USDA United States Department of Agriculture

Natural Resources Conservation Service

Montana Water Supply Outlook Report

June 1, 2024

Precipitation added to the high elevation snowpack in Montana during May. Snowmelt was delayed which resulted in below normal runoff for many rivers last month. Pictured above is Rock Creek near Red Lodge, where total streamflow volume last month was only about 50% of its normal May volume. The delayed melt and additional accumulation resulted in snowpack conditions that are near normal at several high elevation locations, but overall the snowpack remains below normal in most locations. June 1 water supply forecasts are now available and range from well below normal to above normal for Montana rivers. (Photo: Florence Miller 5/26/2024)

Table of Contents

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Statewide Overview

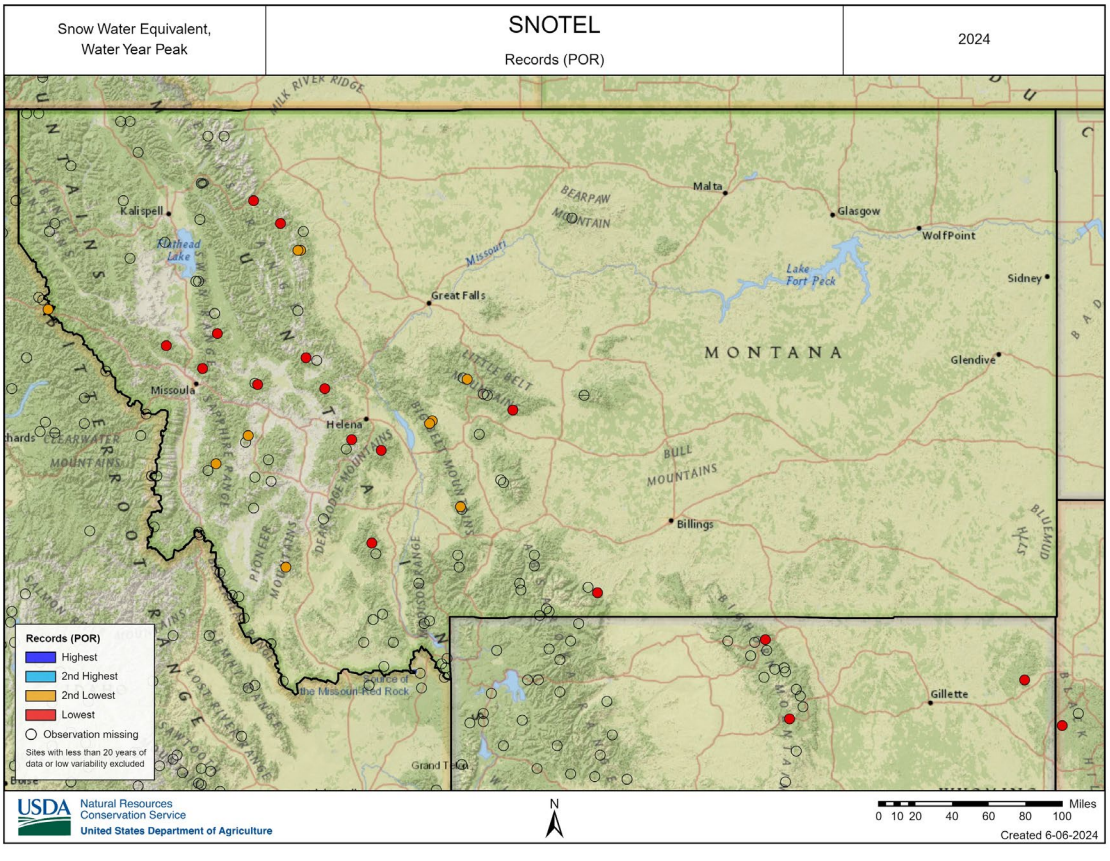
Summary

Summer is fast approaching and as Montana wraps up the 2024 snow accumulation season recent weather helped improve the water supply outlook, however the outlook remains below normal in many locations. Last month brought a mix of snow, rain, and sunshine across Montana. While that is not uncommon weather for this time of the year, some locations did not receive the moisture they needed. The Kootenai, Lower Clark Fork, Jefferson, and upper Madison River basins experienced below normal precipitation last month. All other basins received above normal precipitation, and some of the storm totals were exceptional. Periods of cool weather delayed snowmelt and increased snowpack percentages in many basins. The Gallatin, Smith-Judith Musselshell, Powder, and Tongue saw the largest increases. June 1 snowpack percentages currently range greatly, from well above normal in the Bighorn Mountains to well below normal around Helena and the Rocky Mountain Front.

Peak or maximum snow water equivalent levels occurred within 1-2 weeks of normal in most basins, but those levels were largely below normal seasonal maximums. Across the region SNOTEL sites experienced record low or near record low seasonal snowpack peaks. That includes lower elevations in the Bighorn Mountains where snowpack percentages are currently highest. In contrast, several high elevation locations in the northern Swan, northern Gallatin, and Bighorn Mountains made substantial gains during April and May and reached near normal snowpack peaks. About 50-70” of snow remains at the highest elevations around Glacier National Park and Yellowstone National Park, but nearly all of the lower elevation snowpack is gone.

The largest water supply outlook improvement occurred in the Powder and Tongue River basins, which are now forecasted to have 120-130% of streamflow volume over the next couple months. The Upper Yellowstone, Gallatin, Madison, and Flathead also made significant gains over the last month and are now expected to have 80-90% of normal streamflow volume through July. All other water supply forecasts range from 70-80% of normal, except for rivers in the region extending from the Bighole River to the Rocky Mountain Front, which are expected to have about 40-60% of normal streamflow.

The adjacent map shows SNOTEL sites that experienced a record low (red) or second lowest (orange) snow water equivalent peak this season.



Statewide Overview

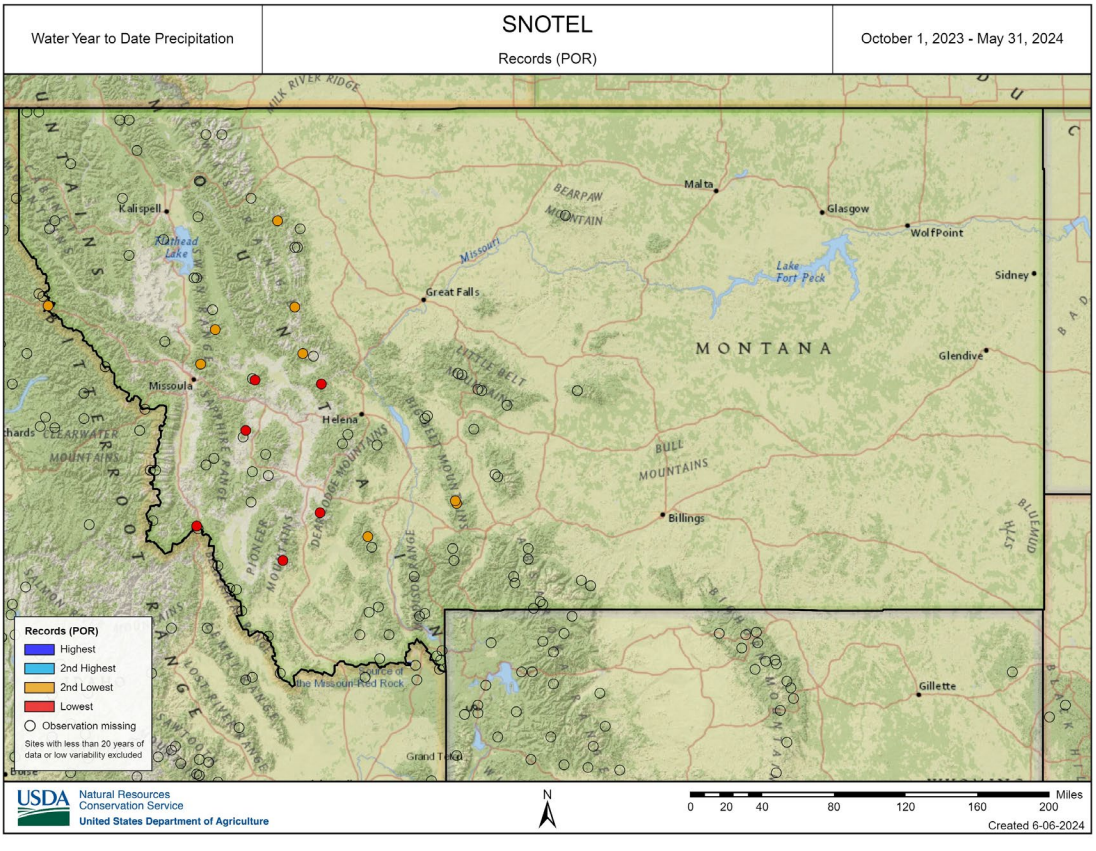
Precipitation

May is generally a wet month in Montana, particularly east of the Continental Divide, and that was mostly true this year. Most of the state received above normal precipitation last month and some locations received a substantial amount of snow. Precipitation was fairly consistent during May, with several storms arriving during the month. The largest storm occurred around May 6-10. Rocky Boy SNOTEL in the Bears Paw Mountains recorded 8.4" of precipitation during this storm, which was in addition to 2" of precipitation received during the first several days of May. Other SNOTEL sites in the Belt, Absaroka, Beartooth, Bighorn, Rocky Mountain Front, Flathead, and Bitterroot Mountains received 3-5" of precipitation during this mid-month storm. Total May precipitation at high elevations in the Flathead and central Montana was 8-13", which was well above normal for those locations.

Above normal precipitation during May was not inclusive for all of Montana. May precipitation in the western Kootenai, Lower Clark Fork, northern Jefferson, and southern Madison was only 80-90% of normal. Most SNOTEL sites in that region reported a total of 2-4" of precipitation for the entire month. Total monthly precipitation was 100-110% of normal in the Upper Missouri near Helena and Upper Clark Fork River basin. All other basins received 115-170% of normal precipitation last month. The Bighorn was at the lower end of that range. Central Montana and the Tongue were at the upper end of that range.

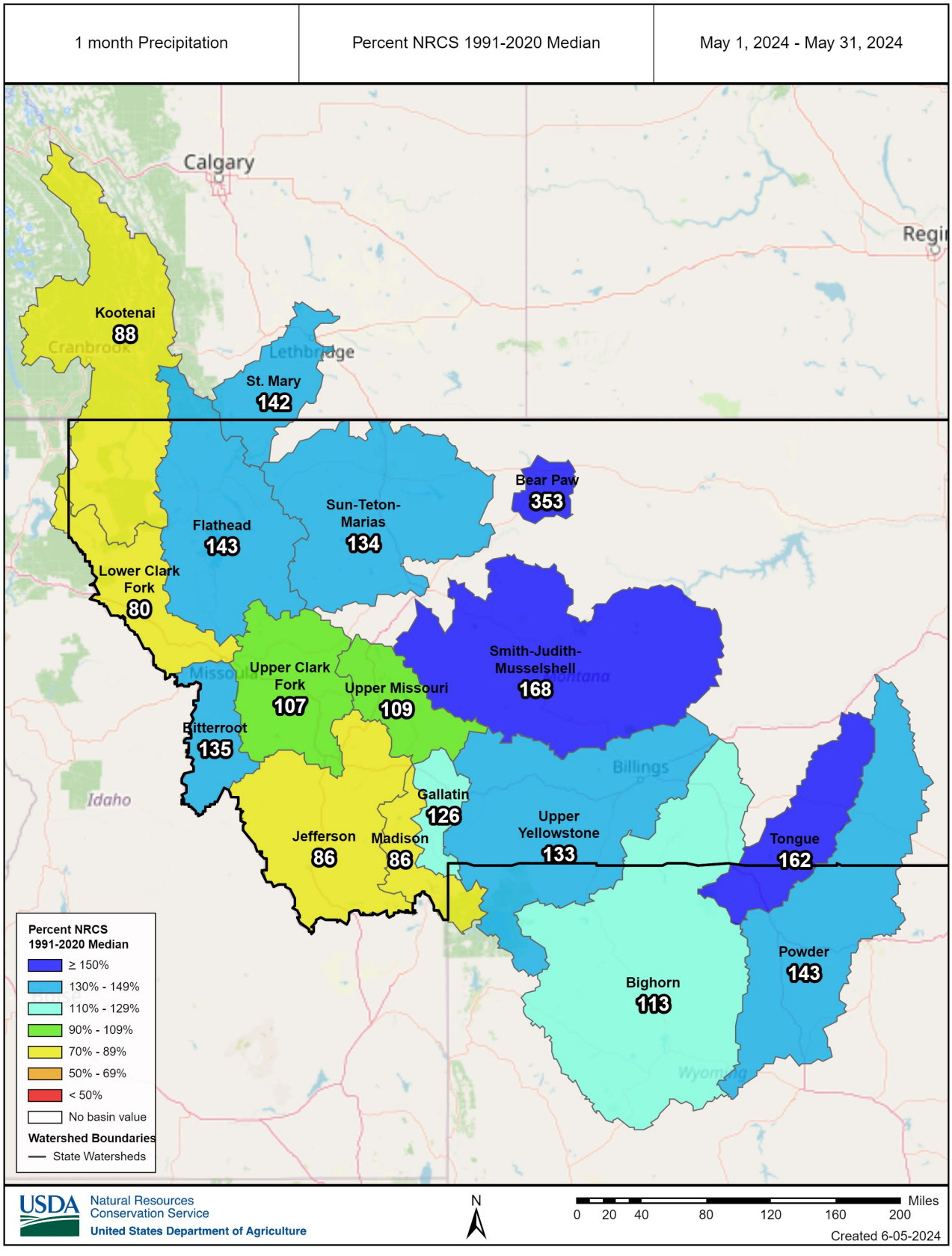
Total water year precipitation has improved from last month in all basins except the Madison, which due to lack of precipitation recently near West Yellowstone has decreased slightly to 88% of normal. In the Bears Paw Mountains May precipitation was so significant that total water year precipitation improved from well below normal to 143% of normal. In general, the Bighorn, Powder, and Tongue River basins lacked precipitation this water year, but a large storm in October combined with several large storms this spring have totaled about 100-105% of normal water year precipitation. All other basins are reporting about 75-95% of normal water year precipitation.

The adjacent map shows 14 SNOTEL sites in western Montana that are currently reporting lowest (red) or second lowest (orange) water year precipitation on record. One example, Saddle Mountain SNOTEL at 7940 feet in the southern Bitterroot Mountains has received 20.1" of precipitation since October 1. Its median is 28.0", the maximum June 1 total in 46 years of record is 43.6" which occurred in 1996, and the previous minimum was 20.3" in 2005.



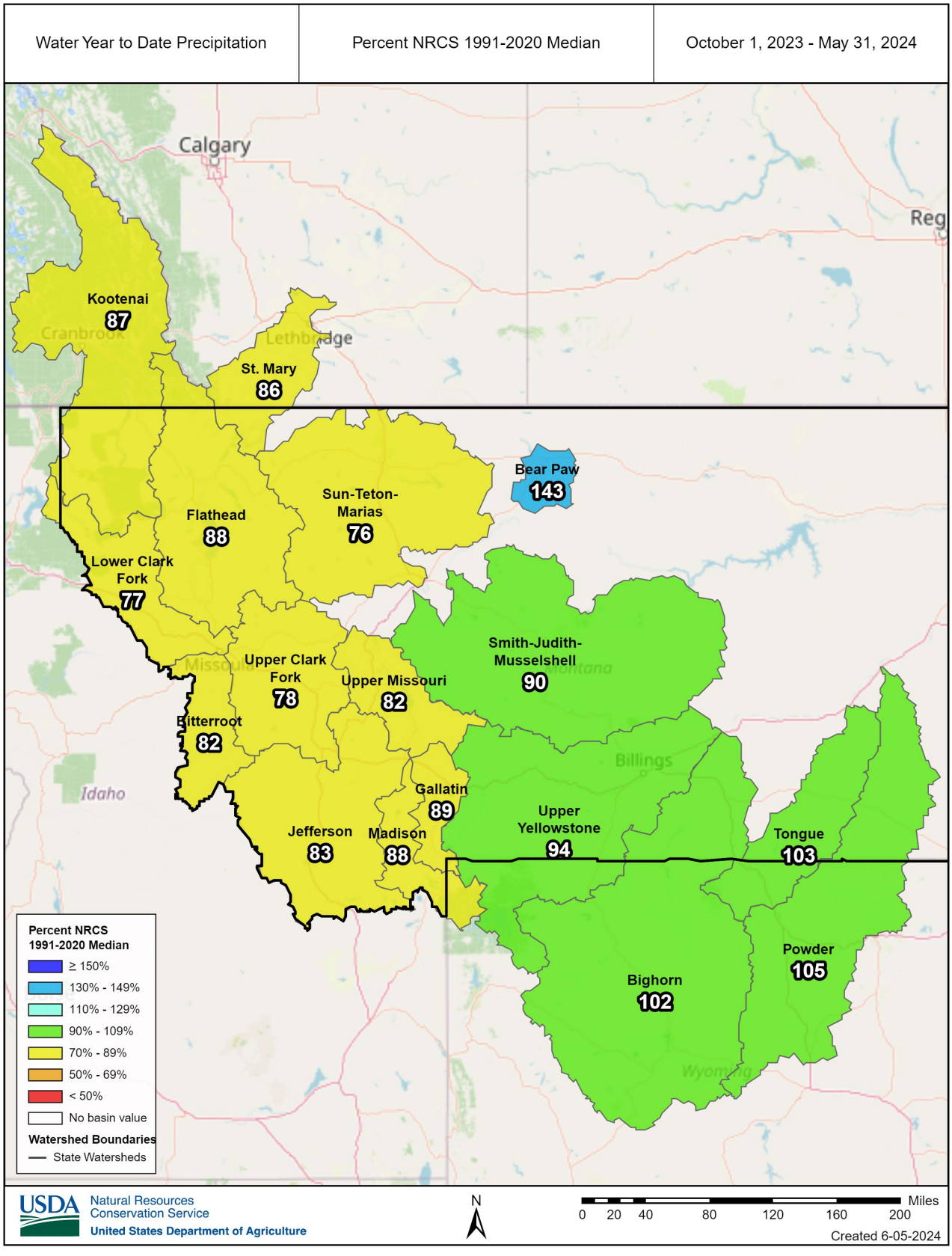
Statewide Overview

Precipitation (Continued)



Statewide Overview

Precipitation (Continued)



Statewide Overview

Snowpack

Several storms brought significant snow accumulation to the mountains during May, however most of it melted as quick as it arrived. The good news is that accumulation combined with cool weather during May was helpful given the lack of snow earlier this season. A near normal amount of snow exists at several of the highest elevation locations, but nearly all of the low elevation mountain snowpack melted out in April. Snowpack percentages have increased from May 1 in all but the Kootenai, Sun-Teton-Marias, and Upper Missouri basins. The snowpack in the Tongue and Powder River basin are highest at over 250% of normal. The snowpack in the Upper Missouri near Helena and Sun-Teton-Marias basins are lowest at about 5-15% of normal. Most other snowpack percentages are in the 70-100% range for June 1. Keep in mind that all May 1 snowpack percentages were well below normal this year, and May 1 snowpack percentages were closer to when the snowpack peaked this season. Therefore, even though higher elevation SNOTEL sites may appear to have near normal conditions, the peak snowpack was still well below normal in many locations. Current snowpack percentages are closer to normal, compared to what might be expected, because of delayed melt at the highest elevations.

Peak snow water equivalent this year occurred within 1-2 weeks of normal. In general, the lower elevation mountain snowpack peaked on the early side, and the upper elevation snowpack peaked slightly later than normal. Peak snow water equivalent was about 60-80% percent of normal at most SNOTEL sites this season. One of the more significant peak snow water equivalent deficits occurred at the North Fork Jocko SNOTEL in the southern Mission Mountains, which had its lowest snow water equivalent peak in 34 years. North Fork Jocko SNOTEL peaked this year at 28.9” SWE and 77” snow depth. The median peak is 43.5” SWE and about 110” of snow depth. Several of the highest elevation locations in Montana and northern Wyoming did make significant gains this spring and peaked at near normal levels (90-100%). Those locations include Noisy Basin SNOTEL (6040 ft) in the northern Swan Mountains, Shower Falls SNOTEL (8100 ft) in the northern Gallatin, and several high elevation SNOTEL sites in the Bighorns.

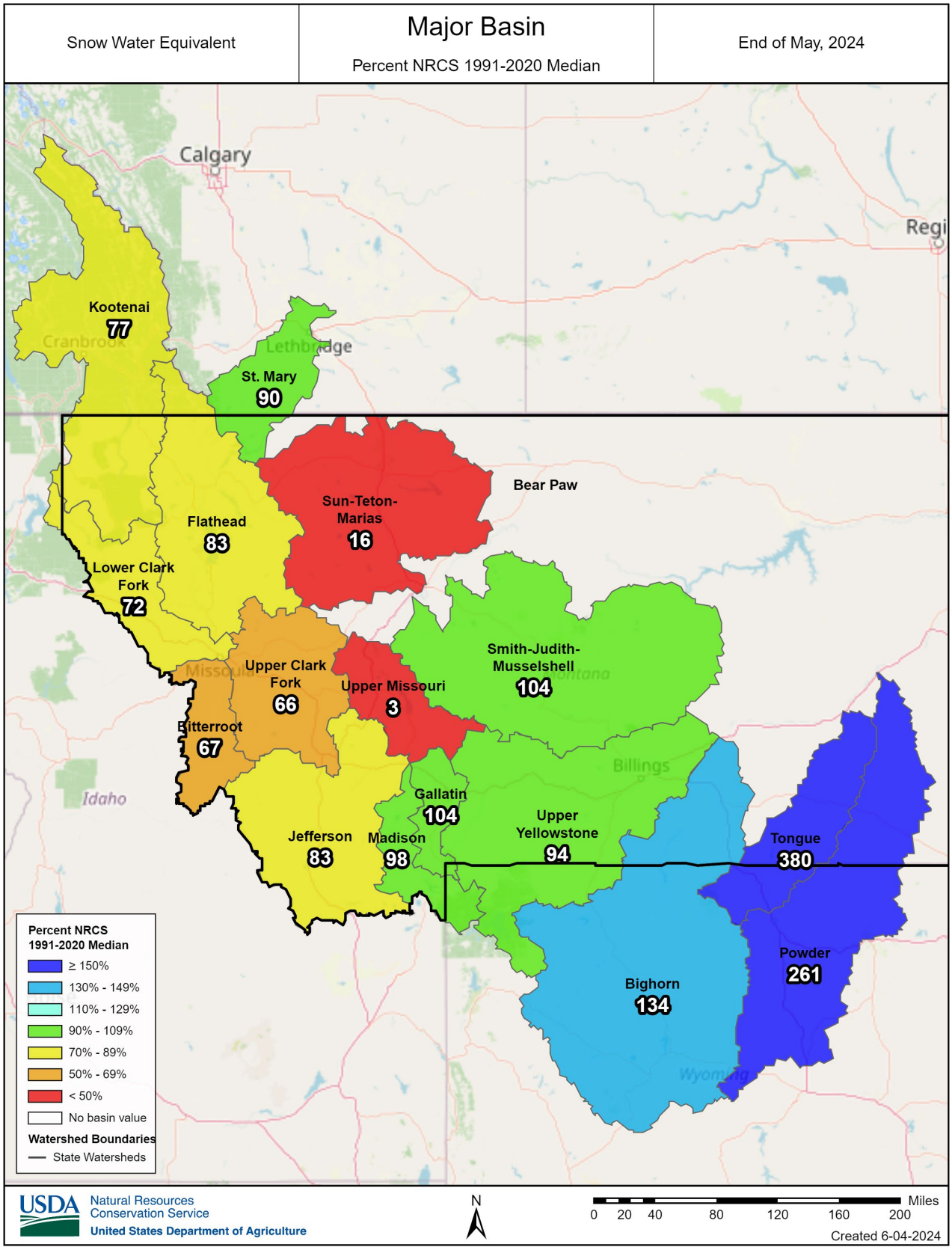
The highest elevations around Glacier and Yellowstone National Park still have about 50-70” of snow. The Bighorn Mountains, which have the highest snowpack percentage, only have 30-40” of snow remaining. Out of 154 NRCS snow survey stations measured on June 1, 77 are currently melted out. Melt out was about 1-2 weeks early for many stations. For Frohner and Tizer SNOTEL sites near Helena it was their second earliest, only behind 2015.

Water Year 2024 - Major Basin - Snowpack Percent of Normal ('91-'20)

Basin	Nov 1	Dec 1	Jan 1	Feb 1	Mar 1	Apr 1	May 1	Jun 1
Kootenai	62	64	62	67	79	80	77	77
Flathead	67	63	53	65	71	74	68	83
Upper Clark Fork	116	37	36	44	66	67	56	66
Bitterroot	144	35	50	60	73	72	54	67
Lower Clark Fork	90	58	47	55	66	73	68	72
Jefferson	91	48	51	55	73	80	69	83
Madison	86	58	54	57	73	85	74	98
Gallatin	81	52	54	53	65	76	66	104
Upper Missouri	125	41	33	41	71	73	42	3
Smith-Judith-Musselshell	116	63	49	51	65	67	55	104
Sun-Teton-Marias	121	48	26	34	53	57	41	16
St. Mary	77	72	51	55	65	73	77	90
Upper Yellowstone	103	60	55	55	65	79	67	94
Bighorn	117	85	75	74	85	95	86	134
Powder	93	60	51	51	63	67	70	261
Tongue	154	92	66	64	65	73	79	380

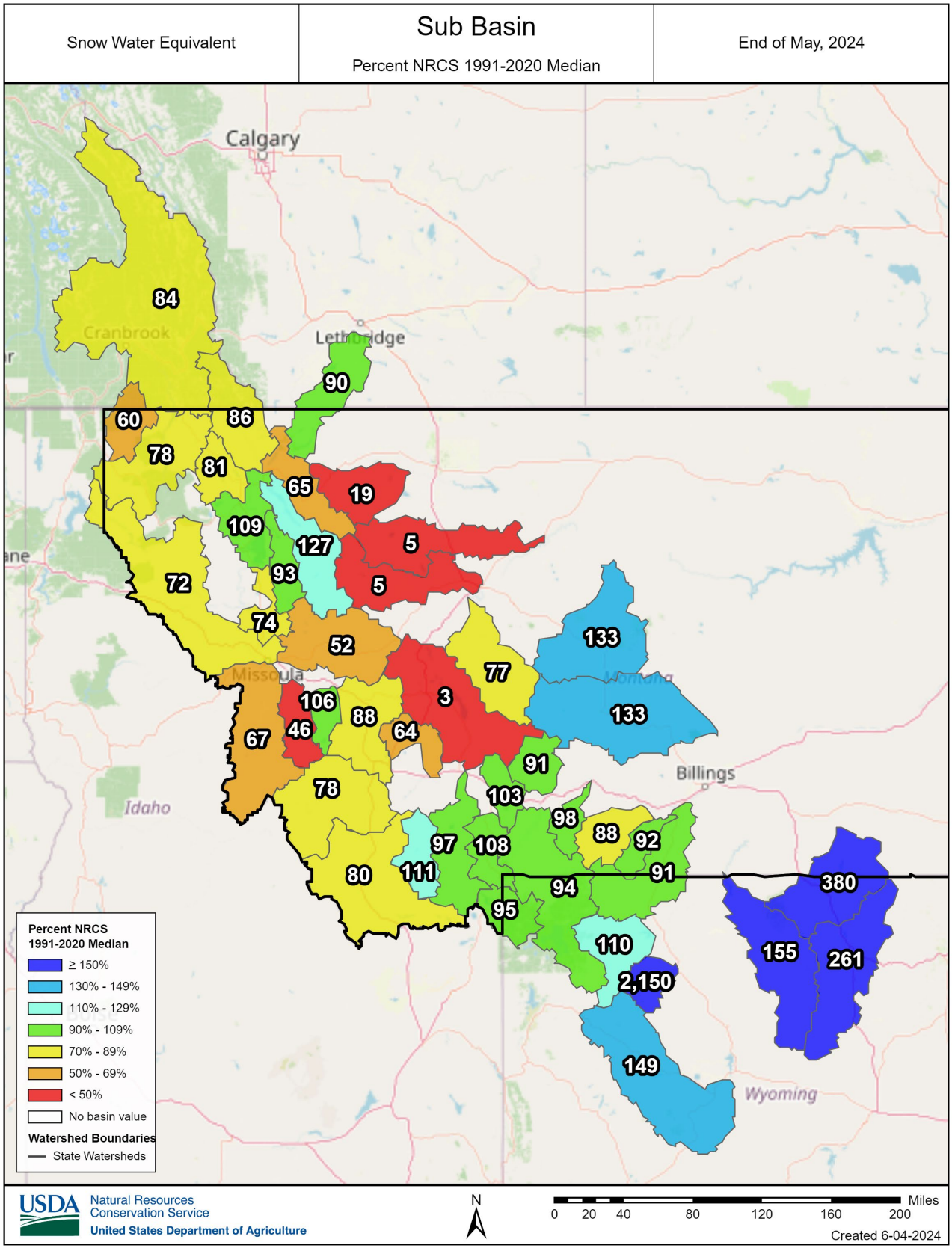
Statewide Overview

Snowpack (Continued)



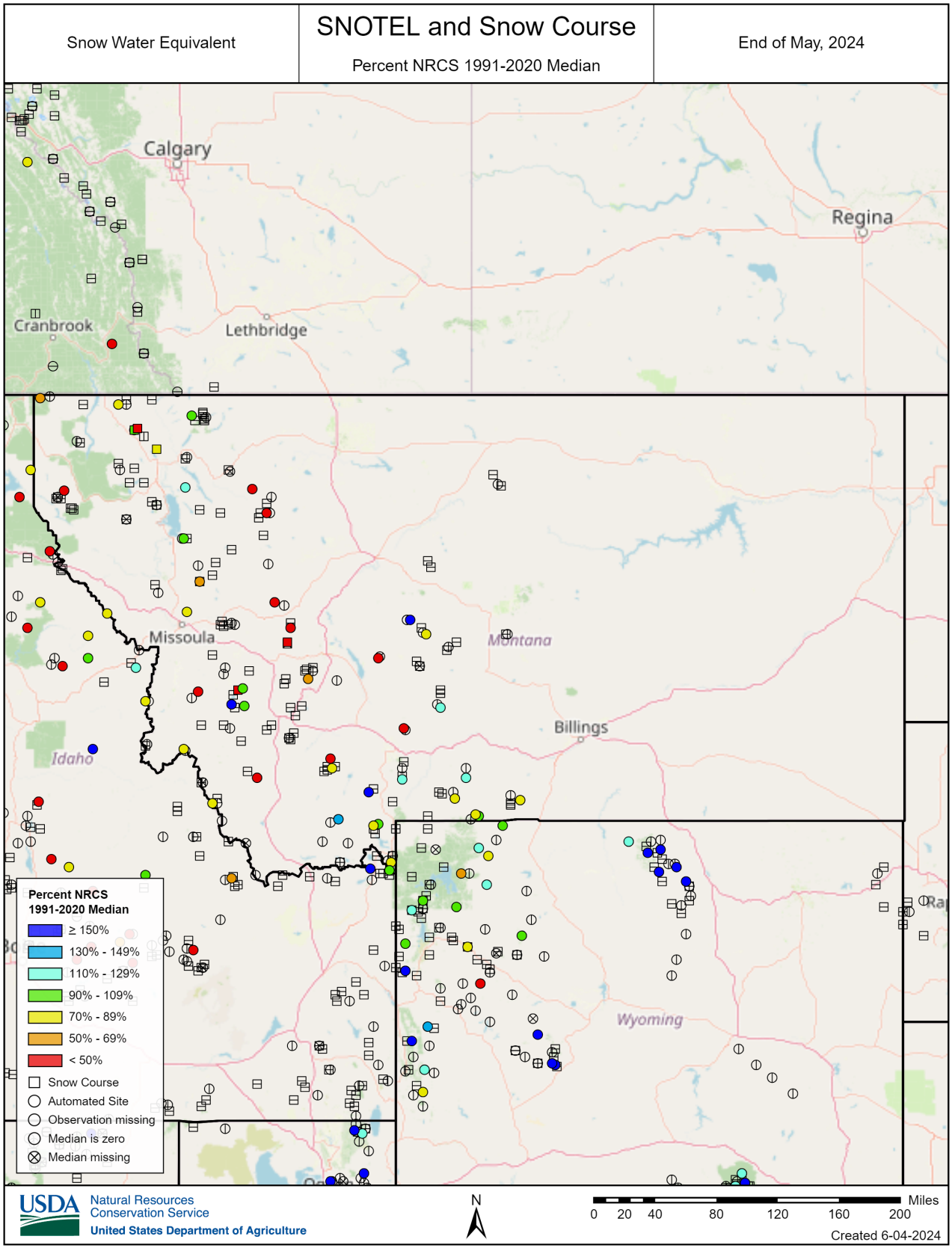
Statewide Overview

Snowpack (Continued)



Statewide Overview

Snowpack (Continued)



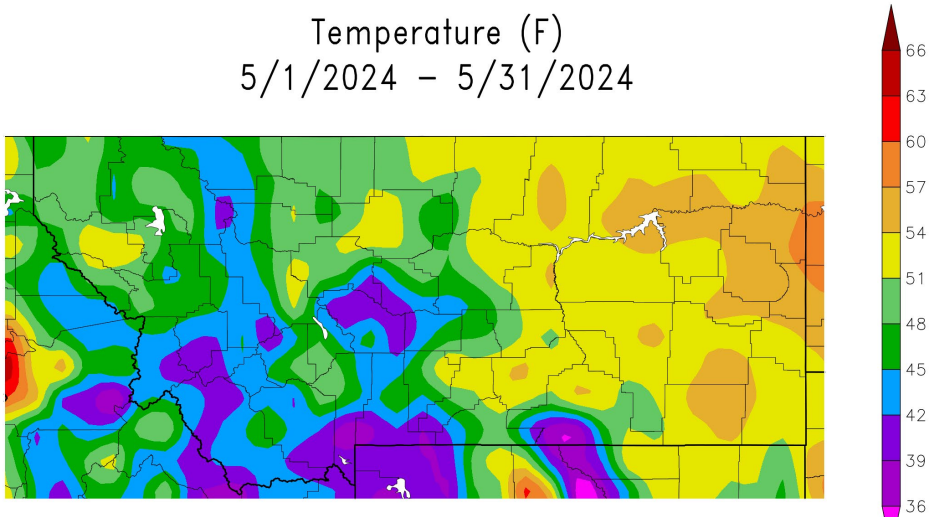
Statewide Overview

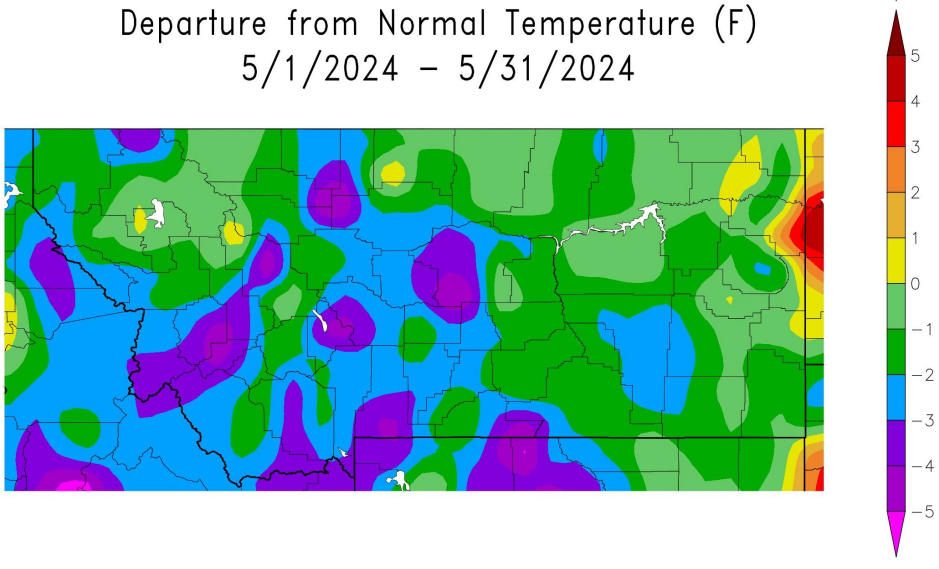
Temperature

Temperatures were largely cooler than normal across Montana during May. Overall, western Montana had near normal to -4° F below normal temperatures. The eastern part of the state had normal to -1° F below normal temperatures.

Temperatures at Montana and northern Wyoming SNOTEL sites oscillated throughout May. During the first few days of May daily average temperature at most SNOTEL sites was cooler than normal, with several higher elevation sites recording daily minimum temperatures below 10° F from May 2-5. Average daily temperatures then increased to above normal at SNOTEL sites, with a handful of lower elevation sites experiencing daily maximum temperatures exceeding 75° F between May 12-13. SNOTEL average daily temperatures then dipped to slightly cooler than normal from May 17-25. Temperatures spiked again in late May with the maximum daily temperatures exceeding 75° F at nearly a dozen SNOTEL sites between May 28-30. However, this day-by-day temperature analysis can be misleading, as temperatures still averaged below normal for the month.

The overall cooler than average temperatures helped delay snowmelt at the higher elevations. This trend greatly helped the snowpack and water supply outlook for June 1. Continued cooler temperatures could continue to preserve the higher elevation snowpack and help buffer the effects of this year's low snowpack, while warmer than normal temperatures could do the opposite.

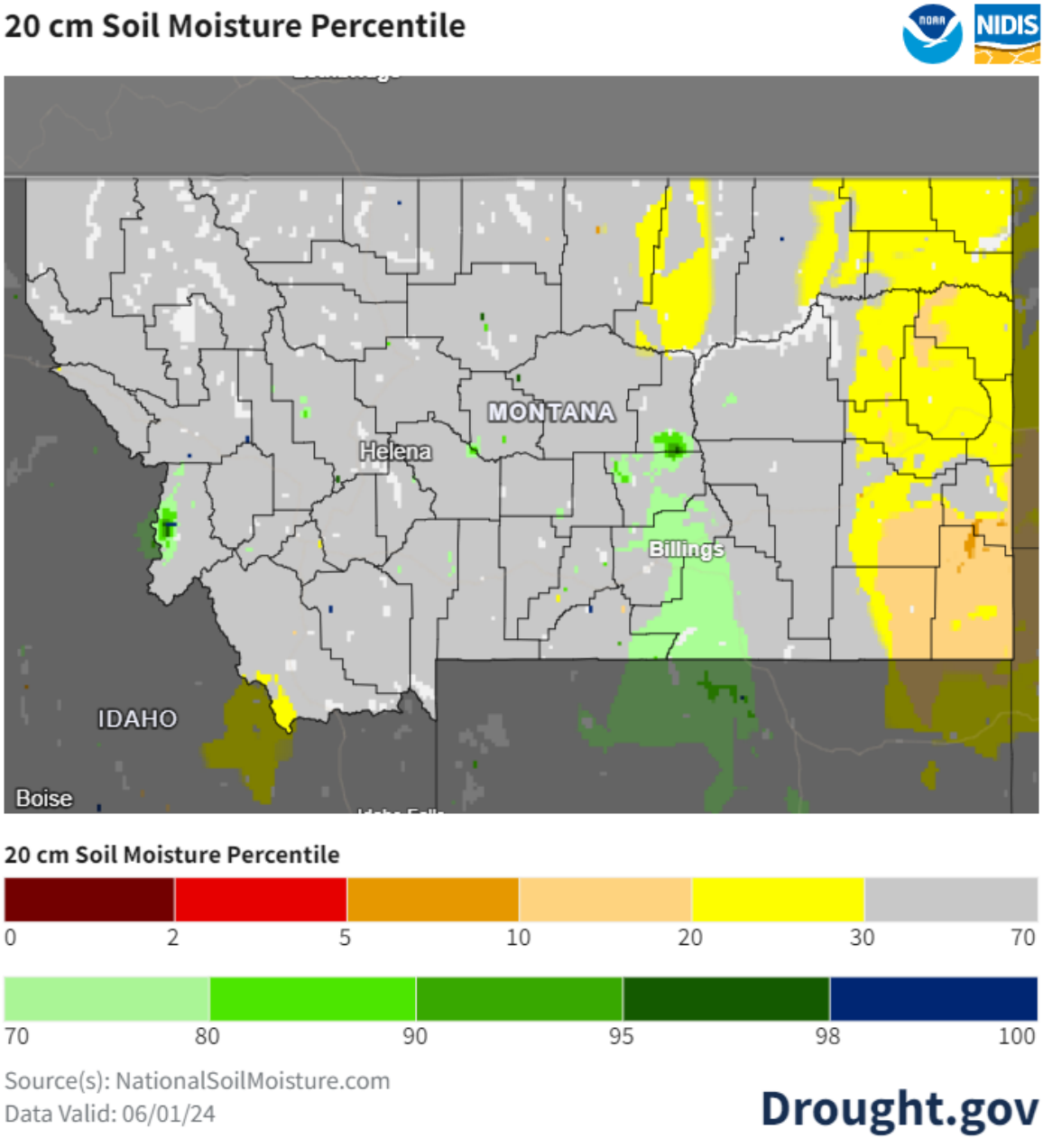




Statewide Overview

Soil Moisture

Soil moisture in the top 20 cm across Montana has improved drastically since last month. Most of the state has relatively normal soil moisture. The far eastern side of the state has below normal soil moisture, with northeastern corner of the state having soil moisture in the 20-30th percentile, and the southeastern corner of the state having soil moisture in the 10-20th percentile. This is still a marked improvement from soil moisture conditions in the region last month, where most of the state had below normal soil moisture in the 0-30th percentile. There are some pockets of above normal soil moisture in south central Montana and along the Idaho state line. Overall, May precipitation has helped soil moisture conditions across the state. Given an overall low snow year, continued precipitation would be helpful in maintaining normal soil moisture conditions.



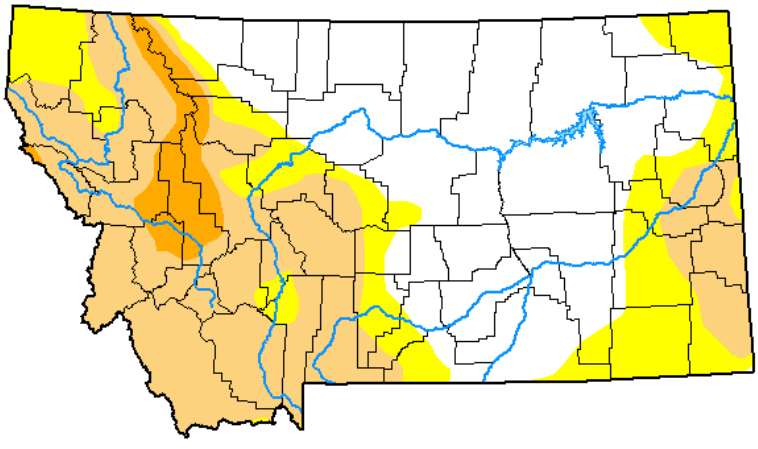
Statewide Overview

Drought Monitor

Since last month, drought conditions have improved across Montana. According to the U.S. Drought Monitor map published on June 4th, 2024, 37% of Montana is classified as moderate (D1) to severe (D2) drought, with 56% of Montana classified as abnormally dry (D0) or drought conditions. This is an improvement from last month, where 43% of Montana was classified as moderate (D1) to extreme (D3) drought, and 86% of the state was classified as abnormally dry (D0) or drought conditions. The most notable changes are the removal of D3 (extreme drought) conditions in the state, with the downgrade from D3 to D2 in the easter portion of Flathead County. In western Montana, Granite, Deerlodge, and Ravalli counties have downgraded from D2 to D1 drought conditions, while Madison, Beaverhead and Jefferson counties have increased from D1 to D2 drought conditions. Central Montana has largely decreased from abnormally dry to no drought conditions. Eastern Montana has improved as well, with a decrease in D1 and D0 areas.

U.S. Drought Monitor

Montana



June 4, 2024

(Released Thursday, Jun. 6, 2024)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	43.83	56.17	37.37	4.63	0.00	0.00
Last Week *05-28-2024*	43.82	56.18	37.52	7.87	0.09	0.00
3 Months Ago *03-05-2024*	5.42	94.58	48.60	21.98	2.36	0.00
Start of Calendar Year *01-02-2024*	39.20	60.80	21.30	2.68	0.00	0.00
Start of Water Year *09-26-2023*	56.28	43.72	37.28	23.21	9.51	0.00
One Year Ago *06-06-2023*	51.42	48.58	18.43	3.52	0.00	0.00

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

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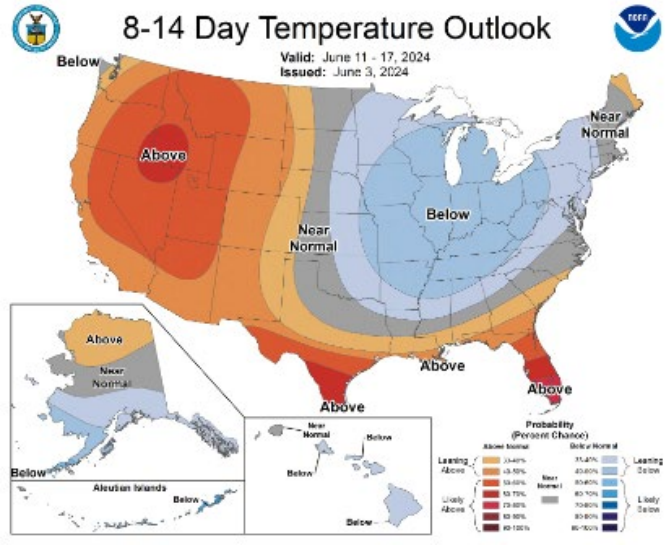
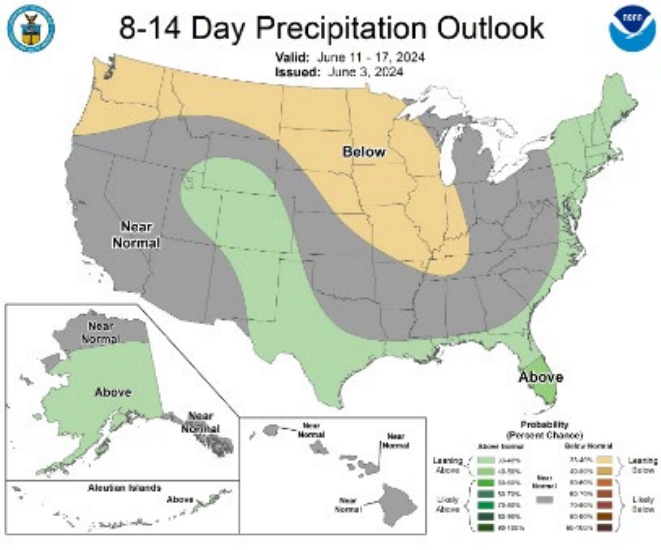
droughtmonitor.unl.edu

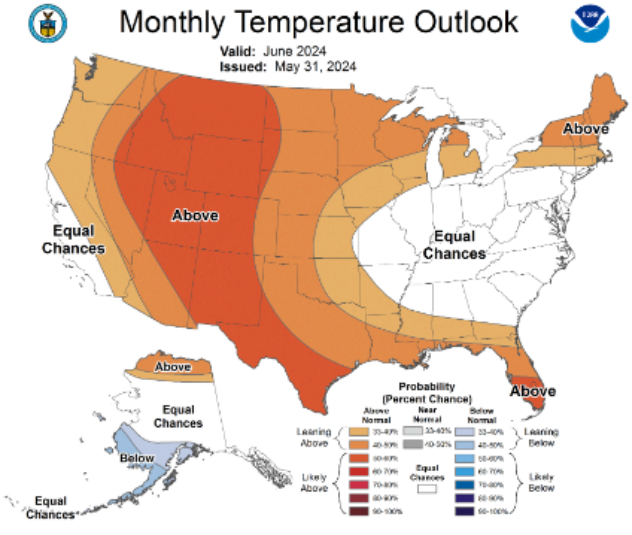
Statewide Overview

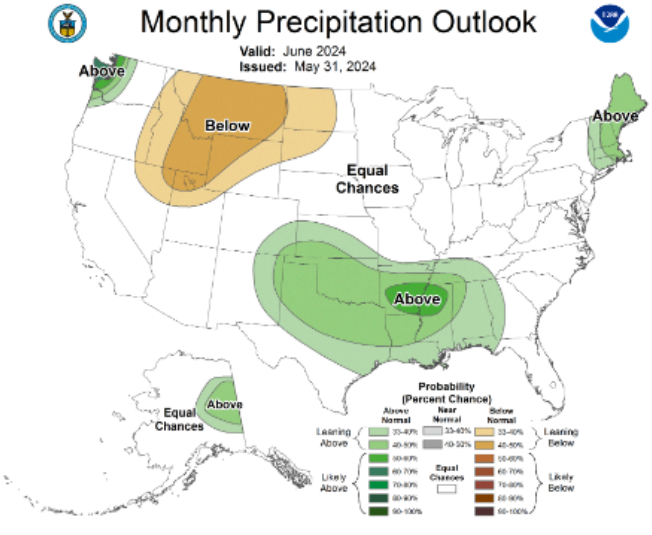
Weather Outlook

According to the NOAA Climate Prediction Center temperatures are leaning above or likely above normal for the next 8-14 days across Montana, with the western side of the state forecasted to likely have above normal temperatures and the eastern side of the state leaning towards above normal temperatures. The northern and central latitudes across Montana are leaning towards slightly below normal precipitation for the next 8-14 days, while the southern latitudes of the state are projected to have near normal precipitation for the next 8-14 days. The monthly outlook continues this trend of above normal temperatures and below normal precipitation. Temperatures are predicated to be likely above normal across most of Montana throughout June. Precipitation across most of Montana is predicted to be likely below normal for the month of June, with the northwest and southeast corners of the state leaning towards only slightly below normal precipitation.









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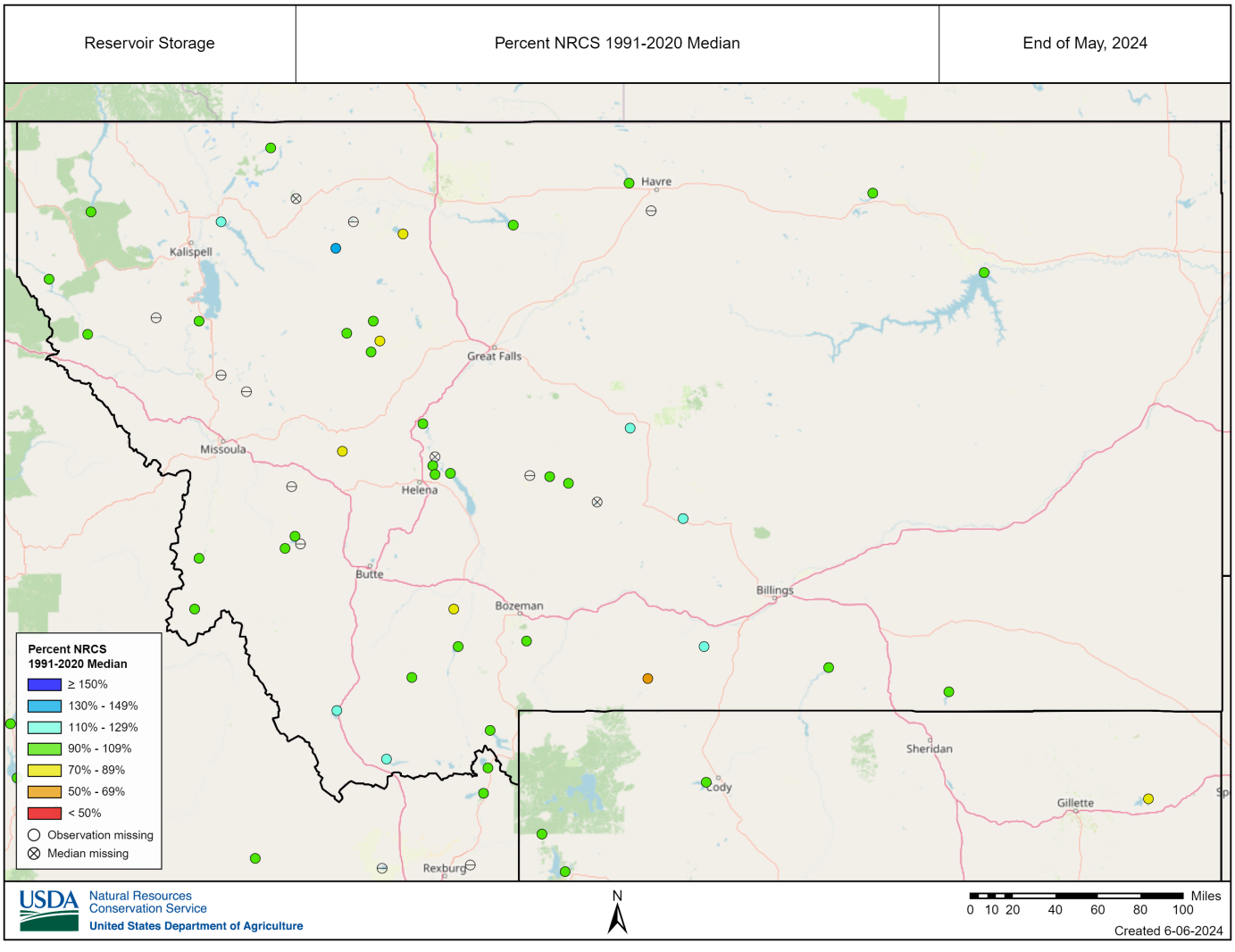
Statewide Overview

Reservoirs

Most Montana reservoirs had near normal reservoir storage for the end of May. Ackley Lake, Clark Canyon, Cooney, Deadman's Basin, Hungry Horse Lake, Lima, and Swift reservoirs were all at or above 110% of normal levels for the end of May. Lake Frances, Mystic Lake, Nevada Creek, and Willow Creek reservoirs were all at or below 90% of normal levels for the end of April. The remaining reservoirs across the state were reporting reservoir storage at near normal levels between 90% and 110% of median values.



Statewide Overview

Reservoirs (Continued)

End of May - Reservoir Storage Percent of Capacity

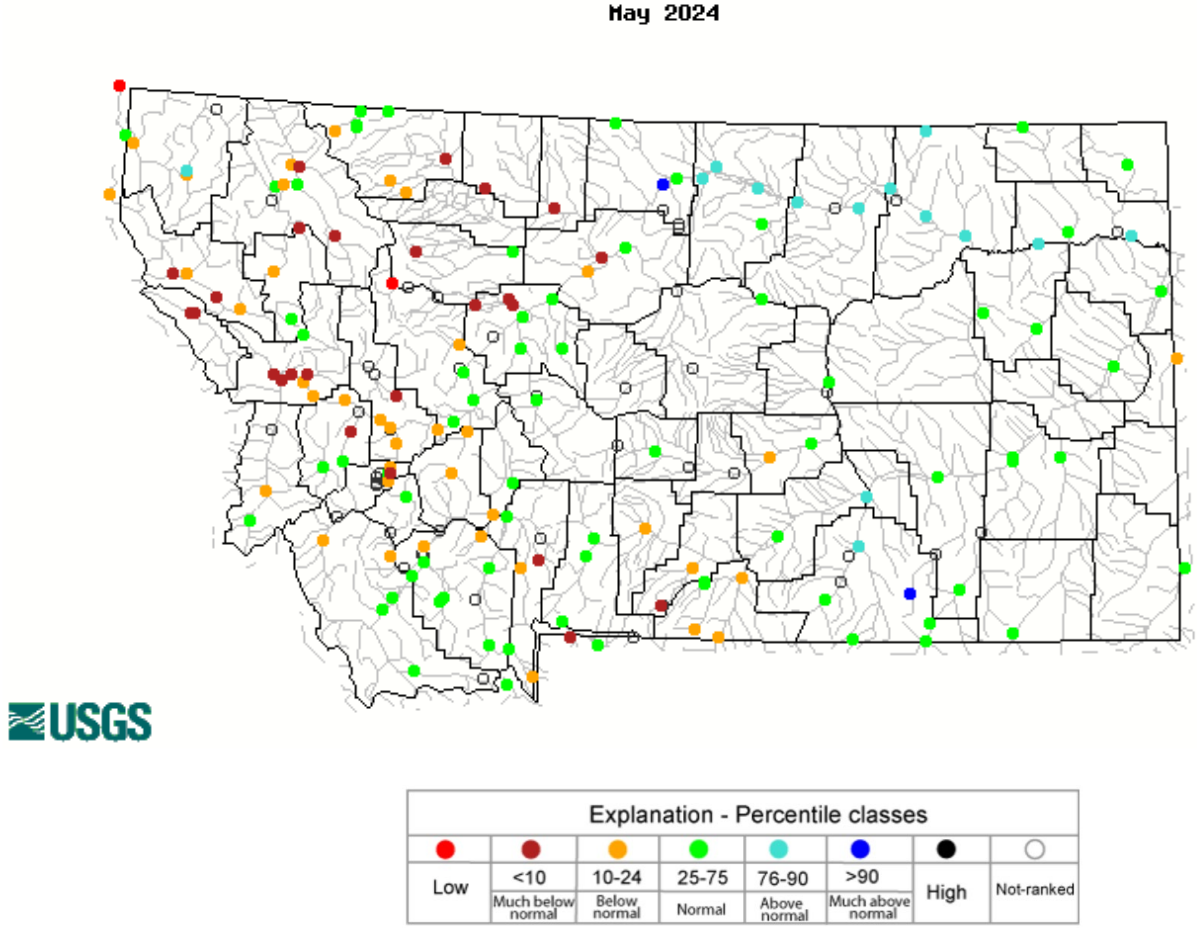
Reservoir	Basin	Current % Capacity	Last Year % Capacity	Median % Capacity
Smith River Res	Smith-Judith-Musselshell	108	109	108
Deadman's Basin Res	Smith-Judith-Musselshell	105	105	87
Bair Res	Smith-Judith-Musselshell	87	96	83
Swift Res	Sun-Teton-Marias	100	100	77
Lake Frances	Sun-Teton-Marias	48	49	65
Lake Elwell (Tiber)	Sun-Teton-Marias	57	60	61
Gibson Res	Sun-Teton-Marias	88	100	92
Mystic Lake	Upper Yellowstone	17	33	27
Cooney Res	Upper Yellowstone	104	103	92
Ruby River Reservoir	Jefferson	98	99	99
Lima Reservoir	Jefferson	98	95	84
Clark Canyon Res	Jefferson	65	49	52
Painted Rocks Lake	Bitterroot	104	105	104
Lake Como	Bitterroot	107	109	103
Bull Lake	Bighorn	61	70	63
Buffalo Bill	Bighorn	74	81	69
Boysen	Bighorn	82	96	86
Bighorn Lake	Bighorn	61	62	64
Lake Helena	Upper Missouri	86	85	86
Holter Lake	Upper Missouri	99	99	99
Helena Valley Reservoir	Upper Missouri	84	98	93
Canyon Ferry Lake	Upper Missouri	85	84	81
Lake Koocanusa	Kootenai	74	87	69
Hungry Horse Lake	Flathead	95	90	86
Flathead Lake	Flathead	91	95	86
Nelson Res	Milk	78	79	79
Fresno Res	Milk	70	67	65
Noxon Rapids Reservoir	Lower Clark Fork	93	95	98
Fort Peck Lake	Lower Missouri	77	71	76
Nevada Creek Res	Upper Clark Fork	69	88	90
Georgetown Lake	Upper Clark Fork	96	100	96
Tongue River Res	Tongue	101	103	99
Lake Sherburne	St. Mary	63	88	59
Hebgen Lake	Madison	94	87	91
Ennis Lake	Madison	90	88	87
Middle Creek Res	Gallatin	99	97	97

Statewide Overview

Streamflow

There have been two significant snowmelt driven river level increases this spring. The first occurred in mid-April during a period of clear skies and above normal temperatures. That first release was caused mostly by lower-to-mid mountain elevation snowmelt. The second and larger increase occurred in mid-May and included a component of snowmelt from the highest elevation snowpack. Many rivers, particularly those west of the Continental Divide, likely peaked for the season during the mid-May snowmelt release and many of those peaks were well below normal. One example is the Blackfoot River near Bonner which reached 3080 cubic feet per second (cfs) on May 17. Pending a rain influenced higher peak, that might have been the seasonal high for the Blackfoot River. 3080 cfs ranks as the third lowest peak on record, behind 1941 (1940 cfs) and 1977 (2190 cfs). Rivers near Glacier and Yellowstone National Park, which still have a substantial amount snow at the surrounding higher elevations, will likely peak during the first couple weeks of June.

For many Montana rivers total streamflow volume for the entire month of May was well below normal. Several rivers west of the Continental Divide and along the Rocky Mountain Front experienced near record low (<10 percentile) total streamflow volume last month. That includes the Clark Fork, Bitterroot, Blackfoot, Swan, Middle Fork Flathead, South Fork Flathead, Marias, Cut Bank, Teton, and Sun River. In part, the low flows were due to cool weather and delayed snowmelt but can also be attributed to the overall lack of water year precipitation in that region. In contrast, exceptional precipitation during May in north central Montana resulted in well above normal streamflow in the Milk River. Normal peak streamflow dates range from mid-May to early-June in Montana. Montana's primary snow accumulation season has ended and weather over the next two weeks will dictate if higher streamflow peaks occur and the timing of total available streamflow over the next couple months.

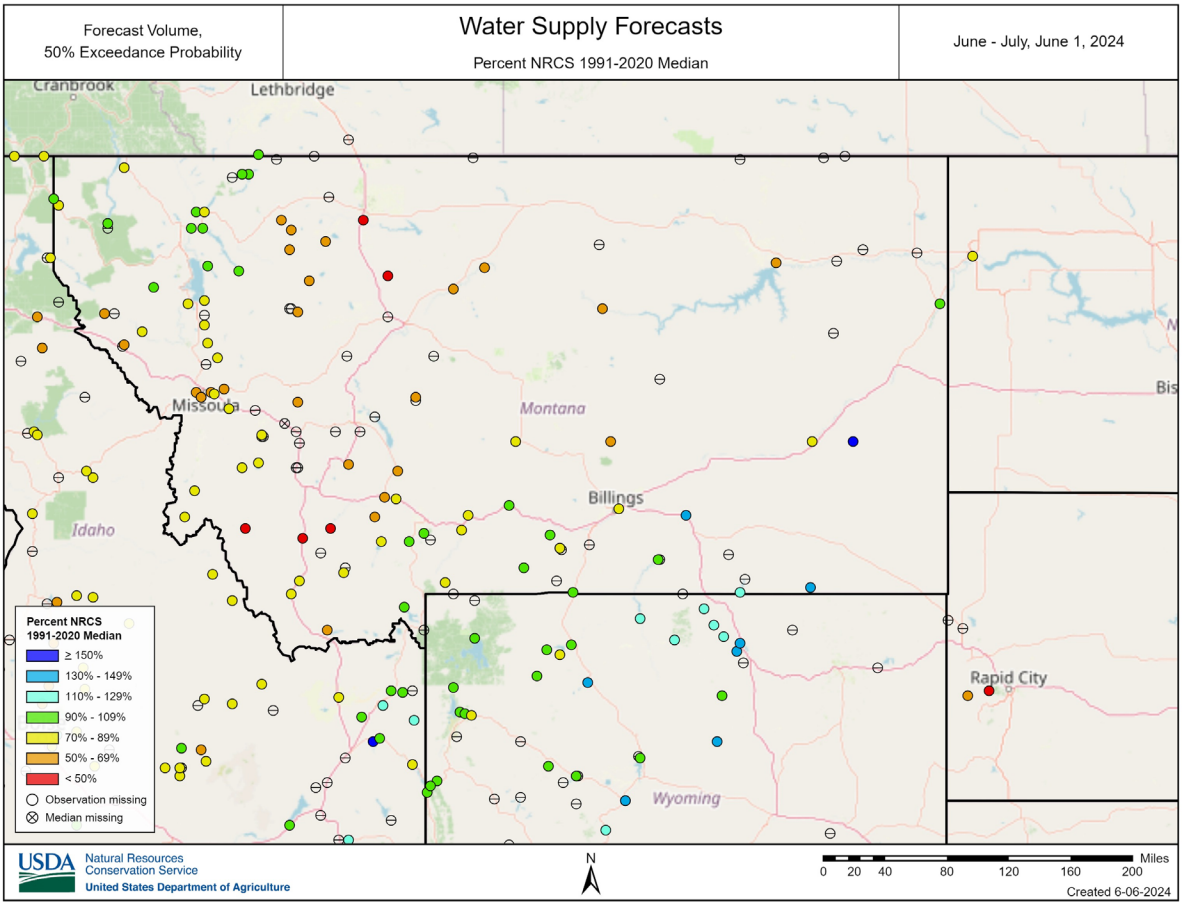


Statewide Overview

Water Supply Forecasts

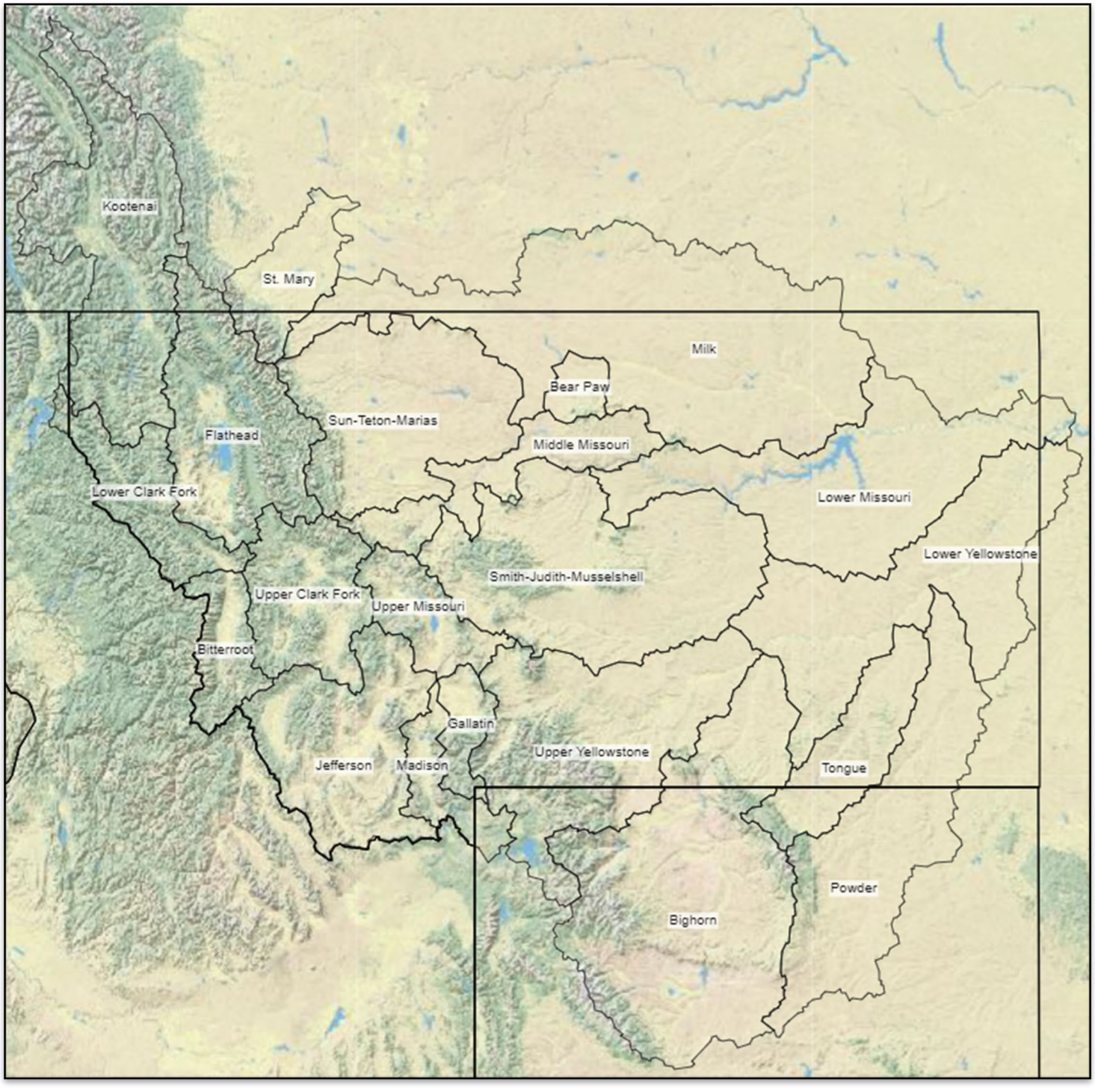
Precipitation and cool weather during May added to water year precipitation totals and delayed snowmelt in many locations. The portion of snowmelt that did not occur during May will now occur in the upcoming months, which resulted in higher June 1 water supply forecasts compared to May 1 forecasts. The largest increases occurred in the Powder and Tongue River basins which increased from about 65-75% to 120-140% of normal forecasted streamflow volume (May/June-July, 50% exceedance). The Yellowstone, Gallatin, Madison, and Flathead all have a substantial amount of snow remaining at the highest elevations and forecasts have improved to about 80-90% of normal streamflow volume through July. Forecasts in the Smith-Judith-Musselshell improved from about 50% to 70% of normal. The Jefferson, Sun-Teton-Marias, Upper Clark Fork are still forecasted to have about 50-60% normal streamflow volume for the June-July time period.

Most June-September water supply forecasts improved from last month's forecasts, but not as much as the June-July forecasts. In nearly all basins the snowpack peaked below normal this season, which will most likely have an impact on flows later this summer. For example, the Smith-Judith-Musselshell is forecasted to have only 55% of normal streamflow volume for the June-September time period, compared to about 70% for June-July. Locations of greatest concern are the Sun, Teton, Marias, Blackfoot, Jefferson and Bighole Rivers which are forecasted to have less than 50% of normal streamflow volume for June-September. Most other basins are forecasted to have about 60-90% of normal streamflows through September. The Bighorn, Powder and Tongue are now forecasted to have 105-155% of normal streamflow. From a water supply perspective above normal precipitation during the summer almost always welcomed, and that is certainly true this year in Montana. Slower than normal melt of the remaining high elevation mountain snowpack would also help sustain closer to normal streamflows later in the summer.



Basin Overview

Montana River Basin Definitions

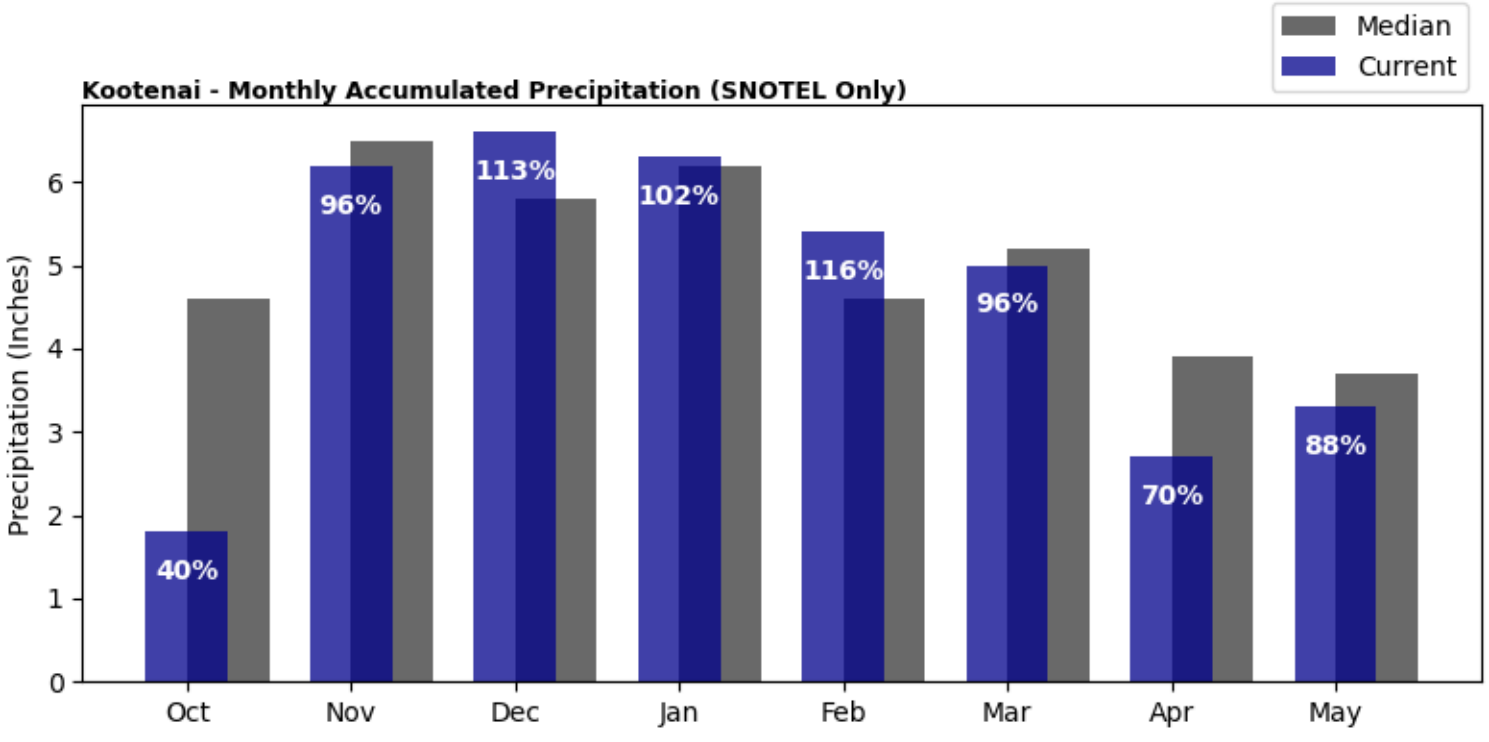


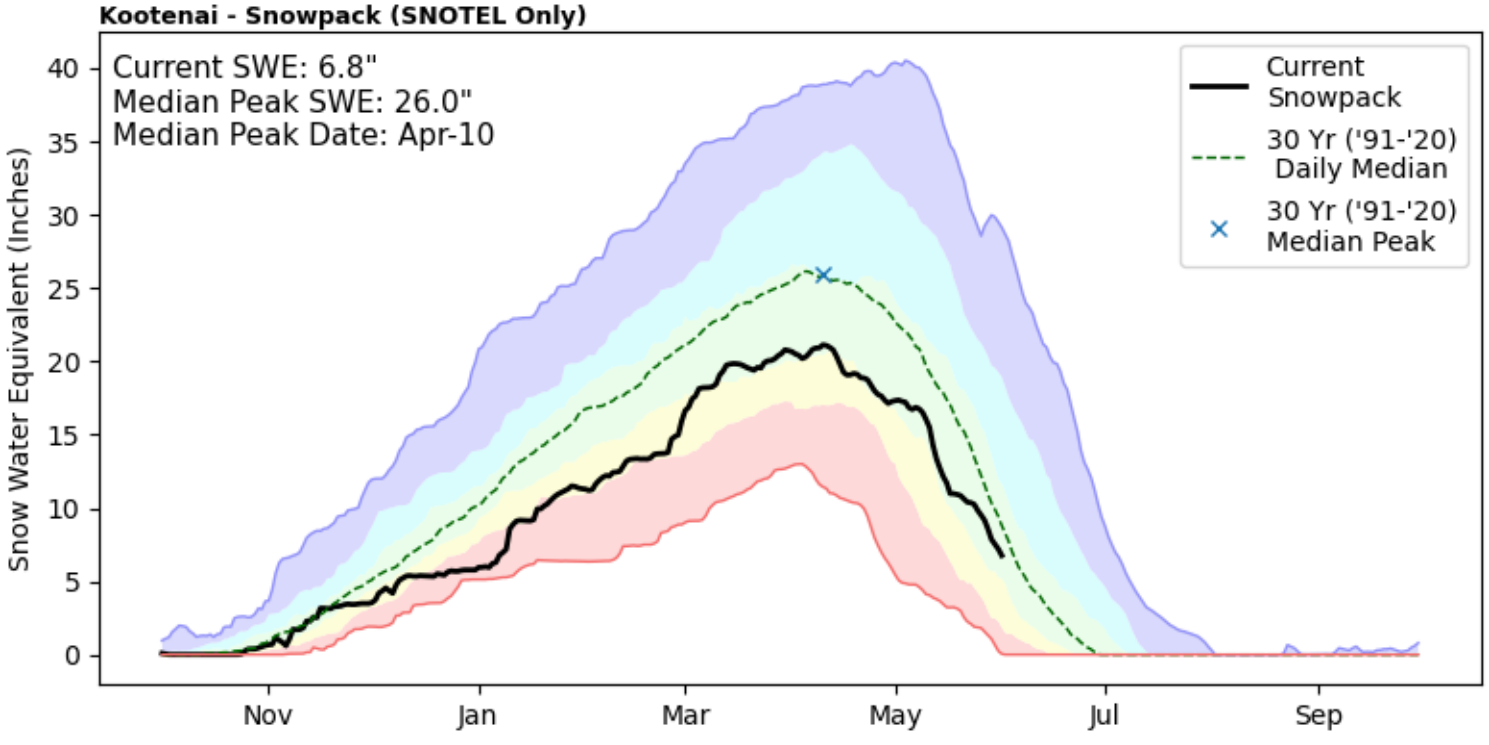
The following basin overview sections only include basins that have SNOTEL sites. For example, there is no basin overview for the Lower Yellowstone, because there are no SNOTEL sites associated with that basin. Water supply information for basins not included in the following sections can be found at https://nwcc-apps.sc.egov.usda.gov/

Basin Overview

Kootenai

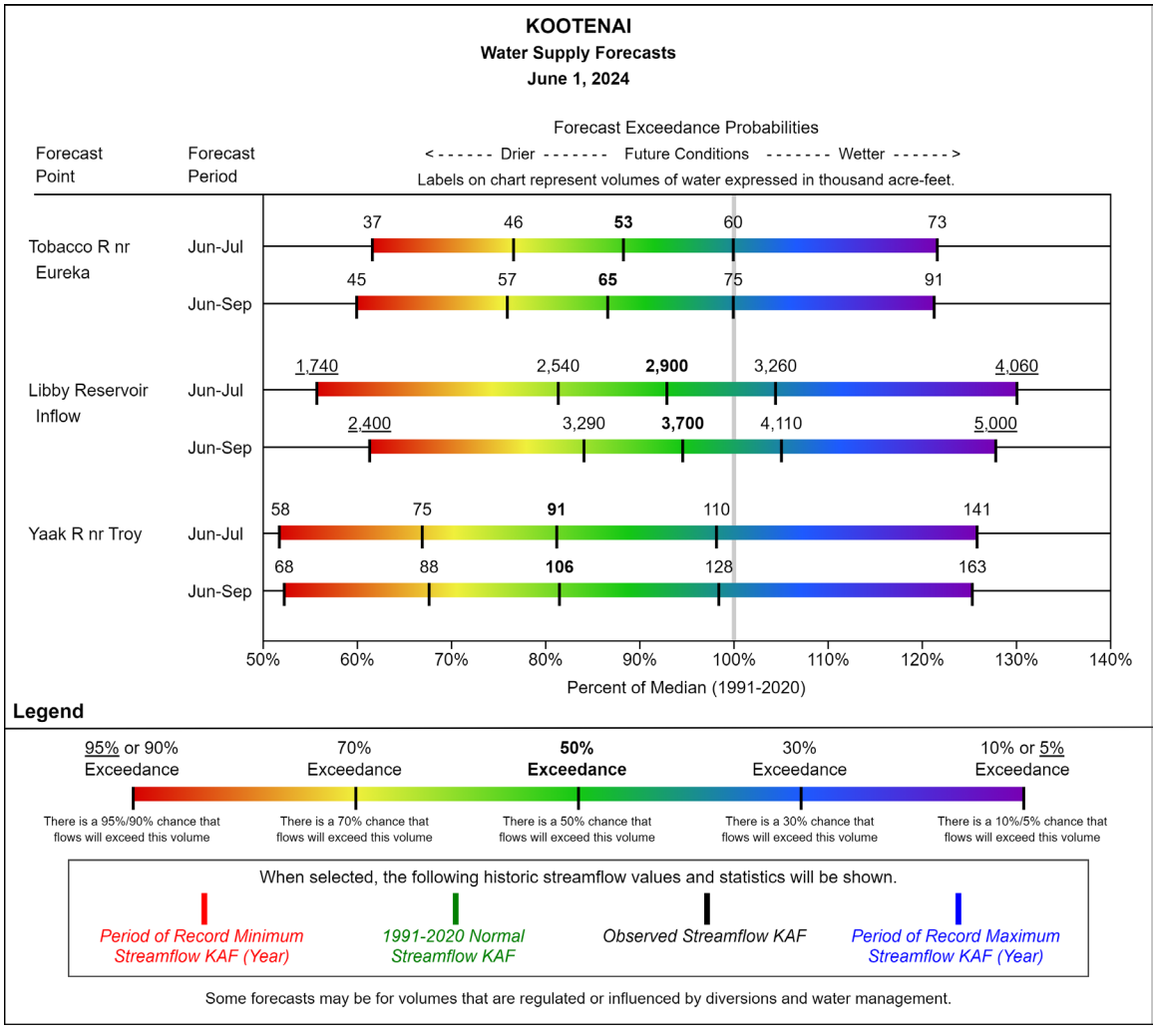
Precipitation in May was below normal at 88%, which brings the seasonal accumulation (October-May) to 87% of median. The snowpack in the Kootenai is well below normal at 77% of median, compared to 1% at this time last year.





Basin Overview

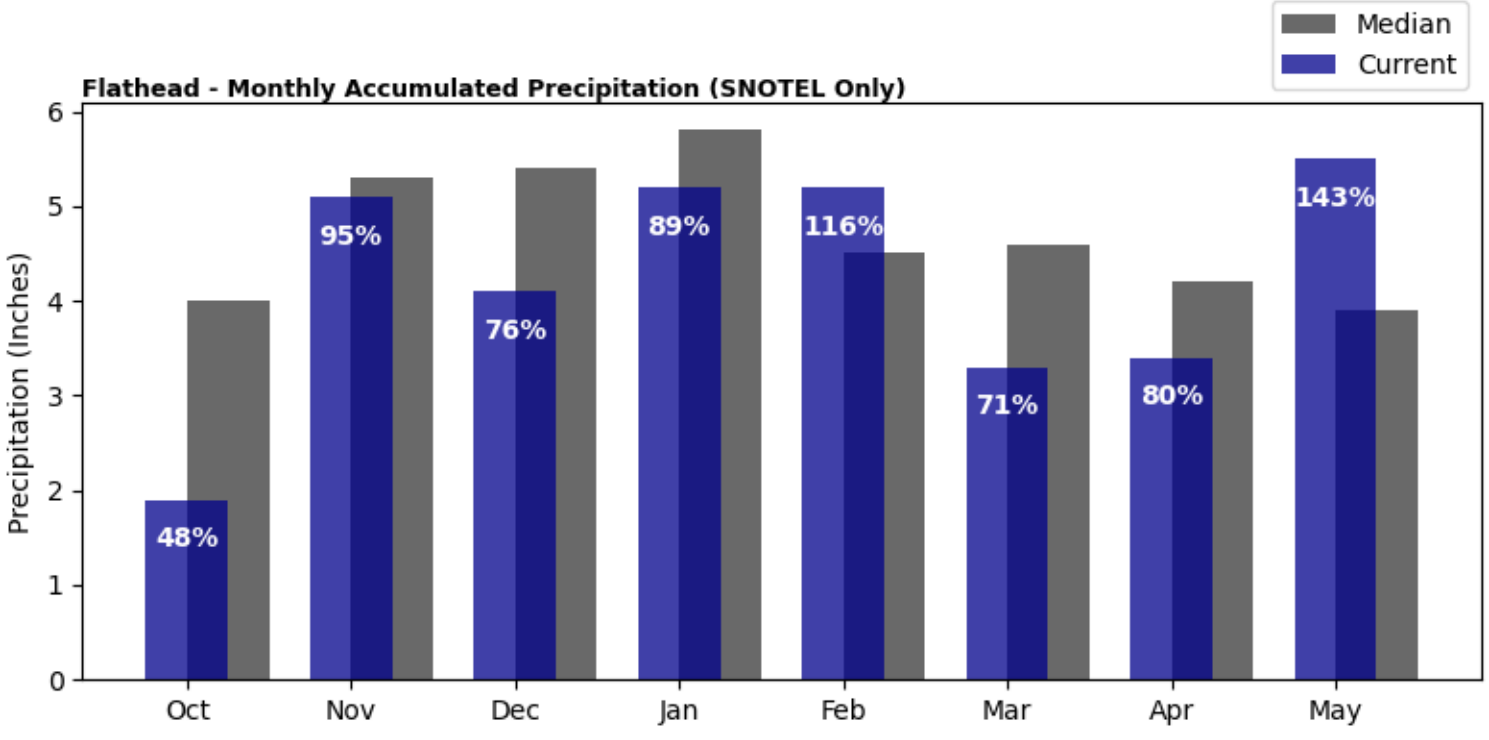
Kootenai (Continued)

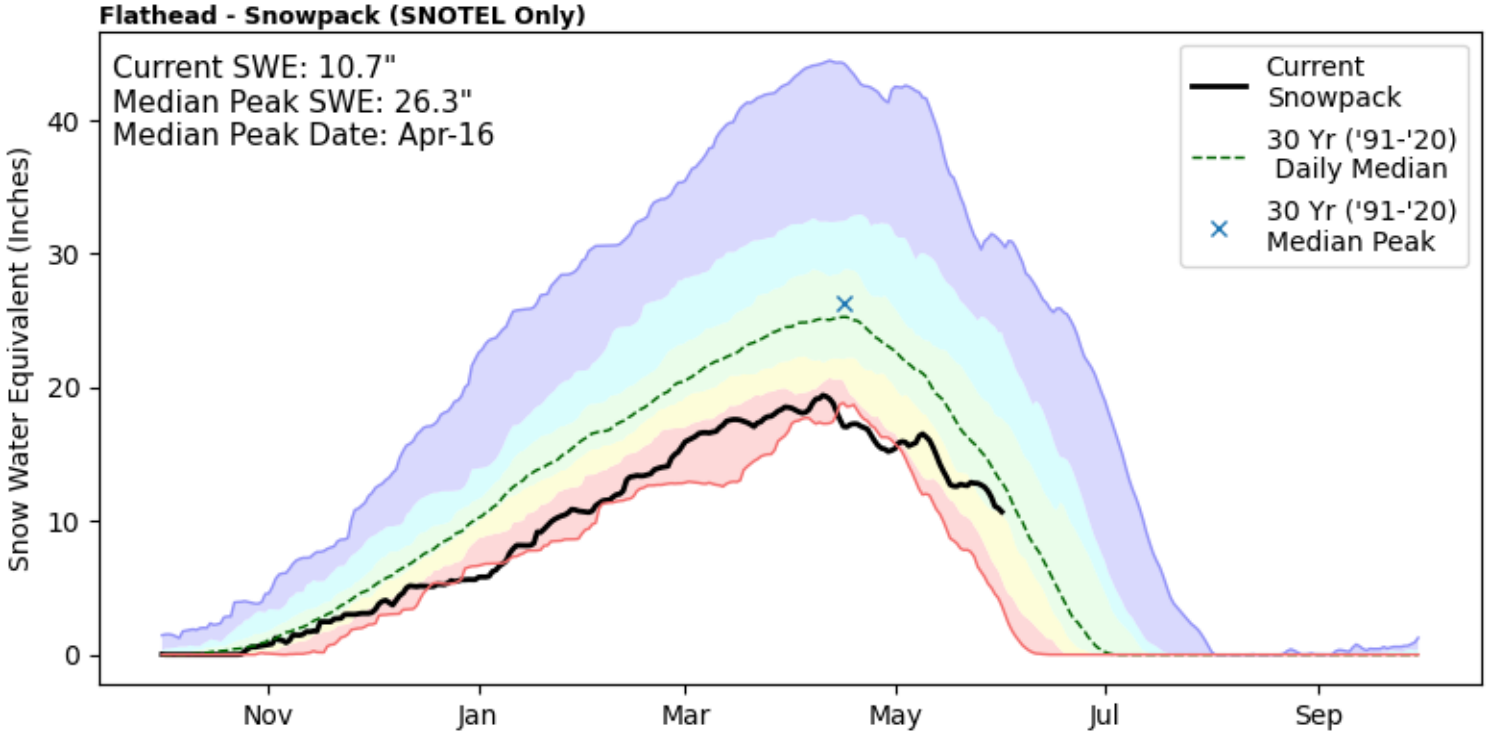


Basin Overview

Flathead

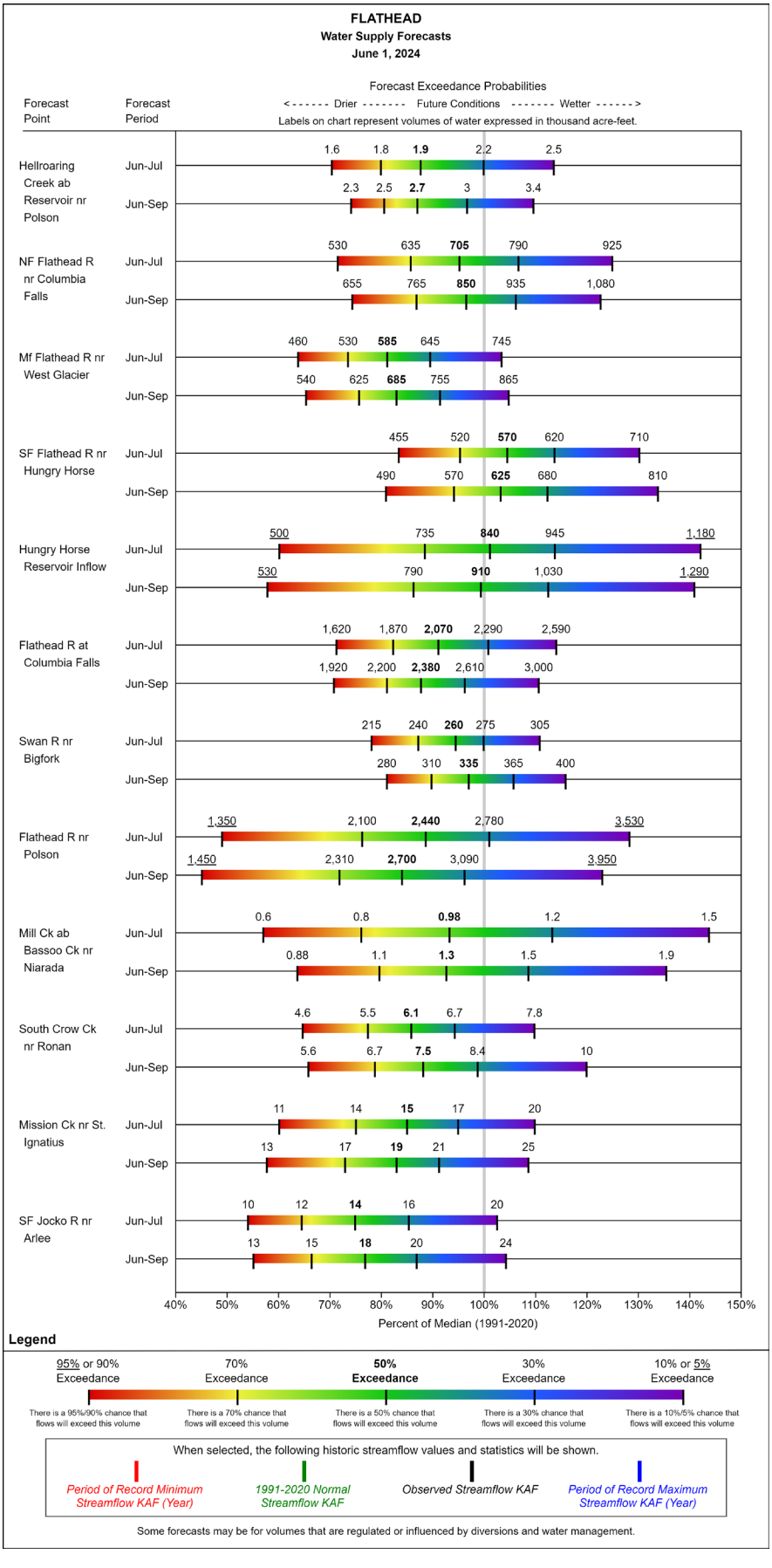
Precipitation in May was well above normal at 143%, which brings the seasonal accumulation (October-May) to 88% of median. The snowpack in the Flathead is below normal at 83% of median, compared to 24% at this time last year.





Basin Overview

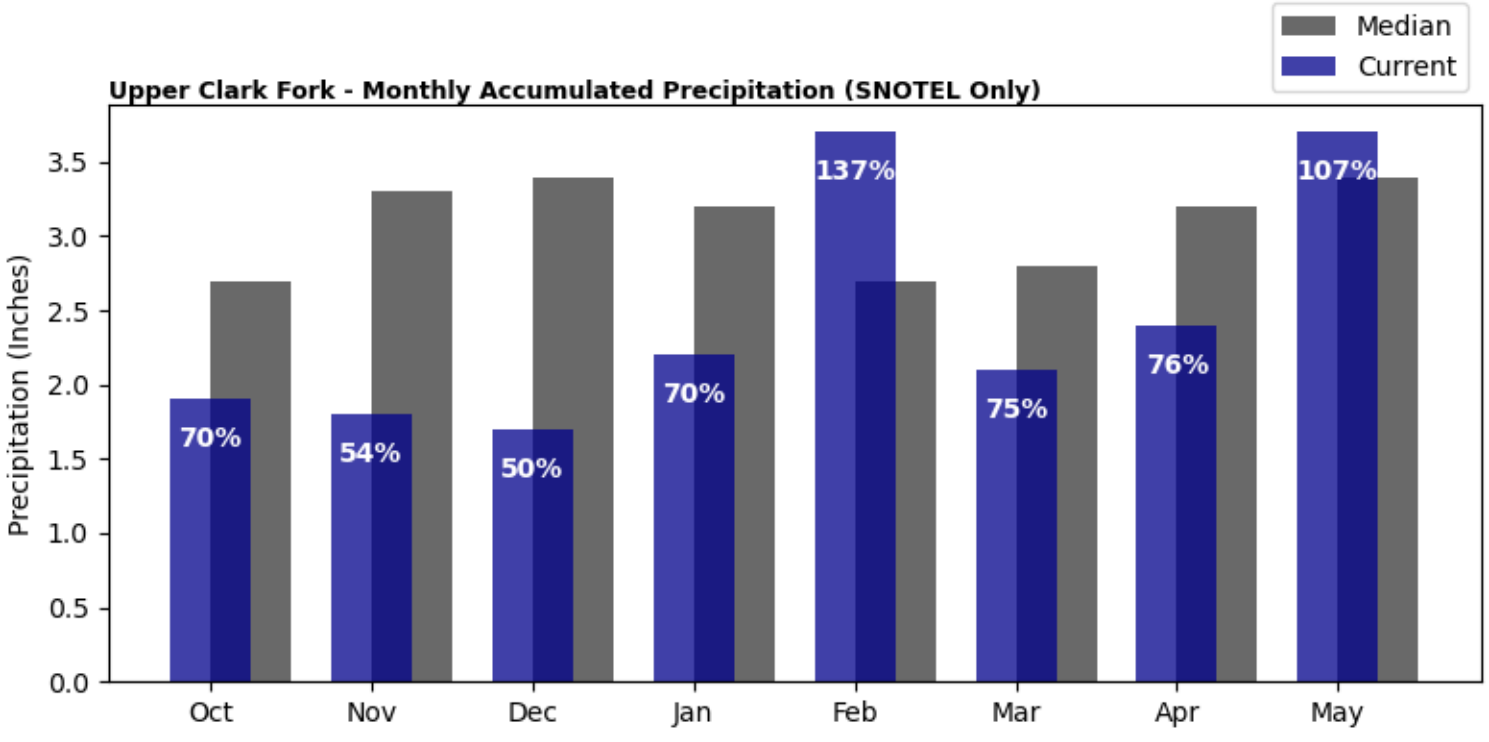
Flathead (Continued)

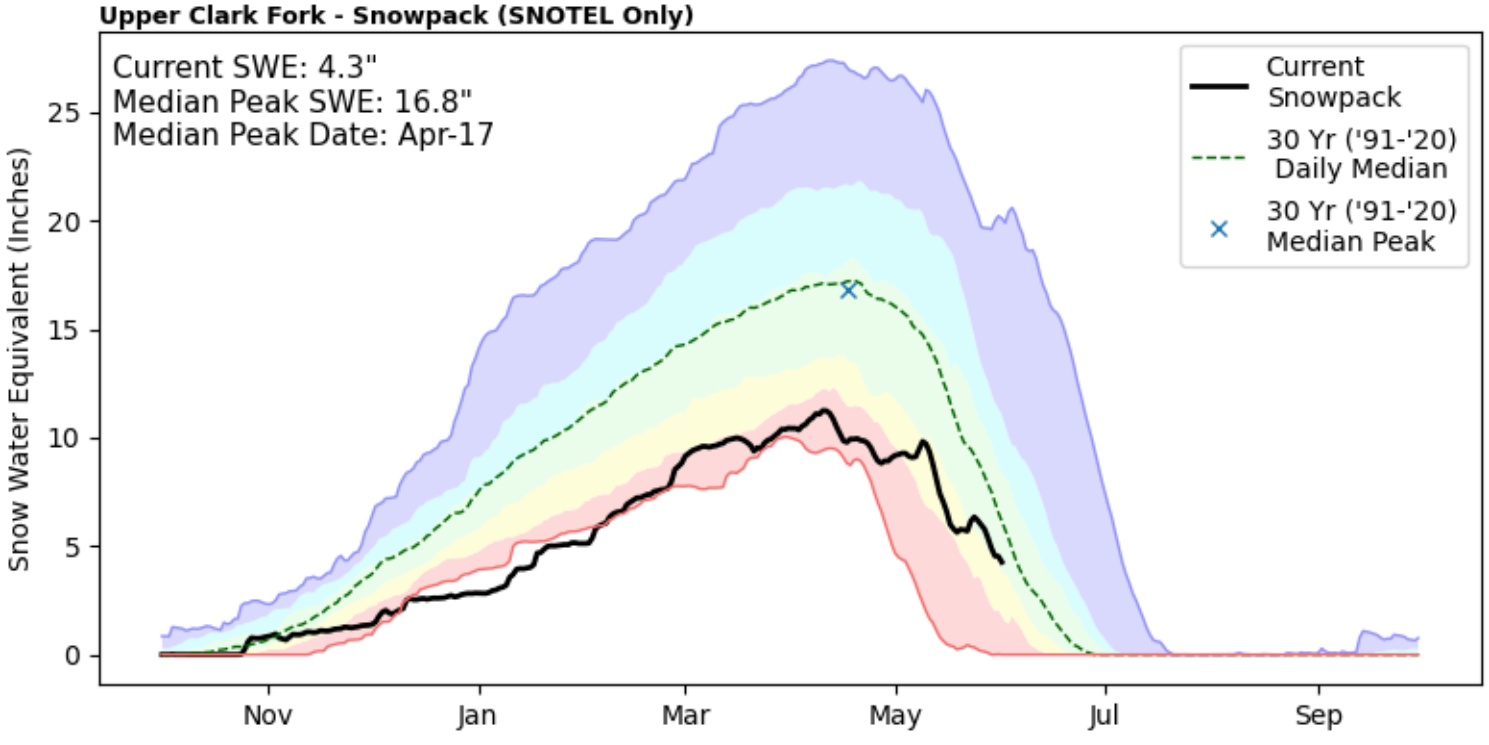


Basin Overview

Upper Clark Fork

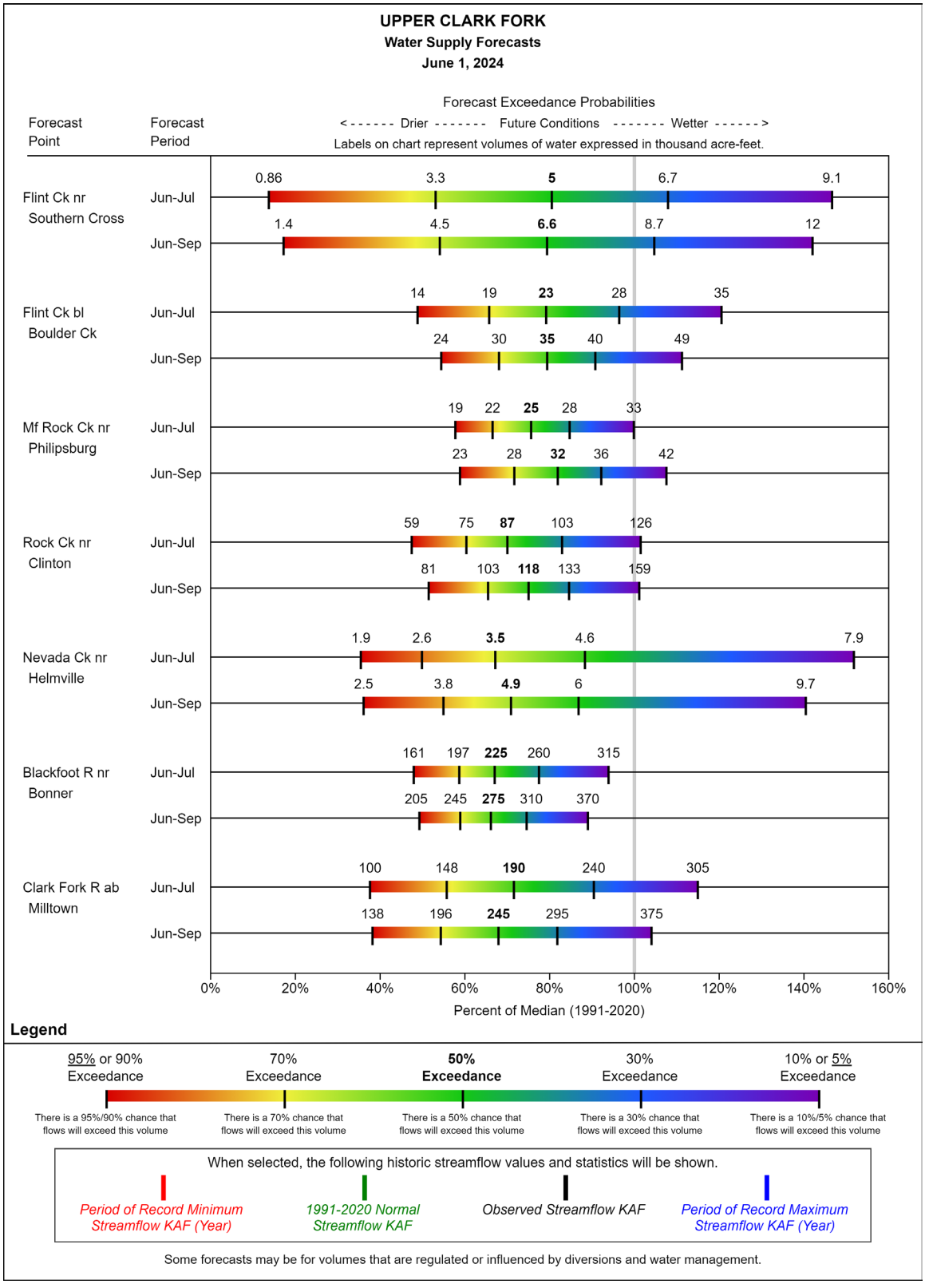
Precipitation in May was above normal at 107%, which brings the seasonal accumulation (October-May) to 78% of median. The snowpack in the Upper Clark Fork is well below normal at 66% of median, compared to 40% at this time last year.





Basin Overview

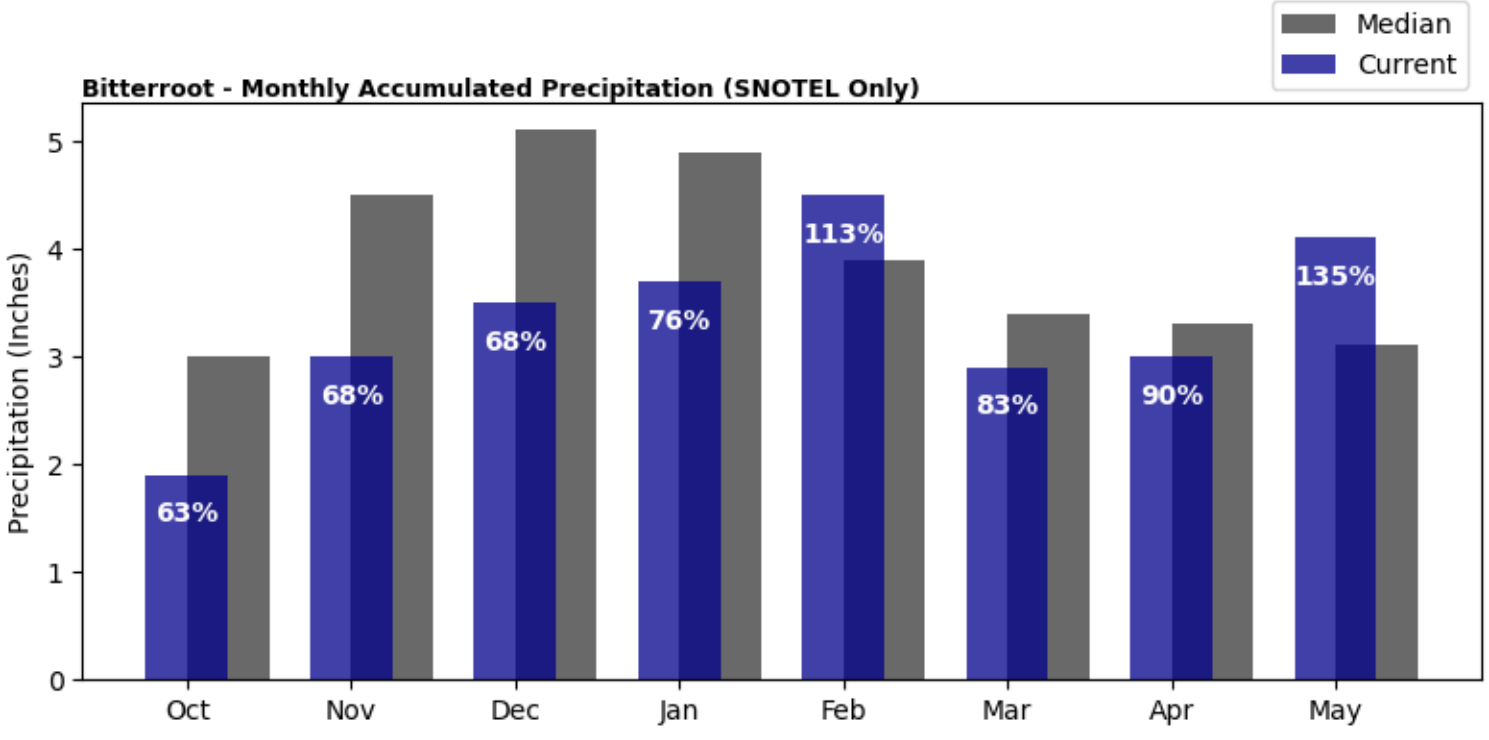
Upper Clark Fork (Continued)

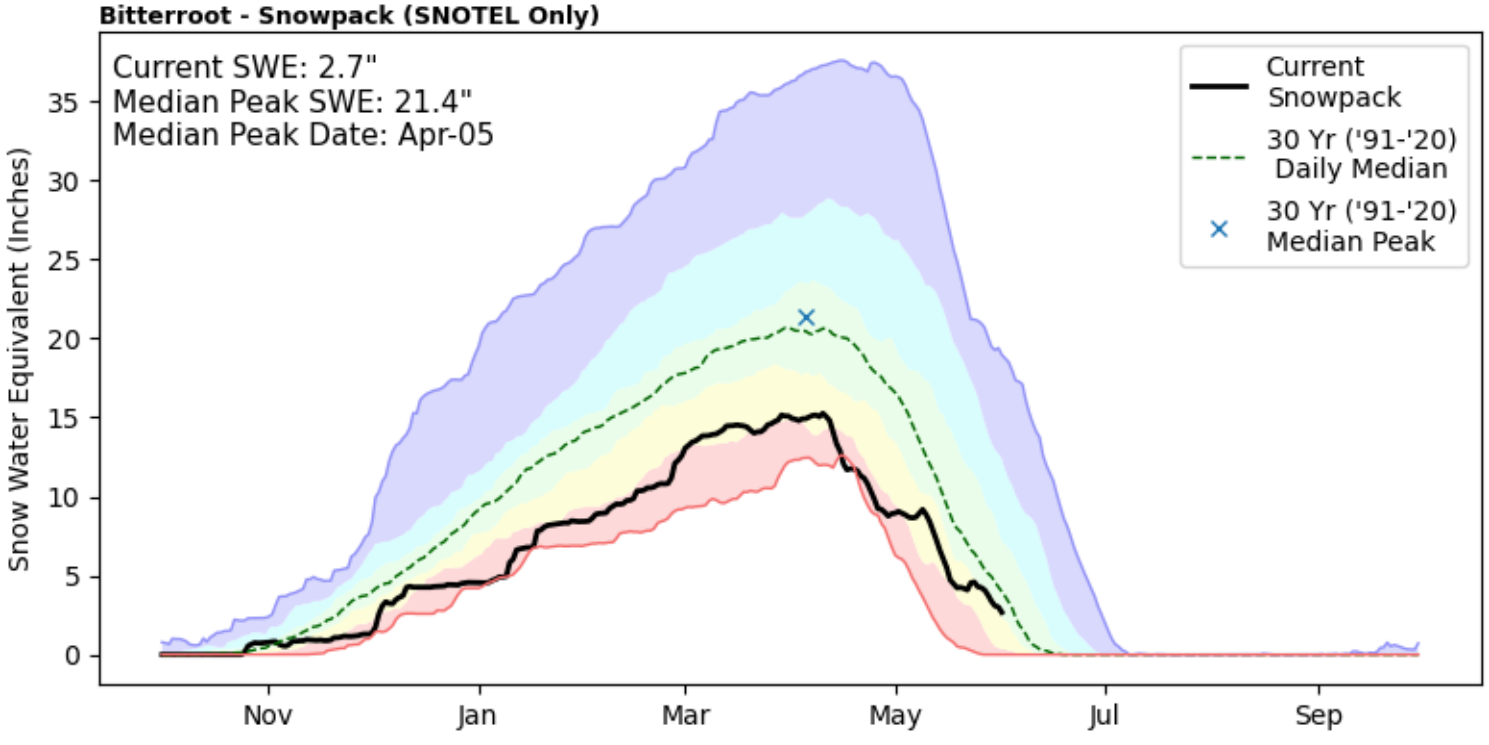


Basin Overview

Bitterroot

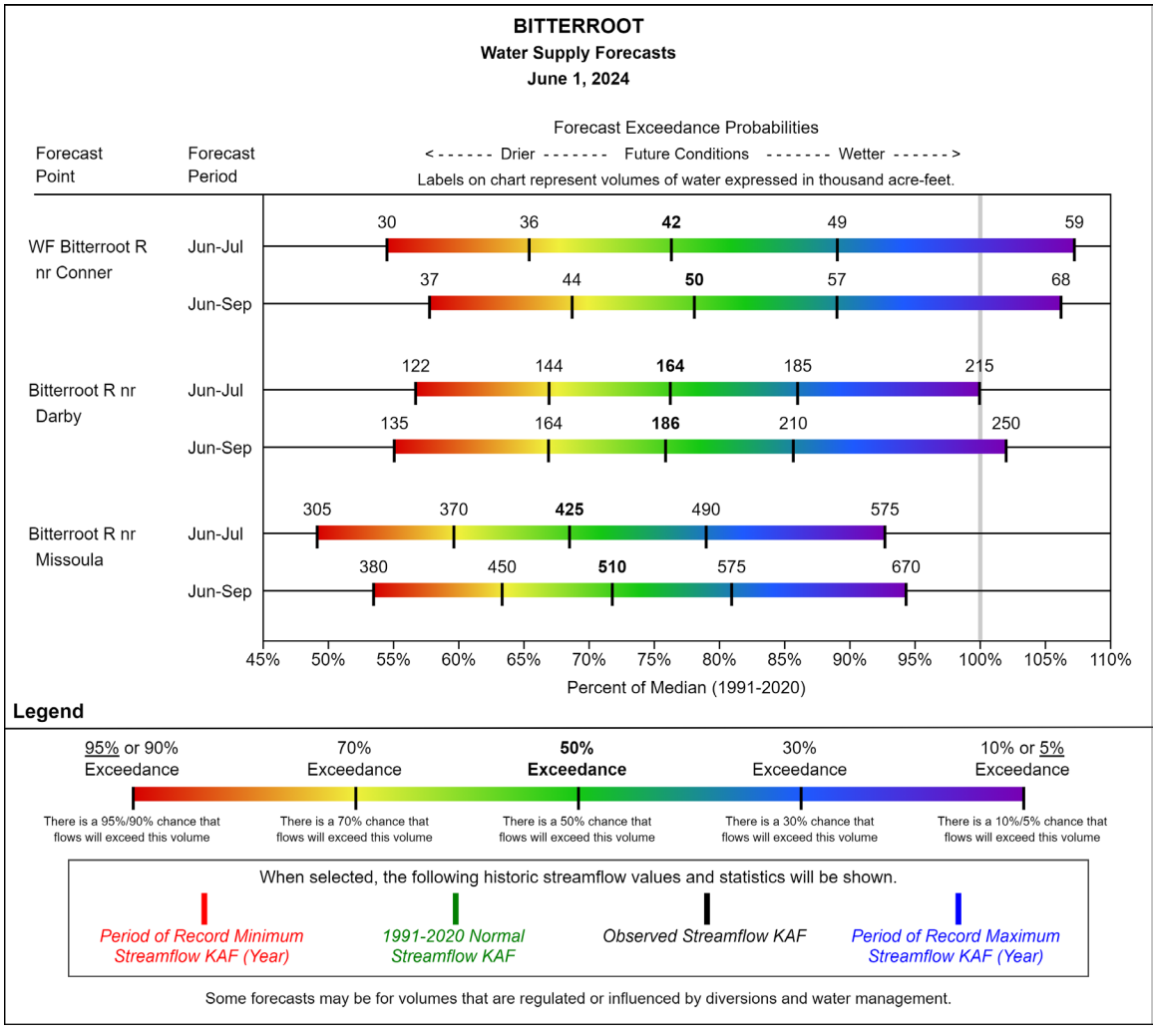
Precipitation in May was well above normal at 135%, which brings the seasonal accumulation (October-May) to 82% of median. The snowpack in the Bitterroot is well below normal at 67% of median, compared to 12% at this time last year.





Basin Overview

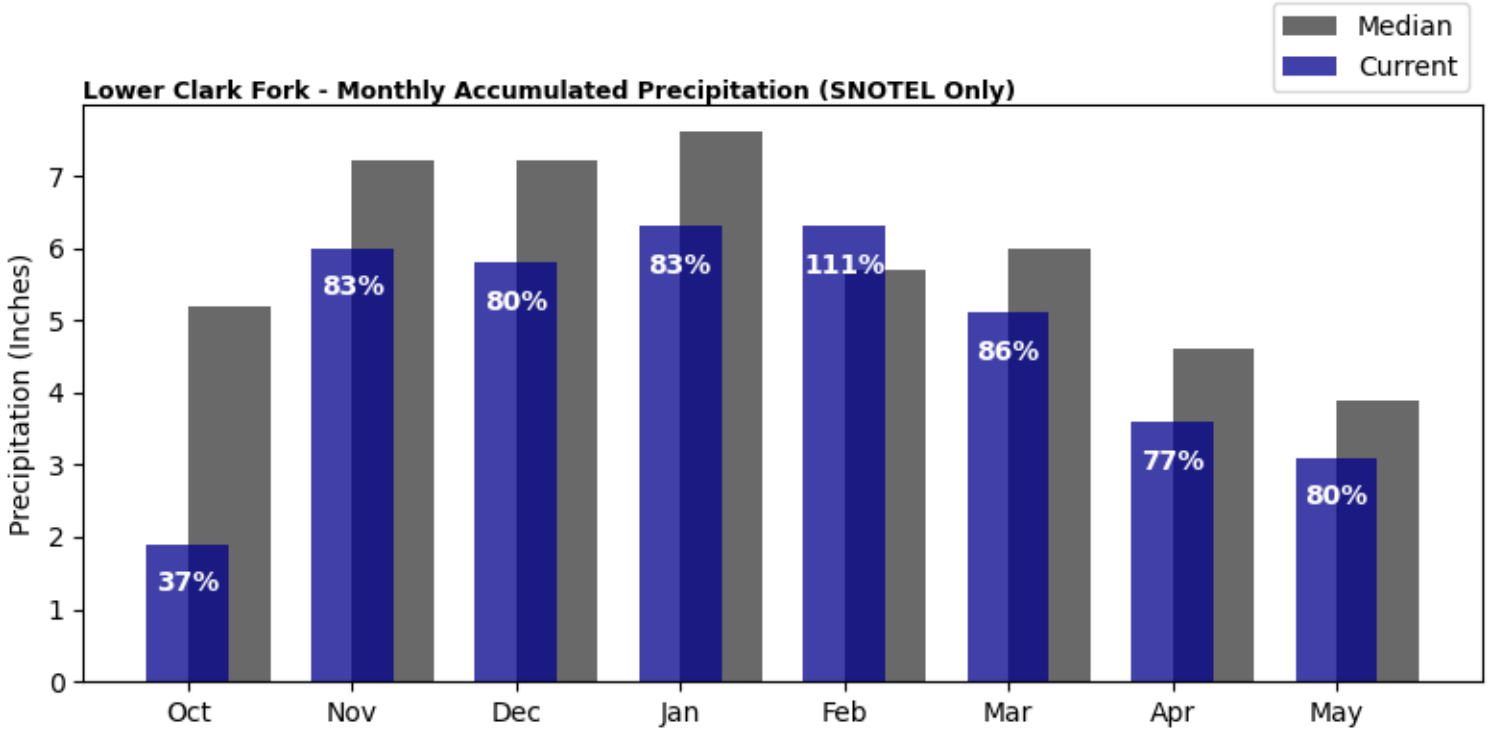
Bitterroot (Continued)

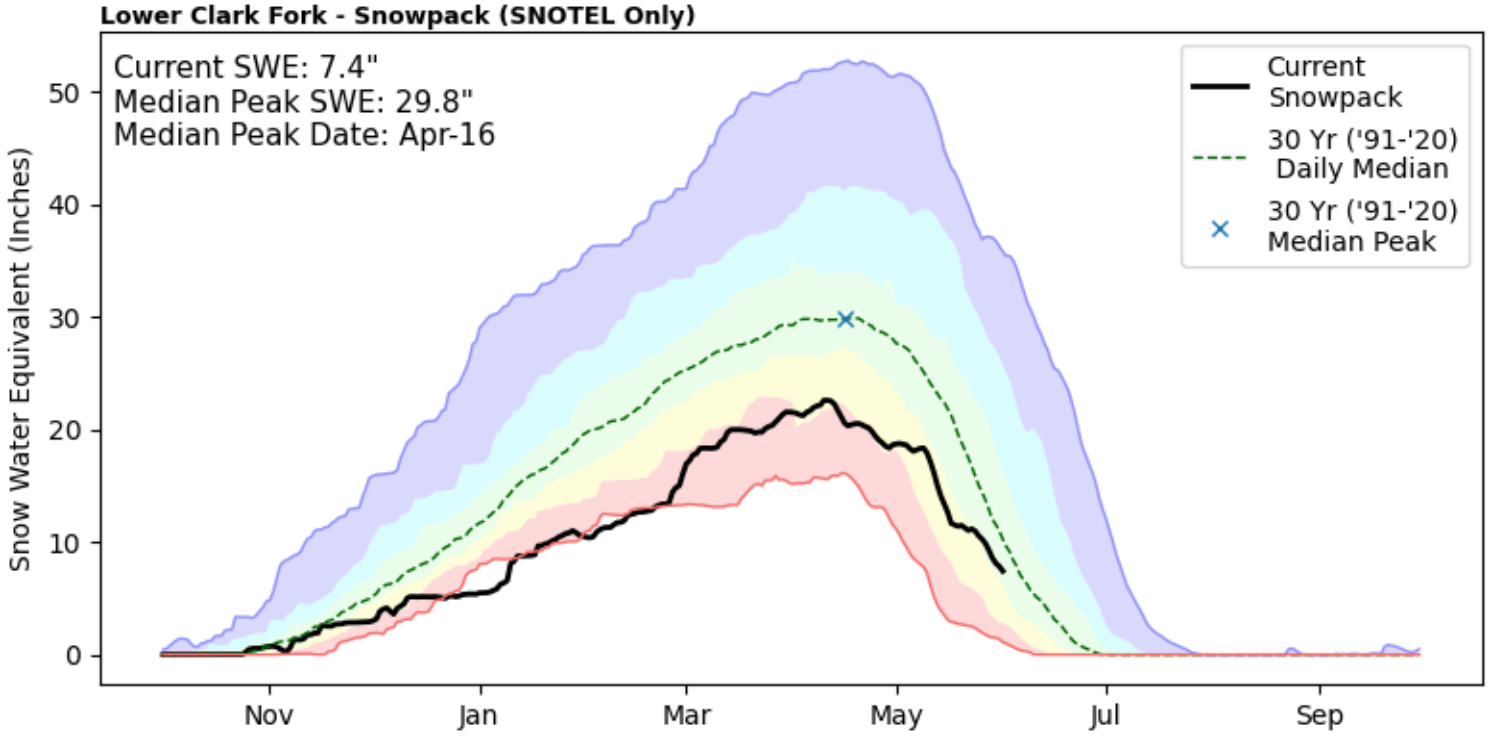


Basin Overview

Lower Clark Fork

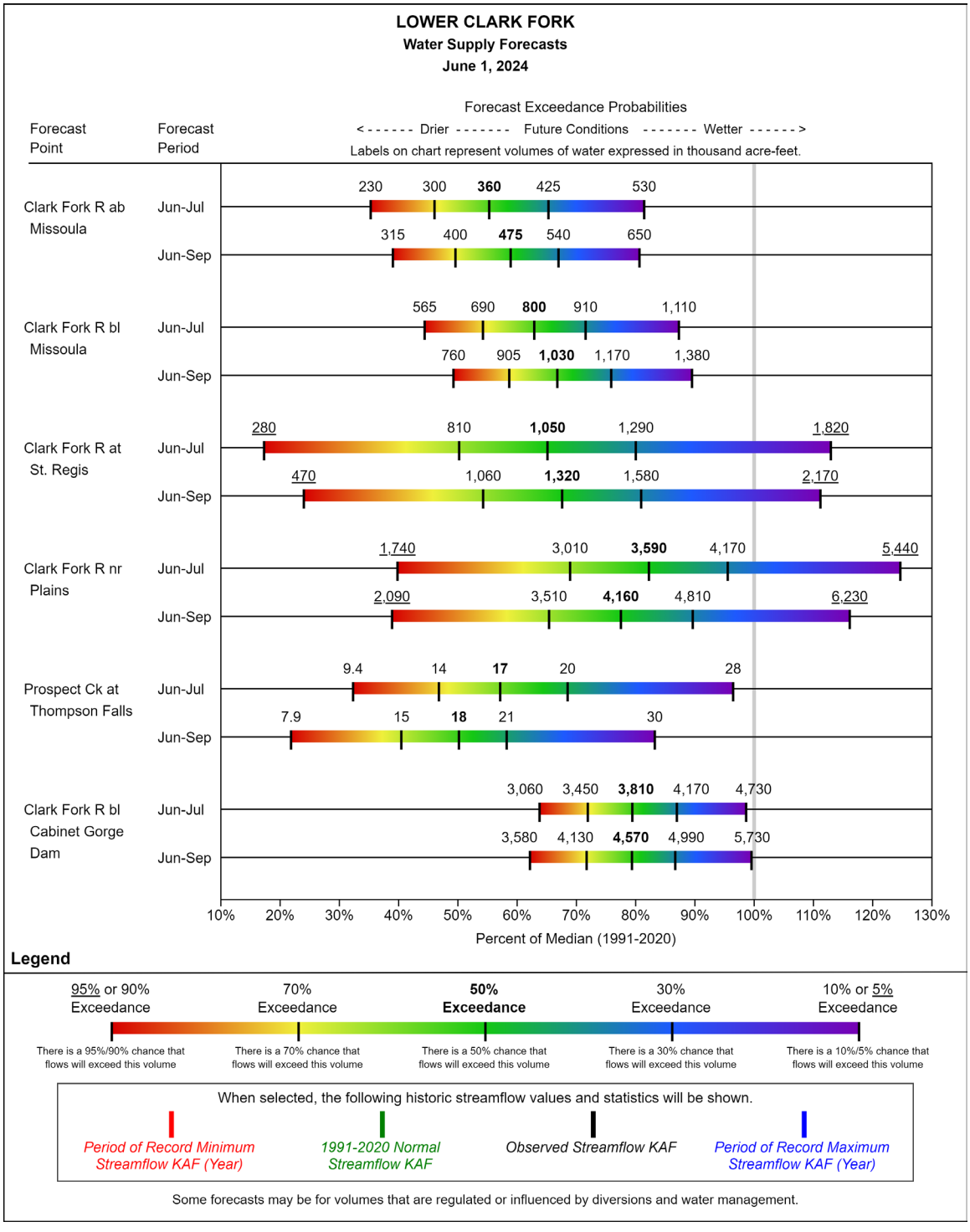
Precipitation in May was below normal at 80%, which brings the seasonal accumulation (October-May) to 77% of median. The snowpack in the Lower Clark Fork is well below normal at 72% of median, compared to 28% at this time last year.





Basin Overview

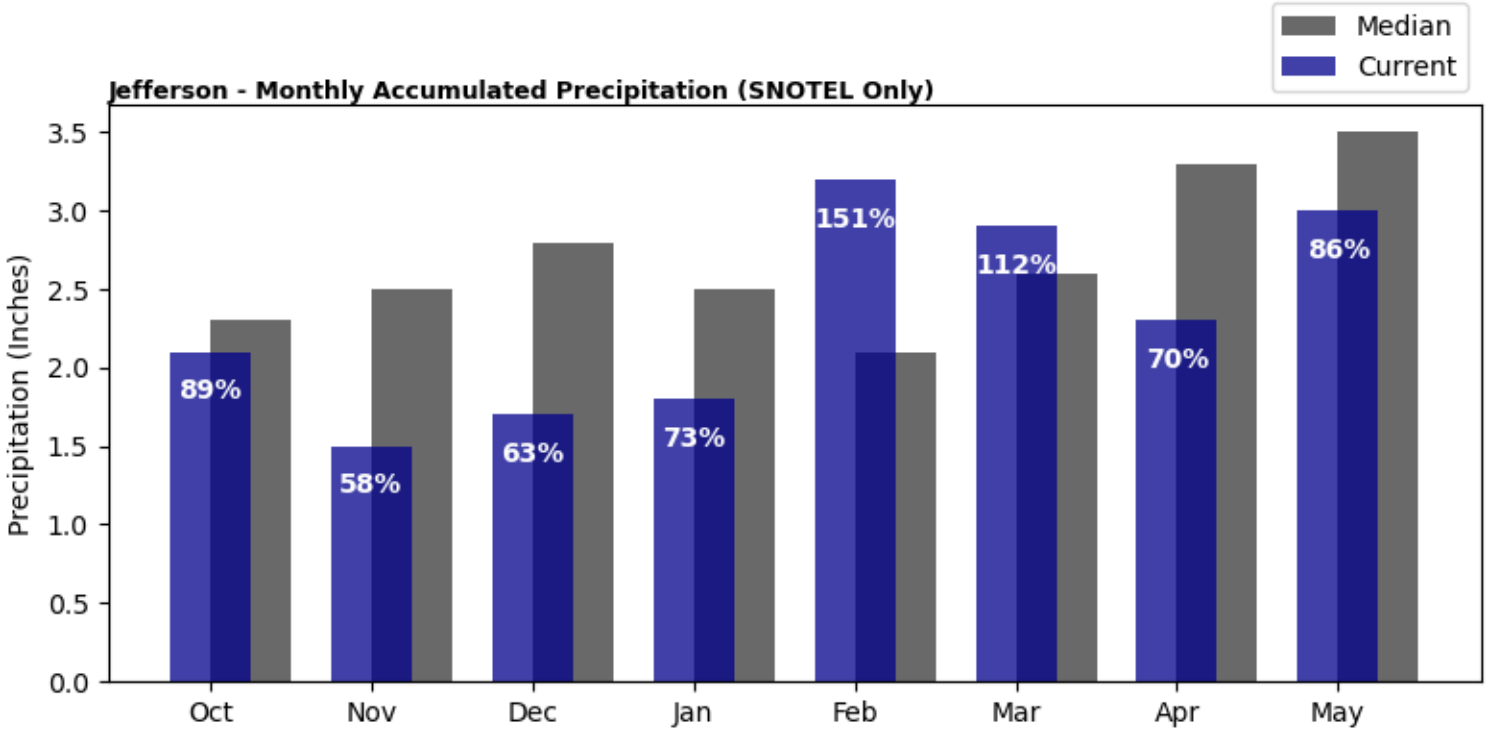
Lower Clark Fork (Continued)

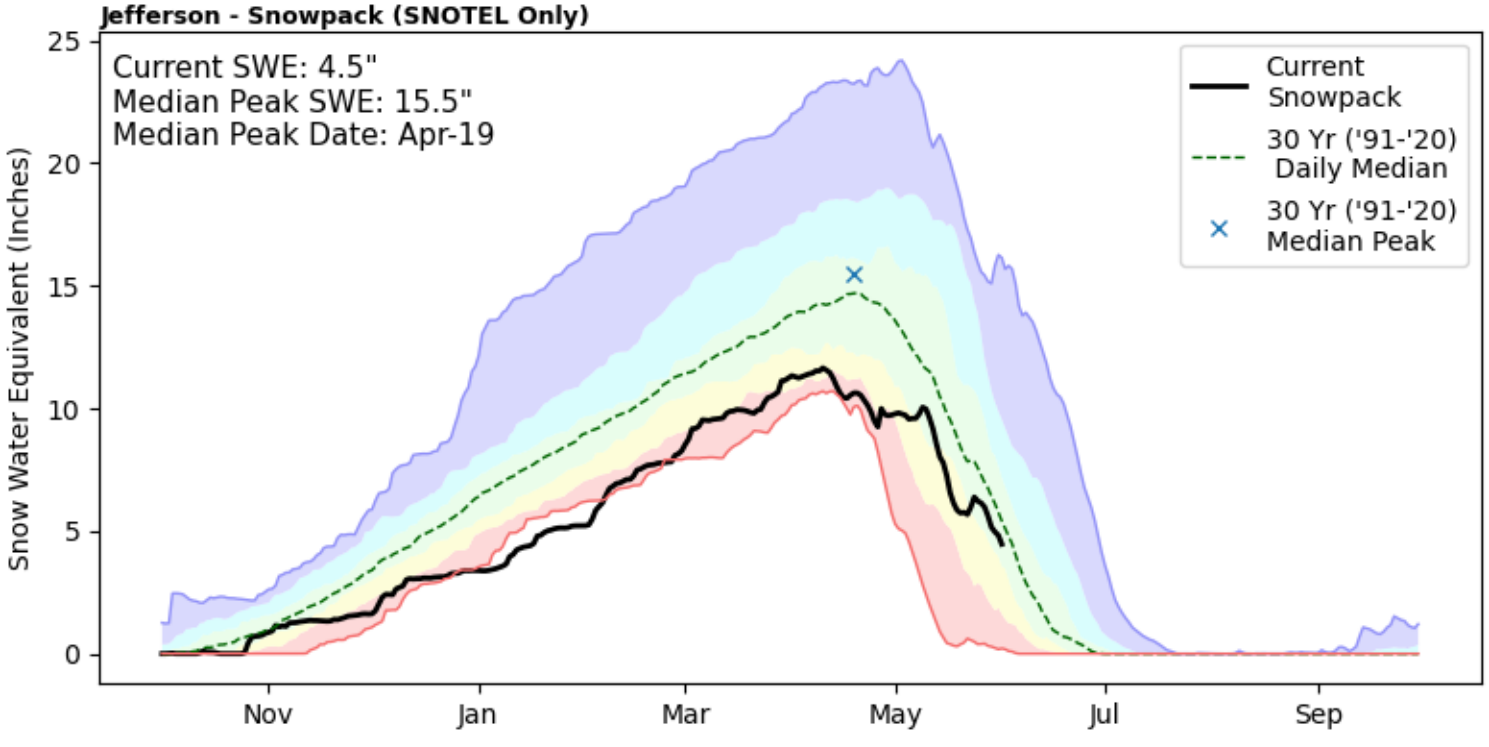


Basin Overview

Jefferson

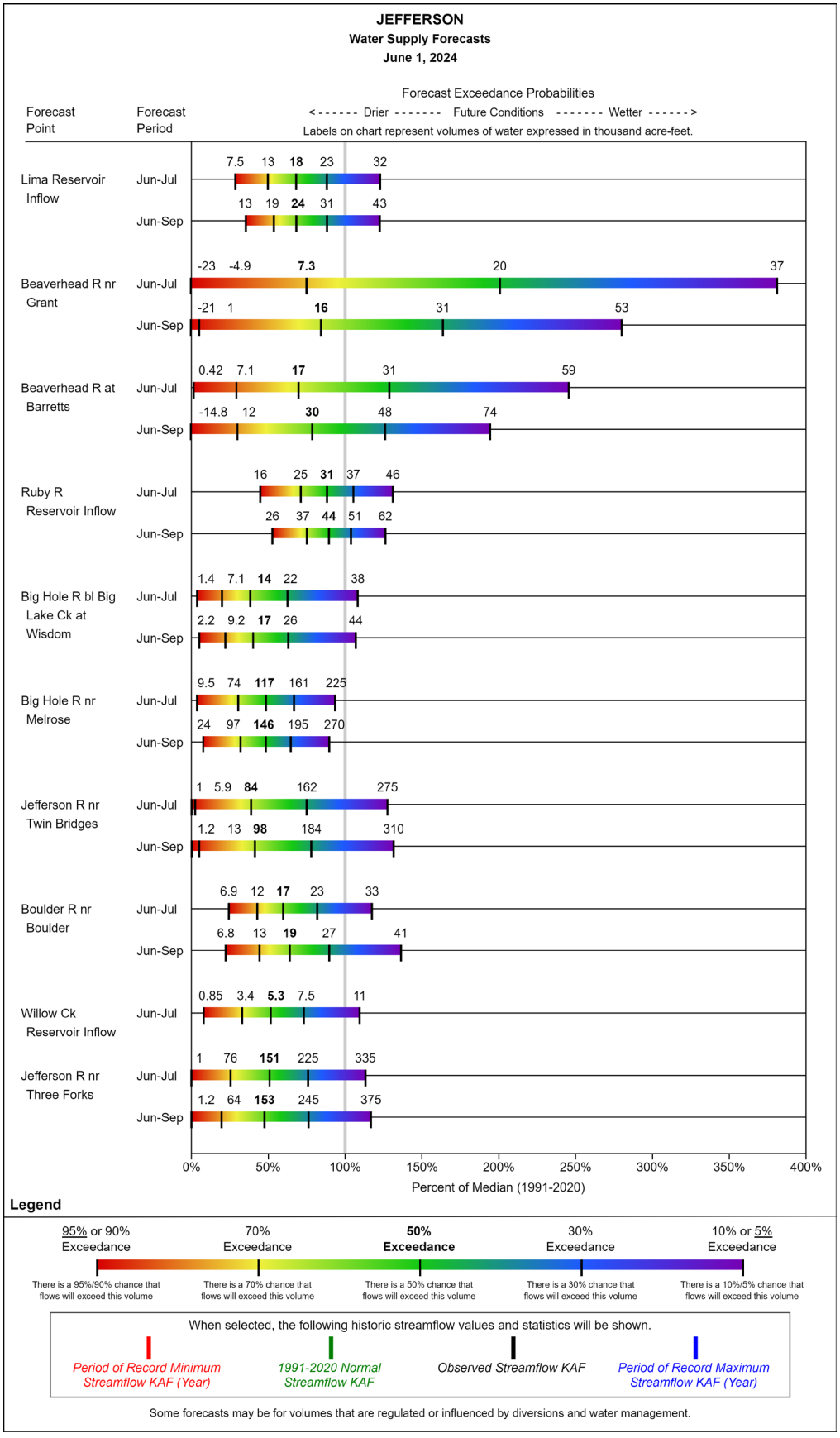
Precipitation in May was below normal at 86%, which brings the seasonal accumulation (October-May) to 83% of median. The snowpack in the Jefferson is below normal at 83% of median, compared to 54% at this time last year.





Basin Overview

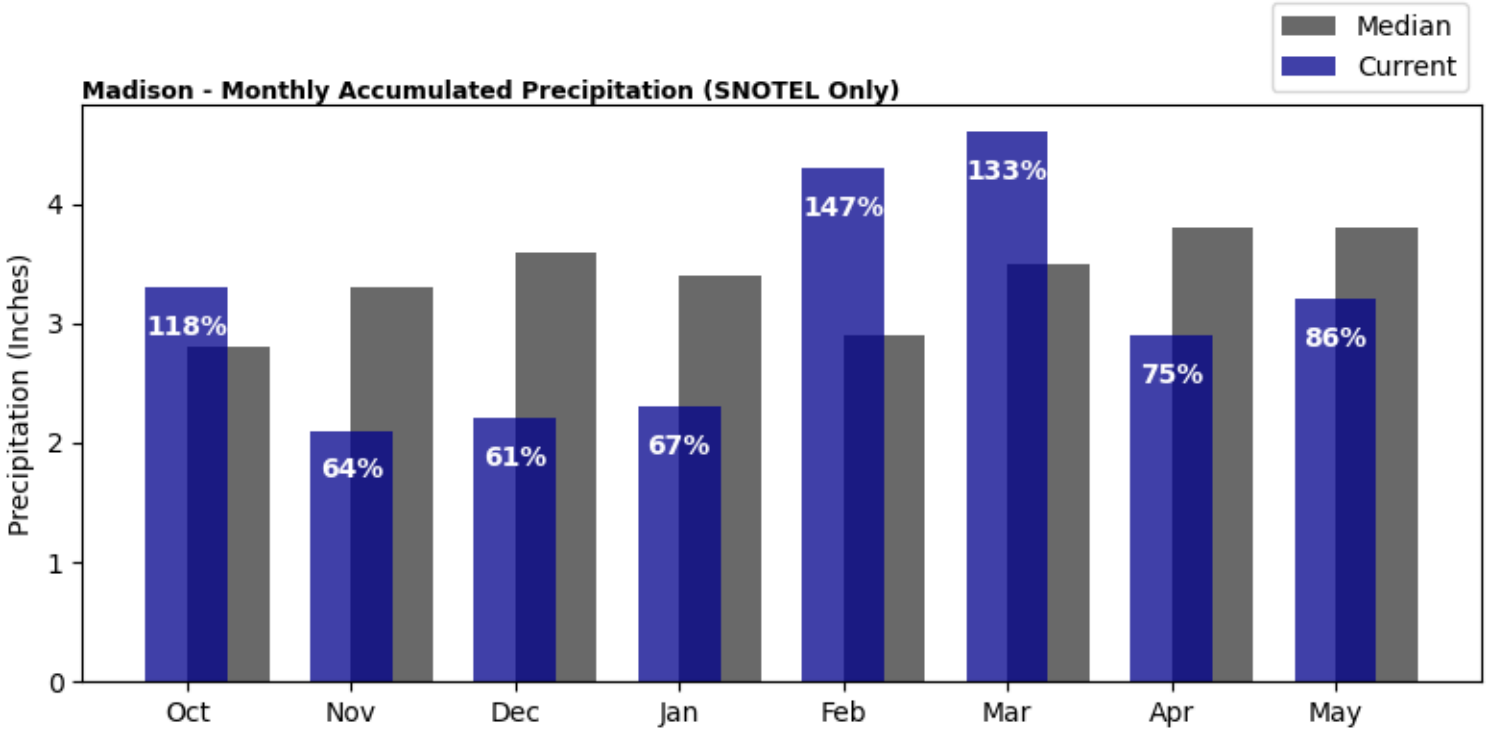
Jefferson (Continued)

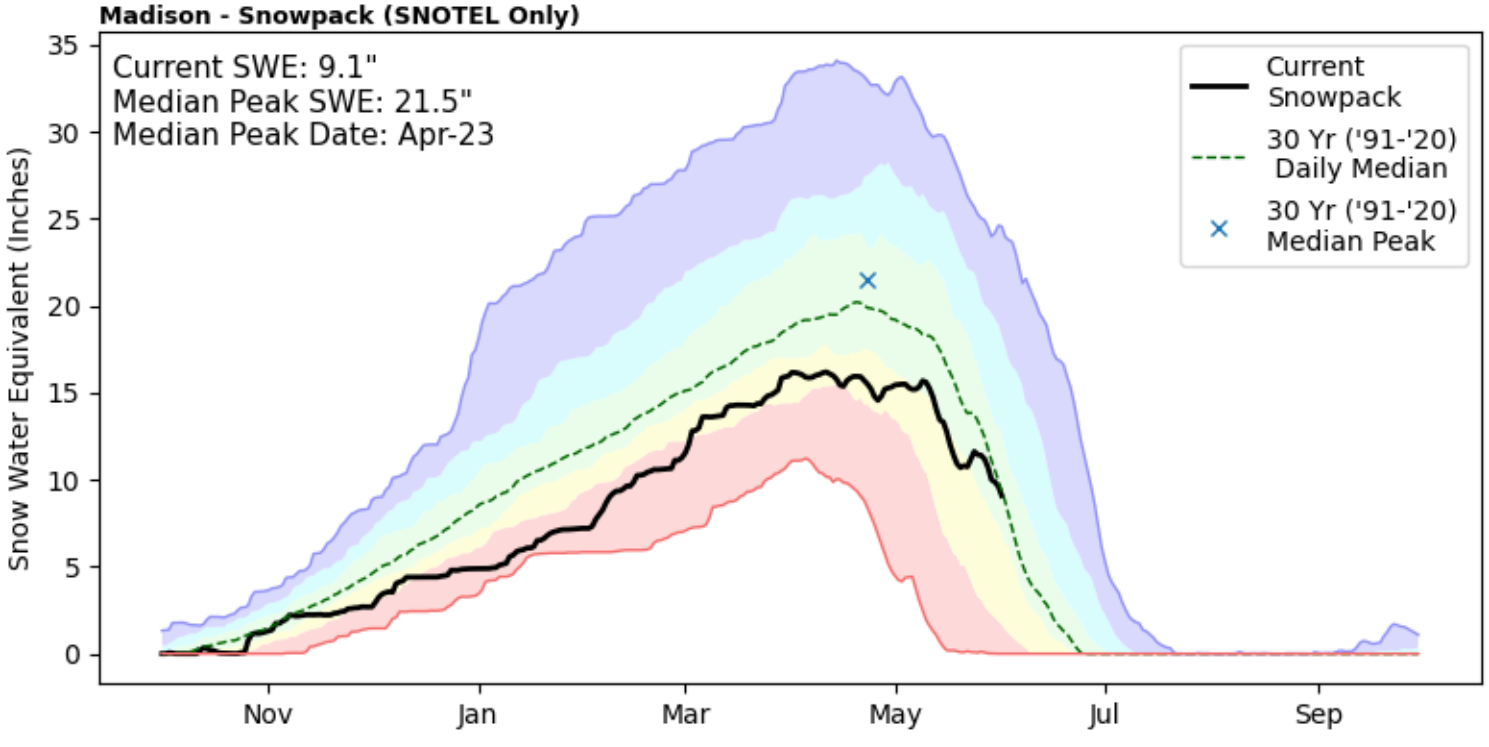


Basin Overview

Madison

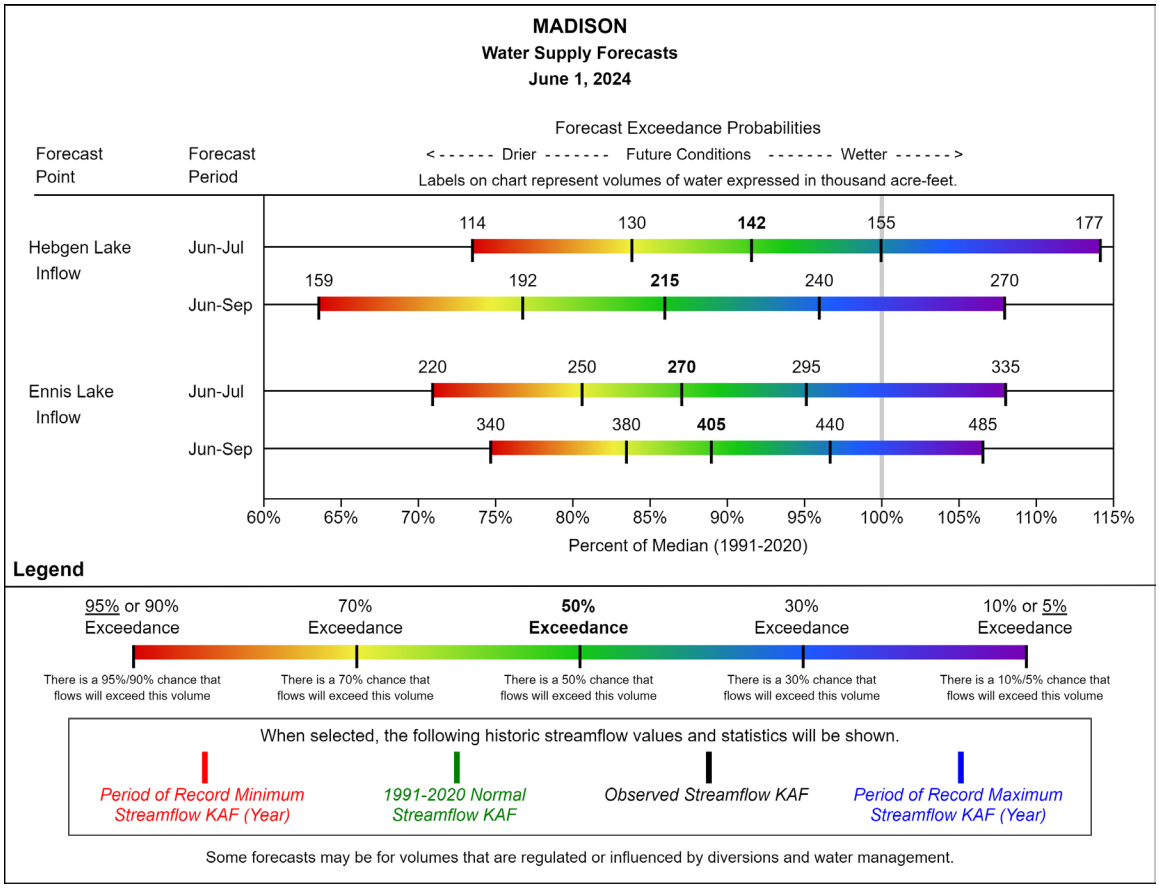
Precipitation in May was below normal at 86%, which brings the seasonal accumulation (October-May) to 88% of median. The snowpack in the Madison is near normal at 98% of median, compared to 74% at this time last year.





Basin Overview

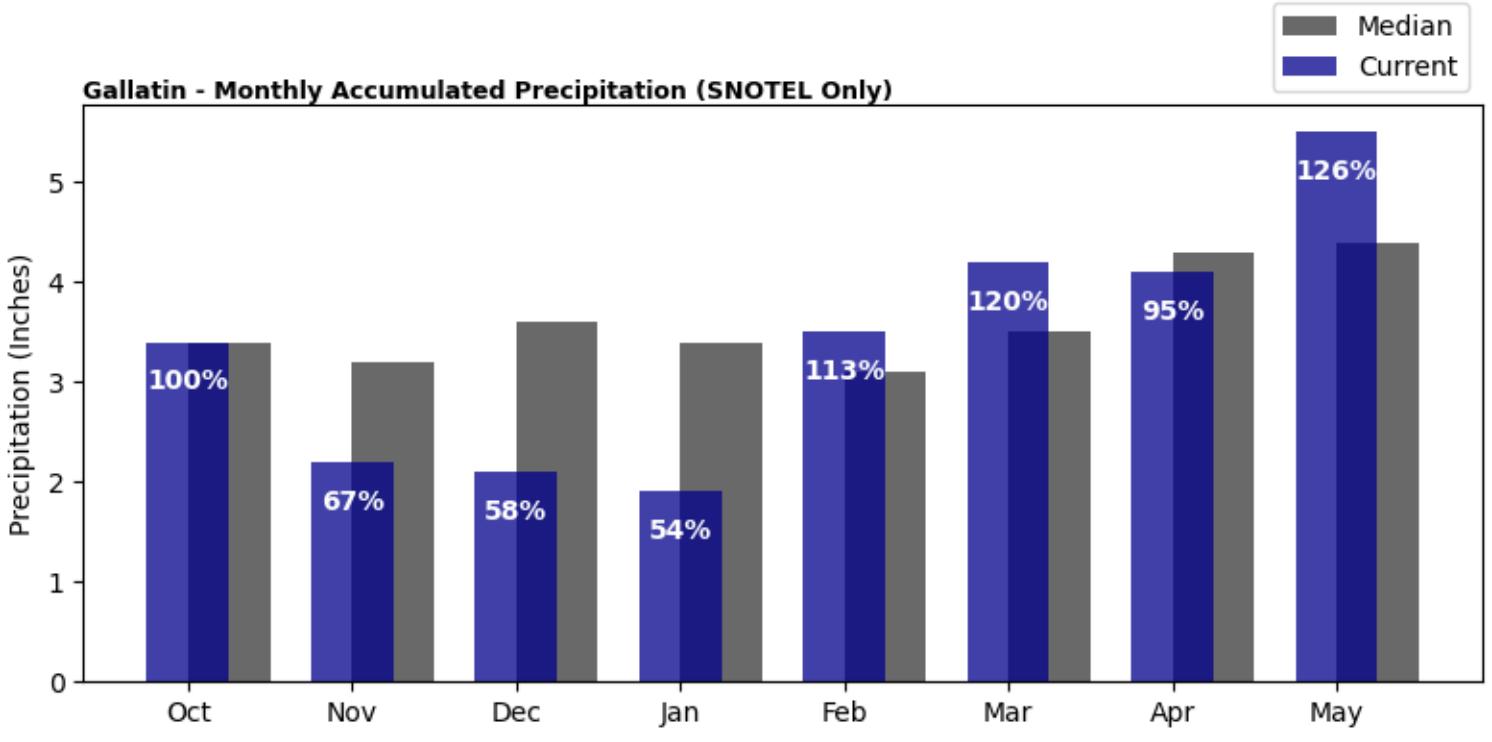
Madison (Continued)

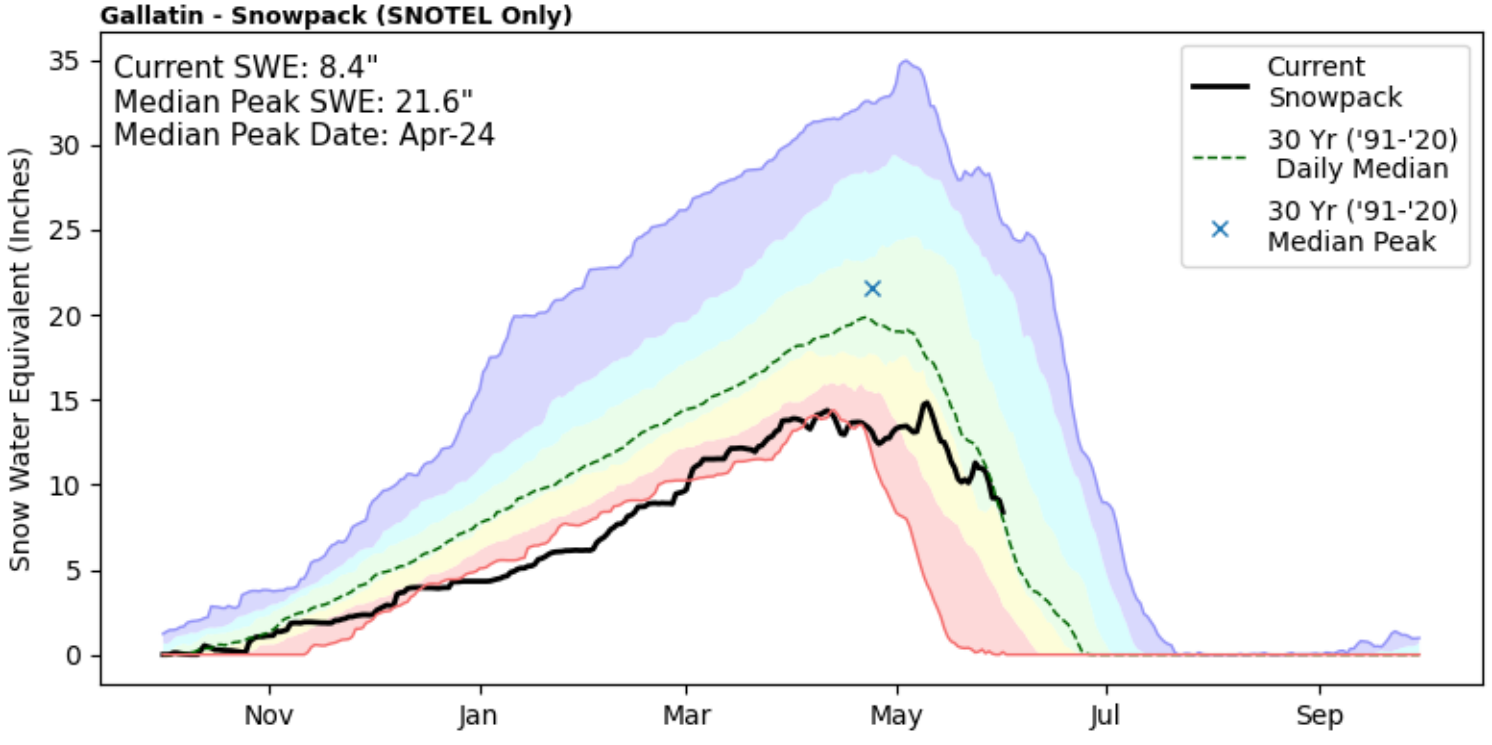


Basin Overview

Gallatin

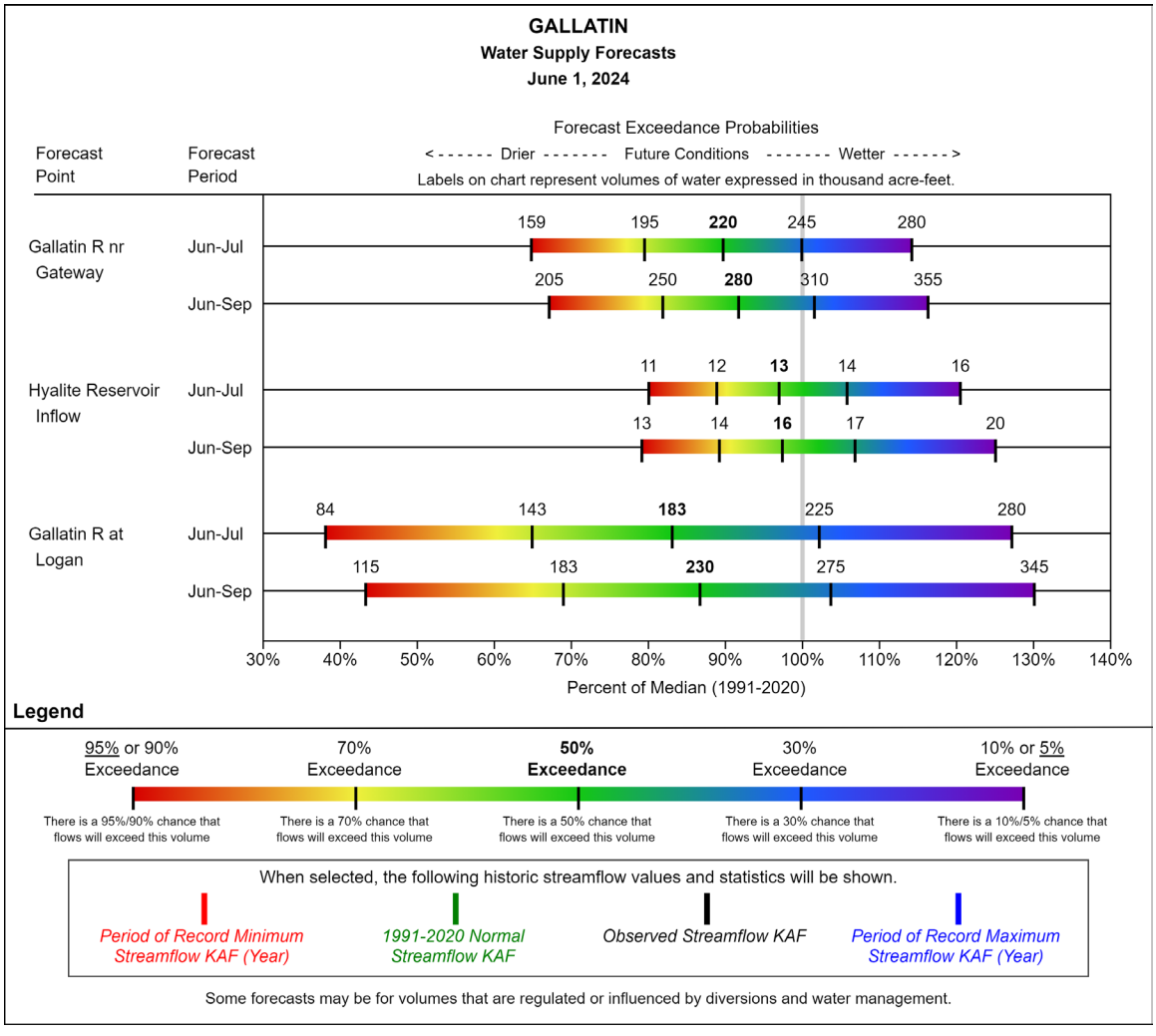
Precipitation in May was well above normal at 126%, which brings the seasonal accumulation (October-May) to 89% of median. The snowpack in the Gallatin is near normal at 104% of median, compared to 52% at this time last year.





Basin Overview

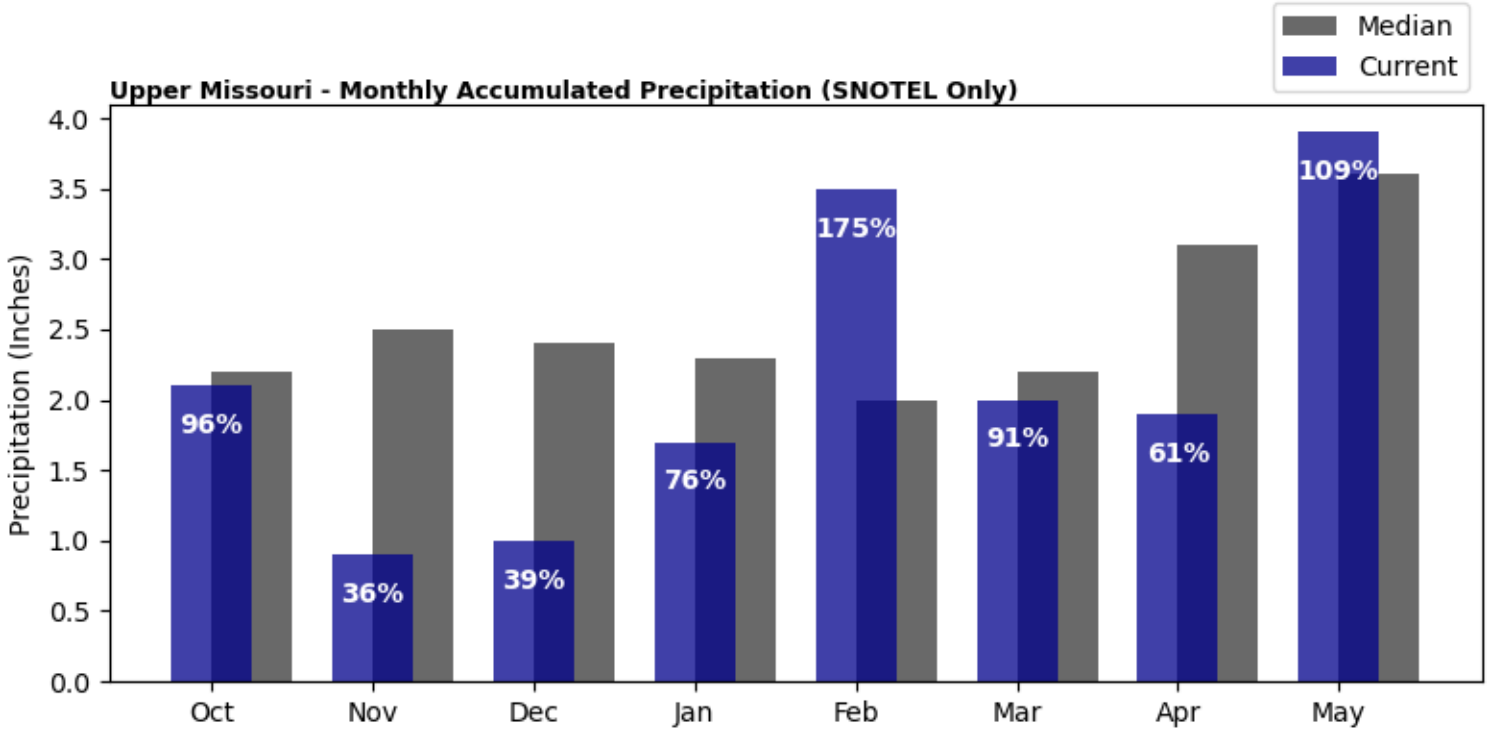
Gallatin (Continued)

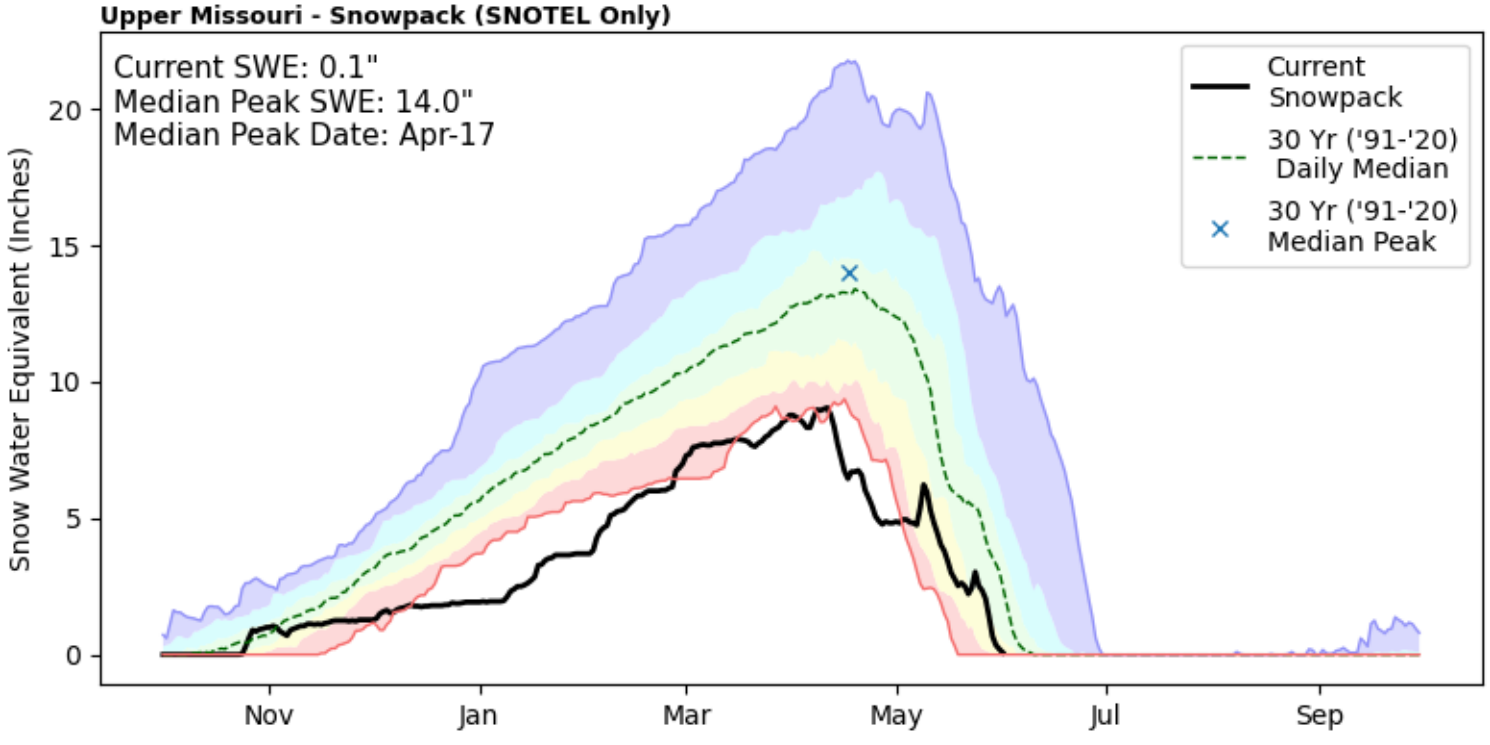


Basin Overview

Upper Missouri

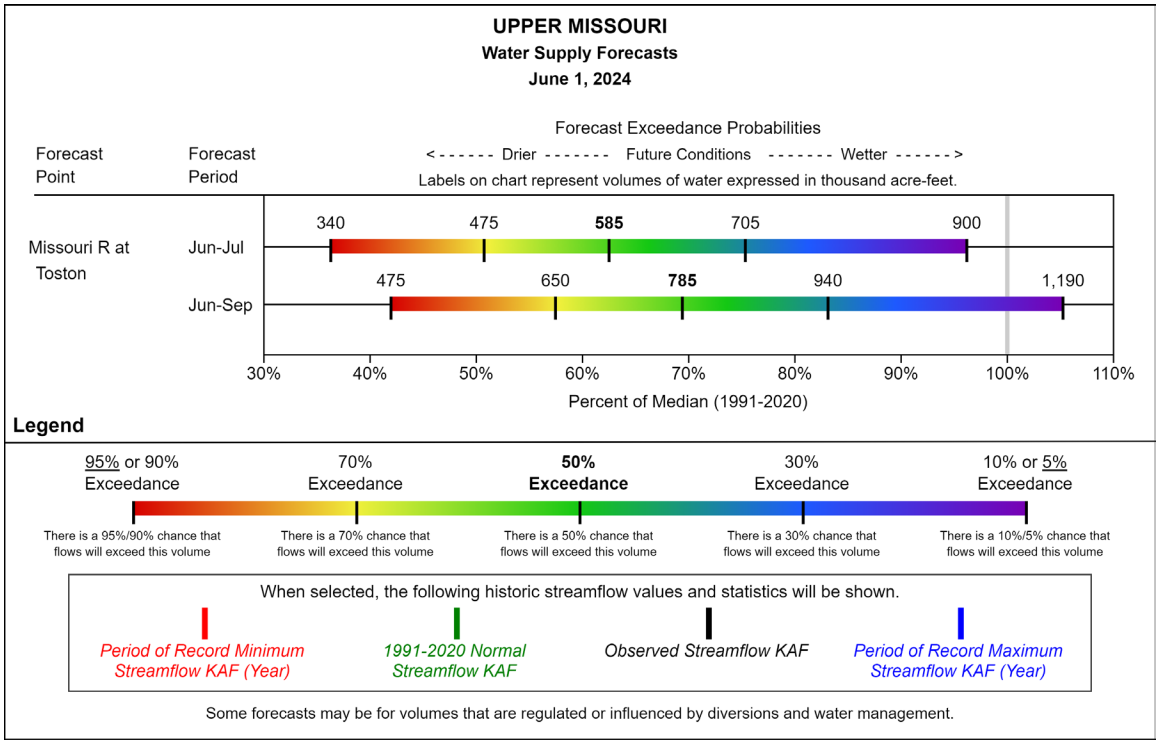
Precipitation in May was above normal at 109%, which brings the seasonal accumulation (October-May) to 82% of median. The snowpack in the Upper Missouri is well below normal at 3% of median, compared to None% at this time last year.





Basin Overview

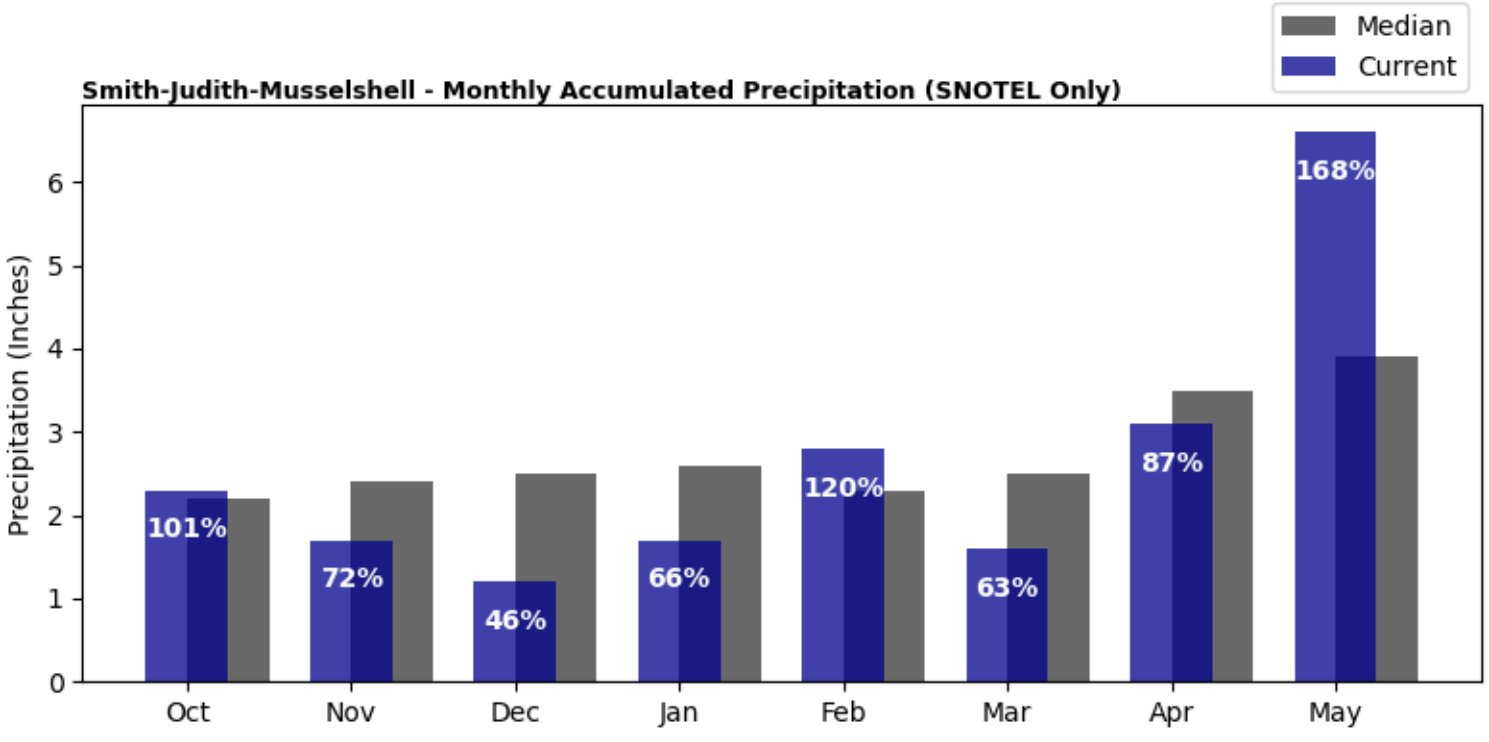
Upper Missouri (Continued)

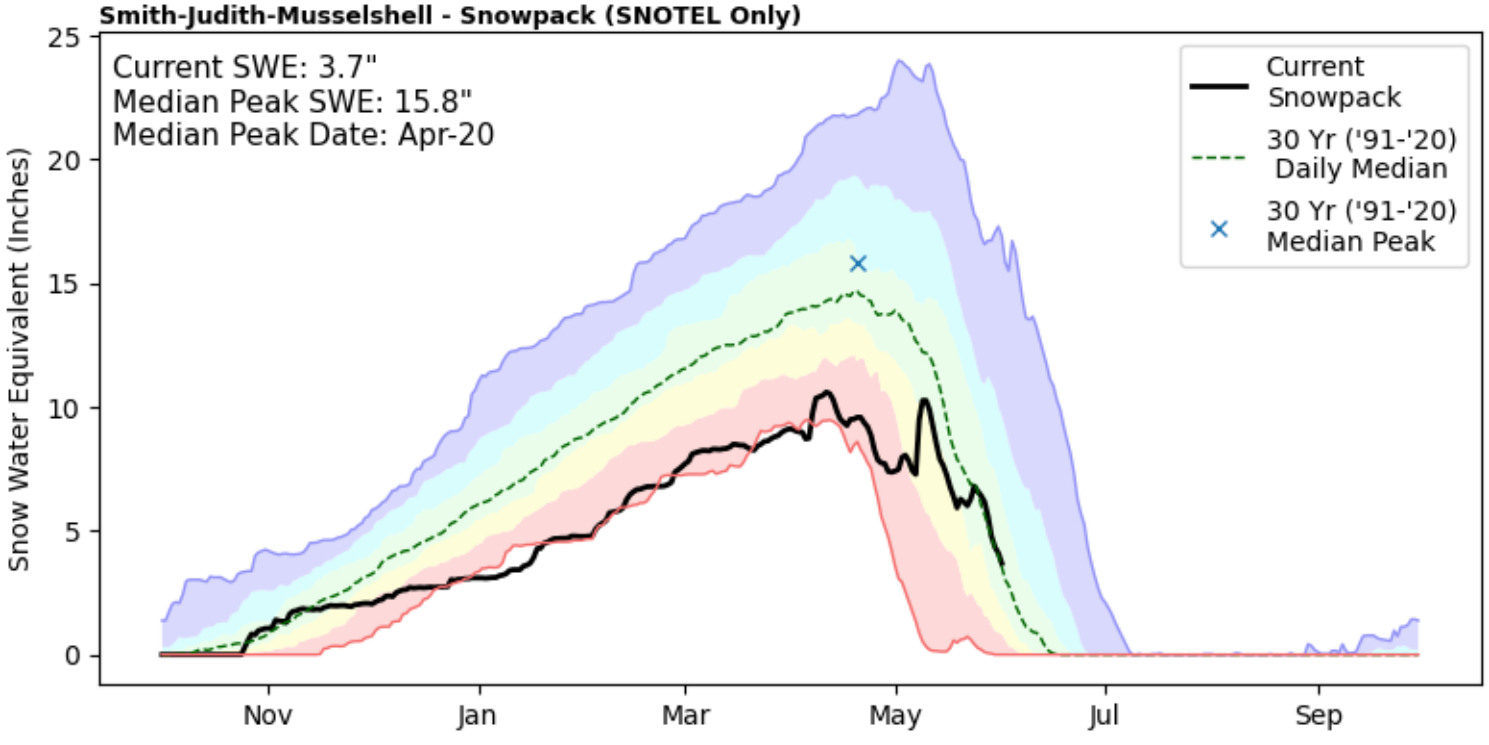


Basin Overview

Smith-Judith-Musselshell

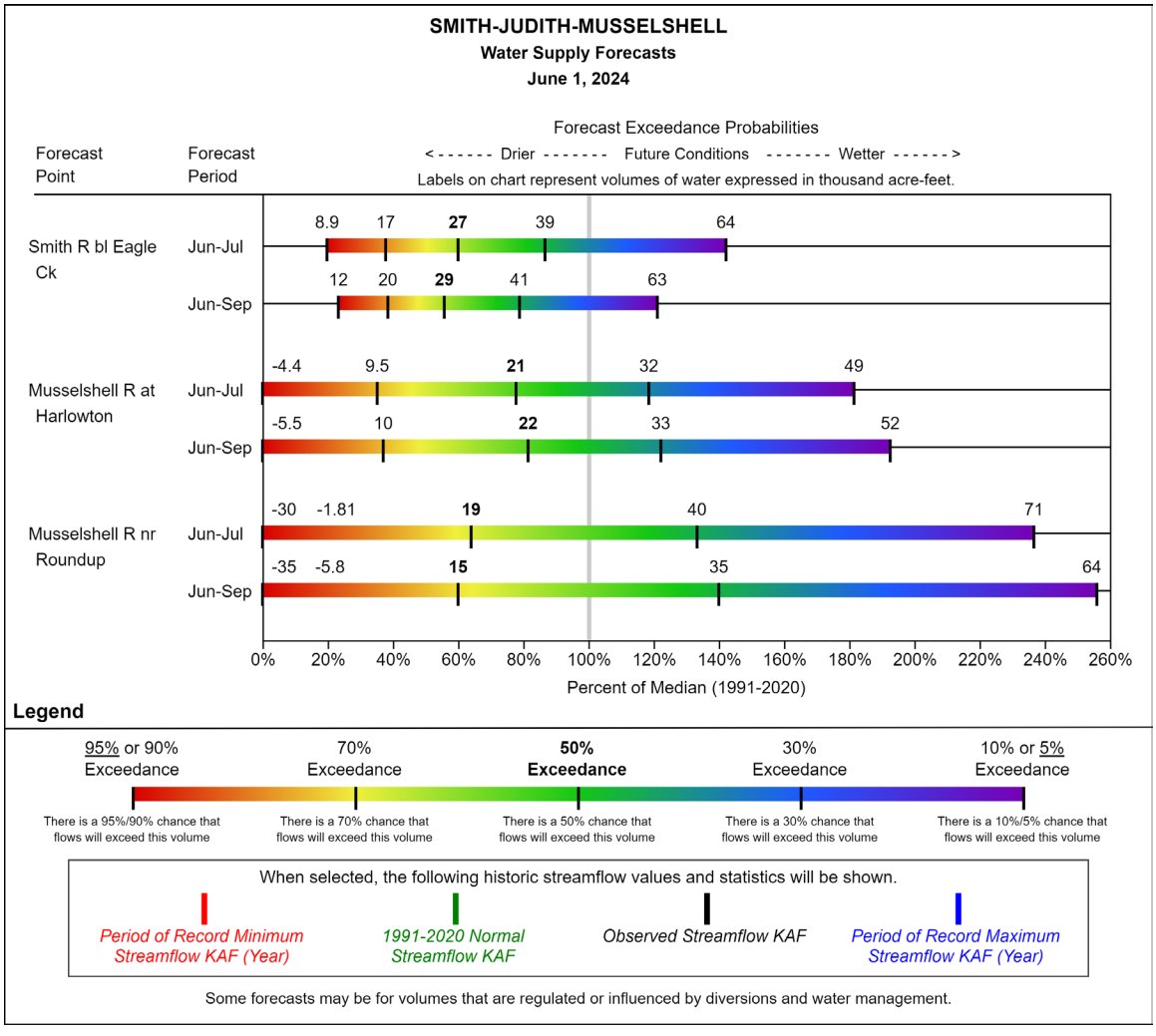
Precipitation in May was well above normal at 168%, which brings the seasonal accumulation (October-May) to 90% of median. The snowpack in the Smith-Judith-Musselshell is near normal at 104% of median, compared to 25% at this time last year.





Basin Overview

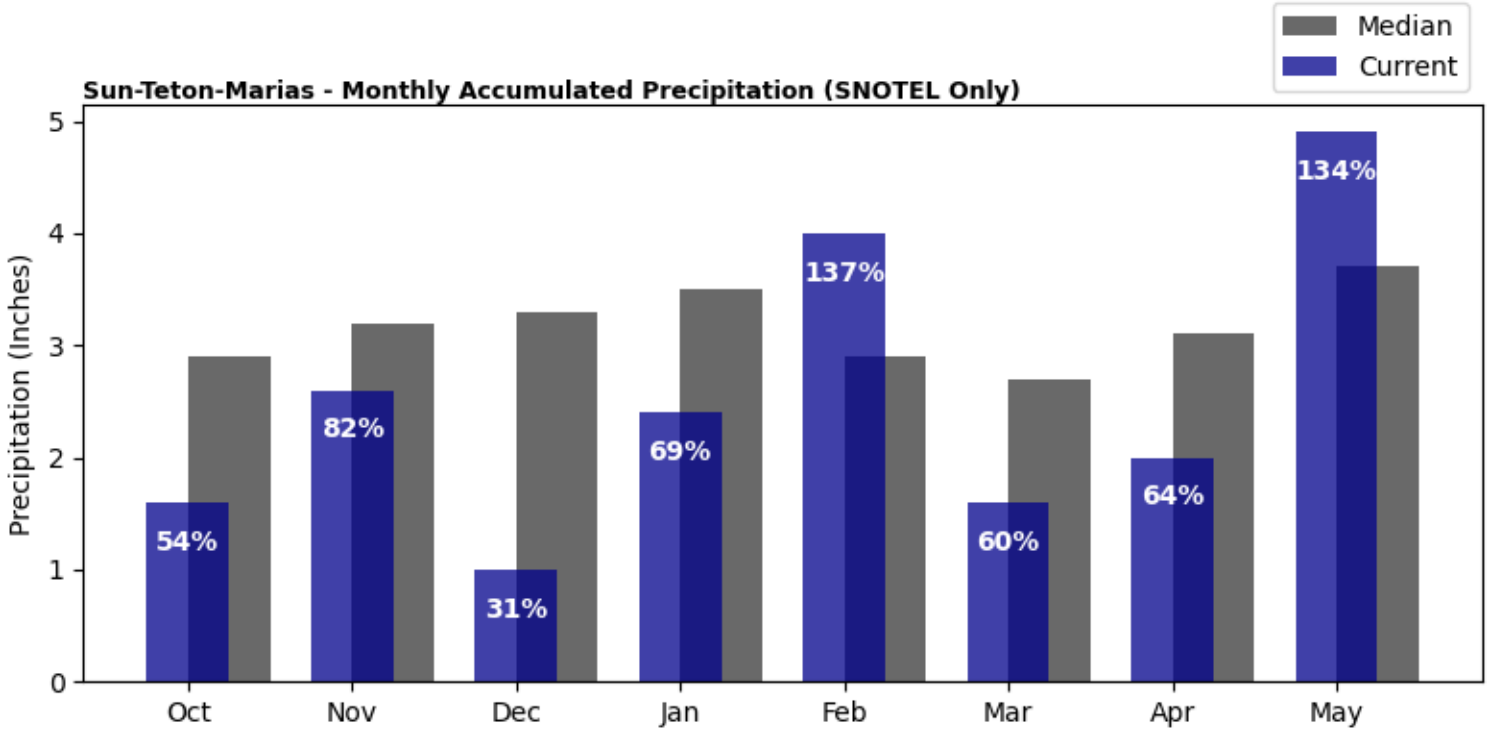
Smith-Judith-Musselshell (Continued)

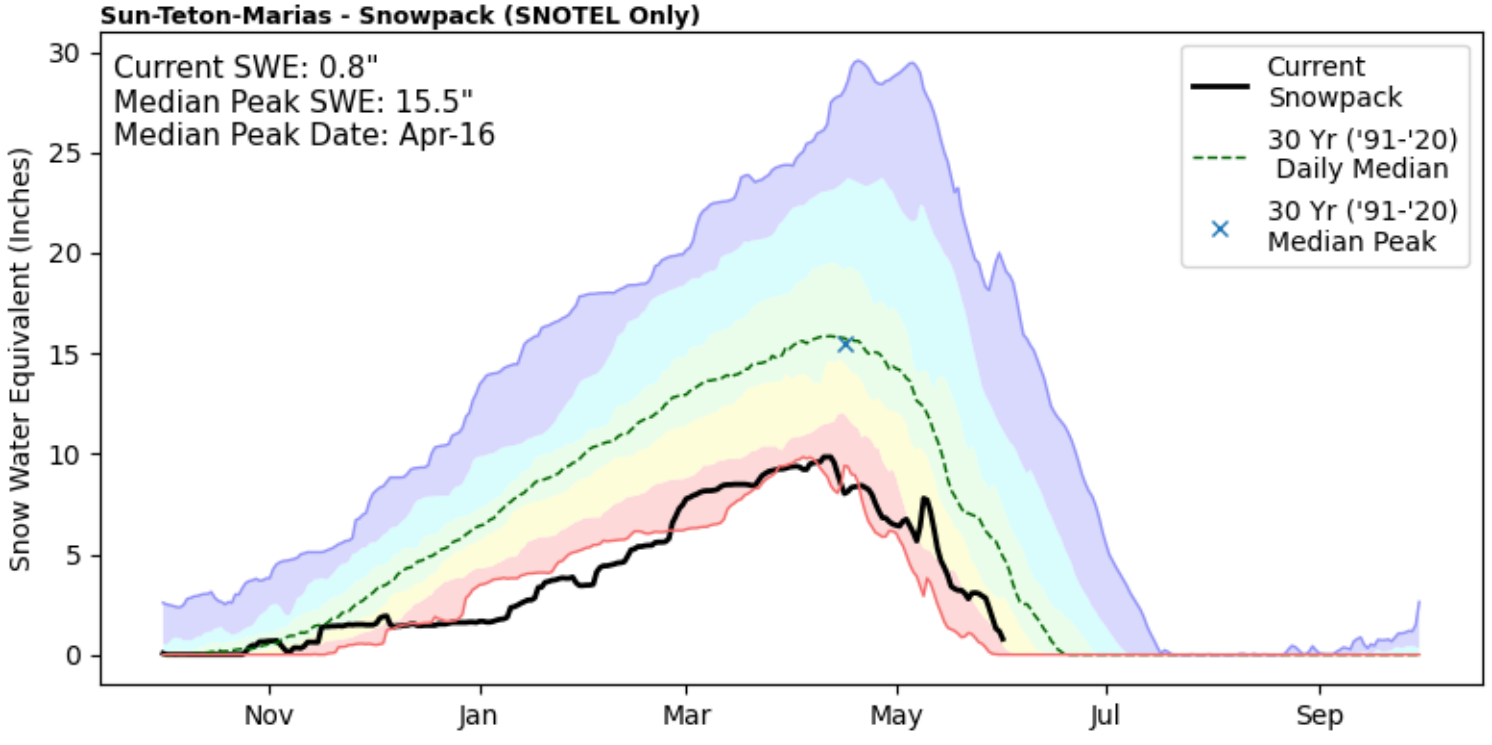


Basin Overview

Sun-Teton-Marias

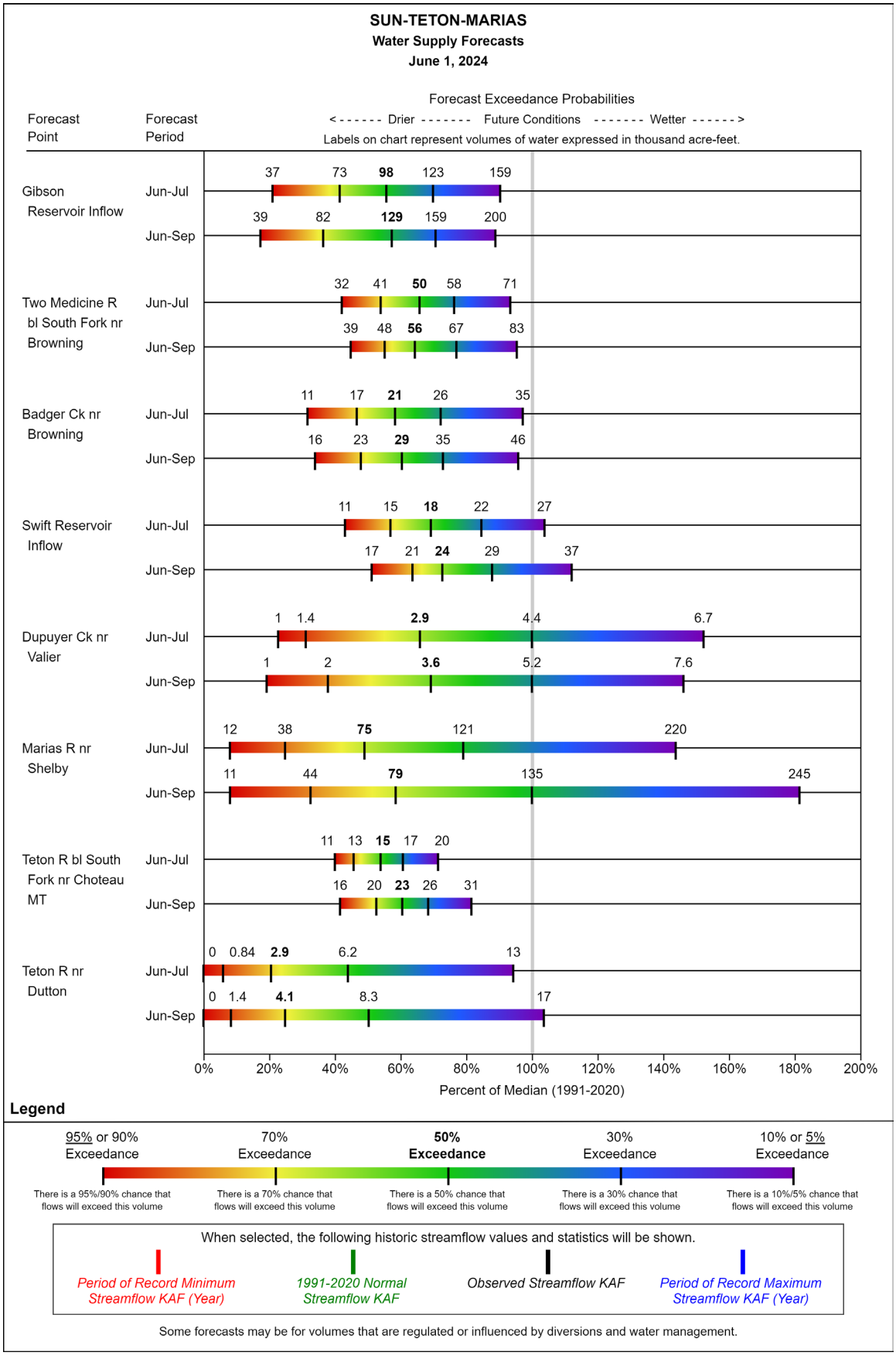
Precipitation in May was well above normal at 134%, which brings the seasonal accumulation (October-May) to 76% of median. The snowpack in the Sun-Teton-Marias is well below normal at 16% of median, compared to None% at this time last year.





Basin Overview

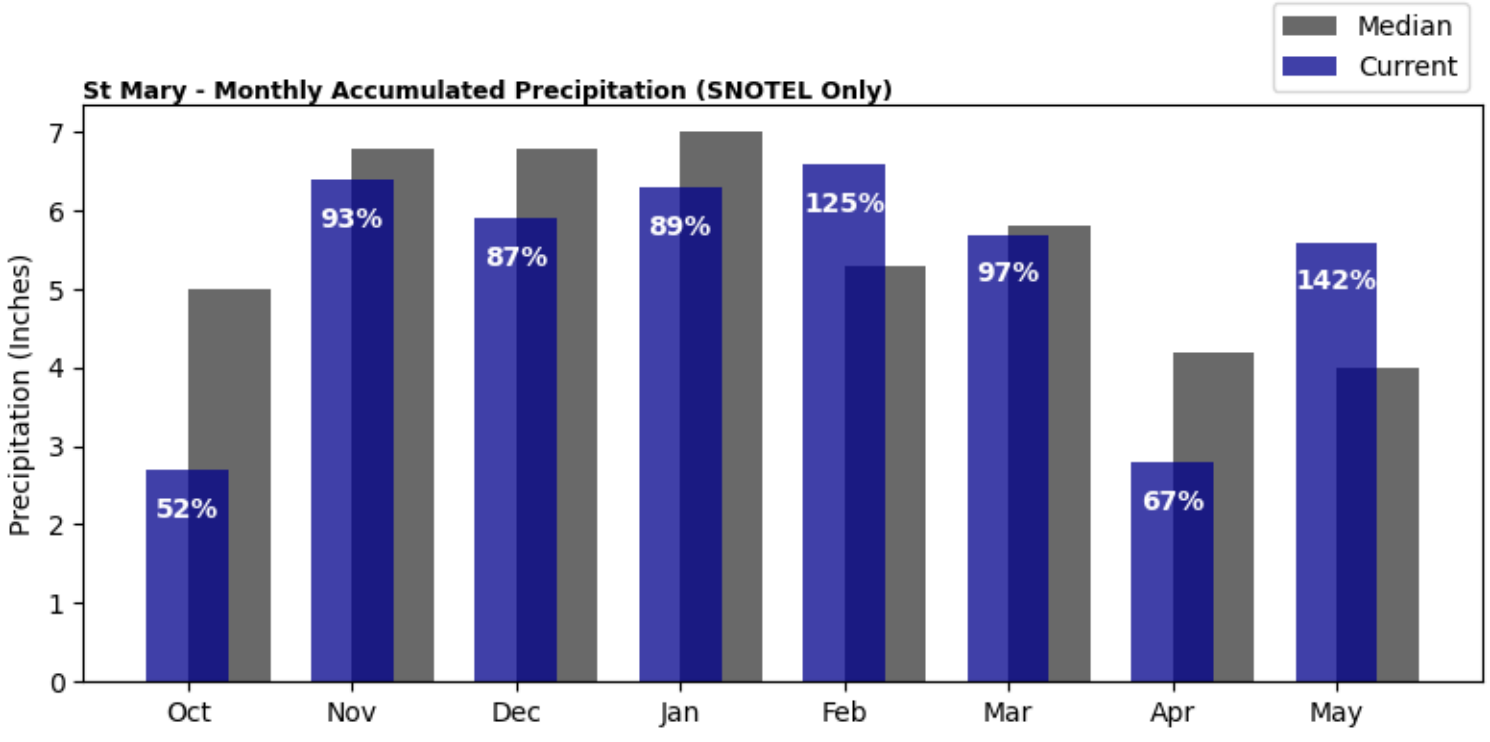
Sun-Teton-Marias (Continued)

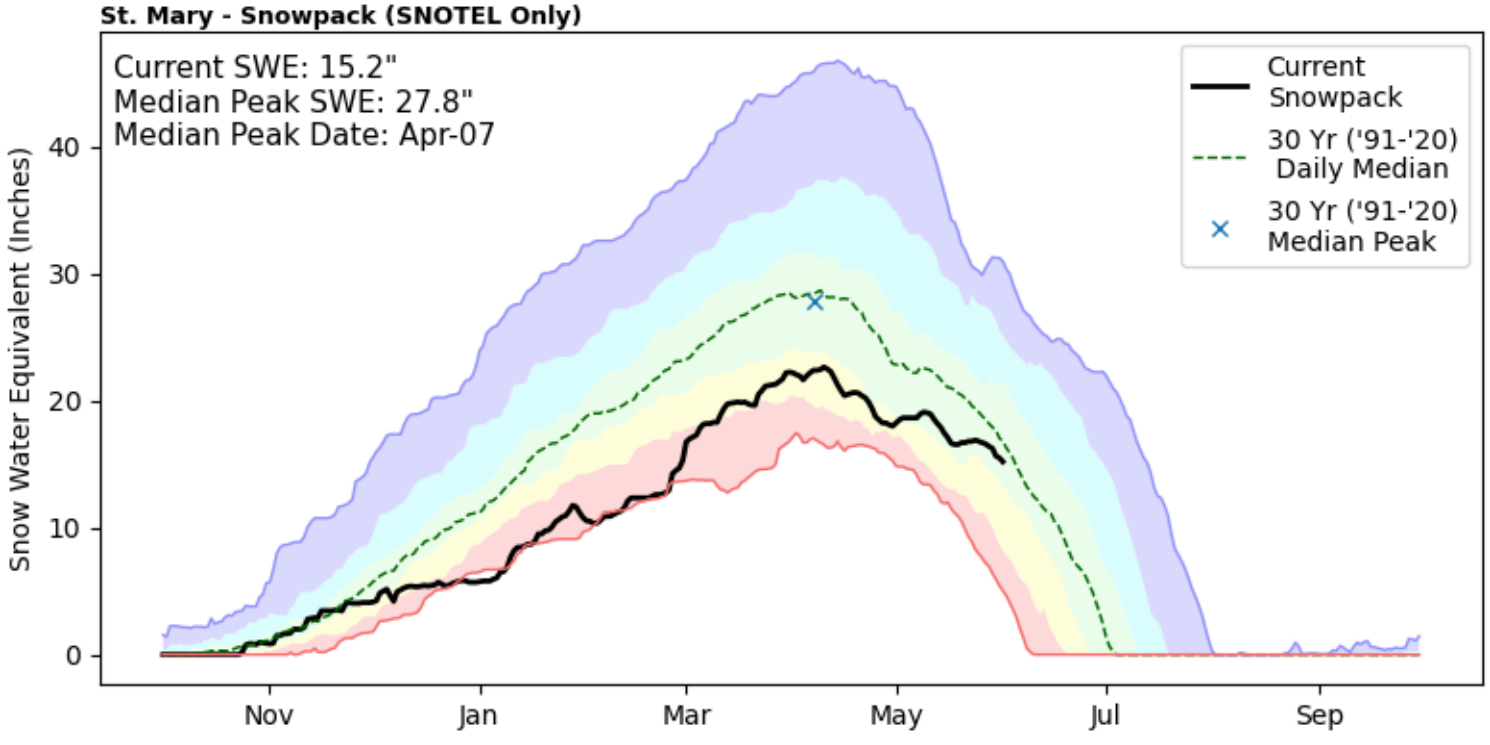


Basin Overview

St. Mary

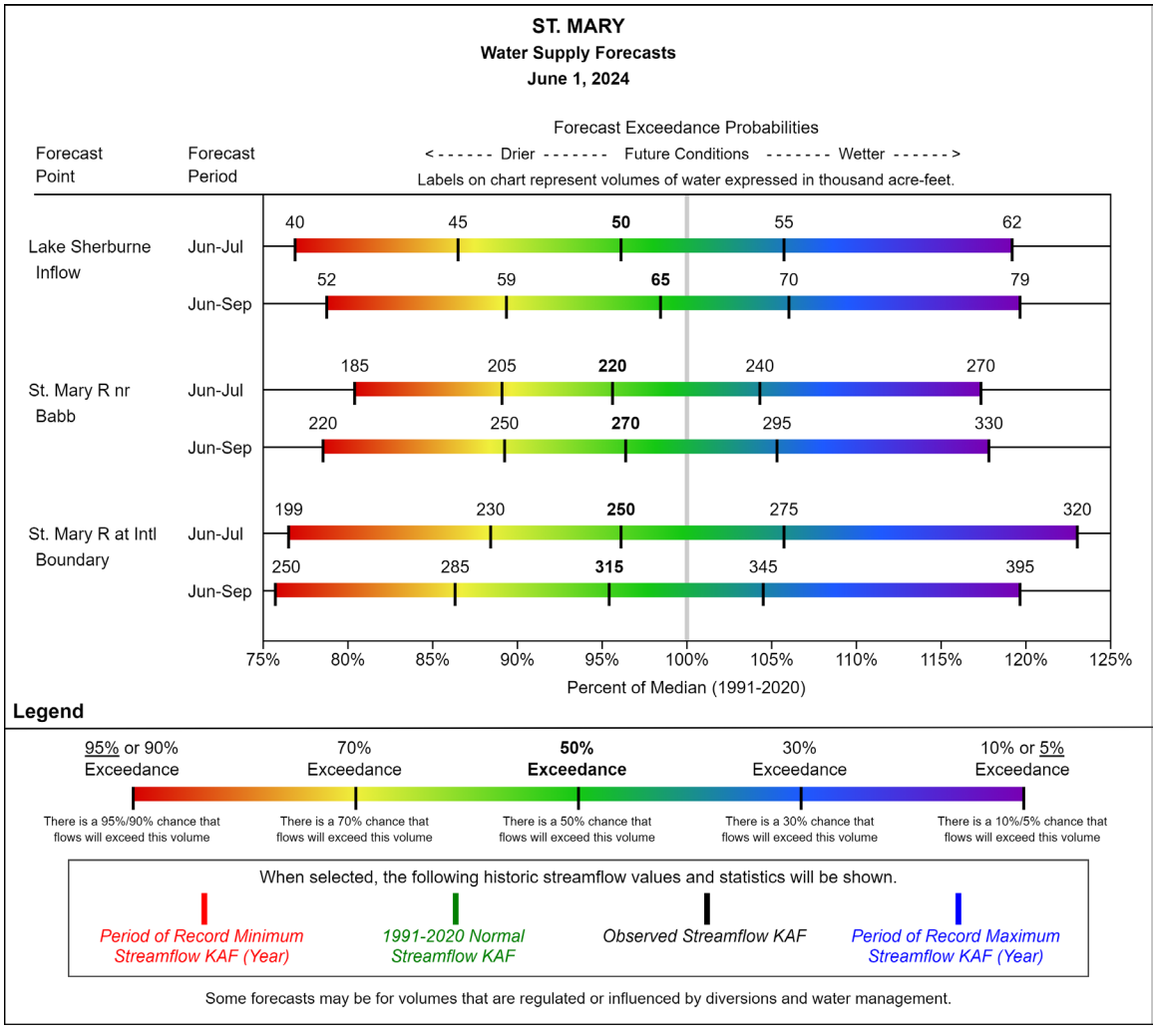
Precipitation in May was well above normal at 142%, which brings the seasonal accumulation (October-May) to 86% of median. The snowpack in the St. Mary is below normal at 90% of median, compared to 30% at this time last year.





Basin Overview

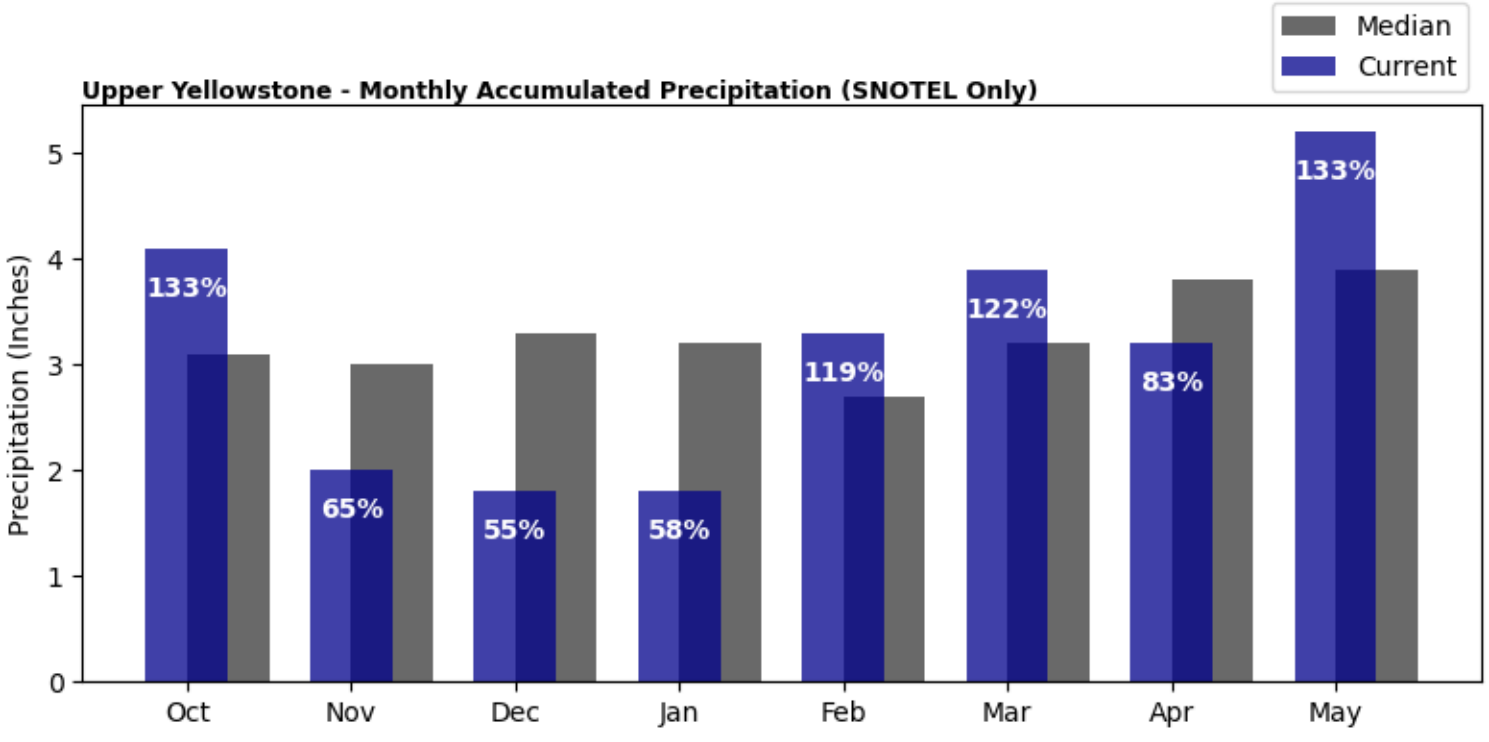
St. Mary (Continued)

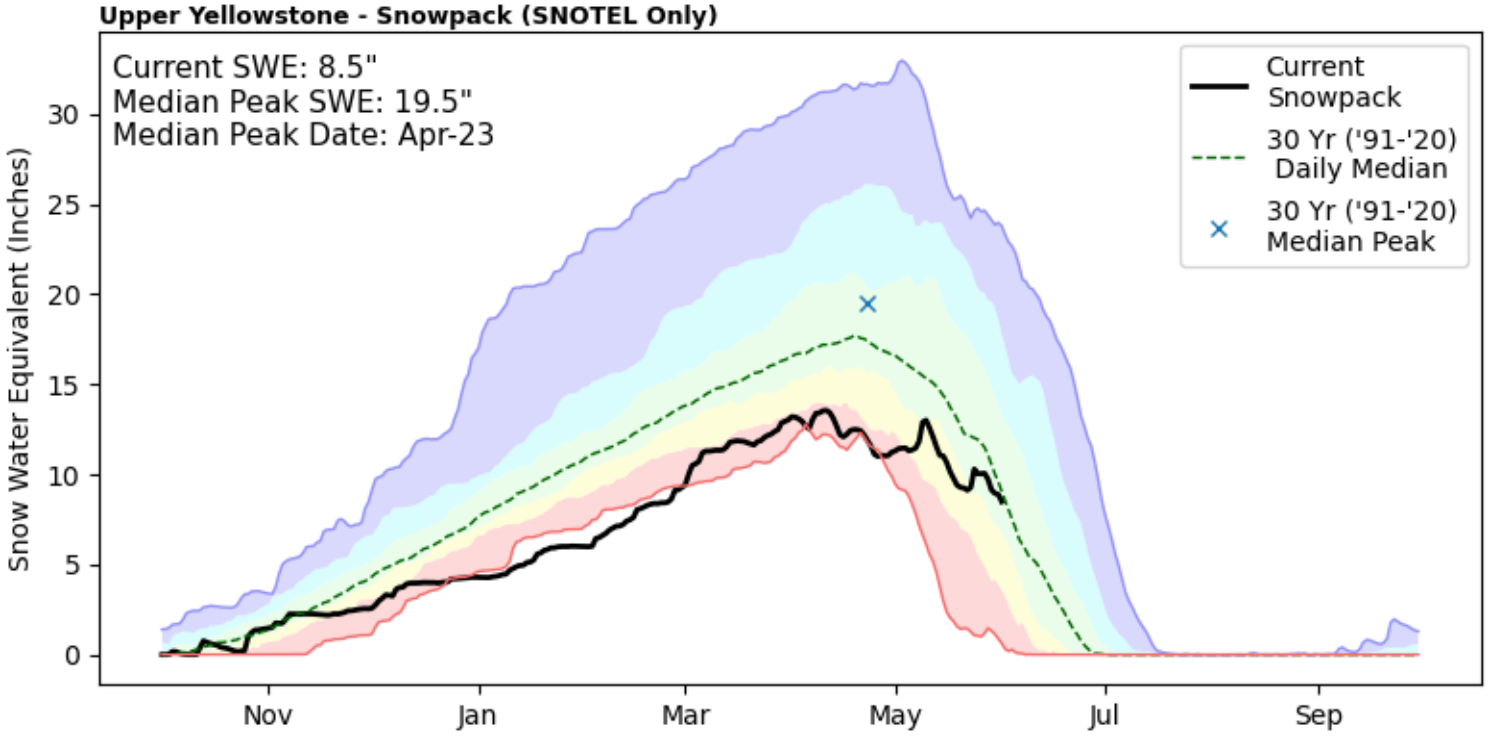


Basin Overview

Upper Yellowstone

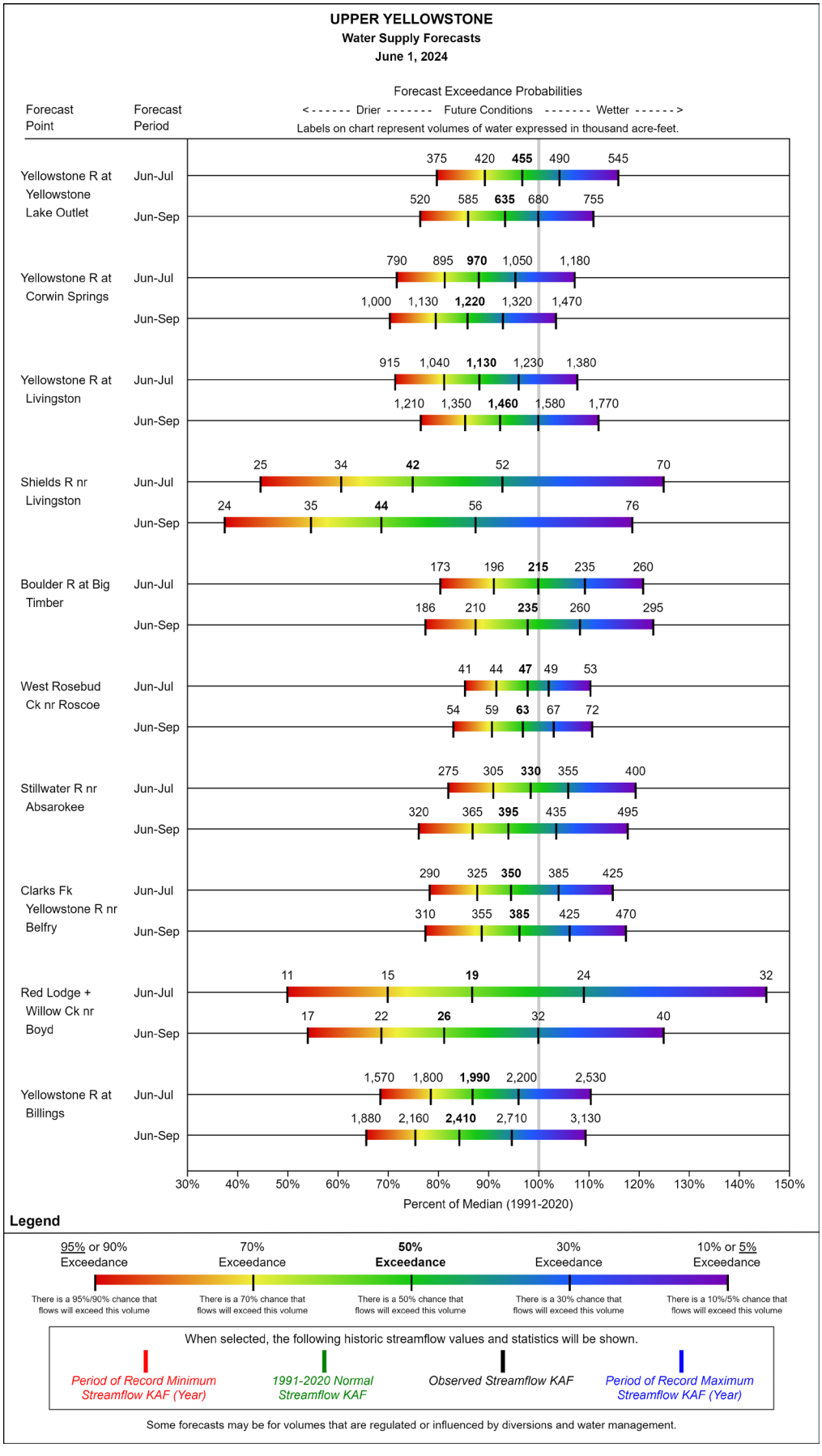
Precipitation in May was well above normal at 133%, which brings the seasonal accumulation (October-May) to 94% of median. The snowpack in the Upper Yellowstone is below normal at 94% of median, compared to 48% at this time last year.





Basin Overview

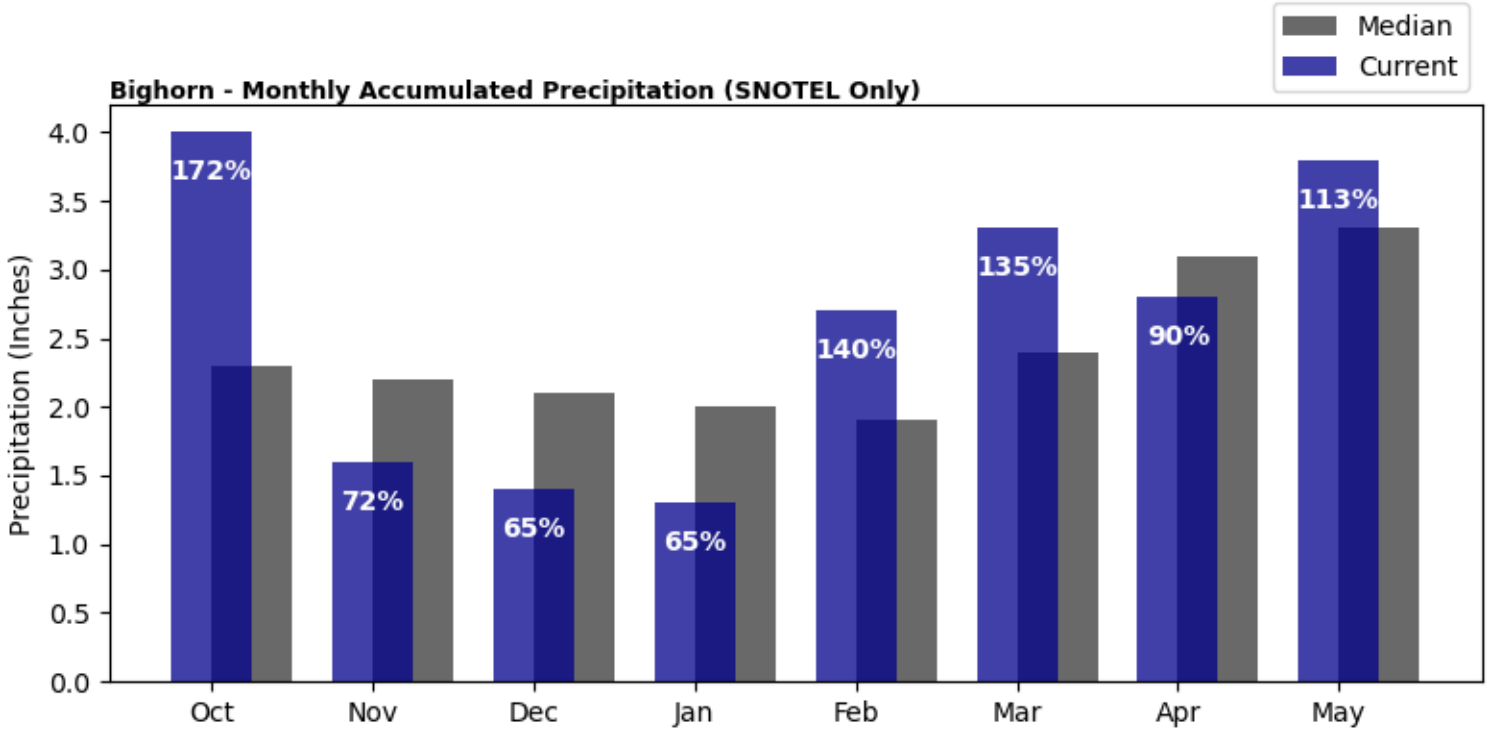
Upper Yellowstone (Continued)

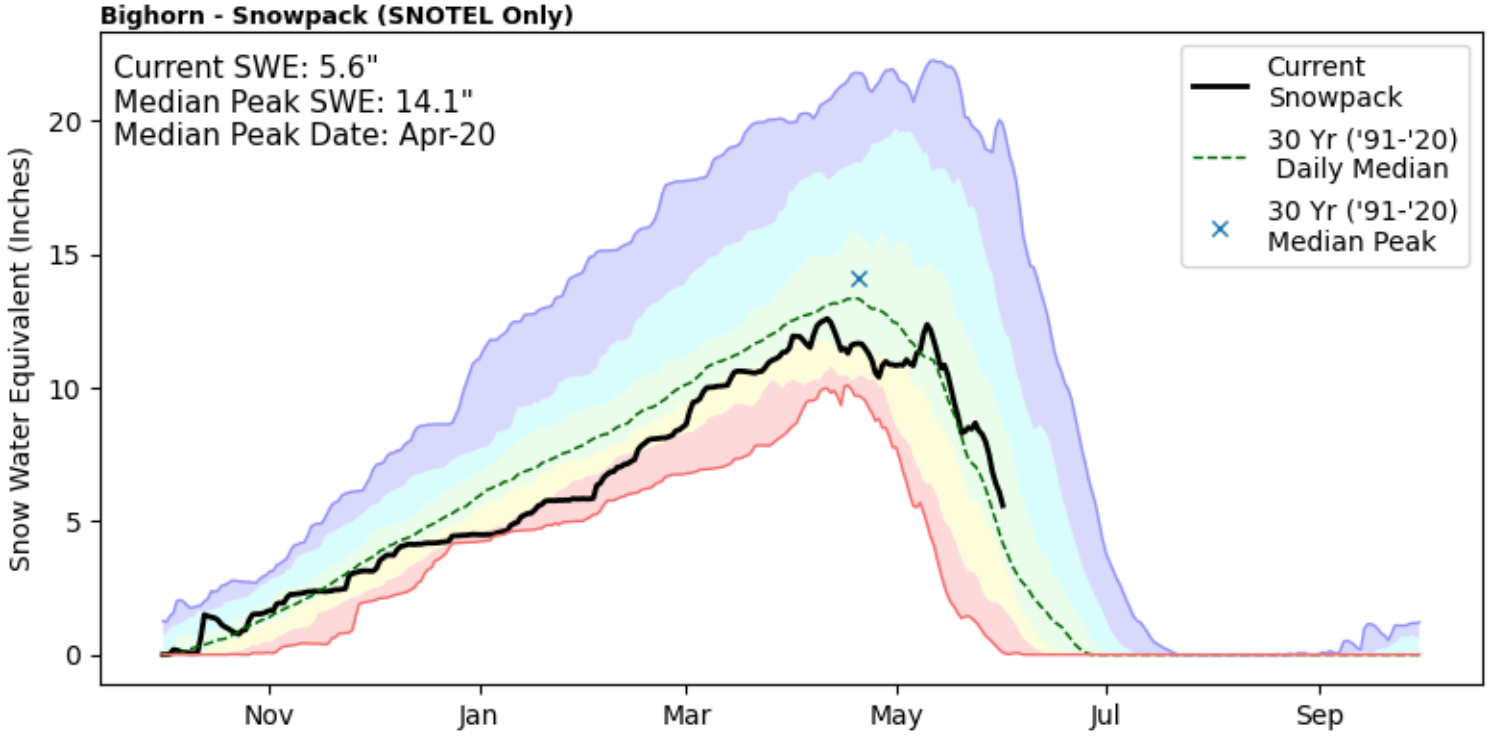


Basin Overview

Bighorn

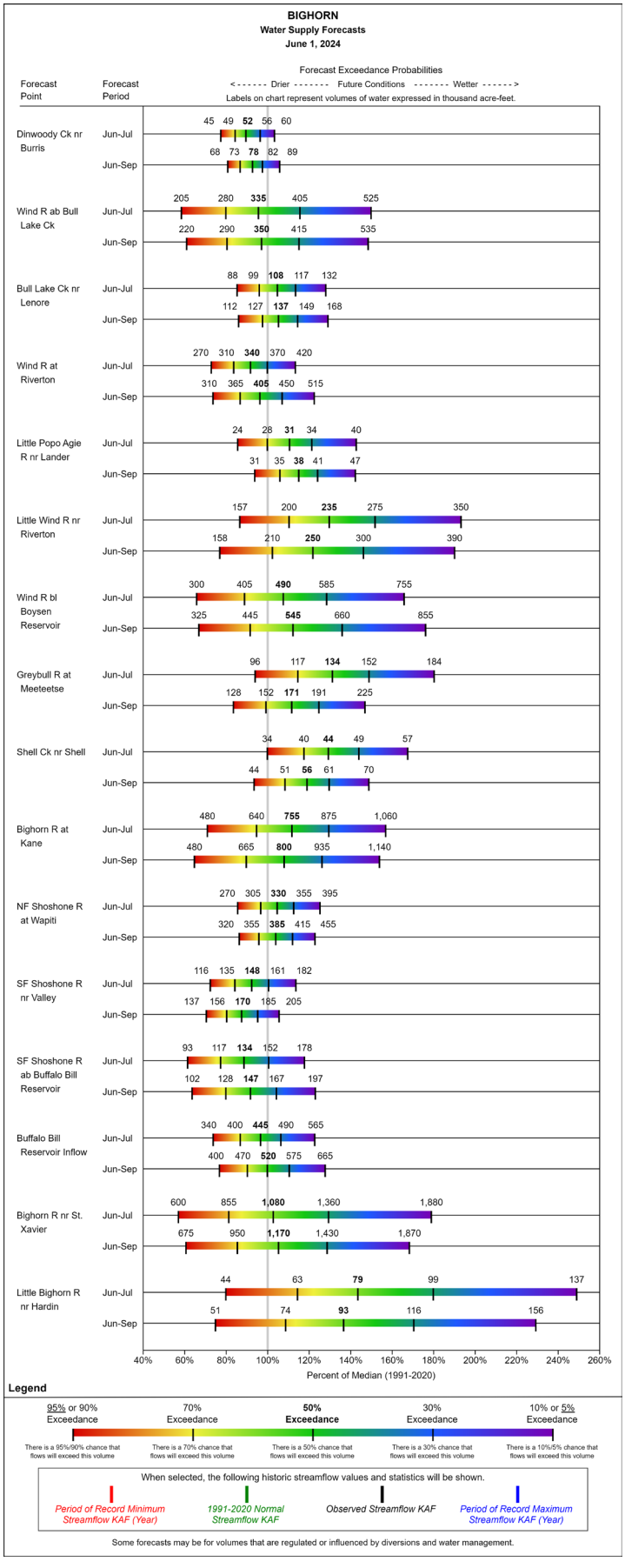
Precipitation in May was above normal at 113%, which brings the seasonal accumulation (October-May) to 102% of median. The snowpack in the Bighorn is well above normal at 134% of median, compared to 45% at this time last year.





Basin Overview

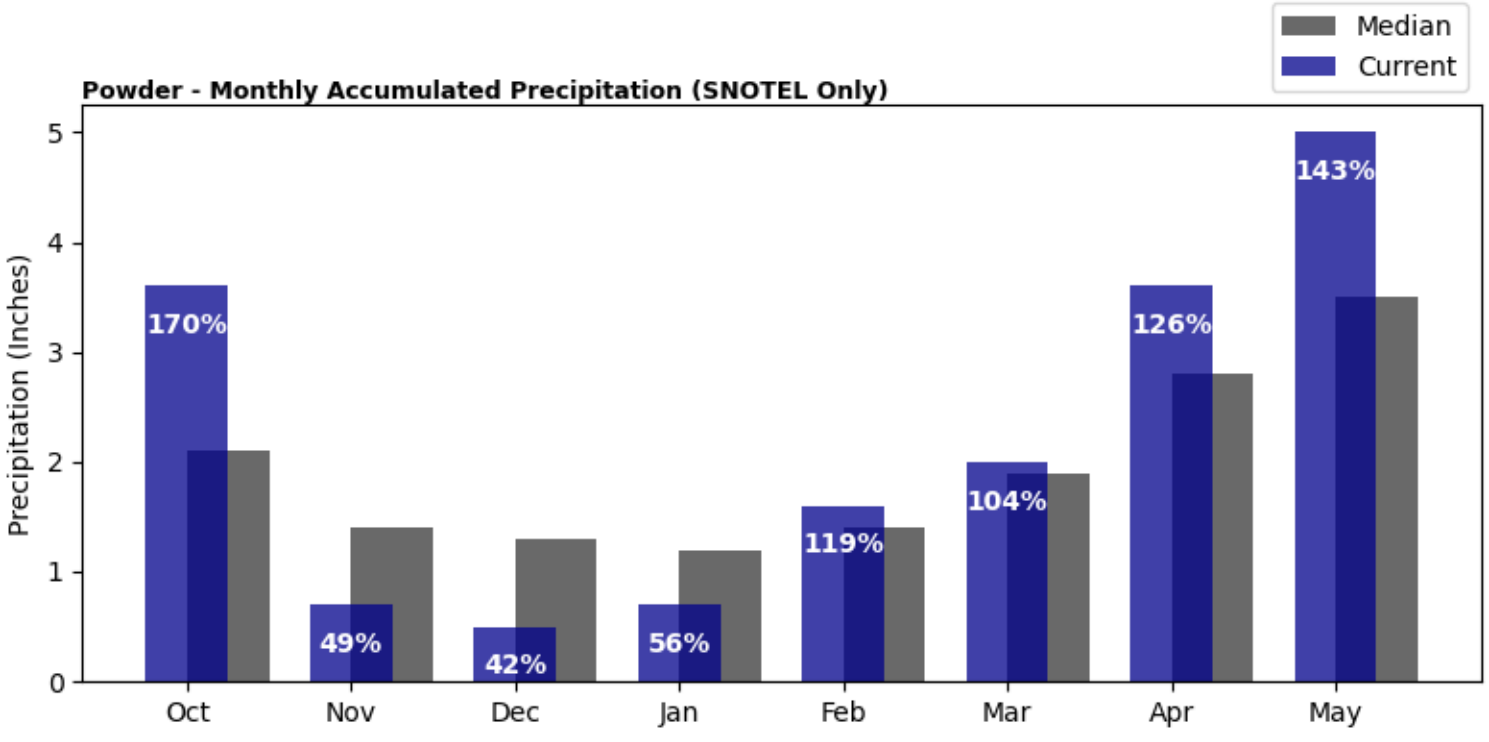
Bighorn (Continued)

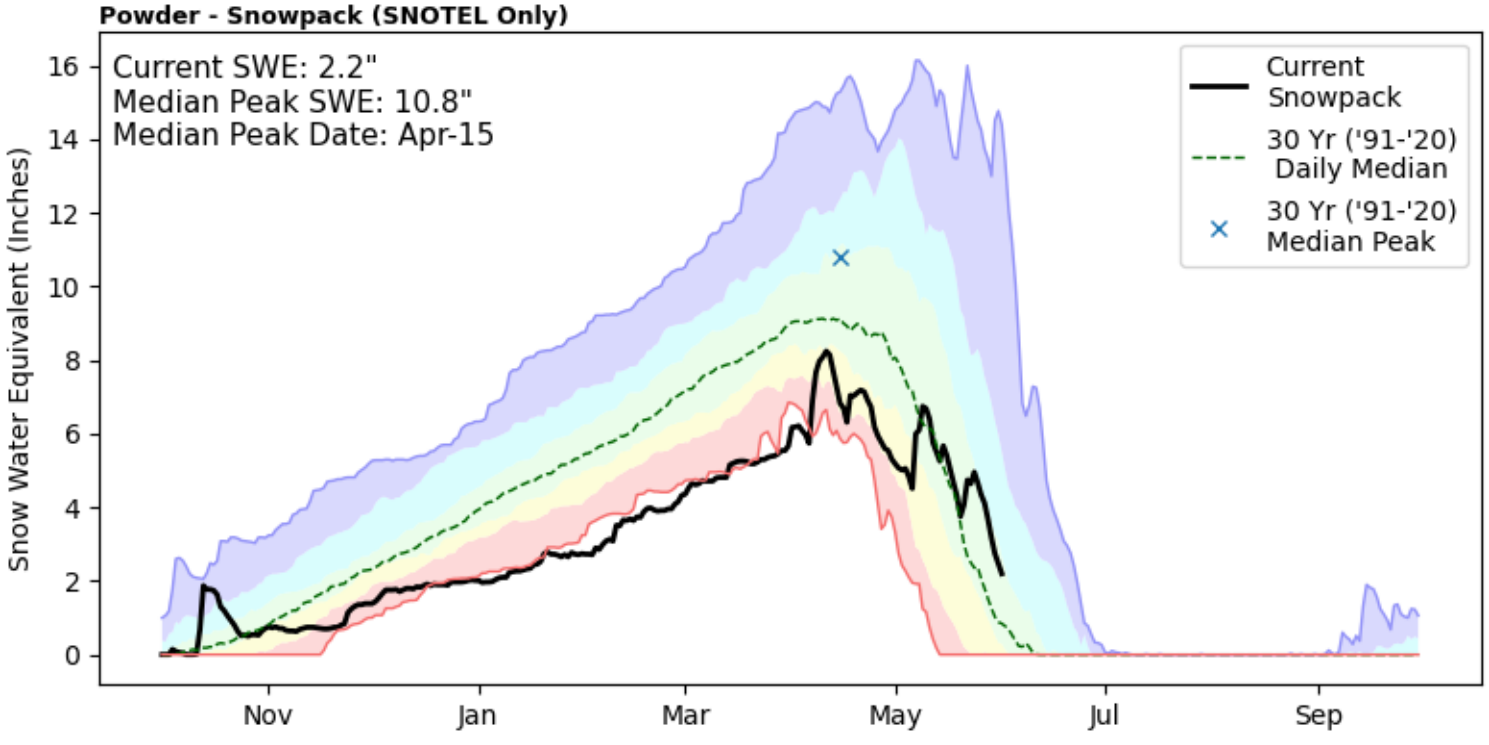


Basin Overview

Powder

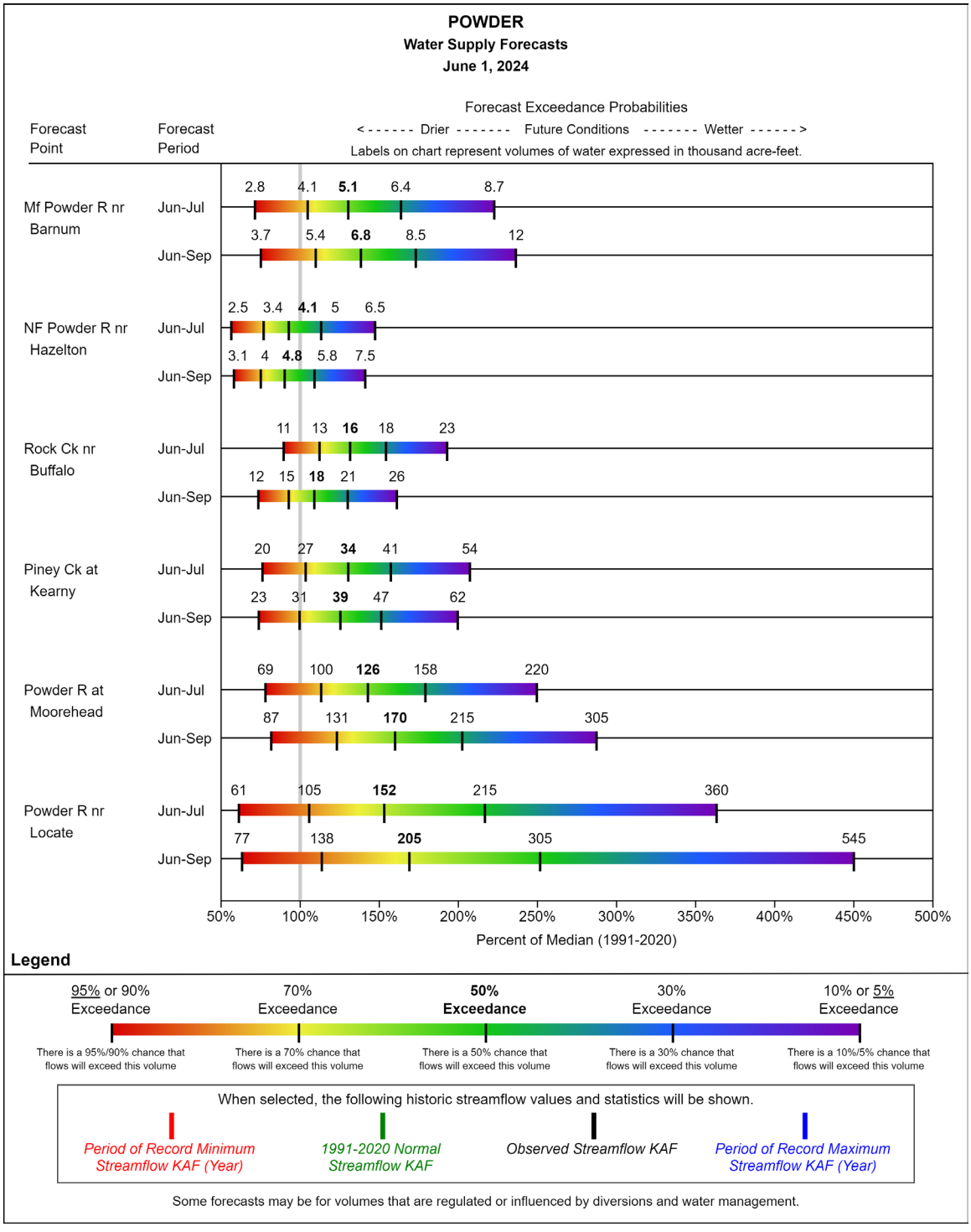
Precipitation in May was well above normal at 143%, which brings the seasonal accumulation (October-May) to 105% of median. The snowpack in the Powder is well above normal at 261% of median, compared to 10% at this time last year.





Basin Overview

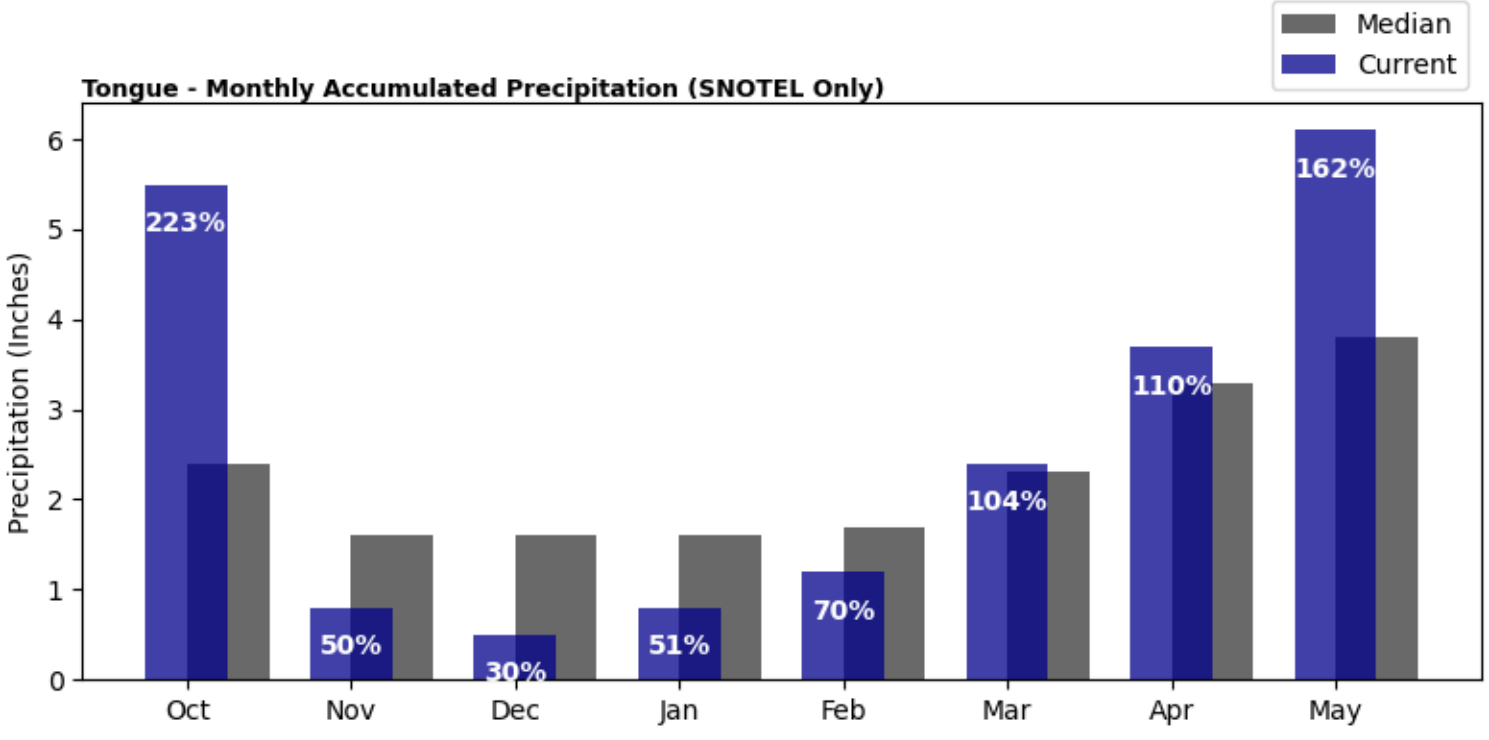
Powder (Continued)

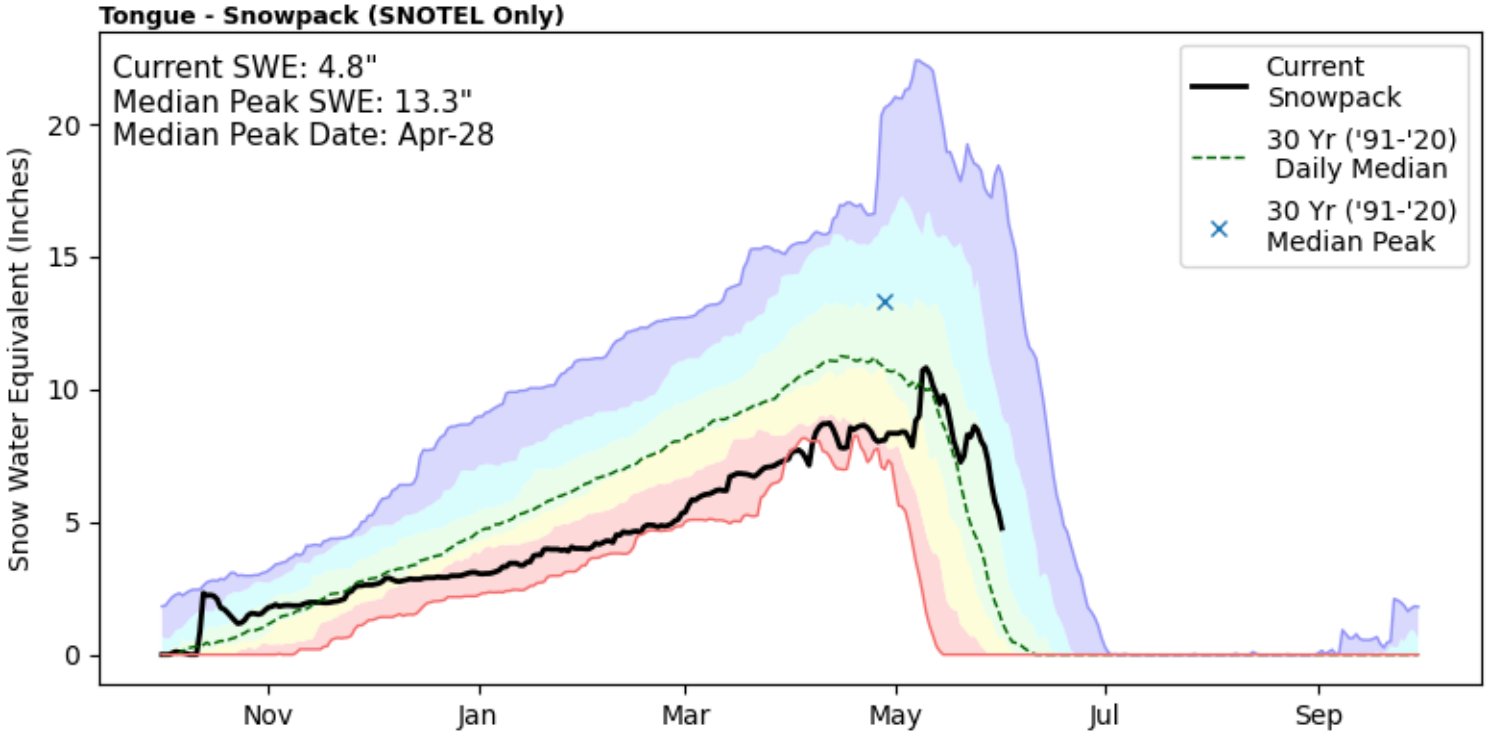


Basin Overview

Tongue

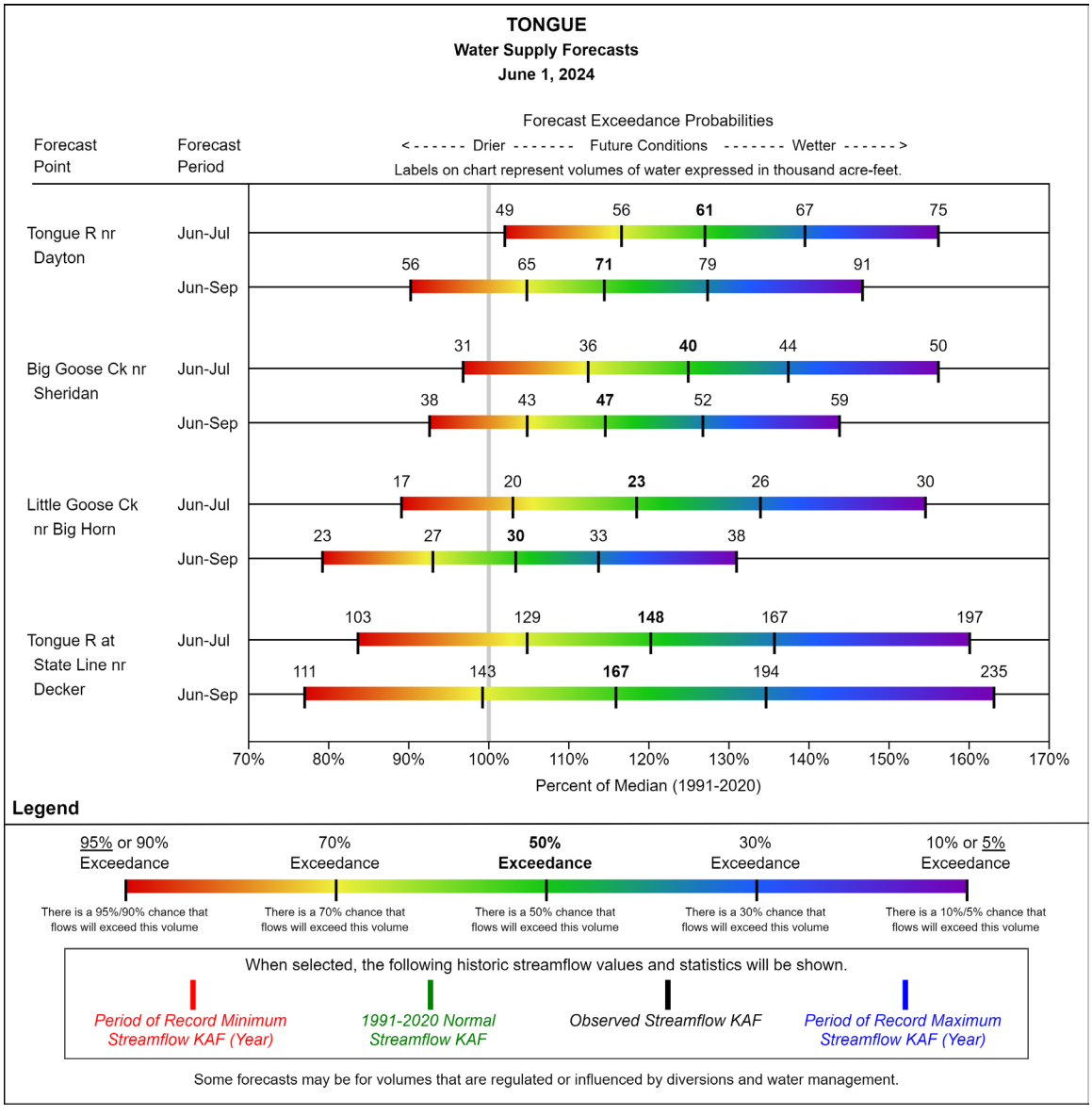
Precipitation in May was well above normal at 162%, which brings the seasonal accumulation (October-May) to 103% of median. The snowpack in the Tongue is well above normal at 380% of median, compared to None% at this time last year.





Basin Overview

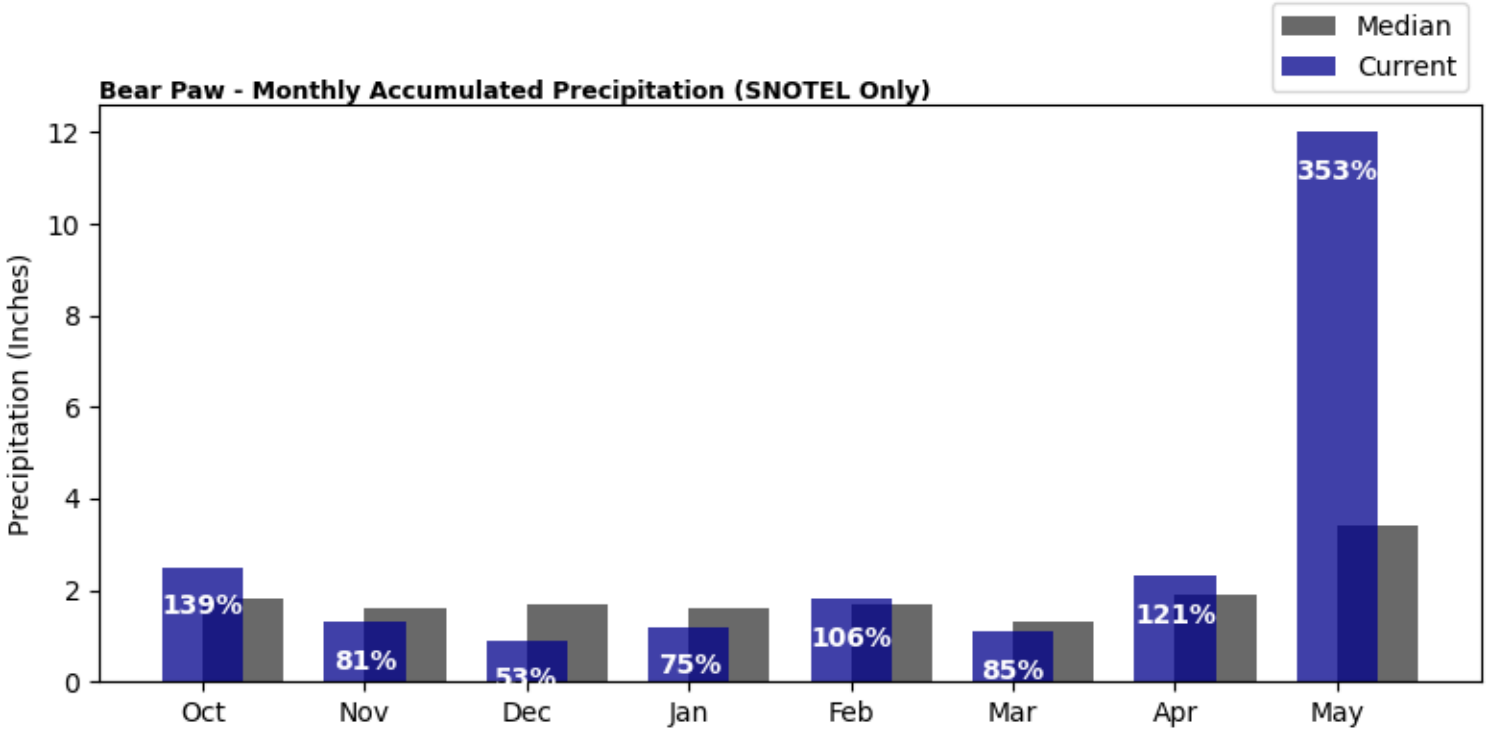
Tongue (Continued)

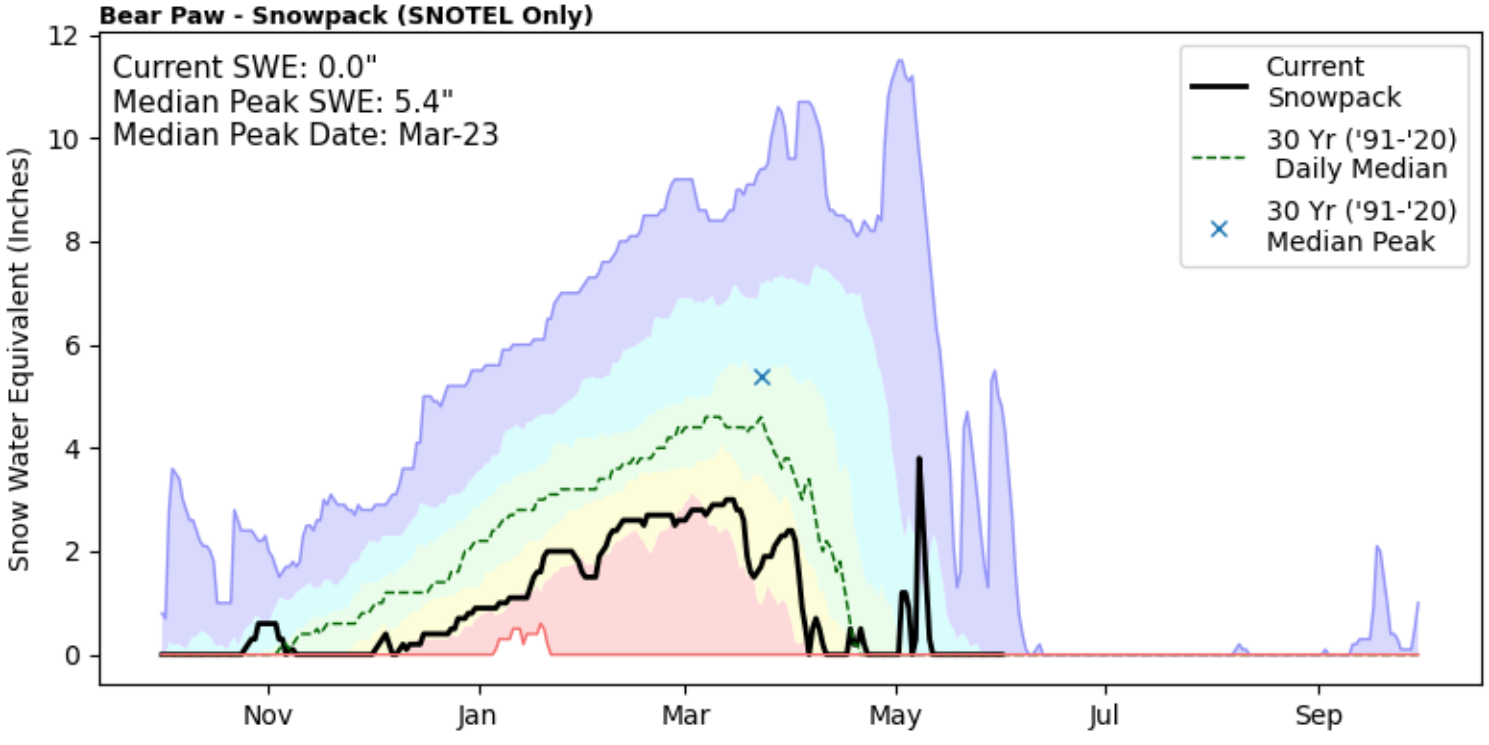


Basin Overview

Bear Paw

Precipitation in May was well above normal at 353%, which brings the seasonal accumulation (October-May) to 143% of median. The snowpack in the Bear Paw is None at None% of median, compared to None% at this time last year.





Appendix

Water Supply Forecast Information

Most of the annual streamflow in the Western United States originates as snowfall that has accumulated high in the mountains during winter and early spring. As the snowpack accumulates, hydrologists estimate the runoff that will occur when it melts. Predictions are based on careful measurements of snow water equivalent at selected index points. Precipitation, temperature, soil moisture and antecedent streamflow data are combined with snowpack data to prepare runoff forecasts.

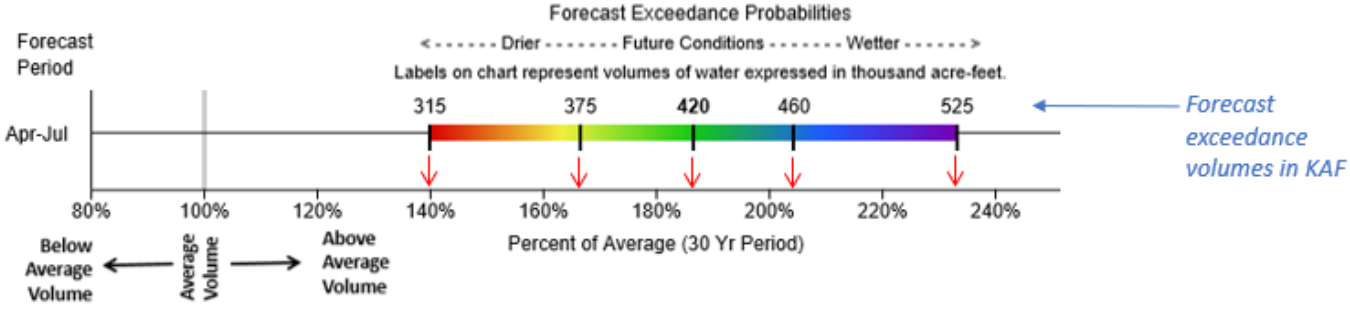
Forecast uncertainty originates from two sources: (1) uncertainty of future hydrologic and climatic conditions, and (2) error in the forecasting procedure. To express the uncertainty in the most probable forecast, four additional forecasts are provided. The actual streamflow can be expected to exceed the most probable forecast 50% of the time. Similarly, the actual streamflow volume can be expected to exceed the 90% forecast volume 90% of the time. The same is true for the 70%, 30%, and 10% forecasts. Generally, the 90% and 70% forecasts reflect drier than normal hydrologic and climatic conditions in the coming months; the 30% and 10% forecasts reflect wetter than normal conditions. As the forecast season progresses, a greater portion of the future hydrologic and climatic uncertainty will become known, and the additional forecasts will move closer to the most probable forecasts.

Interpreting Water Supply Forecast Charts

Typically, the Natural Resources Conservation Service (NRCS) has presented streamflow forecasts as a table format showing the five exceedance probabilities compared to the 30-year average as follows:

	Forecast Exceedance Probabilities for Risk Assessment Chance that actual volume will exceed forecast						
Forecast Period	90% (KAF)	70% (KAF)	50% (KAF)	% Avg	30% (KAF)	10% (KAF)	30yr Avg (KAF)
APR-JUL	315	375	420	187%	460	525	225

The Forecast Chart provides a visual alternative to the table. The forecast range is represented by a colored bar. Vertical lines on the bar signify the five forecast exceedances. Below is an example. The numbers above the forecast bar are the five exceedance probability volumes in thousand acre-feet (KAF). Each exceedance forecasts percent of median can be estimated by looking at the horizontal axis. The gray line centered above 100% on the horizontal axis represents the 1991-2020 historical median streamflow for the forecast period.



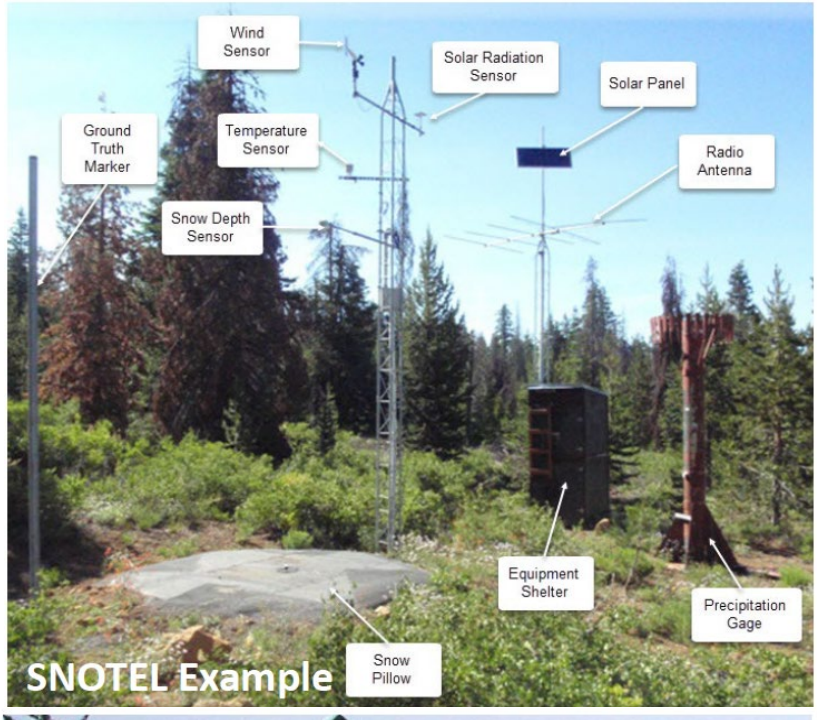
In the example, the entire forecast bar is shifted right of the gray line indicating a forecast for above normal streamflow. The 50% exceedance is represented by the black line in the green portion of the colored bar. This represents a forecast volume of 420KAF which is ~185% of average. If drier than normal future conditions occur the 70% exceedance forecast may be more likely (375KAF or ~165% of average). If future conditions turn wetter than normal, the 30% exceedance forecast may be more likely (460KAF or ~205% of average). Water users are encouraged to consider the range of forecast exceedances instead of relying solely only on the 50% forecast.

Appendix

Monitoring Station Overview

SNOTEL

The NRCS operates an extensive, automated data collection network called SNOTEL (short for Snow Telemetry). SNOTEL sites are designed to operate unattended in remote mountain locations. Data are collected and transmitted hourly and available on the internet. Daily data (midnight values) are quality checked by NRCS hydrologists on at least a weekly basis. SNOTEL sites provide snowpack water content data via a pressure-sensing snow pillow. Other data include snow depth, water year precipitation accumulation, air temperature with daily maximums, minimums, and averages. The earliest NRCS SNOTEL sites have data back to the mid-1970s.



Snow Course

Snow courses are measurement transects where snow tubes are used by snow surveyors during the winter season to determine the depth and water content of the snowpack. Hollow snow tubes are used to vertically core the snowpack. The tubes are then weighed to determine the water content of the snow. Generally, snow courses are situated in meadows or forest openings protected from the wind. A snow course measurement is the average of a number of sample points, typically 5 or 10. Snow courses are measured on a monthly basis typically between January 1 and June 1. Snow courses provide a longer record than SNOTEL. The earliest snow courses in the Montana have data back to the 1920s.

Snow Water Equivalent (SWE)

Sometimes also called snow water content, this is the amount of water contained within the snowpack. It can be thought of as the depth of water (in inches) that would result if you melted the snowpack. For example, if a snowpack containing 12” of SWE melted instantaneously, there would be a puddle of water 12” deep on the ground.

SWE measurements made by snow pillows or snow tubes rely on the fact that water weighs the same whether it is liquid or frozen.

Weight of frozen water = Weight of liquid water

Snow core inside snow tubes

Appendix

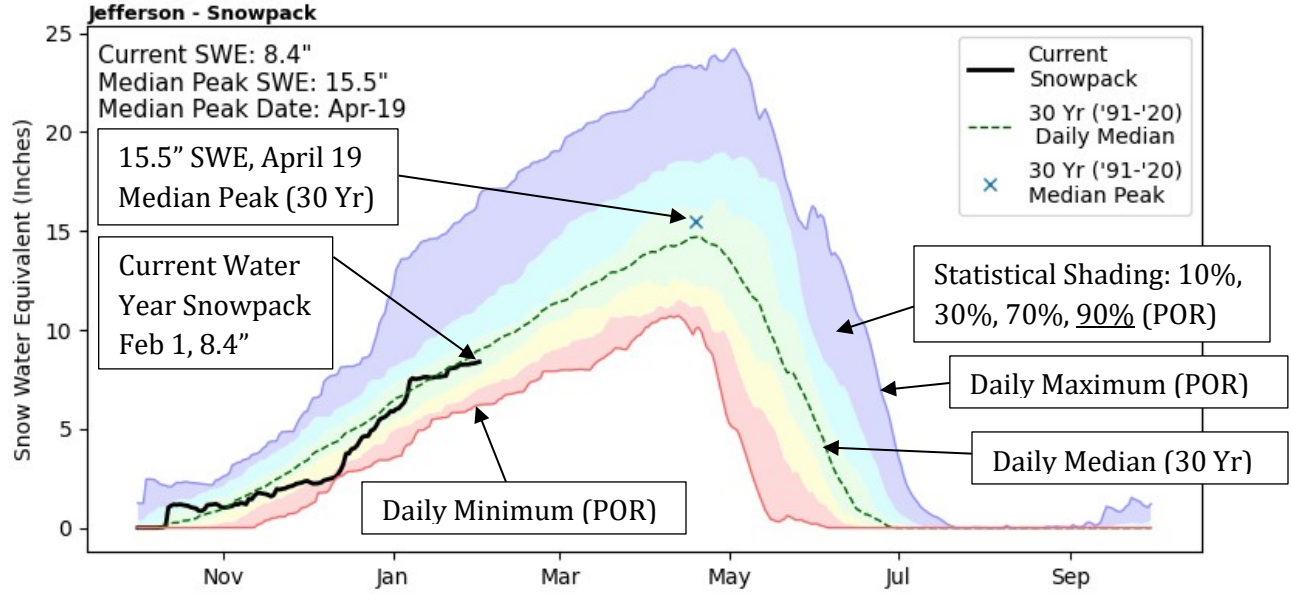
Additional Information

Climatic and Hydrologic Normals

The Snow Survey and Water Supply Forecasting (SSWSF) normals are site-specific measures of central tendency (either the median or average) for a data type, such as snow water equivalent (SWE). The statistics are calculated over a 30-year period and updated each decade, in agreement with World Meteorological Organization (WMO) standards. This 30-year reference period was chosen to characterize the current hydroclimatology at each station. The most recent medians and averages have been updated to include data for the water years 1991-2020. The National Water and Climate Center (NWCC) also provides medians and averages for the 1981-2010 and 1971-2000 reference periods for stations with sufficient data. The normals available from the NWCC include the median and average for SWE, snow depth (snow courses only), precipitation, volumetric streamflow, and reservoir storage. Values are calculated from data collected by NRCS-managed stations and external agencies such as the U.S. Geological Survey (USGS), National Weather Service (NWS), state agencies, and private organizations. Normal is calculated for various durations including daily, month-to-date, semi-monthly, monthly, seasonal, and annual based on the data type. More information is available here: https://www.nrcs.usda.gov/resources/data-and-reports/climatic-and-hydrologic-normals

Interpreting Snowpack Charts

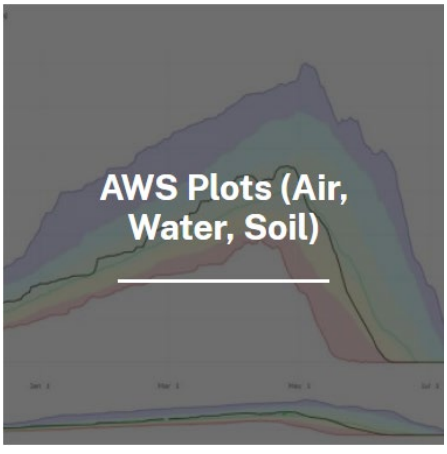
Snowpack charts displayed in this report are created using daily (midnight) snow water equivalent (SWE) values at SNOTEL sites determined to represent the basin. Snow Course data is not included. Plotted lines are the average of each SNOTEL's individual values. For example, the "Current Snowpack" on January 1st is the average all SNOTEL SWE values in that basin for that day. The "30 Yr. ('91-'20) Daily Median" is the average of each SNOTEL's median SWE value for a given day. The upper and lower extent (blue/red lines) show the maximum/minimum daily SWE values, which is determined using the "Current Snowpack" SWE value for all days in the period of record (POR). Snowpack peak SWE dates differ from season to season, as a result the high point on the "30 Yr. ('91-'20) Daily Median" line is not the true median peak SWE. The point "X" is plotted by calculating the median peak date and median peak value independently. Similar charts with other basin definitions are available here: https://nwcc-apps.sc.egov.usda.gov/basin-plots/#mt

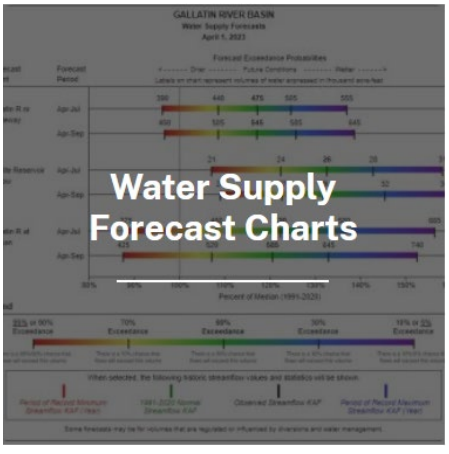


Appendix

Links and Resources

Products and Reports (click image)





Interactive Map Predefined Links

Snow

- Snow Water Equivalent > Daily > Percent of 1991-2020 Median > **Stations** | **Basins**
- Snow Water Equivalent > End of Previous Month (SNOTEL and Snow Course) > Percent of 1991-2020 Median > **Stations** | **Basins**
- Snow Depth > Daily > **Stations**
- Snow Density > End of Previous Month (SNOTEL and Snow Course) > **Stations**

Precipitation

- Month-to-Date > Daily > **Stations**
- Water Year-to-Date > Daily > Percent of 1991-2020 Median > **Stations** | **Basins**
- Previous Month > Percent of 1991-2020 Median > **Stations** | **Basins**
- Previous 3 Months > Percent of 1991-2020 Average > **Stations** | **Basins**

Streamflow

- Observed (Adjusted Volume) > Previous Month > Percent of 1991-2020 Median > **Stations** | **Basins**
- Forecast (Adjusted Volume) > Most Recent (Available March 1 through June 1) > Percent of 1991-2020 Median > **Stations** | **Basins**

Reservoir Storage

- End of Previous Month > Percent of 1991-2020 Median > **Stations**

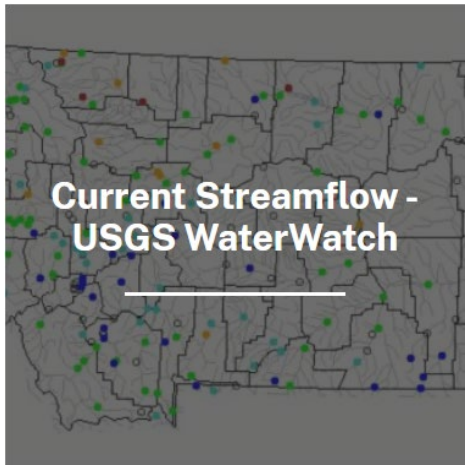
Other

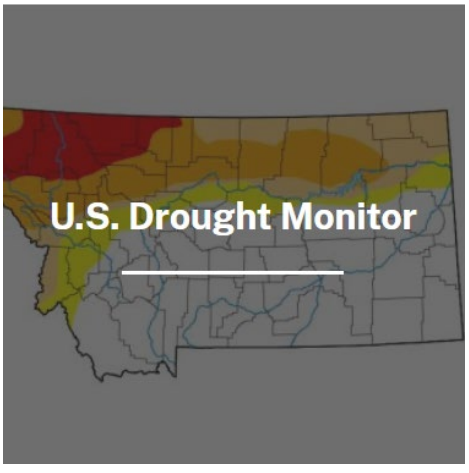
- Snow Water Equivalent > Daily > Compared to POR > **Stations**
- Snow Water Equivalent > End of Previous Month (SNOTEL and Snow Course) > Percentile > **Stations**
- Water Year-to-Date Precipitation > Daily > Compared to POR > **Stations**

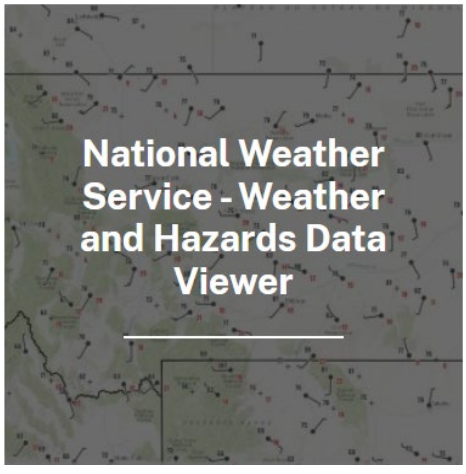
Appendix

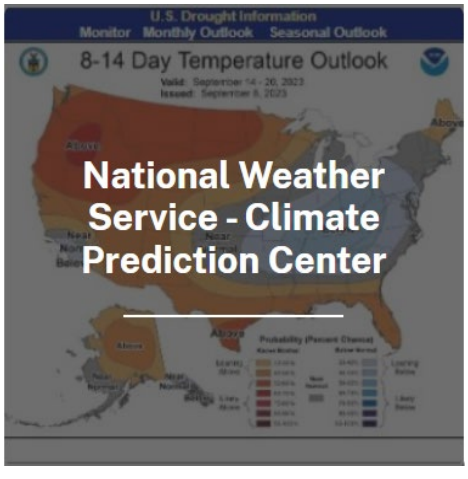
Links and Resources (Continued)

External Agencies (click image)









Additional Drought Information

- U.S. Drought Monitor
- National Integrated Drought System (Drought.gov)
- USDA Drought Portal (News and Resources)
- Farm Services Agency Montana News Releases (Information on Programs and Deadlines)
- Farm Services Agency Disaster Assistance Programs
- Montana Department of Natural Resources and Conservation Drought Management

Snow Survey Program FAQ

Frequently Asked Snow Survey Questions - Montana | Natural Resources Conservation Service (usda.gov)

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