



September 2021

# FEDERAL REAL PROPERTY ASSET MANAGEMENT

Additional Direction in  
Government-Wide  
Guidance Could  
Enhance Natural  
Disaster Resilience

# GAO@100 Highlights

Highlights of [GAO-21-596](#), a report to congressional requesters

## Why GAO Did This Study

The federal government spends billions of dollars each year to manage real property assets, such as buildings, levees, and roads. The rising frequency and severity of natural disasters expose these assets to damage and the government to fiscal liabilities. In 2020, the United States experienced 22 separate billion-dollar natural disasters. As the owner of real property assets, federal agencies can enhance the natural disaster resilience of real property through asset management. This can include actions to prepare for disasters.

GAO was asked to determine how agencies prevent or reduce damage to real property caused by natural disasters. This report addresses (1) how selected agencies have incorporated natural disaster resilience into their assets and (2) the extent to which government-wide guidance directs agencies to incorporate natural disaster resilience into asset management.

To conduct this work, GAO reviewed key characteristics and principles for asset management and natural disaster resilience from GAO's prior work; reviewed agency documents; interviewed officials from four selected agencies that owned a large number of assets (U.S. Army Corps of Engineers, General Services Administration, National Park Service, and FWS); and reviewed OMB guidance.

## What GAO Recommends

GAO recommends that OMB direct agencies to incorporate assessments of natural disaster risk information, such as from vulnerability assessments, into asset management investment decisions. OMB had no comments on this recommendation.

View [GAO-21-596](#). For more information, contact Jill Naamane at (202) 512-2834 or [naamanej@gao.gov](mailto:naamanej@gao.gov).

September 2021

## FEDERAL REAL PROPERTY ASSET MANAGEMENT

### Additional Direction in Government-Wide Guidance Could Enhance Natural Disaster Resilience

## What GAO Found

Selected agencies have taken some actions to incorporate resilience to natural disasters into their assets through processes used to make portfolio-wide decisions—known as “asset management”. GAO has previously identified characteristics for effective asset management, such as using quality data on assets. GAO found that selected agencies varied in how they incorporated resilience when applying these characteristics. For example, some agencies collected natural disaster risk data across their portfolios by conducting vulnerability assessments, whereas, others have not. In addition, officials from all four selected agencies said they primarily incorporate resilience information when constructing or repairing individual projects by using current design standards or assessing specific natural disaster risks. For example, according to officials from the U.S. Fish and Wildlife Service (FWS), a building at the McFaddin National Wildlife Refuge in Texas was able to sustain multiple hurricanes because it was rebuilt to exceed design standards.

#### Project at the McFaddin National Wildlife Refuge that Elevated Concrete Piers and Improved the Roof Design to Address Hurricane Risks



Source: The Department of the Interior's Fish and Wildlife Service. | GAO-21-596

GAO found that federal government-wide guidance and requirements on asset management direct agencies to address risks such as climate change but do not explicitly direct them to incorporate natural disaster resilience into asset management decisions. In particular, a January 2021 executive order requires agencies to develop a climate action plan describing their vulnerabilities. However, neither this order nor Office of Management and Budget's (OMB) guidance require agencies to use the information collected to make investment decisions. Accordingly, agencies with high exposure to future natural disasters may not proactively incorporate resilience into decisions when prioritizing investments across their portfolios. According to the International Organization for Standardization's standard on climate change and GAO's *Disaster Resilience Framework*, organizations should assess how they might be affected by climate change, including natural disasters, and apply that information to decision-making. Using information gathered from tools, such as vulnerability assessments, can help agencies determine if an investment in assets to enhance resilience could provide the most value to the agencies in meeting their missions when compared to other potential investments.

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## Abbreviations

Army Corps	U.S. Army Corps of Engineers
CESL	Comprehensive Evaluation of Projects with Respect to Sea Level Change
FCM	Federation of Canadian Municipalities
<i>Framework</i>	<i>Disaster Resilience Framework</i>
FRPP	Federal Real Property Profile Management System
FWS	Fish and Wildlife Service
GSA	General Services Administration
ISO	International Organization for Standardization
NIBS	National Institute of Building Sciences
NPS	National Park Service
OMB	Office of Management and Budget's
<i>Strategy</i>	<i>National Strategy for Efficient Use of Real Property</i>

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September 14, 2021

The Honorable Gary C. Peters  
Chairman

The Honorable Rob Portman  
Ranking Member  
Committee on Homeland Security and Governmental Affairs  
United States Senate

The Honorable Ron Johnson  
Ranking Member  
Permanent Subcommittee on Investigations  
Committee on Homeland Security and Governmental Affairs  
United States Senate

The Honorable Tom Carper  
United State Senate

Natural disasters such as hurricanes, sea level rise, and wildfires can expose federal real property assets—including office buildings, levees, roads, and bridges—to physical damage that can require substantial resources to repair or rebuild. In fact, over the past 5 fiscal years, Congress has appropriated billions of dollars to federal agencies to help repair assets following natural disasters. According to the National Oceanic and Atmospheric Administration, in 2020, the United States experienced 22 natural disaster events costing more than \$1 billion in damages, surpassing the previous record of 16 such events that occurred in 2011 and 2017.<sup>1</sup> For example, seven hurricanes or tropical storms that resulted in at least \$1 billion in damages made landfall in the United States in 2020, and the nation had a record-breaking wildfire season, which burned more than 10.2-million acres. The U.S. Global Change Research Program projects that disaster costs will likely increase as

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<sup>1</sup>National Oceanic and Atmospheric Administration, National Centers for Environmental Information, *Billion-Dollar Weather and Climate Disasters*, accessed May 25, 2021, <https://www.ncdc.noaa.gov/billions/>. The National Centers for Environmental Information used data from a variety of public and private sources to estimate the total costs of these events (i.e., the costs in terms of dollars that would not have been incurred had the event not taken place). Insured and uninsured losses are included in cost estimates and sources include the National Weather Service, the Federal Emergency Management Agency, U.S. Department of Agriculture, National Interagency Fire Center, and the U.S. Army Corps, among others. The estimates do not take into account losses to natural capital or assets, health care-related losses, or values associated with loss of life.

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certain extreme weather and climate-related events become more frequent and intense due to changes in the climate.<sup>2</sup> The rising number of these events and reliance on the federal government for assistance is a source of federal fiscal exposure. Accordingly, we designated *Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks* as a high-risk area in February 2013.<sup>3</sup>

Federal agencies have opportunities to enhance the resilience of their real property to natural disasters through asset management—the processes, procedures, and policies used to enable portfolio-wide decision-making.<sup>4</sup> We and other organizations, such as the National Academy of Engineering and the United Nations, have identified climate resilience as a promising avenue to reduce the costs of natural disasters and maximize the value of infrastructure investments.<sup>5</sup> Enhancing the natural disaster resilience of a portfolio of assets includes, for example, hazard mitigation (actions taken to lessen the impact of disasters) and climate adaptation (actions taken to address the actual and anticipated effects of climate change). You asked us to determine how agencies

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<sup>2</sup>D.R. Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.), U.S. Global Change Research Program, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, vol. 2 (Washington, D.C.: 2018). Under the Global Change Research Act of 1990, the U.S. Global Change Research Program coordinates and integrates global change research across 13 federal agencies. The Office of Science and Technology Policy within the Executive Office of the President oversees the Program.

<sup>3</sup>GAO, *High-Risk Series: An Update*, [GAO-13-283](#) (Washington, D.C.: Feb. 14, 2013). See also *High-Risk Series: Dedicated Leadership Needed to Address Limited Progress in Most High-Risk Areas*, [GAO-21-119SP](#) (Washington, D.C.: Mar. 2, 2021).

<sup>4</sup>In November 2018, we reported that asset management can help agencies optimize limited funding and target resources to achieve the most benefits for their missions, goals, and objectives. See GAO, *Federal Real Property Asset Management: Agencies Could Benefit from Additional Information on Leading Practices*, [GAO-19-57](#) (Washington D.C.: Nov. 5, 2018).

<sup>5</sup>By reducing asset vulnerabilities to climate impacts, governments can reduce the costs of disaster events, while also acquiring greater value from infrastructure investments. See GAO, *Disaster Resilience Framework: Principles for Analyzing Federal Efforts to Facilitate and Promote Resilience to Natural Disasters*, [GAO-20-100SP](#) (Washington, D.C.: Oct. 23, 2019). National Academy of Engineering, “Engineering for Disaster Resilience” *The Bridge: Linking Engineering and Society*; vol.49, No.2 (2019). United Nations, *Managing Infrastructure Assets for Sustainable Development: A handbook for local and national governments* (New York, United Nations, 2021). According to this 2021 United Nations report, the economic value of climate resilience can be significant.

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prevent or reduce damage to physical infrastructure caused by natural disasters. This report addresses:

- how selected agencies have incorporated natural disaster resilience into their assets, and
- the extent to which government-wide guidance directs federal agencies to incorporate natural disaster resilience into asset management.

To describe how selected agencies have incorporated natural disaster resilience into their assets, we reviewed documents (e.g., policies, plans, and guidance) and interviewed officials from the following four selected agencies: (1) the U.S. Army Corps of Engineers (Army Corps), (2) the General Services Administration (GSA), (3) the Department of the Interior's Fish and Wildlife Service (FWS), and (4) the Department of the Interior's National Park Service (NPS). To facilitate our analysis of the information we collected from these agencies, we selected three key characteristics of effective asset management from our November 2018 report. The three key characteristics we selected are establishing formal policies and plans, using quality data, and maximizing an asset portfolio's value.<sup>6</sup> We selected these characteristics because they are relevant to how agencies can incorporate natural disaster reliance into asset management. We also reviewed our October 2019 report that established a Disaster Resilience Framework to identify benefits that can be gained from incorporating natural disaster resilience into asset management.<sup>7</sup> This Framework established three broad principles that organizations can consider when analyzing potential opportunities to enhance natural

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<sup>6</sup>In our November 2018 report, we established six key characteristics for effective asset management. The key characteristics of effective asset management that we did not select for our review are: maintaining leadership support, promoting a collaborative organizational culture, and evaluating and improving asset management practices. We did not select these because they are not as relevant to how agencies incorporate natural disaster resilience into asset management. See [GAO-19-57](#).

<sup>7</sup>[GAO-20-100SP](#).

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disaster resilience.<sup>8</sup> We selected two of these principles to focus on for this review—the information principle (e.g., using reliable information) as well as the integration principle (e.g., integrating resilience into relevant federal efforts). We selected these two principles because they are relevant to asset management.

To select the four agencies, we analyzed real property data reported by agencies to GSA's fiscal year 2018 Federal Real Property Profile (FRPP) Management System.<sup>9</sup> Specifically, we analyzed FRPP data on the number of buildings and structures, the location of these assets, and the assets' replacement value. Based on our analysis, we selected the four agencies because they own a large number of buildings and structures, have assets located across the country, and have asset portfolios with high total replacement values. We used fiscal year 2019 FRPP data—the latest available when we wrote this report—to describe selected agencies' assets (i.e., number of buildings and structures, replacement value). We assessed the reliability of the fiscal year 2018 and 2019 FRPP data used for this review by reviewing documentation, interviewing GSA officials, and verifying data with officials from our selected agencies, and we concluded the data were sufficiently reliable for the purposes of selecting agencies for inclusion in our review and describing selected agencies' assets.

To gather illustrative examples from selected agencies on incorporating natural disaster resilience into their assets, we reviewed documents or interviewed agency officials from 12 construction, repair, or rehabilitation projects. See appendix I for the projects we selected. We selected projects that, according to agency annual budget documents or agency officials, were new construction or high-priority repair or rehabilitation projects in fiscal years 2018, 2019, or 2020 or, according to agency officials, received supplemental appropriations for disaster assistance at some point from fiscal years 2015 through 2019. While information we obtained from the selected agencies and projects is not generalizable to

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<sup>8</sup>The three principles are information (e.g., using reliable information), integration (e.g., integrating resilience into relevant federal efforts), and incentives (e.g., using incentives to promote investments in disaster risk reduction). We did not focus on the incentives principle because it is not directly relevant to asset management. The October 2019 report that established the Framework stated that some of the principles are likely to be more relevant in the analysis of certain federal efforts than others and that it is appropriate to apply the principles that are relevant to specific circumstances. See [GAO-20-100SP](#).

<sup>9</sup>The FRPP Management System is managed by GSA and is comprised of data on real property assets submitted annually by federal agencies.

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all federal agencies, it provides a range of examples of agencies' experiences with managing assets and natural disaster resilience.

To determine the extent to which government-wide guidance directs federal agencies to incorporate natural disaster resilience into asset management, we reviewed government-wide guidance and other federal requirements related to asset management or climate change, including the Office of Management and Budget's (OMB) *Capital Programming Guide*, OMB memos relevant to asset management, and current and previous executive orders that discuss climate change or asset management.<sup>10</sup> We also interviewed officials from GSA, OMB, and the Federal Real Property Council.<sup>11</sup> We compared the government-wide guidance to the International Organization for Standardization's (ISO) 14090 standard on climate change adaptation and our Disaster Resilience Framework.<sup>12</sup> We selected ISO 14090 because it is an internationally recognized standard that aligns to our selected three key characteristics of effective asset management. We selected specific practices within the standard. Specifically we focused on:

- embedding climate change adaptation into organization policies and plans
- assessing information to gain knowledge about climate effects, and
- considering climate change adaptation in investment decisions.

We also reviewed actions taken by Australia, Canada, and the Adaptation Climate Change Coordination Group in Europe, led by the Netherlands.

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<sup>10</sup>OMB, *Capital Programming Guide V 3.1 Supplement to OMB Circular A-11: Planning, Budgeting, and Acquisition of Capital Assets* (Washington, D.C.: 2020); OMB, *Implementation of Agency-wide Real Property Capital Planning*, Memorandum M-20-03 (Washington, D.C.: Nov. 6, 2019); OMB, *Issuance of An Addendum to the National Strategy for the Efficient Use of Real Property*, Memorandum M-20-10 (Washington, D.C.: Mar. 6, 2020); Exec. Order No. 13653, 78 Fed. Reg. 66,817 (Nov. 1, 2013); Exec. Order No. 13834, 83 Fed. Reg. 23,771 (May 17, 2018); Exec. Order No. 14008, 86 Fed. Reg. 7,619 (Jan. 27, 2021), Exec. Order No. 14030, 86 Fed. Reg. 27,967 (May 25, 2021)

<sup>11</sup>The Federal Real Property Council, chaired by OMB, develops guidance and shares leading practices in real property management among federal agencies.

<sup>12</sup>ISO, *ISO 14090 Adaptation to Climate Change—Principles, Requirements, and Guidelines* (Switzerland: 2019). The ISO is an international, independent, non-governmental organization with a membership of 165 national standards bodies, including the American National Standards Institute. According to ISO's website, ISO has published more than 23,000 international standards and additional documentation across almost every industry. See also [GAO-20-100SP](#).

We selected these countries because they are experienced with asset management, have similar climate risks to the United States, and have taken steps to incorporate natural disaster resilience into asset management nationwide. For more information on our scope and methodology, see appendix I.

We conducted this performance audit from January 2020 to September 2021 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

## Background

### Managing Federal Real Property Assets

The federal government is the largest real property owner in the United States and spends billions of dollars to operate and maintain its assets, which include buildings, structures, and flood control systems. Our four selected agencies own over 100,000 buildings and structures across the country, ranging from harbors to visitor centers to offices, some of which are in areas that could be significantly affected by natural disasters. For example, the Army Corps manages flood control and navigation assets, such as levees and dikes, which have been susceptible to hurricanes and other flooding risks, while NPS manages national parks, such as Yellowstone and Yosemite, which are located in fire-prone areas. See table 1 for more information on their asset portfolios.

**Table 1: Summary of Fiscal Year 2019 Real Property Asset Portfolios of Four Selected Federal Agencies**

Agency	Total Number of Owned Buildings	Total Number of Owned Structures	Total Replacement Value of Owned Buildings and Structures (dollars in billions)	Examples of Owned Buildings or Structures
U.S. Army Corps of Engineers	797	3,721	5.5	Flood control and navigation structures
Fish and Wildlife Service	6,316	35,793	36.5	Levees, fish hatcheries, dams
General Services Administration	1,567	202	90	Offices, warehouses, and parking structures
National Park Service	26,620	36,408	125	Housing, visitor centers, monuments and memorials

Source: GAO analysis of agency documentation and fiscal year 2019 Federal Real Property Profile data. | GAO-21-596

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Each federal agency is responsible for managing the assets it owns, both individually and as a portfolio. The management of individual assets focuses on the lifecycle activities of a building or structure, such as its design, performance, and maintenance. Asset management, on the other hand, is a broader, more strategic focus on a portfolio of assets. According to ISO, asset management is the coordinated activity of an organization to realize value from its assets. For the purposes of our report, we define asset management as the processes, procedures, support systems, organizational roles and responsibilities, and policies used to enable portfolio-wide asset management decision-making. Asset management practices may include, for example, developing an understanding of how each of an organization's assets contributes to its success; managing and investing in those assets in such a way as to maximize that success; and fostering a culture of effective decision making through leadership support, policy development, and staff training. Further, asset management practices should continually evolve to match each agency's organizational objectives and changing asset portfolio. This evolution could include, for example, matching an organization's objectives to address climate risks and improve resilience to natural disasters.

A number of standards and leading practices exist to guide organizations in developing effective asset management practices. For example, the ISO 55000 standards—an international consensus standard on asset management—identifies key asset management practices, and the ISO 14090 standard outlines climate adaptation approaches.<sup>13</sup> Within the federal government's executive branch, OMB is responsible for providing leadership in managing assets and has provided direction to federal agencies by issuing various government-wide policies, guidance, and memorandums related to asset management.<sup>14</sup> For example, OMB's *Capital Programming Guide* outlines a capital planning process, including how agencies should effectively and collectively manage a portfolio of

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<sup>13</sup>ISO, *ISO 55000 Asset Management—Overview Principles and Terminology* (Switzerland: 2014). ISO 55000 consists of three separate standards. For the purposes of this report, we refer to the three standards collectively as ISO 55000.

<sup>14</sup>GSA's Office of Government-wide Policy also provides leadership in managing assets by identifying, evaluating, and promoting best practices to improve the efficiency of real property management processes. This office has provided guidance for federal agencies and published performance measures.

capital assets and requirements for agencies' strategic asset management plans.

## GAO's Key Characteristics of Effective Asset Management

In November 2018, we identified six key characteristics of effective asset management.<sup>15</sup> We developed these characteristics based on a review of the ISO 55000 standards, asset management literature, and interviews with experts. We reviewed six federal agencies in 2019 and found that each had a real property asset management framework that reflected some of the six characteristics.<sup>16</sup> However, we found that the agencies varied in how they performed activities in these areas. In that report, we recommended that OMB take steps to improve existing information on federal asset management to reflect leading practices such as those described in ISO 55000 and the key characteristics we identified.<sup>17</sup> Three of the six characteristics—establishing formal policies and plans, using quality data, and maximizing an asset portfolio's value—are relevant to how agencies can incorporate natural disaster resilience into asset management. See table 2 for a description of these three characteristics and the benefits of adopting them.

**Table 2: Selected Characteristics of Effective Asset Management**

Characteristic	Description	Benefit
<b>Establishing Formal Policies and Plans</b>	Organizations should have a clearly defined governance regime that includes a strategic asset management plan that ties to the organization's mission and strategic objectives, defines the asset management scope, and defines the roles and responsibilities for each part of the organization.	It can help agencies utilize their assets to support their missions and objectives.
<b>Using Quality Data</b>	Organizations should collect, analyze, and verify accuracy of asset data, including the organizations inventory of assets and data on each asset's condition, age, maintenance cost, and criticality to the organizations.	It can help agencies ensure that they get the most value from their assets.
<b>Maximizing an Asset Portfolio's Value.</b>	Organizations should develop an asset management policy to identify the value of their assets to achieve their mission and strategic objectives, and invest in those assets in such a way as to derive the greatest value from them.	It can help can help agencies better target resources toward assets that will provide the greatest value to them in meeting its missions.

Source: GAO-21-596.

<sup>15</sup>GAO-19-57. The six characteristics include: (1) establishing formal policies and plans, (2) maximizing an asset portfolio's value, (3) maintaining leadership support, (4) using quality data, (5) promoting a collaborative organizational culture, and (6) evaluating and improving asset management practices.

<sup>16</sup>In 2019, we reviewed the asset management practices of the Forest Service, GSA, Army Corps, NPS, and the National Aeronautics and Space Administration.

<sup>17</sup>As of June 2021, this recommendation remains open pending further action from OMB.

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Note: That Disaster Resilience Framework also includes an additional principle—incentives (e.g. using incentives to promote investments in disaster risk reduction). We did not focus on this principle because it is not directly relevant to asset management

We also found that asset management experts and practitioners cited additional benefits of adopting practices derived from these characteristics including: (1) improved data and information about assets, (2) better-informed decisions, and (3) financial benefits, such as cost avoidance and better management of financial resources.

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## U.S. Natural Disaster Risks and Related Impacts

According to the U.S. Global Change Research Program, climate change poses serious risks to many of the United States' environmental and economic systems, although its implications cannot be predicted with certainty.<sup>18</sup> In the United States, for example, high temperature extremes, heavy precipitation events, high-tide flooding events along the coastline, ocean acidification and warming, and forest fires in the western United States and Alaska have been and are all projected to continue increasing. In contrast, land and sea ice cover, snowpack, and surface soil moisture have been and are expected to continue declining in the coming decades. Climate change is also altering the characteristics of many extreme weather and climate-related events, according to the *Fourth National Climate Change Assessment*. Some of these events have already become more frequent, intense, widespread, or of longer duration, and many are expected to continue to worsen. According to the U.S. Global Change Research Program, future climate risks are subject to several sources of uncertainty. For example, climate scientists find varying ranges of uncertainty in many areas, including observations of climate variables and the analysis and interpretation of those measurements, in part, because the factors that may contribute to future climate risks (e.g. economic, political, and demographic factors) can be difficult to predict with confidence far into the future.

As we reported in October 2019, the cost of recent disasters to federal real property assets has illustrated the need to plan for natural disaster and extreme weather risks and invest in natural disaster resilience.<sup>19</sup>

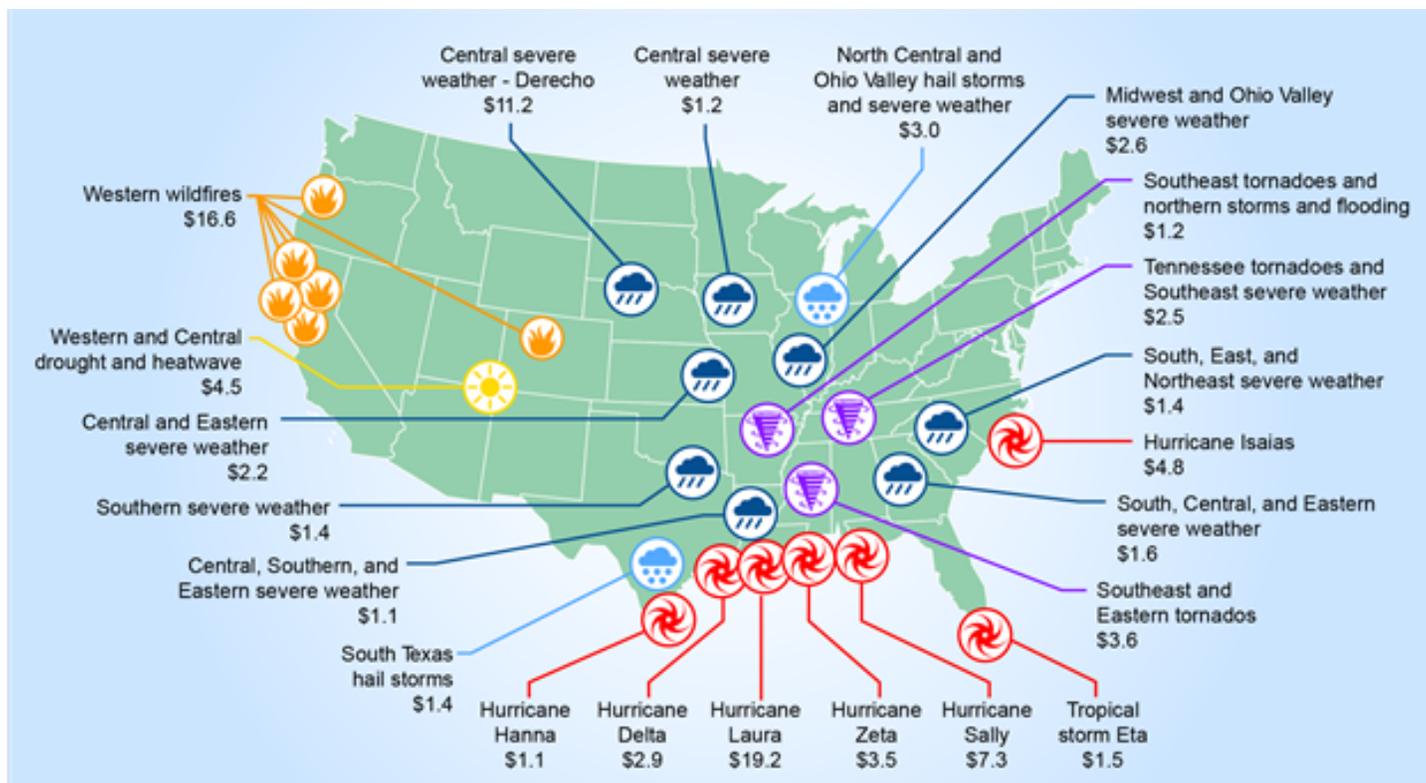
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<sup>18</sup>Alexa Jay et al., "Overview," in *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, vol. 2 (Washington, D.C.: U.S. Global Change Research Program. November 2018).

<sup>19</sup>GAO, *Climate Resilience: A Strategic Investment Approach for High-Priority Projects Could Help Target Federal Resources*, [GAO-20-127](#), (Washington, D.C.: Oct. 23, 2019).

According to the National Oceanic and Atmospheric Administration, calendar year 2020 was the sixth consecutive year in which the U.S. experienced 10 or more weather and climate disaster events each costing more than \$1 billion in overall damages (i.e. an estimation of costs that reflect direct effects of weather and climate events, not including indirect effects, and constitute total losses, both insured and uninsured).<sup>20</sup> More specifically, in 2020, the United States experienced 22 such natural disasters, costing about \$95 billion (see figure 1). From 2016 to 2020, the cost of such disasters in the United States averaged \$123.3 billion each year.

**Figure 1: Weather and Climate Disaster Events in the United States in 2020 Costing More Than \$1 Billion in Damages (Dollars in Billions)**



Source: National Oceanic and Atmospheric Administration's National Centers for Environmental Information. | GAO-21-596

<sup>20</sup>NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2021). <https://www.ncdc.noaa.gov/billions/>, DOI: 10.25921/stkw-7w73 and Smith, A.B., Katz, R.W. US billion-dollar weather and climate disasters: data sources, trends, accuracy and biases. *Nat Hazards* 67, 387-410 (2013). <https://doi.org/10.1007/s11069-013-0566-5>

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Note: The National Centers for Environmental Information used data from a variety of public and private sources, such as the National Weather Service or Federal Emergency Management Agency, to estimate the total costs of these events (i.e., the costs in terms of dollars that would not have been incurred had the event not taken place). Insured and uninsured losses are included in cost estimates. The estimates do not take into account losses to natural capital or assets, health care-related losses, or values associated with loss of life.

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## Enhancing Natural Disaster Resilience of Real Property Assets

After certain natural disasters in the past, Congress has provided supplemental appropriations to help agencies rebuild or recover. We reported in 2019 that most of the federal government's efforts to reduce disaster risk were reactive and that many revolved around disaster recovery. We found in 2015 that the federal government has primarily funded disaster resilience projects in the wake of disasters—when damages have already occurred and opportunities to pursue future risk reduction may conflict with the desire for the immediate restoration of critical infrastructure.<sup>21</sup> Years later, in the wake of Hurricanes Harvey, Irma, and Maria, Congress appropriated supplemental funds so agencies could address the necessary expenses related to the consequences from those disasters. As part of those appropriations, FWS and NPS received over \$200 million each for construction expenses. In 2019, we found that the federal government does not have a strategic federal approach for investing in the highest priority climate-resilience projects.<sup>22</sup>

We have also reported that the federal government invests in activities to reduce risks not associated with a specific, recent disaster. For example, in April 2018 we found that since 1993, OMB reported more than \$154 billion in funding across the government for federal activities to understand and address climate change.<sup>23</sup> Disaster-resilient assets—those able to accommodate or quickly recover from disruptions caused by extreme weather events—can reduce potential physical damages, and thus, may also reduce future needs for Congress to appropriate

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<sup>21</sup>GAO, *Hurricane Sandy: An Investment Strategy Could Help the Federal Government Enhance National Resilience for Future Disasters*, [GAO-15-515](#) (Washington, D.C.: July 30, 2015).

<sup>22</sup>[GAO-20-127](#).

<sup>23</sup>OMB has reported federal climate change funding in three main categories since 1993 to 2017—clean energy technology to reduce emissions; science to better understand climate change; and international assistance for adaptation, clean energy, and sustainable landscapes. According to our findings in 2018, most federal funding since 1993 has been dedicated to technology efforts. See GAO, *Climate Change: Analysis of Reported Federal Funding*, [GAO-18-223](#) (Washington, D.C.: Apr. 30, 2018).

supplemental funds. A 2018 study by the National Institute of Building Sciences (NIBS) concluded that disaster resilience investments could save from \$3 to \$11 per dollar invested, depending on the circumstances and type of disaster.<sup>24</sup>

## GAO’s Disaster Resilience Framework

In October 2019, we issued the Disaster Resilience Framework to serve as a guide for federal actions to facilitate and promote resilience to natural disasters. The framework is organized around three broad overlapping principles for those who provide oversight or management to consider when analyzing potential opportunities to enhance resilience.<sup>25</sup> Two of the principles—using reliable information and integrating resilience into relevant federal efforts—are the most relevant to asset management. For example, the principle of information promotes the use of accurate and comprehensive natural disaster risk data that can help decision makers understand the extent of their risks (see table 3). In the context of asset management, generating such information could help inform asset investment decisions. For more information on the Framework, see appendix II.

**Table 3: Selected Principles from GAO’s Disaster Resilience Framework Relevant to Asset Management**

Principle	Description	Selected Examples
Information	Accessing information to help decision-makers identify current and future risks and the effects of potential risk reduction strategies.	<ul style="list-style-type: none"> <li>Enhance the reliability of disaster risk information produced.</li> <li>Generate and share additional information that would help decision makers understand their disaster risk.</li> <li>Help decision makers identify and select among disaster risk reduction alternatives.</li> </ul>
Integration	Integrating analysis and planning to help decision-makers take coherent and coordinated resilience actions	<ul style="list-style-type: none"> <li>Establish overarching strategies that guide resilience efforts.</li> <li>Ensure that resilience goals are incorporated into relevant strategies.</li> <li>Prioritize resilience goals that reflect the most pressing resilience challenges.</li> </ul>

Source: GAO-20-100SP. | GAO-21-596.

<sup>24</sup>Multihazard Mitigation Council, National Institute of Building Sciences, *Natural Hazard Mitigation Saves: 2018 Interim Report* (Washington, D.C.: December 2018).

<sup>25</sup>The three principles are information (e.g., using reliable information), integration (e.g., integrating resilience into relevant federal efforts), and incentives (e.g. using incentives to promote investments in disaster risk reduction). We did not focus on the incentives principle because it is not directly relevant to asset management. In our October 2019 report that established the Framework, we stated that some of the principles are likely to be more relevant in the analysis of certain federal efforts than others and that it is appropriate to apply the principles that are relevant to specific circumstances. See [GAO-20-100SP](#).

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Note: That the Disaster Resilience Framework also includes an additional principle—using incentives to promote investments in disaster risk reduction. We did not focus on this principle because it is not directly relevant to asset management.

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## Selected Agencies Incorporated Some Natural Disaster Resilience into Individual Projects and Their Asset Management Programs

In our review of selected agencies' asset management programs both individually and as a portfolio, we found that the four selected agencies incorporated natural disaster resilience on a project by a project basis, such as when constructing a new asset. In addition to the efforts to incorporate natural disaster resilience within individual projects, our selected agencies had undertaken, or planned to take, some actions to incorporate natural disaster resilience into their broader asset management.

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## Selected Agencies Incorporated Natural Disaster Resilience into Individual Projects by Using Design Standards and Assessing Natural Disaster Risks

Officials from the four selected agencies told us they incorporated natural disaster resilience through the management of individual projects. Specifically, they incorporated natural disaster resilience into individual projects in two ways: by using applicable design standards and building codes, and by assessing natural disaster risks. Officials we spoke with said that these efforts have helped them address natural disaster risks to individual projects.

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## Incorporating Natural Disaster Resilience into Individual Projects by Using Design Standards and Building Codes

Officials from all four selected agencies told us they make individual projects more resilient to natural disasters by using applicable and current design standards and building codes in their new construction and repair projects.<sup>26</sup> For example, standards that GSA developed for new federal facility construction, major repair, and alteration projects have design and construction requirements that aim to ensure that the structures of a facility resist natural hazards such as earthquakes and floods.<sup>27</sup> Building

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<sup>26</sup>Design standards and building codes aim to promote the safety, reliability, productivity, and efficiency of infrastructure.

<sup>27</sup>GSA, *Facilities Standards for the Public Buildings Service*, PBS-P100 (Washington, D.C.: July 2018). In addition to new construction, major repairs, and alterations of federal facilities, the standards are also applicable to lease construction facilities that the federal government intends to own or has an option to purchase.

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codes developed by standards-setting organizations may ensure that exterior walls and roofs include flashing and drainage so that they are resistant to the weather.<sup>28</sup> Officials from FWS and NPS told us that standards and codes have had a role in addressing future fiscal risk from weather events. However, as discussed further below, the standards and codes may not be fully effective in helping agencies anticipate extreme weather or changes in climate condition.

**McFaddin National Wildlife Refuge Facility  
Designed to Withstand Hurricane Winds  
and Storm Surge**

In September 2008, Hurricane Ike flooded a national wildlife refuge in Texas with more than 15 feet of storm surge and significantly damaged refuge facilities. To help rehabilitate the refuge, officials from the U.S. Fish and Wildlife Service (FWS) said they used supplemental disaster assistance to relocate an office in the refuge to higher ground. FWS officials said they also reconstructed the office on elevated concrete piers, which exceeded design standards, and installed a durable roof. FWS officials said the new office has sustained three hurricanes and five tropical storms without damage.



Source: The Department of the Interior's Fish and Wildlife Service. | GAO-21-596

Officials from all four selected agencies told us they can exceed design standards and building codes for individual projects based on the project team's professional judgment regarding natural disaster risks. For example, GSA officials from a recently started laboratory construction project in Colorado said that in the project's planning phase, an architect and engineer will assess climate risks, including hail events, which are anticipated to grow in intensity in the Denver area. Based on this information, officials said they may decide to use construction materials above the industry standard to protect the building. Similarly, NPS officials said that they have sometimes exceeded design standards by using concrete instead of wooden framing to help withstand hurricanes. Officials from GSA and NPS noted, however, that it can be difficult to exceed minimum standards since such improvements must compete for limited funding with other project priorities, such as life safety and physical security. An official from the Army Corps also noted that it can be difficult to exceed design standards without a clear return-on-investment in the context of a project's overall costs and benefits. Another Army Corps official said that it is difficult for project designers to obtain approval for the additional costs associated with exceeding design standards when natural disaster risks, such as the projected extent of sea level rise, are uncertain.

While federal agencies' use of design standards and building codes can help make individual projects more resilient to natural disasters, our November 2016 report found that the standards and codes are based on climate information from historical observations, not forward-looking

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<sup>28</sup>Standards-developing organizations, such as professional engineering societies and trade associations within the construction industry, are organizations that issue design standards and building codes.

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climate information such as projections.<sup>29</sup> Thus, the standards and codes may not be fully effective in helping agencies anticipate extreme weather or changes in climate conditions. Organizations that develop standards and codes generally incorporate climate information from historical observations in design standards and building codes.<sup>30</sup> This information can include average seasonal temperatures or expected precipitation rates for particular areas that could be relevant in the selection of materials or construction techniques. However, in November 2016, we found that selected standards-developing organizations generally did not use forward-looking climate information—such as projected rainfall rates—in design standards and building codes. Reports we reviewed and representatives of standards-developing organizations and federal officials we interviewed for the 2016 report identified challenges to using the best available forward-looking climate information in design standards and building codes, such as difficulty in identifying such information. Using the best available climate information, including forward-looking information, can help support risk-based decisions and investments. We recommended that the Department of Commerce take action to help standards-developing organizations consider such information.<sup>31</sup>

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<sup>29</sup>GAO, *Climate Change: Improved Federal Coordination Could Facilitate Use of Forward-Looking Climate Information in Design Standards, Building Codes, and Certifications*, [GAO-17-3](#) (Washington, D.C.: Nov. 30, 2016). The U.S. Global Change Research Program has noted that while uncertainties limit scientists' ability to predict the future changes in climate, scientists can develop plausible climate projections of what might happen under a given set of assumptions, such as population, energy sources, technology, and atmospheric levels of carbon dioxide. For example, climate models can provide a wide range of possible temperatures. See Jerry M. Melillo, Terese (T.C.) Richmond, and Gary W. Yohe, Eds., U.S. Global Change Research Program, *Climate Change Impacts in the United States: The Third National Climate Assessment* (Washington, D.C.: October 2014).

<sup>30</sup>Standards-developing organizations, such as the International Code Council and the American Society of Civil Engineers, develop certain design standards and building codes through a formal, consensus-based process. The climate information used in some standards and codes can be based on historical observations of climate conditions as well as forward-looking projections of what climate change may mean for local areas, such as how increased flow for a particular river may increase flooding.

<sup>31</sup>[GAO-17-3](#). The Secretary of Commerce is responsible for coordinating and fostering executive branch implementation of a policy on federal participation in the development of voluntary consensus standards, including design standards and building codes. We recommended that the Secretary of Commerce coordinate a government-wide effort to provide the best available forward-looking climate information to standards-developing organizations for their consideration in the development of design standards and building codes. As of April 2021, the Secretary of Commerce has not taken this action.

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## Incorporating Natural Disaster Resilience into Individual Projects by Assessing Natural Disaster Risk

Three of the four selected agencies—GSA, NPS, and the Army Corps—have developed tools to assess some natural disaster risks for individual projects to help them determine how to design those projects and address the risks. In June 2019, we and others have reported that assessing natural disaster risks—and then developing actions to address them—can help agencies reduce the exposure of the facilities to greater than anticipated damage or degradation as a result of extreme weather events or climate change effects.<sup>32</sup> For example:

GSA developed a tool that profiles observed and projected changes in climate to help the agency’s project teams determine mid-term to long-term risks over a project’s intended useful life. According to GSA officials, a climate profile is developed for each project that the agency either deems mission critical, has an intended service life of over 30 years, or has an historic or cultural status.<sup>33</sup> The profile identifies, for example, the effects of existing extreme weather and the plausible range of projected changes in precipitation and temperature conditions. According to a GSA official familiar with the agency’s natural disaster resilience efforts, projections can help the agency understand the exposure of an asset to potential changes in climate and the asset’s ability to withstand changing weather conditions. Project managers may use the climate profile to help determine a project’s location or facility design. Such determinations are made in the context of budget limitations and competing priorities, according to GSA officials. For example, GSA officials told us they undertook a project to repair the Alton Lennon Federal Building and U.S. Courthouse in North Carolina after substantial damage by Hurricane Florence in September 2018. According to the officials, while the focus of the project is to restore the building to existing conditions, some aspects of the project will also improve the resilience of the building to natural disasters. For example, upgrading the building’s roof and windows will improve the resilience of the building to natural disasters. Natural disasters that might affect the building include, according to GSA’s climate profile, hurricanes and associated precipitation. GSA officials said

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<sup>32</sup>GAO, *Climate Resilience: DOD Needs to Assess Risk and Provide Guidance on Use of Climate Projections in Installation Master Plans and Facilities Designs*, [GAO-19-453](#) (Washington D.C.: June 12, 2019).

<sup>33</sup>In fiscal year 2020, GSA developed seven new climate profiles for proposed capital projects, according to a GSA official familiar with the agency’s natural disaster resilience efforts. This official said that the number of profiles developed each fiscal year fluctuates based on the number of projects in GSA’s capital program.

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that the team is limited in its ability to enhance the building's resilience to natural disasters due to certain funding limitations.

**Mammoth Hotel Rehabilitation Project at Yellowstone National Park to Improve Earthquake Resistance**

A National Park Service (NPS) project team used the agency's natural hazard checklist to determine whether some natural disaster risks were applicable to a hotel rehabilitation project at a national park in Wyoming. The team found several applicable risks, including stronger earthquakes, wildfires, and heavy snow loads. As a result, NPS incorporated some structural upgrades to the facility during construction, such as adding new plywood to the floors to provide more resistance in an earthquake.



Source: The Department of the Interior's National Park Service. | GAO-21-596

NPS developed a checklist of natural hazards to help managers determine whether some natural disaster risks (e.g., coastal storm surge, wildfires, and tornadoes) are applicable to the planning and design of new construction or major rehabilitation projects. For example, NPS used this tool to help identify natural disaster risks applicable to the Mammoth Hotel at Yellowstone National Park in Wyoming. NPS made structural changes to address some of the identified risks (see sidebar). For another project, NPS rehabilitated the roof at the Jefferson Memorial in Washington D.C. to address damage caused by water leaking from the roof into the interior of the memorial. As a part of this project, NPS officials said they used the agency's natural hazard checklist to determine whether certain natural disaster risks were applicable to the project. The team found several applicable risks, including hurricanes and flooding. To help ensure the memorial roof could better withstand precipitation and to improve water drainage, NPS made changes to the memorial's roof and drainage system. See figure 2. Although project managers should use the tool to assess risks, according to NPS officials, they may not be able to pursue specific mitigation strategies based on their findings given competing priorities.

**Figure 2: Project at the Jefferson Memorial That Sealed Roof Tiles, Added Drains, and Installed Pipes (left to right) to Address Precipitation Risks**



Source: GAO. | GAO-21-596

Note: These photos were taken from the roof of the Jefferson Memorial during the rehabilitation project that consisted of replacing the roofs that circle the dome to keep the building watertight and dry. Additionally, the large marble “tiles” covering the portico, the front entry that projects towards the Tidal Basin, was lifted to replace the deteriorated waterproofing below. Improvements to roof drains, downspouts, and gutters were also completed, some of these improvements are shown above.

The Army Corps has also developed tools that it and other agencies can use to address natural disaster risks. For example, in 2018, it publicly released its Sea Level Tracker, which enables users to visualize changes in mean sea level and other relevant tidal statistics. Where sea level is a concern, Army Corps guidance requires an analysis and consideration of the effects of a range of potential rates of sea level rise to inform project design decisions. GSA officials also said managers use the Sea Level Tracker and other tools to help reduce flood-related risks for some projects. A GSA official noted that using such tools helps GSA consider future natural disaster risks.

## Selected Agencies Have Taken Some Actions to Incorporate Natural Disaster Resilience into Asset Management

In our review of selected agencies’ broader asset management, we found that they had taken some actions to incorporate natural disaster resilience into key characteristics for asset management—such actions as establishing policies and plans, using quality data, and maximizing an

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## Incorporating Natural Disaster Resilience when Establishing Policies and Plans

asset portfolio's value.<sup>34</sup> Agencies' actions varied, however. For example, NPS and the Army Corps have conducted vulnerability assessments on certain natural disaster risks over the last 5 years while GSA and FWS are currently exploring the possibility of collecting data on such risks. In addition, when prioritizing potential asset investments that would provide the maximum value across their portfolios, officials at all four selected agencies told us they face other priorities that can limit their ability to allocate resources to projects that address future natural disaster risks or climate trends.

In our review of selected agencies' policies and plans related to asset management, we found that three of the four selected agencies—NPS, GSA, and the Army Corps—had established documentation to guide portfolio-wide natural disaster resilience efforts. FWS officials told us they had not yet established such documentation but may do so in the future. Establishing policies and plans, such as asset management plans, investment strategies, or technical orders can help agencies take a more strategic approach to managing their asset portfolios.<sup>35</sup> Further, our Disaster Resilience Framework states that planning can help decision makers take coherent and coordinated resilience actions.<sup>36</sup> We found that the policies and plans used to guide our selected agencies' natural disaster resilience efforts covered areas such as direction to key decision-makers, potential informational resources, and procedures to identify and assess natural disaster risks. For example:

- **NPS:** In 2015, NPS published a memorandum to guide park management in the face of significant risks from climate change and other natural disasters. More specifically, it provided guidance on how facilities can incorporate the effects of climate change and other natural disaster risks when making decisions at national parks. The memorandum also directed managers to proactively identify and document facility vulnerabilities to climate change and other natural disaster risks. In addition, in 2021, NPS released its *Planning for a Changing Climate* guide. The guide is intended to assist park planners and managers in addressing climate change and associated hazards in plans for infrastructure and facilities.

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<sup>34</sup>[GAO-19-57](#).

<sup>35</sup>See Table 2 in this report. Establishing policies and plans is one of the six key characteristics for effective asset management identified in [GAO-19-57](#).

<sup>36</sup>See Table 3 in this report. Planning is part of the principle of integration identified in [GAO-20-100SP](#).

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- **GSA:** As part of its fiscal year 2022 Capital Investment and Leasing Program guidance, GSA highlighted enhancing resilience and reducing vulnerabilities to observed and expected changes in extreme weather as a requirement for certain assets. Beginning in fiscal year 2022, GSA’s regional offices must determine a common understanding of the extreme weather and incremental climate-related risks for the lifetime of a project. In addition, the guidance identifies a number of resources to help determine applicable risks and address identified vulnerabilities.<sup>37</sup>
  - **Army Corps:** In 2015, the Army Corps established a Resilience Initiative to guide how the agency can improve its support of community resilience and provide a framework for improving the contributions to resilience that the Army Corps delivers. Since then, the Army Corps has incorporated natural disaster resilience into a variety of policies and plans. Examples include guidance on engineering regulations, a risk assessment for flood management, and procedures to evaluate sea level change. Further, according to Army Corps officials, they are in the process of developing a Strategic Asset Management Plan to align with ISO 55000 standard on asset management practices. As of August 2021, the plan was undergoing internal review before its issuance.
  - **FWS:** According to agency officials, while FWS does not have explicit guidance to address climate change or natural disasters as part of its asset management, it is currently in the process of developing such guidance. These officials also told us they use the Department of the Interior’s Planning Guidelines—budget guidance for deferred maintenance and capital planning. That guidance states that bureaus must consider natural hazard risks and resilience in procurement, acquisition, real property, or leasing decisions. FWS officials also told us the agency may develop guidance in the future to address climate change and other natural disaster risks once it has a better understanding of the applicable risks to certain assets, although there are no timeframes for developing this guidance.

## Incorporating Natural Disaster Resilience when Using Quality Data

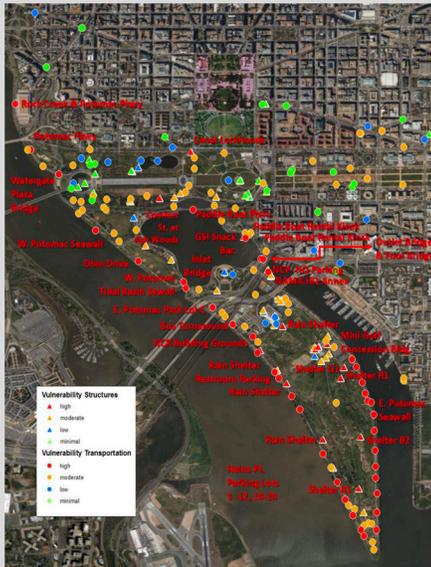
In our review of selected agencies’ use of natural disaster risk data, we found that NPS and the Army Corps have begun collecting applicable natural disaster risk and climatic data that can help them evaluate and

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<sup>37</sup>Resources identified include Volume I: Climate Science Special Report (CSSR) of the Fourth National Climate Assessment issued (November 2017) and Volume II: Impacts, Risks, and Adaptation in the United States (November 2018), among others.

**National Mall and Memorial Parks Coastal Hazards and Climate Change Vulnerability Assessment**

In April 2017, a National Park Service (NPS) project team in coordination with Western Carolina University assessed the coastal hazards and vulnerabilities of over 200 assets (buildings, shelters, and transportation assets such as parking lots and trails/walkways) located within or around the National Mall. The total replacement value for the National Mall and Memorial Parks is estimated at over \$6 billion. The assessment found that about half of the assets had moderate exposure to coastal hazards and sea level rise and about another quarter of the assets had a high exposure. In total, the high vulnerability assets have a combined current replacement value of \$388 million, based on NPS’s internal facilities management system. Based on this assessment, officials were able to determine that only one structure had both a high vulnerability and a high criticality to the park.



Source: The Department of the Interior’s National Park Service. | GAO-21-596

make decisions about their asset portfolios while GSA and FWS are exploring potential data collection avenues. Using quality information—such as condition, age, and criticality to the organization—when making decisions about assets can help agencies ensure that they get the most value from their assets.<sup>38</sup> Further, the *Disaster Resilience Framework* states that having reliable and authoritative information about current and future risks can help decision-makers to better assess their risks.<sup>39</sup> Natural disaster risk and climatic trend data can consist of identifying and assessing potential changes to temperature, precipitation, sea level, and freeze–thaw cycles, amongst others. We found some of our selected agencies collected such information, although they generally did not use

<sup>38</sup>See Table 2 in this report. Using quality data is one of the six key characteristics for effective asset management identified in [GAO-19-57](#).

<sup>39</sup>See Table 3 in this report. Information about current and future risks is part of the information principle identified in [GAO-20-100SP](#).

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this data to drive investment decision making across their portfolios, as discussed below.<sup>40</sup> For example:

- **NPS:** Over the past several years, NPS has conducted vulnerability assessments to assess the effects of storm surge and sea level rise for its coastal parks. More specifically, NPS partnered with Western Carolina University to create a Coastal Hazards and Sea-level Rise Asset Vulnerability Assessment Protocol, which establishes a standard methodology and set of best practices for conducting vulnerability assessments for coastal facilities. These assessments allow managers to compare the vulnerability of coastal park's assets across local, regional, and national levels. According to agency officials, as of April 2021, NPS has assessed the exposure of approximately 100 parks to the risk of rising sea levels and 79 parks for storm surge vulnerabilities.
- **Army Corps:** In September 2014, the Army Corps completed its first phase of its Comprehensive Evaluation of Projects with Respect to Sea Level Change (CESL) vulnerability assessment. This assessment determined the effect of sea level change at the 50- and 100-year planning horizons for certain coastal projects. The purpose of this assessment was to conduct a series of progressively more detailed screening-level assessments of the vulnerability of the Army Corps projects to the effects of changing sea levels. This process will identify projects that require more detailed analyses and those which will require adaptation sooner. According to the preliminary results from the first phase, out of the 1,500 projects assessed, about 500 projects were considered to be affected by sea level change—25 percent of which were classified as potentially having high or very high risks.
- **GSA:** According to GSA officials, the agency is exploring the possibility of incorporating additional risk information, such as flooding, in its Building Assessment Tool Survey. In November 2018, we reported that GSA, as part of its asset management program, uses this tool to assess the overall condition of the agency's assets and what investments the agency may need to make. GSA then uses the data collected from the survey, conducted every 2 years, to calculate a Facility Condition Index, which is the asset's current needs divided by its replacement value. However, according to GSA officials, as of

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<sup>40</sup>NPS uses this data, in part, to create Climate Change Summary Reports for facility planning at its national parks. For example, at the Everglades National Park, NPS identified hotter air temperatures and altered patterns and changing humidity, and increased extreme precipitation, among others risks, that are likely to affect park facilities.

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Incorporating Natural Disaster Resilience when Maximizing an Asset Portfolio's Value

March 2021, no decisions to include natural and climate disaster risk information have been made.

- **FWS:** According to FWS officials, the agency is in the preliminary stages of developing a pilot program to identify climate change risks at ravine and coastal field station facilities. The officials said they plan to conduct flooding vulnerability assessments at approximately three to five facilities. No field stations had been selected as of March 2021, and no timeframes have been established, but officials said these assessments may be able to inform future agency guidance on addressing climate change and other natural disasters.

In our review of selected agencies' processes for prioritizing asset investments, we found the agencies all had documentation describing a scoring process for prioritizing projects. These processes are based on criteria, such as asset condition, cost, or criticality to the mission. Generally, they do not include potential effects of natural disasters and climatic trends. Prioritizing investments can help agencies better allocate resources toward assets that will provide the greatest value to the agency in meeting its mission and objectives.<sup>41</sup> Additionally, the Disaster Resilience Framework further states that understanding the value of risk-reduction investments can assist decision-makers in identifying and selecting among investment opportunities.<sup>42</sup>

When prioritizing asset investments, our selected agencies generally allocate resources to mission priorities such as deferred maintenance. For example:

- **Army Corps:** Army Corps guidance states that the agency approves projects based on a portfolio-wide comparison of scores, in which the agency considers the condition of the asset and the consequences to the agency's mission if a failure were to occur.
- **FWS and NPS:** Both agencies within the Department of the Interior, according to departmental guidance, rank and score potential projects based, in part, on asset conditions, criticality, and agency investment strategies that generally give the highest scores and consideration to

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<sup>41</sup>See table 2 in this report. Maximizing value is one of the six key characteristics for effective asset management identified in [GAO-19-57](#).

<sup>42</sup>See table 3 in this report. Understanding the value of risk-reduction strategies is part of the information principle identified in [GAO-20-100SP](#).

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projects that manage deferred maintenance to prevent further deterioration.

- **GSA:** Proposed GSA projects, according to its guidance, should include opportunities where investment can be used to achieve long-term savings. Space optimization and other cost saving projects with significant financial return on investment, such as those that can reduce lease costs, are to be prioritized by central office evaluations.

All four selected agencies have taken steps to address natural disaster resilience. Officials from each agency said they had not yet incorporated information on resilience into their portfolio investment decisions. For example, one agency stated that congressional supplemental funds reduce the incentive for agencies to invest additional funds in resilience efforts. FWS also stated that agencies should be highly encouraged to pursue resilience investments with the greatest return. The work that the Army Corps and NPS have conducted on assessments that identify assets vulnerable to expected changes in extreme weather and climatic trends is key to informing how to allocate resources to provide the most value to the agency in meeting their missions and objectives. An Army Corps official who is responsible for asset management stated that natural disaster resilience investments can provide value in meeting their mission due to the potential to (1) limit the consequences of future natural disasters, including costs, and (2) ensure critical infrastructure remains operational after a disaster. As of the time of this review, agencies have not yet used the results of these assessments to drive asset investment decisions across their portfolios.

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## Government-Wide Guidance Includes Direction to Identify Climate Risks but Does Not Include Incorporating Natural Disaster Resilience into Asset Management Decisions

Federal government-wide guidance and other requirements on asset management and climate change that we reviewed direct agencies to identify climate change risks and conduct risk management practices but do not include direction to incorporate natural disaster resilience into asset management decisions. For example, OMB's *Capital Programming Guide*—the federal government's primary asset management guidance—relevant OMB memos, and a January 2021 executive order on climate change provide direction to federal agencies on some asset management activities, but they do not provide direction on incorporating natural disaster resilience, including climate actions, into asset management. In June 2019, the ISO published a new standard on adaptation to climate change.<sup>43</sup> This standard discusses the importance of using climate information to inform decision-making, which can enhance natural disaster resilience. Over the last several years, national governments and areas outside of the United States—Australia, Canada, and Europe—have taken asset management actions to enhance resilience through initiatives such as: developing a national climate resilience strategy and guidance on incorporating climate change resilience into asset management processes, or on using climate change information when making decisions about infrastructure investments.<sup>44</sup>

**OMB Capital Programming Guide.** This guide is intended to assist agencies in planning and using assets in a way to achieve the maximum value on their investments in order for their asset portfolios to achieve their goals with the lowest-life cycle costs and the least risk. A critical component to long term planning, according to the guide, is risk management. The guide provides direction to agencies to identify potential risks when planning and designing projects and to continue risk management activities throughout the asset's life-cycle, including common areas of project risk for agencies to consider such as risks associated with technology, project schedule, and resources. However, it does not mention the risks that natural disasters may pose. The guide also directs certain agencies to comply with two executive orders signed

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<sup>43</sup>ISO, *ISO 14090 Adaptation to Climate Change—Principles, Requirements, and Guidelines* (Switzerland: 2019).

<sup>44</sup>Australia, Canada, and Europe are relevant to the United States because they have similar climate risks, such as extreme heat, droughts, wildfires, and heavy precipitation resulting in floods.

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in 1977.<sup>45</sup> Specifically, agencies proposing to construct federal buildings in floodplains or wetlands must take certain risk mitigation steps, such as considering alternatives that would reduce adverse impacts on the floodplains or wetlands.<sup>46</sup> However, it does not direct agencies to consider the impact to federal buildings outside of floodplain or wetland areas, or risks due to climate change, such as hurricanes, earthquakes, or fires. According to OMB officials, it is the responsibility of the agencies to determine what risks, including those of natural disasters, pose a threat to maintaining its mission critical assets. If such risks exist, the officials said that they expect agencies to consider natural disaster resilience as a fundamental element of their asset management programs.

**Australian National Strategy Incorporates Natural Disaster Resilience into Asset Management**

In December 2015, the Australian government, a leader in asset management, released a *National Climate Resilience and Adaptation Strategy (the Strategy)* that establishes the government's vision for a climate-resilient country and identifies a set of principles to guide adaptation practices and climate resilience building. To enhance the resilience of physical infrastructure to climate change, the Strategy emphasizes consideration of current and future disaster risk information in planning decisions, such as when, where, and how physical infrastructure should be built.

Sources: Commonwealth of Australia, *National Climate Resilience and Adaptation Strategy* (2015). | GAO-21-596

**OMB memorandums.** In fiscal year 2020, OMB issued two memos to federal agencies relevant to asset management. According to OMB officials, these two memos, when taken together with the Capital Programming Guide, provide an appropriate framework for managing an asset portfolio. However, these memos do not provide direction for enhancing the natural disaster resilience of federally owned assets. More specifically, they do not direct agencies to assess or consider natural disaster risks in portfolio-wide decision-making. The first memo, issued in November 2019, provides capital planning requirements.<sup>47</sup> For example, it requires agencies to develop policies, plans, and processes that describe how their capital planning will help them achieve their mission, including conducting needs assessments, analyzing alternatives, and prioritizing projects. The second memo, issued in March 2020, is an addendum to the National Strategy for Efficient Use of Real Property (Strategy)—issued in 2015—to improve the mission effectiveness and cost efficiency of agencies' real property portfolios. For example, the strategy aims to optimize agency portfolios to support their missions by having the right

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<sup>45</sup>OMB, "Capital Programming Guide," Supplement V 3.1 Supplement to OMB Circular A-11: *Planning, Budgeting, and Acquisition of Capital Assets*, section 39.1 (Washington, D.C.: Dec. 2020). See also Exec. Order No. 11988, 42 Fed. Reg. 26951 (May 24, 1977) (Floodplain management) and Exec. Order No. 11990, 42 Fed. Reg. 26961 (May 24, 1977) (Protection of wetlands).

<sup>46</sup>In addition, in May 2021, Executive Order 13690 of January 15, 2015 was reinstated, thereby re-establishing the federal flood risk management standard, under which federal agencies are to work to improve the resilience of communities and federal assets with respect to current and future flood risks. See Exec. Order No. 14030, § 5(e), 86 Fed. Reg. 27,967, 27,969 (May 25, 2021).

<sup>47</sup>OMB, *Implementation of Agency-wide Real Property Capital Planning*, Memorandum M-20-03 (Washington, D.C.: Nov. 6, 2019).

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type of property, at the right location, and at the right cost. The March 2020 addendum to the Strategy is intended to outline the scope and content for a future publication of a more comprehensive National Strategy for Federal Real Property. This work includes considering leading real property management practices from other national governments.<sup>48</sup> The memo also states that OMB plans to work with the Federal Real Property Council and GSA to perform this outreach. As of April 2021, OMB staff told us they did not have plans to perform this work. One example of incorporating natural disaster resilience into asset management from another national government is Australia's 2015 *National Climate Resilience and Adaptation Strategy*.

**Executive order on the climate crisis.** On January 27, 2021, a new executive order stated that the country faces a climate crisis and encouraged federal agencies to align the management of federal real property to climate actions. This executive order requires each agency to develop a Climate Action Plan describing its climate vulnerabilities and steps the agency can take to increase resilience to the effects of climate change on its facilities and operations.<sup>49</sup> This aligns with the key characteristic of asset management for establishing policies and plans.<sup>50</sup> These Climate Action Plans were due by May 21, 2021, within 120 days after the date of the order, with implementation updates required annually thereafter. Although the order requires agencies to identify natural disaster risks—as we encourage in our 2019 Disaster Resilience Framework—it does not explicitly require that agencies incorporate the climate vulnerabilities they identify into their asset investment decisions. For example, it does not require agencies to use information collected on current and future climate risks to set priorities and make investment decisions across asset portfolios. By incorporating such information into these decisions—a characteristic of effective asset management supported by the Disaster Resilience Framework and ISO standards—agencies can be more confident that their investments in natural disaster

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<sup>48</sup>OMB, *Issuance of An Addendum to the National Strategy for the Efficient Use of Real Property*, OMB Memorandum M-20-10 (Washington, D.C.: Nov. 6, 2020).

<sup>49</sup>Exec. Order No. 14008, § 211, 86 Fed. Reg. 7,619 (Jan. 27, 2021). In addition, a May 2021 executive order, *Climate-Related Financial Risk*, requires agencies to include in their Climate Action Plans actions to integrate climate-related financial risk into their respective agency's procurement process. Exec. Order No. 14030, § 5(d), 86 Fed. Reg. 27,967, 27,969 (May 25, 2021).

<sup>50</sup>See table 2 in this report.

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resilience will provide the greatest value to the agency in meeting its mission and objectives.

#### **Canadian Guidance on Incorporating Climate Change Resilience into Asset Management**

In Canada—a country with over 20 years of experience in asset management—the federal government provides funding to municipalities for asset management. A non-governmental organization, the Federation of Canadian Municipalities (FCM), administers these funds for the Canadian federal government and operates programs that support municipalities in using them. FCM has developed readily available guidance and resources such as guides, case studies, and videos to help municipalities prioritize infrastructure investments and integrate climate change considerations into asset management practices.

Source: GAO analysis of FCM information. | GAO-21-596

#### **European Guidance on Using Climate Change Information in Investment Decisions**

The Adaptation to Climate Change Coordination Group in Europe developed guidance for organizations involved with infrastructure on how to systematically include climate adaptation information. The guidance states that climate models, and other factors, such as the possibility of adaptation over an infrastructure's useful life, can help organizations make decisions about their infrastructure investments.

Source: The European Committee for Standardization and European Committee for Electrotechnical Standardization's Adaptation to Climate Change Coordination Group, *Tailored Guidance for Standardization Technical Committees: How to Include Climate Change Adaptation in European Infrastructure Standards*, version draft 9 (2019). | GAO-21-596

OMB officials said that taken together, its guidance, in addition to the memos and the January 2021 executive order, provides direction for agencies when considering natural disaster resilience in their asset management. The officials also told us that they purposefully keep the capital programming guidance broad because agencies have many and varying types of risks to address. In addition, the Capital Programming Guide was designed to allow agencies to have flexibility in how they implement its directions. However, as with the 2021 executive order, this OMB guidance and the memos do not explicitly direct agencies to link the identification of natural disaster and climatic risks to existing asset management processes for investment decision-making. Officials from all four selected agencies also told us that they were unaware of any government-wide guidance to incorporate natural disaster resilience into asset management. Given the discretion to choose whether to consider the risks of natural disasters and climatic trends in their investment decision-making, even agencies with significant exposure to future natural disasters may not incorporate resilience into their asset management programs. For example, as discussed above, some of the agencies in our review collected natural disaster risk and climatic data, but none of them had yet incorporated such information when making investment decisions. One example of developing guidance on incorporating resilience to climate change into asset management processes is from Canada. An organization has developed guidance for municipalities on addressing climatic change in asset management.<sup>51</sup>

ISO 14090—the standard on adaptation to climate change—states that organizations should assess how their activities and services might be affected by climate change, including natural disasters, and apply that information to decision-making. Using information gathered from tools such as, risk assessments or vulnerability assessments, can help inform investment decisions within the broader context of an asset portfolio by fully understanding the potential cost and benefit trade-offs.

Understanding these trade-offs can help determine if an investment may provide the most value to the agency in meeting its mission when

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<sup>51</sup>The Canadian federal government provides funding to municipalities for asset management. The Federation of Canadian Municipalities (FCM) represents the municipalities in negotiations with the federal government and operates programs that support municipalities in using federal funds.

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compared to other potential investments. Our Disaster Resilience Framework also emphasizes integration of resilience information into decision-making, such as by using tools that can contribute to an understanding of climate risks to identify and select among potential investments.<sup>52</sup> An example of taking this approach is the work of the Adaptation to Climate Change Coordination Group, led by the Netherlands, which has developed guidance that encourages the use of climate information to help make infrastructure investment decisions. Using this type of information can help agencies determine if an investment in assets to enhance resilience could provide the most value to the agencies in meeting their missions when compared to other potential investments.

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## Conclusions

Natural disasters and other extreme weather events are expected to become more frequent, intense, and widespread, potentially resulting in increased costs to the federal government. As outlined in the Disaster Resilience Framework, considering opportunities to enhance the resilience of agencies' asset portfolios is increasingly vital to limiting the government's fiscal exposure from natural disasters.<sup>53</sup> Accordingly, it is important that agencies assess applicable risks from natural disasters and then apply that information to asset investment decisions. Agencies have independently taken some actions to enhance the resilience of their asset portfolios, but these actions vary in their maturity and scope. The January 2021 executive order is important to ensuring that agencies identify and assess applicable natural disaster risks. However, without explicit direction, the extent to which agencies will incorporate that information into asset management decisions to maximize their portfolio's value is uncertain. Directing agencies to consider natural disaster risk and climate data when making investment decisions could enhance the overall resilience of agencies' asset portfolios. This enhanced resilience, in turn, could reduce the need for federal assistance and help limit the federal government's fiscal exposure from natural disasters.

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## Recommendation for Executive Action

The Acting Director of OMB should direct agencies to incorporate, as applicable, their assessments of natural disaster risk information, such as from vulnerability assessment and other risk assessments, into asset management investment decisions. Such direction could include, for

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<sup>52</sup>[GAO-20-100SP](#)

<sup>53</sup>[GAO-20-100SP](#)

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example, updating existing guidance on capital planning.  
(Recommendation 1).

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## Agency Comments

We provided a draft of this report to the Office of Management and Budget, the Army Corps of Engineers, the General Services Administration, and the Department of the Interior's Fish and Wildlife Service and National Park Service for comment.

The Office of Management and Budget, the Army Corps of Engineers, and the Department of the Interior's Fish and Wildlife Service and National Park Service provided technical comments, which we incorporated as appropriate. The General Services Administration had no comments on the draft report.

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We are sending copies of this report to the appropriate congressional committees, the Acting Director of the Office of Management and Budget, the Administrator of the General Services Administration, the Secretaries of Defense and the Interior, and other interested parties. In addition, the report is available at no charge on the GAO website at <https://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or [naamanej@gao.gov](mailto:naamanej@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.



Jill Naamane  
Acting Director, Physical Infrastructure

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# Appendix I: Objectives, Scope, and Methodology

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This report addresses (1) how selected agencies have incorporated natural disaster resilience into their assets and (2) the extent to which government-wide guidance directs federal agencies to incorporate natural disaster resilience into asset management.

To describe how selected agencies have incorporated natural disaster resilience into their assets, we reviewed documents (e.g., policies, procedures, and plans) and interviewed officials from the following four selected agencies:

- the U.S. Army Corps of Engineers (Army Corps),
- the General Services Administration (GSA),
- the Department of the Interior's Fish and Wildlife Service (FWS), and
- the Department of the Interior's National Park Service (NPS).

To facilitate our analysis of the information we collected from these agencies, we selected three key characteristics of effective asset management from our November 2018 report. The three key characteristics we selected are establishing formal policies and plans, using quality data, and maximizing an asset portfolio's value.<sup>1</sup> We selected these characteristics because they are relevant to how agencies can incorporate natural disaster resilience into asset management. We also reviewed our October 2019 report that established a Disaster Resilience Framework to identify benefits that can be gained from incorporating natural disaster resilience into asset management. This Framework established three broad principles that organizations can consider when analyzing potential opportunities to enhance natural

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<sup>1</sup>In our November 2018 report, we established six key characteristics for effective asset management. The key characteristics of effective asset management that we did not select for our review are: maintaining leadership support, promoting a collaborative organizational culture, and evaluating and improving asset management practices. We did not select these because they are not as relevant to how agencies incorporate natural disaster resilience into asset management. See [GAO-19-57](#).

disaster resilience.<sup>2</sup> We selected two of these principles to focus on for this review—the information principle (e.g., using reliable information) as well as the integration principle (e.g., integrating resilience into relevant federal efforts). We selected these two principles because they are the most relevant to asset management.

To select the four agencies, we analyzed real property data reported by agencies to GSA's fiscal year 2018 Federal Real Property Profile (FRPP) Management System.<sup>3</sup> Specifically, for agencies reporting at least one civilian-owned building or structure in the United States and its territories, we analyzed data on the number of real property building and structures, the location of these asset based on the Federal Emergency Management Agency's regional structure, and asset-replacement value.<sup>4</sup> We selected the four agencies because they own a large number of buildings and structures, have assets located across the country, and have asset portfolios with high total replacement values.<sup>5</sup> We used fiscal year 2019 FRPP data—the latest available when we wrote this report—to describe, for the selected agencies, the number of owned buildings and structures and their assets' replacement value. We assessed the reliability of the fiscal year 2018 and 2019 FRPP data by reviewing documentation, interviewing GSA officials, and verifying data with officials from our selected agencies, and we concluded the data were sufficiently

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<sup>2</sup>The three principles are information (e.g., using reliable information), integration (e.g., integrating resilience into relevant federal efforts), and incentives (e.g., using incentives to promote investments in disaster risk reduction). We did not focus on the incentives principle because it is not directly relevant to asset management. In our October 2019 report that established the Framework, we stated that some of the principles are likely to be more relevant in the analysis of certain federal efforts than others and that it is appropriate to apply the principles that are relevant to specific circumstances. See [GAO-20-100SP](#).

<sup>3</sup>The FRPP Management System is managed by GSA and is comprised of data on real property assets submitted annually by federal agencies. Agencies submit data to the FRPP for their sub-component agencies as applicable.

<sup>4</sup>We analyzed FRPP data by sub-component agency when applicable. For example, we analyzed FRPP data from the Department of the Interior's FWS and NPS. For the purposes of our reporting, we refer to agencies and their sub-components as "agencies."

<sup>5</sup>We selected agencies (a) with a large number of buildings and structures because these agencies are more likely to have experience with managing assets or incorporating resilience into their assets; (b) with assets located across the country to account for various natural disasters that may be unique to some regions, such as hurricanes or wildfires; and (c) whose asset portfolios have high total replacement values because greater fiscal exposure generally heightens the need for effective asset management and need for resilience actions.

reliable for the purposes of selecting agencies for inclusion in our review and describing selected agencies' assets.

To gather illustrative examples from selected agencies on incorporating natural disaster resilience into their assets, we reviewed documents or interviewed agency officials, such as project managers, from the selected agencies on 12 construction, repair, or rehabilitation projects. See table 1.

**Table 4: Twelve Selected Construction, Repair, or Rehabilitation Projects**

Selected agency	Description of selected projects
U.S. Army Corps of Engineers	<ul style="list-style-type: none"> <li>• Construction of a new lock (Sault Ste. Marie, Michigan)</li> <li>• Major rehabilitation of the Columbia River Jetty System (Oregon and Washington)</li> <li>• Repair of a levee following Hurricane Harvey (Texas City, Texas)</li> </ul>
General Services Administration	<ul style="list-style-type: none"> <li>• Construction of a new courthouse (Huntsville, Alabama)</li> <li>• Construction of a new federal laboratory (Lakewood, Colorado)</li> <li>• Repair of the Alton Lennon Federal Building and U.S. Courthouse following Hurricane Florence (Wilmington, North Carolina)</li> </ul>
Department of the Interior's Fish and Wildlife Service	<ul style="list-style-type: none"> <li>• Repair of a seawall at the Merritt Island National Wildlife Refuge following Hurricane Irma (Titusville, Florida)</li> <li>• Rehabilitation of three high hazard dams at the Wichita Mountains Wildlife Refuge (Indianapolis, Oklahoma)</li> <li>• Repair and rehabilitation of a building at the McFaddin National Wildlife Refuge following Hurricane Ike (Sabine Pass, Texas)</li> </ul>
Department of the Interior's National Park Service	<ul style="list-style-type: none"> <li>• Construction of a new dormitory at the Klondike Gold Rush National Historical Park (Skagway, Alaska)</li> <li>• Repair of the Jefferson Memorial's roof and attic following excessive rain and leakage (Washington, D.C.)</li> <li>• Seismic retrofit and rehabilitation of the Mammoth Hot Springs Hotel in Yellowstone National Park (Mammoth Hot Springs, Wyoming)</li> </ul>

Source: GAO. | GAO-21-596

We selected projects that, according to agency annual budget documents or agency officials, were new construction or high-priority repair or rehabilitation projects in fiscal years 2018, 2019, or 2020 or, according to agency officials, received supplemental appropriations for disaster assistance at some point from fiscal years 2015 through 2019.

The projects we selected reflect a variety of buildings and structures located across the country. For construction, repair, or rehabilitation projects included in annual budget documents, we selected projects where the selected agencies recommended relatively high amounts of funding because they have significant long-term financial risks and thus have a greater need for incorporating natural disaster resilience into their

asset management practices. While information we obtained from the selected agencies and projects is not generalizable to all federal agencies, it provides a range of examples of agencies' experiences with managing assets and natural disaster resilience.

To determine the extent to which government-wide guidance directs federal agencies to incorporate natural disaster resilience into asset management, we reviewed government-wide guidance related to asset management or climate change, namely the Office of Management and Budget's (OMB) Capital Programming Guide, OMB memos relevant to asset management, and current and previous executive orders that discuss climate change or asset management.<sup>6</sup> We also interviewed officials from GSA, OMB and the Federal Real Property Council.<sup>7</sup> We compared the government-wide guidance to the International Organization for Standardization's (ISO) 14090 standard on climate change adaptation and our Disaster Resilience Framework.<sup>8</sup> We selected ISO 14090 because it is an internationally-recognized standard that aligns to our three selected characteristics of effective asset management. We selected specific practices within the standard that aligned with characteristics for effective asset management; specifically we focused on embedding climate change adaptation into organization policies and plans, assessing information to gain knowledge about climate impacts, and considering climate change adaptation in investment decisions.

We also reviewed ISO standards on asset management<sup>9</sup> and interviewed individuals from academia and an organization knowledgeable about

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<sup>6</sup>OMB, *Capital Programming Guide, V 3.1 Supplement to OMB Circular A-11: Planning, Budgeting, and Acquisition of Capital Assets* (Washington, D.C.: 2020); OMB, *Implementation of Agency-wide Real Property Capital Planning*, OMB Memorandum M-20-03 (Washington, D.C.: Nov. 6, 2019); OMB, *Issuance of An Addendum to the National Strategy for the Efficient Use of Real Property*, OMB Memorandum M-20-10 (Washington, D.C.: Mar. 6, 2020). Exec. Order No. 14030, 86 Fed. Reg. 27,967 (May 25, 2021).

<sup>7</sup>The Federal Real Property Council, chaired by OMB, develops guidance and shares leading practices in real property management among federal agencies.

<sup>8</sup>ISO, *ISO 14090 Adaptation to Climate Change—Principles, Requirements, and Guidelines* (Switzerland: 2019). The ISO is an international, independent, non-governmental organization with a membership of 165 national standards bodies, including the American National Standards Institute. According to ISO's website, ISO has published more than 23,000 international standards and additional documentation across almost every industry. See also [GAO-20-100SP](#).

<sup>9</sup>ISO, *ISO 55000 Asset Management—Overview Principles and Terminology* (Switzerland: 2014). ISO 55000 consists of three separate standards. For the purposes of this report, we refer to the three standards collectively as ISO 55000.

asset management and natural disaster resilience. We also reviewed actions taken by Australia, Canada, and the Adaptation Climate Change Coordination Group in Europe, led by the Netherlands. We selected these countries because they are experienced with asset management, have similar climate risks to the United States, and have taken steps to incorporate natural disaster resilience into asset management nationwide.

We conducted this performance audit from January 2020 to September 2021 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

# Appendix II: GAO's Disaster Resilience Framework

Figure 3: GAO's Disaster Resilience Framework



Source: GAO. | GAO-21-596

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# Appendix III: GAO Contact and Staff Acknowledgments

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## GAO Contact:

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### Acknowledgments:

In addition to the contact named above, Amelia Bates Shachoy (Assistant Director), Bill Colwell (Analyst-in-Charge), Ross Gauthier (Analyst-in-Charge), Whitney Allen, Roshni Davé, Kathryn Godfrey, Gina Hoover, Susan Irving, Terrence Lam, Josh Ormond, Minette Richardson, Jennifer Rudisill, Janet Temko-Blinder, Joseph Thompson, and Amelia Michelle Weathers made key contributions to this report.

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