



# Dam Safety in the United States

A Progress Report on the National Dam Safety Program  
Fiscal Years 2012 and 2013

*August 2014*



Homeland  
Security

*Federal Emergency Management Agency*

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# Message from the Administrator

August 26, 2014

I am pleased to present the following report, *Dam Safety in the United States: A Progress Report on the National Dam Safety Program Fiscal Years 2012 and 2013*. The report has been prepared by the Federal Emergency Management Agency pursuant to Section 215 of the Dam Safety Program Act of 2006 (33 U.S.C. § 467 note).

The report describes the status of the National Dam Safety Program, including the progress achieved by participating States and Federal agencies and recommendations for improving dam safety in the United States.

Pursuant to congressional requirements, this report is being provided to the following Members of Congress:

*The Honorable Barbara Boxer*, Chairwoman, Environment and Public Works Committee, United States Senate

*The Honorable David Vitter*, Ranking Member, Environment and Public Works Committee, United States Senate

*The Honorable Thomas R. Carper*, Chairman, Transportation and Infrastructure Subcommittee, Environment and Public Works Committee, United States Senate

*The Honorable John Barrasso*, Ranking Member, Transportation and Infrastructure Subcommittee, Environment and Public Works Committee, United States Senate

*The Honorable William Shuster*, Chairman, Transportation and Infrastructure Committee, United States House of Representatives

*The Honorable Nick J. Rahall II*, Ranking Member, Transportation and Infrastructure Committee, United States House of Representatives

*The Honorable Lou Barletta*, Chairman, Economic Development, Public Buildings, and Emergency Management Subcommittee Transportation and Infrastructure Committee, United States House of Representatives

*The Honorable André Carson*, Ranking Member, Economic Development, Public Buildings, and Emergency Management Subcommittee, Transportation and Infrastructure Committee, United States House of Representatives

Inquiries related to this report may be directed to me at (202) 646-3900, or to the Department's Deputy Chief Financial Officer, Peggy Sherry, at (202) 447-5751.

Sincerely,



W. Craig Fugate  
FEMA Administrator



# Executive Summary

The Federal Emergency Management Agency (FEMA) has prepared *Dam Safety in the United States: A Progress Report on the National Dam Safety Program Fiscal Years 2012 and 2013* pursuant to the Dam Safety Program Act of 2006, which requires a biennial report to Congress on the progress that has been achieved in dam safety during the previous two Fiscal Years (FYs).

Dams are a vital part of the infrastructure in the United States and provide many benefits but also present significant risks. Benefits include recreation, flood control, fire protection, irrigation, water supply, wildlife habitat, and hydroelectric power. The major risk is dam failure, which releases the energy of the water stored behind the dam and can cause loss of life and extensive damage to property and the environment. The risk of failure is higher in dams that are not properly maintained or operated.

Catastrophic dam failures in West Virginia, Idaho, and Georgia during the 1970s killed 175 people, injured thousands, left thousands homeless, and caused billions of dollars of damage. These dam failures led to the creation of the National Dam Safety Program (NDSP) in 1979, which is administered by FEMA. Much progress has been made in dam safety since the NDSP was established, but dams continue to fail, causing loss of life and damage to property and the environment.

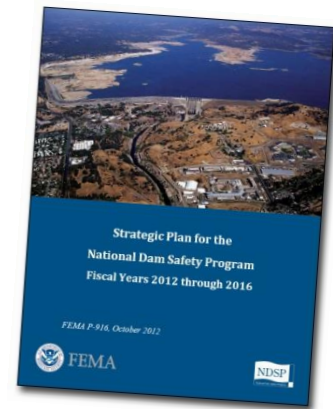
In 2013, the National Inventory of Dams (NID), which is maintained by the U.S. Army Corps of Engineers, listed 87,359 dams in the United States. Approximately 17 percent (14,726) were classified as high-hazard potential and approximately 14 percent (12,406) as significant-hazard potential. Hazard potential is classified according to the potential of a dam to affect the safety and health of citizens and to cause property damage if the dam fails. Classifications reflect only the consequences of the failure of a particular dam and do not reflect the condition of the dam.

The NDSP mission is to “reduce risks to life, property, and the environment from dam failure by guiding public policy and leveraging industry best practices across the dam safety community.” To help improve the condition and safety of the Nation’s dams, FEMA provides grants to the States to reduce the likelihood and consequences of dam failures, promote public awareness of the benefits and risks related to dams, and promote research and training for State dam safety and other professionals.

The NDSP is supported by the National Dam Safety Review Board (Review Board) and the Interagency Committee on Dam Safety (ICODS), both of which are chaired by FEMA. The Review Board monitors the safety of dams in the United States and State implementation of NDSP requirements and advises the FEMA Administrator on national dam safety policy. ICODS coordinates among Federal agencies on dam safety issues and collaborates with the Review Board to ensure consistency and support between the Federal and non-Federal elements within the dam community.

The Federal agencies that own or regulate dams continue to implement FEMA 93, *Federal Guidelines for Dam Safety*. They also participate in the Review Board and ICODS and provide resources and expertise whenever possible. FEMA continues to work with its sister agencies in the Department of Homeland Security as well as with other Federal agencies through the NDSP and related programs.

In FY 2012 and FY 2013, the NDSP was guided by FEMA P-916, *Strategic Plan for the National Dam Safety Program Fiscal Years 2012 through 2016*. The NDSP has seen the following significant progress in FY 2012 and 2013 in achieving the five goals set forth in the Strategic Plan:



- *Goal 1: Reduce the likelihood of dam failures.* This goal was advanced by increases in State-regulated dam inspections, improved reporting on the condition of dams, development of a new database on dam failures, and providing dam safety assistance to States and Federal agencies.
- *Goal 2: Reduce the potential consequences resulting from dam failures.* Progress includes an increase in the number of Emergency Action Plans (EAPs) for State-regulated high-hazard potential and significant-hazard potential dams, the development of EAP Guidelines and new hazard mapping tools, and the completion of an EAP outreach program. A Consequences of Dam Failure training course was conducted in May 2012.
- *Goal 3: Promote public awareness of the benefits and risks related to dams.* The National Research Council's *Dam and Levee Safety and Community Resilience: A Vision for Future Practice*, published in 2012, is a significant contribution to advancing this goal. FEMA furthered this goal by its 2013 publication of *Living with Dams: Know Your Risk*, a brochure for the public; developing a new Dam Safety Awareness Plan; and hosting and coordinating National Dam Safety Awareness Day events.
- *Goal 4: Promote research and training for State dam safety and other professionals.* FEMA, with assistance from the Review Board, developed a new curriculum for dam safety training. The NDSP also provided training to State dam safety officials and others in the dam safety community and published a number of new technical guidelines and best practices.
- *Goal 5: Align relevant Federal programs to improve dam safety.* FEMA began holding senior leadership meetings attended by leaders from Federal agencies, States, and the private sector; collaborated with Federal agencies on projects such as the Pocket Safety Guide for Dams and Impoundments; and investigated unregulated dams on Federal lands.

During FY 2012 and FY 2013, the efforts to improve dam safety have played an important role in reducing the loss of life and damage to property and the environment from dam failures and would not have been possible without the dedication and hard work of the caretakers of our Nation's dams.



# Dam Safety in the United States: A Progress Report on the National Dam Safety Program Fiscal Years 2012 and 2013

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# Preface

On May 31, 1889, the South Fork Dam in Johnstown, Pennsylvania, failed after days of unusually heavy rainfall, sending torrents of water downstream, killing 2,200 people, and leaving thousands homeless. The Johnstown disaster was the worst dam failure in the United States in the number of lives lost and injuries. In 1999, May 31 was designated as National Dam Safety Awareness Day in commemoration of the disaster and as a call to action. This year marks the 125th anniversary of the Johnstown flooding and is a solemn reminder of the importance of dam safety.

The Johnstown dam failure showed that dams can fail without warning and cause widespread loss of life, damage, and disruption. The total number of dam failures in the United States is unknown, but from January 2005 to June 2013, there were 173 reported dam failures and 587 incidents, in which dam failure would likely have occurred without intervention.<sup>1</sup>



Johnstown, PA, after the dam failure, 1889 (NOAA)

The risk of dam failure and loss from dam failure can be reduced, but it requires planning and coordination. Mitigation measures focus on reducing dam failures and managing the risks posed by dams. The measures include good land use planning; designing or remediating dams to make them less likely to fail; inspecting dams regularly; developing, implementing, and exercising Emergency Action Plans (EAPs) for dams with high- or significant-hazard potential; other local emergency preparedness and response planning activities; implementing warning systems; raising public awareness about the risks; and conducting regular student evacuation drills.

Reducing the risk of dam failure has been the driving force of the National Dam Safety Program (NDSP) since it was established by Executive Order 12148 in 1979. Central to the NDSP mission is to ensure that the public and property owners downstream are informed of the risk from dam failure.

The U.S. Census Bureau estimates that the U.S. population will have increased by approximately 130 million by 2050. The increased population will likely result in development in currently unpopulated areas below aging dams, which will increase the at-risk population and trigger the reclassification of many low- or significant-hazard potential dams as high-hazard potential. Parents should be confident that school officials are aware of dams in the vicinity and have evacuation procedures in place and students have been drilled on personal safety actions. Public

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<sup>1</sup> ASDSO, “Dam Failures and Incidents” (2013). Accessible at <http://www.damsafety.org/news/?p=412f29c8-3fd8-4529-b5c9-8d47364c1f3e>. Accessed December 27, 2013.

officials should be confident that dams are being properly inspected, operated and maintained and that EAPs are being implemented for high- and significant-hazard potential dams. Emergency response personnel should react to dam failure crises with assurance and awareness of estimated impacts based on dam risk information provided by dam owners and regulators and scenario exercises. Business owners should be confident that they have taken the steps needed to ensure employee safety and continuity of operations. Homeowners should be aware of what to expect and to be self-sufficient, if necessary.

The NDSP has made great strides in public awareness, inspections and hazard assessments, engineering design, construction methods, emergency action planning, and response and recovery readiness. Yet the Nation still has vulnerabilities to dam failures, and much work remains.

The progress that has been made in dam safety during Fiscal Years 2012 and 2013 is described in this report. The progress is the result of the dedication and hard work of engineers, concerned citizens, policymakers, scientists, and public officials at all levels, all of whom are resolved to keep children safe in their schools, make communities and businesses resilient to dam failures, and promote effective emergency response.

# I. Introduction

A number of catastrophic dam failures in the 1970s served as the primary catalyst for the creation of the National Dam Safety Program (NDSP or Program). Since the Program's establishment in 1979, there have been dam failures in every region of the United States. As a result of the Program, inspections of dams have increased, the number of Emergency Action Plans (EAPs) for high-hazard potential dams has increased, and better tools and guidance for dam operation and maintenance have been developed.



Failure of Teton Dam (Idaho) from seepage (1976)

Although much remains to be done, particularly in the development of EAPs for high-hazard potential dams, the work that has been done under the Program has played an important role in reducing the loss of life and damage to property and the environment from dam failures and would not have been possible without the dedication and hard work of the caretakers of our Nation's dams.

The Dam Safety Act of 2006 (33 U.S.C. § 467 note) requires the Director (now Administrator) of the Federal Emergency Management Agency (FEMA) to submit a biennial report on the National Dam Safety Program (NDSP or Program) to Congress. The act requires the report to include the status of the NDSP and the progress achieved by Federal agencies and participating States in implementing FEMA 93, *Federal Guidelines for Dam Safety* (FEMA, 2004) during the 2 preceding Fiscal Years.

This report, *Dam Safety in the United States: A Progress Report on the National Dam Safety Program Fiscal Years 2012 and 2013*, is submitted to Congress in compliance with the Dam Safety Act of 2006.

During the reporting period, FEMA and its partners in the Program have taken a proactive approach to address the following challenges in dam safety:

- Dams are continuing to age, with many now exceeding their design life expectancy. The average age of dams in the United States is 55 years (ASCE, 2013).
- The 2013 update to the National Inventory of Dams (NID) (2013 NID)<sup>2</sup> lists 14,726 dams as high-hazard potential, meaning their failure would likely result in loss of life.

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<sup>2</sup> In this report, 2013 NID is used as the abbreviation for the U.S. Army Corps of Engineers' *National Inventory of Dams, 2013 State Dam Safety Program Performance Information Summary for the 2012 Reporting Year*.

- The increase in population downstream of dams is driving the increase in the number of dams that are classified as high-hazard potential and is a compelling argument for coordinated emergency action planning.
- The environmental impacts of dams are now being studied more closely, particularly in the context of issues presented by climate change. Natural disasters have increased in frequency and intensity and have produced cascading impacts, including those affecting dams. The result is a greater need to adopt multi-hazard strategies.

As required by the Dam Safety Act of 2006, this report includes the progress that has been made in dam safety as part of the NDSP during the reporting period. Highlights of the progress are as follows:

- Publication of FEMA P-916, *Strategic Plan for the National Dam Safety Program for Fiscal Years 2012–2016* (FEMA, 2012b) and preparation of the Dam Safety Awareness Plan;
- Identification of opportunities for integrating dam safety into community resilience;
- Increased communication and planning with leaders in dam safety and in other hazard areas and with the emergency management community with the goal of achieving greater coordination and efficiencies in today’s multi-hazard environment;
- More inspections of dams and increases in the development and implementation of EAPs for high- and significant-hazard potential dams;
- Development of new tools and guidance for the operation and maintenance of dams; and
- Continued monitoring of the status of U.S. dams, as defined in the Dam Safety Act of 2006, through the NID maintained by the U.S. Army Corps of Engineers (USACE).

Although much has been accomplished, much remains to be done. Work completed in FY 2012–2013 will have applications immediately or in the near future in reducing the risk posed by dams. The work that has been done during the report period has laid a strong foundation for realizing similarly effective outcomes in future years.

The structure of this report is based on FEMA P-916, *Strategic Plan for the National Dam Safety Program Fiscal Years 2012 through 2016* (FEMA, 2012b), which provides a template for measuring progress in dam safety in the United States. The contents of the report are as follows:

- Chapter I: Introduction
- Chapter II: Overview of U.S. Dams in 2013 – hazard potential of U.S. dams as of 2013, primary purposes of U.S. dams as of 2013, and ownership of U.S. dams
- Chapter III: National Dam Safety Program – history, statutory authorization, and leadership and administration of the NDSP and a description of the National Inventory of Dams (NID)
- Chapter IV: National Dam Safety Program Accomplishments – NDSP goals and objectives and the progress that has been made during the reporting period toward achieving them

- Chapter V: Federal Agency Activities – dam-related responsibilities of Federal agencies that own or regulate dams and the dam-safety-related activities of the agencies during the reporting period
- Chapter VI: Related Programs – other programs involved in dam safety and their dam-safety-related activities
- Chapter VII: References
- Appendix A: NDSP Management Chronology – National Dam Safety Review Board and the Interagency Committee on Dam Safety meetings during the reporting period
- Appendix B: Partners and Stakeholders – NDSP partners and organizations with interest in dam safety
- Appendix C: Acronyms and Abbreviations

## II. Overview of U.S. Dams in 2013

*Federal Guidelines for Dam Safety: Hazard Potential Classification System for Dams* (FEMA, 2004) provides a system for classifying dams according to the potential impact a dam failure would have on upstream or downstream areas or at locations remote from the dam. The classifications do not reflect dam condition but rather the consequences of a dam failure.

Hazard potential classifications reflect the consequences of dam failure, not the condition of the dam

The three classifications are as follows:

- High-hazard potential – failure will probably cause loss of human life
- Significant-hazard potential – failure will result in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can affect other concerns
- Low-hazard potential – failure will result in no probable loss of human life and low economic and/or environmental losses

According to the 2013 NID, there are 87,359 dams in the United States (see Figure 1). Approximately 17 percent (14,726) are classified as high-hazard potential, and approximately 14 percent (12,406) are classified as significant-hazard potential. The majority of dams (approximately 67 percent or 58,956) are classified as low-hazard potential (2013 NID). See Figure 2.

Of the 87,359 dams in the United States, States regulate approximately 80 percent, and Federal agencies own or regulate approximately 6 percent. State and local governments own approximately 25 percent, and private entities own approximately 65 percent (2013 NID). Hoover Dam, which is owned by the Bureau of Reclamation, impounds the Nation’s largest reservoir— Lake Mead on the Colorado River in Clark County, Nevada, which has a storage capacity of more than 30 million acre-feet of water.



Hoover Dam on the Colorado River



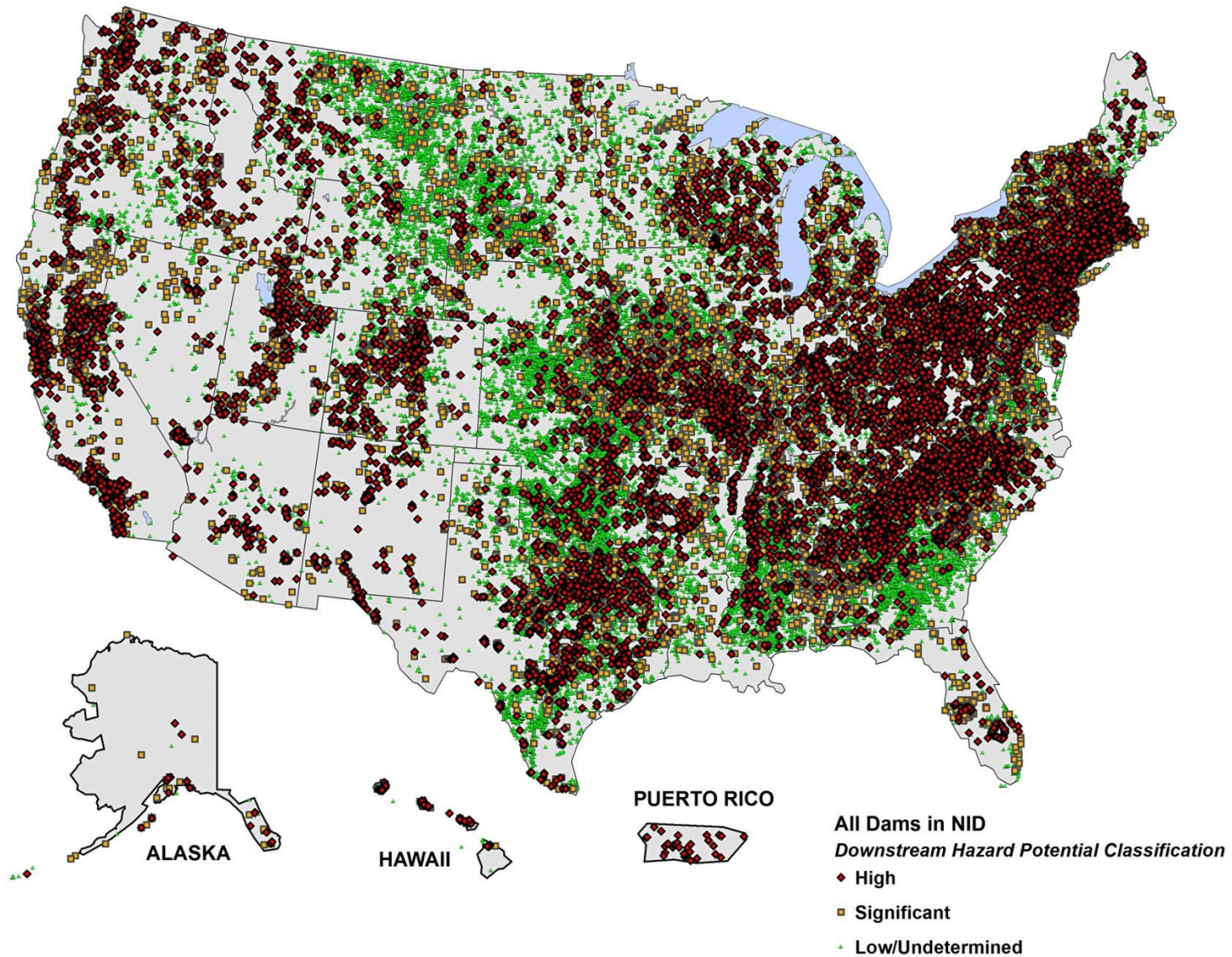


Figure 1. U.S. NID dams (2013 NID)



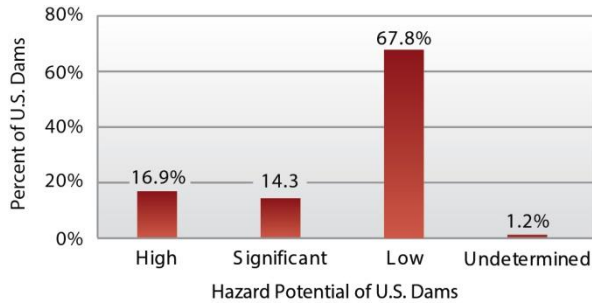


Figure 2. Hazard potential of U.S. dams in 2013 (adapted from 2013 NID)

The NID includes almost 500 dams that are 200 feet or more in height and more than 18,000 dams that are 15 feet or less in height. The Federal Government owns 35 percent of the Nation’s tallest dams. With a height of 770 feet, Oroville Dam, which is on the Feather River in Butte County, California, and owned by the California Department of Water Resources, is the tallest dam in the United States.



Oroville Dam (California Department of Water Resources)

The primary purposes of U.S. dams in 2013 are shown in Figure 3. Approximately half of the dams are used primarily for recreation (32 percent) or flood control (17 percent) (2013 NID).

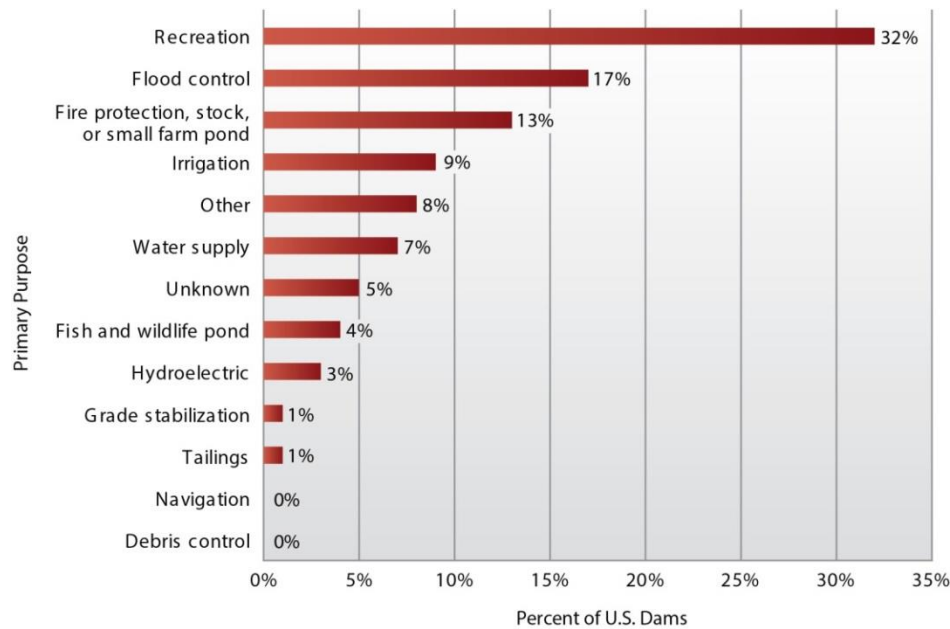


Figure 3. Primary purpose of U.S. dams in 2013 (adapted from 2013 NID)

### III. National Dam Safety Program

On February 26, 1972, a tailings dam in Buffalo Creek, West Virginia, failed, devastating a 16-mile valley with 6,000 inhabitants. In a matter of minutes, 125 people were killed, 1,100 people were injured, and more than 3,000 were left homeless. On June 5, 1976, Teton Dam in Idaho failed, leaving 11 people dead and causing \$1 billion in damage. In November 1977, Kelly Barnes Dam in Georgia failed, killing 39 people, most of them college students.



Flooding caused by the failure of Teton Dam in eastern Idaho as it was filling for the first time (1976) (waterarchives.org)

These catastrophic dam failures led to national efforts to ensure the safety of America’s dams. In 1978, the Department of the Army initiated the National Dam Inspection Program. In 1979, President Jimmy Carter signed Executive Order 12148, creating the Federal Emergency Management Agency and making FEMA responsible for, among other things, coordinating efforts to promote dam safety. In 1979, FEMA published the *Federal Guidelines for Dam Safety* (FEMA, 1979).

The National Dam Safety Program (NDSP) was established by the Water Resources Development Act of 1986 (33 U.S.C. §§ 2201 et seq.). The program was initially administered by the Secretary of the Army, but the administration was transferred to the Director of FEMA (now Administrator) by the National Dam Safety Program Act of 1996, which was part of the Water Resources Development Act of 1996 (33 U.S.C. §§ 2201 et seq.). Congress reauthorized the NDSP in 2002 and 2006.

The NDSP is dedicated to providing the information and tools needed to ensure a future in which people are safe from, and property and prosperity are resilient to, the impact of dam failures.

The purpose of the NDSP, as expressed in the Dam Safety Act of 2006, is 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” (33 U.S.C. § 467 note).

The objectives of the NDSP are to:

- Ensure that new and existing dams are safe through the development of technologically and economically feasible programs and procedures for national dam safety hazard reduction;
- Encourage acceptable engineering policies and procedures to be used for dam site investigation, design, construction, operation and maintenance, and emergency preparedness;

- Encourage the establishment and implementation of effective dam safety programs in each State based on State standards;
- Develop and encourage public awareness projects to increase public acceptance and support of State dam safety programs; and
- Develop technical assistance materials for Federal and State dam safety programs; provide Federal technical assistance for dam safety to the non-Federal sector; and develop technical assistance materials, seminars, and guidelines to improve security for dams in the United States.

FEMA P-916, *Strategic Plan for the National Dam Safety Program for Fiscal Years 2012–2016* (FEMA, 2012b), defines the NDSP vision and mission. Realization of the NDSP mission requires the development and application of knowledge based on research and engineering best practices; making the public more aware of the risks from dam failures; and assisting State, local, and private-sector leaders in the development and adoption of consistent and comprehensive standards and policies.

**National Dam Safety Program Vision**

The benefits and risks of dams are understood and risks are managed to improve public safety, economic strength, national security, and to sustain the environment.

**National Dam Safety Program Mission**

Reduce risks to life, property, and the environment from dam failure by guiding public policy and leveraging industry best practices across the dam safety community

The *Strategic Plan for the National Dam Safety Program* also describes the requirement to take a collaborative approach to dam safety and dam risk management in alignment with Presidential Policy Directive (PPD)-8, which established the National Preparedness System. PPD-8 provides the approach, resources, and tools for meeting the National Preparedness Goal, “a secure and resilient Nation capable of preventing, protecting against, mitigating, responding to, and recovering from the threats and hazards that pose the greatest risk.”

## Dam Safety Act of 2006

The Dam Safety Act of 2006 reauthorized funding for the NDSP, specified dollar amounts through FY 2011 (in addition to any dollar amounts made available for similar purposes in any other Dam Safety Act and dollar amounts made available under other subsections), and continued all of the legislatively mandated activities established by the National Dam Safety Program Act of 1996 (33 U.S.C. §§ 467 et seq.) and the Dam Safety and Security Act of 2002

(33 U.S.C. § 467). The activities include grants to the States for the improvement of State dam safety programs; training for State dam safety staff and inspectors; a program of technical and archival research; and funding to maintain and update the NID.

Under the Dam Safety Act of 2006, FEMA is authorized to carry out a number of initiatives. These initiatives are summarized as follows:

- Continue the National Dam Safety Review Board to monitor the safety of dams in the United States, monitor State implementation of the NDSP, and advise FEMA;
- Coordinate Federal efforts in dam safety by chairing the Interagency Committee on Dam Safety;
- Transfer technical information among the Federal and State sectors;
- Provide for the education of the public, State and local officials, and private industry on the hazards of dam failure and related matters;
- Provide funding to the States to establish and maintain dam safety programs through a State assistance program;
- Provide training for State dam safety staff and inspectors;
- Establish a program of technical and archival research to develop and support:
  - Improved techniques, historical experience, and equipment for rapid and effective dam construction, rehabilitation, and inspection;
  - Devices for the continued monitoring of the safety of dams;
  - Maintenance of information resources systems needed to support managing the safety of dams; and
- Guide the formulation of effective public policy and advance improvements in dam safety engineering, security, and management.

The Department of Homeland Security (DHS) is the Sector-Specific Agency (SSA) that is responsible for the Dam Sector. Dam safety and dam security are complementary programs, and sector stakeholders routinely collaborate and coordinate activities. For example, FEMA participates in Dam Sector groups chaired by DHS, such as the Government Coordinating Council and the Sector Coordinating Council. There also is significant cross-representation of the Federal and State professionals who are involved in dam safety and dam security and serve on the DHS-chaired groups and the groups chaired by FEMA under the National Dam Safety Program (see the following subsection and Chapter VI, Related Programs).

## Leadership of the National Dam Safety Program

The National Dam Safety Program Act of 1996 transferred the administration of the NDSP to FEMA. Under FEMA's leadership, the States, Federal agencies, professional organizations, and others collaborate to encourage individual and community responsibility for dam safety.

FEMA's mission is "to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards." The following initiatives help FEMA carry out its mission:

- Foster a whole community approach to emergency management nationally;
- Build the Nation's capacity to stabilize and recover from a catastrophic event;
- Build unity of effort and common strategic understanding among the emergency management team; and
- Enhance FEMA's ability to learn and innovate as an organization.

FEMA administers the NDSP through its Federal Insurance and Mitigation Administration (FIMA). FIMA is a national leader in helping communities address and reduce disaster risks and has the lead responsibility for implementing FEMA's mitigation and insurance mission. After a disaster, FIMA provides critical services and expert personnel for response and recovery.

FIMA has three divisions: Risk Analysis, Risk Reduction, and Risk Insurance. The NDSP is administered by the Risk Analysis Division.

FEMA is supported in its leadership of the NDSP by the National Dam Safety Review Board and the Interagency Committee on Dam Safety (ICODS), both of which are chaired by FEMA.

## National Dam Safety Review Board

The Water Resources Development Act of 1996, as amended by the Dam Safety and Security Act of 2002 and the Dam Safety Act of 2006, established the National Dam Safety Review Board (Review Board) to (1) monitor the safety of dams in the United States, (2) monitor State implementation of NDSP requirements, and (3) advise the Administrator on national dam safety policy.

The Review Board consists of:

- A representative from FEMA selected by the FEMA Administrator to serve as Chair of the Review Board;
- Representatives from four Federal agencies that serve on ICODES;
- Five members selected by the FEMA Administrator from among State dam safety officials; and
- One member selected by the FEMA Administrator to represent the private sector.

Members are selected based on their recognized professional level of dam safety experience.

FEMA established five standing Work Groups to assist the Review Board in performing its duties and achieving its goals. The Work Groups are the Dam Safety Research Work Group, Dam Safety Training Work Group, Work Group on the NID, Work Group on Emergency Action

Planning for Dams, and the Communications and Outreach Work Group (established in FY 2013). Ad hoc task groups are established under the Work Groups to address specific projects and requirements. The activities of the Review Board and its standing Work Groups and associated Task Groups are described in Chapter IV.

The meetings of the Review Board that were held during the reporting period are listed in Appendix A.

## Interagency Committee on Dam Safety

The Interagency Committee on Dam Safety (ICODS) was established in 1980 and formally established by the Water Resources Development Act of 1996. ICODS meets quarterly. The ICODS meetings during the reporting period are listed in Appendix A.

ICODS consists of representatives from all Federal agencies that build, own, operate, or regulate dams. The ICODS agencies are:

- U.S. Department of Agriculture
- Department of Defense
- Department of Energy
- Department of the Interior
- Department of Labor, Mine Safety and Health Administration
- The Federal Energy Regulatory Commission
- Department of State, International Boundary and Water Commission
- Nuclear Regulatory Commission
- Tennessee Valley Authority

The duties of the ICODS are to encourage the establishment and maintenance of effective Federal programs, policies, and guidelines to enhance dam safety for the protection of human life and property. ICODS accomplishes these duties by serving as the permanent forum for the following activities:

- Coordination and information exchange among Federal agencies on dam safety issues, including implementation of the *Federal Guidelines for Dam Safety* (FEMA, 1979);
- Achievement of the objectives related to the Federal element, as described in Section 8 of the Dam Safety Act of 2006; and
- Collaboration with the Review Board to ensure consistency and support between the Federal element and non-Federal element to accomplish a unified National Dam Safety Program.

## FEMA Regional Support

FEMA Headquarter (HQ) staff work closely with their counterparts at the Regional level to support the effective partnership with the States and local communities in implementing and executing NDSP activities. FEMA Regional staff support local outreach, training delivery, oversight and execution of cooperative agreements, disaster operations, and technical assistance on local projects. Their active involvement and support ensures that NDSP's mission and activities are integrated in local mitigation planning, grant decisions, and other local activities.

Examples of the activities and initiatives undertaken by the FEMA Regions are as follows:

- Together with FEMA HQ, championed a more active role for the FEMA Regions in coordinating with State dam safety programs from an operational, mitigation, preparedness, disaster, planning, and grant perspective;
- In FY 2012, a pilot program was launched in Regions IV, VI, VIII and IX to help manage State dam safety grants. In FY 2013, management of dam safety State-assistance grants was transferred to all FEMA Regions.
- Conducted site visits and held discussions with ICODS agencies on how to improve communication and coordination;
- Conducted site visits to State dam safety offices to discuss the NDSP, dam-related research and training products, and mitigation planning;
- Supported the development of technical guidance and outreach materials;
- Attended dam tabletop and functional exercises;
- Began the Dam Sector Analysis Tool (DSAT) Decision Support System for Water Infrastructural Security (DSS-WISE) dam safety pilot program to determine best practices and procedures from a FEMA perspective and hosted a successful DSAT DSS-WISE short course in Atlanta with more than 40 participants in 19 locations;
- Worked on a multi-hazard risk analysis project with the FEMA Region IV Earthquake program to develop State maps reflecting combined dam and earthquake hazards; and
- Reviewed the dam safety section of State mitigation plans.



Dam safety tabletop exercise

## Data and Performance Tracking

FEMA and its partners in the NDSP track data of national significance for State and Federal dams through the National Inventory of Dams (NID). FEMA also implemented performance-



based eligibility criteria in FY 2013 for States participating in the NDSP grant assistance program in the areas of safety inspections, emergency action planning, and condition assessment of dams. Both of these performance tracking programs are described below.

## National Inventory of Dams

The National Dam Inspection Act of 1972 (33 U.S.C. § 467) authorized the USACE to inventory dams in the United States. The USACE published the initial NID in 1975 and updated it as resources permitted over the next 10 years. The Water Resources Development Act of 1986 authorized the USACE to maintain and periodically publish an updated NID. The Water Resources Development Act of 1996 reauthorized the NID and provided a dedicated funding source. The USACE also began close collaboration with FEMA and State regulatory offices to obtain more accurate and complete information. The Dam Safety and Security Act of 2002 reauthorized the NDSP and included the maintenance and update of the NID by the USACE. The Dam Safety Act of 2006 reauthorized the maintenance and update of the NID.

The goal of the NID is to include all dams in the United States that meet at least one of the following criteria:

- High-hazard potential classification – loss of one human life is likely if the dam fails;
- Significant-hazard potential classification – no probable loss of human life but possible economic loss, environmental damage, disruption of lifeline facilities, or impact on other concerns if the dam fails;
- Equal to or more than 25 feet tall and more than 15 acre-feet in storage capacity; and
- More than 6 feet tall and equal to or more than 50 acre-feet storage capacity.

Most of the dams that meet NID criteria are regulated by Federal or State agencies, which maintain detailed information on the dams in their jurisdictions. The USACE maintains the NID by periodically collecting dam characteristics from 49 States (Alabama currently has no dam safety legislation or formal dam safety program), Puerto Rico, and 18 Federal offices.

The USACE has developed a web-based application that allows State and Federal agencies to map their local database fields and values to NID database fields and values. The application provides flexibility for State and Federal agencies. For the 2013 NID update, States submitted dam information to the USACE, and the USACE updated the information using the web-based application. For the next NID update, State and Federal agencies will update the web-based application directly.

The application ensures that the data have the proper NID codes and required information. The USACE resolves duplicate and conflicting data from the 68 data sources to obtain the most complete, accurate, and updated NID. Today, the NID database consists of 70 database fields that describe the physical and regulatory aspects of a dam.



The USACE completed its most recent update to the NID in FY 2013. The update captures more accurate and more comprehensive data on existing dams, changes in existing dams, and new dams. As the update process continues, the quality of information at all levels in the Nation's dam safety community continues to improve. State inspections and data sharing among State and Federal agencies verify or amend existing data and identify or provide missing information. This approach leverages the economic advantages of a partnership effort, fosters cooperation among State and Federal agencies, and strengthens government and non-government risk management and decision-making at the State, local, and national levels.

Since the authorization and implementation of the NDSP, it has become increasingly clear that a breadth of information is required to support dam safety. These data needs include:

- Documenting the condition of the Nation's dams;
- Tracking the existence and progress of dam safety programs; and
- Supporting dam safety professionals responsible for evaluating and maintaining the safety of dams in the United States.

## FEMA's Implementation of Performance Measures

To improve the effectiveness of the State assistance program, FEMA implemented performance-based eligibility criteria in FY 2013 for awarding grant funds. The performance criteria are intended to ensure that grants are awarded only to State dam safety programs that can efficiently and effectively use the funds to improve dam safety and meet NDSP goals and objectives identified in FEMA P-916, *Strategic Plan for the National Dam Safety Program Fiscal Years 2012 through 2016* (FEMA, 2012b). State grant applications must address one or more of the following goals of the Strategic Plan:

- Reduce the likelihood of dam failures;
- Reduce the potential consequences resulting from dam failure;
- Promote public awareness of the benefits and risks related to dams; and
- Promote research and training for State dam safety and other professionals.

States' grant applications must identify dam safety/dam risk management tasks to accomplish in the FY 2013 work plans. Eligible State work plans must clearly identify how the State's proposed tasks relate to the goals provided above. After a State submits its work plan, FEMA will either approve the plan or discuss modifying the plan tasks given the circumstances for that State.

FEMA has implemented the following performance metrics for NDSP State assistance grants:

### Metric 1: Safety Inspections

$$\frac{\text{Number of high-hazard potential dams inspected} \times 100\%}{\text{Number of high-hazard potential dams due for inspection}}$$

**Metric 2: Emergency Action Plans**

$$\frac{\text{Number of high-hazard potential dams with Emergency Action Plans} \times 100\%}{\text{Number of high-hazard potential dams}}$$

**Metric 3: Condition Assessments**

$$\frac{\text{Number of high-hazard potential dams with condition assessments entered into the NID} \times 100\%}{\text{Number of high-hazard potential dams}}$$

State performance toward each metric is classified as low, intermediate, or high, as follows:

Performance	Metric Value
Low	0 to 49%
Intermediate	50 to 74%
High	75 to 100%

For each low-performing metric, States will dedicate a minimum of 33 percent of the grant award to improving one or more of the low-performing metrics. The work plan will set performance objectives for tasks related to the dedicated funding.

States with no low-performing metrics will, for each intermediate performing metric, dedicate a minimum of 10 percent of the grant award toward tasks that increase performance in the intermediate-performing metric. The work plan will set performance objectives for tasks related to the dedicated funding.

States that do not meet the performance objectives for the tasks that they proposed in their work plans over two consecutive grant cycles may lose their eligibility for dam safety State assistance for the next grant cycle.

## IV. National Dam Safety Program Accomplishments

FEMA P-916, *Strategic Plan for the National Dam Safety Program Fiscal Years 2012 through 2016* (Strategic Plan) (FEMA, 2012b) serves as a new format for reporting on accomplishments and activities in this biennial report. The Strategic Plan defines 5 goals and 12 objectives for activities, expected results, and outcomes for the 5-year strategic planning period (FY 2012–2016).

The goals and objectives are linked to the NDSP activities defined in the Dam Safety Act of 2006. By following the structure of the Strategic Plan, this report allows the reader to assess how the Program accomplishments and activities in FY 2012 and FY 2013 have achieved progress toward the goals.

The sections below contain the accomplishments that have been made and the activities that have taken place during the reporting period, creating a baseline for the Program beginning in FY 2012. Future biennial reports will follow this format, providing FEMA and its partners in the NDSP a straightforward and simple means of tracking and evaluating Program performance.

### *Goal 1: Reduce the Likelihood of Dam Failures*

Reducing the likelihood of dam failures is at the heart of the Program. The four objectives for this goal encompass the activities that are critical to dam safety—increasing dam inspections and condition assessments, tracking the rate of high- and significant-hazard potential dam failures in the United States, and supporting other Federal and State dam safety programs.

The risk associated with a dam failure has two components: the probability of failure and the consequences of failure. Goal 1 addresses the first component, and Goal 2 addresses the second.

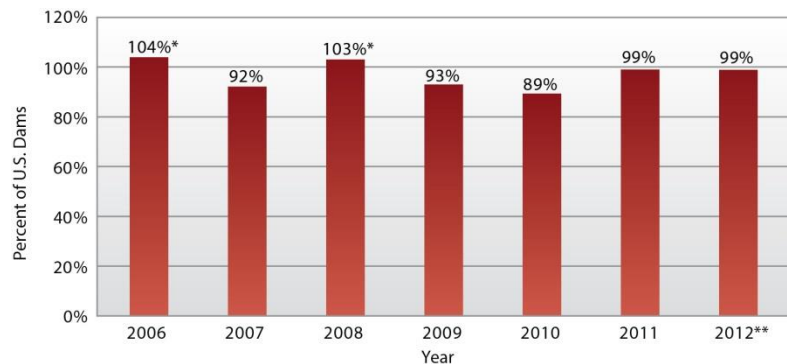
The NDSP can significantly reduce the risk to life and property from dam failures by providing Federal and State dam safety officials and dam owners with the tools to identify, prioritize, and mitigate the risk. The information on the risk must in turn be shared with the downstream public.

*Objective 1: Assess all high- and significant-hazard potential dams for the risks they pose to life, property, and the environment*

**Accomplishment: State-regulated dam inspections increased.** Formal inspections include a review to determine whether the dam meets current accepted design criteria and practices. The inspection should include a review of all pertinent documents including instrumentation, operation, and maintenance and, to the degree necessary, documentation on investigation, design, and construction. The inspection should also verify that operating and emergency response instructions are available and understood, instrumentation is adequate, and data are assessed to ensure that structures are performing as designed. Intermediate inspections include a thorough field inspection of the dam and appurtenant structures and a review of the records of inspections made at and following the last formal inspection.

Based on State dam safety legislation, 16 States inspect high-hazard potential dams every year, 19 States inspect every 2 years, 5 States inspect every 3 years, 1 State inspects every 4 years, and 9 States inspect every 5 years.

Figure 4 shows the percentage of State-regulated high-hazard potential dams that were inspected of the total number that were due for inspection from 2006 to 2012. In 2012, the percentage was 99 percent. Figure 5 shows the percentage of the State-regulated high-hazard potential dams that were inspected of the total number of State-regulated high-hazard potential dams due for inspection in 2012.



\* Inspection percentages may be above 100 percent for any given year because of a State's inspection frequency and scheduling

\*\* In 2012, 48 percent of the States performed formal inspections of State-regulated high-hazard-potential dams, but 56 percent of the total State-regulated high-hazard-potential dam inspections were formal.

Figure 4. Percentage of State-regulated high-hazard potential dams that were inspected of the total number that were due for inspection from 2006 to 2012 (adapted from 2013 NID)

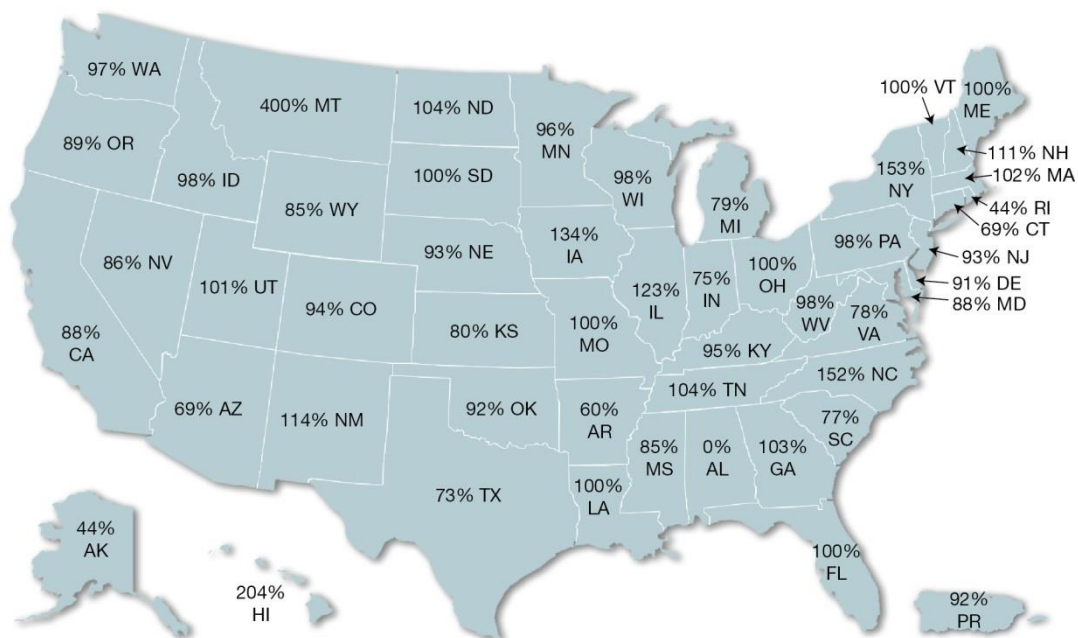


Figure 5. Percentage of the State-regulated high-hazard potential dams that were inspected of the total number of State-regulated high-hazard potential dams due for inspection in 2012 (adapted from 2013 NID); Puerto Rico with 92% is not shown. Inspection percentages may vary above and below 100% for any given year based on a State's inspection frequency and scheduling.

Table 1 provides the same information that is shown in Figure 5 but in a tabular format.

Table 1. Percentage of the State-Regulated High-Hazard Potential Dams Inspected of the Total Number of State-Regulated High-Hazard Potential Dams due for Inspection in 2012

State	Percentage of HHP Dams Inspected	State	Percentage of HHP Dams Inspected	State	Percentage of HHP Dams Inspected
Alabama	0%	Louisiana	100%	Ohio	100%
Alaska	44%	Maine	100%	Oklahoma	92%
Arizona	69%	Maryland	88%	Oregon	89%
Arkansas	60%	Massachusetts	102%	Pennsylvania	98%
California	88%	Michigan	79%	Puerto Rico	92%
Colorado	94%	Minnesota	96%	Rhode Island	44%
Connecticut	69%	Mississippi	85%	South Carolina	77%
Delaware	91%	Missouri	100%	South Dakota	100%
Florida	100%	Montana	400%	Tennessee	104%
Georgia	103%	Nebraska	93%	Texas	73%
Hawaii	204%	Nevada	86%	Utah	101%
Idaho	98%	New Hampshire	111%	Vermont	100%
Illinois	123%	New Jersey	93%	Virginia	78%
Indiana	75%	New Mexico	114%	Washington	97%
Iowa	134%	New York	153%	West Virginia	98%
Kansas	80%	North Carolina	152%	Wisconsin	98%
Kentucky	95%	North Dakota	104%	Wyoming	85%

Source: 2013 NID

HHP = high-hazard potential

Inspection percentages may be above 100% because of a State's inspection frequency and scheduling.

Figure 6 shows the percentage of State-regulated significant-hazard potential dams that were inspected of the total number that were due for inspection from 2006 to 2012.

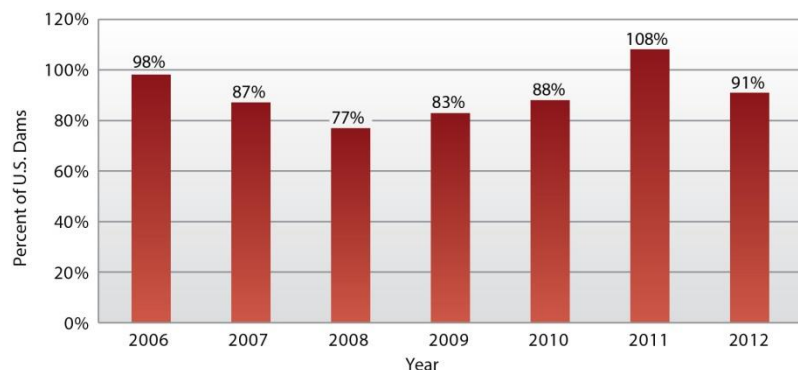
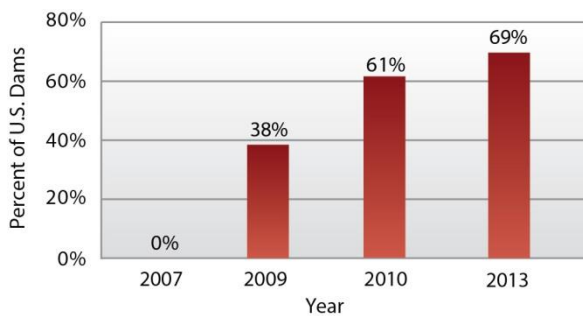


Figure 6. Percentage of State-regulated significant-hazard potential dams that were inspected of the total number that were due for inspection from 2006 to 2012 (adapted from 2013 NID)

**Objective 2:** Reduce the number of deficient dams in the United States

**Accomplishment: Understanding of remediation needs improved by condition reporting of dams.** According to the 2013 Report Card from the American Society of Civil Engineers (ASCE), “the nation’s dams are aging and the number of high-hazard potential dams is on the rise. Many of these dams were built as low-hazard dams protecting undeveloped agricultural land. However, with an increasing population and greater development below dams, the overall number of high-hazard dams continues to increase, to nearly 14,000 in 2012. The number of deficient dams is estimated at more than 4,000, which includes 2,000 deficient high-hazard dams” (ASCE, 2013).

In FY 2009, the USACE began collecting data from the States and Federal agencies on the condition assessments of high-hazard potential dams to include in the NID. Figure 7 shows the percentage of NID high-hazard potential dams with a condition assessment from 2007 to 2013. The conditions assessments increased from 38 percent in 2009 to 69 percent in 2013.



Piping flow through the dam as a result of dam concrete failure



Concrete deterioration

Figure 7. Percentage of high-hazard potential dams with condition assessments for 2007–2013 (adapted from 2013 NID)

States and Federal agencies voluntarily submit condition assessment data to the NID on high-hazard potential dams (see Table 2).

Table 2. Percentage of High-Hazard Potential Dams  
with an NID Condition Assessment in 2013 Based on Source Agency Information

Agency	HHP Dams with Condition Assessment (%)	Agency	HHP Dams with Condition Assessment (%)	Agency <sup>(1)</sup>	HHP Dams with Condition Assessment (%)
Alabama	0%	Nebraska	98%	Bureau of Indian Affairs	75%
Alaska	80%	Nevada	93%	Bureau of Land Management	0%
Arizona	92%	New Hampshire	96%	Bureau of Reclamation	100%
Arkansas	78%	New Jersey	100%	Department of Energy	0%
California	100%	New Mexico	97%	Federal Energy Regulatory Commission	99%
Colorado	95%	New York	0%	Fish and Wildlife Service	100%
Connecticut	0%	North Carolina	92%	U.S. Forest Service	54%
Delaware	88%	North Dakota	0%	International Boundary and Water Commission	100%
Florida	0%	Ohio	93%	Mine Safety and Health Administration	86%
Georgia	87%	Oklahoma	91%	National Park Service	94%
Hawaii	97%	Oregon	95%	Tennessee Valley Authority	100%
Idaho	99%	Pennsylvania	98%	U.S. Air Force	100%
Illinois	0%	Puerto Rico	97%	U.S. Army	88%
Indiana	98%	Rhode Island	1%	U.S. Army Corps of Engineers	94%
Iowa	98%	South Carolina	87%	U.S. Navy	100%
Kansas	98%	South Dakota	0%		
Kentucky	5%	Tennessee	69%		
Louisiana	100%	Texas	41%		
Maine	100%	Utah	83%		
Maryland	99%	Vermont	0%		
Massachusetts	99%	Virginia	86%		
Michigan	85%	Washington	84%		
Minnesota	89%	West Virginia	11%		
Mississippi	91%	Wisconsin	0%		
Missouri	29%	Wyoming	22%		
Montana	69%				

Source: 2013 NID

HHP = high-hazard potential

(1)The Natural Resources Conservation Service is not listed because it does not own or regulate any high-hazard potential dams.

The NID has five condition ratings: satisfactory, fair, poor, unsatisfactory, and not rated. The definitions are as follows:

- **Satisfactory** – No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.
- **Fair** – No existing dam safety deficiencies are recognized for normal loading 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.

- **Poor** – A dam safety deficiency is recognized for loading conditions that may realistically occur. Remedial action is necessary. A poor rating may also be used when uncertainties exist as to critical analysis parameters that identify a potential dam safety deficiency. Further investigations and studies are necessary.
- **Unsatisfactory** – A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.
- **Not rated** – The dam has not been inspected, is not under State jurisdiction, or has been inspected but, for whatever reason, has not been rated.

Figure 8 shows the conditions assessments of the high-hazard potential dams that have condition assessments as of 2013. Of the 69 percent of high-hazard potential dams that have condition assessments, 36 percent are in less than satisfactory condition (fair, poor, unsatisfactory) and 31 percent do not have a condition assessment. Figure 9 shows that the number of deficient high-hazard potential dams reported in NID for 2009, 2010, and 2013 is increasing. Figure 10 shows the number of State-regulated high-hazard potential dams that were remediated and the State-regulated high-hazard potential dams that were in need of remediation from 1999 to 2012. The data on deficient dams and remediation needs are critical to providing decision-makers with an understanding of the resources that will be required over the short and long term to repair and maintain our Nation’s dam infrastructure.

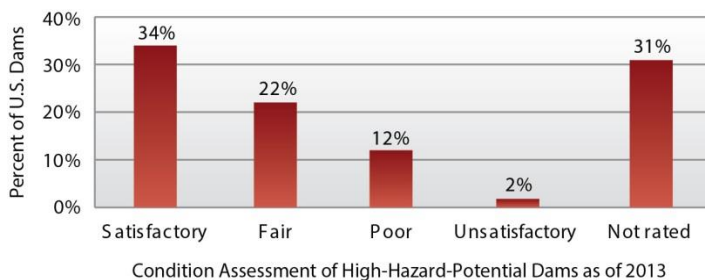


Figure 8. Condition assessment of high-hazard potential dams with condition assessments as of 2013 (adapted from 2013 NID)

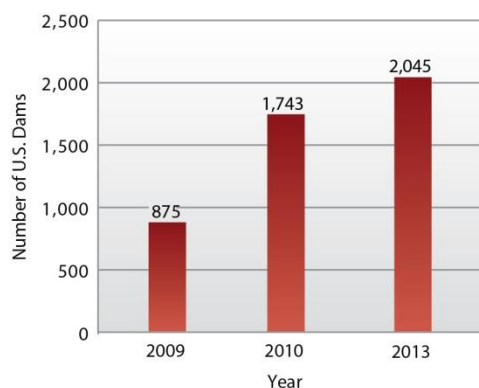


Figure 9. Number of deficient high-hazard potential dams reported in NID for 2009, 2010, and 2013 (adapted from 2013 NID)



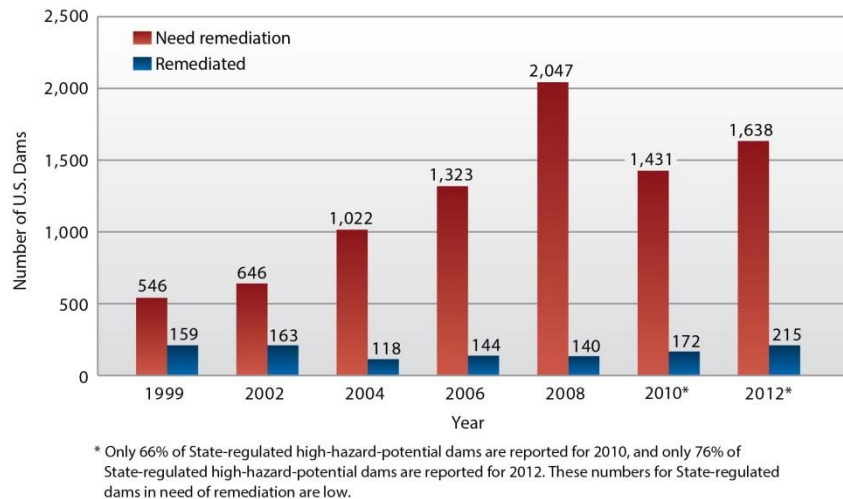


Figure 10. State-regulated high-hazard potential dams remediated and State-regulated high-hazard potential dams in need of remediation, 1999 to 2012 (adapted from 2013 NID); remediated federally regulated dams not included

**Objective 3:** *Learn from dam failures in the United States and worldwide to improve dam safety programs*

**Accomplishment: New database on dam failures.** During this reporting period, the DHS Dams Sector began work on the development of a database on dam failures as part of the Dams Sector Analysis Tool. This effort will provide the dam safety community over the long term with a valuable tool and best practices to improve the safety of dams worldwide. The accomplishments resulting from work in this area, which is now in the beginning stages, will be described in the next biennial report on the NDSP to Congress.



Example of a dam failure

**Objective 4:** *Support Federal and State dam safety programs*

**Accomplishment: State dam safety program improvements.** FEMA funding provided to the States participating in the NDSP is vital to ensuring the safety of State-regulated dams in the United States, now approximately 80 percent of the 87,359 dams listed in the 2013 NID. The prerequisite for State participation in the NDSP is the establishment of a State regulatory program for dam safety. All of the States except Alabama have regulatory programs and participate in the NDSP. A continuing priority of the NDSP is for Alabama to enact legislation so that it can participate and bring the number of participating States to 50.<sup>3</sup>

<sup>3</sup> Other DHS/FEMA grant programs for State and local hazard mitigation activities include the Emergency Management Performance Grants Program, Hazard Mitigation Grant Program, and the Pre-Disaster Mitigation Grant Program. Dam-safety-related work under these programs is described in Chapter VI.

Although State programs vary in the scope of authority, program activities typically provide for the following:

- Safety evaluation of existing dams;
- Review of plans and specifications for dam construction and major repairs;
- Periodic inspections of construction on new and existing dams; and
- Review and approval of Emergency Action Plans (EAPs).

The State assistance component of the NDSP is intended to help States bring the necessary resources to bear on inspection, classification, and emergency planning for dam safety. The NDSP allows States to identify their priorities for dams and to take appropriate action according to available resources.

In FY 2012–2013, FEMA awarded approximately \$14 million in assistance funds to Puerto Rico and the 49 participating States. The State assistance awards were based on the total number of dams (low-, significant-, and high-hazard potential) the State reports to the NID, as required by the Dam Safety Act of 2006.

The uses of dam safety grants from selected States are listed in Table 3. Typical uses of funding are training, development and dissemination of public outreach materials, dam inspections, and activities related to the development and implementation of EAPs.

Table 3. Selected State Uses of Dam Safety Grants

State	Use of Dam Safety Grants
Arkansas	<ul style="list-style-type: none"> <li>• Revised the <i>Operations and Maintenance Manual</i> for distribution to owners of all dams</li> <li>• Prepared EAPs and performed periodic safety inspections</li> <li>• Conducted public outreach, including dam owner workshops</li> </ul>
California	<ul style="list-style-type: none"> <li>• Developed EAP guidelines and attended EAP exercises</li> <li>• Prepared inundation maps and reevaluated downstream hazard</li> </ul>
Georgia	<ul style="list-style-type: none"> <li>• Performed a total of 26 dam-break routings to determine the appropriate classification for the dam; determined 20 dams to be high-hazard potential</li> <li>• Supported two engineering positions; the engineers have completed more than 400 inspections of high-hazard potential dams in the past 3 years</li> </ul>
Idaho	<ul style="list-style-type: none"> <li>• Performed dam safety inspections and dam failure modeling/inundation mapping</li> <li>• Purchased a remote-controlled camera for inspection of outlet conduits and computers and peripheral components</li> </ul>
Indiana	<ul style="list-style-type: none"> <li>• In partnership with the Indiana Department of Homeland Security, created and practiced Incident and Emergency Action Plans for all State-owned high-hazard potential dams</li> <li>• Provided awareness outreach to stakeholders, including residential realtors through the Indiana Association of Realtors; as part of the residential real-estate certification program, delivered the class “Digging into Dams” to thousands of Association members</li> </ul>

Table 3 (cont.). Selected State Uses of Dam Safety Grants

State	Use of Dam Safety Grants
Iowa	<ul style="list-style-type: none"> <li>• Provided salary, expenses and equipment for four part-time dam inspectors; the inspectors have inspected approximately 75 dams since being hired in July 2001</li> <li>• Conducted breach analysis for hazard determination and breach mapping for EAPs</li> <li>• Started conducted inspections regularly for all high-hazard potential and large dams; breach mapping and additional inspections have enabled the staff to increase enforcement activities</li> <li>• Conducted owner workshops and presentations at local conferences</li> <li>• Although Iowa does not require EAPs, provided EAP templates and breach inundation maps to high-hazard potential dam owners (21 of 91 high-hazard potential dams have EAPs)</li> </ul>
Kansas	<ul style="list-style-type: none"> <li>• Conducted workshops to educate public and dam owners on dam safety and State requirements</li> <li>• Hired a public outreach coordinator</li> <li>• Created publications for agency website and distribution at exhibits, conferences, and workshops</li> <li>• Reviewed new and existing EAPs to evaluate conformance with FEMA EAP Guidelines and State regulations</li> <li>• For inundation mapping, reviewed 186 map to determine whether breach analysis and map meet State regulations; completed a dam breach analysis and inundation map for six State-owned high-hazard potential dams</li> <li>• Completed 89 hazard classification reviews, priority given to dams in developing communities</li> <li>• Reviewed 119 consultant dam safety inspection reports and completed 8 safety inspections</li> </ul>
Kentucky	<ul style="list-style-type: none"> <li>• Purchased emergency response equipment</li> <li>• Provided technical training to dam safety personnel</li> </ul>
Louisiana	<ul style="list-style-type: none"> <li>• Compiled a list of unregistered dams by reviewing the U.S. Geological Survey Quadrangle maps and aerial photographs and located 124 dams, ponds, and reservoirs were located, which were inventoried, added to the data file, and subsequently inspected by State dam safety inspectors</li> </ul>
Missouri	<ul style="list-style-type: none"> <li>• Inspected all State-regulated dams on a 2-, 3-, and 5-year schedule based on hazard classification; conducted an average of 200+ routine inspections each year, along with 50 to 100 site visits during repairs and modifications to existing dams and construction of new dams</li> <li>• Completed 10 to 20 visits in response to real or perceived emergencies to provide technical advice and assistance to dam owners and local emergency responders</li> <li>• Reviewed plans for repair and modification of existing dams and construction of new dams (10 to 20 dams per year)</li> </ul>
Nebraska	<ul style="list-style-type: none"> <li>• Ensured that all high-hazard potential dams have a current condition assessment and are tracked in Nebraska inventory of dams</li> <li>• Inspected high-hazard potential dams. Inspected all non-federally owned high-hazard potential dams and provided all inspection reports to the dam owners in 2013</li> <li>• Updated EAPs for State-regulated dams</li> </ul>
Nevada	<ul style="list-style-type: none"> <li>• Hired a consultant for periodic dam safety inspections, hazard verification of significant-hazard potential dams, inundation mapping, and EAP development</li> <li>• Conducted dam owner, EAP, and regulations workshops</li> </ul>

Table 3 (cont.). Selected State Uses of Dam Safety Grants

State	Use of Dam Safety Grants
New Jersey	<ul style="list-style-type: none"> <li>• Conducted public awareness seminars for dam owners.; a recent seminar attended by 110 dam owners, consultants, and others</li> <li>• Assisted local emergency management officials in the development and planning of EAP exercises for 10 high-hazard potential dams</li> <li>• Improved the Dam Safety Section webpage to better inform dam owners, engineers, and the public on dam safety</li> </ul>
New Mexico	<ul style="list-style-type: none"> <li>• Increased a half-time dam safety staff member to full time</li> <li>• Provided technical training to dam safety personnel</li> </ul>
New York	<ul style="list-style-type: none"> <li>• Conducted dam owner outreach and provided training</li> <li>• Hired additional staff and consultants for inspections</li> <li>• Conducted pilot project for dam safety awareness/evaluation training for county personnel</li> </ul>
Oklahoma	<ul style="list-style-type: none"> <li>• Purchased a remote-controlled camera for inspection of outlet conduits and a computer and inspection equipment</li> </ul>
South Carolina	<ul style="list-style-type: none"> <li>• Provided technical training for dam safety personnel</li> <li>• Purchased vehicles for use in dam safety inspections</li> </ul>
Texas	<ul style="list-style-type: none"> <li>• Developed publications on dam inspections, construction, and regulations</li> <li>• Hired consultant for dam inspections and dam failure inundation mapping</li> </ul>

Source: 2013 NID; FEMA Regional Reports to FEMA HQ

**Accomplishment: National Dam Safety Review Board and Interagency Committee on Dam Safety provided guidance and expertise.** The National Dam Safety Review Board and ICODS continued to meet quarterly during this reporting period (see Appendix A). Both groups, frequently working in concert, provide FEMA with advice on Federal and State issues in dam safety as described below. FEMA uses their expertise in guiding the direction of work carried out under the NDSP.

In addition to completing FEMA P-916, *Strategic Plan for the National Dam Safety Plan for Fiscal years 2012 through 2016* (FEMA, 2012b), and the new Dam Safety Awareness Plan, the Review Board and ICODS also:

- Began work on the development of a new framework for identifying research needs in dam safety and determining the best venues and organizations to carry out the research;
- Contributed their expertise on many of the technical resources discussed in this chapter;
- Developed enhancements to the performance-based system for State assistance grants; and
- Developed position papers and resolutions on issues of national interest, such as information security needs for dams and the identification of non-Federal dams on Federal lands. This resolution, which was adopted by FEMA and transmitted by the Associate Administrator for the FEMA Federal Insurance and Mitigation Administration (FIMA) to the ICODS agencies, recommends that each Federal agency with non-Federal dams on

their land submit a status report to the Review Board for inclusion in the biennial reports to Congress on the NDSP.

## *Goal 2: Reduce the Potential Consequences Resulting from Dam Failures*

Goal 2 addresses the second component of the risk equation: the consequences of a dam failure. The most common consequences are loss of human life, injuries, and damage to property.

Emergency action planning, particularly for the dams that pose the greatest risk, is one of the cornerstones of Goal 2. Equally important are the ongoing efforts of the NDSP to improve the consequence evaluation of dam failure.



Voluntary evacuation because of flooding (North Dakota, 2009)

**Objective 5:** *Promote a program of Emergency Action Plan (EAP) implementation, compliance, and exercise for all high- and significant-hazard potential dams in the United States*

**Accomplishment: EAPs for State-regulated high- and significant-hazard potential dams increased.** Today, approximately 69 percent of all State-regulated high-hazard potential dams have an existing EAP, a significant improvement since 1998 when States participating in the NDSP began to receive grant funding (see Figure 11).

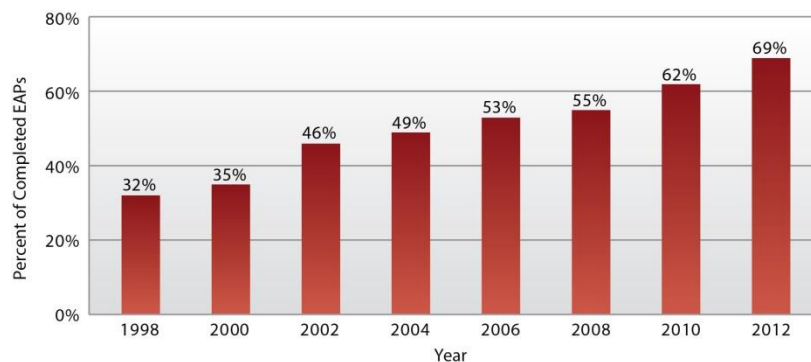
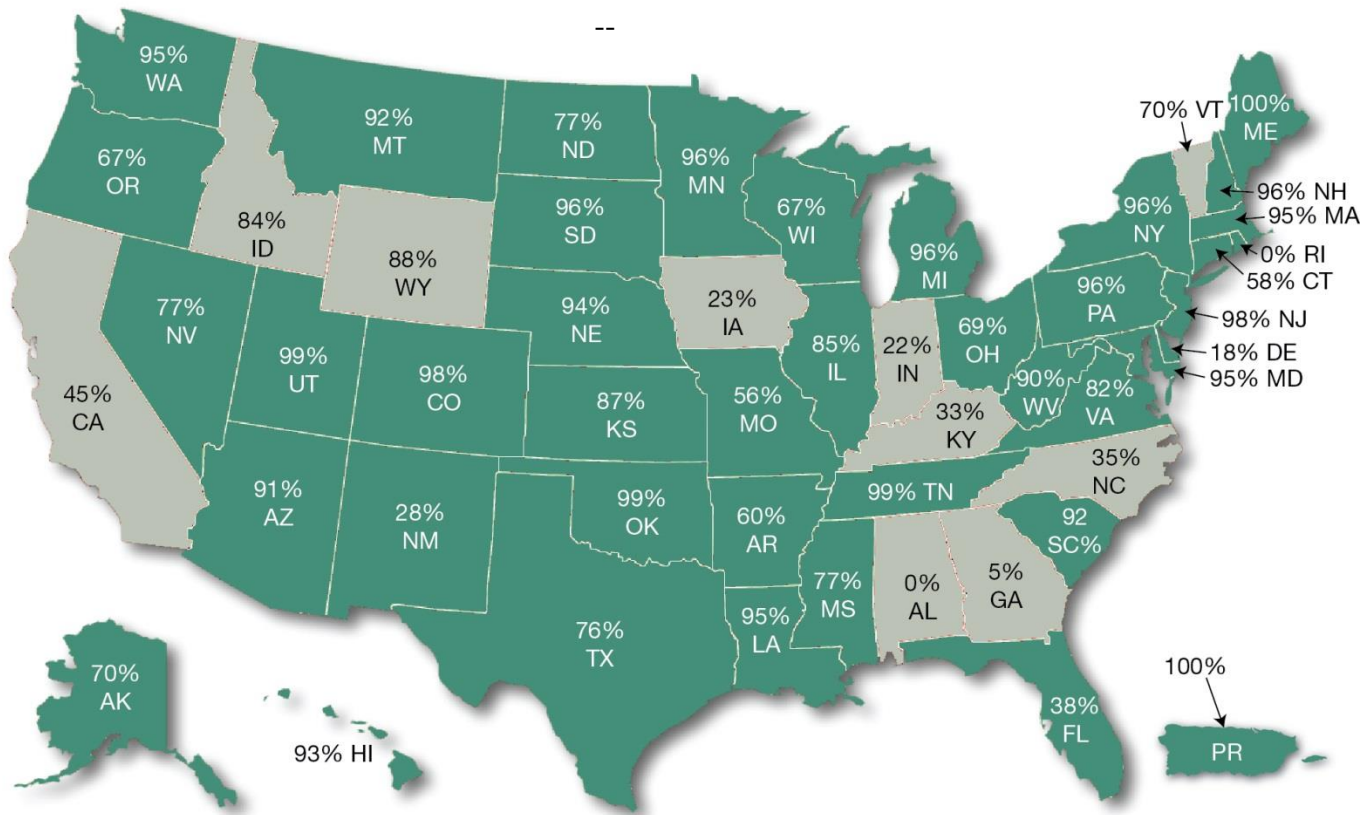


Figure 11. Percentage of EAPs completed for State-regulated high-hazard potential dams, 1998 to 2012 (adapted from 2013 NID)

Ten States do not have the authority to require a dam owner of a high-hazard potential dam to prepare an EAP: Alabama, California, Georgia, Idaho, Indiana, Iowa, Kentucky, North Carolina, Vermont, and Wyoming (see Figure 12).

For 2012, 23 states reported 90 percent or more of their State-regulated high-hazard potential dams had an existing EAP. In the last 5 years, three states have increased the number of EAPs for State-regulated high-hazard potential dams more than 50 percent. Eight states have increased EAPs 20 to 49 percent, and seven states have seen a smaller increase at less than 20 percent. Nine states have decreased their EAP completion percentage due to an increase in the number of State-regulated high-hazard potential dams (see Figure 13 and Table 4).



**Yes** State has authority to require owner of State-regulated high-hazard potential dam to prepare an Emergency Action Plan  
**NO** State does not have authority to require owner of State-regulated high-hazard potential dam to prepare an Emergency Action Plan

<b>YES</b>	AK, AR, AZ, CO, CT, DE, FL, HI, IL, KS, LA, MA, MD, ME, MI, MN, MO, MS, MT, ND, NE, NJ, NM, NV, NY, OH, OK, OR, PA, PR, RI, SC, SD, TN, TX, UT, VA, WA, WI, WV
<b>NO</b>	AI, CA, GA, IA, ID, IN, KY, NC, VT, WY

Figure 12. Percentage of State-regulated high-hazard potential dams with an EAP and the States with and without the authority to require the dam owners to prepare an EAP (adapted from 2013 NID)



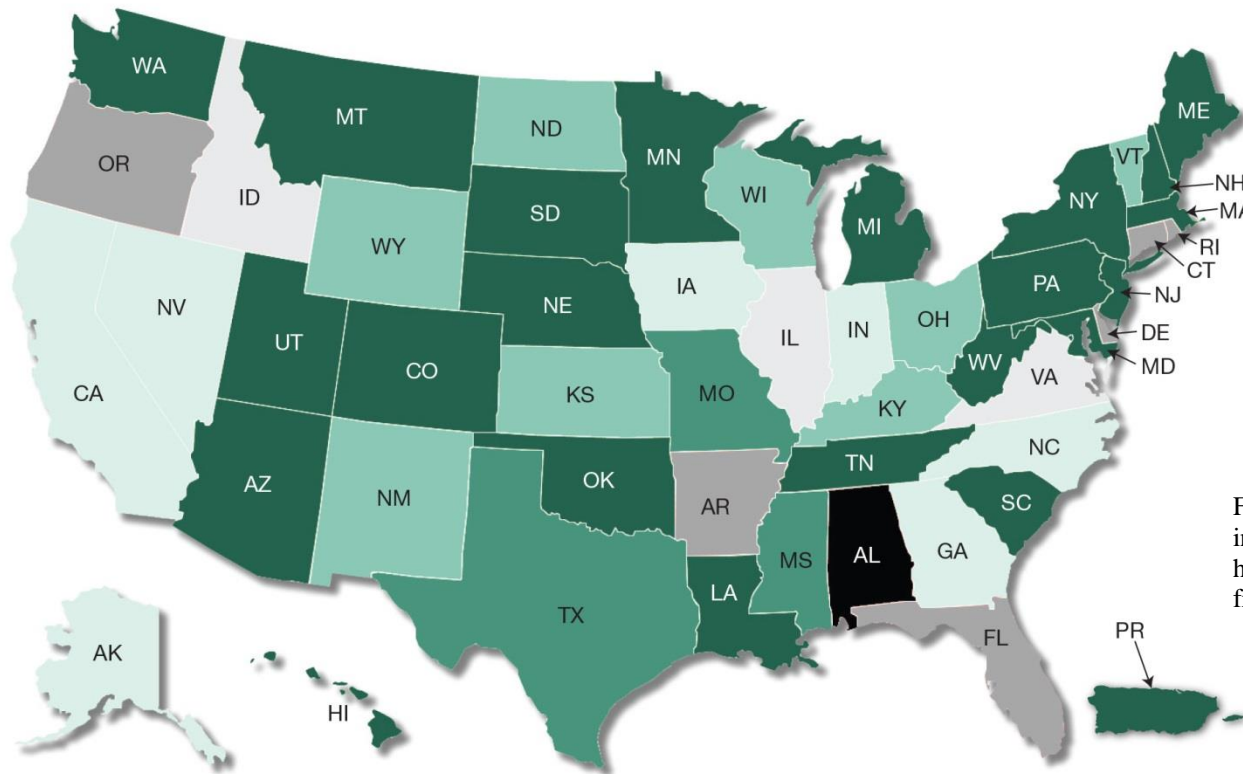


Figure 13. EAP implementation and increases in EAPs for State-regulated high-hazard potential dams (adapted from 2013 NID)



Table 4. Changes in EAPs since 2007 for State-Regulated High-Hazard Potential Dams

	Emergency Action Plan						
	90% Complete in 2012	50 >% Increase, 2007 to 2012	20-49% Increase, 2007 to 2012	< 20% Increase, 2007 to 2012	Small Decrease, 2007 to 2012; Currently >80%	Decrease, 2007 to 2012	0% Complete
<b>State</b>	Arizona	Mississippi	Kansas	Alaska	Idaho	Arkansas	Alabama
	Colorado	Missouri	Kentucky	California	Illinois	Connecticut	
	Hawaii	Texas	New Mexico	Georgia	Virginia	Delaware	
	Louisiana		North Dakota	Indiana		Florida	
	Maine		Ohio	Iowa		Oregon	
	Maryland		Vermont	Nevada		Rhode Island	
	Massachusetts		Wisconsin	North Carolina			
	Michigan		Wyoming				
	Minnesota						
	Montana						
	Nebraska						
	New Hampshire						
	New Jersey						
	New York						
	Oklahoma						
	Pennsylvania						
	Puerto Rico						
	South Carolina						
	South Dakota						
	Tennessee						
	Utah						
	Washington						
	West Virginia						

Source: 2013 NID



Figure 14 shows the EAP completion percentage for State-regulated significant-hazard potential dams.

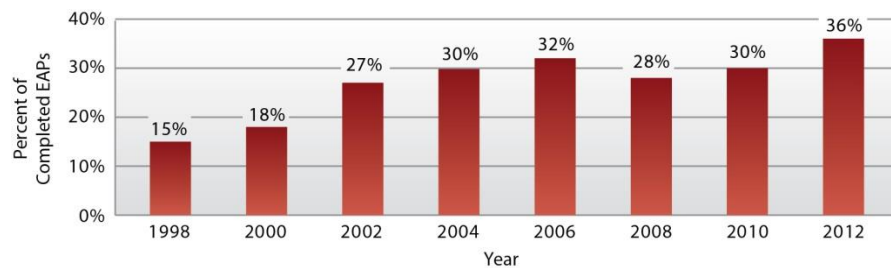
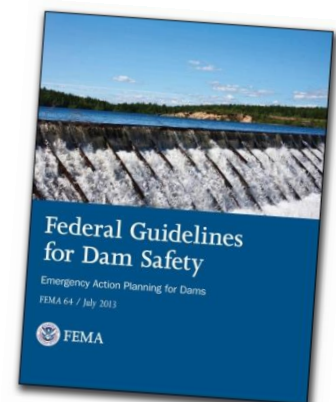


Figure 14. EAP completion percentage for State-regulated significant-hazard potential dams (adapted from 2013 NID)

Ohio and Colorado are two examples of States that have reduced the potential consequences from dam failures.

- The Ohio Department of Natural Resources developed an outreach project with its grant funds to increase the number of EAPs and improve communication with and between dam owners and local officials. Outreach included assisting Soil and Water Conservation Districts (SWCD) in preparing EAPs and coordinating meetings with dam owners, public safety officials, and community leaders. Eight SWCD offices trained by Ohio Dam Safety staff used an EAP template to develop EAPs for significant- and low-hazard potential dams. SWCD personnel met with dam owners and the emergency management agencies to write the EAP. In 2013, the fourth year for these county meetings, 19 meetings (covering 21 counties) were completed, with a total attendance of 179 dam owners and 276 local officials. At the end of 2013, 52 of Ohio’s 88 counties were covered, with the remaining 36 counties slated for the next 2 years.
- The Colorado Department of Natural Resources is developing a cloud-based website and data platform for sharing datasets. The Dam Safety Branch plans to use the website, the Colorado Prototype Inundation Mapping Data Website, as a portal for emergency management personnel and floodplain managers. Staff will be able to export and view dam failure inundation mapping for use in their programs. The department also plans to partner with owners of large dams who currently have their own data for inclusion in the dataset. The website includes a Geographic Information System (GIS) interface, shows dam locations, and highlights the downstream inundation area. In the future, this website may be used as a portal for the public to assess their risk from a dam failure and as a model for use by other States.

**Accomplishment: New Emergency Action Planning Guidelines developed.** In FY 2013, FEMA updated FEMA 64, *Federal Guidelines for Dam Safety: Emergency Action Planning for Dams*. The updated document, now available as FEMA P-64 (FEMA, 2013c), encourages comprehensive and consistent emergency action planning to protect lives and reduce property damage and emphasizes the importance of collaboration between the dam owner and emergency management authorities in developing, implementing, and



exercising EAPs. The updated guidelines also incorporate approaches and practices consistent with the National Response Framework and many contemporary emergency action planning concepts available from a variety of sources.

**Accomplishment: EAP Marketing and outreach program completed.** In the spring of 2011, FEMA completed work on an EAP marketing and outreach campaign for the States. This pilot project promotes the implementation of EAPs for high-hazard potential dams and targets dam owners, State emergency managers, regulators, selected State government officials, the news media, and the public. Project work is focused on communication strategies, including email, direct mail, post cards, news releases, public service announcements, workshops, the support of mayors and businesses, interviews with radio stations, and the creation of a website ([www.damsafetyaction.org/](http://www.damsafetyaction.org/)). As part of the initiative, three brochures focusing on dam owners, the public, and inundation mapping were developed. With FY 2013 funding, FEMA began the process for national implementation of this successful outreach project.

*Objective 6: Improve consequence evaluation for dams nationwide*

**Accomplishment: Consequences of Dam Failure Training Course.** The Consequences of Dam Failure Training Course, conducted at FEMA's Emergency Management Institute (EMI) in May 2012, was designed to enhance dam safety and emergency management officials' understanding of the technologies and methodologies to estimate the impacts of dam failure on human life and property in downstream communities. The information presented during the workshop, which was attended by dam owners and regulators, security specialists, and State and local emergency managers, can be incorporated into State and local emergency preparedness plans, response planning, and recovery efforts.

**Accomplishment: GeoDam-BREACH toolset developed.** The NDSP developed a new GIS toolset in FY 2013, Geospatial Dam Break, Emergency Action Planning, Consequences and Hazards (GeoDam-BREACH). The tool enables users to develop simplified dam break inundation zones, facilitates the efficient development of consistent EAPs, and supports the goals of FEMA's Risk MAP Program by facilitating the creation of non-regulatory Risk MAP datasets and consequence assessments for dam safety.

*Goal 3: Promote Public Awareness of the Benefits and Risks  
Related to Dams*

Many Americans are unaware that they live downstream of a dam, much less downstream of a deficient dam. Further, many Americans are not aware that they live downstream of a deficient dam that does not have an EAP to provide for warning and evacuation in the event the dam fails. Even when there is an EAP, those living downstream may not be aware of it.

The NDSP supports the development of dam risk public awareness initiatives, including the development and dissemination of materials to all appropriate audiences. The Program supports local campaigns and information to assist the public preparing for, responding to, and recovering

from dam failures. Public awareness initiatives also include raising awareness of the benefits of building and maintaining dams in the United States.

To increase public awareness, the Program strives to reach the widest range of diverse audiences in a cost-effective manner. A variety of methods are used to reach audiences, including outreach campaigns, in partnership with local communities, that are targeted to the public, consumers, and businesses; articles and presentations for professionals and public groups; dissemination of informational materials at public forums and conferences; cooperative efforts with other Federal agencies and the States; and communications initiatives to increase public awareness of dam risk and how to take the appropriate mitigation actions.

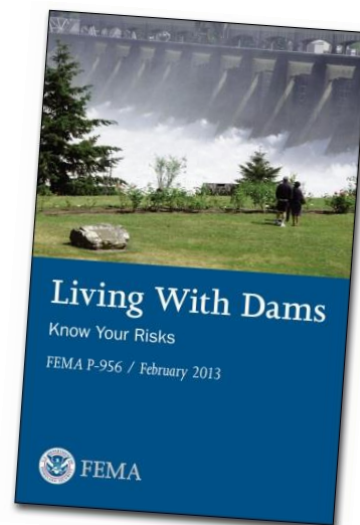


Collapse of Lake Delhi Dam (Iowa) in 2010 severed a road

**Objective 7:** *Convey the risk posed by dams to motivate and effect change*

**Accomplishment: National Academy of Sciences study on dams and community resilience completed.** In FY 2012, the National Research Council of the National Academy of Sciences published *Dam and Levee Safety and Community Resilience: A Vision for Future Practice*, a study on the policy, economic, and human behavioral drivers that promote or inhibit the expansion of dam and levee hazard mitigation and safety programs to promote community resilience (National Research Council, 2012). The study makes recommendations on the tools, information, and guidance that can help broaden the scope of dam and levee safety to include community-level mitigation, preparation, response, and recovery from dam failures.

**Accomplishment: Living with Dams: Know Your Risk brochure published.** The brochure (FEMA, 2013g) is targeted toward communicating the risks posed by dams to the public. The brochure provides information on the benefits and risks associated with dams and how to prepare for and mitigate those risks.



**Objective 8:** *Convey the important and unique roles of Federal and State dam safety programs in keeping Americans safe from dam failures*

**Accomplishment: National Dam Safety Awareness Day events held.** The first FEMA-hosted National Dam Safety Awareness Day was held on May 31, 2000,



in Washington, D.C. The theme was “Dams. They’re in your community, know your risk.” In FY 2012, FEMA again hosted National Dam Safety Awareness Day events to commemorate the Johnstown disaster of 1889, the worst dam failure in U.S. history, and to encourage and empower individual and community responsibility for dam safety. The hosting of these events is consistent with FEMA’s “whole community” approach to emergency management, and very much on target with FEMA’s goal of keeping Americans safe from a dam failure. The 2012 National Dam Safety Awareness Day event was successful, and a number of States hosted their own Dam Safety Awareness Days in 2013.

**Accomplishment: New Dam Safety Awareness Plan developed.** In FY 2013, FEMA developed a new Dam Safety Awareness Plan (FEMA, 2013) that outlines an approach for helping stakeholders at all levels gain a better understanding of the risks and benefits associated with living and working near dams. The plan defines the stakeholder groups essential in communicating key messages and clarifies these risks and benefits for a variety of targeted audiences, such as dam owners and operators, local officials, and people who live or work near dams. The plan recommends tactics at both the national and regional levels, as well as a timeline for implementation, and evaluation criteria. FEMA will implement the plan in collaboration with the new Review Board Communications and Outreach Work Group and will partner with stakeholders at the national, regional, and local levels to raise awareness and encourage actions regarding the benefits and risks associated with dams.

#### *Goal 4: Promote Research and Training for State Dam Safety and Other Professionals*

Developing research products and providing training for dam safety professionals—with a focus on State dam safety staff—are two cornerstones of the NDSP. The Program not only develops research in the form of technical guidance, policies, engineering best practices, and safety guidelines but also promotes the efficient and effective implementation and application of these products at the State and Federal levels. As part of critical infrastructure protection and resilience research programs, the DHS and other Federal agencies and partners conduct research in areas such as blast effects on dam components and the design of innovative blast mitigation measures to protect dams, gates, levees, and related infrastructure. This research is described in Chapter VI, Related Programs. Similarly, the Program ensures that training courses are developed and delivered to State dam safety professionals in collaboration with the industry and according to the Program’s priorities and the needs of the community.

#### *Objective 9: Establish and implement a national course of study for State dam safety professionals*

**Accomplishment: Training for State dam safety professionals provided.** Since the inception of the NDSP, FEMA has supported a strong, collaborative training program for State dam safety professionals and dam owners. With funds provided for training, FEMA has continued to expand existing training products, begun new initiatives to keep abreast with evolving technology, and enhance the sharing of expertise between the Federal and State sectors.

FEMA has leveraged procurement vehicles such as competitive contracts, interagency agreements and cooperating technical partners (CTP) agreements to develop and deliver training and informational materials to dam safety professionals. Using a cooperative technical agreement with the Association of State Dam Officials (ASDSO), FEMA has been able deliver technical training courses through ASDSO's technical webinars, and regional and annual conferences. The topics include soil mechanics, plant and animal penetrations of earthen dams, hydraulic analysis of spillways, seepage, and emergency action planning.

In FY 2012 and FY 2013, FEMA funding supported the training of more than 5,000 stakeholders at dam safety workshops, seminars, and courses across the United States.

***Objective 10:** Supplement training programs for other professionals that have roles in dam risk management*

**Accomplishment: National Dam Safety Program Technical Workshop Series provided.** An important national training initiative is the National Dam Safety Program Technical Workshop Series. The goal is to invite recognized authorities in engineering to discuss analysis techniques, construction methods, and other issues that can increase the expertise and information available to engineers in the dam safety community.

The Technical Workshop Series is national in scope and inclusive of State and local dam safety professionals and the private sector. The workshops have hosted a distinguished roster of speakers. More than 5,000 participants from the State, Federal, and private sectors have attended the workshops.

To date, 20 Technical Workshops have been held, including two workshops held during this reporting period at FEMA's EMI:

- Technical Seminar No. 19, Filter, Drains, and Geotextiles in Dams and Levees, February 22-23, 2012
- Technical Seminar No. 20, Overtopping Protection for Dams, February 20-21, 2013

**Accomplishment: Training aids for dam safety provided.** The Training Aids for Dam Safety (TADS) program is one of the most successful training initiatives from FEMA and its partners. TADS is a self-contained, self-paced training course consisting of 21 modules (workbooks and videos) for engineers, technicians, dam owners, water resource managers, public officials, and the public. In FY 2013, FEMA tasked the Review Board to evaluate of all 21 TADS modules and recommend a multi-year plan to update all module workbooks and videos. The Review Board recommendations are expected in FY2014.

***Objective 11:** Promote understanding of the knowledge and techniques needed to safely evaluate, operate, maintain, design, and construct dams*

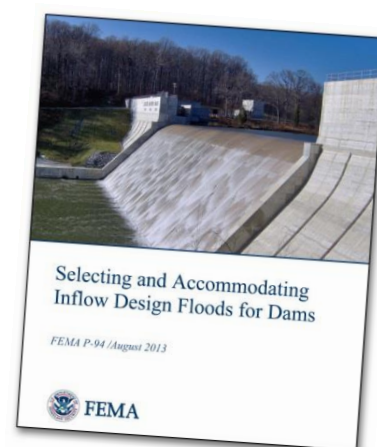
**Accomplishment: Federal Guidelines for Inundation Mapping of Flood Risks published.** In FY 2013, FEMA published FEMA P-946, *Federal Guidelines for Inundation Mapping of Flood Risks Associated with Dam Incidents and Failures* (FEMA, 2013e). The Guidelines provide



information for Federal and State agencies, along with local communities, dam owners, and emergency management officials, on how to reduce the flood risk associated with dams. The document is intended as a resource for developing State-specific guidelines for dam safety and as a reference manual for dam safety professionals to map dam breach inundation zones. The GeoDam-BREACH toolset supports the application of this document.

**Accomplishment: Summary of Existing Guidelines for Hydrologic Safety published.** FEMA P-919, *Summary of Existing Guideline for Hydrologic Safety of Dams* (FEMA, 2012c), documents the present state of the practice for evaluating the hydrologic safety of dams, including inventorying current practices used by State and Federal agencies. The document also includes a review of hydrologic guidelines currently used in each State and Federal agency that owns or regulates dams.

**Accomplishment: Updated Federal Guidelines on Inflow Design Flood published.** The main objectives of FEMA P-94, *Selecting and Accommodating Inflow Design Flood for Dams* (FEMA, 2013d), are to recommend appropriate procedures for selecting and accommodating the inflow design flood for dams based on current and accepted practices and to promote a reasonable degree of consistency and uniformity among State and Federal agencies.



**Accomplishment: Filters for Embankment Dams: Best Practices for Design and Construction published.** This technical guidance document (FEMA, 2011) provides procedures and guidance for best practices concerning embankment dam filter design and construction and represents an effort to collect and disseminate current information where technical consensus has been reached. The publication is intended for those familiar with embankment dams, such as designers, inspectors, construction oversight personnel, and dam safety engineers.

**Accomplishment: A Strategy to Reduce the Risks and Impacts of Dams on Floodplains.** This publication was developed through a cooperative technical agreement with the Association of State Floodplain Managers (ASFPM). This document provides a national risk reduction strategy for communities affected by dams. The document provides floodplain management officials and community leaders a better understanding of the how dams affect floodplains and how to better integrate dam safety into community floodplain management and risk reduction activities. The strategy provides suggestions on:

- How to improve community understanding of the effects of dams on floodplains and floodplain management;
- How communities can find information on dams from their states that may impact their responsibilities; and

- Steps that can be taken to ensure that communities and state are aware of the hazards associated with dams and are prepared to deal with them through appropriate mitigation strategies.

### *Goal 5: Align Relevant Federal Programs to Improve Dam Safety*

Achieving better alignment of Federal programs that can improve dam safety is a strategic priority. Stronger alignment not only results in the more tangible outcome of a reduction in the potential consequences to life and property from dam failure but also ensures a unity of effort, promotes mutual understanding of the key priorities, and realizes other synergies.

**Objective 12:** *Leverage the resources, capabilities, and authorities of the Federal partners to promote the mission, goals, and objectives of the NDSP to achieve greater efficiencies*

**Accomplishment: Senior leadership meetings held.** In early FY 2013, FEMA initiated the first in a series of dam safety senior leadership meetings. The goal for the meetings was to gather senior leaders from the Federal, State, and private sectors to identify issues and challenges of national importance in dam safety and set a course of action for addressing them in a coordinated manner. At a second meeting in July 2013, senior leaders agreed to focus on three issues for the next fiscal year: identification and documentation of best practices for information sharing; the development of a National Dam Safety Exercise; and the implementation of a new model for identifying research needs in dam safety. In FY 2014, FEMA will coordinate work on these issues with the Review Board and ICODS. A third senior leadership meeting will be held in early 2014 to assess progress and determine next steps.

**Accomplishment: Pocket Safety Guide for Dams and Impoundments published.** The *Pocket Safety Guide for Dams and Impoundments* (FEMA, 2012a) is the result of a partnership between FEMA and the U.S. Forest Service National Technology and Development Program to produce a communications tool for promoting and increasing dam/impoundment safety in Federal land management agencies and among private owners.

**Accomplishment: Unregulated Non-Federal dams on Federal lands investigated.** In late 2011, ICODS established a Task Group to study the problem of unregulated non-Federal dams on Federal lands, primarily private dams constructed on Federal lands or private dams constructed on private lands later acquired by a Federal land management agency, such as the FS. Many Federal agencies have concerns regarding their responsibilities for these dams, and many States exercise varying degrees of regulatory authority for them. The report on the issue, which will be jointly developed by ICODS and the Review Board, will include Federal agency data on these dams and recommendations for the implementation of a consistent policy for their oversight and maintenance. The final report will be issued in early FY 2014.

**Accomplishment: Federal Guidelines for Dam Safety update.** Since 1979, the Federal agencies responsible for the design, construction, operation, and maintenance of dams have followed FEMA 93, *Federal Guidelines for Dam Safety* (FEMA, 1979), in their management



procedures to ensure dam safety. In FY 2013 FEMA, following consultation with ICODS, determined that it is now time to assess the *Guidelines* for their currency and to incorporate references to new documents and standards. A workshop was held in November 2013 to review the current *Guidelines* to develop a strategy for moving forward with their update. Details will be reported in the next Progress Report.

## V. Federal Agency Activities

Although Federal agencies own or regulate only about 6 percent of the dams in the United States, many of them are significant in size (see Figure 15), benefit to the public, and hazard potential and would result in serious consequences if they failed.

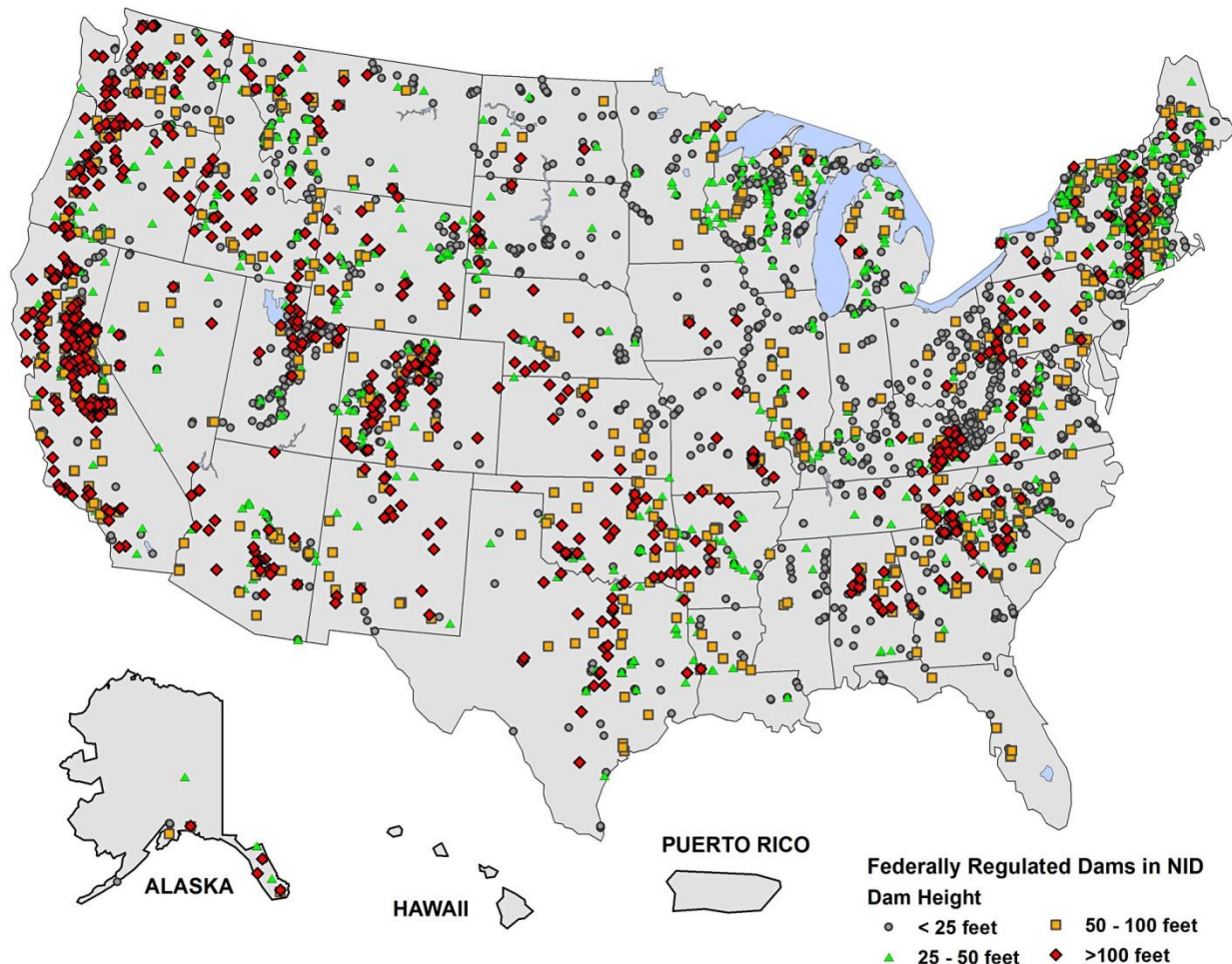


Figure 15. Federally regulated dams listed in the 2013 NID

## Federal Agency Dam-Related Responsibilities

The Federal agencies that own or regulate dams in the United States and their dam-related responsibilities are listed below.

**The U.S. Department of Agriculture (USDA)** mission areas include farm agricultural services, natural resources and environment, research, and rural development. These missions lead the USDA to be a major planner, designer, financier, constructor, owner, or regulator of more than one-third of the 87,359 dams listed in the 2013 NID. USDA dams provide livestock water, municipal water and wastewater, industrial water, flood protection, irrigation, fish and wildlife

habitat, recreation, sediment detention, and manure storage and treatment. The following six USDA agencies are involved with dams:

- The **Agricultural Research Service (ARS)** conducts internationally recognized research in hydrologic, hydraulic, erosion, and sedimentation processes applicable to dams. ARS currently owns and operates only one dam, which is at its research facilities. ARS uses the engineering assistance of the Natural Resources Conservation Service as needed for the inspection and maintenance of this dam.
- The **Farm Services Agency (FSA)** provides financial assistance for dams through loans, loan guarantees, and grants to farmers and ranchers for land and water resource conservation or natural disaster recovery. FSA financial assistance is limited and typically provides only a small portion of the cost of small dams.
- The **U.S. Forest Service (FS)** designs, finances, constructs, owns, operates, maintains, and regulates dams in conjunction with the management of national forests and grasslands. FS owns approximately 500 that meet NID criteria and administers permits for approximately 1,200 privately owned dams. For the permitted dams, the dam owner designs, constructs, and operates the dam and FS reviews and approves activities related to the safety of the dam.
- The **Natural Resources Conservation Service (NRCS)** designs, finances, and constructs dams under its technical and financial assistance programs for individuals, groups, organizations, and governmental units for water storage, sediment detention, and flood protection. NRCS has provided technical assistance for more than 29,000 dams and financial assistance for approximately 12,000 of these dams.
- The **Rural Housing Service (RHS)** finances dams through loans, loan guarantees, and grants to public entities, local organizations, and non-profit corporations for rural community facilities. Fewer than 60 dams have been financed under former or current programs.
- The **Rural Utilities Service (RUS)** finances dams through loans and loan guarantees under its Electric Program to cooperative associations, public bodies, and other utilities in rural areas for hydroelectric and thermal electric power plants. RUS also finances dams through loans, loan guarantees, and grants to rural communities under its Water and Waste Program for water and wastewater facilities. Fewer than 90 dams have been financed under these programs.

**The Department of Defense (DoD)** is extensively involved with dams as a permitter, owner, manager, planner, designer, constructor, and financier. The following DoD agencies are responsible for, or involved with, dams:

- The **Department of the Air Force (Air Force)** is responsible for dams on Air Force bases in the continental United States. The Air Force has jurisdiction over 39 dams.

- The **Department of the Army (Army)** Installation Management Command (IMCOM) is responsible for dams either on Army garrisons or controlled by Army garrisons. The Army has jurisdiction over 249 dams.
- The **Department of the Navy (Navy)** has dam safety responsibility for dams on Navy bases. There are 28 dams under Navy jurisdiction for safety inspections.
- The **U.S. Army Corps of Engineers (USACE)** has a diverse inventory of 707 dams in 44 States. The dams serve a variety of purposes, including navigation, flood risk management, water supply, irrigation, hydropower, recreation, environmental, and combinations of these purposes. Corps dams vary in age from more than 100 years to less than 10 years. Most have not been filled to their maximum design event.

The **Department of Energy (DOE)** own and has jurisdiction of 12 dams at three sites. The purpose of all DOE dams is water impoundment.

The **Department of the Interior (DOI)** mission is to protect and provide access to the Nation's natural and cultural heritage and to honor trust responsibilities to Indian tribes and commitments to island communities. Through its Bureaus, DOI is responsible for the planning, design, construction, operation, and maintenance of approximately 2,500 dams that meet the NID reporting requirements.

- The **Bureau of Indian Affairs (BIA)** is responsible for 910 dams on Indian reservations, of which 135 are high- and significant-hazard potential dams. The BIA Safety of Dams Program works with Indian tribes to maintain these dams. BIA is responsible for all dams on Indian lands, in accordance with the Indian Dams Safety Act of 1994 (25 U.S.C. §§ 3801–3804).
- The **Bureau of Land Management (BLM)** owns 9 high-hazard potential and approximately 680 low-hazard potential dams on BLM lands. BLM also maintains an inventory of approximately 544 private dams (dams owned by others but located on BLM lands).
- The **Bureau of Reclamation (Reclamation)** is a Federal water resource management and development agency authorized to operate in 17 western States. The Reclamation inventory currently consists of 474 dams throughout the West.
- The **U.S. Fish and Wildlife (FWS)** operate facilities associated with fish and wildlife conservation. FWS dams and water control structures are located on National Wildlife Refuges, waterfowl production areas, national fish hatcheries, and on some private land through easement agreements with the FWS. FWS has 285 dams.
- The **National Park Service (NPS)** Dam Safety Program is a centrally managed public safety program whose goal is to assist national parks with the management of dam and levee safety risks. The NPS is responsible for 56 dams and water impoundment structures.



- The **Office of Surface Mining Reclamation and Enforcement (OSMRE)** ensures that coal mining activities are being conducted in a manner that protects citizens and the environment, restores the land to beneficial use following mining, and mitigates the effects of past mining by pursuing reclamation of abandoned mine lands. The OSMRE Dam Safety Program ensures that dams under its regulatory authority do not present unacceptable risks to public safety, property, and the environment. OSMRE oversees 69 dams.
- The **U.S. Geological Survey (USGS)** own and maintain one embankment dam at its National Center for Earth Resources Observation and Science 18 miles northeast of Sioux Falls, South Dakota.

The purpose of the **Department of Labor, Mine Safety and Health Administration (MSHA)** is to prevent death, disease, and injury from mining and to promote safe and healthful workplaces for the Nation’s miners. Section 3(h)(1) of the Federal Mine Safety and Health Act of 1977 (Mine Act) (30 U.S.C. 801 et seq.) defines a “coal or other mine” and includes “structures, facilities, ... or other property including impoundments, retention dams, and tailings ponds used in or to be used in, or resulting from, the work of extracting such minerals from their deposits ...”

Dams associated with mining operations are regulated by MSHA under Title 30 of the Code of Federal Regulations. Specifically, 30 CFR § 77.216 (Water, sediment or slurry impoundments) pertains to dams at coal mines, and 30 CFR §§ 56.20010 and 57.20010 (Retaining dams) pertain to dams at metal and nonmetal mines. These authorities are unchanged from the previous biennial report. As of October 2013, there were 1,862 dams listed in the MSHA dam inventory.



Example of a diversion dam (Imperial Diversion Dam, California/Arizona border) (Bureau of Reclamation)

The **Department of State, International Boundary and Water Commission (IBWC)** is composed of a U.S. Section (USIBWC) and a Mexican Section; IBWC is charged with carrying out the provisions of a number of treaties between the United States and Mexico. IBWC has jurisdiction over two large international storage dams and four diversion dams on the Rio Grande and Colorado Rivers. The USIBWC is responsible for the maintenance of the American Diversion Dam and five sediment control and flood control dams owned by the Caballo Soil and Water Conservation District.

The **Federal Energy Regulatory Commission (FERC)** is authorized by the Federal Power Act (16 U.S.C. § 791a et seq.) to issue licenses to individuals, corporations, States, and municipalities to construct, operate, and maintain dams, water conduits, reservoirs, powerhouses, transmission lines, or other project works necessary for the development of non-Federal

hydroelectric projects (1) on navigable streams, (2) on public lands of the United States, (3) at any government dam, and (4) on streams over which the Congress has jurisdiction under the Commerce Clause of the U.S. Constitution. As of September 1, 2013, there were 2,525 dams under FERC jurisdiction.

The **Nuclear Regulatory Commission (NRC)** has regulatory authority over one uranium mill tailings dam, storage water pond dams at in situ leach mining facilities, and dams integral to the operation of licensed facilities or the possession and use of licensed material that pose a radiological safety-related hazard if they fail. Exceptions in the third category are dams that are submerged in other impoundments or dams regulated by other Federal agencies. The NRC regulates nine low-hazard potential dams.

The **Tennessee Valley Authority (TVA)** is authorized by the Tennessee Valley Authority Act of 1933 (16 U.S.C. § 831) to approve plans for the construction, operation, and maintenance of all structures affecting flood control, navigation, or public lands or reservations in the Tennessee River System. TVA is responsible for the planning, design, construction, operation, and maintenance of 118 dams and dikes.

## Federal Agency Dam-Related Activities

A Presidential Memorandum on October 4, 1979, directed the Federal agencies that own or regulate dams to adopt and implement the *Federal Guidelines for Dam Safety (Guidelines)* (FEMA, 1979), which was issued by the ad hoc ICODS, and directed the heads of these agencies to submit progress reports to the Administrator of FEMA. Since the initial reports in 1980, the Administrator of FEMA has solicited follow-up progress reports from the agencies every 2 years.

Since the *Guidelines* were published, all of the Federal agencies responsible for dams (the ICODS agencies) have been implementing to varying degrees the provisions of the *Guidelines*, sharing resources whenever possible to achieve results in dam safety and developing strategies to address diminishing resources and decreases in staffing levels. Some Federal agencies also maintain comprehensive research and development and training programs.

For assessment purposes, FEMA supplies the ICODS agencies each reporting cycle with a format to ensure completeness and uniformity among responses. Using the format, the ICODS agencies supply a brief description of their dam safety responsibilities, followed by a report on their progress in complying with the areas that are covered by the *Guidelines*:

- Organization, administration, and staffing
- Independent reviews
- Dam inventories
- Inspection programs
- Dam safety rehabilitation programs
- Management effectiveness reviews

- Dam safety training
- Dam failures and remedial actions
- Emergency action planning
- Research and development and special initiatives
- State dam safety agency involvement
- Public concerns

For this reporting period, the ICODS land management agencies were also asked to discuss the status of non-federally owned dams on their lands (i.e., number and hazard classification, responsibility for regulation, inspection and EAP status, and any circumstances or issues that result in some of these dams not being regulated).

The progress that has been made by the ICODS agencies during this reporting period in the areas specified in the *Guidelines* is described in the following subsections. Information from previous reporting periods is included as needed.

## Organization, Administration, and Staffing

Activities related to organization, administration, and staffing during the reporting period are as follows:

- TVA – At the beginning of FY 2012, the TVA Dam Safety Governance Organization (DSG) was a business unit within River Operations, a strategic business unit under the Chief Operating Officer. In the spring 2012, DSG moved to a newly formed strategic business unit, Policy and Oversight. The new organizational structure was intended to position DSG to more effectively oversee all asset owners.
- NRCS – The NRCS reports that its dam engineering expertise and staffing levels have generally declined over the past decades with overall decreases in Federal dam design and construction activity. NRCS installed 1,262 dams in 1965, 206 in 1990, 138 in 2000, and 2 in 2012.
- FS – Each FS region has its own challenges based on the region’s uniqueness in aerial extent, number of dams, number of States within the region, as well as skill sets. Common themes to address these challenges are use of contractors, working with other local, State, and Federal dam safety organizations, and sharing FS personnel across regions.
- The FERC – As of September 1, 2013, there were 126 technical and support staff in the FERC Division of Dam Safety and Inspections (D2S1), the same number of technical and support personnel at the end of the last reporting period.
- USACE – The USACE reports that fiscal constraints of sequestration and the continuing resolution have added complexity to the management of its portfolio of dams. Critical dam safety activities are being funded, but some routine dam operations and maintenance go unfunded, creating an environment in which some important safety program requirements



are not being accomplished. The USACE has taken the following steps to mitigate deficiencies in administration and staffing:

- Centralized staffing;
- Developed national centers for Risk Management, Mapping, Modeling, and Consequence Estimation; and Production of Dam Safety Modifications;
- Increased technical training opportunities;
- Increased developmental positions;
- Enhanced recruitment efforts; and
- Increased capability in architectural and engineering (A/E) support via industry training and national contracts.

The entire USACE Dam Safety Program includes approximately 700 full-time equivalent (FTE) positions with more than 14,700 combined years of dam safety experience, an increase over the last reporting period.

- **BLM** – BLM reports a decrease of 2+ FTEs in its State offices since the last reporting period. Engineering positions in New Mexico and Utah have been lost to hiring freezes.
- **BIA** – The BIA increased its dam safety program staff since the last report, increasing from 11.9 FTEs at the end of FY 2011 to 16 FTEs at the end of FY 2013.

## Independent Reviews

Activities related to independent reviews during the reporting period are as follows:

- **IBWC** – A panel of binational expert consultants was convened to review the preliminary evaluation of IBWC’s Falcon Dam embankment, concrete structure, seepage areas, and performance of a Risk Analysis Study and the Dam Safety Modification Study for Amistad Dam.
- **TVA** – The TVA Dam Safety Independent Review Board provided programmatic and technical expertise, guidance, and recommendations on 16 projects and initiatives, including the Blue Ridge Dam rehabilitation project and risk screenings for TVA dams.
- **NRCS** – The NRCS National Design, Construction and Soil Mechanics Center in Fort Worth, Texas, completed 20 independent dam design reviews. NRCS policy requires an independent review for the design of dams with a high-hazard potential classification, a drainage area greater than 40 square miles, or a height greater than 50 feet.
- **FS** – The FS conducts independent reviews in different ways across the regions. Regions 1 and 4 cooperate with the States and FERC to review rehabilitation/modification plans. Regions 2 and 3 collaborate with Reclamation for Screening Level Risk Assessments, hazard classifications, and safety inspections. Region 9 contracts with A/E firms for review and design. Several regions use the USACE. All regions conducted functional assistance

trips in FY 2012 and FY 2013. These trips included operation and maintenance (O&M) inspections, site assessments for construction, construction monitoring, incident evaluation, post-fire structural analyses, assessments of burned watersheds upstream of dams, and installation of Early Warning Systems (EWS).

- **The FERC** – FERC staff independently reviewed the safety and adequacy of 481 dams. Staff reviews include evaluation of site geological conditions and review of subsurface and structure investigations, hydrologic and hydraulic studies, stability and stress analyses of all major structures under all possible loading conditions, construction plans and specifications, and suitability of proposed construction materials.
- **USGS** – The USGS commissioned Reclamation in September 2013 to perform a formal dam safety assessment of its dam. A report of findings and recommendations will be completed in 2014.
- **OSMRE** – OSMRE is a regulatory agency and is responsible for reviews of design, construction, and operations of dams in privately owned mine sites in Tennessee, Washington, and on Indian lands. The remaining States with active coal mining have been granted primacy. Under primacy, OSMRE transfers regulatory authority to a State after a review of the State’s program reveals it is no less effective than the Federal regulations.
- **Reclamation** – Reclamation continued to employ an Independent Review Panel to provide an ongoing evaluation of Reclamation’s dam safety program. The panel’s findings were incorporated into the Dam Safety Officer (DSO) Annual Program Evaluation Report to the Commissioner.
- **MSHA** – During the reporting period, coal companies submitted approximately 800 design plans to MSHA for review and approval. Included were plans for the construction of new dams, plans for modification of existing dams, and revised plans responding to MSHA technical review questions. Plans are reviewed by district personnel with specialized training or forwarded to Technical Support’s Mine Waste and Geotechnical Engineering Division. District and Technical Support personnel meet with mine operators and their design consultants as needed to discuss and resolve design and operational issues.

## Dam Inventories

Activities related to dam inventories during the reporting period are as follows:

- **Reclamation** – Reclamation maintains a current, comprehensive inventory of dams that reflects the status of each dam and categorizes the associated risk. At the end of FY 2013, Reclamation had 474 dams. Of these, 367 are rated as high- or significant-hazard potential dams. These 367 dams are located at 246 project facilities and form the core of the Dam Safety Program.
- **DOE** – In its previous progress report, DOE reported a total of 14 water impoundment structures under its jurisdiction. In 2012, DOE reduced that number to 12 dams at three sites following the deliberate breach of 2 low-hazard potential dams at Rocky Flats. Of the

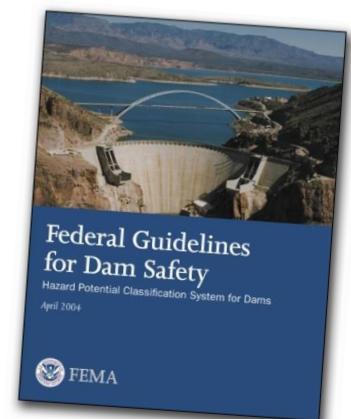
12 dams, 2 are high-hazard potential, 1 is significant-hazard potential, and the remaining 9 are low-hazard potential.

- **TVA** – TVA maintains an inventory of dams that is entered into the NID. Since the last reporting period, TVA has removed 24 duplicates from the NID and added 34 structures, for a total of 118 dams. The updates reflect changes in hazard classification for 10 dams.
- **NRCS** – In 2013, the NRCS compiled the NID data on a geospatial database called GeoObserver for Dams. The database allows States to update the national database at any time and provides end users at the national level with the most up-to-date information.

In 2013, the NRCS also began implementation of DamWatch, a web-based monitoring tool. Once DamWatch is operational, the NRCS will have access to real-time monitoring of conditions at the approximately 12,000 dams constructed with NRCS financial assistance.

In 2010 and 2011, the NRCS reclassified the only NID-size ARS dam from low- to high-hazard potential because of changes in downstream land use. NRCS has provided preliminary rehabilitation recommendations to upgrade the structure.

- **FS** – In May 2011, the FS released a rewrite of the *Forest Service Manual (FSM) 7500, Water Storage and Transmission*, which details FS dam safety policy and defines a jurisdictional dam. The FS database indicated a total of 512 FS-owned dams that meet jurisdictional requirements. These dams include 40 high-hazard potential dams, 100 significant-hazard potential dams, and 372 low-hazard potential structures. Of the 512 dams, 45 do not have NID numbers. The FS has also identified 94 dams with NID numbers that do not meet NID requirements because of height/storage or data gaps. The FS will continue to address discrepancies in the database during the next reporting cycle.
- **USACE** – USACE - In FY 2012 and FY 2013, two dams were added to the USACE inventory; Brown Lake Dam and Woonsocket Falls Dam. USACE removed one dam, Elk Creek, because there is no longer a pool behind it and the project is now the Elk Creek Fish Passage Corridor. USACE has adjusted its dam inventory based on improved understanding of downstream consequences, resulting in a net increase of 13 dams (521 high-hazard potential; 140 significant-hazard potential; and 46 low-hazard potential dams). The hazard potential classification changed for 10 USACE dams during the reporting period.
- **Army** – The Army added nine dams to its inventory. No changes in downstream usage of any Army dams were reported.
- **Air Force** – The Air Force is reporting 39 dams under its jurisdiction, an increase of 16 dams since the last reporting period. As part of joint base consolidation, the Air Force assumed responsibility for 12 dams at Joint Base McGuire-Dix-Lakehurst.
- **OSMRE** – OSMRE reviews and updates its inventory of dams annually. For national consistency, OSMRE is currently



working to update its regulations to eliminate its use of the NRCS Classification System and replace it with *Federal Guidelines for Dam Safety: Hazard Potential Classification System for Dams* (FEMA, 2004).

- **BLM** – BLM reports that one dam in New Mexico, Encino 49, was reclassified from high- to low-hazard potential and that one dam in Nevada, Arrow Canyon, was classified as high-hazard potential. During the 2010 NID update, BLM discovered and reported a problem with the way BLM dams are identified in the NID. During the 2012 NID update, the BLM provided a revised NID submittal that used only one agency name for the BLM.
- **FWS** – The FWS is investigating nearly 200 dams that appear as “owned by the U.S. Fish and Wildlife Service” on the NID or are listed in the NID as “non-Federal dams on Service land.” These structures may meet the dam criteria and need to be added to the FWS inventory. Field investigations are typically combined with scheduled dam inspections at refuge or hatchery facilities. Since the last reporting period, the FWS has added nearly 30 dams to its inventory.
- **NPS** – The NPS completed a major review of the entire NPS inventory of dams. Approximately 340 dams were found to be below the *Guidelines* size requirements and were removed from the inventory.
- **MSHA** – As of August 1, 2013, there were 1,862 dams listed in the MSHA inventory. This represents a decrease of 129 dams since the previous report. The largest change was in the number of low-hazard potential dams at metal and nonmetal mines (decrease of 113 dams). This decrease was primarily the result of the re-evaluations of dam physical dimensions, which led to the dams not meeting the NID inclusion criteria.

## Inspection Programs

Activities related to inspection programs during the reporting period are as follows:

- **Reclamation** – Reclamation reviews each facility annually and includes high- or significant-hazard potential dams. In FY 2012-2013, Reclamation conducted a total of 601 facility examinations.
- **IBWC** – In 2012, the 5-year inspections were performed for the IBWC’s International Dam, Amistad Dam, and Falcon Dam. Weekly or monthly inspections were also performed by field office personnel on all IBWC dams.
- **NRC and FERC** – The NRC continued to use the technical assistance of the FERC for its inspections at NRC-licensed facilities. This cooperative effort is the result of an Interagency Memorandum of Agreement signed in September 1992. During this reporting period, NRC and FERC completed inspections at seven of the nine NRC-licensed facilities.
- **TVA** – TVA conducted a total of 2,735 dam safety inspections, including informal, intermediate, and formal inspections. The inspections resulted in 10 critical findings, all

of which have been addressed or are being addressed through follow-up actions or additional monitoring.

- **NRCS** – NRCS policy encourages State agencies to assume responsibility for routine inspections of existing NRCS-assisted dams. NRCS provides technical assistance for routine inspections as resources permits and as requested by the dam owner. The inspections of NRCS-assisted dams are conducted by hundreds of organizations ranging from State agencies conducting formal inspections to walkover O&M inspections by non-engineers. NRCS does not maintain national data on the number or types of inspections conducted on each NRCS-assisted dam each year.
- **FS** – The FS requires O&M inspections of its high-hazard potential dams yearly, significant-hazard potential dams every 5 years, and low-hazard potential dams every 10 years. More than 140 O&M inspections were conducted in FY 2012 and FY 2013. FS regulations require safety inspections on high-hazard potential dams and hazard assessments on significant-hazard potential dams every 5 years. The FS struggles with completing these inspections and assessments on schedule and is investigating using more simplified analysis tools to accomplish these tasks or to conduct at least a screening-level analysis to help set priorities.
- **RUS** – The RUS does not own, operate, or regulate any of the dams it finances. The dam owners are responsible for the proper operation, maintenance, and inspection of these facilities and are subject to all State requirements regarding inspection, maintenance, and operation.
- **The FERC** – The FERC inspects all of its high- and significant-hazard potential projects annually and its low-hazard potential and exempted projects every 3 years. FERC staff completed 3,373 inspections of its high- and significant-hazard potential projects. In addition, FERC independent consultants completed 537 formal inspections. These inspections are required every 5 years for licensed or exempted dams that exceed 32.8 feet in height, have a gross storage capacity of 2,000 acre-feet or more, or have a high downstream hazard potential.
- **USACE** – The USACE conducted 281 comprehensive inspections and evaluations of its dams. In-house technical experts related to project design and construction conducted 209 periodic inspections and 72 periodic assessments (formal inspections). Engineering staff also conducted 535 informal inspections annually. All formal inspections are documented.
- **Army** – The Army conducted 203 dam inspections (137 periodic and 66 annual). Of these inspections, 15 dams were considered to have critical findings, such as erosion of spillways and seepage.
- **BLM** – BLM reports that tight travel ceilings and sequestration have kept the Arizona State Office from performing or helping to perform the numerous dam inventories/condition assessments of dams under BLM Arizona's jurisdiction.

- **FWS** – FWS dam safety staff provides oversight, monitors, and participates in scheduled dam safety inspections. The FWS completed 54 formal Safety Evaluation of Existing Dams (SEED) dam inspections and 48 intermediate SEED inspections. The dams included 91 low-hazard potential, 3 significant-hazard potential, and 8 high-hazard potential dams. Inspections on all high- and significant-hazard potential dams are now being conducted every 3 years.
- **NPS** – In 2012, four formal and two intermediate inspections were performed for NPS high- and significant-hazard potential dams. In 2013, six formal and five intermediate were performed. Any unsafe conditions are brought to the immediate attention of the superintendent and the DSO. No unsafe conditions were found during the reporting period.
- **MSHA** – Dams at mines are privately owned, and MSHA regulations require mine operators to conduct inspections, assessments, and other activities consistent with current, prudent engineering practices. Dams associated with coal mines must be inspected by the operator every 7 days. MSHA conducts inspections of all dams associated with a mine as part of a complete mine inspection – four times a year for underground mines and two times a year for surface mines. Additionally, high-hazard potential dams associated with coal mines are inspected quarterly by MSHA and during critical phases of construction, as defined in MSHA’s impoundment inspection handbook (U.S. Department of Labor, 2007).

## Dam Safety Rehabilitation Programs

Activities related to dam safety rehabilitation programs during the reporting period are as follows:

- **NRCS** – NRCS completed construction of 17 rehabilitation projects. Examples of recently completed rehabilitation projects include the South River 10A dam in Virginia and the New Creek 14 dam in West Virginia.
- **The FERC** – The FERC completed 93 dam safety modifications at a cost of \$570 million. In addition, 242 dam safety modifications are ongoing or under review.
- **USACE** – The USACE estimates that it would cost about \$24 billion to repair its dams. In recent years, major repairs have been funded at \$500 million annually. At those funding levels, the currently known issues would be completed in 2058. No major dam rehabilitation projects were completed in FY 2012 or FY 2013.
- **MSHA** – All dams under MSHA jurisdiction are owned by mining companies and constructed by these companies or their contractors. The goal of MSHA is to ensure that the dams are designed, constructed, and maintained in accordance with current, prudent engineering practice. MSHA does not maintain data on the cost of repair because dams within MSHA’s jurisdiction are privately rather than publicly owned. All responsibility for the cost of repair lies with the mining company.

- **TVA** – TVA completed a total of 48 projects or analyses supporting dam safety rehabilitation during the reporting period. Examples are instrument installation and automation, slope buttressing, concrete growth slot cutting, and finite element analyses.
- **BIA** – BIA completed four dam safety modifications with an approximate total cost of \$16 million and has five ongoing modifications with an approximate total cost of \$40 million. BIA has three dam safety modifications in final design stage.
- **Reclamation** – Reclamation had five ongoing modifications during this reporting period with a total approximate cost of \$163.2 million, excluding the Folsom facility modifications. The ongoing Folsom facility modifications have a total project cost of approximately \$326 million.

## Management Effectiveness Reviews

Activities related to management effectiveness reviews during the reporting period are as follows:

- **TVA** – In FY 2010, TVA’s OIG performed an audit of TVA’s dam safety program. Audit findings indicated that TVA (1) was taking steps to identify and mitigate risks, (2) was adhering to the *Guidelines*, with a few exceptions and (3) had a comprehensive dam safety program. All recommendations were addressed by March 2012.
- **The FERC** – The FERC conducted two summary management reviews, as required by the Federal Managers’ Financial Integrity Act of 1982 (31 U.S.C. §1352). The Assurance Memoranda from the reviews attested that the D2S1 was able to meet its management goals and objectives, there were no obstacles or funding shortfalls affecting the ability to accomplish its mission, and there were no reportable problems requiring the attention of higher management.
- **USACE** – Progress of the USACE Dam Safety Program is tracked using the Dam Safety Program Management Tools (DSPMT). One method of using DSPMT data is to selectively export data associated with key routing activities in the form of a Dam Safety Scorecard. The scorecard is not an indicator of a dam’s condition, but it does provide a uniform and consistent way of evaluating routine program implementation. The staffing and funding metric is a measure of whether delays or nonperformance are attributed to staffing or funding. During this reporting period, the scorecard has remained relatively stable with a fair to good overall rating.
- **DOI** – The DOI OIG performed an evaluation of the BLM Safety of Dams Program, with an emphasis on emergency preparedness. The final OIG evaluation report, “Final Evaluation Report – Bureau of Land Management, National Park Service, and Office of Surface Mining Reclamation and Enforcement’s Safety of Dams: Emergency Preparedness,” was issued on December 27, 2012. The report identified 11 recommendations, six of which were attributed to BLM. BLM has taken corrective action



to address the six recommendations, most of which relate to EAPs and EAP exercises, and all recommendations have been closed by the OIG.

- **Reclamation** – Reclamation recently developed a Facility Reliability Rating (FRR) system to assess the reliability/condition of its high- and significant-hazard potential dams. The FRR is intended to provide an outcome-oriented performance measure for Federal reporting purposes and to be used as a tool in evaluating when necessary future funding/resources should be directed to certain dams. Ratings are based on a set of weighted criteria to evaluate operations, maintenance, and management factors/activities that affect the reliability/condition of these dams.

## Dam Safety Training

Activities related to dam safety training during the reporting period are as follows:

- **IBWC** – The IBWC reports some impact in its safety of dams training resulting from Executive Order 13589, November 9, 2011, to reduce government travel.
- **FS** – Because of travel restrictions that are the result of budget reductions, the FS did not initiate any nationally coordinated dam safety training activities during this reporting period. At present, there is a general skill set decline in dam breach flood routing and certain design skills (seismic and outlet works). Sharing of skills across the regions will be necessary. Skill sharing will be supplemented by A/E contracts and the use of other agency expertise. The FS Technology and Development Center, in partnership with FEMA, assisted FEMA to develop FEMA P-911, *Pocket Safety Guide for Dams and Impoundments* (FEMA, 2012a), and is developing a training video based on the Guide.
- **The FERC** – To spend training funds more efficiently and effectively, FERC determined that training courses should be developed to address specific staff needs. As a result, FERC has concentrated its efforts and resources on designing courses that more directly support its dam safety training requirements. Emphasis also was placed on developing individual development plans, which has resulted in staff attending 310 training sessions, or about 2 training classes per staff. Internal staff training courses conducted during this reporting period covered topics such as historic failures and potential failure modes of concrete dams and seismic ground motions. FERC also continues to support the NDSP Training Aids for Dam Safety (TADS) program and has identified staff to further develop and improve the TADS modules.
- **USACE** – The USACE has an extensive training program in all matters related to its water resource mission and coordinates its training efforts with Reclamation, FERC, and TVA. The training program for engineers and dam operation and maintenance personnel consists of seminars and conferences, formal classroom training, and periodic onsite training. Site-specific training has been performed for 75 percent of USACE dams within the last 5 years. In FY 2012 and FY 2013, the USACE held 10 sessions of its dam safety course with approximately 33 attendees at each session.

- **Reclamation** – In FY 2012 and FY 2013, Reclamation did not hold the SEED seminars because of a Solicitor’s Office interpretation that Reclamation did not have legislative authority to collect tuition. Reclamation plans to hold the SEED seminar in FY 2014, but the seminar will be limited to Reclamation personnel. Reclamation’s Risk Advisory Team staff have developed numerous technical training courses, workshops, and case history presentations that are available to agencies with dam safety programs and are often conducted cooperatively with the USACE.
- **NPS** – NPS worked with Reclamation to develop and deliver a new onsite dam tender training course. The course is held at and is customized to the needs of a park and includes a visit to the park’s dams. This training replaces the need to attend Reclamation’s SEED course and is being delivered first to parks with high-hazard potential dams.
- **MSHA** – MSHA recognizes the importance of dam safety training, both for MSHA employees and mining industry personnel. All MSHA inspectors receive training on dams that includes an overview of dam safety, hazardous condition recognition, and when to request an engineer or other specialist for assistance. During this reporting period, the 28th and 29th Annual Dam Safety Training Seminars were held at MSHA’s National Mine Health and Safety Academy in Beckley, West Virginia, for dam safety specialists. Approximately 200 people attended the seminars, including MSHA staff and dam safety personnel from other Federal and State agencies.
- **TVA** – Dam safety training at TVA comprises in-house training courses and external conferences and workshops. TVA personnel are trained in inspection procedures, problem detection and evaluation, instrumentation, and emergency preparedness.

## Dam Failures and Remedial Actions

Activities related to dam failures and remedial actions during the reporting period are as follows:

- **TVA** – TVA experienced three dam safety incidents during the reporting period (two at Widows Creek and one at Blue Ridge Dam). Remediation was successfully undertaken following the three incidents. Analysis to bring the Blue Ridge Dam up to current industry standards for seismic qualifications is scheduled to begin in FY 2014.
- **NRCS** – There were no NRCS dam failures. Six States reported emergency spillway erosion and repair on 24 dams. Two States reported slope and wave erosion repair on 9 dams, and 26 States reported repair or rehabilitation activities on 159 dams
- **FS** – FS was able to implement an EAP during an actual emergency in June 2013 at the Cook Lake Dam in South Dakota. The dam was able to bypass the flood flows resulting from severe weather conditions without any incident.
- **The FERC** – Since October 2011, there have been 46 incidents at dams under FERC jurisdiction. Most of the incidents resulted from operational failures of project facilities such as penstocks and gates. The incidents did not cause significant damage, and information about each incident was coordinated with the appropriate State agency.

- **USACE** – There were no failures of USACE dams. An incident occurred at the Marseilles Dam in April 2013 when seven barges broke loose from a tow during historic flooding on the Illinois River. An assessment of the dam and temporary repairs of the inoperable gates are underway.
- **Navy** – The Navy’s Cheatham Dam located in Yorktown, Virginia, had an outlet pipe fail. The USACE was called to investigate the problem and provided a short-term fix. Development of a long-term solution is ongoing.
- **BIA** – There were 10 reported incidents at BIA dams during the reporting period, all of which were flood-related.
- **FWS** – There was a failure of a low-hazard potential dam located in the Rocky Mountain Arsenal National Wildlife Refuge in Denver, Colorado, on September 12, 2013. The dam failed due to erosion of the concrete-lined emergency spillway following more than 10 inches of rain in 48 hours. This dam is a non-Federal dam located on FWS property and was previously owned by the U.S. Army. It is operated and maintained by the Urban Flood Control District and the City of Denver. More than 500 residents were evacuated due to flooding in the downstream area.
- **NPS** – During the September 2013 Colorado Great Flood, more than 15 inches fell at Rocky Mountain National Park’s Lily Lake Dam. The installed remote electronic detection system alerted the National Monitoring Center. NPS facilities staff and the DSO were notified in the middle of the night about the large rainfall event, and the park began nearly full-time monitoring of the dam. There were high spillway flows, but fortunately the dam had been fully modified in 2012 with articulated concrete block overtopping protection. Reclamation stated that if the dam had not been repaired, the dam would likely have failed, and 29 houses below the dam would have been affected. An after-incident meeting and report are planned so that lessons learned can be used for program improvement.
- **MSHA** – During the reporting period, there were 11 incidents resulting in failure or requiring remedial actions. Of these events, two occurred at coal mines and nine at metal and nonmetal mines. Once MSHA became aware of an incident, an investigation was conducted to identify hazardous conditions, determine the probable cause of the occurrence, and ensure that appropriate steps were taken by the mine operator to resolve the problem and prevent recurrence. The mining company is responsible for investigating the problem, engaging consulting engineers, if needed, and implementing corrective measures, subject to MSHA concurrence. The coal mine incident resulted in the fatality of an equipment operator working on the embankment. No injuries resulted from incidents involving metal and nonmetal dams.

## Emergency Action Planning

Activities related to emergency action planning during the reporting period are as follows:

- **IBWC** – In FY 2013, the IBWC completed updates to EAPs for all of its dams. The USIBWC will provide the Mexican Section with copies of the updated EAPs and will continue to work with the Mexican Section to create conformity between the two Sections’ EAPs.
- **TVA** – EAPs have been developed and are being maintained for all TVA high- and significant-hazard potential dams. The EAPs are consistent with the Department of Homeland Security (DHS) National Incident Management System and with FEMA P-64, *Federal Guidelines for Dam Safety: Emergency Action Planning for Dams* (FEMA, 2013c). TVA also conducts EAP exercises to provide training opportunities and to verify that the EAPs provide information and guidance needed for effective notification and information exchange during an emergency. External participation includes county and State emergency management agencies, the National Weather Service (NWS), the USACE, the U.S. Coast Guard, and others, when applicable. To comply with new agency dam safety procedures, TVA began exercising more dams annually in FY 2012.
- **NRCS** – NRCS does not have the authority to require the development of EAPs on existing dams, but does require the development of EAPs before providing technical or financial assistance on high-hazard potential dams. Although more EAPs are implemented by the owners of NRCS-assisted dams every year, there are still more than 1,000 NRCS-assisted high-hazard potential dams without an EAP. The NRCS is constantly encouraging dam owners to develop EAPs. During the reporting period, NRCS completed 326 new and 435 updated EAPs on high-hazard potential dams. In coordination with local sponsors and emergency managers, NRCS also conducted 49 EAP exercises. California and Oklahoma report that 100 percent of their high-hazard potential dams have EAPs.
- **FSM**– FSM 7500 requires an EAP for all dams operated by the FS with a high-hazard potential classification. All but two high-hazard potential dams have EAPs in place or in draft, but most of the EAPs have not been exercised because of budget constraints and shortage of personnel. Many EAPs need to be updated and revised. Updating EAPs on FS-owned dams is emphasized in its dam safety program. The FS is installing an EWS on all FS-owned high-hazard potential dams and some significant-hazard potential dams (seven were installed during the reporting period).

The FS does not have credible information for Special Use dams on the number of EAPs, status, or implementation. Most special use permitted dams are under the jurisdiction of the States that own and/or regulate these dams, and it is the responsibility of the State DSO to require and implement these EAPs. The number and extent of exercising of EAPs for Special Use (permitted) dams is being investigated.

- **The FERC** – The FERC EAP Program was the first to be fully developed for dam owners and is used a model worldwide. All FERC-regulated dams requiring an EAP have one. Each year, FERC-regulated dam owners are required to meet face-to-face with primary emergency management agencies to discuss their EAPs, and all dam owners participate in annual drills to test the state of training and readiness of key personnel responsible for

actions during an emergency. In FY 2012 and FY 2013, about 112 functional exercises were performed at FERC-regulated projects.

In 2013, FERC also required dam owners in their annual EAP updates to include a more detailed description of their operating procedures during high-flow events and to ensure that the EAPs include improved coordination with emergency management and adjacent communities. This enhancement was implemented as a result of lessons learned from recent storm events on the East Coast. During Hurricane Irene and Hurricane Sandy, inexperienced management and dam tenders lacked training and instructions to operate projects during extreme high-flow events.

- **USACE** – The USACE had EAPs in place at 402 of 403 high-hazard potential dams, 125 of 132 significant-hazard potential dams, and 20 of 22 low-hazard potential dams. Fifty-five percent of the EAPs were updated, and 135 dam safety exercises were conducted.
- **OSMRE** – OSMRE is a regulatory agency and cannot write EAPs for owners of private dams. OSMRE does not require exercises to be conducted. However, OSMRE requires that Hazard Response Plans be written when a hazard is recognized. OSMRE has recognized the need to update its regulations and is currently drafting a proposed rule to require that (1) dam classifications be consistent with FEMA 333, (2) all high- and significant-hazard potential dams use FEMA P-64 (FEMA, 2013c) to develop an effective EAP and require regular updates and testing of EAPs, and (3) After Action Reports be developed and submitted and approved by the regulatory authority.
- **BIA** – BIA has a current completion rate of 100 percent for its high- and significant-hazard potential dams. The BIA emergency management program consists of preparation and exercising of the EAPs, along with the installation of an EWS at each dam, ultimately tying all the EWSs into the BIA 24/7 National Monitoring Center, which provides 24/7 emergency monitoring of BIA high- and significant-hazard potential dams. In addition, all downstream entities potentially affected by the failure of a dam are encouraged to participate in the EAP exercises.
- **Reclamation** – EAPs have been developed and are updated annually for all of Reclamation’s high- and significant-hazard potential dams in accordance with Reclamation’s policy, Emergency Management Directive FAC 01-01. Reclamation conducted 104 tabletop exercises and 49 functional exercises during the reporting period.
- **FWS** – All high- and significant-hazard potential FWS dams have updated EAPs. The FWS continues to implement an annual testing program for EAPs, which consists of a simplified test. The simplified test verifies that the EAP is available and up-to-date and that the communications network is current. FWS conducted 11 EAP exercises during the reporting period.
- **MSHA** – MSHA policy states that mine operators should develop and maintain EAPs to be consistent with current, prudent engineering practice and the *Federal Guidelines for Dam Safety*. However, MSHA does not require an EAP. Many dams under MSHA jurisdiction are required to have EAPs by State regulations. MSHA recognizes the benefits of EAPs

and will continue to encourage mine operators to develop EAPs for high-hazard potential dams.

## Research and Development and Special Initiatives

Activities related to research and development (R&D) and special initiatives during the reporting period are as follows:

- **NRC** – The NRC is finalizing three draft technical reports on probable maximum precipitation estimates in the southeastern United States. With the assistance of Reclamation, the NRC also began developing guidance related to extreme precipitation in the Tennessee Valley.
- **TVA** – TVA is a member of the Centre of Energy Advancements through Technical Innovation (CEATI). TVA participates on the CEATI Dam Safety Interest Group to study topics such as best practices in dam safety performance monitoring and data analysis management, gauging the effectiveness of dam safety programs, dam safety inspection procedures, guidance, and training for plant managers. TVA also participates with the FERC, Reclamation, and the USACE in Joint Federal Dam Safety Risk Management meetings.
- **NRCS and ARS** – NRCS and ARS are continuing a major, long-term R&D effort to model erosion processes in earth spillways during flood flows and on embankment dams during overtopping flows. The latest ARS-developed earth spillway erosion model has been incorporated into the existing NRCS SITES design software, which is used to develop inflow hydrographs by NRCS curve number procedures, compute spillway system hydraulics, calculate peak reservoir calculations, and determine ultimate spillway headcut advance for a single dam or multiple sites in a series. The latest ARS-developed embankment overtopping model and an ARS breach model are included in the NRCS Windows Dam Analysis Modules (WinDAM) software.
- **ARS** – The ARS has ongoing R&D programs focused on rehabilitation and dam safety. Research is being conducted in the following areas: (1) the impact that steps and slopes have on air entrainment, energy dissipation, and flow depth for the design of roller-compacted concrete (RCC) spillways, (2) the theoretical relationships for determining training wall height for converging RCC spillways, (3) methods for reservoir sedimentation and shoreline wave erosion and embankment protection, and (4) development of a rapid 2-dimensional flood-routing model and GIS Decision Support System for Water Infrastructural Security (DSS-WISE). The DSS-WISE system was used to provide dam-break flood maps to FEMA Region IV during Hurricane Isaac in August 2012.
- **USACE** – USACE research programs include investigations of (1) methodologies for monitoring, inspecting, and nondestructive testing and condition assessments of steel and concrete components, (2) evaluation and quantification of failure modes in earth structures resulting from internal and external erosion, (3) improved modeling of hydraulic impacts,

and (4) and a focused effort started in FY 2013 to address multiple facets of aging infrastructure. The USACE has also created the Modeling, Mapping and Consequences Production Center (MMC), which provides hydrologic modeling, consequence estimates, and flood inundation mapping for dams and levees. The MMC supports risk assessments, prioritization, and management decisions for dam safety.

- **OSMRE** – OSMRE’s Applied Science Program is funding projects relevant to the protection of impoundments. For example, one study is examining the effects of coal mine blast vibrations on impoundments. OSMRE’s Appalachian Region has been conducting a region-wide basin breakthrough study and a compaction study. OSMRE’s Mid-Continent Region conducted regulatory program oversight projects encompassing refuse piles with slurry cells and sediment ponds. OSMRE’s Western Region worked with Washington State’s Department of Ecology to investigate coal impoundments.
- **DOI** – DOI has undertaken an Enterprise Architecture (EA) initiative to transform the business practices of reducing dam safety risk within DOI. The initiative is consistent with the President’s Management Agenda and expanded electronic government. The intent is to simplify and modernize business practices and integrate individual bureau processes for lower costs and efficiencies. Potential dam safety lines of business identified for transformation include the role of oversight, risk management, and emergency management.
- **Reclamation** – Reclamation continues to emphasize the use of risk analysis in its evaluation processes. Experiences and approaches in risk analysis and risk assessment are shared internationally. Reclamation is also collaborating with other Federal agencies, including the USACE, FERC, TVA, and FEMA, on developing joint Federal risk management approaches and policies.
- **FWS** –FWS completed a pilot comprehensive review, developed by Reclamation that uses incremental damage assessment and risk assessments in the rehabilitation of its existing dams. In 2012, the comprehensive review of one of the larger FWS dams with a large at-risk population, Lake Darling Dam, was completed. Three additional comprehensive reviews will be completed for Little Grassy Dam, Umbarger Dam, and Dorris Dam.

## State Dam Safety Agency Involvement

Activities related to State dam safety agency involvement during the reporting period are as follows:

- **TVA** – TVA makes annual contact with as many EAP holders as practicable. Contact consists of face-to-face orientation sessions during which EAP holders are provided with the updated version of the EAP, a description of the changes, and the opportunity to ask questions. EAP holders who cannot be met with face-to-face are contacted by phone annually. TVA also includes affected State entities in its exercises.



- **NRCS** – The majority of NRCS States work closely with their State agencies to discuss issues and exchange information. NRCS has a Memorandum of Understanding (MOU) with dam safety agencies in 28 States to coordinate dam safety activities, including NRCS aging watershed issues and recent rehabilitation authorities.
- **FS** – State dam safety involvement is a crucial component of the FS dam safety mission. Most regions have cooperative relationships with all of their States. MOUs have been developed to guide the interaction between the State agencies and the FS. On occasion, State dam safety personnel provide technical assistance and support primarily to FS-regulated dams, providing owners a low-cost option that enables them to comply with scheduled inspections and maintenance. In most instances, State dam safety laws have been written to give the regulating State dam safety agency jurisdictional authority over non-Federal dams on Federal lands in their respective States.
- **The FERC** – The FERC Dam Safety Program maintains a strong collaborative and cooperative relationship with all State dam safety agencies. State dam safety officials are invited to attend all FERC dam safety inspections, and all inspection reports and dam safety information are made available to State dam safety offices on request.
- **Reclamation** – Reclamation continues to maintain strong working relationships with State dam safety agencies. Reclamation has MOUs with the 17 western States where Reclamation has facilities. Meetings between Reclamation and the States are typically conducted annually, but travel restrictions imposed since FY 2012 have resulted in significant less face-to-face contact. State representatives may also participate with Reclamation staff on dam safety inspections. States have participated with Reclamation on specific issues associated with individual structures, such modifications, reservoir restrictions, and environmental concerns.
- **NPS** – The NPS will be interacting more with the States for proper regulation of the 19 dams owned by others on NPS lands. For non-Federal dams located upstream from park lands, the NPS will also be engaging States to ensure that parks are included in the dam owner’s EAP.

## Public Concerns

Activities related to public concerns during the reporting period are as follows:

- **TVA** – TVA meets with local officials, conducts public meetings, and issues press releases before the start of construction on any of its dams. TVA also conducts environmental reviews according to the National Environmental Policy Act of 1969 (42 U.S.C. §§ 4321 et seq.) to document potential consequences of proposed actions.
- **NRCS** – NRCS programs work in partnership with private landowners and local sponsors to ensure adequate procedures for the early assimilation of public views into dam planning, construction, and operation. Several States have noted strained relationships with project sponsors and watershed districts that have acquired land rights for approved project dams

but are waiting for Federal funding to begin construction. NRCS estimates that the unfunded Federal commitment for new dam construction exceeds \$2 billion.

- **USACE** – In FY 2013, the USACE saw an increased public interest and concern in (1) the management of water operations to facilitate both navigation during low-flow events as well as releases during flood events, (2) increases in water supply reallocations to address drought conditions, particularly in the arid Southwest, and (3) the potential negative effects of mineral extraction activities on or adjacent to Federal infrastructure. In response to these concerns, the USACE has increased engagement and communication with stakeholders and sponsors and re-examined and revised policies related to these issues.
- **NPS** – NPS dam safety activities at Lily Lake Dam were conducted in a way to ensure that the public was aware of activity and objectives. The public was invited to comment on the proposed repair or breach of the dam and also to become aware of the EAP and exercise for the dam held in 2012. During the dam repair, the public was notified of the project and informed about possible access issues. Similarly, the public was involved in the repair of Star Fort Pond Dam at Ninety Six National Historic Site in South Carolina.

## Non-Federal Dams on Federal Lands

Activities related to non-Federal dams on Federal lands during the reporting period are as follows:

- **NRCS** – NRCS has provided technical assistance for approximately 200 non-Federal NID-size dams on Federal lands. The non-Federal owners of these dams are responsible for coordinating all actions, activities, and permits with responsible Federal land agencies.
- **FS** – Non-Federal dams on FS lands fall under Special Use (permitted) authorization, Ditch Bill easement, or DOI easement, and most are regulated by State dam safety agencies. The FS is responsible for regulation of Special Use dams and Ditch Bill easement dams on FS land not regulated by State agencies. No dam failures have been reported since the last reporting period. Inspection reports of Special Use (permitted) dams are reviewed as they become available. DOI easement dams on FS lands are dams that the FS has no authority to regulate. The FS can take action to protect FS lands if the dam is on the verge of failure and will or is causing damage to FS lands. Most DOI easement dams are regulated by State dam safety agencies. When there is no State regulation, the FS tries to work with the owner on dam safety.
- **USACE** – According to the 2010 NID, there were potentially six high-hazard potential dams and eight significant-hazard potential dams on USACE property. After further review, it was determined that only two significant-hazard potential non-Federal dams are located on Corps property. Both of these dams are regulated by State dam safety offices.
- **Air Force** – There is one non-Federal dam on Air Force property in Alaska. The dam is regulated and inspected by the State.

- **BLM** – BLM is participating on the ICODS Non-Federal Dams Task Group and is working with other Federal agencies to develop procedures and guidelines to ensure the safety of private dams on Federal land. In most cases, the State dam safety agencies perform inspections of dams that are on BLM land but privately owned. BLM issues right-of-way permits with terms and conditions that outline safety requirements for the operation, maintenance, and construction of dams in compliance with BLM Manual Handbook H-9177-1, Dam Condition Assessment Guidelines for Embankment Dams, and the *Guidelines*. Some dams were built in trespass or are orphaned, and there may be a lack of oversight on those uncontrolled dams. BLM will continue to investigate private dams on its land and determine the agencies that will be responsible for implementing dam safety activities.
- **Reclamation** – The 2013 NID showed that 28 non-Federal dams could be on Reclamation land. Of these, 7 are listed as high- or significant-hazard potential dams, and 21 are low-hazard potential dams. Although verification is ongoing, current findings indicate the following:
  - The seven high- or significant-hazard potential dams are not on Reclamation lands
  - Of the 21 low-hazard potential dams:
    - Five are likely to be Reclamation dams
    - Two appear to be on Reclamation land
    - Three may be on or partially within Reclamation boundaries
    - Five are not on Reclamation lands
    - Six could not be verified because the locations provided in the NID were found to be incorrect
- **FWS** – The NID lists 98 dams as “non-Federal dams” on FWS property, including 10 high-hazard potential and 10 significant-hazard potential dams. The FWS investigated and found no high- or significant- hazard potential dams on FWS land. The remaining 78 low-hazard potential dams are being researched. Many are not on FWS property and cannot be located because of inaccurate coordinates in the NID. The FWS has many dams on this list that are already in the FWS inventory and are being routinely inspected by the FWS. Other dams will be investigated during the next scheduled visit to the field station to determine whether each is an FWS-owned dam or a non-Federal dam owned by a corporation, private owner, or a government agency. The FWS will initiate appropriate action to ensure that the *Guidelines* are followed.
- **NPS** – There are a total of 19 non-NPS dams on NPS lands (six high-, four significant-, and nine low-hazard potential). The DSO and the Pacific Northwest Regional Dam Safety Coordinator inspected four of the dams, including one high-hazard potential dam, at Sequoia National Park. The other five high-hazard potential dams are large hydroelectric

dams regulated by the FERC. Efforts will continue on these dams to ensure that the dams are properly regulated.

- **MSHA** – MSHA does not own the dams it regulates. Dams are owned by mining companies, and MSHA is typically unaware of the land ownership details. MSHA is working with other Federal agencies that own or lease lands for the development of resources to ensure that MSHA has identified all dams at mines under its jurisdiction on Federal lands. For example, MSHA became aware of one mine in western Kentucky located on Federal land. TVA informed MSHA that TVA leased the land to the mine operator and that the mining operation includes a coal waste dam. MSHA met with the TVA to discuss regulation of the dam.
- **TVA** – There are currently six non-Federal dams on TVA-owned property. Lease terms associated with four of the dams do not grant TVA the right to conduct dam safety inspections or require the operator to adhere to TVA’s dam safety criteria. TVA transferred ownership of the other two dams, both situated on backwater areas of Norris Lake, and no longer has inspection or maintenance responsibilities for these dams.

## Additional Observations

Additional observations during the reporting period are as follows:

- **IBWC** – The IBWC reports that it is continuously working to improve the security at each of its dams along the U.S./Mexico border. Threat analyses and vulnerability assessments have been conducted at Falcon and Amistad Dams, and security enhancements have been implemented at Falcon Dam. Vulnerability assessments are planned for the American, International, Anzalduas, and Retamal Dams in 2014, with security enhancements scheduled to begin at the end of 2014.
- **FS** – With the increasing age of dams, there is a need to heighten awareness of potential dam failures and their impacts and consequences. Another challenge for the FS dam safety program is to maintain and update the Dams Module of the FS National Database. The Dams Module is a small part of the FS National Database, and maintaining and updating it are not always priorities.
- **USACE** – Approximately half of the USACE dams have serious deficiencies. The most common problem in the portfolio of dams is foundation and embankment seepage. Dynamic hydrologic and seismic hazards, age-related degradation, and burgeoning development drive the current risk environment. The Corps Civil Works Program has functioned for many years building and maintaining this portfolio of dams. Underinvestment, accelerating risks, and increasing costs are all threats to dam safety.
- **OSMRE** – OSMRE has joint regulatory authority with Montana for the Absaloka Mine. OSMRE considers portions of the permitted area, referred to as Crow Ceded Strip, to be Indian lands while Montana does not. The mine has two impoundments that are classified as significant-hazard potential but do not have EAPs. OSMRE is working to determine its

authority to require the permittee to develop an EAP on these lands because of the unique ownership.

- **NPS** – The NPS is assisting the National Capital Region with the managing risks associated with the NPS-owned Washington D.C. levee. The risks of failure of this levee far exceed the risks of other NPS-owned hydraulic structures.

## VI. Related Programs

As the lead agency for the National Dam Safety Program (NDSP), FEMA has worked for years with its sister agencies within DHS and with many other Federal agencies, the States, and private industry on related programs and initiatives to advance dam safety in the United States. The work that has been undertaken on related programs in FY 2012 and FY 2013 is summarized below.

### DHS Programs and Initiatives

#### National Protection and Programs

##### Directorate's Office of Infrastructure Protection

PPD-21, Critical Infrastructure Security and Resilience, advances a national unity of effort to strengthen and maintain secure, functioning, and resilient critical infrastructure. PPD-21 establishes national policy on critical infrastructure security and resilience. The responsibility is shared among Federal, State, local, tribal, and territorial entities and public and private owners and operators of critical infrastructure. The directive also refines and clarifies the critical infrastructure-related functions, roles, and responsibilities across the Federal Government and enhances overall coordination and collaboration. Federal SSAs are responsible for the 16 sectors defined in the directive. The Office of Infrastructure Protection within DHS serves as the SSA for the Dams Sector.

The Dams SSA actively collaborates with sector stakeholders to identify and implement programs that enhance the protection and resilience of dams across the Nation. The collaboration occurs under the auspices of the Critical Infrastructure Partnership Advisory Council (CIPAC). The CIPAC framework provides a forum that allows government and private-sector partners to conduct effective information sharing and coordinate a broad spectrum of infrastructure protection activities across all sectors. As part of the CIPAC framework, the Dams Sector Coordinating Council and Government Coordinating Council constitutes a focal point for public-private coordination of infrastructure protection efforts for dams and related facilities.

Protective programs and resilience strategies encompass a wide spectrum of efforts, including implementing active or passive countermeasures and improving security protocols, hardening or retrofitting facilities to improve their performance under extreme loadings, implementing cybersecurity measures, building operational redundancy, implementing back-up systems to minimize disruptions, implementing consequence-mitigation programs, conducting exercises, enhancing business continuity planning, and designing and planning multi-scenario restoration and recovery procedures. Effective information exchange among owners, regulators, and their associated communities can also contribute to enhancing the protection and resilience of the Dams Sector.

The Dams SSA, in collaboration with the USACE, developed the Dams Sector Analysis Tool (DSAT), an effective web-based tool to integrate available information on critical infrastructure facilities across the sector. DSAT provides an integrated platform to consolidate analysis tools

and data collection mechanisms supporting the screening, prioritization, characterization, and analysis of critical assets. DSAT webinars are conducted for existing and potential users by the Dams SSA, providing an overview of the DSAT capabilities.

The collaborative partnership among government and non-government entities across the Dams Sector has resulted in the development of a variety of tools and products focused on improving protection and enhancing resilience. For example, sector partners collaborated to develop a Consequence-Based Top-Screen methodology that systematically assembles consistent data to identify and prioritize assets based on human impacts, economic consequences, and disruption of critical functions (e.g., water delivery, navigation, electricity production).

To support the dam safety community in better identifying and assessing dam failure risks, the Dams SSA, in collaboration with the DHS Science and Technology Directorate and the USACE, has sponsored the development of web-based flood simulation capabilities that can effectively support emergency management planning for flood-related threats. The dam-break flood mapping capabilities, which are implemented on the DSAT platform, are designed for use by owners, operators, emergency managers, and community planners. The results include flood inundation areas as well as day-time and night-time estimates for the population at risk. The automated dam-break flood simulation capabilities can significantly improve emergency management planning efforts related to flooding hazards caused by potential dam failures.

Other important activities have focused on information sharing and outreach. For example, the Dams SSA, in collaboration with the ASDSO, developed the Dam Security and Protection Technical Seminar (E260). The seminar provides owners/operators, State dam safety officials, and other stakeholders with information on security, protection, and crisis management issues to improve understanding of dam-related security and protection concepts. The Dams SSA has also developed the Consequences of Dam Failure Workshop (E261) in collaboration with FEMA. The course provides target audiences with information needed to define and estimate consequences for dam failure scenarios. The objectives are to help participants understand that the consequence assessment is an important part of risk management strategies, how to establish initial priorities using consequence data, and that consequence estimation plays an important role in emergency preparedness efforts.

To ensure that all dam stakeholders have access to information related to protective programs, sector partners have collaborated with the Dams SSA to develop a series of handbooks and guides focused on security awareness, protective measures, and crisis management. The handbooks also serve as the basis for the development of associated web-based training modules. Sector partners have also supplied templates, models, and outlines of their plans for site physical security, pandemics, computer incident response, recovery, exercises, and continuity of operations to assist other sector partners in developing resilience strategies. The reference documents and training resources are accessible through the Homeland Security Information Network-Critical Infrastructure Dams Portal.



Within their agencies' critical infrastructure protection and resilience research programs, DHS and other Federal partners such as the USACE and the Bureau of Reclamation have coordinated their research investments and shared results to better understand blast effects on dam components (such as embankment and concrete dams, reservoir control gates, lock chambers and gates, intake and outlet structures, and hydropower plants). These agencies funded efforts to conduct physical blast testing of dams, gates, locks, and levees; improve numerical modeling capabilities; establish standoff requirements for water-side approaches to dam complexes; and develop designs of innovative blast mitigation measures to protect dams, gates, levees, and related infrastructure.

The Protective Security Coordination Division (PSCD) is a division of the National Protection and Programs Directorate's Office of Infrastructure Protection (IP) that provides programs and initiatives to enhance the protection and resilience of the Nation's critical infrastructure with respect to all-hazards incidents. PSCD develops and deploys a scalable assessment methodology to identify critical infrastructure vulnerabilities, support collaborative security planning, and provide options for consideration to enhance protective measures and risk mitigation strategies.

Based within the National Protection and Programs Directorate's (NPPD) Office of Infrastructure Protection (IP), PSCD's primary mission is to proactively engage with Federal, State, local, tribal, and territorial government mission partners and members of the private sector stakeholder community to enhance the protection and resilience of the Nation's critical infrastructure. PSCD supports the IP field presence through 96 headquarters and field-based critical infrastructure security specialists known as Protective Security Advisors (PSAs). Eighty-nine field-based PSAs and Regional Directors are deployed throughout all 50 States and Puerto Rico, serving as onsite critical infrastructure and vulnerability assessment specialists.

PSAs serve as the link between State and local, tribal, and territorial organizations and Department of Homeland Security (DHS) infrastructure protection resources. They coordinate vulnerability assessments, training, and other DHS products and services; provide a vital link for information sharing in steady-state and incident response; provide support to officials responsible for planning and leading National Special Security Events (NSSEs) and Special Event Activity Rating events; assist facility owners and operators with obtaining security clearances; and support incident response, recovery, and reconstitution efforts as Infrastructure Liaisons at Joint Field Offices during contingency events.

PSCD develops and deploys a scalable assessment methodology to identify critical infrastructure vulnerabilities, support collaborative security planning, and provide options for consideration to enhance protective measures and risk mitigation strategies. Voluntary PSCD vulnerability security surveys and assessments include: Site Assistance Visits (SAVs); Enhanced Critical Infrastructure Protection (ECIP) security surveys conducted using the Infrastructure Survey Tool (IST); Regional Resiliency Assessment Program (RRAP) projects; and Computer Based Assessment Tool (CBAT) imagery captures.

SAVs are non-regulatory vulnerability assessments that assist owners and operators of critical infrastructure with identifying and documenting vulnerabilities, protective measures, planning needs, and options for consideration to increase protection from and resilience to a wide range of hazards. IP conducts SAVs in coordination with other Federal, State, local, tribal and territorial government entities and participating facilities.

Through SAVs, the Department of Homeland Security (DHS) enhances the capabilities and resources of critical infrastructure owners and operators for identifying and mitigating vulnerabilities; detecting and preventing terrorist attacks; and responding to, recovering from, and remaining resilient against all-hazard events.

By assessing the overall security posture of a facility, ECIP security surveys provide protective measures to critical infrastructure; inform facility owners and operators of the importance of their facilities and current terrorist threats; and develop strong relationships between critical infrastructure owners and operators, DHS, and Federal, State, and local law enforcement partners.

The IST is a Web-based vulnerability survey tool that applies weighted scores to identify vulnerabilities and trends for infrastructure and across sectors. The tool allows DHS to identify and document critical infrastructure overall security; provide information for protective measures planning and resource allocation; facilitate government information sharing; and enhance its ability to analyze data and produce improved metrics. This includes a dashboard which creates a facility protective measures index that can be used to compare against similar facilities; incorporates a Resilience Measurement Index composed of four components: preparedness, mitigation measures, response capabilities, and recovery mechanisms; and informs protective measures planning and resource allocation.

The RRAP is a cooperative, IP-led assessment of specific critical infrastructure and a regional analysis of the surrounding infrastructure. The RRAP evaluates critical infrastructure on a regional level to examine vulnerabilities, threats, and potential consequences from an all-hazards perspective to identify dependencies, interdependencies, cascading effects, resilience characteristics, and gaps. Each year, RRAP projects are selected by IP with input and guidance from Federal and State partners. RRAP projects, which are voluntary and non-regulatory, focus on specific infrastructure sectors within defined geographic areas and address a range of hazards having potential regionally and nationally significant consequences.

The RRAP produces a comprehensive Resiliency Assessment to present project results and findings, including key resilience gaps and options for consideration in addressing these shortfalls. The Resiliency Assessment, along with supporting documents and information, are provided to select RRAP participants in the form of a multimedia presentation. Facility owners and operators, regional organizations, and government agencies can use the results to help guide strategic investments in equipment, planning, training, and resources to enhance the resilience and protection of facilities, surrounding communities, and entire regions.

CBAT is a data collection and presentation medium designed to support critical infrastructure security, special event planning, and response operations. CBAT imagery captures provide immersive video, geospatial, and hypermedia data of critical facilities, surrounding areas, transportation routes, etc. and integrates assessment data from the ECIP security surveys, SAVs, and other relevant materials. The data is used to support the RRAP; NSSEs; other special events; and the initiatives of facility owners and operators, local law enforcement, and emergency response personnel. The CBAT's final product is a DVD containing self-executing presentation software that is provided to the facility representative and/or the primary stakeholder of an RRAP project or special event security planning personnel. The final products assist these users in planning and in making rapid and informed incident preparedness and management decisions.

PSCD's voluntary assessments and security surveys are useful in identifying cross-sector vulnerability concerns and developing asset-specific options for consideration, respectively. However, they are not intended to be used as detailed risk assessments nor are the options for consideration deemed to be requirements or definitive statements of security vulnerabilities.

IP Protective Security Advisors conduct assessments in collaboration with facility owners and operators interested in complementing their security efforts through active participation in these voluntary programs. These multiple IP assessments play an important role in establishing the overall security and resilience posture of the most critical assets within the sector. During Fiscal Years 2012 and 2013, the following assessments were conducted on Dam facilities:

- ECIP 86; 39 on Leveled facilities
- IST 41; 12 on Leveled facilities
- SAV 30; 14 on Leveled facilities
- Computer-Based Assessment Tool 14; 8 on Leveled facilities
- Regional Resiliency Assessment Program 4 (2 CBAT; 2 SAV); all Leveled facilities

In 2013, the Office of Cyber and Infrastructure Analysis (OCIA) supported an RRAP project in assessing the impacts that would result the loss of the Emsworth Dam on water supply systems drawing water from the Pittsburgh Pool. The assessment included identifying system resilience and existing mitigation measures. Additionally, there have been several products produced by OCIA which analyze the infrastructure protection community's risk environment from terrorist attacks, natural hazards, and other events, and highlight the analytic capabilities required to produce infrastructure protection related risk analytic products. The information is provided to support the activities of the Office of Infrastructure Protection, and to inform the strategies and capabilities of Federal, State, local, and private sector partners. The products include:

- (U//FOUO) Virtual Risk Analysis Cell Pilot Critical Infrastructure Assessment: Soo Locks

- (U//FOUO) Hurricane Sandy Impact on Risk of Dam Failures
- (U//FOUO) Modeling and Simulation Note: Alaska Earthquake Scenario Analysis
- In Response to Your Question
  - (U//FOUO) What is the risk of catastrophic dam failures<sup>1</sup> resulting from Hurricane Sandy?
  - (U//FOUO) Are hurricane conditions likely to cause catastrophic dam failures?

## FEMA Risk Analysis Activities

FEMA manages several risk analysis programs, including Flood Hazard Mapping, Multi-Hazard Mitigation Planning, and Hazards U.S. Multi-Hazard (Hazardus), which assess the impact of natural hazards and lead to effective strategies for reducing risk. These programs support the DHS objective to “strengthen nationwide preparedness and mitigation against natural disasters.” Established in 2009, Risk Mapping, Assessment, and Planning (Risk MAP) integrates and aligns the individual risk analysis programs into a more effective unified strategy, with a vision to deliver quality data that increase public awareness and lead to action that reduces risk to life and property.

The work being performed under Risk MAP is grounded in current authorities provided in the National Flood Insurance Reform Act of 1994 (42 U.S.C. § 4001 note); the NDSP, as expressed in Section 215 of the Water Resources Development Act of 1996, as amended; the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1988 (Stafford Act) (42 U.S.C. §§ 5121–5206, as amended); and the Biggert-Waters Flood Insurance Reform Act of 2012 (BW-12) (126 Stat. 919).

In the Nation’s comprehensive emergency management framework, the analysis and awareness of natural hazard risk continues to pose challenges. For communities to make informed risk management decisions and take action to mitigate risk, a consistent risk-based approach to assessing potential vulnerability and losses and tools to communicate the message is needed. Risk MAP aims to close this gap. By analyzing and depicting flood risk, communities and the American public can better understand their risk and make informed decisions to reduce vulnerability.

Risk MAP not only addresses gaps in flood hazard data but also uses updated data to form a solid foundation for risk assessment and floodplain management and to provide local, State, and Tribal Governments with information needed to mitigate flood-related risks. Risk MAP is introducing new products and services extending beyond the traditional digital flood maps, including visual illustration of flood risk, analysis of the probability of flooding, economic consequences of flooding, and greater public engagement tools. FEMA is increasing its work with officials to help use flood risk data and tools to effectively communicate risk to citizens and enable communities to enhance their mitigation plans.

BW-12 reauthorized the National Flood Insurance Program (NFIP) through September 30, 2017. The law required changes to all of the major components of the program, including flood insurance, flood hazard mapping, grants, and the management of floodplains. Many of the changes are designed to strengthen the fiscal soundness of the NFIP by ensuring that flood insurance rates more accurately reflect the real risk of flooding. The changes are being phased in over time and began in 2013. Many of the provisions related to flood hazard mapping reflect the work and approaches that are already being implemented as part of the Risk MAP program, including mapping the 100-year and 500-year floodplain for populated areas, as well as areas behind flood control structures, including levees and dams.

FEMA has also reviewed its approach to mapping flood hazards with respect to non-accredited levees. FEMA recognizes that levee systems that do not fully meet the requirements for accreditation may still provide some measure of flood risk reduction. In July 2013, FEMA released the *Analysis and Mapping Procedures for Non-Accredited Levees* (FEMA, 2013a) approach document, outlining the new process for analyzing and mapping the landward side of non-accredited levees. The new approach does not change existing regulations, but it provides a flexible, repeatable, cost-effective, and collaborative process that reflects the impact of non-accredited levee systems as flood control structures. As a result, FEMA is able to implement a more refined analysis and mapping process for levee systems.

FEMA devised this new approach by leading a multidisciplinary project team composed of representatives from FEMA, the USACE, and experts from the academic and engineering communities to evaluate technical options for non-accredited levees. This team explored a broad spectrum of levee analysis and mapping procedures. Based on the results of the development, testing, review, and public comment efforts, FEMA created and is implementing a levee analysis and mapping approach that is flexible and will produce more precise flood hazard maps and supporting data where levee systems are involved.

FEMA continues to collaborate with local, State, regional, Tribal, national, and other Federal partners in communicating its objectives and implementing Risk MAP to reduce risks to life and property and build resilience across the Nation.

## FEMA Hazard Mitigation Assistance Program

FEMA provides three hazard mitigation grant programs which, together, comprise FEMA's Hazard Mitigation Assistance (HMA) program. Although the programs share the common goal to reduce the risk of loss of life and property due to natural hazards, the programs differ in funding and the hazards to be mitigated. Flood risk reduction measures are eligible for funding under all three HMA programs: the Pre-Disaster Mitigation (PDM) Program, Flood Mitigation Assistance (FMA) Program, and Hazard Mitigation Grant Program (HMGP).

The PDM Program is authorized under Section 203 of the Stafford Act. The purpose of the PDM Program is to assist States, Territories, Indian Tribal governments, and local communities to implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to

the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters. Funding is provided annually to implement cost-effective hazard mitigation activities that complement a comprehensive mitigation program.

The FMA Program is authorized under Section 1366 of the National Flood Insurance Act of 1968 (42 U.S.C. § 4026, as amended). The purpose of this Program, which is funded annually, is to reduce or eliminate risk of flood damage to buildings insured under the NFIP.

HMGP, which is authorized under Section 404 of the Stafford Act, is designed to assist in the implementation of long-term hazard mitigation measures and to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following Presidential disaster declarations. Funding is available following a Presidential major disaster declaration to implement projects in accordance with State, Tribal, and local priorities.

FEMA HMGP does not fund any activities related to the construction or repair of dams. Funding for development of State, local, and Tribal hazard mitigation plans is eligible under all three HMA programs. A basic requirement of these plans involves identifying hazards to which the community is susceptible and analyzing the risk to buildings, infrastructure, and lives. Mitigation planning enables jurisdictions to focus on areas at high risk for flooding, including locations downstream of dams. Mitigation planning encompasses the identification of flood hazard mitigation projects as an element of a community, Tribal, or State mitigation strategy to improve risk reduction and public safety associated with dams.

## National Flood Insurance Program Community Rating System

The Community Rating System (CRS), a part of FEMA's NFIP, was initiated in 1990 to recognize and encourage community implementation of floodplain management activities that exceed the minimum Federal floodplain management requirements of the NFIP. Under the CRS, flood insurance premiums for policyholders in a CRS-participating community are reduced to reflect the added flood risk protection that results from local flood risk reduction, outreach, and educational activities that help communities to become more sustainable and disaster resistant.

Among the many CRS-recognized activities is Activity 630 (Dams), which provides CRS credit points to communities that take action to reduce the threat of failure of a high-hazard potential dam and also prepare for the flood if a failure does occur. The CRS credit criteria were developed in accordance with attributes of the model dam safety program recommended by the ASDSO. In 2012 and 2013, the CRS activity credit criteria and credit points for Activity 630 (Dams) were evaluated, updated, and revised. Under the 2013 *CRS Coordinator's Manual* (FEMA, 2013f), the CRS emphasizes the public safety aspects of high-hazard potential dams.

CRS-participating communities that would be affected by a flood from the failure of a high-hazard potential dam can obtain credit points under Activity 630 (Dams) in several ways, as noted below.

The State Dam Safety Program credit reflects FEMA's efforts to increase the involvement of State programs in emergency planning for dam failures and to work more with communities and the public. Communities within a State receive CRS credit for that State's (1) condition assessment rating, (2) risk communication and public awareness activities, such as training for dam owners or coordination with State and local emergency officials, and (3) percentage of EAPs for high-hazard potential dams within the State. State programs are reviewed every year in conjunction with ASDSO to determine the number of points provided to CRS communities for each State's dam safety program.

Local dam safety program credit has four components:

- **Dam failure recognition system** credit is for having a system to advise the emergency manager when a dam may be in danger of failure. The system must be tested monthly.
- **Dam failure warning** credit is for having different ways to warn people threatened by a dam that may fail. It must include an outreach project targeted to the residents in the affected area.
- **Dam failure operations plan** credit is provided if the community has a plan for its response operations that includes specified steps to be taken at different flood levels. There must be annual exercises or drills of the plan.
- **Dam failure critical facilities planning** credit is for advance coordination of dam failure warning and response activities with the operators of critical facilities.

To receive CRS credit for its local program, a community must be conducting activities in all four of the above components. In addition, the community must:

- Have a dam failure warning and response plan that has been adopted by the community's governing body;
- Implement one or more outreach projects to the residents and businesses in the area(s) expected to be inundated by a dam failure; and
- Conduct at least one exercise or drill of the dam failure warning and response plan each year. This can be an exercise for (or an actual response to) a flood, levee failure, dam failure, or hurricane.

## National Weather Service

The National Weather Service (NWS) Office of Climate, Water, and Weather Services, Hydrologic Services Division (HSD), coauthored *Dam Risk Reduction Strategy Report* (NWS, 2013). For the report, HSD was responsible for documenting the meteorologic and hydrologic conditions associated with the flood events of January 2009 Pacific-Washington, May 2010 Nashville-Tennessee, and June 2011 Minot-North Dakota.

HSD participates in the ICODS and Review Board meetings and serves on the Review Board Work Group on Emergency Action Planning. At the joint ICODS and Review Board meeting in



April 2013, HSD participated in a discussion of the updated FEMA P-94, *Selecting and Accommodating Inflow Design Flood for Dams* (FEMA, 2013d) and its impacts on Federal agencies. After the discussion, HSD alerted the NWS Office of Hydrologic Development (OHD) and Hydromet Design Studies Center to potential misunderstandings related to the Probable Maximum Precipitation, NWS Hydrometeorological Reports, and Climate Change. It was recommended that these concerns be addressed in concert with the Advisory Committee on Water Information (ACWI) Subcommittee on Hydrology (SOH).

Serving as the chair of ACWI-SOH, HSD worked with the FEMA NDSP staff to raise awareness of the hydrologic needs of dam owners among the 20 participating Federal and non-government member organizations of SOH. FEMA's NDSP requirements were presented at the SOH Quarterly meeting in April 2013. Recognizing the shared responsibility for ensuring dam safety, SOH will align the mutual interests of the NDSP with the two SOH workgroups, Extreme Storms Events and Hydrologic Frequency Analysis.

OHD also worked with FEMA to import NWS Simplified Dambreak code into GeoDam-BREACH. GeoDam-BREACH and its associated toolset were delivered in August 2012 and beta tested by NWS and several States including Virginia, Kentucky, North Carolina, Iowa, and Mississippi. The NWS Mid-Atlantic River Forecast Center tested GeoDam-BREACH version 1.0.0.16, provided positive feedback, and recommended documentation of the mapping algorithm, model output uncertainties, model assumptions, and guidance for the number of cross sections.

At the Joint National Dam Safety Review Board and ICODS Virtual Quarterly Meeting on April 10, 2013, the FEMA-funded research on inflow design and hydrologic safety and the impacts of the research on Federal agencies was discussed. One conclusion was that the NWS hydrometeorological reports and the terms "probable maximum precipitation" and "climate change" continue to be misunderstood. NWS plans to work with FEMA to address the lack of understanding as follows:

- NWS will coordinate with the Advisory Committee on Water Information Subcommittee on Hydrology (<http://acwi.gov/hydrology/index.html>) and its FEMA representative to (1) brief member agencies on the FEMA-funded research on inflow design and hydrologic safety at an upcoming quarterly meeting, (2) discuss the recommendations from the research, and (3) explore ways to improve the connection between ACWI-SOH and FEMA.
- NWS will work with FEMA to discuss NOAA's hydrometeorological studies and precipitation frequency analyses (<http://www.nws.noaa.gov/oh/hdsc/index.html>) at a future National Technical Information Seminar, which will be sponsored by FEMA's National Dam Safety Program, to help practitioners understand the differences between the hydrometeorological studies and precipitation frequency analyses and the future needs of the dam safety community.

# U.S. Geological Survey Activities

## Streamflow Information

Information on the flow in rivers and streams is a vital national asset that safeguards life and property and helps ensure adequate water resources for a healthy economy. The USGS operates and maintains the largest streamgauge network in the world, with approximately 8,000 active streamgages in 2012. Historical streamflow information is also available at approximately 20,000 locations where streamflow monitoring has been discontinued. Nearly all of the existing streamgages have real time telemetry that records and transmits streamflow information electronically so that information is available on the Internet in real time (data are typically recorded at 15- to 60-minute intervals and transmitted hourly). USGS streamflow information is used for dam safety and risk assessments, including (1) real-time operation and management of water flowing in and out of reservoirs, (2) reservoir designs and operations based on long-term conditions, (3) flood forecasting, such as by the NWS, and (4) floodplain delineation, such as by FEMA.

USGS streamflow applications and mapping are equally important in dam safety and risk assessment. For example, the USGS StreamStats online program estimates and maps streamflow, including estimated flood flows and watershed characteristics for gaged and ungaged streams. StreamStats (<http://water.usgs.gov/osw/streamstats/>) is currently available for 27 states. USGS manages the WaterWatch web page (<http://waterwatch.usgs.gov>) that provides real-time information for the entire Nation relative to conditions over a 30-year history. A separate map highlights streamgauge locations that are currently approaching or are above flood stage. Most recently, the USGS developed the WaterAlert (<http://maps.waterdata.usgs.gov/mapper/wateralert/>) service, which provides real-time notices through email and text messages of water flows and other parameters that exceed user pre-specified threshold conditions, and WaterNow, which provides immediate current real-time information in response to user emails and text messages.

The USGS streamgauge network is funded through partnerships with more than 850 Federal, State, regional, local, and tribal agencies. The primary USGS streamgauge funding programs are the Cooperative Water Program and the National Streamflow Information Program. Fortunately, many State and local partner agencies value the data and often step in to preserve funding for many of the threatened gages.

## Dam Removal

Dam removal has been increasing in recent years. Unfortunately, information is lacking on river and ecological responses to abrupt changes in flow regime and sediment following dam removal. USGS is helping to fill in the gaps in areas such as the Pacific Northwest where the Elwha Dam and Glines Canyon Dam on the Elwha River have been removed. USGS is monitoring sediment transport downstream of dams and surveying river cross sections at select locations. USGS is also monitoring associated estuarine environments and fish populations to assess effects from

dam removal. Such studies help to fully understand flooding hazards and minimize river ecosystem disruptions caused by dam removal that could also be expected to occur in a dam failure.

## Climate Change

Anticipation of adequate water supplies and runoff to reservoirs is increasingly difficult because of climate variability and changes to winter precipitation and snow packs. In the future with a warming climate, the past may not be a good predictor of the future. For example, USGS studies on climate change and how it will affect runoff in Pacific Northwest rivers and other northern areas show a scenario of increased runoff in the winter and smaller snow packs in the spring. Management of dams on our reservoirs will require a new approach to the timing of storage and releases to safely manage the system for flooding and water supply.

## Flood Inundation Mapping

Adequate information about the construction of dams or potential downstream hazards in the event of a dam breach is not available for many reservoirs across the Nation, such as in the Black Hills National Forest in western South Dakota and northeastern Wyoming. In 2009, the FS identified the need for reconnaissance-level dam-breach assessments for four reservoirs in the Black Hills National Forest with the potential to flood downstream structures. Flood hydrology and dam-breach hydraulic analyses for selected reservoirs were conducted by USGS in cooperation with the FS to estimate the areal extent of downstream inundation. Three high-flow breach scenarios were considered for cases when the dam is in place (overtopped) and when a dam break (failure) occurs: the 100-year recurrence 24-hour precipitation, 500-year recurrence peak flow, and the probable maximum precipitation. Inundation maps were developed to show the estimated extent of downstream floodwater from simulated scenarios. Simulation results were used to determine the hazard classification of a dam break, based primarily on the potential for loss of life or property damage resulting from downstream inundation because of the flood surge. The resulting flood-inundation maps provide valuable information to city officials, emergency managers, and local residents for planning the emergency response in a dam breach.

## Paleofloods

A recent paleoflood study in South Dakota and Oregon documenting the frequency and magnitude of rare floods has applicability for dam safety. Such studies provide information on prehistoric floods and can give an indication of possible major flooding to assess dam safety and risks. USGS is working with the NRC to assess the potential for use of paleofloods at nuclear facilities where risk-based design requires protection against very rare floods.

## Flood-Frequency Analysis

USGS is working with partners to update Federal flood-frequency analysis guidelines (Bulletin 17-B) (USGS, 2002). The new methods feature improved techniques for flood-record extension to include historic (pregaged) and paleoflood data. The USGS PeakFQ software used by many agencies to conduct flood-frequency analysis is also being updated to incorporate the new methods.

## Earthquake Monitoring

The following dam safety-related projects are supported by the USGS Earthquake Hazards Program (EHP) or implemented by EHP-funded science centers on behalf of other agencies:

- USGS operates 70 seismic stations on dams in 9 states.
- USGS is working with Bonneville Power and DOE on the earthquake safety of dams near Hanford, Washington.
- The Division of Safety of Dams of the California Department of Water Resources uses USGS ShakeCast for prioritizing inspections following significant earthquakes.
- The USACE is developing a strategy for USGS ShakeCast implementation.
- There are several other users (mostly utilities) that also monitor dams using ShakeCast.
- USGS has dam-specific earthquake monitoring projects with water agencies in California.
- In the Sacramento–San Joaquin River Delta area, USGS operates a seismic array to monitor earthquakes in the vicinity of the levee system.
- USGS is working with Los Angeles Department of Water and Power to monitor water pipeline crossings of the San Andreas fault for ground displacement.

## VII. References

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## Appendix A: NDSP Management Chronology

The National Dam Safety Review Board and the Interagency Committee on Dam Safety meetings during Fiscal Years 2012 and 2013 are listed below.

<b>Meeting</b>	<b>Date</b>
ICODS	October 18, 2011
Board	October 18–19, 2011
ICODS	January 10, 2012
Board	January 10–11, 2012
ICODS	April 10, 2012
Board	April 10–11, 2012
Senior Leader	July 10, 2012
Board	July 10–11, 2012
ICODS	July 11, 2012
Board	October 10–11, 2012
ICODS	October 11, 2012
ICODS	January 9, 2013
Board	January 9–10, 2013
Joint Board and ICODES	April 10, 2013
Senior Leader	July 10, 2013
Board	July 10–11, 2013
ICODS	July 11, 2013
Board Work Group	Quarterly
Board and ICODES Task Group	As required

Board = National Dam Safety Review Board

ICODS = Interagency Committee on Dam Safety



## **Appendix B: Partners and Stakeholders**

There are many national and international organizations with interests in dam safety. A number of non-governmental organizations, companies, universities, and individuals are active partners in the National Dam Safety Program. Engineering consulting firms design, oversee construction and rehabilitation, and at times inspect dams for owners or regulators. Those in academia conduct research and teach the next generation of dam safety engineers. Some of these organizations are:

- American Consulting Engineers Council
- American Public Works Association
- American Rivers
- American Society of Civil Engineers
- Associated General Contractors of America, Inc.
- Association of State Dam Safety Officials
- Association of State Floodplain Managers
- Centre of Energy Advancements through Technological Innovation
- Earthquake Engineering Research Institute
- Electric Power Research Institute
- International Association of Emergency Managers
- National Association of Counties
- National Association of Flood & Stormwater Management Agencies
- National Conference of State Legislatures
- National Emergency Management Association
- National Hazards Center
- National Hydropower Association
- National Society of Professional Engineers
- National Watershed Coalition
- Portland Cement Association
- United States Society on Dams

## Appendix C: Acronyms and Abbreviations

2013 NID	USACE, <i>National Inventory of Dams, 2013 State Dam Safety Program Performance Information Summary for the 2012 Reporting Year</i>
ACWI	NWS Advisory Committee on Water Information
A/E	architectural and engineering
ARS	Agricultural Research Service
ASCE	American Society of Civil Engineers
ASDSO	Association of State Dam Safety Officials
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BW-12	Biggert-Waters Flood Insurance Reform Act of 2012
CEATI	Centre of Energy Advancements through Technical Innovation
CFR	Code of Federal Regulations
CIPAC	Critical Infrastructure Partnership Advisory Council
CRS	Community Rating System
D2S1	FERC Division of Dam Safety and Inspections
DHS	Department of Homeland Security
DoD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DSAT	Dam Sector Analysis Tool
DSG	TVA Dam Safety Governance Organization
DSO	Dam Safety Officer
DSPMT	Dam Safety Program Management Tools
DSS-WISE	Decision Support System for Water Infrastructural Security
EAP	Emergency Action Plan
EHP	USGS Earthquake Hazards Program
EMI	Emergency Management Institute
EWS	Early Warning System
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIMA	Federal Insurance and Mitigation Administration
FMA	FEMA Flood Mitigation Assistance Program
FRR	Facility Reliability Rating
FS	U.S. Forest Service

FSA	Farm Services Agency
FSM	Forest Service Manual
FTE	full-time equivalent
FWS	U.S. Fish and Wildlife Service
FY	Fiscal Year
GIS	Geographic Information System
<i>Guidelines</i>	<i>Federal Guidelines for Dam Safety</i>
Hazus	Hazards U.S. Multi-Hazard
HMA	Hazard Mitigation Assistance (FEMA)
HMGP	Hazard Mitigation Grant Program FEMA)
HQ	Headquarters
HSD	Hydrologic Services Division (NWS)
IBWC	International Boundary and Water Commission
ICODS	Interagency Committee on Dam Safety
IP	Office of Infrastructure Protection
MMC	Modeling, Mapping and Consequences Production Center (Corps)
MOU	Memorandum of Understanding
MSHA	Mine Safety and Health Administration
NDSP	National Dam Safety Program
NFIP	National Flood Insurance Program
NID	National Inventory of Dams
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NWS	National Weather Service
O&M	operation and maintenance
OHD	Office of Hydrologic Development (NWS)
OIG	Office of the Inspector General
OSMRE	Office of Surface Mining Reclamation and Enforcement
PDM	Pre-Disaster Mitigation (FEMA)
PPD	Presidential Policy Directive
Program	National Dam Safety Program
PSCD	Protective Security Coordination Division
R&D	research and development
RCC	roller-compacted concrete
Reclamation	Bureau of Reclamation

RHS	Rural Housing Service
Risk MAP	Risk Mapping, Assessment, Planning
RUS	Rural Utilities Service
SEED	Safety Evaluation of Existing Dams
SOH	Subcommittee on Hydrology (NWS ACWI)
Strategic Plan	<i>Strategic Plan for the National Dam Safety Program Fiscal Years 2012 through 2016</i>
SSA	Sector-Specific Agency
SWCD	Soil and Water Conservation District
TADS	Training Aids for Dam Safety
TVA	Tennessee Valley Authority
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
USIBWC	U.S. Section, IBWC