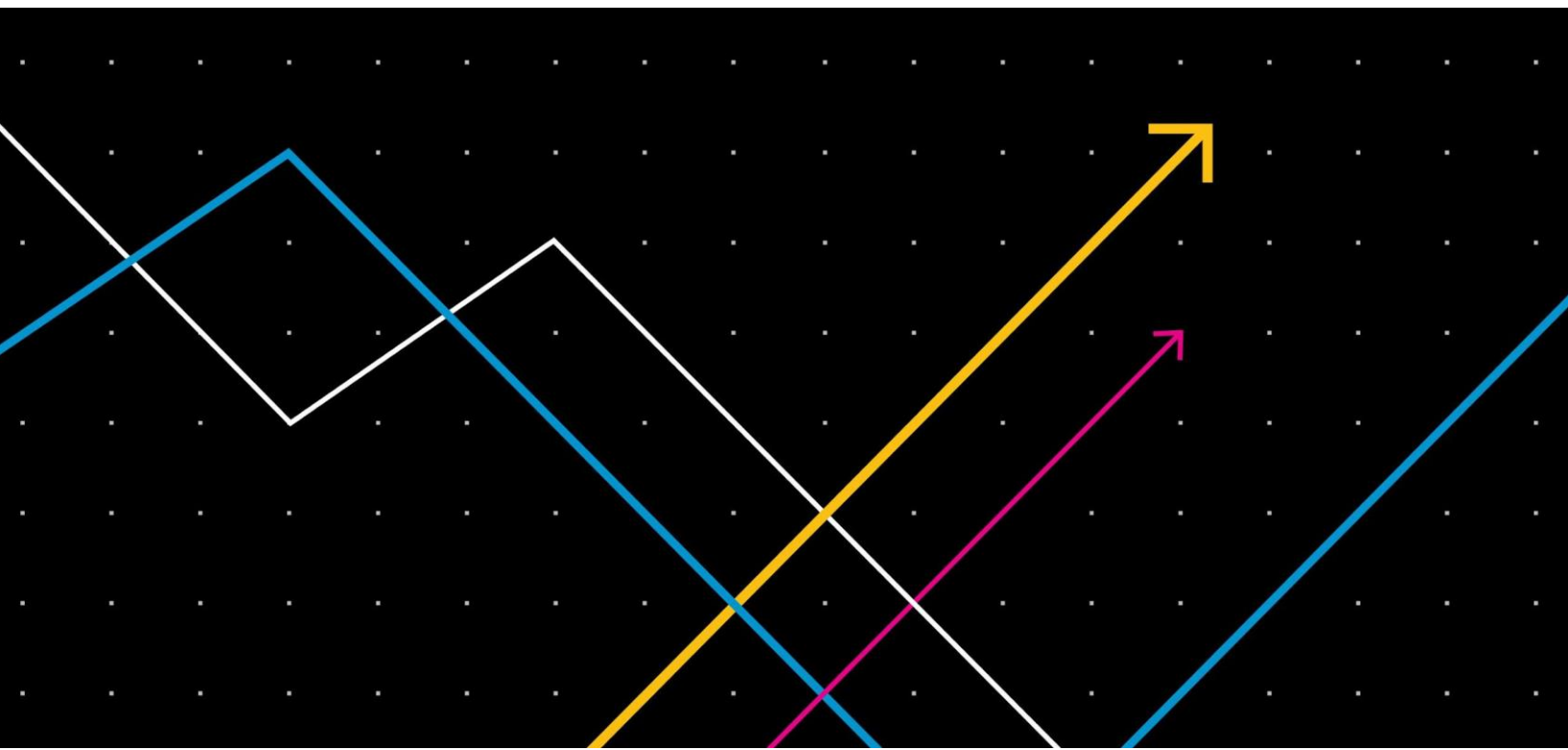




RESEARCH REPORT

State Flood Resilience and Adaptation Planning

Challenges and Opportunities

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March 2022



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Acknowledgments

This report was funded by the American Flood Coalition in partnership with The Pew Charitable Trusts. We are grateful to them and to all our funders, who make it possible for Urban to advance its mission.

The views expressed are those of the authors and should not be attributed to the Urban Institute, its trustees, or its funders. Funders do not determine research findings or the insights and recommendations of Urban experts. Further information on the Urban Institute's funding principles is available at urban.org/fundingprinciples.

Special thanks to Dr. Carlos Martín, Rubenstein Fellow at the Brookings Institution's Metropolitan Policy Program, who provided guidance and review throughout the research process; Dr. Gavin Smith, AICP, Professor, Department of Landscape Architecture and Environmental Planning at North Carolina State University, who served as our expert reviewer; and Sara McTarnaghan, who provided valuable management. We also thank our partners Mathew Sanders, Sarah Edwards, and Laura Lightbody from The Pew Charitable Trusts and Melissa Roberts, Summer Modelfino, and Gian Tavares from the American Flood Coalition. Further thanks to our reviewers, including Blake Nanney and Kara Kempinski from the American Institute of Architects, Breanna Shea and Kate Giannini from the Iowa Flood Center, and Ryan Colker from the International Code Council.

Executive Summary

State governments are key actors in establishing and implementing flood hazard mitigation and adaptation efforts. In addition to coordinating many aspects of postflood response and recovery, they invest the largest share of public-sector dollars on flood mitigation and often determine how federal dollars will be spent, guiding efforts ranging from large infrastructure projects (such as coastal reconstruction, levees, and drainage systems) to public education around flood risk and home flood insurance. As part of a larger floodplain management system and owners of significant areas of land, states serve as an important intermediary and regulator between local governments and special water districts that implement mitigation and land development activities on the ground and the federal agencies tasked with overseeing floodplain management and funding.

However, most states do not have a deliberate or comprehensive approach to addressing flood hazards beyond the minimal and often perfunctory federal requirements. States typically cannot preempt local land use decisions that may increase flood exposures. State governments' bureaucracies, further, are hard-pressed to work across relevant siloes of emergency management, water utility commissions, environmental policy, and housing and community development. States' current flood planning and consequent ability to bring their financial and intellectual resources to bear, therefore, are largely insufficient to meet current need. The anticipated effects of climate change, including coastal sea level rise and increased severity of precipitation, further highlight the urgent need to address this gap.

This study sought to assess the current state of state-level flood planning. First, the research team developed a framework to evaluate planning processes and plan qualities based on extant mitigation planning scholarship that would be applied consistently throughout the study. Categories of framework criteria included (1) general plan characteristics; (2) the plan development process; (3) the plan's catalyst and initial conceptualization; (4) the scientific quality and documentation of flood risk assessment; (5) incorporation of explicit plan implementation; (6) characteristics of plan governance and coordination between state agencies, local governments, and external stakeholders; and (7) the level and quality of public engagement and transparency in the plan.

Second, the team conducted a national survey of active flood plans in all 50 states, five territories, and the District of Columbia. The team collected and performed detailed document reviews of 148 relevant plans. The plans included climate action plans (22), resilience plans (12), direct flood response plans that included mitigation components (2), emergency management plans (3), explicitly labeled

flood plans (7), water management plans (19), coastal management plans (29), state hazard mitigation plans, or SHMPs (53), and combined hazard mitigation/climate plans (1) that addressed all environmental hazards and are required by the Federal Emergency Management Agency. Clear patterns emerged from the survey:

- **Flooding was often only a small component of most plans in the review.** Aside from SHMPs and coastal plans, the most common plan types in the survey were climate plans; resilience plans, which address shocks and stressors across all locally identified hazards; and water plans, which primarily address state management of water resources, including supply and quality, but also may address water-related hazards.
- **Most plans did not include meaningful incorporation of social vulnerability.** Only 24 plans (from 22 states) of the 148 plans included in the survey had extensive discussion of social vulnerability that clearly connected the geographic risk assessment to discussions of specific vulnerable populations within the area.
- **Just over half of the relevant plans surveyed for which a time frame was determined were developed over the course of one year or less, leaving little time for meaningful public engagement.**
- **Few plans included strategies to assist low-capacity localities (i.e., geographically defined areas with limited government resources, low funding, or a lack of technical skills) or to track and monitor improvements in local capacity to address flood hazards.**
- **Contractors played extensive roles in producing state plans, although emergency management departments led the development of one-third of all plans in our review.** The involvement of contractors suggests that the art and science of flood planning may increasingly involve professionalization and private practice, potentially omitting local connections and institutional knowledge from the process.

Finally, the survey's descriptive findings helped us identify five states whose diversity of experience and planning approaches might provide supplemental insights: North Carolina, Colorado, Iowa, Florida, and Washington. For each state, we conducted extensive interviews with local stakeholders and collected and reviewed additional documentation to produce profiles of flood hazard mitigation planning. The profiles provide a richness and texture to the flood planning documented in the national survey, including the following notable observations:

- **All states' and territories' SHMPs served as a summary of activities rather than as a strategic planning document.** Government interviewees in all profiled states noted that the primary goal of their SHMP was to comply with Federal Emergency Management Agency requirements in order to access federal funding rather than as an opportunity for establishing a state-level strategy for floods. SHMPs provide consistent and predictable information on activities to mitigate all hazards, including floods, but they are not structured as coherent, comprehensive plans with the quality of other state-level, aggressive, outcome-oriented plans, such as those produced for economic, housing, and environmental management purposes.
- **Much flood mitigation planning followed major floods.** Aside from the periodic and mandatory SHMP cycles, respondents from three sample states (Colorado, Iowa, and North Carolina) all attributed advances in their respective mitigation approaches to major floods that catalyzed state attention and highlighted the inadequacies of their prior approaches.
- **Public engagement as plans developed was highly variable.** Some of the largest engagement efforts were associated with new and experimental initiatives that connected state-level strategy to local communities or efforts that engaged directly with members of the public. Other state flood planning efforts, however, compiled wish lists of state leaders or summaries of cross-agency activities and, consequently, involved little to no public outreach. Though required by the Federal Emergency Management Agency, SHMPs also fell into the pool of plans undergoing minimal public engagement.
- **Thoughtful and robust incorporation of social vulnerabilities into flood hazard mitigation plans is a work in progress.** Though encouraged by contemporary hazard scholarship and practice, states have yet to integrate a careful review of the factors and indicators that are likely to disadvantage some of their residents in relation to flood exposure, such as poverty, physical disability, housing tenure and quality, racial discrimination, language proficiency, and chronic health conditions. Of the five profiled states, Colorado, North Carolina, and Washington had plans that discussed social vulnerability extensively. In contrast, Iowa and Florida each had one plan with cursory discussion.
- Significant coordination gaps between state and local governments exist, especially with low-resourced localities and communities within higher-resourced ones. Barriers to participation in state planning and plans included a lack of labor hours to research and respond to funding opportunities, a lack of local technical expertise needed to assess and describe flood risks, and in some cases, a history of exclusion due to racial or other biases. Consequently, the needs

and perspectives of some flood-exposed regions in a state may not be fully integrated in state plans.

- **More proactive flood planning is expected as state governments grapple with the impacts of climate change.** In all the profiled states, new flood-related initiatives have either recently been established or are currently being developed.

The state profiles highlighted ways to fill the gaps that were identified in the survey regarding current flood mitigation planning. Consequently, the research team recommends that states pursue the following groups of activities:

- **Establish a central conceptual source for strategic flood planning that identifies values, goals, and outcome indicators to use across all state efforts.** Flood planning is frequently spread across multiple plans and plan types, and a wide range of state departments and nongovernmental stakeholders are involved in developing and implementing state policies and programs. Establishing a single plan and home that sets a vision for all aspects of flood planning within a state allows for greater coordination between efforts and assurance that state actions are working toward a commonly understood goal. Similarly, by planning at a frequency beyond SHMP cycle requirements (and not only in response to floods), state planners have opportunities to think critically about the state's goals and priorities, not just its needs in a flood's aftermath. Finally, reliable funding allows planners to think ahead and critically assess the goals and values behind plans before beginning planning processes, as well as to ensure quality flood risk assessment, coordination, and public participation.
- **Incorporate more rigorous, accurate, and nuanced data for both flood exposure and social vulnerability.** For exposures, flood risk models based on historical trends will not capture new threats posed by climate change, including sea level rise and increased rainfall. Many states acknowledge these threats even if they currently fall short of including more accurate probabilistic models into their assessments. Similarly, better demographic and behavioral data about residents in flood-exposed regions can help planners design more responsive infrastructure, social programming, and communication tools. Though states have limited financial resources, they have more leverage than local jurisdictions and support state universities and research centers. States should support data collection, analysis, and projection but collaborate with counties, municipalities, and special districts to share the costs proportionally while making findings available for all to use.

- **Incorporate plan objectives into day-to-day operations to help ensure implementation.**
Named projects and initiatives with concrete details and prioritizing projects based on plan goals, timelines, committed funds, and responsible parties and individuals will help move flood strategies from planning to action.
- **Provide resources, design projects, and share benefits, in coordination with local communities within the state.** States must learn how to engage low-capacity localities in planning efforts and ensure that low-capacity communities have access to planning resources and support. Financial and knowledge resources in the form of advanced technical support may be necessary. These costs may be offset by the cobenefits to be shared from better-designed projects with these local stakeholders.
- **Invest in and experiment with community engagement and transparency of flood planning efforts and resulting plans.** Public engagement can be costly and time consuming, but community members possess unique knowledge of the reality of flood challenges. Engagement can also create a public and civil-sector leaders who are more informed about flood risks.

State Flood Resilience and Adaptation Planning

State governments are key actors in establishing and implementing flood hazard mitigation and adaptation efforts. In addition to coordinating many aspects of postdisaster response, they often spend their own financial resources on mitigation projects, such as flood controls. They also determine how federal and state mitigation dollars will be spent, guiding efforts ranging from large infrastructure projects, such as coastal reconstruction, levees, and drainage systems, to public education around flood risk and home flood insurance. As part of a larger floodplain management system, states serve as an important intermediary between local governments that implement activities on the ground and the federal agencies tasked with overseeing floodplain management (including the US Army Corps of Engineers and the Federal Emergency Management Agency, or FEMA), and they provide essential funds to support state and local mitigation projects. States inform how key national policies are applied through their stake in local land use and development and by providing funds for regional flood mitigation and maintenance projects across the clusters of their communities that directly face flood hazards. However, most states do not have a deliberate or comprehensive approach to addressing flood hazards. The effects of climate change, including coastal sea level rise and increased severity of rainfall events in many parts of the country, have led to increased flooding and costs, making this issue relevant, if not urgent.

State governments also control many of the core policy tools needed to mitigate and adapt to flooding, including the institution of sales, property, and income taxes; eminent domain; and land use regulation within their borders. These tools allow states to determine their own approaches to flood protection based on their own resources and needs, but not without restraint. State governments are subject to their own constitutions and political systems, which frequently dictate when and how they can use their powers. Although some states retain the authority to control land use directly, many have ceded this power to counties, municipalities, or other forms of local government. Likewise, some states have constitutional or political limits on taxation or debt financing, leaving more limited options for financing flood planning and mitigation. This diversity in government structure is essential to understanding and assessing the various approaches and strategies states have used to work toward and fund flood adaptation and mitigation efforts. US territories and the District of Columbia do not hold the full powers of states, but they hold similar de facto powers.

This study explored the current state of state-level flood planning in the US by reviewing a broad sample of flood plans from all 50 states, five territories (American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and US Virgin Islands), and the District of Columbia and by developing state profiles for five states that have addressed flood risk in qualitatively more comprehensive ways than their peers.

Background

States vary significantly in their need and ability to mitigate and respond to flooding. States with well-known exposure to flooding include those with coastal regions exposed to sea level rise and hurricanes, as well as those situated on major river systems, such as the Mississippi and the Missouri. However, every state has some exposure, be it to seasonal flash flooding, dam overflows, or infrequent yet devastating severe rainfall. In addition to their varied exposure to flooding, states differ in their approaches to controlling some of the key tools to mitigate flooding, namely land use, taxation, and development. They also vary in capacity, with some states having access to more financial resources to invest in collecting and analyzing data, planning, and protective infrastructure. However, despite their diversity, all states and territories plan for and implement flood and other hazard mitigation projects within the framework laid out by federal programs and policies.

In this section, we provide an overview of the needs and constraints of states and territories in planning for floods and the federal frameworks in which they operate.

States' Flood Planning Needs and Constraints

States' flood planning needs vary based on the frequency of flooding events and their types of flood risk exposure, as well as their capacity to assist local governments. Some of these variations are obvious, as in the distinction between coastal and noncoastal states. But flood needs also vary by terrain, current and projected rainfall amounts, the location of river systems and watersheds, soil types, and land use.

Within states, the flood exposure of high-density or infrastructure-intensive areas can be an important factor when allocating assistance, whether it involves the provision of funding, data, or educational and outreach initiatives addressing flood hazard mitigation and adaptation needs. In states with rapidly growing urban centers, such as Colorado, new development on the urban fringe has brought pressures to allow building on or near floodplains. Likewise, states with major population

centers that are vulnerable to hurricane damage and sea level rise face constant challenges to protect against increasingly frequent and severe hazards. In all cases, states must also grapple with how and where to focus state and federal resources, which requires prioritizing who and what to protect.

FINANCIAL CAPACITY

In addition to exposure, states vary by capacity in technical analysis and modeling, administrative capabilities, and available financial resources. Access to the necessary finances to continually fund data collection and analysis on hydrologic systems, land elevation, land use patterns, and the distribution and characteristics of populations and assets is essential in ensuring long-term flood protections, as is the availability of financing mechanisms for large infrastructure projects. However, states and territories vary significantly in their levels of funding and their abilities to leverage financing, potentially leading to disparities in the quality of and approach to flood protection and the level to which they depend on federal resources.

Access to the necessary finances to continually fund data collection and analysis on hydrologic systems, land elevation, land use patterns, and the distribution and characteristics of populations and assets is essential in ensuring long-term flood protections, as is the availability of financing mechanisms for large infrastructure projects.

Measures of revenue and bonding capacity can provide some insight into this variation. State own-source revenue, a measure that includes most forms of income not received from the federal government, varies greatly in per capita and absolute terms, highlighting the relative abilities of some states to fund advanced data and analysis and robust planning processes. In 2019, for example, own-source revenue ranged from a high of \$15,000 per capita in the District of Columbia to \$5,000 in Tennessee. In absolute terms, California had the largest own-source revenue at \$420 billion, whereas South Dakota represented the lower bound at \$5.5 billion.¹ Likewise, states vary in their capacities to raise funds for capital projects, which may include gray and green flood protective infrastructure. S&P Global Ratings rates states' bonding capacity based on the debt outstanding on general obligation funds (those funds set aside for required spending). Currently, all states have investment-grade scores (BBB or above), but variation between states can affect their ability to raise funds for capital projects, such as flood hazard mitigation infrastructure. Those with the highest rankings, AAA (15 states) or AA

(30 states), have extremely strong or very strong bonding capacity, meaning that state bonds are a low-risk investment, and bond issues are likely to raise desired funds quickly. However, states with scores of A (3 states) or BBB (2 states) have lower bonding capacity, meaning that they may currently carry more debt or other financial obligations, such as employee pensions, and are higher risk for investors. These states may also have more difficulty raising funds locally, reducing internal capacity for investing in protective infrastructure.

GOVERNANCE STRUCTURE

A key way states differ in their approach to flood planning comes from the level of administrative autonomy they provide to local governments. Broadly speaking, states take two approaches to this question: home-rule states allow most or all local governments broad autonomy, limiting them only by powers expressly retained by the state government. Conversely, Dillon's rule states retain autonomy at the state level, only allowing local governments the powers expressly delegated. Relevant to flood planning, key mitigation tools, including zoning, building codes, other land use regulations, and local taxation, are frequently powers retained by local governments in home-rule states, limiting the state's ability to create statewide standards.

In practice, significant variation exists within both home-rule and Dillon's rule states. Some home-rule states, for example, cede autonomy to incorporated municipalities, while administering unincorporated areas directly. Likewise, some Dillon's rule states will grant some municipalities—typically major cities and highly urbanized counties—home rule while maintaining direct administrative control otherwise. In some states, home rule only applies to municipalities, but in others, counties and townships have significant autonomy.

Home-rule and Dillon's rule systems each present opportunities and constraints for state-level flood planning. Home-rule systems, for example, provide the opportunity for communities to develop locally tailored policies and may reduce barriers to local government fundraising where and when it is needed. When the local and state governments collaborate closely, the state can support local efforts with data and technical assistance. However, home-rule states face limitations in enacting policies directly and must rely on other policy levers, such as grant programs, to advance regional or state goals. Dillon's rule states provide a more direct pathway to state-level flood planning, as the state typically retains more control of taxation and land use policies. However, without a clear and consistent approach to floodplain management planning, states run the risk of responding to political expediency rather than reliably addressing risk across the state, regardless of their approaches to municipal administration.

STATES IN THE FEDERAL FLOOD PLANNING FRAMEWORK

States are the primary recipients of federal resources dedicated to response, recovery, mitigation, and adaptation, and they often rely on these funds when developing their own flood plans. As a result, federal agencies hold significant influence in directing flood planning efforts. Although FEMA provides much of the federal funding available for flood hazard mitigation, the US Department of Housing and Urban Development (HUD) has also funded work through Community Development Block Grant – Disaster Recovery grants and the National Disaster Resilience Competition. Other agencies providing mitigation funding include the National Oceanic and Atmospheric Administration (NOAA) and the Small Business Administration. Most of these funds, however, have been made available only after a major flood has occurred, and states spend them only after other rebuilding and recovery activities have been satisfied.

Mitigation funds provided by FEMA require states to develop multihazard mitigation plans that comply with national standards. However, research has shown that many states have developed hazard mitigation plans that meet only the minimal requirements, viewing these plans primarily as a means to access federal funding rather than as an opportunity to systematically assess risk and develop appropriate policies and projects (Smith 2020). Many states have come to rely on these risk assessments for all hazard mitigation planning, including flooding. However, these assessments frequently rely on historical data that are not suited for current and changing climate conditions and do not incorporate all flood types and risks (Wing et al. 2022)

The Stafford Act (formally the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988) codified federal disaster assistance to states, leading to a growth of interest in federal mitigation investment in the 1990s. New efforts toward hazard mitigation were codified in the Disaster Mitigation Act of 2000, which updated established national policy tied to disaster response, hazard mitigation, and disaster recovery. More recently, the passage of the Disaster Recovery Reform Act and the ensuing creation of the Building Resilient Infrastructure and Communities (BRIC) program emphasize predisaster hazard mitigation funding programs. In addition to establishing current federal, state, and local roles in responding to disasters, the Stafford Act first called for states and local governments to develop disaster emergency preparedness plans. It also established federal cost shares for state and local mitigation activities. Although this financial support was an explicit response to hazard mitigation needs beyond what some state budgets could support, it also required states to develop, maintain, and implement hazard mitigation plans based on national standards (Institute of Medicine of the National Academies 2015). A national review of these state plans, however, found

that they were often weak and provided little clear guidance for states to proactively address hazard risk (Godschalk et al. 2009).

The Disaster Mitigation Act of 2000 sought to amend identified weaknesses in the Stafford Act by requiring states to engage in mitigation planning as a prerequisite to receive financial postdisaster mitigation assistance (Institute of Medicine of the National Academies 2015). Although the requirements have changed over time, this provision remains in effect, with the result that all states, territories, and the District of Columbia have developed state hazard mitigation plans (SHMPs) that conform to federal guidelines.² As we discuss next, these documents have become a core aspect of state flood planning, frequently serving as the primary or only state-level flood risk assessment, as well as the only centralized review of all flood mitigation activities at the state or local level.

FEMA-led hazard mitigation grant programs that can be applied to flood mitigation activities and require an adopted and approved SHMP include the Flood Mitigation Assistance program, the Hazard Mitigation Grant Program, permanent projects undertaken through the Public Assistance Program, and the Pre-Disaster Mitigation Grant Program, which was replaced by the BRIC program in 2020. Public Assistance Program funds are primarily postdisaster response funds to clean and repair public spaces and buildings, but projects can incorporate mitigation features directed toward future events. Only Flood Mitigation Assistance and BRIC funds are available before a disaster.

Almost 89 percent of FEMA mitigation funding from 2010 to 2018 came through the Public Assistance Program and the Hazard Mitigation Grant Program (GAO 2021). Flood Mitigation Assistance accounted for only 8 percent of mitigation grants (\$878.8 million), with the Pre-Disaster Mitigation Grant Program accounting for the remaining 4 percent (\$452.6 million; GAO 2021). The BRIC program represents a significant new investment in predisaster mitigation funding available to states, with \$1 billion available in FY 2021 in a combination of state allocations (\$56 million) and competitive funds (DHS 2021a). Flood Mitigation Assistance funding for FY 2021 is set at \$160 million (DHS 2021b). This amount represents a significant increase from the \$700 million available through BRIC and Flood Mitigation Assistance for FY 2020.³

The Baseline: State Hazard Mitigation Plans

SHMPs, which FEMA requires states and territories to have to access federal mitigation grants, are the most direct form of influence the federal government holds over state flood and other hazard mitigation planning. FEMA guidelines for SHMPs follow rudimentary compliance requirements for flood risk assessments and outline policies and projects intended to mitigate identified risks. FEMA

reviews and approves SHMPs for compliance with federal statutes, agency rules, and program practice. SHMPs are updated every five years, with most states due to submit updated plans in 2023. Many of the SHMP requirements are designed to ensure that states have adequate data on flood risk and have appropriately assessed their internal needs and capabilities, but states typically do not treat them as such (Smith 2020).

As of 2021, FEMA had identified six required SHMP elements, each of which must be revised to reflect changes with each plan update:⁴

- the **planning process** used to develop the plan, including how the state emergency managers coordinated with other state agencies and stakeholders
- a **hazard identification and risk assessment**, including an assessment of the type and location of all natural hazards, their probability of occurring, the vulnerability of state assets and the associated financial losses, and the vulnerability of jurisdictions within the state and changes in their land uses
- a **mitigation strategy** with goals to reduce long-term vulnerabilities, actions to reduce them, and identified sources of funding
- the **state's mitigation capabilities**, including hazard and land management policies, existing pre- and postmitigation programs, capabilities to mitigate state hazards, and current and potential sources of funds for mitigation activities
- the state's **coordination with local governments**, including an assessment of their mitigation capabilities and description of the state's technical and financial support of their plans
- the **process and timing of reviewing local and tribal mitigation plans** with the state

States can also develop enhanced state hazard mitigation plans (E-SHMPs). If approved, E-SHMPs allow states to receive additional federal matching support for qualified programs. E-SHMPs must include five additional elements in their plans:

- integration with other state and/or regional planning initiatives across FEMA mitigation programs and use of FEMA data and technical assistance
- demonstrable commitments to comprehensive mitigation for all hazards through additional activities such as training, partnerships, funding, technical assistance, and codes and ordinances

- documented capability for implementing their plan shown through eligibility and prioritization criteria for future actions and evidence of past actions' effectiveness
- demonstration of cost-effectiveness of actions and budgetary drawdowns
- timeliness of grant applications and required documentation (such as environmental reviews, benefit-cost analyses, and quarterly progress and financial reports) and on-time project completion

FEMA incorporates new requirements as SHMP guidelines are updated. The primary objective of these requirements is to help FEMA gain a sense of the hazard mitigation needs of each state and territory while still allowing state governments significant latitude in how they approach mitigation efforts. All states and territories currently have FEMA-approved plans, and 15 have approved E-SHMPs. However, although the plans provide an impetus for states to take planning actions and work to standards that may not have been previously present, they can also be a limiting factor.

In the case of flooding, FEMA provides regulatory flood insurance rate maps and nonregulatory flood risk maps.⁵ These maps go beyond basic flood hazard information and provide most of the data used by states in their flood risk assessments (FEMA 2021). Although states are not restricted from using more advanced analysis and modeling techniques for their flood risk assessments, using FEMA-provided data eases the process of plan review and approval. States are thus disincentivized to allocate the financial and time costs of data collection and analysis that do not conform to FEMA expectations.

Reliance on FEMA flood data limits state flood risk assessments in three ways. First, the flood levels calculated in FEMA's flood insurance studies are based on historical data; they do not consider changes in flood patterns caused by climate change, such as sea level rise and increased precipitation.⁶ FEMA is in the early stages of implementing Risk Rating 2.0, a new methodology for pricing flood insurance based on individual property risk rather than the flood zone in which the property is located (FEMA 2021). However, this method will not be fully implemented for renewing policies until April 2022. Further, the accuracy and level of rigor of these data vary by location, with high-value or high-density areas assessed with greater rigor than those of outlying rural areas (Congressional Budget Office 2017).

Second, the assessments do not consider all types of flooding. Flood insurance studies—the basis for flood insurance rate maps and flood risk maps—include riverine flooding; lacustrine flooding of lakes and ponds; storm-related coastal flooding; and shallow flooding, ponding, and sheet flow (FEMA 2005). Other forms of flooding, such as dam overflow and postwildfire flooding in mountainous

regions, are simply not captured. Moreover, these assessments do not require accounting for rapid rain accumulation or changes in population that may include development in outlying areas, nor are areas considered that see compounding flood risks, such as coastal estuaries (Keller et al. 2017).

Third, many flood insurance rate maps are severely outdated. FEMA has noted improvements in the frequency by which it updates data, but a recent report from the Association of State Floodplain Managers found that “roughly 3,300 communities...have maps over 15 years old, with several of these having paper maps over 30 years old and based on using obsolete mapping methods” (ASFPM Foundation 2020). A 2017 audit conducted by the US Department of Homeland Security’s Office of Inspector General found that not only were FEMA maps frequently outdated, but increasing numbers of maps were becoming outdated every year (DHS 2017). A report released in the same year by the Congressional Budget Office found that counties with flood maps produced 16 or more years ago were disproportionately likely to be in areas with high flood risk (Congressional Budget Office 2017).

STATE ACTIONS BEYOND SHMP PLANNING

In recent years, incited by the shock of intense disasters or chronic flooding, several states have surpassed the baseline SHMP requirements for flood planning, showing that there is both a need and a precedent for more extensive flood hazard mitigation. This evolution in state planning demonstrates how states have used the urgency of postdisaster contexts to advance their own mitigation efforts. Following Hurricane Katrina, for example, the Louisiana state legislature formed the Coastal Protection and Restoration Authority, charged with the development and implementation of comprehensive coastal protection. The Coastal Protection and Restoration Authority integrates resources and expertise from multiple state agencies and was tasked with the creation of the Coastal Master Plan, which is updated every six years.⁷ Likewise, following the devastation of Superstorm Sandy in the Northeast, the New York City Panel on Climate Change partnered with NOAA, FEMA, and independent researchers to update New York’s long-term sustainability plan, which influences decisions from infrastructure to community preparedness. In North Carolina, responding to the chronic challenge of tidal flooding and sea level rise, then-governor Northam signed an executive order in 2018 mandating the creation of a coastal resilience master plan aimed to align state efforts around flood planning (State of North Carolina 2018).

Ultimately, coastal sea level rise and the increased severity of high precipitation have led to increased flooding and financial losses. Planning using the most accurate data and techniques available is a relevant, if not urgent, issue for the nation. States, with their funding, leadership, and intellectual levers, are the keystones to this effort.

Study Overview

To assess the current state of state-level flood planning, we included two major components in this study: a national survey of flood plans and state profiles of flood mitigation planning in five states selected for their diversity of experiences and approaches to flood mitigation and adaptation. We looked at flood planning and mitigation efforts by using an analytical framework developed to identify the strength of plans across a variety of domains, including plan development and conceptualization; the existence, contents, and quality of flood risk assessments; measures to ensure implementation; governance and coordination; and public engagement and transparency.

Analytical Framework

To consistently assess the quality of flood plans for both the survey and the state profiles, we developed a framework based on general categories and specific features identified in the academic literature to define plan strengths and gaps. We identified two categories for general plan characteristics and development identifiers and five substantive domains of indicators to be assessed. These basic themes and domains formed the basis for both study components.

We drew each domain from literature on good plan quality, adapting evaluation criteria to specifically focus on flood plans. First, we looked at plan conceptualization, which is the direction-setting function of a plan. Conceptualization is important to set the context of what conditions the plan is intended to achieve, such as flood risk reduction or climate change adaptation (Berke, Smith, and Lyles 2012). Regarding specific flood risk assessment, accurate measurements (e.g., stream flow gauges and community-level flood modeling) allow for insight into what hazards to expect, what areas and populations may be exposed, how different socioeconomic factors influence vulnerability, and best practices for targeting mitigation efforts (Cutter, Boruff, and Shirley 2003; Mileti 1999; Moel et al. 2015). High-quality mechanisms, such as measurable objectives, for implementation and monitoring and the quality of plan outcomes are important indicators for the likelihood of implementation (Norton 2008). We examined governance and coordination to understand the interaction between plans and planning entities within the state since strong integration is critical for ensuring all dimensions of flood preparedness are taken into account, and resources can flow freely between stakeholders at the substate level (Smith and Birkland 2012). Finally, we looked at public engagement, as failure to integrate local perspectives can lead to further fragmentation of planning and hazard mitigation actions and can lead to a loss of valuable local knowledge connecting data to on-the-ground reality (Goggin et al. 1990). If done well, a flood plan can provide a common framework for all state agencies and other stakeholders and provide a strategy for guiding investment at the state and federal levels (Berke 1996).

The two categories for general plan characteristics and development identifiers and the five substantive domains of indicators are as follows:

- **Plan characteristics** captures basic background information on the plan, such as authoring agency, length of plan, duration of validity, and year adopted. These basic characteristics offer baseline information on each plan that can serve as proxies to plan quality. The length of the plan, for example, suggests how detailed its information is, and duration of validity indicates the update period.
- **Plan development** describes how long a plan was in development and who the mandating authority is. Information on the mandating authority offers insight into what prompted the creation of a plan and whether it was in fulfillment of a federal requirement or was a state-led initiative, such as an executive order.
- **Plan conceptualization** assesses the degree to which a plan's components work toward a particular goal or vision. Measures include the existence of a stated set of principles or values, a clear expression of the conditions the plan seeks to attain that would achieve that vision, and evidence that the principles or values guide the plan's recommendations or stated actions.
- **Flood risk assessment** assesses the type, severity, and geography of flood risk. Measures include the source data for the assessment (using FEMA-provided data as a baseline), whether the plan calculates risk only on historical data or if it uses projections based on climate or land use models, the proportion of the state's geography that is analyzed, the geographic scale of analysis, the units the plan uses to quantify potential losses, and whether and to what degree the plan incorporates social vulnerability. Adequate management of flooding relies on an a priori understanding of flood risk and vulnerability, including a spectrum of data sources and cited methodology.
- **Plan implementation** describes the features that facilitate the implementation of goals, policies, and projects. Actions include whether the plan enumerates specific projects; whether the plan identifies specific departments, offices, or organizations as responsible for implementing those projects; whether specific individuals are identified as responsible; whether the plan includes any mechanisms for enforcement or incentive to designated actors; and whether the plan includes provisions for technical assistance to support implementors, especially substate entities or communities (Berke, Smith, and Lyles 2012; Mazmanian and Kraft 1999).

- **Governance and coordination** assesses the degree to which the plan accounts for the actions of parties outside the state government, including substate entities such as county and municipal governments and quasigovernmental organizations; nongovernmental stakeholders; and federal planning efforts. This domain also assesses whether a plan cross-references other plans in the state or whether they account for local capacity building. Substate entities play a crucial and often underacknowledged role in disaster recovery (Klein 2007), and the collaboration of entities can improve understanding of local needs (Smith and Birkland 2012).
- **Public engagement and transparency** assesses the degree to which plans reflect the needs and priorities of state residents and the degree to which state residents have access to the plans. Measures include whether the plan is online and easy to locate, whether the plan is written in language accessible to a reader without specialized knowledge, whether the plan is available in a language other than English, and whether and to what degree the plan shows evidence of public engagement in the planning process. Research suggests that public engagement in hazard mitigation planning can improve the assessment and awareness of risk (Macris 2000; Meyer et al. 2018). Although private citizens may lack the expertise to comment on technical aspects of plans, they have the lived knowledge to inform the values of a plan, and engagement can help increase community buy-in from the onset.

National Survey of Flood Plans

The survey assessed a sample of plans that addressed flood adaptation or mitigation from all states, five territories, and the District of Columbia. The selected plans did not capture all state-level flood planning activities. They were typically coordinating documents in which states expressed priorities and approaches and summarized efforts to address flood hazards. Through this national review, we aimed to assess some indicators of the quality of state flood planning at this time.

The survey of flood plans involved assessing state and territory government websites and agencies likely to be involved in flood planning and identifying plans through online archival searches and public document inquiries with relevant departments, agencies, and commissions.⁸ In addition to dedicated state flood planning entities, targeted organizational units included authorities related to hazard mitigation, environmental protection, community development or comprehensive land use, water management (including water resources and storm water), and public works; coastal commissions; and boutique sustainability or resilience offices. We identified the relevant departments through each state and territory's published information on their organizational structure. We then

reviewed these documents and removed those that did not address flooding, hazard mitigation, or climate change adaptation strategies and those that were research reports rather than forward-looking plans. We limited the review to adopted plans or those pending approval. Our final sample was 148 documents, distributed across types as shown in table 1. A full list of all plans included in our review is available in appendix A, and the plan review framework showing how we used the domains described above to score each plan is included in appendix B.

TABLE 1

Number of Plans, by Type

Plan type	Number of plans
Coastal 309 plan	29
Climate action plans	22
Resilience plans	12
Direct response plan	2
Emergency management	3
Flood plan	7
Hazard mitigation	53
Combined hazard mitigation/climate plan	1
Water plan	19
Total count	148

Source: Authors' data.

Note: Direct response plans were included in the survey only if they contained a mitigation, adaptation, or resilience component. Coastal 309 plans are designed to fulfill the federal requirements to be eligible for the Coastal Zone Enhancement Grants Program, as described in section 309 of the Coastal Zone Management Act of 1972.

The largest number of plans that we collected were SHMPs, because each state had one as a requirement for FEMA funding. Similarly, coastal 309 plans are a requirement of the Coastal Zone Enhancement Program in coastal states and territories. We reviewed each plan through a thorough review of the table of contents, executive summary (if available), and a brief review of plan chapters and appendices. For each plan, we collected a set of indicators as laid out in the research framework.

State Profiles

The five sample states (Washington, Colorado, Iowa, Florida, and North Carolina) were selected through a purposive sampling process to represent the diversity of flood planning contexts within the US, while capturing particular points of innovation and good practice.

We created a sampling criterion to identify the five cases for state profiles that included both state- and plan-level measures. Four state-level measures were standardized into quintiles to allow for comparison: population, an index of local government autonomy, total number of FEMA flood-related

declarations, and total flood-related individual assistance activations as a proxy for experience with severe flooding. The additional state measures were authorizing legislation (i.e., home-rule or Dillon's rule states) and whether the state was coastal or landlocked. We also took special consideration of Iowa as a National Disaster Resilience Competition awardee for flood mitigation activities.

Six plan-level criteria were used to ensure that the selected states had plans grounded in a theoretical basis of strong planning principles. These criteria included that at least one flood plan within the state met values and principles criteria, had committed funds, incorporated climate change projections, showed high levels of public engagement and transparency, coordinated with substate bodies, and showed evidence of cross-plan coordination.

The five states selected for review represented a diverse selection based on our criteria. Some of the states offered opportunities to examine unique or outstanding practices, while others provided insights based on their challenges or through a combination of challenges and successes. Brief profiles are included in the body of this report, and full state profiles are available in appendix D.

DOCUMENT REVIEW

We conducted an exhaustive search for all state-level flood-related planning documents, including relevant components of more general plans, to ensure we understood the full scope of each state's planning efforts. We reviewed these plans in greater detail than those collected in the survey by using the qualitative coding software NVivo, noting key activities outlined and features of the plan as well as any information included on the planning process and implementation. At this stage, we also sought to qualify measures of effectiveness for each criterion of planning and plan elements advanced in the survey.

INTERVIEWS

From June through October 2021, Urban conducted semistructured interviews with four to five experts and one to two stakeholder representatives from each of the five states. The expert interviews were with key individuals from plan-authorizing agencies and focused on the planning process, highlighting areas of success and innovation as well as any challenges. When appropriate, we spoke to individuals involved in major flood mitigation initiatives rather than flood plans. For example, we interviewed managers of the Iowa Watershed Approach (IWA) rather than additional individuals involved with the SHMP (the only official plan in the state). The stakeholder interviews were with organizations invested in flood policy at the state level, with the goal of recruiting one environmentally

focused stakeholder and one socially focused stakeholder. Urban identified stakeholders for each state through document reviews, online searches, and recommendations from other interviewees and our partners.

Protocols were designed for semistructured 30- to 60-minute interviews. Interview guides were designed to align with the framework used for the survey but allowed for focus in particular areas of knowledge or detail on a specific program as appropriate. Interviews were conducted one-on-one virtually and according to Urban Institute's Institutional Review Board requirements for human subject protections, including respondent confidentiality and consent and the security of the data respondents provide.

Survey Findings

Our survey of flood plans found a wide variety of approaches to flood planning by states and territories, ranging from minimal use of the SHMP to access federal support to complex networks of plans that addressed various aspects of flooding. The findings here, organized by domain, show this variation, but they also show the central consistency of the SHMP. Overall, the diversity of approaches to flood hazard mitigation planning shows that the number or specific focus of individual plans in the states matters less than the existence of a comprehensive and strategic approach. A detailed glossary of terms used in each domain covered below is available in appendix C.

Overview of Flood Plans

PLAN CHARACTERISTICS

Scan results suggest that flood planning at the state level is largely spread across multiple state agencies and offices.⁹ Through this review, it became clear that most states do not have a stand-alone flood plan. Rather, flood mitigation planning is embedded within other state documents, such as FEMA-mandated SHMPs, climate resilience plans, Coastal Zone Management Act section 309 plans, or state water plans.

The common ground between all states is the existence of a SHMP, which frequently links the otherwise decentralized efforts of various departments and agencies (Berke et al. 2015). Although SHMPs are required to cover all hazards present in each state, they frequently function as the primary or only state-level flood risk assessment. In six states (Iowa, Kentucky, Missouri, Tennessee, Utah, and

Wyoming), the SHMP was the only plan identified as addressing flooding. The ubiquity of SHMPs suggests that the federal mandates set a floor for planning expectations. Whether states engage in risk assessment, mitigation or adaptation planning, or other flood planning activities, they must align their approach with SHMP standards to receive federal assistance. Although SHMPs provide a centralized location for states to collect and display flood mitigation activities, the existence of a SHMP does not mean that integrated flood planning efforts are happening within the state (Berke, Smith, and Lyles 2012).

Although SHMPs are required to cover all hazards present in each state, they frequently function as the primary or only state-level flood risk assessment.

Outside of SHMPs, only five states (Colorado, West Virginia, Nebraska, North Dakota, and California) and one territory (US Virgin Islands) had stand-alone flood plans that focused exclusively on flood hazard risks as opposed to larger natural hazard mitigation. California had two stand-alone flood plans. Most of these plans are old: the Nebraska plan was last updated in 2013, the North Dakota plan in 2011, and the West Virginia plan in 2004. Of these, two (Colorado and Nebraska) are expansions on the flood sections of the states' SHMPs. In North Dakota, the plan was a response to the 2011 flood season, which saw overflow of the Mouse, Missouri, Sheyenne, and Red Rivers. The North Dakota plan develops recommendations based on lessons learned for state agencies, with particular focus on interagency coordination and capacity building for local communities, but it does not establish any new funding mechanisms or specific mitigation activities. The West Virginia plan states an intention to centralize flood protection and mitigation efforts to coordinate formerly piecemeal government activities and includes a risk assessment and recommendations. However, the plan does not appear to have been updated since 2004. The two California plans address complementary aspects of flooding. The 2016 Resource Management Strategy of the California Department of Water Resources takes a high-level, multibenefit approach to flood mitigation in the state, and the 2016 State Plan of Flood Control Descriptive Document Update (the original plan was adopted in 2010) focuses on the maintenance of protective flood infrastructure.

Although the existence of a stand-alone plan may not prove a high level of flood preparedness, it indicates that the state has put effort and attention on the issue and has sought to create a strategy. The cases we just discussed mostly covered similar ground to the flood section of a SHMP, but only

the Colorado and California plans were current, highlighting that although focused plans have the potential to catalyze coordinated and deliberate action, political commitment by the state remains imperative. More typically, flood planning was dispersed across various plan types. On average, each state had between two and three (mean = 2.64) plans that addressed flooding. Notably, a full 25 percent of the plans that addressed flooding came from just eight states.

We found that states typically had relatively current plans that addressed flooding, with most having plans updated in the last four years—largely a factor of SHMPs having an update requirement every five years. A wave of plans was released in 2020. However, many states continue to work from at least some plans that have not been updated in at least five years. Four states had not published a plan since 2016. Updated plans ensure that states are working from the most up-to-date flood risk information, which is especially important for properly adapting to shifting conditions caused by climate change. Table 2 lists the 148 plans in our review by the years in which they were adopted or completed.

TABLE 2
Plans by Year Completed or Adopted

Year	All Plans		Excluding SHMPs	
	Number	Percent	Number	Percent
2014 or older	23	16%	23	24%
2015–17	30	20%	26	28%
2018	41	28%	8	9%
2019	21	14%	7	7%
2020	28	19%	26	28%
2021	5	3%	4	4%

Source: Authors' data.

PLAN DEVELOPMENT

As the most common state flood plans are SHMPs, emergency management departments led the development of one-third of all plans in our review. In addition to lead state agencies, contractors played extensive roles in producing state plans. Though a standard practice for most planning agencies today, the outsourcing to contractors suggests the evolution of flood plans may occur through professional practice and exchange, becoming formulaic rather than relying on robust public engagement, which may omit local connections and institutional knowledge from the process.

Although the planning literature does not prescribe a specific length of time for planning activities, discussions of public engagement and community-led planning note that gathering public support for a planning process—an important feature when seeking to protect human lives and assets—requires

significant time investment for education and trust building even before meaningful public input and feedback can be garnered (Toor, Cox, and Wyckoff 2014). Just over half (52 of 99) of the plans in the survey for which a time frame was determined were developed over the course of one year or less. The exact activities captured in the development period varied, but they typically included initial planning and conceptualization, data collection, and public engagement. This time frame remained dominant across all breakdowns of plan types and states.

The plan review found that almost all state plans that addressed flooding were initially mandated by a state legislature, regardless of the plan type. Eighty percent (118 of 148) of the plans were developed in response to a request or standing requirement from a state legislature. This included 52 of the 53 SHMPs, as well as 70 percent of non-SHMP plans. Most of the remaining plans were requested by governors. These figures indicate the importance of state legislative processes in catalyzing planning efforts and the impact that political will may play on whether new initiatives are implemented.

Plan Conceptualization

Plans included a broad range of elements that indicate robust planning, such as clear visions, desired targets, and a connection between the vision, the targets, and the implementation measures. Flood plans overwhelmingly (77 percent) included a clear vision—that is, a statement of the principles on which recommendations, policies, or initiatives in the plan were based. More than half included desired targets (explicitly stated goals that were tied to the plan’s vision). Most (71 percent) showed a clear link, whether explicitly or implicitly, between the vision stated in the plan and the plan’s findings and recommendations. Yet flooding was often only a small component of most plans in the review. Aside from SHMPs and 309 coastal plans, the most common plan types in the survey were climate plans; resilience plans that addressed shocks and stressors across all locally identified hazards; and water plans, which primarily addressed state management of water resources, including supply and quality, but only sometimes addressed water-related hazards. Even among the plans that included a coherent set of actions that tied into desired targets and a larger vision, those visions were not flood focused.

Flood Risk Assessment

States assess flood risk for all state areas ranging from coastal to inland. The survey showed that most plans (97 of 148) included or referenced risk assessments conducted for the full state.

State plans most commonly assessed flood risk at the county level, similar to national emergency management units of policy intervention. Forty-four percent (65 of 148) of the plans primarily discussed flooding at the county level. Twenty-four percent (36 of 148) of the plans discussed flooding broadly for coastal areas, but only small shares incorporated floodplain analyses (9 percent of plans), census tract analyses (2 percent), or other substate analyses (8 percent). A focus on county-level risk likely stems from the fact that many states compile risk assessments from local mitigation plans as an input to their SHMPs.¹⁰ Additionally, counties are often the governing bodies responsible for implementing flood mitigation projects and are therefore a natural jurisdictional measure for risk alignment.

Additionally, we found that meaningful incorporation of social vulnerability has a long way to go. Survey data show that plans that included social vulnerability analysis typically included only a state-level profile or a more advanced study, but without specifically targeted interventions. Only 24 plans (from 22 states) of the 148 plans had extensive discussion of social vulnerability that clearly connected the geographic risk assessment to discussions of specific vulnerable populations within the area. Fifty plans had a cursory discussion that identified social factors that may place populations at disproportionate risk to hazards but did not explicitly link that discussion to the geographic risk assessment. Seventy-four plans lacked any discussion of social vulnerability. Equitable flood mitigation and adaptation requires an understanding of how populations with limited resources face unique challenges (Berke, Kartez, and Wenger 1993).

Survey data show that plans that included social vulnerability analysis typically included only a state-level profile or a more advanced study, but without specifically targeted interventions.

Similarly, a minority of plans (21 of 148) incorporated nondollar value quantification of risk (e.g., levels of potential displacement) into their risk assessments, but most (74 of 148) relied on property unit value or similar measures.

Plan Implementation

Implementation measures are central to good planning because they are the bridge from plan to execution. The more concrete details within a plan on proposed projects, project prioritization, timelines, committed funding, and responsible parties for execution, the easier it is to move toward implementation. We found that most states had plans that met basic criteria for incorporating implementation measures. Almost all plans (145 of 148) included specific projects, and most (116 of 148) described eligibility criteria for inclusion. Slightly under half (48 percent) included project prioritization, although this proportion decreased when SHMPs were excluded (30 percent). Almost all plans identified parties responsible for specific activities, although most did not include any method for ensuring responsible parties would act. Few (17 percent) identified responsible individuals by name or job.

Most plans (76 percent) included no special funding mechanisms, such as special bond issues. Special funding mechanisms are an important source of infrastructure funds because they allow states to access resources to build high-cost items using funding sources that are dedicated over the total period of the project. Special funding mechanisms are nonappropriation funding that we cataloged separately from traditional funding sources because they are dependent on certain factors, such as the state's credit rating or the assumption that tax revenue will go up, for the state to be able to access them.

FEMA Hazard Mitigation Assistance was the primary source of funding identified in the plans, although not all plans described funding sources. Other sources of state funds appeared in plans, but only 26 percent had fully committed funding earmarked for projects within the plan. Yet other funding sources for implementation exist: 33 states referenced state-level hazard mitigation assistance distinct from FEMA funds. These state funds may be dedicated specifically to hazard mitigation or could be applicable to a range of uses, hazard mitigation included.

Local governments are important implementers of state plans. Eighty-two percent of plans identified counties as parties responsible for implementation, and 78 percent identified municipalities. The information collected from the survey did not allow us to identify the specific tasks designated to local governments. However, we know that SHMPs, which typically include activities reported from local hazard mitigation plans, overwhelmingly included both physical (e.g., gray infrastructure, nature based) and nonphysical (e.g., planning, education outreach) infrastructure projects (91 percent), whereas non-SHMP plans often included only nonphysical projects (45 percent).

As most plans rely on local jurisdictions for implementation, technical assistance is crucial for building local capacity. As seen in the survey, most states provided some technical assistance to local government implementers, but the type and quality varied. The most common form of technical assistance offered to implementing bodies such as local governments was training assistance, which included training in development of local hazard mitigation plans in compliance with FEMA and use of analytic tools. Eighty-nine percent of plans overall and all SHMPs included provisions for training assistance. Just over half of plans (55 percent) included provisions for technical assistance related to data sharing, such as risk assessments or data tools, although this percentage was higher for SHMPs (72 percent). Fewer plans (37 percent) included provisions related to funding, such as guidance on grant applications and drawing down funds, and even fewer (20 percent) provided assistance outside of the training, data, or funding categories.

Governance and Coordination

State plans showed high levels of coordination with lower-level (municipal and county) government, reflecting reliance on local governance for substate context. More than half the plans included evidence of extensive collaboration with municipalities (51 percent) or counties (54 percent). However, few included evidence of engagement with water districts (4 percent), wastewater districts or authorities (7 percent), or regional planning organizations or councils of governments (11 percent). A relatively small share (25 percent) included extensive coordination with tribal bodies. Coordination with local governments is a crucial step in state planning to properly understand local context, conditions, and capabilities (Goggin et al. 1990).

Although over half the state plans showed coordination with municipal and county government, few plans included strategies to assist low-capacity localities—that is, geographically defined areas with limited government resources, low funding, or a lack of technical skills—or to track and monitor improvements in local capacity to address flood hazards. This finding is consistent with recent research (Smith and Vila 2020). Despite high levels of dependence on localities across all plans, only 39 percent of plans included strategies to assist low-capacity communities to plan for or implement flood mitigation or adaptation. Fewer plans (29 percent) encouraged local governments to assist low-capacity areas within their jurisdictions, and fewer still (23 percent) included any provisions to track or monitor improvements in local capacity. This local assistance is particularly important for communities that have been systematically excluded from government aid, such as predominantly Black or tribal communities. Without disrupting the system and supporting capacity building, these communities will continue to be systemically excluded from mitigation planning.

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Our survey showed that home-rule states were less likely than Dillon's rule states to provide state funding for plan implementation. Fifty-three percent of plans from Dillon's rule states identified the state as a primary source of funding for implementation projects, whereas only 39 percent of home-rule states did so. Similarly, 19 percent of plans from Dillon's rule states included state-provided hazard mitigation assistance as a project funding source (distinct from assistance originating from FEMA), but only 6 percent of plans in home-rule states did so. Eighty-four percent of plans from Dillon's rule states but only 17 percent of plans from home-rule states identified other state or private sources of funding. However, the funding available was committed more often in home-rule state plans (35 percent) than in Dillon's rule state plans (25 percent), and a larger share of home-rule state plans included a full budget than did plans from Dillon's rule states (39 percent versus 29 percent). These distinctions are important for understanding the role that state governance plays in plan implementation and funding opportunities. Dillon's rule states were more likely to fund programs directly, whereas home-rule states tended to take a less direct role as facilitators to local planning efforts and use funding as additional incentive for local governments to adopt specific policies or implement state priorities. Home-rule states were more likely to depend on federal funding sources, but they also were more likely to have funding fully or partially committed to planned hazard mitigation projects and to have a specific budget included in planning documents (table 3).

TABLE 3

Funding Measures, by State Rule Type*Percentage*

	Dillon's Rule	Home Rule	Hybrid
Primary source of funding–state	53	39	61
Primary source of funding–federal	47	61	35
FEMA Hazard Mitigation Assistance	48	12	9
State hazard mitigation assistance	20	6	9
Other state or private funding	84	17	19
None	12	2	2
Funding fully committed	25	35	22
Funding partially committed	42	43	65
No funding committed	32	22	13
Budget included	29	39	26
Partial budget included	17	13	17
No budget included	54	48	57

Source: Authors' data.**Public Engagement and Transparency**

Through our research we found that plans are typically available online, but identifying relevant plans is challenging. Of the 148 plans included in the survey, 145 were online and easy to find. The remaining three required extensive navigation to locate or requests by phone and email to government offices. Although plans are available online, the diversity of plan types that address flooding create challenges for members of the public in identifying where to look. This challenge is compounded by the absence of many flood investments and programs from any coordinated planning effort.

Although the vast majority of plans are available, they may not be accessible to many readers. Less than half of plans reviewed were written in accessible language, meaning they minimized the use of technical language and sector-specific jargon. Moreover, only one plan is available in a language other than English: Puerto Rico's Plan de Adaptación ante los Cambios Climáticos. Translation may not be necessary for all plans, especially those not intended to be public facing, but the lack of plans or plan summaries available in Spanish or other languages creates an additional barrier to public engagement, especially in states with large linguistic minorities.

We also found that high-quality data visualization is rare in flood plans. Data visualization can serve many purposes, making assessing quality difficult. In the survey, plans were considered to have high-quality data visualizations if the visualization purpose was obvious at a glance and the design

elements (color, line, weight, texture, and position) had easily identifiable purposes, with little to no extraneous information. Based on this definition, a scant 16 percent of plans included high-quality demographic visualizations. Higher proportions included high-quality land use visualizations (24 percent) and flood hazard visualizations (25 percent). However, the quality of visualizations may be improving. Of the plans created after 2018, 24 percent included high-quality demographic visualizations, 28 percent included high-quality land use visualizations, and 31 percent included high-quality flood hazard visualizations.

Public engagement was limited, especially with hazard mitigation plans. Among plans included in the survey, the most common public engagement activity was a cursory feedback period (75 percent of plans), meaning that efforts did not go beyond programmatic requirements. Evidence of feedback sessions, including public meetings and workshops, appeared in about half the plans, but many of these (24 percent) were cursory. Public comment periods are a requirement of SHMPs, and survey findings suggested that they were handled largely as a check-the-box activity rather than as a purposeful form of engagement.

State Profile Findings: Five States' Flood Mitigation Planning Experiences

The state profiles were developed to complement the national view offered by the survey of flood plans. The five states profiled were selected not only for their notable experiences with flooding and efforts toward flood hazard mitigation but also for their diversity in exposure type, governance approach, and geographic location. These accounts of flood hazard mitigation efforts in North Carolina, Colorado, Iowa, Florida, and Washington were intended to provide richness of experience not available in the national survey and to offer insight into why state flood hazard mitigation efforts vary in approach and outcome.

Flood Planning in Sample States

The five sampled states represent a range of experiences with flooding, as well as approaches to adaptation and mitigation. In this section, we review the current state of planning in each state along with brief context.

NORTH CAROLINA

North Carolina faces both inland and coastal flood hazards. The coastal and central Piedmont regions of the state are most vulnerable to destructive flooding from hurricanes and tropical storms, and the mountainous western region is vulnerable to flash flooding and snowmelt runoff from the mountains. In total, 18.2 percent of land in North Carolina is in a floodplain. North Carolina has experienced three billion-dollar floods since 2013, including an estimated \$17 billion from Hurricane Florence in 2018 and \$4.8 billion from Hurricane Matthew in 2016 (Office of Governor Roy Cooper 2018). More recently, NOAA estimated that North Carolina experienced \$12 billion in flood-related disasters between 2015 and 2021.¹¹

Background

In the wake of Hurricane Florence, Governor Roy Cooper enacted Executive Order 80 on climate change, which called for the development of a risk resilience plan and a Climate Change Interagency Council, which includes members from 10 state departments and the Office of the Governor. In the same year, the legislature established the North Carolina Office of Recovery and Resiliency (NCORR) under the Department of Public Safety. NCORR is charged with managing approximately \$1 billion in Community Development Block Grant Disaster Recovery and Mitigation funds, in addition to funds from the State Disaster Recovery Acts of 2017 and 2018 and the Storm Recovery Act of 2019.¹² In addition to recovery efforts, NCORR serves as a central point for resilience in the state, leading the state's strategic buyout program, funding affordable housing developments with disaster-resilient features, and investing in resilient infrastructure. Although NCORR is tasked with addressing all disaster types, respondents noted that the organization has a special focus on flooding due to the circumstances of its inception.

Before the passage of the state's 2021 budget, NCORR was also tasked with leading the implementation of the 2020 North Carolina Climate Risk Assessment and Resilience Plan (CRRP). The 2020 CRRP identifies key climate hazards facing North Carolina based on statewide climate projections. The plan identifies increases in coastal flooding, inland flooding, and hurricanes as three hazards with likely to certain increases. However, recommendations are largely limited to increased coordination among government agencies, identifying new research needs, and the integration and prioritization of investment in public and natural infrastructure improvements. Although the 2021 budget, which was passed on November 18, 2021, retains NCORR's budget, it places significant resilience funding in other departments, such as the Department of Environmental Quality. According to one informant, NCORR still has an important coordination role, but its place in the new landscape is in flux.

The E-SHMP was last updated in February 2018, before Hurricane Florence and Executive Order 80. In alignment with FEMA requirements, the plan incorporates climate projections in the risk and vulnerability assessment by using high-quality NOAA data. Although the E-SHMP reflects high levels of coordination with local communities and across government agencies, it includes only a limited discussion of social vulnerability and does not incorporate social vulnerability into the risk and vulnerability assessment. Mitigation actions in this Dillon's rule state include several direct actions by state government, including property acquisition and elevation. However, the plan still focuses on encouraging and supporting local hazard mitigation planning, allowing for some land use and taxation tools to be leveraged by local governments.

Current Activities

Government and stakeholder respondents noted that North Carolina has made progress on several objectives outlined in the CRRP, including the convening of an interagency resilience team, the establishment of the North Carolina Resilient Communities Program to build local resilience capacity, and the incorporation of risk assessments into the next E-SHMP. However, state respondents observed that the lack of regulatory power or dedicated funding for implementation has hindered progress, noting that the plan primarily provides a qualitative discussion of state needs rather than establishing concrete goals and metrics.

The 2020 CRRP update calls for the E-SHMP and CRRP to form the core of a state resilience approach. The plan specifies that more locally specific climate projections that are outlined in the risk assessment will be incorporated into the next E-SHMP, which is expected in 2022. State government informants confirmed that the state will be incorporating the 2020 CRRP into the E-SHMP update, which they noted should include not only statewide data, but regional, watershed-level data.

Interviewees noted that recent legislation may prove transformative for flood planning in North Carolina. The recently adopted 2022–23 budget includes \$20 million to develop a statewide Flood Resiliency Blueprint, which “shall form the backbone of a State flood planning process that increases community resiliency to flooding, shall be a resource for riverine and stream management to reduce flooding, and should support the establishment and furtherance of local government stormwater maintenance programs.”¹³ The budget also funds a range of flood-specific projects, including shoreline stabilization and the development of natural flood barriers, and makes permanent three of the four resilience positions in NCORR. It also earmarks \$15 million in the state Land and Water Conservation Fund for floodplain restoration projects and creates a new \$100 million Stormwater Reserve, which will reside in the Department of Environmental Quality.

Key Themes

In our conversations with state government officials and stakeholders, multiple interviewees commented on the piecemeal nature of flood planning in the state, noting the current lack of coordinated leadership despite the high-level guidance of the Climate Change Interagency Council. Two government informants pointed to high levels of attention and funding directed to coastal flooding following Hurricanes Irene and Matthew, but they also noted that these efforts did not result in a sustained or deliberate approach. Stakeholders and government respondents applauded the establishment of NCORR, but they observed that the resiliency office within NCORR is limited both by its small size (it has a staff of four) and by the lack of a direct line of communication with the governor, given that NCORR sits within the Department of Public Safety. Furthermore, neither the Division of Emergency Management, which is responsible for administering disaster preparedness activities and programs available to the state through FEMA, nor the Department of Environmental Quality, which is responsible for managing the state's natural resources, has regulatory authority to enforce plans.

Respondents noted tension in state priorities between ongoing recovery from Hurricanes Matthew and Florence and the need for longer-term strategic planning. They noted that garnering political will for extended planning faced direct challenges from residents with unmet needs, such as for home repairs, buyouts, or elevations. One respondent noted that funding for the ongoing unmet recovery needs often does little to improve protection across the state, further observing that current budget proposals include over \$150 million for individual physical mitigation infrastructure projects but only \$20 million in funding for a statewide flood resilience framework. One stakeholder provided context on how following Hurricane Floyd in 1999, there was an influx of federal funding for flood hazard mitigation, but because the state did not backfill with state funds, programs dried up when the federal money ran out. This program loss highlights the challenge of intermittent funding, especially with large influxes of federal recovery funds, for creating sustainable, long-term planning in the state.

COLORADO

Colorado, a landlocked state, is defined geographically by the Front Range of the Rocky Mountains, which runs north to south, dividing the mountainous western half of the state from the eastern prairies. FEMA identifies riverine flooding as a hazard in all Colorado counties. Mountainous regions also experience postwildfire flooding and both planned and unplanned dam overflow flooding, which are not identified by FEMA. A recent flood in the state occurred in 2013, when a cold front stalled out over the Front Range, causing flooding across 17 counties, with the greatest damage in the highly populated areas of Boulder County, Larimer County, and near Denver. The Front Range floods

resulted in two presidential disaster declarations and federal investment of approximately \$118,700,000 in individual assistance, \$343,644,427 in public assistance, and \$320,346,000 in Community Development Block Grant funds (Colorado Department of Local Affairs; FEMA 2018).¹⁴

Background

The Colorado Resiliency Office (originally named the Colorado Recovery Office) was created by then-governor John Hickenlooper in response to the 2013 Front Range flood to coordinate state-level response, leverage funding sources, and build lasting partnerships across state agencies and stakeholders (Colorado Resiliency Office 2015). Since that time, the office has been rehoused in the Department of Local Affairs in order to establish a statewide resiliency framework (adopted in 2015 and updated in 2020) and coordinate local resilience efforts. Colorado is one of the few states that has a separate flood mitigation plan, the Flood Hazard Mitigation Plan for Colorado (FHMP). This plan was first adopted in 1982 following the Lawn Lake Dam failure flood. Since 2004, FHMP updates have been incorporated into the SHMP process, and since 2007 the FHMP has been aligned with the mitigation element requirements of the Disaster Mitigation Act of 2000, allowing it to function as an official annex to the SHMP (Colorado Water Conservation Board 2018).

Current Activities

Colorado is a home-rule state. Almost all incorporated municipalities are responsible for local flood planning and control key tools, such as direct collection of sales, use, and property taxes, and they have significant leeway in developing land use regulations and utilities plans, as well as day-to-day local statutory measures. The 2015 Colorado Resiliency Framework confirms this approach, noting “as a home-rule state, the strength of Colorado resides in the right to local self-governance.... A top-down approach is not appropriate in most instances and ongoing multi-disciplinary conversations are locally driven” (Colorado Resiliency Office 2015).

Current flood-related plans include the state FHMP and the E-SHMP, both led by the Office of Emergency Management, and the Colorado Resiliency Framework, led by the Colorado Resiliency Office. By design, the FHMP mirrors the organizational structure of the SHMP, with both plans using many of the same data sources and analysis techniques. The key value of the FHMP is an extended risk assessment, which goes into greater detail than the E-SHMP on methodology, data sources used, and specific types of flood risk, and the FHMP’s extensive list of recommended actions and activities beyond those included in the SHMP. Furthermore, these actions are given a priority ranking (high, medium, or low priority) based in part on the criteria laid out in the Colorado Resiliency Framework (Colorado Resiliency Office 2020).

Although not a flood-specific plan, the Colorado Resiliency Framework discusses the damages floods have caused, citing them as a leading shock faced by the state. Although none of the strategies target flooding specifically, many incorporate practices associated with improved flood planning. Such practices include standardizing and aligning climate models used for scenario planning¹⁵ in state, regional, and local planning efforts; incorporating performance metrics to demonstrate resilience improvement; and incorporating resilient watershed-based management to develop a “holistic watershed approach to identify cross-cutting projects that...[improve] climate and natural hazard resiliency” (Colorado Resiliency Office 2020, 55). The framework also defines a set of “resiliency prioritization criteria designed to enable State departments and agencies to prioritize resiliency efforts that produce multiple benefits while using limited available resources” (Colorado Resiliency Office 2020, 11). As noted, these resiliency prioritization criteria have been integrated into the FHMP, and as of 2019, they were used by the Colorado Division of Homeland Security and Emergency Management to prioritize local community grant proposals for FEMA mitigation funds (DHSEM 2019).

The 2015 Colorado Climate Plan, which was developed and is implemented by a wide range of state agencies with water efforts led by the Colorado Water Conservation Board, and the 2015 Colorado Water Plan, developed and implemented by the Colorado Water Conservation Board, both discuss flooding to a limited degree. The Colorado Climate Plan, which is a climate adaptation and mitigation plan, notes that climate change models predict increased extreme precipitation in the state during the winter months, but it does not include any recommendations specifically for flooding.

Key Themes

Local government officials we spoke with largely agreed that the SHMP, the FHMP, and the Colorado Resiliency Framework work together to address flooding. Although the original iteration of the FHMP predates the SHMP, respondents noted that the FHMP update process has moved from its original home in the Department of Natural Resources to be part of the SHMP cycle. One informant noted that the FHMP has essentially merged with the SHMP, functioning as an annex and structured to provide increased depth and detail on flood mitigation strategy.

Informants also observed that the connectivity between the plans is a result of many of the same people working on all three, with different offices taking leadership. The Resilience Strategy 2020 update, the most recently completed planning process in the area, included a process of analyzing state plans, including the SHMP and FHMP, in developing the Resiliency Framework. Likewise, respondents from the Office of Emergency Management and the Flood Technical Assistance Partnership, a committee of the Colorado Association of Stormwater and Floodplain Managers, noted

that the goals and assessment framework from the Resilience Strategy will continue to be incorporated into the 2023 SHMP and FHMP processes.

Despite this connectivity, informants noted some siloing of flood activities in the state government. They observed that the division of efforts between the Colorado Water Conservation Board and the Colorado Division of Homeland Security and Emergency Management creates some gaps between the data that are collected and the data that are needed. The Colorado Water Conservation Board works directly with local and regional floodplain managers and is responsible for collecting and analyzing state data; the Division of Homeland Security and Emergency Management is responsible for coordinating local planning processes, developing the SHMP, distributing most federal dollars, and providing technical assistance to local communities. Although the Flood Technical Assistance Partnership works to enhance communication between government agencies, it is limited by its position outside of state government.

One interviewee noted that the separation of the Dam Safety Branch in the Division of Water Resources under the Department of Natural Resources has been a key area of disconnect. According to dam safety staff, data on dam-related floodplains and probabilities of failure were not included in the state's flood risk assessment until 2012. Today, the dam safety office houses key aspects of risk analysis, including the overlay of social vulnerability indicators with flood risk, although the social vulnerability indicators were not fully integrated into the flood risk assessment in the SHMP. However, the information gap remains. One respondent noted that spillway flows (the water that passes over a dam by design during big floods) have not been incorporated into state flood mapping or risk assessment.

Interviewees confirmed the limited nature of public engagement with flood planning. Informants speaking about both the SHMP and the FHMP noted extensive coordination between state agencies and local governments, but they could not recall any efforts to engage the public, either directly or through partner advocacy organizations. The Resiliency Framework process involved public engagement in the form of a public survey and several targeted focus groups. However, no evidence exists that these efforts discussed flooding beyond contextualizing the threat in the larger state resilience landscape.

This lack of public engagement was reflected by our stakeholder discussion. As a member of a local water advocacy organization, one stakeholder noted engagement with Denver and other government bodies. Indeed, she observed that the state has limited power to enforce flood protection

policies, observing that “land use planning is really difficult in Colorado because of home rule. There's money to be made by selling homes by trees and water, so it's hard to discourage that.”

Colorado has advanced its flood planning practices as part of an effort to improve resilience in the state following the Front Range floods of 2013. These efforts have resulted in increased cooperation between the various departments and agencies that are responsible for components of flood planning, including coordination on the development of the SHMP and the linked FHMP, the incorporation of resiliency criteria into how projects are prioritized in the 2018 FHMP update, and the use of the criteria in determining how to distribute grant funds to local governments. However, the silos between the Office of Emergency Management, the Office of Dam Safety, the Colorado Water Conservation Board, and the Colorado Resiliency Office remain and continue to cause knowledge and communication gaps.

As a home-rule state, Colorado is limited in its ability to directly implement flood mitigation or adaptation policies or programs. In a rapidly growing state, this limitation has created tensions in areas bordering regulatory and other known floodplains, as the state relies on local governments to enforce locally developed land use regulations. Interviewees noted that the state views its role in flood planning as providing data and technical support to local governments to develop their own flood and general hazard mitigation plans, an observation supported by the 2020 Resiliency Framework. However, the state has used innovative tools to advance resilience standards, such as incorporating its own additional scoring to prioritize hazard mitigation projects and the distribution of FEMA funds. These resilience standards include key features of strong planning, including considering local impacts of climate change and substantial incorporation of social vulnerability into local plans and actions.

Although the relative absence of public engagement in the flood planning processes is not unusual, it places a special onus on local governments to develop policies that are likely to have ramifications for neighboring municipalities and unincorporated areas. Greater outreach and public education on the state's role in flood mitigation and adaptation could lead to greater support for planning processes that extend beyond local boundaries.

IOWA

Floods are the most common disaster in the state of Iowa, and the state experiences both flash flooding and riverine flooding. Significant flash floods in 2017 and 2018 were followed by major floods on the Missouri and Mississippi Rivers in 2019 that caused an estimated \$1.4 billion in damage in Iowa and a presidential disaster declaration in 57 counties in the state, as well as extensive damage in neighboring Missouri and Nebraska.¹⁶ During the prior decade, riverine flooding from June 8 to July

1, 2008, caused widespread damage and precipitated a renewed focus within the state on flood hazard mitigation. The city centers of Cedar Rapids and Iowa City saw substantial damage and during this event, and 86 of the state's 99 counties were included in the governor's disaster declaration. The extensive flooding forced 38,000 Iowans to evacuate, and 21,000 housing units were impacted (Iowa Department of Homeland Security 2009).

Background

Following the devastation of the 2008 floods, the state legislature funded the creation of two key bodies focused on flooding: the Iowa Flood Center (IFC) and the Iowa Flood Mitigation Board. The IFC, which is housed at the University of Iowa, serves as the only academic center in the country focused solely on flooding. IFC monitors riverine flooding across the state with a network of stream sensors that measures river levels in real time and runs advanced flood modeling to provide flood alerts and forecasts for communities within the state. Through a \$15 million project funded through HUD after the 2008 floods, the IFC, in collaboration with the Iowa Department of Natural Resources and US Army Corps of Engineers, used available statewide lidar data to update flood maps for the entire state. The map products are reviewed by FEMA before becoming adopted flood insurance rate maps.

The Iowa Flood Mitigation Board was established four years later in 2012 by the Iowa General Assembly with the mission of creating a flood mitigation program in the state to “support projects aimed at addressing gaps in communities’ resilience to floods and breaking the costly cycle of damage and rebuilding” (The Pew Charitable Trusts 2019). The board allows localities to submit proposals for flood mitigation projects that the board reviews for potential approval and funding (The Pew Charitable Trusts 2019). The board is composed of 14 members from the public and state agencies as well as four ex officio members from the state legislature. Funds are raised from sales tax increments or appropriated by the state General Assembly.¹⁷

Current Activities

In 2016, HUD awarded the state of Iowa \$97 million through its National Disaster Resilience Competition for the development of the Iowa Watershed Approach (IWA). A partnership between universities, nonprofits, and state agencies, IWA selected nine watersheds in the state with histories of flooding. For each watershed, it supported the establishment of a watershed management authority—a new governance body—to oversee implementation of a watershed-based flood mitigation plan based on a watershed-scale hydrologic assessment. The goal of the project was to strategically identify and implement upstream green and ecologically sound mitigation efforts to

reduce the magnitude of downstream flooding while minimizing environmental impact and negative externalities. To be able to substantively measure and monitor projects' flood risk reduction, IWA chose nine watersheds with a subbasin size of hydrologic unit code 8.¹⁸

Despite the extensive work of the IFC and the IWA, Iowa has minimal state-level formal flood planning. The Iowa Enhanced Hazard Mitigation Plan is the only state plan that addresses flooding. The plan meets the requirements for enhanced status, but it does not take significant steps beyond the benchmark requirements. For example, although the plan refers to changes in hazard risks caused by climate change, it does little to incorporate climate projections into the plan itself. Likewise, although social vulnerability is acknowledged, it is not incorporated into risk analysis or accounted for in mitigation strategies. Flood risk is assessed using historical crop damage from riverine flooding and property damage from riverine and flash flooding.

Key Themes

Iowa serves as an example of a state with limited state-level flood planning yet substantive flood mitigation activities. As a home-rule state, limited regulatory authority exists to promote the implementation of coordinated flood mitigation planning and implementation, so responsibility had been ceded to academic and quasigovernmental organizations to lead the efforts. This approach places the onus on local governments and organizations outside of state government, such as IFC and IWA, to initiate planning and coordination.

IWA is a central actor in the flood planning ecosystem within the state. Its origin from HUD's National Disaster Resilience Competition highlights the importance of federal funding in catalyzing flood mitigation efforts. Although some SHMPs simply check the box for federal planning requirements rather than developing nuanced, engagement-led products, it is important to acknowledge the role that federal funding can play in filling state gaps.

The IFC is both the institutional home of IWA and the primary partner for technical assistance with flood mapping, contracting with the state government to produce regulatory maps to submit for approval to FEMA as flood insurance rate maps. In addition to these "by the books" maps, informants described developing a more detailed predictive flood model, combining topography from LiDAR surveys, data from specialized boats measuring the topography of river bottoms, and river gauge data. These models can create probabilistic inundation maps for 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year floods.¹⁹ Informants noted the critical separation of these two efforts, observing that the data and analytic tools they use are "a generation or two" past what is used at FEMA. Consequently, the products they develop would be difficult to get approved as regulatory products in a timely manner.

Instead, IFC serves as a centralized resource for Iowa communities doing their own flood planning. Respondents observed that IFC fields frequent requests for data, analysis, and technical assistance from municipalities and other localities across the state and shares methods and approaches with professionals in other states. One interviewee noted that IWA and IFC staff spend significant time traveling around the state to communicate directly with landowners and residents to learn and to teach the on-the-ground reality of flood hazards and challenges to mitigation. As one informant noted, “If you don’t go, you don’t know.”

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Respondents noted that before IWA was created, the state lacked standard legal authority for watershed management. The development of watershed management authorities that oversee water management issues across jurisdictional boundaries is a significant step in this direction, and although these bodies lack the regulatory power that local jurisdictions might have, they represent a structural adjustment that provides a locally tailored but consistent approach to flood management for those areas within the state where they exist. As a home-rule state, Iowa may have greater ease in establishing regional authorities, although respondents noted challenges in garnering buy-in, especially in rural agricultural areas upstream from large population centers.

Although Iowa state code identifies the E-SHMP as one of three parts of the state’s comprehensive emergency plan, it lags behind the work being done by IFC.²⁰ Interviewees involved with the SHMP noted that they primarily value the plan as a tool to access federal dollars, and they further observed that the decision to pursue the enhanced status was based on already meeting the criteria and seeking the extra financial incentive. They added that the need for mitigation projects by local governments always far exceeds the available resources, so pursuing the enhanced plan was an opportunity to make more funds available. Several government and stakeholder informants also noted that most state legislators appear to have little awareness of flood planning activities in the state despite the stated centrality of the issue.

In relation to addressing the needs of socially vulnerable communities, government informants noted that IWA encountered barriers as a result of its novel approach of addressing the root cause of flooding, focusing mitigation projects upstream from areas at high risk of flooding. Although they sought to align their efforts with HUD's requirement to provide benefits to low- and moderate-income households, IWA staff found that HUD's approach to measuring benefits made upstream mitigation projects difficult to justify when benefits would be seen by vulnerable populations downstream.

In 2020, IWA submitted a FEMA BRIC application. Interviewees said they hoped local communities would use the application as a template to reduce the starting energy needed for them to produce their own applications.²¹ They viewed the goal of the program as building local capacity so that the initiatives can continue without support and guidance from IWA, which is slated to end in December 2022. The watershed management authorities are in the process of determining how to sustain funding after the program ends. Interviewees explained that all IWA watersheds are set to complete flood mitigation installation by June 2022, and IWA is looking for additional funding sources to support those communities in implementing their projects.

FLORIDA

Because of its geography, Florida is prone to coastal, basin, and flash flooding. The entire state is vulnerable to flooding because of its large amount of coastline, significant drainage systems, and low elevations. Low-lying inland areas are vulnerable to riverine and basin flooding following intense rainfall. Rapid development has increased the area of impervious surfaces across the state and with it the risk of urban flash flooding. Other flood hazards in the state include lower and upper tidal reach flooding and dam failures. The majority of the major floods in the state have resulted from severe storms or hurricanes. In 2017, Hurricane Irma caused extensive flooding in southern Florida from storm surge and rainfall.

Background

Although the state has one of the highest levels of exposure to sea level rise and hurricanes in the country, formal flood planning at the state level is minimal. The E-SHMP currently serves as the state's flood risk assessment, and the primary governance bodies are five water management districts (WMDs) with the responsibility to manage flood protection and mitigation infrastructure within their districts. The WMDs have sales and value-added taxation powers within their districts, making them somewhat independent of state control, although they are overseen by the Department of Environmental Protection and appointed by the governor.

The five regional WMDs follow major watershed boundaries. Although the WMDs do not have the same comprehensive planning approach as conceptualized in the IWA, and they operate some of the most extensive flood protection infrastructure in the country, informants noted that the WMDs do not frequently coordinate across their boundaries. In addition, as one informant pointed out, some municipalities operate their own local WMDs, which manage projects internal to their municipal boundaries, somewhat fragmenting the watersheds.

In addition to the activities of the individual WMDs, the state also manages some flood protection activities directly. For example, the Department of Environmental Protection manages coastal and wetland protection, housing much of the coastal flooding and sea level rise state initiatives, including the newly developed Sea-Level Impact Projection tool and the 309 Coastal Management Strategy. The Sea-Level Impact Projection tool is a data tool to project sea level rise on oceanfront coasts that will offer local communities a uniform assessment to guide development. The tool is jointly funded through NOAA and state dollars. Although the tool was initially intended to be an input to statewide land use regulation, the bill funding the project removed this component before it was adopted.²² In addition, in 2019, Governor Ron DeSantis created the position of chief resilience officer within the state to coordinate resilience activities across public, private, and academic sectors.²³ Originally housed in the governor's office, the Colorado Resiliency Office is now housed in the Department of Environmental Protection. Although this office is officially responsible for resilience across all hazards, the original position announcement and annual reports place heavy emphasis on sea level rise and coastal flooding (Office of Governor Ron DeSantis 2019).

The impact of the Southeast Florida Regional Climate Change Compact has also been substantial in influencing state-level flood planning. The compact, started in 2009 by leaders from Broward, Miami-Dade, Monroe, and Palm Beach Counties, developed and adopted its own climate action plan separate from that of the state.²⁴ This action led to similar efforts in the Tampa region and, according to one informant, has influenced the state's efforts to improve standardized sea level rise.²⁵

Current Activities

Although the E-SHMP acknowledges the potential effects of climate change on flooding within the state, the risk assessment only relies on historical data. Flood risk is measured for both the 100- and 500-year floodplains; units of risk assessment include population in floodplains, the total economic value within the floodplain, and direct economic loss (Florida Division of Emergency Management 2018).

The development of the E-SHMP was done through the Florida Division of Emergency Management (FDEM) without the assistance of an engineering contractor. Although FDEM organized an interdepartmental mitigation planning committee, one respondent who participated noted that meetings were largely informational, with different agencies sharing information on projects occurring in the state. The E-SHMP relies on FEMA data for its flood risk assessment; however, some local municipalities use more detailed data in their local plans, which are then incorporated into the state plan. An interviewee noted that FEMA planning grants are typically initiated by and filtered directly to the WMDs, rather than FDEM, to update flood hazard maps. One government interviewee reported that FDEM had received technical assistance from Florida Atlantic University on how to incorporate climate change and sea level rise into the plan but noted that the findings from that report are not yet incorporated into the current E-SHMP. Our review of the E-SHMP found that the plan discusses sea level rise and increasing vulnerability of coastal areas, as well as the effects of a warmer atmosphere on flooding, but these factors do not appear to be accounted for in assessing the probability of future floods. In relation to incorporating climate change into future planning strategies, an interviewee reported FDEM sees its role as consisting of distributing FEMA funds for mitigation and recovery to local jurisdictions with the perception that they understand their own changing risk best. The current E-SHMP does not include substantial discussion of social vulnerability. An interviewee noted that although it would be possible for WMDs to incorporate social vulnerability into their analyses, they currently only measure risk through property damage.

Some WMDs provide more advanced risk assessments than are available through the E-SHMP. The South Florida WMD, for example, develops its own models that incorporate land use change and sea level rise scenarios as well as rainfall trends based on historical trends and climate change projections. A stakeholder we spoke with noted that the WMD models have tended to focus on inland and urban flooding but that current efforts are shifting to look at agricultural risk.

Recent actions indicate a significant shift in the level of state government engagement with flood planning. Governor DeSantis signed SB 1954 in May 2021, calling for a Statewide Flooding and Sea Level Rise Resilience Plan and a statewide flood risk assessment by the Department of Environmental Protection to inform the Resilience Plan and creating the Resilient Florida Grant Program. The grant program will provide funding to local governments for the cost of planning for and addressing threats from flooding and sea level rise and encourage the formation of regional resilience coalitions to coordinate intergovernmental initiatives. The legislation also establishes the Florida Flood Hub for Applied Research and Innovation to collaborate with academic and research institutions on the state's

flooding and sea level rise challenges. The legislation dedicated \$100 million each year to these efforts beginning in 2022.²⁶

The state is also developing a watershed master plan with community-level data that can be used by municipalities to create local watershed plans. FDEM applied for Hazard Mitigation Grant Program funding for a planning project and received \$26 million to support every community in the state to complete a watershed management plan at the hydrologic unit code 12 level. Communities must complete a plan to be eligible for state resiliency grant funding (Florida Division of Emergency Management 2018).

Key Themes

To date, government respondents and stakeholders noted that state-level flood planning in Florida has been primarily passive, responding to specific needs after local or major disasters rather than investing in long-term planning. One expert observed that with the high concentration of population along the coast, the state has historically taken more of an interest in coastal flood mitigation despite the need for mitigation inland, because of both riverine flooding and tidal floods linked to sea level rise. The informant observed that this predisposition may be partially attributable to the relative power of the Office of Resilience and Coastal Protection, whose scope does not include inland flooding.

As several interviewees noted, the mitigation needs of the state far outpace resources, with one observing, “You could use the whole state budget and still have more you would want to fund.” The main lack, according to government interviewees, is the time and cost needed to get detailed data on flood risk and vulnerability and sea level rise changes. An interviewee at a WMD noted that in recent years, the state has been more supportive of resiliency assessments, but it had been inactive in the past, which left multiple WMDs behind on creating comprehensive flood risk assessments.

Multiple government informants observed that Florida’s approach to date has been to place the responsibility for flood mitigation and planning on the regional and local level with a belief that localities are better able to understand their risks and vulnerabilities. This approach allows for flexibility between local contexts, but it leaves a gap for a larger coordinated effort and oversight for a cohesive mitigation effort, and it does not ameliorate the recurring tension of diverse local vulnerabilities.

The passage of SB 1954 may indicate a turning point in how the state views its role in flood planning. The final content of the Statewide Flooding and Sea Level Rise Resilience Plan and the outcomes of the grant program will provide more concrete evidence of the state’s approach in the

coming years, but the programmatic and funding commitment points to this new approach. This shift aligns with the observations of stakeholder and government informants, who observed that although climate change remains a controversial topic in Florida, it is impossible to ignore the reality of sea level rise and the impacts that it has already had along the state's highly developed and populated coastline.

WASHINGTON

Washington is a coastal state with multiple mountain ranges separating wet coastal regions from a dry inland territory. In most of the state, flooding occurs as the result of extended precipitation in late fall and winter. Rain-on-snow floods also occur for a short portion of the year from snowmelt, but these floods are becoming more frequent with climate change. Flooding often occurs in the foothills of the Cascade Range in Eastern Washington and in the northeastern highlands during spring snowmelt. One major flood occurred in 2009 when an atmospheric river associated with a stalled thunderstorm dropped eight inches of rain in one day over Western Washington, with associated flooding of nearly all rivers and urban and small streams, resulting in over \$72 million in damages, 1,500 landslides, and 44,000 evacuations.²⁷

Background

The key actors in flood planning and mitigation in Washington are the state Department of Natural Resources (DNR), which manages 5.6 million acres of land and water in the state and develops, maintains, and implements the 2020 Plan for Climate Resilience; the Emergency Management Division, which is responsible for the development, monitoring, and implementation of the SHMP; and the Department of Ecology, which manages the Floodplains by Design (FbD) program in partnership with the Nature Conservancy; and the Puget Sound Partnership. The Climate Impacts Group at the University of Washington is also involved in flood planning.

In 1987, Washington established the Flood Control Assistance Account Program (FCAAP), which provides funding and guidance to local jurisdictions for undertaking comprehensive flood planning (State of Washington Department of Ecology 2021).²⁸ The program supported local flood mitigation planning until 2008, when it was defunded during the financial crisis. FCAAP was reinstated for the 2021–23 funding cycle.

Current Activities

Key plans addressing flooding in Washington include the 2018 E-SHMP, the 2020 DNR Plan for Climate Resilience, and an Integrated Climate Response Strategy released in 2012. The Integrated Climate Response Strategy addresses flooding topically but does not include any recommendations targeted to mitigation or adaptation. The Climate Resilience plan, which focuses on state lands,

likewise identifies flood risk as a factor within the larger climate resilience strategy. Flood risks are situated within the context of coastal hazards, and risk is quantified in relation to ecosystem and habitat impacts. Government interviewees noted that although the Climate Resilience plan is not a flood plan, because of DNR's management of a significant portion of public lands within the state, it is central to understanding the department's priorities. However, the Climate Resilience plan only extends to areas within DNR's jurisdiction, that is, state lands.

The Washington State Coastal Zone Management Section 309 Strategy and Assessment also addresses flooding, specifically noting sea level rise, coastal erosion, subsidence, and coastal flooding as key flood hazards. This plan identifies the E-SHMP as the source of coastal risk assessment and mitigation strategies.

The 2018 E-SHMP relied mostly on past occurrences for the flood risk analysis, but expert stakeholders noted that the next plan will use more rigorous methods and rely on data-driven and science-based analysis provided by the Climate Impacts Group at the University of Washington. They also commented that social vulnerability was “semiquantitative” in the 2018 E-SHMP, meaning that census tracts were used to assess who was exposed to flood hazards. However, the Emergency Management Division plans to integrate the CDC's Social Vulnerability Index into the 2023 plan.

Current Status

In 2013, Washington established Floodplains by Design (FbD), a public–private partnership between the Department of Ecology, the Nature Conservancy, and the Puget Sound Partnership. It grew out of an observation that previous floodplain management initiatives were siloed in emergency management, away from natural resource management efforts, which led to unintended consequences and duplicative and inefficient results.²⁹ The program seeks to support programs that integrate ecological preservation and habitat restoration. FbD states that it uses an integrated floodplain management approach that aims to “improve the resiliency of floodplains for the protection of human communities and the health of the ecosystem, while supporting values important in the state such as agriculture, clean water, a vibrant economy and outdoor recreation” (Floodplains by Design 2018, 1).

FbD provides grant funding on a biennial funding cycle. Projects are expected to be completed on a two- to three-year timeline.³⁰ The 2019–20 grant cycle had \$50.4 million appropriated, with awards ranging from \$500,000 to \$9.4 million. Projects must have a 20 percent match to the FbD funding, but communities defined as economically distressed can have this match waived.³¹ The 2018 five-year FbD vision seeks to expand the program's reach by “building more robust capacity and management

systems, assessing whether and how to engage with the policy/regulatory framework, and identifying and positioning integrated floodplain management for bigger resources” (Floodplains by Design 2018, 4). The vision includes recommendations to incorporate FbD principles into existing state flood statutes.

In 2021, the state funded FCAAP again after a gap of 13 years. The program has \$1.5 million in funding available for flood planning and \$100,000 available for implementing emergency flood mitigation projects.³² Planning grants have a 25 percent local match, and applicants go through a competitive application process, while emergency flood response projects have a 20 percent match and are awarded on a first-come, first-served basis.³³ Comprehensive flood plans funded through FCAAP must follow state regulations to be approved.³⁴ Eligible entities for funding include cities, towns, counties, federally recognized tribes, conservation districts, and special purpose districts, such as flood control districts. Applications for the first cohort of FCAAP grants for the 2021–23 biennium are closed as of September 30, 2021.³⁵

On May 17, 2021, Governor Jay Inslee signed SB 5141, the Healthy Environment for All Act, into law. This act seeks to “reduce environmental and health disparities in Washington state and improve the health of all Washington state residents by implementing the recommendations of the environmental justice task force.”³⁶ The Healthy Environment for All Act defines environmental justice as part of state law and requires the use of a racial justice lens in all agency plans, program implementation, and enforcement involving the environment. It creates a council to oversee the implementation of this measure and funds the analysis of “cumulative impacts and overburdened communities...to measure the link between environmental quality and human health, disaggregated by race”.³⁷ According to interviewees, the law has not yet been implemented, but one noted the expectation that it will affect future E-SHMP cycles, as well as other state environmental activities.

Interview Themes

Despite having multiple plans that address flooding, interviewees viewed the E-SHMP as a central document, bringing together the different flood programs, including FbD and FCAAP, into a comprehensive plan. Stakeholders viewed FbD and FCAAP as the central components to the overall flood mitigation strategy in the state, noting that they work in tandem to fund planning (FCAAP) and implementation (FbD). Although the programs were not designed together, stakeholders noted that when FCAAP was reinstated, policymakers thought of it as extending FbD funds to allow for support of planning and implementation of flood mitigation projects.

One government interviewee highlighted the focus on multiple benefits as a performance measure in FbD grants, ensuring that funded projects merge flood hazard reduction with ecological preservation and restoration. This interviewee noted that because of this connection with other environmental concerns, FbD holds broad appeal with a range of interest groups like conservationists, farmers, and homeowners. This support has shown to be more substantial and durable than public support for one-off mitigation efforts.³⁸ One drawback to the program noted by interviewees, however, is a perceived focus on inland flooding over coastal flooding, as areas at risk of riverine flooding in Washington are predominantly agricultural or protected lands that they believed lent themselves to the multibenefit integrative approach of the program.

Of the major flood initiatives in the state, FbD, which holds collaboration as a core tenet, has served as a model for extensive community engagement. During the conceptualization of the program, the leading agencies held dozens of workshops to bring together diverse stakeholders, including state agencies, cities, counties, local landholders, and the public. Conversely, in relation to the E-SHMP, state agencies meet quarterly to discuss various climate adaptations and risks, but these meetings largely focus on sharing information rather than coordinating on implementation. Engagement in the 2018 E-SHMP was limited to state agencies and technical experts who provided feedback on risk assessments. However, for the 2023 SHMP, interviewees noted that the Emergency Management Division will be moving to a statewide risk assessment of four regions with comprehensive community engagement to bridge the quantitative analysis with what communities are observing on the ground.

The state's coordination with local governments is complex. As a Dillon's rule state, Washington has established statewide flood mitigation planning through the E-SHMP. However, the state relies on local governments for implementation. This reliance on local planning is noted in the SHMP and present in the FbD, and the FCAAP program model relies on counties, tribal governments, and conservation districts as the watershed-level conveners to implement multimillion dollar mitigation projects. Interviewees noted that both FbD and FCAAP work to connect state goals to local efforts through their grantmaking, as well as through direct engagement with local communities. However, interviewees also noted that this focus on local communities is not echoed at the state level, where communication between departments can be challenging, even while working toward the same goals.

Land use policies are similarly split between state and local governments. The state's Growth Management Act guides local land use planning in some counties to encourage concentrated urban growth, sprawl reduction, environmental protection, and shoreline management.³⁹ However, in most other circumstances, land use is controlled by county and tribal governments. This distribution of responsibility has led to disparities in data quality between wealthy counties that can extensively

survey their lands and compile risk data and lower-capacity communities that have lower-quality data to inform flood mitigation projects. One interviewee described how the value of FbD can be undermined in localities where local government institutions lack the staff or the technical capacity needed to apply for grants, let alone implement complex programs and report back to the state. FCAAP is seeking to remediate this problem through a current focus on assisting lower-capacity localities to develop flood plans, partially by encouraging wealthier counties to include lower-capacity localities within their borders in their comprehensive planning process. This practice may help with access, but as one interviewee observed, it creates a new dynamic in which low-capacity localities are dependent on their county to help them with their flood planning.

Federally recognized tribal nations are also key actors in Washington's hazard planning. In addition to acting as regular partners in hazard mitigation processes and FbD and FCAAP engagements, tribal communities have the legal right to use public lands. Because of this, they are heavily engaged by the DNR in discussions of public land use. Government interviewees reported that disproportionate impacts to select communities and special considerations for tribal communities were directly addressed in DNR's Plan for Climate Resilience as a result of tribal involvement.

Overall, even with renewed state investment in FCAAP, FbD, and the E-SHMP, interviewees noted that flood mitigation needs far exceed the available resources in Washington, especially with new climate change threats. One interviewee observed that flooding has not been a recent priority as the state legislature tends to focus on the most recent disasters, namely heat and wildfires. The state is also facing a debate on how to balance distributing funds in the most impactful way while also serving diverse priorities. Expansive need and limited resources beg the question of whether to focus on regional or local projects and how to create the greatest benefits while maintaining equity. Investing in select areas with the potential for significant flood risk reductions creates a trade-off of leaving other jurisdictions without support.

Cross-Site Observations

Despite broadly differing contexts and experiences with flooding, our five sample states' experiences with flooding and approaches to mitigation can offer some insight into the challenges and opportunities that state governments encounter in this area. In this section, we share some of these key themes and discuss how they relate to the findings from the national survey.

Plan Conceptualization

CATALYTIC EVENTS

To date, flood hazard mitigation planning apart from the SHMP cycle has frequently occurred in states following major disasters, making conceptualization a reactive process. Respondents from Colorado, Iowa, and North Carolina all attributed advances in their respective state approaches to major floods that highlighted the inadequacies of their prior approaches. In each case, program documentation supports this observation: IWA was funded by the National Disaster Resilience Competition based on the state's showing unmet needs resulting from the 2011 floods. Likewise, the Colorado Resiliency Office and strategy were created by the governor in response to the 2013 Front Range floods, and NCORR and North Carolina's risk resilience plan came about as a result of legislative and executive action following Hurricane Florence.

This reactive approach to addressing flood mitigation needs has some benefits as well as significant drawbacks. It allows decisionmakers to see inadequacies in stark relief at moments when the need for action is obvious. This attention provides an opportunity for advocates of flood adaptation and mitigation to advance the agenda and to bring attention to other risks and gaps in protection in addition to those made obvious by the disaster in question. It can also buy political will from the public to support significant investments in these spaces.

However, this attention comes too late for impacted communities and is typically not sustained. Stakeholders in North Carolina pointed to the significant funds coming into the state following Hurricane Floyd in 1999 drying up, leaving unmet remediation needs, many of which have not been addressed to date. One interviewee described a landscape of abandoned houses in heavily affected coastal regions where neither remediation funds nor buyouts have materialized, leading to extended poverty and some communities never recovering. Likewise, an informant in Washington noted that this question of attention also occurs with smaller-scale disasters. This government interviewee observed that although flooding received some attention in the state legislature in recent sessions, it has been overshadowed by extreme heat and wildfires.

STATE HAZARD MITIGATION PLANS

SHMPs differ from other flood planning activities because FEMA provides significant financial incentive for states to update their plans every five years, and therefore these plans are not developed in reaction to a specific event or threat. As seen in the survey of flood plans, in some states, the SHMP is the only document that includes all state flood (and other) hazard mitigation activities.

However, in our five profile states, these plans typically serve as a compilation of the state's hazard mitigation activities rather than a strategic planning document. Indeed, government interviewees in all the profile states noted that the primary goal of their SHMP development process was to comply with FEMA requirements for access to funding rather than a space to establish a state-level strategy for flood mitigation. Likewise, in the profile states with enhanced plans, including Colorado and Iowa, interviewees observed that enhanced status was sought because the state already met the criteria and could therefore qualify for the higher levels of federal financial assistance.

Overall, although SHMPs serve to collect information on flood and hazard mitigation activities, they are not written as coherent, comprehensive plans.

NEW EFFORTS AT COMPREHENSIVE PLANNING

More recently, this cycle may be shifting as a result of the more frequent and severe disasters that have been associated with climate change. In all five profile states, new flood-related initiatives have either recently been established or are currently being developed. In Florida, we see new recognition of sea level rise and significant financial commitment to addressing flooding through resilience efforts and more advanced risk assessments. Likewise, in North Carolina, the state legislature has recently funded an update of flood data and analysis techniques, as well as a substantial investment in the statewide Flood Resiliency Blueprint. Although the Colorado Resiliency Office was established in 2013, the government updated the Resiliency Framework in 2020. New measures include ensuring implementation of initiatives that affect flood-related planning, including the need to incorporate multibenefit approaches to the work and the need for all flood and other hazard mitigation initiatives to meet the state's resilience checklist to qualify for state or federal funding. In Iowa, respondents within government and other stakeholders shared that the state is seeking funding through BRIC and other sources to maintain and extend the work of IWA, seeking to establish the practice for larger portions of the state and as a long-term approach.

The survey showed that the number of state-level climate, resilience, and water plans that address flooding adopted is higher in the past 5 years than in the 10 years prior. Although the survey does not allow us to see why these plans were produced, it is likely they were in part a response to increased awareness of sea level rise and increasing disaster risk, if not to climate change directly.

Flood Risk Assessment

FLOOD MODELING DATA

Government respondents from all five profile states reported that their state had strong data resources to supplement data sources provided by the federal government. However, as in our survey, evidence suggests that significant variation exists. Both Colorado and Iowa have invested significantly in improving their data capabilities. In Colorado, this investment included the development of the Colorado Hazard Mapping Program, which included expanding the LiDAR topographic data available within the state; field surveys of flood infrastructure; advanced hydrology and hydraulic methods to analyze water flow; and regulatory 2-D models. For the hazard mapping project, all data were created to meet FEMA's standards, and FEMA committed to reviewing the information. Likewise, in Iowa, IFC has developed extensive and near real-time probabilistic inundation maps of a wider range of flood levels than are available elsewhere. Conversely, in Florida, data capabilities are held largely in the WMDs and the state government, leading to some parts of the state having more advanced risk assessments than others. Current state-level risk assessment in Florida relies on historical data, although this practice is likely to change with the passage of SB 1954.

INFLUENCE OF STATE HAZARD MITIGATION PLANS

Despite having more advanced data available, informants in all five of our sampled states noted that non-SHMP flood plans and programs depend on the risk assessment conducted as part of the SHMP. As noted, informants from IFC and IWA reported running separate analyses: one "by the book" to be used in the SHMP and certified by FEMA, and one that can provide more detailed information to local communities with technology "several generations" ahead of FEMA. Likewise, dam safety experts in Colorado noted having high-quality data on dam spillways and conditions for overflows. Although these risk assessments typically do not account for climate change, some SHMPs include language acknowledging its impact on flood risk.

Most SHMPs rely on historical data, despite new requirements from FEMA to include probabilistic flood modeling and incorporate climate change into risk assessments. Indeed, our survey of plans showed that only 46 percent of SHMPs currently include climate projections in their risk assessments. Although all of our profile states acknowledged climate change in their SHMPs, they mostly did so in limited ways, indicating that even those states that comply with this measure may not do so in a meaningful way. Florida and Washington, for example, discussed the effects of climate change generally, but they did not include it as a factor in the formal risk assessment. North Carolina and

Colorado discussed probabilistic change at the state level only. Iowa noted the possibility that estimates will change, but it did not include any prediction of the scale or frequency of future flooding.

Given that the incorporation of climate change is a new requirement, it is not surprising that most states have not yet complied in a meaningful way, especially when the data and methods that make this requirement more possible to achieve are not yet approved by FEMA. However, government interviewees from two states noted that plans for the next SHMP update include more extensive use of climate data. In North Carolina, one informant said that his office is working with NOAA to drill down its climate projection data for the state to the subcounty level. Likewise, in Iowa, an informant said that watershed-level analysis, as well as more advanced climate modeling, should be reflected in the state's 2023 updated flood hazard risk assessment. As high-exposure states like North Carolina and Florida invest in their own flood risk assessments and planning processes, the 2023 SHMP updates may show a significant improvement in this area.

However, informants in Iowa expressed plans to incorporate climate change models, along with their watershed model, into the next SHMP risk assessment. Likewise, informants reported that the North Carolina legislature is currently considering funding for a new flood resilience plan that would use local data drilled down from NOAA models applied to local communities by local researchers. Informants in Iowa, North Carolina, Colorado, and Washington noted intentions to incorporate more advanced data collection techniques, including watershed-level analysis; incorporation of location-specific climate change models; and new data sources, such as location-specific drill-downs of NOAA climate data, into their 2022 SHMP risk assessments. Informants in Florida and North Carolina also reported plans for new flood risk assessments that will incorporate new data sources and new methods that will account for forms of flooding not previously measured, including flooding from rainfall and sea level rise.

DEMOGRAPHIC DATA AND SOCIAL VULNERABILITY

As we have seen, understanding the risks posed by flooding requires knowing who is exposed to flood hazards, as well as what areas are likely to flood. Strong mitigation plans require that those groups and areas are accurately identified, both in location and needs, so they can be accounted for in planning hazard mitigation. Of our sample states, Colorado, North Carolina, and Washington have plans that discuss social vulnerability extensively, whereas Iowa and Florida each have one plan with cursory discussion.

The North Carolina CRRP includes high-quality, meaningful analysis of environmental and climate justice issues that may provide a strong standard for other planning processes. The plan addresses the

impacts of structural racism and compounding vulnerabilities on groups of people, including Native Americans; the increased exposure of very low-income individuals; and the role of unaffordable housing and existing inequalities in mitigation and climate adaptation measures. Analysis in this plan includes geographic overlays of hazard exposure with specific vulnerabilities, such as the concentration of African American communities in specific floodplains. The plan includes concrete recommendations tied to this analysis, such as identifying the specific agencies responsible, as well as recommendations for state-level policy changes and further research and data.

Washington's DNR plan includes an extensive and nuanced discussion of the differential impacts of climate change and climate change interventions; discusses the tools available within the state to analyze the environmental health impacts on specific vulnerable groups; and calls for actions, including the establishment of an environmental justice advisory committee, research to identify highly impacted groups, and the creation of an Environmental Justice and Equity Strategy (Washington Department of Natural Resources 2020). However, no specific timeline, funding, or responsible parties are identified for these actions.

Unexpectedly, over half (13 of 24) of the plans in our survey that included extensive discussion of social vulnerability were SHMPs (6 plans) and E-SHMPs (7 plans). This included the Colorado and Washington E-SHMPs, but the discussion of social vulnerability in those two documents is relatively limited. The Colorado E-SHMP is the more advanced. It includes a discussion of social vulnerability factors, such as age, wealth, and English ability, and describes how both a social capital and a social vulnerability index were calculated. However, it is unclear how this analysis feeds into overall hazard vulnerability assessments. Washington's E-SHMP incorporates data on social vulnerability into a Washington State Risk Index along with built environment and community resilience indicators to establish a baseline for the state's risk assessment. Although this allows for some nuance in understanding how similar hazard exposure across counties within the state may result in different levels of risk, the aggregation of social vulnerability into a single component of an index hides the significant differences in the degree and types of challenges that socially vulnerable populations face. For example, Black communities that have been forced to live in high-exposure areas because of histories of official residential segregation, redlining, and policies designed to exclude them from wealth building may benefit from some interventions (e.g., zoning reforms, community-based hazard mitigation planning, equity-focused outcomes) that differ from interventions that may benefit older adults, people with disabilities, and others with mobility impairments (e.g., universal design, advanced planning around access to alternative transportation options).

Conducting flood risk assessments provides states the opportunity to pursue a detailed analysis of social vulnerability, including which socially vulnerable groups exist within the state, where each group exists, their degree of geographic clustering, the degree of compounding vulnerabilities, and which specific groups have high exposure to flooding. Whether included in SHMPs or in other risk assessments, these data would allow for more targeted interventions to help vulnerable populations in ways that are better suited to their particular needs.

FINANCIAL SUPPORT FOR DATA

In several of our state profiles, advances in data quality and analysis are a result of one-time investments. In North Carolina, for example, stakeholders noted a “boom and bust” cycle to state funding, with substantial investments in data following Hurricanes Matthew and Florence but no plan attached for updates. Likewise, the substantial investment in IWA led to several model projects that are expected to show decreases in flood risk in part because of data-driven upstream interventions. However, this work may not be able to continue after the initial funding ends in 2022. Conversely, IFC’s flood mapping work will continue as it has continual state funding. Continued FEMA investment and partnership in Colorado has also allowed the Colorado Hazard Mapping Program to continue, although the ability to continue to update technology and techniques as the program ages will depend on continued state support.

Plan Implementation

In line with findings from our survey, the profile states all have plans that met the basic criteria for incorporating implementation measures, including systems of prioritization, identification of responsible parties, mechanisms for enforcement where appropriate, and provisions for technical assistance to support implementers.

However, many of the key programs in our state profiles were not the result of official plans but were established as stand-alone programs, often created in the wake of major disasters. Many of these programs, such as IWA and FbD, provide critical services for their states. However, the lack of comprehensive flood planning leaves them functioning independently from a larger strategic structure. In some cases, this lack of coordination has led to serendipity: the establishment in Washington of FCAAP as a planning grant bolstered the potential impact of FbD. More often, however, a lack of comprehensive flood planning has led to a complex network of agencies with overlapping jurisdictions, and in some cases, it has created gaps in information or unequal policies. In Colorado, for example, stakeholders noted that data on dam overflow inundations are available but are not incorporated into

the SHMP, partially because of the separation between the Office of Dam Safety and the Emergency Management Office.

The success of flood planning could be bolstered through its incorporation into comprehensive state planning efforts that would account for all flood hazard mitigation activities. New initiatives such as the forthcoming North Carolina Flood Resiliency Blueprint and Florida's flood resilience plan process may provide opportunities to create centralized repositories for knowledge and data, integrate planning across substate political boundaries, and create mechanisms to ensure continued funding for updated data and analysis.

Governance and Coordination

Our state profiles uncovered many examples of strong coordination among state government agencies and between state government agencies, local governments, and other stakeholders. However, several gaps also appeared, indicating areas of opportunity to strengthen flood planning practice and improve hazard mitigation outcomes.

In our state profiles, coordination between state agencies overall was strong, although some limitations in data sharing and knowledge persisted, as summarized above. Greater gaps appeared between state agencies and local governments, especially in low-resourced localities. As with states, localities vary in their capacity to develop and implement local flood hazard mitigation plans and activities. Federal and state governments are aware of this issue and have established provisions for technical and financial assistance to assist local governments with mitigation planning. Indeed, it is a federal requirement for SHMPs to include plans for this support. Interviewees from our profile states noted involvement of localities, often citing major city and regional governments such as Denver and Boulder in Colorado and Des Moines and Dubuque in Iowa.

However, evidence suggests many low-resourced localities have greater difficulty engaging in state-level flood planning and accessing state resources locally. Government interviewees in Washington, for example, noted that local governments need to write and submit a successful application to access state planning resources. Although the state provides workshops and fields specific requests for technical assistance, the local government would still need to have an individual with the time and specific focus on flood mitigation to use this technical assistance and to assemble an application. Moreover, even with funding, the locality would need to have available staff to develop the plan. One interviewee pointed out that low-capacity local governments could seek help from their county governments. However, this solution still leaves them at a disadvantage when compared to

cities that not only are able to commit staff to local hazard mitigation planning but also may be in the room when guidance for state support is developed. In home-rule states that rely on local governments to lead hazard mitigation efforts, this hierarchy can leave low-resourced localities even further behind.

In other cases, gaps in state engagement may be a result of entrenched racist power structures. A stakeholder in North Carolina observed that although Black communities in localities with a government that actively advocates for their interests benefit from state government investment in hazard mitigation, those in municipalities with entrenched racist power structures are more likely to have their priorities disregarded in local planning efforts and not reflected in state plans, and so the community sees less benefit from state funding sources.

New government efforts for equity such as the Healthy Environment for All Act in Washington, the Colorado Resiliency Framework, and the North Carolina CRRP may provide tools, such as incorporation of equity into grant reviews and program performance metrics or legal vehicles to expose and correct systemic disproportionate exposure, for states to address inequities in access. However, the states would need sustained commitment to enforce these laws and plans, and for now, the inequities remain.

Public Engagement and Transparency

Although the extensive engagement processes frequently used in municipal and neighborhood planning can add time and expense, understanding lived experiences and the specific challenges that state residents have in relation to flooding and other hazards can serve the dual purpose of providing valuable information for the states and educating the public on what flood mitigation in the state looks like and how it affects them.

Some plans and initiatives in our profile states showed very high levels of public engagement, but this was not consistent across planning efforts. Some of the largest engagement efforts were associated with new and experimental initiatives, such as IWA, which connects the state strategy to local communities, and the Colorado Hazard Mapping Program, which engaged directly with members of the public, allowing them to provide feedback on the updated flood maps that the program developed.⁴⁰ However, in other plans, stakeholders frequently noted a reliance on local governments to foster public engagement. This reliance was especially true for SHMPs, which instead focused on cross-departmental, stakeholder, and, to a varying degree, local government coordination. In interviews, government informants in every state noted that the engagement aspect of the hazard

mitigation process came with the development of local hazard mitigation plans, which the state then folded into the state plan.

Some stakeholders from projects that involved high levels of engagement noted that engagement has created some resistance to the project, particularly when interventions in upstream areas may be perceived as disrupting rural headwater communities while benefiting downstream urban centers. However, such conflicts are not unusual for engagement processes. Neighborhood and city planners often see these conflicts as a necessary part of the process of coming to a solution that has broad public support.

Implications

In many ways, flood planning is underdeveloped at the state level. As we have seen, flooding is addressed in most states across a variety of plans with differing purposes and focuses. Despite its inadequacies, the SHMP often serves as the main point for consolidating flood risk assessment and mitigation activities across the state.

However, our deep dives have shown that even in this context, states are undertaking significant efforts to address flooding through dedicated funding for local mitigation projects; investing in improved data collection and analysis; and implementing new approaches to mitigation, such as addressing flooding at the source upstream from high-exposure areas and using nature-based mitigation techniques.

In this section, we review the five domains of our analytical framework to identify areas of opportunity for states to strengthen their flood hazard mitigation practice. Many of these recommendations are mutually reinforcing and can work together to advance plans that improve sustainable protection for all state residents.

Conceptualization

Recommendation: Establish a central source for strategic flood planning that identifies values, goals, and outcome indicators to use across all state efforts.

Our survey showed that flood planning is frequently spread across multiple plans and plan types. Likewise, our state profiles showed that a wide range of state departments and nongovernmental stakeholders are involved in developing and implementing state policies and programs. Establishing a

single plan and home that sets a vision for all aspects of flood planning within a state, identifies specific and concrete goals, and monitors indicators to evaluate progress toward desired outcomes can allow for greater coordination between efforts and provide assurance that state actions are working toward a commonly understood goal.

Recommendation: Establish timelines to update flood plans other than SHMPs regularly, not just following disasters.

Both our survey of plans and our state profiles showed that most flood hazard mitigation efforts by states occurred in response to disasters that exposed a state's susceptibility to flood damage. Although SHMPs are updated on a five-year cycle, their ties to federal funding and requirements mean that they are used not as strategic planning tools but rather as summaries of activities and capabilities. By planning proactively and regularly, state planners have opportunities to think critically about their state's goals and priorities, not just its needs.

Recommendation: If possible, identify dedicated funding for flood and other hazard mitigation planning, including funding for continual data collection and analysis.

Ensuring that planning processes are well funded and supplied with up-to-date and relevant data is an important aspect of ensuring that plans are conceptually sound as flood risks change. Reliable funding allows planners to think ahead and critically assess the goals and values behind plans prior to beginning planning processes, as well as to ensure quality flood risk assessment, coordination, and public participation.

Flood Risk Assessment

Recommendation: Incorporate probabilistic models that center climate change and analysis into risk assessments.

The flood risk models in our survey that are based on historical trends will not capture new threats posed by climate change, including sea level rise and increased rainfall. Many states acknowledge these threats even if they currently fall short of including them in their risk assessments, and all five profile states have taken steps to incorporate new weather patterns into their risk assessments. Likewise, FEMA is moving toward requiring future-oriented flood modeling and accounting for climate change in SHMPs. As weather patterns are changing quickly, making these models central to assessments of all flood planning will be essential, even in states with historically low flood exposure. For states with the resources to do so, modeling that accounts for climate change may involve

collecting data locally, beyond what is available through FEMA's notably outdated flood maps, as in the case of IFC. North Carolina provides another model by working closely with NOAA to use national climate models to drill down and understand effects in local communities.

Recommendation: Incorporate demographic data, including data on socially vulnerable communities, as central components of risk assessments.

Vulnerability to flood hazards is not just a matter of how people and structures are protected but also of who is protected. We know that some populations, including racial and ethnic minorities and people with low incomes, have been forced to live in floodplains and other high-exposure areas because of exclusionary and racist housing policies and other forms of systemic discrimination. Others, such as people with disabilities, older adults, and young people, also face greater exposure to harm from flooding. Because of this history of direct and systemic discrimination, any decision that avoids addressing social vulnerability explicitly is likely to reinforce these inequities.

Despite this, most plans we reviewed in the survey did not consider vulnerable communities or did so only minimally. Those plans that did most often used vulnerability indexes to identify the location of vulnerable communities and overlaid these maps to indicate where they coincided with flood zones. Moving beyond this simple mapping exercise to identify which specific populations are exposed and targeting mitigation activities to their unique needs should be equal in importance to creating flood models based on current climate and hydrologic data.

Implementation

Recommendation: Incorporate plan objectives into day-to-day operations to help to ensure implementation.

In our survey, we found that most plans included many of the features associated with higher probability of implementation, including having projects and initiatives with concrete details; prioritizing projects based on plan goals, including a timeline; identifying and committing funding; and identifying responsible parties and individuals. However, we also found that these features did not always lead to implementation.

Colorado had a new mechanism to ensure implementation: the integration of resilience goals into performance metrics for relevant state departments and as review criteria for hazard mitigation grant applications from local governments. By building these goals into everyday operations, the plan's

objectives not only remain present in regular decisionmaking, but they are disseminated across state government and to all local governments that engage with hazard mitigation.

Governance and Coordination

Recommendation: Focus efforts on ensuring all communities have access to state funding and technical support.

The most significant gap in coordination between government agencies identified in our survey and state profiles appeared in how states engage low-capacity localities in planning efforts and how they ensure that low-capacity communities have access to planning resources and support. Efforts in this area include direct state government outreach and engagement in communities that are known to have limited resources and have not participated in planning exercises nor applied for state funding. Likewise, identifying alternative methods for low-capacity localities to access funding aside from competing for state grants may be essential. Reserving some mitigation funds for capacity building may allow some communities to engage, but advanced technical support, such as providing dedicated staff to assess needs and write and administer funding requests, may also be necessary.

Recommendation: Highlight the cobenefits of projects to help with buy-in and coordination across stakeholders.

Cobenefits are positive benefits that flood mitigation efforts have on other objectives. For example, creating parks as natural flood zones can increase community well-being and property values. Highlighting benefits distinct from the benefits of flood mitigation can allow for the engagement of a broader group of stakeholders and funding sources. In Washington, this focus on cobenefits in the FbD program encouraged a range of stakeholders, such as floodplain managers, local parks directors, and conservation districts interested in integrated floodplain management, to achieve shared outcomes, including flooding mitigation, habitat restoration, and improved recreational space.

Participation and Transparency

Recommendation: Engage with local communities where they are to tap into lived knowledge of the real-world impacts of flooding.

Public engagement can be costly and time consuming. However, the unique knowledge that community members possess of the reality of flood challenges is essential data for meaningful hazard

mitigation planning. These data are crucial for supplementing models and targeting mitigation efforts where they are most needed. IFC used community engagement as a core tenet of its approach to modeling, both to supplement its data and to enhance it through buy-in from farmers across the state who helped with data collection.

Recommendation: Budget appropriate time and funds for meaningful public engagement into all planning processes to ensure public education and input on state flood hazard mitigation efforts and to produce better plans.

Engagement can serve the dual purpose of creating a public that is more informed about flood risks and state hazard mitigation efforts and providing valuable information to planners on the specific needs and priorities of diverse state residents. In addition to providing lived experience, this engagement can function as a check against the accuracy of flood data and risk assessments. However, meaningful engagement takes time and resources. It requires engaging with residents on site and taking the time to build trust, provide education on current risks and mitigation efforts, and develop a shared purpose.

Appendix A. Plans Included in the Survey

State or territory	Plan title	Year	Link	Department
Alabama	Alabama State Hazard Mitigation Plan	2018	https://alabamaema.files.wordpress.com/2018/11/state-of-alabama_state-hazard-mitigation-plan-2018-update_final_07182018.pdf	State of Alabama
Alabama	Alabama Coastal Area Management Program Strategic Plan	2013	http://sarpc.org/wp-content/uploads/2016/02/ACAMP-Strategic-Plan-2013-2018.pdf	Alabama Department of Conservation and Natural Resources; Alabama Department of Environmental Management
Alaska	State Hazard Mitigation Plan	2018	https://ready.alaska.gov/Plans/Documents#ASMP	Alaska Department of Military and Veteran Affairs, Division of Homeland Security and Emergency Management
Alaska	Alaska Stormwater Guide	2011	https://dec.alaska.gov/media/13246/akswguide.pdf	Alaska Department of Transportation and Public Facilities
Alaska	Alaska's Climate Change Strategy: Addressing Impacts in Alaska	2020	https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.174.6135&rep=rep1&type=pdf	Alaska Climate Change Sub-Cabinet
American Samoa	Territory of American Samoa Multi-Hazard Mitigation Plan	2015	https://www.wsspc.org/wp-content/uploads/2016/07/AmericanSamoa_mitigationplan15-20.pdf	American Samoa Territorial Hazard Mitigation Council
American Samoa	Territory of American Samoa Section 309 Assessment and Strategy	2016	https://coast.noaa.gov/data/czm/enhancement/media/as309-2016.pdf	American Samoa Coastal Management Program, Department of Commerce
Arizona	State of Arizona Hazard Mitigation Plan	2018	https://dema.az.gov/sites/default/files/publications/EM-PLN_State_Mit_Plan_2018.pdf	Arizona Department of Emergency and Military Affairs
Arizona	Arizona State Emergency Response and Recovery Plan	2019	https://dema.az.gov/sites/default/files/publications/EM-PLN_SERRP.pdf	Arizona Department of Emergency and Military Affairs
Arkansas	State of Arkansas All-Hazards Mitigation Plan	2018	https://www.dps.arkansas.gov/wp-content/uploads/2020/05/2018_Final_State_of_Arkansas_HMP.pdf	Arkansas Department of Emergency Management
Arkansas	Arkansas Water Plan: Update 2014	2014	https://www.agriculture.arkansas.gov/wp-content/uploads/2020/05/A	Arkansas Natural Resources Commission

State or territory	Plan title	Year	Link	Department
			MzMwNDg5NWlxMTJiYzZkNA	
Connecticut	2019 Connecticut Natural Hazards Mitigation Plan Update	2019	https://drought.unl.edu/archive/plans/GeneralHazard/state/CT_2019.pdf	Department of Energy and Environmental Protection; Department of Emergency Services and Public Protection
Connecticut	Connecticut Climate Change Preparedness Plan	2011	https://portal.ct.gov/-/media/DEEP/climatechange/ConnecticutClimatePreparednessPlan2011pdf.pdf	Governor's Steering Committee on Climate Change Adaptation Subcommittee
Connecticut	Final Report: Connecticut State Water Plan	2018	https://www.dropbox.com/s/7obqd9e9j3clqta/Connecticut%20State%20Water%20Plan_FINAL%20REPORT-Compressed%20Version.pdf?dl=1	Department of Emergency Services and Public Protection
Delaware	State of Delaware All-Hazard Mitigation Plan	2018	https://dema.delaware.gov/contentFolder/pdfs/HazardMitigationPlan.pdf	Delaware Emergency Management Agency
Delaware	Preparing for Tomorrow's High Tide: Recommendations for Adapting to Sea Level Rise in Delaware	2013	http://www.dnrec.delaware.gov/coastal/Documents/SeaLevelRise/FinalAdaptationPlanPublished.pdf	Delaware Department of Natural Resources and Environmental Control
Delaware	Climate Framework for Delaware	2014	http://www.dnrec.delaware.gov/energy/Documents/The%20Climate%20Framework%20for%20Delaware%20PDF.pdf	State of Delaware, Department of Natural Resources and Environmental Control
Florida	Enhanced State Hazard Mitigation Plan	2018	https://www.floridadisaster.org/globalassets/dem/mitigation/mitigate-fl--shmp/shmp-2018-full_final_approved.6.11.2018.pdf	Florida Division of Emergency Management
Florida	Florida's Energy and Climate Change Action Plan	2008	https://drought.unl.edu/archive/plans/Climate/state/FL_2008.pdf	Governor's Action Team on Energy and Climate Change
Florida	Final Assessment and Strategies FY 2016–2020 Prepared in Accordance with Section 309 of the Coastal Zone Management Act	2015	https://floridadep.gov/sites/default/files/FCMP_FY2016-20_Assessment.pdf	Florida Coastal Management Program
Georgia	Georgia Hazard Mitigation Strategy: Standard and Enhanced Plan	2019	https://gema.georgia.gov/document/publication/2019-georgia-hazard-mitigation-strategypdf/download	Georgia Emergency Management and Homeland Security Agency

State or territory	Plan title	Year	Link	Department
Georgia	Georgia Coastal Management Program Section 309 Assessment	2020	https://coastalgadnr.org/sites/default/files/crd/CZM/GCMPdocs/Final%20GCMPP%202021-2025%20Assessment%20and%20Strategy.pdf	Georgia Coastal Management Program
Guam	2019 Guam Hazard Mitigation Plan	2019	https://ghs.guam.gov/sites/default/files/final_2019_guam_hmp_20190726.pdf	Guam Homeland Security Office of Civil Defense
Guam	Guam Coastal Management Program Bureau of Statistics and Plans 2020-2025	2020	https://bsp.guam.gov/wp-content/uploads/2020/11/GCMP_Section309_2020_DRAFT.pdf	Guam Coastal Management Program
Hawaii	State of Hawai'i 2018 Hazard Mitigation Plan	2018	https://dod.hawaii.gov/hiema/files/2020/06/2018-State-HI-HMP-Update-100218.pdf	Hawai'i Emergency Management Agency
Hawaii	Section 309 Assessment and Strategy FY 2021-2025	2020	https://files.hawaii.gov/dbedt/op/czm/program/doc/hczmp_draft_sec_309_assessment_and_strategy_2021-2025.pdf	Hawaii Coastal Zone Management Program Office of Planning; Department of Business, Economic Development & Tourism, State of Hawaii
Hawaii	Hawai'i Sea Level Rise Vulnerability and Adaptation Report	2017	https://climateadaptation.hawaii.gov/wp-content/uploads/2017/12/SLR-Report_Dec2017.pdf	State of Hawai'i Department of Land and Natural Resources, Office of Conservation and Coastal Lands
Hawaii	Water Resource Protection Plan: 2019 Update	2018	https://files.hawaii.gov/dlnr/cwrm/planning/wrpp2019update/WRPP_ALL_201907.pdf	State of Hawai'i Commission on Water Resource Management
Idaho	State of Idaho Hazard Mitigation Plan	2018	https://ioem.idaho.gov/preparedness-and-protection/mitigation/state-hazard-mitigation-plan/	Office of Emergency Management
Idaho	Idaho State Water Plan	2012	https://idwr.idaho.gov/files/iwrb/2012/2012-State-Water-Plan.pdf	Idaho Water Resources Board
Illinois	2018 Illinois Natural Hazard Mitigation Plan	2018	https://drought.unl.edu/archive/plans/GeneralHazard/state/IL_2018.pdf	Illinois Emergency Management Agency
Illinois	Illinois Coastal Management Program: Section 309 Assessment and Strategy 2016-2020	2015	https://www2.illinois.gov/dnr/cmp/Documents/Section309/ICMPSection309PlanFINAL.pdf	Illinois Coastal Management Program
Illinois	Illinois Lake Michigan Implementation Plan: Creating a Vision for the Illinois Coast	2013	https://www2.illinois.gov/dnr/cmp/Documents/Illinois_Lake_Michigan_Implementation_Plan_FINAL.pdf	Illinois Department of Natural Resources, Illinois Coastal Management Program

State or territory	Plan title	Year	Link	Department
Indiana	2019 State of Indiana Multi-Hazard Mitigation Plan	2019	https://drought.unl.edu/archiv e/plans/GeneralHazard/state/I N_2019.pdf	Indiana Department of Homeland Security
Indiana	Indiana Lake Michigan Coastal Program: Coastal Zone Management Section 309 Enhancement Grant Program Assessment and Multi-Year Strategy 2021–2025	2020	https://www.in.gov/dnr/lake-michigan-coastal-program/files/Im-IN-Sect-309-plan-2021-2025.pdf	Indiana Department of Natural Resources, Indiana Lake Michigan Coastal Program
Iowa	Iowa Comprehensive Emergency Management Plan: Part B: Iowa Hazard Mitigation Plan	2018	https://homelandsecurity.iowa.gov/wp-content/uploads/2020/09/low aHMPSection5-508-Compliant.pdf	Iowa Homeland Security and Emergency Management
Kansas	Kansas Hazard Mitigation Plan	2018	https://kansastag.gov/KDEM.a sp?PageID=186	Kansas Hazard Mitigation Team
Kansas	Kansas Water Plan	2014	https://kwo.ks.gov/water-plan/water-plan/archived-water-plans	Kansas Water Office
Kentucky	Kentucky Hazard Mitigation Plan	2018	https://kyem.ky.gov/recovery/Pages/2018-Kentucky-Hazard-Mitigation-Plan-.aspxf	Kentucky Division of Emergency Management
Louisiana	2019 State Hazard Mitigation Plan Update	2019	http://gohsep.la.gov/Portals/0/Documents/Mitigate/HMPlan/2019HM-plan-final.pdf	Louisiana Governor's Office of Homeland Security and Emergency Preparedness
Louisiana	Our Land and Water: A Regional Approach to Adaptation	2019	https://s3.amazonaws.com/lasafe/Final+Adaptation+Strategi es/Regional+Adaptation+Strat egy.pdf	Louisiana's Strategic Adaptations for Future Environments (LA SAFE)
Louisiana	Louisiana's Comprehensive Master Plan for a Sustainable Coast	2017	http://coastal.la.gov/wp-content/uploads/2017/04/2017-Coastal-Master-Plan_Web-Book_CFinal-with-Effective-Date-06092017.pdf	Coastal Protection and Restoration Authority
Louisiana	Louisiana Coastal Management Program: Coastal Zone Management Act Section 309 Assessment and Strategy for 2016–2020 Enhancement Cycle	2016	https://coast.noaa.gov/data/czm/enhancement/media/la309-2016.pdf	Louisiana Department of Natural Resources
Maine	Maine State Hazard Mitigation Plan	2019	https://www.maine.gov/mema/sites/maine.gov.mema/files/in line-files/State%20Hazard%20Miti gation%20Plan%202019%20U pdate_10.8.2019.pdf	Main Emergency Management Agency
Maine	Maine Won't Wait: A Four-Year Plan for Climate Action	2020	https://climatecouncil.maine.gov/future/sites/maine.gov.futu re/files/inline-	Maine Climate Council

State or territory	Plan title	Year	Link	Department
Maine	Maine Coastal Program Strategic Outlook 2016-2020	2020	files/MaineWontWait_December2020.pdf https://coast.noaa.gov/data/czm/enhancement/media/me309-2016.pdf	Maine Coastal Program Department of Agriculture, Conservation and Forestry
Maryland	State of Maryland 2016 Hazard Mitigation Plan	2016	https://mema.maryland.gov/community/Documents/2016_Maryland_Hazard_Mitigation_Plan_final_2.pdf	Maryland Emergency Management Agency
Maryland	Climate Action Plan	2008	https://mde.maryland.gov/programs/Air/ClimateChange/Documents/www.mde.state.md.us/assets/document/Air/ClimateChange/Introduction.pdf	Maryland Commission on Climate Change
Maryland	Maryland's Coastal Zone Enhancement Plan	2015	https://coast.noaa.gov/data/czm/enhancement/media/md309-2016.pdf	Maryland Chesapeake & Coastal Service
Massachusetts	Massachusetts State Hazard Mitigation and Climate Adaptation Plan	2018	https://www.mass.gov/files/documents/2018/10/26/SHMCAP-September2018-Full-Plan-web.pdf	Massachusetts Emergency Management Agency
Massachusetts	Water System Master Plan	2018	https://www.mwra.com/publications/masterplan/2018/mp-water.pdf	Massachusetts Water Resources Authority
Massachusetts	Section 309 Assessment and Five-Year Strategy for CZM Program Enhancement (FY2021-2025)	2020	https://www.mass.gov/doc/section-309-assessment-and-five-year-strategy-for-czm-program-enhancement-fy2021-2025/download	Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs, Office of Coastal Zone Management
Michigan	Michigan Hazard Mitigation Plan	2019	https://www.michigan.gov/documents/msp/MHMP_480451_7.pdf	Emergency Management and Homeland Security Division, Michigan Department of State Police
Michigan	Section 309 Assessment and Five-Year Strategy for Coastal Zone Management Enhancement Fiscal Years 2016-2020	2015	https://coast.noaa.gov/data/czm/enhancement/media/mi309-2016.pdf	Michigan Coastal Zone Management Program, Office of the Great Lakes, Department of Environmental Quality
Minnesota	Minnesota State Hazard Mitigation Plan	2019	https://dps.mn.gov/divisions/hsem/hazard-mitigation/Documents/2019-mn-hmp-only.pdf	Department of Public Safety, Division of Homeland Security and Emergency Management
Minnesota	2020 State Water Plan: Water and Climate	2020	https://www.eqb.state.mn.us/sites/default/files/documents/	Environmental Quality Board

State or territory	Plan title	Year	Link	Department
Minnesota	One Watershed, One Plan: Transition Plan	2016	2020_water-plan%20FINAL.pdf http://bwsr.state.mn.us/sites/default/files/2019-08/1W1P_Transition%20Plan.pdf	Minnesota Board of Water and Soil Resources
Minnesota	Adapting to Climate Change in Minnesota	2017	https://www.pca.state.mn.us/sites/default/files/p-gen4-07c.pdf	Interagency Climate Adaptation Team
Minnesota	Section 309 Assessment and Strategies for 2011-2015	2011	https://files.dnr.state.mn.us/waters/lakesuperior/coastalenhancement/309as2011.pdf	Minnesota's Lake Superior Coastal Program
Minnesota	Beyond the Status Quo: 2015 Environmental Quality Board Water Policy Report	2015	https://www.eqb.state.mn.us/sites/default/files/documents/WaterReport_091515_v2_0.pdf	Environmental Quality Board
Mississippi	Mississippi Coastal Program: Coastal Zone Management Act § 309 Assessment and Strategy 2016-2020	2015	https://dmr.ms.gov/wp-content/uploads/CRM/MS-Final-309-Assessment-and-Strategy-2016-2020.pdf	Mississippi Department of Marine Resources
Mississippi	Mississippi State Hazard Mitigation Plan	2018	https://www.msema.org/wp-content/uploads/2020/10/State-of-Mississippi-2018-plan-update-with-Dam-Safety-FEMA-revisions-2020-07-15.pdf	Mississippi Emergency Management Agency
Mississippi	State Comprehensive Emergency Management Plan: 2020 CEMP	2020	https://68r.d9e.myftpupload.com/wp-content/uploads/2020/04/2020-MS-CEMP-Basic-Plan.pdf	Mississippi Emergency Management Agency, Office of Preparedness Planning Bureau
Missouri	Missouri State Hazard Mitigation Plan	2018	https://sema.dps.mo.gov/docs/programs/LRMF/mitigation/MO_Hazard_Mitigation_Plan2018.pdf	Missouri Department of Public Safety, State Emergency Management Agency
Montana	2018 Update State of Montana Multi-Hazard Mitigation Plan Statewide Hazard Assessment	2018	https://des.mt.gov/Mitigation/Documents/2018_State-of-Montana-MHMP.pdf	Montana Department of Military Affairs Disaster and Emergency Services
Montana	Montana Climate Solutions Plan	2020	https://deq.mt.gov/Portals/112/DEQAdmin/Climate/2020-09-09_MontanaClimateSolutions_Final.pdf	Montana Climate Solutions Council
Nebraska	Flood Hazard Mitigation Plan: State of Nebraska	2013	https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/flood-hazmit-plan.pdf	Nebraska Department of Natural Resources
Nebraska	2021 Nebraska State Hazard Mitigation Plan	2021	https://nema.nebraska.gov/sites/nema.nebraska.gov/files/doc/hazmitplan2021.pdf	Nebraska Emergency Management Agency

State or territory	Plan title	Year	Link	Department
Nebraska	Annual Report and Plan of Work for the State Water Planning and Review Process	2019	https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/statewide/annual-report-to-legislature/2019/20190913_AnnualReportToLeg_final.pdf	Nebraska Department of Natural Resources
Nevada	The State of Nevada Enhanced Hazard Mitigation Plan	2018	https://data.nbmrg.unr.edu/Public/NEHMP/StateOfNevadaEnhancedHazardMitigationPlan2018.pdf	Nevada Division of Emergency Management
Nevada	Nevada State Water Plan	1999	http://water.nv.gov/waterplan/detail.aspx	State of Nevada Division of Water Resources
Nevada	State of Nevada Disaster Recovery Framework	2018	https://dem.nv.gov/uploadedFiles/demnv.gov/content/About/NV%20Recovery%20Framework%202018%20Rev.pdf	Nevada Department of Public Safety, Division of Emergency Management
New Hampshire	State of New Hampshire Multi-Hazard Mitigation Plan	2018	https://prd.blogs.nh.gov/dos/hsem/wp-content/uploads/2015/11/State-of-New-Hampshire-Multi-Hazard-Mitigation-Plan-Update-2018_FINAL.pdf	New Hampshire Department of Homeland Security and Emergency Management
New Hampshire	Preparing New Hampshire for Projected Storm Surge, Sea-Level Rise, and Extreme Precipitation: Final Report and Recommendations	2016	https://www.nhcrhc.org/wp-content/uploads/2016-CRHC-final-report.pdf	New Hampshire Coastal Risk and Hazards Commission
New Hampshire	Coastal Zone Management Act Section 309 Enhancement Grants Program Assessment and Strategy July 2021–June 2025	2020	https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/r-wd-20-01.pdf	New Hampshire Department of Environmental Services
New Hampshire	The New Hampshire Climate Action Plan: A Plan for New Hampshire's Energy, Environmental and Economic Development Future	2009	https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/r-ard-09-1.pdf	New Hampshire Department of Environmental Services
New Jersey	2019 New Jersey State Hazard Mitigation Plan	2019	http://ready.nj.gov/mitigation/2019-mitigation-plan.shtml	State of New Jersey Office of Emergency Management
New Jersey	New Jersey Coastal Management Program Section 309 Assessment and Strategy 2021-2025	2019	https://www.nj.gov/dep/cmp/docs/309-assessment-and-strategy-2021-2025.pdf	New Jersey Department of Environmental Protection, Office of Policy and Coastal Management

State or territory	Plan title	Year	Link	Department
New Mexico	New Mexico State Hazard Mitigation Plan	2018	https://drought.unl.edu/archive/plans/GeneralHazard/state/NM_2018.pdf	New Mexico Department of Homeland Security and Emergency Management
New Mexico	New Mexico State Water Plan Part I: Policies	2018	https://www.ose.state.nm.us/Planning/SWP/2018/2-2018_SWP_Part_I_Policies_pluAppendixes.pdf	New Mexico Interstate Stream Commission
New York	2019 New York State Hazard Mitigation Plan	2020	https://drought.unl.edu/archive/plans/GeneralHazard/state/NY_2019.pdf	New York State Mitigate NY
New York	Climate Action Plan Interim Report	2010	https://www.dec.ny.gov/docs/administration_pdf/irpart1.pdf	New York State Climate Action Council
New York	New York State Coastal Management Program 309 Assessment and Strategies: July 1, 2021 through June 30, 2025	2020	https://dos.ny.gov/nys-2021-5-yr-assessment-and-strategy	New York State Department of State
North Carolina	State of North Carolina Hazard Mitigation Plan	2018	https://files.nc.gov/ncdps/documents/files/State%20of%20North%20Carolina%20Hazard%20Mitigation%20Plan%20Final%20As%20Adopted.pdf	North Carolina Department of Public Safety
North Carolina	North Carolina Climate Risk Assessment and Resilience Plan	2020	https://files.nc.gov/ncdeq/climate-change/resilience-plan/2020-Climate-Risk-Assessment-and-Resilience-Plan.pdf	North Carolina Department of Environmental Quality
North Carolina	Assessment and Strategy of the North Carolina Coastal Management Program: FY 2021-2025	2020	https://files.nc.gov/ncdeq/Coastal%20Management/documents/DRAFT-North-Carolina-2021-2025-Assessment---Strategy---March-13-DRAFT.pdf	NC Division of Coastal Management
North Dakota	Enhanced Mitigation Area Operations Plan	2018	https://www.nd.gov/des/uploads/resources/1125/2018-9-20-draft-enhanced-mitigation-maop.pdf	North Dakota Department of Emergency Services – Division of Homeland Security
North Dakota	2011 Flood Report: Response and Recovery	2011	https://www.des.nd.gov/sites/www/files/documents/docs/HLS-RECOV-Flood_Recovery_Report-2011-2_20190530.pdf	North Dakota Department of Emergency Services, Division of Homeland Security
Northern Mariana Islands	Commonwealth of the Northern Mariana Islands Standard State Mitigation Plan	2018	https://opd.gov.mp/library/reports/2018-cnmi-ssmp-update.pdf	Commonwealth of the Northern Mariana Homeland Security and Emergency Management

State or territory	Plan title	Year	Link	Department
Northern Mariana Islands	2021-2025 Section 309 Assessment and Strategy Report	2020	https://dcrm.gov.mp/wp-content/uploads/crm/CNMI_2021-2025_309-AS-Report_Final.pdf	Bureau of Environmental and Coastal Quality, Division of Coastal Resources Management
Ohio	State of Ohio Hazard Mitigation Plan	2019	https://www.ema.ohio.gov/mip/planning_sohmp.aspx	Department of Public Safety
Ohio	Ohio Coastal Program Enhancement Plan: Coastal Zone Management Act §309 Assessment and Strategy 2016-2020	2015	https://coast.noaa.gov/data/czm/enhancement/media/oh309-2016.pdf	Ohio Department of Natural Resources, Office of Coastal Management
Oklahoma	Standard Hazard Mitigation Plan for the Great State of Oklahoma	2019	https://www.ok.gov/OEM/Programs_&Services/Mitigation/State_Mitigation_Plan.html	State of Oklahoma
Oklahoma	Oklahoma Comprehensive Water Plan: Executive Report	2012	https://www.owrb.ok.gov/supply/ocwp/pdf_ocwp/WaterPlanUpdate/draftreports/OCWP%20Executive%20Rpt%20FINAL.pdf	Oklahoma Water Resources Board
Oregon	Oregon Natural Hazards Mitigation Plan	2015	https://www.oregon.gov/lcd/NH/Documents/Approved_2015ORNHMP.pdf	
Oregon	Oregon's 2017 Integrated Water Resources Strategy	2017	https://www.oregon.gov/owrd/WRDPublications1/2017_IWRS_Final.pdf	Oregon Water Resources Department
Oregon	Oregon Coastal Management Program Section 309 Assessment and Strategy 2021-2025	2020	https://www.oregon.gov/lcd/OCMP/Documents/DRAFT_OCMP_Assessment_Strategy_2021-2025.pdf	Oregon Coastal Management Program
Pennsylvania	Commonwealth of Pennsylvania 2018 State Hazard Mitigation Plan	2018	https://pahmp.com/wp-content/uploads/2018/10/PA-2018-Approved-HMP.pdf	Pennsylvania Emergency Management Agency
Pennsylvania	Section 309 Assessment and Strategy of Pennsylvania's Coastal Resources Management Program	2020	https://www.dep.pa.gov/Business/Water/Compacts%20and%20Commissions/Coastal%20Resources%20Management%20Program/Pages/default.aspx	Department of Environmental Protection
Puerto Rico	Plan de Adaptación ante Los Cambios Climáticos	2016	http://www.drna.pr.gov/noticias/pacc-drna/	Departamento de Recursos Naturales y Ambientales
Puerto Rico	Assessment and Strategies FY 2016–FY 2020	2015	https://coast.noaa.gov/data/czm/enhancement/media/pr309-2016.pdf	Puerto Rico Coastal Zone Management Program
Rhode Island	State of Rhode Island Hazard Mitigation Plan	2018	http://www.riema.ri.gov/forms-additional-resources/documents/Rhode%20Island%202019%20State%20Hazard%20Mitigation%20Plan-COMBINED_DRAFT.pdf	Rhode Island Emergency Management Agency
Rhode Island	Resilient Rhody: An Actionable Vision for	2018	http://climatechange.ri.gov/documents/resilientrhody18.pdf	State of Rhode Island

State or territory	Plan title	Year	Link	Department
	Addressing the Impacts of Climate Change in Rhode Island			
Rhode Island	Shoreline Change Special Area Management Plan (SAMP)	2018	http://www.crmc.ri.gov/samp_beach/SAMP_Beach.pdf	Rhode Island Coastal Resources Management Council
Rhode Island	Program Assessment and Strategy for Enhancement	2020	http://www.crmc.ri.gov/news/pdf/2020Section309AandS_PublicComment.pdf	Rhode Island Coastal Resources Management Council
Rhode Island	SafeWater RI: Ensuring Safe Water for Rhode Island's Future	2013	https://health.ri.gov/publications/reports/2013EnsuringSafeWaterForRhodeIslandsFuture.pdf	Rhode Island Department of Health
South Carolina	South Carolina Hazard Mitigation Plan	2018	https://www.scecmd.org/media/1391/sc-hazard-mitigation-plan-2018-update.pdf	South Carolina Emergency Management Division
South Carolina	Adapting to Shoreline Change: A Foundation for Improved Management and Planning in South Carolina	2010	https://scdhec.gov/sites/default/files/Library/CR-009823.pdf	South Carolina Department of Health and Environmental Control, Shoreline Change Advisory Committee
South Carolina	South Carolina Coastal Management Program Section 309 Assessment and Strategy 2016-2020	2015	https://coast.noaa.gov/data/czm/enhancement/media/sc309-2016.pdf	South Carolina Department of Health and Environmental Control, Division of Ocean and Coastal Resource Management
South Dakota	State of South Dakota Hazard Mitigation Plan	2019	https://dps.sd.gov/resource-library/hazard-mitigation-plan-april-2019.pdf	South Dakota Hazard Mitigation Team
South Dakota	2020 Annual Report and 2021 State Water Plan	2020	https://boardsandcommissions.sd.gov/bcuploads/PublicDocs/2020%20ANNUAL%20BWNR-Final%20(1).pdf	South Dakota Board of Water and Natural Resources
Tennessee	State of Tennessee Hazard Mitigation Plan	2018	https://www.tn.gov/content/dam/tn/tema/documents/hazard-mitigation-plan/Tennessee%20Hazard%20Mitigation%20Plan%202018%20FINAL.pdf	Tennessee Department of Military, Tennessee Emergency Management Agency
Texas	State of Texas Hazard Mitigation Plan	2018	http://tdem.wpengine.com/wp-content/uploads/2019/08/txHazMitPlan.pdf	Texas Department of Public Safety, Division of Emergency Management
Texas	Texas Coastal Resiliency Master Plan	2019	https://coastalstudy.texas.gov/resources/files/2019-coastal-master-plan.pdf	Texas General Land Office
Texas	Texas Coastal Management Program Section 309 Assessment and Strategies Report: 2016-2020	2015	https://coast.noaa.gov/data/czm/enhancement/media/tx309-2016.pdf	Texas General Land Office, Texas Coastal Management Program

State or territory	Plan title	Year	Link	Department
US Virgin Islands	United States Virgin Islands Territorial Hazard Mitigation Plan	2019	https://www.usviodr.com/wp-content/uploads/2019/09/2019-Territorial-Hazard-Mitigation-Plan_Revisions_29May2020-6.12.20.pdf	Virgin Islands Territorial Emergency Management Agency
US Virgin Islands	Virgin Islands Flood Hazard Mitigation Plan	2000	http://www.irf.org/wp-content/uploads/2015/10/VIFloodHazardMitigationPlan_VITEMA_2000.pdf	Virgin Islands Territorial Emergency Management Agency
US Virgin Islands	US Virgin Islands Coastal Zone Management Program, Section 309 Assessment and Strategy 2018-2021	2018	http://geographicconsulting.com/wp-content/uploads/2018/02/USVI-309-Assessment_2018_draft_final-1.pdf	US Virgin Islands Department of Planning and Natural Resources, Division of Coastal Zone Management
Utah	2019 Utah State Hazard Mitigation Plan	2019	https://hazards.utah.gov/wp-content/uploads/Utah-SHMP-Ch1-Introduction.pdf	Utah Department of Public Safety, Division of Emergency Management
Vermont	2018 Vermont State Hazard Mitigation Plan	2018	https://vem.vermont.gov/sites/demhs/files/documents/2018%20Vermont%20State%20Hazard%20Mitigation%20Plan%20-%20Final%20Adopted_Interactive.pdf	Vermont Emergency Management
Vermont	Vermont's Roadmap to Resilience: Preparing for Natural Disasters and the Effects of Climate Change in the Green Mountain State	2013	https://resilientvt.files.wordpress.com/2013/12/vermonts-roadmap-to-resilience-web.pdf	Institute for Sustainable Communities
Vermont	Vermont Economic Resiliency Initiative	2015	https://accd.vermont.gov/sites/accdnew/files/documents/CD/CPR/CPR-VERI-FinalReport.pdf	Vermont Department of Housing and Community Development
Virginia	Commonwealth of Virginia Hazard Mitigation Plan	2018	http://drought.unl.edu/archive/plans/GeneralHazard/state/VA_2018.pdf	Virginia Department of Emergency Management
Virginia	Virginia Coastal Resilience Master Planning Framework: Principles and Strategies for Coastal Flood Protection and Adaptation	2020	https://oldcc.gov/sites/default/files/resources/Virginia-Coastal-Resilience-Master-Planning-Framework-October-2020.pdf	Office of the Governor
Virginia	Virginia Section 309 Coastal Needs Assessment & Strategies	2021	https://www.deq.virginia.gov/home/showpublisheddocument/8346/637540014441970000	Virginia Coastal Zone Management Program
Washington	Washington State Enhanced Hazard Mitigation Plan	2018	https://mil.wa.gov/asset/5d1626c2229c8	Washington Emergency Management Division

State or territory	Plan title	Year	Link	Department
Washington	Washington Coastal Zone Management Section 309 Assessment & Strategy, 2021-2025	2020	https://ecology.wa.gov/DOE/files/a6/a6c3ed59-01b0-4098-ab09-75aedb4905b6.pdf	State of Washington Department of Ecology
Washington	Safeguarding Our Lands, Waters, and Communities: DNR's Plan for Climate Resilience	2020	https://www.dnr.wa.gov/publications/em_climateresilienceplan_feb2020.pdf?r5qt4w	Washington State Department of Natural Resources
Washington	Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy	2012	https://apps.ecology.wa.gov/publications/publications/1201004.pdf	State of Washington Department of Ecology
Washington, DC	Climate Ready DC: The District of Columbia's Plan to Adapt to a Changing Climate	2016	http://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/CRDC-Report-FINAL-Web.pdf	Department of Energy & Environment
Washington, DC	District Response Plan	2015	https://hsema.dc.gov/sites/default/files/dc/sites/hsema/page_content/attachments/District%20Response%20Plan%202015.pdf	Homeland Security and Emergency Management Agency
West Virginia	West Virginia Statewide Standard Hazard Mitigation Plan 2018	2018	https://emd.wv.gov/MitigationRecovery/Documents/WV%20State%20Hazard%20Mitigation%20Plan%20FINAL%2011-2018.pdf	Division of Homeland Security and Emergency Management
West Virginia	West Virginia Flood Plan	2004	http://www.wvca.us/flood/pdf/wv_statewide_plan.pdf	West Virginia Conservation Agency
Wisconsin	2016 State of Wisconsin Hazard Mitigation Plan	2016	https://dma.wi.gov/DMA/divisions/wem/mitigation/docs/HazardMitigationPlan/2016_WI_Hazard_Mitigation_Plan.pdf	Wisconsin Emergency Management
Wisconsin	Wisconsin's Changing Climate: Impacts and Adaptation	2011	https://wicci.wisc.edu/wp-content/uploads/2019/12/2011-wicci-report.pdf	Wisconsin Department of Natural Resources
Wisconsin	Wisconsin Coastal Management Program Needs Assessment and Strategy 2021-2025	2020	https://doa.wi.gov/DIR/Coastal_309-Assessment-Strategy_2021-2025_DRAFT.pdf	Wisconsin Department of Administration, Wisconsin Coastal Management Program
Wyoming	Wyoming State Hazard Mitigation Plan	2016	https://www.wsspc.org/wp-content/uploads/2019/07/Final_Wyoming-State-Mitigation-plan_012516.pdf	Wyoming Office of Homeland Security

Source: Authors' analysis of state documentation.

Note: List includes all state and territory plans identified by the research team that include discussions of flood hazard mitigation, adaptation, or resilience. Therefore, multiple plans have been included for most states.

Appendix B. Plan Review Framework

Measure title	Indicator	Brief description
Basic Information		
State	state names	name of state where plan was developed/applied
Plan title	full title of plan	
Status of development/adoptions	- in development - under review by [legislative body, governor's office, department, public consultation] - adopted by [legislature, governor, other]	if the plan had been adopted and by what approving bodies of government (legislature, governor, other)
Year adopted or anticipated	year (add "anticipated" if not yet adopted)	
Length of plan	number of pages	a proxy for level of detail or extent
Duration of validity	number of years (note "start [YEAR]" if not yet valid or "ended [YEAR]" if past window	number of years plan is or was expected to be valid
Author	- consultant - agency - other (name)	the primary body or bodies that developed the plan, including name of consulting firm, departmental office, or other entity
Plan format		
Plan type	- flood plan - hazard mitigation plan - community development plan - land use plan - other [name]	All plans collected had a flood component, whether an explicit section of the plan or woven in. Plan type was intended to identify the different types of plans that may include flooding components.
Chapter names	list of names of chapters	This list allowed for easy review and could be used to search for specific words or terms.
Primary outline structure	- risk focused - project focused - location focused - other	The structure of the primary outline could provide insight to the basis for plan development beyond understanding the risk assessment process. We wanted to see whether location-focused (e.g., organized around different regions) plans would be more a result of different risk types or more for political purposes of ensuring equal attention.
Plan development		
Duration of development	in months/years	how long the plan has been in development
Mandating authority	- governor - legislature - judiciary - other	the main actor mandating the plan

Measure title	Indicator	Brief description
Terms of mandate	- Disaster Mitigation Act based - other	whether the plan was designed to be in fulfillment of FEMA's regulatory requirements under the 2000 Disaster Mitigation Act as per 44 CFR 201.3(c)
Domain 1: Plan conceptualization		
Statement of principles or values	- data driven - sustainability or resilience frame - social equity - other - none	a clear statement of the principles on which recommendations, policies, or initiatives in the plan are based
Plan includes desired conditions that reflect values	- yes - no	a specific set of desired outcomes (a vision) that reflects a set of values
Principles or values guide plan implementation (actions or policies)	- yes explicitly - yes implicitly - no	whether policies, initiatives, and recommendations are oriented toward achieving stated desired outcomes
Domain 2: Flood Risk Assessment		
Risk estimation source	- FEMA - locally generated - other [name]	source of data for assessment
Risk basis	- past events - projections incorporating climate change projections - projections incorporating land use elements	whether basis for current risk (and for the period of validity of the plan) is based on historical data or on a projection model that incorporates climate change impacts and/or changes in land use
Geography of risk analysis	- regional - full state	whether analysis was conducted for the whole state or only for targeted regions, such as those in a floodplain
Geographic units of risk analysis	- substate region - county - subcounty unit - tract - floodplain boundary - other	geographic scale of flood assessment analysis
Unit of risk quantification	- dollar value - property unit value - replacement cost - loss of life - level of displacement - other	how the plan quantifies potential losses based on risk of flooding or opportunity cost of not employing policies or projects
Discussion of populations affected and vulnerability	- extensive - cursory - none	whether the plan incorporates a substantive discussion of the populations at risk based on the risk assessment, assesses social and environmental vulnerability, and incorporates these factors into planning
Relative economic impact of flood events incorporated into planning	- yes - no	whether the relative economic impact of various flood scenarios is incorporated into planning

Measure title	Indicator	Brief description
Domain 3: Plan Implementation		
Plan enumerates specific projects	■ yes ■ no	whether plan specifically enumerates statewide or local projects
Responsible parties identified	■ state ■ counties ■ municipalities ■ water districts ■ wastewater authorities ■ regional planning organizations or councils of government ■ tribal nations ■ nonprofits/volunteer organizations ■ other	whether specific projects, recommendations, or policies are explicitly linked to specific actors
Enforcement mechanisms	■ regulatory ■ state funding tied ■ state acting directly ■ none ■ other	whether plan policies are required by regulation, incentivized through funding, or implemented by the state acting directly
Plan includes budgetary projections and funding sources	■ budgetary projections ■ funding sources ■ no	how much specific projects, policies, or recommendations would cost, where the funding would come from, and how it would be financed (if relevant)
Plan includes provisions for technical assistance for substate entities or communities	■ yes ■ no	provisions for substate entities implicated in state plans for how to access technical assistance for local planning or enacting state plans
Domain 4: Governance and Coordination		
■ Coordination with substate bodies ■ municipalities ■ counties ■ water districts ■ wastewater ■ regional planning organizations ■ councils of government ■ tribal nations ■ other	■ extensive ■ cursory ■ none	how coordination with substate governmental and quasigovernmental bodies will happen, including alignment of planning processes, engagement, and funding flows
Coordination with nongovernmental stakeholders	■ anchor institutions ■ universities ■ business associations ■ nonprofit/volunteer group/advocacy groups ■ private citizens ■ other	role of nongovernmental actors in flood risk management and response, including planning alignment (when applicable) and partnerships
Coordination with higher-level planning efforts	■ regional (associations of states or transborder, e.g., Michigan and Ontario) ■ federal	whether and how plan aligns with national, transborder, regional, or international planning efforts

Measure title	Indicator	Brief description
	- international - none	
Domain 5: Public Engagement and Transparency		
Plan is online and easy to locate	- yes - no	
Plan is written in accessible language	- yes - no	
Plan is available in language other than English	- yes, in full [NAME LANGUAGE OR LANGUAGES] - a summary or fact sheet is available in [NAME LANGUAGE OR LANGUAGES] - no	
- Evidence of public engagement participatory sessions - feedback period - outreach to stakeholder communities	- extensive - cursory - none	whether public engagement went beyond or merely fulfilled mandatory requirements

Appendix C. Glossary of Terms Used in Review of Flood Plans

Overarching: Plan Categories

Coastal state: A count of all plans that fit the relevant category from states or territories that have coastlines on the Atlantic or Pacific Oceans, the Gulf of Mexico, or any of the Great Lakes.

Noncoastal state: A count of all plans that fit the relevant category from states or territories that do not have coastlines on the Atlantic or Pacific Oceans, the Gulf of Mexico, or any of the Great Lakes.

SHMP: A count of all plans that fit the relevant category that fulfilled the federal requirements to be recognized as a standard or enhanced state hazard mitigation plan.

Non-SHMP: A count of all plans that fit the relevant category that did not fulfill the federal requirements to be recognized as a state hazard mitigation plan.

Old: Plans adopted between 1999 and 2018.

Recent: Plans adopted in 2018 or later.

Basic Information Measures

Plan Type by State

This indicator provided counts by state and territory for each plan type we included in our survey, survey which only included plans that had specific analysis, policies, or actions related to floods or flooding. Some states had plans that fit in one or more of the categories but were not included in our survey because we determined they were not flood related.

Climate/resilience plan: A count of state climate adaptation or resilience plans that addressed flooding.

Non-309 coastal plan: A count of non-309 state coastal plans that focused on coastal regions and addressed unique coastal hazards, such as sea level rise, coastal erosion, storm surges, or coastal flooding.

Direct response plan: A count of plans focused on coordinating disaster response efforts with specific reference to flooding. Direct response plans were only included if they incorporated preparedness, adaptation, or mitigation planning directly related to flooding.

Flood plan: A count of plans exclusively focused on flooding.

State hazard mitigation plan (SHMP): A count of plans designed to fulfill the federal requirements to be recognized as a standard state hazard mitigation plan. Enhanced state hazard mitigation plans and SHMP/climate plans were not included.

Enhanced state hazard mitigation plan (E-SHMP): A count of plans specifically created to fulfill all federal requirements to be recognized as enhanced state hazard mitigation plans.

SHMP/climate plan: A count of plans designed to fulfill the federal requirements to be recognized as a standard state hazard mitigation plan and to function as the state's or territory's primary climate adaptation plan. Only the Massachusetts Integrated State Hazard Mitigation and Climate Adaptation Plan fit this category.

State water plan: A count of plans focused on water management with specific reference to flooding, in addition to other water-related issues such as water supply or contamination.

Emergency management plan: A count of plans addressing emergency management and with a specific discussion of flooding, but not designed to conform to SHMP requirements. Emergency management plans were only included if they incorporated preparedness, adaptation, or mitigation planning directly related to flooding.

309 Coastal strategy plan: A count of plans designed to fulfill the federal requirements to be eligible for the Coastal Zone Enhancement Grants Program, as described in section 309 of the Coastal Zone Management Act of 1972.

Status of Adoption or Development

This indicator summarized the adoption status of all plans in the survey, providing breakdowns by approval status and approving body.

Adopted: A count of plans that had been officially adopted by a state or federal office (as relevant).

Under review: A count of plans that had been adopted by a state government but were currently under review by a relevant federal agency. Only SHMP, E-SHMP, and Coastal 309 plans are reviewed by federal agencies.

In development: A count of plans available and published online but not officially accepted by a state or federal office.

Unknown status: A count of plans that did not have clear information in the plan document or associated documents or websites on the plan's adoption status.

Length of Plan

This indicator summarized the number of pages of all plans included in the survey.

Average length: The mean number of pages of all plans included in the relevant breakout.

Maximum length: The number of pages of the longest plan in the relevant breakout.

Minimum length: The number of pages of the shortest plan in the relevant breakout.

Duration of Plan Validity

This indicator summarized the length of time plans identified as their period of validity. Plans categorized as “undetermined” did not include information on a period of validity.

Plan Authors

This indicator identified the body listed as the lead organizational author of plans included in the survey. Only the authorizing body is included in this indicator—plans listed as authored by state agencies may have engaged external consultants for portions of the plan's authorship or analysis.

State agency: A count of plans primarily authored by a state agency based on authorships noted in plan documents.

Consultant: A count of plans primarily authored by a consultant based on authorships noted in plan documents.

State agency and consultant: A count of plans authored jointly by a state agency and a private consultant based on authorships noted in plan documents.

State agency and local governments: A count of plans authored by a state agency and local governments based on authorships noted in plan documents.

State agency and university: A count of plans authored by a state agency and a local university center, office, or department based on authorships noted in plan documents.

University: A count of plans authored primarily by a university center, office, or department based on authorships noted in plan documents.

Undetermined: A count of plans that did not include information on authorship.

Number of Plans by Type

This indicator provided the number of plans included in the survey by plan type. For definitions of terms, see the earlier section in this appendix, Basic Information Measures: Plan Type by State.

Duration of Plan Development

This indicator summarized the amount of time, measured in years, that plans included in the survey were under development, according to information included in the plan texts, web pages, or accompanying documentation.

Mandating Authority

This indicator summarized the authority that mandated the creation of plans included in our survey.

Governor: The number of plans for which the state governor or governor's office initiated the development of the plan.

Legislature: The number of plans for which the state legislative body initiated the development of the plan.

Quasigovernmental entity: The number of plans for which a quasigovernmental body, such as a special water authority, a coastal authority, a regional planning organization, or similar body, initiated the development of the plan.

State agency: The number of plans for which a state agency initiated the development of the plan.

Undetermined: The number of plans for which the authority that mandated the creation of the plan could not be determined.

Terms of Mandate

This indicator summarized the legal terms on which the plan was mandated.

Disaster Mitigation Act based: A count of plans created in response to the Disaster Mitigation Act of 2000. This count included all SHMPs, E-SHMPs, and SHMP/climate plans.

Executive order: A count of all plans created in response to an order of the relevant governor or state executive office.

Act of legislature: A count of all plans created in response to an act of a state legislature or to fulfill a standing statutory requirement.

State constitution: A count of all plans created in fulfillment of a state constitutional requirement.

Federal requirement: A count of all plans created in response to a federal requirement other than the Disaster Mitigation Act of 2000.

Other: A count of all plans created in response to a specific impetus other than those listed above.

Undetermined: A count of all plans for which the terms of mandate could not be determined.

Domain 1: Plan Conceptualization

Vision

This indicator summarized the primary vision expressed in the plans included in the survey. A vision was defined as a clear statement of the principles on which recommendations, policies, or initiatives in the plan were based. The categories for visions were based on terms used in the plans' vision statements, not on externally imposed definitions. Categories identified included resilience, sustainability, conservation, and planning.

Desired Targets Included

This indicator summarized the number of plans in the survey that included desired targets. Desired targets referred to explicitly stated goals that were tied to the plan's vision. For example, if a plan's vision were to improve community resilience to flooding, the desired targets might be a reduction in loss of life from future 100-year floods and increased ability for a community to return to normal economic activity following a 100-year flood.

Plan Implementation Guided by Vision

This indicator summarized whether there was a clear link, whether explicit or implicit, between the vision stated in the plan and the plan's findings and recommendations.

Integration of Plan Elements

This indicator summarized whether the plan's recommendations (projects and policies) flowed clearly from the plan vision, targets, risk assessment, and data analysis. A designation of "yes" indicated that most or all of the plan's projects followed clearly from the plan vision, targets, risk assessment, and data analysis. A designation of "partially" indicated that some, but not all, of the plan's recommendations followed.

Domain 2: Flood Risk Assessment

Geography of Risk Assessment

This indicator summarized the geographic extent of risk assessment conducted as part of the plan.

Full state: All land in the state was analyzed.

Coastal: Only coastal zones were analyzed.

Watersheds: Only areas identified as within specific watersheds were analyzed.

Specified project area: Only areas identified as within the area of impact for a specific project or projects were analyzed.

No risk assessment: No risk assessment was included in the plan.

Unit of Risk Assessment

This indicator summarized the units of risk assessment used in plans. These categories were not mutually exclusive, because some plans used multiple units of analysis.

County: Risk was assessed and expressed at a county level.

Floodplain: Risk was assessed and expressed using the boundaries of one or more floodplains.

Substate region: Risk was assessed and expressed using substate geographic nonhydrographically defined regions other than counties or survey tracts.

Watershed: Risk was assessed and expressed using the boundaries of one or more watersheds.

Coastal: Risk was assessed and expressed for coastal regions.

Survey tract: Risk was assessed and expressed at the survey tract level.

Other: Risk was assessed and expressed at a geographic level other than the categories identified above.

Minimal or none: Risk was not substantively assessed or expressed in the plan.

Unit of Risk Quantification

This indicator summarized how the plan quantified potential losses based on the risk of flooding or the opportunity cost of not employing policies or projects. These categories were not mutually exclusive, as some plans used multiple units of risk quantification.

Property unit value: Risk was quantified and expressed in terms of the value of property (house, office, apartment) that would be vulnerable in the flood zone.

Dollar value: Risk was quantified and expressed in terms of a dollar value for damages incurred because of flood hazards.

Loss of life: Risk was quantified and expressed in terms of number of lives lost.

Replacement cost: Risk was quantified and expressed in terms of the cost to replace assets damaged in a flood.

Crop loss: Risk was quantified and expressed in terms of the crops lost in a flood that were no longer viable to use and sell.

Level of displacement: Risk was quantified and expressed in terms of the number of people who were forced to relocate from their homes due to a flood.

Other: Risk was quantified and expressed in units other than those expressed above.

None: Risk was not quantified or expressed in the plan.

Discussion of Populations Affected

This indicator summarized the degree to which a plan addressed the impact of flood hazards on the general population. A designation of “extensive” indicated that the plan directly addressed how flood hazards would impact populations. A designation of “cursory” indicated that the plan identified populations within the state and their general vulnerabilities but did not relate the discussion directly to flood risk. A designation of “limited” indicated that the plan included a state-level discussion of populations with no geographic breakdown and no discussion of who would be affected by flood hazards.

Discussion of Social Vulnerability

This indicator summarized the degree to which a plan identified social factors that predispose some individuals, families, and communities to disproportionately suffer the effects of natural hazards. Examples of such factors include race, wealth, level of English proficiency, access to a vehicle, and employment status. A designation of “extensive” indicated that the plan clearly connected the geographic risk assessment to discussions of specific vulnerable populations within the area. A designation of “cursory” indicated that the plan identified social factors that may place populations at disproportionate risk to hazards but did not explicitly link that discussion to the geographic risk assessment. A designation of “none” indicated that the plan did not include any discussion of social vulnerability.

Discussion of Relative Economic Impact

This indicator summarized whether the relative economic impact of various flood scenarios was incorporated into planning relative to specific locations or communities. An example would be the

differing levels of economic impact to an area that may result from a 100-year flood versus a 500-year flood.

Inclusion of Geographic Exposure and Vulnerability Analysis

This indicator summarized whether a plan included a geographic exposure and vulnerability analysis, such as performing a geographic overlay of Social Vulnerability Index values with flood risk maps. This measure captured the degree to which individuals, families, and communities would be subject to flood hazard, as well as any underlying social vulnerabilities that may result in disproportionate impacts. The existence of this analysis was further broken down to indicate the level of credibility and rigor behind the assessment. “Yes, no evidence of credible source” indicated that an assessment was conducted with limited transparency on methods or assumptions. “Yes, by credible scientists or consultants, no evidence of peer review” indicated that the assessment was done by a credible source, but the methods and results were not evaluated through a peer review process. “Yes, by credible scientists or consultants and peer reviewed” indicated that the assessment was done by a credible source, and the methods and results were evaluated through a rigorous peer review process.

Risk Basis

This indicator summarized whether a plan based its risk assessment on historical data or whether it incorporated climate change and development projections. Plans that based their risk assessment on past events and on climate projections were counted in both categories. Plans may have included multiple sources for their risk assessment.

Past events: Risk was assessed using data from historical floods.

Climate projections: Risk was assessed using projections that accounted for future changes in conditions resulting from climate change.

Land use projection: Risk was assessed using projections that accounted for future changes in land use.

Population growth projections: Risk was assessed using projections that accounted for future changes in population size.

Domain 3: Plan Implementation

Specific Projects Enumerated

This indicator summarized whether a plan enumerated specific projects, either local or statewide.

Physical infrastructure: The plan identified projects that involved physical infrastructure, such as levee construction, road repair, or building renovations.

Nonphysical projects: The plan identified projects that did not involve any physical infrastructure, such as increased education, data collection, or community outreach.

None: The plan did not identify projects of any kind.

Eligibility Criteria for Projects Included

This indicator summarized whether a plan contained information on the criteria used to select projects for inclusion in the plan. Examples of eligibility criteria include alignment with plan goals, a metric list used to score projects, or cost effectiveness.

Actions for Local Governments Included

This indicator summarized whether a plan contained specific actions that local governments could take to enhance potential access to state-managed Hazard Mitigation Assistance and other mitigation funding.

Specific Policies Enumerated

This indicator summarized whether a plan enumerated policies to be enacted to advance or support the plan.

Prioritized Projects

This indicator summarized whether a plan that identified specific projects prioritized or sequenced the projects based on impact, need, urgency, or other values. Prioritization was in reference to the

implementation of projects, and therefore a plan may have included eligibility criteria without further indicating project prioritization.

Responsible Parties

This indicator summarized whether the plan identified responsible parties for specific projects or recommendations. These categories were not mutually exclusive, because some plans included multiple responsible parties.

State: The number of plans that designated state agencies as responsible for implementing specific projects or recommendations.

Counties: The number of plans that designated county agencies and governments as responsible for implementing specific projects or recommendations.

Municipalities: The number of plans that designated municipal agencies and governments as responsible for implementing specific projects or recommendations.

Nonprofits/volunteer organizations: The number of plans that designated nonprofit or volunteer organizations as responsible for implementing specific projects or recommendations.

Universities: The number of plans that designated universities or university researchers as responsible for implementing specific projects or recommendations.

Regional planning organizations or councils of government: The number of plans that designated regional planning organizations or councils of government as responsible for implementing specific projects or recommendations.

Businesses: The number of plans that designated business associations or private-sector partners as responsible for implementing specific projects or recommendations.

Tribal nations: The number of plans that designated tribal nation agencies or governments as responsible for implementing specific projects or recommendations.

Water districts: The number of plans that designated water districts as responsible for implementing specific projects or recommendations.

Wastewater authorities: The number of plans that designated wastewater authorities as responsible for implementing specific projects or recommendations.

Other: The number of plans that designated entities other than those listed above as responsible for implementing specific projects or recommendations.

Responsible Individual Identified

This indicator summarized whether a specific individual identified by name or job title was responsible for implementing projects or recommendations identified in the plan. This indicator is more specific than identifying a responsible agency.

Enforcement Mechanism

This indicator summarized the tools that a plan enumerated to ensure implementation of plan projects and recommendations. These tools were not mutually exclusive, and multiple mechanisms could exist in the same plan.

State acting directly: Actions would be taken directly by a state agency.

Regulatory: Policies would be enforced through regulatory measures, such as a statute or the use of consent decrees.

Incentive-based approach: Incentives, typically in the form of funding in areas not directly related to implementation of the project or policy in question, would be used as a means to motivate implementation by local governments or other bodies.

State funding tied: The administration of state funding in other areas was directly tied to the implementation of the project or policy in question.

None: No mechanisms were identified to be used for enforcement.

Funding Sources

This indicator summarized whether a plan identified sources for project financing by source type. A plan may have included multiple funding sources.

FEMA Hazard Mitigation Assistance: The number of plans that identified FEMA Hazard Mitigation Assistance as a funding source for projects. Funds may be administered by the state but originated from FEMA mitigation programs: Building Resiliency Infrastructure and Communities, Hazard Mitigation Grant Program, Flood Mitigation Assistance, and Pre-Disaster Mitigation Grant Program.

State hazard mitigation assistance: The number of plans that identified state hazard mitigation funds as the funding source for projects. State hazard mitigation funds are specifically and explicitly earmarked for hazard mitigation. Federal hazard mitigation funds are administered by states or other more general state funds.

Other: The number of plans that identified funding sources other than those listed above to provide funding for projects.

None: The number of plans that did not identify any funding source for projects.

Committed Funding

This indicator summarized whether funding was fully, partially, or not at all committed to support projects within the plan. “Fully” designated that the projects in a plan had funding completely committed. “Partially or staged” designated that a portion of the projects within a plan had funding committed, or funding for one stage of the projects was committed. “None” designated that no funding had been committed to projects within a plan.

Budget Included

This indicator summarized whether a plan included a budget for its projects. “Yes” designated that a full budget was included for each project. “Partially” designated that a budget was included for a portion of the projects in a plan but not the full plan, and “none” designated that no budget was included for any projects within a plan.

Primary Funding Source Identified

This indicator identified the primary funding source for projects within a plan. Although a plan may have identified multiple funding sources, the primary funding source was the main entity that provided the majority of funding for the plan and its projects.

State: Plan projects were primarily funded through state funds.

Federal: Plan projects were primarily funded through federal funds.

Private sector: Plan projects were primarily funded through private-sector funds.

Special Funding Mechanisms

This indicator summarized whether a plan identified any special funding mechanisms for projects. Special funding mechanisms are innovative methods for raising funds outside of traditional grants or proposals.

State bond: The number of plans that identified state bonds, which are the issuance of indebtedness by a state government, as a mechanism for funding projects.

Tax increment financing: The number of plans that identified tax increment financing, which is the diversion of future increases in property tax revenue toward current costs, as a mechanism for funding projects. Tax increment financing is often, but not exclusively, used for large infrastructure projects.

Green bond: The number of plans that identified green bonds, which are bonds used for prespecified projects with positive environmental benefits, as a mechanism for funding projects.

Local bond: The number of plans that identified local bonds, which are the issuance of indebtedness by local governments, as a mechanism for funding projects.

Other: The number of plans that identified special funding mechanisms other than those listed above, such as mitigation banking, settlement funds, or stormwater fees, for funding projects.

None: The number of plans that did not identify any special funding mechanisms.

Provisions for Technical Assistance

This indicator summarized whether a plan included provisions for substate entities implicated in the plan to access technical assistance. “Yes–provided by state” designated that state agencies would directly implement the technical assistance. “Yes–provided by other body” designated that a third party, typically a consulting firm or private technical assistance agency, would implement the technical assistance. Technical assistance identified in a plan could be provided by multiple sources.

Training technical assistance: The number of plans that included provisions for technical assistance related to trainings, such as for planning, report writing, or project implementation.

Data technical assistance: The number of plans that included provisions for technical assistance related to data, such as through sharing risk assessment data or data tools.

Funding technical assistance: The number of plans that included provisions for technical assistance related to funding, such as guidance on grant applications and drawing down funds.

Other technical assistance: The number of plans that included provisions for technical assistance related to topics other than training, data, or funding.

Proposed Timelines for Project Completion

This indicator summarized whether a plan included a proposed timeline for project completion. “Yes” designated that a full timeline for projects was included. “Partial” designated that a timeline for a portion of projects, or a more general timeline, such as near term and long term, was included. “No” designated that no timeline for project completion was included.

Domain 4: Governance and Coordination

Coordination with Substate Bodies

This indicator summarized whether a plan included a description of how coordination with substate governmental and quasigovernmental bodies would happen, including alignment of planning processes, engagement, and funding flows. “Extensive” indicated that the plan included full or significant coordination with lower-level plans or activities. “Cursory” indicated high levels of consultation, but not necessarily explicit tie-in with local planning or policy. “None” indicated that no coordination with substate bodies was described.

Municipality coordination: The number of plans that included a description of coordination with municipal governments or agencies.

County coordination: The number of plans that included a description of coordination with county governments or agencies.

Water district coordination: The number of plans that included a description of coordination with quasigovernmental water districts.

Wastewater authority coordination: The number of plans that included a description of coordination with wastewater authorities.

Regional planning organizations or councils of government coordination: The number of plans that included a description of coordination with regional planning organizations or councils of government.

Tribal coordination: The number of plans that included a description of coordination with tribal nations or agencies.

Evidence of State Hazard Mitigation Committee

This indicator summarized whether a plan described the existence of a state hazard mitigation committee (e.g., the Nevada State Hazard Mitigation Planning Committee), which is a team created specifically to lead and manage mitigation planning.

Other State Plans Referenced

This indicator summarized whether a plan referenced other state plans, either to contextualize the scope of the plan in relation to other state planning efforts or as a means to integrate actions and policies across plans.

Coordination with Nongovernmental Stakeholders

This indicator summarized whether a plan included a description of the role of nongovernmental actors in flood risk management and response, including planning alignment (when applicable), partnerships, and similar arrangements. A plan may have included coordination with more than one type of nongovernmental stakeholder.

Universities: The number of plans that described coordination with universities or academic institutions.

Nonprofits/volunteer organizations: The number of plans that described coordination with nonprofits or volunteer organizations.

Businesses: The number of plans that described coordination with business associations or private-sector partners.

Private citizens: The number of plans that described coordination with private citizens not in association with any specific organization.

Anchor institutions: The number of plans that described coordination with anchor institutions, such as hospitals.

Other: The number of plans that described coordination with other nongovernmental stakeholders not previously listed.

Section not available: The section including information on coordination with non-governmental stakeholders was not publicly available in the Kansas Water Plan.

None: The number of plans that did not describe coordination with any nongovernmental stakeholders.

Coordination with Higher-Level Planning

This indicator summarized whether a plan explicitly aligned with national, transborder, regional, or international planning efforts. A plan may have included coordination with more than one higher-level effort.

Federal: The number of plans that aligned with federal planning efforts.

Regional: The number of plans that aligned with regional planning efforts across states.

Transborder (Canada): The number of plans that aligned with transborder planning efforts in Canada.

Section not available: The section including information on coordination with higher-level planning was not available in the Kansas Water Plan.

None: The number of plans with no description of alignment with any higher-level planning efforts.

Strategy to Assist Low-Capacity Communities

This indicator summarized whether a plan included specific actions or strategies to engage low-capacity communities (i.e., communities whose limited social, economic, or political capital hampered their ability to implement plan objectives). “Yes” designated that a plan included a thorough strategy for assisting low-capacity communities. “Limited” designated that a plan included a strategy for assisting low-capacity communities but lacked substantive pieces, and “no” designated that a plan did not include a strategy to assist low-capacity communities.

Local Governments Assistance of Low-Capacity Areas

This indicator summarized whether a plan encouraged or required local governments to include an explicit strategy to assist low-capacity neighborhoods or citizens in local plans. This indicator could include targeting projects in these areas or specific grant opportunities for low-capacity areas.

Provisions to Track Improved Local Capacity

This indicator summarized whether a plan tracked how flood planning and recovery capacity changed at the local level. This indicator could include metrics on completion of plans, number of staff, or grant dollars received.

Domain 5: Public Engagement and Transparency

Online Accessibility

This indicator summarized whether a plan was hosted online and accessible to find through a search engine. Plans that were not easy to find were either not fully online or required extensive searching to access the correct document.

Language Accessibility

This indicator summarized whether a plan was written in language that someone without specific training or professional knowledge would be able to read and easily understand. Use of equations and technical jargon are key indicators of inaccessible language.

Available in Language Other than English

This indicator summarized whether a plan was translated into a language other than English. Only the Puerto Rico Climate Adaptation Plan was available in Spanish; all other plans were only available in English.

Policy Visualizations

This indicator summarized whether a plan included visualizations of proposed projects or policies, such as where specific projects would be located, geographic areas protected by a project, or links to scenario planning.

Data Visualizations

This indicator summarized whether a plan used maps or other visuals to communicate relevant key data pertaining to demographics, land use, or flood hazards. Designation of quality was informed by the use of design features identified with clear communication, including strategic use of color, weight, white space, and text to communicate the map's or visualization's intended message.

High quality: Visualization purpose was obvious at a glance, and the design elements (color, line, weight, texture, and position) had easily identifiable purposes, with little to no extraneous information.

Middling: Visualization had a clear purpose that users could identify with attention. Some design elements had meaning, but some effort may be needed to understand them.

Low quality: Visualization purpose was obscured or not present. Design elements were not easy to distinguish or had no distinct meaning.

None: Plan did not include any visualizations for the relevant subcategory (demographics, land use, flood hazard).

Evidence of Engagement

This indicator summarized whether a plan included information on different means of engaging with the public. "Extensive" designated intentional and purposeful efforts to engage the general public and solicit a range of stakeholders in the process. "Cursory" designated efforts that included engagement but did not go beyond programmatic requirements, such as the FEMA mandatory public comment period. "None" designated that no public engagement occurred.

Participatory sessions: Any form of engagement, such as charrettes, informational meetings, or design workshops, that allowed the public to provide input into the plan development process.

Feedback period: A time when public input was accepted to inform the plan or raise concerns about its contents.

Outreach to stakeholders: Methods used to reach a diverse array of stakeholders and solicit their input on and engagement with the plan.

Appendix D. Full State Profiles

Colorado

Flood Experience

Colorado is a noncoastal state with a land area of approximately 104,000 square miles. The Front Range of the Rocky Mountains runs north to south, dividing the mountainous western half of the state from the eastern prairies. Although FEMA identifies riverine flooding as a hazard in all Colorado counties, mountain regions also experience postwildfire flooding and both planned and unplanned dam overflow flooding. The largest recent flood in the state occurred in 2013, when a cold front stalled out over the Front Range, causing flooding across 17 counties, with the greatest damage in the highly populated areas of Boulder County and near Denver. The Front Range floods resulted in two presidential disaster declarations and federal investment of approximately \$118,700,000 in individual assistance (table D.1), \$343,644,427 in public assistance, and \$320,346,000 in Community Development Block Grant funds (FEMA 2018).⁴¹

The current (2018) E-SHMP identifies Front Range communities, and particularly Boulder County, as having the greatest risk of flooding, with a Hazus analysis showing a potential economic loss of \$507,910,000 in Boulder County alone.

TABLE D.1

Disaster Declarations and Federal Individual Assistance in Colorado, 2010–20

Year	Number of declarations	Individual and households program	Housing assistance	Total individual assistance
2010	0	\$0	\$0	\$0
2011	0	\$0	\$0	\$0
2012	0	\$0	\$0	\$0
2013	2	\$56,900,000	\$61,800,000	\$118,700,000
2014	0	\$0	\$0	\$0
2015	1	\$0	\$0	\$0
2016	0	\$0	\$0	\$0
2017	0	\$0	\$0	\$0
2018	0	\$0	\$0	\$0
2019	0	\$0	\$0	\$0

2020	0	\$0	\$0	\$0
Total	3	\$56,900,000	\$61,800,000	\$118,700,000

Source: Author's analysis of "OpenFEMA Dataset: Disaster Declaration Summaries v2," FEMA, last refreshed March 6, 2022; and "OpenFEMA Dataset: Individuals and Households Program – Valid Registrations v1," FEMA, last refreshed March 5, 2022.

Other major floods of note include the Lawn Lake Dam failure flood of 1982, in which \$31 million (in 2017 dollars) in damages were incurred and four lives were lost (CWCB 2018, 3-44), and the Big Thompson Canyon thunderstorm flood of 1976, which killed 144 people and incurred over \$40 million in damages (CWCB 2018, 3-39–3-40).

Governance

Colorado is a home-rule state in which almost all incorporated municipalities directly collect sales, use, and property taxes. Home-rule entities in the state have significant leeway in developing land use regulations and utilities plans, as well as day-to-day local statutory measures. A small number of municipalities remain under the former "statutory town" framework, in which the state government administers financing. Counties are considered direct arms of the state government. Although counties can establish "house rule," this practice only extends to determining the local structure of government—state law and administrative policies remain (Legislative Council Staff 2018, 9). Two local governments, Denver and Broomfield, are established as combined city and county governments and hold the rights of home-rule cities (Legislative Council Staff 2018, 25).

Several state government offices and related bodies are involved in flood planning within Colorado. The primary actors are as follows:

- **The Office of Emergency Management**, housed under the Division of Homeland Security and Emergency Management, is responsible for the development, monitoring, and implementation of the SHMP and "integrates emergency management efforts across all levels of government, including state, local, tribal and federal."⁴²
- **The Office of Dam Safety of the Division of Water Resources** is housed under the Department of Natural Resources. The Office of Dam Safety monitors the state dam and levee system and calculates the floodplains of planned and unplanned dam overflow floods.
- **The Colorado Resiliency Office** was established by the governor following the 2013 Front Range floods to "support a long-term adaptable and vibrant future...by building stronger, safer, and more resilient systems in the face of natural disasters and other shocks and

stressors.”⁴³ Although originally housed in the governor’s office, it was later moved to the Department of Local Affairs.

- **The Colorado Water Conservation Board**, part of the Department of Natural Resources, develops and maintains the state’s hazard mapping capabilities, including the regulatory flood maps and also administers the National Flood Insurance Program regulations on behalf of the State.

Plans and Initiatives

Colorado currently has five plans that address flood adaptation and mitigation: the E-SHMP, the Flood Mitigation Plan (FHMP), the Colorado Resiliency Framework, the Colorado Climate Plan, and the Colorado Water Plan.

- **Enhanced State Hazard Mitigation Plan:** Colorado’s enhanced state hazard mitigation plan was adopted in late 2018. The plan was developed by a core planning team of DHSEM staff and consultants from Michael Baker International and Wood Environment & Infrastructure Solutions, Inc. in addition to the State Hazard Mitigation Team. Planning began in October 2017. The flood risk assessment came from the Colorado Flood Mitigation Plan and relied on both historical data and changes based on future population growth and land development. Flood risk is measured at the county level for economic loss, buildings damaged, and people displaced. Colorado’s plan includes mitigation goals and objectives that are directly tied to each mitigation action as well as the agency responsible for implementation, however there is no dedicated funding tied to the actions.
- **Flood Mitigation Plan:** Colorado developed its first FHMP in 1982 following the Lawn Lake Dam failure flood. Since 2004, FHMP updates have been incorporated into the SHMP process, and since 2007 the FHMP has been aligned with the Disaster Mitigation Act’s mitigation element requirements, allowing the FHMP to function as an official annex to the SHMP (CWCB 2018, 2-4). The original plan was developed by the Colorado Water Conservation Board, but current planning efforts are led by an interdepartmental Flood Technical Assistance Partnership comprising the Colorado Water Conservation Board, Colorado Department of Transportation, and FEMA (CWCB 2018, 2-5). By design, much of the FHMP mirrors the structure of the SHMP, with both using many of the same data sources and analysis techniques. The risk assessment included in the FHMP goes into greater detail than the SHMP on methodology, data sources used, and specific types of flood risk. Greater

emphasis is placed on the variety of flood types present in Colorado, and the FHMP provides an extensive list of recommended actions and activities beyond those included in the SHMP. These actions are given a high-, medium-, or low-priority ranking based in part on the criteria laid out in the Colorado Resiliency Framework (CWCB 2018, 4-38–4-39).

- **Colorado Resiliency Framework:** The Colorado Resiliency Framework, first released in 2015 and updated in 2020, is designed to reduce overall risk to Colorado communities; enhance resiliency planning capacity in Colorado communities; develop, align, and streamline policies to empower resiliency; create a culture that fosters resiliency; and ingrain resiliency into investments in Colorado. Although not a flood-specific plan, the framework includes discussion of the damages floods have caused, citing them as a leading shock faced by the state. The plan avers the primary source of action in the state as local communities, specifically citing home rule: “As a home-rule state, the strength of Colorado resides in the right to local self-governance.... A top-down approach is not appropriate in most instances and ongoing multi-disciplinary conversations are locally driven” (Colorado Resiliency Office 2015, 4-4). Although none of the strategies target flooding specifically, many incorporate practices associated with improved flood planning. Such practices include standardizing and aligning climate models used for scenario planning in state, regional, and local planning efforts; incorporating performance metrics to demonstrate resilience improvement; and incorporating resilient watershed-based management to develop a “holistic watershed approach to identify cross-cutting projects that...[improve] climate and natural hazard resiliency” (Colorado Resiliency Office 2020, 55). The plan also defines a set of resiliency prioritization criteria “designed to enable State departments and agencies to prioritize resiliency efforts that produce multiple benefits while using limited available resources” (Colorado Resiliency Office 2020, 11). As noted above, these criteria have been integrated into the FHMP, and as of 2019, were used by the Division of Homeland Security and Emergency Management to prioritize proposed grant projects (DHSEM 2019).
- **Other plans:** The 2015 Colorado Climate Plan and the 2015 Colorado Water Plan both discuss flooding to a limited degree. The Colorado Climate Plan, which is a climate adaptation and mitigation plan, notes that climate change models predict increased extreme precipitation in the state during the winter months. The plan does not include any recommendations that speak directly to flooding. The Colorado Water Plan is primarily concerned with the health and reliability of the water supply. However, the plan does acknowledge flooding and notes certain risks, such as the disruption of water delivery services, that are not addressed in other plans. No proposed actions address flood adaptation or mitigation.

Interview Themes

Local government officials we spoke with largely agree that the SHMP, the FHMP, and the Resilience Framework work together to address flooding. Although the original iteration of the FHMP predates the SHMP, respondents noted that the FHMP update process has moved from its original home in the Department of Natural Resources to be part of the SHMP cycle. One informant noted that the FHMP has essentially merged with the SHMP, functioning as an annex, structured to provide increased depth and detail on flood mitigation strategy.

Informants also observed that the connectivity between the plans is a result of many of the same people working on all three, with different offices taking leadership. The Resilience Strategy 2020 update, the most recently completed planning process in the area, included a process of analyzing state plans, including the SHMP and FHMP, in developing the Resiliency Framework. Likewise, respondents from the Office of Emergency Management and the Flood Technical Assistance Partnership noted that the goals and assessment framework from the Resilience Strategy will continue to be incorporated into the 2023 SHMP and FHMP processes.

Despite this connectivity, informants noted some siloing of flood activities in the state government. They observed that the division of efforts between the Colorado Water Conservation Board and the Division of Homeland Security and Emergency Management creates some gaps between the data that are collected and the data that are needed. The Colorado Water Conservation Board is focused on working directly with local and regional floodplain managers and is responsible for collecting and analyzing state data. The Division of Homeland Security and Emergency Management is responsible for coordinating local planning processes, developing the SHMP, distributing most federal dollars, and providing technical assistance to local communities.

One interviewee noted that the separation of the dam safety office in the Division of Water Resources has been a key area of disconnect. According to dam safety staff, data on dam-related floodplains and probabilities of failure were not included in the state's flood risk assessment until 2012. Today, the dam safety office houses key aspects of risk analysis, including the overlay of social vulnerability indicators with flood risk, although social vulnerability indicators were not fully integrated into the flood risk assessment in the SHMP. However, the information gap remains. One respondent noted that spillway flows (the water that passes over a dam by design during big floods) have not been incorporated into state flood mapping or risk assessment.

Interviewees confirmed the limited nature of public engagement with flood planning. Informants speaking about both the SHMP and FHMP noted extensive coordination between state agencies and

local governments, but they could not recall any efforts to engage the public, either directly or through partner advocacy organizations. The Resiliency Framework process involved public engagement in the form of a public survey and several targeted focus groups. However, no evidence exists that these efforts discussed flooding beyond contextualizing the threat in the larger state resilience landscape.

This lack of public engagement was reflected by our stakeholder discussion. As a member of a local water advocacy organization, one stakeholder noted engagement with Denver and other government bodies. Indeed, she observed that the state has limited power to enforce flood protection policies, observing that “land use planning is really difficult in Colorado because of home rule. There's money to be made by selling homes by trees and water, so it's hard to discourage that.”

Overarching Observations

Colorado has advanced its flood planning practices as part of an effort to improve resilience in the state following the Front Range floods of 2013. These efforts have resulted in increased cooperation between the various departments and agencies that are responsible for components of flood planning, including coordination on the development of the SHMP and the linked FHMP; the incorporation of resiliency criteria into prioritization in the 2018 FHMP update; and the use of the criteria in determining how to distribute grant funds to local governments. However, the silos between the Office of Emergency Management, the Office of Dam Safety, the Colorado Water Conservation Board, and the Colorado Resiliency Office remain, and continue to cause knowledge and communication gaps.

As a home-rule state, Colorado is limited in its ability to directly implement flood mitigation or adaptation policies or programs. In a rapidly growing state, this limitation has created tensions in areas bordering regulatory and other known floodplains, as the state relies on local governments to enforce locally developed land use regulations. The state views its role in flood planning as providing data and technical support to local governments to develop their own flood and general hazard mitigation plans. However, the state has used innovative tools to advance resilience standards, such as incorporating its own additional scoring to prioritize hazard mitigation projects and the distribution of FEMA funds. These resilience standards include key features of strong planning, including considering local impacts of climate change and substantial incorporation of social vulnerability into local plans and actions.

Although the relative absence of public engagement in the flood planning processes is not unusual, it places a special onus on local governments to develop policies that are likely to have

ramifications for neighboring municipalities and unincorporated areas. Active and direct public engagement in the SHMP and FHMP planning processes may be impractical, but greater outreach and public education on the state's role in flood mitigation and adaptation could lead to greater support for planning processes that extend further beyond local boundaries.

Iowa

Flood Experience

Floods are the most common natural disaster in the state of Iowa, and the state experiences both flash flooding and riverine flooding. Recent significant flash floods in 2017 and 2018 were followed by a major flood on the Missouri and Mississippi Rivers in 2019 that caused an estimated \$1.4 billion in damage in Iowa and a presidential disaster declaration in 57 counties in the state (table D.2), as well as extensive damage in neighboring Missouri and Nebraska (Kelley 2017; Pitt 2019). The prior decade, riverine flooding from June 8 to July 1, 2008, caused widespread damage and precipitated a renewed focus within the state on flood hazard mitigation. The city centers of Cedar Rapids and Iowa City saw substantial damage and during this event, and 86 of the state's 99 counties were included in the governor's disaster declaration. The extensive flooding forced 38,000 Iowans to evacuate, and 21,000 housing units were impacted (Iowa Department of Homeland Security 2009).

TABLE D.2

Disaster Declarations and Federal Individual Assistance in Iowa, 2010–20

Year	Number of declarations	Individual and households program	Housing assistance	Total individual assistance
2010	0	\$0	\$0	\$0
2011	1	\$4,820,194	\$4,623,721	\$9,443,915
2012	0	\$0	\$0	\$0
2013	1	\$0	\$0	\$0
2014	1	\$0	\$0	\$0
2015	0	\$0	\$0	\$0
2016	2	\$0	\$0	\$0
2017	0	\$0	\$0	\$0
2018	0	\$0	\$0	\$0
2019	2	\$15,300,000	\$13,600,000	\$28,900,000
2020	0	\$0	\$0	\$0
Total	7	\$20,120,194	\$18,223,721	\$38,343,915

Source: Author's analysis of "OpenFEMA Dataset: Disaster Declaration Summaries v2," FEMA, last refreshed March 6, 2022; and "OpenFEMA Dataset: Individuals and Households Program – Valid Registrations v1," FEMA, last refreshed March 5, 2022.

Governance

Iowa is a home-rule state. Home rule, enacted through an amendment to the state constitution, gives cities and counties the ability to determine their own local affairs, except for the ability to levy taxes without the direct approval of the General Assembly. If a county and municipality authority contradict one another, the will of the municipality prevails (Crowley and Duster 2008).

The primary state governmental offices and related bodies involved in flood planning within Iowa are as follows:

- **Iowa Department of Homeland Security and Emergency Management:** This agency has the primary responsibility for the development and writing of the E-SHMP. The Department of Homeland Security and Emergency Management additionally manages federal mitigation grants and provides technical assistance to local communities for mitigation planning.⁴⁴
- **Iowa state hazard mitigation team (SHMT):** The SHMT was established through an executive order by the governor and includes members from various state agencies who provide resources and technical assistance to the creation of the E-SHMP. The primary SHMT members are representatives from the Iowa Department of Natural Resources, Iowa Department of Transportation, Iowa Economic Development Authority, Iowa Department of Cultural Affairs, Iowa Department of Public Safety—State Fire Marshal Division, and Iowa Department of Homeland Security and Emergency Management. Additional state agencies participate in the SHMT by providing input as needed on their areas of expertise.
- **Iowa Silver Jackets Team:** The Silver Jackets, created in 2011, act as the SHMT for flood risk activities in the SHMP. Their responsibilities include reporting and evaluating progress on flood mitigation actions and projects, identifying implementation issues, and providing briefings on updates. Similar to SHMT, the Iowa Silver Jackets Team is composed of members from a range of state, federal, nonprofit, and private partners.

Plans and Initiatives

Iowa currently has just one state-level plan, its 2018 E-SHMP, that addresses flooding adaptation and mitigation. However, extensive modeling and mitigation capacity building are done by the Iowa Flood Center (IFC) and the Iowa Watershed Approach (IWA).

- **Iowa Enhanced Hazard Mitigation Plan:** The Department of Homeland Security and Emergency Management released the most recent iteration of the E-SHMP in 2018. The E-SHMP was completed in accordance with the Robert T. Stafford Disaster Relief and Emergency Assistance Act to fulfill FEMA requirements and allow the state to be eligible for additional federal emergency recovery funding. The plan includes a flood hazard risk assessment that compiles data on historical disasters and assesses areas with assets at greatest vulnerability to flood damage. Flood risk was assessed using historical crop damage from riverine flooding and property damage from riverine and flash flooding. Changing future conditions caused by climate change were addressed, but not formally modeled, in the risk assessments.
- **Iowa Watershed Approach:** In 2016, HUD awarded the state of Iowa \$97 million through its National Disaster Resilience Competition. The program is a partnership between universities, nonprofits, and state agencies and focuses on nine watersheds. Each watershed has its own watershed management authority, which is charged with developing a hydrologic assessment and watershed plan and implementing flood mitigation projects to reduce the magnitude of downstream flooding. To be able to substantively measure and monitor the flood risk reduction projects, IWA focused on nine watersheds with a subbasin size of hydrologic unit code 8.⁴⁵
- **Iowa Flood Center:** The IFC was created following the 2008 floods with funding from the Iowa state legislature. The IFC is housed within the University of Iowa and serves as an academic center focused on flooding in Iowa, providing detailed flood maps and a network of sensors to monitor stream flow across the state.⁴⁶ In response to the 2008 floods, in 2010 the Department of Natural Resources and IFC launched a program to update all of the floodplain maps across the state. The program was funded with \$15 million from HUD.⁴⁷
- **Iowa Flood Mitigation Board:** The Iowa Flood Mitigation Board was established in 2012 by the General Assembly with the mission of creating a flood mitigation program in the state. Various state agencies can submit proposals for flood mitigation projects that the board reviews for potential approval and funding. The board is composed of 14 members from the

public and state agencies, as well as four ex officio members from the state legislature. Funds are raised from sales tax increments or appropriated from the state General Assembly.⁴⁸

Interview Themes

The Iowa Code established three parts to the Iowa Comprehensive Emergency Plan, with the Iowa Hazard Mitigation Plan as one of those components. Interviewees noted that the motivation for pursuing an enhanced status was to increase federal funding available to the state. They added that the need for mitigation projects by local governments always far exceeds the available resources, so pursuing the enhanced plan was an opportunity to make more funds available. The SHMT comprises various state agencies, and during each plan update, they review each section of the plan and update the goals, prioritizations, accomplishments over the previous five years, and mitigation actions. The Silver Jackets act as the flood mitigation team and identify flood mitigation actions specific to the state.

IFC is the primary partner for technical assistance with flood mapping and uses a modeling and monitoring approach to flood risk assessment. IFC has both community maps that comply with FEMA requirements and more detailed flood inundation maps. These detailed maps combine topography from LiDAR surveys, data from specialized boats on the topography of river bottoms, and river gauge data into models to create probabilistic inundations maps (2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year floods).⁴⁹ Interviewees noted that they expect the next E-SHMP to include flood risk assessments that incorporate climate change projections.

For the SHMP, there was a public comment period and public meeting that received no engagement. The state hazard mitigation officer viewed the integration of local plans, which tend to have more extensive engagement, into the larger plan as the conduit for incorporating public feedback into the E-SHMP.

Conversely, IWA and IFC placed a large focus on direct communication and engagement with landowners and residents across the state to better understand the on-the-ground reality of flood concerns and challenges. As one interviewee phrased it, “If you don’t go, you don’t know.” Within the state, there is no standard legal authority for watershed management, so IWA worked to establish watershed management agencies that link up at geographic structure levels.

In relation to addressing the needs of socially vulnerable communities, HUD requirements concerning low- and moderate-income households directed where IWA chose to focus its efforts.

However, interviewees noted a slight tension between how HUD measured benefits to a community and the structure of watershed planning; a project may be located upstream, but the reductions in flooding are seen by vulnerable populations downstream.

In 2020, IWA submitted a FEMA Building Resilient Infrastructure and Communities application. Interviewees said they hoped local communities would use it as a template to reduce the starting energy needed for them to produce their own applications. They viewed the goal of the program as building local capacity so that initiatives can continue without support and guidance from IWA, which is slated to end in December 2022. The water management agencies are in the process of determining how to sustain funding after the program ends. Interviewees explained that all watersheds with funding for plans are set to complete them by June 2022 and that IWA is looking for additional funding sources to support those communities in implementing their projects.

Overarching Observations

Iowa serves as an example of a state with limited state-level flood planning but substantive flood mitigation activities. As a home-rule state, limited regulatory authority exists to promote the implementation of coordinated flood mitigation planning and implementation, so responsibility had been ceded to academic and quasigovernmental organizations to lead these efforts. This approach places the onus on substate actors to initiate planning and coordination, as seen with IFC and IWA.

IWA, which is a central actor in the flood planning ecosystem within the state, stemmed from HUD's National Disaster Resilience Competition, which highlights the importance of federal funding in catalyzing flood mitigation efforts. Although we see with SHMPs that federal planning requirements can lead to plans that simply check the box for requirements rather than to nuanced, engagement-led products, it is important to acknowledge the role that federal funding can play in filling state gaps. The counter to this positive influence are the limits of FEMA's flood risk assessment criteria, which resulted in redundancy in IFC's efforts to produce both FEMA-compliant flood inundation maps and higher-quality maps using stream monitoring and modeling.

Florida

Flood Experience

Because of its geography, Florida is prone to coastal, riverine, and flash flooding. The entire state is vulnerable to flooding due to the large amount of coastline, significant drainage systems, and low elevations. Low-lying inland areas are vulnerable to riverine flooding following intense rainfall, and drainage from rivers in Alabama and Georgia flow into the state. Rapid development has increased the area of impervious surfaces in the state and with it the risk of flash flooding. Other flood hazards in the state include lower and upper tidal reach flooding and dam failures. The majority of the major floods in the state have resulted from severe storms or hurricanes. Most recently, in 2017, Hurricane Irma caused extensive flooding in southern Florida from storm surge and rainfall. Florida's susceptibility to flooding resulted in 19 disaster declarations between 2010 and 2020 (table D.3).

TABLE D.3

Disaster Declarations and Federal Individual Assistance in Florida, 2010–20

Year	Number of declarations	Individual and households program	Housing assistance	Total individual assistance
2010	0	\$0	\$0	\$0
2011	0	\$0	\$0	\$0
2012	1	\$0	\$0	\$0
2013	0	\$0	\$0	\$0
2014	0	\$0	\$0	\$0
2015	0	\$0	\$0	\$0
2016	3	\$29,793,304	\$24,804,983	\$54,598,287
2017	6	\$1,033,609,675	\$722,109,675	\$1,755,719,350
2018	2	\$150,000,000	\$123,000,000	\$273,000,000
2019	3	\$0	\$0	\$0
2020	4	\$35,300,000	\$27,600,000	\$62,900,000
Total	19	\$1,248,702,979	\$897,514,658	\$2,146,217,637

Source: Author's analysis of "OpenFEMA Dataset: Disaster Declaration Summaries v2," FEMA, last refreshed March 6, 2022; and "OpenFEMA Dataset: Individuals and Households Program – Valid Registrations v1," FEMA, last refreshed March 5, 2022.

Governance

Florida is a modified home-rule state. In 1973, the state adopted a constitutional amendment ratifying the Home Rule Powers Act, which allows municipal governments the ability to "exercise power for

municipal purposes except as otherwise provided by law.”⁵⁰ However, these powers do not extend to fiscal home rule, as all taxing authority remains with the state.⁵¹ The primary state government offices and related bodies involved in flood planning within Florida are as follows:

- **Florida Department of Environmental Protection (DEP):** DEP is responsible for managing the environmental resources within Florida and is divided into three main areas: land and recreation, regulation, and ecosystem restoration.⁵² DEP has oversight authority over the regional water management districts (WMDs) and manages coastal and wetland protection, housing most of the coastal flooding and sea level rise state initiatives, including the Sea-Level Impact Projection tool and the 309 Coastal Management Program (Florida Department of Environmental Protection 2021).⁵³ In addition, in 2019, Governor DeSantis created the position of chief resilience officer within the state to coordinate resilience activities across public, private, and academic sectors (Office of Governor Ron DeSantis 2019).⁵⁴ Originally housed in the governor’s office, the chief resilience officer is now housed in DEP. Although officially responsible for resilience across all hazards, the original position announcement and annual reports place heavy emphasis on sea level rise and coastal flooding (Office of Governor Ron DeSantis 2019).
- **Water management districts:** The five regional WMDs within the state are Northwest Florida, Suwannee River, St. Johns River, Southwest Florida, and South Florida. One main responsibility of the WMDs is to “construct, operate and maintain flood protection structures throughout their region to prevent increases in flooding events.”⁵⁵ WMDs are responsible for the administration of water resources at the regional level, with general supervision from DEP. Board members for the WMDs are appointed by the governor, and the districts have their own special tax districts with ad valorem tax abilities.
- **Florida Division of Emergency Management (FDEM):** FDEM is responsible for the development, monitoring, and implementation of the E-SHMP.
- **Southeast Florida Regional Climate Change Compact:** Although not part of state government, the impact of the Southeast Florida Regional Climate Change Compact has been substantial in influencing state-level flood planning. The compact, started in 2009 by leaders from Broward, Miami-Dade, Monroe, and Palm Beach Counties, developed and adopted its own climate action plan separate from that of the state. One aspect of the compact is the Unified Sea Level Rise Projection for Southeast Florida, which was created with the goal of informing adaptation strategies and policies and is updated every five years.⁵⁶

This action led to similar efforts in the Tampa region, and according to one informant, it has influenced the state's efforts to improve standardized sea level rise projections (Sun Sentinel Editorial Board 2018).⁵⁷

Plans and Initiatives

The main state-level flood planning documents in Florida are the 2018 E-SHMP; the Final Assessment and Strategies FY 2021–FY 2025, which contains the state's response to Coastal Zone Management Act section 309 (Florida Coastal Management Program 2020); and Florida's Energy and Climate Change Action Plan (Governor's Action Team 2008). The latter two plans both address flooding but do so to a lesser degree than the E-SHMP. Additionally, in the 2021 legislative session the Florida legislature enacted SB 1954, which provides substantive funding and structure for future flood initiatives.

- **E-SHMP:** Florida's E-SHMP was last updated in 2018. The Florida state hazard mitigation team was combined with the Silver Jackets to create the Mitigate FL Working Group, which led the plan update process beginning in 2016. Although the E-SHMP acknowledges the potential effects of climate change on flooding within the state, the risk assessment only relies on historical data. Flood risk is measured for both the 100- and 500-year floodplains; units of risk assessment include population in floodplains, the total economic value within the floodplain, and direct economic loss.⁵⁸ Each of Florida's 67 counties has a multihazard local mitigation strategy, and Florida is one of two states with the authority to review and approve local mitigation strategy plans. Although the E-SHMP includes information on available funding sources and the project selection process for projects submitted to the state for mitigation funding, it does not include a list of project or policy recommendations.
- **Senate Bill 1954:** The "Always Ready" legislation was signed into law on May 12, 2021. The bill calls for a three-year Statewide Flooding and Sea Level Rise Resilience Plan and a statewide flood risk assessment by the DEP to inform the Resilience Plan; creates the Resilient Florida Grant Program, which will provide funding to local governments for the cost of planning for and addressing threats from flooding and sea level rise; encourages the formation of regional resilience coalitions to coordinate intergovernmental initiatives; and establishes the Florida Flood Hub for Applied Research and Innovation to collaborate with academic and research institutions on the state's flooding and sea level rise challenges. The legislation dedicated \$100 million each year to these efforts beginning in 2022.⁵⁹

- **Other plans:** Flooding is addressed as a hazard to the state in both the 2008 Energy and Climate Change Action Plan and the Final Assessment and Strategies FY 2021–FY 2025. Although the Energy and Climate Change Action Plan identifies flooding as a risk, no recommendations specifically focus on addressing flooding. The section 309 strategy identifies nine priority areas and outlines coastal restoration projects. Sea level rise, coastal erosion, subsidence, and coastal flooding are the main flood hazards addressed in the plan; however, the risk analysis is high level and pulls from the E-SHMP.

Interview Themes

The development of the E-SHMP was done through FDEM without the assistance of an engineering contractor. Although FDEM organized an interdepartmental mitigation planning committee, one respondent who participated noted that meetings were largely informational, with different agencies sharing their activities on projects occurring in the state. The E-SHMP relies on FEMA data for its flood risk assessment, but some local municipalities use more detailed data in their local plans, which are then incorporated into the state plan. An interviewee noted that FEMA planning grants to update flood hazard maps are typically initiated by and filtered directly to WMDs rather than FDEM. One government interviewee reported that FDEM has received technical assistance from Florida Atlantic University on how to incorporate climate change and sea level rise into the plan, but noted that the findings from that report are not yet incorporated into the current E-SHMP.

Our review of the E-SHMP found that although the plan discusses sea level rise and increasing vulnerability of coastal areas, as well as the effects of a warmer atmosphere on flooding, these factors do not appear to be accounted for in assessing the probability of future floods. In relation to incorporating climate change into future planning strategies, an interviewee from FDEM saw its role as primarily distributing FEMA funds for mitigation and recovery, and noted that local jurisdictions understand their own changing risk best. The current E-SHMP does not include substantial discussion of social vulnerability or any policy recommendations. A respondent characterized it as a report detailing hazard risk assessments and how the state will move forward with its current and future planning and programs.

Some WMDs provide more advanced risk assessments than are available in the E-SHMP. The South Florida WMD, for example, develops its own models that incorporate land use change and sea level rise scenarios, as well as rainfall trends based on historical trends and climate change projections. A stakeholder we spoke with noted that the WMD models have tended to focus on inland and urban

flooding but that current efforts are shifting to look at agricultural risk. The stakeholder also noted that although it would be possible for WMDs to incorporate social vulnerability into their analyses, they currently only measure risk through property damage.

In 2019, Governor DeSantis appointed a chief resilience officer within DEP with the goal of creating more consistent communication and coordination around resilience issues. However, the position has had multiple turnovers and is currently unfilled. The main role of DEP in local flood planning is to provide technical assistance to local governments by connecting them to funding mechanisms or regulatory approaches. As one interviewee put it, DEP does not have regulatory authority, so its approach is to provide technical assistance where they can. A respondent from the South Florida WMD challenged this notion, suggesting that local communities would go to their WMD for technical assistance rather than the state because of the regional organization's more localized expertise.

Governor DeSantis signed SB 1954 in May 2021, calling for a Statewide Flooding and Sea Level Rise Resilience Plan and a statewide flood risk assessment by the DEP to inform the Resilience Plan and creating the Resilient Florida Grant Program. The grant program will provide funding to local governments for the cost of planning for and addressing threats from flooding and sea level rise and will encourage the formation of regional resilience coalitions to coordinate intergovernmental initiatives. The legislature created ranking criteria for project applications to the Resilient Florida Grant Program. These criteria heavily weigh the degree to which projects address flood risk based on vulnerability assessments, as well as the regional importance of the project and ecosystem benefits. The local match component to the grant is waived for economically distressed communities.

The state is also in the process of developing a watershed master plan with community-level data that can be used by municipalities to create local watershed plans. FDEM received \$26 million through the Hazard Mitigation Grant Program to support every community in the state to complete a watershed management plan. Communities must complete a plan to be eligible for state resiliency grant funding. In addition, any state-funded construction projects within the coastal building zone must now go through a Sea-Level Impact Projection study to determine the risk of the project. DEP has a public-access Sea-Level Impact Projection tool to assist entities with the study.⁶⁰

Overarching Observations

To date, government respondents and stakeholders noted that state flood planning in Florida has been primarily reactive, responding to specific needs after local or major disasters rather than investing in

long-term planning. One expert observed that with the high concentration of population along the coast, the state has historically been interested in coastal flood mitigation despite the need for mitigation inland, both because of riverine flooding and tidal floods linked to sea level rise. The informant observed that this focus may be partially attributable to the relative power of the Office of Resilience and Coastal Protection, whose scope does not include inland flooding.

As several interviewees noted, the mitigation needs of the state far outpace resources, with one observing, “You could use the whole state budget and still have more you would want to fund.” The main lack, according to government interviewees, is the time and cost needed to get detailed data on flood risk and vulnerability and sea level rise changes. An interviewee at a WMD noted that in recent years, the state has been more supportive of resiliency assessments, but it had been inactive in the past, which left multiple WMDs behind on creating comprehensive flood risk assessments.

Multiple government informants observed that Florida’s approach to date has been to place the responsibility for flood mitigation and planning on the regional and local level with a belief that localities are better able to understand their risks and vulnerabilities. This approach allows for flexibility between local contexts, but it leaves a gap for a larger coordinated effort and larger oversight, and it does not ameliorate the recurring tension of diverse local vulnerabilities.

The passage of SB 1954 may indicate a turning point in how the state views its role in flood planning. The final content of the state flooding resilience plan and the outcomes of the grant program will provide more concrete evidence of the state’s approach in the coming years, but the programmatic and funding commitment points to this new approach. This change aligns with the observations of stakeholder and government informants, who observed that although climate change remains a controversial topic, it is impossible to ignore the reality of sea level rise and the impacts that it has already had along the state’s highly developed and populated coastline.

North Carolina

Flood Experience

North Carolina faces both inland and coastal flood hazards. The coastal and central Piedmont regions of the state are most vulnerable to destructive flooding from hurricanes and tropical storms, and the mountainous western region is vulnerable to flash flooding and snowmelt runoff from the mountains. In total, 18.2 percent of land in North Carolina is in a floodplain. North Carolina has experienced three

billion-dollar floods since 2013, including an estimated \$17 billion from Hurricane Florence in 2018 and \$4.8 billion from Matthew in 2016 (Office of Governor Roy Cooper 2018). Sixteen flood-related disaster declarations were issued in North Carolina between 2010 and 2020 (table D.4).

TABLE D.4

Disaster Declarations and Federal Individual Assistance in North Carolina, 2010–20

Year	Number of declarations	Individual and households program	Housing assistance	Total individual assistance
2010	1	\$0	\$0	\$0
2011	2	\$37,200,000	\$31,100,000	\$68,300,000
2012	0	\$0	\$0	\$0
2013	2	\$0	\$0	\$0
2014	0	\$0	\$0	\$0
2015	1	\$89,800,000	\$78,000,000	\$167,800,000
2016	3	\$138,400,000	\$101,700,000	\$240,100,000
2017	0	\$0	\$0	\$0
2018	2	\$134,000,000	\$110,000,000	\$244,000,000
2019	3	\$0	\$0	\$0
2020	2	\$0	\$0	\$0
Total	16	\$399,400,000	\$320,800,000	\$720,200,000

Source: Author's analysis of "OpenFEMA Dataset: Disaster Declaration Summaries v2," FEMA, last refreshed March 6, 2022; and "OpenFEMA Dataset: Individuals and Households Program – Valid Registrations v1," FEMA, last refreshed March 5, 2022.

Governance

North Carolina is a Dillon's rule state, meaning that local governments only have powers and duties that are expressly or necessarily granted to them by the state. The primary state government offices and related bodies involved in flood planning in North Carolina are as follows:

- **North Carolina Office of Recovery and Resilience (NCORR):** NCORR was established in September 2019 following Hurricane Florence and is housed within the Department of Public Safety. NCORR manages nearly \$1 billion in Community Development Block Grant Disaster Recovery and Mitigation funding as well as additional state funding from the State Disaster Recovery Acts of 2017 and 2018 and the Storm Recovery Act of 2019.⁶¹ In addition to recovery efforts, NCORR serves as a central point for resilience in the state, leading the state's strategic buyout program, funding affordable housing developments with disaster-resilient features, and investing in resilient infrastructure.

- **North Carolina Division of Emergency Management:** This agency is housed within the Department of Public Safety and is responsible for administering disaster preparedness activities and programs available to the state through FEMA, including the BRIC program, the first round of which brought \$24.7 million in funding to five projects across North Carolina. It is also responsible for the development and update of the SHMP as well as the review of local mitigation plans. Floodplain Mapping and the National Flood Insurance Program are also housed within NCEM.⁶²
- **North Carolina Department of Environmental Quality (DEQ):** DEQ is responsible for managing the state's natural resources. The department carries out the Coastal Zone Management Act and is responsible for the development of the state's Coastal Zone Management Act section 309 strategy. DEQ also developed the 2020 Climate Risk Assessment and Resilience Plan (CRRP) as directed by Executive Order 80.⁶³ DEQ is also responsible for developing the newly funded Flood Blueprint, coastal storm damage mitigation, and stream debris cleaning.

Plans and Initiatives

- **State of North Carolina E-SHMP:** The E-SHMP was last updated in 2018 by the Risk Mitigation Branch of North Carolina Emergency Management in partnership with a consulting agency. In alignment with FEMA requirements, the plan incorporates climate projections in the risk and vulnerability assessment using high-quality NOAA data. The North Carolina Flood Mapping Program produced digital flood hazard maps for all counties in the state based on historical data for its flood hazard risk assessment and does not include any modeling of projected climate change. The E-SHMP reflects high levels of coordination with local communities and across government agencies, but it includes only a limited discussion of social vulnerability and does not incorporate social vulnerability into the risk and vulnerability assessment. As a Dillon's rule state, mitigation actions include several direct actions by state government, including property acquisition and elevation. However, the plan still focuses on encouraging and supporting local hazard mitigation planning, allowing for some land use and taxation tools to be leveraged by local governments.⁶⁴
- **North Carolina Climate Risk Assessment and Resilience Plan:** The CRRP stemmed from Executive Order 80, which directed state agencies to directly address climate change. The plan was developed by DEQ with climate data from the North Carolina Institute for Climate Studies at North Carolina State University. The plan is one of the documents that constitute

the state's resiliency strategy, which also includes the North Carolina Climate Science Report, state agency resilience strategies, statewide vulnerability assessment and resilience strategies, and the North Carolina Enhanced Hazard Mitigation Plan.⁶⁵

- **Assessment and Strategy of the North Carolina Coastal Management Program:** The section 309 strategy in this report identifies nine priority areas and outlines coastal restoration projects. Sea level rise, coastal erosion, subsidence, and coastal flooding are the main flood hazards addressed in the plan; however, the risk analysis is high level and pulls from the E-SHMP.⁶⁶
- **Executive Order 80:** Following Hurricane Florence, Governor Roy Cooper signed Executive Order 80, declaring "North Carolina's commitment to address climate change and transition to a clean energy economy."⁶⁷ The executive order called for the creation of the CRRP and a Climate Change Interagency Council, for each agency to evaluate the impacts of climate change on its programs, and an annual status report on the progress of the order among other commitments.

Interview Themes

Interviewees noted that although the CRRP was developed with an awareness of the E-SHMP, it was completed before the E-SHMP update, so the two plans do not directly dovetail. Multiple interviewees noted that integrating the two plans is a goal for future updates. DEQ developed the CRRP, but many of the initiatives described in the "Path Forward" ending section of the plan are housed within NCORR. Neither the E-SHMP nor the CRRP have regulatory authority to enforce the implementation of the plans.

The North Carolina Floodplain Mapping Program developed its own database for flood vulnerability data that is used for hazard mitigation planning and includes local, high-resolution data on statewide building footprints and first-floor elevation.⁶⁸ This information is available on a public state flood risk portal. However, an interviewee noted that there are still limited efforts at the state level to incorporate climate change into flood modeling.

Although the E-SHMP and CRRP are not currently coordinated, the 2020 update of the latter calls for the two plans to form the core of a state resilience approach. The CRRP specifies that more locally specific climate projections that are outlined in the CRRP will be incorporated into the next E-SHMP, which is expected in 2022. State government informants confirmed that the state will be

incorporating the 2020 CRRP into the E-SHMP update, which they noted should include not only statewide data but also regional, watershed-level data.

The newly approved state budget may prove transformative for flood planning in North Carolina. This budget, ratified in November 2021, dedicated \$800 million over the next two years to disaster recovery, flood prevention, and other needs related to more intense storms and climate change. An allocation of \$20 million in funds has been dedicated to creating a Flood Resiliency Blueprint to predict where flooding will happen and help communities prepare. Three positions in NCORR are now permanently funded after having been temporarily funded for three years. Additionally, funding was allocated for technical assistance to build local capacity for flood planning, physical and natural flood protection infrastructure, and funds to match federal disaster funding.⁶⁹

According to one member of NCORR, several initiatives from CRRP have begun, including an interagency resilience team; incorporating risk assessments into the next SHMP; the North Carolina Resilient Communities Program to build local resilience capacity; and agency resilience strategy reports. This interviewee noted that implementing CRRP is a challenge because it has neither regulatory teeth nor funding for implementation, and it is more a qualitative discussion of the issues than a defined framework with concrete goals and metrics. The approved legislative budget includes funding for the development of a Flood Resiliency Blueprint that would be housed within DEQ in the Division of Mitigation Services. Multiple interviewees believed funding and development of the Flood Resiliency Blueprint would be a critical step toward comprehensive flood planning.

The public engagement process for CRRP was led by DEQ, and NCORR was involved as a participant in the stakeholder engagement piece. DEQ conducted five working group sessions across the state and brought in local experts, local government staff, and community members to participate in discussions of climate risk and impacts in their areas. A respondent noted that councils of governments were instrumental in bringing relevant local stakeholders to these working groups. Interviewees believed that the meetings were comprehensive in their engagement and that they had inclusive outreach to relevant stakeholders and the public.

Overarching Observations

Multiple interviewees commented on the piecemeal nature of flood planning in the state and the lack of either a comprehensive plan or planning entity. Although NCORR has a vision for integrated flood planning, NCORR as it currently exists (with a four-person staff) does not have the capacity to oversee the necessary work and has no direct line to the governor. Furthermore, neither North Carolina

Emergency Management nor DEQ have regulatory authority to enforce plans. Even though authority exists at the state level in this Dillon's rule state, these findings highlight the importance of intentional coordination and adequate capacity building for a successful planning landscape.

Interviewees also noted that tension exists between ongoing recovery from Hurricanes Matthew and Florence and the need for longer-term strategic planning. They commented on the difficulty of garnering political will for extended planning when there are unmet immediate needs of residents waiting for home repairs, buyouts, or elevations. Respondents commented on the juxtaposition they saw between \$20 million in funding for a statewide flood resilience framework and \$167 million for a range of physical flood mitigation infrastructure projects in the proposed state legislative budget. According to one interviewee, within the state there exists both (1) a recognition of the need to plan, consolidate data, and pick priorities and (2) huge pressure to move forward with projects and see impact. One stakeholder provided context on how following Hurricane Floyd in 1999 there was an influx of federal funding for flood hazard mitigation, but because the state did not backfill that with state funds, programs dried up when the federal money ran out. This highlights the challenge of intermittent funding, especially with large influxes of federal recovery funds, for creating sustainable, long-term planning in the state.

Washington

Flood Experience

Washington is a coastal state with multiple mountain ranges separating wet, coastal regions from a dry inland territory. In most of the state, flooding occurs as the result of extended precipitation in late fall and winter. Rain-on-snow floods also occur for a short portion of the year from snowmelt, but they are becoming more frequent with climate change. Flooding often occurs in the foothills of the Cascade Range in Eastern Washington and in the northeastern highlands during spring snowmelt.

Severe flooding resulted from a major thunderstorm in Western Washington in 2009. The storm dropped three to eight inches of rain in one day over every county in Western Washington and flooded nearly all rivers and urban and small streams in that part of the state. Record or near-record flooding occurred in the Snoqualmie, Tolt, North Fork Stillaguamish, Naselle, Snohomish, Newaukum, and Skookumchuck Rivers. Flooding from the storm resulted in over \$72 million in damages, 1,500

landslides, and 44,000 evacuations.⁷⁰ Table D.5 shows the number of flood-related disaster declarations in Washington between 2010 and 2020.

TABLE D.5

Disaster Declarations and Federal Individual Assistance in Washington, 2010–20

Year	Number of declarations	Individual and households program	Housing assistance	Total individual assistance
2010	0	\$0	\$0	\$0
2011	0	\$0	\$0	\$0
2012	0	\$0	\$0	\$0
2013	0	\$0	\$0	\$0
2014	0	\$0	\$0	\$0
2015	0	\$0	\$0	\$0
2016	1	\$0	\$0	\$0
2017	1	\$0	\$0	\$0
2018	1	\$0	\$0	\$0
2019	0	\$0	\$0	\$0
2020	1	\$0	\$0	\$0
Total	4	\$0	\$0	\$0

Source: Author’s analysis of “[OpenFEMA Dataset: Disaster Declaration Summaries v2](#),” FEMA, last refreshed March 6, 2022; and “[OpenFEMA Dataset: Individuals and Households Program – Valid Registrations v1](#),” FEMA, last refreshed March 5, 2022.

Governance

Several state government offices and related bodies are involved in flood planning within Washington. The primary actors are as follows:

- **Department of Natural Resources (DNR):** DNR manages 5.6 million acres of land and water in the state and develops, maintains, and implements the Plan for Climate Resilience, which it released in 2020. DNR is involved indirectly in flood management through its habitat and ecosystem restoration programs, which manage 2.4 million acres of aquatic lands.⁷¹
- **Emergency Management Division (EMD):** EMD is housed within the Washington Military Department. EMD is responsible for the development, monitoring, and implementation of Washington’s SHMP and to “minimize the impact of disasters and emergencies on the people, property, environment and economy.”⁷² EMD additionally oversees management of federal hazard mitigation grants and provides technical assistance to local jurisdictions for developing local mitigation plans and managing mitigation grants.⁷³

- **Department of Ecology:** The Department of Ecology is a central agency for coastal and inland flooding and manages the Floodplains by Design (FbD) program in partnership with the Nature Conservancy and the Puget Sound Partnership. The Department of Ecology also manages the Flood Control Assistance Account Program (FCAAP) and the Coastal Zone Management Program.⁷⁴

Other relevant partners involved in flood planning include the Nature Conservancy, Puget Sound Partnership, Bonneville Environmental Foundation, American Rivers, and the Climate Impacts Group at the University of Washington.

Plans and Initiatives

- **Washington State E-SHMP:** The E-SHMP was developed by EMD with the guidance of representatives from various state agencies who met regularly and gave written approval of the sections relating to their agencies' areas of expertise. There has also been movement within the state to focus on coordinating planning efforts, and the E-SHMP is required to reference other state plans to receive FEMA funding. The E-SHMP is integrated with the state's Critical Areas Ordinances, the Community Rating System for the National Flood Insurance Program, and critical infrastructure dependency mapping.
- **Safeguarding Our Lands, Waters, and Communities: DNR's Plan for Climate Resilience:** The purpose of this plan was to advance climate resilience within DNR and across the land and water that it manages. Climate resilience is defined in the plan as "being prepared for, and adapting to, current and future climate-related changes."⁷⁵ Each chapter in the report is structured around resource-specific challenges and opportunities in a changing climate and addresses DNR's role, how climate change impacts DNR's responsibilities, DNR's priority responses, and sector-wide needs and opportunities. Flood risk is a factor within the larger climate resilience strategy rather than a stand-alone focus. Flood risks are situated within the context of coastal hazards, and risk is quantified in relation to ecosystem and habitat impacts. The plan discusses the disproportionate impacts of climate change on tribal communities and communities already facing economic, social, or environmental disparities. The current plan has broad resiliency goals and does not identify specific projects. Although the plan is not a flood-specific plan, because of DNR's management of a significant portion of public lands within the state, the plan is central to understanding the department's priorities and approach related to natural resource management and resilience.

- **Preparing for a Changing Climate: Washington State’s Integrated Climate Response Strategy:** This plan was released in 2012 by the Department of Ecology. The plan is primarily concerned with climate change adaptation and mitigation. Rather than focusing on risk, the plan focuses on response strategies for key sectors. Flood risk is dispersed through different sectors rather than as a stand-alone hazard. Data on the impacts of climate change in the state in this plan came from the 2009 Washington Climate Change Impacts Assessment. The plan ends with recommendations to raise support for mitigation and adaptation actions focused on continued research and education.
- **Other plans:** The Washington State Coastal Zone Management section 309 Assessment and Strategy 2021–2025 is a five-year strategy that is a requirement of the Coastal Zone Management Act. The strategy identifies nine priority areas and outlines coastal restoration projects. Sea level rise, coastal erosion, subsidence and coastal flooding are the main flood hazards addressed in the plan, but the risk analysis is high level and pulls from the E-SHMP.
- **Floodplains by Design:** FbD is a state program conceptualized through a partnership between the Department of Ecology, the Nature Conservancy, and the Puget Sound Partnership.⁷⁶ The grant program funds flood hazard mitigation programs that integrate ecological preservation and habitat restoration. The program grew out of an observation that previous floodplain management initiatives were siloed, which led to unintended consequences, duplicative, or inefficient results.⁷⁷ During the initial planning phases of the program, an exerted effort occurred to engage relevant stakeholders from dozens of agencies and organizations, ranging from FEMA and the US Army Corps of Engineers to private-sector partners, through roundtable workshops to solicit feedback. FbD uses an integrated floodplain management approach that aims to “to improve the resiliency of floodplains for the protection of human communities and the health of ecosystems, while supporting values important in the region such as agriculture, clean water, a vibrant economy, and outdoor recreation.”⁷⁸ The Department of Ecology tracks 16 project outcomes for FbD related to on-the-ground activities like construction and acquisitions. Metrics include floodplain area restored, improved river ecosystem functioning, number of people with reduced flood risk, and abated damage costs. As of October 2021, FbD had funded 45 projects in 15 major floodplains; reduced flood risk for 2,212 homes or structures; and reconnected 7,217 acres of floodplains.⁷⁹ FbD provides grant funding on a biennial funding cycle; projects are expected to be completed on a two- to three-year timeline.⁸⁰ The 2019–20 grant cycle had \$50.4 million appropriated, with awards ranging from \$500,000 to \$9.4 million. Projects must have a 20 percent match to the FbD funding, but communities defined as economically distressed can have this match

waived.⁸¹ Entities eligible to apply include counties, cities, special-purpose districts such as flood control districts, federally recognized tribes, conservation districts, nonprofits, or municipal corporations.⁸²

- **Flood Control Assistance Account Program:** The Washington legislature established FCAAP to provide funding and guidance to local jurisdictions for comprehensive flood planning and mitigation projects.⁸³ FCAAP was defunded in 2008 during the financial crisis but reinstated for the 2021–23 funding cycle. The program has \$1.5 million in funding available for flood planning and \$150,000 available for implementing emergency flood mitigation projects.⁸⁴ Planning grants have a 25 percent local match, and applicants go through a competitive application process; emergency flood response projects have a 20 percent match and are awarded on a first-come, first-served basis.⁸⁵ Comprehensive flood plans funded through FCAAP must follow state regulations to be approved.⁸⁶ Eligible entities for funding include cities, towns, counties, federally recognized tribes, conservation districts, and special-purpose districts, such as flood control districts. Applications for the first cohort of FCAAP grants for the 2021–23 biennial are closed.⁸⁷
- **Healthy Environment for All Act:** Washington recently passed the Healthy Environment for All Act (SB 5141), which defines environmental justice into state law, expands equitable community engagement, and requires all agencies to incorporate environmental justice into their plans and programs.

Interview Themes

Interviewees viewed the E-SHMP as bringing together the different flood programs into a comprehensive plan. Both FbD and FCAAP are central components to the overall flood mitigation strategy in the state. Interviewees saw FCAAP and FbD working in tandem: FCAAP funds flood plans, and FbD can fund the implementation projects. FCAAP is driven by laws and regulations, but FbD is a public–private partnership that has flexibility for funding projects, particularly around what it will accept as a local match (e.g., other grant funds, land acquisitions, in-kind materials). One interviewee commented that because FbD is multibenefit, meaning that it funds projects that merge flood hazard reduction with ecological preservation and restoration, it appeals to a broad range of interest groups like conservationists, farmers, and homeowners. This broad appeal makes galvanizing political support easier for FbD projects than for other, more siloed, mitigation efforts.⁸⁸ The FbD program largely focuses on inland flooding rather than coastal flooding. An interviewee commented that areas at risk

of riverine flooding in Washington are predominantly agricultural or protected lands, which they believed lent themselves to the multibenefit integrative approach of the program.

Although the 2018 E-SHMP relied mostly on past occurrences for the flood risk analysis, expert stakeholders noted that the next plan will use more rigorous methods and rely on data-driven and science-based analysis provided by the Climate Impacts Group at the University of Washington. They also commented that social vulnerability was “semiquantitative” in the 2018 E-SHMP, meaning that census tracts were used to assess who was exposed to flood hazards. However, EMD plans to integrate the CDC’s Social Vulnerability Index into the 2023 plan.

A key challenge in Washington is that the state has both riverine and coastal flooding, and each hazard requires different data and technical knowledge. This challenge is compounded by climate change blending hazards and creating cascading effects. An example of this compounded effect occurred during the heat dome in the summer of 2021, when 30 percent of the snowpack melted on Mount Rainier over four days, creating intense runoff.⁸⁹ One interviewee noted that it has been challenging for EMD to progress with flood risk assessments and mitigation actions as they also work to balance concurrent disaster responses for wildfires and COVID-19.

Of the major flood initiatives in the state, FbD employed the most extensive community engagement process, and it holds collaboration as a core tenet of the program. During the conceptualization of the program, the leading agencies held dozens of workshops to bring together diverse stakeholders, including state agencies, cities, counties, local landholders, and the general public. Conversely, in relation to the E-SHMP, state agencies meet quarterly to discuss various climate adaptations and risks. However, these meetings largely focus on sharing information rather than coordinating on implementation. Engagement in the 2018 E-SHMP was limited to state agencies and technical experts who provided feedback on risk assessments. However, looking toward the 2023 SHMP, interviewees noted that EMD will be moving to a statewide risk assessment of four regions with comprehensive community engagement to bridge the quantitative analysis with what communities are observing on the ground.

Federally recognized tribes in the state have the right to use public lands and are therefore heavily engaged by DNR in discussions on land use. Disproportionate impacts to select communities and special considerations for tribal communities were directly addressed in DNR’s plan for climate resilience. A stakeholder we interviewed commented that DNR plans a two-year update to the plan that is metric tied and data driven with clear tracking.

Although Washington is a Dillon's rule state, land use is controlled by counties. This distribution of responsibility has led to disparities in data quality between wealthy counties that can collect extensive surveys of their lands and compile risk data and lower-capacity communities that lack this capacity and therefore have lower-quality data to inform flood mitigation projects. One interviewee explained that although FbD is a valuable program because it seeks to create multiple benefits across sectors, it can also be challenging for jurisdictions that lack the technical capacity needed to implement complex programs and report back to the state. FCAAP has a current focus on assisting lower-capacity communities to develop flood plans. It is working to accomplish this goal by encouraging wealthier jurisdictions to include lower-capacity ones in their comprehensive planning process. One interviewee observed that this practice created a dynamic in which low-capacity communities are dependent on their county to help them with their flood planning.

Overarching Observations

Washington has expanded its flood preparation activities in an attempt to include multibenefit integrative projects that break down traditional restoration siloes in the state. Interviewees viewed FbD and FCAAP as structured to work in tandem to create comprehensive flood plans that align with state and FEMA requirements and subsequently have funding for implementation.

Washington structures its flood mitigation planning around state-level goals and then relies on local governments for implementation. This practice is seen across the E-SHMP, FbD, and FCAAP, which rely on counties, tribal governments, or conservation districts as the watershed-level conveners to implement multimillion dollar mitigation projects. This approach shifts flood mitigation governance to local levels, which allows for more flexibility to address a range of contexts, capacities, and risks, rather than attempting to achieve everything at the state level. A challenge that comes with this approach, however, is a lack of coordinated state-level flood management. This challenge shows that Dillon's rule states may have similar challenges to home-rule states with coordination if their approach and culture around flood planning limit their role in local affairs.

Currently, salmon habitat protection and restoration are a main focus of the governor's and DNR's ecological protection efforts. Flood mitigation is often a tangential positive externality of habitat restorations (such as adding woody debris to riverbanks or supporting beaver habitats to avoid flooding) rather than an intentional stand-alone focus. Although these actions are crucial to comprehensive floodplain management, they do not highlight direct flood risk.

Even with renewed investment in FCAAP, FbD, and the E-SHMP, interviewees noted that flood mitigation needs far exceed the available resources in the state, especially with new climate change threats. Furthermore, the majority of flood mitigation resources are focused on inland riverine areas, leaving a gap in coastal preparations. This disconnect highlights the challenge that states face in comprehensively preparing for flood risk.

The state is also facing a debate on how to distribute funds in the most impactful way while also serving diverse priorities. Expansive need and limited resources force policymakers to decide whether to focus on regional or local projects and how to create the greatest benefits while maintaining equity. Investing in select areas with the potential for significant flood risk reductions creates a trade-off of leaving other jurisdictions without support.

Notes

- ¹ “State and Local Revenues,” State and Local Finance Initiative, Urban Institute, <https://www.urban.org/policy-centers/cross-center-initiatives/state-and-local-finance-initiative/state-and-local-backgrounders/state-and-local-revenues>.
- ² “Hazard Mitigation Plan Status,” Federal Emergency Management Agency, last updated February 4, 2022, <https://www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning/status>; ———. 2021. “Flood Map Products.” Washington, DC: Federal Emergency Management Agency. <https://www.fema.gov/flood-maps/products-tools/products>.
- ³ “Fiscal Year 2020 Notices of Funding Opportunities for Hazard Mitigation Assistance Grants,” Federal Emergency Management Agency, accessed November 1, 2021, <https://www.fema.gov/grants/mitigation/fy2020-nofo>.
- ⁴ The following list summarizes the requirements for FEMA approval. A full description of the requirements is available in FEMA’s State Mitigation Plan Review Guide” (FEMA 2015).
- ⁵ A complete list and descriptions of regulatory and nonregulatory FEMA flood map products is available at <https://www.fema.gov/flood-maps/products-tools/products>.
- ⁶ In the current guidance, which was released in March 2015, FEMA added a new standard that SHMPs would incorporate “consideration of changing environmental or climate conditions that may affect and influence the long-term vulnerability from hazards in the state,” including the probability of future hazard events.” However, the provision notes that credit will be given for effort to move toward full compliance. See FEMA (2015).
- ⁷ “About CPRA,” Louisiana Coastal Protection and Restoration Authority, accessed February 24, 2022. <https://coastal.la.gov/about/>.
- ⁸ Selection bias may have influenced our final collection of plans as we would only know of a plan’s existence if our initial web scan uncovered some reference to it. A handful of older-cycle SHMPs were included in the survey as they were the most recent plans available on state websites.
- ⁹ For the purposes of this report, state-level plans are those that have been developed by state government agencies and formally adopted by the state government. Although plans developed by regional offices (e.g., watershed authorities or water management districts) include some plans that focus on specific areas of the state (such as coastal zones), they were not included. Flood planning and flood plans refer to any state-level plan that addresses flood adaptation, mitigation, or resilience, regardless of the primary plan type or purpose.
- ¹⁰ In most cases, local hazard mitigation plans must be reviewed and approved by FEMA in a process similar to that for SHMPs. However, several states have received delegation from FEMA to review and approve local plans. As of September 30, 2021, those states included Florida, New Hampshire, North Dakota, Ohio, Vermont, and Wisconsin (<https://www.fema.gov/emergency-managers/risk-management/hazard-mitigation-planning/status>).
- ¹¹ “Billion-Dollar Weather and Climate Disasters: Summary Stats: Billion-Dollar Events to Affect North Carolina from 2015-2021 (CPI-Adjusted),” National Centers for Environmental Information, accessed February 28, 2022, “<https://www.ncdc.noaa.gov/billions/summary-stats/NC/2015-2021>.”
- ¹² “About Us,” ReBuild NC, accessed November 1, 2021, <https://www.rebuild.nc.gov/about-us>.
- ¹³ General Assembly of North Carolina, SB 105, Section 5.9.(c), 32, 2021, <https://www.ncleg.gov/Sessions/2021/Bills/Senate/PDF/S105v7.pdf>.

- ¹⁴ Other federal programs that provided funding following the 2013 Front Range floods include the US Small Business Administration's low-interest disaster loans and three FEMA programs: the Hazard Mitigation Grant Program, Disaster Unemployment Assistance, and Transitional Sheltering Assistance; ———. 2018. "2013 Colorado Floods: FEMA Public Assistance Overview." Washington, DC: Federal Emergency Management Agency. <https://www.fema.gov/press-release/20210318/2013-colorado-floods-fema-public-assistance-overview>.
- ¹⁵ Scenario planning involves developing a set of assumptions based on fact to plan for a variety of future possibilities. In the case of flood planning, scenario planning may involve developing models with assumptions of high, medium, and low levels of sea level rise or increased rainfall. These assumptions are used to identify alternate strategies to meet stated goals based on the different scenarios (Lehr et al. 2017).
- ¹⁶ David Pitt, "Midwest Flooding Costs Increasing, with \$1.6B Damage in Iowa," *Associated Press*, March 22, 2019, <https://apnews.com/article/cc5a796b2eab4784900e853f1ba8d854>; Matt Kelley, "Heavy Rains Fall on Dry Ground in Southeast Iowa," *Radiolowa*, September 21, 2017, <https://www.radioiowa.com/2017/09/21/heavy-rains-fall-on-dry-ground-in-southeast-iowa/>.
- ¹⁷ "Iowa Flood Mitigation Board," Iowa Department of Homeland Security and Emergency Management, accessed November 11, 2021, <https://homelandsecurity.iowa.gov/flood-mitigation-board/>.
- ¹⁸ "Iowa Watersheds," Iowa Watershed Approach, accessed November 1, 2021, <https://iowawatershedapproach.org/watersheds/>.
- ¹⁹ Iowa Flood Information System," Iowa Flood Center, accessed November 1, 2021, https://ifis.iowafloodcenter.org/ifis/app/?snap_view=fmap.
- ²⁰ The other two components are the State of Iowa Disaster Recovery Plan and the State of Iowa Emergency Response Plan (https://homelandsecurity.iowa.gov/wp-content/uploads/2020/11/Basic_Rec_Plan.pdf).
- ²¹ As of July 2021, FEMA announced that the application in question was not awarded funding (<https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/after-apply/fy-2020-subapplication-status>).
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