

Prepared in cooperation with the Montana Department of Natural Resources and Conservation and the Federal Emergency Management Agency

# June 2022 Floods in the Upper Yellowstone River Basin

Washout on State Highway 419 along the Stillwater River, south of Nye, Montana. Photograph taken by Seth Siefken, U.S. Geological Survey, on June 21, 2022.

## Introduction

Extraordinary floods surged down the Yellowstone River and its tributaries in northwestern Wyoming and south-central Montana on June 13–15, 2022. Evacuations were carried out in Yellowstone National Park, the Stillwater Mine, and the towns of Belfry, Fromberg, Livingston, and Red Lodge, Montana. Campers were rescued by boat from campgrounds in the Beartooth foothills along the Stillwater River in Montana (<https://www.ktvq.com/news/local-news/raging-beast-campers-rescued-from-flooded-stillwater-river>; Hauter, 2022). Many roads and bridges were destroyed, including the main road to the north entrance of Yellowstone National Park from Gardiner, Mont. Homes, other buildings, and vehicles were washed away.

During the flood, U.S. Geological Survey (USGS) staff worked to maintain real-time data from streamgages by making field measurements of streamflow and repairing damaged equipment while communicating the latest streamflow information with the public and with local, State, and Federal agencies. After the flood, staff surveyed high-water marks (HWMs), computed peak streamflow at streamgages unreachable during the flood, and updated flood-frequency estimates for streamgages in the Upper Yellowstone River Basin (fig. 1).

Streamflows were the highest on record at 17 streamgages in the Upper Yellowstone River Basin. River stages were highest on record at most of those streamgages (fig. 1, table 1). The flood-related data and analyses summarized in this fact sheet are available online:

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- USGS National Water Information System database (<https://waterdata.usgs.gov/nwis/>; U.S. Geological Survey, 2024),
- StreamStats (<https://streamstats.usgs.gov/ss/>; Sando and others, 2016),
- ScienceBase landing page for USGS peak-flow frequency analyses (<https://www.sciencebase.gov/catalog/item/5852f60be4b0e2663625ee71>; U.S. Geological Survey, 2018), and
- USGS Flood Event Viewer (<https://stn.wim.usgs.gov/fev/#2022JuneMTFlood>; U.S. Geological Survey, 2022).

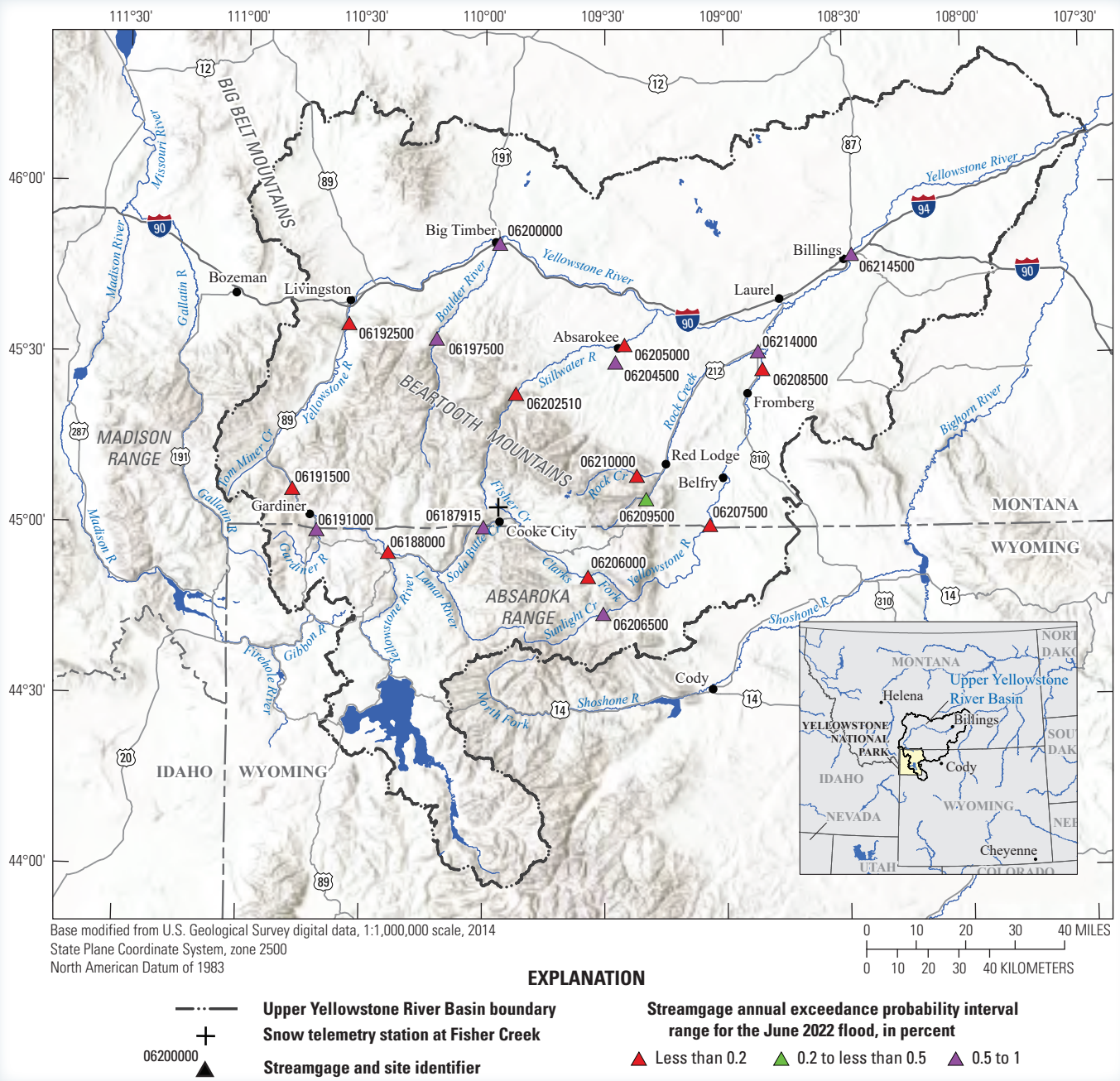
## June 2022 Drought, Snowpack, and Precipitation

On June 7, 2022, much of Montana and Wyoming, including parts of the Yellowstone River Basin, were in moderate to exceptional drought (National Drought Mitigation Center, 2022). In the Absaroka Range and the Beartooth Mountains, however, snowpack continued to build in late May, and by early June, the snowpack was much greater than average for the time of year (Natural Resources Conservation Service, 2024). The snow water equivalent at the Fisher Creek snow telemetry site in the Beartooth Mountains was 35.1 inches



U.S. Geological Survey staff surveying a high-water mark (debris line) along Rock Creek in Red Lodge, Montana. Photograph taken by Seth Siefken, U.S. Geological Survey, on June 29, 2022.

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**Figure 1.** Locations of selected streamgages and a snow telemetry station in the Upper Yellowstone River Basin. Streamgauge information from U.S. Geological Survey (2024) and snow telemetry information from Natural Resources Conservation Service (2024).

(in.), or 144 percent of the 1991–2020 average for that site (Natural Resources Conservation Service, 2024). On June 8, 2022, an atmospheric river caused heavy rain in Washington, Oregon, and California before moving inland toward Idaho and Montana (Center for Western Weather and Water Extremes, 2022). From June 9 to June 13, 2–5 in. of rain fell on melting snow over parts of the Upper Yellowstone River Basin, for a combined “total water event” of 4–9 in. (National Oceanic and Atmospheric Administration, 2022).

### Flood Frequencies and Peak Timing

Frequency of floods can be described in terms of annual exceedance probability (AEP) or the percentage chance that a flood of a given size will be exceeded in any year. Larger floods are less likely and therefore correspond to smaller AEPs. The 2022 peak streamflows were greater than the 1-percent AEP flood for 18 streamgages and were greater than the 0.2-percent AEP flood for 9 streamgages (table 1).

At most streamgages in the Upper Yellowstone River Basin, streamflow peaked on June 13, 2022. Sudden increases in streamflow (fig. 2) at USGS streamgages Lamar River near Tower Ranger Station in Yellowstone National Park, Wyoming (06188000), and Yellowstone River at Corwin Springs, Mont. (06191500), just north of Yellowstone National Park, provided a warning for the downstream communities of Livingston and Billings, Mont. The time between peak streamflow at Corwin Springs and peak streamflow at Livingston (about

**Table 1.** Peak stage and streamflow data for June 2022, previous maximum streamflow and associated stage for period of record, and annual exceedance probability (AEP) ranges at selected streamgages. Unless otherwise noted, streamflow for the 2022 flood event peaked on June 13, 2022. Also unless otherwise noted, AEP data are from Siefken and others (2023).

[Peak streamflow and stage data and streamgage information are from the U.S. Geological Survey National Water Information System (U.S. Geological Survey, 2024). Dates are given in month/day/year and month/year formats. mi<sup>2</sup>, square mile; ft<sup>3</sup>/s, cubic foot per second; ft, foot; AEP, annual exceedance probability; YNP, Yellowstone National Park; <, less than; --, no data, not computed, or not determined; ab, above; Cr, Creek; nr, near; W F, west fork]

Station number	Station name	Period of record (water years) through water year 2022	Contributing drainage area (mi <sup>2</sup> )	Flood of June 2022				Previous maximum		Date
				Peak streamflow (ft <sup>3</sup> /s)	Peak stage (ft)	Time	AEP interval range (percent)	Peak streamflow (ft <sup>3</sup> /s)	Stage associated with peak streamflow (ft) <sup>a</sup>	
06187915	Soda Butte Creek at Park Boundary, at Silver Gate, Montana <sup>b, c</sup>	1999–2022	30.9	1,610	4.94	2300	0.5–1	1,430	3.67	5/31/2020
06188000	Lamar River near Tower Ranger Station, YNP, Wyoming <sup>b</sup>	1923–69, 1985–86, 1989–2022	668	33,500	17.19	0730	<0.2	19,500	12.15	6/10/1996
06191000	Gardner River near Mammoth, YNP, Wyoming <sup>b</sup>	1939–72, 1984–2022	199	2,540	6.06	1130	0.5–1	2,110	5.09	6/5/2010
06191500	Yellowstone River at Corwin Springs, Montana <sup>d</sup>	1890–93, 1911–2022	2,615	54,700	14.72	1415	<0.2	32,200	10.92	6/10/1996
06192500	Yellowstone River near Livingston, Montana	1897–1905, 1929–32, 1938–2022	3,551	55,200	11.63	2215	<0.2	40,600	10.15	6/30/2011
06197500	Boulder River near Contact, Montana	1910–16, 1929, 1951–69, 1971–75, 1982–83, 2022	225	7,100	--	--	0.5–1	6,800	7.48	6/19/1975
06200000	Boulder River at Big Timber, Montana	1947–53, 1955–2022	525	11,300	8.56	1838	0.5–1	10,400	8.33	6/1/2020
06202510	Stillwater River ab Nye Cr nr Nye, Montana	1980–91, 2022	192	13,800	--	--	<0.2	6,400	7.6	7/10/1983
06204500	Rosebud Creek near Absarokee, Montana	1935–69, 2022	396	6,200	--	--	0.5–1	5,790	5.28	6/15/1967
06205000	Stillwater River near Absarokee, Montana	1911–14, 1935–2022	936	16,900	10.49	1145	<0.2	12,000	7.17	6/15/1967
06206000	Clarks Fork Yellowstone River below Crandal Creek near Painter, Wyoming	1918, 1930–32, 1950–57, 2020, 2022	447	23,000	14.96	--	<0.2	17,900	13.5	6/1918
06206500	Sunlight Creek near Painter, Wyoming	1918, 1930–32, 1946–71, 2022	137	3,120	6.98	--	0.5–1	4,000	5.8	1918
06207500	Clarks Fork Yellowstone River near Belfry, Montana	1922–2022	1,153	23,700	12.68	1300	<0.2	14,800	9.97	6/9/1981
06208500	Clarks Fork Yellowstone River at Edgar, Montana <sup>e</sup>	1922–32, 1934–69, 1987–2022	2,045	22,000	13.09	0545	<0.2	11,400	9.5	6/1/2020
06209500	Rock Creek near Red Lodge, Montana	2000–22	108	3,020	7.98	--	0.2–0.5	2,040	7.78	6/29/2011
06210000	W F Rock Creek below Basin Creek near Red Lodge, Montana	1938–1956, 2022	51.1	2,280	--	--	<0.2	933	3.88	6/6/1952
06214000	Rock Creek at Rockvale, Montana	1921–22, 1932, 1934–40, 1985–90, 2022	562	5,150	--	--	0.5–1	3,350	5.19	5/8/1988
06214500	Yellowstone River at Billings, Montana <sup>f</sup>	1904–05, 1918, 1929–2022	11,807	83,600	16.37	0930	0.5–1	82,000	15	6/12/1997

<sup>a</sup>At several sites, peak stage was during another year.

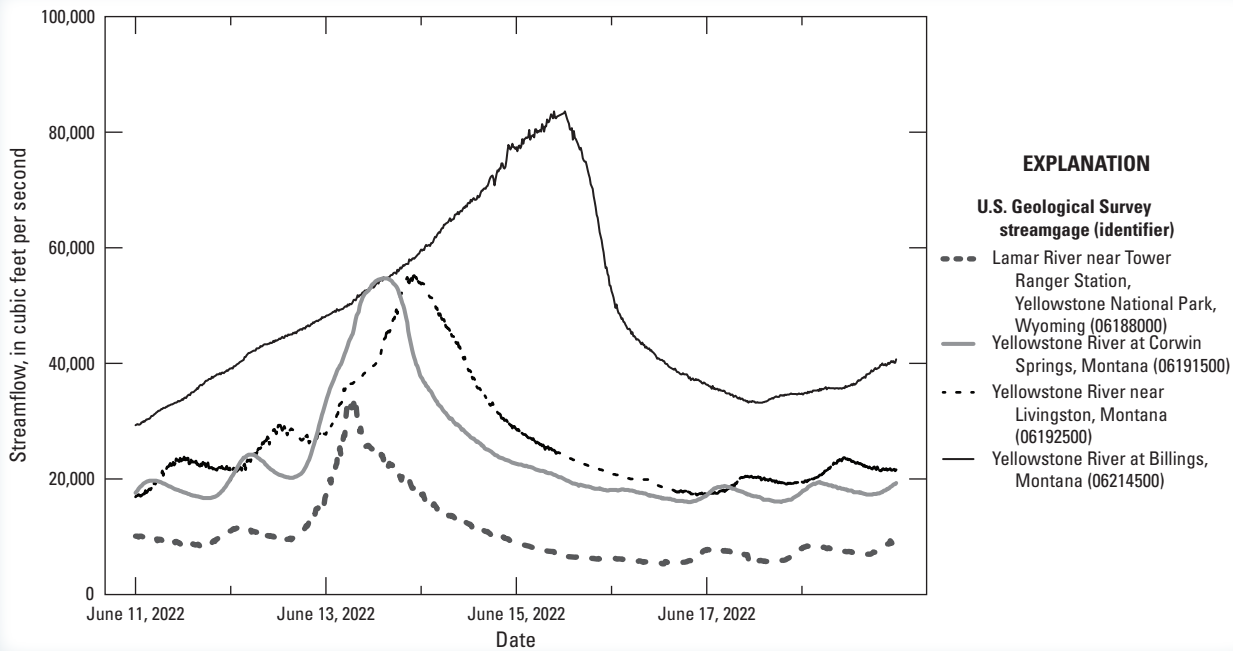
<sup>b</sup>AEPs were calculated using data through 2015 (Sando and others, 2016) and do not include the 2022 flood peak.

<sup>c</sup>The 2022 peak streamflow was on June 12, 2022, at Soda Butte Creek at Park Boundary at Silver Gate.

<sup>d</sup>At the Yellowstone River at Corwin Springs, Montana, the 1996 peak streamflow was also 32,200 ft<sup>3</sup>/s.

<sup>e</sup>The 2022 peak streamflow was on June 14, 2022, at Clarks Fork Yellowstone River at Edgar, Montana.

<sup>f</sup>The 2022 peak streamflow was on June 15, 2022, at Yellowstone River at Billings, Montana.



**Figure 2.** Hydrographs for streamgages on the Lamar River and Yellowstone River, Wyoming and Montana, June 11–18, 2022 (U.S. Geological Survey, 2024).

50 miles downstream from Corwin Springs) was about 7 hours (fig. 2). The time between peak streamflow at Livingston and peak streamflow at Billings (about 140 miles downstream from Livingston) was about 35 hours. The peak arrived at Billings on the morning of June 15, 2022.

### HWM Data on the USGS Flood Event Viewer

Staff from the USGS and Montana Department of Natural Resources and Conservation surveyed locations and elevations of HWMs along three streams in Montana: Rock Creek in Red Lodge, Clarks Fork of the Yellowstone River at Fromberg, and Yellowstone River from Tom Miner

Creek to Laurel. The HWM descriptions, locations, and elevations are available on the USGS Flood Event Viewer (<https://stn.wim.usgs.gov/fev/#2022JuneMTFlood>; U.S. Geological Survey, 2022). Funding from the Federal Emergency Management Agency and Montana Department of Natural Resources and Conservation made this HWM work possible.

The 1918 Yellowstone River flood caused the Harvat Bridge washout in Livingston, Montana (image number 2011.010.0395 provided by the Yellowstone Gateway Museum, used with permission).



## Historical Floods

The Yellowstone River is no stranger to large flood events. Written records of large floods exist as far back as 1873, and a major event was recorded in 1881. One of the largest flood events on the Yellowstone River was in 1894. Papers stated, “The Yellowstone reached the climax Wednesday (6th) when it was twenty inches above the high-water mark of last year and several inches higher than two years ago” (The Stillwater Bulletin, 1894, p. 4). Farmers, ranchers, and citizens across the State struggled with water pouring onto their lands and into their cities, thinking anything larger was unimaginable. However, 24 years later, in 1918, another drastic flood swept across cities along the Yellowstone River, devastating towns, businesses, and family homes. In Billings, Mont., reporters recorded water heights that exceeded the previously recorded HWM by 19 in. (The Billings Gazette, 1918a, b). The water rose rapidly, causing trains to overturn and bridges to be washed out. Travel came to a stop across the southern half of the State (Billings Evening Journal, 1918; The Billings Gazette, 1918c; Park City Pioneer, 1918). Smaller towns like Columbus took on mass amounts of water, and papers reported water was 3–4 feet deep over the approaches to the Yellowstone River (The Billings Gazette, 1918c). This was the largest well-recorded flood event before 2022; however, several other large flood events along the Yellowstone River have been documented in recent years, including 1978, 1996, 1997, and 2011. The 1978, 1996, and 1997 floods submerged historic sites such as Pompey’s Pillar, shutting down travel across the lower half of the State (Crisp, 1996). The flood of 1978 exceeded \$33 million in damage, and 19 counties between Montana and Wyoming were listed as disaster areas (Parrett and others, 1984).

## Changes in Historical Peak Streamflows

The 2022 Upper Yellowstone River Basin floods were rare compared to floods over the past century (table 1). Could climate and other changes in the basin make them more likely in the future? Scientists have searched historical climate and streamflow data for evidence that precipitation, temperature, and streamflow have been changing. Marti and others (2024) and Ryberg and others (2024) determined that annual peak streamflows have increased for one or more of the periods analyzed at most of the Upper Yellowstone River Basin streamgages included in their analyses.



U.S. Geological Survey staff measuring streamflow on the Yellowstone River near Livingston, Montana. Photograph taken by Dan Armstrong, U.S. Geological Survey, on June 14, 2022.

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