



## DAMS



THE WEHR DAM IN SOUTH WHITEHALL TOWNSHIP IN PENNSYLVANIA  
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# DAMS

## EXECUTIVE SUMMARY

There are 3,380 state-regulated dams in Pennsylvania that provide for the drinking water, irrigation, flood control, hydropower, recreation and industrial water needs of the state. While dams provide many needed services, if they are not properly invested in and maintained, they can pose a risk to life and property within the state. This is particularly true of high hazard potential dams; should these fail, there is probable loss of human life and substantial property damage. There are 803 high hazard potential dams in Pennsylvania, 743 of which are state-regulated. Of the state-regulated high hazard dams, 44% are considered deficient, a reduction from 67% in 2014. While this is encouraging, approximately 33% of the deficient dams are still considered unsafe, meaning they do not meet current Pennsylvania Department of Environmental Protection standards. Estimates show \$1.1 billion is needed to repair deficient and unsafe dams in Pennsylvania.

## BACKGROUND

Historic dam failures in Pennsylvania spurred the state to become a national leader in dam safety. In 1889, more than 2,200 lives were lost when the South Fork Dam near Johnstown failed, and in 1977 heavy rainfall near Johnstown caused six local dams to fail, claiming 41 additional lives. Pennsylvania became the first state to pass dam safety legislation following the 1911 failure of the Austin Dam in Potter County. Pennsylvania's tragic history of dam failures should continue to motivate investment in the aging infrastructure that dots the state. Although 57% of the dams in Pennsylvania are privately owned, both public and private dam owners lack the funding needed to repair and maintain their dams. As populations increase and development expands in both urban and rural areas, dams pose a growing safety hazard to Pennsylvanians living throughout the state through deteriorating infrastructure and construction downstream of dams that were not built to current design standards.

## CONDITION & CAPACITY

Dams are inventoried and their condition is tracked in the National Inventory of Dams (NID). The NID only includes all high and significant hazard potential classification dams, as well as low hazard potential dams that meet specific height and reservoir storage requirements. Some of the smaller, low hazard potential dams that are managed by the Pennsylvania Department of Environmental Protection (PADEP) Division of Dam Safety are excluded from the NID.

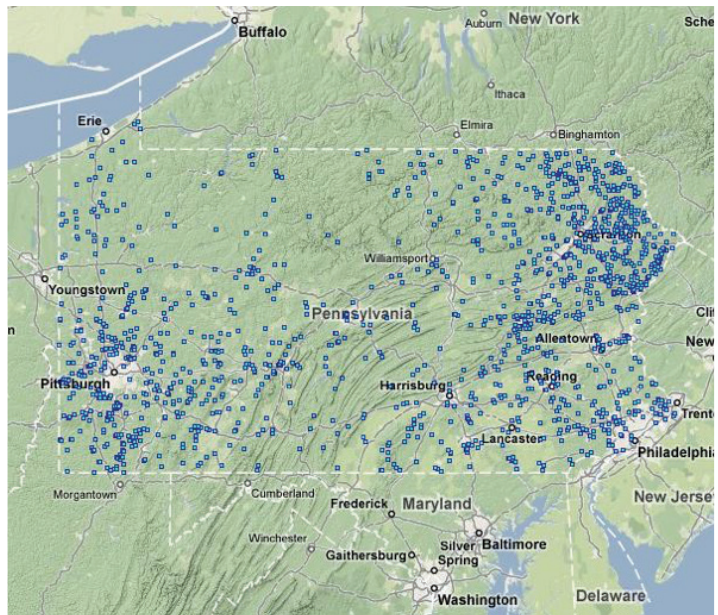
Dam hazard ratings refer strictly to the potential for downstream impacts and do not reflect the condition of the dam. High hazard potential dams are those whose failure would cause probable loss of human life and substantial property damage. Significant hazard potential dams are those whose failure would result in no probable loss of human life but would likely cause economic loss. The current NID, published in 2016, lists 1,525 dams in Pennsylvania. As of 2016, over 1.6% of the dams in the United States were located in Pennsylvania, but over 5% of the high hazard potential dams were in the state.

There are 3,380 state-regulated dams located in Pennsylvania, including 743 high hazard potential dams (22%); 289 significant hazard potential dams (9%); and 2,348 low hazard potential dams (69%).

Deficient dams are estimated using the NID rating methodology whereby all dams not meeting the 'Satisfactory' or 'Fair - General Lack of Maintenance' ratings are considered deficient. Of these deficient dams, a portion have deficiencies that, if not corrected, could result in the partial or complete failure of the dam or any associated structure or facility with subsequent loss of life or substantial property damage. Of the 743 high hazard potential state-regulated dams in Pennsylvania, 329 (44%) are considered "deficient", which is an improvement over the 67% of high hazard potential dams reported "deficient" in 2014. Currently, one third (103 of 329) of the deficient dams are still considered unsafe. Unsafe dams do not meet PADEP's current standards, such as inadequate stability and spillway capacity to safely pass high flood events and active deficiencies (seepage, movement or cracking) which require active monitoring or repairs in order to maintain the stability of the structure.

Pennsylvania is continually adding new dams to its database and reclassifying others as downstream conditions and development change. New dams are added to account for recently constructed dams, as well as older dams that were not previously included in the state's database. Figure 1 illustrates the location of Pennsylvania dams included in the NID.

FIGURE 1. NID STATE MAP OF DAMS IN PENNSYLVANIA



Source: [www.nid.usace.army.mil](http://www.nid.usace.army.mil)

The average design life of a dam is generally considered to be 50 years, at which point the structure is anticipated to require significant maintenance or upgrades. Based on the NID database, 858 (approximately 56%) of the dams in Pennsylvania are at least 50 years old, meaning substantial continued maintenance can be expected. One alternative to continued maintenance is dam removal, which occurred at 51 dams in Pennsylvania from 2014 through 2017, including 11 high hazard dams. Pennsylvania is a leader in dam removals, due in part to the streamlined permitting process created by PADEP. In cases of dam removal, the dam is often obsolete, and although there would be capacity to rebuild a dam at that location, the economics and environmental benefits of dam removal outweigh the need for replacement of the dam.

In the past four years, two events have occurred in the U.S. that have driven increased review and evaluation of dam safety. The first was the October 2015 record rainfall (estimated at a 1,000-year flood event) in South Carolina that caused at least 51 dams to breach or fail (SCDHEC, 2018). This event brought increased awareness of the need for dam safety and emergency preparedness in advance of an extreme event. The second event that caused increased interest in dam safety was the 2017 near-complete-failure of the Oroville Spillway in California. This event caused the evacuation of over 100,000 people and brought about the recognition of the need for adequate inspections and early action to prevent future failures. Although these events occurred in other states, they are good reminders of why Pennsylvania needs a robust maintenance and inspection program that incorporates the best engineering and science practices into protecting the state's residents.

## FUNDING & FUTURE NEED

Repair costs can vary significantly based upon many factors. The PADEP Division of Dam Safety estimates average repair costs can often range from \$75,000 to \$4 million per dam, generally increasing with increased hazard potential. The total cost for upgrading Pennsylvania's 1,091 deficient dams is estimated at \$1.1 billion.

There are several programs to help fund and finance dam projects in Pennsylvania. The Pennsylvania General Assembly passed Act 13 in 2012, overhauling the state's oil and gas laws. Act 13 established the Marcellus Legacy Fund which allocates funds for initiatives including statewide flood mitigation projects. Individual projects can receive up to \$500,000. Additionally, the Pennsylvania Infrastructure Investment Authority (PENNVEST) provides low-interest loans for water projects throughout the state, including dam projects. The H2O PA Act, passed in 2008, provided funding to assist with infrastructure for drinking water projects. To date, 24 major dams received funding through the H2O PA Act; however, the program closed in 2018, and future funding will be limited, if it exists at all. Finally, in 2013 the PADEP's safety fee package was increased, generating new funding to cover approximately one third of the Division of Dam Safety Program operational costs.

More recently, House Bill 431 (formerly House Bill 1712) was incorporated into the fiscal code as part of the budget passed by the state in June 2018. This bill will establish the Private Dam Financial Assurance Program (Program) and the Private Dam Financial Assurance Fund (Fund). The Program will provide a revolving loan for private dam owners to meet their requirements under the 1978 Dam Safety and Encroachments Act, which requires proof of financial responsibility by dam owners. Additionally, the bill will establish a Fund in the state treasury, where money and accrued interest will be available for the PADEP's use should it need to remove, repair, or otherwise take corrective measures in the event a dam owner fails to comply with regulatory requirements.

In Washington, the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016 authorized the High Hazard Potential Dam Rehabilitation Program to provide federal grant assistance for the rehabilitation, repair, or removal of non-federal high hazard potential dams. This program stands to benefit Pennsylvania dams by allowing communities to make preemptive investments into aging infrastructure, and in the process, make the downstream communities safer. Unfortunately, this program has yet to receive any funding through the appropriations process; therefore, most dam repair funding is currently provided by the dam owner or state funds; or in the case of dam removal, combined state and non-governmental organization (NGO) funding.

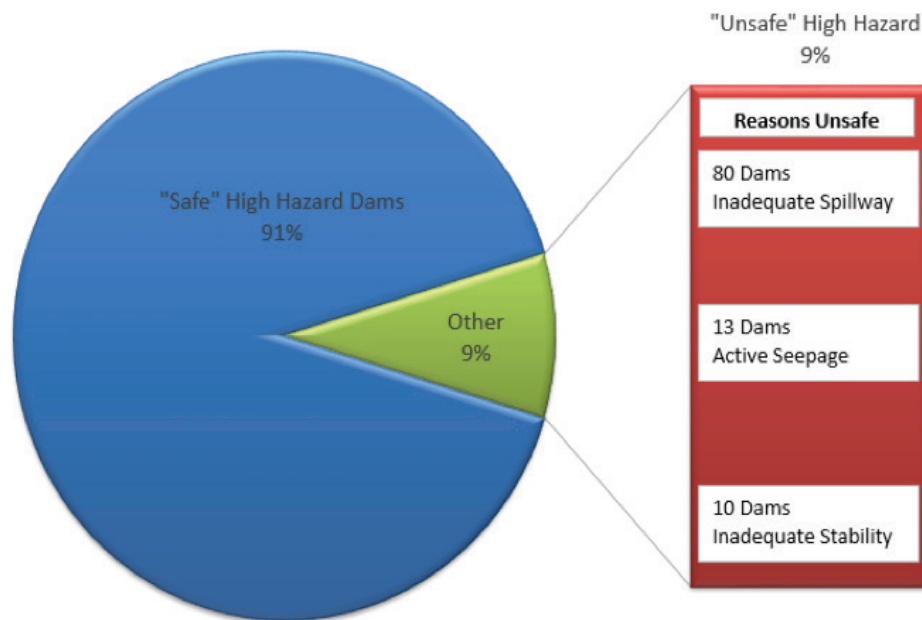
## PUBLIC SAFETY & RESILIENCE

Each of the dams within Pennsylvania are classified based on the potential risk to the public and loss to the state's economy. Each dam is assigned a category based on size (dam height and storage capacity) and hazard potential (life and economic loss). The purpose of classification is to determine the design and operation requirements for each dam based on consequences that may occur in the event of an operational or structural failure.

PADEP has an extensive inspection program for both public and private dams. The purpose of the inspections is to verify the condition and proper maintenance/operation of the dam. Based on the inspection observations, the PADEP determines if the dam is "safe" for continued operation. The goal is to discover and remediate any deterioration/issues before a potential failure. Early remediation potentially lowers the repair cost and risk to the public.

A list of "unsafe" high and significant hazard dams that do not meet their design requirements is maintained by PADEP. As illustrated in Figure 2, currently 9% (or 73 dams) of Pennsylvania's 809 high hazard dams (includes 66 non-state-regulated and the 743 state regulated high-hazard dams) are considered "unsafe." Based on the Pennsylvania State Code, an "unsafe" dam is defined as: "A dam with deficiencies of such a nature that if not corrected could result in the failure of the dam with subsequent loss of lives or subsequent property damage." The main reasons dams in Pennsylvania are considered "unsafe" include: inadequate spillway capacity to safely pass the design flood, inadequate stability under the recommended loading conditions, and active seepage through the dam. Until these "unsafe" dams are repaired, they pose an increased risk to public safety and economic loss. There is overlap between the "deficient" and "unsafe" dam rankings, with "unsafe" dams generally being a subset within the "deficient" ranked dams.

**FIGURE 2. CURRENT CONDITION OF PENNSYLVANIA HIGH HAZARD DAMS**



PADEP commissioned a state-specific study, currently underway, on the Probable Maximum Precipitation (PMP) to more accurately predict storm inflows for dams. When completed, the study will replace outdated federal guidelines with Pennsylvania-specific data that is expected to provide improved estimations of runoff amounts that will aid in accurately determining and designing for spillway overflow capacity.

PADEP requires dam owners to develop and maintain an Emergency Action Plan (EAP) for significant and high hazard dams. To date, PADEP has an EAP for over 50% of these dams in Pennsylvania; however 95% of the high-hazard dams have an EAP in place. These EAPs alert emergency personnel and the public of emergencies that may lead to failure of the dam and outline appropriate responses. Pennsylvania began electronic filing of EAPs in 2014. The electronic formatting of EAPs provides better access to this critical document during an emergency. Pennsylvania expects to have all EAPs filed electronically by 2023.



## RECOMMENDATIONS TO RAISE THE GRADE

- Perform incremental dam break analyses for “unsafe” dams to limit the potential of catastrophic cascading failures. In 2011, PADEP updated their regulations to require high hazard dams to consider incremental dam break analysis. This type of analysis accounts for the effects of the flows from an upstream dam failure on downstream dams.
- Develop EAPs for all high and significant hazard dams to increase public safety and acknowledgement of the potential risk.
- Evaluate unsafe and deficient dams using the updated PMP guidelines, once they are available.
- Continue appropriations of public funding to assist financially burdened, high-hazard and significant-hazard dam owners with rehabilitation and maintenance projects that benefit public safety.

## SOURCES

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