Flood: RISKS AND MITIGATION

7.1 Identifying and Profiling Flood Hazards

Source: DNR https://geology.utah.gov/map-pub/survey-notes/geologic-hazard-map-of-st-george/

Brief Overview of Flood Hazards

Floods have proven to be the most destructive natural disaster in terms of economic loss to the citizens of Utah. Various type of flood hazards exist within the state including flash floods, stream bank and overbank flooding, alluvial fan flooding, debris flow & mud slides, dam breaks, post-fire flooding, and more. Flooding in Utah originates from four distinct

processes: flash flooding, long-term rainfall events, spring snowmelt river flooding, and dam break flooding.

Types of floods

Flash Floods: A flash flood is a rapid flooding of low-lying areas in less than six hours, which is caused by intense rainfall from a thunderstorm or several thunderstorms. Flash floods can also occur when there are drought-like conditions.

Debris/Mudflow: Describes a condition where there is a river, flow or inundation of liquid mud down a hillside usually as a result of a dual condition of loss of brush cover, and the subsequent accumulation of water on the ground preceded by a period of unusually heavy or sustained rain. A mudslide (i.e. mudflow) may occur as a distinct phenomenon while a landslide is in progress, and will be recognized as such by the Administrator only if the mudflow, and not the landslide, is the proximate cause of damage that occurs. - CFR 44 definition.

Long-Term Rainfall Events: Large storm events can stall out over an area for days. These heavy rains can lead to severe flooding by oversaturating the ground, overfilling storm drains, or causing rivers to spill over their banks or levees.

Dam Failure/Levee Breaches: Dam failure or levee breeches can occur with little warning. Intense storms may produce a flood in a few hours or even minutes for upstream locations. Flash floods 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 or the accumulation of melting snow. There are more than 87,000 dams in the United States. Approximately one third of these pose a "high" or "significant" hazard to life and property if failure occurs.

Spring Snowmelt River Flooding: Warmer temperatures and resulting snow melt can produce large amounts of runoff in a short period of time, as each cubic foot of compacted snow contains gallons of water. During the early spring, frozen land prevents melting snow or rainfall from seeping into the ground. The water then runs off the surface and flows into lakes, streams, and rivers, causing excess

water to spill over their banks. Add seasonal storms to the mix, and the result is often severe spring flooding.

Ice Jam: Pieces of floating ice carried with a stream's current can accumulate at any obstruction to the stream flow. These ice jams can develop near river bends, mouths of tributaries, points where the river slope decreases, downstream of dams and upstream of bridges or obstructions. The water that is held back may cause flooding or flash flooding upstream. If the obstruction suddenly breaks then flash flooding may occur downstream.

Sheet flooding: Flooding that occurs on flat or low slope areas and results in a broad, shallow sheet across a large area. Sheet or shallow flooding means a designated AO, AH, AR/AO, AR/AH, or VO zone on a community's Flood Insurance Rate Map (FIRM) with a 1 percent or greater annual chance of flooding to an average depth of 1 to 3 feet where a clearly defined channel does not exist, where the path of flooding is unpredictable, and where velocity flow may be evident. Such flooding is characterized by ponding or sheet flow.

Overtopping/Ponding: Overtopping may consist of water level behind a dam rising above the top of a dam and spilling over to the other side. Wave overtopping also exists where wave run-up flows over the top of a crest or slope, usually a beach, dune, or structure.

Flooding effects the majority of Utah due to heavy mountain precipitation and runoff. Consistent wildfires throughout the state exacerbate existing flood risks. Southern Utah in particular has a higher risk of flash flooding due to its slot canyons and infrequent but heavy storm systems. Southern Utah can experience changes in its geography from sediment movement in its flash floods as well.

Conditions which may exacerbate floods	
Impermeable surfaces	Constrictions
Steeply sloped watersheds	Obstructions
Debris	Droughts
Contamination	Soil saturation
Velocity	Wildfire
Soil erosion	Erosion Hazard Zones
New construction/urban development	Invasive vegetation
Climate Variability	Severe Weather Events

Flooding can cause foreign contaminants to pollute waterways and move downstream. Too much sediment or nutrients entering a waterway has negative impacts on downstream water quality. If a water level rises too high it can remove vegetation or degrade slops and increase erosion. This can cause loss of habitat, dispersal of unwanted weed species, lower fish production, loss of proper wetland functions, release of contaminants, and loss of recreational areas. One environmental factor that has emerged from flooding in Utah is when floods have reached sewage treatment plants like from the 2017 Cache and Box Elder County floods. This caused spillage of sewage into the flood waters but did not result in any negative human health effects. While physical land damage caused by flooding can be easier to predict and mitigate than the uncertain factors of environmental pollution, the long term impacts of chemical contamination on the environment should not be overlooked.

There are many possible sources of chemical contamination during floods, including:

- dumping grounds
- graveyards
- chemical factories and warehouses
- oil storage and gas stations
- municipal and private sewer systems and septic tanks
- chemical heavy businesses, i.e. drycleaners
- household chemicals

Common contaminants include but are not limited to:

- agricultural chemicals, pesticides, fertilizers
- lubricants, hydraulic oils, crude oil
- flammable liquids, gasoline, propane, kerosene
- corrosive liquids, batteries
- heavy metals, arsenic, mercury, lead, copper, chromium
- paint, solvents, polyester resin
- cleaners and household chemicals, aerosols, detergents

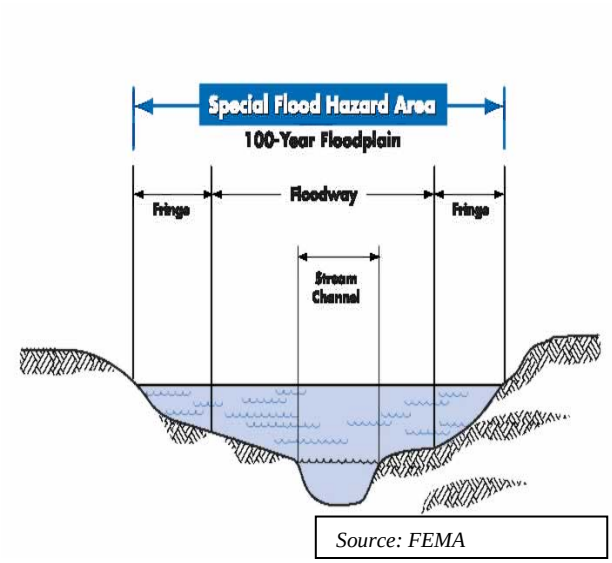
Utah specific cause for flood events:

Closed basin flooding: A portion of the Great Basin resides in Utah and contains various closed basin lakes. The Great Salt Lake, for example, is an endorheic lake that is closed off and achieves equilibrium through evaporation. Other closed basin lakes either do not have a natural outlet or only a relatively small one to discharge surplus water. This can lead to flooding as snowmelt or other precipitation cause the lake level to rise faster than it can drain. Closed basin flooding lasts longer as it cannot peak and recede as easily as rivers or streams.

Severe cloudburst storms: Cloudburst storms are defined by a rainfall rate equal to or greater than 3.9 inches per hour. They consist of both micro and macro downbursts. A downburst that is less than 2.5 miles in diameter is considered a microburst. A downburst

that is greater than 2.5 miles in diameter is considered a macroburst. Both can result in high wind speeds and heavy precipitation. Cloudbursts have been recorded in Utah for over a century and continue to be an unpredictable threat.

Snow pack melt rates: Utah has a total of 41 key irrigation reservoirs for water storage. How well they fill is dependent on the amount of snowfall received and the temperature through the winter. A gradual warming in the spring can lead to manageable snowmelt. When warmer and/or wet spring conditions occur there is a possibility for flooding from excess snowpack runoff.



Source: FEMA

Flood Definitions

1% Special Flood Hazard Area (100-year flood): Applies to an area that has a 1 percent chance, on average, of flooding in any given year. However, a 100-year flood could occur two years in a row, or once every 10 years. The 100-year-flood is also referred to as the base flood. Some agencies use the term called the 1% Annual Exceedance Probability.

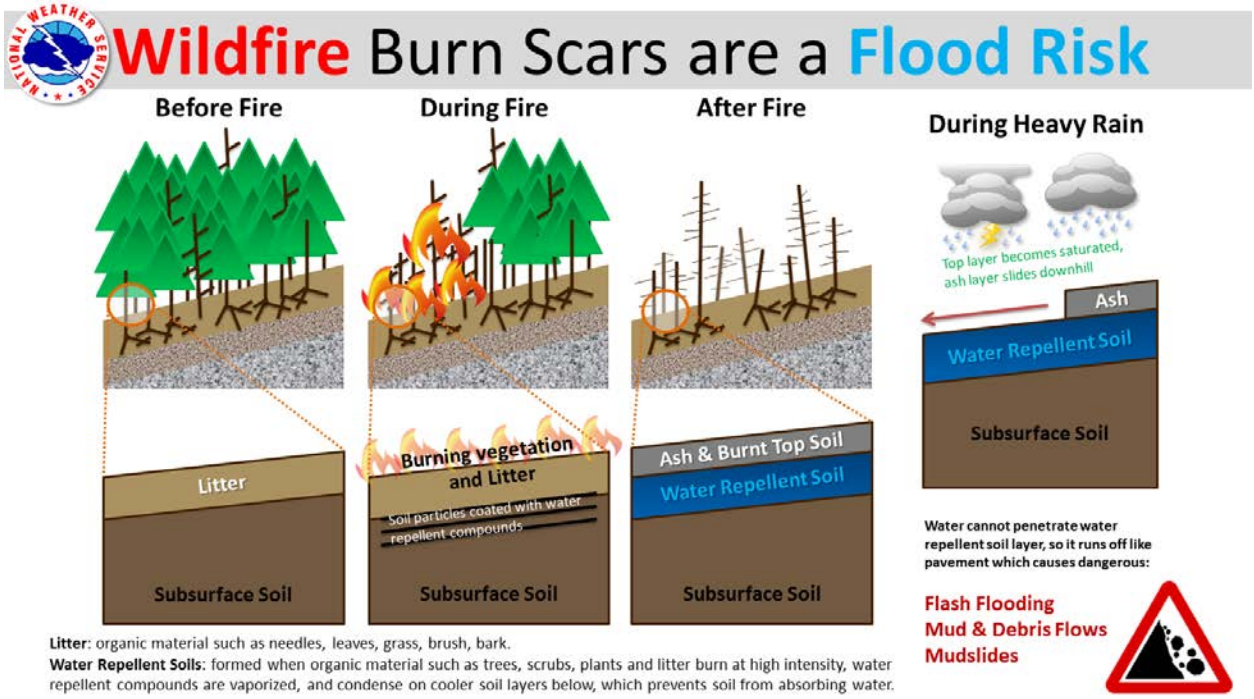
0.2% Special Flood Hazard Area (500-year flood): A 0.2 percent (500-year) floodplain is an area at risk for flooding from a bayou, creek or other waterway overflowing during a 0.2 percent (500-year) flood. Structures located in a 0.2 percent (500-year) floodplain have a minimum of a 0.2 percent chance of flooding in any given year.

Flood Recurrence Interval	Chance of occurrence during any given year
5 year	20%
10 year	10%
50 year	2%
100 year	1%
500 year	0.20%

Relationship with Other Hazards

- Burn Scars – Following a wildfire, the ground can be covered in a burn scar that has the potential to develop into a debris flow, following precipitation events.

Figure 1. Wildfire Burn Scars are a Flood Risk

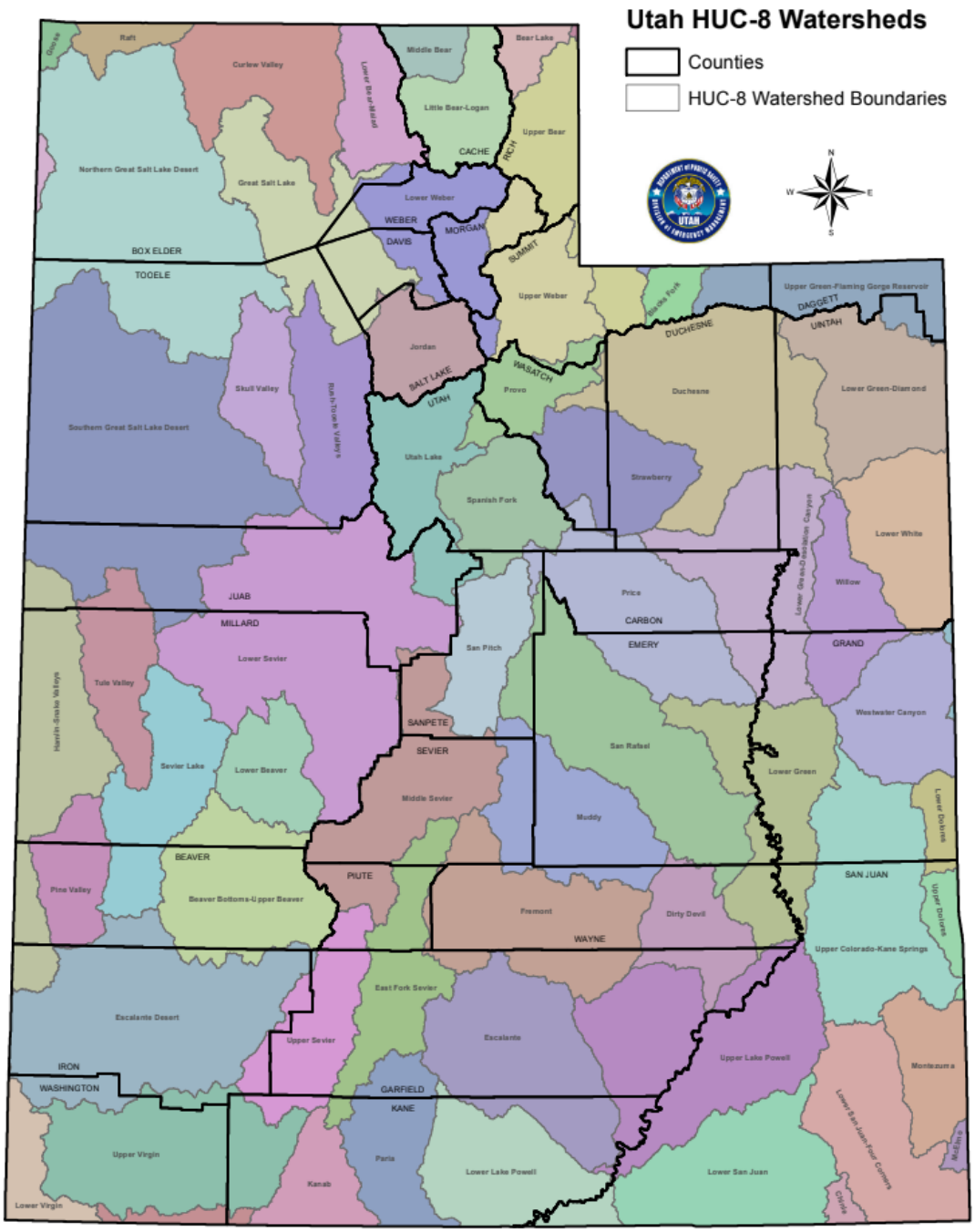


- Drought - Increased intensity of rain events may increase drought vulnerability and are not always effective drought relief. Soil erosion from intense rain events can damage healthy soil. Droughts can still happen even in a wetter climate while going quickly from drought to flood or flood to drought within months.

- Standing water hazards - Standing waters caused by floods can cause considerable risks. They may hide danger below the waters that are not seen. Downed power lines, open plumbing or irrigation ditches, or other hazards may exist. In addition, diseases such as E. coli, Hepatitis, HIV/AIDS, TB, and others can be potentially be in standing flood waters from sewage overflow or flood victims.

Utah Watersheds

A watershed is an area of land that is divided up into a boundary in which water drains. There are around 65 Hydrological Unit Code (HUC) 8 watersheds that are found within the boundaries of Utah. **Map 1. Utah HUC-8 Watersheds**



Recent Presidentially Declared Disasters related to flooding include:

FEMA Disaster Declarations:

Utah Severe Winter Storms and Flooding (DR-1955) (Washington & Kane Counties)
Incident Period: December 20, 2010 - December 24, 2010
Major Disaster Declaration declared on February 11, 2011
Public Assistance - Dollars Approved
$8,741,951.72
Total Public Assistance Grants (PA) - Dollars Obligated †
$724,120.65
Emergency Work (Categories A-B) - Dollars Obligated †
$7,709,066.07
Permanent Work (Categories C-G) - Dollars Obligated †
Preliminary Damage Assessment: Primary Impact: Damage to roads and bridges · Total Public Assistance cost estimate: $5,777,975
Utah Flooding (DR-4011) (Box Elder, Cache, Weber, Morgan, Tooele, Salt Lake, Summit, Wasatch, Daggett, Utah, Duchesne, Uintah, Millard, Sanpete, Emery, Sevier, Beaver, and Piute Counties, and Uintah and Ouray Indian Reservation)
Incident Period: April 18, 2011 - July 16, 2011
Major Disaster Declaration declared on August 08, 2011
Public Assistance - Dollars Approved
$8,866,504.31
Total Public Assistance Grants (PA) - Dollars Obligated †
$4,575,044.65
Emergency Work (Categories A-B) - Dollars Obligated †
$3,985,085.66
Permanent Work (Categories C-G) - Dollars Obligated †
Preliminary Damage Assessment: Primary Impact: Emergency protective measures · Total Public Assistance cost estimate: $12,727,373
Utah Severe Storm and Flooding (DR-4088) (Washington County)
Incident Period: September 11, 2012 - September 12, 2012
Major Disaster Declaration declared on November 03, 2012
Public Assistance - Dollars Approved
$1,754,866.86
Total Public Assistance Grants (PA) - Dollars Obligated †
$115,231.81
Emergency Work (Categories A-B) - Dollars Obligated †
$1,582,225.05
Permanent Work (Categories C-G) - Dollars Obligated †
Preliminary Damage Assessment: Primary Impact: Damage to water control facilities · Total Public Assistance cost estimate: $3,823,565

Utah Severe Winter Storms and Flooding (DR-4311) (Box Elder and Cache Counties)
Incident Period: February 07, 2017 - February 27, 2017
Major Disaster Declaration declared on April 21, 2017
Dollars Approved not yet available.
Preliminary Damage Assessment: Primary Impact: Damage to roads and bridges · Total Public Assistance cost estimate: $5,983,005

Table 1. Historical Flooding Events in Utah

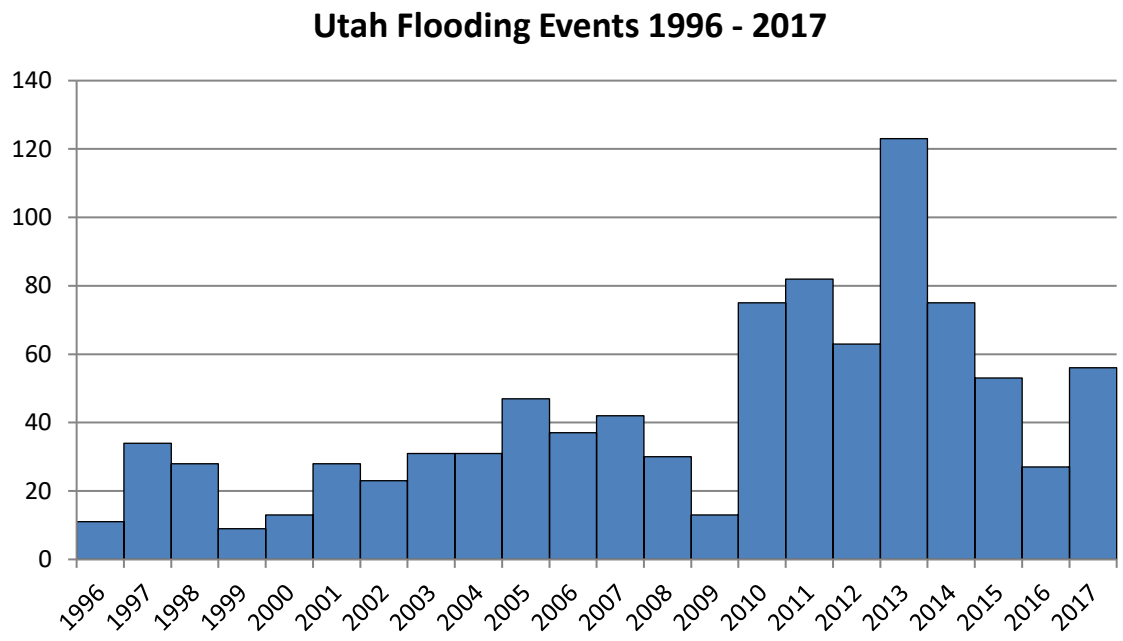
Date:	Area affected:	Recurrence Interval (in yrs.)	Remarks
July 4, 1884	Colorado River	>100	Probably snowmelt combined with rainfall
Aug. 13, 1923	Tributaries to Great Salt Lake between Ogden and Salt Lake City	Unknown	Locally intense thunderstorms. Deaths, 7; Damage, $3,000,000
Apr. 28-June 11, 1952	Strawberry, upper Price, upper San Rafael, Ogden, Weber, Provo, and Jordan Rivers; Blacksmith Fork and Spanish Fork; upper Muddy and Chalk Creeks	25 to >100	Melting of snowpack having maximum-of-record water content for Apr. 1. Disaster declared. Death, 2; Damage, $8.4 million
June 16, 1963	Duchesne River	>100	Dam failure
June 10-11, 1965	Ashley Creek and other streams between Manila and Vernal and west of Manila.	>100	Three days of intense rainfall on thick snowpack above altitude 9,200 feet. Deaths, 7; Damage, $814,000
Dec. 6-7, 1966	Virgin and Santa Clara Rivers.	25 to >100	Four days of light to intense rainfall of as much as 12 inches. Damage, $1.4 million
Aug. 1-2, 1968	Cottonwood Wash and other nearby tributaries to San Juan River	50 to >100	Locally intense thunderstorms following 11 days of rainfall. Damage, $34,000
Sept. 5-7, 1970	San Juan River and tributaries from McElmo Creek to Chinle Creek.	25 to >100	Record breaking rainfall. Deaths, 2; Damage, $700,000
Aug. 27, 1972	Vernon Creek	>100	Locally intense thunderstorms
Apr. 10-June 25, 1983	Lower Duchesne and Jordan Rivers and tributaries; upper Price, Bear, Sevier, and San Pitch Rivers; Chalk, East Canton, Trout, and George Creeks, Great Salt Lake and tributaries	25 to >100	Runoff from greater than average snowpack for Apr. 1 and spring precipitation. Deaths, 1; Damage, $41 million.
May 22, 1984	Sevier Lake	Unknown	Runoff in Sevier River from Nov. 1982 through June 1984 exceeded upstream reservoir capacity; about 1.5 million acre-feet of water conveyed to Sevier Lake. On May 22, 1984 lake reported to be as much as 35 feet deep after being nearly dry since about 1880.
June 15, 1984	Utah Lake	Unknown	Runoff from greater than normal precipitation since Sept. 1982 increased lake level to 101-year record of 5.46 feet above compromise level on June 15, 1984. Damage, $5.9 million.
June 3, 1986	Great Salt Lake	Unknown	Large runoff from greater than normal precipitation since Sept. 1982 increased lake level to 140-year record elevation of 4,211.85 feet on June 3, 1986. Damage, $268 million.

July 11, 1999	The largest disaster in Riverdale's history occurred.	Unknown	At approximately 12:08 p.m. a section of the Davis-Weber Canal gave way above the Pinebrook Subdivision. The break in the canal sent thousands of gallons of water and mud down onto the homes below.
Sep. 11, 2002	Santaquin, Utah County	Unknown	Post fire debris flow following a heavy localized thunderstorm damaged homes and roads resulting in significant cleanup by local community and county.
Jan. 8-12, 2005	Santa Clara and Virgin Rivers, Red Cliff Recreation Area	25-20 (Santa Clara) 10-25 & >100 (Virgin)	A rain on snow event resulting from a stalled storm system brought abundant precipitation throughout the state. Damage estimates were estimated at $300 million dollars.
April 28 - June 29, 2005	Lower Bear River Basin, Duchesne, and Sevier Basins	>100	Heavy and frequent localized precipitation events from April 28, 2005 until June 29, 2005, resulted in an estimated $2.9 million dollars in damages to public and private properties, roads, and bridges. A Presidential Disaster Declaration was declared.
Jul. 11, 2009	A portion of a hillside in Logan gave way; breached a canal barrier	Unknown	A canal failed and sent tons of water and debris cascading into a neighborhood 150 feet below. One home was destroyed, eight others seriously damaged, and three people died.
Jun. 10, 2010	Salt Lake County, Summit County, Piute County, Uintah County, and the Uintah and Ouray	>50	Water and debris flow from springtime snowmelt and precipitation caused an estimated $916,868 in damages to public and private property in multiple jurisdictions throughout the state.
Dec. 20-24, 2011	Garfield, Kane, and Washington Counties	Unknown	Heavy rainfall and snow led to flooding. Homes, roads, public facilities damaged. Damages estimated at $6 million dollars. A Presidential Disaster Declaration was declared.
April 18-July16, 2011	Beaver, Box Elder, Cache, Daggett, Duchesne, Emery, Millard, Morgan, Piute, Salt Lake, Sanpete, Sevier, Summit, Tooele, Uintah, Utah, Wasatch, Weber counties, and Ouray Indian Reservation	Unknown	Record breaking snowpack, heavy spring rains and warm summer temperatures led to flooding. Estimated damage was $12.7 million. A Presidential Disaster Declaration was declared.
Sep. 11, 2012	Santa Clara, Ivins, and St. George	Unknown	The Laub Detention Dam failed as a result of heavy rainfall and possible rodent burrows in the dam. 66 homes, 18 businesses, and numerous public facilities were damaged. A Presidential Disaster Declaration was declared.
Sep. 14, 2015	Washington County	Unknown	Heavy rainfall led to flash floods in Hildale, Zion's National Park, and Hurricane. 13 people were killed in Hildale, 7 in Zion, 1 in Hurricane.
Sep. 14, 2015	Carbon County	Unknown	A strong and moist Pacific storm brought widespread precipitation and severe weather to Utah. Two tornadoes were reported on September 22, and other significant impacts included strong gusty winds, large hail, and widespread flash flooding. $4 million in damages occurred.
Feb. 7-27, 2017	Box Elder and Cache Counties	Unknown	Heavy rain on frozen ground led to sheet flooding throughout the counties. An estimated $6 million

			dollars in damages occurred. A Presidential Disaster Declaration was declared.
Jul. 26, 2017	Salt Lake County	Unknown	Thunderstorms continued across Utah for the last week of July, with many storms producing heavy rainfall. This led to flash flooding in many locations, including a particularly damaging flood in Salt Lake City. A lightning strike also led to two injuries on the morning of July 28. $8.75 million in damages occurred.

There have been 931 recorded flood events in Utah from 1996 – 2017, of which 799 of those have been flash flood events. The years with the highest number of recorded flood events since 1996 are 2013, 2011, 2010/2014, and 2012.

Figure 2. Number of Flood Events in Utah 1996 - 2017



There has been a total of $948,200 of recorded crop damage and a total of $414,488,500 of property damage from flooding events in Utah since 1996. The year with the highest amount of recorded crop damage since 1996 is 1998 with $571,200 and the year with the highest amount of recorded property damage since 1996 is 2005 with $300,157,000. The 1983 Utah floods cost about $102,378,000 (inflation adjusted to 2017 dollars). And the 1984 Utah floods cost about $14,125,000 (inflation adjusted to 2017 dollars).

Figure 3. Flood Crop Damage in Utah 1996 - 2017

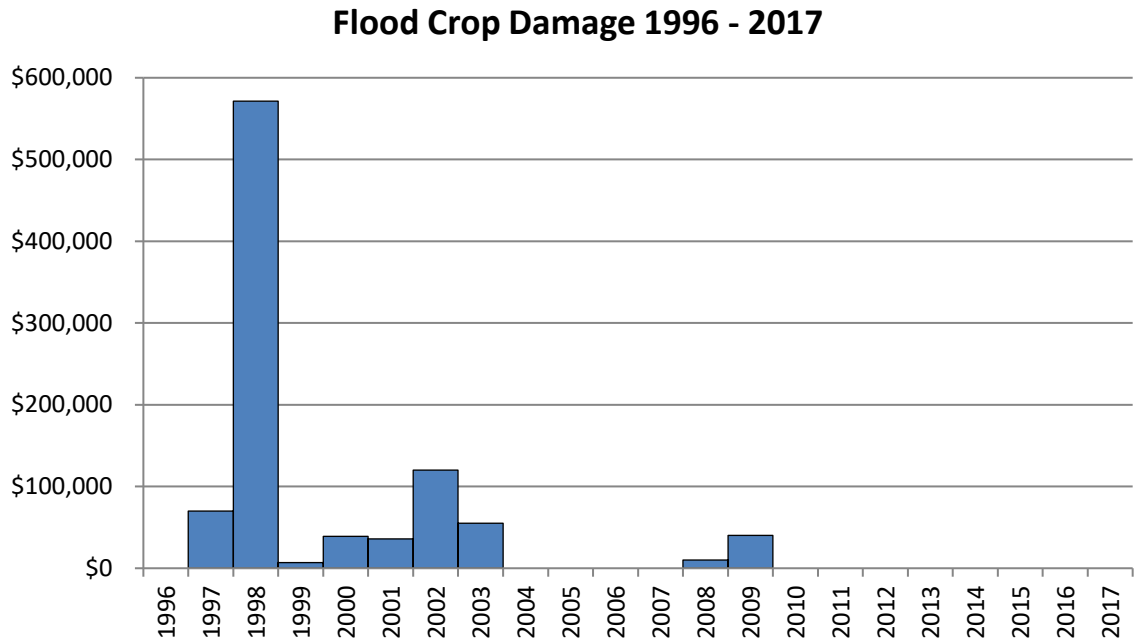
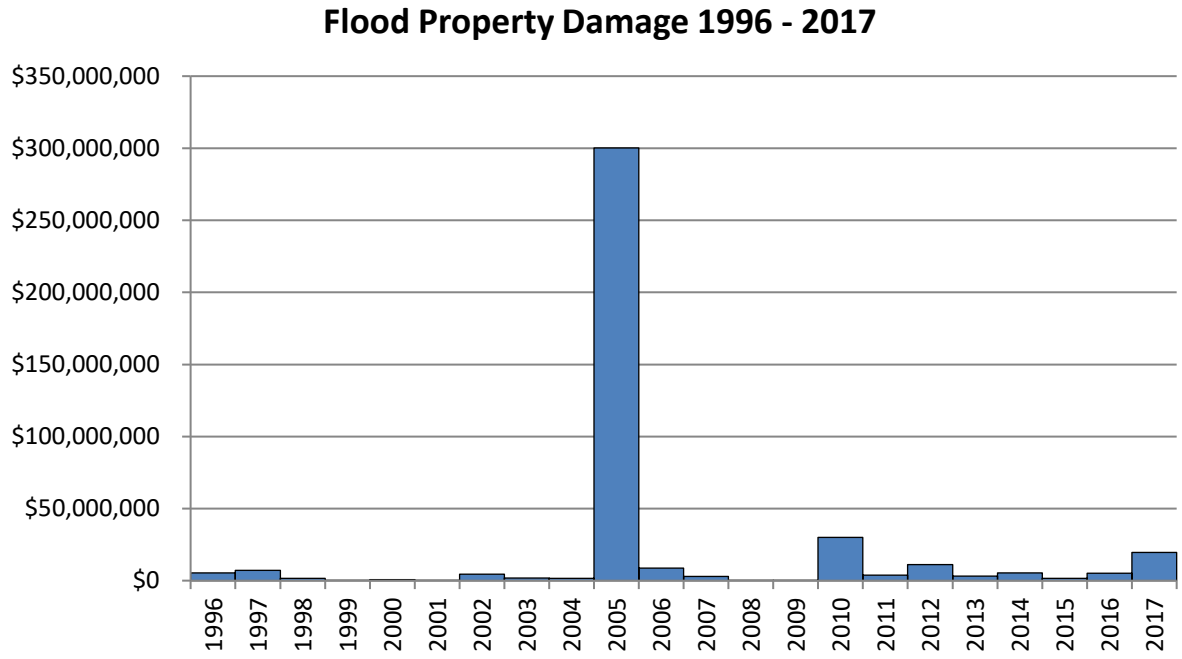
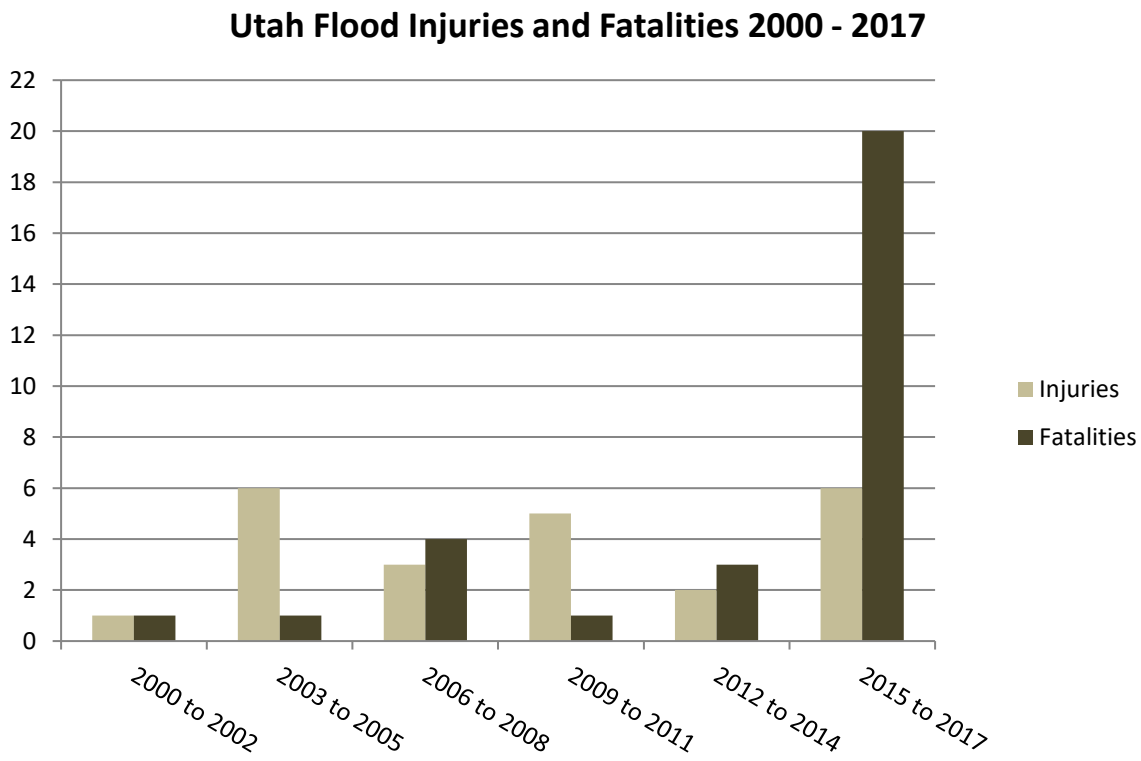


Figure 4. Flood Property Damage in Utah 1996 - 2017



There have been 23 recorded injuries and 30 recorded deaths in Utah from floods since 2000. In 2017, there were 20 fatalities from floods, the most of any year in Utah.

Figure 5. Utah Flood Injuries and Fatalities 2000 - 2017



Regulations and Flooding

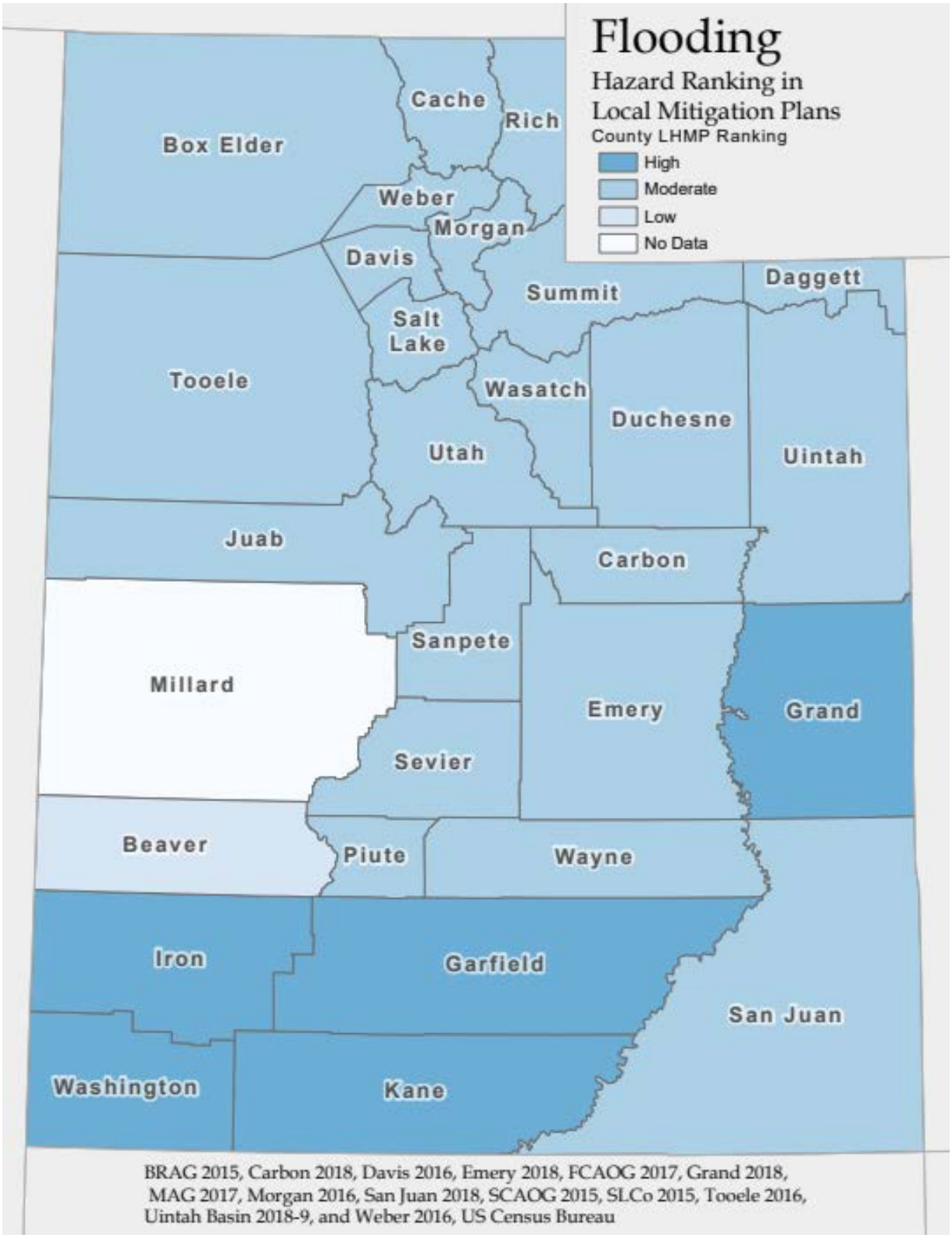
Utah Floodplain laws are in accordance with National, State, and Local Building Codes. While FEMA does set a basic standard of regulations for communities participating in the NFIP, NFIP ordinances and regulations are handled by the community at a community level.

7.2 Assessment of Local Flood Vulnerability and Potential Losses

A map was created that shows the hazard ranking for flood for each county as reported in the LHMPs. The hazard ranking is calculated from a combination of severity (categorized from 0-4) and frequency (categorized from 0-4). This allows for a ranking from 0-8 when combined.

Based on the reporting in LHMPs, Grand, Iron, Garfield, Washington, and Kane counties were ranked the highest risk to flooding. The rest of the state (except Millard, which provided no data) is ranked low for flooding risk.

Map 2. Flood Hazard Rankings from LHMPs



All of the LHMPs were reviewed to gather data on flood vulnerabilities and loss estimates related to people, residential units, commercial units, and critical facilities. Not all LHMPs reported on such data. Salt Lake, Tooele, Cache, Davis, and Weber reported the most people at risk to flooding. Washington County reported the highest residential units at risk to flood with 8687 units with a total value of $1,756,890,240. There are six counties that reported over $100,000,000 in residential unit value at risk to flooding (Box Elder, Cache, Iron, Salt Lake, Tooele, and Washington counties).

Iron County reported the highest number of commercial units vulnerable to flooding with 345 commercial units with total value of $142,570,470. However, Salt Lake County had the highest value for commercial units at risk to flooding of $331,750,000. There were four counties that reported over $100,000,000 in commercial unit value being at risk to flooding. Box Elder County reported the highest number of critical facilities at risk to flooding with 64 facilities.

Table 2. Flood Vulnerabilities and Loss Estimates from LHMPs

Flood

County	People	Residential Units		Commercial Units		Critical Facilities
		Units	Value	Units	Value	
Box Elder	1566	494	$118,364,979	164	$94,760,779	64
Cache	5490	1695	$452,286,843	182	$181,492,919	49
Carbon	370	68	$12,000,000	2	$5,160,000	22
Davis	2,311	245	$37,810,000	3	$18,370,000	
Emery	55	11	$4,050,000	2	$3,690,000	58
Garfield		405	$37,465,708	35	$8,468,743	
Grand	284	82	$14,350,000	1	$6,530,000	26
Iron		2030	$236,000,955	345	$142,570,470	
Kane		288	$32,810,419	39	$11,078,175	
Morgan	539	117	$6,370,000		$2,850,000	
Salt Lake	13,777	2,255	$342,730,000	47	$331,750,000	
San Juan	424	77	$21,960,00		$1,410,000	
Tooele	8350	2502	$444,319,997	97	$66,180,069	55
Weber	1789	378	$27,530,000	7	$30,570,000	3
Washington		8687	$1,756,890,240	331	$294,807,500	

National Flood Insurance Program (NFIP) and Floodplain Mapping

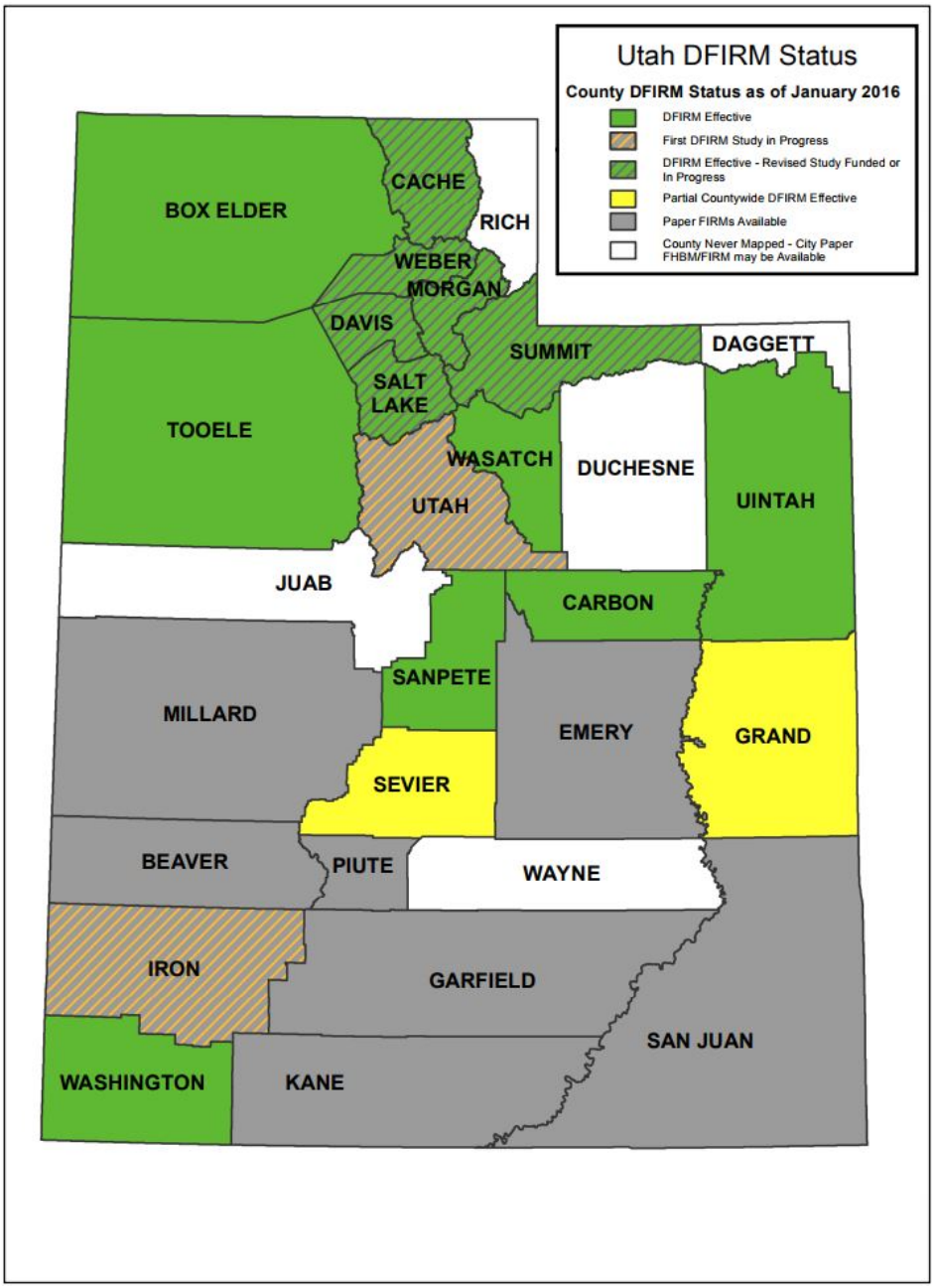
Utah currently has 220 communities that participate in the National Flood Insurance Program, which is up from 212 communities since the 2014 SHMP. The only remaining 2 counties in Utah that do not participate in the NFIP are Juab and Wayne counties.

Table 3. Utah 2018 NFIP Statistics by County

County	Total Premium	A-Zone	No. Polices	Total Coverage	Total Claims Since 1978	Total Paid Since 1978
Beaver	$0	0	0	$0	2	$7,119
Box Elder	$31,500	7	40	$11,704,200	22	$364,456
Cache	$95,916	28	135	$38,058,200	41	$130,487
Carbon	$63,242	15	46	$10,807,500	7	$38,093
Daggett	$51	0	1	$45,000	0	$0
Davis	$204,696	98	361	$100,107,500	141	$941,853
Duchesne	$4,912	4	6	$532,700	7	$13,054
Emery	$3,681	5	8	$1,501,000	5	$12,159
Garfield	$9,859	5	11	$2,952,300	1	$3,627
Grand	$45,351	82	99	$19,994,500	0	$0
Iron	$58,243	22	105	$28,454,700	18	$102,123
Juab	$1,475	0	3	$430,000	6	$0
Kane	$39,701	9	46	$12,241,600	6	$68,409
Millard	$830	0	2	$700,000	76	$1,265,725
Morgan	$26,621	15	52	$13,841,000	9	$10,887
Piute	$1,150	0	3	$910,000	0	$0
Rich	$3,621	2	3	$636,000	1	$2,842
Salt Lake	$747,827	500	1,022	$244,166,300	354	$1,626,597
San Juan	$605	0	2	$350,000	0	$0
Sanpete	$11,746	3	20	$5,308,500	10	$4,349
Sevier	$13,499	5	15	$4,632,200	14	$38,843
Summit	$332,105	436	604	$128,528,700	32	$85,392
Tooele	$19,382	11	24	$5,576,900	5	$19,157
Uintah	$44,773	20	54	$12,477,500	13	$80,456
Utah	$256,015	98	401	$121,235,800	89	$675,596
Wasatch	$25,762	8	54	$16,181,400	11	$39,289
Washington	$280,433	86	509	$157,636,300	46	$407,521
Wayne	$0	0	0	$0	1	$0
Weber	$186,465	66	213	$55,819,000	71	$243,108
Total	**$2,509,461**	**1525**	**3839**	**$994,828,800**	**988**	**$6,181,142**

The following map shows the Utah Digital Flood Insurance Rate Map Status as of November 2018. Green areas are those with digital Flood Insurance Rate Maps (dFIRMs) effective, Yellow are partial county-wide dFIRMs effective, Orange/Gray stripped are first time county-wide studies in progress, gray are those counties with effective paper FIRMs/ Flood Hazard Boundary Maps (FHBM), white areas are counties that do not have flood risk identified - but city paper FIRMs/FHBMs may be available. Gray striped areas are those counties that have paper maps but a re-study is funded or in progress.

Map 3. Utah DFIRM Status

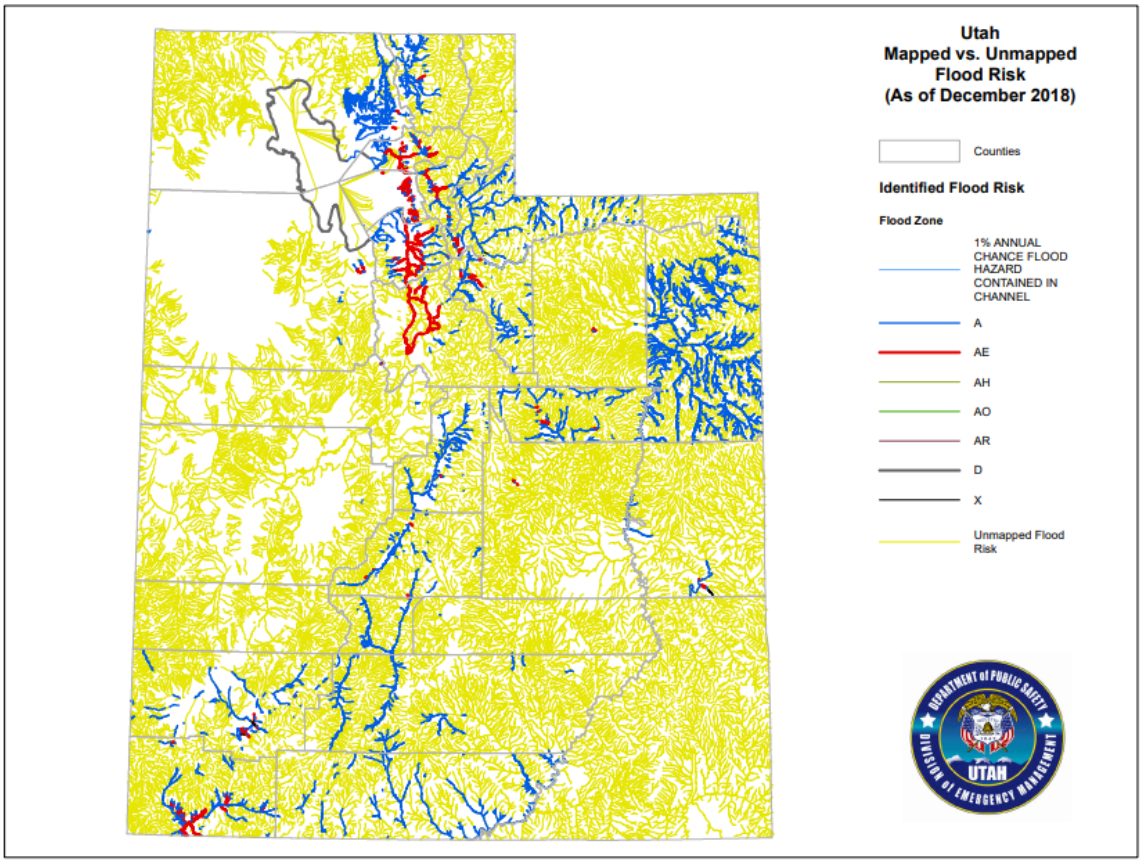


The communities that have had updated map panels since the last plan update in 2014 include:

- Huntsville – 6/02/2015
- Morgan (City) – 12/07/2017
- Morgan County – 12/07/2017
- Riverdale – 6/02/2015
- Roy – 6/02/2015
- Ogden – 6/02/2015
- South Ogden – 6/02/2015
- Uintah (City) – 6/02/2015
- Washington Terrace – 6/02/2015
- Weber County – 6/02/2015

The following map is of Utah indicating streams where a flood risk is mapped on a FEMA Flood Insurance Rate Map (FIRM). Yellow indicates streams without a flood risk identified. All other colors indicate streams with a mapped flood risk and their associated FEMA Flood Insurance Rate Map (FIRM) flood zone designation. Utah has 8.2% of its streams mapped and 91.8% unmapped. Data is based on the FEMA Coordinated Needs Management System (CNMS).

Map 4. Utah Mapped vs. Unmapped Floodplains



Repetitive Loss Properties

As of 2018, Utah has a total of 25 repetitive loss properties. In Utah, the local jurisdictions are expected to monitor their respective repetitive loss properties and if any of them are to become severe repetitive loss properties than the community is to make sure that the property is brought into compliance with NFIP regulations. The SHMP has repetitive loss properties as a goal to focus on mitigating those properties.

Table 4. Utah Repetitive Loss Properties

Jurisdiction	Repetitive Loss Properties	Last CAC Date	Last CAV Date
Cache County	8	10/20/2016	10/11/2018
Iron County	2	1/12/2017	8/2/2016
Morgan County	2	3/22/2018	9/15/2015
Salt Lake County	5	9/20/2016	2/20/2013
West Jordan	2	9/3/2015	6/18/2015
Washington County	2	11/23/2015	8/3/2016
Weber County	4	9/22/2016	2/28/2017
Total	**25**		

HAZUS Analysis

The Utah Division of Emergency Management (DEM) created a statewide HAZUS study region to perform an average annualized loss (AAL) analysis. An AAL analysis allows DEM to examine losses across the state both in terms of total expected loss per year as well as per capita loss per year.

One of the outputs from HAZUS is an AAL analysis related to Direct Economic Losses for Buildings. These results are shown in the following table. There are nine counties where HAZUS estimates more than $2,000,000 in annual direct economic losses: Cache, Carbon, Duchesne, Salt Lake, Sanpete, Sevier, Summit, Utah, and Washington counties. Twenty-one of the 29 counties in Utah have HAZUS estimates of more than $1,000,000 in annual direct economic losses. As part of our AAL analysis, we calculated the per capita direct economic losses by dividing the total direct economic losses by the 2017 Census population estimates for each county. Salt Lake County had the highest total direct economic losses ($34,658,000). Piute County had the highest per capita losses ($390.14). There are six counties where HAZUS estimates more than $200 in per capita losses from flooding.

Table 5. HAZUS Flood Results for Utah by County

Utah AAL Direct Economic Losses for Buildings for Flooding

	Capital Stock Losses					Income Losses					
County	Building Loss	Contents Loss	Inventory Loss	Loss Ratio (%)	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss	2017 Census Population Estimates	Per Capita Losses (in actual dollars)
Beaver	$132,000	$87,000	$1,000	0.1	$58,000	$10,000	$85,000	$15,000	$388,000	6,386	$60.76
Box Elder	$358,000	$230,000	$2,000	0.1	$260,000	$110,000	$135,000	$80,000	$1,175,000	54,079	$21.73
Cache	$1,970,000	$1,598,000	$43,000	0.1	$913,000	$567,000	$713,000	$400,000	$6,204,000	124,438	$49.86
Carbon	$1,482,000	$3,066,000	$222,000	0.2	$2,000	$1,000	$3,000	$0	$4,776,000	20,295	$235.33
Daggett	$7,000	$5,000	$0	0.1	$1,000	$4,000	$2,000	$0	$19,000	1,029	$18.46
Davis	$227,000	$218,000	$0	0	$148,000	$199,000	$960,000	$47,000	$1,799,000	347,637	$5.17
Duchense	$1,058,000	$629,000	$4,000	0.1	$445,000	$142,000	$287,000	$119,000	$2,684,000	20,026	$134.03
Emery	$171,000	$116,000	$0	0.1	$46,000	$51,000	$105,000	$11,000	$500,000	10,077	$49.62
Garfield	$594,000	$441,000	$3,000	0.2	$196,000	$180,000	$332,000	$118,000	$1,864,000	5,078	$367.07
Grand	$386,000	$428,000	$6,000	0.1	$199,000	$377,000	$1,078,000	$206,000	$2,680,000	9,674	$277.03
Iron	$430,000	$387,000	$3,000	0.1	$206,000	$162,000	$401,000	$53,000	$1,642,000	51,001	$32.20
Juab	$265,000	$226,000	$5,000	0.1	$189,000	$121,000	$164,000	$63,000	$1,033,000	11,250	$91.82
Kane	$626,000	$450,000	$1,000	0.2	$152,000	$132,000	$191,000	$58,000	$1,610,000	7,567	$212.77
Millard	$373,000	$529,000	$38,000	0.2	$148,000	$98,000	$366,000	$34,000	$1,586,000	12,863	$123.30
Morgan	$464,000	$374,000	$4,000	0.1	$288,000	$234,000	$297,000	$92,000	$1,753,000	11,873	$147.65
Piute	$140,000	$119,000	$0	0.2	$67,000	$85,000	$110,000	$33,000	$554,000	1,420	$390.14
Rich	$124,000	$61,000	$0	0.1	$44,000	$16,000	$24,000	$8,000	$277,000	2,391	$115.85
Salt Lake	$4,205,000	$5,525,000	$139,000	0	$4,034,000	$7,006,000	$11,414,000	$2,335,000	$34,658,000	1,135,649	$30.52
San Juan	$615,000	$373,000	$3,000	0.3	$205,000	$58,000	$120,000	$47,000	$1,421,000	15,356	$92.54
Sanpete	$451,000	$457,000	$17,000	0.1	$368,000	$287,000	$507,000	$138,000	$2,225,000	30,035	$74.08
Sevier	$526,000	$466,000	$10,000	0.1	$278,000	$194,000	$466,000	$112,000	$2,052,000	21,316	$96.27
Summit	$1,232,000	$849,000	$4,000	0.1	$665,000	$474,000	$1,054,000	$250,000	$4,528,000	41,106	$110.15
Tooele	$283,000	$190,000	$0	0	$140,000	$95,000	$125,000	$47,000	$880,000	67,456	$13.05
Uintah	$184,000	$124,000	$0	0	$78,000	$53,000	$77,000	$15,000	$531,000	35,150	$15.11
Utah	$8,197,000	$6,315,000	$75,000	0.2	$4,093,000	$4,247,000	$4,579,000	$2,016,000	$29,522,000	606,425	$48.68
Wasatch	$345,000	$218,000	$1,000	0	$175,000	$85,000	$235,000	$48,000	$1,107,000	32,106	$34.48
Washington	$3,949,000	$3,147,000	$53,000	0.2	$1,394,000	$1,028,000	$1,284,000	$543,000	$11,398,000	165,662	$68.80
Wayne	$186,000	$94,000	$0	0.2	$64,000	$9,000	$293,000	$20,000	$666,000	2,719	$244.94
Weber	$209,000	$188,000	$0	0	$180,000	$213,000	$606,000	$57,000	$1,453,000	251,769	$5.77
TOTAL	$29,189,000	$26,910,000	$634,000	0.11	$15,036,000	$16,238,000	$26,013,000	$6,965,000	$120,985,000	3,101,833	$109.21

7.3 Assessment of State Flood Vulnerability and Potential Losses

An analysis was completed on state-owned facilities and flood risk zones. State facility GIS point data was overlayed on available preliminary or effective Digital Insurance Rate Maps to determine the number of state-owned facilities that are in A, V, or Shaded X flood risk zones. A total of 340 state-owned facilities were found to be in A, V, or Shaded X flood risk zones with a total value of $859,701,341. Because not all of Utah has D-FIRMS these numbers do not represent the total number of state-owned facilities at risk to flooding.

Table 6. State Facilities in Flood Risk Zones

County	Count Facilities	Insured Value of Facilities	Facilities in Flood Risk Areas (A Zones, V Zones and Shaded X Zones)	Insured Value of State Facilities in Flood Risk Areas
Beaver	35	$41,032,093	0	$0
Box Elder	200	$298,041,925	15	$28,341,678
Cache	613	$3,340,693,369	6	$14,577,427
Carbon	113	$162,484,250	4	$8,058,313
Daggett	20	$3,415,881	0	$0
Davis	278	$1,393,256,017	33	$196,343,547
Duchesne	72	$37,934,210	0	$0
Emery	108	$41,071,459	0	$0
Garfield	59	$20,808,298	0	$0
Grand	81	$62,763,853	28	$33,192,571
Iron	224	$490,154,483	20	$13,777,374
Juab	41	$13,469,125	0	$0
Kane	51	$15,679,404	0	$0
Millard	78	$94,808,959	0	$0
Morgan	48	$25,152,828	10	$6,820,889
Piute	23	$4,841,000	0	$0
Rich	84	$11,160,077	0	$0
Salt Lake	1,463	$7,274,528,270	70	$205,978,951
San Juan	111	$111,325,088	0	$0
Sanpete	204	$437,926,899	13	$2,404,460
Sevier	135	$209,506,871	5	$1,290,019
Summit	128	$158,297,671	16	$48,918,383
Tooele	89	$296,471,019	3	$3,900,790
Uintah	117	$262,341,461	6	$2,290,904
Utah	577	$2,272,452,584	44	$182,979,669
Wasatch	178	$104,105,879	39	$61,555,877

Washington	215	$620,545,353	22	$47,941,747
Wayne	33	$4,730,187	0	$0
Weber	317	$1,267,926,750	6	$1,328,742
Total	**5,695**	**$19,076,925,263**	**340**	**$859,701,341**

SOURCES: Utah Automated Geographic Reference Center (state facility data); Federal Emergency Management Agency, Map Service Center (data for all counties with either effective or preliminary Digital Flood Insurance Rate Maps)

The Utah Division of Emergency Management (DEM) created a statewide HAZUS study region to perform an average annualized loss (AAL) analysis. An AAL analysis allows DEM to examine losses across the state both in terms of total expected loss per year as well as per capita loss per year.

The total AAL Direct Economic Losses from the HAZUS analysis for the whole state of Utah is $120,985,000. As part of our AAL analysis, we calculated the per capita direct economic losses by dividing the total direct economic losses by the 2017 Census population estimates for the whole state. The per capital loss for the entire state is $109.21.

Table 7. HAZUS Flood Results for Utah

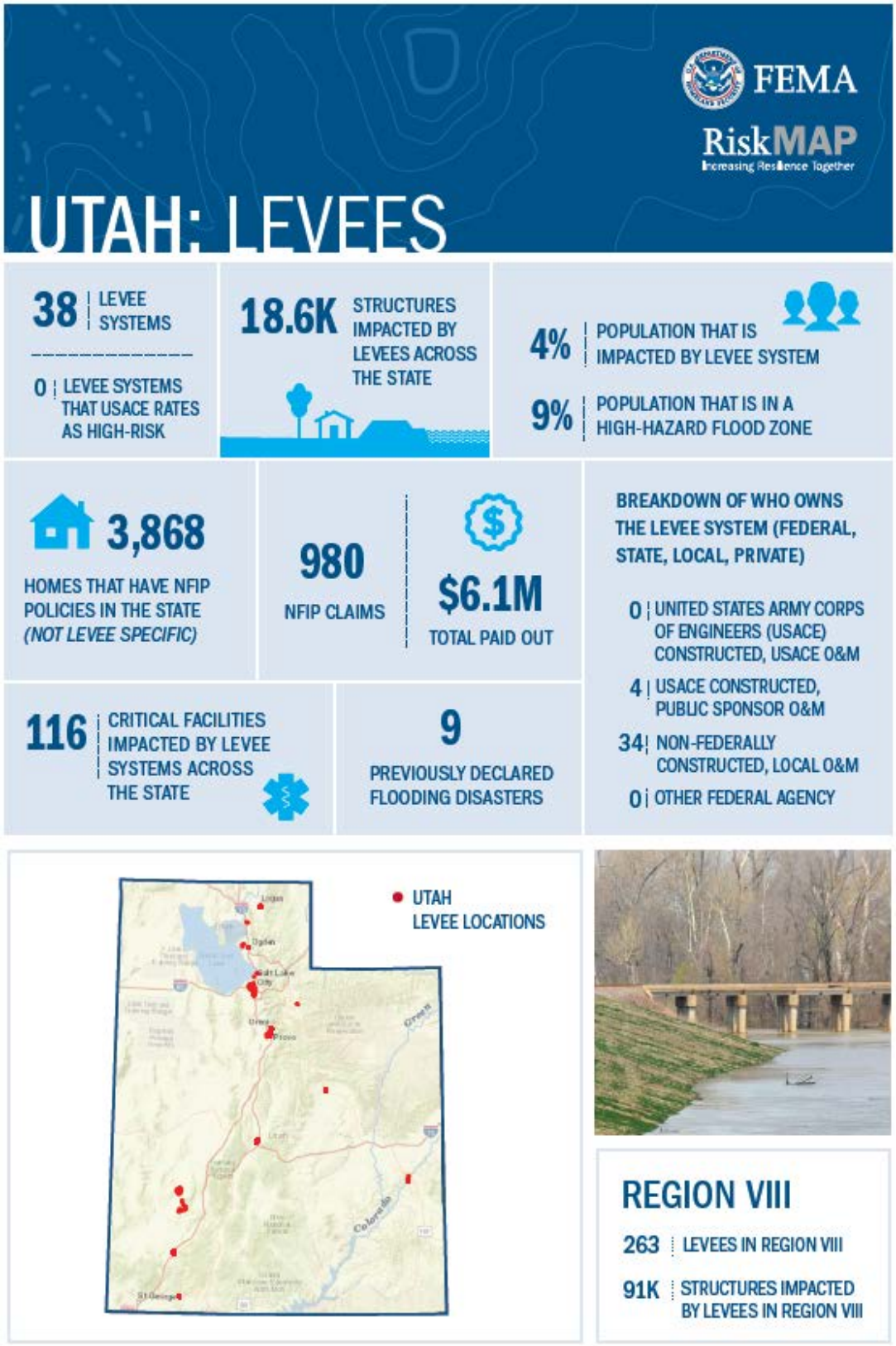
Utah AAL Direct Economic Losses for

	Capital Stock Losses					Income Losses					
County	Building Loss	Contents Loss	Inventory Loss	Loss Ratio (%)	Relocation Loss	Capital Related Loss	Wages Losses	Rental Income Loss	Total Loss	2017 Census Population Estimates	Per Capita Losses (in actual dollars)
TOTAL	$29,189,000	$26,910,000	$634,000	0.11	$15,036,000	$16,238,000	$26,013,000	$6,965,000	$120,985,000	3,101,833	$109.21

Levees

According to FEMA, Utah has 38 levee systems, of which 4 were constructed by USACE and 34 were constructed non-federally. There are around 18,600 structures impacted by levees. Around 4% of Utah's population is affected by the levee systems. Utah has 0 levee systems that are rated high-risk by USACE.

Figure 6. Utah Levees

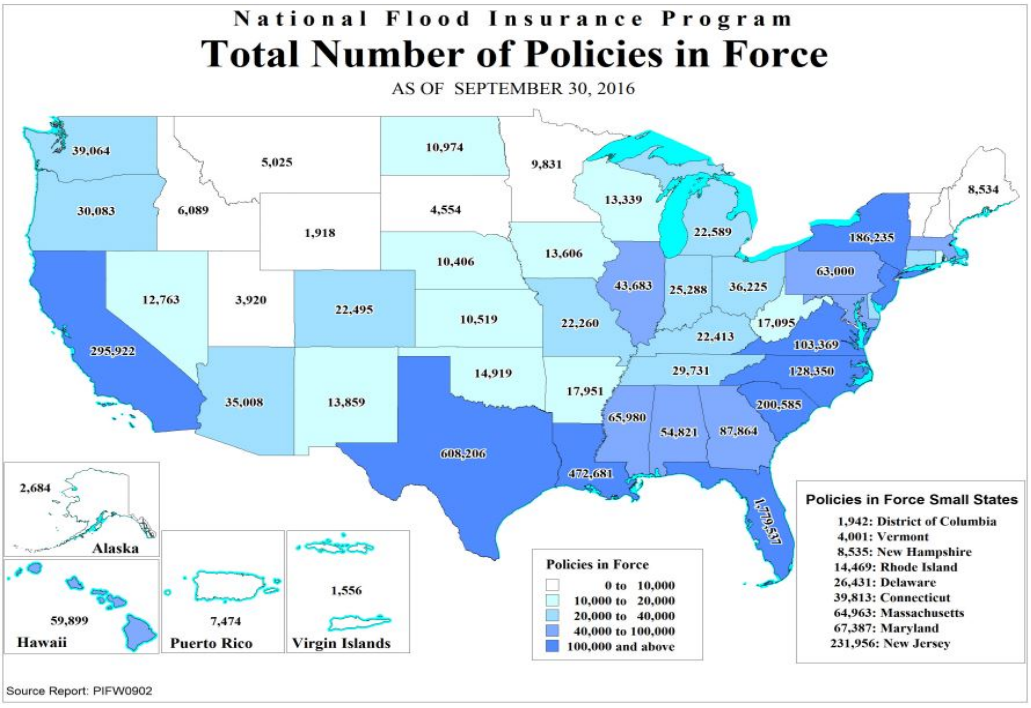


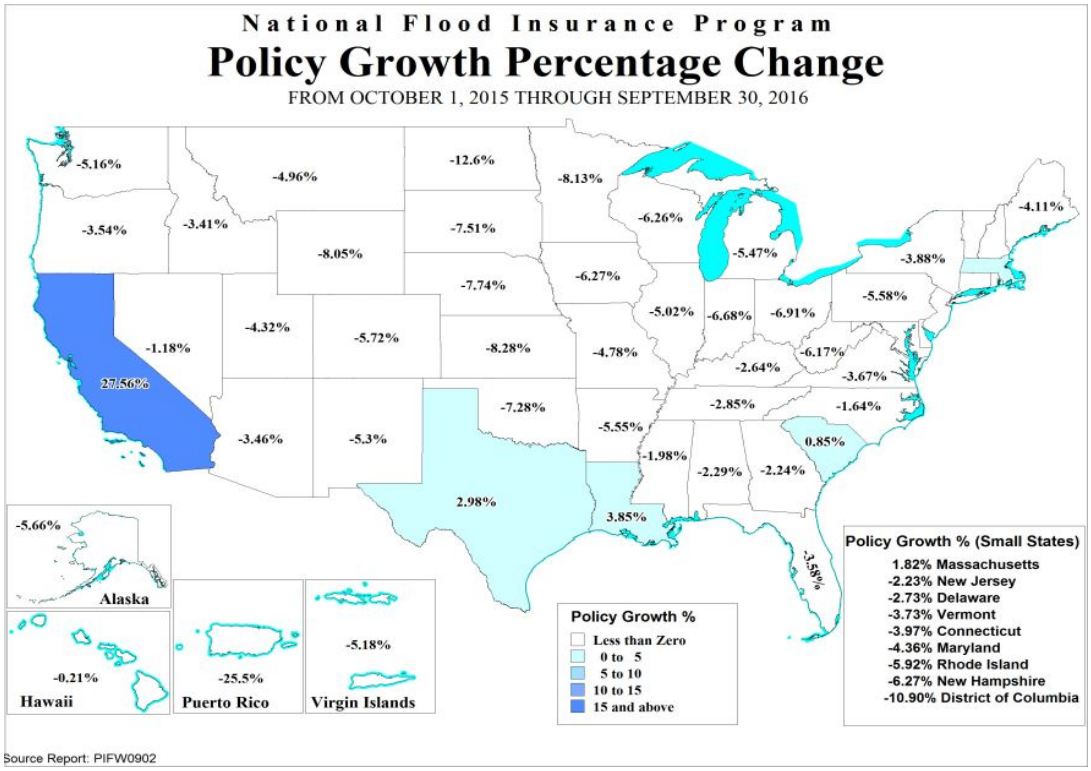
NFIP on a State Level

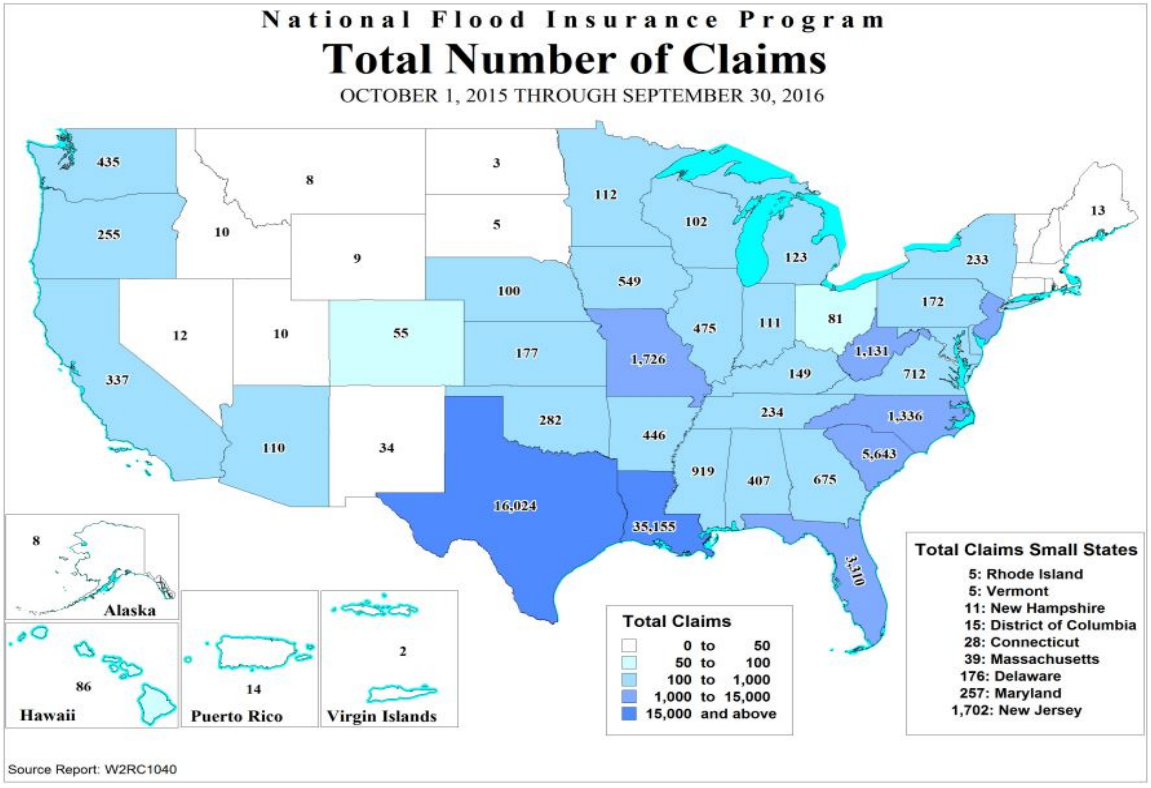
Utah has 220 communities that participate in the NFIP as of October 2018. In September 2016, there were 3920 NFIP policies. Utah has had 10 NFIP claims in the 2018 fiscal year for a total of $45,818 claim payments. In addition, Utah has had a total of 988 claims for a total of $6,181,129 in claims paid since 1978. Utah is on the lower end of NFIP policies and claims when compared with the nation. The table and maps show how Utah compares with some nearby states and the rest of the nation.

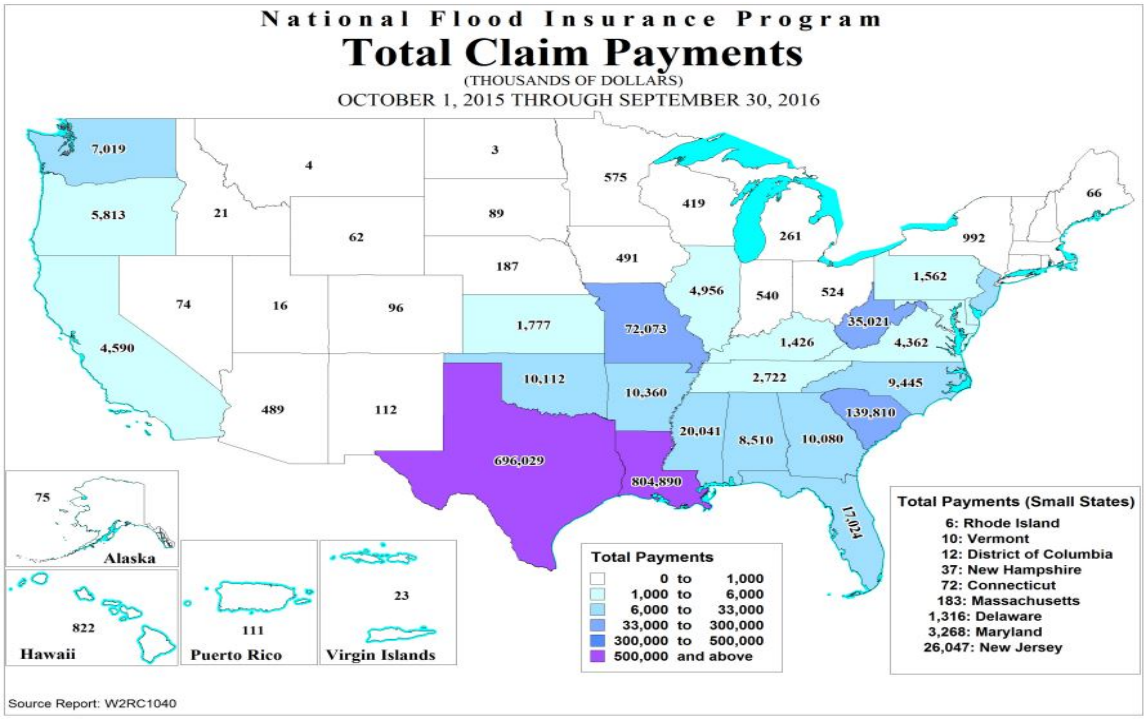
Table 8. NFIP Statistics for Utah as of October 1, 2018

NFIP Statistics for Utah vs FEMA Region 8 and Countrywide										
State	# of Current Policies	Policy Change Last 12 Mos.	Premium	Average Premium	Coverage	# Claims Paid FY	Claims Payments FY	# of Claims Since 1978	Claims Paid Since 1978	Participating Communities
Colorado	20997	1.05%	$18,005,056	$856	$5,484,561,700	56	$564,327	5,123	$86,846,526	252
Montana	5207	5.98%	$3,671,811	$703	$1,126,272,000	115	$869,018	2,046	$11,501,855	136
North Dakota	9587	10.08%	$6,492,829	$675	$2,663,434,300	7	$1,612	13,216	$259,452,832	330
South Dakota	3335	9.00%	$3,105,629	$928	$749,103,100	19	$90,925	3,371	$40,376,567	229
Utah	**4004**	**0.55%**	**$2,590,764**	**$675**	**$1,054,146,000**	**10**	**$45,818**	**988**	**$6,181,129**	**220**
Wyoming	1768	15.41%	$1,568,702	$881	$459,870,800	12	$16,447	513	$3,011,671	85
Total	**44,898**	4.18%	**$35,434,791**	$789	**$11,537,387,900**	**219**	**$1,588,147**	**25,257**	**$407,370,580**	1252
Country wide	**5,106,090**	**1.46%**	**$3,573,247,697**	**$700**	**$1,308,698,134,900**	**33983**	**$806,149,374**	**2,385,545**	**$68,594,217,541**	**22,346**
from Bureaunet State Fact Sheet Data and Policy Summary Data										
W2RP102M-Policy Statistics w CIF Counts-Static Reports										


National Flood Insurance Program
Total Number of Policies in Force
AS OF SEPTEMBER 30, 2016
39,064
30,083
6,089
5,025
1,918
10,974
4,554
9,831
13,339
22,589
8,534
186,235
63,000
10,406
13,606
43,683
25,288
36,225
12,763
3,920
22,495
10,519
22,260
22,413
17,095
103,369
295,922
14,919
29,731
128,350
35,008
13,859
17,951
200,585
65,980
54,821
87,864
608,206
472,681
17,79,537
2,684
Alaska
59,899
Hawaii
7,474
Puerto Rico
1,556
Virgin Islands
Policies in Force
0 to 10,000
10,000 to 20,000
20,000 to 40,000
40,000 to 100,000
100,000 and above
Policies in Force Small States
1,942: District of Columbia
4,001: Vermont
8,535: New Hampshire
14,469: Rhode Island
26,431: Delaware
39,813: Connecticut
64,963: Massachusetts
67,387: Maryland
231,956: New Jersey
Source Report: PIFW0902


National Flood Insurance Program
Policy Growth Percentage Change
FROM OCTOBER 1, 2015 THROUGH SEPTEMBER 30, 2016
-5.16%
-4.96%
-12.6%
-8.13%
-3.54%
-3.41%
-7.51%
-6.26%
-4.11%
-8.05%
-5.47%
-3.88%
-7.74%
-6.27%
-5.58%
-5.02%
-6.68%
-6.91%
-4.32%
-5.72%
-8.28%
-4.78%
-1.18%
-6.17%
-2.64%
-3.67%
27.56%
-7.28%
-2.85%
-1.64%
-3.46%
-5.3%
-5.55%
0.85%
-1.98%
-2.29%
-2.24%
2.98%
3.85%
-3.58%
-5.66%
Alaska
-0.21%
Hawaii
-25.5%
Puerto Rico
-5.18%
Virgin Islands
Policy Growth %
Less than Zero
0 to 5
5 to 10
10 to 15
15 and above
Policy Growth % (Small States)
1.82% Massachusetts
-2.23% New Jersey
-2.73% Delaware
-3.73% Vermont
-3.97% Connecticut
-4.36% Maryland
-5.92% Rhode Island
-6.27% New Hampshire
-10.90% District of Columbia
Source Report: PIFW0902


National Flood Insurance Program
Total Number of Claims
OCTOBER 1, 2015 THROUGH SEPTEMBER 30, 2016
435
255
337
8
10
12
10
110
3
5
9
55
34
100
177
282
16,024
112
102
549
1,726
446
35,155
123
475
111
919
407
13
233
172
81
1,131
149
712
234
1,336
5,643
675
3,310
8
Alaska
86
Hawaii
14
Puerto Rico
2
Virgin Islands
Total Claims
0 to 50
50 to 100
100 to 1,000
1,000 to 15,000
15,000 and above
Total Claims Small States
5: Rhode Island
5: Vermont
11: New Hampshire
15: District of Columbia
28: Connecticut
39: Massachusetts
176: Delaware
257: Maryland
1,702: New Jersey
Source Report: W2RC1040


National Flood Insurance Program
Total Claim Payments
(THOUSANDS OF DOLLARS)
OCTOBER 1, 2015 THROUGH SEPTEMBER 30, 2016
7,019
5,813
4,590
4
21
74
16
96
489
112
3
62
89
187
1,777
10,112
696,029
575
419
491
72,073
10,360
804,890
261
4,956
540
524
1,426
2,722
20,041
8,510
10,080
17,024
66
992
1,562
35,021
4,362
9,445
139,810
75
Alaska
822
Hawaii
111
Puerto Rico
23
Virgin Islands
Total Payments
0 to 1,000
1,000 to 6,000
6,000 to 33,000
33,000 to 300,000
300,000 to 500,000
500,000 and above
Total Payments (Small States)
6: Rhode Island
10: Vermont
12: District of Columbia
37: New Hampshire
72: Connecticut
183: Massachusetts
1,316: Delaware
3,268: Maryland
26,047: New Jersey
Source Report: W2RC1040

Climate Change Impacts

The risk of flooding in Utah is likely to increase throughout the twenty-first century. The increase in flood risk will occur in two ways. One, warmer temperatures will increase the risk of rain-on-snow events. Two, climate change will increase the incidence of extreme precipitation events and likely lead to an increase in flash flooding.

Rain-on-snow events can cause widespread flooding during winter and early spring in river basins throughout Utah. One such event occurred in Box Elder County when the Bear River reached record flows during February 2017 after a warm atmospheric river-type winter storm caused rainfall at low and mid-elevation areas. Heavy rainfall and the melting of low- to mid-elevation snowpack led to extensive flooding in the lower Bear River basin. Events like this are likely to become more common under future conditions.

Climate change will cause an increase in extreme precipitation events.[6] Extreme precipitation events are storms that cause a very large amount of rain or snow to fall in a very short period of time. The North American monsoon impacts many areas of southern and eastern Utah during late summer to early fall. During the monsoon, thunderstorms often drop an inch of precipitation in a very short period of time. Intense precipitation over short time periods often causes flash flooding, especially when precipitation falls in regions that are geographically pre-disposed to rapid runoff. In a warmer climate, the atmosphere can hold more water. The increased water vapor in the atmosphere means that there is a higher probability of extreme precipitation events that can cause flash flooding.

7.4 Mitigation Efforts for Flood Hazards

In a message sent out to Utah communities asking for a brief list of past, current, or future flood mitigation efforts their community has undertaken (eg. planning efforts, zoning laws, development codes, outreach programs, retrofitting projects, etc.), 22 Communities responded.

Harrisville, Utah – adopted the Weber County Flood-Emergency Mitigation plan. (On 3/8/16)

Castle Valley – Town was originally designed with only one ingress and egress and thus no emergency access. Many lots were poorly platted and thus have flood hazards. The community is not in the NFIP. Here is the mitigation efforts they've undertaken:
* Gained easements and right-of-way for a 4-season, emergency ingress and egress to the community
* Active project to build and maintain this road as a 4-season road
* Regularly clean out drainages to remove rock and other debris that impedes flow and clogs culverts
* Stream alteration permit with the UDWRi to maintain Castle Creek drainage
* Our zoning allows property owners to alter drainages only when they maintain the historic flow exit from their property
* We use some stream crossings as check dams to slow flood run-off
* We operate under a 1983 drainage plan
* There are a series of check dams on various ephemeral streams which were never maintained nor were easements gained and transferred to the Town. This is a problem and one J-key retention pond has been identified for conservation and return to use as a retention pond.

Utah County – This winter (pending staff availability) they are planning on reviewing the requirements of their Flood Plain Overlay found in Section 5-11 of the Utah County Land Use Ordinance, including adding the requirement/reference to a floodplain development permit.

Duchesne County – Joined the NFIP 3/30/17. They have a flood hazard zone chapter in their ordinance. Mike Hyde (FPA) said to contact the emergency management office for more info (435-602-7001)

Alta – Requirement of 50' from the high waterline and prohibition on building on any slope over 30% precludes anything from being built in an area with flood risk.

Payson – Due to the flood of 1983. Only current flood mitigation efforts are to monitor ditches and canals during high water runoff from Payson Canyon in the Spring and hot spots to hopefully remove obstructions and deal with issues as they come. They have replaced or installed storm drain catch basins and sumps in some areas and built a few

retention ponds in areas as well as trying to get curb and gutter installed where they can to minimize the chance of flooding. They could really use Dry Creek and Peteetneet Creek Channels piped which would eliminate almost any chance of flooding any area of the city but the price tag is too high.

Roosevelt – The city had a major flooding event on Sept. 22, 2016. Since then they have worked to install additional detention basins as well as installing a new 48" culvert in the area of the greatest flooding. They have also cleaned several drain lines and evaluated the drainage system for other possible improvements.

Hurricane – Got approved for an NRCS project that will help minimize their floodplain through town.

Heber – Worked with FEMA to prepare DFIRM maps for the area that were published and effective March 0212. The city updated its ordinance in Dec. 2011 to be more in line with FEMA's model ordinance. All new development is reviewed and appropriate measures are implemented to ensure properties are protected or aware of any flood risks. One example is noting the boundaries of floodplains located on new subdivision plats and zoning maps.

Blanding – No mitigation efforts have been undertaken.

Cedar Fort – No mitigation efforts have been undertaken.

Eureka – Eureka is a Super Fund Site. The flood concerns are a result of the work the EPA did to mitigate the lead hazard found in the soil. The road base the EPA used to line the sides of their streets after they removed the tainted soil is much too light and washes away every time it rains or snow melts. This is leaving cuts up to the asphalt which in turn causes the asphalt to fail. Their solution is to fill the washed out areas with more of the same road base. This is washing to the main drainage ditch which runs the full length of town, east to west. It has been explained to them that this is not acceptable because once that ditch is filled with road base all of Main Street will become a river every time it rains. They are in plans to resolve this issue but lack funding. ACE are willing to do the engineering but there is a 2 year wait.

New Harmony – No plans. They did do one several years ago in cooperation with the county where they cleared out the streambeds in the area.

Apple Valley – No specific codes. They recently replaced a bridge over a wash and also started collecting a monthly storm drainage fee. Those funds go toward storm drainage projects to facilitate flows.

Herriman – Past or current projects are:
Silver Bowles berm/sedimentation pond.
6000 W concrete barriers and silt fencing.
12400 S 6000 W (Miller lot) diversion berms.

Realignment/Rechanneling of Copper Creek.
Installation of slide gates for dynamic outfall from detention ponds.

Woods Cross – Recently completed projects include:
1950 South Detention basin. A 3 acre foot basin, approximate cost $300,000. This will help in high flow run off and surcharging of pipes that had potential of urban flooding
Legacy Storm Drain Pipe 900 LF of 36" pipe 2700 LF of 24' pipe with misc. structures, Total Cost $290,000. This project prevents low land flooding and backup in existing drainage piping. Revised ordinances and standards that reflect what the design storm water infrastructure is for Woods Cross City.

Morgan City – New Flood Prevention Ordinance recently passed.

Nephi City – New Stormwater Master Plan that has been completed to aid in the mitigation of flood waters. Juab County also has a section in their plan that references flooding.

Richmond City - We follow the flood plains established on the County map and I did actively participate in an up-dating of that document last year. 5. As a result of training I received, in February of 2011 the City passed an ordinance establishing a new Chapter 10-600 to our revised ordinances entitled "Flood Damage Prevention." This ordinance was designed to bring us into compliance with Utah Code (Annotated) 10-3-701 and 17-53-201. I realize that the above is not overly exciting, but we are way ahead of where we were in 1990. This request from you has brought to light a serious question that we, as a City, will have to resolve. Our administrative staff is comprised of two part-time employees, specifically myself as City Manager and our City Treasurer. I am retiring at the end of this year which means whoever is hired to replace me will, in all likelihood, have to undergo all of the training and essentially "relearn" what has taken me years to learn. We also suffer from the usual shortage of funds – for instance we did not have funds available for me to attend the conference at Ruby's Inn held September 25-29 of this year. In short, I walk out the door and so does all of the knowledge and experience. May I make a suggestion that as you work on the new revision of the Hazard Mitigation Plan, would it be possible to incorporate what would amount to a check-list of essential information that "newbies" such as my replacement could easily follow including references to the appropriate legislation, rules, etc.?

Ogden City - we have a storm water master plan. We have past, current, and future projects to restore the river, repair existing storm drain structures, add additional detention area, and retrofitting. We do have zoning laws, development codes, and outreach programs.

Hildale City – Past: 2015-2016 Willow Alley Flood Channel and Canyon Street Bridge Structure culvert (completed Summer 2015) Grant from the CIB $1,490,500 Hildale City General Fund $71,178. 2016-2017 Willow Alley Detention Basin – NRCS Grant - administrated through Washington County Public Works 2015- 2016 General Plan. 2016 Hildale City is now a member of FEMA – Flood Insurance. Current: 2017-2018 Central,

Carling and Canyon Street Detention Project – Grant/loan through the Community Impact Board will be bidding Fall/Winter 2017- in progress
2017-2018 Utah Avenue Curb Project (Utah Avenue and State HWY 59 and Utah Avenue and Oak Street) - Hildale City General Fund Project-
New ordinance on Development Standards October 2017 – including adopting APWA Standards Future projects: Updating Low Income Housing in General Plan
Zoning –Ordinances and Maps

Draper:
1. Adoption of Storm Drain Master Plan in 2012.
2. Title 9-Land Use and Development Regulations
3. Title 12-Flood Damage Regulations
4. Title 17-Land Development
5. The City sets aside funding to address areas where drainage systems are in need of retrofitting on an annual basis.

Cache and Box Elder
Flood insurance is a mitigation strategy. This is our risk and this is what we want to do about it. Risk Map is a great resource to have for mitigation. Higher quality mapping helps give the best information possible to keep people safe. Good to put how much of the state has Lidar. Doesn't mean we have to explain LIDAR. We want to increase our mapping quality and quantity throughout the state. Lidar and mapping is one way to do it.
UFSMA – Utah Floodplain and Stormwater Management Association. The annual UFSMA conference every year is hosted by the Utah Division of Emergency Management.

Trainings

NFIP trainings - The Utah Division of Emergency Management along with FEMA have provided NFIP basic, 101, MT1 & MT2 classes to floodplain administrators throughout the state in preparation for the Certified Floodplain Manager exam.
Community Visits, CCO's, CAV's, CAC's – Helps verify first hand that communities are implementing ordinances and following them. Involves visits to SFHA and areas that may be at risk or in need of mitigation. We have given them new higher standards templates for ordinances and floodplain permits.

Community Rating System (CRS)

The Community Rating System (CRS) recognizes and encourages community floodplain management activities that exceed the minimum NFIP standards. Depending upon the level of participation, flood insurance premium rates for policyholders can be reduced up to 45%. Besides the benefit of reduced insurance rates, CRS floodplain management activities enhance public safety, reduce damages to property and public infrastructure, avoid economic disruption and losses, reduce human suffering, and protect the environment. Technical assistance on designing and implementing some activities is available at no charge. Participating in the CRS provides an incentive to maintaining and improving a

community's floodplain management program over the years. Implementing some CRS activities can help projects qualify for certain other Federal assistance programs.

Table 9. CRS Communities in Utah

Community	County	Points /Class Rating	Effective Date
LOGAN	CACHE	8/10%	10/01/2003
BOUNTIFUL	DAVIS	9 /5%	10/01/1991
CENTERVILLE	DAVIS	7 /15%	10/01/2008
WEST BOUNTIFUL	DAVIS	9 /5%	10/01/1996
MOAB	GRAND	9 /5%	10/01/2011
OREM	UTAH	7 /15%	05/01/2008
PROVO	UTAH	8 /10%	10/01/1996
SANTA CLARA	WASHINGTON	9 /5%	10/01/1995
ST. GEORGE	WASHINGTON	6 /20%	05/01/2004
NORTH OGDEN	WEBER	8 /10%	05/01/2013

NFIP Outreach Activities in Utah

Some of the NFIP outreach activities that have taken place since the last plan update include:

- Utah Preparedness Expo
- Insurance Association Conference at the South Towne Expo Center
- Utah Insurance Commission Agent Training at the State Office Building
- Flood Awareness Week in March
- Multi Agency Resource Center (MARC) after the SLC Flooding
- Community Packets sent out to all participating and non-participating communities.
- Billboards throughout the state about flood safety/risk awareness.
- Community assistance and outreach meetings following the Box Elder and Cache County floods.
- Community assistance and outreach meetings post Carbon and Hildale floods.
- “High & Dry” Newsletter that goes to all FPA’s throughout the state as well as their community officials and UFSMA members.
- UFSMA
- Northern Utah Preparedness Fair
- Preparedness on the Hill
- Utah Prepare Expo
- Mapping meetings
- Trainings: NFIP 101, CRS, ASFPM 273, Legal Issues Workshop

RiskMAP Future Projects

The following table contains the future projects for Utah's RiskMAP program as contained in Utah's RiskMAP 5-year Business Plan.

Utah Flood Risk Project Priority
2019-2023

Year	Project
2019	
	Great Salt Lake Phase 2
	LiDAR: Greater Sevier addition
	BLE: Greater Sevier addition
	State-wide Alluvial Fan Inventory
	Utah Flood Risk Portfolio
2020	
	Washington County Phase 3-4
	Tooele County Phase 2
	Greater Sevier Phase 2
	LiDAR: Sanpete, Carbon, Emery
	LiDAR: Grand County/ Green River
2021	
	Wasatch/Uintah Basin Phase 2
	BLE: Utah County
	Great Salt Lake Phase 3-4
2022	
	Greater Sevier Phase 3-4
	Tooele County Phase 3-4
	BLE: Grand/Green River
	BLE: Sanpete/Carbon/Emery
	LIDAR: Beaver and Iron
2023	
	Utah County Phase 2
	Wasatch/Uintah Basin Phase 3-4

Note: Projects are based on the Utah Risk MAP 5-Year Business Plan, dated November 2018. Priorities and projects may change as projects are completed.

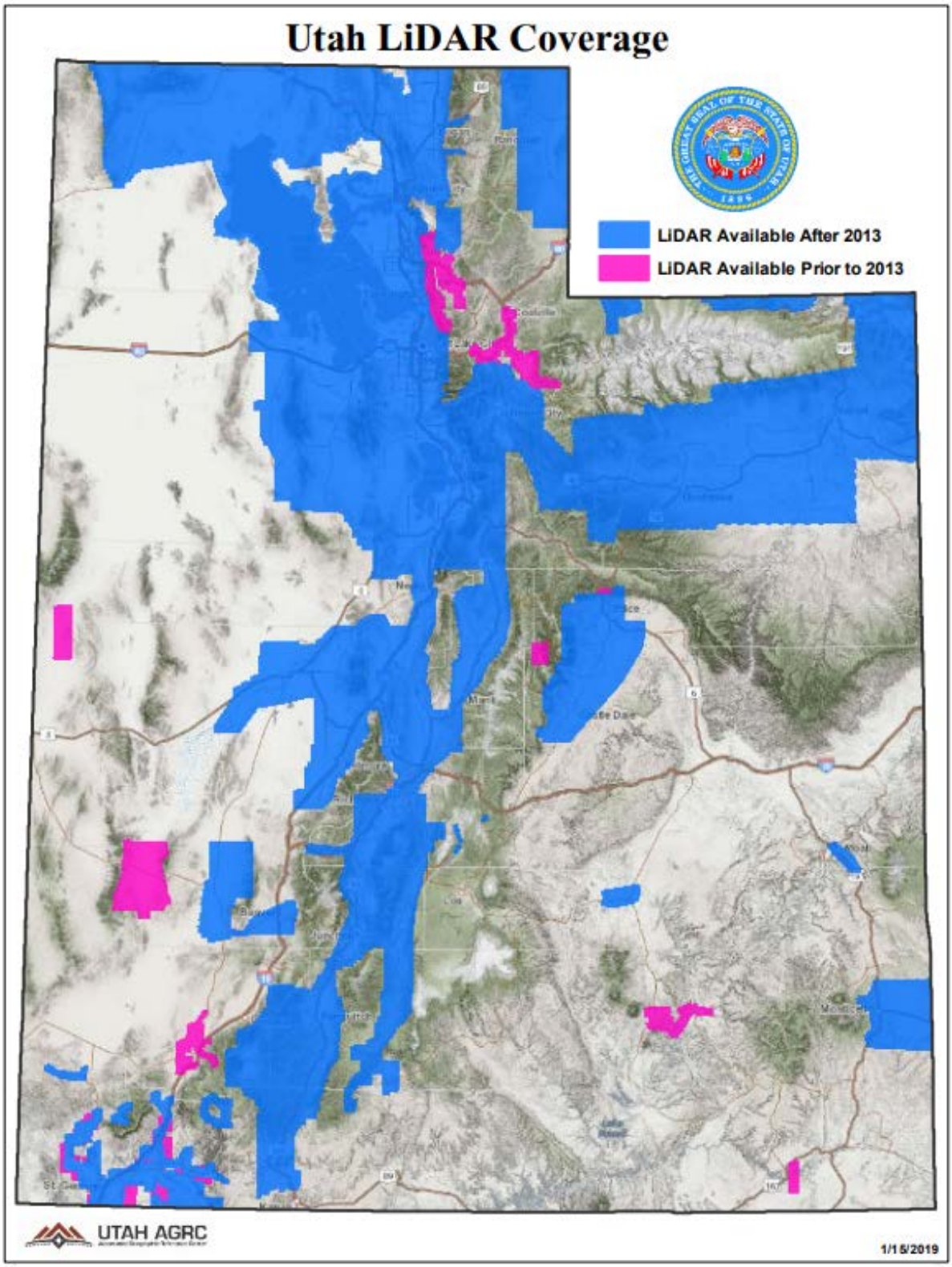
LiDAR Increases Since 2014

Utah's total land area is approximately 84,869 mi2. Various lidar datasets date back to 2001 with about 5565 mi2 of USGS Lidar Base Specifications QL1 and QL2 lidar from previous years that were acquired through USGS 3DEP Program Cooperative Agreements with the State of Utah. In 2018, about 17,883 mi^2 of new lidar data are being collected, leaving about 61,421 mi2 remaining to be acquired statewide.

To accomplish the State's goal for 100% coverage, Risk MAP partners with the Utah Automated Geographic Reference Center (AGRC) and the Utah Geological Survey (UGS) to provide funding and acquisition areas. Currently, Utah does not have State-wide funding for lidar acquisition and relies on individual funding partners to to increase the coverage for the state.

Since 2014, the Utah Risk MAP Program, through FEMA CTP grants, has provided approximately $1,287,000 in lidar acquisition funding to acquire areas within the counties of: Salt Lake, Utah, Cache, Washington, Juab, Sanpete, Millard, Sevier, Piute, Garfield, Kane, Box Elder, and Weber.

Map 5. Utah LiDAR Coverage



National Resource Conservation Service (NRCS)

NRCS through its Emergency Watershed Protection Program conducts many flood mitigation projects every year. A list of some of the past NRCS flood mitigation projects is included here:

Project Number	Project Sponsor	Financial Assistance
5061	Cache County - Logan Canal Landslide	$17,850,000.00
5072	Washington County - Dec 2010 Flooding	$6,590,668.00
5073	Kane County - Spring 2011 Flooding	$1,182,338.00
5074	Sevier County - Spring 2011 Flooding	$3,500,000.00
5077	Spanish Fork City - Spring 2011 Flooding	$500,000.00
5078	Duchesne County - Spring 2011 Flooding	$5,500,000.00
5079	Cache County - Spring 2011 Flooding	$9,500,000.00
5080	Sanpete County - Spring 2011 Flooding	$1,628,989.66
5081	Salt Lake County - Spring 2011 Flooding	$2,000,000.00
5082	Utah Dept. of Ag & Food - Spring 2011 Green River Flooding Tusher Diversion	$4,650,000.00
5083	North Utah County Water Conservancy District - Spring 2011 Dry Creek Flooding	$1,000,000.00
5084	Weber County - Spring 2011 Flooding	$13,000,000.00
5086	Sevier County - 2011 Clear Creek Flood	$700,000.00
5088	Alpine City - 2012 Quail Fire	$1,390,793.00
5088	Carbon County - 2012 Seeley Fire	$650,000.00
5088	Duchesne County - 2012 Church Camp Fire	$250,000.00
5088	Emery County - 2012 Seeley Fire	$2,250,000.00
5088	Kane County - Paria River Flooding	$250,000.00
5088	Millard County - 2012 Clay Springs Fire	$4,650,000.00
5088	Sanpete County - 2012 Wood Hollow Fire	$1,800,000.00
5088	Saratoga Springs City - 2012 Dump Fire	$2,285,200.00
5090	San Juan County - Piute Creek & Hatch Flooding	$650,000.00
5091	Enoch City - Flash Flooding	$1,000,000.00
5093	Ivins City - Flash Flooding	$500,000.00
5094	Cache County - 2012 Millville Fire	$78,980.39
5094	Summit County - 2013 Rockport Fire	$130,226.00
	Grand Total	**$83,487,195.05**

NRCS Flood Mitigation Projects FY 2017 & 2018:		
Name	**County**	**Total Cost**
Ashley Valley Watershed	Uintah	$15,107,386
Cottonwood Creek Watershed	Emery	$16,670,000
Duchesne County Water Conservancy District	Duchesne	$29,800,000
Losee Canyon – Saratoga Springs	Utah	$1,635,000
Lower Price River	Carbon	$7,500,810
Pleasant Creek Watershed	Sanpete	$18,807,047
Price River Watershed Restoration & Enhancement	Emery	$47,809,300
Skull Valley Indian Reservation	Tooele	$3,100,000
Upper Weber River Watershed	Weber	$5,840,000
Pleasant Grove-Mill Ditch-Amend (2017 EA underway)	Utah	$1,580,000
Glenwood Town – EA or EE (Flood)	Sevier	$1,329,000
Tri-Valley Revision – Daniels Creek (Irrigation)	Wasatch	$3,210,500
Tri-Valley Revision – Lake Creek (Flood)	Wasatch	$1,830,000
Parowan Valley	Iron	$15,500,000
North Ogden – Weber-Box Elder Conservation District	Weber	$4,457,000
Richfield – West Sevier Watershed	Sevier	$9,265,000
Cove Reservoir Watershed (Irrig, Rec)	Kane	$14,400,000
Santaquin Watershed (Flood)	Utah	$5,548,500
Warner Draw Watershed (Gould, Disposal, Virgin-Mix)	Washington	$17,075,000
Total		**$220,464,543**

Flood Terms

Alluvial: Flooding occurring on the surface of an alluvial fan or similar landform which originates at the apex and is characterized by high-velocity flows; active processes of erosion, sediment transport, and deposition; and unpredictable flow paths. Alluvial fan flooding is depicted on a Flood Insurance Rate Map (FIRM) as Zone AO, with a flood depth and velocity.

Base Flood Elevation (BFE): As shown on the FIRM, is the elevation of the water surface resulting from a flood that has a 1% chance of occurring in any given year. The BFE is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum

(NGVD) of 1929, the North American Vertical Datum (NAVD) of 1988, or other datum referenced in the FIS report.

CRS: The Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements.

FIRM: A FIRM is a map created by the NFIP for floodplain management and insurance purposes. Digital versions of these maps are called DFIRMs. A FIRM will generally show a community's base flood elevations, flood zones, and floodplain boundaries. As a property owner/renter, you can use this map to get a reliable indication of what flood zone you're in. However, maps are constantly being updated due to changes in geography, construction and mitigation activities, and meteorological events. Therefore, for a truly accurate determination, contact your insurance agent or company, or your community floodplain manager.

Floodway: The stream channel and portion of the adjacent floodplain that must remain open to permit passage of the base flood without raising the water surface elevation by more than one foot.

Flood Recurrence Interval: Average period of time for a flood that equals or exceeds a given magnitude.

Fringe: The portion of the 1-percent-annual-chance Special Flood Hazard Area (SFHA) that is not within the regulatory floodway, and in which development and other forms of encroachment may be permitted if allowed by FEMA and the community.

Microbursts – A localized sudden downdraft that occurs within a thunderstorm. It is typically no more than 2.5 miles in diameter and cause significant precipitation and/or wind events.

NFIP: The National Flood Insurance Program (NFIP) was established with the passage of the National Flood Insurance Act of 1968. The NFIP is a federal program enabling property owners in participating communities to purchase flood insurance as protection against flood losses, while requiring State and local governments to enforce floodplain management ordinances that reduce future flood damages. Over 20,300 communities participate in the NFIP.

Risk MAP Program: FEMA's Risk Mapping Assessment and Planning (Risk MAP) Strategy combines mapping, assessment, and planning tools in to one program to encourage beneficial partnership and innovative use of data to achieve reduction in flood losses.

Riverine: Also known as fluvial flooding. It is the most common flooding event according to FEMA. This occurs when the amount of water in a river exceeds its capacity and

overflows. This can be due to prolonged and excessive rainfall, heavy snow melt, ice jams, or river blockage. The two main types of riverine flooding is overbank and flash flooding. Overbank flooding is characterized by gradual rising of water over a river's banks while flash flooding is an intense, high velocity torrent of water into a water channel.

Stream Channel: A naturally or artificially created open conduit that periodically or continuously contains moving water or which forms a connecting link between two bodies of water.

Water Year: The 12-month period from October 1 through September 30, identified by the calendar year in which it ends.

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