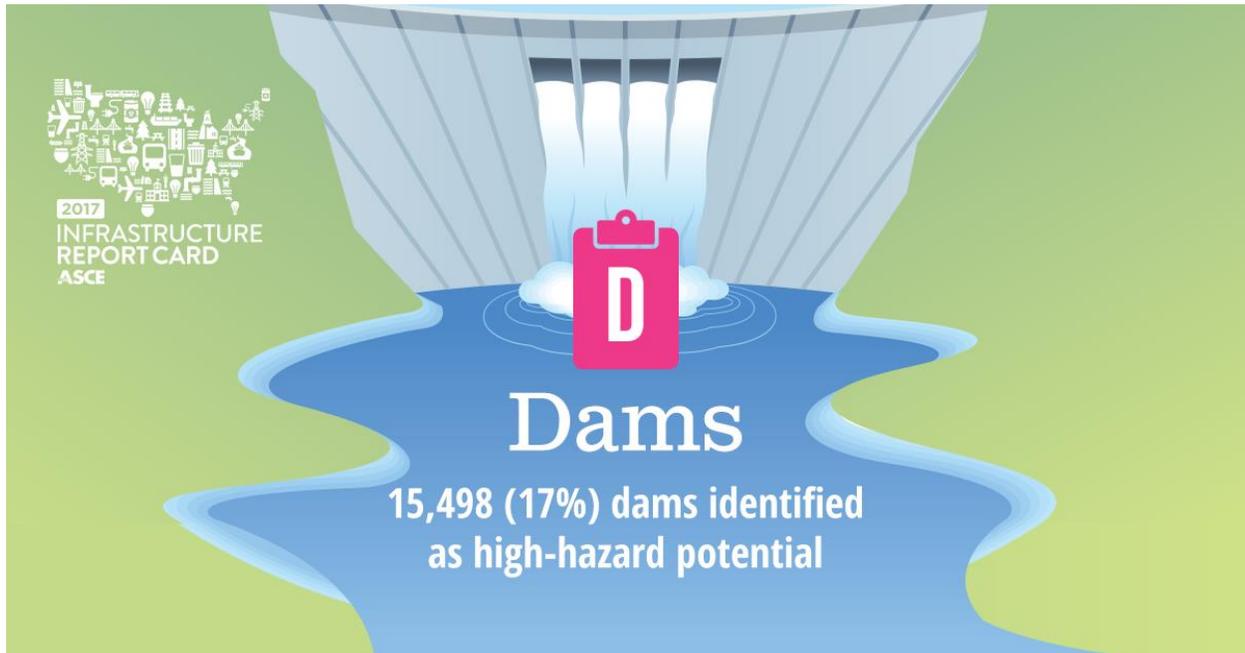




## 2017 INFRASTRUCTURE REPORT CARD



### SUMMARY

Dams provide vital service and protection to our communities and economy. The average age of the 90,580 dams in the country is 56 years. As our population grows and development continues, the overall number of high-hazard potential dams is increasing, with the number climbing to nearly 15,500 in 2016. Due to the lack of investment, the number of deficient high-hazard potential dams has also climbed to an estimated 2,170 or more. It is estimated that it will require an investment of nearly \$45 billion to repair aging, yet critical, high-hazard potential dams.

### CONDITIONS & CAPACITY

Dams come in a variety of sizes and serve a number of purposes. Our nation's dams provide essential benefits such as drinking water, irrigation, hydropower, flood control, and recreation. The public most commonly thinks of engineering marvels like the Hoover Dam in Nevada rather than the smaller structure that created the lake at the center of a planned community. No matter how large or small, dams have a powerful presence that frequently is overlooked until failure has occurred.

The safe operation and proper maintenance of dams is critical to sustaining the benefits, while mitigating the risk of a dam failure. Yet despite their importance, thousands of dams remain in need of rehabilitation to meet current design and safety standards. These structures are not only aging, but are subject to stricter criteria because of increased downstream development and advancing scientific knowledge predicting flooding, earthquakes, and dam failures.

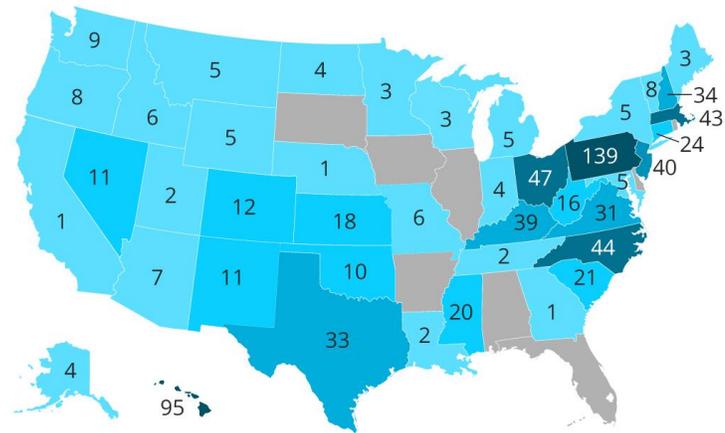
Dams are classified based on their hazard potential, or anticipated consequences in the case of failure. The failure of a dam that is classified as high-hazard potential is anticipated to cause a loss of life. The



## 2017 INFRASTRUCTURE REPORT CARD

number of high-hazard potential dams is growing rapidly; as of 2015, there are approximately 15,500 dams in the United States that are classified as high-hazard potential. This number has climbed from 10,213 high-hazard potential dams in 2005 and is anticipated to continue to climb as areas below dams continue to be developed. With population growth expected to slow, the U.S. has an opportunity to more methodically develop currently unpopulated areas to avoid placing homes and other structures below dams, thereby reducing the number of structures classified as “high-hazard potential.” Another 11,882 dams are currently labeled as significant hazard potential, meaning a failure would not necessarily cause a loss of life, but could result in significant economic losses. While these figures climb, the increase has slowed because more dams are inspected on a more regular basis, allowing for the identification of deficiencies before they lead to a failure.

Dams that May Qualify for National Rehabilitation Funds



The average age of our nation’s dams is 56 years. By 2025, seven out of 10 dams in the United States will be over 50 years old. Fifty years ago dams were built with the best engineering and construction standards of the time. However, as the scientific and engineering data have improved, many dams are not expected to safely withstand current predictions regarding large floods and earthquakes. In addition, many of these dams were initially constructed using less-stringent design criteria for low-hazard potential dams due to the lack of development.

### FUNDING & FUTURE NEED

Investment is needed to rehabilitate deficient dams and to improve the efficacy of policies and regulatory programs that oversee dam safety programs. Upgrade or rehabilitation is necessary due to deterioration, changing technical standards, and improved techniques, as well as better understanding of the area's precipitation conditions, increases in downstream populations, and changing land use. When a dam's hazard classification is changed to reflect an increased hazard potential, the dam may need to be upgraded to meet an increased need for safety. Many dam owners, especially private dam owners, find it difficult to finance rehabilitation projects.

The Association of State Dam Safety Officials estimates that the combined total cost to rehabilitate the nation’s non-federal and federal dams exceeds \$64 billion. To rehabilitate just those dams categorized as most critical, or high-hazard, would cost the nation nearly \$22 billion, a cost that continues to rise as maintenance, repair, and rehabilitation are delayed.

The U.S. Army Corps of Engineers estimates that more than \$25 billion will be required to address dam deficiencies for Corps-owned dams. At current investment rates, these repairs would take over 50 years



## 2017 INFRASTRUCTURE REPORT CARD

to complete. The Bureau of Reclamation has identified approximately 20 of its high- and significant-hazard potential dams as in need of repair or upgrade. The cost of those actions is estimated at \$2 billion over the next 15 years.

The Water Infrastructure Improvements for the Nation (WIIN) Act signed into law in 2016 authorized a national dam rehabilitation and repair program, which would help fund the repair, removal, or rehabilitation of the nation's non-federal, high-hazard potential dams. When fully appropriated the provision has the potential to help to repair some of the highest priority dam safety rehabilitation projects in the country. Until this program is funded a lack of financial resources will continue to be a reason dam owners are unable to implement needed repairs and upgrades.

Nearly half of all states have a grant or low-interest revolving loan program to assist dam owners with repairs. This local commitment of funds can help to make the potential federal grants go even further. Overall, state dam safety program staffing has increased over the past several years. In 2015 state programs spent over \$49 million<sup>1</sup> on their regulatory programs, a 10% increase from just four years ago. The federal National Dam Safety Program was reauthorized by the Water Resources Reform and Development Act (WRRDA) in 2014 but has not seen a full appropriation at authorized levels.

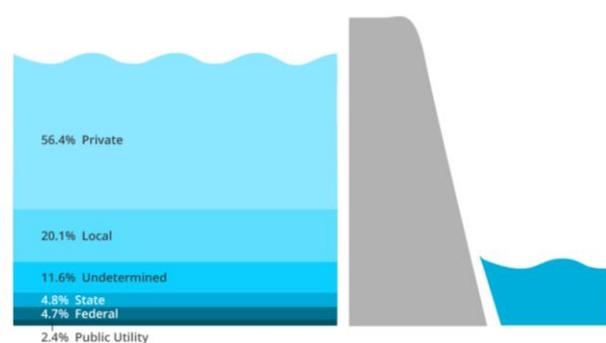
### PUBLIC SAFETY & RESILIENCE

In order to improve public safety and resilience, the risk and consequences of dam failure must be lowered. Progress requires better planning for mitigating the effects of failures; increased regulatory oversight of the safety of dams; improving coordination and communication across governing agencies; and the development of tools, training, and technology.

Dam failures not only risk public safety, they also can cost our economy millions of dollars in damages. Failure is not just limited to damage to the dam itself. It can result in the impairment of many other infrastructure systems, such as roads, bridges, and water systems. When a dam fails, resources must be devoted to the prevention and treatment of public health risks as well as the resulting structural consequences. For this reason, emergency action plans (EAPs) for use in the event of an impending dam failure or other uncontrolled release of water are vital. The number of high-hazard potential dams with an EAP has increased in recent years; as of 2015 77% of dams have EAPs – up from 66% in the 2013 Report Card and marked progress toward the national goal of 100%.

Our nation's dams are owned and operated by many different entities including all levels of government. However more than half are owned by a private entity. The federal government owns 3,381 dams, or approximately 4% of the nation's

Dams Ownership in the United States





## 2017 INFRASTRUCTURE REPORT CARD

dams. The U.S. Army Corps of Engineers owns only 709 dams, more than half of which are 50 years old. With the majority of dams privately held, these structures likely rely on state dam safety programs for inspection. State dam safety programs have primary responsibility and permitting, inspection, and enforcement authority for more than three-quarters of the nation's dams. Therefore, state dam safety programs bear a large responsibility for public safety, but unfortunately, many lack sufficient resources, and in some cases, enough regulatory authority, to be effective. The national number of dams per state safety program employee totals 205. For perspective, some of the top state dam safety programs such as California, Colorado, New Jersey, and Pennsylvania have less than 135 dams per staff member (the California Division of Safety of Dams, a robust state dam safety program with regulatory oversight over many of the nation's most consequential dams, has only 20 dams per staff member). Despite continued efforts by public safety and engineering advocacy groups, Alabama continues to remain the only state without a dam safety regulatory program.

EAPs play the biggest role in keeping people and property safe in the event of a dam breach or failure. As of 2013, just five states had 100% of high-hazard potential dams with EAPs. Several states are making notable progress on increasing the percentage of dams with EAPs, including Hawaii, which went from having 2 dams with EAPs in 1999 to 120 in 2015.

Innovative approaches in risk management have the potential for seeing the costs of rehabilitation go down. The dam safety engineering practice is moving towards a risk-based decision-making process for the design, rehabilitation, and operation of dams. Risk-based decisions enable the dam owner to better utilize limited funding and prioritize projects by focusing on repairs and operational changes that reduce risk to acceptable levels, thus improving community resilience. Engineers, dam owners, regulators, and emergency management professionals should be engaging communities potentially affected by a dam failure in order to provide a fair portrayal of risk. Through broader community collaboration, stakeholders will be better able to support land use decisions, emergency action planning, and maintenance and rehabilitation funding, which will reduce community risk in the long term.

a

### RAISING THE GRADES—SOLUTIONS THAT WORK NOW

- Fund the national dam rehabilitation and repair funding program to cost-share repairs to non-federal, high-hazard potential dams.
- Develop emergency action plans for every high-hazard potential dam by 2021.
- Implement a national public awareness campaign to educate individuals on the location and condition of dams in their area and become more “dam aware.”
- Implement better public education about high-hazard potential dams, specifically ensuring the public has a better understanding of the dam rating system and how we determine condition.
- Encourage incentives to governors and state legislatures to provide sufficient resources and regulatory authorities to their dam safety programs.
- Require federal agencies that own, operate, or regulate dams to meet the standards of Federal Guidelines for Dam Safety.
- Encourage improved land use planning at the local level so that communication about how dams affect local areas is more accurately known and considered in future planning.



## DEFINITIONS

**Emergency Action Plan** - A formal document that identifies potential emergency conditions at a dam and specifies preplanned actions to be followed to minimize property damage and loss of life should those conditions occur. The EAP contains procedures and information to assist the dam owner in issuing early warning and notification messages to responsible downstream emergency management authorities. It also should include inundation maps to show the emergency management authorities the critical areas for action in case of an emergency.

**Dam Owner** – Party or parties responsible for the safety and liability of the dam and for financing its upkeep, upgrade, and repair.

**Dam Regulator** – Party or parties responsible for dam safety enforcement including the safety evaluations of existing dams, review of plans and specifications for dam construction and major repair work, periodic inspections of construction work on new and existing dams, and review and approval of emergency action plans.

**High-Hazard Potential Dam** – A dam in which failure or mis-operation is expected to result in loss of life and may also cause significant economic losses, including damages to downstream property or critical infrastructure, environmental damage, or disruption of lifeline facilities.

**Significant-Hazard Potential Dam** – A dam in which the failure or mis-operation is not expected to cause loss of life, but results in significant economic losses, including damages to downstream property, critical infrastructure, environmental damage, or disruption of lifeline facilities.

**Low-Hazard Potential Dam** – A dam located in a rural or agricultural area where failure would not only cause the loss of the dam itself but may cause minor damage to nonresidential and normally unoccupied buildings, or rural or agricultural land.

## SOURCES

Association of State Dam Safety Officials, [2015 Statistics on State Dam Safety Regulation](#), August 2016

Federal Emergency Management Agency, [National Dam Safety Program Fact Sheet](#)

Federal Emergency Management Agency, [The National Dam Safety Program Biennial Report to U.S. Congress, Fiscal Years 2014-2015](#), August 2016

U.S. Army Corps of Engineers, [National Inventory of Dams](#)