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Dam Safety Overview and the Federal Role

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SUMMARY

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Dam Safety Overview and the Federal Role

Dams provide various services, including flood control, hydroelectric power, recreation, navigation, and water supply, but they require maintenance, and sometimes rehabilitation and repair, to ensure public and economic safety. Dam failure or incidents can endanger lives and property, as well as result in loss of services provided by the dam. Federal government agencies reported owning 3% of the more than 91,000 dams listed in the National Inventory of Dams (NID), including some of the largest dams in the United States. (Thousands more dams fall outside the definition for NID inclusion.) The majority of NID-listed dams are owned by private entities, nonfederal governments, and public utilities. Although states have regulatory authority for over 71% of NID-listed dams, the federal government plays a key role in dam safety policies for both federal and nonfederal dams.

Congress has expressed interest in dam safety over several decades, often prompted by critical events such as the 2017 near failure of Oroville Dam's spillway in California and the 2020 failure of two hydropower dams in Michigan. Dam failures in the 1970s that resulted in the loss of life and billions of dollars of property damage spurred Congress and the executive branch to establish the NID, the National Dam Safety Program (NDSP), and other federal activities regarding dams. These programs and activities have increased safety inspections, emergency planning, and dam rehabilitation and repair. Since the late 1990s, some federal and state dam safety programs have shifted from a standards-based approach to a risk-management approach. A risk-management approach seeks to mitigate failure of dams and related structures by conducting comprehensive inspections, enacting risk reduction measures, and prioritizing rehabilitation and repair of structures whose failure would pose the greatest threat to life and property.

Responsibility for dam safety is distributed among federal agencies, nonfederal agencies, and private dam owners. The Federal Emergency Management Agency's (FEMA's) NDSP facilitates collaboration among these stakeholders. The National Dam Safety Program Act, as amended (33 U.S.C. §§467 et seq.), authorizes the NDSP at $13.4 million annually through FY2023. The federal government is directly responsible for maintaining the safety of federally owned dams. The U.S. Army Corps of Engineers and the Bureau of Reclamation own 42% of federal dams, including many large dams. The remaining federal dams are owned by the Forest Service, Bureau of Land Management, Fish and Wildlife Service, Department of Defense, Bureau of Indian Affairs, Tennessee Valley Authority, Department of Energy, International Boundary and Water Commission, and the U.S. Department of Agriculture. Congress has provided various authorities for these agencies to conduct dam safety activities, rehabilitation, and repair. Congress also has enacted legislation authorizing the federal government to regulate or rehabilitate and repair certain nonfederal dams. Other federal agencies regulate dams associated with hydropower projects, mining activities, and nuclear facilities and materials. Selected nonfederal dams may be eligible for rehabilitation and repair assistance from certain agency programs which are described further in the CRS Report R47383, *Federal Assistance for Nonfederal Dam Safety*.

Congress may consider oversight and legislation relating to dam safety in the larger framework of infrastructure improvements and risk management, or as an exclusive area of interest. Some of these issues are related to many of the nation's dams and the federal agencies involved in their dam safety activities, while others are focused on specific dams or specific federal agencies. Selected issues include the following:

- Federal agency effectiveness in addressing dam safety for federal and nonfederal dams, including implementing appropriations (e.g., recent influx of funding from the Infrastructure Investment and Jobs Act [P.L. 117-58]) and determining the sufficient amount of future appropriations to provide for dam safety activities
- Whether, and if so how, to incentivize and support federal and nonfederal agencies and dam owners to incorporate risk (e.g., risk-informed decisionmaking) in their dam safety practices and how effective these agency practices are at addressing the risk for communities surrounding and downstream of dams
- Oversight of the National Oceanic and Atmospheric Administration's mandate to update probable maximum precipitation study methods to incorporate future climate conditions and of how federal and state agencies may use these methods to inform dam regulations and design
- Tradeoffs between disclosing dam risk information for public awareness versus preventing individuals or groups seeking to compromise dams and their operating infrastructure for malicious purposes, including through cybersecurity attacks, from gaining this knowledge, and how to reduce the vulnerability of dams and their operating infrastructure from such potential attacks that could compromise dam safety.

Contents

Figures

Tables

Contacts

Introduction

Dams may be used to provide flood control, navigation, drinking water, hydroelectric power, irrigation, recreation, fish and wildlife management, and/or waste management benefits. Construction of dams often causes environmental change (e.g., alteration of riverine habitat). Owning a dam also may require financial expenditures for operation and maintenance, rehabilitation (i.e., bringing a dam up to current safety standards), and repair. Federal agencies reported owning 3% of the more than 91,000 dams in the National Inventory of Dams (NID), including some of the country's largest dams (e.g., the Bureau of Reclamation's Hoover Dam in Nevada is 730 feet tall with storage capacity of over 30 million acre-feet of water).[1] Most dams in the United States are owned by private entities, state or local governments, or public utilities.

Dam failure and incidents—episodes that, without intervention, likely would have resulted in dam failure—may threaten public safety, local and regional economies, and the environment; they also may result in the loss of services provided by a dam.[2] Dams can deteriorate as they age, which may increase the risk of failures and incidents and thereby may increase the potential safety threat.[3] Lack of maintenance and misoperation may amplify dam deterioration. Development in areas surrounding dams and their reservoirs may amplify the risks associated with dam deterioration. Security threats, such as cybersecurity attacks that could alter dam operations, are also a concern for dam safety. Seismic events, floods, and wildfire and associated debris flows also may impact dams. In recent years, several dam safety incidents have highlighted the public safety risks posed by the failure of dams and related facilities.

Congress has expressed an interest in dam safety over several decades, often prompted by destructive events. Dam failures in the 1970s that resulted in the loss of life and billions of dollars in property damage prompted Congress and the executive branch to establish the NID, the National Dam Safety Program (NDSP), and other federal activities related to dam safety.[4] Following terrorist attacks on September 11, 2001, the federal government focused on dam security and the potential for acts of terrorism at major dam sites.[5] As dams age and the population density near many dams increases, attention has turned to mitigating the risk of dam

[1] Federal agencies self-report dam ownership to the National Inventory of Dams (NID). NID data in this report were assessed on January 24, 2023, with data last updated on January 18, 2023. Federal agencies reported owning 2,825 dams with some dams owned by multiple federal agencies. One acre-foot of water is the amount of water that will cover an acre of land to a depth of one foot, or approximately 326,000 gallons.

[2] Dam incidents may include overtopping, spillway malfunction or failure, and piping (i.e., internal erosion caused by seepage), among others. Federal Emergency Management Agency (FEMA), *The National Dam Safety Program, Biennial Report to the United States Congress, Fiscal Years 2018-2019*, FEMA P-2189, November 2022, at https://www.fema.gov/sites/default/files/documents/fema_ndsp-report-congress-fy18-fy19.pdf.

[3] Many dams are built for an intended operational lifespan of 50 years. Dams may continue to operate for their purpose after the 50-year period and may benefit from rehabilitation to expand their operational lifespan and address current safety standards.

[4] Failure of a private mine tailings dam at Buffalo Creek, WV, in 1972, flooded a 16-mile valley and killed 125 people; Bureau of Reclamation's Teton Dam, ID, failed in 1976, killing 11 people and causing $1 billion in property damage; and the private Kelley Barnes Dam, GA, failed in 1977, killing 39 people and causing $2.8 million in damage. FEMA, *The National Dam Safety Program, Biennial Report to the United States Congress, Fiscal Years 2016-2017*, May 2019, at https://www.fema.gov/sites/default/files/2020-08/national-dam-safety_biennial-report-2016-2017.pdf. Hereinafter FEMA, *National Dam Safety Program*, 2016-2017.

[5] FEMA, *Dam Safety and Security in the United States: A Progress Report on the National Dam Safety Program in Fiscal Years 2002 and 2003*, December 2003, at https://www.fema.gov/sites/default/files/2020-08/2002-2003-progress-report_dam-safety.pdf.

failure through dam inspection programs, rehabilitation, and repair, in addition to preventing and preparing for emergencies.[6]

This report provides an overview of dam safety and associated activities in the United States, highlighting the federal role in dam safety. The primary federal agencies involved in these activities include the Federal Emergency Management Agency (FEMA), the U.S. Army Corps of Engineers (USACE), the Bureau of Reclamation (Reclamation), and the Federal Energy Regulatory Commission (FERC). The report also discusses potential issues for Congress, such as the federal role in and funding for dam safety activities; adoption of risk-informed decisionmaking for dam safety; and awareness of dam safety risks and security issues. The report does not discuss in detail emergency response to a dam incident, dam building and removal policies, or state dam safety programs.

Safety of Dams in the United States

Dam safety generally focuses on preventing dam failure and incidents. Challenges to maintaining dam safety include aging and inadequately constructed dams, frequent or severe floods (for instance, due to climate change), misoperation of dams, and dam security.[7] The risks associated with dam misoperation and failure also may increase as populations and development encroach on the areas upstream and downstream of some dams.[8] Safe operation and proper maintenance of dams and associated structures is fundamental for dam safety. In addition, routine inspections by dam owners and regulators determine a dam's hazard potential (see "Hazard Potential," below) and possible needs for rehabilitation and repair.[9]

Dams by the Numbers

USACE maintains the NID, a database of dams in the United States.[10] For a dam to be included in the NID, it must be an artificial barrier that has the ability to impound water, wastewater, or any liquid-borne material for the purpose of storage or control of water that (1) is at least 25 feet in height with a storage capacity of more than 15 acre-feet, (2) is greater than 6 feet in height with a storage capacity of at least 50 acre-feet, or (3) poses a significant threat to human life or property should it fail (i.e., high or significant hazard dams).[11] Thousands of dams do not meet these criteria; therefore, they are not included in the NID.

[6] FEMA, *National Dam Safety Program*, 2016-2017; National Research Council (NRC), *Dam and Levee Safety and Community Resilience: A Vision for Future Practice*, 2012, at https://doi.org/10.17226/13393. Hereinafter National Research Council, *Dam and Levee Safety*.

[7] Michelle Ho et al., "The Future Role of Dams in the United States of America," *Water Resources Research*, vol. 53, no. 2 (2017), at https://doi.org/10.1002/2016WR019905.

[8] FEMA, *Risk Exposure and Residual Risk Related to Dams*, 2017, at https://www.fema.gov/sites/default/files/2020-08/ta2-risk_exposure_residual_risk_related_dams.pdf. Hereinafter FEMA, *Risk Exposure*.

[9] Hazard potential reflects the amount and type of damage that a failure would cause. FEMA, *Federal Guidelines for Dam Safety Risk Management*, FEMA P-1025, 2015, at https://www.fema.gov/sites/default/files/2020-08/fema_dam-safety_risk-management_P-1025.pdf.

[10] Online NID data are used throughout this report unless otherwise specified. State and federal agencies self-report dam information to the NID. In this report, the number of dams owned by federal agencies are based on federal agency reporting to the NID. State agencies also reported additional dams owned by the federal government, though CRS could not confirm ownership of these dams. The NID can be accessed at https://nid.sec.usace.army.mil. Hereinafter NID, assessed on January 24, 2023, with data last updated on January 18, 2023.

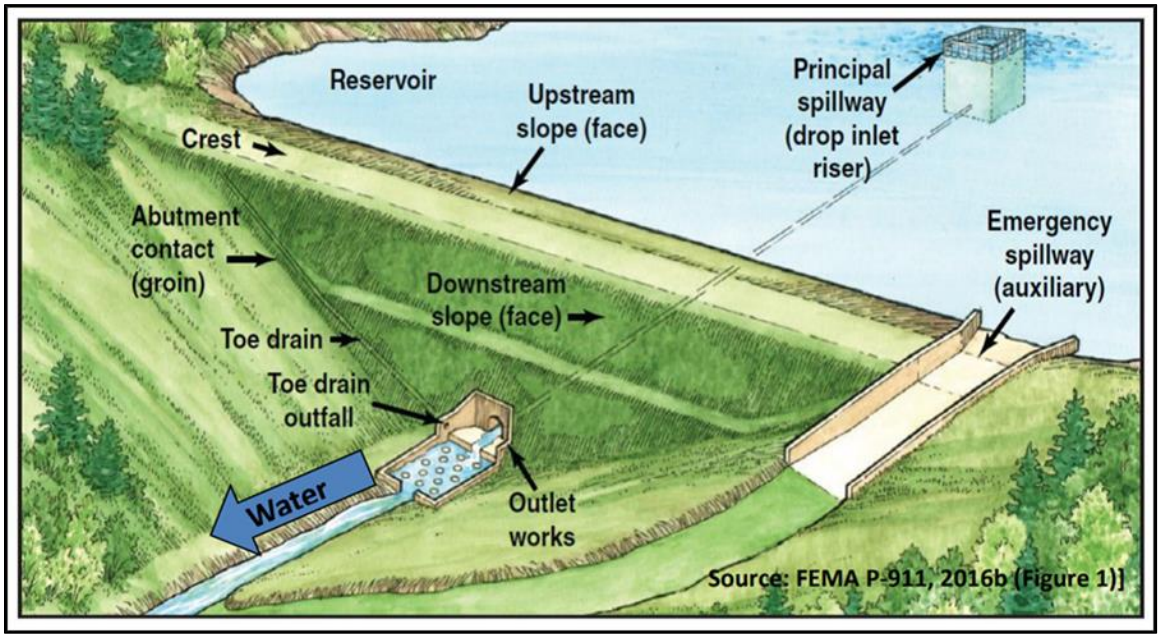
[11] 33 U.S.C. §467.

National Inventory of Dams

After several dam failures in the early 1970s, Congress authorized the U.S. Army Corps of Engineers (USACE) to inventory the nation's dams and tasked it with other dam safety responsibilities in P.L. 92-367 (33 U.S.C. §467d). Pursuant to the act, USACE first published the National Inventory of Dams (NID) in 1975. The NID now includes over 91,000 dams. States, territories, and federal agencies report the information contained in the database; these entities collaborate closely with USACE to improve the accuracy and completeness of information. Starting in 2021, the NID has allowed agencies to update data in real-time instead of only through annual calls for information. In addition, USACE also now includes flood inundation maps for most USACE dams, which show possible flooding from dam incidents by modeling a limited set of standard flood scenarios. The NID allows other agencies to provide inundation maps for their dams. Multiple acts have reauthorized appropriations for the NID; most recently, the Water Resources Development Act of 2018 (Title I of P.L. 115-270) extended the NID's annual authorization of appropriations of $500,000 through FY2023. From FY2014 to FY2022, Congress appropriated $400,000 annually to maintain the NID; in FY2023, Congress appropriated $500,000 to maintain the NID. The NID can be accessed at https://nid.sec.usace.army.mil.

The most common type of dam is an earthen dam (see **Figure 1**), which is made from natural soil, rock, or mining waste materials. Other dam types include concrete dams, tailings dams (i.e., dams that store mining byproducts), overflow dams (i.e., dams regulating downstream flow), and dikes (i.e., dams constructed at a low point of a reservoir of water).[12] This report does not cover levees, which are manmade structures designed to control water movement along a landscape.

Figure 1. Illustration of an Earthen Dam



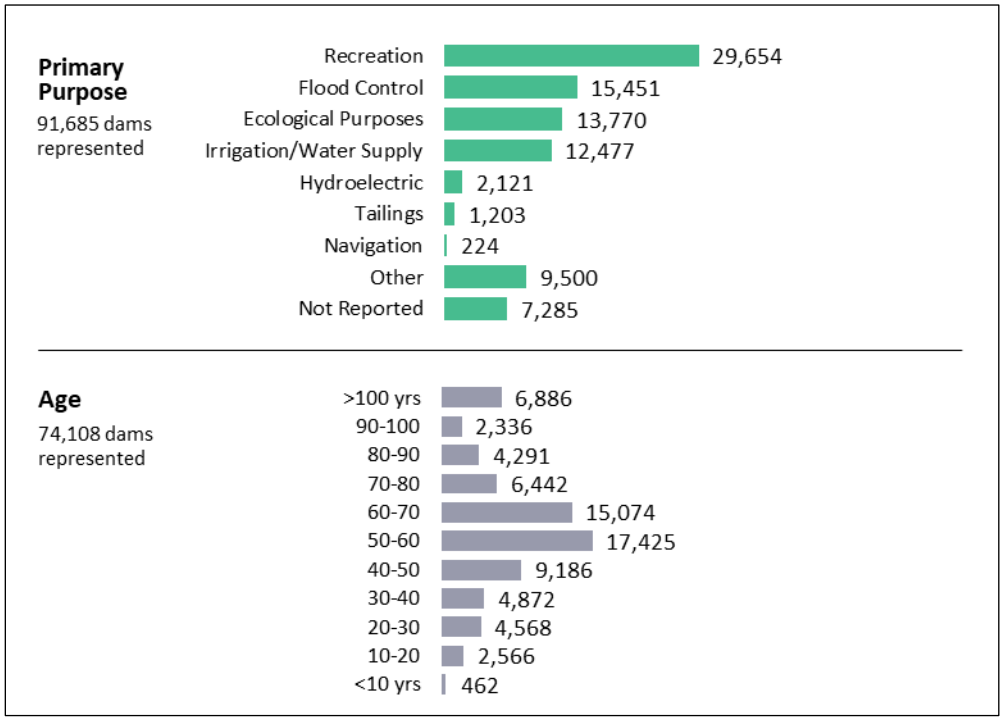
Source: FEMA, *Pocket Safety Guide for Dams and Impoundments*, 2016, at https://www.fema.gov/sites/default/files/2020-08/fema_911_pocket_safety_guide_dams_impoundments_2016.pdf.

Notes: Earthen dams use natural materials, generally with minimum processing, and can be built with primitive equipment under conditions where any other construction material would be impracticable. Other dam types (e.g., concrete dams, tailings dams that store byproducts of mining operations) may have alternative design and structural components.

[12] The United States Society on Dams, "Types of Dams," at https://www.ussdams.org/dam-levee-education/overview/types-of-dams/.

The nation's dams have been constructed for various purposes: recreation, flood control, ecological management (e.g., fisheries management), irrigation and water supply, hydroelectricity, mining, navigation, and others (see **Figure 2**). A dam may serve multiple purposes. Although some dams were built before 1900s (e.g., ~2,300 of the dams in the NID), nearly half of dams in the NID were built between 1950 and 1980 (over 43,000 NID dams).[13] After this period, construction of new dams slowed (e.g., the NID lists a little over 4,700 dams built since 2000). Dams are built to the engineering and construction standards and regulations that apply at the time of their construction. As a result, some dams may not meet current dam safety standards, which have evolved over time as scientific data and engineering have improved.[14] These dams may not operate properly or may even fail from certain flooding and seismic events that are now known to be possible at the site based on improved understanding of weather and flood data, such as probable maximum flood, and seismic data.

Figure 2. National Dam Statistics



Source: Congressional Research Service (CRS) with National Inventory of Dams (NID) data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023.

Notes: Some dams have multiple purposes. The "Ecological Purposes" category includes dams used for various fish and wildlife ponds or fire protection, and the "Other" category may include dams used for debris control and grade stabilization. A total of 17,577 dams in the NID had no age of construction reported.

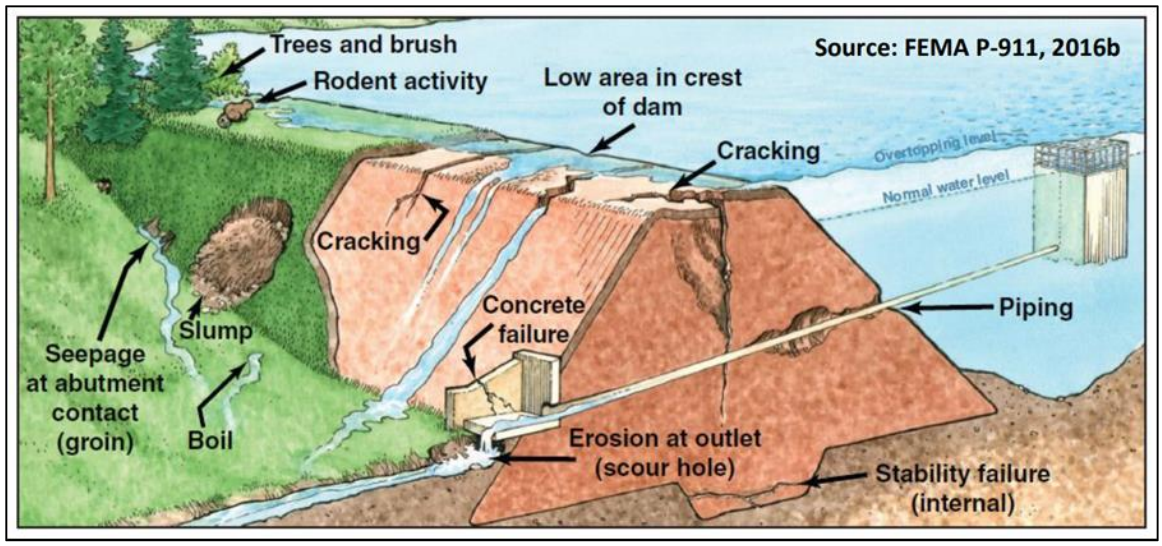
[13] NID, accessed on January 24, 2023, with data last updated on January 18, 2023. 17,577 dams in the NID had no age of construction reported.

[14] American Society of Civil Engineers, *Infrastructure Report Card: Dams*, 2021, at https://www.infrastructurereportcard.org/dams/; hereinafter ASCE, *Infrastructure Report Card*.

Dam Failures and Incidents

Dam failures and incidents may occur for various reasons. Potential causes include floods that may exceed design capacity; faulty design or construction; misoperation or inadequate operation plans; overtopping, with water spilling over the top of the dam; foundation defects, including settlement and slope instability; cracking caused by movements, including seismic activity; inadequate maintenance and upkeep; and piping, when seepage through a dam forms holes in the dam (see **Figure 3**).[15]

Figure 3. Selected Potential Failure Modes of Dams



Source: FEMA, *Pocket Safety Guide for Dams and Impoundments*, 2016, at https://www.fema.gov/sites/default/files/2020-08/fema_911_pocket_safety_guide_dams_impoundments_2016.pdf.

Notes: The figure is of an earthen dam; other dams may have different potential modes of failure. Some potential failure modes are not illustrated, such as spillway damage and sinkholes.

Engineers and organizations have documented dam failure in an ad hoc manner for decades.[16] Some report over 1,600 dam failures resulting in approximately 3,500 casualties in the United States since the middle of the 19th century, although these numbers are difficult to confirm.[17] Between 2000 and 2020, states reported 270 failures and 581 non-failure dam safety incidents.[18]

A number of more recent dam incident and failure events have led to increased attention on the condition of dams and the federal role in dam safety. Many failures are of spillways and small dams, which may result in limited flooding and downstream impact compared to large dam failures. Flooding that occurs when a dam is breached may not result in life safety consequences

[15] National Research Council, *Dam and Levee Safety*.

[16] Personal correspondence between CRS and ASDSO, June 13, 2019. National Research Council, *Dam and Levee Safety*.

[17] National Research Council, *Dam and Levee Safety*; personal correspondence between CRS and ASDSO, June 13, 2019. Although these sources provide information on dam failures and casualties, this information is self-reported.

[18] A *nonfailure incident* is an incident at a dam that will not, by itself, lead to a failure but that requires investigation and notification of internal and/or external personnel. The failure and nonfailure incident estimate may be uncertain. Because reporting is voluntary, few private or local dams are included. Nonfailure events also may represent a drowning or injury not directly arising from a dam with structural deficiencies. ASDSO, "Roadmap to Reducing Dam Safety Risks," at https://www.damsafety.org/Roadmap.

or significant property damage.[19] Still, some dam failures have resulted in notable disasters in the United States.[20] Some notable dam failures and incidents since 2000 include the following:

- In May 2020, following several days of heavy rain, two dams failed in Michigan, resulting in widespread flooding and the evacuation of approximately 10,000 downstream residents.[21]
- In March 2019, the latest dam failure fatality occurred when a hydropower dam in Nebraska failed because of an icy flood. There was no formal emergency action plan, because the dam was not classified as a high hazard potential dam.[22]. *High hazard potential* means the loss of at least one life is probable from a dam failure.
- In 2017, the near failure of Oroville Dam's spillway in California resulted in a precautionary evacuation of approximately 200,000 people and more than $1.1 billion in emergency response and repair.[23]
- From 2015 to 2018, over 100 dams breached in North Carolina and South Carolina due to record flooding.[24]
- Floods resulting from hurricanes in 2017 filled reservoirs of dams to record levels in some regions—for example, USACE's Addicks and Barker Dams in the Houston, TX, area; the Puerto Rico Electric Power Authority's Guajataca Dam in Puerto Rico; and USACE's Herbert Hoover Dike in Florida.[25]
- The March 2006 failure of the private Ka Loko Dam in Hawaii killed seven people.[26]
- The 2003 failure of the Upper Peninsula Power Company's Silver Lake Dam in Michigan caused more than $100 million in damage.[27]

[19] National Research Council, *Dam and Levee Safety*. Gregory B. Baecher et al., *Review and Evaluation of the National Dam Safety Program*, University of Maryland, 2011, at https://www.fema.gov/media-library-data/20130726-1830-25045-3217/damsafetyreport.pdf. Hereinafter Baecher et al., *Review and Evaluation*, University of Maryland.

[20] Baecher et al., *Review and Evaluation*, University of Maryland; Stanford University, *Dam Failures in the U.S.*, 2018, at http://npdp.stanford.edu/sites/default/files/reports/npdp_dam_failure_summary_compilation_v1_2018.pdf.

[21] On May 19, 2020, following several days of heavy rain, the Edenville Dam on the Tittabawasee River in Gladwin County, MI, failed and sent a large volume of water downstream; this water overtopped the Sanford Dam in Midland County, MI. U.S. Geological Survey, "Dam Breaks in Michigan," at https://www.usgs.gov/centers/eros/dam-breaks-michigan.

[22] ASDSO, *Spencer Dam Failure Investigation Report*, April 2020, at https://damsafety.org/SpencerDamReport.

[23] *Spillways* are structures to release water from a dam, either as part of regular operations or as part of emergency operations to reduce water volume or water pressure on the dam and mitigate the risk of failure. ASDSO, Lessons Learned, "Case Study: Oroville Dam (California, 2017)," at https://damfailures.org/case-study/oroville-dam-california-2017/.

[24] Federal Emergency Management Agency (FEMA), *The National Dam Safety Program: Biennial Report to the United States Congress, Fiscal Years 2016-2017*, May 2019, at https://www.fema.gov/sites/default/files/2020-08/national-dam-safety_biennial-report-2016-2017.pdf. Hereinafter FEMA, *National Dam Safety Program*, 2016-2017.

[25] FEMA, *National Dam Safety Program*, 2016-2017.

[26] Kristina Costa and Donna Cooper, "The 10 States Most Threatened by High-Hazard, Deficient Dams," Center for American Progress, 2012, at https://www.americanprogress.org/issues/economy/news/2012/09/20/38679/the-10-states-most-threatened-by-high-hazard-deficient-dams/.

[27] Ibid.

Oroville Dam, CA

In February 2017, failure of key components of the Oroville Dam, part of a state-owned hydropower project in California licensed by the Federal Energy Regulatory Commission (FERC), highlighted the risks that may be associated with hydropower dams and raised questions about FERC's oversight of dam safety. Following higher-than-forecasted inflows from precipitation, snowpack, and subsequent runoff, Oroville Dam operators opened the dam's main service spillway gates, which resulted in the spillway crumbling on one side. In addition, overtopping of the ungated auxiliary spillway (also referred to as the emergency spillway) initiated erosion of the bedrock that supports the spillway. These deficiencies prompted concerns about possible dam failure, and local emergency management officials issued an evacuation order for nearly 200,000 residents downstream of the dam. Dam operators increased water releases from the damaged main service spillway until dam water levels were safe enough to begin repairs on the spillway structures. Spillway repairs and emergency response cost an estimated $1.1 billion. At the time of the incident, FERC was reviewing the Oroville Dam project's relicensing application. In January 2018, an independent forensic team and a FERC after-action panel raised questions about the thoroughness of the state's and FERC's oversight of the project, among other factors that may have contributed to the incident (see section on "Regulation of Hydropower Dams"). The incident also prompted a wave of new state executive and legislative actions in California requiring inspections of 93 spillways; emergency action plans and inundation maps for all dams posing a significant threat to human life or property; and public data release of hazard classifications, condition assessments, and dam incident inundation maps.

Sources: *Independent Forensic Team Report, Oroville Dam Spillway Incident*, 2018, at https://damsafety.org/sites/default/files/files/Independent%20Forensic%20Team%20Report%20Final%2001-05-18.pdf; Federal Energy Regulatory Commission (FERC), *FERC After Action Panel Report*, November 23, 2018, at https://damfailures.org/wp-content/uploads/2022/07/IR_FERC_Oroville.pdf; personal correspondence between CRS and the California Division of Safety of Dams on June 4, 2019.

Notes: Figure is an overview of the Oroville Dam facility prior to February 2017.

Hazard Potential

Federal guidelines set out a hazard potential rating to quantify the potential harm associated with a dam's failure or misoperation.[28] As described in **Table 1**, the three hazard ratings (low, significant, and high) do not indicate the likelihood of failure; instead, the ratings reflect the amount and type of damage that a failure would cause. **Figure 4** depicts the number of dams

[28] FEMA, *Federal Guidelines for Dam Safety: Hazard Potential Classification System for Dams*, 2004, at https://www.fema.gov/media-library-data/20130726-1516-20490-7951/fema-333.pdf.

listed in the NID that are classified as high hazard in each state; 60% of dams in the NID are classified as low hazard. From 2000 to 2023, thousands of dams were reclassified, increasing the number of high hazard dams from 9,921 to 14,934.[29] According to FEMA, the primary factor increasing dams' hazard potential is *hazard creep*—development upstream and downstream of a dam, especially in the dam failure inundation zone (i.e., downstream areas that would be inundated by water from a possible dam failure), that increases the potential consequences of a dam failure.[30] Reclassification from low hazard potential to high or significant hazard potential may trigger more stringent requirements by regulatory agencies, such as increased spillway capacity, structural improvements, more frequent inspections, and creating or updating an emergency action plan (EAP).[31] Some of these requirements may be process and procedure based, and others may require structural changes for existing facilities.

Table 1. Hazard Potential of Dams in the United States

Hazard Potential	Result of Failure or Misoperation	Number of NID Dams	Percent of NID Dams
High Hazard	• Loss of at least one life is probable • Other economic or environmental loss possible but not necessary for this classification	14,934	16%
Significant Hazard	• No probable loss of human life • Could result in economic loss, environmental damage, disruption of lifeline facilities, etc.	10,387	11%
Low Hazard	• No probable loss of human life • Few economic or environmental losses; losses are generally limited to the owner	54,819	60%
Undetermined	• Hazard potential has not been designated or was not provided	11,545	13%

Sources: FEMA, *Federal Guidelines for Dam Safety: Hazard Potential Classification System for Dams*, 2004, at https://www.fema.gov/media-library-data/20130726-1516-20490-7951/fema-333.pdf; and National Inventory of Dams (NID) data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023.

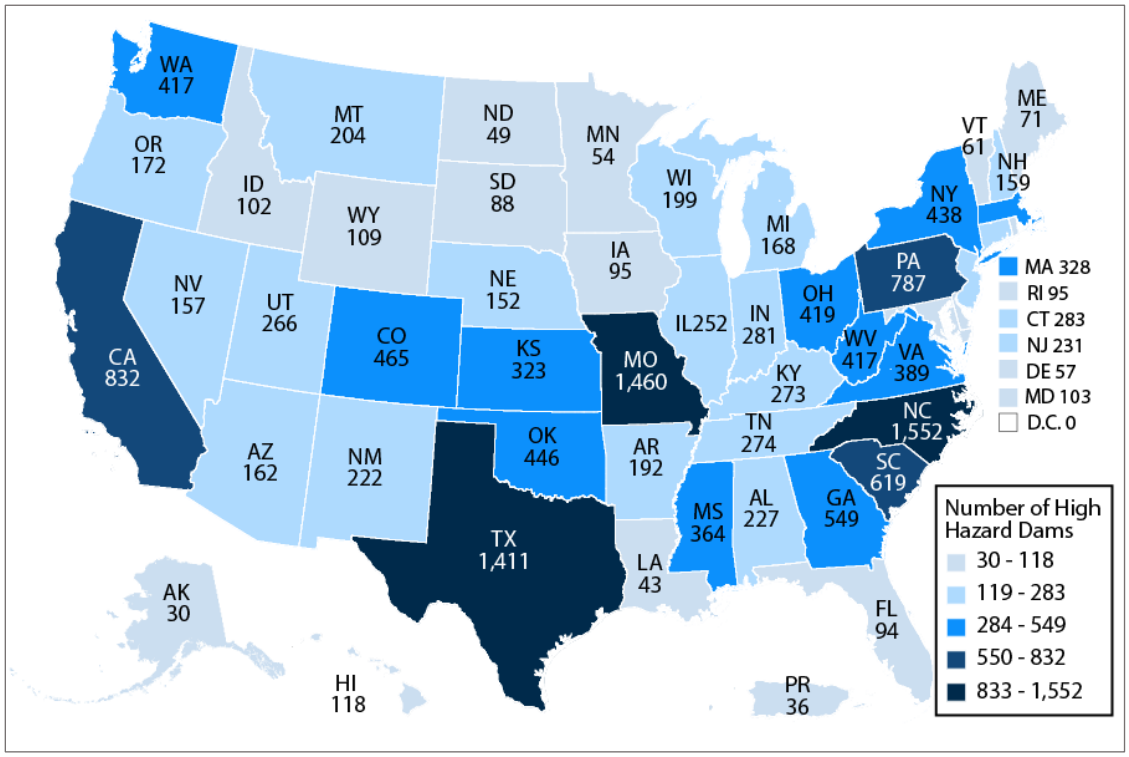
Notes: Low hazard dams are not included in the NID if they are less than 25 feet in height with a storage capacity of 15 acre-feet or less, or are 6 feet or less in height with a storage capacity of less than 50 acre-feet.

[29] FEMA, *National Dam Safety Program*, 2016-2017. NID, accessed on January 24, 2023, with data last updated on January 18, 2023.

[30] FEMA, *National Dam Safety Program*, 2016-2017; FEMA, *Risk Exposure*.

[31] ASCE, *Infrastructure Report Card*; U.S. Congress, House Committee on Transportation and Infrastructure, Subcommittee on Economic Development, Public Buildings, and Emergency Management, *Proposed Amendments to and Reauthorization of the National Dam Program Act*, 109th Cong., 2nd sess., July 26, 2006.

Figure 4. High Hazard Dams in States and Territories



Source: CRS using National Inventory of Dams (NID) data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023. Data for Texas are from 2019 NID data.

Notes: Guam has one high hazard dam. The NID does not list dams from territories other than Guam and Puerto Rico.

Risk Management

Preventing dam failure involves proper location, design, and construction of structures and regular technical inspections, O&M, and rehabilitation and repair of existing structures.[32] Preparing and responding to dam safety concerns may involve community development planning, emergency preparation, and stakeholder awareness.[33] Dam safety policies may address the risk that dams pose by focusing on preventing dam failure while preparing for the consequences if failure occurs.

Federal agencies and state dam safety agencies traditionally applied a deterministic, standards-based approach to dam safety by mainly considering a dam's structural integrity to determine how it would withstand maximum probable floods and maximum credible earthquakes. This approach resulted in these agencies providing condition assessments—assessments of relative dam deficiencies determined from inspections. The NID still includes condition assessments as reported by state agencies (see **Table 2**) and some federal agencies.[34] Of the 13,669 high hazard

[32] FEMA, "Dam Operation and Maintenance," at https://www.fema.gov/dam-operation-and-maintenance.

[33] FEMA, *Risk Reduction Measures for Dams*, 2018, at https://www.fema.gov/sites/default/files/2020-08/fact-sheet_risk-reduction-measures-dams.pdf. Hereinafter FEMA, *Risk Reduction*.

[34] Condition is an assessment of any potential dam deficiencies determined from inspections. States and federal agencies may have additional definitions and rating applications that are used to classify dams, which may vary from state to state as well as among federal agencies. ASCE, Infrastructure Report Card; FEMA, *The National Dam Safety*

potential nonfederal dams in the NID as of January 2023, 61% had satisfactory or fair condition assessment, 15% had a poor or unsatisfactory condition assessment, and 24% were not rated.[35] For dams rated as poor and unsatisfactory, state regulatory agencies may take actions to reduce risk, such as reservoir drawdowns, and may convey updated risk and response procedures to stakeholders.[36]

Table 2. Condition Assessment of Nonfederal Dams in the United States

Condition Ratings	Description of Condition Rating	High Hazard Dams	Significant Hazard Dams	Low Hazard Dams	Undetermined Hazard Dams
Satisfactory	• No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all conditions in accordance with the minimum applicable regulatory criteria or tolerable risk guidelines.	4,515	2,428	4,308	334
Fair	• No existing dam safety deficiencies are recognized for normal operating conditions. • Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. • Risk may be in the range to take further action.	3,881	2,315	4,234	1,038
Poor	• A dam safety deficiency is recognized for normal operating conditions that may realistically occur. • Remedial action is necessary. • Uncertainties may exist to identify a potential dam safety deficiency and investigations and studies are necessary.	1,758	1,513	3,367	185
Unsatisfactory	• A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.	251	116	304	98
Not Rated	• The dam has not been inspected, is not required to be inspected, or has been inspected but not rated.	3,265	3,721	41,346	9,884

Source: National Inventory of Dams (NID) data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023; and USACE, *National Inventory of Dams, Data Dictionary*, August 2022, at https://nid.usace.army.mil/#/documents.

Notes: A *dam safety deficiency* is an unacceptable dam condition that may affect the safety of the dam either in the near term or in the future.

Program: Biennial Report to the United States Congress, Fiscal Years 2012-2013, 2014, at https://www.fema.gov/media-library-data/1467048771223-c5323440700a175565a2c0c9d604f9e3/DamSafetyUnitedStatesAug2014.pdf.

[35] NID data accessed on January 24, 2023, with data last updated on January 18, 2023.

[36] National Research Council, *Dam and Levee Safety*.

Some federal agencies (e.g., Reclamation, USACE, FERC) have since transitioned from this solely standards-based approach for their dam safety programs to a portfolio-wide risk-informed decisionmaking (RIDM) management approach to dam safety. These and other federal agencies working toward adopting a RIDM management approach no longer report condition assessment to the NID. Instead, some of these agencies use rating systems, such as the ones in **Table 3**. According to FEMA, "a risk-management approach seeks to improve the resilience of dam infrastructure and mitigate failure of dams and related structures through inspection programs, risk reduction measures, and rehabilitation and repair."[37] In the context of dam safety, risk comprises three parts:[38]

- the likelihood of a triggering event (e.g., flood or earthquake),
- the likelihood of a dam safety deficiency resulting in adverse structural response (e.g., dam failure or spillway damage), and
- the magnitude of potential consequences resulting from the adverse event (e.g., loss of life or economic damages).

Evaluating and reducing risk requires a framework that explicitly evaluates the level of risk if no action is taken, including for all modes of failure (e.g., seepage of water and sediment through a dam), and recognizes the monetary and nonmonetary costs and benefits of reducing risks when making decisions. The RIDM framework comprises risk assessment, risk management, and risk communication. The RIDM assessment process aims to inform better decisionmaking and to enable more effective use of limited resources. Some state dam safety agencies (e.g., Colorado) also are working to incorporating a risk management approach.[39]

Table 3. Summary of Dam Safety Rating Systems for USACE (DSAC) and Bureau of Reclamation (DSPR)

	USACE Dam Safety Action Classification Ratings (DSAC)	Reclamation Dam Safety Priority Ratings (DSPR)
1	**Very High Urgency—**almost certain to fail immediately to a few years under normal operations or the combination of consequences and failure probability is extremely high.	**Immediate Priority—**active failure mode or extremely high likelihood of failure requiring immediate actions to reduce risk.
2	**High Urgency—**likelihood of failure during normal operations or a consequence of an event is too high to assure public safety or the combination of consequences and failure probability is very high.	**Urgent Priority—**potential failure modes are judged to present various serious risks, which justify urgency to reduce risk.
3	**Moderate Urgency—**dam may have issues where the incremental risk is moderate and the level of life-risk is unacceptable except in unusual circumstances.	**Moderate to High Priority—**potential failure modes appear to be dam safety deficiencies that propose a significant risk of failure, and actions are needed to better define risks or to reduce risks.
4	**Low Urgency—**dam is inadequate but with low risk, such that the combination of consequences and failure probability is low. Dam may not meet all USACE engineering guidelines.	**Low to Medium Priority—**potential failure modes appear to indicate a potential concern but do not indicate a pressing need for action.

[37] FEMA, *The National Dam Safety Program: Biennial Report to the United States Congress, Fiscal Years 2018-2019*, November 2022, at https://www.fema.gov/sites/default/files/documents/fema_ndsp-report-congress-fy18-fy19.pdf.

[38] Personal correspondence between CRS and FEMA, June 26, 2019.

[39] State of Colorado, Department of Natural Resources, *Guidelines for Comprehensive Dam Safety Evaluation (CDSE) Risk Assessments & Risk Informed Decision Making (RIDM)*, March 8, 2021, at https://dnrweblink.state.co.us/dwr/ElectronicFile.aspx?docid=3566811&dbid=0.

	USACE Dam Safety Action Classification Ratings (DSAC)	Reclamation Dam Safety Priority Ratings (DSPR)
5	**Normal—**considered safe, meeting all agency guidelines, with tolerable residual risk.	**Low Priority—**potential failure modes do not appear to present significant risk, and there are no apparent dam safety deficiencies.

Sources: Bureau of Reclamation, *Dam Safety Public Protection Guidelines: A Risk Framework to Support Dam Safety Decision-Making*, 2011, at https://www.usbr.gov/ssle/damsafety/documents/PPG201108.pdf. U.S. Army Corps of Engineers (USACE), *Safety of Dams – Policy and Procedures*, Engineering Regulation 1110-2-1156 at https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-1156.pdf.

Rehabilitation and Repair

Rehabilitation typically consists of bringing a dam up to current safety standards (e.g., increasing spillway capacity, installing modern gates, addressing major structural deficiencies), and repair addresses damage to a structure. Rehabilitation and repair are different from day-to-day O&M. In 2022, the Association of State Dam Safety Officials estimated that $75.7 billion was needed to rehabilitate nonfederal dams; of that amount, $24.0 billion was needed for high hazard potential nonfederal dams.[40] Federal agencies report various funding estimates needed for rehabilitation and repair of dam that they manage. Some stakeholders project that funding requirements for dam safety rehabilitation and repair will continue to grow as infrastructure ages, risk awareness progresses, and design standards evolve.[41]

Preparedness

Dam safety processes and products—such as EAPs and inundation maps—may support informed decisionmaking to reduce the risk and consequences of dam failures and incidents.[42] An EAP is a formal document that identifies potential emergency conditions at a dam and specifies preplanned actions to minimize property damage and loss of life.[43] EAPs identify the actions and responsibilities of different parties in the event of an emergency, such as the procedures for issuing early warning and notification messages to emergency management authorities. EAPs also contain inundation maps to show emergency management authorities the critical areas for action in case of an emergency (see **Figure 5** for a map illustration of potential inundation areas due to a hypothetical dam breach).[44] Many agencies that are responsible for dam oversight require or encourage dam owners to develop EAPs and often oversee emergency response simulations (i.e., tabletop exercises) and field exercises.[45] Requirements for EAPs often focus on high hazard

[40] ASDSO, *The Cost of Rehabilitating Our Nation's Dams*, March 2022, at https://damsafety-prod.s3.amazonaws.com/s3fs-public/files/Cost%20of%20Rehab%20Report-2022%20FINAL.pdf.

[41] ASCE, *Infrastructure Report Card*.

[42] FEMA, *Risk Reduction*.

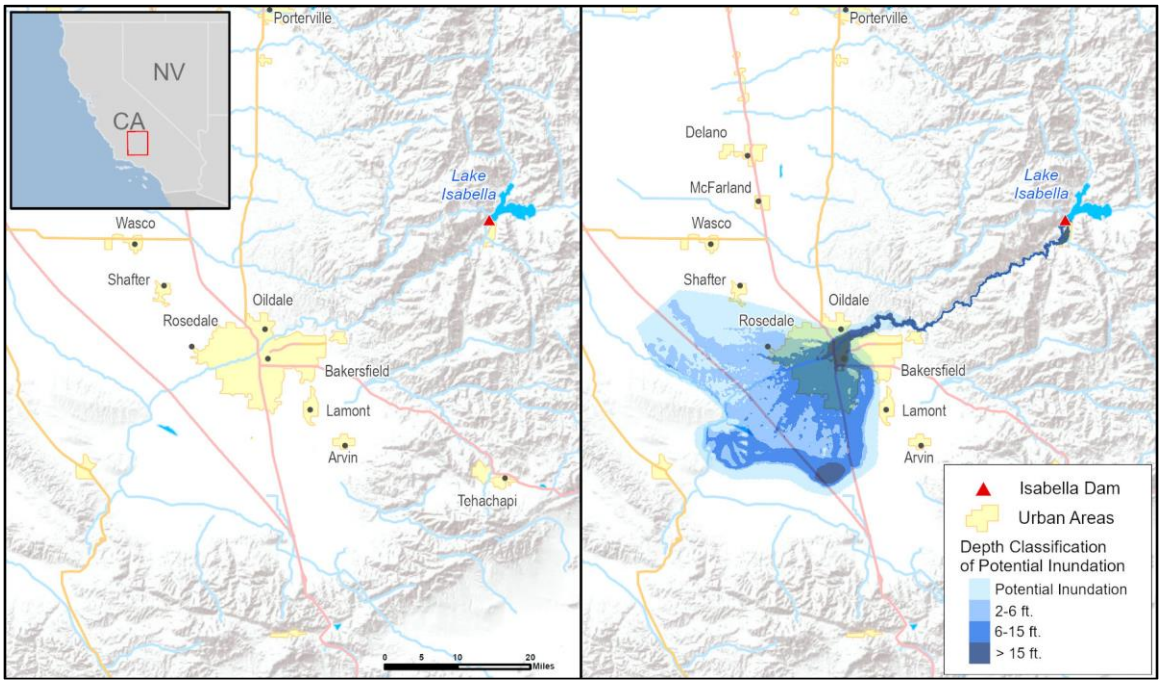
[43] FEMA, *Federal Guidelines for Dam Safety: Emergency Action Planning for Dams*, 2013, at https://www.swc.nd.gov/pdfs/fema_64_emergency_action_planning_dams.pdf.

[44] Inundation area from dam or associated structural failure is typically calculated using computer models. These include hydrologic runoff and hydraulic flow models as well as models that estimate dam failure breach formation and discharge hydrographs. The models use parameters such as precipitation, snowmelt (if needed), runoff rates, watershed slope, downstream channel topography and other characteristics. The models used in most cases are HEC-RAS (developed by USACE) and DSS-WISE developed by the University of Mississippi for the Department of Homeland Security.

[45] FEMA, *National Dam Safety Program*, 2016-2017. Tabletop exercises are designed to help test a hypothetical situation, such as a dam failure, and evaluate responders' ability to respond and work together.

dams. In 1999, 35% of state regulated high hazard potential dams had EAPs.[46] In January 2023, the percentage of high hazard potential dams in the United States with EAPs was 82% for state-regulated dams and 97% for federally owned dams.[47]

Figure 5. USACE Potential Flood Inundation Map for Isabella Dam



Source: CRS with data from National Inventory of Dams (NID) data accessed at https://nid.sec.usace.army.mil.

Notes: Flood inundation maps illustrate how far flood water may extend beyond the river channel by overlaying a shaded zone on a map of the river and its surrounding topography. These maps also show how deep the flood waters are anticipated to be for various flood scenarios. These projected flood depths are displayed as ranges (in feet) for specific sections of the potentially flooded areas. In particular, the U.S. Army Corps of Engineers (USACE) develops a set of flood inundation maps for each of its dams by modeling a limited set of standard flooding scenarios. The map above is for a hypothetical breach occurring at USACE's Isabella Dam when water levels are at the top of the active storage pool. USACE completed dam safety modification construction in 2022; this scenario is based on modeling from before this construction project. Flood inundation maps are designed to show the upper limit of potential impacts. Not all the standard flooding scenarios are equally likely to occur, and the maps are not intended to be predictive of what situations will occur. Flood inundation maps are available in the NID for most USACE dams. Currently, most other federal agencies do not publicly release inundation maps for federally owned dams. Some states, such as California, provide flood inundation map information on their own websites.

Federal agencies have developed tools to assist dam owners and regulators, along with emergency managers and communities, to prepare for, monitor, and respond to dam failures and incidents.

- FEMA's RiskMAP program provides flood maps, tools to assess the risk from flooding, and planning and outreach support to communities for flood risk mitigation.[48] A RiskMAP project may incorporate the potential risk of dam failure or incidents.

[46] ASDSO, "Roadmap to Reducing Dam Safety Risks," at https://www.damsafety.org/Roadmap.

[47] NID data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023.

[48] FEMA, "Risk Mapping, Assessment and Planning (Risk MAP)," at https://www.fema.gov/flood-maps/tools-

- FEMA's Decision Support System for Water Infrastructure Security (DSS-WISE) Lite allows states to conduct dam failure simulations and human consequence assessments.[49] Using DSS-WISE Lite, FEMA conducted emergency dam-break flood simulation and inundation mapping of 36 dams in Puerto Rico during the response to Hurricane Maria in 2017.
- DamWatch is a web-based monitoring and informational tool for 11,800 nonfederal flood control dams built with assistance from the U.S. Department of Agriculture.[50] When these dams experience a critical event (e.g., threatening storm systems), essential personnel are alerted via an electronic medium and can implement EAPs if necessary.
- The U.S. Geological Survey's ShakeCast is a post-earthquake awareness application that notifies responsible parties of dams about the occurrence of a potentially damaging earthquake and its potential impact at dam locations.[51] The responsible parties may use the information to prioritize response, inspection, rehabilitation, and repair of potentially affected dams.

Federal Role and Resources for Dam Safety

In addition to owning dams, the federal government is involved in multiple areas of dam safety through legislative and executive actions. Following USACE's publication of the NID in 1975 as authorized by P.L. 92-367, the Interagency Committee on Dam Safety—established by President Jimmy Carter through Executive Order 12148—released safety guidelines for dams regulated by federal agencies in 1979.[52] In 1996, the National Dam Safety Program Act (Section 215 of the Water Resources Development Act of 1996, as amended; P.L. 104-303; 33 U.S.C. §§467 et seq.) established the National Dam Safety Program (NDSP), the nation's principal dam safety program, under the direction of FEMA. Congress has reauthorized the NDSP and enacted other dam safety programs and activities related to federal and nonfederal dams.[53] A chronology of selected federal dam safety actions is provided in the box below.

resources/risk-map.

[49] FEMA, DSS-WISETM HCOM: Human Consequences of Dam-Break Floods, at https://www.fema.gov/media-library-data/1593524739829-955771e7e1eed3a8d6a36a5d1e79abf7/DSS-WISE_HCOM_Fact_Sheet.pdf.

[50] U.S. Engineering Solutions, "DamWatch," at https://www.usengineeringsolutions.com/dam-watch/.

[51] U.S. Geological Survey (USGS), "The USGS ShakeCast System," at https://www.usgs.gov/news/usgs-shakecast-system.

[52] Executive Order 12148, "Federal Emergency Management," 44 *Federal Register* 43239, 1979, at https://www.archives.gov/federal-register/codification/executive-order/12148.html. The federal guidelines for dam safety established a basic structure for agencies' dam safety programs. The guidelines have been updated subsequently. FEMA, *Federal Guidelines for Dam Safety*, 2004, at https://www.fema.gov/sites/default/files/2020-08/fema_dam-safety_P-93.pdf. Hereinafter FEMA, *Federal Guidelines*.

[53] Baecher et al., *Review and Evaluation*, University of Maryland.

Chronology of Selected Federal Administrative and Legislative Actions for Dam Safety

1972 An Act to Authorize the Secretary of the Army to Undertake a National Program of Inspection of Dams (P.L. 92-367)	Authorized the U.S. Army Corps of Engineers (USACE) to undertake a national program of dam inspection, to create the National Inventory of Dams (NID), and to provide recommendations to Congress for dam safety policies. Inspections were not undertaken due to a lack of appropriations and uncertainty in the federal government's authority to inspect nonfederal dams.
1975	USACE publishes the first version of the NID.
1977 Memorandum from President Carter	Directed federal agencies to review their dam safety practices and established an ad hoc Interagency Committee on Dam Safety (ICODS).
1978	USACE established a National Dam Inspection Program and reported that one-third of the nonfederal dams inspected in a preliminary "Phase I Inspection Program" survey were unsafe. Subsequently, more states established or enhanced dam safety programs.
1978 Reclamation Safety of Dams Act of 1978 (P.L. 95-578)	Authorized the Bureau of Reclamation (Reclamation) to make dam safety modifications at Reclamation dams.
1979 President Carter issued Executive Order 12148	Required the newly established Federal Emergency Management Agency (FEMA) to coordinate agency efforts to promote dam safety. Formally established the ICODS, which also released the first *Federal Guidelines for Dam Safety* in 1979.
1984 Reclamation Safety of Dams Act Amendments of 1984 (P.L. 98-404)	Altered funding of Reclamation dam safety modification projects by instituting a nonfederal cost share of 15%.
1986 Water Resources Development Act of 1986 (P.L. 99-662)	Authorized USACE to distribute grants to state dam safety programs, provide inspection trainings, update the NID, establish a National Dam Safety Review Board (NDSRB) with seven members, and research dam safety. Only activities related to the NID were subsequently funded. Provided cost-share parameters for USACE dam modifications and activities at USACE-constructed dams.
1987	FEMA published the *Model State Dam Safety Program*, a guideline for developing state dam safety programs.
1994 Indian Dams Safety Act of 1994 (P.L. 103-302)	Directed the Bureau of Indian Affairs (BIA) to classify the condition of dams on Indian lands, establish a dam safety maintenance and repair program, and rehabilitate dams in an unsatisfactory condition.
1996 Water Resources Development Act of 1996 (P.L. 104-303)	Established the National Dam Safety Program (NDSP) under FEMA by transferring many dam safety activity authorities from USACE. Reauthorized grants to state dam safety programs and research at reduced funding levels and training at the same funding level. Established the NDSRB under FEMA with 11 members. Authorized USACE to continue NID updates.
2000 Grain Standards and Warehouse Improvement Act of 2000 (P.L. 106-472)	Established a Small Watershed Rehabilitation Program to provide technical and financial assistance for design and rehabilitation of aging dams constructed under certain U.S. Department of Agriculture programs.
2002 Dam Safety and Security Act of 2002 (P.L. 107-310)	Reauthorized the NDSP, added national security considerations to the legal framework, and increased authorization of appropriations for grants to state dam safety programs and research.
2006 Dam Safety Act of 2006 (P.L. 109-460)	Reauthorized the NDSP with increased authorization of appropriations and added condition assessment ratings to the NID.

2014 Water Resources Reform and Development Act of 2014 (P.L. 113-121)	Reauthorized the NDSP and increased the authorization of appropriations amounts (including the NID). Directed FEMA to implement a dam safety public awareness initiative and to add nongovernment organizations to the NDSRB.
2016 Water Infrastructure Improvements for the Nation Act (P.L. 114-322)	Authorized FEMA to provide grants for design and construction assistance to nonfederal sponsors for rehabilitation, repair, or removal of eligible high hazard dams (i.e., Rehabilitation of High Hazard Potential Dam Grant Program). Established Indian Dam Safety Deferred Maintenance Funds to address deferred maintenance, repair, and replacement needs of Indian high hazard and low hazard dams. Established a Tribal Safety of Dams Committee.
2018 America's Water Infrastructure Act of 2018 (P.L. 115-270)	Reauthorized appropriations for the NDSP through FY2023 and provisions of Section 3101 (Indian Dam Safety) of P.L. 114-322 through FY2030. Directed the Federal Energy Regulatory Commission (FERC) to assess nonfederal dam structures before expediting hydropower development licensing at nonpowered dams and closed-loop pumped storage projects.
2020 Consolidated Appropriations Act, 2021 (P.L. 116-260)	Amended the authorization for FEMA's Rehabilitation of High Hazard Potential Dam Grant Program. Created a new USACE account, Water Infrastructure Finance and Innovation Program Account, and through the account provided first funds for the Corps Water Infrastructure Financing Program (as authorized by 33 U.S.C. §§3901-3914) to provide credit assistance for nonfederal dam safety projects.
2021 Infrastructure Investment and Jobs Act (P.L. 117-58)	Provided authority and/or appropriations for various activities directly or indirectly related to dam safety activities, such as $148 million for NDSP state program grant assistance, $585 million for the Rehabilitation of High Hazard Potential Dam Grant Program, and $67 million for other NDSP activities.
2022 James M. Inhofe National Defense Authorization Act for Fiscal Year 2023 (P.L. 117-347)	Amended the National Dam Safety Program Act to direct USACE to develop a national low-head dam inventory and authorized $30 million to do so.

Source: CRS using selected public laws and executive orders; FEMA, *The National Dam Safety Program: Biennial Report to the United States Congress, Fiscal Years 2016-2017*, May 2019, at https://www.fema.gov/sites/default/files/2020-08/national-dam-safety_biennial-report-2016-2017.pdf; and the National Research Council (NRC), *Dam and Levee Safety and Community Resilience: A Vision for Future Practice*, 2012, at https://doi.org/10.17226/13393.

National Dam Safety Program

The NDSP is a federal program established to facilitate collaboration among the various federal agencies, states, and owners with responsibility for dam safety.[54] The NDSP also provides dam safety information resources and training, conducts research and outreach, and supports state dam safety programs with grant assistance. The NDSP does not mandate uniform standards across dam safety programs.

[54] The stated purpose of the NDSP was "to reduce the risks to life and property from dam failure in the United States through the establishment and maintenance of an effective national dam safety program to bring together the expertise and resources of the Federal and non-Federal communities in achieving national dam safety hazard reduction." FEMA, *National Dam Safety Program*, 2016-2017. National Research Council, *Dam and Levee Safety*. For information on the National Dam Safety Program (NDSP), see FEMA, "National Dam Safety Program," at https://www.fema.gov/national-dam-safety-program.

Advisory Bodies of the National Dam Safety Program

The National Dam Safety Review Board (NDSRB) advises FEMA's director on dam safety issues, including the allocation of grants to state dam safety programs. The board is to consist of five representatives appointed from federal agencies, five state dam safety officials, and one representative from the private sector.[55] The Interagency Committee on Dam Safety (ICODS) serves as a forum for coordination of federal efforts to promote dam safety. ICODS is chaired by FEMA and is to include representatives from FERC, the International Boundary and Water Commission, the Nuclear Regulatory Commission (NRC), the Tennessee Valley Authority, and the Departments of Agriculture, Defense, Energy, the Interior (DOI), and Labor (DOL).[56]

Assistance to State Dam Safety Programs

Every state (except Alabama) has established a regulatory program for dam safety, as has Puerto Rico.[57] Collectively, these programs have regulatory authority for 71% of the NID dams.[58] State dam safety programs typically include safety evaluations of existing dams, review of plans and specifications for dam construction and major repair work, periodic inspections of dams and construction work on new and existing dams, reviews and approval of EAPs required for certain dams,[59] and engagement with local officials and dam owners on emergency preparedness activities.[60] Funding levels and narrow state statutory authorities may limit the activities of some state dam safety programs.[61] In 2021, 15 states had more than seven full-time employees in their dam safety program.[62] In addition, some states—Alabama, Florida, Indiana, Kentucky, Vermont, and Wyoming—have not provided regulatory bodies with the authority to require dam owners of high hazard potential dams to develop EAPs.[63] However, state budgets, and accordingly staffing

[55] 33 U.S.C. §467f(f). For more information, see FEMA, "Advisory Committees," at https://www.fema.gov/emergency-managers/risk-management/dam-safety/advisory-committees#review-board.

[56] 33 U.S.C. §467e.

[57] FEMA, *National Dam Safety Program*, 2016-2017.

[58] NID data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023. States define their own regulatory jurisdiction (the height, volume, and type of dams to be regulated). According to ASDSO, most states follow the NID criteria, but regulatory statutes vary among states. Some states exempt categories of dams from inspection based on the purpose of the impoundment or the owner type. For example, Delaware law exempts dams owned by private individuals and entities; Missouri law exempts all agricultural purpose dams and dams less than 35 feet in height regardless of storage volume and potential hazard; and Texas law exempts privately owned significant hazard and low hazard potential dams storing less than a maximum of 500 acre-feet in counties with population less than 350,000, excluding dams within municipal corporate limits. Personal correspondence between CRS and ASDSO on August 30, 2019.

[59] An emergency action plan (EAP) is a formal document that identifies potential emergency conditions at a dam and specifies preplanned actions to minimize property damage and loss of life. EAPs identify the actions and responsibilities of different parties in the event of an emergency, such as the procedures to issue early warning and notification messages to emergency management authorities. EAPs also contain inundation maps to show emergency management authorities the critical areas for action in case of an emergency.

[60] FEMA, *Model State Dam Safety Program*, 2022, at https://damsafety-prod.s3.amazonaws.com/s3fs-public/files/FEMA%20316_Model%20State%20Dam%20Safety%20Program_2022.pdf; FEMA, *National Dam Safety Program*, 2016-2017.

[61] ASDSO, "State Performance and Current Issues," at https://damsafety.org/state-performance.

[62] Past recommendations were for one full-time employee for every 20 state-regulated dams. Updated draft guidance to states may provide broader recommendations for staffing needs based on the different types of programs, such as state agencies that perform most dam safety work in-house compared with states that outsource work or require dam owners to hire engineers to perform inspections. Personal correspondence between CRS and ASDSO on October 17, 2022.

[63] Regulations for high hazard potential dams vary by state, although FEMA has encouraged requiring EAPs for high hazard potential dams. Personal correspondence between CRS and ASDSO on October 17, 2022. ASDSO, *Summary of*

levels, have increased over the past couple decades (e.g., 317 full-time employees in 1999 compared with nearly 455 full-time employees in 2022).[64]

The National Dam Safety Program Act authorizes state assistance programs under the NDSP. This assistance includes (1) grant assistance to state dam safety programs that are working toward or meeting minimal requirements as established by the National Dam Safety Program Act,[65] (2) grants for rehabilitation of high hazard potential dams, and (3) trainings for state inspectors, among other assistance. For more information on NDSP assistance for states, see CRS Report R47383, *Federal Assistance for Nonfederal Dam Safety*.

National Dam Safety Program Reporting

At the end of each odd-numbered fiscal year, FEMA is to submit to Congress a report describing the NDSP's status, federal agencies' progress at implementing the *Federal Guidelines for Dam Safety*, progress achieved in dam safety by states participating in the program, and any recommendations for legislation or other actions (33 U.S.C. §467h).[66] Federal agencies and states provide FEMA with annual program performance assessments on key metrics such as inspections, rehabilitation and repair activities, EAPs, staffing, and budgets. USACE provides summaries and analysis of NID data (e.g., inspections and EAPs) to FEMA. FEMA published *The National Dam Safety Program Biennial Report to the United States Congress, Fiscal Years 2018–2019* on November 17, 2022.[67] As of March 2023, FEMA had not published a biennial report covering subsequent years.

Association of State Dam Safety Officials

The Association of State Dam Safety Officials (ASDSO) comprises 3,000 state, federal, and local dam safety professionals and private sector experts organized to improve dam safety through research, education, and communication. After its establishment in 1983, ASDSO worked with the Federal Emergency Management Agency (FEMA) to publish the *Model State Dam Safety Program* to assist state officials in initiating or improving their state programs. The model outlines the key components of a dam safety program and provides guidance on the development of state programs, including legislative authorities, to minimize risks created by unsafe dams. ASDSO continues to support various elements of the National Dam Safety Program, especially through training initiatives and outreach to dam owners. The Model Dam Safety Program was most recently updated in 2022. The *Model State Dam Safety Program* may be accessed at https://damsafety-prod.s3.amazonaws.com/s3fs-public/files/FEMA%20316_Model%20State%20Dam%20Safety%20Program_2022.pdf. For more information on ASDSO, see https://damsafety.org/.

Federally Owned Dams

Federally owned dams are dams owned by the federal government that are managed by one or more federal agencies. The federal government is responsible for maintaining dam safety of federally owned dams by performing maintenance, inspections, rehabilitation, and repair work.

State Laws and Regulations on Dam Safety, May 2022, at https://damsafety-prod.s3.amazonaws.com/s3fs-public/files/FINAL%20-%202020%20Update%20State%20Laws%20and%20Regulations%20Summary_0.pdf.

[64] ASDSO, "Roadmap to Reducing Dam Safety Risks," at https://www.damsafety.org/Roadmap.

[65] The National Dam Safety Program Act, as amended, (Section 215 of the Water Resources Development Act of 1996; P.L. 104-303) established 10 criteria that state dam safety programs must meet or be working toward meeting to be eligible for the grant assistance program (33 U.S.C. § 467f).

[66] FEMA, *National Dam Safety Program*, 2016-2017.

[67] FEMA, "Dam Safety in the United States: A Progress Report on the National Dam Safety Program," at https://www.fema.gov/emergency-managers/risk-management/dam-safety/progress-report.

No single agency regulates all federally owned dams; rather, each federal dam is regulated according to the policies and guidance of the individual federal agency that owns the dam.[68] The *Federal Guidelines for Dam Safety* provides basic guidance for federal agencies' dam safety programs.[69]

According to the NID, in January 2023, federal agencies reported managing 2,825 federal dams, with some dams managed by multiple federal agencies (**Figure 6**).[70] Federally owned dams may be under the jurisdiction of three broad categories of federal agencies:

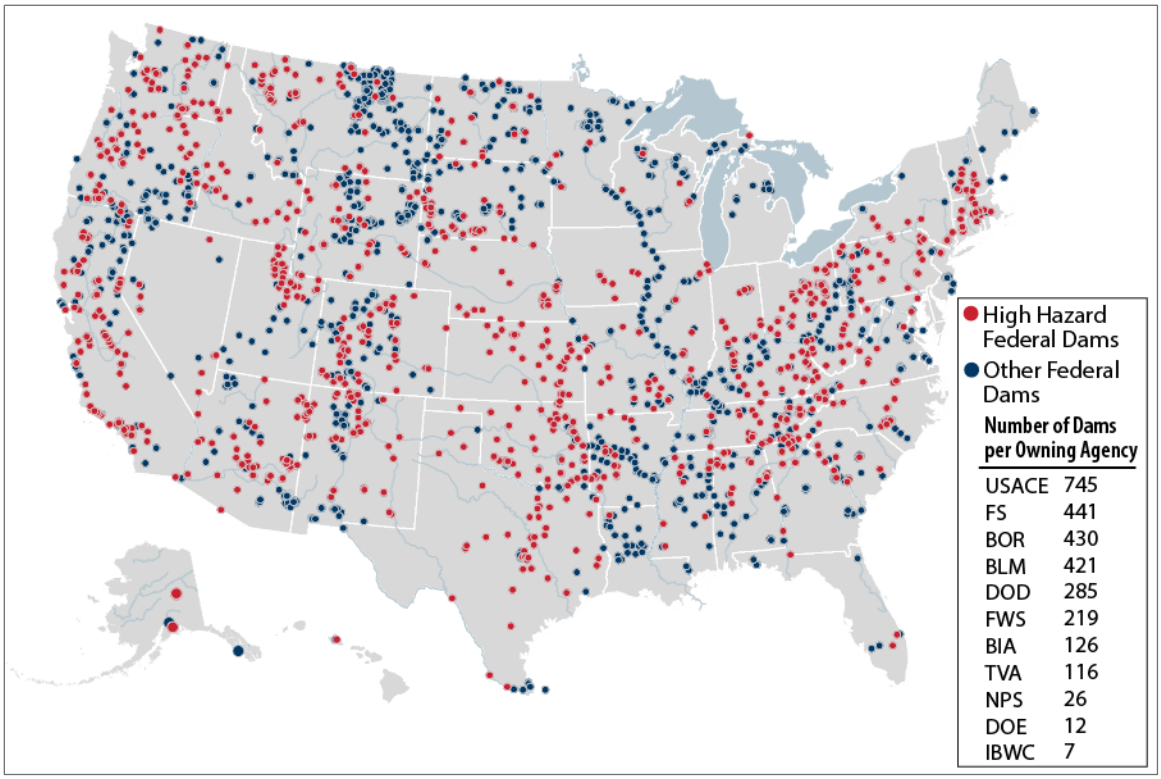
- Agencies that primarily manage water resources—USACE and Reclamation—manage 42% of federal dams in the NID, including many large dams. Dams managed by these agencies may be located on lands managed by other agencies.
- Agencies that manage most federal lands, collectively known as the federal land management agencies (i.e., the Bureau of Land Management, U.S. Fish and Wildlife Service, Forest Service [FS], and National Park Service), manage 39% of federal dams in the NID, which are typically smaller dams.
- Agencies that manage the remainder of federal dams, such as the Department of Defense and the Tennessee Valley Authority.

[68] FEMA, *National Dam Safety Program*, 2016-2017.

[69] FEMA, *Federal Guidelines*. At times, some agencies have received criticism of their dam safety programs in carrying out the *Federal Guidelines for Dam Safety*. For example, in 2014, the Department of Defense (DOD) Inspector General found that DOD did not have a policy requiring installations to implement a dam safety inspection program consistent with the *Federal Guidelines for Dam Safety*. Office of the Inspector General, U.S. Department of Defense, *DOD Needs Dam Safety Inspection Policy to Enable the Services to Detect Conditions that Could Lead to Dam Failure*, U.S. Department of Defense, 2014, at https://media.defense.gov/2019/Aug/22/2002174057/-1/-1/1/DODIG-2015-062.PDF. Hereinafter Inspector General, *DOD Needs Dam Safety Inspection Policy*.

[70] Federal agencies self-report dam management to the NID. Other federal agency documents may list more dams managed by their agencies that are not included in the NID. For this report, dam management data are from the NID unless otherwise noted. NID data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023.

Figure 6. Location of Federal Dams and Number of Dams Owned per Agency



Source: CRS using National Inventory of Dams (NID) data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023.

Notes: No federal dams are in Puerto Rico, and one is in Guam. In addition to the agencies shown in the figure, the U.S. Department of Agriculture's Agricultural Research Service owns one high hazard dam. Multiple federal agencies may own a dam. USACE = U.S. Army Corps of Engineers, FS = Forest Service, BOR = Bureau of Reclamation, FWS = U.S. Fish and Wildlife Service, BLM = Bureau of Land Management, DOD = Department of Defense, BIA = Bureau of Indian Affairs, TVA = Tennessee Valley Authority, NPS = National Park Service, DOE = Department of Energy, IBWC = International Boundary and Water Commission.

The *Federal Guidelines for Dam Safety* recommend that agencies formally inspect each dam that they own at least once every five years; however, some agencies require more frequent inspections and base the frequency of inspections on the dam's hazard potential or their risk-management approach.[71] Inspections may result in an update of the dam's hazard potential, among other categorical amendments. After identifying dam safety deficiencies, federal agencies may undertake risk reduction measures (e.g., nonstructural operation changes) or rehabilitation and repair activities. Agencies may not have funding available to immediately undertake all nonurgent rehabilitation and repair; rather, they generally prioritize their rehabilitation and repair investments based on various forms of assessment and schedule these activities in conjunction with the budget process.[72] At some agencies, dam rehabilitation and repair needs must compete

[71] FEMA, *Federal Guidelines*; National Research Council, *Dam and Levee Safety*.

[72] FEMA, *National Dam Safety Program*, 2016-2017; Michelle Ho et al., "The Future Role of Dams in the United States of America," *Water Resources Research*, 2017, vol. 53, pp. 982-998.

for funding with other construction projects (e.g., buildings and levees).[73] The following sections briefly discuss dam safety activities at the three agencies managing the most federal dams.

U.S. Army Corps of Engineers

USACE implements a dam safety program consisting of inspections and risk analyses for USACE-operated dams, and performs risk reduction measures or project modifications to address dam safety risks.[74] USACE uses a risk-informed approach for all dam safety program decisions and applies the Dam Safety Action Classification System (DSAC), which is based on the likelihood of failure in combination with loss of life, economic, or environmental consequences (see **Table 3**).[75]

Congress provides funding for USACE's various dam safety activities through the Investigations, O&M, and Construction accounts.[76] The Inventory of Dams line item in the Investigations account provides funding for the maintenance and publication of the NID. The O&M account provides funding for routine O&M of USACE dams and for NDSP activities, including assessments of USACE dams.

The Construction account provides funding for nonroutine dam safety activities (e.g., dam safety rehabilitation and repair modifications).[77] The Dam Safety and Seepage/Stability Correction Program conducts nonroutine dam safety evaluations and studies of extremely high-risk or very high-risk dams (DSAC 1 and DSAC 2).[78] Under the program, an issue evaluation study may evaluate high-risk dams, dam safety incidents, and unsatisfactory performance, and then provide determinations for modification or reclassification. If recommended, a dam safety modification study would further investigate dam deficiencies and propose alternatives to reduce risks to tolerable levels; a dam safety modification report is issued if USACE recommends a modification.[79] USACE funds construction of dam safety modifications through project-specific

[73] FEMA, *National Dam Safety Program*, 2016-2017.

[74] The dam safety program is managed from headquarters, with the dam safety officer responsible for making all dam safety decisions and ensuring consistent prioritization decisions. USACE districts are responsible for executing the dam safety program, with oversight from their Dam Safety Production Centers (DSPCs). DSPCs are responsible for reviewing products and ensuring that all dam safety products meet policy requirements for the program. The Risk Management Center, which is available as a resource to all districts, provides expertise in dam safety disciplines and reviews dam safety products from a portfolio perspective. Personal correspondence between CRS and USACE, July 15, 2019. USACE prescribes flood and navigation operations for certain nonfederal dams under the authority of Section 7 of the Flood Control Act of 1944. However, USACE policy states that the nonfederal project owner of these dams "is responsible for the safety of the dam and appurtenant facilities and for regulation/operation of the project during surcharge storage…which results when the total storage space reserved for flood control is exceeded." USACE, *Water Control Manual*, Chapter 4, 1110-2-240, May 30, 2016, at https://www.publications.usace.army.mil/portals/76/publications/engineerregulations/er_1110-2-240.pdf.

[75] Incremental risk is the risk (e.g., the likelihood and consequences of inundation) to the reservoir area and downstream floodplain that can be attributed to the presence of the dam should the dam breach, overtop, or undergo malfunction or misoperation. For more information, see https://www.usace.army.mil/Missions/Civil-Works/Dam-Safety-Program/Program-Activities/.

[76] Personal correspondence between CRS and USACE, July 15, 2019.

[77] Personal correspondence between CRS and USACE, July 15, 2019.

[78] Sometimes USACE also evaluates Dam Safety Action Classification (DSAC) 3 dams under the Seepage/Stability Correction Program. Personal correspondence between CRS and USACE, July 15, 2019.

[79] Interim risk-reduction measures for dam safety are developed, prepared, and implemented to reduce the probability and consequences of failure to the maximum extent that it is reasonably practicable while long-term remedial measures are pursued. USACE, *Engineering and Design, Water Control Management*, ER-1110-2-240, 2016, at https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-240.pdf.

line items in the Construction account. Modification of USACE-constructed dams for safety purposes may be cost shared with nonfederal project sponsors using two cost-sharing authorities: major rehabilitation and dam safety assurance (see below).[80] USACE schedules modifications under all of these programs based on funding availability.

- *Major rehabilitation* is for significant, costly, one-time structural rehabilitation or major replacement work. Major rehabilitation applies to dam safety repairs associated with typical degradation of dams over time. Nonfederal sponsors are to pay the standard cost share based on authorized purposes. USACE does not provide support under major rehabilitation for facilities that were turned over to local project sponsors for O&M after they were constructed by USACE.
- *Dam safety assurance* cost sharing may apply to all dams built by USACE, regardless of the entity performing O&M. Modifications are based on new hydrologic or seismic data or changes in state-of-the-art design or construction criteria that are deemed necessary for safety purposes. Application of the authority provided by Section 1203 of the Water Resources Development Act of 1986 (P.L. 99-662; 33 U.S.C. §467n) reduces a sponsor's responsibility to 15% of its agreed nonfederal cost share.[81]

Bureau of Reclamation

Reclamation's dam safety program, authorized by Reclamation Safety of Dams Act of 1978, as amended (P.L. 95-578; 43 U.S.C. §§506 et seq.), provides for inspection of and repairs to qualifying projects at Reclamation dams. Reclamation conducts dam safety inspections through the Safety Evaluation of Existing Dams (SEED) program using Dam Safety Priority Ratings (DSPR; see **Table 3**).[82] Corrective actions, if necessary, are carried out through the Initiate Safety of Dams Corrective Action (ISCA) program. With ISCA appropriations, Reclamation funds modifications on priority structures based on an evolving identification of risks and needs.

The Reclamation Safety of Dams Act Amendments of 1984, as amended (P.L. 98-404; 42 U.S.C. §§506 et seq.) requires a 15% cost share from sponsors for dam safety modifications when modifications are based on new hydrologic or seismic data or changes in state-of-the-art design or construction criteria that are deemed necessary for safety purposes. Costs resulting from age and normal deterioration or lack of maintenance of structures are considered project costs and are allocated and deemed reimbursable based on the authorized project purposes and existing law. In 2015, P.L. 114-113 amended the Reclamation Safety of Dams Act to increase Reclamation's authority, before needing congressional authorization to approve a modification project, from $1.25 million to $20 million.[83] The act also authorized the Secretary of the Interior to develop

[80] According to ER 1110-2-1156, projects with a formal agreement that identifies the cost sharing percentages for major rehabilitation or dam safety modifications must be cost shared with a nonfederal sponsor in accordance with the agreement (i.e., contract). Projects without a formal agreement will be cost shared at the same ratio as the original cost sharing for the project. Cost sharing for navigation and hydropower projects may differ in accordance with USACE authorities and policies. USACE, *Safety of Dams—Policy and Procedures*, ER 1110-2-1156, 2014, at https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-1156.pdf?ver=2014-04-10-153209-550.

[81] Section 1139 of the Water Infrastructure Improvements for the Nation Act (WIIN Act; P.L. 114-322) mandated the issuance of guidance on the state-of-the-art provision, and in March 2019, USACE began to implement a new policy that allows for the state-of-the-art provision across its dam portfolio.

[82] Reclamation, *Dam Safety Public Protection Guidelines: A Risk Framework to Support Dam Safety Decision-Making*, 2011, at https://www.usbr.gov/ssle/damsafety/documents/PPG201108.pdf.

[83] 43 U.S.C. §509.

additional project benefits, through the construction of new or supplementary works on a project in conjunction with dam safety modifications, if such additional benefits are deemed necessary and in the interests of the United States and the project. Nonfederal and federal funding participants must agree to a cost share related to the additional project benefits. [84]

The Commissioner of Reclamation also serves as the DOI's chair for the DOI Working Group on Dam Safety and Security and advises the Secretary of the Interior on program development and operation of the dam safety programs within DOI.[85] In this role, Reclamation provides training to other DOI agencies with dam safety programs and responsibilities, and Reclamation's dam safety officer represents DOI on the ICODS.[86]

U.S. Forest Service[87]

The FS manages dams on its lands, within the National Forest System (NFS), and may authorize nonfederal entities to use NFS lands for dams through a special use authorization (SUA; see box on "Nonfederal Dams on Federal Lands").[88] In addition, dams managed by other federal agencies (e.g., USACE, Reclamation) are located on NFS lands; the federal agency managing the dam has responsibility for those dams.

FS policies provide for general requirements and procedures for FS dams, such as classification, O&M plans, EAPs, and construction and design criteria.[89] FS policy requires NFS units to have a systematic dam inspection program, through which dams' maintenance needs, hazardous situations, operations, and other attributes are monitored.[90] Any dam with "deficiencies that significantly affect the integrity of the facility" must be repaired as soon as possible, or removed from service until repairs can be made if needed to protect human life or surrounding lands and resources.[91] The FS also requires routine hazard assessments, through which consequences of dam failure are evaluated.[92]

The FS typically uses general funding for capital improvement, maintenance, and deferred maintenance,[93] which includes dams, roads, structures, and other FS-managed infrastructure. Therefore, funding for dams, particularly major maintenance or rehabilitation (i.e., activities that cost more than $250,000), competes for funding along with other infrastructure projects in the

[84] The costs associated with developing the additional project benefits are to be allocated exclusively among beneficiaries of the additional project benefits and to be repaid consistent with provisions of Federal Reclamation law (43 U.S.C. §§371 et seq.).

[85] Reclamation, *2021 DOI Annual Report on Dam Safety*, July 2022. To mitigate risks for DOI dams, Department Manual Series 38, Part 753, "Dam Safety and Security Programs," provides requirements and guidance to execute DOI's responsibility for dam safety, including the management of dam safety programs within BIA, BLM, Reclamation, FWS, NPS, and OSMRE.

[86] Personal correspondence between CRS and Reclamation, July 8, 2019.

[87] This section was authored by Anne Riddle, analyst in natural resources policy.

[88] The U.S. Forest Service (FS) may build and operate dams on National Forest System (NFS) lands in accordance with the FS's general authorities to plan and manage uses of the NFS (16 U.S.C. §§1600 et seq.; 16 U.S.C. §1601).

[89] Forest Service Manual 7500, "Water Storage and Transmission" and subchapters.

[90] FS Manual 7510, "Project Administration." Inspection frequency is based on the hazard classification of the dam.

[91] FS Manual 7530.1, "Construction."

[92] FS Manual 7510, "Project Administration."

[93] *Deferred maintenance* is defined as maintenance that was not performed as needed or scheduled and was put off to a future time. See, for example, Financial Accounting Standards Advisory Board (FASAB), *Statement of Federal Financial Accounting Standards 42: Deferred Maintenance and Repairs: Amending Statements of Federal Financial Accounting Standards 6, 14, 29 and 32*, April 25, 2012, p. 5, at http://www.fasab.gov/pdffiles/handbook_sffas_42.pdf.

FS's capital improvement prioritization procedures.[94] To the extent that FS dams have deferred maintenance needs, they could be eligible for deferred maintenance funding provided in discretionary or mandatory appropriations, such as mandatory funding from the National Parks and Public Land Legacy Restoration Fund established by the Great American Outdoors Act.[95] According to the agency, the FS attempts to prioritize its high hazard dams or addressing urgent safety situations when determining how to use its limited resources.

Dam Rehabilitation and Repair on Tribal Lands

The Secretary of the Interior is responsible for the safety of all dams on Tribal lands in accordance with the Indian Dams Safety Act of 1994, as amended (P.L. 103-302; 25 U.S.C. §§3801 et seq.). The Bureau of Indian Affairs (BIA) is in charge of 126 high or significant hazard dams listed in the National Inventory of Dams (NID). The BIA dams are on 43 tribal reservations. The average age of these dams is 70 years. In addition, there are over 700 additional low hazard potential or unclassified dams (not listed in the NID) on tribal lands. While BIA maintains overall responsibility, *federally recognized tribes* can operate and maintain dams on tribal lands under the Indian Self-Determination and Education Assistance Act (ISDEAA, P.L. 93-638, as amended). Under ISDEAA, tribes can request the authority to conduct certain activities that otherwise would be conducted by federal agencies.

Congress funds dam safety activities on tribal lands within the Resources Management Construction line item under the BIA Construction account, which has received annual and supplemental appropriations (e.g., through the Infrastructure Investment and Jobs Act; P.L. 117-58). In April 2016, the BIA testified to the U.S. Senate Committee on Indian Affairs that $556 million was needed for deferred maintenance and repairs of BIA dams, with the backlog increasing by approximately 6% each year since 2010. Low hazard dams receive less federal support and attention than high and significant hazard dams. The BIA reports that it is not aware of all low hazard dams under its jurisdiction. The Water Infrastructure Improvements for the Nation Act (WIIN Act; P.L. 114-322) established two Indian dam safety funds for the BIA to address deferred maintenance needs at eligible dams. Eligible dams are those included in the BIA Safety of Dams Program established under the Indian Dams Safety Act of 1994 that are either dams owned by the federal government and managed by the BIA or dams that have deferred maintenance documented by the BIA. Over FY2017-FY2030, the WIIN Act, as amended by America's Water Infrastructure Act of 2018 (P.L. 115-270), authorized $22.75 million per year for the High Hazard Indian Dam Safety Deferred Maintenance Fund and $10 million per year for the Low Hazard Indian Dam Safety Deferred Maintenance Fund. As of FY2023, Congress has not provided appropriations to these funds to rehabilitate eligible dams.

Source: Bureau of Indian Affairs, *Reports to Congress to Meet the Requirements of the Water Infrastructure Improvement for the Nation (WIIN) Act of 2016 Title III, Subtitle A—Safety of Dams and Subtitle B—Irrigation*, 2017. The number of high and significant hazard dams are from NID data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023.

Federal Oversight of Nonfederal Dams

Some federal agencies are involved in dam safety activities of nonfederal dams; these activities may be regulatory or consist of voluntary coordination (see box on "Nonfederal Dams on Federal Lands").

Congress has enacted legislation to regulate hydropower projects, certain mining activities, and nuclear facilities and materials.[96] These largely nonfederal facilities and activities may utilize dams for certain purposes. States also may have jurisdiction or ownership over these facilities, activities, and associated dams, and therefore may oversee dam safety in coordination with applicable federal regulations.[97]

[94] FEMA, *National Dam Safety Program*, 2016-2017.

[95] P.L. 116-152. For more information, see CRS In Focus IF11636, *The Great American Outdoors Act (P.L. 116-152)*, by Carol Hardy Vincent, Laura B. Comay, and Bill Heniff Jr.

[96] FEMA, *National Dam Safety Program*, 2016-2017.

[97] FEMA, *National Dam Safety Program*, 2016-2017.

Nonfederal Dams on Federal Lands

In addition to federal dams on federal lands, there are also nonfederal dams on federal land. The NID as updated in January 2023 reports that there are 1,766 nonfederal dams on federal lands. Most of these dams are located on federal land management agencies' land, although other agencies also have nonfederal dams located on their lands. These dams were either constructed on federal lands under an agreement with the federal agency or constructed on lands that were later acquired by the federal government. Federal agencies may have authorities for regulating nonfederal dams on federal lands or may have policies outlining the division of responsibilities between federal agencies and nonfederal entities as established through agreements. Some dams are inspected and regulated by the relevant state government, depending on the state's authority. Federal agencies may try to work with dam owners whose dams are not regulated by federal or state agencies to carry out dam safety practices.

Regulation of Hydropower Dams

Under the Federal Power Act (16 U.S.C. §§791a-828c), FERC has the authority to issue licenses for the construction and operation of hydroelectric projects, among other things.[98] Many of these projects involve dams, some of which may be owned by a state or local government. According to FERC, the agency regulates over 2,500 dams.[99] Of these, 1,754 are nonfederal dams listed in the NID as of January 2023; 807 of these nonfederal dams are classified as high hazard, with 147 in California, 86 in New York, and 69 in Michigan.[100] Before FERC can issue a license, FERC reviews and approves the designs and specifications of dams and other structures for the hydropower project. Each license is for a stated number of years (generally 30-50 years), and must undergo a relicensing process at the end of the license.

Along with nonfederal hydropower licensing, FERC is responsible for dam inspection during and after construction.[101] FERC staff are to inspect regulated dams at regular intervals.[102] The owners of projects with dams higher than 32.8 feet or with a total storage capacity of more than 2,000 acre-feet are required to contract independent consulting engineers, approved by FERC, for more thorough inspections every five years.[103] Should any inspection identify a deficiency, FERC

[98] For inquiries related to FERC licensure, congressional clients may contact Kelsi Bracmort, CRS Specialist in Natural Resources and Energy Policy. For more information, see CRS Report R42579, *Hydropower: Federal and Nonfederal Investment*, by Kelsi Bracmort, Adam Vann, and Charles V. Stern.

[99] FERC, Hydropower Primer, A Handbook of Hydropower Basics, February 2017, p.1, at https://www.ferc.gov/sites/default/files/2020-05/hydropower-primer.pdf.

[100] FEMA, *National Dam Safety Program*, 2016-2017; NID data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023.

[101] FERC requires licensees to prepare EAPs and conducts training sessions on how to develop and test these plans. For more information on FERC's dam safety activities, see FERC, "Dam Safety and Inspections," at https://www.ferc.gov/dam-safety-and-inspections.

[102] According to 18 C.F.R. §12.4, a FERC representative may "test or inspect any water power project or project works or require that the applicant or licensee perform such tests or inspections or install monitoring instruments" and "require an applicant or a licensee to submit reports or information, regarding…the design, construction, operation, maintenance, use, repair, or modification of a water power project or project works; and …any condition affecting the safety of a project." In 2019, FERC indicated that its staff inspect high hazard potential dams at least once per year, significant hazard potential dams at least every one to three years, and low hazard potential dams at least every three to six years. Personal correspondence between CRS and FERC, September 19, 2019. However, FERC noted that in 2020 and 2021, the agency did not perform all of its normal dam safety inspections due to the COVID-19 pandemic and requested information from licensees through questionnaires or relied upon licensees to perform their own dam safety inspections. FERC, Office of Energy Projects, Division of Dam Safety and Inspections, "2021 Annual Letter to Licensees and Exemptees – Reminder of Responsibilities," April 26, 2021, at https://cms.ferc.gov/media/2021-annual-letter-licensees-and-exemptees-reminder-responsibilities, and "Annual Letter – Highlighted Items for 2022 and Reminder of Responsibilities," June 13, 2022, at https://cms.ferc.gov/media/annual-letter.

[103] 18 C.F.R. §12, subpart D.

would require the project owner to submit a plan and schedule to remediate the deficiency.[104] FERC then is to review, approve, and monitor the corrective actions until licensees have addressed the deficiency.[105] If a finding is highly critical, FERC has the authority to require risk-reduction measures immediately; these measures often include reservoir drawdowns.[106]

FERC Response to Selected Hydropower Incidents

Following the spillway incident in 2017 at Oroville Dam, CA, a federal after-action panel and a state forensic team released reports in 2018 that raised questions about the thoroughness of FERC's oversight of dam safety.[107] Among other findings, the panel's report concluded that the established FERC inspection process, if properly implemented, would address most issues that could result in a failure. However, the panel's report stated that several failures occurred in the last decade because certain technical details, such as spillway components and original design, were overlooked and not addressed in the inspection or by the owner.[108] A 2018 GAO review also found that FERC had been prioritizing individual dam inspections and responses to urgent dam safety incidents, but had not conducted portfolio-wide risk analyses.[109] In response, FERC reported in 2021 that it had completed a screening-level risk analysis of 754 high and significant hazard dams in its portfolio and initiated 24 projects to address the risks it identified.[110] In addition, FERC produced draft guidelines in 2016 for RIDM, with a similar risk management approach as USACE and Reclamation.[111] FERC has allowed dam owners—generally those with a portfolio of dams—to pilot RIDM, using the draft guidelines, for their inspections and prioritizing rehabilitation and repairs instead of using the current deterministic, standards-based approach.[112]

Based on these evaluations and other reasons, FERC revised 18 C.F.R. §12, which went into effect April 11, 2022.[113] FERC revised the independent-consultant safety-inspection program,

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[104] The plan is due within 60 days of the findings.

[105] FERC, *Risk-Informed Decision Making*.

[106] FERC, *Risk-Informed Decision Making*.

[107] California's Department of Water Resources engaged an independent forensic team to develop findings and opinions on the causes of the incident. FERC also convened an after-action panel to evaluate FERC's dam safety program at Oroville focusing on the original design, construction, and operations, including the five-year safety review process. John W. France, *Independent Forensic Team Report, Oroville Dam Spillway Incident*, 2018, at https://damsafety.org/sites/default/files/files/Independent%20Forensic%20Team%20Report%20Final%2001-05-18.pdf. FERC After Action Panel, *Assessment of Oroville Spillway Incident Causes and Recommendations to Improve Effectiveness of the FERC Dam Safety Program*, 2018, at https://www.ferc.gov/industries/hydropower/safety/projects/oroville/12-06-18/report.pdf.

[108] After the Oroville incident, a FERC-led initiative to examine dam structures comparable to those at Oroville Dam identified 27 dam spillways at FERC-licensed facilities with varying degrees of safety concerns; FERC officials stated they are working with dam licensees to address the deficiencies. GAO, *Dam Safety: FERC Should Analyze Portfolio-Wide Risks*, GAO-19-19, at https://www.gao.gov/products/GAO-19-19. Hereinafter GAO, *Dam Safety*.

[109] GAO, *Dam Safety*. FERC also identifies challenges with implementing a risk-informed dam safety program as a regulatory agency compared to an agency that owns dams (e.g., USACE and Reclamation). FERC identifies that complete adoption of risk-informed decisionmaking is dependent on amending regulations and policies, and the capacity of industry to perform risk analysis. Personal correspondence between CRS and FERC, September 19, 2019.

[110] GAO, *Dam Safety*.

[111] FERC, *Risk-Informed Decision Making (RIDM) Risk Guidelines for Dam Safety*, 2016, at https://www.ferc.gov/industries/hydropower/safety/guidelines/ridm.asp. See also, FERC, "Risk-Informed Decision Making (RIDM)," at https://cms.ferc.gov/dam-safety-and-inspections/risk-informed-decision-making-ridm.

[112] FERC, "Some Observations from FERC Risk Analysis Pilot Projects," May 19, 2022, at https://cms.ferc.gov/media/some-observations-ferc-risk-analysis-pilot-projects.

[113] FERC, "FERC Finalizes Dam Safety Regulations," December 16, 2021, at https://www.ferc.gov/news-events/news/

described above, so that the required scope of these inspections alternates between a new, more in-depth comprehensive assessment and a periodic inspection.

- Periodic inspections are to focus on the performance of the project over the previous five years and include a field inspection, a review of project operations, an in-depth review of monitoring data trends and behavior, and an evaluation of whether any potential failure modes are occurring.[114]
- Comprehensive assessments are to include a deep dive into every aspect of a project, including detailed review of the project's design, engineering analyses, and construction history; evaluation of spillway adequacy; potential failure mode analysis; and risk analysis.[115]

The regulation update also changed the process by which FERC reviews and evaluates the qualifications of independent consultants that conduct the inspections and assessments. Inspections are now to be conducted by an independent consultant team, which may consist of one or more independent consultants as well as additional supporting team members. The regulation update also included revised safety incident reporting, revised definitions, and codified FERC's existing Owner's Dam Safety Program requirement.[116] In addition, FERC published four new engineering guideline chapters that provide further guidance related to the regulatory changes.[117]

Regulation of Dams Related to Mining

At mining sites, dams may be constructed for water supply, water treatment, sediment control, or the disposal of mining byproducts and waste (i.e., tailings dams).

Under the Federal Mine Safety and Health Act of 1977, as amended (P.L. 91-173; 30 U.S.C. §§801 et seq.), the Department of Labor's Mine Safety and Health Administration (MSHA) regulates private dams used in or resulting from mining.[118] According to MSHA, approximately 1,640 dams are in its inventory. Of these, 520 are listed in the NID as of January 2023, with 255 classified as high hazard.[119] As a regulator, MSHA develops standards and conducts reviews,

ferc-finalizes-dam-safety-regulations. FERC, "Safety of Water Power Projects and Project Works," 87 *Federal Register* 1490, January 11, 2022.

[114] Federal Energy Regulatory Commission, *Staff Presentation | Final Rule Regarding Safety of Water Power Projects and Project Works*, December 16, 2021.

[115] Ibid.

[116] In 2012, FERC established a requirement that owners of high and significant hazard dams prepare and maintain an Owner's Dam Safety Program, which formalizes a licensee's policies and procedures related to organizational oversight and responsibility, internal communication, resource allocation, and continuous improvement. FERC, Letter to All Licensees and Exemptees of High and Significant Hazard Potential Dams Requiring Submittal of an Owner's Dam Safety Program, August 2012, at https://www.ferc.gov/sites/default/files/2020-04/letter-submit-odsp.pdf.

[117] See Chapters 15-18 at FERC, "Engineering Guidelines for the Evaluation of Hydropower Projects," at https://www.ferc.gov/industries-data/hydropower/dam-safety-and-inspections/eng-guidelines.

[118] P.L. 91-173, as amended by P.L. 95-164, (30 U.S.C. §801) directs that the "Secretary shall make inspections of each underground coal or other mine in its entirety." Impoundment facilities, retention dams, and tailings ponds are included in the definition of a coal or other mine and are required to be included in these inspections. The Mine Safety and Health Administration regulates dams under Title 30 of the *Code of Federal Regulations*. See Department of Labor, Mine Safety and Health Administration, "Safety Topic: Impoundments and Dams," at https://www.msha.gov/training-education/safety-and-health-materials/safety-topic-impoundments-and-dams. For inquiries related to Mine Safety and Health Administration regulations, congressional clients may contact Scott D. Szymendera, CRS Analyst in Disability Policy.

[119] NID data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18,

inspections, and investigations to ensure mine operators comply with those standards. According to agency policies, MSHA is to inspect each surface mine and associated dams at least two times a year and each underground mine and associated dams at least four times a year.[120]

Under Title V of the Surface Mining Control and Reclamation Act of 1977, as amended (SMCRA; P.L. 95-87; 30 U.S.C. §§1251-1279), DOI's Office of Surface Mining Reclamation and Enforcement (OSMRE) administers the federal government's responsibility to regulate active coal mining operations to minimize environmental impacts during mining and to reclaim affected lands and waters after mining.[121] OSMRE regulations require coal mining operators to demonstrate that dams are constructed, maintained, and removed in accordance with federal standards (30 C.F.R. §715.18).[122] According to the 2021 DOI Annual Report on Dam Safety, OSMRE regulates 69 dams at coal mines under OSMRE's federal and Indian lands regulatory authority.[123] Twenty-four states have primary regulatory authority (i.e., primacy) for dams under SMCRA authority: for primacy, states must meet the requirements of SMCRA and be no less effective than the federal regulations.[124] If the dam is noncompliant with the approved design at any time during construction or the life of the dam's operation, OSMRE or the approved state regulatory authority is to instruct the coal mining operator to correct the deficiency immediately or cease operations.[125]

Regulation of Dams Related to Nuclear Facilities and Materials

The Nuclear Regulatory Commission (NRC) was established by the Energy Reorganization Act of 1974 (P.L. 109-58; 42 U.S.C. §§5801 et seq.) as an independent federal agency to regulate and license nuclear facilities and the use of nuclear materials as authorized by the Atomic Energy Act of 1954, as amended (P.L. 83-703).[126] Among its regulatory licensing responsibilities pertaining

2023.

[120] FEMA, *National Dam Safety Program*, 2016-2017. According to FEMA's National Dam Safety Program Biennial Report to the United States Congress, Fiscal Years 2018 –2019, MSHA has a number of regulatory shortcomings as it relates to tailings dams in the non-coal mining industry. Specifically MSHA does not require engineering design plans, an independent review of plans, and does not define inspection frequency for owners/operators of non-coal-mine tailings dams. In addition to inspecting existing dams, MSHA must approve the plans for certain new dams at coal mines before construction can begin. 31 C.F.R. §77.216.

[121] For inquiries related to the Office of Surface Mining Reclamation and Enforcement (OSMRE), congressional clients may contact Lance Larson, CRS Analyst in Environmental Policy.

[122] Current regulations do not require EAPs for OSMRE-regulated dams. According to the 2021 DOI Dam Safety Report, OSMRE and the Solicitor's Office have developed an opinion supporting OSMRE's authority to prepare regulations under the Surface Mining Control and Reclamation Act requiring EAPs and After Action Reports to be included as requirements in surface coal mining permits consistent with the *Federal Guidelines for Dam Safety*.

[123] Reclamation, *2021 DOI Annual Report on Dam Safety*, July 2022. According to the report, current regulations do not require EAPs for OSMRE-regulated dams, but OSMRE and the Solicitor's Office have developed an opinion supporting OSMRE's authority to prepare regulations under the Surface Mining Control and Reclamation Act requiring EAPs and After Action Reports to be included as requirements in surface coal mining permits consistent with the *Federal Guidelines for Dam Safety*. States regulate dams under the state program. For more information on OSMRE's dam safety activities, see OSMRE, "Dam Safety," at https://www.osmre.gov/programs/TDT/damsafety.shtm.

[124] Section 503 of the Surface Mining Control and Reclamation Act of 1977, as amended (SMCRA; P.L. 95-87; 30 U.S.C. §1253).

[125] FEMA, *National Dam Safety Program*, 2016-2017. 30 U.S.C. §1271 authorizes the Secretary of the Interior or the Secretary's authorized representative to immediately order a cessation of surface coal mining and reclamation operations or the relevant portion thereof if a condition, practice, or violation creates an imminent danger to the health or safety of the public, or is causing, or can reasonably be expected to cause significant, imminent environmental harm to land, air, or water resources.

[126] For inquiries related to the licensing and operations of uranium mining and milling, congressional clients may

to dams, NRC regulates uranium mill tailings dams, storage water pond dams at in situ leach (ISL) uranium recovery facilities, and dams integral to the operation of other licensed facilities that may pose a radiological safety-related hazard should they fail.[127] Currently, NRC directly regulates seven dams.[128] If NRC shares regulatory authority with another federal agency (e.g., FERC, USACE, Reclamation), NRC defers regulatory oversight of the dam to the other federal agency.[129] Under NRC's authority to delegate regulatory authority, states may regulate dams associated with nuclear activities based on agreements with NRC (i.e., *agreement state programs*).[130]

Federal Support for Nonfederal Dams

Nonfederal dam owners generally are responsible for investing in the safety, rehabilitation, and repair of their dams.[131] In 2022, the Association of State Dam Safety Officials estimated that $75.7 billion was needed to rehabilitate nonfederal dams; of that amount, $24.0 billion was needed for high hazard potential nonfederal dams.[132] Currently, 22 states provide a limited amount of assistance for these activities (e.g., rehabilitation, repair) through grant or low-interest revolving loan programs.[133] Some federal programs may specifically provide limited assistance to nonfederal dams that meet various eligibility criteria (e.g., the Small Watershed Rehabilitation Program is only available to dams that were originally constructed with assistance from the Natural Resources Conservation Service); these programs are in **Table 4** and described in CRS Report R47383, *Federal Assistance for Nonfederal Dam Safety*.[134]

contact Lance Larson, CRS Analyst in Environmental Policy. Regulation authorities are from the Atomic Energy Act of 1954, as amended (P.L. 83-703); the Energy Reorganization Act of 1974, as amended (P.L. 93-438); and the Uranium Mill Tailings Radiation Control Act of 1978, as amended (P.L. 95-604). FEMA, *National Dam Safety Program*, 2016-2017.

[127] Exceptions include dams that are submerged in other impoundments that do not pose flooding threats or dams regulated by other federal agencies. Nuclear Regulatory Commission regulations are available at https://www.nrc.gov/reading-rm/doc-collections/cfr/; 10 C.F.R. §40 includes regulations relating to impounding byproduct materials.

[128] NID data accessed at https://nid.sec.usace.army.mil on January 24, 2023, with data last updated on January 18, 2023.

[129] FEMA, *National Dam Safety Program*, 2016-2017. L. Joseph Callan, *Status Report on Implementation of Dam Safety Program*, NRC, SECY-97-110, 1997, at https://www.nrc.gov/docs/ML1228/ML12284A135.pdf.

[130] For more information on agreement state programs, see NRC, "Agreement State Program," at https://www.nrc.gov/about-nrc/state-tribal/agreement-states.html.

[131] FEMA, *National Dam Safety Program*, 2016-2017.

[132] ASDSO, *The Cost of Rehabilitating Our Nation's Dams*, March 2022, at https://damsafety-prod.s3.amazonaws.com/s3fs-public/files/Cost%20of%20Rehab%20Report-2022%20FINAL.pdf. There were 13,676 high hazard potential dams in the NID, as of a November 3, 2022, update. 11,538 dams did not have a hazard potential classification (i.e., there was no indication of whether the dam has a high, significant, or low hazard classification).

[133] The number of states with a grant or loan program was self-reported by states through a State Dam Safety Program Performance Questionnaire conducted by ASDSO in 2021. Personal correspondence between CRS and ASDSO, October 17, 2022.

[134] In addition, more general federal programs, such as the Community Development Block Grant Program, offer broader funding opportunities for which dam rehabilitation and repair may qualify under certain criteria.

Table 4. Selected Federal Programs That May Support Nonfederal Dam Safety Projects

Agency	Program	Type of Federal Assistance
Federal Emergency Management Agency	Rehabilitation of High Hazard Potential Dam Grant Program	Grant
	Flood Mitigation Assistance Program	Grant
	Hazard Mitigation Grant Program	Grant
	Building Resilient Infrastructure and Communities Program	Grant
	Safeguarding Tomorrow Revolving Loan Fund Program	Grants to capitalize state revolving funds
U.S. Army Corps of Engineers	Corps Water Infrastructure Financing Program	Credit assistance, such as secured loans or loan guarantees
	P.L. 84-99 Rehabilitation Program	Repair of damaged flood control works
Natural Resources Conservation Service	Small Watershed Rehabilitation Program	Grant
Department of Energy	Maintaining and Enhancing Hydroelectricity Incentives	Incentive payment

Source: CRS.

Notes: For more information on these programs, see CRS Report R47383, *Federal Assistance for Nonfederal Dam Safety*.

Issues for Congress

Congress may consider oversight and legislation relating to dam safety in the larger framework of infrastructure improvements and risk management or as an exclusive area of interest. The following sections discuss selected issues that may be of interest. Some of these issues relate to many of the nation's dams and the federal agencies involved in their dam safety activities (e.g., security issues). Other issues focus on specific types of dams (e.g., dams eligible for funding from the Infrastructure Investment and Jobs Act [IIJA; P.L. 117-58]) or specific federal agencies (e.g., the National Oceanic and Atmospheric Administration [NOAA] updating methodologies for probable maximum precipitation studies). In some cases, certain federal agencies have pioneered new policies or approaches to dam safety activities (e.g., USACE disclosing inundation map data for most of its facilities; FERC changing regulations to address risk considerations) that Congress may be interested in evaluating and potentially facilitating adoption by other federal agencies. If Congress chooses to address a certain dam safety issue, Congress may first consider which dams and federal agencies are the focus of that issue, then strategize legislation and oversight efforts targeting those dams and/or agencies.

Federal Role and Funding for Dam Safety Activities

Since the 1970s, the federal government has developed and overseen national dam safety standards, and it has increasingly provided technical and grant assistance for nonfederal dam safety. These activities, as well as the enhancement of federal agencies' dam safety programs, have improved certain dam safety metrics; nonetheless, deficiencies in federal and state programs

may have contributed to recent incidents. Congress may consider oversight activities related to federal implementation of dam safety practices. For example, in 2017, the Senate Committee on Appropriations directed USACE, Reclamation, and FERC to brief the Senate Committee on Appropriations on efforts to incorporate lessons learned from the failure of Oroville Dam's spillway into dam inspection protocols across all three agencies and their state partners.[135] Although incidents and reviews may result in recommending improvements to federal dam safety programs, some agencies have reported financial and other limitations to revising or expanding their dam safety programs.[136] Congress may consider these obstacles in determining whether new authorities or appropriations are needed. For example, in the 117th Congress, the Twenty-First Century Dams Act (H.R. 4375/S. 2356) would have authorized a national dam inspection program and a national dam assessment, in addition to increasing authorization of appropriations for various federal agency dam activities and programs.

Individual dam O&M, rehabilitation, and repair costs can range from thousands to hundreds of millions of dollars.[137] The responsibility for these expenses lies with dam owners; however, many nonfederal dam owners are not willing or able to fund these costs.[138] Although some states have created a state-funded grant or low-interest revolving loan program to assist dam owners with repairs, ASDSO notes that existing programs seem to vary significantly in the scope and reach of available financial assistance.[139] Some stakeholders suggest another financial mechanism for supporting dam safety would be public-private partnerships, particularly supported by beneficiaries of dam services.[140] Congress provides regular appropriations for federal agency dam safety activities and programs, and in the 117th Congress, the IIJA provided an influx of funding for some of these and other programs that may support dam safety.

Infrastructure Investment and Jobs Act

The IIJA provided supplemental appropriations to Reclamation's dam safety program, to the NDSP for its activities and grants, and for programs that may support nonfederal dam safety projects (see **Table 5**).

[135] The Senate Committee on Appropriations report (S.Rept. 115-132) accompanying the Energy and Water Development Appropriations Bill, 2018 (S. 1609), further instructed that the briefing include analysis of the Forensic Investigation Team report examining the causes of the Oroville Dam spillway failures; the utility of a subsequent independent panel to evaluate whether the USACE, Reclamation, and FERC should revise their dam safety procedures in light of lessons learned from the Oroville incident; whether additional safety inspections should be required after large storms; whether the projected effects of climate change and atmospheric rivers are appropriately considered in safety requirements and testing protocols; whether new noninvasive structural health monitoring technologies have the potential to improve safety inspections; and whether additional actions should be taken to ensure the safety of dams without emergency spillways.

[136] FEMA, *National Dam Safety Program*, 2016-2017.

[137] ASDSO, *Cost of Rehabilitating*.

[138] ASDSO, *Cost of Rehabilitating*; written testimony submitted by American Rivers for U.S. Congress, Senate Committee on Environment and Public Works, *Flood Control Infrastructure: Safety Questions Raised by Current Events*, 115th Cong., 1st sess., March 1, 2017.

[139] Personal correspondence between CRS and ASDSO, October 2, 2019.

[140] "Dam Safety 3.0 – Changing Our Paradigm," general session at the ASDSO Dam Safety 2022 Conference, Baltimore, MD, September 20, 2022.

Table 5.Selected IIJA Funding for Dam Safety Activities

Agency	Program/Activity	IIJA Funding
Bureau of Indian Affairs	Construction, repair, improvement, and maintenance of irrigation and power systems, safety of dams, water sanitation, and other facilities	$250 million
Bureau of Reclamation	Safety of Dams Program	$500 million
Department of Energy	Maintaining and Enhancing Hydroelectricity Incentives	$554 million
Federal Emergency Management Agency	National Dam Safety Program (activities and assistance to states)	$67 million
	National Dam Safety Program (grants to state dam safety programs)	$148 million
	Rehabilitation of High Hazard Potential Dam Grant Program	$585 million, of which $75 million is for dam removal
Natural Resources Conservation Service	Small Watershed Rehabilitation Program	$118 million
U.S. Army Corps of Engineers	Corps Water Infrastructure Financing Program	$75 million, of which $65 million is for the cost of direct or guaranteed loans and $11 million is for administrative expenses

Source: CRS.

Notes: IIJA = Infrastructure Investment and Jobs Act (P.L. 117-58). Appropriations were made available in FY2022 except for some portions of appropriations from the Bureau of Indian Affairs, Bureau of Reclamation, and Department of Energy, which are to become available in subsequent fiscal years. All appropriations are to remain available until expended except funding for the National Dam Safety Program for activities and assistance to states (available until FY2026). Some of these programs are specific to dam safety activities, while dam safety is one of multiple eligible activities for others.

Congress may conduct oversight of these agencies' use of the appropriated funds, which may be in different stages of implementation. For example, Reclamation has released spend plans for FY2022 through FY2023,[141] whereas other agencies are first developing policy and procedures for new programs (e.g., USACE's proposed rule for the Corps Water Infrastructure Financing Program and request for information for DOE's Maintaining and Enhancing Hydroelectricity Incentives).[142] FEMA's NDSP is conducting listening sessions in FY2023 to determine how best to administer its funds based on the needs and capacity of state dam safety agencies and dam owners.[143] Some attendees of the initial sessions petitioned for flexibility to implement potential increased grant funding (e.g., ability to use funding over multiple fiscal years), among other concerns.

Another potential oversight issue includes agencies' capacity to administer this level of awards, contracts, and procurements and to perform project management and oversight. For example, in

[141] Reclamation, "Bipartisan Infrastructure Law Investments," at https://www.usbr.gov/bil/2022-spendplan.html.

[142] USACE, "Credit Assistance and Related Fees for Water Resources Infrastructure Projects," 87 *Federal Register* 35473, June 10, 2022. DOE, "Biden Administration Launches $630 Million in Programs to Modernize Nation's Hydropower Fleet," June 30, 2022, at https://www.energy.gov/articles/biden-administration-launches-630-million-programs-modernize-nations-hydropower-fleet.

[143] "Dam Safety 3.0 – Changing Our Paradigm," general session at the ASDSO Dam Safety 2022 Conference, Baltimore, MD, September 20, 2022. FEMA, "Infrastructure Investment and Jobs Act (IIJA) Listening Sessions," at https://www.fema.gov/emergency-managers/risk-management/dam-safety/listening-sessions.

December 2022, DOI described challenges in increasing staffing at Reclamation to implement IIJA activities (e.g., hiring staff with necessary engineering and hydrology expertise).[144] Congress also may consider how to measure the effectiveness of these investments in improving national dam safety and what future level of appropriations to provide to these activities and programs while they implement IIJA funding. For example, Congress provided less funding to the Small Watershed Rehabilitation Program in FY2022 and noted that the reduction was based on IIJA additions.[145]

Adoption of Risk-Informed Decisionmaking

The dam safety community has increasingly espoused the benefits of shifting dam safety programs from a standards-based approach to an RIDM approach; however, many programs face hurdles to implementing RIDM policies.[146] Reclamation and USACE were the first agencies to implement RIDM management; these agencies also have more resources and expertise to manage their large dam portfolios than most other federal and state agencies. Following the 2017 incident at Oroville Dam, some federal and state agencies have increased efforts to incorporate RIDM into management of their dam safety portfolios. For example, FERC has allowed owners to pilot RIDM using draft guidelines it published in 2016, and the agency updated its regulations in 2022 to include comprehensive inspections in its inspection program, among other updates. Colorado's Dam Safety Program has developed comprehensive dam safety evaluation tools to enable potential failure mode analysis and has created semi-quantitative risk assessment analyses to enable repeatable assessments across its regulatory dam portfolio.[147] While dam safety experts say RIDM and its components (e.g., comprehensive assessments) are needed to prevent incidents such as those experienced recently,[148] incorporating these practices may require development of new guidelines, certain personnel expertise, and more financial resources.[149] For example, comprehensive assessments are more costly than visual inspections and can require certain inspection expertise.

Congress may consider whether, and if so how, to support the adoption and implementation of RIDM approaches for dam safety. For example, Congress may conduct oversight of the NDSP's efforts to support dam safety agencies' and communities' adoption of RIDM policies. In September 2022, FEMA stated that the NDSRB's working group on risk was developing a risk matrix and respective tools and training for dam agencies to implement the matrix.[150] FEMA

[144] Testimony from Deputy Secretary of the U.S. Department of the Interior (DOI) the Honorable Tommy P. Beaudreau, in U.S. Congress, Senate Committee on Energy and Natural Resources, *Full Committee Hearing to Examine the Department of the Interior's Implementation of the Infrastructure Investment and Jobs Act*, hearings, 117th Cong., 2nd sess., December 13, 2022, at https://www.energy.senate.gov/hearings/2022/12/full-committee-oversight-hearing-to-examine-the-department-of-the-interior-s-implementation-of-the-infrastructure-investment-and-jobs-act.

[145] Explanatory statement submitted by Mr. Leahy, Chair of the Senate Committee on Appropriations, regarding H.R. 2617, Consolidated Appropriations Act, 2023," Congressional Record, vol. 168, part 198 (December 20, 2022), p. S7826.

[146] "Dam Safety 3.0 – Changing Our Paradigm," general session at the ASDSO Dam Safety 2022 Conference, Baltimore, MD, September 20, 2022.

[147] Colorado Division of Water Resources, "Dam Safety," at https://dwr.colorado.gov/services/dam-safety.

[148] John W. France, et al. *Independent Forensic Team Final Report, Investigation of Failures of Edenville and Sanford Dams*, May 2022, at https://damsafety-prod.s3.amazonaws.com/s3fs-public/files/Edenville-Sanford_Final%20Report_Main%20Report%20and%20Appendices.pdf.

[149] "Dam Safety 3.0 – Changing Our Paradigm," general session at the ASDSO Dam Safety 2022 Conference, Baltimore, MD, September 20, 2022.

[150] Ibid.

could update the *Federal Guidelines for Dam Safety* to further incorporate aspects of RIDM. IIJA appropriations of $67 million for the NDSP supports authorized activities of the program, which may include training and other activities to advance RIDM adoption and implementation. For example, this IIJA funding could potentially support activities such as FEMA's collaborative technical assistance series, which is to help communities at risk of dam-related flooding to better understand their risk landscape and the potential consequences of dam-related emergencies.[151] Congress could also require certain aspects of RIDM policies in authorities for dam safety programs. For example, the authority for the FEMA's Rehabilitation of High Hazard Potential Dam Grant Program requires that tribal or local governments with jurisdiction over the area in which a dam receiving the grant is located has in place a hazard mitigation plan that includes all dam risks and complies with the Disaster Mitigation Act of 2000 (P.L. 106-390).[152] While these requirements may ultimately improve RIDM practices, these requirements can result in application burdens for communities that are unfamiliar with these policies or do not have the resources to implement them.

Incorporating Future Conditions for Risk Management

Understanding how risk may change over time is also an aspect of RIDM. National probable maximum precipitation (PMP) studies have long been used for regulation and design of infrastructure, including dams, but the federal government has not updated PMP studies or methodologies to capture precipitation patterns and events of recent decades and the potential impacts of climate change.[153] According to the World Meteorological Organization,

> The objective of a probable maximum precipitation (PMP) estimate is to calculate the probable maximum flood (PMF) used in the design of a given project at a particular geographical location in a given watershed, and to further provide information that could assist in designing the size (dam height and reservoir storage capacity) of the given project and dimension of the flood-carrying structures (spillway and flood carrying tunnel) of the project.[154]

NOAA first developed methodologies for estimating PMP in the 1940s and applied them across the nation through studies in the late 20th century.[155] State dam safety programs developed statutes, rules, and guidance documents for the design of facilities partly based on these studies.[156] Given that increased atmospheric moisture is an anticipated climate change effect, dam safety officials and engineers have petitioned for updated extreme precipitation estimation tools that can inform design and risk understanding of dams and associated structures under these future conditions.[157] NOAA has not officially updated these studies or methodologies to include new

[151] FEMA has stated it aims to expand application of this assistance. Ibid and FEMA, "Dam Safety Collaborative Technical Assistance," at https://www.fema.gov/emergency-managers/risk-management/dam-safety/technical-assistance.

[152] 33 U.S.C. §467f-2(d).

[153] National Academy of Sciences, Engineering, and Medicine (NASEM), "Modernizing Probable Maximum Precipitation Estimation (Committee Meeting #1)," February 16, 2023, at https://www.nationalacademies.org/event/02-16-2023/modernizing-probable-maximum-precipitation-estimation-committee-meeting-1. Hereinafter NASEM, PMP Committee Meeting #1, 2023.

[154] World Meteorological Organization, *Manual on Estimation of Probable Maximum Precipitation (PMP)*, WMO-No. 1045, 2009, at https://damfailures.org/wp-content/uploads/2020/10/WMO-1045-en.pdf.

[155] National Oceanic and Atmospheric Administration (NOAA), "HDSC PMP Documents," at https://www.weather.gov/owp/hdsc_pmp.

[156] ASDSO, "Roadmap to Reducing Dam Safety Risks," at https://www.damsafety.org/Roadmap.

[157] NASEM, PMP Committee Meeting #1, 2023. ASDSO, 2022-2027 Strategic Plan, at https://damsafety-

methods, technologies, or decades of more recent storm data libraries.[158] Some state dam safety programs have started to employ new studies conducted by entities outside the federal government,[159] or have created methodologies to consider the range of impacts due to a changing climate specific to their state.[160] Others find these alternatives too difficult to attempt.[161] Some federal agencies have conducted site-specific PMP studies for certain facilities or are piloting their own methodologies.[162] For example, USACE has evaluated numerical weather model-based precipitation maximization methods for areas dominated by atmospheric rivers.[163] This varied practice has led to inconsistencies between minimum dam-related design criteria, including for repair and rehabilitation of dams and associated spillways, and understanding of risk among federal and state agencies.[164]

IIJA provided appropriations for NOAA to develop "next-generation water modeling activities, including modernized precipitation frequency and probable maximum studies."[165] This process is starting with a National Academy of Sciences, Engineering, and Medicine (NASEM) study to recommend an updated approach for estimating PMP in a changing climate, appropriate for decision-maker needs.[166] The Providing Research and Estimates of Changes in Precipitation Act (PRECIP Act; Division D of P.L. 117-229) authorized this study, including certain study requirements. The act also directed NOAA to

- develop and publish a national guidance document two years after the study, to be updated at least every 10 years, that provides best practices that can be followed by regulatory agencies and other users;
- update and publish PMP estimates for the nation 6 years after the study and updated at least every 10 years; and
- conduct research in the field of extreme precipitation estimation with partners.

prod.s3.amazonaws.com/s3fs-public/files/ASDSO%202022-2027%20Strategic%20Plan_FINAL_0.pdf.

[158] ASDSO, "Roadmap to Reducing Dam Safety Risks," at https://www.damsafety.org/Roadmap.

[159] For example, see selected studies by Applied Weather Associates at "AWA Current and Recently Completed Projects," at https://www.appliedweatherassociates.com/awa-projects.html.

[160] For example, Colorado partnered with NOAA in order to determine an atmospheric moisture factor to add to probable maximum precipitation values to capture potential future conditions. The *Colorado – New Mexico Regional Extreme Precipitation Study* results provide engineers with tools to estimate extreme precipitation for spillway design across the state of Colorado. Colorado Division of Water Resources, "Dam Safety," at https://dwr.colorado.gov/services/dam-safety. New Mexico Office of the State Engineer, "CO-NM Regional Extreme Precipitation Study (CO-NM REPS) Final Reports," at https://www.ose.state.nm.us/dams/conmpf_reports.php.

[161] "Dam Safety 3.0 – Changing Our Paradigm," general session at the ASDSO Dam Safety 2022 Conference, Baltimore, MD, September 20, 2022.

[162] NASEM, PMP Committee Meeting #1, 2023.

[163] For more information on atmospheric rivers, see CRS Insight IN12094, *Atmospheric Rivers: Background and Forecasting*, by Eva Lipiec and Nicole T. Carter. Yusuke Hiraga, et al., "Comparison of Model-Based Precipitation Maximization Methods: Moisture Optimization Method, Storm Transposition Method, and Their Combination," *Journal of Hydrologic Engineering*, vol. 28, no. 1 (January 2023).

[164] NASEM, PMP Committee Meeting #1, 2023. ASDSO, "Roadmap to Reducing Dam Safety Risks," at https://www.damsafety.org/Roadmap.

[165] IIJA appropriated $492 million to NOAA for this and "coastal and inland flood and inundation mapping and forecasting." NOAA, "Flood and Inundation Mapping and Forecasting," at https://www.noaa.gov/infrastructure-law/infrastructure-law-climate-data-and-services/flood-and-inundation-mapping-and-forecasting.

[166] NASEM, "Modernizing Probable Maximum Precipitation Estimation," at https://www.nationalacademies.org/our-work/modernizing-probable-maximum-precipitation-estimation.

Despite these efforts, concerns remain that NOAA will not update these methodologies in time to be included into FEMA's and others' efforts to update their policies and products or to be considered in infrastructure investments funded by the IIJA and other federal appropriations.[167] Congress could conduct oversight of NOAA's progress on updating PMP methodologies and studies. Further, Congress could direct NOAA to issue interim guidance to practitioners in the short-term,[168] or to use funding to support nonfederal entities' development of targeted PMP studies.[169] However, regulations for dams informed by PMP studies may impact long-term and costly decisions in dam design and rehabilitation;[170] therefore, employing interim methodologies prior to NOAA's anticipated methodologies may ultimately result in further inconstancies and debate regarding these decisions.

Dam Public Awareness and Security Issues

According to some advocacy groups, many Americans are unaware that they live upstream or downstream of a dam.[171] Further, if they are aware, the public may not know if a dam is deficient, has an EAP, or could cause destruction if it failed.[172] A lack of public awareness may stem from a lack of access to certain dam safety information, the public's confidence in dam integrity, or other reasons.[173] Dam safety processes and products (such as inspections, EAPs, and inundation maps) are intended to support decisionmaking and enhance community resilience. Some of the information related to dam safety and resulting products may not be readily available to all community members and stakeholders because access to dam safety information has generally restricted from public access due to security concerns.[174]

The September 11, 2001, terrorist attacks drew attention to the security of many facilities, such as the nation's water supply and water quality infrastructure, including dams. Damage or destruction of a dam by a malicious attack (e.g., terrorist attack, cyberattack) could disrupt the delivery of water resource services, threaten public health and the environment, or result in catastrophic flooding and loss of life. As a consequence of the September 11, 2001, terrorist attacks, federal policy and practices restricted public access to most information related to the condition assessment of dams and consequences of dam or component failure. For example, according to USACE, it had limited data regarding condition assessments for dams in the NID stating that they met the definition of a vulnerability assessment of *critical infrastructure* as defined by the

[167] "Dam Safety 3.0 – Changing Our Paradigm," general session at the ASDSO Dam Safety 2022 Conference, Baltimore, MD, September 20, 2022. NASEM, PMP Committee Meeting #1, 2023.

[168] In September 2022, the Director of FEMA's National Dam Safety Program stated that it inquired about interim guidance from NOAA, to which NOAA responded no; however, FEMA stated the agencies meet monthly. "Dam Safety 3.0 – Changing Our Paradigm," general session at the ASDSO Dam Safety 2022 Conference, Baltimore, MD, September 20, 2022.

[169] For example, Section 40004 of P.L. 117-169, commonly referred to as the Inflation Reduction Act, appropriated $200 million to NOAA to "support advancements and improvements in research, observation systems, modeling, forecasting, assessments, and dissemination of information related to weather, coasts, oceans, and climate, including climate research." The White House, *Building a Clean Energy Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action*, January 2023, notes that $50 million of this funding is for grants. Grants could support nonfederal entities' development of targeted PMP studies.

[170] NASEM, PMP Committee Meeting #1, 2023.

[171] Written testimony submitted by American Rivers for U.S. Congress, Senate Committee on Environment and Public Works, *Flood Control Infrastructure: Safety Questions Raised by Current Events*, 115th Cong., 1st sess., March 1, 2017.

[172] ASDSO, "State Performance and Current Issues," at https://damsafety.org/state-performance.

[173] Baecher et al., *Review and Evaluation*, University of Maryland.

[174] National Research Council, *Dam and Levee Safety*.

Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA PATRIOT) Act of 2001 (P.L. 107-56).[175] Then the NDSRB recommended in FY2017 for USACE to consider modifying security restrictions in the NID.[176] In November 2021, USACE updated the NID to no longer restrict data, including condition assessments and other risk-related information.[177] Still, some states do not publicly report certain data (e.g., Alabama and Illinois do not publicly report condition assessment data, and Texas does not publicly report hazard potential), so this information is not included in the NID.[178]

Congress may consider reevaluating the appropriate amount of information to share (e.g., inundation scenarios from dam failure) to address public safety concerns and what amount and type of information not to share to address concerns about malicious use of that information. There are tradeoffs involved in sharing certain types of data. For example, sharing inundation-mapping data with the public may raise awareness of the potential risk of living near or downstream of a dam, but misinterpretation of that information could cause unnecessary alarm in downstream communities and could provide information to malicious entities on which dams would have the most potential for harm if attacked.[179] Inundation-mapping data generally have typically been shared with emergency managers and responders rather than with the public at large.[180] Some argue that disclosure to these officials is sufficient, as it provides the information to the officials who bear responsibilities for emergency response.[181] Others argue the need for this information to be public so that communities better understand risk and improve local land use planning. In 2020, USACE changed its policy that, when inundation mapping is available, it is shared with the public.[182] Accordingly, in January 2022, USACE made inundation mapping for most of its dams available online through the NID.[183] USACE is also conducting a pilot project with California, Colorado, and New York for these states to host inundation maps of certain dams that they own and/or regulate on the NID.[184]

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[175] Section 1016 of the Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA PATRIOT) Act of 2001 (P.L. 107-56) defines critical infrastructure as systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters. According the Department of Homeland Security, a vulnerability assessment will identify areas of weakness that could result in undesired consequences and will take into account intrinsic structural weaknesses, protective measures, resilience, and redundancies. Department of Homeland Security, *Dams Sector Security Guidelines*, 2015, at https://damsafety.org/sites/default/files/files/dams-sector-security-guidelines-2015-508.pdf.

[176] FEMA, *National Dam Safety Program*, 2016-2017.

[177] National Inventory of Dams, "FAQS," at https://nid.sec.usace.army.mil/#/what-is-nid/faqs.

[178] Personal correspondence between CRS and USACE, August 5, 2022 and February 2, 2023.

[179] Personal correspondence between CRS and FEMA, June 26, 2019.

[180] Some states, such as Virginia, Wisconsin, and California, release potential inundation data to the public. FEMA, *National Dam Safety Program*, 2016-2017. Baecher et al., *Review and Evaluation*, University of Maryland.

[181] Baecher et al., *Review and Evaluation*, University of Maryland; U.S. Congress, House Committee on Transportation and Infrastructure, Subcommittee on Economic Development, Public Buildings and Emergency Management, *Proposed Amendments to and Reauthorization of the National Dam Program Act*, 109th Cong., 2nd sess., July 26, 2006.

[182] USACE commanders can choose to withhold inundation maps as for official use only in situations where there are significant security concerns. USACE, Inundation Maps and Emergency Action Plans and Incident Management for Dams and Levee Systems, EC 1110-2-6075, October 1, 2020.

[183] There may be no inundation map for a USACE dam where there is no potential loss of life or where the inundation map is being updated or completed. Personal correspondence between CRS and USACE, August 5, 2022.

[184] Personal correspondence between CRS and USACE, August 5, 2022.

Efforts to Address Cybersecurity Risks

In addition to managing information flow to the public to address risk, Congress might consider the risk of individuals or groups compromising dams and their operating infrastructure for malicious purposes. This may include a physical attack or cyber intrusions to access and manipulate dam industrial control systems for malicious purposes.[185] In 2016, the Department of Justice charged an Iranian national with obtaining unauthorized access into the supervisory control and data acquisition systems of the Bowman Dam, located in Rye, NY, in August and September of 2013. According to the indictment, the attackers gained access to information about the status and operation of the dam, and would have been able to remotely operate the sluice gate had it not already been manually disconnected for maintenance.[186] This incident and others have focused attention on the cybersecurity of dams and other critical infrastructure assets.[187]

In 2016, for the first time, Department of Homeland Security's (DHS's) Industrial Control Systems Cyber Emergency Response Team included dams in its assessments along with other types of infrastructure.[188] A 2018 Department of the Interior Office of the Inspector General (OIG) report highlighted poor security practices at two unnamed critical infrastructure dams owned by Reclamation,[189] and a 2022 Tennessee Valley Authority OIG report noted various issues with the cybersecurity controls of the TVA's non-power dam control system.[190] In March 2023, following a series of executive actions related to cybersecurity of critical infrastructure, the White House released a new national cybersecurity strategy for the federal government to better support the defense of critical infrastructure against emerging cybersecurity threats.[191]

DHS coordinates public-private partnerships for critical infrastructure security and resilience at the federal level. The Dams Sector is one of 16 critical infrastructure sectors designated by

[185] According to the National Institute of Standards and Technology, an industrial control system is an "information system used to control industrial processes such as manufacturing, product handling, production, and distribution. Industrial control systems include supervisory control and data acquisition systems used to control geographically dispersed assets, as well as distributed control systems and smaller control systems using programmable logic controllers to control localized processes." NIST, Computer Security Resource Center Glossary, at https://csrc.nist.gov/glossary/term/industrial_control_system.

[186] Department of Justice, Office of Public Affairs, "Seven Iranians Working for Islamic Revolutionary Guard Corps-Affiliated Entities Charged for Conducting Coordinated Campaign of Cyber Attacks Against U.S. Financial Sector," press release, March 24, 2016, https://www.justice.gov/opa/pr/seven-iranians-working-islamic-revolutionary-guard-corps-affiliated-entities-charged.

[187] See Department of Justice, "Seven Iranians Working for Islamic Revolutionary Guard Corps-Affiliated Entities Charged for Conducting Coordinated Campaign of Cyber Attacks Against U.S. Financial Sector," March 24, 2016, at https://www.justice.gov/opa/pr/seven-iranians-working-islamic-revolutionary-guard-corps-affiliated-entities-charged.

[188] National Cybersecurity and Communications Integration Center, *ICS-CERT Annual Assessment Report, Industrial Control Systems Cyber Emergency Response Team, FY 2016*, https://www.cisa.gov/sites/default/files/Annual_Reports/FY2016_Industrial_Control_Systems_Assessment_Summary_Report_S508C.pdf.

[189] Office of the Inspector General, U.S. Department of the Interior, *U.S. Bureau of Reclamation Selected Hydropower Dams at Increased Risk from Insider Threats*, 2017-ITA-023, June 2018, at https://www.oversight.gov/sites/default/files/oig-reports/FinalEvaluation_ICSDams_Public.pdf.

[190] Office of the Inspector General, Tennessee Valley Authority, *Non-Power Dam Control System Cybersecurity*, 2022-17340, June 1, 2022, at https://www.oversight.gov/report/TVA/Non-Power-Dam-Control-System-Cybersecurity.

[191] The strategy builds off Executive Order 14028, "Improving the Nation's Cybersecurity," 86 *Federal Register* 26633-26647, May 11, 2021 and other executive actions. For instance, the White House released a National Security Memorandum on Improving Cybersecurity for Critical Infrastructure Control Systems on July 28, 2021, at https://www.whitehouse.gov/briefing-room/statements-releases/2021/07/28/national-security-memorandum-on-improving-cybersecurity-for-critical-infrastructure-control-systems/. White House, *National Cybersecurity Strategy*, March 2023, at https://www.whitehouse.gov/wp-content/uploads/2023/03/National-Cybersecurity-Strategy-2023.pdf.

Presidential Policy Directive 21 (PPD-21) as having national-level significance to issues of security, the economy, and public health.[192] DHS is the Sector Risk Management Agency (SRMA) for the Dams Sector, acting through the Cybersecurity and Infrastructure Security Agency (CISA).[193] As the SRMA, CISA is responsible for leading, facilitating, and supporting the security and resilience of the Dams Sector. CISA provides technical assistance and training opportunities, and guides sector partners and stakeholders through the Dams Sector Government Coordinating Council (Dams Sector GCC)—a government interagency group—to help them improve the safety, security, and resiliency of their facilities. The Dams Sector GCC coordinates these activities via its private-sector counterpart, the Dams Sector Coordinating Council.[194]

A 2021 OIG report found that CISA could not demonstrate how its oversight has improved security and resilience in the sector.[195] The report raised a number of issues and recommendations related to CISA's lack of coordination and tracking of activities and performance, outdated sector plans, gaps in information shared with FEMA, and not effectively using the Homeland Security Information Network Critical Infrastructure Dams Portal—a DHS-run secure online information-sharing and coordination site—to provide critical information to sector stakeholders.

Congress may consider various options for addressing the risk exposure of the nation's dams to cybersecurity threats. Congress may conduct oversight on CISA's actions as the SRMA for the Dams Sector and its response to recommendations from the 2021 OIG report. While CISA concurred with all of the report's recommendations, it is not clear if the agency has fulfilled its commitments. For instance, one recommendation and concurrence was for CISA to update its Dams Sector-Specific Plan by the end of FY2022; as of March 2023, the 2015 plan remains in place.[196] Congress could also consider enacting legislation to address certain specific recommendations. For example, the report and ASDSO have recommended that CISA and FEMA's NDSP increase coordination.[197] Congress could consider amending the National Dam Safety Program Act to add CISA as a member of its advisory bodies (see "Advisory Bodies of the National Dam Safety Program") or to direct coordination between the agencies regarding resilience and security.

The National Cybersecurity Strategy released by the Biden Administration in March 2023 outlines improving cybersecurity through new and updated regulations and through financial

[192] Homeland Security Act of 2002 (P.L. 107-296) and Presidential Policy Directive (PPD) 21, "Critical Infrastructure Security and Resilience."

[193] The dams sector, in this context, comprises dam projects, navigation locks, levees, hurricane barriers, mine tailings impoundments, and other similar water retention and control facilities. Cybersecurity and Infrastructure Security Agency (CISA), *Dams Sector Overview*, April 2021, at https://www.cisa.gov/sites/default/files/2023-01/dams-sector-overview-042021-508.pdf. For more information on critical infrastructure issues, see CRS Report R45809, *Critical Infrastructure: Emerging Trends and Policy Considerations for Congress*, by Brian E. Humphreys.

[194] The Dams Sector Coordinating Council (SCC) is a self-run and self-governed organization of nonfederal owners and operators and trade associations that represents the spectrum of assets within the sector. The Dams Government Coordinating Council (GCC) acts as the government partner to the SCC to plan, implement, and execute sector wide security programs for the sector's assets. The GCC includes representatives from federal, state, local, and tribal owners and operators, and federal and state regulators of sector assets. CISA, *Dams Sector Overview*, April 2021, at https://www.cisa.gov/sites/default/files/2023-01/dams-sector-overview-042021-508.pdf.

[195] Office of Inspector General, U.S. Department of Homeland Security, *CISA Can Improve Efforts to Ensure Dam Security and Resilience*, OIG-21-59, September 9, 2021, at https://www.oig.dhs.gov/sites/default/files/assets/2021-09/OIG-21-59-Sep21.pdf.

[196] U.S. Department of Homeland Security, *Dam Sector Specific Plan*, 2015, at https://www.cisa.gov/sites/default/files/publications/nipp-ssp-dams-2015-508.pdf.

[197] ASDSO, "Roadmap to Reducing Dam Safety Risks," at https://www.damsafety.org/Roadmap.

incentives, among other means.[198] Since the majority of the nation's dams are regulated by state agencies, federal involvement in improving cybersecurity through regulations may be limited. Congress may direct federal agencies that own dams to strengthen cybersecurity policies. It may also direct FERC to require changes to mandatory cybersecurity reliability standards for the bulk electricity system (including hydropower assets) developed and implemented by the North American Electric Reliability Corporation (NERC), a nonprofit industry-led organization for electric reliability. FERC exercises oversight of and provides guidance for the development and implementation of NERC standards.[199] Regarding nonfederal dams, FEMA could use appropriations, including those provided by the IIJA, to support state agencies and nonfederal dam owners in their efforts to improve dam cybersecurity. Congress could also amend existing program authorizations or create new programs that authorize technical and/or financial assistance for cybersecurity improvements at nonfederal dams. However, Congress may consider trade-offs in using limited funds for security improvements if such a use detracts from investments in dam safety actions such as inspections, rehabilitation, and repair.

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[198] The White House, "Fact Sheet: Biden-Harris Administration Announces National Cybersecurity Strategy," March 2, 2023, at https://www.whitehouse.gov/briefing-room/statements-releases/2023/03/02/fact-sheet-biden-harris-administration-announces-national-cybersecurity-strategy/.

[199] For additional information, see "Mandatory and Enforceable Critical Infrastructure Protection Standards" section in CRS Report R46959, *Evolving Electric Power Systems and Cybersecurity*, by Richard J. Campbell.