3.2 Risk Assessment: Flood

Description

Flooding is the partial or complete inundation of normally dry land. Types of flooding experienced in Idaho are numerous and include: riverine flooding, flash floods, alluvial fan flooding, ice/debris jam flooding, levee/dam/canal breaks, stormwater, sheet or areal flooding, and mudflows (especially after a wildfire). Flooding has produced the most damaging and costly disasters in Idaho, and significant events have occurred regularly throughout the history of the State. There is often no sharp distinction between the various types of flood events. Nevertheless, these types of floods are widely recognized and helpful in considering not only the range of flood risk but also appropriate responses.

Source: IOEM

Riverine Flooding

Overbank flooding of rivers and streams is the most common type of flood event. The floodplain is an area of land adjacent to a stream or river that often floods during periods of high water flows. A regulatory floodway may be established within a floodplain, where the channel of a river or other watercourse and the adjacent land areas are reserved in order to carry the deep and/or fast flowing water from a 1% flood event. Floodplains and floodways are designated in order to communicate flood risk to land owners in the area and to promote flood resistant development within the floodplain.

Channels are defined, ground features that carry water such as rivers, creeks, streams, or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas, causing a flood (FEMA 2007).

Riverine floodplains range from narrow, confined channels to wide, flat areas depending on topography. The volume of water in the floodplain, and the flow rate at which it moves through the floodplain, is a function of the size of the contributing watershed, topographic characteristics such as watershed shape and slope, and climatic and land-use characteristics. In steep, narrow valleys, flooding usually occurs quickly, is of short duration, and floodwaters are likely to be rapid and deep. In relatively flat floodplains, areas may remain inundated for days or even weeks, but floodwaters are typically slow moving and relatively shallow and may accumulate over long periods of time.

Flooding of large rivers often results from large-scale weather systems that generate prolonged rainfall over wide areas. These same weather systems may cause flooding in hundreds of smaller basins that drain to major rivers. Small rivers and streams are susceptible to flooding from intense rainfall in localized weather systems, annual spring floods from snowmelt, and rain-on-snow events. The extent of flooding depends on the depth of winter snowpack and spring weather patterns.

The National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) defines the flood stage for river forecast points in the State of Idaho. Flood stage is the river height or flow volume at which water begins to overflow banks and poses a definite hazard to life or property. Roads, infrastructure, and property near a river may be inundated when the river exceeds the flood stage. A flood stage is established by historical flood events, modeling, and input by local governments in coordination with the NWS, and is used to communicate short term flood potential resulting from current weather conditions. A flood stage supplements the risk communication provided by floodplain designation. The Base Flood Elevation is the elevation of a flood with a 1% annual chance of occurring, often referred to as the 100 year flood. A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. (https://www.fema.gov/floodway)

The term "500-year flood" is the flood that has a 0.2 percent chance of being equaled or exceeded each year. The 500-year flood could occur more than once in a relatively short period of time. Statistically, the 0.2 percent (500-year) flood has a 6-percent chance of occurring during a 30-year period of time, the length of many mortgages.

Flash Floods

Flash floods are, "a rapid and extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). However, the actual time threshold may vary in different parts of the country" (NWS 2009). Flash floods may also occur in draws or gulleys where there is no stream or creek. These are characterized by a rapid rise in water level, high velocity, and large amounts of debris. Major factors in flash flooding are the intensity and duration of rainfall and the steepness of watershed and stream gradients. The amount of watershed vegetation, the natural and artificial flood storage areas, and the configuration of the stream bed and floodplain are contributing features. Flash floods may result from the failure of a dam, rapid snowmelt, loss of vegetation due to wildfire, or the sudden breakup of an ice jam. Flash flooding in urban areas is an increasingly serious problem due to the removal of vegetation the replacement of ground cover with impermeable surfaces that increase runoff, and the construction of drainage systems that increase the speed of runoff. Flash floods can roll boulders, tear down trees, undermine infrastructure, and scour new channels. Rapidly rising water can reach heights of 30 feet or more. Flash flood-producing rains can also trigger mudslides (NWS 2017).

Alluvial Fan Floods

Alluvial fan flooding is most prevalent in the arid Western States. Alluvial fans are made of sediments that are deposited where a stream or river leaves a defined channel and enters a broader and flatter floodplain. Alluvial generally occur where a stream exits a higher gradient reach into a lower gradient, such as a mountain stream reaching a lower valley, or at the exit of a confined canyon. As the water slows with the changing gradient, it tends to first drop its coarse-grained sediments, and then its fine-grained sediment. As sediments are deposited, the flow path becomes unpredictable due to the random nature of the deposition. The result is a fan-shaped deposit of alluvium. Alluvial fans are especially dangerous and convey high flood risk. When the stream or river repeatedly deposits sediment onto its alluvial fan, the flow paths can become erratic and unpredictable between events, typically following and switching between poorly defined channels, or even acting as sheet flow across the fan. Alluvial fans are also dangerous because each high flow event may cause rapid changes and form new channels or flow paths. FEMA designates Zone AO as the 1% annual chance flood zone for shallow flooding, sheet flow, or areas with high flood velocities on alluvial fans. Human activities often exacerbate flooding and erosion problems on alluvial fans. Roads act as drainage channels, carrying high-velocity flows to lower portions of the fan, while fill, leveling, grading, and structures can alter flow patterns.

Pit Capture

Gravel pits and other pond features in the floodplain of rivers pose a flood risk through pit capture. A pit capture occurs when there is a difference in water elevation between the river and a pond, resulting capture has the potential to permanently change the course of a river and significantly alter the streambed and gradient of the river, both upstream and downstream of the event.

When a pit capture occurs, water from the river will first flow into the pit. The initial avulsion can be sudden. Erosion occurs at the site of the breach, both widening and deepening the opening and will continue upstream from the breach in the form of a headcut, or downcutting of the river bed. The sediment carried by the river plus the sediment transported due to the headcut, will generally settle out of the water column in the pit. As the water surface equalizes between the river and pit, it will seek an exit point where it can directly return to the river channel, or sometimes flow overland if a direct connection is not available until a path back to the river is found. The end result of a pit capture is that a portion of a river channel may be largely abandoned and the river will continue to reinforce its new flow path. This new flow path may shift additional flood risk into areas that were not directly threatened before.

There are two primary failure modes that can cause a pit capture. The first is an overtopping failure, where the river stage rises above a bank and simply overtops it, causing erosion and downcutting of that bank and opening a breach. The second mechanism begins with piping, a hydraulic phenomenon where subsurface water finds an underground flow path moving sediments through the ground and into the pit. As the process continues, the "pipes" can get larger as more sediment is entrained and moved out of the bank. Once enough material has moved, the bank may begin to collapse, which then can lead to the overtopping mechanism to take over and reinforce the pit capture. A bench scale video of a pit capture is available at https://www.youtube.com/watch?v=Se5HzG8MPKk.

Ice Jam Floods

An ice jam is an accumulation of ice that acts as a natural dam or constriction and restricts flow of a body of water. Ice jams can occur under a variety of conditions. Ice jams may build up to a thickness great enough to raise the water level and cause flooding (Northeast States Emergency Consortium 2017; FEMA 2008). Ice jams may be caused by frazil ice, which is made up of needle shaped ice crystals that form in supercooled, turbulent water, and often has a slushy appearance. Frazil ice can be transported downstream to a point where it may start to accumulate and contribute to ice jams, often building up around other chunks of ice or against constrictions and obstructions.

Cassia County flooding
Source: Photo courtesy of Cassia County

Ice jam floods can occur during fall freeze-up from the formation of frazil ice, during midwinter periods when stream channels freeze solid to form anchor ice, and during spring break-up when rising water levels from snowmelt or rainfall break the existing ice cover into large floating masses (or floes) that lodge at bridges and other constrictions. Damage from ice jam flooding usually exceeds that caused by open water flooding. Flood elevations are usually higher than predicted for free-flow conditions, and water levels may change rapidly. Additional physical damage is caused by the force of floes striking buildings and other structures.

Sheet Flooding

Sheet flooding is sometimes referred to as areal flooding. This is a type of flood hazard with shallow depths of 1 to 3 feet flowing overland. The flooding does not come from a stream or body of water, but from heavy rains on relatively impervious surfaces, rapid snow melt, or rain on snow and spreads across the landscape. The water flows across the ground towards natural and artificial drainage channels, generally in excess of their capacities. This leads to sustained flooding until the water drains or is pumped, impacting homes, roads, businesses, and agriculture. The sheet flow hazard may be represented by the zone designation AO on Flood Insurance Risk Maps.

Rain on Snow Flooding

Rain on snow increases the snowmelt rate, which can cause flooding. Rain on snow events in the spring are particularly dangerous as warmer weather returns along with breezy winds increasing runoff on multiple rivers and streams. Especially in recent years, this has affected the entire state in areas with snowpack. Sheet flooding occurs in areas where the ground is still frozen with existing snow cover, and is further exacerbated by the fluctuating temperatures with warming and cooling cycles. When the temperatures cool and precipitation falls as snow again, chances of flooding increase as it melts with the next rain on snow event as the temperatures warm. Areas that have previously flooded and not quite dried out yet may have locations where the ground is still frozen. Mid-level slopes that did not receive snow in January for example, but did in February, have potential flood concerns. Heavy snowpack areas are closely monitored during spring rain on snow events.

Debris Jam Floods

Debris jam floods occur when foreign material (soil, rock, vegetation, or snow) forms a dam and blocks water flows along a stream. The debris may come from landslides, avalanches, or mud flows. Wildfires can exacerbate the potential for debris jams by removing protective vegetation and creating hydrophobic soils and weakened slopes.

Groundwater Flooding

Groundwater flooding occurs in low-lying areas when the water table rises above the land surface and is prevalent in braided streams with migratory channels, which experience significant deposition of sediment and gravel. This leads to a water table that is directly influenced by river levels. Flooding occurs in low lying areas away from the stream which fill as the water table rises with the river. Groundwater flooding can also occur near levees during high water, leading to percolation, piping, and sand boils.

Dam Failure

A dam is defined as an artificial barrier constructed across a watercourse for the purpose of storage, control, or diversion of water. Most dams typically are constructed of earth, rock, and/or concrete. Instead of storing water, some dams are designed and constructed to impound mine tailings slurry, wastewater, and liquefied industrial or food processing byproducts. A dam failure generally implies an uncontrolled release of impounded water or waste due to a catastrophic collapse, breach, or overtopping of the dam resulting in downstream flooding.

The Idaho Department of Water Resources (IDWR) defines a dam as any artificial barrier or embankment together with appurtenant works, constructed for the purpose of storing water or that stores water, which is 10 feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier, as determined by IDWR, or from the lowest elevation of the outside limit of the barrier, if it is not across a stream channel or watercourse, to the maximum water storage elevation, and has or will have an impounding capacity at maximum water storage elevation of 50 acre-feet or more.   Dams can take many forms, and may not be immediately obvious.

As of 2018, IDWR regulates nearly 600 water storage dams and more than 20 mine tailings impoundment structures located throughout the state. It should be noted that regardless of size, any water storage embankment may be regulated for public safety if IDWR determines that the potential failure consequences would result in significant damage to downstream life or property (IDWR 2017).

The storage area behind a dam commonly is referred to as the reservoir. The volume of storage in the reservoir is typically measured in acre-feet. An acre-foot is the volume of water that covers one surface acre of land (43,560 ft^2) to a depth of 1 foot (1 acre-foot equals 325,850 gallons). In most cases, three (3) factors influence the potential severity of a full or partial dam failure: the height of the dam, the amount of water impounded, and the extent of development and infrastructure located downstream.

Figrue 3.2.A. American Falls Dam, Power County, Idaho / *Source: Reclamation*

Dam failure occurs when a dam has structural or operational issues, and releases dangerously high flows to downstream areas most dams have a section called a spillway or weir over or through which water flows, either intermittently or continuously, and some have hydroelectric power generation systems installed. Compared to other flood hazards in Idaho, dam failures are rare, but can cause significant damage and loss of life when they occur, placing high flows into river channels with little or no advance warning, similar to flash flooding. The failure of the Teton Dam in 1983 is an example of this hazard. The downstream reach of the river can have extensive development, leading to a significant loss of life, property damage, and subsequent economic impacts. Dam failures can result from any one or a combination of the following causes:

- Prolonged periods of rainfall or snowmelt runoff that exceeds the design capacity of the emergency spillway;
- Poor design, including inadequate spillway capacity, resulting in overtopping of the dam;
- Internal erosion caused by embankment or foundation leakage or piping;
- Lack of necessary maintenance and/or repair of deficient components;
- Improper construction , including the use of inadequate construction materials and practices;

- Negligent operation, including the failure of the dam owner to implement previously recommended safety features, practices, or standards of care;
- Failure of upstream dams on the same waterway;
- Landslides into reservoirs, which cause surges that result in overtopping;
- High winds, which can cause significant wave action and result in substantial erosion; and
- Earthquakes, landslides, and prolonged high winds; the latter which can cause significant wave erosion.

Levee or Dike Failure

Levees are man-made structures, usually an earthen embankment designed and constructed with sound engineering practices to contain, control, or divert the flow of water in order to provide protection from temporary flooding. A levee is built parallel to a body of water, typically a river, to protect the lives and properties behind it. Currently, there are thousands of miles of levees across the United States. No levee provides full protection from flooding. Levees can be constructed using various materials ranging from soil, rock, concrete, sandbags, gabions, sheet-piling, or any combination thereof. Railroad and highway grades can act as levees, even though they may not have been constructed specifically for that purpose.

Similar to earthen dams, levees may fail by breaching or overtopping. Breaches may potentially cause the most damage and can occur either through gradual erosion or sudden breaks, both of which can result in large amounts of water to flow uncontrolled onto adjacent lands. Contributors to levee failures include inadequate design, poor construction, and lack of repair or maintenance to remove invasive vegetation and burrowing animals, earthquakes, and large floods that can cause erosion or overtopping. However, levees are unlike dams, which typically are designed and constructed against overtopping for all but the most extreme of hydrologic events. Some levees are designed to a particular level of flood protection. The minimum standard for the United State Army Corps of Engineers (USACE) Rehabilitation and Inspection Program is 10% or a 10-year flood with 2 feet of freeboard. Other levees were built to meet an immediate need without the benefit of a deliberate design. These do provide some level of protection, but may have been poorly constructed, and the level of protection may not meet the USACE minimum standard. The implication to communities protected by a levee against a 100-year flood is not one of whether the levee will be overtopped, but instead when and/or how often the levee will be overtopped resulting in its potential failure and catastrophic flooding of adjacent lands. Communities need to consider fully the flood risks and establish protection measures for levee failures before they occur. Up to date surveys of the height of the levee relative to its surroundings and awareness of any low areas at the top of the levee are important in reducing unexpected overtopping. During a flood event, the top of the levee may be raised temporarily by sandbags or other means to prevent overtopping. When a levee is overtopped and the land side of the levee is not adequately armored, the flowing waters can erode and undercut the levee, causing it to collapse. Water flowing through or under a levee will weaken and cause flooding on the land side. Water easily can flow through animal tunnels, along channels in the soil left by root systems, or through poorly compacted or sandy soils.

"Sand boils" on the land side of the levee are an indication of water seepage. Wave action or scouring on the water side of the levee can reduce the width of the levee causing it to fail.

Canal Failure

Canals are found throughout Idaho and provide essential irrigation to agricultural lands. Irrigation in Idaho goes as far back as at least 1839 when missionaries put in a ditch for crop irrigation during the summers. By 1864, many important canal companies were getting started in Idaho. In the early 1900s, much of the arid land in southwest Idaho was development through reclamation projects. These projects included dams to collect water and provide flood control and canals to deliver water to agricultural areas (Idaho State Historical Society 1971).

Figure 3.2.B. Irrigation Canal in Canyon County

Source: Idaho Press Tribune 2013

In Idaho, irrigation districts and private irrigation companies are entities which own water rights and distribute water. The structure of each entity varies. Information regarding each type, as described by IDWR, is as follows:

- Irrigation districts are created pursuant to local elections authorized by a county commission upon petition of land owners. They are typically created for the purpose of new irrigation development or acquiring irrigation projects, but they may be created for other reasons. Irrigation districts hold water rights and own diversion facilities and infrastructure, and are governed by a state of by-laws created by a board of directors who are elected by district members. The districts are public, involuntary, semi-municipal fee-collecting entities controlled by local landowners.

Private irrigation companies are often referred to as irrigation companies, canal companies, mutual ditch companies, and reservoir companies. They are privately-formed, non-profit, fee-collecting companies that furnish delivery of water for irrigation purposes. A company holds water rights and members own shares in the company. Water is typically allocated annually by share, and shareholders pay assessments for maintenance of water conveyance infrastructure and related expenses. The size and number of ditches or canals administered by such companies vary. Private irrigation companies typically elect boards of directors and often adopt by-laws (IDWR 2017).

Most canals in Idaho are earthen structures and share many of the same potential failure modes with dams and levees of breaching or overtopping. The probability for canal failure is increased and the risks to life and property are greater when development encroaches on canals hindering maintenance, repair, and regular inspection.

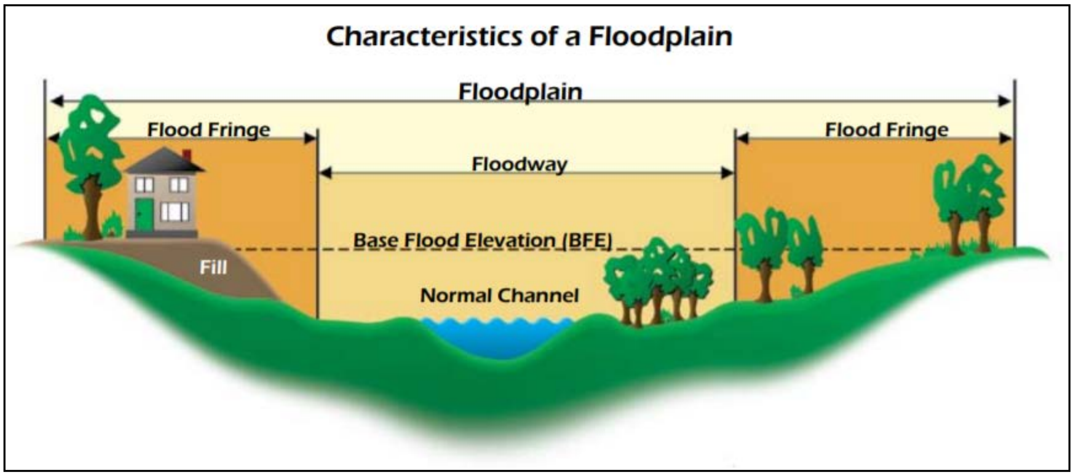
Location, Extent, and Magnitude

Most flooding occurs along natural stream or river channels. The land along a stream or river that is identified as being susceptible to flooding is called the floodplain. The Federal standard for floodplain management under the National Flood Insurance Program (NFIP) is the "base floodplain" (also known as the 100-year floodplain, 1% annual chance floodplain, and Special Flood Hazard Area [SFHA]). This area is determined using historical data indicating that in any given year there is a 1% chance of the base flood occurring or 1 in 100, probability that water levels will exceed this magnitude. Base floods can occur in any year, even successive ones. The 1-percent annual chance flood is now the standard used by most federal and state agencies and by the NFIP (FEMA 2002). The one-percent annual chance of flood hazard zones (both A and V-zones) and 0.2-percent annual chance flood zone throughout Idaho are identified in Figure 3.2.D.

Major floods have historically occurred in Idaho every one to two years and are considered the most serious and costly natural hazard affecting the State. The amount of damage caused by a flood is influenced by the speed and volume of the water flow, the length of time the impacted area is inundated, the amount of sediment and debris carried and deposited, and the amount of erosion that takes place.

Floods vary greatly in frequency and magnitude. Small flood events occur much more frequently than large, devastating events. Statistical analyses of past flood events can be used to establish the likely magnitude and recurrence intervals (period between similar events) of future events.

Figure 3.2.C. Characteristics of a Floodplain, as defined by the National Flood Insurance Program (NFIP).



Source: NFIP Guidebook 2009

The term floodplain has two meanings, practical and regulatory. In practical terms, a floodplain is the area inundated by floodwaters, and this area changes based on the magnitude of the flood event. Where the surface of the land is relatively undisturbed by human activities, flood prone areas can be recognized by a well-defined natural, flat "floodplain", by natural levees along stream banks, by alluvial fans, abandoned channel meanders, or by soil types that are associated with floodplains. In altered or urbanized areas, these features will be less distinct; they may be obscured or removed by development. Where structures have been placed in the floodplain, the natural flooding processes may have been so altered that these features no longer accurately define the floodplain.

In regulatory terms, a floodplain is an area where specific regulations and programs (such as the NFIP) apply. The floodway, a subdivision of the floodplain, is of special regulatory interest. More stringent regulations are imposed in the floodway, because changes here can have a greater impact on the overall flood regime than those in the remainder of the floodplain (the ‘flood fringe’).

Application of these terms and concepts to sheet or aereal flooding, flash floods, and ice/debris jam break floods can be confusing. The term “inundation zone” may be used in place of floodplain and should be considered analogous. Like floodplains, inundation zones for these natural events may be determined by projecting the anticipated volume of water (e.g., runoff from the ‘base’ storm or excess runoff not conducted by a stormwater system). Historical inundation zones may be observed through field study of terrain features and vegetation, but, although they may be associated with recognizable terrain features such as canyons or gulches, areas subject to these floods are often less obvious than those located on a typical riverine floodplain. It is important to note that all of these types of flooding are very unpredictable in scale and location, and dependent on a number of unpredictable factors. The hazard will likely not be described or mapped until after the event has occurred.

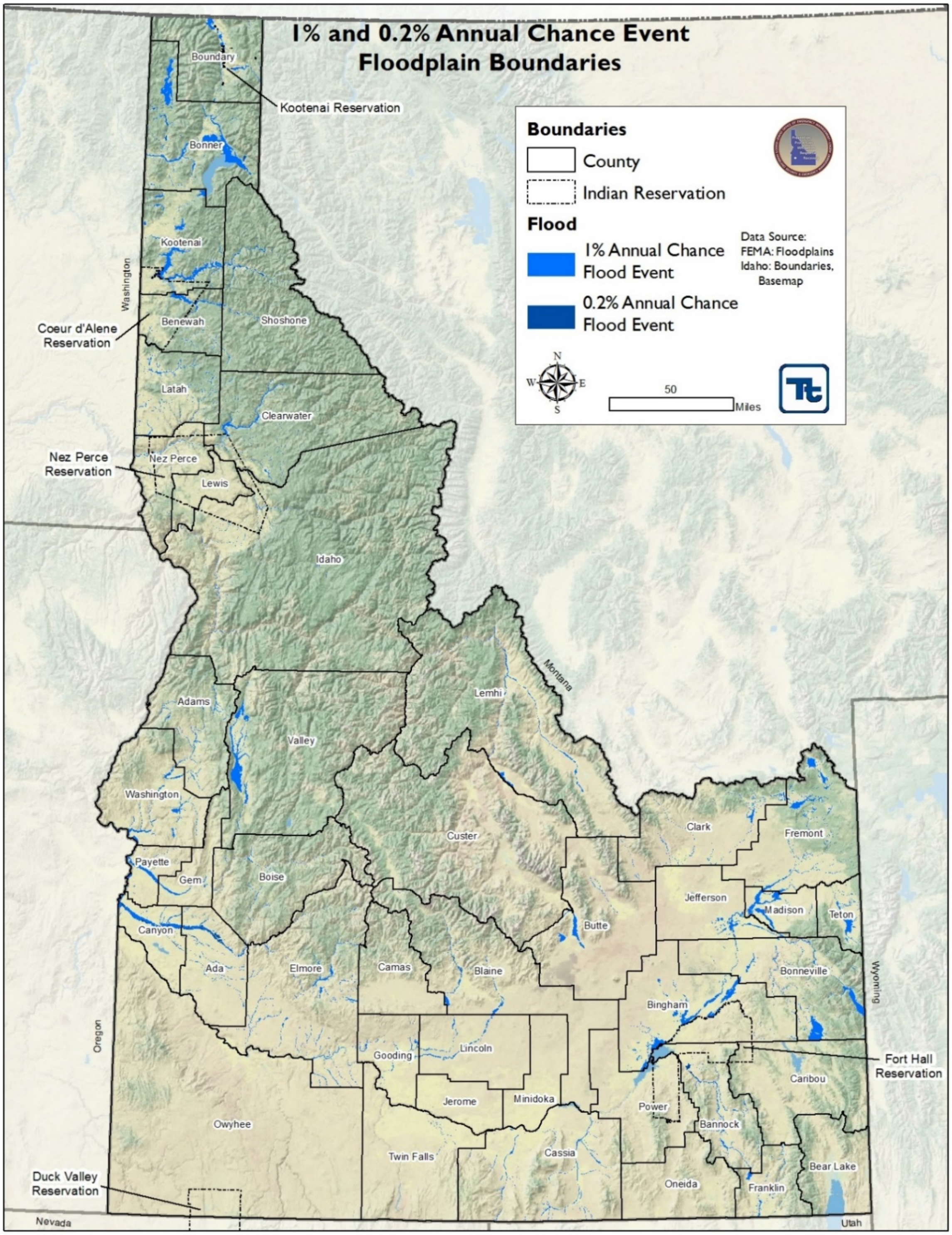
The effects of the failure of dams, levees, or canals can be difficult to determine, but inundation zones can be estimated or modeled using known or assumed conditions. For example, the storage capacity of a dam provides a baseline to identify the downstream inundation zone, or historical flood events can be used to model inundation areas from a levee failure. Inundation zones for canals may be estimated from the expected maximum flows and water elevations relative to the surrounding landscape.

IOEM Canal Videos

Two videos that demonstrate canal safety have been completed, and released to the public for viewing statewide. Idaho relies heavily on the expertise of our Technical Working Groups for important subject matter, and the contributions of professionals who were interviewed to provide valuable information in the making of these videos. IOEM coordinated with the Idaho Military Division to employ the videographer who shot the videos over two-days in May, 2020 and then through great effort, coordination, and editing was able to finish the work by the June, 2021 timeline.

The videos were posted to YouTube in July of 2021 and both will be incorporated into IOEM’s social media promotional plan. IOEM shared the videos with its Technical Working Groups, public schools, and County Emergency Managers statewide to be used as an informational and educational tool for elected officials and public consumption. The messages conveyed by the videos are intended for everyone to view to help protect precious water resources and its associated critical infrastructure to continue promoting public safety. This project was funded through a HMGP post-fire grant. The finished videos links are: https://youtu.be/HW4HSHkLjbM and https://youtu.be/ZmAnoAq-Cfk.

Figure 1.2.D. FEMA Flood Hazard Areas in Idaho



Watersheds

The Idaho Office of Emergency Management released its last version of its Multi-Hazard Risk Portfolio. This document contains maps, statistics, and information pertaining to watersheds. The flood risk ranking for hydrologic unit code (HUC8) watersheds (sub-basins) are prioritized across the State. These rankings were predicated on the following criteria: population, property, and professional judgment. The Idaho Silver Jackets core team was asked to provide the professional judgment, as all participating agencies were provided an opportunity to rank their 'Top 10' watersheds of focus, from the point of view of each agency's vision statement. Figure 3.2.KK highlights those watersheds. Dams, levees, and canals are structures in the watersheds that may be at risk to and/or contribute to flooding. The IDWR maintains an inventory of dams and their downstream hazard potential, available online at https://www.idwr.idaho.gov/dams/map.html. USACE maintains an inventory of levees, and is available on line at http://nld.usace.army.mil. The location, extent, and magnitude descriptions of the top ten watersheds follows.

Lower Boise

The Lower Boise Sub-Basin is home to hundreds of thousands of people who live in or near the Boise River floodplain. Digital Flood Insurance Rate Maps (DFIRMs) are available across both Ada and Canyon counties, and present a comprehensive depiction of the flood risk in the valley. Spring flooding is a significant threat to properties and people located along the Boise River. Lucky Peak, Arrowrock and Anderson Ranch dams upstream of this basin provide flood control and storage capacity for the Boise River and its tributaries; however, they cannot fully prevent flooding from occurring. The Idaho Department of Water Resources (IDWR) classifies dams according to their downstream damage potential. With a combined reservoir volume of 949.7 KAF, each of the three dams upstream of the Boise watershed is attributed with the highest damage classification. Beyond these three, there are 9 significant and 10 high risk dams within the Boise sub-basin. Hundreds of thousands of people living downstream of the reservoirs are at risk of annual flooding.

Upper Snake-Rock

The Upper Snake-Rock Sub-Basin is home to tens of thousands of people, of which very few live in or near the Snake River floodplain. Flooding within the Upper Snake-Rock Sub-Basin could affect life and property, especially along the highly incised Snake River canyon, of which exists relatively few residents and property. Effected properties can include residential, commercial, and agricultural lands along the river. No bankfull flow values were available for this, or any other gage station near the city of Twin Falls, and so only annual peak flows are available. Besides flow values, another flood hazard includes a potential dam breach at Milner Dam in an adjacent sub-basin, which would flow into this sub-basin, and flood the Snake River Canyon. The Milner storage volume is 36.3 KAF, and the dam has a High downstream damage classification. Tributaries are a notable problem to the area, specifically Rock and Clover Creek. The topography in this watershed is prone to sheet flooding.

Payette

The Payette Sub-Basin is home to hundreds of people who live in or near the Payette River floodplain. Flooding within the Payette Sub-Basin could affect life and property, especially the cities of Emmett, Horseshoe Bend, New Plymouth, and Payette that have 16,235 residents, combined. Affected properties can include residential, commercial, and agricultural lands along the river. Flood hazards can include high stream flows that exceed bankfull discharge. At the USGS gage near the city of Horseshoe Bend, this discharge is 12,700 cfs, and annual peak flow events exceed bankfull discharge. Another flood hazard includes a potential dam breach at Black Canyon Reservoir with a storage volume of 29.8 KAF. The dam has a High downstream damage classification. Ice jam flooding along the Snake River in Payette County is common. Post-wildfire flooding in the large Pioneer Fire area has been identified as a potential risk in this watershed.

South Fork Coeur d'Alene

Seven communities in this sub-basin are along the South Fork Coeur d'Alene River. The South Fork Coeur d'Alene Lake Sub-Basin has considerable risk to human life and property. There are three multiple loss communities (Pinehurst, Wallace, Kellogg) in this sub-basin. At the USGS gage near Kellogg, the bankfull discharge of the SF Coeur d'Alene River is 1,940 cfs. Annual peak flows have exceeded 2,000 cfs many times in the past. There are 9 dams considered by IDWR

Weiser

The Weiser Sub-Basin is largely privately owned with population and development concentrated along the Weiser River and the towns of Weiser (pop. 5507), Midvale (pop. 171), Council (pop. 839), and Cambridge (pop. 328). The primary river system in this sub-basin is the Weiser River. There are several reservoirs in the sub-basin including Lost Valley Reservoir and Crane Creek Reservoir. The majority of the development in this sub-basin is agricultural, mostly along the Weiser River with some on Mann Creek and the Little Weiser. Flood hazards can include seasonal high stream flows that exceed bankfull discharge. At the USGS gage near the city of Weiser, the bankfull discharge is 9720 cfs, and annual peak flow events have exceeded that flow many times. The Weiser River exceeded its banks in 2011 resulting in the closure of Hwy. 95. In this sub-basin, there are 19 dams considered by IDWR to be of High or Significant risk. The majority of the at-risk dams in this basin are a flooding risk to residential and farmland development downstream. Of the 73 dams in the IDWR database listed in this sub-basin, none are on the Weiser River. Ice jam flooding is common along the Weiser and Snake Rivers.

St. Joe

The St. Joe Sub-Basin is home to residents of St. Maries and spans much of Shoshone and Benewah County. The St. Joe and St. Maries Rivers make up the major water system within the basin. There are two repetitive loss properties as a result of flooding from the St. Joe River. Flood hazards from the St. Joe River include seasonal high stream flows that exceed bankfull discharge. At the USGS gage at the town of Calder, this discharge is 15,500 cfs. Annual peak flow events frequently occur that exceed bankfull discharge. Flows will increase at places further downstream like the town of St. Maries. Ice jams have also compounded flooding concerns along the St. Joe River in the past. In this sub-basin, there are no flood control structures to regulate the strong waters of the St. Joe; however many levees exist.

Big Wood

The Big Wood Sub-Basin is home to thousands of people that live in or near to the Big Wood River floodplain. The populated areas within the Big Wood boundaries include Sun Valley, Ketchum, Hailey, and Bellevue. Flooding within the Big Wood Sub-Basin could greatly disrupt life and property to Blaine County. Much of the population in the sub-basin lives along the Big Wood River and are susceptible to flooding from Ice jam and ice dam flooding, main channel and side streams, sheet flooding in lower elevations, and debris flooding from avalanches and post-wildfire events. Annual precipitation in this region is between 16 to 30 inches per year. At the USGS streamgage in Hailey, the Big Wood river bankfull discharge is 2,290 cfs. In 2017, flows on the Big Wood approached 7,000 cfs several times, and floods have historically occurred along the Big Wood or its tributaries. Snowmelt and rain-on-snow are the primary cause of riverine and sheet flooding. There are eight dams in the sub-basin categorized as posing a high to significant risk of flooding. The dams are along tributaries to the Big Wood and Malad Rivers. The largest dams are the Magic Reservoir Dam and the Trail Creek Dam, which is within the city limits of Sun Valley.

Lower Kootenai

The Lower Kootenai is home to most of the residents of Boundary County including the communities of Bonners Ferry (pop. 2543) and Moyie Springs (pop. 718). The Kootenai River is the major water system in the area. USGS stream gages at Leonia represent high stream flows. There is a high risk dam at McArthur Reservoir, south of Bonner's Ferry. Land along the banks of the river is used for agriculture and rural development.

Clearwater

The Clearwater Sub-Basin is home to thousands of people who live in or near the Clearwater River floodplain, as well as its tributaries, which include the Potlatch, Lapwai Creek, Orofino Creek, and Lawyers Creek. A majority of the land and inhabited properties in this basin belong to the Nez Perce Tribe. The tributaries in this watershed are at risk to post-wildfire flooding from multiple events. The largest flood event would be a dam breach at the Dworshak reservoir upstream of this sub-basin. The volume of the reservoir is 3,453 KAF. A population of 164,208 lives in adjacent sub-basins, downstream of the reservoir that would be affected by a catastrophic dam breach, including the cities of Lewiston, Idaho, and Clarkston, Richland, Pasco, and Kennewick in Washington. The Idaho Department of Water Resources (IDWR) classifies dams according to their downstream damage potential, and the Dworshak dam is attributed with the highest damage classification. Other risks include regular flooding of properties along the tributaries of the Clearwater River, as well as sheet flooding, mudslides, and landslides.

American Falls

The American Falls Sub-Basin is home to thousands of people, with the majority living near the main flooding source: the Snake River. The cities of Blackfoot, American Falls, and Shelley are the largest cities. This sub-basin is susceptible to sheet flooding and ice jams due to its minimal slope and significant rural agricultural and urban development along the Snake River. Flood hazards can include seasonal high stream flows that exceed bankfull discharge. At the USGS gage near the city of Blackfoot, this discharge is 19,200 cfs, and annual peak flow events exceed bankfull discharge. In this sub-basin, there are three dams considered by IDWR to be of High or Significant risk; Gem State Dam, Simplot Effluent Irrigation (EI) Dam, & American Falls Dam. Gem State and Simplot EI dams are a flooding risk to residential development and farmland downstream. The City of Shelley is within five miles downstream of the Gem State Dam and the Simplot EI Dam is on the outskirts of the City of Chubbuck.

Severity

Flood studies use historical records and statistical methods to determine the probability of occurrence for different discharge levels. A structure located within a Special Flood Hazard Area (SFHA) shown on an NFIP map has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage. The SFHA boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the water elevation resulting from a given discharge level, which is one of the most important factors used in estimating flood damage.

Two factors that influence the potential severity of a full or partial dam failure are: (1) the amount of water impounded; and (2) the density, type, and value of development and infrastructure located downstream. Dam failures can be swift and sudden and would produce a very significant flash flood downstream.

In the event of a levee failure, floodwaters may ultimately inundate the protected area landward of the levee. The extent of inundation is dependent on the flooding intensity. For example, failure of a levee during a 1-percent annual chance flood will inundate the 100-year floodplain previously protected by the levee. Canal failures are inherently unpredictable. Floodwaters influenced by the surrounding topography may inundate the side of the canal where a failure occurs. The extent of inundation is dependent on the flow the canal was carrying and how quickly the canal can be shut off once flooding is identified. Residential and commercial buildings near system overtopping or breach locations will suffer the most damage from the initial failure flood wave.

Warning Time

Flood warnings and flash flood warnings and watches are issued by the local NWS Weather Forecast Office in the region. The NWS will update the watches and warnings and will notify the public when they are no longer in effect. Watches and warnings for flooding in Idaho are as follows:

Flash Flood Warning: Issued when flash flooding is occurring or imminent;
Flash Flood Watch: Issued when flash flooding is possible within the next 48 hours;
Flood Statement: Provides follow-up information regarding flood and flash flood warnings and advisories that are occurring or have occurred;
Flood Warning: Issued when river flooding is occurring or imminent;
Flood Watch: Issued when there is a potential for long duration main stem river flooding within the next 72 hours;
Hydrologic Outlook: Discusses possibility of flooding beyond 72 hours, water supply, or drought conditions;
Hydrologic Statement: Communicates notable hydrologic conditions that do not involve flooding, such as within river bank rises, minor ice jams, etc.; and
Urban/Small Stream Flood Advisory: Issued when short duration (less than six hours) localized flooding in city areas is occurring or imminent (usually not life threatening) (Pocatello Weather Forecast Office 2012).

Due to the sequential pattern of meteorological conditions needed to cause serious flooding, it is unusual for a flood to occur without any warning. Warning times for floods can be between 24 and 48 hours. Flooding is more likely to occur due to a rainstorm when the soil is already wet and/or streams are already running high from recent previous rains. Pre-existing conditions when a storm begins are called “antecedent conditions”.

Flash flooding may occur with little warning time, particularly in areas that have a contributing factor, such as a recently burned watershed or frozen ground. The antecedent conditions and a tracked weather system would still prompt watches and warnings from the NWS. More warning time may be given in the case of rain-on-snow or general snowmelt flooding, as the snowpack will be well known and tracked as well.

Dams can fail with little warning. Intense storms may produce a flood in a few hours or even minutes for upstream locations. Flash floods can occur within six hours of the beginning of heavy rainfall, and dam failure may occur within hours of the first signs of breaching. Other failures and breaches can take much longer to occur, from days to weeks, as a result of debris jams, the accumulation of melting snow, buildup of water pressure on a dam with deficiencies after days of heavy rain, etc. Flooding can occur when a dam operator releases excess water downstream to relieve pressure from the dam.

Warning time for dam failure varies depending on the cause of the failure. In events of extreme precipitation or massive snowmelt, evacuations can be planned with sufficient time. In the event of a structural failure because of earthquake, there may be no warning time. A dam's structural type also affects warning time. Earthen dams do not tend to fail completely or instantaneously. Once a breach is initiated, discharging water erodes the breach until either the reservoir water is depleted or the breach resists further erosion. Concrete gravity dams also tend to have a partial breach as one or more monolith sections are forced apart by escaping water. The time of breach formation ranges from a few minutes to a few hours (USACE 1997).

High and significant hazard dam owners are required to prepare and maintain Emergency Action Plans (EAP). The EAP is to be used in the event of a potential dam failure or uncontrolled release of stored water. Owners are also required to have established protocols for flood warning and response to imminent dam failure in the flood warning portion of its adopted emergency operations plan. These protocols are tied to the emergency action plans also created by the dam owners. These documents are customarily maintained as confidential information, although copies are required to be provided to the IDWR for response purposes.

Like dam failures, levee and canal warning times depends on the cause of the failure. A structural failure can be sudden and perhaps with little to no warning despite warnings regarding the structural integrity of the system. If heavy rains are impacting a system, communities located in the immediate danger zone can be evacuated before a failure occurs. If the failure is caused by overtopping, the community may or may not be able to recognize the impending failure and evacuate. If a failure occurs suddenly, evacuation may not be possible.

Secondary Impacts

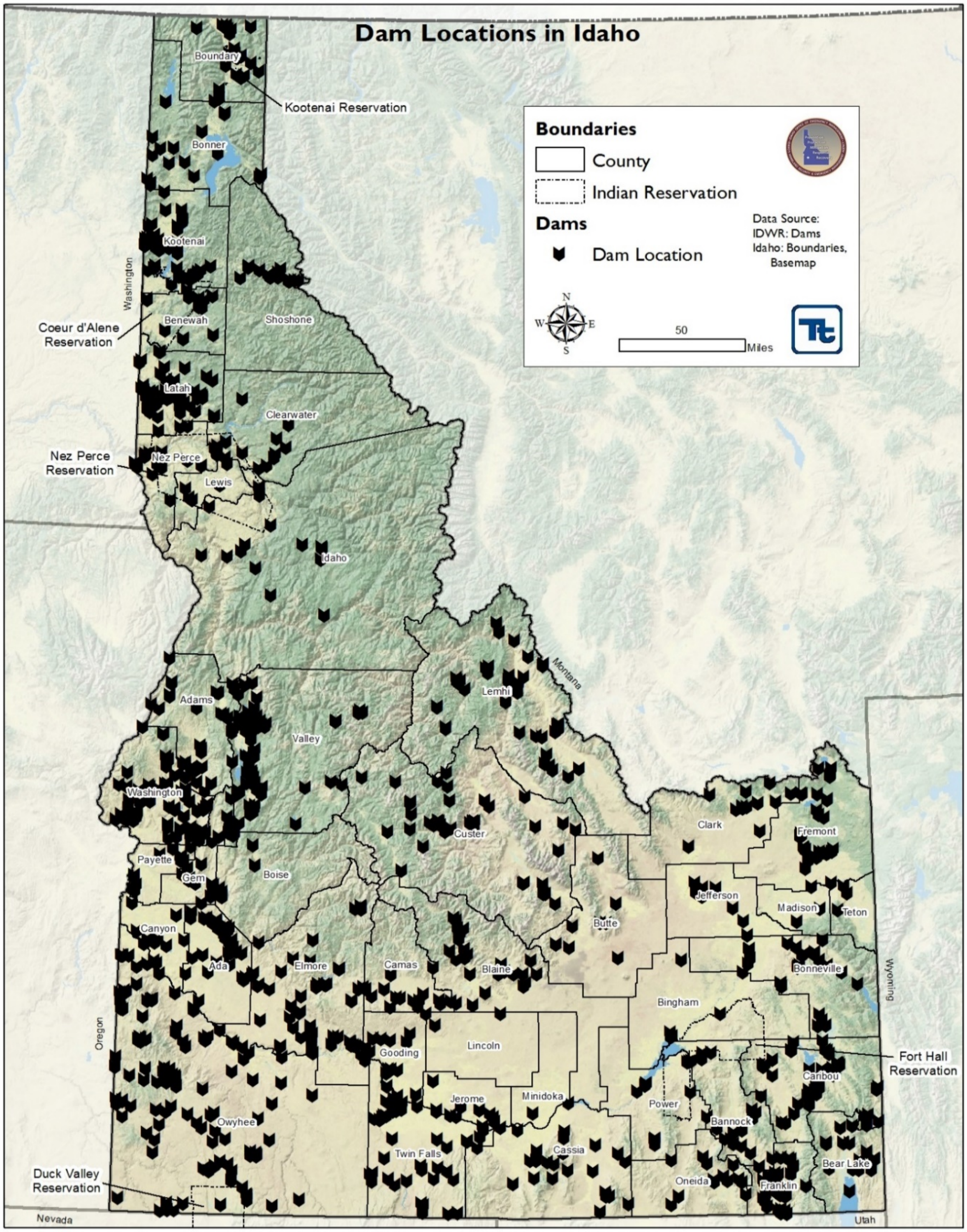
Floods can influence other hazards, both natural and human-caused. Flood events can lead to failures of dams, levees, or canals. Landslides are also often-times caused by flood. Conversely, a flood event could help to lessen the hazards of both wildfire and drought, if only for a short time period. All of the human-caused hazard events covered in this Plan could be influenced in some way or another by a flood event. Flood impacts on infrastructure and facilities could initiate a hazardous material or radiological release, or a cyber disruption. Standing water left after a flood event could increase the susceptibility for a pandemic event to occur. Floods can also damage aboveground and underground electrical equipment, leading to power outages in impacted areas. Power generation facilities can be severely impacted by flooding as well. Flooding can cause extensive damage to public utilities and disrupt the delivery of services. Loss of power and communications can occur. Drinking water and wastewater treatment facilities may be out of operation.

Flooding from dam, levee, or canal failure may cause potential secondary hazards such as landslides, bank erosion, and destruction of habitat. Floodwaters carried to points downstream damage areas where it would not otherwise be expected. Environmental incidents occur due to hazardous materials releases when floodwaters infiltrate facilities that store these types of materials. Utilities such as power, cable, and phone lines located in the inundation zones may also be susceptible to damage. Loss of these utilities could create additional problems for those impacted by flooding from dam, levee, or canal failure. It is important to point out that systems can both fail and be vulnerable to riverine or flash flooding, sheet flooding, rain on snow events, earthquakes, and progressive erosion. Floods caused by system failures have resulted in loss of life and property damage.

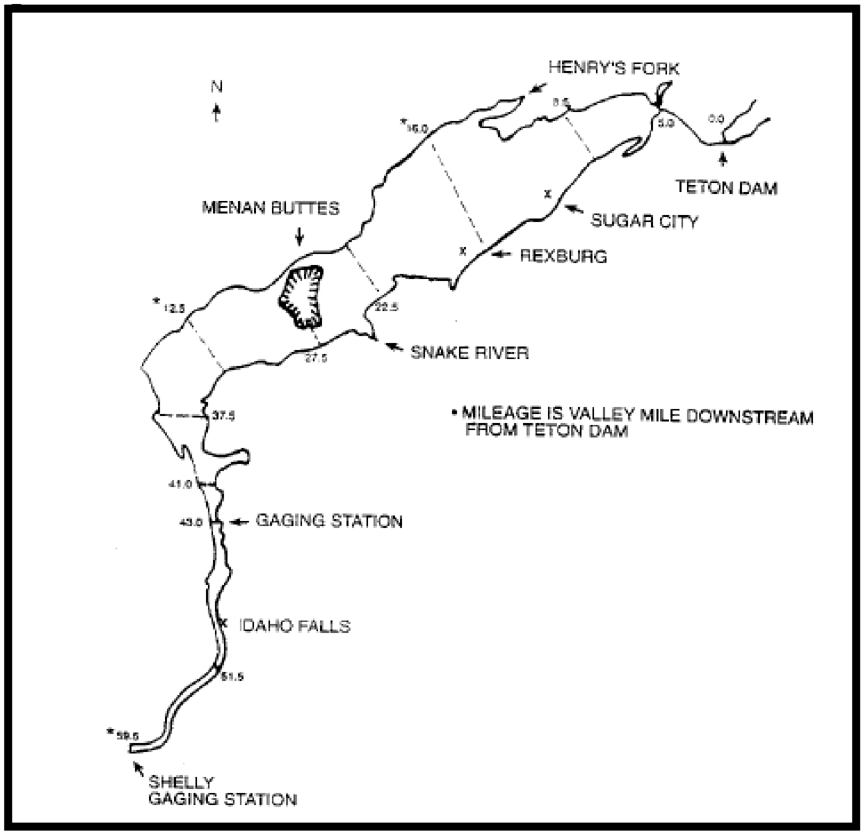
Dams

According to the 2016 National Inventory of Dams (NID, https://www.idwr.idaho.gov/dams), there are 473 dams in Idaho. Of these 473 dams, federal agencies own 36; State agencies own 16; local agencies own 19; public utilities companies own 25; and private entities own 372. Ownership of 5 dams is not listed. The dams listed in the NID meet at least one of the following criteria: high hazard potential, significant hazard potential, equal or exceed 25 feet in height and exceed 15 acre-feet in storage, or equal or exceed 50 acre-feet storage and exceed six feet in height (USACE 2017). However, the IDWR maintains a listing of 1,165 dams across Idaho (IDWR 2017). Please note that the listing of dams maintained by IDWR includes regulated, non-regulated, pending, reclaimed, breached, and dams with no identified status. The difference in these numbers is due to the methods of reporting for both databases. Figure 3.2.E displays the location of these dams throughout the state.

Figure 3.2.E. Locations of Dams in Idaho



In Idaho, the Teton Dam, a 300-foot-high earthen dam with a 3,000-foot-long crest and 250,000 acre-feet of stored water, failed catastrophically on June 5, 1976. This failure caused significant damages to the downstream Teton-Snake River Valley, with the inundation of an area as much as 9 miles wide and as far as 16 miles downstream of the dam (see Map 3.2.F).



Map 3.2.F.: Teton Dam Inundation Area (Shelly Gaging Station is approximately 60 miles downstream of Teton Dam) / Source: IOEM

A study conducted by the National Weather Service (NWS) explained that the Teton Dam failure had an approximate instantaneous peak value of 2,183,000 cfs at the dam itself, a peak period of 1.43 hours, and a total duration of significant outflow of about 6 hours. This instantaneous peak discharge was about 30 times greater than the flood of record at Idaho Falls. The flood attenuated significantly as it moved downstream. The peak flow recorded at USGS Gage 13060000, Snake River near Shelley, ID, was recorded as 67,300 cfs on June 6, 1976. Nevertheless, the damage was significant and widespread, especially closer to the Teton Dam site.

Dams greater than or equal to 10 feet high or reservoirs with a storage capacity greater than or equal to 50 acre-feet are regulated by the Idaho Department of Water Resources (IDWR) Dam Safety Program. Each dam inspected by IDWR has a classification for both size and hazard. The size classification is a combination of dam height and reservoir storage capacity, as described below:

- Large – 40 feet high or more, or with a storage capacity of more than 4,000 acre-feet of water. *104 dams are currently listed as large*.
- Intermediate – between 20 and 40 feet high or with a storage capacity of 100 to 4,000 acre-feet of water. *198 dams are currently listed as intermediate*.
- Small – 20 feet high or less, with a storage capacity of less than 100 acre-feet of water. *244 dams are currently listed as small*.

- The hazard rating that is used by the Dam Safety Program to classify dams and reservoirs is based on a three-tier system consisting of Low, Significant, and High hazard categories. These classifications are further described below in Table 3.2.H.
- It is important to note that the hazard classification assigned to any particular structure is based solely on the potential consequences to downstream life and property based on a potential failure of the dam and uncontrolled release of water. In addition, "Hazard" is not to be used synonymously with the term "Risk". Risk incorporates the probability of failure; thus risk is equal to some probability that a failure will occur multiplied by the resulting consequences to downstream life and property.

Figure 3.2.G. Cascade Dam

The extent or magnitude of a dam failure event can be measured in terms of the classification of the dam. USACE developed the classification system shown in 3.2.H for the hazard potential of dam failures. USACE hazard rating systems is based only on the potential consequences of a dam failure; it does not take into account the probability of such failures.

Table 3.2.H. United States Army Corps of Engineers Hazard Potential Classification

Hazard Category[a]	Direct Loss of Life	Lifeline Losses	Property Losses	Environmental Losses
Low	None (rural location, no permanent structures for human habitation)	No disruption of services (cosmetic or rapidly repairable damage)	Private agricultural lands, equipment, and isolated buildings	Minimal incremental damage
Significant	Rural location, only transient or day-use facilities	Disruption of essential facilities and access	Major public and private facilities	Major mitigation required
High	Certain (one or more) extensive residential, commercial, or industrial development	Disruption of essential facilities and access	Extensive public and private facilities	Extensive mitigation cost or impossible to mitigate

a. Categories are assigned to overall projects, not individual structures at a project.
b. Loss-of-life potential is based on inundation mapping of area downstream of the project. Analyses of loss-of-life potential should take into account the population at risk, time of flood wave travel, and warning time.
c. Lifeline losses include indirect threats to life caused by the interruption of lifeline services from project failure or operational disruption; for example, loss of critical medical facilities or access to them.
d. Property losses include damage to project facilities and downstream property and indirect impact from loss of project services, such as impact from loss of a dam and navigation pool, or impact from loss of water or power supply.
e. Environmental impact downstream caused by the incremental flood wave produced by the project failure, beyond what would normally be expected for the magnitude flood event under which the failure occurs.

Source: United States Army Corps of Engineers 1995

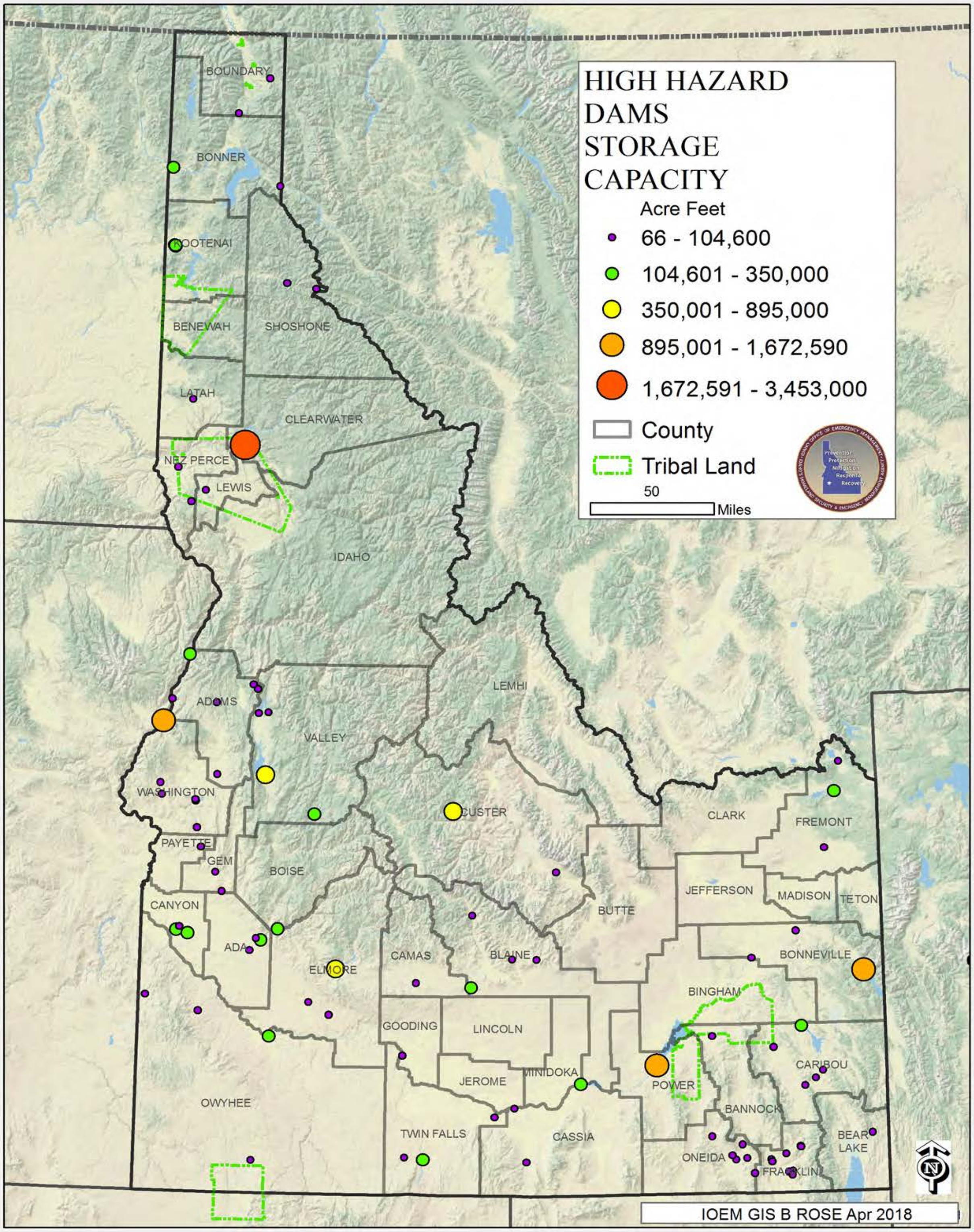
IDWR hazard rating classification for dams and reservoirs is based on a three-tier system consisting of low, significant, and high-hazard categories. The hazard classification given to any particular structure is based solely on the potential consequences to downstream life and property that would result from a failure and sudden release of water (IDWR 2017). High standard State definitions of each hazard classification is as follows:

High Hazard rating is given if a failure of a structure were to occur, the resulting consequences likely would be a direct loss of human life and extensive property damage. All high-hazard dams must be properly designed, and responsibly maintained and safely operated at all times due to the consequences of a failure being so great. IDWR considers the inundation of residential structures with flood water from a dam break to a depth greater than or equal to two feet to be a sufficient reason for assigning to a dam a high-hazard rating. An up-to-date Emergency Action Plan is a requirement for all owners of high hazard dams.

Significant Hazard rating is given to structures whose failure would result in significant damage to developed downstream property and infrastructure or that may result in an indirect loss of human life.

Low Hazard dams typically are located in sparsely populated areas that would be largely unaffected by a breach of the dam. Although the dam may be totally destroyed, damages to downstream property would be restricted to undeveloped land with minimal impacts to existing infrastructure (IDWR 2017).

Figure 3.2.I. Identified High Hazard Dams in Idaho



Levees

Most of the levees in Idaho are locally owned and maintained. There exists many miles of levees that have not been mapped, measured, or adequately inspected. Per Idaho Statute, levees are exempted from the IDWR dam safety regulations, and there is no other state agency tasked with specific duties to provide for public safety as it relates to design, construction, or inspection of levees. In most instances, the design, construction, and maintenance of levees is left to the discretion of local entities. Strategies being discussed at the State are to develop a state safety program to regulate new levees in general accordance with the Draft Recommendations for a National Levee Safety Program as presented in the 2009 Report to Congress.

The USACE owns and maintains only 2000 miles of levees nationwide; however, it is federally authorized to inspect levees with local non-federal sponsors who then are responsible for routine maintenance and repair. The USACE offers flood fight training to qualified jurisdictions. The USACE developed a National Levee Database (NLD) through the Levee Safety Program with information and mapping of those Idaho levees that are included in the Corps Levee Safety Program. Unfortunately, the levees listed in the database represent a small percentage of the total number of levees in the state. The NLD is being expanded to capture local levee information on a volunteer basis.

In Idaho, there are 115 individual levee systems accounting for approximately 234 miles of documented levees (U.S. Army Corps of Engineers [USACE] 2017). Table 3.2.J lists the locations of levee systems throughout the State as reported in the USACE National Levee Database; this list is subject to change without notice. These systems represent the levees that are actively inspected and have maintained a "minimally acceptable" rating or better in the USACE Rehabilitation and Inspection Program (RIP). The table includes levees that are sponsored federally, by the State, or locally.

Table 3.2.J. Idaho Levee Systems Monitored by USACE.

County	Sponsor(s)	System Name	Segment(s)	Length (Miles)
Blaine County	Flood Control District #9 Of Idaho	Zinc Spur	1	0.17
Canyon County	Flood Control District #11 Of Idaho	Young (Left Bank)	1	0.69
Idaho County	Flood Control District #6 Of Idaho - Division 2	White Bird (Right Bank)	1	1.1
Idaho County	Flood Control District #6 Of Idaho - Division 2	White Bird (Left Bank)	1	0.11
Washington County	Washington County Flood Control District #3	Twin Bridges	1	0.56
Lemhi County	Lemhi County, ID	Tomanovich K.	1	0.48
Lemhi County	City Of Salmon, ID, Lemhi County, ID	Tomanovich & Tomanovich Extension	3	1.58
Bingham County	Bingham County, ID	Todd Lambert	1	0.12

County	Sponsor(s)	System Name	Segment(s)	Length (Miles)
Kootenai County	Eastside Highway District	Tamarack Ridge	1	0.55
Nez Perce County	Nez Perce County, ID	Sweetwater	1	0.55
Ada County	Flood Control District #10 Of Idaho	Strunk-Stillwell	1	0.89
Idaho County	City Of Stites, ID	Stites	1	0.95
Blaine County	Flood Control District #9 Of Idaho	Star Bridge (Left Bank)	1	0.24
Benewah County	City Of St. Maries	St Maries	1	2.55
Washington County	Washington County Flood Control District #3	Smith, WM.-Einsbar-Green	1	1.76
Lewis County, Nez Perce County	Lewis County, Idaho	Slickpoo (St. Joseph)	1	0.37
Canyon County	Flood Control District #11 Of Idaho	Slate-Allen	1	0.11
Canyon County	Flood Control District #11 Of Idaho	Ross and Link	1	0.27
Benewah County	Riverdale Diking District	Riverdale	1	2.53
Canyon County	Flood Control District #11 Of Idaho	Ray Morden	1	0.34
Latah County	Latah County, ID	Potlatch Junction (Deep Creek)	1	0.56
Bannock County	City Of Pocatello, ID	Pocatello 5 (Right Bank - Lower)	1	1.47
Bannock County	City Of Pocatello, ID	Pocatello 4 (Left Bank - Lower)	1	2.29
Bannock County	City Of Pocatello, ID	Pocatello 3 (Left Bank - Middle)	1	0.89
Bannock County	City Of Pocatello, ID	Pocatello 2 (Right Bank - Upper)	1	3.09
Bannock County	City Of Pocatello, ID	Pocatello 1 (Left Bank - Upper)	1	2.15
Lemhi County	Lemhi County, ID	Piper	1	0.17
Shoshone County	Shoshone County, Unknown	Pine Creek Segment 5	2	0.2
Shoshone County	Shoshone County	Pine Creek Segment 4	1	0.31
Shoshone County	City Of Pinehurst, Shoshone County	Pine Creek Segment 3/Pinehurst	2	2.21
Shoshone County	Shoshone County	Pine Creek Segment 2	1	0.64
Shoshone County	Shoshone County	Pine Creek Segment 1	1	2.14
Nez Perce County	Nez Perce County, ID	Peck 3	1	0.13
Nez Perce County	Nez Perce County, ID	Peck 1 & 2	2	0.4
Clearwater County	City Of Orofino, ID	Orofino	1	0.27
Bingham County	Bingham County, ID	Nonpareil	1	1.69
Lewis County	City Of Nez Perce, ID	Nez Perce	1	1.15
Ada County	Flood Control District #10 Of Idaho	Mink Farm	1	0.48

County	Sponsor(s)	System Name	Segment(s)	Length (Miles)
Blaine County	Flood Control District #9 Of Idaho	Meyers	1	0.3
Benewah County	Meadowhurst Diking District	Meadowhurst	1	3.89
Madison County	Sunnydell Irrigation District	Lyman Creek (Right Bank)	1	0.83
Madison County	Sunnydell Irrigation District	Lyman Creek (Left Bank)	1	0.79
Washington County	Washington County Flood Control District #3	Lyle	1	0.52
Bonner County	Village Of Clark Fork	Lightning Creek	1	0.74
Gem County	Gem County, ID	Letha Bridge (Left Bank)	1	0.16
Lemhi County	City Of Salmon, ID	Lemhi	1	1.02
Idaho County	City Of Kamiah, ID	Lawyers Creek RB	1	1.56
Idaho County, Lewis County	City Of Kamiah, ID	Lawyers Creek LB	1	1.62
Kootenai County	Kootenai County	Latour Creek	1	0.51
Boundary County	Boundary County	Kootenai Dike District 9	1	4.03
Boundary County	Boundary County	Kootenai Dike District 8	1	7.68
Boundary County	Boundary County	Kootenai Dike District 6	1	11.2
Boundary County	Boundary County	Kootenai Dike District 5	1	3.24
Boundary County	Boundary County	Kootenai Dike District 4	1	5.76
Boundary County	Boundary County	Kootenai Dike District 3	1	3.77
Boundary County	Boundary County	Kootenai Dike District 2	1	3.16
Boundary County	Boundary County	Kootenai Dike District 16 South Segment	1	4.69
Boundary County	Boundary County	Kootenai Dike District 16 North Segment	1	1.85
Boundary County	Boundary County	Kootenai Dike District 15	1	0.95
Boundary County	Boundary County	Kootenai Dike District 13	1	4.29
Boundary County	Boundary County	Kootenai Dike District 12	1	6.02
Boundary County	Boundary County	Kootenai Dike District 11	1	9.08
Boundary County	Boundary County	Kootenai Dike District 10	1	8.39
Boundary County	Boundary County	Kootenai Dike District 1	1	4.25
Idaho County	City Of Kooskia, ID	Kooskia South Fork (Right Bank)	1	1.46
Idaho County	City Of Kooskia, ID	Kooskia South Fork (Left Bank)	1	0.5
Idaho County	City Of Kooskia, ID	Kooskia Middle Fork	1	0.4

County	Sponsor(s)	System Name	Segment(s)	Length (Miles)
Washington County	Washington County Flood Control District #3	Kirk (Upstream)	1	0.51
Washington County	Washington County Flood Control District #3	Kirk (Downstream)	1	0.77
Latah County	City Of Kendrick, ID	Kendrick EDA Project	1	0.36
Latah County	City Of Kendrick, ID	Kendrick	1	0.69
Shoshone County	City Of Kellogg	Kellogg	1	0.85
Payette County	Payette County, ID	John McKinney to Carpenter Levees	5	2.28
Benewah County	St. Joe Drainage District 3	Hwy. 3 (St. Joe)	1	2.59
Butte County	Butte County, ID	Howe	1	0.46
Boise County	City Of Horseshoe Bend, ID	Horseshoe Bend	1	1.31
Canyon County	Flood Control District #11 Of Idaho	Hitch	1	0.24
Payette County	Payette County, ID	Highway 52 Bridge	1	0.48
Gem County, Payette County	Payette County, ID	Highsmith	1	0.48
Jefferson County	Flood Control District #1 Of Idaho	Heise-Roberts 3 (Right Bank - Lower)	1	2.72
Madison County	Flood Control District #1 Of Idaho	Heise-Roberts 2 (Right Bank - Upper)	1	10.08
Jefferson County	Flood Control District #1 Of Idaho, Unknown	Heise-Roberts 1 (Left Bank)	2	30.57
Gooding County	City Of Gooding, ID	Gooding Diversion (Upstream)	1	0.77
Gooding County	City Of Gooding, ID	Gooding Diversion (Downstream)	1	0.1
Gem County	Payette County, ID	Garfield	1	0.51
Blaine County	Flood Control District #9 Of Idaho	Gage	1	0.46
Bingham County	Bingham County, ID	Ferry Butte	1	0.39
Payette County	Payette County, ID	Falk Bridge	1	0.31
Ada County	Flood Control District #10 Of Idaho	Fairgrounds	1	0.23
Gem County	City Of Emmett, ID	Emmett Sewage Lagoon	1	0.49
Gem County	City Of Emmett, ID	Emmett	1	0.71
Lemhi County	Lemhi County, ID	Edwards	1	0.1
Washington County	Washington County Flood Control District #3	Dickerson-Sweet	1	2.16
Blaine County	Flood Control District #9 Of Idaho	Deer Creek	1	0.09
Nez Perce County	City Of Culdesac, ID	Culdesac	1	0.64

County	Sponsor(s)	System Name	Segment(s)	Length (Miles)
Canyon County	Flood Control District #10 Of Idaho	Cromwell	1	0.74
Nez Perce County	Nez Perce County, ID	Cottonwood Church	1	0.12
Benewah County	Cottonwood Diking District	Cottonwood	1	2.22
Kootenai County	City Of Coeur D' Alene	Coeur D' Alene	1	1.63
Benewah County	City Of St. Maries, Shepherd Diking District	Cherry Creek / Shepherd	2	2.38
Payette County	Payette County, ID	Chapman	2	0.76
Kootenai County, Shoshone County	Kootenai County, Shoshone County, Unknown	Cataldo	3	0.99
Lemhi County	Lemhi County, ID	Carmen	1	0.83
Washington County	Washington County Flood Control District #3	Cambridge	1	0.23
Blaine County	Flood Control District #9 Of Idaho	Broadford Bridge / Eccles	1	0.54
Washington County	Washington County Flood Control District #3	Braun	1	0.5
Payette County	Payette County, ID	Bowman	1	0.48
Boundary County	City Of Bonners Ferry	Bonner's Ferry Sewage Treatment Right Bank	1	1.06
Boundary County	City Of Bonners Ferry	Bonner's Ferry Left Bank	1	1.55
Kootenai County	Eastside Highway District	Blue Lake	1	2.67
Bingham County	Flood Control District #7 Of Idaho	Blackfoot 3 (Left Bank of Diversion Channel)	1	0.53
Bingham County	Flood Control District #7 Of Idaho, Unknown	Blackfoot 2 (Left Bank)	2	3.58
Bingham County	Flood Control District #7 Of Idaho	Blackfoot 1 (Right Bank and Right Bank of Diversion Channel)	2	4.82
Blaine County	Flood Control District #9 Of Idaho	Bible Camp	1	0.14
Latah County	City Of Kendrick, ID	Bear Creek	1	0.22

Source: USACE 2017

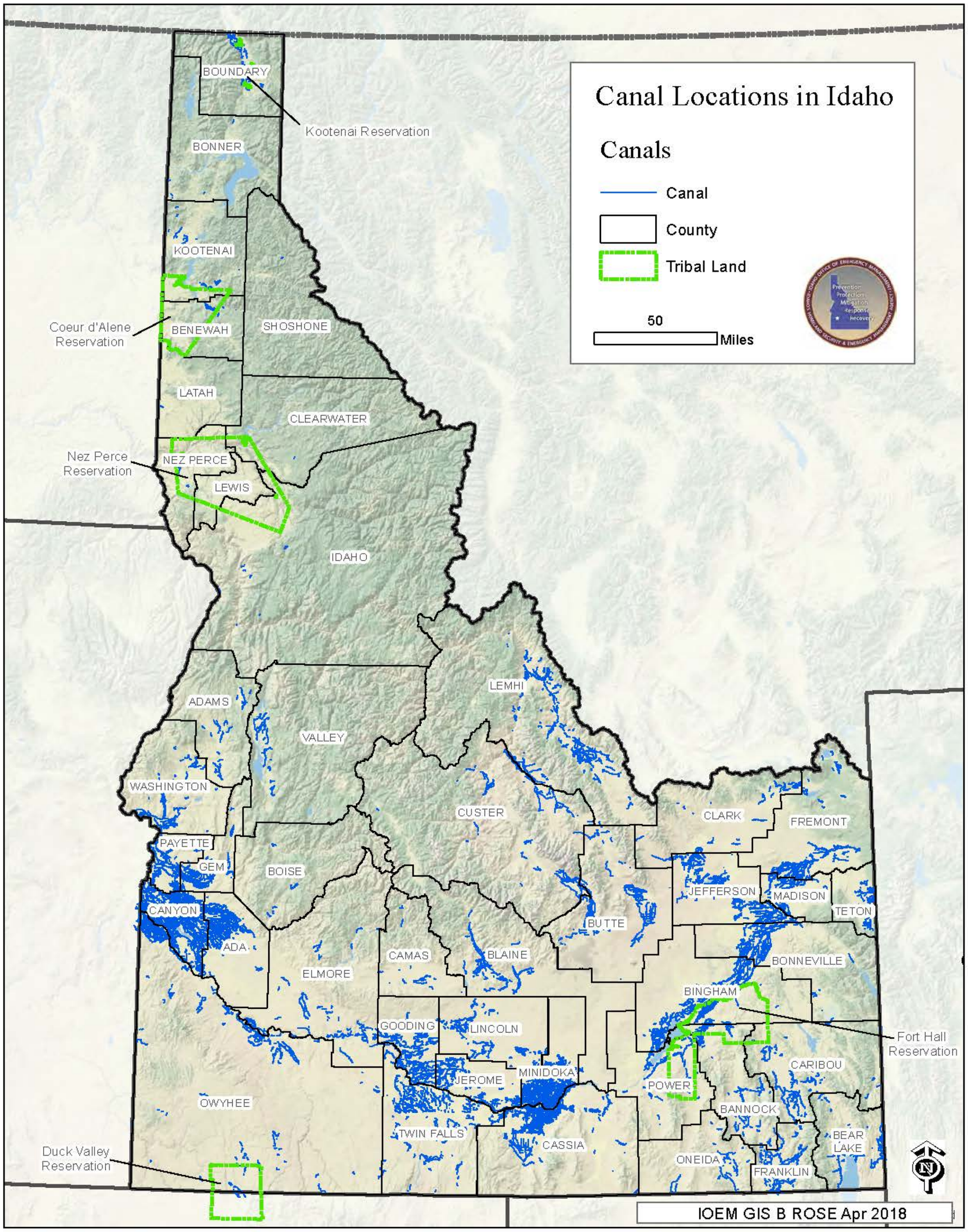
Levees require maintenance to continue to provide the level of protection they were designed and built to offer. Maintenance responsibility belongs to a variety of entities including local, state, and federal government and private landowners. Levee maintenance is a certification requirement for levee accreditation under FEMA's National Flood Insurance program (44CFR § 65.10). Levees may not be certified for maintaining flood protection when the levee owner does not maintain the levee or pay for an independent inspection. The impacts of an un-certified levee include higher risk of levee failure. In addition, insurance rates may increase because FEMA identifies on Flood Insurance Rate Maps that the structures are not certified to protect from a one-percent annual chance flood event (FEMA 2004).

Canals

Agriculture, and eventually development, across the arid portions of Idaho was made possible through the construction of irrigation canals. Water delivery to the agricultural areas included both small early projects and large-scale projects such as dams to collect water and canals to deliver water. The presence of the canals is generally disregarded by the general public, despite the fact that a large number of canals crisscross the State. New and existing community development has encroached on the areas adjacent to the canals. In Ada County, a considerable number of housing developments are situated near large-capacity canals. The proximity of development to this type of high flow, manmade channel creates a significant risk to life, safety, and property. Canal operators in Idaho have statutory easements so that they can maintain their canals and ditches, and many new and existing developments encroach directly into these easements. This encroachment, which in some cases is actually onto the banks of the canal, makes proper maintenance of the canals very difficult and can also compromise the safety of the canal.

Canal operators should be consulted before new developments in the vicinity of their irrigation structures are approved in order to protect canal easements. This will ensure the canal operators have sufficient access to their canals so that they can maintain these irrigation structures and thus prevent future safety issues. Because most canals are privately owned and operated, and their construction precedes Idaho's surface water laws, widespread data for canal failure events is not readily obtainable. The Idaho Silver Jackets technical advisory group has expressed strong interest in monitoring this issue, and IOEM anticipates further discussions regarding flood hazards associated with canals. As seen in 3.2.K, a majority of the canal systems are located in the southern portion of the State.

Figure 3.2.K. Idaho Canal Systems



Past Occurrence

Flooding Previous Occurrence

Many sources provided flooding information regarding previous occurrences and losses associated with flooding (riverine, flash, alluvial fan, ice jams, dam/levee/canal failure) events throughout the State of Idaho. The 2013 Plan discussed specific flooding events that occurred in Idaho through 2012. For this 2018 Plan update, flood events were summarized between January 1, 2012 and October 1, 2017. Table 2.2.M includes events discussed in the 2013 Plan and events that occurred between 2012 and 2017. Figure 3.2.N shows where major flooding events occurred. Major events include those that resulted in losses or fatalities, as reported by NOAA's National Centers for Environmental Information (NCEI). With flood documentation for Idaho being so extensive, not all sources have been identified or researched. Additionally, loss and impact information for many events could vary depending on the source. Therefore, Table 2.2.M may not include all events that have occurred in the state and the accuracy of monetary figures discussed is based only on the available information identified during research for this HMP update.

Figure 3.2.L 1948 Flood Sandpoint, ID /
Source: Ross Hall - www.ccrh.org

According to NOAA's NCEI storm events database, Idaho experienced 617 flooding events between 1950 and 2017. Total property damage was estimated at over $180 million and total crop damage was estimated at over $20 million.

Table 1.2.M. Flood Events in Idaho, 1894 – 2017

Date(s) of Event	Event Type	Counties Affected	Description
1894	Flooding	Statewide	No reference and/or no damage reported.
1927	Flooding	Upper Snake River Basin	No reference and/or no damage reported.
1933	Panhandle Floods	Kootenai and Benewah	In 1933, warm rain on low-elevation snow led to flooding in the Panhandle region, especially on the Coeur d'Alene River at Coeur d'Alene and the St. Joe River at St. Maries. Railroad tracks were covered with 6 feet of water, livestock drowned, all the families had to leave their homes, and in many cases, their houses were washed down the river. Levees were destroyed, and the entire St. Joe valley became one vast lake. Despite USACE levee construction in 1942, additional flooding in this area occurred in 1946, 1948, 1976, and 1996.
1943	Flooding	Boise and Payette River Basins	No reference and/or no damage reported.
1948	Flooding	Northern and Western Idaho	No reference and/or no damage reported.
1955	Flooding	Southwest Idaho	No reference and/or no damage reported.

Date(s) of Event	Event Type	Counties Affected	Description
April 21, 1956	Flooding (DR-55)	N/A	No reference and/or no damage reported.
May 27, 1957	Flooding (DR-76)	N/A	No reference and/or no damage reported.
August 20, 1959	Flash Flood	Ada	The largest precipitation-related flash flood in recent history occurred August 20, 1959, inundating about 50 blocks in Boise and several hundred acres of farmland with water, rocks, and mud.
1959	Boise Floods	Ada	Wildfires in 1959 lead to dramatic flooding and mudslides around the Boise area. The USDA produced a film showing the resulting mitigation efforts, which has recently been posted online (http://www.youtube.com/watch?v=D2JKOgsrU2M).
June 26, 1961	Flooding (DR-116)	N/A	No reference and/or no damage reported.
February 14, 1962	Flooding (DR-120)	Southern and Eastern Idaho	No reference and/or no damage reported.
February 14, 1963	Flooding (DR-143)	Portneuf and Clearwater Basins	No reference and/or no damage reported.
December 31, 1964	Heavy Rains and Flooding (DR-186)	Statewide and Low Elevations	At the end of December 1964, warm rains on snow caused the Payette, Clearwater, and Big and Little Wood Rivers to flood. The Payette River rose to record levels and flooded irrigation ditches and farmland; estimated damage was $21 million, and two deaths were reported.
March 2, 1972	Severe Storms, Extensive Flooding (DR-324)	Latah	No reference and/or no damage reported.
January 25, 1974	Severe Storms and Flooding (DR-415)	Adams, Benewah, Bonner, Boundary, Clearwater, Kootenai, Latah, Shoshone, and Washington	Significant flooding struck the St. Joe River Valley again in January 1974. Damages were estimated at $4 - $5.5 million to public facilities (including roads and utilities) and $1.5 million to private property.
1976	Teton Dam Failure		Teton Dam Failure
January 1984	Ice Jams and Flooding	Lemhi	*Lemhi Ice Jam Floods – 1984.* In January 1984, extensive ice jam formation in the Lemhi River, just above the confluence with the Salmon River, led to flooding in and around the town of Salmon. Weather leading to this ice jam flood was typical, with nighttime temperatures averaging -20°F and daytime temperatures near 0°F. Although initial ice jam build-up began on December 22 in the Salmon River, aggressive ice control and flood fighting had allowed local crews to contain the floodwaters prior to January 19th. Flood damage occurred on January 19, 21, 23, and 28. After the floodwaters receded, ice up to 3 feet thick remained in many homes and ice nearly 5 feet thick remained around homes and along streets. Ice jams are frequent in the area, but the flooding was labeled as a base flood event.
February 16, 1984	Ice Jams and Flooding (DR-697)	Lemhi	On February 16, 1984, President Reagan declared the Lemhi County ice jam, ice, and flooding damages a disaster (under the designation of DR-697). The entire county was included in the declaration. Disaster costs included approximately: $433,000 of public assistance – flood fighting, cleanup, and repair work (including extensive levee reconstruction by the USACE); $613,000 of

Date(s) of Event	Event Type	Counties Affected	Description
			private assistance – SBA home and business loans, insurance claims, and grants. USACE completed Oakley Dam Advance Measures, which were a combination of emergency repairs to outlet controls, and mitigate measures (emergency bypass canal, flashboards) by USACE. Nearly repeated again in 2017. Most of the damage was concentrated in Salmon and in adjacent developed agricultural fields. Only minor injuries were reported, but 325 people were displaced and 81 residences were damaged. Much credit was given to local search and rescue teams for preventing serious injury and loss of life. Businesses, roads, sewers, and levees were also damaged.
May 1991	Flash Flood	Bonner	Warm rain on snow lead to a significant flash flood event near Sandpoint in May 1991. The torrents blew out large sections of the road leading to Schweitzer Basin ski area stranding dozens of people, contaminated the city's primary water supply, and heavily damaged the water treatment facility. The cost to clean out and repair the water treatment facility ran to several hundred thousand dollars. A State Disaster declaration provided some assistance but without a Federal declaration the costs to the local community were very high.
June 25, 1992	Severe Thunderstorm, Flooding	Ada	Between 4 pm and 5 pm, a severe thunderstorm moving from the southeast towards the northwest struck Boise, Idaho. More than one inch of rain fell in less than one hour over the Boise urban area and produced flash flooding. Unofficial storm totals were measured at 1.6 inches in southeast Boise. Many streets in the downtown area were flooded with water one to two feet deep. The storm and flash flood occurred during the Boise River Festival and impacted thousands of people who had gathered in downtown Boise for a parade and other festival activities.
August 22, 1995	Flash Flood	Ada	On August 22, 1995, approximately two inches of rain fell on recently burned mountainous terrain near the North Fork of the Boise River, 45 miles to the northeast of Boise. These heavy rains caused a wall of water, rocks, and mud to flow down several creeks into the North Fork of the Boise River and over roads and campgrounds covering several vehicles.
February 11, 1996	Panhandle Floods (DR-1102)	Benewah, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Lewis, Nez Perce, Shoshone	A combination of existing snow, 10 inches of new snow, and single-digit temperatures the last week of January 1996 caused ice to form on many rivers. The subsequent warming pattern during the first week of February resulted in flooding in the northern Panhandle counties beginning on February 6. On February 11, 1996, the President declared a major disaster in the State of Idaho (designated DR-1102). Ten counties and the Nez Perce Indian Reservation were declared eligible for assistance. Relief totaled \$22,635,325 in public assistance, \$71,639 in individual assistance, \$301,081 from the Natural Resource Conservation Service (NRCS), and \$5,022,353 in hazard mitigation grants. In Clearwater County, 167 homes were damaged or destroyed, 40 commercial buildings were damaged, two churches were damaged and one was destroyed. In the Coeur d'Alene Basin (Kootenai and Shoshone Counties), it was reported that residents were stranded by the floodwaters and had to be contacted by boat, all-terrain vehicles, or helicopters. St. Maries, the Benewah County seat, saw heavy damage despite an extensive levee system; over 100 homes and 19 commercial buildings

Date(s) of Event	Event Type	Counties Affected	Description
			were flooded. At one mill, 1 million board feet of lumber and a drying kiln were lost. Latah County damage included an estimated $1.6 million in damages to the University of Idaho. Nez Perce County had damage near the community of Peck, where 11 homes were destroyed, six had major damage, and two had minor damage. Extensive damage was also reported on the Nez Perce Indian Reservation at Lapwai. Districts 1 and 2 of the Idaho Transportation Department were hit hard by the disaster. In District 1, major damage occurred on U.S. Highway 97 at Carlin Bay; U.S. 2 was closed at Dover, where water covered one-quarter mile of highway. Idaho Highways 200 and 3 were also damaged. Interstate 90 was closed temporarily at Pinehurst and Cataldo. Idaho Highway 6 was closed at Harvard Hill, where approximately 2 miles of road were damaged. 1948 Flood Sandpoint, ID: Source: Ross Hall - www.ccrh.org In District 2, U.S. 95 had 10 miles of damage; it was closed south of Lewiston, where the road washed out in many locations. The stretch of road north of Lewiston at the Palouse Bridge was also closed. Damage occurred on U.S. 12 east, between Cottonwood Creek and Orofino; Idaho 3 was closed from east of Arrow Junction to Juliaetta, with a washout area that was 400 feet long and 12 feet deep. Areas of Idaho Highways 11 and 162 were closed due to rock and mudslides. State Highways 6, 7, 9, and 64 were also damaged, and portions were closed for a period of time.
July 30, 1996	Flash Flood	Cassia	On July 30, 1996, after two hours of heavy rain on the slopes of Black Pine Peak in southeast Cassia County, a flash flood swept across the east bound lanes of Interstate 84, forcing a vehicle off the highway into deep water in a roadside ditch. The vehicle rolled and was carried more than 1,000 feet, and the driver was killed.
December 1996 – January 1997	Northern and Central Floods (DR-1154)	Adams, Benewah, Boise, Bonner, Boundary, Clearwater, Elmore, Gem, Idaho, Kootenai, Latah, Nez Perce, Owyhee, Payette, Shoshone, Valley, Washington	During late December 1996, above-normal snowfall occurred in Northern and Central Idaho. This event was quickly followed by a warm, moist current of air from the subtropics that dumped warm rain or melting snow. The melting snow and heavy rains overwhelmed rivers and their tributaries, leading to severe flooding and widespread landslides mainly in the West- Central region of the State. On December 31, 1996 and January 1, 1997, warm heavy rain fell on extensive low elevation snow in Valley, Boise, Gem, Washington, and Adams Counties. The combination of rapid melting snow and the rain caused numerous mudslides and creeks to exceed their banks. Many roads, bridges, and railroads were washed out along with several homes. The community of South Banks was destroyed as mudslides carrying boulders the size of dump trucks and large trees bulldozed homes down to the canyon below. On January 4, 1997 the President declared a Federal disaster (designated as DR-1154) in the State of Idaho due to severe winter storms, flooding, mud, and landslides related to the above-normal snowfall and spring runoff. Eighteen counties were declared eligible for Federal assistance. Relief totaled $19,404,105 in public assistance, $39,988 in individual assistance, $125,937 from the NRCS, $576,314 from the USACE, and $5,593,892 in hazard mitigation grants. Flood damage was widespread. Railroad tracks and trestles were washed out in dozens of locations. Substantial gravel and silt deposits left by flood waters accumulated on agricultural lands; cattle were

Date(s) of Event	Event Type	Counties Affected	Description
			stranded and farm equipment was submerged and damaged. Pesticide containers and fuel tanks were disturbed by the sudden flooding on the Payette and Weiser Rivers. In the City of Payette, approximately 120 homes and 30 businesses were flooded; most problems from a levee break resulted in floodwaters two to three feet above the base flood elevation. In Gem County, 14 levees were damaged, including all three levees in Emmett, which showed large cracks and sections slumped into the river. On the Weiser River, irrigation canals carried floodwaters to portions of the floodplain that would not have normally been flooded by the river itself; some homes and businesses in Weiser were damaged or destroyed from floodwaters conveyed by these irrigation systems. U.S. 55 was restricted for one week and U.S. 95 experienced eleven washouts that stranded residents for days. McCall was isolated, suffering severe economic hardship due to disruption of its winter recreation activities. Five fatalities occurred as citizens self-evacuated by private aircraft during extreme weather.
March 1997	Northern and Southeastern Floods (DR-1777)	Benewah, Bingham, Bonner, Bonneville, Boundary, Butte, Custer, Fremont, Jefferson, Kootenai, Madison, Shoshone	In early March 1997, Northern Idaho received 12 to 18 inches of snow on top of an existing snowpack that exceeded 150 to170 percent of average. A rainstorm followed which resulted in a rapid snow melt. Precipitation for the month of March in this area was 187 percent of normal. The resulting flooding and mudslides lasted for an extended period and damaged many public facilities, including severe impacts to county road systems due to washouts. Additionally, hazardous material contaminants were identified in the Kellogg area. The President issued a Federal Disaster declaration (DR-1177) on June 13, 1997, for Benewah, Bonner, Boundary, Kootenai, and Shoshone Counties. The Snake River Basin also received a significant amount of snowfall during the winter of 1996-97, with the snowpack exceeding 250 percent of normal in some higher elevations. By May, the substantial snowpack in the higher elevations along the continental divide started to produce above normal runoff. In order to accommodate the rapid accumulation, the Bureau of Reclamation began increasing its releases from Palisades Reservoir. By June 11, the flows coming out of the reservoir coupled with the high tributary discharges produced the highest flows on the Snake River since 1918. At its peak, the Snake River flooded as far as a mile from its banks, and many places were inundated by five feet of water. On June 16, flood fights were conducted on the Snake River at Roberts where voluntary evacuations were in effect. River levels were close to overtopping existing flood control levees and flooding of agricultural lands began far from the main channel as irrigation canals overflowed their banks. Numerous closures of county roads and State highways from water and damage to bridges, especially in Jefferson County, had an impact on transportation as well as on response activities. On June 17, flood fighting efforts continued in several small towns, including Menan, Firth, Blackfoot, and Labelle. On June 18, Interstate 15 was closed for nearly 20 miles between Shelley and Blackfoot. On July 7, 1997, six counties in Southeastern Idaho (Bingham, Bonneville, Custer, Fremont, Jefferson, and Madison) were added to the five northern counties already declared under DR-1177. On July 25, Butte County was also declared. Relief totaled $11,365,667 in public

Date(s) of Event	Event Type	Counties Affected	Description
			assistance, $8,054 in individual assistance, $251,054 from the NRCS, and $1,691,458 in hazard mitigation grants. The State estimated that approximately 500 people were displaced from their homes in Jefferson and Bingham Counties. Agricultural officials estimated that more than 50,000 acres of farm, pasture, and cropland had been flooded; 30,000 in Bingham County alone.
April 14, 2002	Flash Flood	Valley and Boise	On April 14, 2002, flash flooding damaged roads and bridges in Valley and Boise Counties. A debris flow during this event crossed the Banks to Lowman Road near Stair Case rapids. Valley County experienced over 1 million dollars in damage to roads and bridges in the Donnelley area due to small stream flooding.
2003-2005	Flash Floods	Elmore	The road to Atlanta along the Middle Fork of the Boise River was washed out 3 times from 2003 through 2005 due to flash floods and debris flows originating on water repellent soils in the 2003 Hot Creek Fire Burn scar. Vegetation has returned to the burn area and the soil is not as water repellent as it was right after the fire.
June 29, 2004	Severe Thunderstorm, Flash Flood	Ada	On June 29, 2004, between 3:30 pm and 4:30 pm, a severe thunderstorm moving from the southeast towards the northwest struck Boise Idaho. Rainfall accumulations of 1.27 inches in one hour were measured in the north end of Boise that caused flash flooding to develop rapidly. Many streets in the downtown area and in the north end experienced flooding. Minor flood damage occurred to some north end businesses and residential areas. The State Capitol building also sustained some water damage when water entered portions of the basement.
May 6-20, 2005	Flooding (DR-1592)	Nez Perce	A number of storms hit Nez Perce County and a portion of the Nez Perce Indian Reservation from May 6th -20th. On July 6, the President issued a Federal Disaster Declaration (DR-1592). Approximately $1.7 million in damages to infrastructure was assessed and a few individual homes were affected.
April 2006	Flooding	Camas, Lincoln and Gooding	In April 2006, a State disaster was declared and was extended several times to February 2007. The event was caused by above average spring precipitation, heavy runoff, and rapid snowmelt resulting in flooding in Camas, Lincoln, and Gooding Counties. The State's costs were as follows; Gooding County - no State monies were paid, Camas County - $454,171.14, and Lincoln County - $21,757.51.
December 30 – January 4, 2006	Winter Flooding (DR-1630)	Owyhee	From December 30th, 2005 through January 4th, 2006 a severe winter storm and flooding impacted Owyhee County. Presidential Disaster Declaration (DR-1630) was issued on February 28th.
May 15 – June 9, 2008	Panhandle Flooding (DR-1781)	Kootenai, Shoshone	Extensive flooding impacted portions of Kootenai and Shoshone counties from May 15th through June 9th. Over $1 million dollars of bridge and road damages occurred. The President signed the Disaster Declaration (DR-1781) on July 31.
June 2-10, 2010	Northern State Flooding (DR-1927)	Adams, Gem, Idaho, Lewis, Payette, Valley, Washington	Severe storms and associated flooding impacted a large portion of the State between June 2nd and 10th. On July 27th, the President signed off on a Disaster Declaration (DR-1927). Counties impacted included: Adams, Gem, Idaho, Lewis, Payette, Valley, and Washington. Preliminary damage estimates included over $5 million to roads and bridges.

Date(s) of Event	Event Type	Counties Affected	Description
March 31 – April 11, 2011	Northern Idaho Flooding (DR-1987)	Clearwater, Idaho, Nez Perce	Flooding, landslides, and mudslides impacted a large portion of the State between March 31st and April 11th. On May 20th, the President signed off on a Disaster Declaration (DR-1987). Counties impacted included: Bonner, Clearwater, Idaho, Nez Perce, and Shoshone in addition to the Nez Perce Tribe. Preliminary damage estimates to infrastructure totaled $4.6 million.
May 10 – July 19, 2011	Eastern Idaho Flooding	Jefferson, Madison, and Bingham Counties	Late spring temperatures, combined with rain, delayed snowmelt until late April. High flows persisted on the Snake River above American Falls from 10 May to 19 July, with a peak flow of 31.4 KCFS recorded at Blackfoot on 28 May.
February 5-27, 2017	Severe Winter Storms and Flooding (DR-4310)	Statewide	Extreme snowfall amounts in December and January led to extensive flooding issues in February. The hardest hit counties included Cassia, Minidoka, Jefferson, Lincoln and Bingham Counties but all counties in the state experienced at least minor flooding. Flooding began February 4th and continued to affect low lying areas until the end of the month and continued into March. Overall, the State of Idaho had approximately $9.06 million in property damage from this event. In Ada County, neighborhood roads and yards along Cole Road were inundated due to Five Mile Creek flooding. In Bannock County, field flooding occurred throughout the County. A house on Andrew Street in Pocatello also flooded on February 8th. Wallin Road was closed on February 10th in Chubbuck due to water on the road. The area of Marsh Creek also flooded. The Portneuf River in Pocatello reached flood stage on the 11th with flooding in Sacajawea Park. In Benewah County, an ice jam on the St. Joe River flooded portions of St. Joe River Road and making it impassable. Minor field flooding was reported downstream as the ice jam broke up and released the dammed water. Other counties reported sheet flooding, fields flooding, flooded roadways that become impassable, damaged roads, basement flooding, and ice jams. Custer County declared a county disaster due to damages from the flooding and snow melt. On February 10th, an ice jam developed on the St. Joe River between St. Maries and Calder. Water backed up behind the ice jam causing minor flooding upstream in the Town of Calder. St. Joe River Road also flooded in places which led to closing of the road. An ice jam also occurred on Weiser River, just south of Weiser and caused flooding on U.S. Highway 95. Jefferson County was declared a disaster area by the State due to the magnitude of damage. Roadway flooding occurred near Roberts on February 11th and 12th, but extreme flooding commenced after the 19th. Numerous roads were closed throughout the county due to flooding. Water on some roads reached levels that caused cars to float. Road crews described some roads similar to waterfalls. Lincoln County was also declared a disaster area by the State due to significant damage to homes and roadways. Many roads were closed by the 11th with water over roadways from east of Shoshone to the Minidoka County line. The Town of Kimana had significant flooding as well. On March 30, 2017, Governor Otter requested a major disaster declaration due to the severe winter storms and flooding experienced during the period of February 5-27, 2017. The Governor requested a declaration of Public Assistance for 11 counties and hazard mitigation statewide. On April 21, 2017, President Trump declared that a major disaster declaration exists in the State of Idaho. The declaration made Public Assistance available and eligible local governments and certain

Date(s) of Event	Event Type	Counties Affected	Description
			private non-profit organizations. The primary impact from this disaster was damage to roads and bridges. The State requested over $8.7 million in public assistance.
March 6-28, 2017	Severe Storms, Flooding, Landslides and Mudslides (DR-4313)	Benewah, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Shoshone, and Valley	The month of March was a very wet month over the Idaho Panhandle region. A series of storms brought periodic heavy rain to the region. The rain, in combination with warmer temperatures and rapid snowmelt, widespread flooding occurred. Rainfall totals ranged from 4.58 inches in Bonners Ferry to 7.19 inches at the University of Idaho at Moscow. This led to numerous debris flows in steep terrain and widespread flooding in fields and low lying areas. Numerous roads were flooded or cut by debris flows throughout the Idaho Panhandle during the second half of March. The St. Joe River, the Coeur D'Alene River and Palouse River as well as numerous smaller streams and lakes rose above flood stage during this event. The St. Joe River at Calder crested at 13.1 feet on March 16th and 13.5 feet on March 19th. The Weiser River reached minor flood stage. The Palouse River reached major flood stage which led to extensive flooding of fields, parks and roads in the river bottom. The St. Joe River reached flood stages, flooding fields, roads, outbuildings, and yards of residences and businesses. Emergency repairs were needed to stabilize a threatened levee in the town of St. Maries. Flooding along the Payette and Snake Rivers impacted the surrounding fields and roadways. Lake Coeur D'Alene and the Spokane River draining Lake Coeur d'Alene also crested above flood stage damaging numerous docks, parks and homes along the shore line and river. The Lake Coeur D'Alene gauge at Coeur D'Alene recorded a rise above the lake Flood Stage of 2133.0 feet on March 18th. The lake crested at 2134.9 feet on March 21st. The affected counties reported mudslides, extensive field and roadway flooding, sheet flooding, damage to infrastructure, stranded residents, and damage to homes and businesses. In Bonner County, a train carrying 50 to 60 empty coal cars derailed near Kootenai after the trackers were undermined by flooding. A landslide knocked a home off its foundation and carried it down a hill near Sagle. Idaho declared a state of emergency for seven counties in north Idaho to assist recovery crews in obtaining resources to repair damage to area roads and other infrastructure. These counties were also included in a FEMA major disaster declaration. On May 1, 2017, Governor Otter requested a major disaster declaration due to the severe storms, flooding, landslides, and mudslides that occurred during the period of March 6-28, 2017. The Governor requested a declaration of Public Assistance for eight counties and hazard mitigation statewide. On May 18, 2017, President Trump declared that a major disaster declaration exists in the State of Idaho. The declaration made Public Assistance available and eligible local governments and certain private non-profit organizations. The primary impact from this disaster was damage to roads and bridges. The State requested over $9.6 million in public assistance. Overall, the State of Idaho had approximately $10.5 million in damages from this series of flooding events.
April 2017	Flooding (DR-4342)	Ada, Blaine, Bannock, Canyon, and Lincoln	The month of April brought heavy rain, snowmelt and flooding to Idaho. The St. Joe River began to flood in March and remained above minor flood stage at St. Maries through early April. The Big Wood River

Date(s) of Event	Event Type	Counties Affected	Description
			flooded in east-central Gooding County along Highway 46. The Boise River flooded throughout April as a result of flood control efforts by USACE (planned releases from Lucky Peak Reservoir). The Snake River flooded in southern Washington County. In Blaine and Lincoln Counties, releases from Magic Reservoir closed West Magic Road in Magic City (Blaine County). In Lincoln County, there was field flooding from Big Wood River which also washed out a bridge on personal property. Madison County declared a flood emergency. The County experienced river bank erosion due to high runoff. In Bannock County, the Portneuf River continued to flood through much of April with the gauge in Pocatello above flood stage much of the month and occasionally to moderate flooding stage. Sacajawea Park was under water for much of the month. Some flooding continued also in the Inkom area from the river with the area between BlackRock and Inkom off Portneuf road, and the subdivision off of Leo Lane. On October 7, 2017, President Trump declared that a major disaster declaration exists in the State of Idaho.
May 6 – June 16, 2017	Flooding, Landslides, and Mudslides (DR-4333)	Ada, Bannock, Blaine, Camas, Canyon, Custer, Elmore, and Gooding	As in March and April, winter storm melt from record winter snowfall led to flooding in southeast Idaho, especially in the central mountains and along the Big Wood River. Field flooding caused agricultural damage and many roads and facilities were damaged from the floods as well. In Ada and Canyon Counties, the Boise River remained in flood stage during the entire month of May due to the planned release from Lucky Peak dam. In Madison County, minor flooding continued through the month, damaging roads and agricultural crops and a levee. In Bannock County, the Portneuf River remained above flood stage for most of the month with much of the flooding occurring in the Inkom area. The Sacajawea Park in Pocatello remained flooded as well for much of the month. Fields in Inkom encountered agricultural damage with many roads and bridges in that area damaged. In Custer County, the Salmon River at Salmon reached moderate flood stage and caused flooding from the headwaters of the river through Challis into Custer County. Trail Creek, Valley Creek, Garden Creek and Antelope Creek all overflowed banks with flood warnings throughout the month continuing. Backcountry roads and campgrounds experienced major damage. The flooded fields led to significant agriculture damage. In Blaine County, the Big Wood River reached moderate and major flood stage at Hailey. The entire Big Wood River Valley experienced major flooding with as many as 5,000 evacuations from Bellevue to Hailey to Ketchum and Sun Valley. Many people were without power in the valley. Damage in the county included farms, homes, businesses, roadways, bridges, infrastructure, preserves, and levees. On July 19, 2017, Governor Otter requested a major disaster declaration due to flooding, landslides, and mudslides that occurred during the period of May 6-June 16, 2017. The Governor requested a declaration of Public Assistance for five counties and hazard mitigation statewide. On August 27, 2017, President Trump declared that a major disaster declaration exists in the State of Idaho. The declaration made Public Assistance available and eligible local governments and certain private non-profit organizations. The primary impact from this disaster

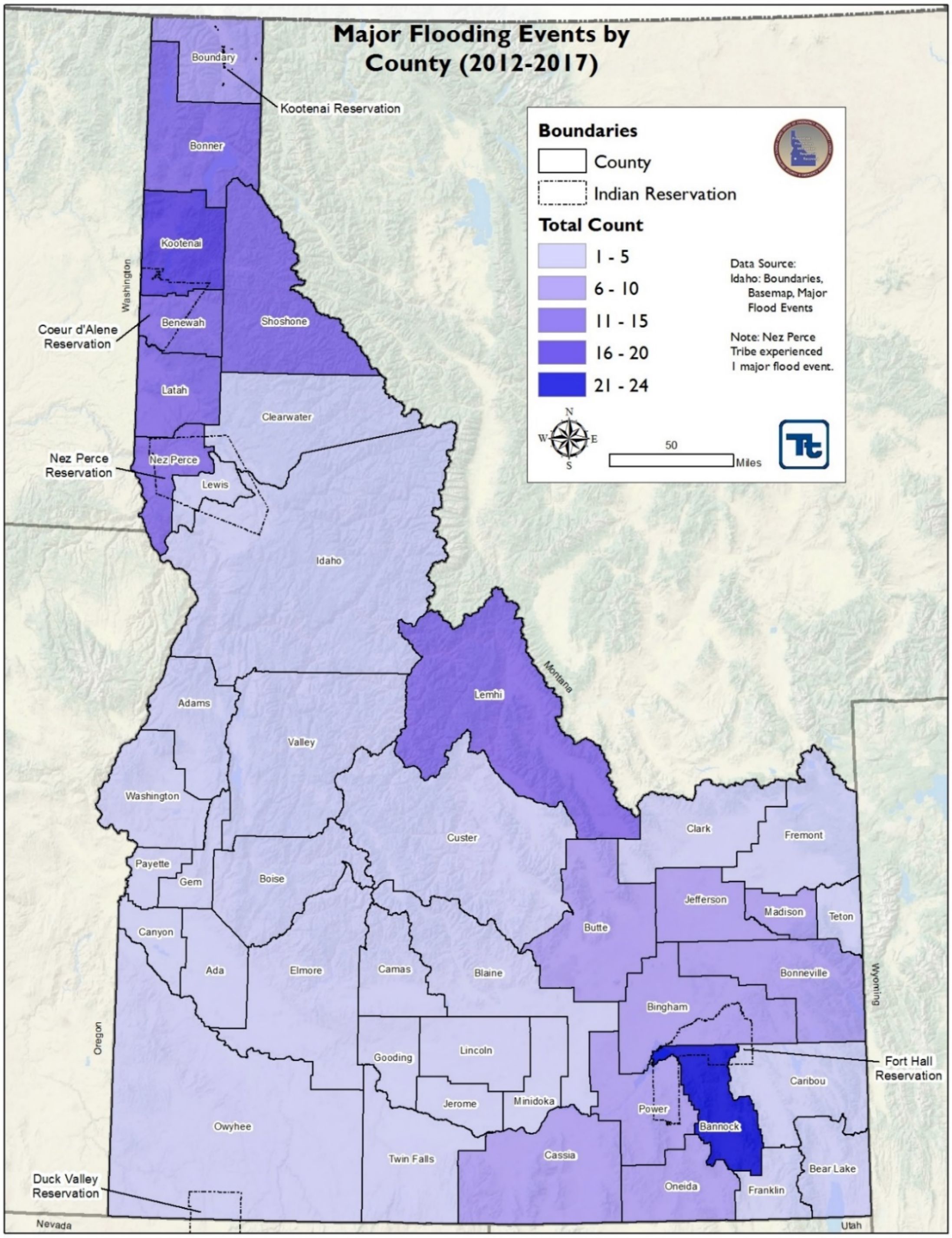
Date(s) of Event	Event Type	Counties Affected	Description
			was damage to roads and bridges. The State requested over $3.8 million in public assistance. Overall, the State had approximately $10.3 million in damages from this event.

Source: Idaho State HMP 2013; FEMA 2017; NOAA NCEI 2017

Extreme precipitation and runoff cause flash floods, which occur throughout the State at all times of the year. Many are not well recorded because they are relatively small and do little damage.

Minor flooding, due to inadequate urban drainage systems, is a common occurrence in Idaho's cities. Climate, mountainous surroundings, and rapid growth have in some cases resulted in insufficient urban drainage systems. For example, Pocatello is located at the mouth of the Portneuf Canyon with generally mountainous terrain bordering the city on the east and south. Showers and thundershowers in the late spring and summer often result in highly localized precipitation concentrations that overwhelm the urban drainage systems and cause significant damage. In September 1998, hundreds of homes in Idaho Falls were damaged when 1.17 inches of rain fell in twenty-four hours overwhelming the drainage system. Flash flooding from severe thunderstorms resulted in basement-flooding in Pocatello in 1999. Pocatello constructed an aqueduct that carries stormwater to settling ponds to mitigate flooding, and the ponds also serve as a natural expansion area for riverine flooding.

Figure 3.2.N. Major Flooding Events by County, 2012-2017



Note: Major events include those identified in the NOAA-NCEI storm events database where there were losses and/or fatalities associated with the event.

Ice Jams Previous Occurrence

Ice jams have played a role in a number of floods in the State. Significant ice jams have occurred on: the Teton, Portneuf, and Snake Rivers in the east; the Little Lost (at Howe), Salmon, and Lemhi Rivers in the central region; the Payette and Weiser Rivers in the west; and the Kootenai (at Bonners Ferry) and Clearwater (extensive overbank flooding in 1974 and 1996) Rivers in the Panhandle region. The most notable ice jam flood was on the Lemhi River near Salmon in 1984, an event that led to a Federal Disaster declaration.

There have been 305 reported ice jams in Idaho since 1909 (CREEL 2017). According to the United States Army Cold Regions Research and Engineering Laboratory's (CRREL) database, ice jams have historically formed at various points along the Antelope Creek, Bannock Creek, Bayview Creek, Bear River, Bear Valley Creek, Beaver Creek, Big Wood River, Blackfoot River, Boise River, Boulder Creek, Bruneau River, Camas Creek, Challis Creek, Clear Creek, Clearwater River, Coeur d'Alene River, Deadwood River, East Fork Bruneau River, East Fork Weiser River, Falls River, Goose Creek, Hayden Creek, Henrys Fork River, Kootenai River, Lemhi River, Lime Creek, Little Lost River, Little Salmon River, Little Wood River, Medicine Lodge Creek, Middle Fork Salmon River, Middle Fork Weiser River, Mission Creek, Moore Creek, Mores Creek, Moyie River, Mud Creek, North Fork Clearwater River, North Fork Payette River, Orofino Creek, Pahsimeroi River, Palouse River, Panther Creek, Payette River, Pine Creek, Porter Creek, Portneuf River, Robie Creek, Saint Joe River, Salmon River, Secesh River, Snake River, South Fork Boise River, South Fork Clearwater River, South Fork Payette River, South Fork Salmon River, St. Joe River, St. Maries River, Sucker Creek, Teton River, Weiser River, West Fork Weiser River, and Yankee Fork Salmon River. Locations of historical ice jam events are indicated in 3.2.O.

For the 2018 Plan update, ice jam events were summarized between January 1, 2012 and October 1, 2017. 3.2.P lists the total number of ice jam events that occurred in each county. Table **3**3.2.Q includes events discussed in the 2013 Plan and events that occurred between 2012 and 2017. Please note that not all sources have been identified or researched. Additionally, loss and impact information for many events could vary depending on the source. Therefore, Table 3.2.Q may not include all events that have occurred in the state and the accuracy of monetary figures discussed is based only on the available information identified during research for this plan update.

Table 3.2.O. Number of Ice Jams between 1909 and 2017, by County

County	Total Number of Ice Jams	County	Total Number of Ice Jams
Ada	9	Gem	0
Adams	11	Gooding	3
Bannock	15	Idaho	3
Bear Lake	0	Jefferson	1
Benewah	12	Jerome	0
Bingham	10	Kootenai	3
Blaine	20	Latah	1
Boise	18	Lemhi	54

County	Total Number of Ice Jams	County	Total Number of Ice Jams
Bonner	0	Lewis	5
Bonneville	4	Lincoln	4
Boundary	6	Madison	1
Butte	18	Minidoka	0
Camas	1	Nez Perce	3
Canyon	1	Oneida	0
Caribou	1	Owyhee	3
Cassia	4	Payette	1
Clark	11	Power	0
Clearwater	4	Shoshone	15
Custer	10	Teton	2
Elmore	2	Twin Falls	0
Franklin	0	Valley	4
Fremont	8	Washington	37

Source: CREEL 2017

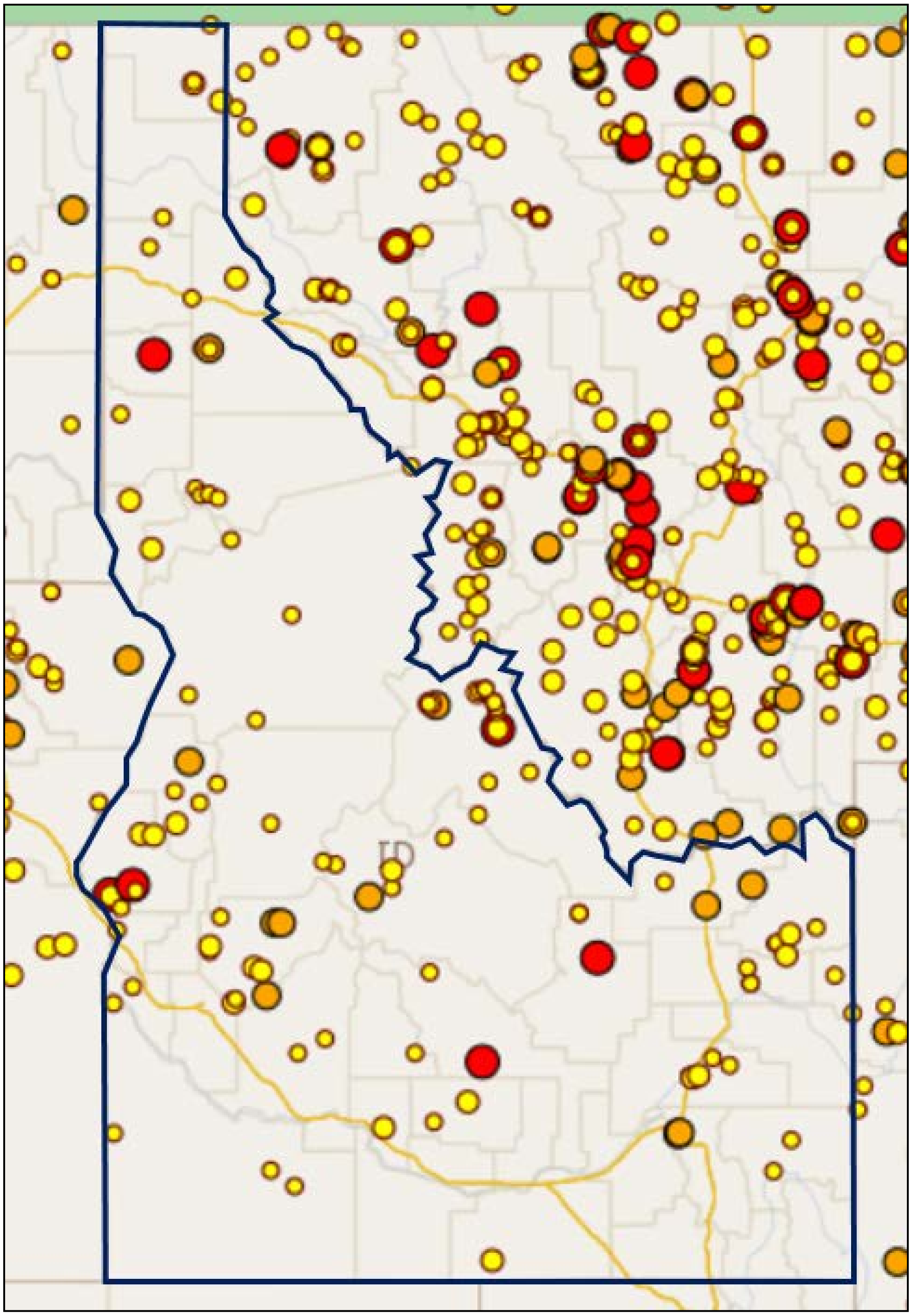
Table 3.2.P. Ice Jams Events in Idaho between 1970 and 2017

Event Date	River/Location	Counties Affected	Description/Losses
January 1984	Lemhi River (DR-697)	Lemhi	In January 1984, extensive ice jam formation in the Lemhi River, just above the confluence with the Salmon River, led to flooding in and around the town of Salmon. Weather leading to this ice jam flood was typical, with nighttime temperatures averaging -20°F and daytime temperatures near 0°F. Although initial ice jam build-up began on December 22 in the Salmon River, aggressive ice control and flood fighting had allowed local crews to contain the floodwaters prior to January 19th. Flood damage occurred on January 19, 21, 23, and 28. After the floodwaters receded, ice up to 3 feet thick remained in many homes and ice nearly 5 feet thick remained around homes and along streets. Ice jams are frequent in the area, but the flooding was labeled as a base flood event. On February 16, 1984, President Reagan declared the Lemhi County ice jam, ice, and flooding damages a disaster (under the designation of DR-697). The entire county was included in the declaration. Disaster costs included approximately: $433,000 of public assistance – flood fighting, cleanup, and repair work (including extensive levee reconstruction by the USACE); $613,000 of private assistance – SBA home and business loans, insurance claims, and grants. Most of the damage was concentrated in Salmon and in adjacent developed agricultural fields. Only minor injuries were reported, but 325 people were displaced and 81 residences were damaged. Much credit was given to local search and rescue teams for preventing serious injury and loss of life. Businesses, roads, sewers, and levees were also damaged. Woody debris commonly piles up in many drainage areas, especially those that have been logged. Lightning Creek (Pend Oreille), Lawyer Creek, and Little Wood River (Ketchum and Hailey) have all experienced flooding from debris jams. Flooding from such events tends to be localized but may cause significant damages.

Event Date	River/Location	Counties Affected	Description/Losses
January 20, 2012	Weiser River	Valley	No reference and/or no damage reported.
January 14, 2013	Salmon River	Lemhi	There was an estimated one mile long ice jam moving through the stretch of the Salmon River that runs through the City of Salmon in Lemhi County. Quickly rising water levels were observed as a result of this ice jam. The Main Street Bridge in the City of Salmon (Highway 93), as well as homes and structures near the banks of the River, experienced minor flooding.
January 21, 2013	Snake River	Washington	Unusual cold weather in January led to freezing-up of the Snake River near Weiser (Washington County).
December 9, 2013	Salmon River	Lemhi	In north central Idaho, ice jams continued to grow on the Salmon River between North Fork and Salmon. The jam was approximately 15 miles long.
December 11, 2013	Snake and Weiser Rivers	Washington	Ice jams were reported at the confluence of the Snake and Weiser Rivers in Weiser (Washington County).
November 16, 2014	Henry's Fork	Fremont	Fremont County Emergency Management reported minor flooding along the Henry's Fork River at St. Anthony due to an ice jam near the South Bridge Street bridge. On November 17th, the jam opened up a channel and the river gauge fell below flood stage.
December 8, 2016	Henry's Fork	Fremont	No reference and/or no damage reported.
December 16, 2016	Salmon River	Lemhi	An ice jam was spotted on the Salmon River in northern Lemhi County, causing minor flooding along the River in the vicinity of 4th of July Creek. Water spread out from the river due to the ice jam and impacting surrounding residents.
December 30, 2016	Big Wood River	Blaine	Ice jams were occurring on Big Wood River above Ketchum, causing isolated flooding.
January 4, 2017	Lemhi River	Lemhi	An ice jam on the Lemhi River in Lemhi County led to the NWS issuing a flood advisory for the area. OEM and law enforcement reported water backing onto a property along the River.
January 7, 2017	Snake River	Washington	15 mile long freeze up ice jam beginning near Farewell Bend State Rec Area, extended upstream to Payette
February 10, 2017	Mores Creek, Saint Joe River, and Weiser River	Ada, Shoshone, and Washington	An ice jam blocked the Weiser River from flowing normally into the Snake River. This led to the NWS issuing a flood warning for the Weiser River near Weiser. Water flowed around the normal channel. The east part of the City of Weiser in Washington County experienced some flood. Peak stage reached 12 feet. Along Mores Creek in Boise (Ada County), an ice jam released and ice and debris flowed downstream, causing elevated stages underneath a concrete bridge that leads to the Wilderness Ranch water treatment facility near Idaho 21.
March 6, 2017	Antelope Creek	Custer	No reference and/or no damage reported.

Sources: Idaho State HMP 2013; CRREL 2017

Figure 3.2.Q. Ice Jams in Idaho



Dam, Levee, and Canal Failure Previous Occurrence

Dam failure is infrequent but can have significant consequences. While there are have been no major failures of dams, levees, or canals recently, there have been major incidents in the past. Idaho has experienced two major dam failures in recent history: Teton Dam (1976) and Kirby Dam (1991). There have also been a number of "near-miss" incidents, where disaster was averted. For the 2018 Plan update, dam, levee, and canal failure events were summarized from 2012 to October 1, 2017. Table 3.2.S includes events discussed in the 2013 Plan and events that occurred between 2012 and 2017.

Figure 3.2.R. Teton Dam Failure, June 1976. / Source: http://www.damsafety.org.

During the first filling of the reservoir, the dam burst when the water was 270ft deep. It drained in less than 6 hours, setting off more than 200 landslides in the canyon below, taking 11 lives, and causing millions of dollars in property damage

Teton Dam Failure – 1976: On June 5, 1976, Teton Dam in Fremont County failed. An estimated 80 billion gallons of water were released from the reservoir into the Upper Snake River Valley. Devastating flooding occurred in Wilford, Sugar City, Rexburg, and Roberts; significant flooding occurred in Idaho Falls and Blackfoot. At the time of its failure, Teton Dam was brand new and stood 305 feet high, with a crest length of 3,100 feet and a base width of 1,700 feet. The dam was a zoned earth-fill structure with a volume of approximately ten million cubic yards. The floodwaters threatened American Falls Dam downstream on the Snake River. Dam managers opened the outlet works on American Falls full bore, to empty the Reservoir and to save American Falls Dam and the string of dams farther down the Snake River. On June 6, President Gerald Ford declared Bingham, Bonneville, Fremont, Madison, and Jefferson Counties a Federal disaster area. Eleven deaths were attributed to the dam failure and subsequent flood. Estimates of monetary damages ranged as high as $2 billion; the Federal government eventually paid over $300 million in claims. The U.S. Department of the Interior Bureau of Reclamation formed a dam safety program after this disaster, which has become a worldwide standard. (source: https://www.usbr.gov/pn/snakeriver/dams/uppersnake/teton/index.html)

Kirby Dam Failure – 1991: During the summer of 1990, it became apparent that the old log crib structure of the Kirby Dam near Atlanta had become unsound and was in jeopardy of failing. The possibility of failure was of special concern due to the large quantity of mine runoff and tailings that had collected behind the dam over the years. A strategy to stabilize the dam was developed by the Idaho Department of Water Resources and the U.S. Forest Service but was unsuccessful. On May 26, 1991, Kirby Dam collapsed, cutting off electrical power and blocking the primary access bridge to Atlanta.

Contaminated sediments (containing arsenic, mercury, and cadmium) were released into the Middle Fork of the Boise River.

Table 3.2.S. Dam, Levee, and Canal Failure Events in Idaho, 2012 to 2017

Dates of Event	Event Type	Counties Affected	Losses / Impacts
1917, 1955, and 1959	New York Canal	Ada	Built from 1906-1908 and enlarged in 1912, the canal runs through Boise, ID west for 40 miles to Lake Lowell. The structure's capacity is 2,800 cfs.
1973	Ridenbaugh Canal Failure	Ada	No reference and/or no damage reported.
June 5, 1976	Teton Dam Failure	Bingham, Bonneville, Fremont, Madison, and Jefferson	On June 5, 1976, Teton Dam failure resulted in eleven deaths and an estimated $2 billion in damages. Approximately 80 billion gallons of water were released flooding Wilford, Sugar City, Rexburg, Roberts, Idaho Falls, and Blackfoot. On June 6, President Gerald Ford declared Bingham, Bonneville, Fremont, Madison, and Jefferson Counties a Federal disaster area.
1984	Oakley Dam Failure	Cassia	Oakley Dam nearly overtopped - constructed canal to mitigate flooding
1984	Twin Falls County Dam Failure	Twin Falls	Salmon Falls Creek release caused flooding
1991	Kirby Dam Failure	Elmore	On May 26, 1991, Kirby Dam collapsed, cutting off electrical power and blocking the primary access bridge to Atlanta. Contaminated sediments (containing arsenic, mercury, and cadmium) were released into the Middle Fork of the Boise River.
2005	Gem County Canal Failure	Gem	Occurred in Emmett, breach necessitated assistance from Gem County Road and Bridge Dept.
2006	Mora Canal Failure	Mora	Constructed from 1909-1911 in Kuna, ID with a 1,300 cfs capacity, the canal breached due to unknown causes.
2009	Logan Northern Canal Failure (Utah)	N/A	Southeast neighboring community Logan, Utah suffered a 2009 failure of the Logan Northern Canal resulting in 3 deaths and extensive residential damages. Just three years prior a Utah State University thesis warned the community of this danger as did multiple landslide studies.
2010	Canyon County Canal Failure	Canyon	Occurred in Wilder, Washed out road
2010	Brown's Pond Dam Failure (DR-1927)	Valley	Browns Pond Dam overtop and breach during rain on snow event - federal declaration
2011	Canyon County Canal Failure	Canyon	Occurred in Caldwell, Washed out roads and flooded several homes
2011	Kootenai County Levee Failure	Kootenai	Hayden Lake imminent threat from wave erosion on dike
2011	Jerome County Canal Failure	Jerome	Occurred in Jerome, Flooded homes, basements, and streets and damaged a section of main railroad tracks.
2011	Elmore County Canal Failure	Elmore	Occurred in Glenns Ferry, Flooded homes, basements, and streets, damaged a section of main railroad tracks
April 22-30, 2012	Flood / Levee Failure	Benewah	Mountain snowmelt along with periods of moderate rainfall led to high flows on the Coeur d'Alene and St. Joe Rivers. Temperatures in the valleys across northern Idaho climbed into the 70s and lower 80s from April 23rd through the 26th. This warm spell was then followed by a cooler, but wet pattern through the end of April. The

Dates of Event	Event Type	Counties Affected	Losses / Impacts
			combination of snowmelt and rainfall resulted in main stem river flooding in the Coeur d'Alene and St. Joe River basins. High levels on Lake Coeur d'Alene resulted in a slow recession of the St. Joe River at St. Maries, which continued to have flooding problems into the month of May. In Benewah County, flood waters from the St. Joe River at St. Maries covered Lagoon Road and inundated some residential properties. Additionally, some damage was observed on the levees. A rotational failure on the riverward side and slippage in a part of the one of the levees occurred with approximately $20,000 in property damage.
July 1-11, 2012	Flood, Planned Dam Release	Boundary	Due to a very wet June and early July, large quantities of water were released out of Libby Dam to accommodate the rising water levels in Lake Koocanusa. Planned dam releases up until this event kept the River at Bonners Ferry just below flood stage. However, added releases from the dam pushed the River above its flood stage, which resulted in widespread flooding along the River at Bonners Ferry and downstream to the Canadian border. In Boundary County, the high flows out of Libby Dam in northwest Montana resulted in widespread flooding along the Kootenai River in and around the city of Bonners Ferry and downstream to the Canadian border. Damage occurred along the dikes in Bonners Ferry. Volunteers shored up 500 feet of levee behind the Kootenai River Inn to prevent water from spilling in. Water filled sub-surface storage areas of the General Feed and Grain located near the river in Bonners Ferry. Sloughing of dikes downstream of Bonners Ferry was observed as well. An extensive amount of water seeped into farm lands throughout the Kootenai River valley. Over 5,000 acres of farm land was damaged resulting in $4 million in crop damage.
2012	Ada County Canal Failure	Ada	Residences in Eagle and Star were threatened by a breach in in poorly maintained section of ditch parallel to the Boise River during the summer of 2012.
August 9, 2013	Heavy Rain, Flash Flood	Lemhi	Slow moving thunderstorms produced heavy rain and flash flooding over the old 2012 Mustang burn scar in Lemhi County. Up to one foot of debris deposited on roads in several places in the County. Increased flow, up to two feet in Colson Creek, broke up a temporary earthen dam that emptied the pond. Approximately $1,000 in property damage from this event.
February 12-14, 2014	Heavy Rain, Snowmelt, Flood	Kootenai	Areas across the Idaho Panhandle experienced moderate to heavy rainfall. In combination with snowmelt and frozen ground, this led to heavy runoff that led to several drive washouts for residents on hilly terrain across Kootenai County. The LA tour Creek washed away a small levee and a parcel of land on South Latour Creek Road. Approximately $160,000 in property damage from this event.
August 13, 2014	Heavy Rain, Flash Flood	Lemhi	Thunderstorms brought heavy rainfall that triggered debris flows across the Mustang burn scar, west of Shoup. The debris flows occurred at Boulder Creek, Owl Creek, Colson Creek and at an unnamed gulch. The unnamed gulch produced a large debris flow with rock onto the main Salmon River Road. A man-made dam located near the delta of Colson Creek was damaged.

Sources: NOAA NCEI 2017; FEMA 2017; Idaho State HMP 2013

FEMA Disaster Declarations

Between 1954 and 2017, FEMA included Idaho in 21 flood-related disasters (DR) or emergencies (EM) classified as one or a combination of the following disaster types: flooding, heavy rains, severe storms, snowmelt, ice jams, landslides, mudslides, and severe winter storms. Generally, these disasters cover a wide region of the State; therefore, they may have impacted many counties. However, not all counties were included in the disaster declarations as determined by FEMA (FEMA 2017).

Based on all sources researched, known flooding events that have affected Idaho and were declared a State or FEMA disaster are identified in Table 3.2.T. This table provides information on the disaster declarations for flooding events, including date of event, state disaster declaration, federal disaster declaration and disaster number, and counties affected. Figure3.2.U illustrates the number of FEMA-declared disasters by county.

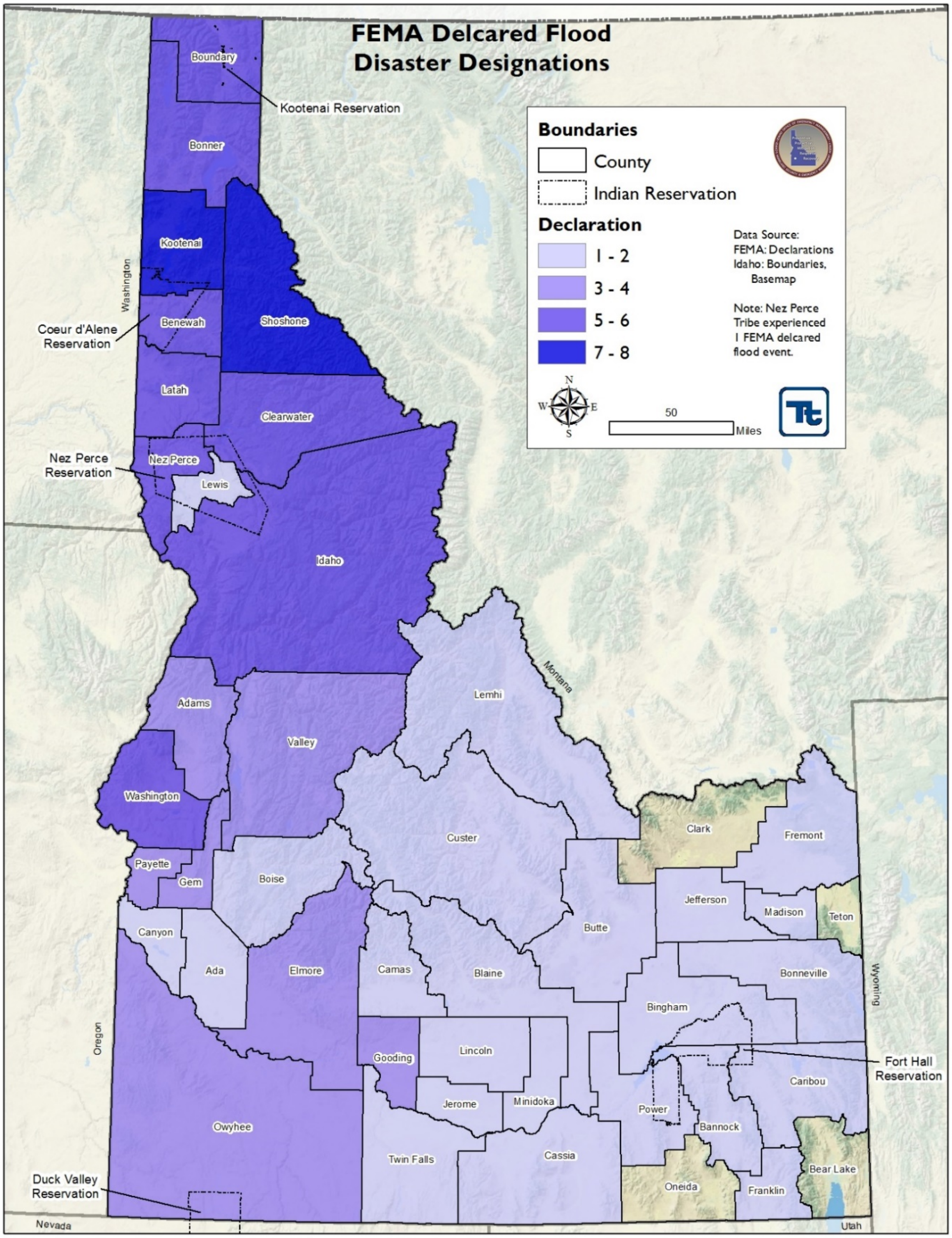
Table 3.2.T. Flood-Related State and Federal Declarations (1954 to 2017)

Year	Date	State	Federal	Counties Affected
1956	April 21, 1956		DR-55	
1957	May 27, 1957		DR-76	
1961	June 26, 1961		DR-116	
1962	February 14, 1962		DR-120	
1963	February 14, 1963		DR-143	
1964	December 31, 1964		DR-186	Ada, Bannock, Benewah, Blaine, Boise, Bonneville, Butte, Camas, Caribou, Cassia, Clearwater, Elmore, Gem, Gooding, Idaho, Jerome, Kootenai, Latah, Lewis, Lincoln, Minidoka, Nez Perce, Owyhee, Payette, Power, Shoshone, and Washington
1972	March 2, 1972		DR-324	Latah
1974	January 25, 1974		DR-415	Adams, Benewah, Bonner, Boundary, Clearwater, Kootenai, Latah, Shoshone, and Washington
1979	January	X		Bingham, Washington
	February	X		Canyon, Washington
	February	X		Nez Perce
1980	March	X		Power, Oneida
1982	February	X		Bonner, Washington
	April	X		Blaine
1983	June	X		Jefferson
1984	February 16, 1984		DR-697	Lemhi
	May	X		Cassia
	May	X		Bannock, Twin Falls
	June	X		Jefferson
	June	X		Owyhee

Year	Date	State	Federal	Counties Affected
	December	X		Lemhi, Butte
1985	January	X		Cassia
1986	January	X		Canyon, Payette, Washington
	February	X		Owyhee
	February	X		Boise
	June	X		Boise, Custer
1990	September	X		Elmore
1991	April	X		Bonner
1994	December	X		North Idaho
1996	February 11, 1996	X	DR-1102	Benewah, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Lewis, Nez Perce, Payette, Shoshone
	May	X		Payette
	June	X		Boundary, Kootenai, Latah, Shoshone
1997	November 1996 - January 1997	X	DR-1154	Adams, Benewah, Boise, Bonner, Boundary, Clearwater, Elmore, Gem, Idaho, Kootenai, Latah, Nez Perce, Owyhee, Payette, Shoshone, Valley, Washington
	March - June 1997	X	DR-1177	Benewah, Bingham, Bonner, Bonneville, Boundary, Butte, Custer, Fremont, Jefferson, Kootenai, Madison, Shoshone
2005	July 6, 2005		DR-1592	Nez Perce
2006	February 27, 2006		DR-1630	Owyhee
	February - April	X		Camas, Lincoln, Gooding
2008	May - July 2008	X	DR-1781	Kootenai, Shoshone
2010	June - July 2010	X	DR-1927	Adams, Gem, Idaho, Lewis, Payette, Valley, Washington
2011	March 31, 2011	X	DR-1987	Bonner, Clearwater, Idaho, Nez Perce, Nez Perce Tribe, Shoshone
	January - February	X		Shoshone
2012	July 5, 2012	ID-02-2012		Boundary
2017	February 5, 2017	ID-02-2017	DR-4310	Bingham, Cassia, Elmore, Franklin, Gooding, Jefferson, Jerome, Lincoln, Minidoka, Twin Falls, and Washington
	March 6, 2017	ID-03-2017	DR-4313	Benewah, Bonner, Boundary, Clearwater, Idaho, Kootenai, Latah, Lewis, Shoshone, and Valley
	March 29, 2017	ID-04-2017	DR-4342	Ada, Canyon, and Gooding
	May 6, 2017	ID-05-2017	DR-4333	Ada, Blaine, Camas, Canyon, Custer, Elmore, and Gooding

Source: Idaho State HMP 2013; FEMA 2017
Note: The date listed is the date the event was included in the declaration.

Figure 3.2.U. FEMA Flood Declarations in Idaho


FEMA Delcared Flood
Disaster Designations
Boundaries
County
Indian Reservation
Declaration
1 - 2
3 - 4
5 - 6
7 - 8
Data Source:
FEMA: Declarations
Idaho: Boundaries, Basemap
Note: Nez Perce Tribe experienced 1 FEMA delcared flood event.
50
Miles
Boundary
Kootenai Reservation
Bonner
Kootenai
Shoshone
Benewah
Coeur d'Alene Reservation
Washington
Latah
Clearwater
Nez Perce Reservation
Nez Perce
Lewis
Idaho
Montana
Lemhi
Adams
Valley
Washington
Custer
Clark
Fremont
Payette
Gem
Boise
Jefferson
Madison
Teton
Canyon
Butte
Ada
Elmore
Camas
Blaine
Bonneville
Wyoming
Bingham
Oregon
Gooding
Lincoln
Fort Hall Reservation
Caribou
Jerome
Minidoka
Power
Owyhee
Bannock
Twin Falls
Cassia
Bear Lake
Duck Valley Reservation
Oneida
Franklin
Nevada
Utah

Future Occurrence

Given the historical occurrences of flooding in Idaho, a probability of future flooding events does exist. While flooding in general is a relatively consistent hazard, there are a number of factors including snowpack, rain on snow, and ice melting with warmer temperatures that can affect the rate, type, and number of flood events. The type of flooding probability varies with each hazard and is summarized below for riverine flooding, dam failure, levee failure, and canal failure.

Flooding Future Occurrence

Reported flood events for over 50 years has provided an acceptable framework for determining the future occurrence in terms of frequency for such events. The probability of the State experiencing a major flood event can be difficult to quantify, but based on the historical record of 46 major flood events (State and Federal declarations) since 1956, Idaho can experience a major flood event once every 1.46 years. Looking at all flood events, minor and major, between 1950 and 2017, there have been 618 flood events in Idaho. Based on this data, Idaho may experience 9.36 flood events each year. Additionally, between 1950 and 2017, there have been 154 reported ice jams in Idaho. Based on this data, Idaho may experience 2.33 ice jams each year.

Dam Failure Future Occurrence

Most of the previously described causes for dam failure can be controlled through good design, proper construction, regular inspection by qualified personnel, and a commitment to strong enforcement to correct identified deficiencies. Likewise, the risk to downstream life and property can be reduced substantially with efforts to limit some types of development adjacent to streams and rivers. Past efforts to proactively mitigate these risks have been met with only limited success. Aging infrastructure and nature's continued ability to visit extreme events on local populations, may increase a dam's overall risk. Idaho's Dam Safety Program oversees the regulation and safety of dams and reservoirs throughout the State in order to protect the health, safety, and welfare of its citizens and their property.

Figure 3.2.V. Hell's Canyon Dam

This program is required to assure proper planning, design review, construction oversight, and inspection of regulated dams and reservoirs. The Department currently regulates nearly 600 water storage dams and more than 20 mine tailings impoundment structures located throughout the State. Dam Safety Program personnel regularly inspect existing projects according to the potential consequences that the dam's failure would present to downstream life and property. The frequency of individual dam inspections depends on the project's physical condition, method of construction, maintenance record, age, hazard rating, and size and storage capacity. Nonetheless, all statutory-sized dams must be inspected by the Department at least every 5 years.

Dam failure events are infrequent and usually coincide with events that cause them, such as earthquakes, landslides, and excessive rainfall and snowmelt. As noted in the Previous Occurrences and Losses section, dam failures typically occur in Idaho as a result of heavy rains or other precipitation. There is a "residual risk" associated with dams. Residual risk is the risk that remains after safeguards have been implemented. For dams, the residual risk is associated with events beyond those that the facility was designed to withstand. However, the probability of any type of dam failure is low in today's dam safety regulatory and oversight environment.

Levee Failure Future Occurrence

A complete levee failure, like dam failures, is rather infrequent and typically coincides with events that cause them such as heavy rainfall. As previously stated, there have been no major documented levee failures in the State of Idaho to date; however, the potential does exist given the varied construction and maintenance procedures in place for systems in Idaho. Aside from unregulated levee systems, some levees that the USACE inspects regularly have not scored well in terms of structural standing. Table3.2.W shows the current inspection ratings for levees deemed 'unacceptable' in Idaho under the USACE program, as this can increase the probability of a future levee failure occurrence.

Table 3.2.W. Inspection Status of Idaho Levees Monitored by the United States Army Corps of Engineers

System Name	Inspection Date	Inspection Rating*
Blue Lake	7/12/1988	UNACCEPTABLE
Bowman	7/8/2014	UNACCEPTABLE
Braun	9/23/2009	UNACCEPTABLE
Cottonwood	8/10/2011	UNACCEPTABLE
Deer Creek	8/3/2016	UNACCEPTABLE
Dickerson-Sweet	7/30/2012	UNACCEPTABLE
Falk Bridge	6/30/2016	UNACCEPTABLE
Gage	8/3/2016	UNACCEPTABLE
Highsmith	9/21/2009	UNACCEPTABLE
Highway 52 Bridge	6/30/2016	UNACCEPTABLE
Hwy. 3 (St. Joe)	7/11/1988	UNACCEPTABLE
John McKinney to Carpenter Levees	6/30/2016	UNACCEPTABLE
Kootenai Dike District 1	10/16/2006	UNACCEPTABLE
Kootenai Dike District 10	10/16/2006	UNACCEPTABLE
Kootenai Dike District 11	10/16/2006	UNACCEPTABLE
Kootenai Dike District 12	10/16/2006	UNACCEPTABLE
Kootenai Dike District 13	10/16/2006	UNACCEPTABLE
Kootenai Dike District 2	10/16/2006	UNACCEPTABLE
Kootenai Dike District 3	10/16/2006	UNACCEPTABLE
Kootenai Dike District 4	10/16/2006	UNACCEPTABLE
Kootenai Dike District 5	10/16/2006	UNACCEPTABLE

System Name	Inspection Date	Inspection Rating*
Kootenai Dike District 6	10/16/2006	UNACCEPTABLE
Kootenai Dike District 8	7/28/2016	UNACCEPTABLE
Kootenai Dike District 9	10/16/2006	UNACCEPTABLE
Latour Creek	11/20/2013	UNACCEPTABLE
Lawyers Creek LB	3/25/2010	UNACCEPTABLE
Lawyers Creek RB	3/25/2010	UNACCEPTABLE
Nez Perce	6/16/2015	UNACCEPTABLE
Pine Creek Segment 3/Pinehurst	11/19/2013	UNACCEPTABLE
Pocatello 1 (Left Bank - Upper)	7/15/2015	UNACCEPTABLE
Pocatello 2 (Right Bank - Upper)	7/15/2015	UNACCEPTABLE
Pocatello 3 (Left Bank - Middle)	7/15/2015	UNACCEPTABLE
Pocatello 4 (Left Bank - Lower)	7/15/2015	UNACCEPTABLE
Pocatello 5 (Right Bank - Lower)	7/15/2015	UNACCEPTABLE
Tamarack Ridge	7/28/2016	UNACCEPTABLE
White Bird (Left Bank)	6/17/2015	UNACCEPTABLE
White Bird (Right Bank)	6/17/2015	UNACCEPTABLE
Zinc Spur	8/3/2016	UNACCEPTABLE

**Three National Levee Database Inspection Ratings can be given: Acceptable, Minimally Acceptable, and Unacceptable. Source: USACE 2017*

Canal Failure Future Occurrence

A canal can be defined as an artificial watercourse, a duct or passage that conveys fluids (Laycock-2007). Most irrigation systems distribute their water through an open canal network. Water flows at a rate which is governed by the canal size, roughness and longitudinal slope. Usually for irrigation, operators are trying to keep the water delivery point at as high an elevation as possible by minimizing the canal longitudinal slope. A wide variety of structures can be inserted in the canal to control water levels, discharges, turbulence, sediment content and velocity, to convey water around or across obstacles, and to measure the flow.

The main causes for failure of irrigation canals would be classified as either hydraulic or hydrologic. Hydraulic failures are those associated with a change in channel roughness that reduces channel capacity or increases the flow rate. Hydrologic failures would be associated with an increase in volume of water that flows through a system. Canals can pose several flood threats that are either hydraulic, hydrologic or a combination of both described as follows:

- Loss of channel capacity due to siltation. This could be associated to design problem, construction or poor management
- Overtopping caused by inflows that exceed channel capacity
- Obstruction by debris can cause a canal to over top
- Errors in operation of flow control facilities
- Bank erosion caused by prolonged periods of high flows beyond design standards

- Vandalism, piping of water, gopher holes, etc. are potential risks
- Excessive seepage to lower adjacent elevations

The probability for canal failure is generally low, however overland flooding, lack of maintenance and regular inspection, and encroachment of subdivisions increases the overall risk and probability.

Relationships with Other Hazards

Floods can influence other hazards, both natural and human-caused. Flood events can lead to failures of dams, levees, or canals, and the reverse as well. Landslides are also often-times caused by flood. Conversely, a flood event could help to lessen the hazards of both wildfire and drought, if only for a short time period. All of the human-caused hazard events covered in this Plan could be influenced in some way or another by a flood event. Flood impacts on infrastructure and facilities could initiate a hazardous material or radiological release, a cyber disruption, or power outage. Standing water left after a flood event could increase the susceptibility for a pandemic event to occur. Flooding can overwhelm waste water treatment facilities, leading to contaminated wells and other water supplies. Inundated agricultural land is out of production until the water drains away.

Environmental Impacts

The environmental impacts of flooding can be quite wide-ranging, from the dispersion of low-level household wastes into the fluvial system to contamination of community water supplies and wildlife habitats with extremely toxic substances. Flood preparedness activities, such as forecasting and warning systems, can help to avoid some of these impacts. Indeed, actions undertaken prior to the event will have repercussions on the level of damages accruing from the flood. Effective mitigate actions, such as sandbagging or constructing temporary levees, can significantly reduce losses, and with advance planning and preparation, prevent some of these secondary environmental impacts. Specifically, the removal of fuel tanks and attention to hazardous wastes would eliminate some of the potential problems. In contrast, inadequate attention to these components of the flood hazard will invariably lead to additional problems and intensify adverse environmental impacts. Similarly during a flood, variables such as depth of water, velocity of flows, and duration of inundation, in combination with land-use attributes, all contribute to the relative severity of flood impact. Floods of greater depth are likely to result in greater environmental damage than floods of lesser magnitude impacting larger areas. Floods of long duration will exacerbate environmental problems, because clean-up will be delayed and contaminants may remain in the environment for a much longer time. The argument is the same for other flood traits; extreme conditions are likely to precipitate additional environmental problems.

Dam, levee, and/or canal failures can have a greater environmental impact than that associated with a normal flood event. The soil loss from erosion and scouring could be significantly greater, because of large amounts of fast-moving water affecting a small area. Great amounts of sediment from erosion can alter the landscape and change the ecosystem. In addition, hazardous materials are carried away from flooded properties and distributed throughout the floodplain. Industrial or agricultural chemicals and wastes, solid wastes, raw sewage, and common household chemicals comprise the majority of hazardous materials spread by floodwaters that pollute the environment and contaminate everything they come in contact with, including the community's water supply.

Climate Change Impacts

Providing projections of future climate change for a specific region is challenging. Shorter term projections are more closely tied to existing trends making longer term projections even more difficult. The further out a prediction reaches the more subject to changing dynamics it becomes. Climate change is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future;
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management, and ecosystem functions; and
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness, and emergency response.

Records have shown that over the past 100 years the State has seen an increase in temperature of one to two degrees (°F). In the coming years, it is predicted that streams will be warmer, populations of several fish species will decline, wildfires will become more common, deserts may expand, and water may be less available for irrigation (USEPA 2016).

Much of the water needed for agriculture, public supplies and other uses throughout Idaho comes from mountain snowpack. As snowpack is very important to the State, so is the timing of snowmelt runoff into rivers and streams. Snowpack is melting earlier each year, and the flow of meltwater into streams during the summer is declining and affecting water demands for agriculture growing season. Rising snowlines caused by warming temperatures will allow more mountain areas to contribute to peak storm runoff. High frequency flood events will also increase with a changing climate (USEPA 2016).

Along with reductions in the amount of snowpack and accelerated snowmelt, scientists project greater storm intensity, which would result in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likely change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, and possibly increase sedimentation behind dams, affecting habitat and water quality. As stated above, climate change may lead to an increase in wildfires, which provides potential for more floods following wildfires, increasing sediment loads and water quality impacts.

Small changes in rainfall, runoff and snowpack may also have significant impacts for water resource systems, including dams, levees and canals. Dams are designed partly based on assumptions about a river's flow behavior, expressed as hydrographs. Changes in weather patterns can have significant effects on the hydrograph used for the design of a dam. If the hygrograph changes, it is conceivable that the dam can lose some designed margin of safety, also known as freeboard. If freeboard is reduced, dam operators may be forced to release increased volumes earlier in a storm cycle in order to maintain the required margins of safety. Such early releases of increased volumes can also increase flood potential downstream.

Development Trend Impacts

An understanding of population and development trends can assist in planning for future development and ensuring that appropriate mitigation, planning, and preparedness measures are in place. The State considered the following factors to examine previous and potential conditions that may affect hazard vulnerability: potential or projected development; projected changes in population; and other identified conditions as relevant and appropriate.

A good deal is known concerning the mechanisms that lead to flooding; consequently, floods or flood conditions generally come with warnings. However, floodwaters can go where they are totally unexpected, warnings are not always heeded, and despite their predictability and history, flood damages continue.

In many cases, the failure to recognize or acknowledge the extent of the natural hydrologic forces in an area has led to development and occupation of areas that can clearly be expected to be inundated on a regular basis. Most streams overflow what are commonly regarded as their channels at least once every one and one-half to two years. Residents downstream of dams or adjacent to levees and canals may become complacent, or have higher expectations, when flooding is reduced over time. Despite this, communities are often surprised when the stream leaves its channel to occupy its floodplain. A past reliance on structural means to control floodwaters and 'reclaim' portions of the floodplain has also contributed to inappropriate development and continued flood-related damages. Unlike the weather and the landscape, this flood-contributing factor can be controlled. Development and occupation of the floodplain places individuals and property at risk. Such use can also increase the probability and severity of flood events (and consequent damage) downstream by reducing the water storage capacity of the floodplain, or by pushing the water farther from the channel or in larger quantities downstream. IDWR's most current State Water Plan discusses the topics of water management and future development, information that could prove useful when discussing and assessing the hazard of flooding. (https://www.idwr.idaho.gov/IWRB/water-planning/state-water-plan.html).

The flood reduction afforded by dams throughout Idaho has allowed the development of lands immediately downstream of these structures. The same can be said of development in areas where levee structures provide protection from certain flooding events. Canals and irrigation structures have been increasingly faced with encroachment by urban and residential structures. For example, the operator of the New York Canal makes every effort to properly maintain the canal, but decades of encroachment by urban and residential structures have compromised its ability to perform necessary maintenance on the canal. This development pattern likely will continue for the foreseeable future, increasing flood risks unless improved mitigation measures are taken. As the State of Idaho population continues to grow and areas continue to be developed the need for conveniently located state services and facilities will increase.

The U.S. EPA's Integrated Climate and Land-Use Scenarios (ICLUS) project generated population and land use projections for the United States through 2100. The project examined multiple scenarios taking into account various population growth and economic development parameters that have been used as the baseline for the Intergovernmental Panel on Climate Change's (IPCC) Special Report on emissions Scenarios (SRES). Population change took into account assumptions regarding fertility, mortality, and immigration, which was then used to drive the land use projections. The SRES provides two development scenarios: economic development (A) and environmentally-driven development (B), where the A scenario will result in more sprawled development, and the B scenario will result in more compact developments close to the existing urban centers. Additionally, the model scenarios included parameters for global development (1) and regional development (2) (EPA, 2013). The model estimated projections for each decade from 2010 to 2100.

The ICLUS scenario 'A2' was selected to examine if changes in land use and housing density estimates from 2010 to 2020 are projected in the flood hazard area. The 2010 data was used as a baseline to determine if any changes in development by 2020 may result in increases or decreases in the hazard area. The resulting housing density and land use categories are defined as follows: Urban, which equates to 0.25 acres/unit; Suburban, which equates to 0.25 to 2 acres/unit; Exurban, which equates to 2 to 40 acres/unit; Rural, which equates to 40 acres/unit; Commercial; and Industrial. As discussed above, it is important to note that the nature of the spatial data may cause results in counties from Table 3.2.X that do not have floodplain data from the National Flood Hazard Layer (NFHL) or the digitized Effective FIRMs.

Table 3.2.X lists the estimated land-use area (square miles) located in the identified flood hazard areas for 2010 and projected area for 2020 by jurisdiction, demonstrating the risk assessment to reflect the changes in development. The most significant changes in land-use are seen in the exurban and rural categories. Overall, 9.0 square miles of exurban area is projected to be developed in the flood hazard area by 2020, with the greatest increase in Canyon County. As for rural land, statewide there is a projected decline of approximately 10.0 square miles of land. This decline is the greatest in Canyon County, where a reduction of 3.2 square miles of rural land is projected; this coincides with the increase in higher housing densities, which will place a greater number of people in the hazard area.

Table 3.2.X. Projected Change in 2010 to 2020 Development Located in the Flood Hazard Area (square miles)

	Urban			Suburban			Exurban			Rural			Commercial/ Industrial		
Jurisdiction	2010	2020	Change	2010	2020	Change	2010	2020	Change	2010	2020	Change	2010	2020	Change
Ada County	0.2	0.2	0.0	2.1	2.8	0.7	8.7	9.3	0.6	9.8	8.5	-1.3	1.6	1.6	0.0

Jurisdiction	Urban			Suburban			Exurban			Rural			Commercial/ Industrial		
	2010	2020	Change	2010	2020	Change	2010	2020	Change	2010	2020	Change	2010	2020	Change
Adams County	0	0	0.0	0	0	0.0	1.3	1.4	0.1	22.4	22.3	-0.1	0	0	0.0
Bannock County	0	0	0.0	0.5	0.5	0.0	2.7	3	0.3	23.1	22.8	-0.3	0.2	0.2	0.0
Bear Lake County	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Benewah County	0	0	0.0	0	0	0.0	2.2	2.2	0.0	11	11	0.0	0	0	0.0
Bingham County	0	0	0.0	0.3	0.3	0.0	16	16	0.0	54.4	54.4	0.0	0	0	0.0
Blaine County	0	0	0.0	0.5	0.5	0.0	3.9	4.3	0.4	13	12.5	-0.5	0.1	0.1	0.0
Boise County	0	0	0.0	0.2	0.2	0.0	2.7	2.9	0.2	4.9	4.8	-0.1	0	0	0.0
Bonner County	0	0	0.0	0.4	0.4	0.0	10.9	10.9	0.0	22.2	22.2	0.0	0.1	0.1	0.0
Bonneville County	0	0	0.0	0.3	0.3	0.0	5.9	6.3	0.4	10.9	10.5	-0.4	0	0	0.0
Boundary County	0	0	0.0	0	0	0.0	0.8	0.8	0.0	19.4	19.4	0.0	0	0	0.0
Butte County	0	0	0.0	0	0	0.0	1	1.1	0.1	27.1	27	-0.1	0	0	0.0
Camas County	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Canyon County	0.1	0.1	0.0	1	1.3	0.3	14.7	17.6	2.9	27.6	24.4	-3.2	0.4	0.4	0.0
Caribou County	0	0	0.0	0	0	0.0	0	0	0.0	0.1	0.1	0.0	0	0	0.0
Cassia County	0	0	0.0	0.1	0.1	0.0	1.6	1.6	0.0	34	34	0.0	0.1	0.1	0.0
Clark County	0	0	0.0	0	0	0.0	0.2	0.3	0.1	22.9	22.8	-0.1	0	0	0.0
Clearwater County	0	0	0.0	0	0	0.0	0.5	0.5	0.0	11.2	11.2	0.0	0	0	0.0
Coeur d'Alene Tribe	0	0	0.0	0.1	0.1	0.0	0.9	1	0.1	4.8	4.8	0.0	0.8	0.8	0.0
Custer County	0	0	0.0	0	0	0.0	0	0	0.0	0.9	0.9	0.0	0	0	0.0
Duck Valley Tribe	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Elmore County	0	0	0.0	0.3	0.3	0.0	1.4	1.5	0.1	28.7	28.7	0.0	0.1	0.1	0.0
Fort Hall Tribe	0	0	0.0	0	0	0.0	0	0	0.0	0.5	0.5	0.0	0	0	0.0

Jurisdiction	Urban			Suburban			Exurban			Rural			Commercial/ Industrial		
	2010	2020	Change	2010	2020	Change	2010	2020	Change	2010	2020	Change	2010	2020	Change
Franklin County	0	0	0.0	0	0	0.0	1	1	0.0	12.3	12.3	0.0	0	0	0.0
Fremont County	0	0	0.0	0.1	0.1	0.0	2	2	0.0	17.2	17.2	0.0	0	0	0.0
Gem County	0	0	0.0	0	0	0.0	1.4	1.4	0.0	7.8	7.8	0.0	0.3	0.3	0.0
Gooding County	0.1	0.1	0.0	0.5	0.5	0.0	1.8	1.8	0.0	14.2	14.2	0.0	0.1	0.1	0.0
Idaho County	0	0	0.0	0.1	0.1	0.0	1.2	1.2	0.0	9.7	9.7	0.0	0	0	0.0
Jefferson County	0	0	0.0	0	0	0.0	3.3	3.3	0.0	9.9	9.9	0.0	0	0	0.0
Jerome County	0	0	0.0	0	0	0.0	0.2	0.2	0.0	0.2	0.2	0.0	0	0	0.0
Kootenai County	0	0	0.0	0.8	0.9	0.1	7.6	8.8	1.2	18.4	17.1	-1.3	0.2	0.2	0.0
Kootenai Tribe	0	0	0.0	0	0	0.0	0	0	0.0	0.3	0.3	0.0	0	0	0.0
Latah County	0	0	0.0	0.1	0.1	0.0	1.7	1.7	0.0	25.9	25.9	0.0	0	0	0.0
Lemhi County	0	0	0.0	0.3	0.3	0.0	3.2	3.3	0.1	29.1	29	-0.1	0.1	0.1	0.0
Lewis County	0	0	0.0	0	0	0.0	0	0	0.0	0.2	0.2	0.0	0	0	0.0
Lincoln County	0	0	0.0	0.1	0.1	0.0	0.2	0.5	0.3	14	13.7	-0.3	0	0	0.0
Madison County	0	0	0.0	0.4	0.4	0.0	17.4	19	1.6	14.1	12.5	-1.6	0.3	0.3	0.0
Minidoka County	0	0	0.0	0	0	0.0	0.1	0.1	0.0	0.4	0.4	0.0	0	0	0.0
Nez Perce County	0	0	0.0	0	0	0.0	0.4	0.4	0.0	4.3	4.3	0.0	0.1	0.1	0.0
Nez Perce Tribe	0	0	0.0	0.3	0.3	0.0	2.1	2.1	0.0	6.3	6.3	0.0	0.2	0.2	0.0
Oneida County	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Owyhee County	0	0	0.0	0	0	0.0	0	0	0.0	0.1	0.1	0.0	0	0	0.0
Payette County	0	0	0.0	0	0	0.0	3.2	3.2	0.0	21.1	21.2	0.1	0.3	0.3	0.0
Power County	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Shoshone County	0.1	0.1	0.0	0.7	0.7	0.0	3.8	3.8	0.0	12	12	0.0	0.2	0.2	0.0
Teton County	0	0	0.0	0	0	0.0	2	2.2	0.2	30.4	30.2	-0.2	0	0	0.0

Jurisdiction	Urban			Suburban			Exurban			Rural			Commercial/ Industrial		
	2010	2020	Change	2010	2020	Change	2010	2020	Change	2010	2020	Change	2010	2020	Change
Twin Falls County	0	0	0.0	0.2	0.2	0.0	1.2	1.2	0.0	1.6	1.6	0.0	0.1	0.1	0.0
Valley County	0	0	0.0	0.2	0.2	0.0	2.6	2.7	0.1	23.4	23.4	0.0	0	0	0.0
Washington County	0	0	0.0	0.2	0.2	0.0	2.8	3.2	0.4	29.5	29.1	-0.4	0.1	0.1	0.0
Idaho Total	**0.7**	**0.7**	**0.0**	**9.8**	**11**	**1.2**	**134.8**	**143.8**	**9.0**	**651.3**	**641.3**	**-10.0**	**5.7**	**5.7**	**0.0**

Source: EPA 2013, FEMA 2017, FEMA Region 10

Notes: Projected development includes changes in housing density and land use.

A positive number in the 'Change' column indicates an increase; a negative number indicates a decrease.

The Idaho Department of Water Resources released a Sample Floodplain Development Permit, which is required for all proposed development in a floodplain. All new buildings require an Elevation Certificate as proof that the lowest flood of the building is elevated to the defined flood protection elevation(FPE), as detailed in Title 46 of Idaho Code (§46-1022). Applicants must consult the local community's Floodplain Administrator to help determine the FPE. This statute was designed to help mitigate flood damages and helped to reduce flood insurance rates for buildings owners located within the floodplain.

New and existing community development has encroached on areas adjacent to canals in the southern portion of the State. In Ada County, a considerable number of housing developments are situated downstream of large capacity canals. The proximity of development to this type of high flow, manmade channel creates a significant risk to life, safety, and property.

Canal operators in Idaho have statutory easements so that they can maintain their canals and ditches, and many new and existing developments encroach directly into these easements. This encroachment, which in some cases is actually onto the banks of the canal, makes proper maintenance of the canals very difficult and can also compromise the safety of the canal.

Population

Map 2.F. in Chapter 2 (State Profile) displays the projected population growth by 2026. Increases in development in and around floodplains will put additional populations at risk and economic stress on the communities due to anticipated increased impacts and damages.

Other Conditions

Wildfires, particularly large-scale fires, can dramatically alter the terrain and ground conditions, making land already devastated by fire susceptible to floods. Normally, vegetation absorbs rainfall, reducing runoff. However, wildfires leave the ground charred, barren, and unable to absorb water; thus, creating conditions perfect for flash flooding and mudflows. Flood risk in these impacted areas remain significantly higher until vegetation is restored, which can take up to five years after a wildfire (FEMA 2013).

Areas directly affected by fires and those located below or downstream of burn areas are most at risk for flooding. Fire perimeters since the last HMP (2013-2016) were intersected with the 1% flood boundary to determine the total area of floodplain that has been affected by wildfires in recent years. Overall, 16 square miles of floodplain were exposed to recent wildfires Statewide, with the greatest area located in Elmore County (4.8 square miles). The next two greatest areas exposed were in Bonneville County (2.7 square miles) and Lincoln County (1.9 square miles).

Vulnerability Assessment and Loss Estimation

To assess the State's risk to the flood hazard, a spatial analysis was conducted using the best available spatially-delineated flood hazard areas. In summary, to determine exposure, the hazard areas were overlaid with the assets to determine the total number and replacement cost value located in the hazard areas. If the facility is located in the hazard area, it is deemed exposed to the hazard and potentially vulnerable to loss. FEMA's HAZUS-MH was used to estimate potential losses to structures from riverine flooding by looking at depth of flooding and type of structure. A Level 2 HAZUS-MH study was conducted incorporating the state-owned and leased buildings and critical facilities as user-defined facilities. For more information on the data and tools used for this analysis, refer to Chapter 3.0.

Flooding

For the riverine flood hazard, FEMA-delineated 1% annual chance flood hazard areas were used (refer to Table 3.2.Y below). FEMA Region X digitized the effective FIRM maps for the majority of the counties not contained in FEMA's National Flood Hazard Layer (NFHL). The flood hazard area utilized for the 2018 State HMP update was derived by merging the NFHL with the digitized versions of the effective FIRM maps. It is recognized that there are areas of the State that do not have digital flood maps available as noted in Table 3.2.Y below; therefore, the riverine flood risk may be understated in this assessment. The Idaho Silver Jackets Team has a project to digitize FIRM maps statewide. Estimated 1% annual chance flood depth grids were generated utilizing 3D Analyst tools in ArcGIS for counties with combined FEMA floodplain data and 1/3 arc-second digital elevation models (DEM) from the U.S.G.S. The depth grids were integrated into HAZUS-MH version 4.0 and the riverine flood model was run to estimate potential losses to the default dasymetric general building stock in HAZUS-MH, and State owned and leased buildings, and critical facilities as user-defined facilities as discussed in this chapter for the 1% annual chance flood event.

Table 3.2.Y lists the riverine flood hazard data that was utilized for purposes of the vulnerability assessment. Figure 3.2.Z displays the spatial distribution of the data sets used.

Table 3.2.Y. Riverine Flood Data Used for the 2018 Plan Update

County	Data (Source and Date)	County	Data (Source and Date)
Ada County	NFHL DFIRM | 10/12/2017	Gem County	Digitized Effective FIRM | 4/17/1978

County	Data (Source and Date)	County	Data (Source and Date)
Adams County	Digitized Effective FIRM | 11/20/2000	Gooding County	Digitized Effective FIRM | 6/19/1985
Bannock County	NFHL DFIRM | 10/12/2017	Idaho County	Digitized Effective FIRM | 8/23/2001
Bear Lake County	No data | N/A	Jefferson County	NFHL DFIRM | 10/12/2017
Benewah County	NFHL DFIRM | 10/12/2017	Jerome County	Digitized Effective FIRM | 9/4/1985
Bingham County	Digitized Effective FIRM | 10/20/1998	Kootenai County	NFHL DFIRM | 10/12/2017
Blaine County	NFHL DFIRM | 10/12/2017	Latah County	Digitized Effective FIRM | 4/15/2002
Boise County	Digitized Effective FIRM | 4/5/1988	Lemhi County	Digitized Effective FIRM | 8/15/1990
Bonner County	NFHL DFIRM | 10/12/2017	Lewis County	Digitized Effective FIRM | 2/12/1986
Bonneville County	Digitized Effective FIRM | 4/2/2002	Lincoln County	Digitized Effective FIRM | 2/5/1986
Boundary County	Digitized Effective FIRM | 8/2/1982	Madison County	Digitized Effective FIRM | 6/3/1991
Butte County	Digitized Effective FIRM | 6/3/1986	Minidoka County	Digitized Effective FIRM | 10/1/1986
Camas County	No data | N/A	Nez Perce County	Digitized Effective FIRM | 4/4/1983
Canyon County	NFHL DFIRM | 10/12/2017	Oneida County	Digitized Effective FIRM | 10/10/2003
Caribou County	No data | N/A	Owyhee County	No data | N/A
Cassia County	Digitized Effective FIRM | 8/15/1983	Payette County	Digitized Effective FIRM | 2/15/1984
Clark County	Digitized Effective FIRM | 9/24/1984	Power County	No data | N/A
Clearwater County	Digitized Effective FIRM | 5/15/1980	Shoshone County	NFHL DFIRM | 10/12/2017
Custer County	No data | N/A	Teton County	Digitized Effective FIRM | 8/4/1988
Elmore County	Digitized Effective FIRM | 3/15/1994	Twin Falls County	NFHL DFIRM | 10/12/2017
Franklin County	Digitized Effective FIRM | 8/19/1985	Valley County	Digitized Effective FIRM | 9/5/1990
Fremont County	Digitized Effective FIRM | 3/18/1991	Washington County	NFHL DFIRM | 10/12/2017

Source: DFIRM Digital Flood Insurance Rate Map

Dam Failure

The IDWR Dam Safety Program maintains a listing of dams by category. Idaho currently has 89 high hazard dams throughout the state. Figure 3.2.I shows the storage capacity of all High Hazard dams that the Dam Safety Program regulates. While some of these dams are quite small relative to the bigger ones, the hazard rating implies that loss of life would occur in the event of a catastrophic breach and uncontrolled release of contents. As the State doesn't make a distinction between one losses or multiple fatalities, a cross section of the larger dams were selected to conduct the inundation loss analysis on, as it is presumed that the potential consequences would be greater than those which are much smaller. This is more so in terms of reservoir storage capacity (volume) vs. dam height. To assess dam failure risk, the dam failure inundation areas for eleven high hazard dams across the state were used. The dam failure inundation areas were used to estimate the exposure to population, state buildings, and critical facilities for the state. Dam inundation spatial datasets were developed for each of the analyzed dams. Gem County developed spatial datasets for Black Canyon Dam. IOEM geo-referenced paper inundation maps provided by USACE and the U.S. Bureau of Reclamation (USBR), then digitized to create GIS data and performed spatial analysis. Below is the list of high hazard dams analyzed. The dam inundation and potential loss analysis can be found in Appendix E, Flood 3.2 DamTables.

- Albeni Falls Dam
- American Falls Dam
- Black Canyon Dam
- Cascade Dam
- Deadwood Dam
- Dworshak Dam
- Little Wood River Dam
- Lucky Peak Dam
- Minidoka Dam
- Palisades Dam
- Ririe Dam

Canal / Levee Failure

To assess levee failure risk, the areas with reduced flood risk due to levees were used to estimate the exposure to population, building, state owned and leased-buildings, and critical facilities for the state. The levee protected areas for FEMA certified levees identified in the National Flood Hazard Layer were utilized. The layer does not contain protection areas for all of the levees in the State; for more information on the location of levees, refer to the 'Location' section in the profile above. FEMA depicts these levee protected areas as the spatial extent equivalent to the 1% annual chance flood event that would result due to a levee failure event. These results were included in the totals for the 1% annual chance flood event for Assessment on Local Vulnerability section.

Spatially-delineated hazard areas delineating canal-failure inundation were not available. To assess risk, the FEMA delineated 1% annual chance flood hazard areas and statewide layer of canals provided by the Idaho Office of Emergency Management GIS Section were utilized to determine which canals that intersect with the flood hazard areas. The total miles of vulnerable canals are reported below by county and tribal nation.

There are no defined stormwater or ice jam hazard areas available at this time. Therefore, the vulnerability to these hazards is discussed in a qualitative nature below.

Assessment of State Vulnerability and Potential Losses

A statewide flood analysis was conducted based on best available data for the State of Idaho. This section discusses statewide vulnerability of areas susceptible to flooding (riverine, dam failure, levee and canal) and potential losses to state assets (state-owned and leased buildings) and critical facilities.

Critical Infrastructure and State Facility Impacts

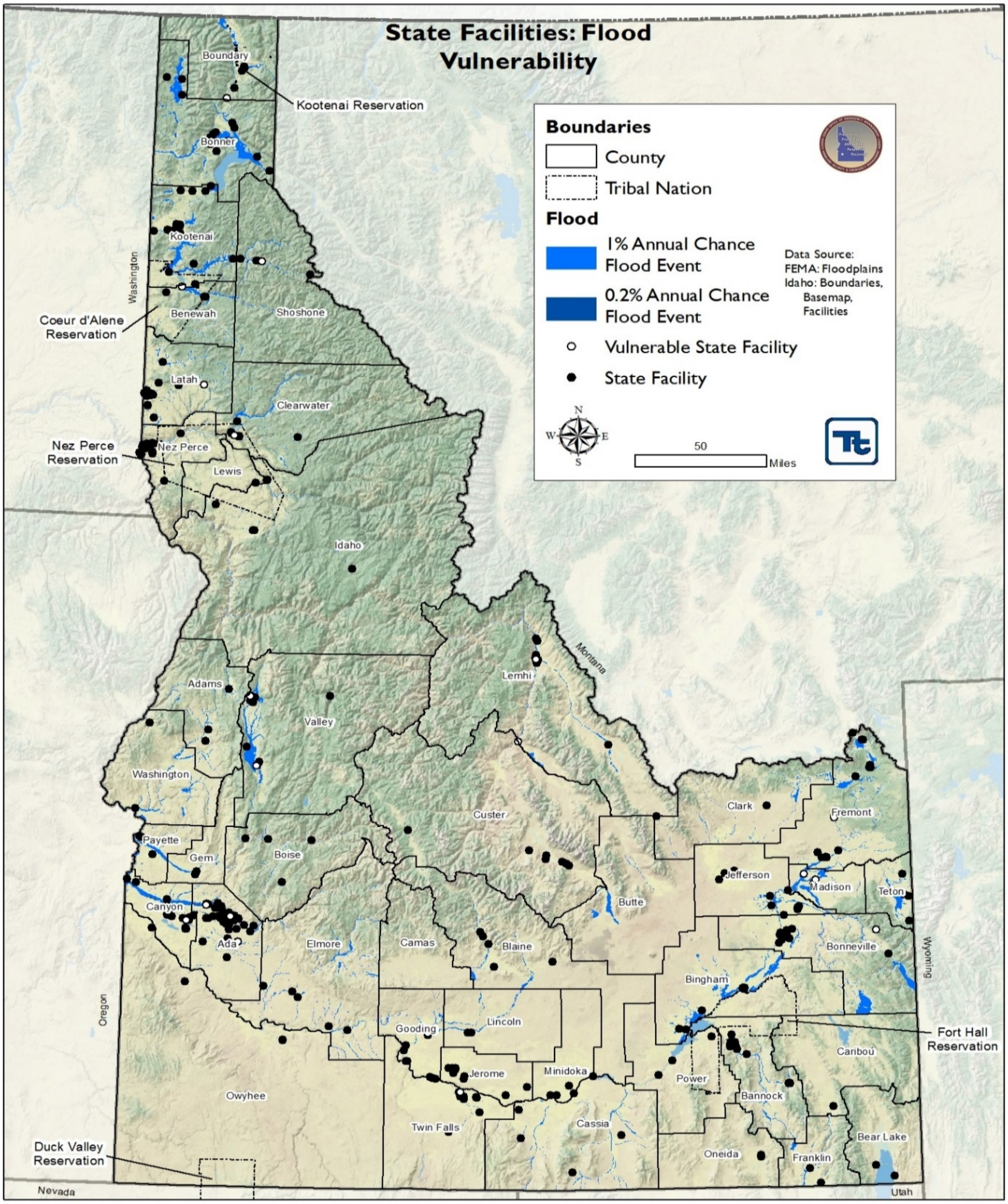
State facilities or infrastructure located in or near floodplains would be possibly impacted by a flood event. State facilities or infrastructure located in the inundation zones of dams, levees, or canals would be those impacted by a failure event. Additionally, flooding has the ability to inundate roadways which could block or restrict access to and from certain areas and facilities in the state.

The analysis for the riverine flood hazard determined there are 131 state-owned buildings (4.8%) located in the 1% annual chance flood hazard area; of which the greatest number are located in Canyon County (58 buildings with a replacement cost value of $5.7 million); all 58 of these buildings are owned by the Department of Juvenile Corrections. Ada County has the greatest state-owned building total replacement cost value located in the SFHA ($14.9 million). The Department of Fish and Game has the greatest total replacement cost value exposed ($14.3 million). Table 1AE (in Appendix E) summarizes the state facilities located in the SFHA by jurisdiction (county or tribal nation), and Table 2AE (in Appendix E). Summarizes the State owned and leased buildings by state agency. Figure 3.2.Z illustrates the state owned and leased buildings located within the SFHA.

Lucky Peak Dam is located in Ada County, not only the most populous county in the State, but home to the State Capitol. There are an estimated 417 state-owned buildings located in the Lucky Peak dam failure inundation, of which 393 are located in Ada County. Of the State entities, Boise State University has the greatest number of buildings (214) and greatest replacement cost value ($1.5 billion) exposed and potentially vulnerable to the Lucky Peak dam failure hazard. In terms of the Black Canyon dam failure hazard, Gem County is the only jurisdiction with State buildings located in the hazard area. The County has 8 State buildings with a total of $1.8 million located in the dam failure inundation hazard area. In regards to the State agencies, the Department of Transportation owns the greatest number of State buildings (4 total) located in the Black Canyon dam failure hazard area, while the Idaho Military Division owns the buildings with the greatest building value located in the hazard area ($769,000). The Coeur d'Alene Tribe has six state buildings located in the levee failure hazard area ($2 million), all of which are owned by the Department of Lands.

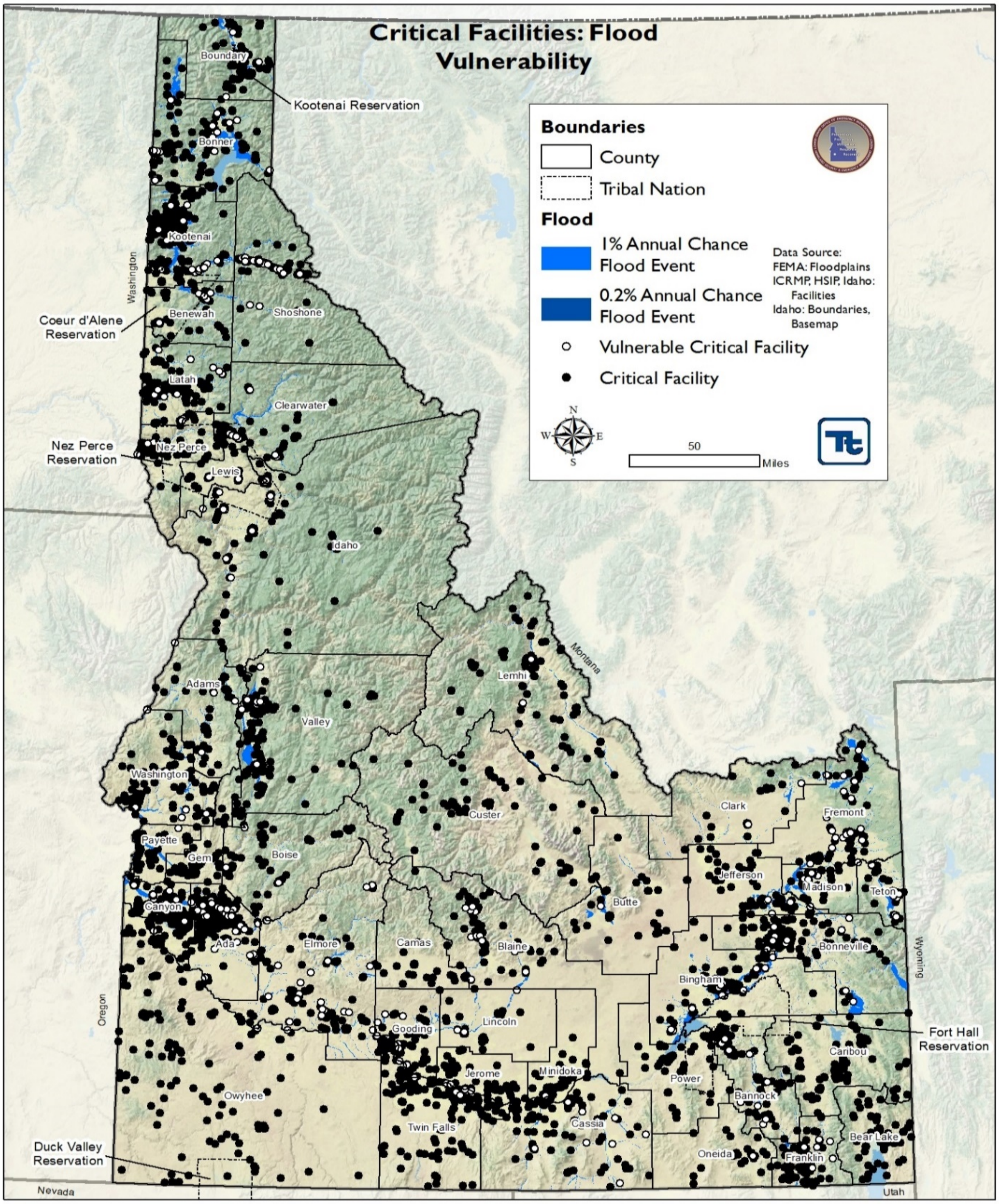
There are 690 critical facilities and infrastructure located in the 1% flood hazard area. Of these, 152 are dams. Excluding dams from the analysis, which by default are located in flood hazard areas, Bingham County has the greatest number of vulnerable critical facilities and infrastructure (59 total). In total, there are 34 facilities vulnerable to the levee failure hazard area; 26 of these facilities are located in Kootenai County. Table 3AE (in Appendix E) summarizes the number of critical facilities and infrastructure located in the hazard area by facility type. Figure 3.2.AA illustrates the critical facilities located within the SFHA in the State.

Figure 3.2.Z. State Facilities in the FEMA Special Flood Hazard Areas in Idaho



Note: A vulnerable facility means that the facility is located in the identified hazard area.

Figure 3.2.AA. Critical Facilities in the FEMA Special Flood Hazard Areas in Idaho



Note: A vulnerable facility means that the facility is located in the identified hazard area.

Canals are a necessary part of the agricultural business in the State of Idaho, but as such they are to be treated as structures to be protected, and are susceptible to flooding as well. Canals can be damaged by flooding, as well as can exacerbate flooding. Canals can become a conduit and exacerbate flooding by transporting floodwaters away from a river or flooding source to areas that may not have otherwise been affected. Table 3.2.BB below lists the miles of canals that intersect the 1% annual chance flood event boundaries by county and Tribal Nation. Boundary County has the greatest proportion of canals in proximity of the 1% annual chance flood event (18.8%), while Bingham County has the greatest total miles in proximity of canals (60.2 mi). Due to the location of the two dams and their dam failure inundation areas evaluated for the vulnerability assessment, Gem and Ada Counties have the greatest total number of canal miles located in the Black Canyon and Lucky Peak dam failure hazard areas, respectively. No canals are in proximity to the FEMA levee protected areas.

Table 3.2.BB. Length of Canal Located in the Flood Hazard Area by County/Tribal National

		1% Flood Event	
Jurisdiction	Total Canal Length (miles)	Length (miles)	Percent (%) of Total
Adams County	28.7	1.0	3.5%
Bingham County	455.6	60.2	13.2%
Boise County	10.6	1.1	10.3%
Bonneville County	385.4	15.2	3.9%
Boundary County	72.0	13.6	18.8%
Butte County	166.9	18.2	10.9%
Camas County	4.9	0.0	<1%
Cassia County	625.1	22.1	3.5%
Clark County	66.9	7.7	11.5%
Elmore County	197.2	4.7	2.4%
Fort Hall Tribe	201.7	7.9	3.9%
Franklin County	214.2	3.7	1.7%
Fremont County	366.2	34.0	9.3%
Gem County	117.2	0.1	<1%
Gooding County	383.1	20.4	5.3%
Idaho County	22.0	0.1	0.4%
Jefferson County	401.0	0.3	<1%
Jerome County	431.5	1.3	<1%
Kootenai Tribe	6.8	0.1	1.3%
Lemhi County	111.2	4.3	3.9%
Lincoln County	220.8	4.7	2.1%
Madison County	165.8	38.2	23.0%

Jurisdiction	Total Canal Length (miles)	1% Flood Event Length (miles)	1% Flood Event Percent (%) of Total
Minidoka County	252.6	1.1	0.4%
Nez Perce County	1.6	0.0	0.3%
Nez Perce Tribe	10.0	0.0	<1%
Payette County	230.2	11.0	4.8%
Teton County	82.3	7.5	9.1%
Twin Falls County	500.4	0.1	0.0%
Valley County	59.4	1.9	3.2%
Idaho Total	**8,315.6**	**280.4**	**3.4%**

Estimating Potential Losses to State Facilities

To estimate the potential loss to state facilities, the HAZUS-MH flood model updated with the statewide Risk Management Technical Records database of state-owned and state-leased buildings. For the purposes of this vulnerability assessment, direct building losses are the estimated costs to repair or replace the damage caused to the building. Table 3.2.CC and Table 3.2.DD**Error! Reference source not found.** below summarize the estimated potential loss to state buildings by jurisdiction and agency, respectively.

The potential damage estimated to state-owned and leased buildings associated with the 1% annual chance flood is approximately $7.5 million which represents less than 1% of the total inventory. The Coeur d'Alene Tribe has the greatest estimated potential loss from State buildings as a result of the riverine flood event. The Department of Parks and Recreation has the greatest estimated potential loss as a result of the riverine flood event when compared with the other State departments and agencies.

Table 3.2.CC. State Building Potential Loss to the 1% Annual Chance Flood Hazard, by Jurisdiction

Jurisdiction	Total Value (all structure and contents)	Estimated Potential Loss: State-Owned Value	State-Leased Value	Total Value	Percent of Total
Ada County	$2,989,418,989	$76,849	$0	$76,849	<1%
Bonner County	$15,374,769	$403,232	$0	$403,232	2.6%
Boundary County	$2,921,183	$15,767	$0	$15,767	<1%
Coeur D'Alene Tribe	$8,410,014	$4,479,677	$0	$4,479,677	53.3%
Kootenai County	$83,386,890	$293,680	$0	$293,680	<1%
Latah County	$1,497,479,249	$325,513	$0	$325,513	<1%

Jurisdiction	Total Value (all structure and contents)	Estimated Potential Loss			
		State-Owned Value	State-Leased Value	Total Value	Percent of Total
Lemhi County	$11,258,674	$1,732,699	$0	$1,732,699	15.4%
Nez Perce Tribe	$26,895,878	$139,011	$0	$139,011	<1%
Idaho Total	**$6,744,949,885**	**$7,466,429**	**$0**	**$7,466,429**	**<1%**

Source: HAZUS-MH v4.0; Risk Management Technical Records
Please note $0 indicates that HAZUS-MH did not estimate potential loss to the state buildings in the database used for this risk assessment. There may be other State buildings that are vulnerable and may experience potential future loss that were not included in this version of RMTC with geographic coordinates.
Value = Replacement Cost Value. Total replacement cost value represents both structural value and estimated contents.

Table 3.2.DD. State Building Potential Loss to the 1% Annual Chance Flood Hazard by Agency

Agency	Total Value (structure and contents)	Estimated Loss			
		State-Owned Value	State-Leased Value	Total Value	Percent of Total
Administration - Department Of	$545,649,861	$0	$0	$0	0.0%
Boise State University	$1,478,845,528	$74,216	$0	$74,216	<1%
Department Of Fish And Game	$106,038,567	$2,448,011	$0	$2,448,011	2.3%
Department Of Lands	$56,967,411	$325,513	$0	$325,513	<1%
Department Of Parks And Recreation	$50,186,766	$4,479,677	$0	$4,479,677	8.9%
Public Health District 2 (North Central)	$10,948,557	$139,011	$0	$139,011	1.3%
Idaho Total	**$6,744,949,885**	**$7,466,429**	**$0**	**$7,466,429**	**<1%**

Source: HAZUS-MH v4.0; Risk Management Technical Records
Please note $0 indicates that HAZUS-MH did not estimate potential loss to the state buildings in the database used for this risk assessment. There may be other State buildings that are vulnerable and may experience potential future loss that were not included in this version of RMTC with geographic coordinates.
Value = Replacement Cost Value. Total replacement cost value represents both structural value.

The State recognizes the vulnerability to transportation and utility infrastructure to the flood hazard. Roads are the primary resource for evacuation to higher ground before and during the course of a flood event. Bridges exposed to flood events can be extremely vulnerable due to the forces transmitted by the velocity and by the impact of debris carried by the water. Floodwaters can also impact above ground utilities by knocking down power lines and radio/cellular communication towers. Power generation facilities can be severely impacted by both the velocity impact of the inundation of floodwaters.

Flooding can cause extensive damage to public utilities and disrupt the delivery of services. Loss of power and communications may occur and drinking water and wastewater treatment facilities may be temporarily out of operation. Flooded streets and roadblocks make it difficult for emergency vehicles to respond to calls for service. Floodwaters can wash out sections of roadway and bridges (Foster 2010).

Assessment of Jurisdiction Vulnerability and Potential Losses

This section discusses the vulnerability of jurisdictions to areas susceptible to flooding. It provides a summary of vulnerability and potential losses to population and buildings by county and Tribal Nation and discusses the jurisdictions most threatened by the identified flood hazards. An exposure analysis was conducted using the spatial hazard areas and the 2010 U.S. Census Block population data and default general building stock data, which is presented in the dasymetric U.S. Census Block data in Hazus-MH version 4.0. Due to the nature of the spatial data, it is possible for the floodplains to generate results in counties from Table 3.2.EE that do not have floodplain data from the NFHL or the digitized effective FIRMs, as the floodplain may overlap into the boundary of another county. This resulted in counties, such as Owyhee County, having vulnerable areas in the tables below. As noted above, the local asset exposure analysis results for the 1% flood zones and FEMA-certified levee areas are presented together.

Riverine Flood and Levee Failure

A spatial analysis was conducted to calculate the total land area located in the 1% annual chance flood zone and area with reduced flood risk protected by a FEMA-certified levee for each jurisdiction. These results are summarized in Table 3.2.EE. Please note the total area is inclusive of land and water. The analysis indicates approximately 1.8% of the State is located within the digitally available 1% annual chance flood zone boundaries, also known as the SFHA. Madison County has the greatest percentage of area located within the SFHA at 10.4%. Bonner County has the greatest levee area in the state based on FEMA's NFHL (0.94 sq. mi.), and the Coeur d'Alene Tribe has the greatest proportion of area located in the levee protected area (0.06%). There are a large number of levees in Idaho that are not included due to the fact that they do not meet FEMA standards.

Table 3.2.EE. Area Location within the 1% Annual Chance Flood Event Boundary (Square Miles) by County/Tribal National

Jurisdiction	Total Area (land and water)	1% Flood Event		Protected by Levee	
		Area	% of Total	Area	% of Total
Ada County	1,059.8	34.6	3.3%	-	-
Adams County	1,369.5	27.9	2.0%	-	-
Bannock County	967.2	30.4	3.1%	-	-
Bear Lake County	1,052.8	-	-	-	-
Benewah County	412.4	15.7	3.8%	0.09	<1%
Bingham County	1,769.7	105.7	6.0%	-	-
Blaine County	2,655.9	25.4	1.0%	-	-
Boise County	1,907.0	15.8	<1%	-	-
Bonner County	1,918.3	154.9	8.1%	0.94	<1%
Bonneville County	1,904.8	97.9	5.1%	-	-
Boundary County	1,275.0	29.6	2.3%	-	-

Jurisdiction	Total Area (land and water)	1% Flood Event		Protected by Levee	
		Area	% of Total	Area	% of Total
Butte County	2,239.6	31.0	1.4%	-	-
Camas County	1,076.7	-	-	-	-
Canyon County	604.0	48.3	8.0%	-	-
Caribou County	1,747.1	-	-	-	-
Cassia County	2,578.5	44.1	1.7%	-	-
Clark County	1,768.2	29.7	1.7%	-	-
Clearwater County	2,378.6	33.8	1.4%	-	-
Coeur d'Alene Tribe	536.5	14.1	2.6%	0.303	<1%
Custer County	4,938.7	-	-	-	-
Duck Valley Tribe	452.6	-	-	-	-
Elmore County	3,102.0	75.5	2.4%	-	-
Fort Hall Tribe	856.3	0.7	<1%	-	-
Franklin County	669.8	18.7	2.8%	-	-
Fremont County	1,901.9	72.6	3.8%	-	-
Gem County	564.6	10.6	1.9%	-	-
Gooding County	734.9	23.2	3.2%	-	-
Idaho County	8,210.1	19.8	<1%	-	-
Jefferson County	1,106.7	28.9	2.6%	-	-
Jerome County	601.9	1.2	<1%	-	-
Kootenai County	1,146.9	96.2	8.4%	0.206	<1%
Kootenai Tribe	3.3	0.4	11.3%	-	-
Latah County	1,076.4	31.4	2.9%	-	-
Lemhi County	4,572.1	40.0	<1%	-	-
Lewis County	89.3	0.4	<1%	-	-
Lincoln County	1,205.9	20.9	1.7%	-	-
Madison County	474.6	49.4	10.4%	-	-
Minidoka County	766.1	3.6	<1%	-	-
Nez Perce County	441.3	8.5	1.9%	-	-
Nez Perce Tribe	1,204.2	13.6	1.1%	-	-
Oneida County	1,203.1	0.05	<1%	-	-
Owyhee County	7,467.6	-	-	-	-
Payette County	410.3	27.7	6.8%	-	-
Power County	1,181.4	-	-	-	-
Shoshone County	2,642.4	20.3	<1%	-	-
Teton County	451.1	33.5	7.4%	-	-
Twin Falls County	1,928.0	5.8	<1%	-	-
Valley County	3,735.2	76.2	2.0%	-	-

Jurisdiction	Total Area (land and water)	1% Flood Event		Protected by Levee	
		Area	% of Total	Area	% of Total
Washington County	1,473.6	48.0	3.3%	-	-
Idaho Total	**83,833.8**	**1,471.3**	**1.8%**	**1.5**	**<1%**

Source:
Note: *Total area includes all land and water.*
% *percent*
SFHA *Special Flood Hazard Area*
- *Floodplain/Levee area not available*

Dam Failure

As discussed in the hazard profile, there are over 1,100 dams located in the State of Idaho. Of these dams, 473 are included in the U.S. Army Corps of Engineers National Inventory of Dams. There are 89 of these dams categorized as having high hazard potential (IDWR, 2018). All of the high hazard dams have an Emergency Action Plan (EAP). The inundation zones from the EAPs were digitized from a cross section of eleven high hazard ranked dams throughout the state, expanding this analysis. The charts depicting potential losses are located in Appendix E, Flood 3.2 DamTables.

Population

To better understand life and property at risk, the population and general building stock located in the 1% annual chance flood event boundaries and areas protected by levees were examined. The impact of riverine flooding on life, health, and safety is dependent upon several factors including the severity of the event and whether or not adequate warning time is provided to residents. Exposure represents the population living in or near floodplain areas that could be impacted should a flood event occur. Additionally, exposure should not be limited to only those who reside in a defined hazard zone, but everyone who may be affected by the effects of a hazard event. For example, people may be at risk while traveling in flooded areas, or emergency service access is compromised during an event. The degree of that impact will vary and is not strictly measurable.

Table 3.2.FF lists the estimated population located within the 1% flood zones and areas protected by FEMA-certified levees by using the 2010 Census block centroid. The limitations of this analysis are recognized and the results should only be used as estimates. The analysis indicates Shoshone County has the highest percent of total population located within the SFHA (22.6%). The following counties have greater than 10% of their population located in the flood hazard area (in descending order): Gooding County, Butte County, Madison County, Lincoln County, Washington County, and Bingham County. Shoshone County has the greatest percent of total population exposed to the flood area (22.6%), while Ada County has the greatest total number of people exposed to the hazard area (13,688 in total).

Table 3.2.FF. Population Located in the 1% Annual Chance Flood Event Boundary and FEMA-Certified Levee Protected Area by Jurisdiction

Jurisdiction	Total Population	Population Located in the Flood Hazard Area	Percent (%) of Total Population	Population Over 65 Located in the Flood Hazard Area	Percent (%) of Total Population	Low Income Population Located in the Flood Hazard Area	Percent (%) of Total Population
Ada County	392,365	13,688	3.5%	2,131	<1%	1,155	<1%
Adams County	3,976	190	4.8%	48	1.2%	18	<1%
Bannock County	80,722	1,833	2.3%	269	<1%	118	<1%
Bear Lake County	5,986	0	0.0%	0	0.0%	0	0.0%
Benewah County	4,743	297	6.3%	82	1.7%	30	<1%
Bingham County	42,775	4,768	11.1%	536	1.3%	267	<1%
Blaine County	21,376	1,266	5.9%	136	<1%	58	<1%
Boise County	7,028	454	6.5%	55	<1%	56	<1%
Bonner County	40,877	1,860	4.6%	409	1.0%	195	<1%
Bonneville County	104,234	1,668	1.6%	245	<1%	86	<1%
Boundary County	10,858	108	1.0%	17	<1%	16	<1%
Butte County	2,891	521	18.0%	101	3.5%	25	<1%
Camas County	1,117	0	0.0%	0	0.0%	0	0.0%
Canyon County	188,923	5,679	3.0%	437	<1%	411	<1%
Caribou County	6,963	0	0.0%	0	0.0%	0	0.0%
Cassia County	22,952	820	3.6%	106	<1%	43	<1%
Clark County	982	55	5.6%	6	<1%	4	<1%
Clearwater County	3,038	78	2.6%	18	<1%	11	<1%
Coeur D’Alene Tribe	6,765	559	8.3%	136	2.0%	53	<1%
Custer County	4,368	19	<1%	4	<1%	2	0.0%
Duck Valley Tribe	356	0	0.0%	0	0.0%	0	0.0%
Elmore County	27,038	1,519	5.6%	188	<1%	105	<1%
Fort Hall Tribe	5,769	0	0.0%	0	0.0%	0	0.0%
Franklin County	12,786	151	1.2%	20	<1%	12	<1%
Fremont County	13,242	317	2.4%	56	<1%	21	<1%
Gem County	16,719	148	<1%	30	<1%	7	<1%
Gooding County	15,464	3,005	19.4%	575	3.7%	316	2.0%
Idaho County	11,936	300	2.5%	78	<1%	41	<1%
Jefferson County	26,140	629	2.4%	85	<1%	18	<1%
Jerome County	22,374	1	<1%	0	0.0%	0	0.0%
Kootenai County	136,271	2,937	2.2%	456	<1%	162	<1%
Kootenai Tribe	114	4	3.5%	2	1.8%	0	0.0%
Latah County	37,244	578	1.6%	68	<1%	25	<1%
Lemhi County	7,936	756	9.5%	212	2.7%	151	1.9%

Lewis County	36	0	0.0%	0	0.0%	0	0.0%
Lincoln County	5,208	638	12.3%	111	2.1%	50	1.0%
Madison County	37,536	5,508	14.7%	454	1.2%	187	<1%
Minidoka County	20,069	0	0.0%	0	0.0%	0	0.0%
Nez Perce County	34,664	145	<1%	18	<1%	11	<1%
Nez Perce Tribe	18,440	1,145	6.2%	265	1.4%	142	<1%
Oneida County	4,286	1	<1%	0	0.0%	0	0.0%
Owyhee County	11,170	46	<1%	7	<1%	5	<1%
Payette County	22,623	656	2.9%	137	<1%	72	<1%
Power County	6,997	0	0.0%	0	0.0%	0	0.0%
Shoshone County	12,765	2,881	22.6%	640	5.0%	477	3.7%
Teton County	10,170	321	3.2%	20	<1%	11	<1%
Twin Falls County	77,230	1,393	1.8%	216	<1%	127	<1%
Valley County	9,862	305	3.1%	77	<1%	10	<1%
Washington County	10,198	1,158	11.4%	234	2.3%	122	1.2%
Idaho Total	**1,567,582**	**58,405**	**3.7%**	**8,685**	**<1%**	**4,620**	**<1%**

Source: United States Census 2010, FEMA 2017, FEMA Region 10
% percent

Of the exposed population, the most vulnerable include the economically disadvantaged and those over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make evacuation decisions based on the net economic impact to their family. Those over 65 are also more vulnerable because they are more likely to seek or need medical attention which may not be available during a flood event, and they may have more difficulty evacuating. In Shoshone County an estimated 640 people over the age of 65 (an estimated 5% of their total population) is located in the floodplain, and an estimated 477 low income individuals (an estimated 3.7% of their total population) is located in the hazard area as well. Ada County has the greatest number of socially vulnerable populations (over 65 years; low income) located in the hazard area.

Property and populations downstream from any dam are vulnerable to harm from dam failure. However, communities downstream of high-hazard dams and large canals should pay particular attention to inspection and maintenance activities that keep their communities safe. Existing and new communities need to respect canal easements so that canal operators have sufficient access to properly maintain their canals to ensure public safety and efficient water delivery. Without these activities and oversight, the vulnerability increases significantly.

The statewide occurrence of a high hazard dam failure should remain low if IDWR Dam Safety Program duties are adequately funded and implemented, and enforcement activities are continued that encourage dam owner responsibility for maintenance and repair; including regular update and testing of their emergency action plan. Tables 4AE (in Appendix E) list the estimated population exposed to the selected eleven high hazard dam inundation areas.

Ada County has the greatest exposure to the Lucky Peak dam failure hazard area with 392,365 people exposed (23.9% of County population). Similarly to the flood hazard, economically disadvantaged and those over the age of 65 are especially vulnerable to dam failure. For the American Falls dam, the population over 65 located in the dam failure area accounts for 12.6% of Minidoka County's total population. Minidoka County has the greatest vulnerability to its economically disadvantaged and elderly population at 15.4% for the American Falls dam failure, with Gem County a close second for the Deadwood Dam failure exposure. Approximately 15.3% of Gem County total population is the low income population.

General Building Stock

To further assess what is at risk, each jurisdiction's general building stock's exposure was examined in both the mapped FEMA 1% annual chance floodplain and dam failure inundation areas. Damages to buildings can displace people from their homes, threaten life safety and impact a community's economy and tax base. To provide a general estimate of the structural/content replacement value exposure, the flood hazard boundaries were overlaid on HAZUS-MH's default general building stock inventory at the Census block level for each county and Tribal Nation. Where the Census block centroid was located within the flood boundary, the building stock values in that Census block were totaled. There are recognized limitations to this analysis. This methodology was conducted for all jurisdictions with available flood hazard data. Refer to Table 4AE (in Appendix E) for a summary of these results.

The total building replacement cost value for buildings within the flood hazard for the State of Idaho is $9.9 billion. Ada County accounts for greater than 25% of that total ($2.75 billion) located in the 1-percent annual chance flood event hazard area.

The following counties have greatest replacement cost value located in the 1-percent annual chance flood event hazard area (in descending order): Shoshone (29.7%), Butte (19.5%), Gooding (19.2%), Kootenai Tribe (16.9%), and Madison (16.5%). Benewah County has an estimated 3.3% of its building stock located in the FEMA-certified levee failure hazard area.

Economic losses to the State of Idaho from flooding include but are not limited to: general building stock damage, agricultural losses and business interruption. These losses will negatively affect the tax base. Damage to general building stock can be quantified using HAZUS-MH as discussed above. Other economic components such as loss of facility use, functional downtime, and social economic factors are less quantifiable. For the purposes of this analysis, the general building stock damage is discussed further.

To estimate the potential losses by jurisdiction, the HAZUS-MH flood model and default general building stock provided by the model were used. This analysis has been refined since the 2013 State HMP due to the updated and improved flood hazard areas and depth grids across the State. Table 3.2.GG summarizes the estimated potential losses to the default general building stock by jurisdiction. As statewide building data (replacement cost value and building attributes required for modeling the flood hazard in HAZUS-

MH) becomes available, the default inventory in HAZUS-MH will be updated to provide more accurate potential losses.

Table 3.2.GG. Estimated Potential General Building Stock Losses from the 1% Annual Chance Flood Event, by Jurisdiction

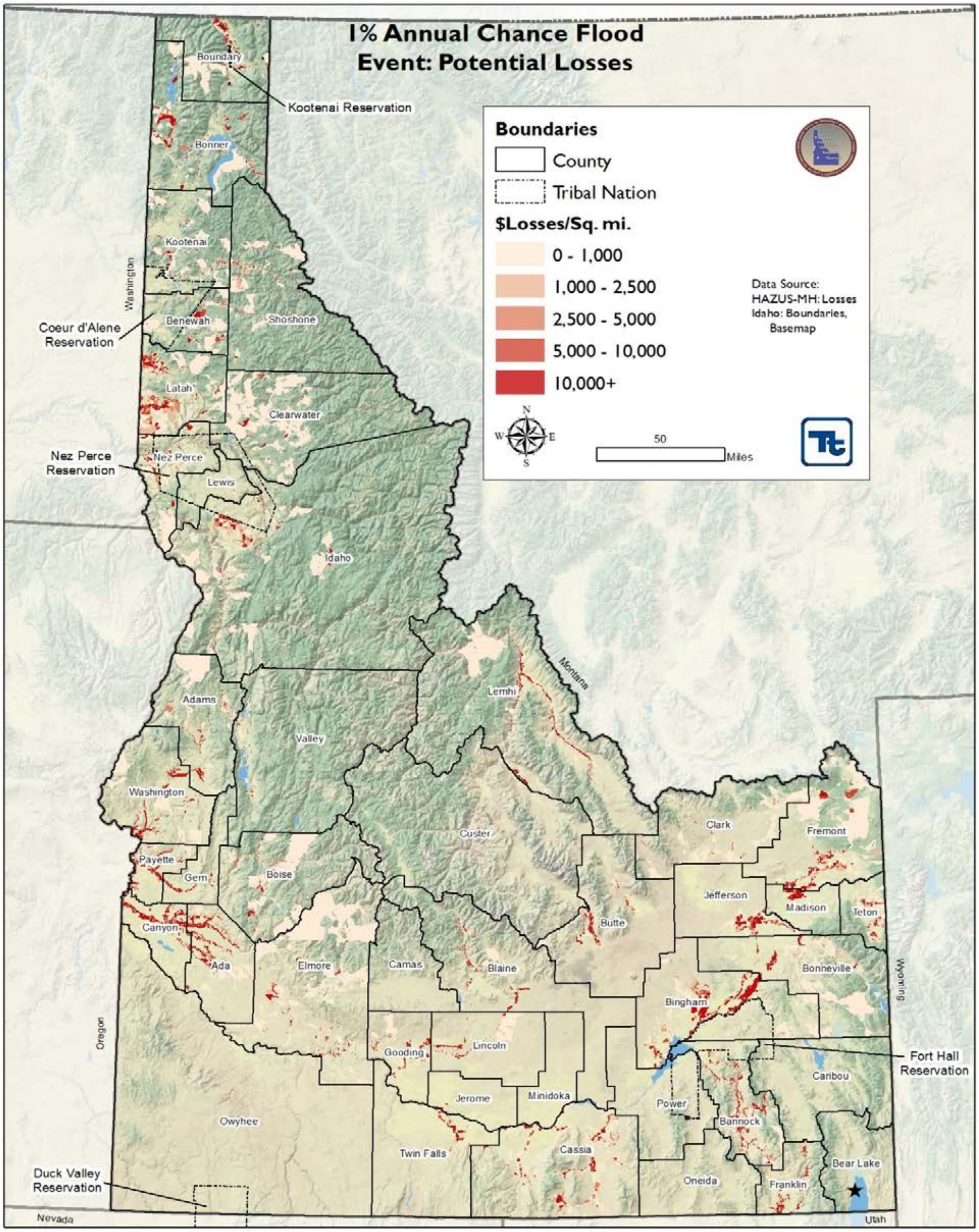
Jurisdiction	Total Replacement Cost Value (RCV)	1% Flood Event	
		Estimated Loss	% of Total
Ada County*	$67,917,280,000	$289,455,000	<1%
Adams County	$768,231,000	$26,782,000	3.5%
Bannock County	$12,223,383,000	$41,778,000	<1%
Bear Lake County	$1,196,118,000	$0	0.0%
Benewah County	$698,652,000	$28,782,000	4.1%
Bingham County	$5,405,079,000	$50,043,000	<1%
Blaine County	$5,476,705,000	$12,519,000	<1%
Boise County	$1,497,585,000	$39,631,000	2.6%
Bonner County	$7,701,597,000	$108,469,000	1.4%
Bonneville County	$18,775,427,000	$18,260,000	<1%
Boundary County	$1,556,926,000	$12,382,000	<1%
Butte County	$452,406,000	$6,239,000	1.4%
Camas County	$247,126,000	$0	0.0%
Canyon County	$24,048,014,000	$54,468,000	<1%
Caribou County	$1,176,048,000	$0	0.0%
Cassia County	$3,061,608,000	$12,424,000	<1%
Clark County	$124,419,000	$601,000	<1%
Clearwater County	$625,216,000	$6,891,000	1.1%
Coeur d'Alene Tribe	$1,379,028,000	$15,413,000	1.1%
Custer County	$987,374,000	$0	0.0%
Duck Valley Tribe	$15,524,000	$0	0.0%
Elmore County	$3,778,122,000	$28,365,000	<1%
Fort Hall Tribe	$596,710,000	$28,000	0.0%
Franklin County	$1,742,513,000	$13,081,000	<1%
Fremont County	$2,807,781,000	$19,511,000	<1%
Gem County	$2,308,168,000	$4,452,000	<1%
Gooding County	$1,934,143,000	$21,776,000	1.1%

Jurisdiction	Total Replacement Cost Value (RCV)	1% Flood Event	
		Estimated Loss	% of Total
Idaho County	$2,057,570,000	$39,039,000	1.9%
Jefferson County	$3,163,139,000	$3,311,000	<1%
Jerome County	$2,620,168,000	$590,000	<1%
Kootenai County	$22,058,607,000	$154,028,000	<1%
Kootenai Tribe	$13,200,000	$812,000	6.2%
Latah County	$5,264,747,000	$21,665,000	<1%
Lemhi County	$1,429,223,000	$39,653,000	2.8%
Lewis County	$11,318,000	$0	0.0%
Lincoln County	$629,652,000	$5,796,000	<1%
Madison County	$3,682,487,000	$14,589,000	<1%
Minidoka County	$2,594,005,000	$153,000	<1%
Nez Perce County	$6,382,936,000	$6,298,000	<1%
Nez Perce Tribe	$2,580,646,000	$39,415,000	1.5%
Oneida County	$684,026,000	$1,740,000	<1%
Owyhee County	$1,258,911,000	$0	0.0%
Payette County	$2,900,679,000	$16,932,000	<1%
Power County	$1,011,694,000	$0	0.0%
Shoshone County	$2,248,057,000	$101,521,000	4.5%
Teton County	$1,793,082,000	$1,931,000	<1%
Twin Falls County	$11,430,233,000	$9,389,000	<1%
Valley County	$3,764,632,000	$15,872,000	<1%
Washington County	$1,615,788,000	$31,573,000	2.0%
Idaho Total	**247,695,983,000**	**$1,315,657,000**	**<1%**

Source: HAZUS-MH v 4.0
** Ada County results reflect the 2018 SHMP analysis that utilized the default dasymetric building dataset in HAZUS-MH v4.0. These results differ from the 2017 Ada County local hazard mitigation plan risk assessment results which utilized a user-defined building stock update based on assessor data.*

HAZUS-MH estimates $1.3 billion in estimated potential damage to the general building stock inventory associated with the 1% annual chance flood event, representing less than 1% of the State's overall total building inventory. Ada County has the greatest estimated potential losses as a result of the 1% annual chance flood event, followed by Kootenai, Bonner, Shoshone and Canyon Counties in descending order. Figure 3.2.HH below displays the potential loss results.

Figure 3.2.HH Estimated Potential Building Losses from the 1% Annual Chance Flood Event



Vulnerability Summary

The IMHRP evaluated the State's flood risk by calculating a risk score on a watershed basis. The risk equation inputs included weighted scores for total population in the watershed, population at risk of flooding, essential facilities in the floodplain, and the presence of levees and hazardous dams. Figure 3.2.KK summarizes the flood risk rank statewide as determined by each watersheds risk score.

In addition to the high-risk ranked watersheds having significant population at risk to flooding, they also have significant or high-hazard dams present and levees present as well. Further, most have highly-ranked essential facilities either present in the watershed or located in the floodplain. Table 3.2.II summarizes the 'high' flood risk-ranked watersheds in descending total risk order.

Table 3.2.II. Watersheds with a 'High' Flood Risk Rank

HUC-8 Watershed	Flood Risk Rank	HUC-8 Watershed	Flood Risk Rank
Lower Boise	1	Idaho Falls	14
Clearwater	2	North Fork Payette	15
Payette	3	Middle Snake-Succor	16
Big Wood	4	Upper Spokane	17
South Fork Coeur d'Alene	5	C.J. Strike Reservoir	18
Weiser	6	Lake Walcott	19
South Fork Clearwater	7	Middle Bear	20
Blackfoot	8	Middle Salmon-Panther	21
American Falls	9	Bear Lake	22
Upper Snake-Rock	10	Coeur d'Alene Lake	23
Lower Kootenai	11	Lower Henrys	24
Portneuf	12	Little Wood	25
St. Joe	13		

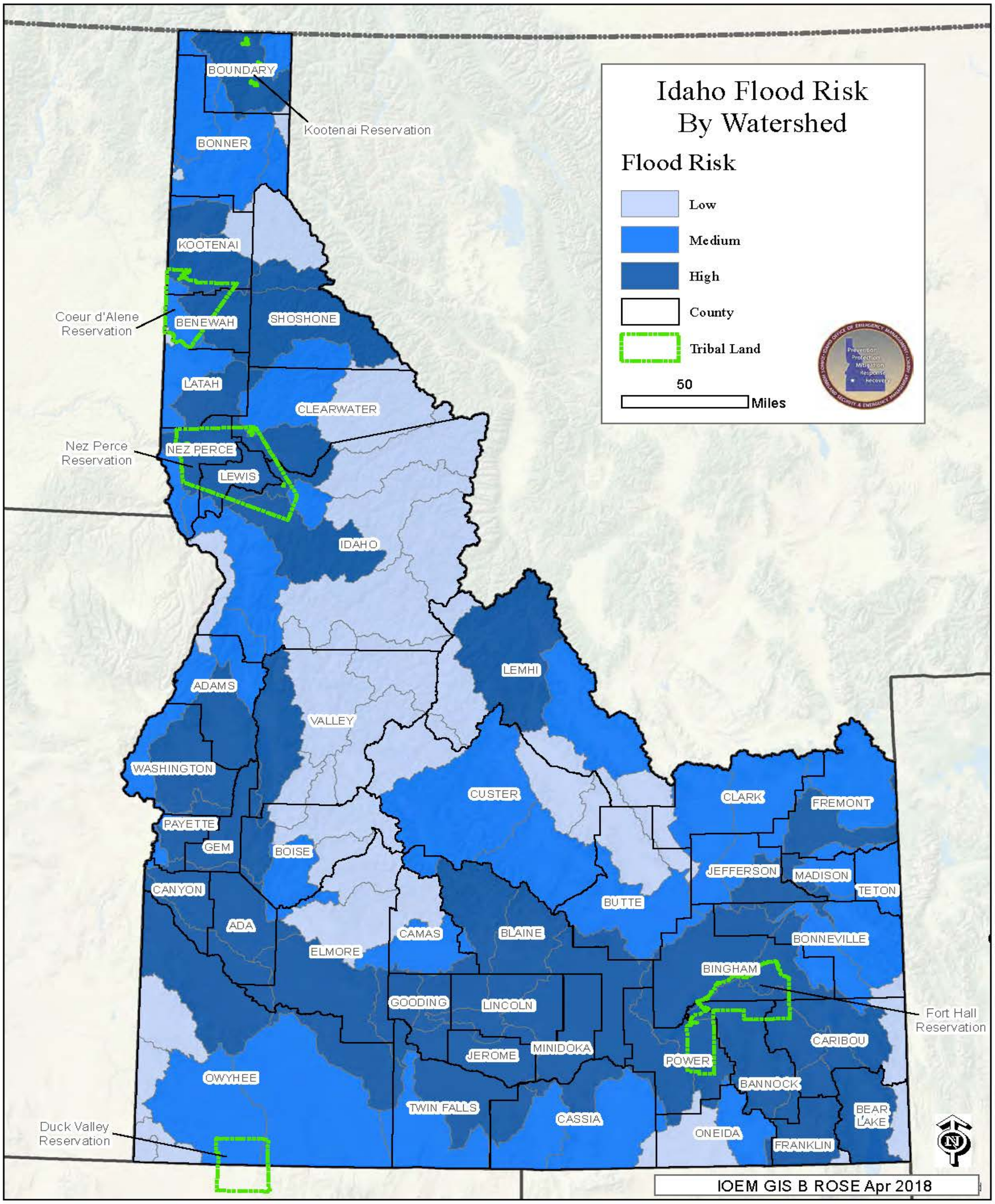
Source: IMHRP, 2015

In an effort to align the IMHRP and State HMP risk analyses, the Counties and Tribal Nations that intersect the high-ranked watersheds are listed in Table 3.2.JJ below.

Table 3.2.JJ. Counties/Tribal Nations Located in the Top 5 High Flood Risk Ranked Watersheds

County/Tribal Nation	HUC-8 Watershed	Flood Risk Rank	County/Tribal Nation	HUC-8 Watershed	Flood Risk Rank
Ada County	Lower Boise	1	Gooding County	Big Wood	4
Adams County	Payette	3	Idaho County	Clearwater	2
Benewah County	South Fork Coeur d'Alene	5	Kootenai County	South Fork Coeur d'Alene	5
Blaine County	Big Wood	4	Latah County	Clearwater	2
Boise County	Payette	3	Lewis County	Clearwater	2
Boise County	Lower Boise	1	Lincoln County	Big Wood	4
Camas County	Big Wood	4	Nez Perce County	Clearwater	2
Canyon County	Lower Boise	1	Nez Perce Tribe	Clearwater	2
Clearwater County	Clearwater	2	Payette County	Payette	3
Custer County	Big Wood	4	Payette County	Lower Boise	1
Elmore County	Lower Boise	1	Shoshone County	South Fork Coeur d'Alene	5
Gem County	Payette	3	Valley County	Payette	3
Gem County	Lower Boise	1	Washington County	Payette	3

Figure 3.2.KK. Idaho Flood Risk by Watershed



As demonstrated by the 2018 SHMP Hazus analysis, the counties with the greatest population, building stock, and critical facilities exposure are: Ada County, Bingham County, Canyon County, Madison County, and Shoshone County. Ada County includes the City of Boise, the most populated city in the State, and is located within the Lower Boise Watershed, the highest rank watershed vulnerable to flood. Additional Counties located within the Lower Boise Watershed include Boise County, Canyon County, Elmore County, Gem County, and Payette County. Of these counties, Ada County, Boise County, Canyon County, and Elmore County are projected to experience an increase in population as estimated by the EPA's ICLUS project. Ada County, Kootenai County, Bonner County, Shoshone County, and Canyon County were estimated to experience the greatest potential losses from the HAZUS-MH flood model, in descending order.

The watersheds that ranked as high risk to flooding coincide with the potential building loss estimates as generated through the 2018 SHMP Hazus analysis for the 1-percent annual chance flood event; Ada County and Canyon County are located in the Lower Boise Watershed, Kootenai County and Shoshone County are located in the South Fork Coeur d'Alene Watershed and Bonner County is located in the Lower Kootenai Watershed. Ada County, Kootenai County, and Shoshone County have the greatest number of NFIP claims, while Blaine County has experienced the greatest claim monetary total of $2.7 million dollars (264 claims).

In terms of the canals, Bingham County, Madison County, and Fremont County have the greatest estimated total mileage of canals exposed to the 1-percent annual chance flood event. These three counties are located in the southeastern region of the State. Results for dam failure and levee failure are difficult to compare to the IMHRP results due to lack of statewide data and their nature as secondary flood hazards.

Consequence Analysis Evaluation

On May 15, 2018, a Consequence Analysis Evaluation was conducted for this hazard scenario, aligning with hazards profiled in the State Hazard Mitigation Plan. The assessment was conducted by a diverse planning team comprised of subject matter experts from across the State. This effort mirrored a similar exercise that occurred during both the 2010 and 2013 State Hazard Mitigation Plan updates, which also analyzed the hazards of flood, earthquake, and wildfire. The exercise is intended to provide another way to assess the State's vulnerability to its hazards and was conducted as a group exercise. Participants were asked to individually rank the following systems on a scale from 0 (no consequences) to 5 (most severe consequences), separately evaluating both the short-term (0-6 month) and long-term (6+ months) consequences of the scenario.

Systems Evaluated:

- The public
- First responders
- Continuity of operations
- Property, facilities, and infrastructure

- Economic conditions
- Public confidence in government

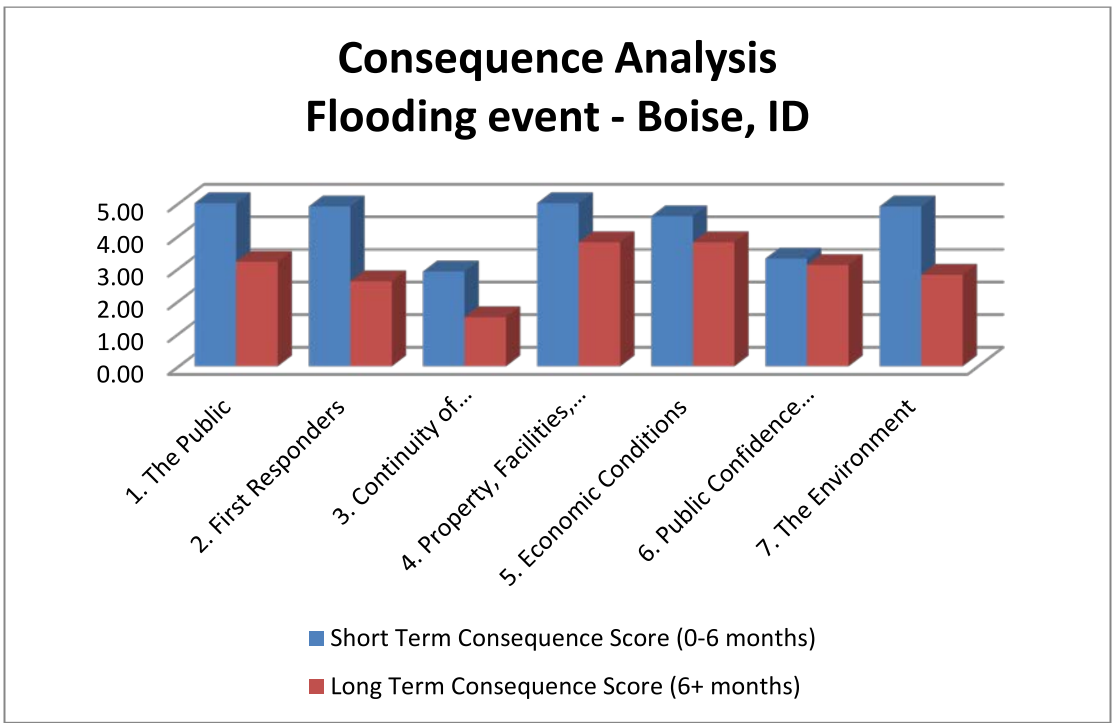
In addition to the ranking exercise, participants also discussed additional questions pertaining to the scenarios, including:

- Would the season and timing of when the event occurred alter any of these consequences?
- What other hazards could be triggered by this initial event?
- Would any regional impacts result from this event?
- Have any changes since the last plan update altered any of these consequences?

Scenario

Spring: A flood scenario resulting from spring thaw and excess rain in Eastern Idaho that saturates the ground and causes the Snake River to flood and the Palisades Dam to fill quickly. The event occurs in the spring at 10:00 AM.

Results



The chart above presents the results of the exercise. Looking at the short-term consequences of this flood event, exercise participants felt that the most severe consequences would be felt by the public, first responders, the built environment, and the environment. From a long-term standpoint, the three systems suffering the most severe consequences (in decreasing order) include the built environment, the economy and the public. Overall, what stands out is that the short-term impacts of this type of flood event are greater than for the long-term.

Some observations of the group to note included:

- The scenario in question would be devastating to the area with severe short and long term effects.
- Utility damage and loss of service, due to possible damage to hydroelectric facilities along river.
- Hazardous Material releases. Wells/water supply damage or contamination.
- Possibility of secondary flooding and damage away from river via irrigation canals and levees that are not able to handle a flood of this magnitude.
- Wide spread damage to transportation network. Agriculture damage would result in a huge regional economic loss.

Mitigation Rationale

Flooding

Flooding is the most serious, devastating, and costly of natural hazards and can occur virtually anywhere. Most Idaho residents live near rivers that are subject to periodic flooding. Floods in Idaho frequently damage roads, farmlands, and structures, often disrupt lives and businesses, and occasionally cause the loss of life. A few streams in Idaho are subject to almost annual flooding, but damaging floods are much less frequent in most areas. Historically, the greatest impact has been to the northern and north-central parts of the State, where communities are vulnerable to flooding of the many rivers, lakes, and creeks in the area due to snowmelt, rain, or rain on snow events. The steep, mountainous terrain creates a flood-prone environment, and development is often confined to areas adjacent to stream channels.

The nature and magnitude of riverine flood-related damages are dependent on:

- Flow volume and velocity - High volume and/or velocity flows carry huge mechanical forces and are capable of damaging even substantial structures. This may be extreme for the failure of a dam, levee, or canal.
- Duration - Long-duration floods of even low volume can cause great damage due to prolonged inundation (e.g., crop damage).
- Bank stability - Bank erosion can alter channel paths and result in a substantial loss of property.
- Sediment load and in-stream debris - Siltation from sediment transport and deposition may decrease the carrying capacity of the channel, exacerbating flood events. Siltation may also decrease reservoir storage capacity, degrade fish and wildlife habitat, change the course of a stream, or introduce chemicals into the stream. In-stream debris increases the likelihood of mechanical damage and may raise flood levels when jams form.
- Secondary hazards - Secondary hazards associated with flooding include landslides, mudslides, structural damage, hazardous materials releases, the spread of pollution and disease.

Generally, flash floods represent the greatest risks to life and property due to the rapid onset, the potentially high velocity of water, and the debris load carried by floodwaters. Flash floods resulting from a series of fast-moving storms may produce more than one flood crest, and the sudden destruction of structures and washout of access routes may result in the loss of life. Flash floods happen somewhere in Idaho almost every year and are a major cause of weather-related fatalities in the United States each year.

The possibility for injury and death from flash floods is heightened because motorists oftentimes underestimate the depth and velocity of floodwaters, causing stalled and flooded vehicles and drowning; nearly half of all flash-flood fatalities are vehicle related, usually occurring when motorists attempt to drive through floodwaters.

Sheet flooding can cause major damage, as flooding can occur when there is rapid snowmelt or rain on snow events. This is a temporary event, however if the ground is frozen then the water and ice have nowhere to go, turning the area into a temporary lake or river. Sheet flooding in 2017 caused millions of dollars in damage to roads and bridges in the southern part of the state.

In general, human hazards during flooding include drowning, electrocution from downed power lines, leaking gas lines, fires and explosions, hazardous chemicals, and displaced wildlife. Economic losses and the disruption of social systems are often enormous. Floods may destroy or damage structures, furnishings, business assets including records, crops, livestock, roads and highways, and railways. They often deprive large areas of electric service, potable water supplies, wastewater treatment, communications, medical care, and many other community services and may do so for long periods of time.

Dam, Canal, and Levee Failure

The primary rationale for mitigating risks associated with dam, canal, and levee failure is the potential for loss of life and economic loss. Presently, a comprehensive inventory of levees and levee systems in Idaho does not exist. The National Levee Database program, run by USACE, does have some information, however participation is voluntary and has not produced a widespread inventory. As more comprehensive levee inventory and inspection programs emerge, additional mitigation of risk associated with levees/ levee systems can be identified. Further, with the exception of some federal-owned levees, most do not benefit from regular safety inspections as typically are provided for Idaho's dams. Risk mitigation is strongly dependent on 1) reducing the probability that failure will occur, and 2) reducing the potential damage to life and property resulting from the failure. Certain dams have been constructed to reduce downstream flooding but they must still release water to prevent being overtopped. This release of water mitigates catastrophic flooding, but some downstream flooding may still occur.

Other factors that contribute to damage to infrastructure systems are encroachment on levees and canals, lack of maintenance on systems, and development of areas downstream of dams creating issues with flooding and management of water release.

General Mitigation Approaches

Flooding

Flood mitigation is principally involved with accommodating desired social and economic goals while preventing losses to life, health, and property. In general, flood damage may be mitigated by protecting life and property from floodwaters through proper floodplain management, actions to increase water storage capacity, structural measures such as levees and dikes, contingency planning by local, county, and state agencies, and educating the public and decision makers to better understand flood hazards. Recommended approaches to implementing these mitigation solutions include:

- Hazard management
- Information/Education
- Preparedness
- Infrastructure
- Regulatory
- Mapping and analysis
- Resilience

A key distinction of flooding, when compared to other hazards, is the extent to which the actions of others can influence the impact of flooding on a community. Activities in the upper portions of a basin that generate additional surface water runoff, in-stream debris, or sedimentation may increase flooding in downstream communities. It is essential that flood mitigation planning address the entire basin and that communities undertaking local planning efforts coordinate and cooperate with adjacent jurisdictions.

An excerpt from "Alluvial Fans: Hazards and Management" (FEMA 165, February 1989)

It must be stressed that any development activity sustained on the active portion of an alluvial fan disrupts and alters the natural flood processes which perpetuate its formation, and subjects any structure situated on the fan to unpredictable, erratic hazards during flood events. Furthermore, any new construction can redirect flood and debris flow to adjacent properties and thereby increase flood hazards in other areas. A comprehensive approach is therefore needed to manage development on fan areas such that the entire fan's natural flood processes and resulting hazards are taken into account. The development and implementation of a comprehensive approach is best handled on the local government level through planning, zoning and building permit processes. Through these processes, future development can be planned and its effects on flood hazards adequately addressed.

A comprehensive or master planning approach to managing growth on an alluvial fan considers fan conditions from apex to tow while guiding future development in a coordinated manner. The keystone of this planning process is the community's selection of flood/debris hazard management tools. The choice of tools will depend upon the nature and location of the hazards, and the location, timing, size and density of existing and future development. These tools can be structural or nonstructural. The fan management plan may be incorporated as a separate element within the community's existing comprehensive plan, or stand alone as a separate document. The planning process incorporates the following steps:

1. Identify the Hazard
2. Plan Future Development
3. Choose Flood Mitigation Tools
4. Enforce Regulations
5. Educate Citizens

Flood Control Districts

Flood Control Districts provide control of rivers, streams, their tributaries, and related structures within the district boundaries in order to protect life and property from flooding. Funded by local taxes and with authority from Idaho Code § 42-3115, the flood control district board of directors accomplishes this goal through various projects, such as removing debris from waterways, repairing and stabilizing stream banks, and constructing and maintaining structural works. A flood control district also has the authority to declare a flooding emergency and help fight floods. Idaho Code Title 42 Chapter 31 further describes the purpose, establishment, and authority of flood control districts. There are 18 active flood control districts in the state. Typically, Flood Control Districts complete channel maintenance, bank stabilization, and gravel removal.

Channel Maintenance: The Flood Control District removes accumulations of woody debris from the river to help maintain a clear channel to reduce the risk of flooding during high river flows. Loose debris can get caught up on bridges or other channel obstructions during higher flows and cause localized flooding damage. Once an obstruction causes the water to overtop the banks, it's difficult to predict where the flood water will go. Generally, the District only removes trees that have already fallen in the river or are about to fall in the channel. If a tree is ready to fall, the District often cuts the trunk 2 to 3 feet above the ground and leaves the root in place to help keep the bank stable. Woody debris needs a drying period prior to burning. The District places wet woody debris outside of the river channel, often in piles designed to provide temporary wildlife habitat. Channel maintenance is completed under permits from the Idaho Department of Water Resources and the Army Corps of Engineers, and consistent with a protocol for tree and brush removal that is approved by the agencies. The Idaho Department of Environmental Quality approves debris burning each week based on weather conditions and stops burning any time air quality is potentially at risk.

Bank Stabilization: Rivers naturally move laterally over time. Sometimes this movement can put property at risk when banks destabilize and erode. The District works with property owners to stabilize eroding banks by placing rock in the river and along the banks to redirect flows and reduce erosion. Generally, this work is requested and largely funded by the property owner, but guided by the District to ensure an effective outcome. The District plants willows in or immediately behind rocks placed along the bank to further stabilize the banks and reestablish vegetation.

Gravel Removal: From time to time, the District works with highway districts to remove gravel at key locations. Accumulated gravel can alter river flow and present a significant risk during a flood. Accumulated gravel is removed from the channel and used by the highway districts for construction projects, which saves taxpayer money.

In comparison to riverine flooding, flash and sheet flooding comes with little warning and is considerably less predictable. These floods are generally triggered by more concentrated events (e.g., focused thunderstorms, rain-on-snow, overwhelmed infrastructure, and dam failures) that are harder to foresee with any reliability. Certain areas, though, due to their terrain and precipitation, can be identified as relatively high risk. Mitigation focuses on factors that can be controlled and providing for an effective evacuation, response, and recovery.

Mitigation for ice and debris jam floods is closely related to riverine and flash flooding mitigation and is not described separately. A critical difference is that when a jam flood occurs, removing the jam is generally not practical and can be dangerous. Ice jams will eventually break up; debris jams will take longer, and removal may have to wait until lower flows are present. One step is to control the jam-forming material prior to the event, which is not always feasible. Another is to identify potential events, including key indicators, and develop appropriate response plans.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) is a federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

Participation in the NFIP is based on an agreement between a local government and the Federal Government that states if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to construction and other ground disturbing activities in mapped Special Flood Hazard Areas (SFHA), the Federal Government will make flood insurance available within the community as a financial protection against flood losses. The SFHA has been defined using topographic and hydrologic information and sometimes engineering studies, to identify what area would be inundated in a 1% annual chance flood event. In this type of event, there is a 1% chance each and every year that a flood of that magnitude could occur or be exceeded.

Cities and counties in the NFIP have adopted an ordinance that meets or exceeds the minimum requirements of the National Flood Insurance Program found in Title 44 CFR § 60.3. The ordinance explains requirements for floodplain development permits, construction standards, and other pertinent information for floodplain management.

Homeowners insurance does not cover flood damage. A private insurance agent can write an NFIP policy or a property owner can buy coverage directly through the NFIP. Flood insurance can be purchased for any property even if it is not shown in an SFHA on a Flood Insurance Rate Map (FIRM). An insurance policy is rated based on typical insurance variables such as amount of coverage for the structure and contents and specifically on the mapped flood zone and the type of construction, especially the foundation. Only buildings and structures, not land, are protected by an NFIP policy.

Lenders have a federal mandate, the “mandatory purchase requirement,” that says if a loan for a property is federally insured or is made by federally insured institutions and the structure is in a SFHA, flood insurance will be required.

The NFIP in Idaho

The NFIP data are also a useful tool to determine areas vulnerable to flood and severe storm hazards for each jurisdiction. A rollup of the NFIP data and information from the recent 2017 flooding in Idaho has been provided by IDWR. From February 5, 2017 through June 15, 2017, 24 counties were affected by severe storms, severe winter storms, and flooding, landslide, and mudslide events. Maureen O’Shea, State NFIP Coordinator, IDWR provided the after action review from this immense disaster in the state.

The counties affected & observed were: Ada, Bingham, Blaine, Bonner, Boundary, Camas, Canyon, Cassia, Clearwater, Custer, Elmore, Franklin, Gooding, Idaho, Jefferson, Jerome, Kootenai, Latah, Lincoln, Minidoka, Shoshone, Twin Falls, Valley, & Washington Counties (24 counties).

The observation included total NFIP claims January 1 to September 30, 2017:

- Total Claims: 224
- 199 Total dollars paid: $2,821,902.00
- Largest claim value: $202,144.00
- Average Claim payment: $12,597.78

FEMA's Joint Field Office (JFO) staff conducted the following activities in Idaho:

- Insurance Agent Outreach:
- Face-to-face agency visits (243 agencies/481 agents);
- Mailing done to 130 agents/agencies in the most rural areas

Idaho has 58 know repetitive loss properties, according to the NFIP Policies, Claims, and Repetitive Loss Statistics and no known SRL properties, however, each year the state of Idaho requests the list of repetitive loss properties from FEMA via an Information Sharing Access Agreement (ISAA). The list from FEMA based on Biggerts Waters Flood Insurance Reform Act of 2012, shows no repetitive loss properties and one severe loss property in Shoshone County. The RL definition in the Act references Section 1370. Section 1370 can be found in 42 United States Code Section 4121.

A severe repetitive loss property is a structure that:

- Is covered under a contract for flood insurance made available under the NFIP; and
- Has incurred flood related damage –
- For which 4 or more separate claims payments have been made under flood insurance coverage with the amount of each such claim exceeding $5,000, and with the cumulative amount of such claims payments exceeding $20,000; or
- For which at least 2 separate claims payments have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

A repetitive loss property is a structure covered by a contract for flood insurance made available under the NFIP that:

- Has incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and
- At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

Both the State Hazard Mitigation Officer and the State Floodplain Administrator are committed to encourage the jurisdictions that contain these structures to pursue mitigation actions with the respective private owners through various FEMA funding streams, either through PDM, FMA or HMGP. The property in Shoshone County is the only Idaho property eligible for elevation, relocation or acquisition through the FMA grant. The NFIP repetitive loss properties provided in the table below would qualify for a FMA grant only through a Community Flood Mitigation Project. The RL and SRL strategy is to work with the local communities to review repetitive loss structures, utilize previous mitigation plans and develop new action plans which include multi-agency collaboration where possible. The state mitigation planner assists jurisdictions when updating mitigation plans and strongly recommends special consideration for action items relating to RL or SRL properties. In the last five years, Bonner County received a PDM grant to purchase a property and return the land to open space.

For repetitive loss properties all pre-existing 27 field verifications were completed. Non-Participating communities received mailing information about the NFIP & how to join the NFIP (67 total = 3 counties & 64 cities). IDWR provided NFIP messaging with External Affairs: two one-page flyers, one for the general public, & one for insurance agent outreach.

The low number of NFIP claims during this time means one of two things: (1) Residences & commercial buildings are being built to the required NFIP standards or higher thus sustaining minimal damage; or (2) Citizens are self-insured for flooding (do not have flood insurance), or have a private (non-NFIP) flood insurance policy. Suggestions for the future include increasing outreach messaging regarding the benefits of purchasing an NFIP (flood) policy.

Table 3.2.LL summarizes the NFIP policies, repetitive loss (RL), and severe repetitive loss (SRL) properties in each county as of October 30, 2017 and the claims in each county as of September 30, 2017. Shoshone County has the highest number of RL properties in the State. There are no Tribal Nations in Idaho participating in the NFIP. Refer to Figures 3.2.MM and 3.2.NN for visual presentations of the number of policies and claims by jurisdiction in the State of Idaho.

Per State statutes 46-1020 (2f) and 46-1023 (2), floodplain zoning requires at a minimum, that any development in a floodplain must be constructed at a flood protection elevation and/or have adequate flood proofing. Thus, helping to reduce the number of properties with repetitive loss or potential severe repetitive losses. If a jurisdiction allows development that does not meet these standards, they are not eligible for state matching funds in a disaster. The state encourages orderly development and wise use of floodplains, thus Idaho has a very low number of repetitive loss properties and no properties with severe repetitive loss.

Table 3.2.LL. Current Status of NFIP Policies, Claims, and Repetitive Loss Statistics

County	Number of Policies	Number of Claims	Total Loss Payment	Number RL Properties	Number of SRL Properties
Ada County	2,976	113	$460,706	2	0
Adams County	15	4	$9,389	0	0
Bannock County	143	37	$109,285	2	0
Bear Lake County	2	0	$0	0	0
Benewah County	84	46	$722,735	10	0
Bingham County	153	33	$140,150	0	0
Blaine County	1,223	264	$2,734,573	3	0
Boise County	62	1	$35,645	0	0
Bonner County	328	35	$149,640	0	0
Bonneville County	146	14	$39,668	0	0
Boundary County	21	3	$8,395	0	0
Butte County	14	0	$0	0	0
Camas County	2	0	$0	0	0
Canyon County	635	25	$96,919	0	0
Caribou County	4	1	$5,340	0	0
Cassia County	34	2	$63,440	0	0
Clark County	1	0	$0	0	0

County	Number of Policies	Number of Claims	Total Loss Payment	Number RL Properties	Number of SRL Properties
Clearwater County	16	9	$37,473	0	0
Custer County	51	2	$44,985	0	0
Elmore County	120	12	$110,123	0	0
Franklin County	7	1	$2,525	0	0
Fremont County	21	2	$0	0	0
Gem County	36	3	$13,823	0	0
Gooding County	66	6	$33,110	0	0
Idaho County	44	5	$9,962	0	0
Jefferson County	73	18	$115,665	4	0
Jerome County	4	1	$0	0	0
Kootenai County	315	81	$663,258	10	0
Latah County	190	30	$224,728	2	0
Lemhi County	82	22	$201,885	0	0
Lewis County	16	0	$0	0	0
Lincoln County	22	2	$5,606	0	0
Madison County	53	9	$19,923	0	0
Minidoka County	22	5	$187,291	0	0
Nez Perce County	42	8	$33,066	0	0
Oneida County	2	0	$0	0	0
Owyhee County	1	0	$0	0	0
Payette County	82	23	$226,347	2	0
Power County	2	0	$0	0	0
Shoshone County	562	128	$959,472	21	0
Teton County	59	3	$11,401	2	0
Twin Falls County	70	15	$26,208	0	0
Valley County	48	1	$0	0	0
Washington County	91	20	$975,707	0	0
Idaho Total	**7,940**	**984**	**$8,478,440**	**58**	**0**

Source: Note: Number of repetitive loss properties and policies are as of October 30, 2017. Claims represent all statuses: Open, Closed with Payment, Closed without payment through September 30, 2017.

Figure 3.2.MM. Total NFIP Policies

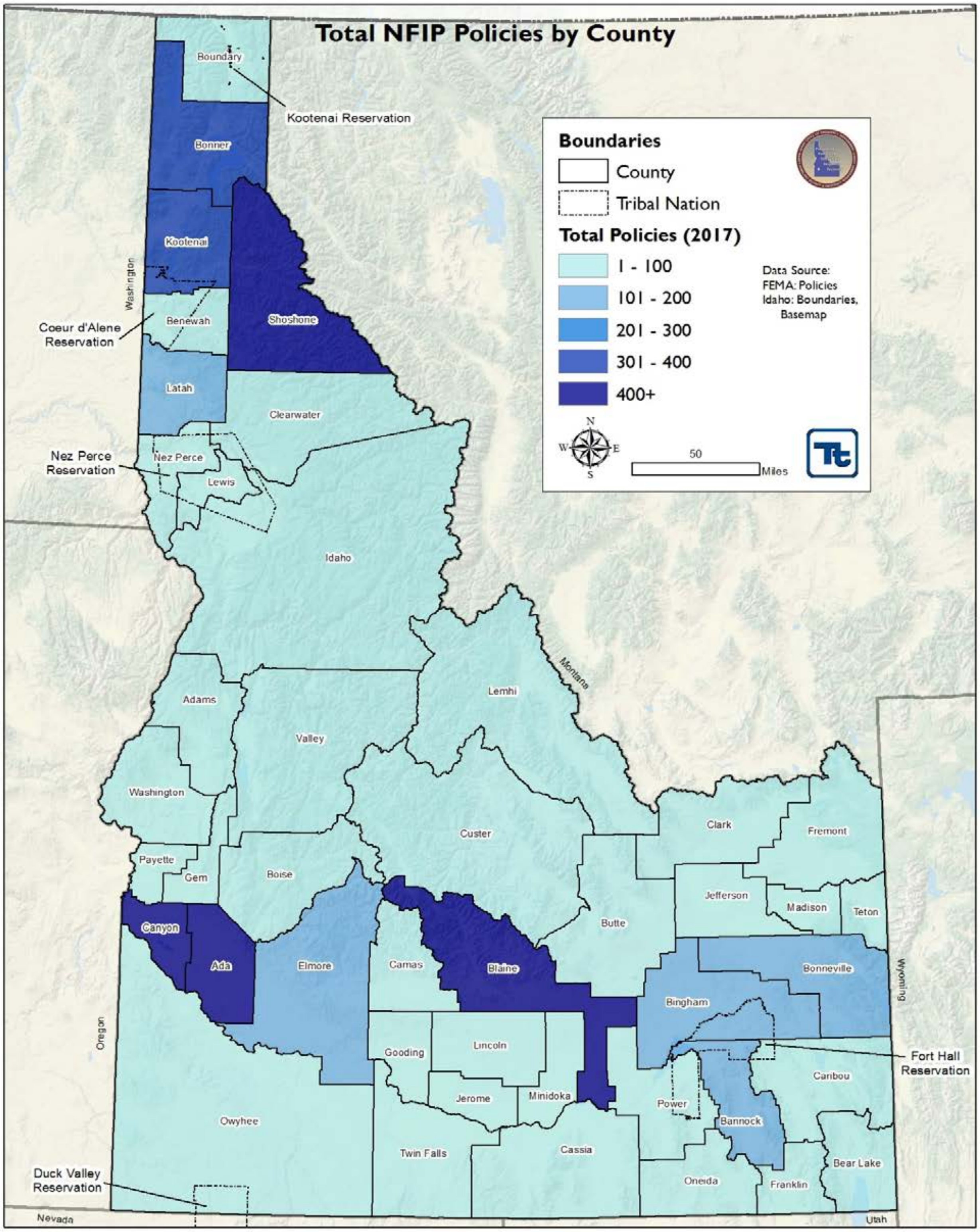
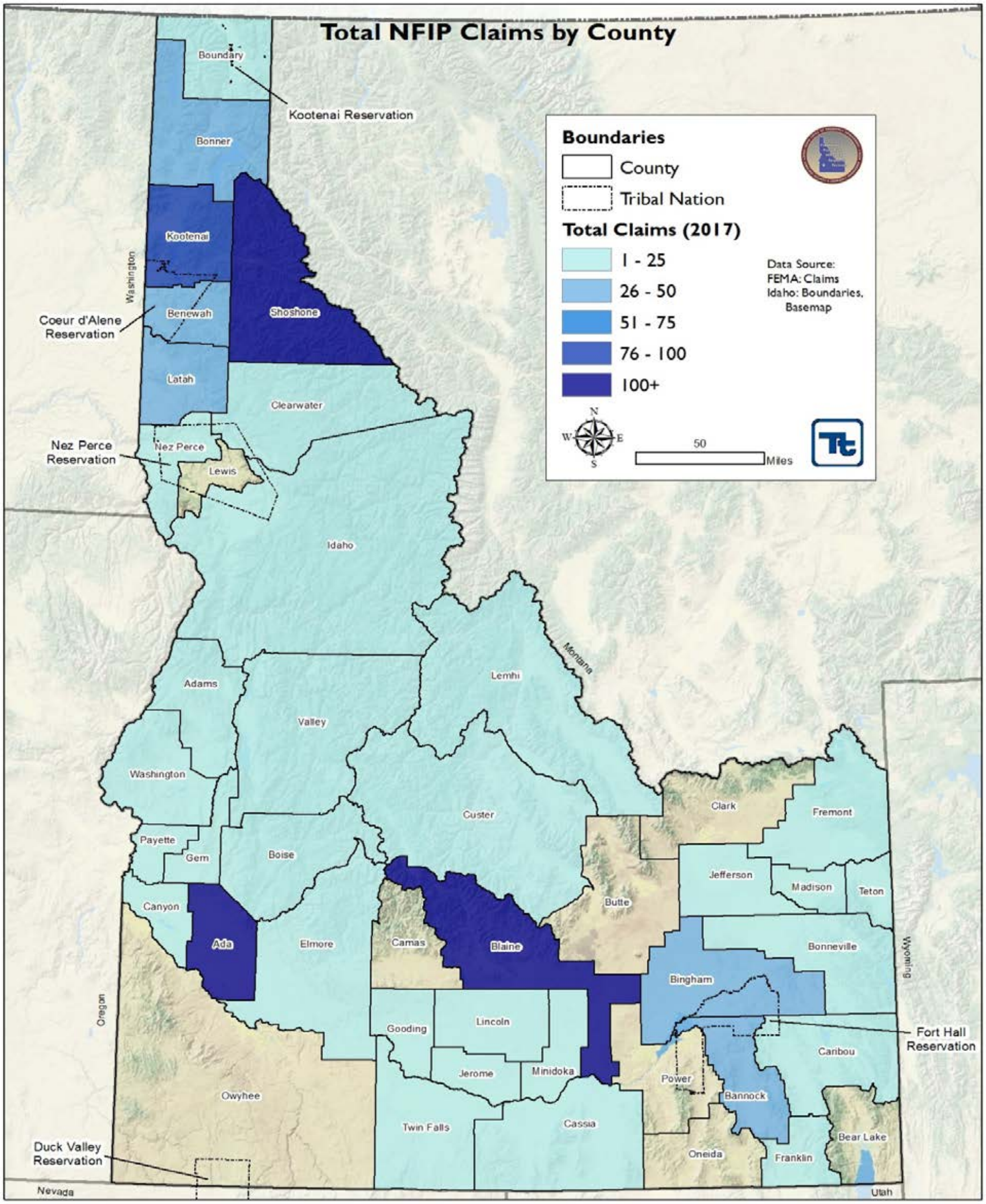


Figure 3.2.NN. Total NFIP Claims



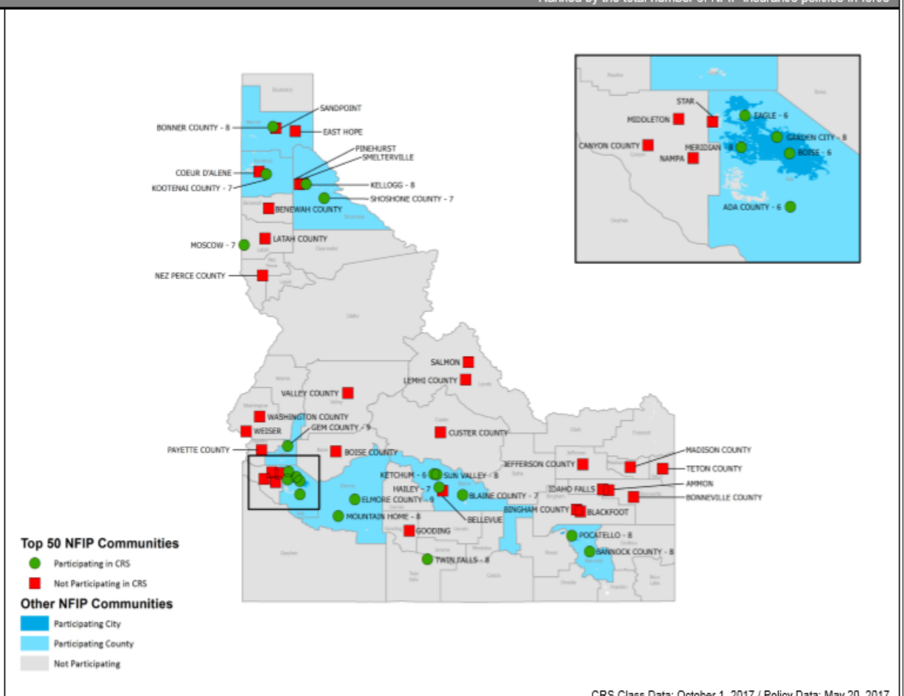
The Community Rating System

The NFIP's Community Rating System (CRS) recognizes community efforts beyond the minimum federal standards by reducing premiums for the community's property owners. The CRS is similar to, but separate from, the private insurance industry's programs that grade communities on the effectiveness of their fire suppression and building code enforcement. A community must apply to the CRS program. The basic minimum requirement is to maintain elevation certificates. Activities that earn CRS credits must be documented. CRS discounts on flood insurance premiums range from 5% up to 45%. The discounts are based on a community's classification, which is based on the number of points earned in 18 public information and floodplain management activities. All communities start at a Class 10, which offers no discount. The highest is a Class 1, where citizens receive a 45% discount on flood insurance premiums. As of October 2017, 175 communities in Idaho participate in the National Flood Insurance Program (NFIP). Of these communities, 20 (or 11%) participate in the Community Rating System (CRS). Of the top 50 Idaho communities (in terms of flood insurance policies-in-force), 20 participate in the CRS. Only policies in the floodplain are eligible to receive the CRS discount. One disadvantage of the program is that it is labor intensive and smaller communities with only one employee and less than 100 policies in the floodplain normally do not have the man power to administer the CRS program.

Top 50 National Flood Insurance Program (NFIP) Policy Count Communities*
and Community Rating System (CRS) Participation

*Ranked by the total number of NFIP insurance policies-in-force

Rank	CID	Community Name	Policies	Class
1	160002	Boise	890	6
2	160004	Garden City	624	8
3	160003	Eagle	471	6
4	165167	Blaine County	451	7
5	160131	Kellogg	364	8
6	160001	Ada County	363	6
7	160023	Ketchum	359	6
8	160076	Kootenai County	245	7
9	160208	Canyon County	245	--
10	160038	Nampa	210	--
11	160022	Hailey	196	7
12	160206	Bonner County	193	8
13	160180	Meridian	129	8
14	160090	Moscow	114	7
15	160018	Bingham County	112	--
16	160025	Sandpoint	103	--
17	160027	Bonneville County	92	--
18	160037	Middleton	87	--
19	160114	Shoshone County	87	7
20	160014	Benewah County	82	--
21	160214	Jefferson County	81	--
22	160024	Sun Valley	77	8
23	160012	Pocatello	76	8
24	160198	Payette County	73	--
25	160021	Bellevue	71	--
26	160058	Mountain Home	67	8
27	160205	Boise County	56	--
28	160230	Teton County	56	--
29	160212	Elmore County	52	9
30	160092	Lemhi County	51	--
31	160120	Twin Falls	51	8
32	160064	Gooding	50	--
33	160124	Weiser	49	--
34	160200	Pinehurst	48	--
35	160211	Custer County	44	--
36	160078	Coeur D'Alene	40	--
37	160220	Valley County	38	--
38	160236	Star	38	--
39	160221	Washington County	36	--
40	160009	Bannock County	35	8
41	160019	Blackfoot	34	--
42	160086	Latah County	33	--
43	160093	Salmon	33	--
44	160117	Smelterville	33	--
45	160217	Madison County	32	--
46	160237	East Hope	30	--
47	160127	Gem County	28	9
48	160029	Idaho Falls	27	--
49	160028	Ammon	23	--
50	160101	Nez Perce County	22	--



For a full list of all CRS Communities as of October 1, 2017, visit http://bit.ly/CRS_FIM_Oct_2017.

Source: https://crsresources.org/files/100/maps/states/idaho_crs_map_october_2017.pdf

Table 3.2.OO lists the 23 current CRS communities in Idaho and their associated class and policy discount.

TABLE 3.2.OO. Idaho CRS Communities

Community Name	County	Class Rating	Policy Discount
Ada County	Ada County	6	20%
Bannock County	Bannock County	8	10%
Blaine County	Blaine County	7	15%
Boise	Ada County	6	20%
Bonner County	Bonner County	8	10%
Eagle	Ada County	6	20%
Elmore County	Elmore County	9	5%
Garden City	Ada County	8	10%
Gem County	Gem County	9	5%
Hailey	Blaine County	7	15%
Kellogg	Shoshone County	8	10%
Ketchum	Blaine County	6	20%
Kootenai County	Kootenai County	7	15%
Meridian	Ada County	8	10%
Moscow	Latah County	7	15%
Mountain Home	Elmore County	8	10%
Pocatello	Bannock County	8	10%
Shoshone County	Shoshone County	7	15%
Sun Valley	Blaine County	8	10%
Twin Falls	Twin Falls County	8	10%

Source: IDWR

Dam, Canal, and Levee Failure

The mitigation of risk associated with dam failure can depend in large part on whether the dam is newly constructed or an older existing structure. New dams can be designed to meet stringent safety criteria, including the passage of extreme flood discharges and resistivity to earthquakes thereby lowering the probability for failure. Land downstream of new dams, or in the vicinity of existing canals, can be zoned or otherwise regulated to limit new construction and exposure, and thus reduce the hazard potential.

Any time there are flood events, concerns resurface regarding levees and dikes in Idaho. The United States Army Corps of Engineers (USACE) has built levees to protect communities from flooding, and then the levees are turned over to local sponsors for maintenance. Idaho residents and elected officials often have false assumptions regarding the ownership and maintenance of canals, levees, and dikes. Addressing the risks associated with existing levees often is problematic, especially when the structure is located on multiple properties and/or ownership cannot be determined easily. The encroachment of existing and new development into canal easements must be addressed so that canal operators can properly maintain their infrastructure. Regarding dams, an important aspect to help reduce risk is the development of an Emergency Action Plan (EAP) that is focused on the proper operation of the dam, advanced warning, and evacuation instructions. Unfortunately, most levees and levee systems in Idaho do not have an equivalent mechanism comparable to EAPs for high hazard dams. In extreme or unique cases, removing a dam, levee, or canal may be the most efficient and cost-effective approach to mitigating imminent risk to life and property by removing the hazard.

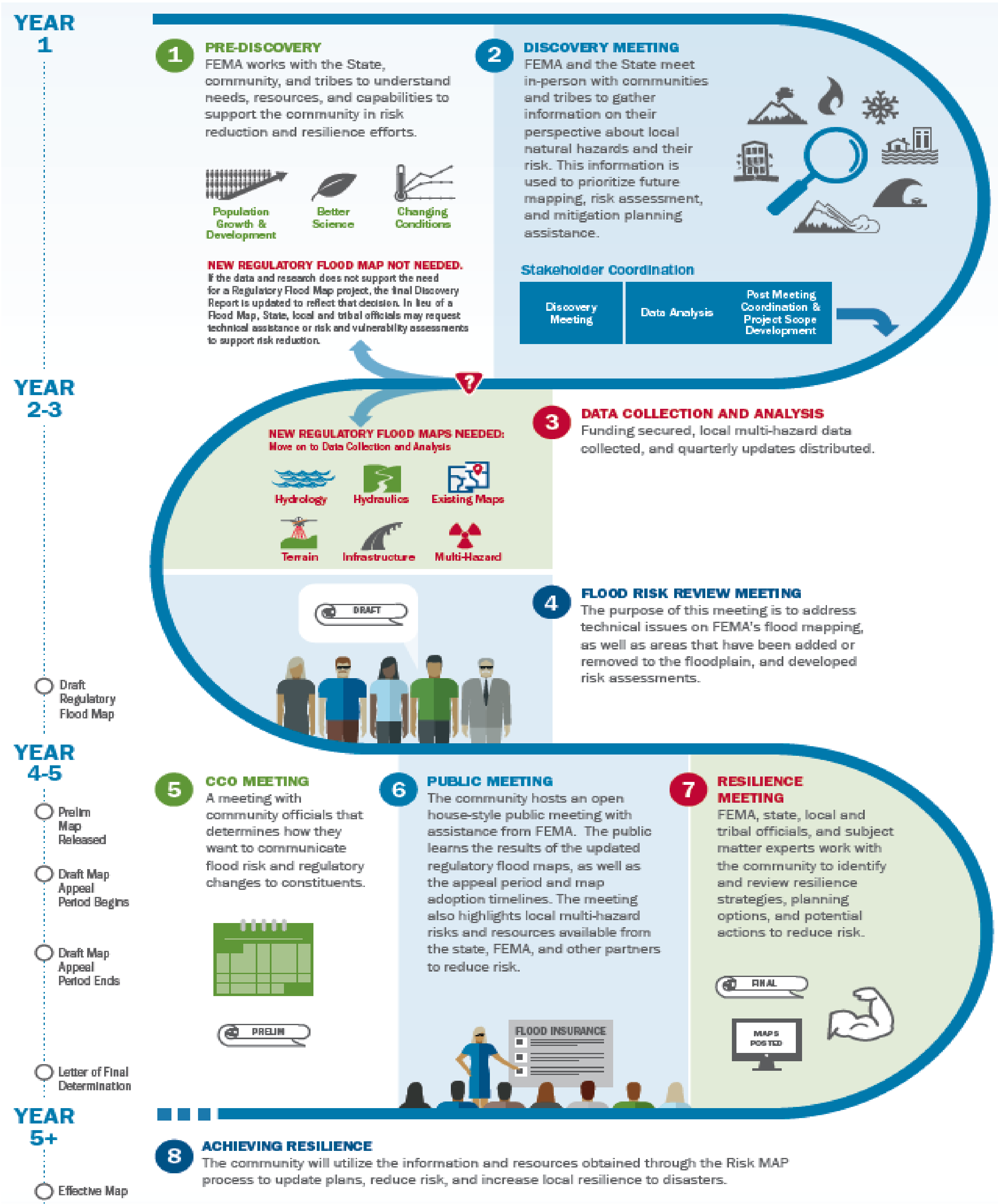
Public awareness measures, such as notices on final plats and public education on dam safety, are proactive mitigation measures that should be implemented by local communities. The US Bureau of Reclamation and operators of canals and irrigation structures must be allowed input on future development in the area of their structures for the safety of both the development and so that operators can safely perform the operation and maintenance of their structures. The US Bureau of Reclamation's authority to prevent encroachments and to deal with existing encroachments, including removal, should be strengthened. Also, Emergency Action Plans that establish potential dam failure inundation limits, notification procedures, and thresholds are prepared for response to potential dam related disaster events.

Mapping/Analysis/Planning

An accurate understanding of a hazard is the first step towards successful mitigation. To fully understand a hazard and the risk that it poses, the ability to accurately assess vulnerability is vital. After vulnerability is determined, it is then possible to assess potential losses if a state inventory of facilities and infrastructure is available. Idaho currently fully embraces FEMA's on-going Risk MAP program, which is an in depth, 5 year process to fully understand the risk. The Discovery process, and the resulting report and map, is comprised of 4 phases. The first phase focuses on data collection from all possible sources to help inform and guide future phases. Phase 2 involves review of all data and follow up communications with locals to begin to identify possible areas of mitigation action. The third phase includes a series of meetings to bring together all watershed stakeholders to continue to refine possible mitigation projects and flood study needs. The fourth and final phase concludes with the creation of the final Discovery Report and Map, which documents the agreed upon desired flood study areas and mitigation project locations. Should additional Risk Map projects be selected to occur in the area, the report and map will be the foundation for defining the future project scope.

The Risk Report provides non-regulatory information to help jurisdictions and stakeholders better understand their risk. This improved risk understanding can then aid in improved communication of those risks to local businesses and citizens, with the end goal of driving mitigation actions to reduce that risk. See Figure 3.2.PP below for a detailed overview of the RiskMAP process.

Figure 3.2.PP. FEMA's RiskMAP Program



Major advances in the availability of various data inputs allowed for an improved vulnerability and loss assessment to be performed. Continued refinement of both vulnerability and inventory data will enable for continued refinements in the risk assessment process.

RiskMAP projects currently planned for 2018 in Idaho are:

- **Portneuf River (Pocatello levee study)** – Preliminary maps expected by summer. The Consultation Coordination Officers (CCO) meeting will likely be in May (possibly virtually) followed by a public meeting as schedules allow.

- **Teton Watershed (Teton County)** – Preliminary maps now are expected in July/August. CCO meeting likely in Aug/Sep, and the public meeting in late Oct/Nov.

- **Teton Watershed (Madison County)** – Awaiting more funding. Preliminary maps in late 2018 at the earliest. CCO and public meeting to follow.

- **Gem County** – Distribute revised draft maps in April. Preliminary maps are expected in late summer/fall 2018. CCO and public meeting to follow.

- **Big Wood Watershed** – Draft work maps are expected in summer of 2019. Meanwhile, we are scoping an interim post event analysis and mapping effort with USACE to support recovery and mitigation.

- **Lower Boise (Canyon County)** – The Letter of Final Determination (LFD) was delayed due to the need to run an appeal period for the city of Star (located in both counties). Appeal start expected in late April. Meanwhile, pursuing Letters of Map Revisions (LOMRs) to remove seclusion boxes and apply the natural valley mapping to reflect non-accredited levees as requested by the county and affected cities.

- **Lower Boise (Ada County)** – Revised prelims issued on 3/14/2018 to reflect removal of seclusion boxes and apply the natural valley mapping to reflect non-accredited levees as requested by the county and the city of Star. A 90-day appeal period for the revised area will follow.

- **Valley County** – The LFD is expected in July. Resilience likely later this year.

- **Payette Watershed (Payette and Boise Co.)** – Ongoing scoping and coordination for funding additional work this year including new detailed studies, non-accredited levee coordination and analysis under the 2013 guidance, and refinement of base level engineering (BLE) flood hazard analysis. This follows last year's meeting to discuss the BLE results and initial levee evaluations. We are also looking at expanding to cover the entire area of Boise County where LiDAR is available or will be acquired.

- **American Falls/Idaho Falls/Blackfoot Watersheds** – Seek to add scope for BLE for the Blackfoot this summer. Continue to discuss scoping needs with communities in the American Falls and

Idaho Falls watersheds, following on last year's meeting to discuss BLE results in those two watersheds.

- **Clearwater Watershed (expanded to cover 5 counties)** – BLE analysis is now starting for areas where LiDAR exist. After review of the final LiDAR footprints, some gaps where found in the project area. Initial draft flood hazard results expected late this year. Scoping out levee evaluations and detailed studies needs to help prioritize additional mapping in the multiple counties with updates to the communities.

- **SE Idaho Area (covering 5 counties)** – Seeking funding for BLE analysis in areas where LiDAR is expected and providing a post discovery update to the communities.

THIS PAGE INTENTIONALLY LEFT BLANK