

Dam Failure

General

A dam is defined as an artificial barrier with the ability to impound water, wastewater, or any liquid-borne material, for the purpose of storage or control of water. A dam failure is a catastrophic type of failure, characterized by the sudden, rapid, and uncontrolled release of impounded water or the likelihood of such an uncontrolled release. It is recognized that there are lesser degrees of failure and that any malfunction or abnormality outside the design assumptions and parameters that adversely affects a dam's primary function of impounding water is properly considered a failure. These lesser degrees of failure can progressively lead to or heighten the risk of a catastrophic failure. Dam failures are usually a secondary effect of massive rainfall and flooding, and occur when too much water enters the spillway system. This will occur with little or no warning. Spring thaws, severe thunderstorms, and heavy rainfall are also contributory factors. Additionally, poor engineering or poor maintenance may also cause dam failures. According to the Federal Emergency Management Agency, dam failure can be attributed to one or more of the following reasons:

- overtopping caused by floods that exceed the capacity of the dam;
- deliberate acts of sabotage;
- structural failure of materials used in dam construction;
- movement and/or failure of the foundation supporting the dam;
- settlement and cracking of concrete or embankment dams;
- piping and internal erosion of soil in embankment dams; and
- inadequate maintenance and upkeep.

The Pennsylvania Department of Environmental Protection and the U.S. Army Corps of Engineers award permits for dams and share inspection responsibilities. Inspection results are characterized as either safe or unsafe. Dams are evaluated on categories, such as slope instability, excessive seepage, and inadequate spillways.

The National Inventory of Dams is a registry that captures information about structures that are greater than or equal to 25 feet in height or impounding 50-acre-feet or more of water (an acre-foot is equal to 325,851 gallons of water), and also includes structures above six feet in height, where failure would potentially cause damage downstream. The dams are classified in terms of hazard potential as "high," "significant," or "low," with high-hazard dams requiring Emergency Action Plans (EAP). There are seven dams in Perry County that are registered with the U.S. Army Corps of Engineers in the National Inventory of Dams. Of these, only one is a high-hazard dam, requiring an EAP – the little Buffalo Creek Dam. According to the National Inventory of Dams, three Perry County dams have a completed EAP.

**Table C.1
Perry County Dam Inventory**

| Dam Name | Principal Water Source | Owner Name | Year Completed | Drainage Area (sq. miles) | Hazard | EAP Completed |
|----------------------|-------------------------------|-----------------------------|-----------------------|----------------------------------|---------------|----------------------|
| Upper | Upper | PA Game Commission | 1919 | 6.5 | Low | NR |
| Little Buffalo Creek | Little Buffalo Creek | DCNR- Bureau of State Parks | 1970 | 13.4 | High | Y |
| Negly | TR Little Juniata Creek | Wilber R. Negley Jr. | 1973 | 0.4 | Low | NR |
| Lake Kimberly | TR Sherman Creek | Robert Klaus | 1970 | 0.18 | Low | NR |
| Lake Heron | TR Susquehanna River | Dean Stevens | 1970 | 0.4 | Significant | Y |
| Newport Plaza Dam | TR Juniata River | Caldwell Development Co. | n/a | 0.28 | Significant | N |
| Cold Storage Dam | TR Little Buffalo Creek | Daniel T. Paul | n/a | 0.96 | Significant | Y |

Source: National Inventory of Dams

History

The National Performance of Dams Program, which maintains a database of failures for all dams listed in the National Inventory of Dams, lists no occurrences of dam failure or major incidents occurring at any of the seven dams in Perry County. While dam failures are mostly minor and cause little damage, Pennsylvania has experienced severe dam failures. The National Performance of Dams Program lists 19 dam failures, included within 44 dam “incidents” in Pennsylvania since May 1889. The worst dam failure experienced in the Commonwealth was in Johnstown in 1889. The resulting flood claimed 2,209 lives and resulted in an estimated \$3.5 million in damage.

Vulnerability

There is always the possibility any dam could fail, however, the probability is low. According to the Pennsylvania Emergency Management Agency (PEMA), minor dam failures occur every year, but their impact is minimal. Usually, they are gradual, low-volume releases that are unexpected and do not cause loss of life or damage to the environment. Perry County has both high-hazard and low-hazard dams within the County.

Dams assigned the significant-hazard potential classification are those where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, or disruption of lifeline facilities, or can impact other concerns. Significant-hazard potential classification dams are often located in predominantly rural or agricultural areas, but could be located in areas with population and significant infrastructure. Dams assigned the high-hazard potential classification are those where failure or mis-operation will probably cause loss of human life.

Probability

The probability of a significant dam failure in Perry County is relatively low. Minor failures occur annually, but have little to no impact. Dam failures are most often a secondary effect of another hazard, such as severe weather, flooding, hurricanes, and tropical storms.

Maximum Threat

Perry County is home to seven dams recorded with the National Inventory of Dams. Only one of these dams is a high-hazard dam and has the required EAP. Three other significant-hazard dams are located in Perry County, two of which have an EAP completed. The greatest threat of a dam failure in Perry County would occur at one of these four dams. Perry County has dam evacuation plans for the dams in Perry County which require a plan by the Department of Environmental Protection (DEP). Perry County also has an Evacuation Plan for Lake Holeman at Little Buffalo State Park as well as several large ponds that meet DEP criteria as a dam. Dam evacuation plans for all dams in Perry County meeting DEP criteria are on file in the Perry County Office of Emergency Management. The status of these plans is coordinated between DEP and the owner of the dam.

Since no dams in Perry County are considered unsafe, vulnerability is limited. Although there have been no past dam failures and no problems presently exist, should the dam at Little Buffalo State Park become unsafe, a large population between the dam and the Juniata River in Newport would be highly vulnerable.

Secondary Effects

Flooding is the most common secondary effect of dam failure. If the dam failure is severe, a large amount of water will enter riverbeds and overflow the stream banks for miles. There may be significant environmental effects, as the resulting flood from a dam failure is likely to disperse debris and hazardous materials downstream that can damage local ecosystems. Debris carried downstream can block roads, cause traffic accidents, disrupt traffic patterns, and delay the delivery of essential services along major traffic corridors. Debris flow can also cause landslides along steep slopes and embankments. The economic and financial impact from damage and recovery can range from minimal to severe, depending on the magnitude of damage and scale of failure.