Montana Water Supply Outlook Report

March 1, 2024

During July 2023, Elk Peak SNOTEL in the Castle Mountains was relocated about one mile away to the original Elk Peak Snow Course. The snow course has been measured manually for March 1 surveys since 1963 and the new SNOTEL will eventually eliminate the need to manually measure the snow course. Pictured is the new Elk Peak Alt SNOTEL taken during March 1, 2024, snow course surveys. While winter weather over the last 7 days added to the snowpack, the snow course remains below normal for March 1. Montana received above normal precipitation during February, but like the Castle Mountains, above normal precipitation is still needed to recover from lack of snow earlier this season. (Photo: Lauren Austin 2/28/2024)

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Statewide Overview

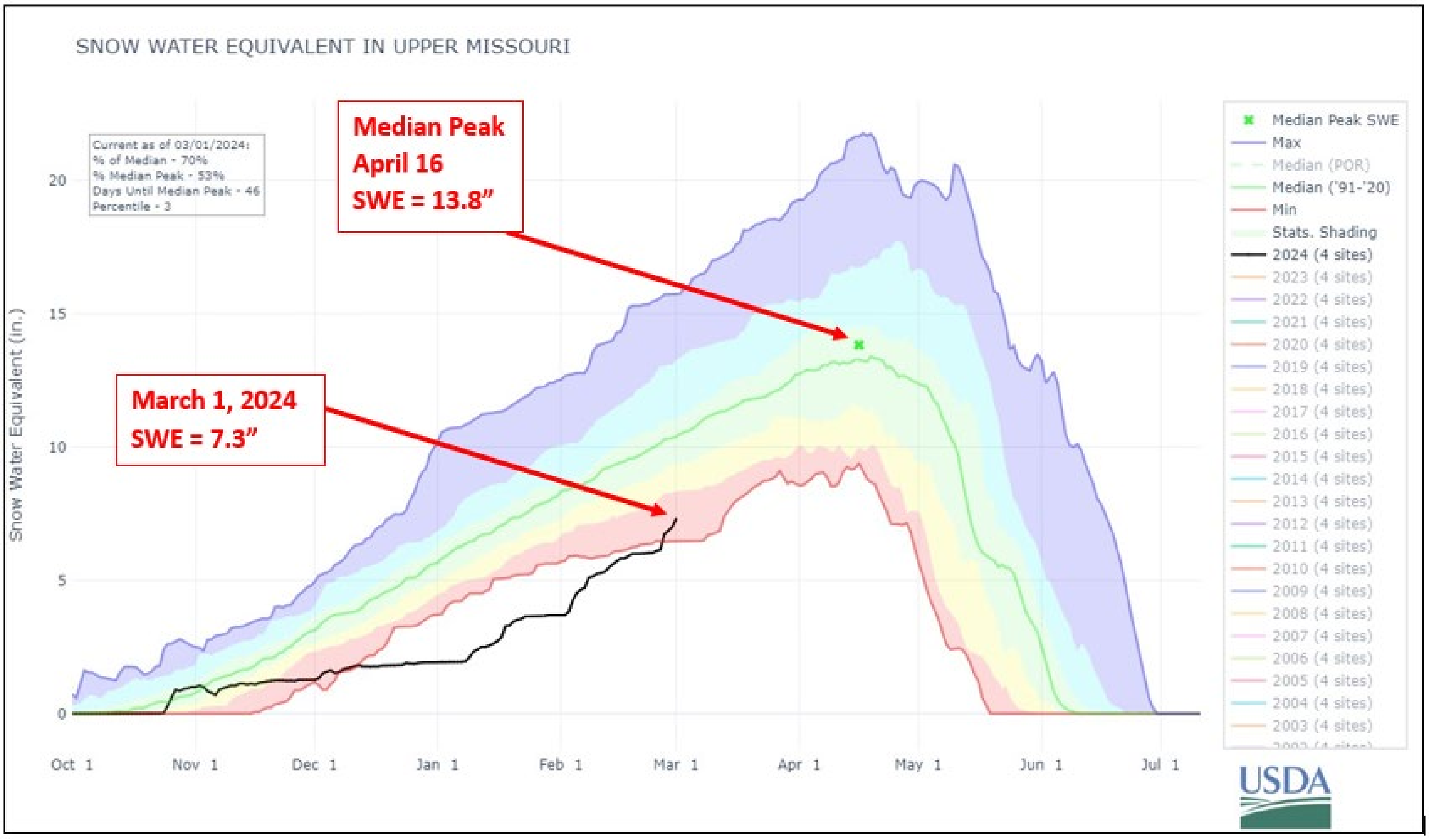
Summary

Following an exceptionally slow start to the water year, winter weather arrived in February and provided much needed precipitation to the region. Precipitation last month was above normal in all but the northern Bighorn Mountains. Snowpack percentages have increased in all basins, but overall, the snowpack remains below normal. The recent improvements were timely, but there are only one to two months remaining in the normal snow accumulation season and more snow is needed.

On January 1, the snowpack at about 110 of 175 NRCS snow monitoring stations reported their lowest or second lowest snowpack on record in Montana. On March 1, less than 60 of 230 stations reported their lowest or second lowest snowpack on record. March 1 snowpack numbers used in this report are calculated from March 1 SNOTEL data (00:00) and data from manually measured snow course surveys that are conducted the last week of February. Since the time that most of those measurements were conducted, a winter storm swept across western Montana. The snowpack has improved from this early March storm, but only put a dent in the large upper elevation snowpack deficits.

Water Supply forecasts are published in the March 1 through June 1 Water Supply Outlook Reports. Given the overall below normal snowpack on March 1, streamflows are expected to be below normal for the April-July and April-September periods. With one to two months remaining in the normal snowpack accumulation season, continued active weather will be needed to make further gains on the snowpack deficit.

The following chart displays the exceptional improvement in snowpack conditions in the mountains surrounding Helena. From early December to mid-February the basin wide snowpack was the lowest on record. Substantial precipitation during February significantly improved the snowpack conditions, but more snow is needed.



Statewide Overview

Precipitation

The first widespread storm of February arrived about the same time the February 1 Water Supply Outlook was being published. That storm delivered 1-2 inches of precipitation to SNOTEL sites across Montana. During the second week of February, high elevation SNOTEL sites in northwest Montana received 2-5 inches of precipitation. Aside from a couple breaks mid-month, precipitation was fairly consistent during February. Closing out the month, a storm spanning February 24-29 delivered 2-5 inches of precipitation to upper elevations across the region. Another winter storm is sweeping through Montana during the first week of March providing much needed precipitation to the region.

Basin wide monthly precipitation totals at SNOTEL sites were above normal in all but the Tongue River basin, which only received about 70% of normal basin wide precipitation last month. Precipitation was near normal in the Bitterroot, Lower Clark Fork, Kootenai, Saint Mary, Gallatin and Upper Yellowstone River basins, however some higher elevation SNOTEL sites in those basins received 120-140% of normal precipitation. Basin wide precipitation was 110-150% of normal in all other Montana river basins. Substantial precipitation was exactly what was needed in order to begin a recover from the widespread lack of snow in Montana yet above normal precipitation will still be needed over the next couple months to compensate for water year deficits.

Despite above normal precipitation last month, water year precipitation remains below normal across Montana. Water year precipitation is about 70-80% of normal, except the Kootenai which is closer to 90%. The Bighorn, Powder, and Tongue River basins have received 90-100% of normal precipitation since October 1, 2023. Several SNOTEL sites in the southern Absaroka and Wind River Mountains are reporting 140-180% of normal water year precipitation, higher than the rest of the region, because of the mid-October storm that delivered 4-6 inches of precipitation. March, April, and May can be a very active time of the year for winter weather in Montana, which is good because winter weather needs to continue for a couple more months.

February - Highest Total Accumulated Precipitation - SNOTEL/SNOLITE

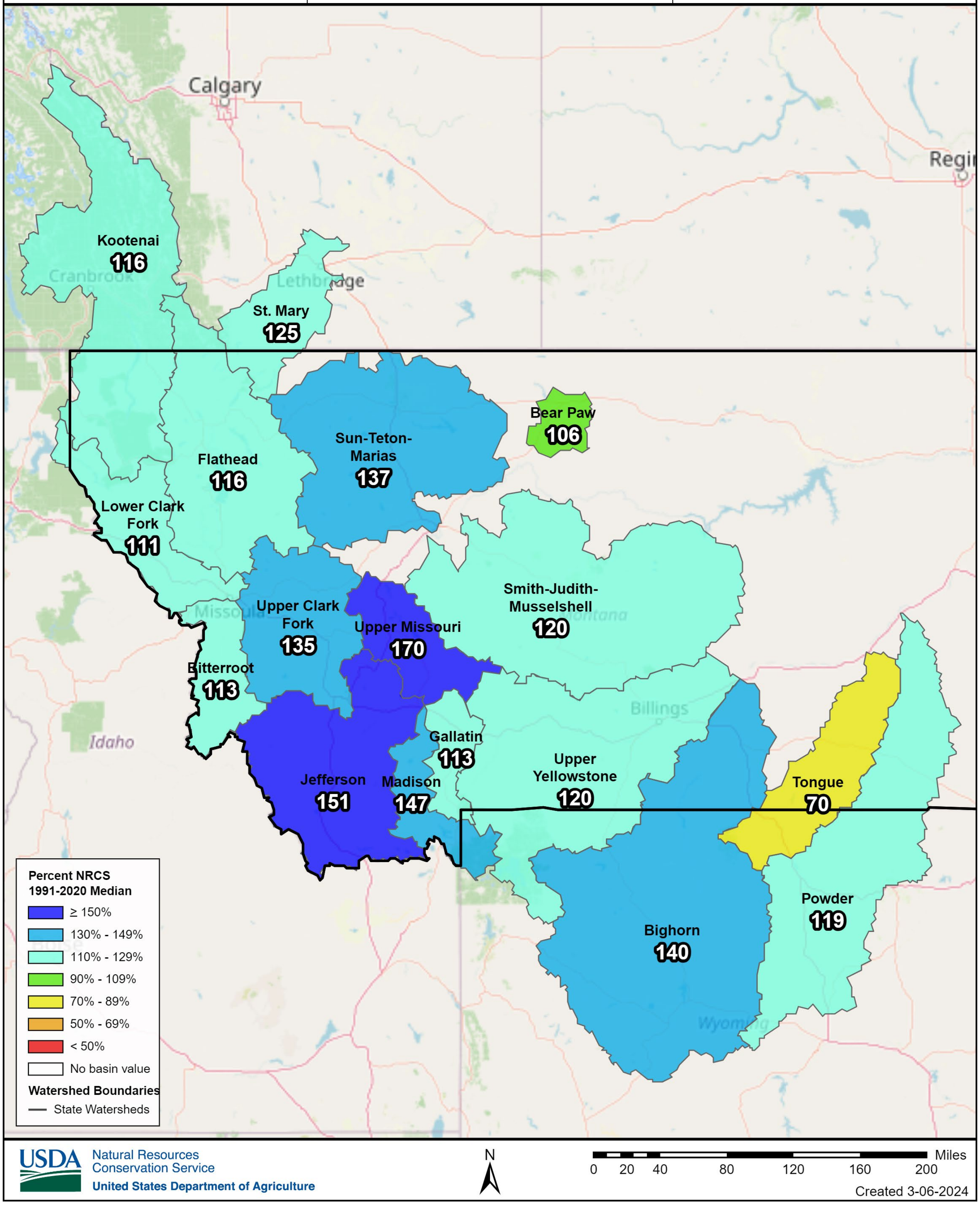
Station	Precipitation (Inches)	Median (Inches)	Elevation	Basin
Bear Mountain	10.2	9.0	5400	Kootenai, Lower Clark Fork
Black Bear	9.0	5.0	8170	Madison
North Fork Jocko	8.4	7.1	6330	Flathead, Upper Clark Fork
Hoodoo Basin	8.2	6.4	6050	Lower Clark Fork
Moss Peak	8.1	5.6	6780	Flathead

February - Lowest Total Accumulated Precipitation- SNOTEL/SNOLITE

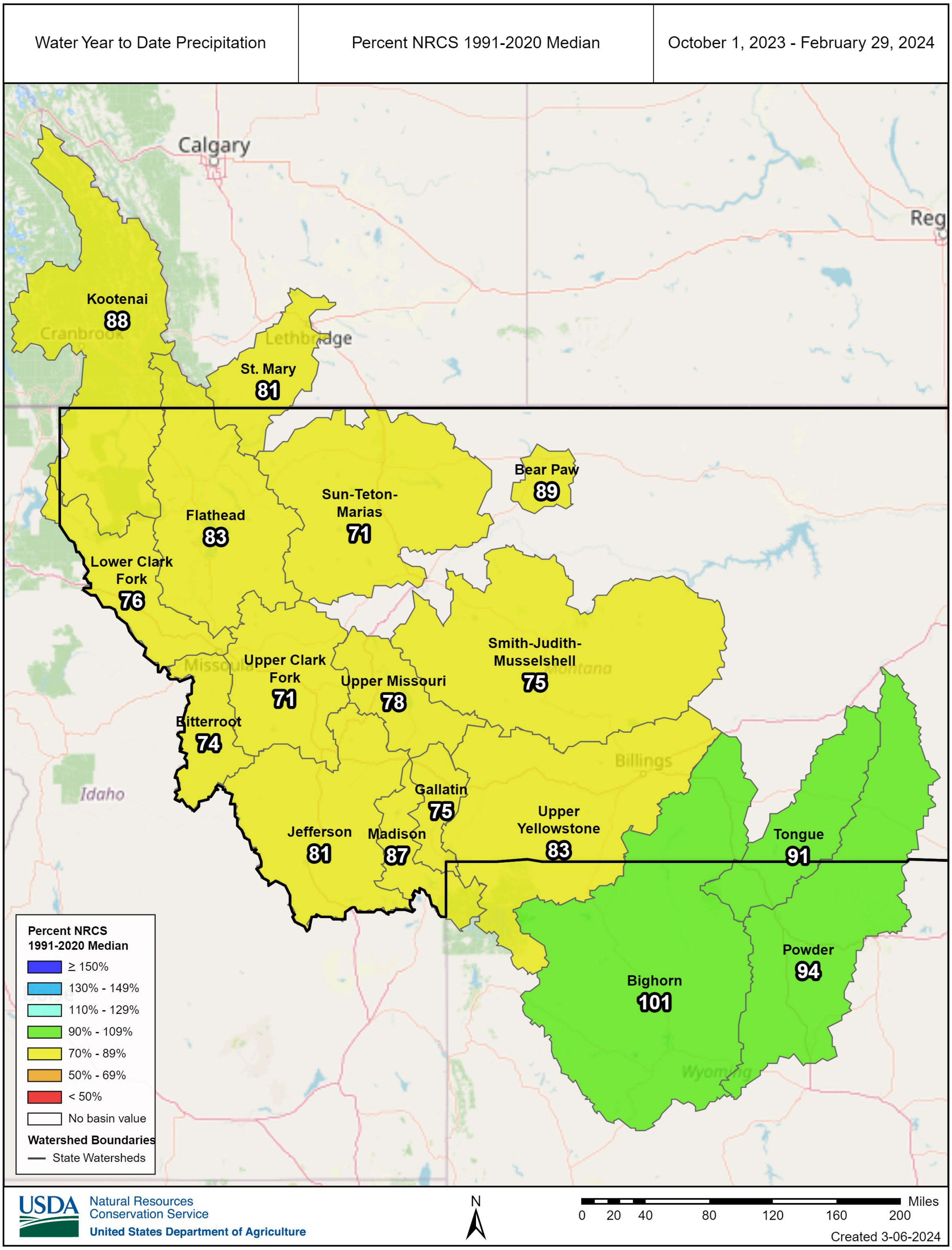
Station	Precipitation (Inches)	Median (Inches)	Elevation	Basin
Combination	0.3	1.2	5600	Upper Clark Fork
Burgess Junction	0.8	1.4	7880	Tongue
Tie Creek	0.9	1.4	6870	Tongue
Bear Trap Meadow	1.1	1.0	8200	Powder, Bighorn
Bone Springs Div	1.1	2.2	9350	Bighorn, Tongue

Precipitation (Continued)

1 month Precipitation	Percent NRCS 1991-2020 Median	February 1, 2024 - February 29, 2024



Precipitation (Continued)



Statewide Overview

Snowpack

Above normal precipitation during February resulted in an increase in basin wide snowpack percentages for all Montana and northern Wyoming river basins. Last month percentages were generally 40-60% of normal, while as of March 1 most percentages are about 65-75% of normal. The largest increase occurred in the Upper Clark Fork and Upper Missouri River basins which improved from about 40% to 70% of normal snowpack conditions. The Sun-Teton-Marias River basin and Bears Paw Mountains improved from about 30% to 50% of normal and the Powder River basin snowpack increased from about 50% to 60% of normal for March 1. The snowpack in the southern Absaroka and Wind River mountains is near to above normal, and as a result the Bighorn snowpack percentage is higher than the rest of Montana's major basins at 85% of normal.

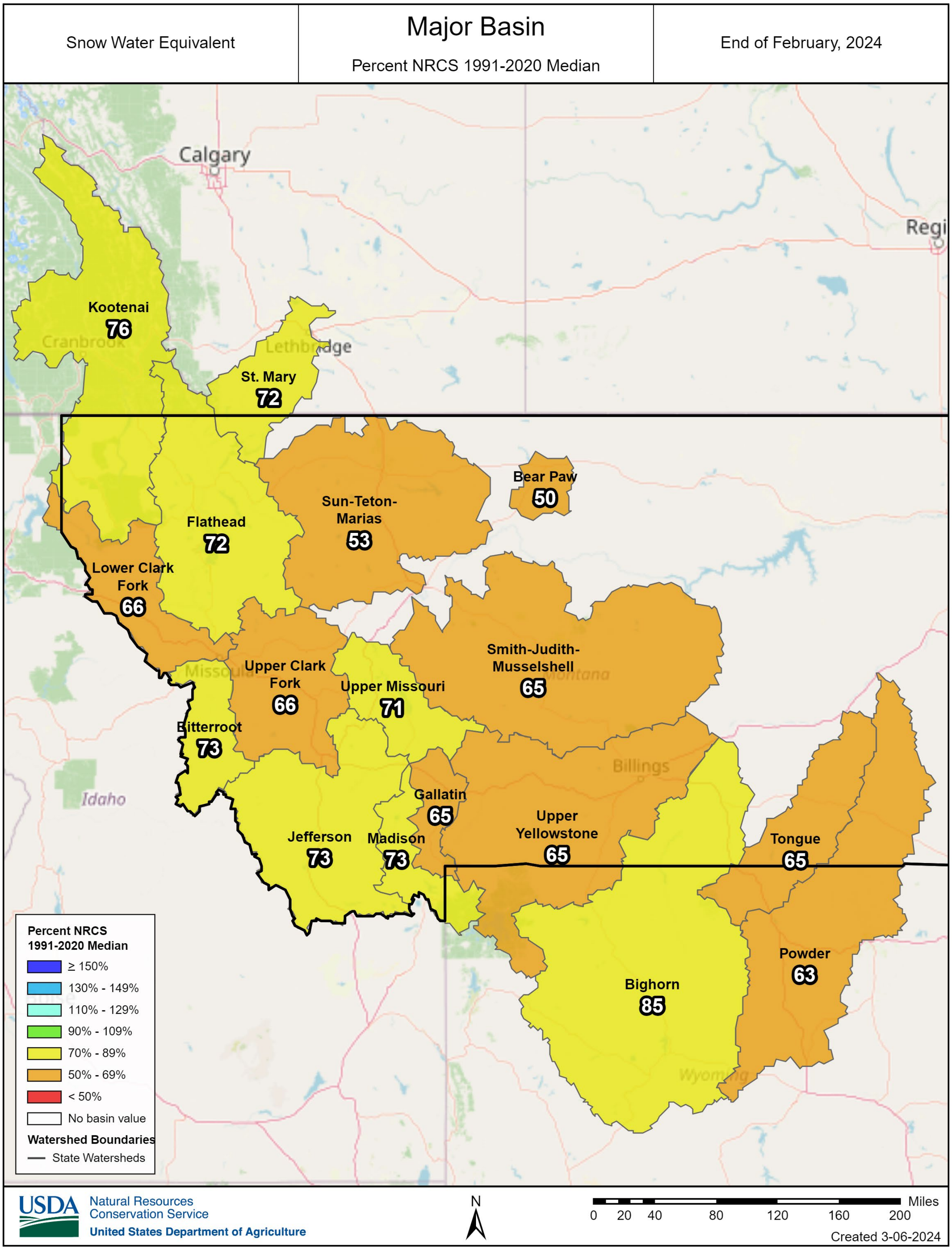
Recent improvements in the snowpack conditions were timely, but widespread deficits remain. While not as many NRCS snow stations are reporting their lowest snowpack on record compared to last month, 200 of about 255 stations still have a snowpack in the 25th percentile or less for their period of record. The largest deficits are at the highest mountain elevations across the state, where the snowpack on March 1 is 10-12" of snow water equivalent below normal. Examples include Poorman Creek SNOTEL (5100 ft - Cabinet Range), Upper Holland Lake SC (6200 ft - Swan Range), Twin Lakes SNOTEL (6400 ft – Bitterroot Range), Fisher Creek SNOTEL (9100 ft – Beartooth Range), and NF Jocko SNOTEL (6330 – Mission Range). Recent precipitation has only begun to make a dent in the upper elevation snowpack deficit, but lower mountain elevation conditions are starting to look better.

One to two months remain in the normal snowpack accumulation season. Upper elevations across Montana typically don't peak until early May but have peaked as late as June (2022, 2018, 2011). The snowpack at the highest elevation is only about 50-60% of normal peak seasonal levels, which in other words means they need to accumulate 18-20" of snow water equivalent to reach normal by May 1. The lowest elevation snow stations are still at least 2" below normal peak snow water equivalent levels. Active weather needs to continue for a couple more months to make up for lack of snow earlier this winter.

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	76	-	-	-
Flathead	67	63	53	65	72	-	-	-
Upper Clark Fork	116	37	36	44	66	-	-	-
Bitterroot	144	35	50	60	73	-	-	-
Lower Clark Fork	90	58	47	55	66	-	-	-
Jefferson	91	48	51	55	73	-	-	-
Madison	86	58	54	57	73	-	-	-
Gallatin	81	52	54	53	65	-	-	-
Upper Missouri	125	41	33	41	71	-	-	-
Smith-Judith-Musselshell	116	63	49	51	65	-	-	-
Sun-Teton-Marias	121	48	26	34	53	-	-	-
St. Mary	77	72	51	55	72	-	-	-
Upper Yellowstone	103	60	55	55	65	-	-	-
Bighorn	117	85	75	74	85	-	-	-
Powder	93	60	51	51	63	-	-	-
Tongue	154	87	59	60	65	-	-	-

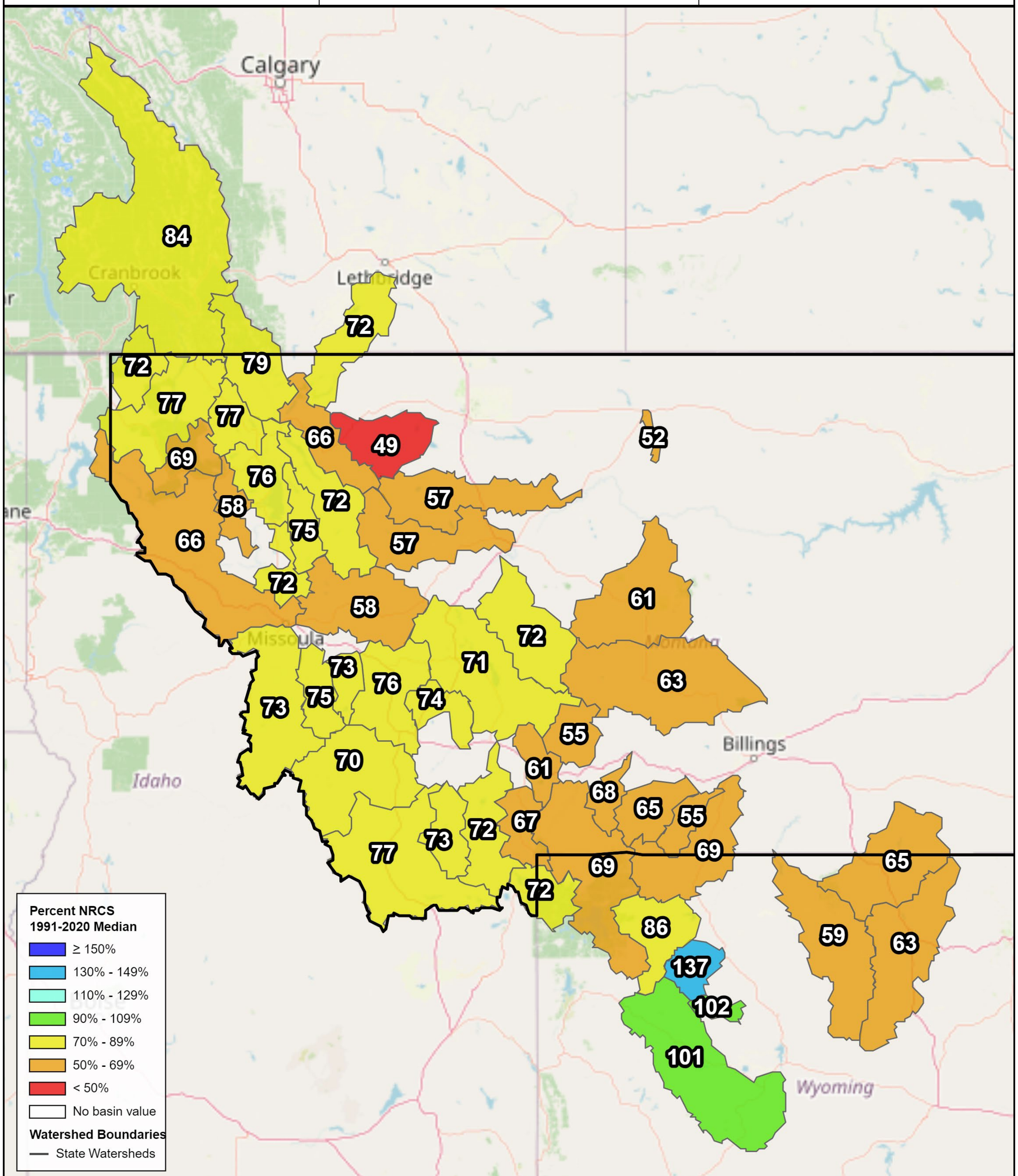
Snowpack (Continued)



Statewide Overview

Snowpack (Continued)

Snow Water Equivalent	Sub Basin Percent NRCS 1991-2020 Median	End of February, 2024



Natural Resources Conservation Service
United States Department of Agriculture

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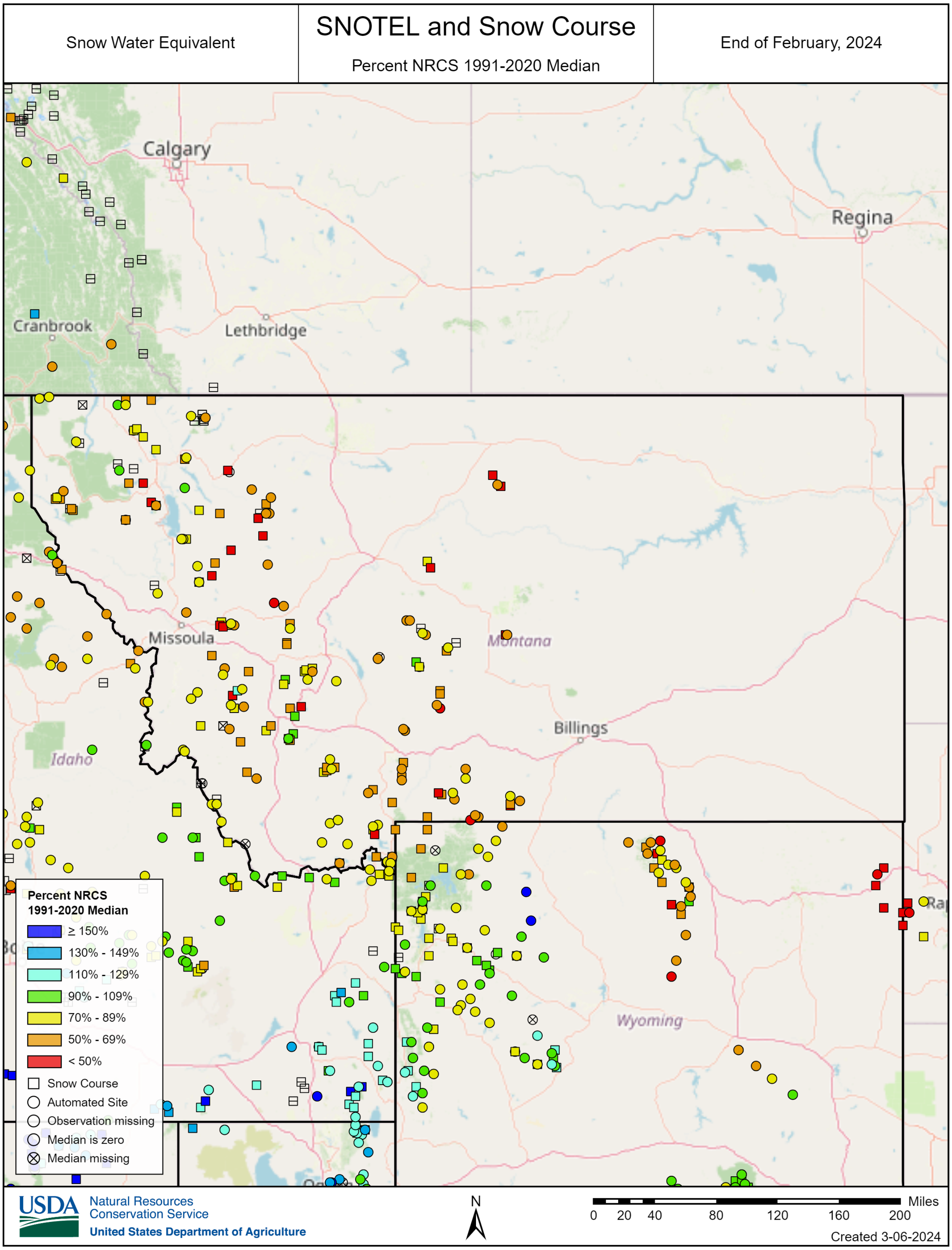
Created 3-06-2024

Statewide Overview

Snowpack (Continued)



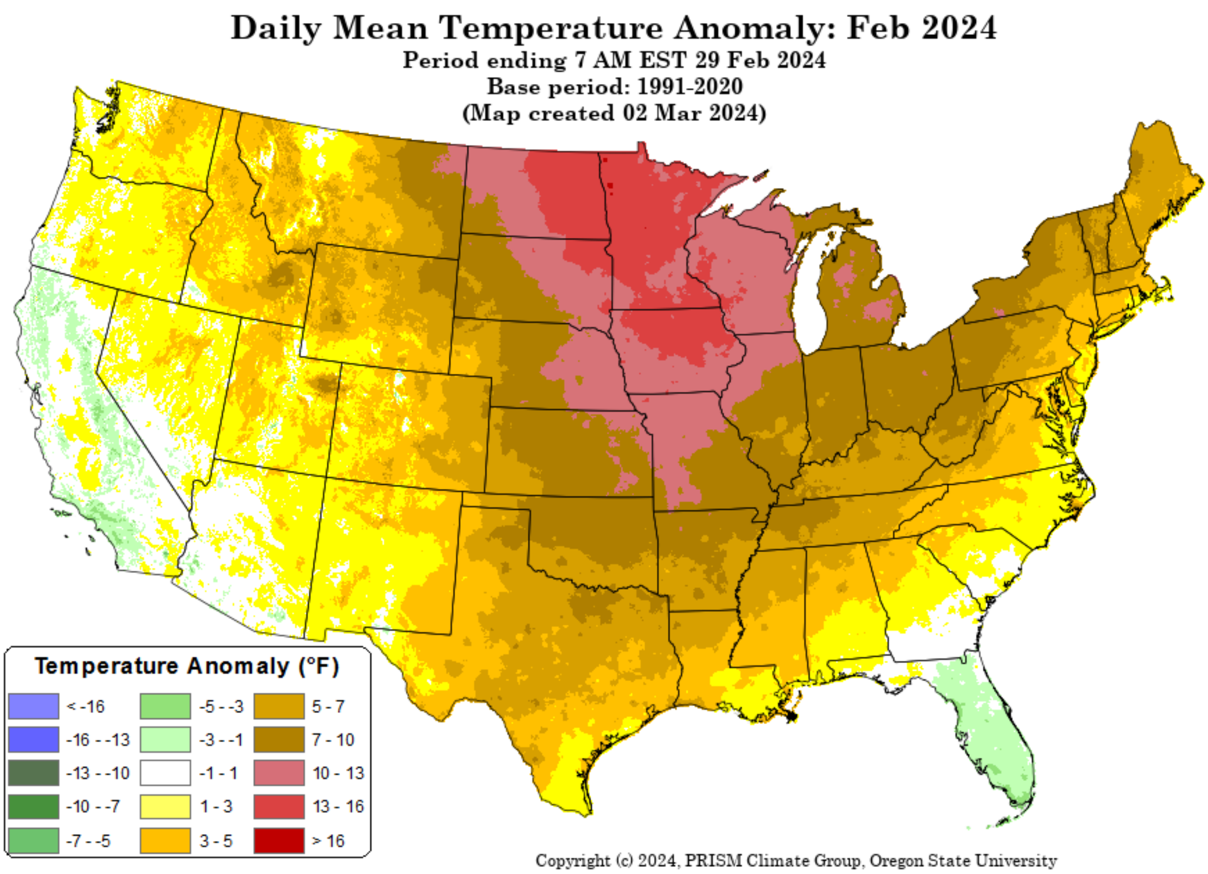
Statewide Overview

Temperature

February temperatures in Montana were above normal on average. The warming trend from the end of January continued through the first week of the month. This was followed by near normal temperatures from February 9-13. There was a short period of colder than normal temperatures from February 13-18. These days contained the coldest daily average temperatures of the month from the group of SNOTELs located in the state. From February 18 on, warmer than normal temperatures were observed statewide, except for a short-lived spike of below normal temperatures around February 27.

Compared to January, the month of February had fewer extreme temperature swings and on the whole felt mild. Compare this to January when the period of widespread well below normal temperatures brought down monthly average temperatures despite well above normal temperatures observed at the end of the month. In February, there were some daily temperature averages below normal, but overall temperatures were above normal for February. Most of the state had temperatures 1-5 °F above normal. The eastern part of the state had the warmest temperatures ranging from 5-10 °F and up to 10-13 °F above normal. The north central portion of the state was closest to normal but still had mostly above normal temperatures.

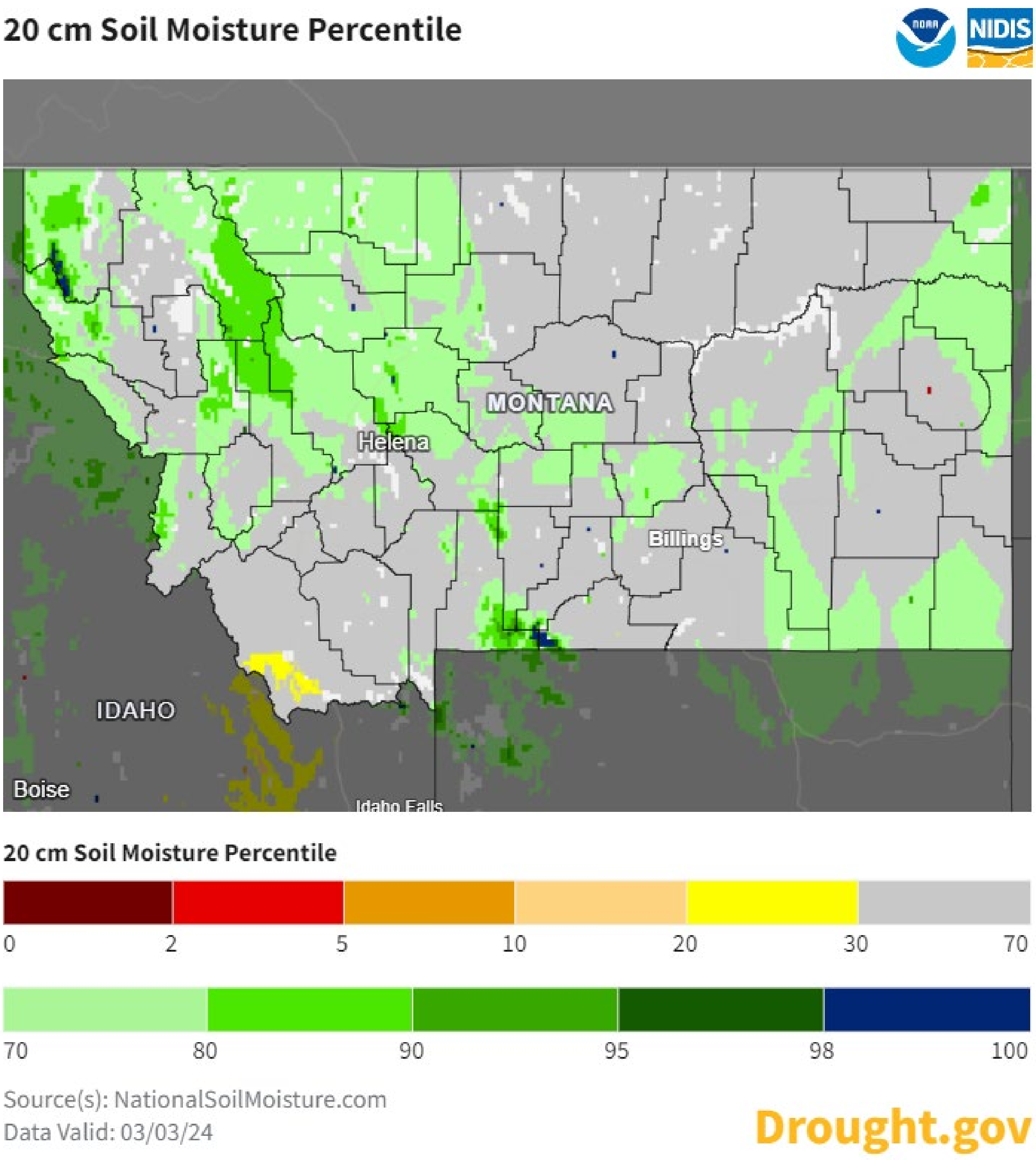
The warmer temperatures affected the valley and lower elevation snowpacks. However, higher elevation areas had temperatures that were close to or below freezing on average for most of the month. Although the snow seemed to melt nearly as fast as it arrived in the valley, the snowpack at higher elevations still hasn't experienced widespread melting.



Statewide Overview

Soil Moisture

Since last month, soil moisture percentiles in the top 20 cm across Montana have improved. Most of the state is in the 30th to 70th percentile, while some areas have increased to the 70th to 90th percentile range. The exception is the area in southwest Montana which is in the 20th to 30th percentile. Some isolated areas are in the 98th to 100th percentile, including the Cabinet and Beartooth mountains. The northwest corner of the state still has the highest relative soil moisture. To continue the trend of widespread soil moisture improvement, more precipitation will be needed as spring approaches.



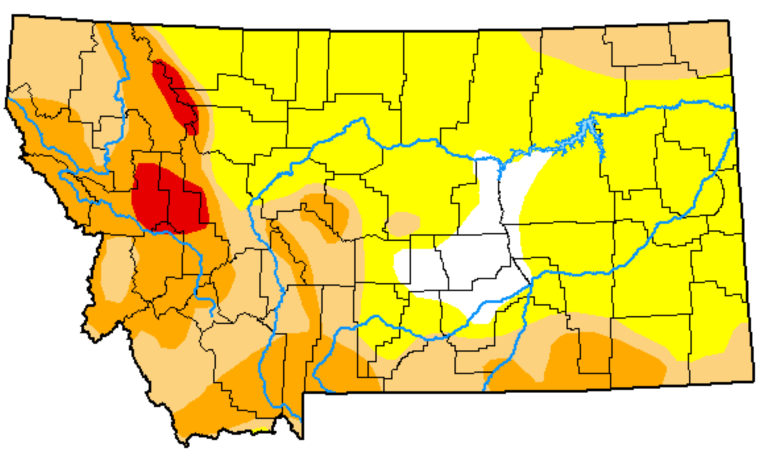
Statewide Overview

Drought Monitor

The recent U.S. Drought Monitor map, released on February 29, 2024, classifies 95% of Montana as D0 (abnormally dry conditions) to D3 (extreme drought). There are currently no regions in Montana that are classified in the D4 (exceptional drought) category or above. Part of Missoula, Powell, and the part of the Rocky Mountain Front are classified as D3, which has been downgraded 1-2 classes from last month. A large swath in eastern Montana from Sheridan County to Bighorn County was also downgraded 1-2 classes and are now D0-D3 status. Recent precipitation and improved soil moisture conditions have warranted a 1 class improvement in part of Pondera, Teton, and Cascade Counties but they still remain in D0 status. With all but about 5% of the state currently in drought status continued precipitation will be necessary to improve conditions statewide.

U.S. Drought Monitor

Montana



February 27, 2024

(Released Thursday, Feb. 29, 2024)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	5.11	94.89	47.30	23.26	2.36	0.00
Last Week *02-20-2024*	11.99	88.01	42.72	21.01	1.35	0.00
3 Months Ago *11-28-2023*	61.29	38.71	12.62	4.48	0.00	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 *02-28-2023*	14.96	85.04	65.91	22.89	3.11	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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NCEI/NOAA

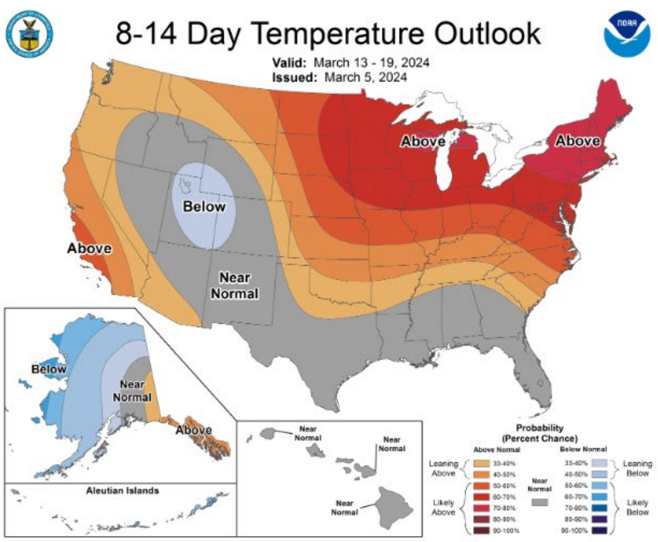
droughtmonitor.unl.edu

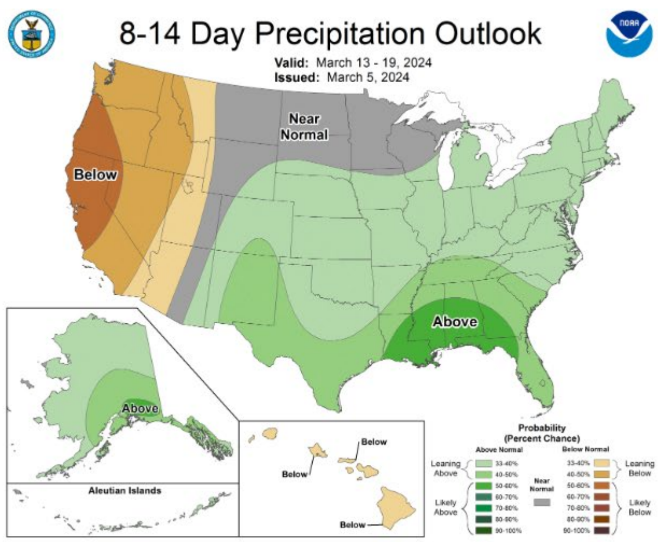
Statewide Overview

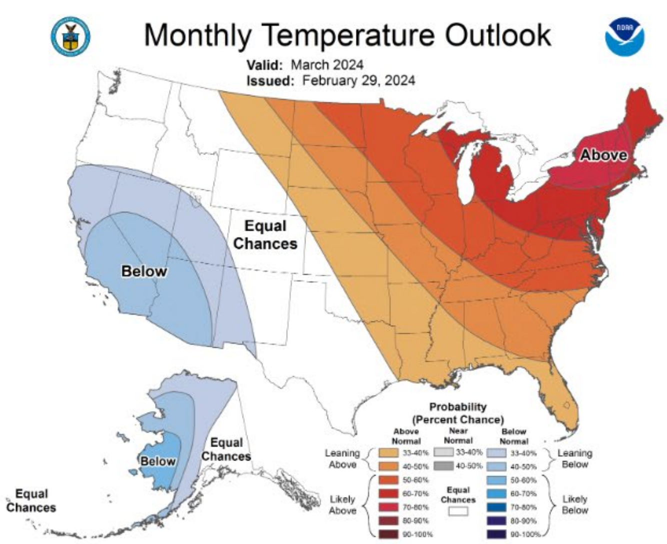
Weather Outlook

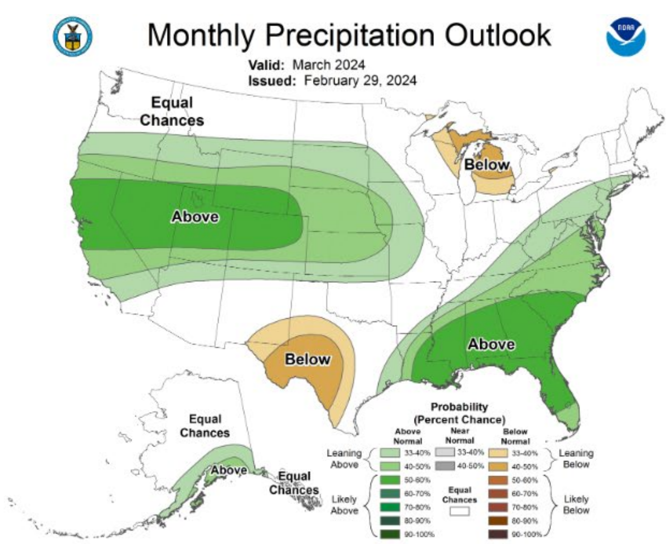
From the NOAA Climate Prediction Center, the next 8-14 days show probabilities of near to slightly above normal temperatures. With the probability of above normal temperatures increasing towards the eastern part of the state. The 8–14-day precipitation outlook calls for mostly near to slightly below normal precipitation. The western and southern portions of the state have a slight probability of below normal precipitation.

For the monthly outlooks, there are equal chances of above and below normal temperatures for the western part of the state and an increased probability for above normal temperatures in eastern Montana. Monthly precipitation leans towards above normal precipitation in the southern portion and equal chances for the rest of the state.





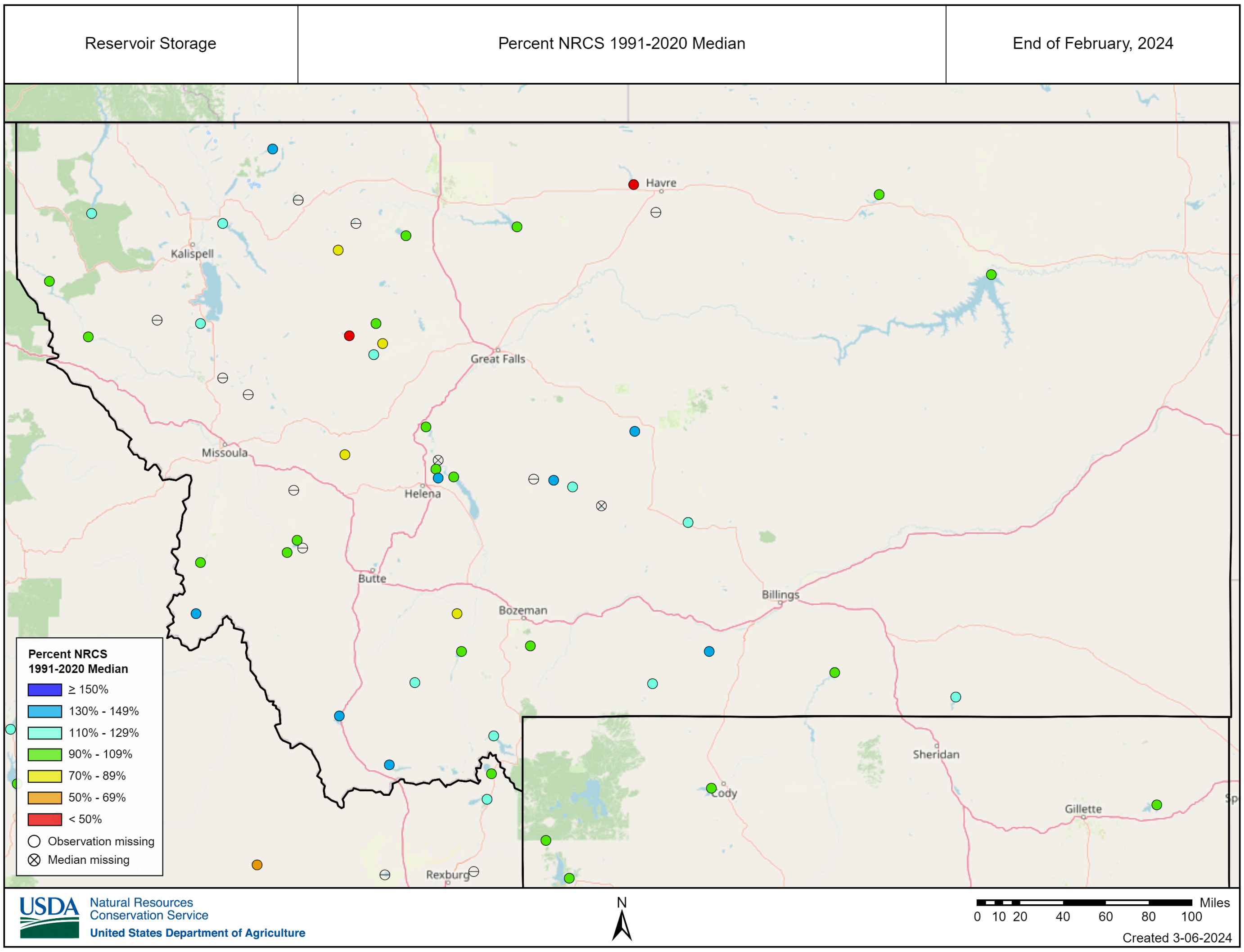




Statewide Overview

Reservoirs

End of February storage levels for many Montana reservoirs are above normal. Lake Koocanusa, Hungry Horse, Flathead Lake, Lake Sherburne, Painted Rocks, Ruby, Helena Valley, Ackley Lake, Bair, Smith River, Deadman's Basin, Nilan, Cooney, Mystic Lake, Clark Canyon, Lima & Tongue River reservoirs are all over 110% of normal for this time of year. The remaining storage facilities across the state are reporting storage at near normal levels with the exception of Fresno and Gibson Reservoirs which are at 44% and 35% of normal respectively.



Statewide Overview

Reservoirs (Continued)

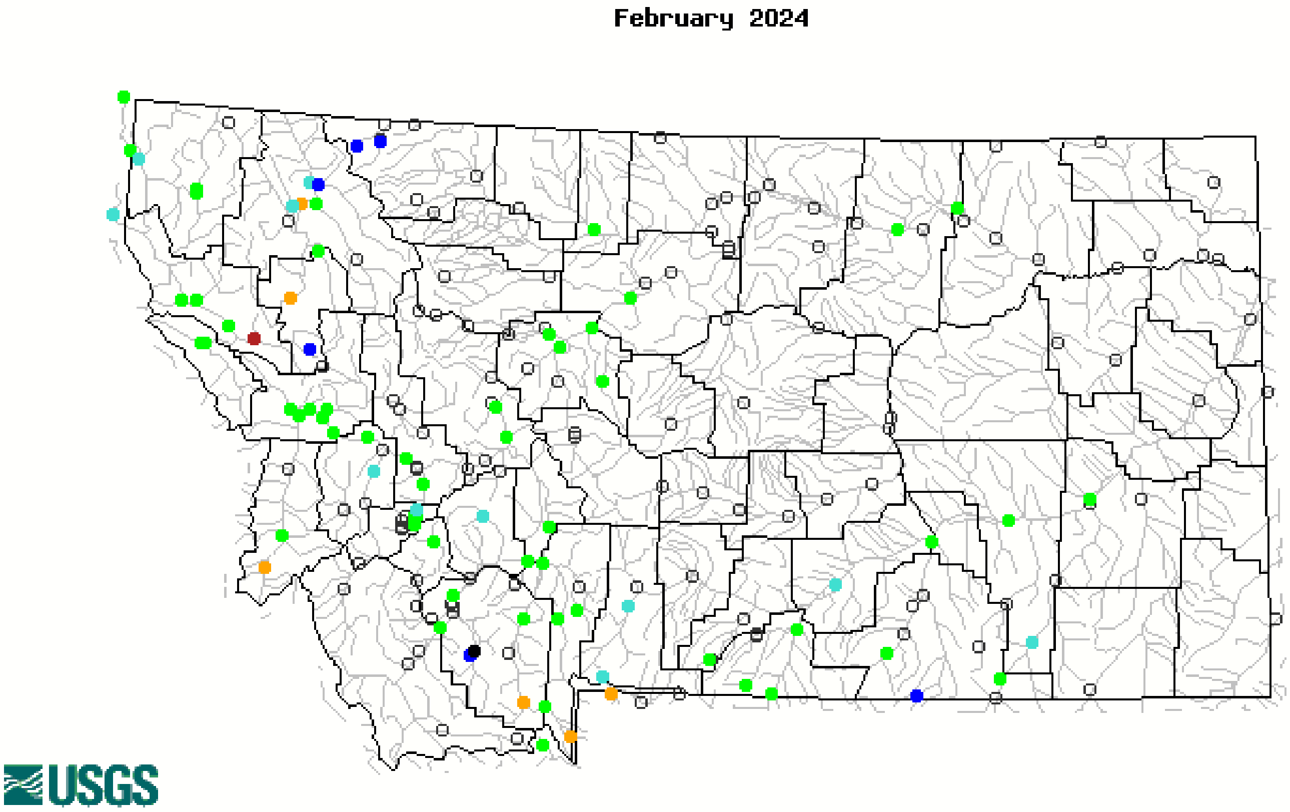
End of February - Reservoir Storage Percent of Capacity

Reservoir	Basin	Current % Capacity	Last Year % Capacity	Median % Capacity
Smith River Res	Smith-Judith-Musselshell	80	-	59
Deadman's Basin Res	Smith-Judith-Musselshell	89	53	71
Bair Res	Smith-Judith-Musselshell	62	25	50
Swift Res	Sun-Teton-Marias	44	51	52
Lake Frances	Sun-Teton-Marias	45	32	44
Lake Elwell (Tiber)	Sun-Teton-Marias	51	52	54
Gibson Res	Sun-Teton-Marias	10	10	29
Mystic Lake	Upper Yellowstone	19	21	17
Cooney Res	Upper Yellowstone	90	74	69
Ruby River Reservoir	Jefferson	84	82	73
Lima Reservoir	Jefferson	68	29	47
Clark Canyon Res	Jefferson	64	39	47
Painted Rocks Lake	Bitterroot	29	25	21
Lake Como	Bitterroot	36	26	38
Bull Lake	Bighorn	47	49	53
Buffalo Bill	Bighorn	74	72	68
Boysen	Bighorn	98	91	92
Bighorn Lake	Bighorn	61	57	60
Lake Helena	Upper Missouri	78	78	86
Holter Lake	Upper Missouri	99	99	99
Helena Valley Reservoir	Upper Missouri	72	68	54
Canyon Ferry Lake	Upper Missouri	75	67	72
Lake Koocanusa	Kootenai	69	62	55
Hungry Horse Lake	Flathead	83	74	72
Flathead Lake	Flathead	53	43	44
Nelson Res	Milk	61	34	56
Fresno Res	Milk	17	30	38
Noxon Rapids Reservoir	Lower Clark Fork	95	93	95
Fort Peck Lake	Lower Missouri	75	64	72
Nevada Creek Res	Upper Clark Fork	43	38	50
Georgetown Lake	Upper Clark Fork	96	89	92
Tongue River Res	Tongue	63	62	55
Lake Sherburne	St. Mary	64	30	47
Hebgen Lake	Madison	85	79	75
Ennis Lake	Madison	75	75	71
Middle Creek Res	Gallatin	54	53	56

Statewide Overview

Streamflow

February monthly streamflow in Montana was mostly near normal. There were only a few outliers above and below normal. Some melting did occur at lower elevations. However, the higher elevation snowpack didn't have widespread melting. The lower elevation snowmelt that occurred didn't produce enough runoff to increase the monthly streamflow to above normal in most places.



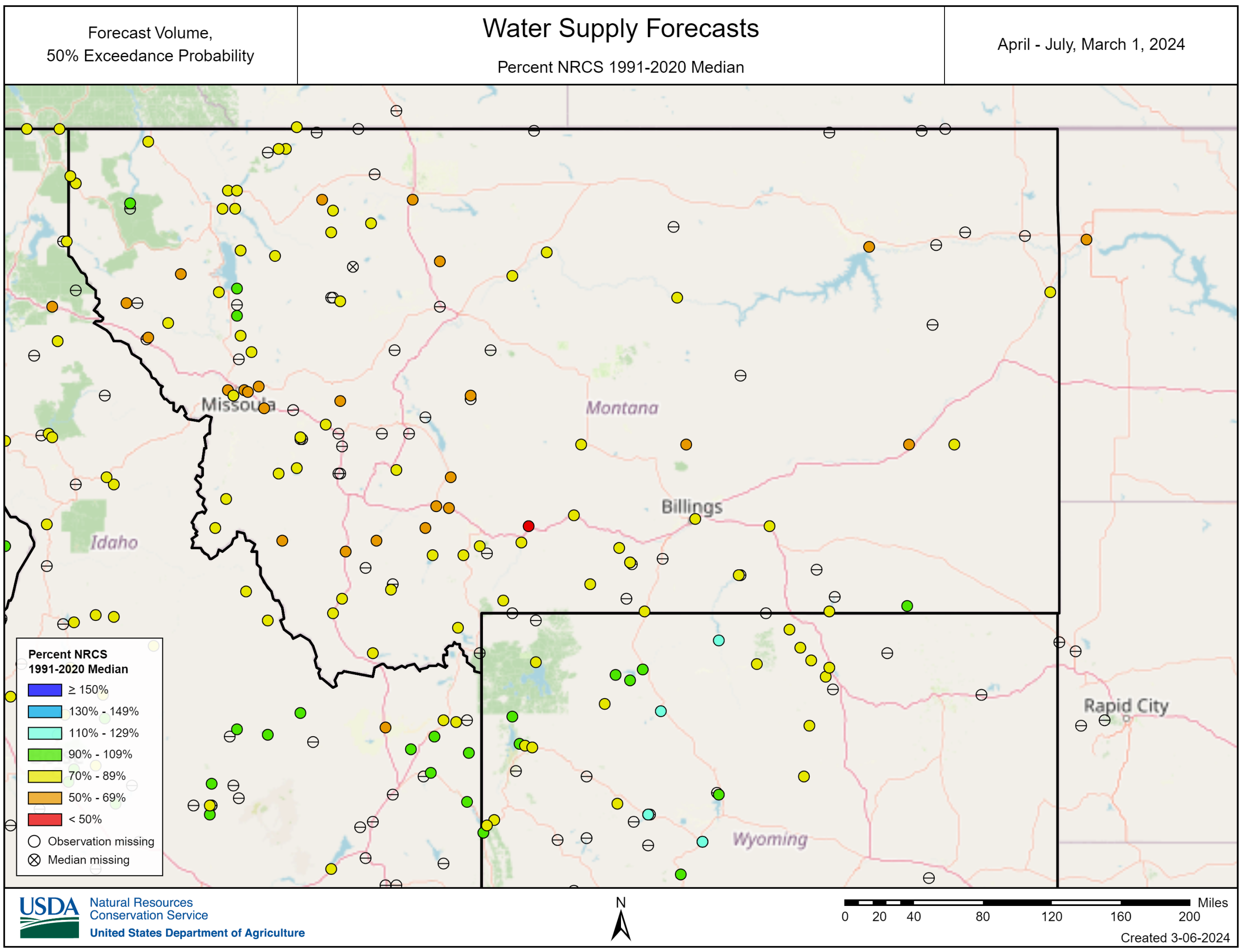
Explanation - Percentile classes							
Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High	Not-ranked

Statewide Overview

Water Supply Forecasts

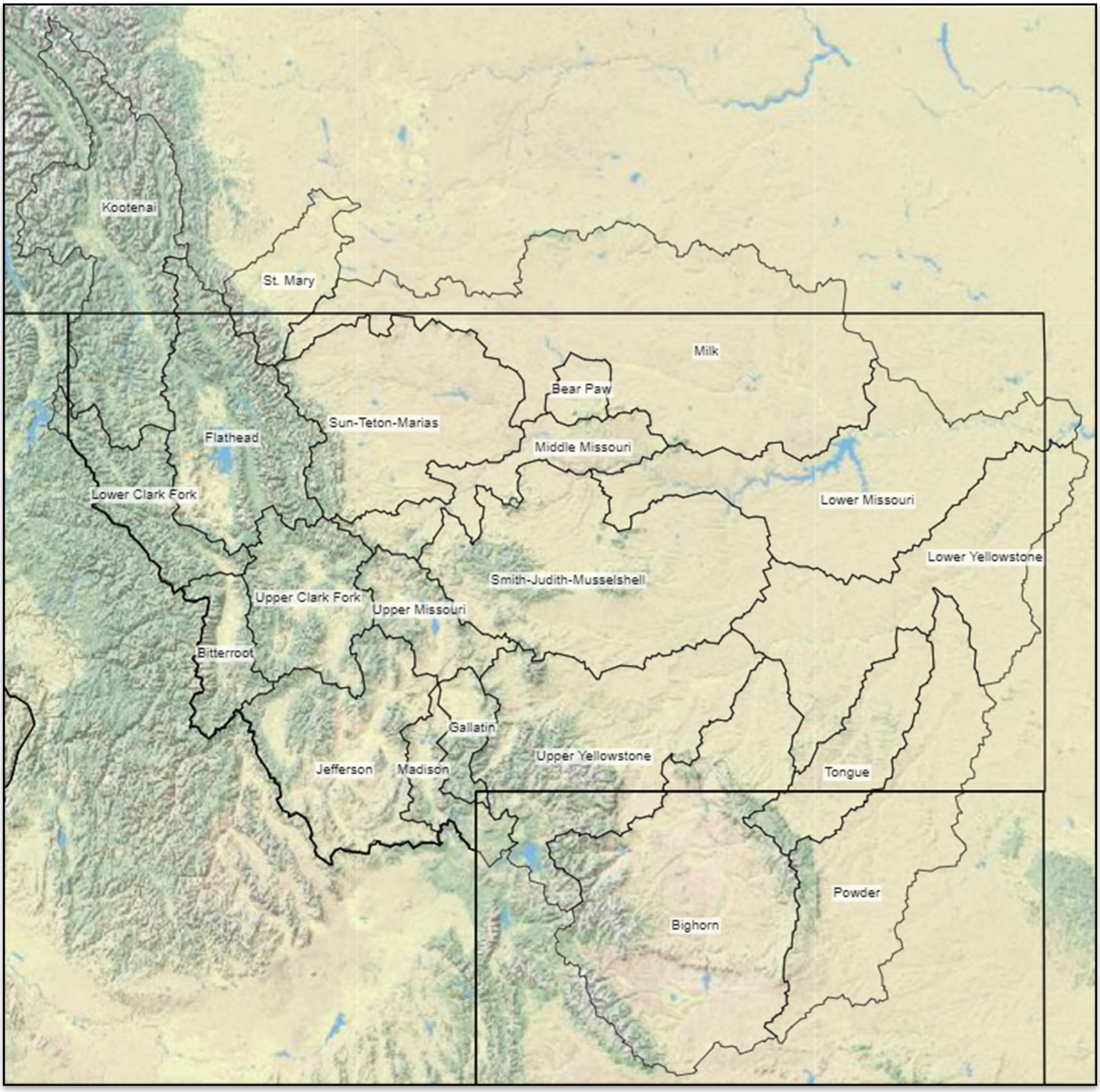
Water supply forecasts are published in the March 1 Water Supply Outlook Report and provide an initial outlook of what spring and summer snowmelt might entail this year. The recently published forecasts trend with water year precipitation and the ensuing snowpack. Given both are currently below normal in most locations, so are most forecasts. April-July streamflows are forecasted to be about 60-80% of normal in Montana. However, forecasts are near to above normal in a couple pockets of the Pend Oreille, Kootenai, and Bighorn River basins where water year precipitation has been closer to normal.

Forecasts published on April 1 and May 1 generally provide a better indication of what the upcoming season will bring. While a full recovery to 100% of normal snowpack would be welcomed, below normal snowpack conditions on May 1 could be supplemented by above normal spring and summer precipitation, assuming snowpack deficits aren't too large this spring. Best case scenario would be above normal precipitation for the next two months followed by normal spring weather.



Basin Overview

Montana River Basin Definitions

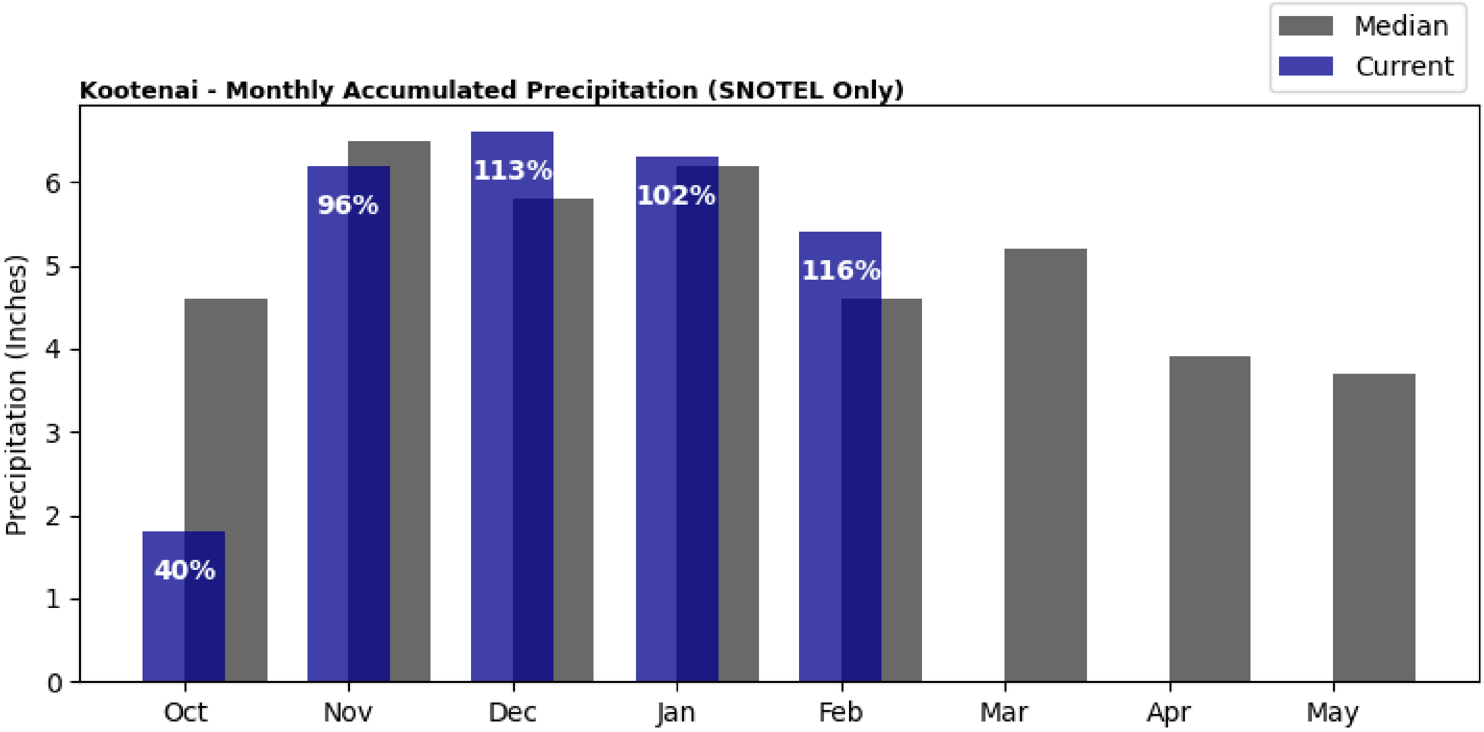


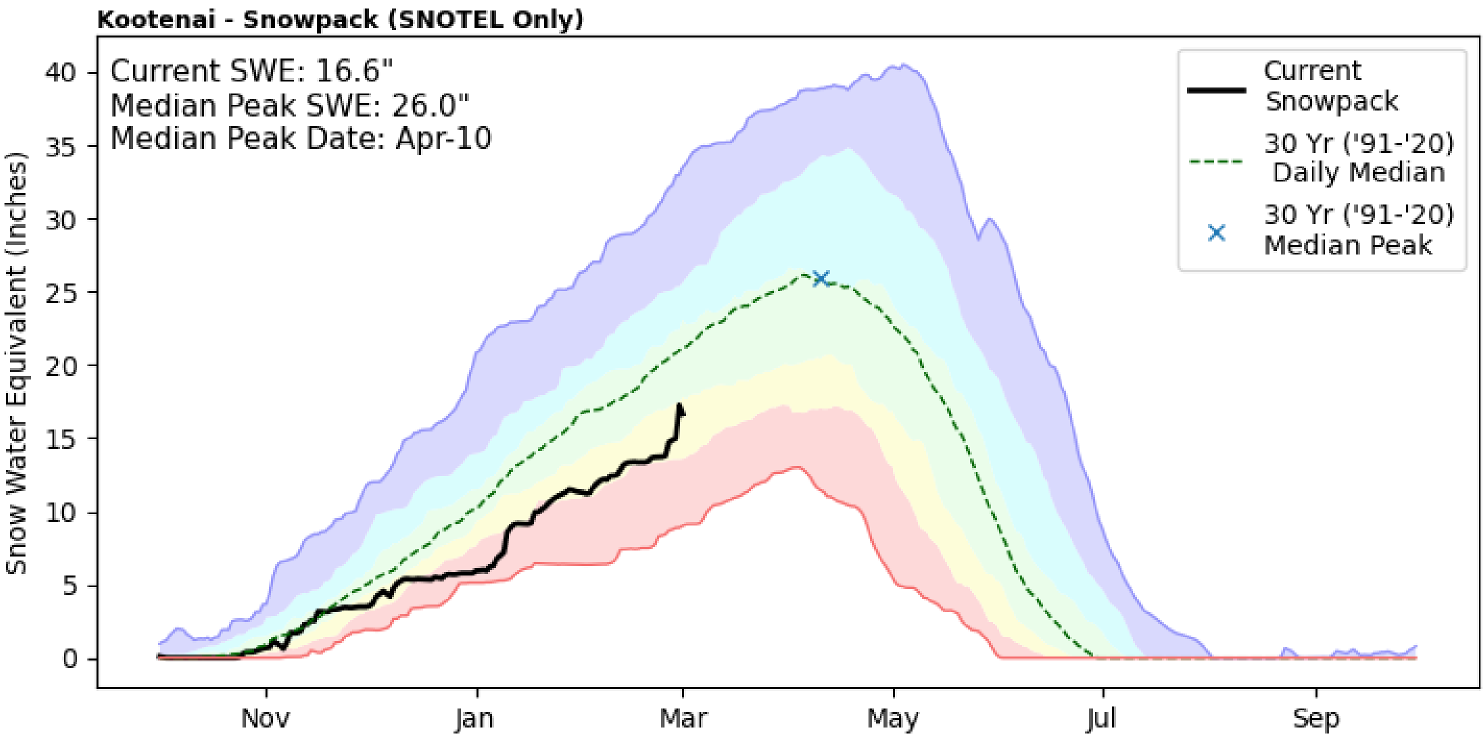
The following basin overview sections only include basins that have SNOTEL sites. For example, there is no basin overview for the Lower Yellowstone, because there are no SNOTEL sites associated with that basin. Water supply information for basins not included in the following sections can be found at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

Basin Overview

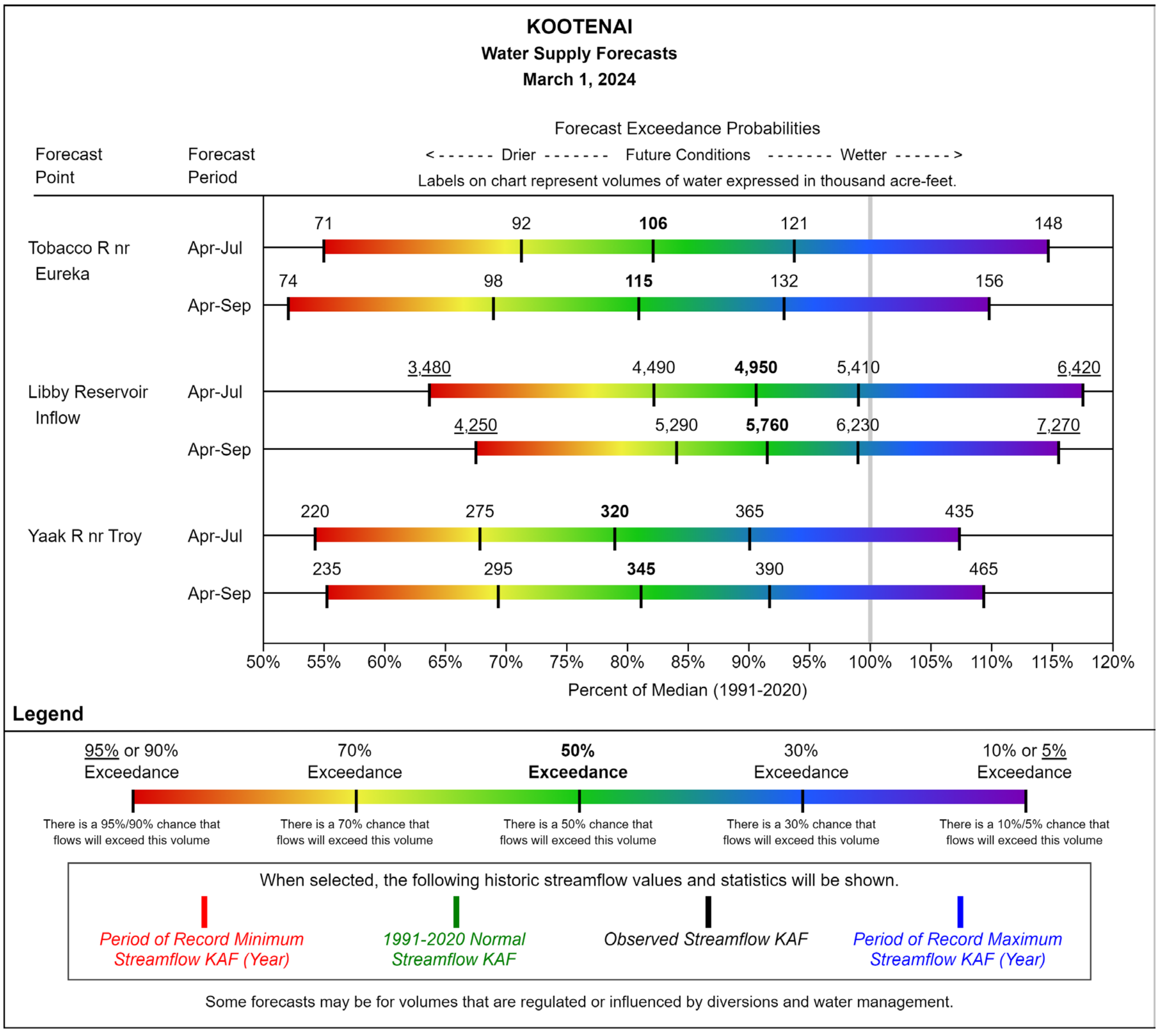
Kootenai

Precipitation in February was above normal at 116%, which brings the seasonal accumulation (October-February) to 88% of median. The snowpack in the Kootenai is well below normal at 76% of median, compared to 85% at this time last year.





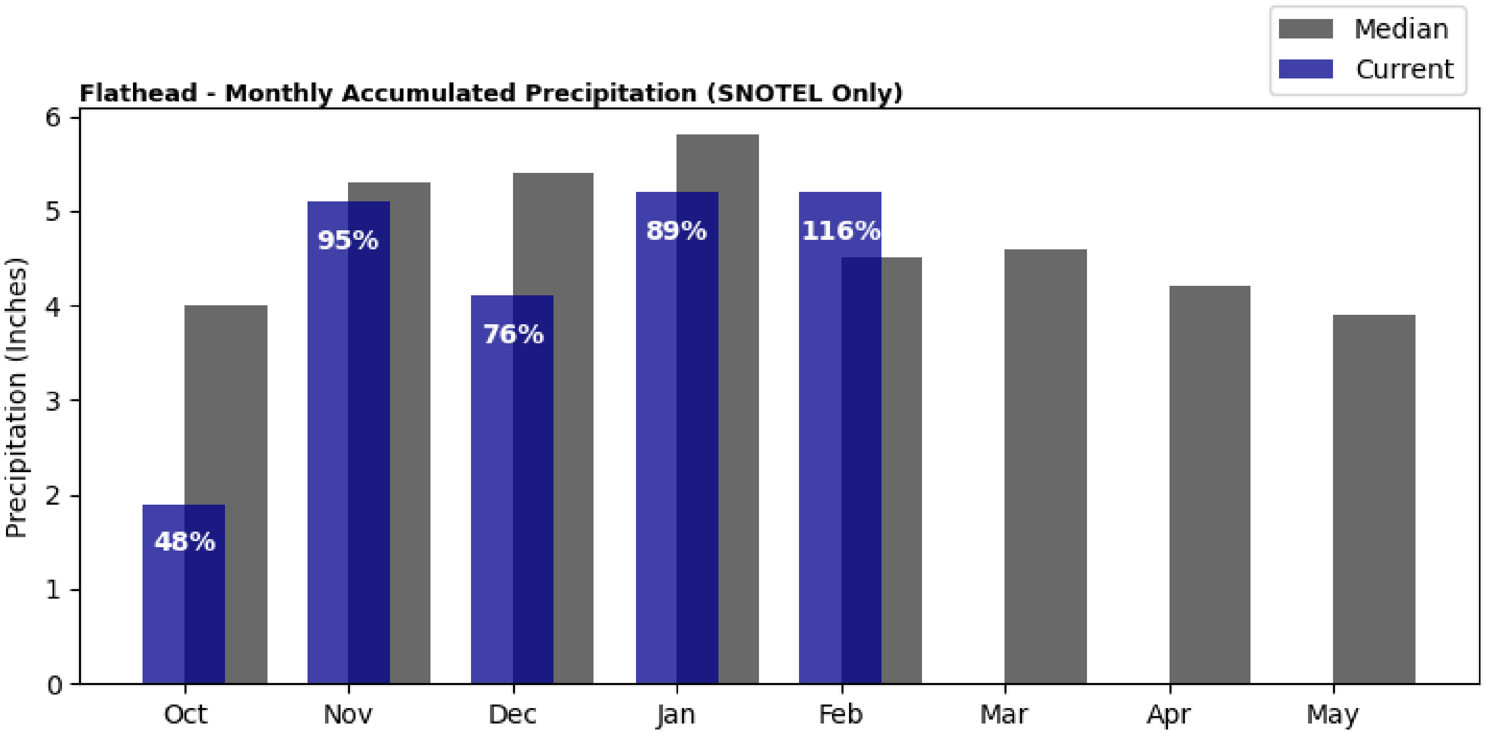
Kootenai (Continued)

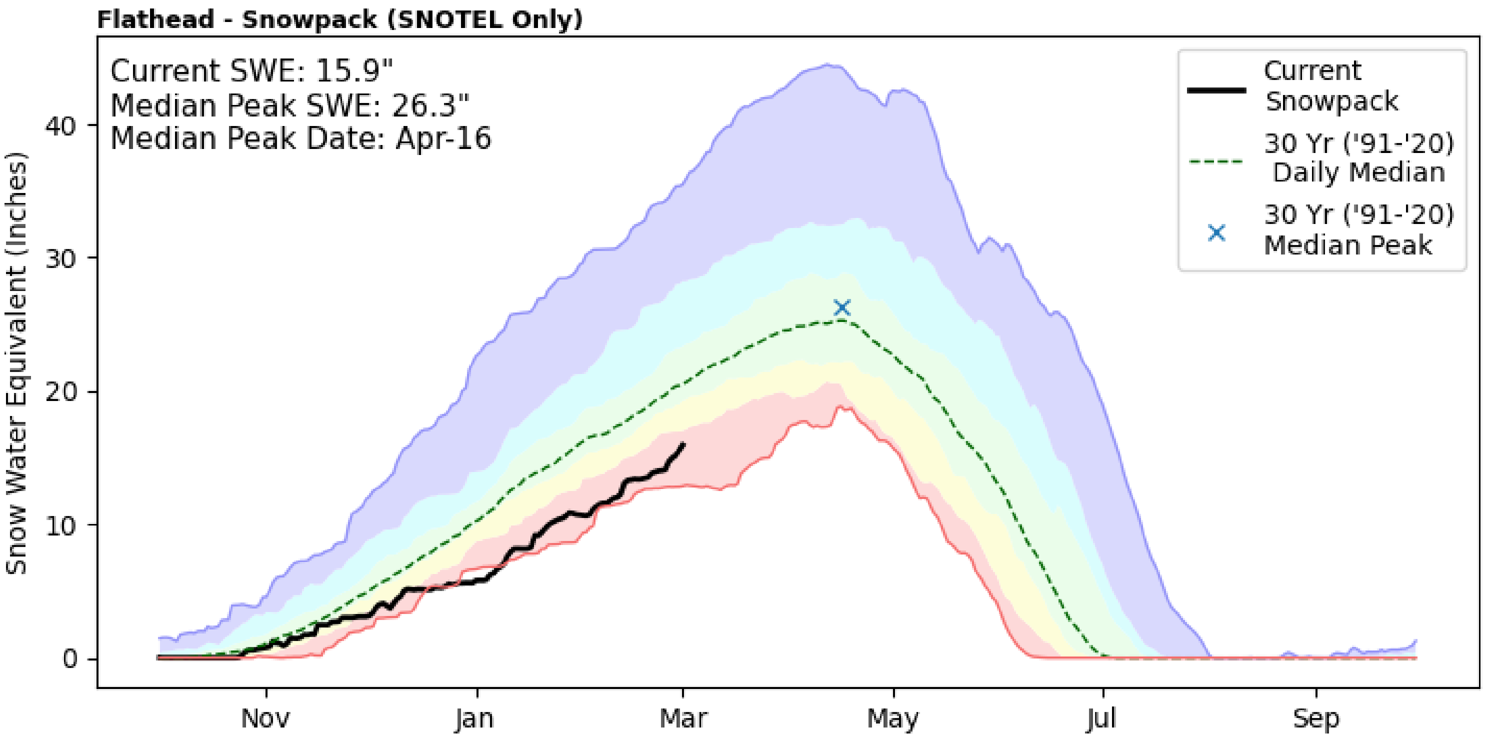


Basin Overview

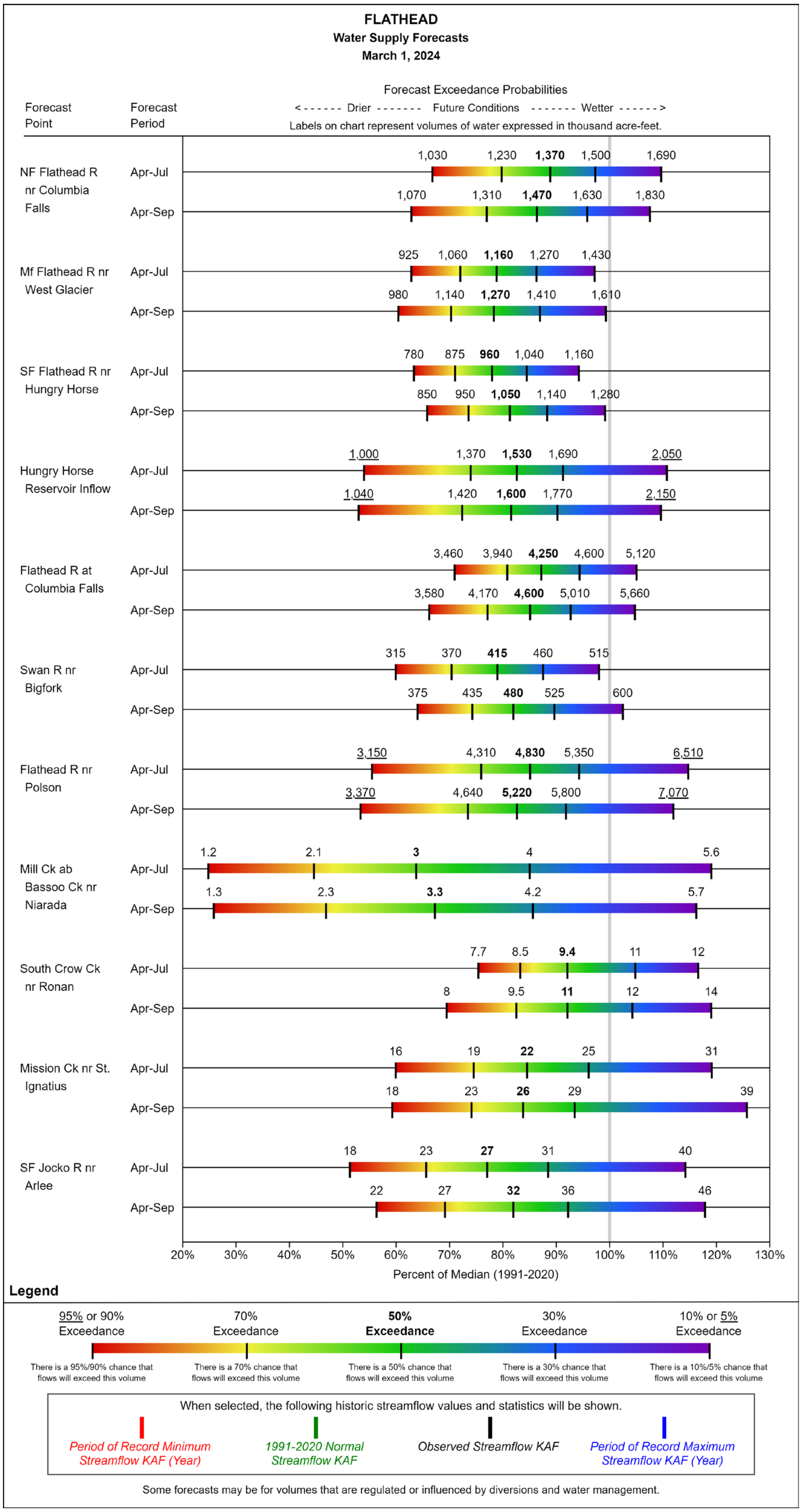
Flathead

Precipitation in February was above normal at 116%, which brings the seasonal accumulation (October-February) to 83% of median. The snowpack in the Flathead is well below normal at 72% of median, compared to 94% at this time last year.





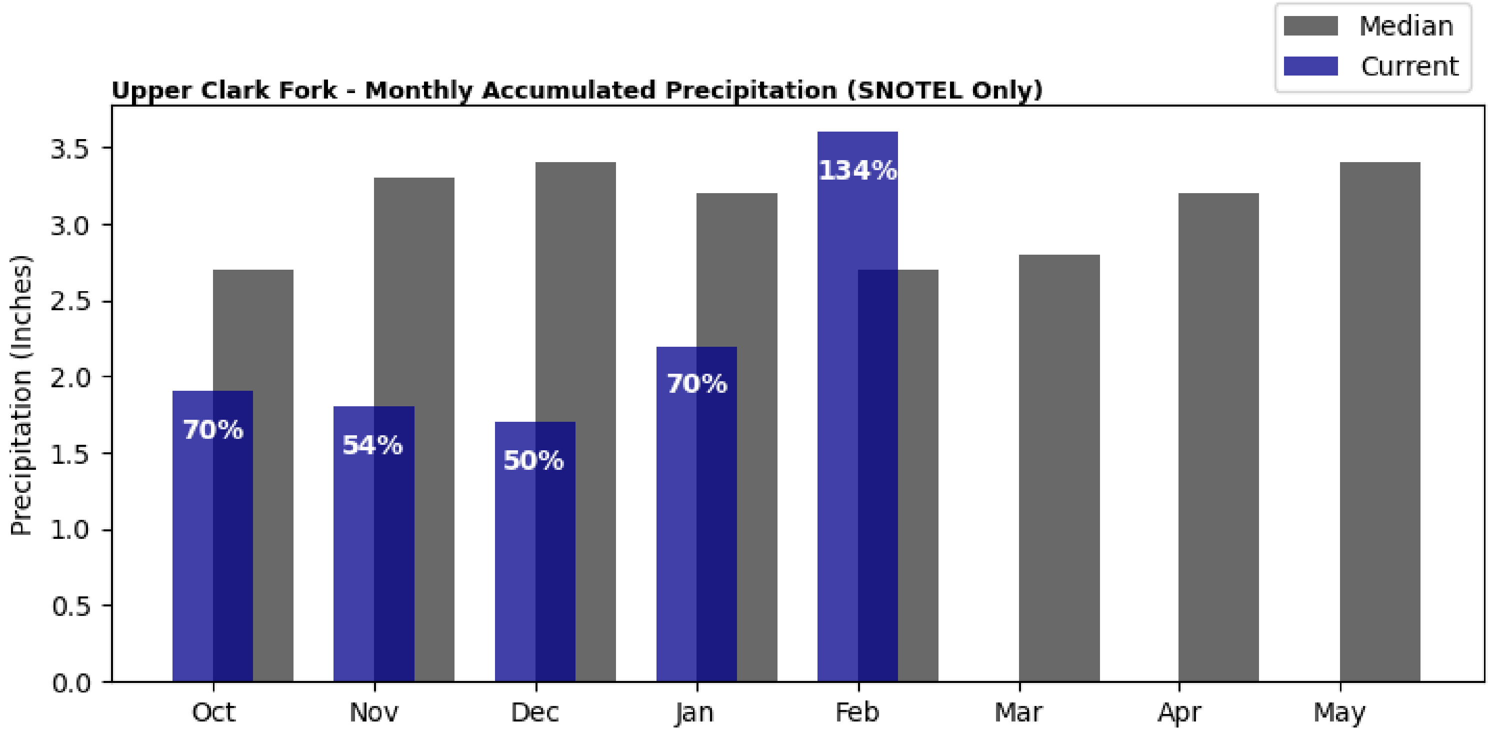
Flathead (Continued)

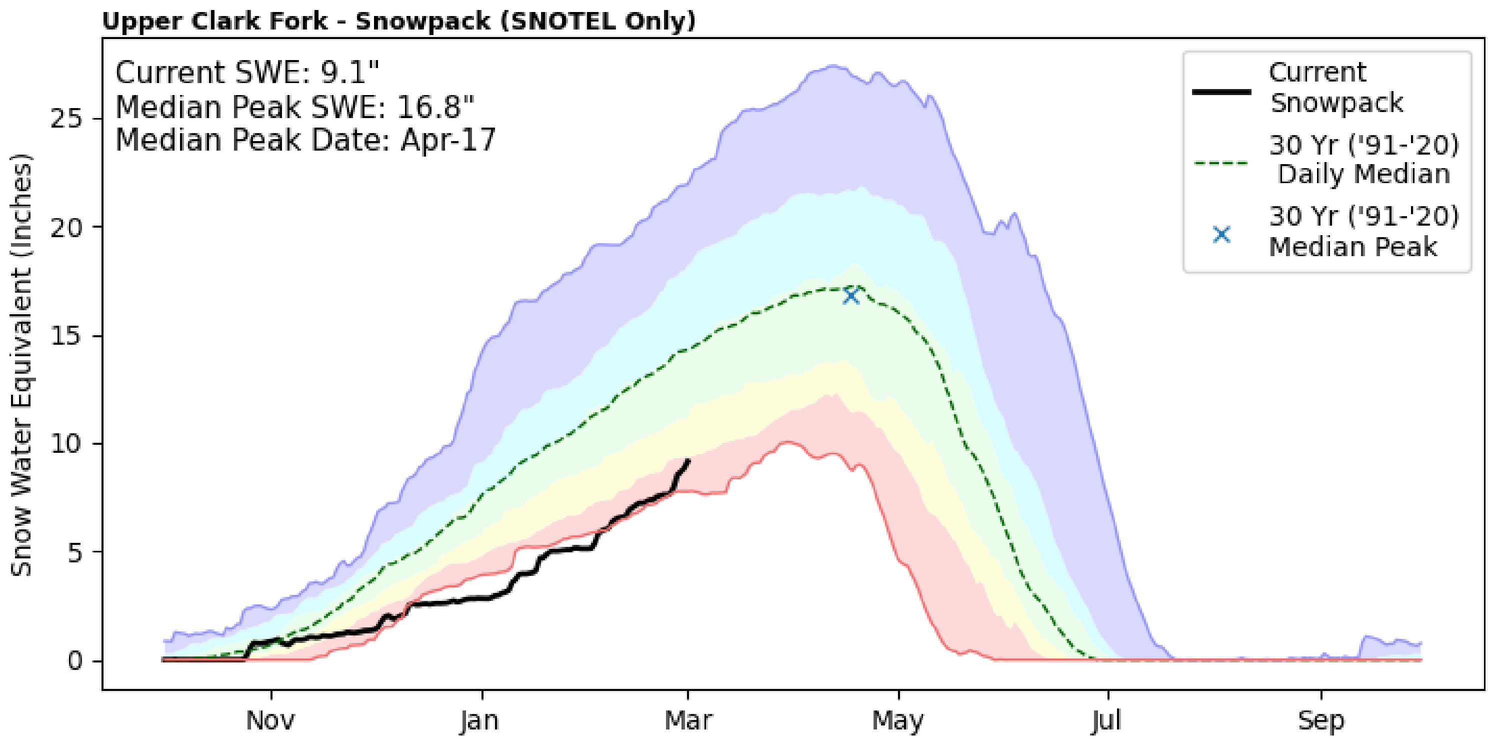


Basin Overview

Upper Clark Fork

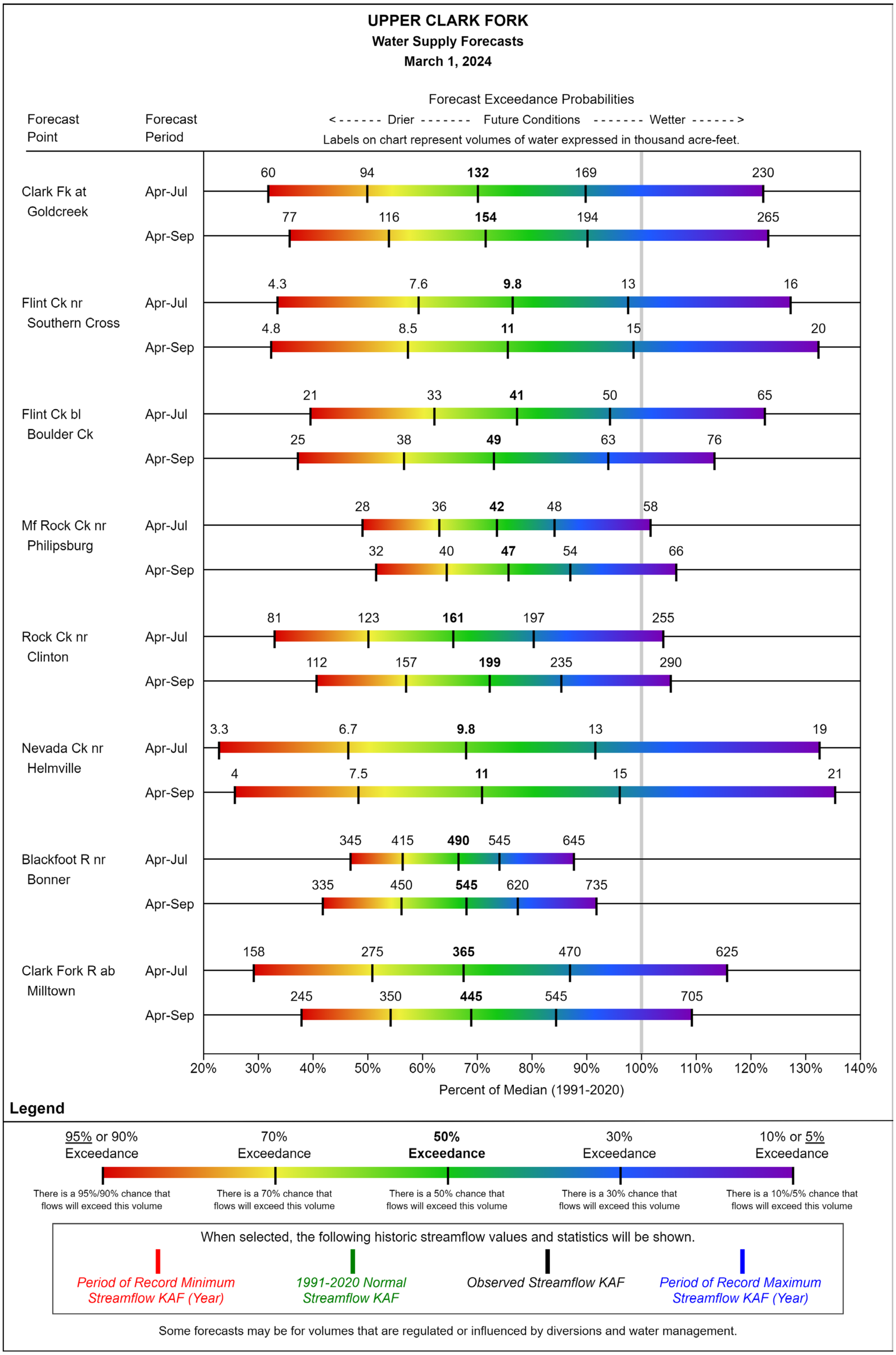
Precipitation in February was well above normal at 135%, which brings the seasonal accumulation (October-February) to 71% of median. The snowpack in the Upper Clark Fork is well below normal at 66% of median, compared to 103% at this time last year.





Basin Overview

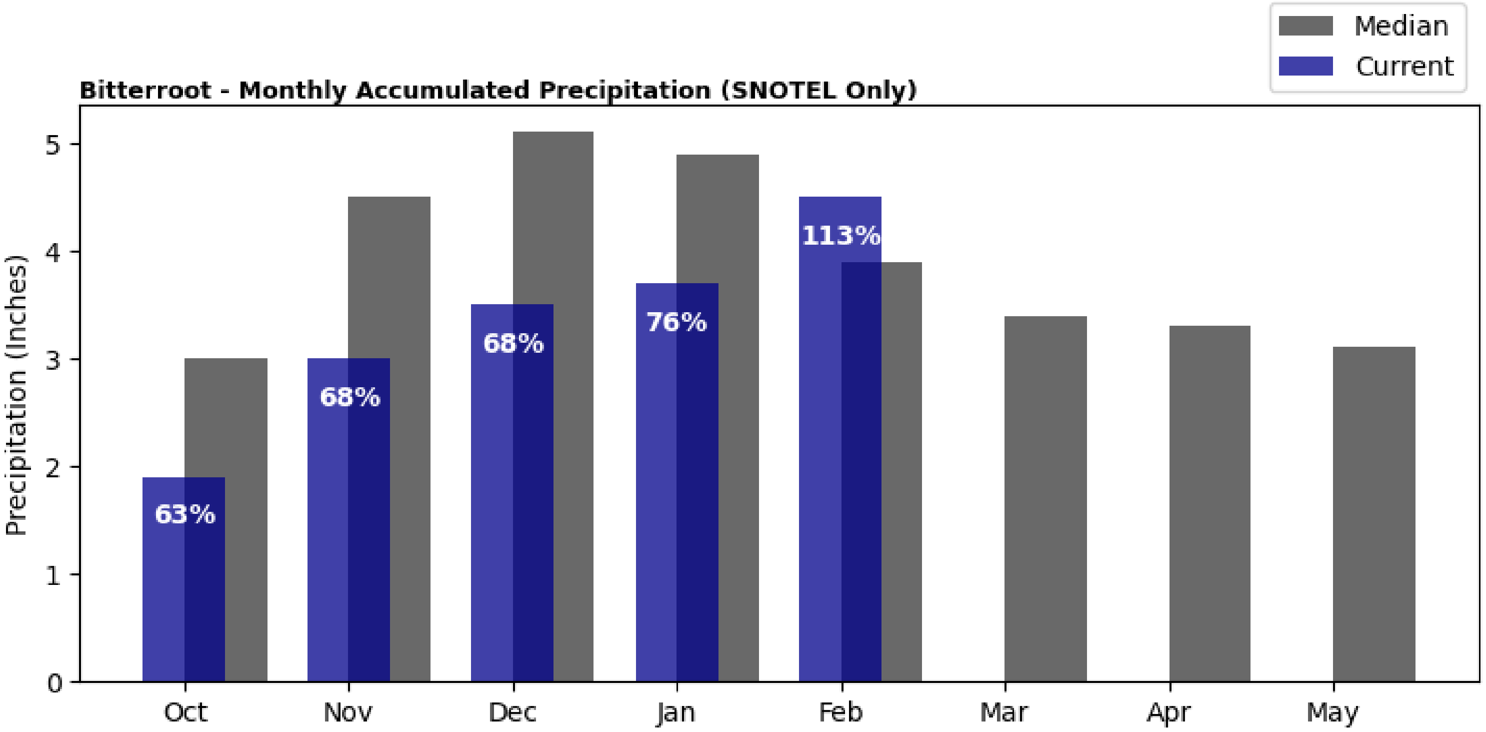
Upper Clark Fork (Continued)

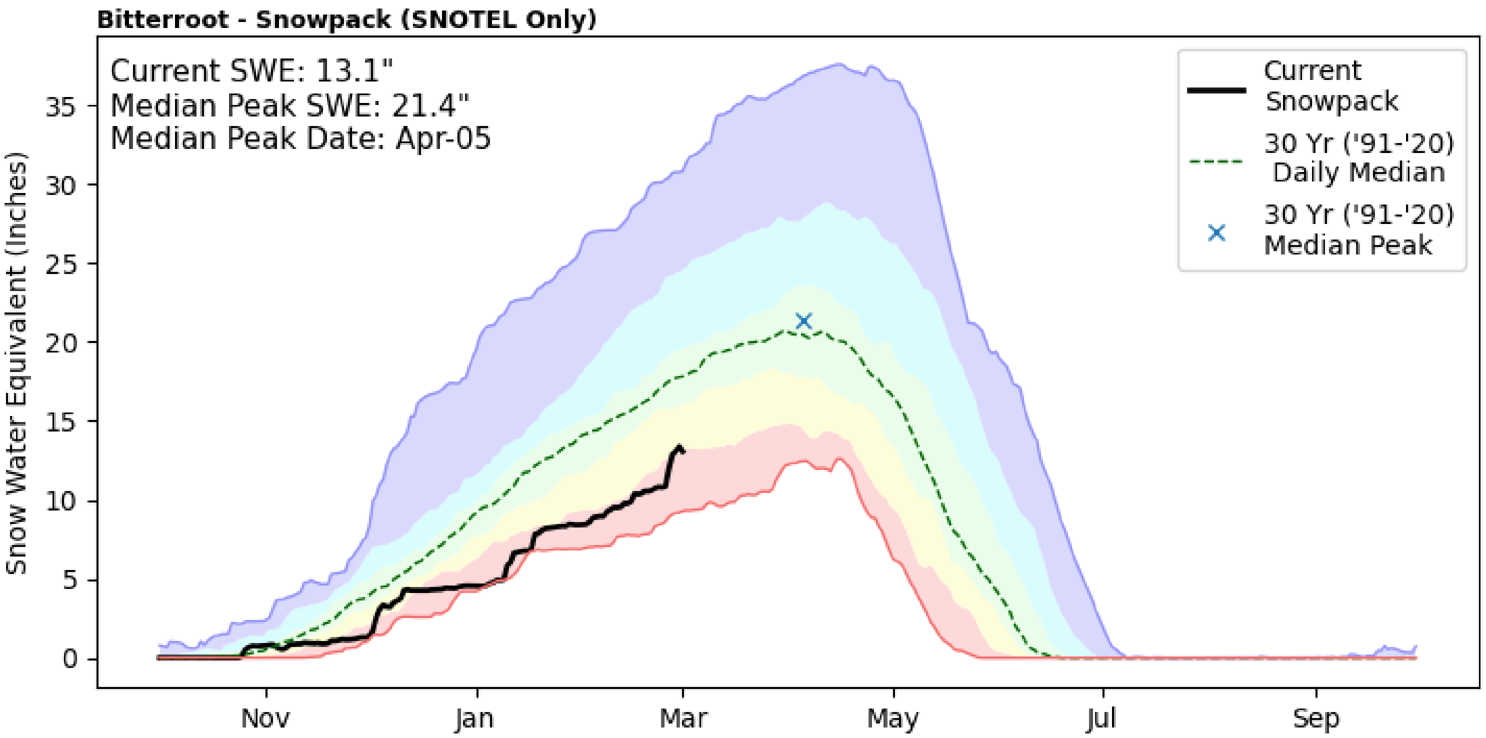


Basin Overview

Bitterroot

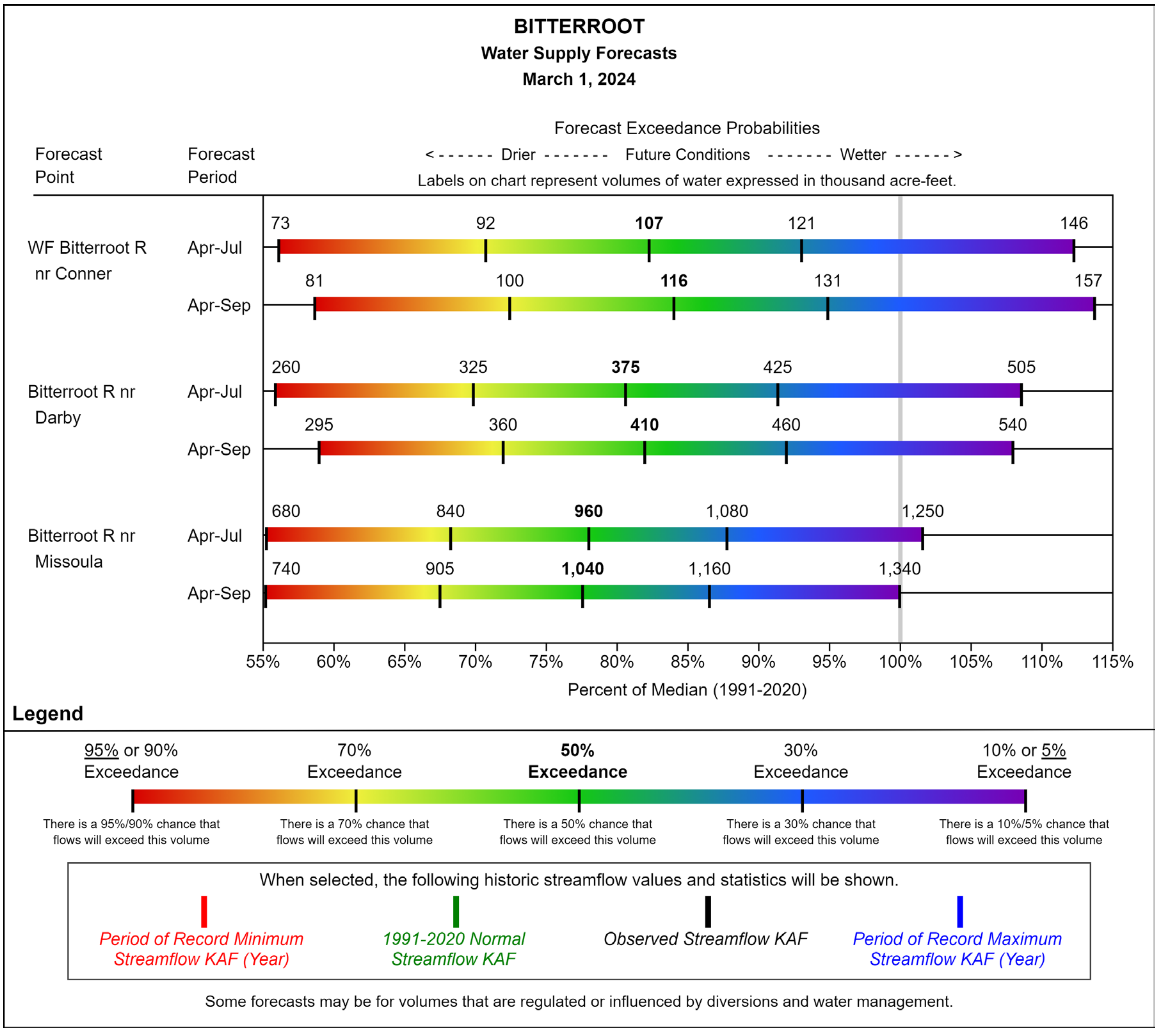
Precipitation in February was above normal at 113%, which brings the seasonal accumulation (October-February) to 74% of median. The snowpack in the Bitterroot is well below normal at 73% of median, compared to 84% at this time last year.





Basin Overview

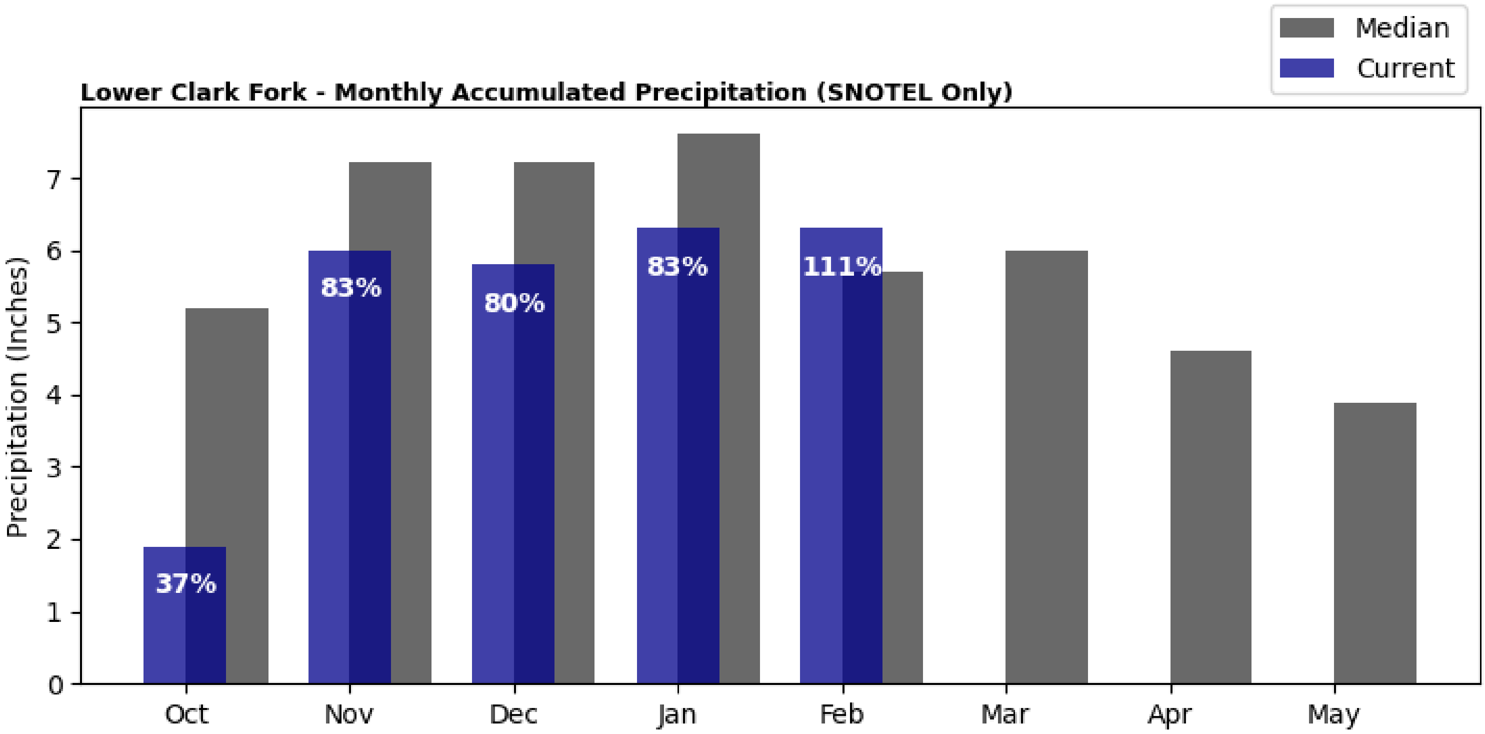
Bitterroot (Continued)

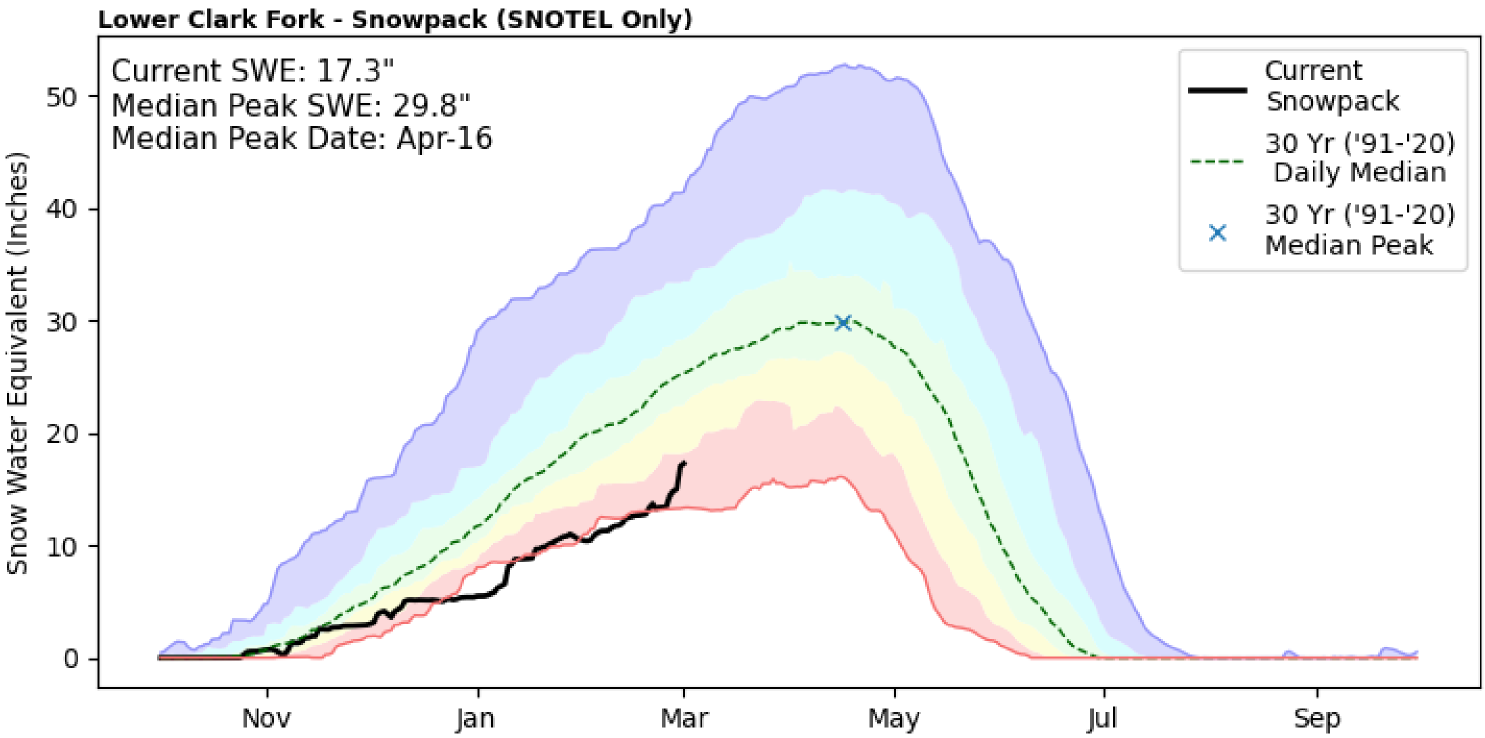


Basin Overview

Lower Clark Fork

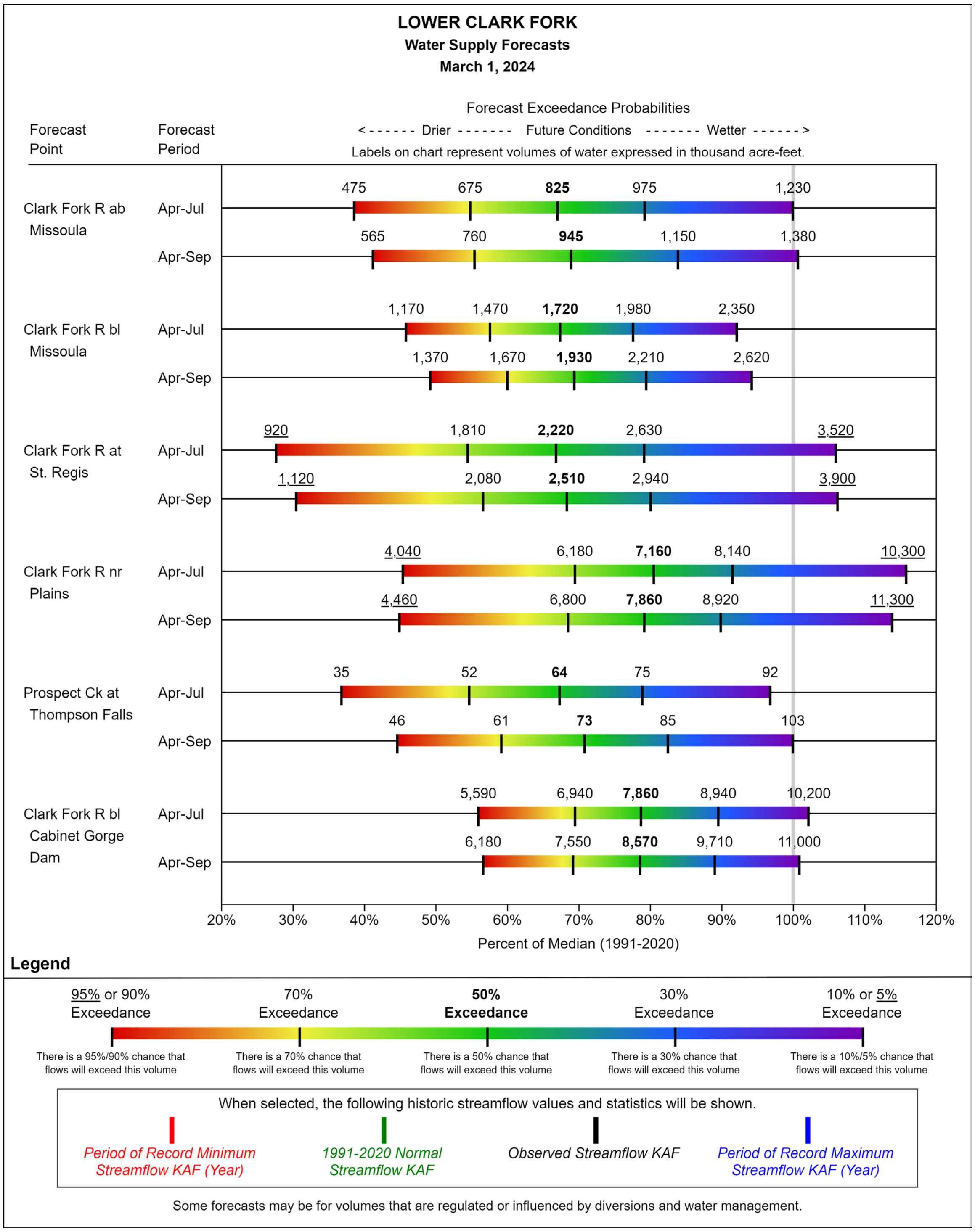
Precipitation in February was above normal at 111%, which brings the seasonal accumulation (October-February) to 76% of median. The snowpack in the Lower Clark Fork is well below normal at 66% of median, compared to 89% at this time last year.





Basin Overview

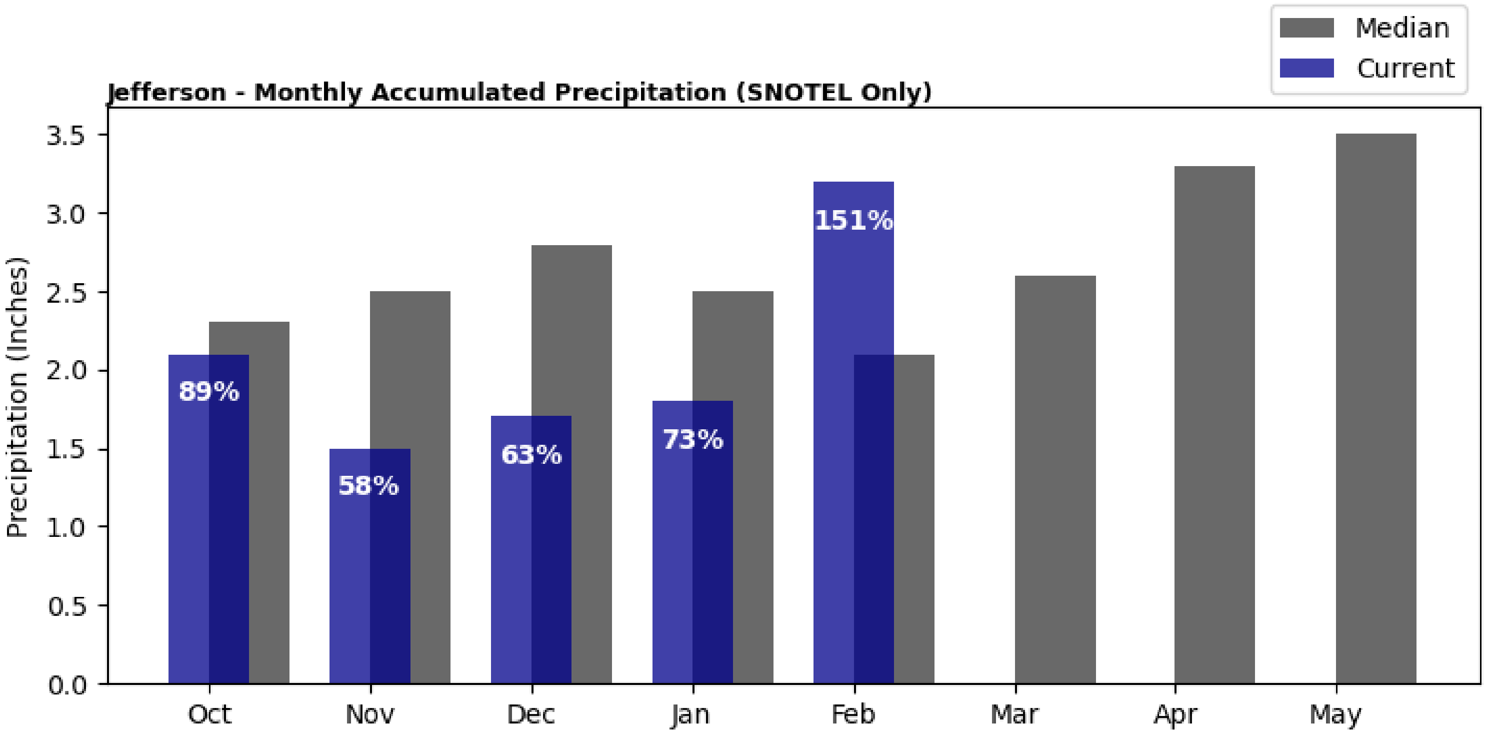
Lower Clark Fork (Continued)

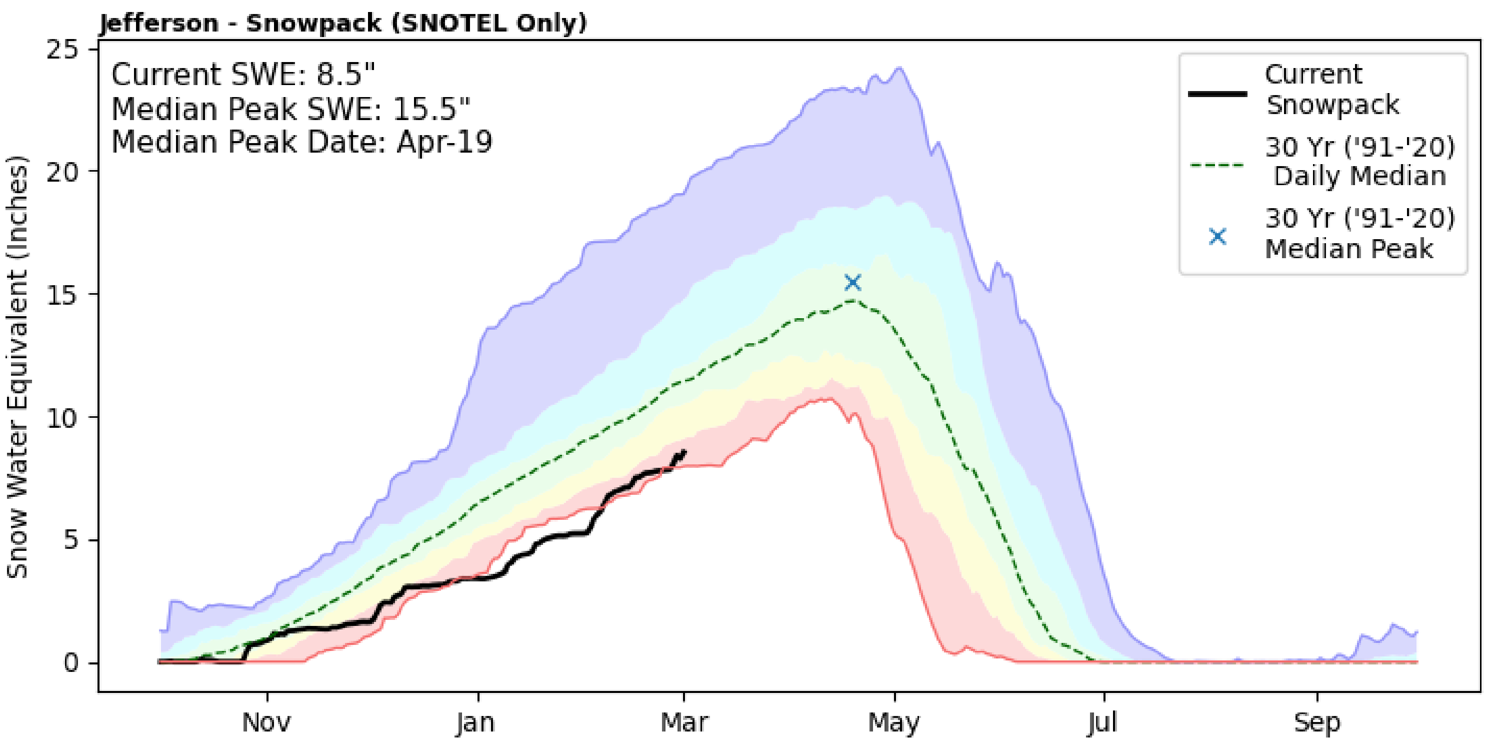


Basin Overview

Jefferson

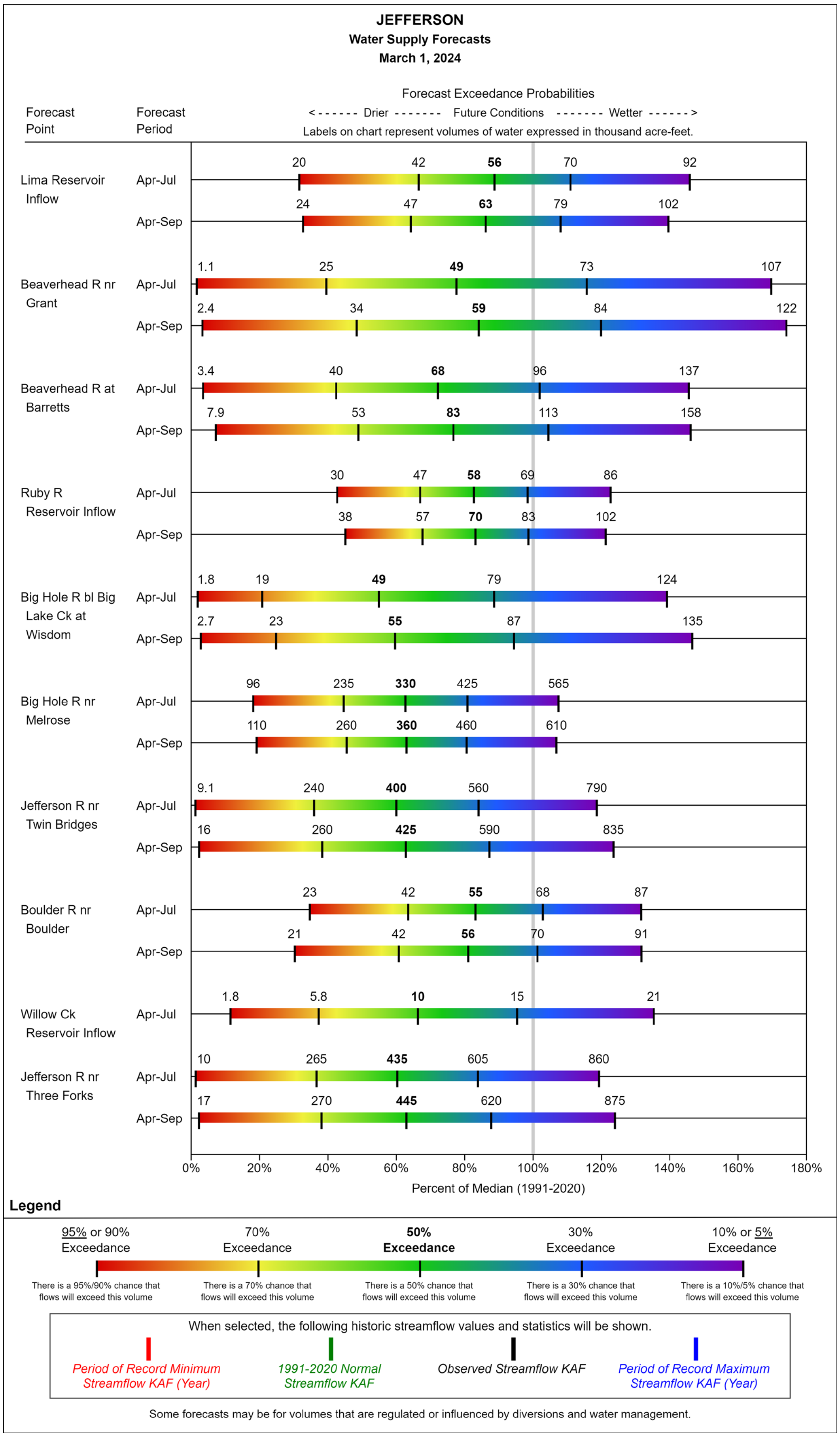
Precipitation in February was well above normal at 151%, which brings the seasonal accumulation (October-February) to 81% of median. The snowpack in the Jefferson is well below normal at 73% of median, compared to 102% at this time last year.





Basin Overview

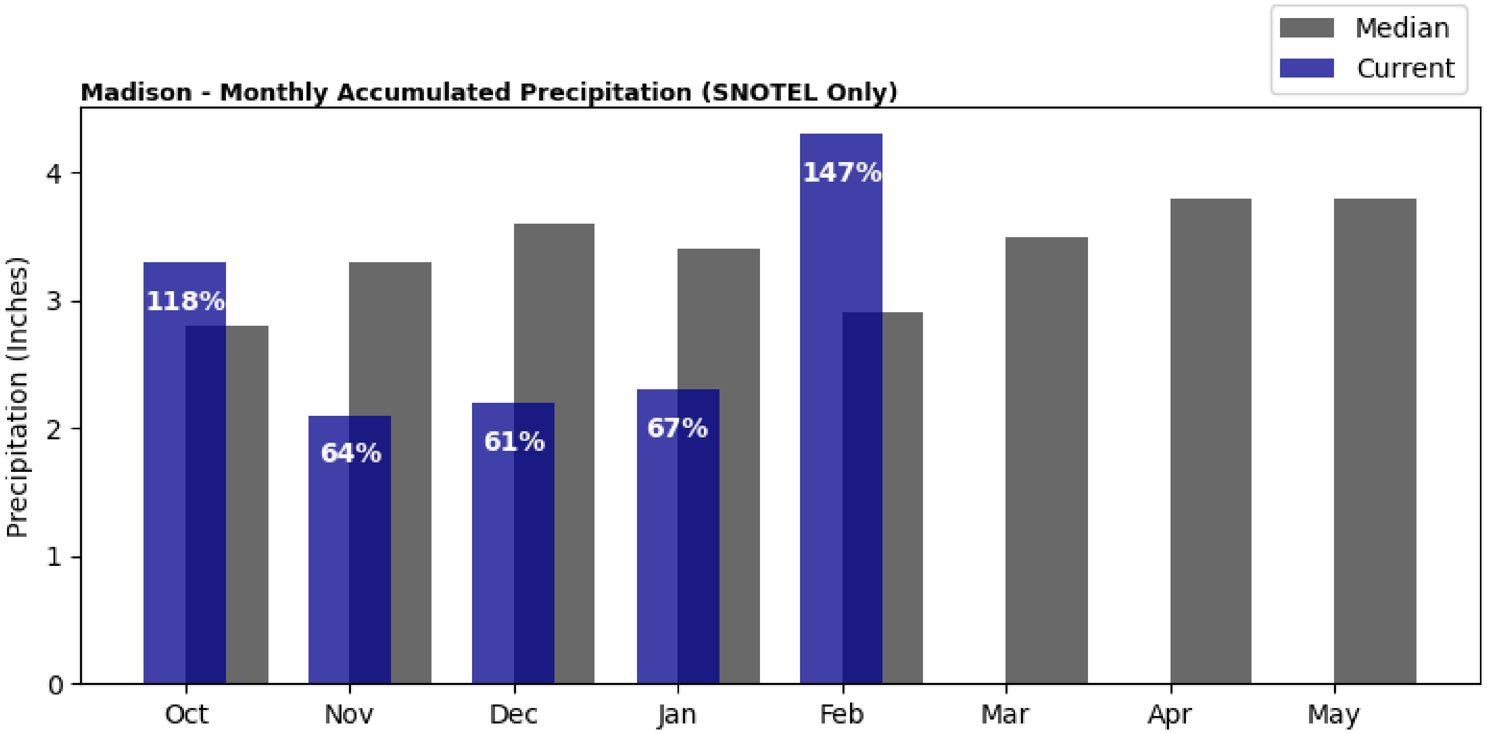
Jefferson (Continued)

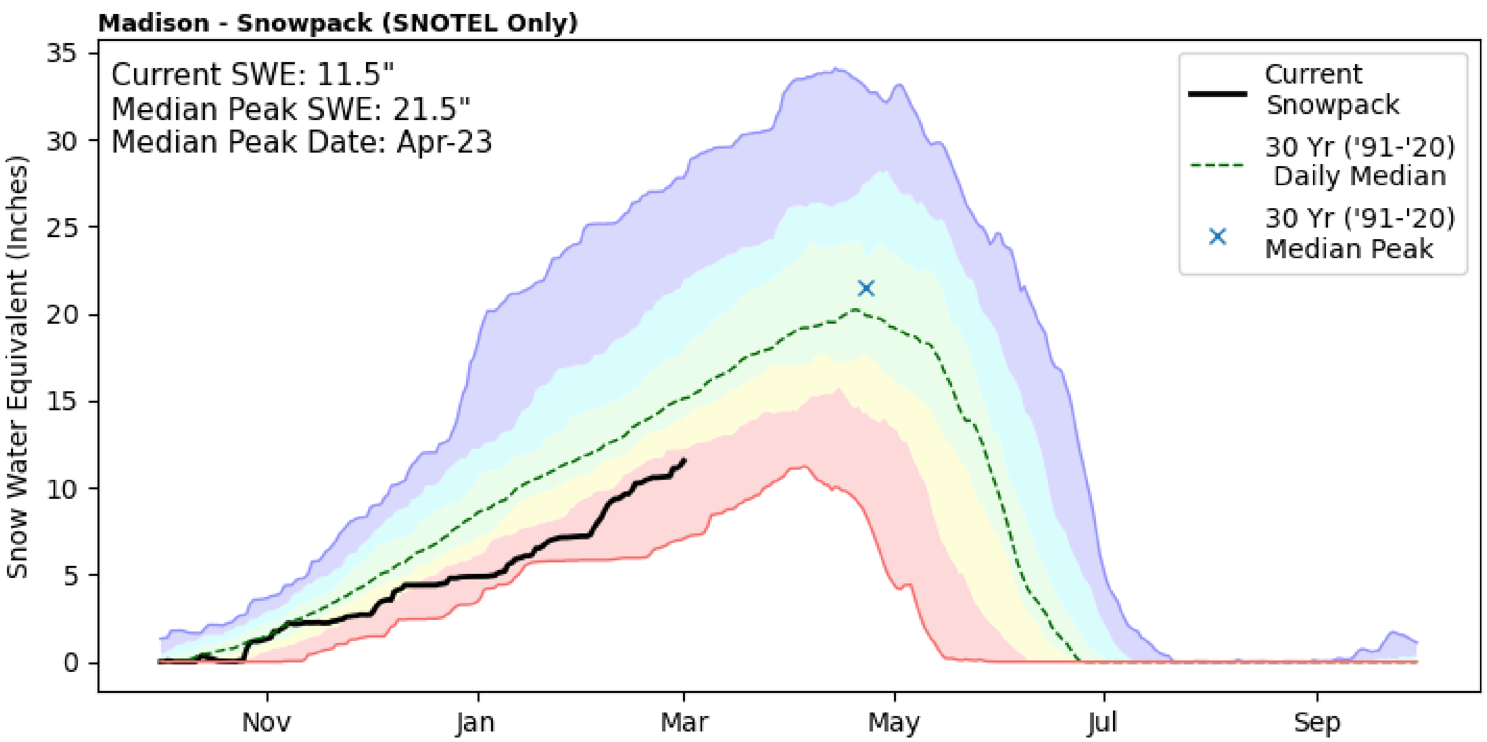


Basin Overview

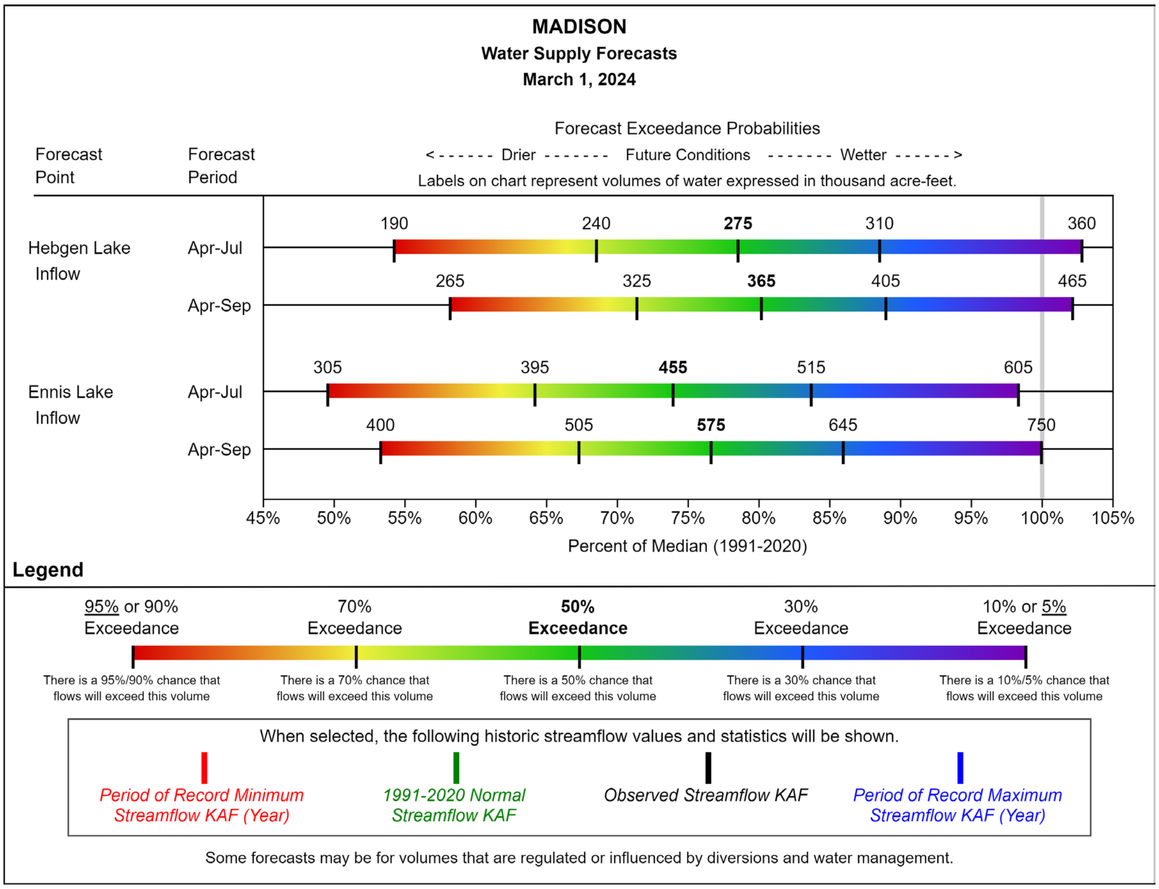
Madison

Precipitation in February was well above normal at 147%, which brings the seasonal accumulation (October-February) to 87% of median. The snowpack in the Madison is well below normal at 73% of median, compared to 116% at this time last year.





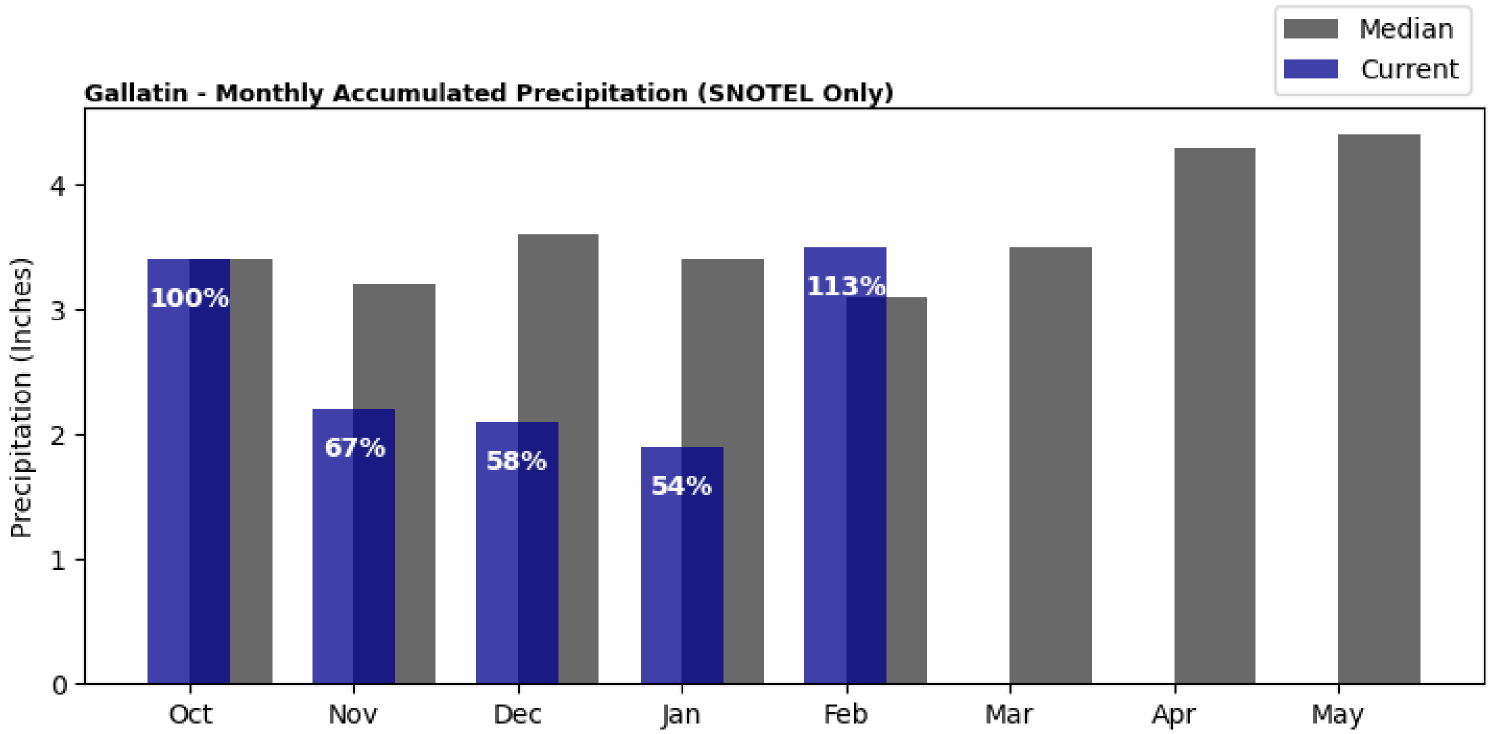
Madison (Continued)

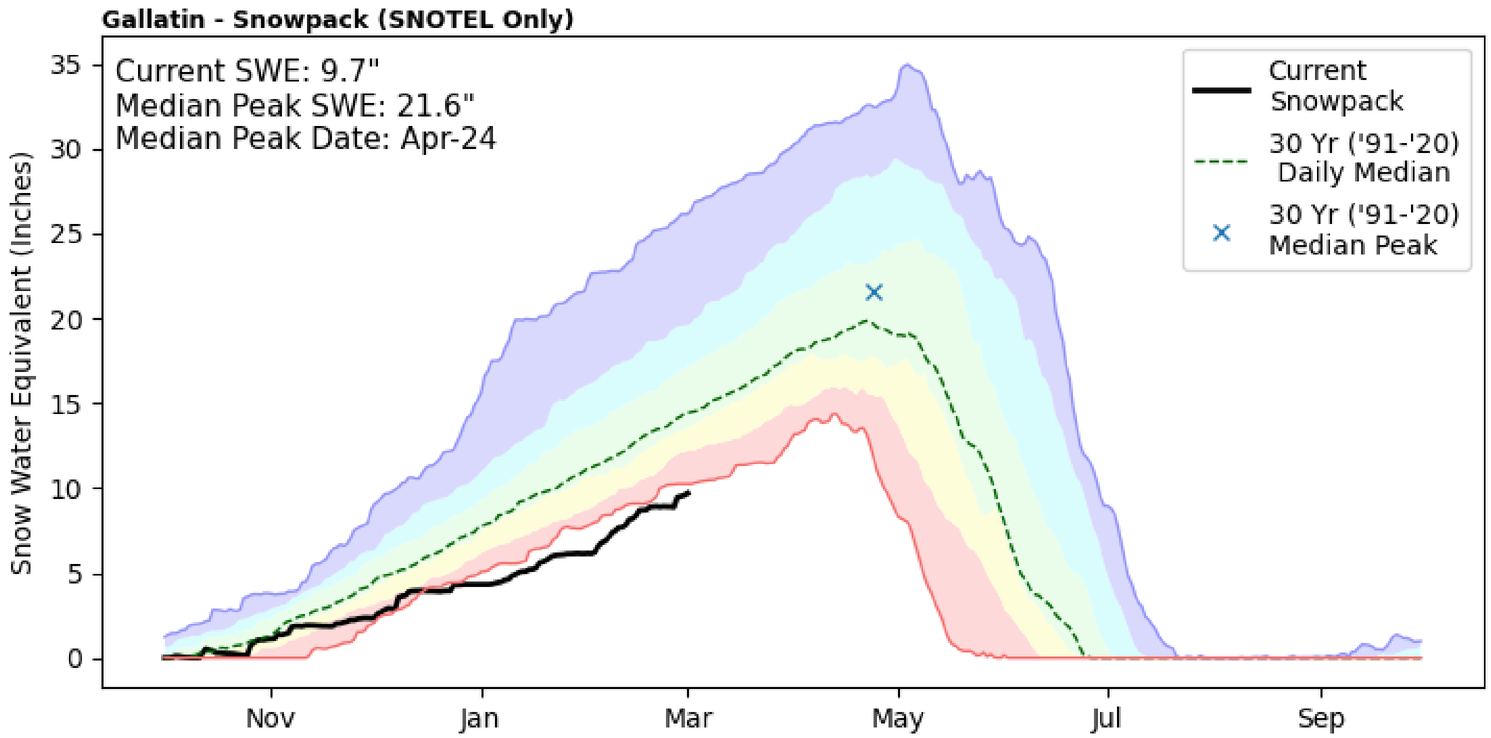


Basin Overview

Gallatin

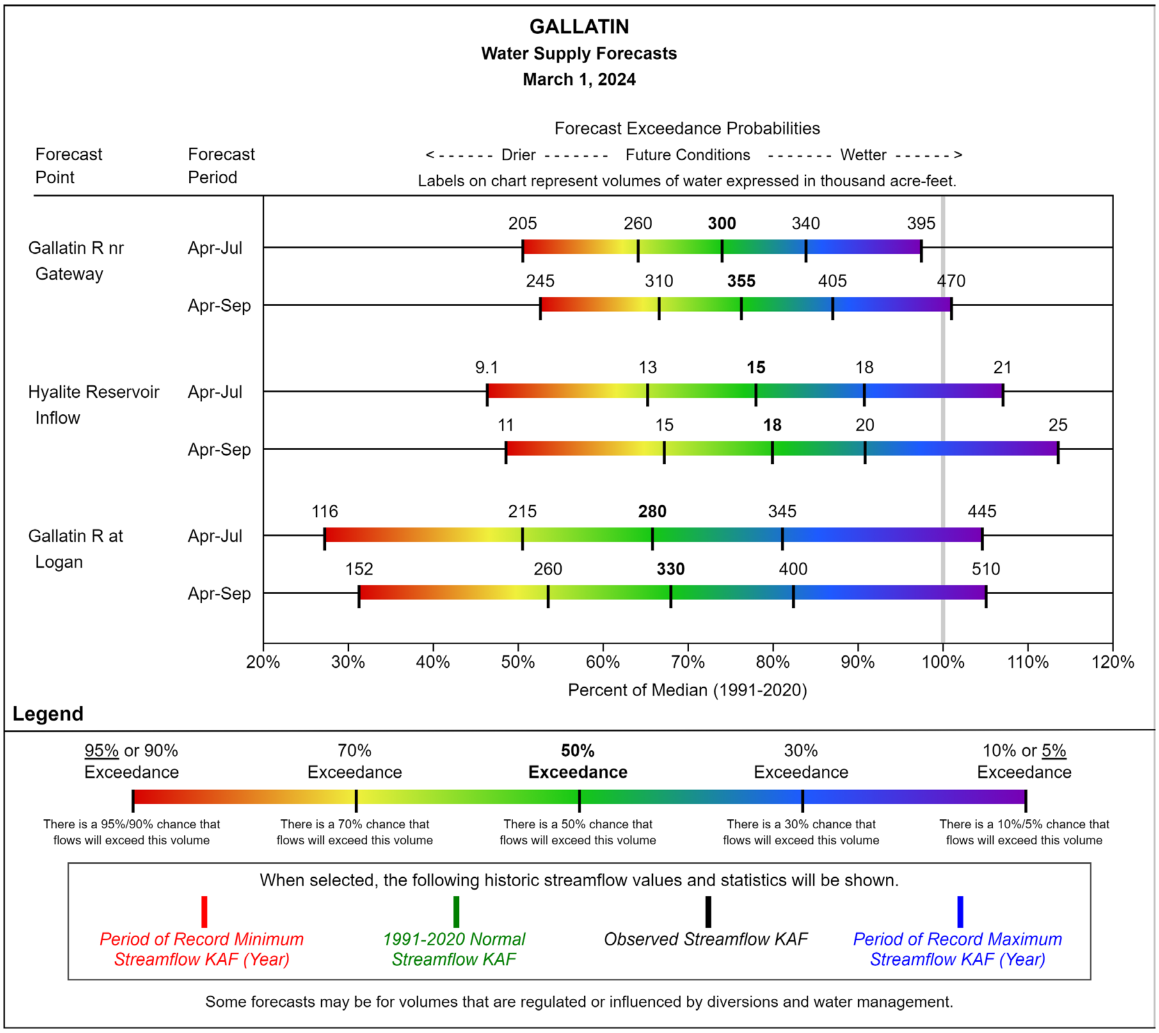
Precipitation in February was above normal at 113%, which brings the seasonal accumulation (October-February) to 75% of median. The snowpack in the Gallatin is well below normal at 65% of median, compared to 113% at this time last year.





Basin Overview

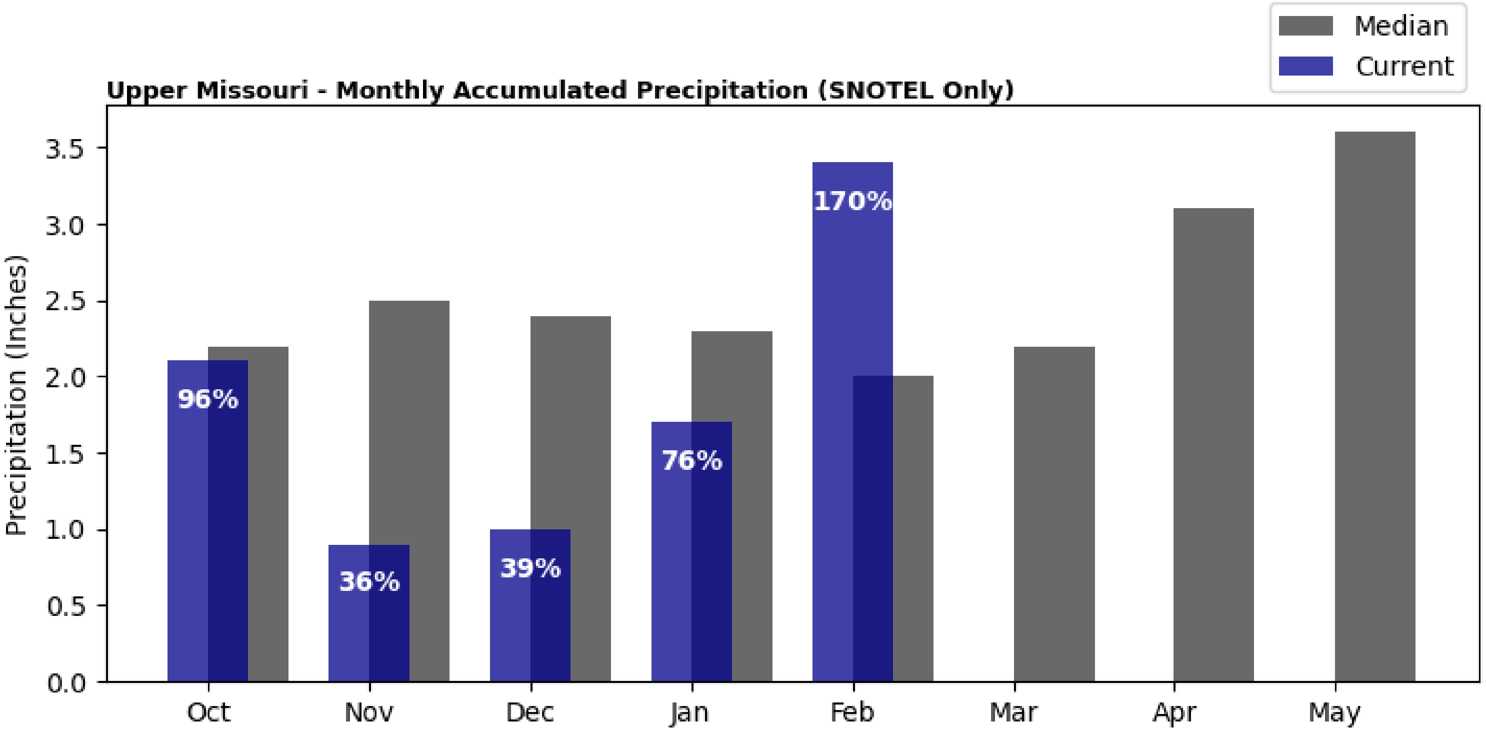
Gallatin (Continued)

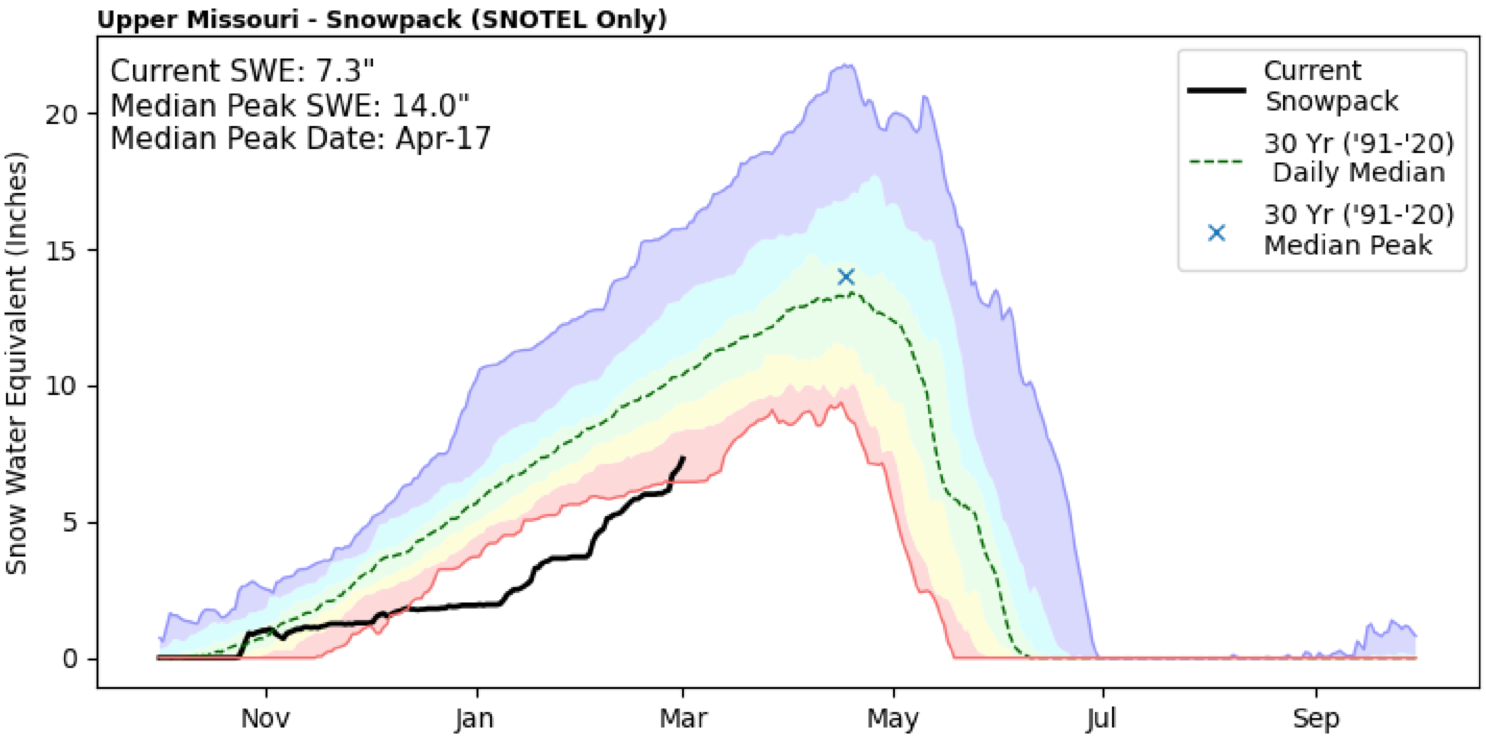


Basin Overview

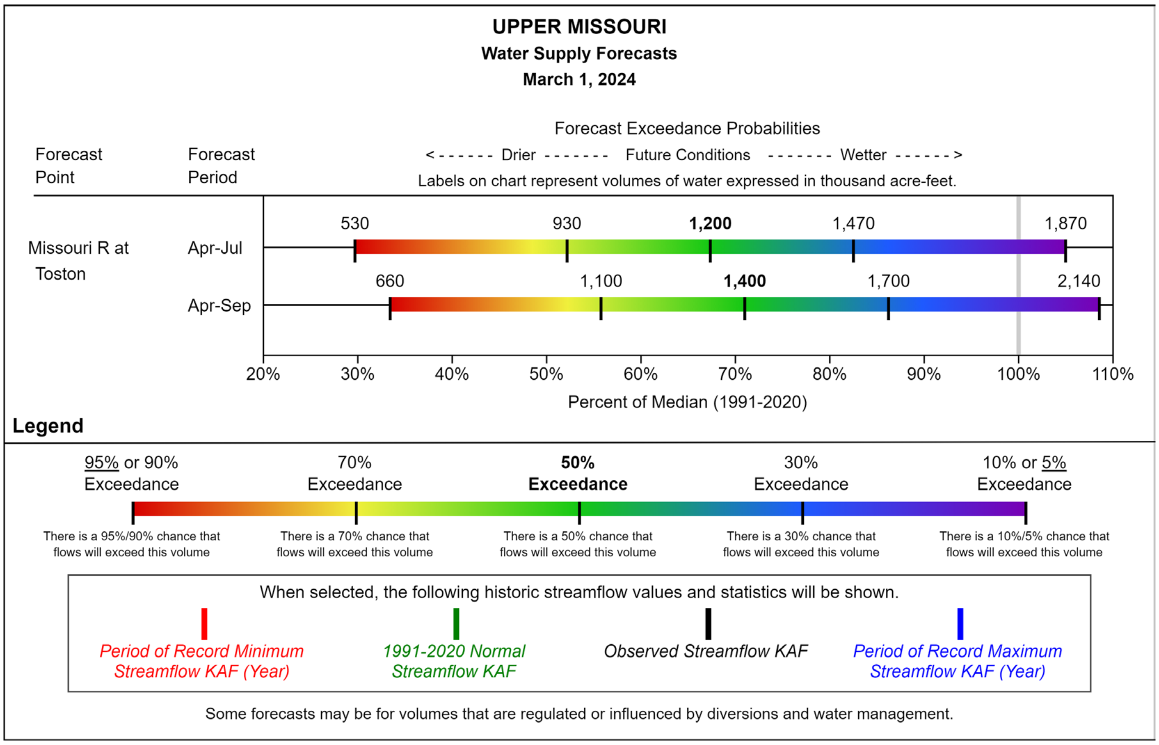
Upper Missouri

Precipitation in February was well above normal at 170%, which brings the seasonal accumulation (October-February) to 78% of median. The snowpack in the Upper Missouri is well below normal at 71% of median, compared to 116% at this time last year.





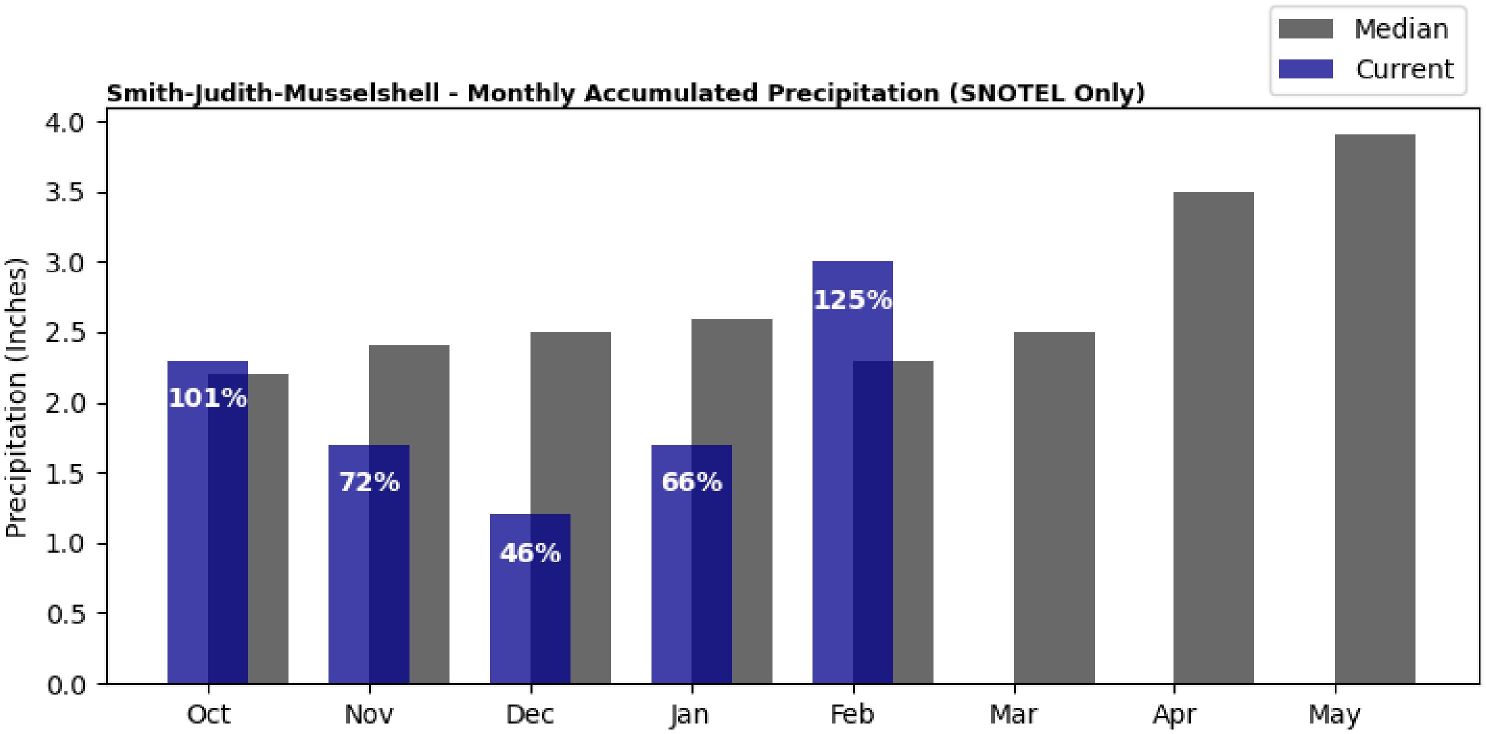
Upper Missouri (Continued)

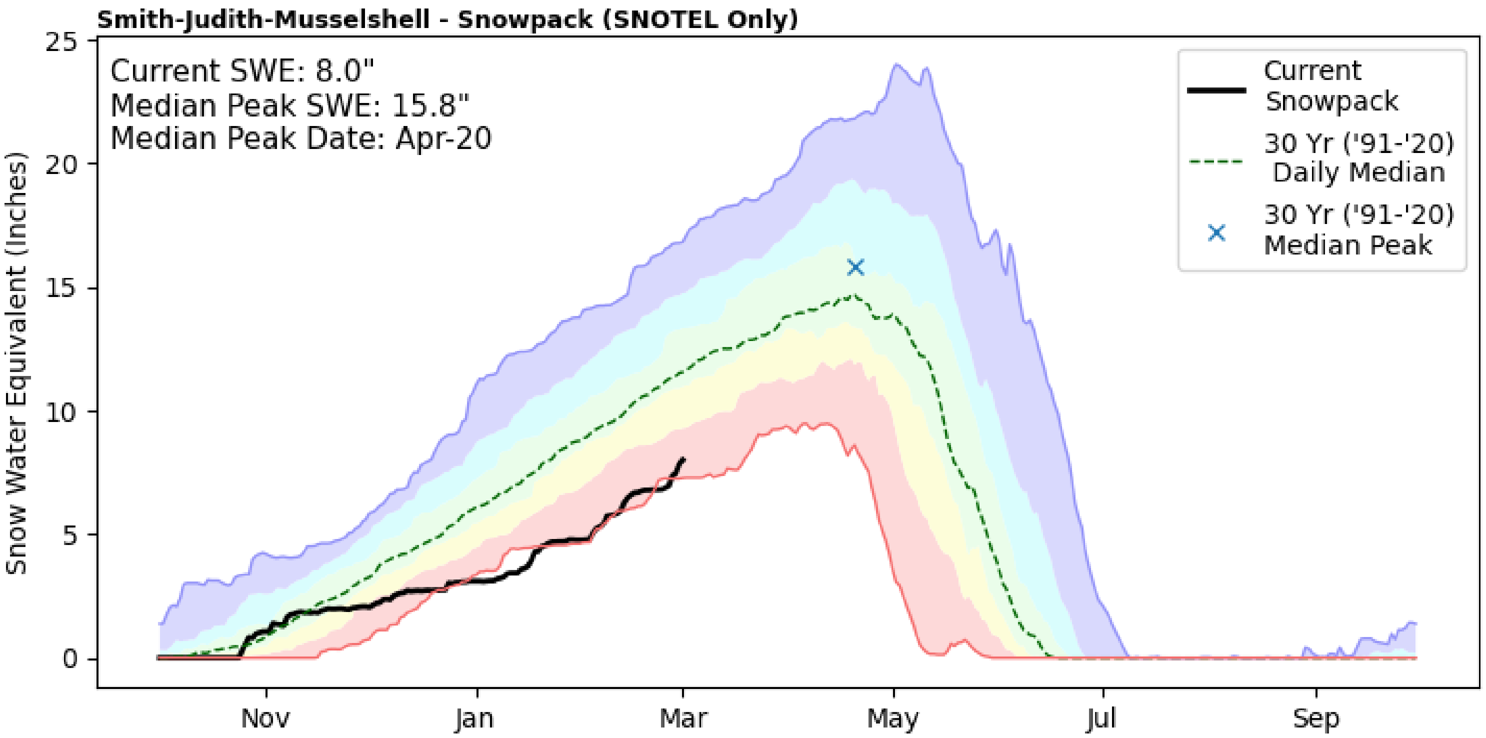


Basin Overview

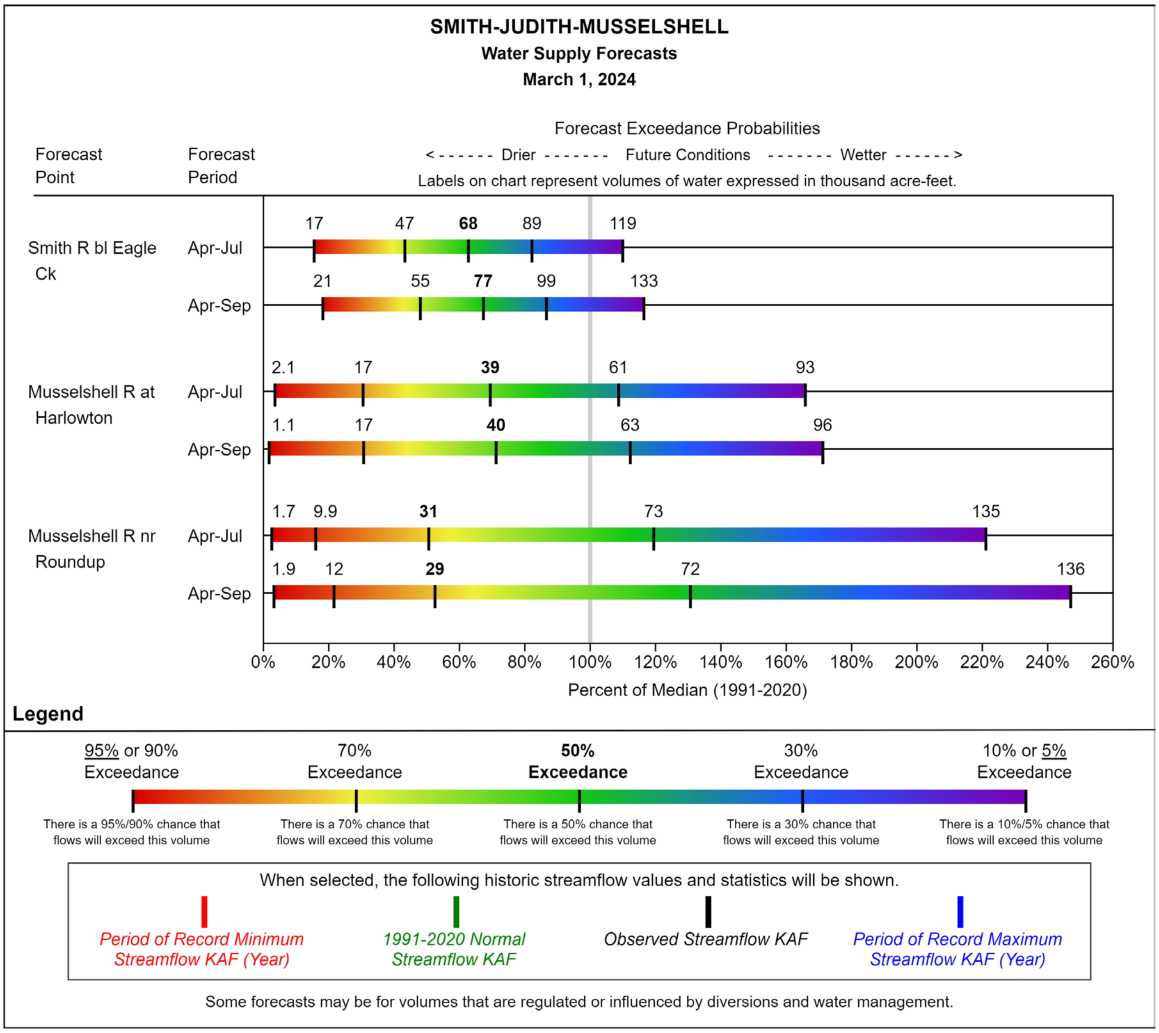
Smith-Judith-Musselshell

Precipitation in February was above normal at 120%, which brings the seasonal accumulation (October-February) to 75% of median. The snowpack in the Smith-Judith-Musselshell is well below normal at 65% of median, compared to 126% at this time last year.





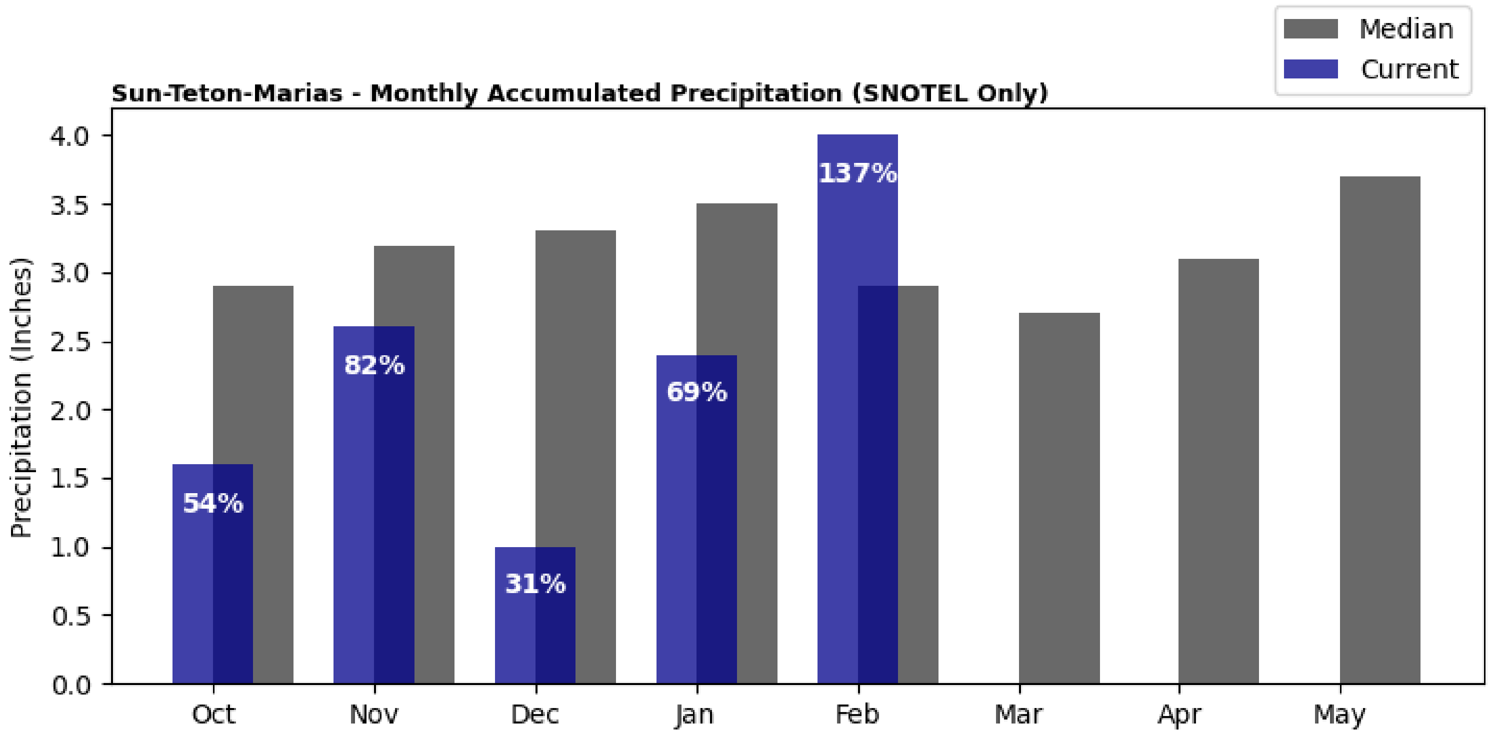
Smith-Judith-Musselshell (Continued)

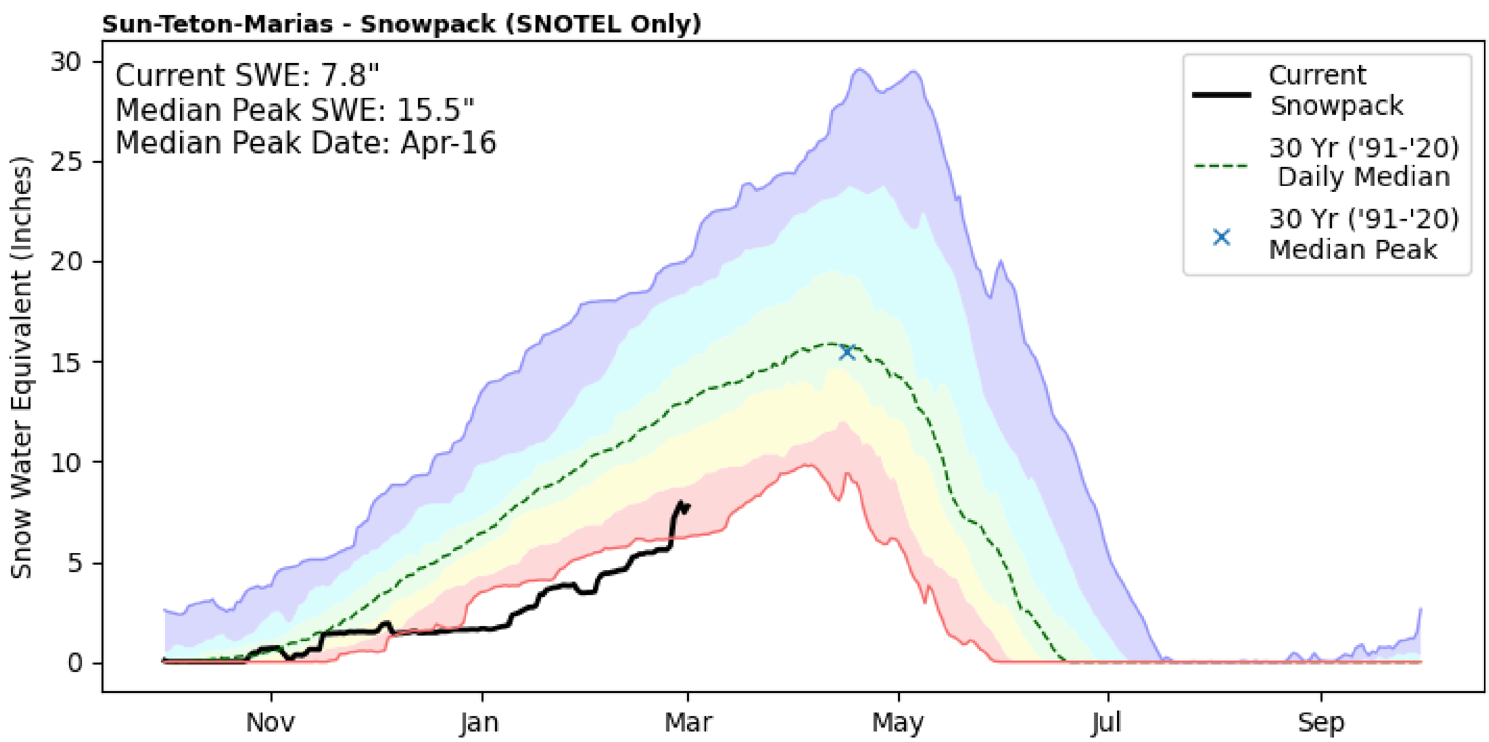


Basin Overview

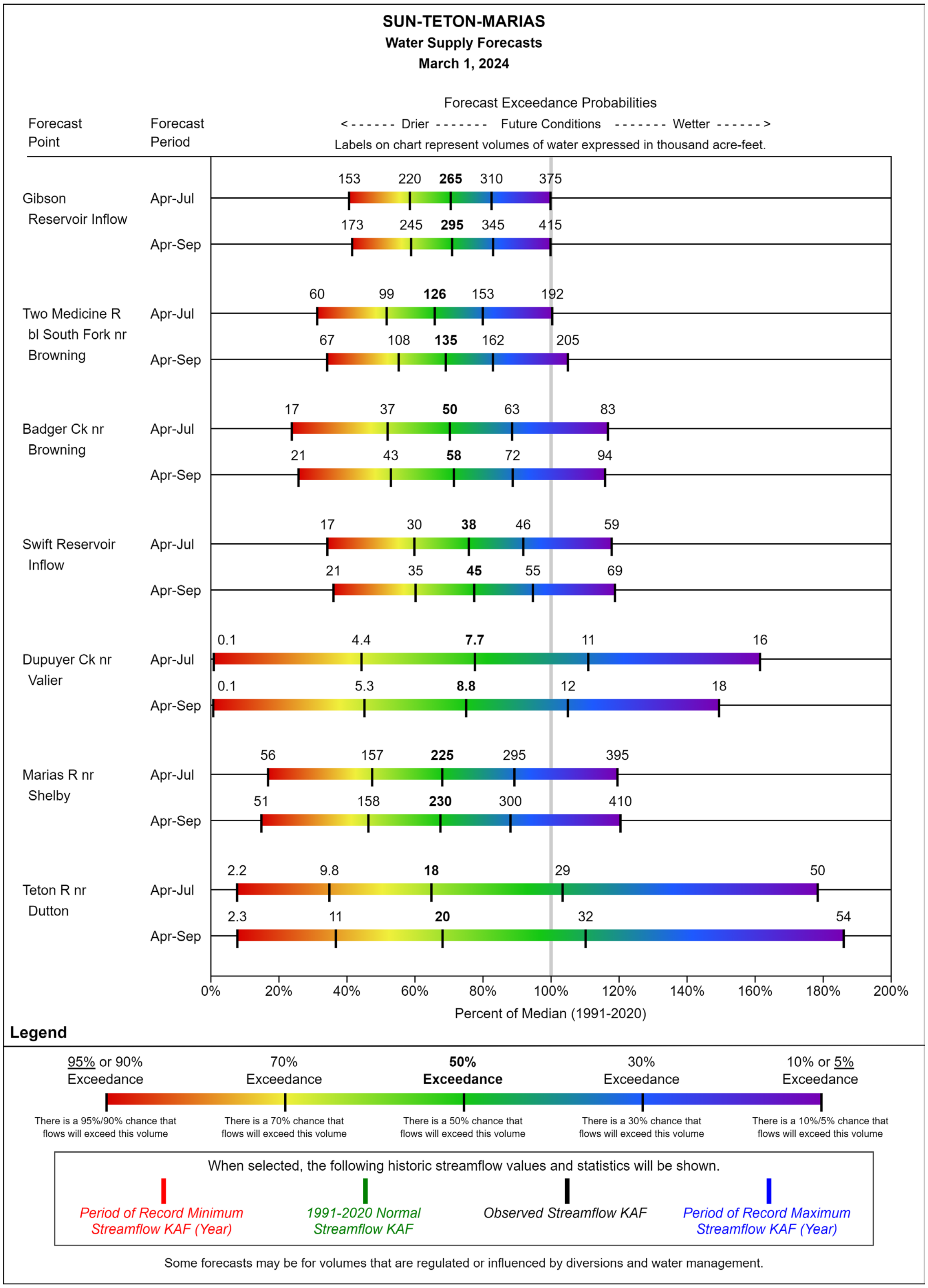
Sun-Teton-Marias

Precipitation in February was well above normal at 137%, which brings the seasonal accumulation (October-February) to 71% of median. The snowpack in the Sun-Teton-Marias is well below normal at 53% of median, compared to 97% at this time last year.





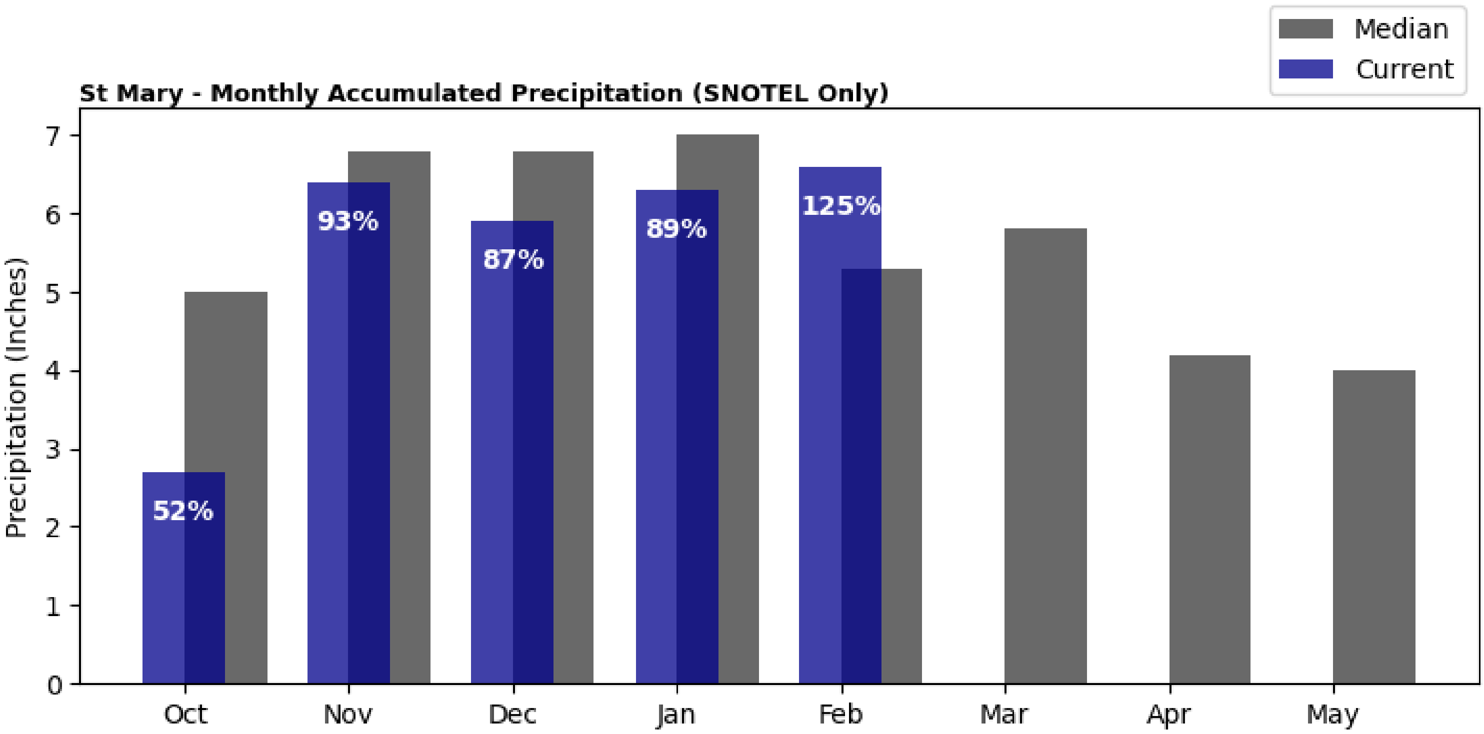
Sun-Teton-Marias (Continued)

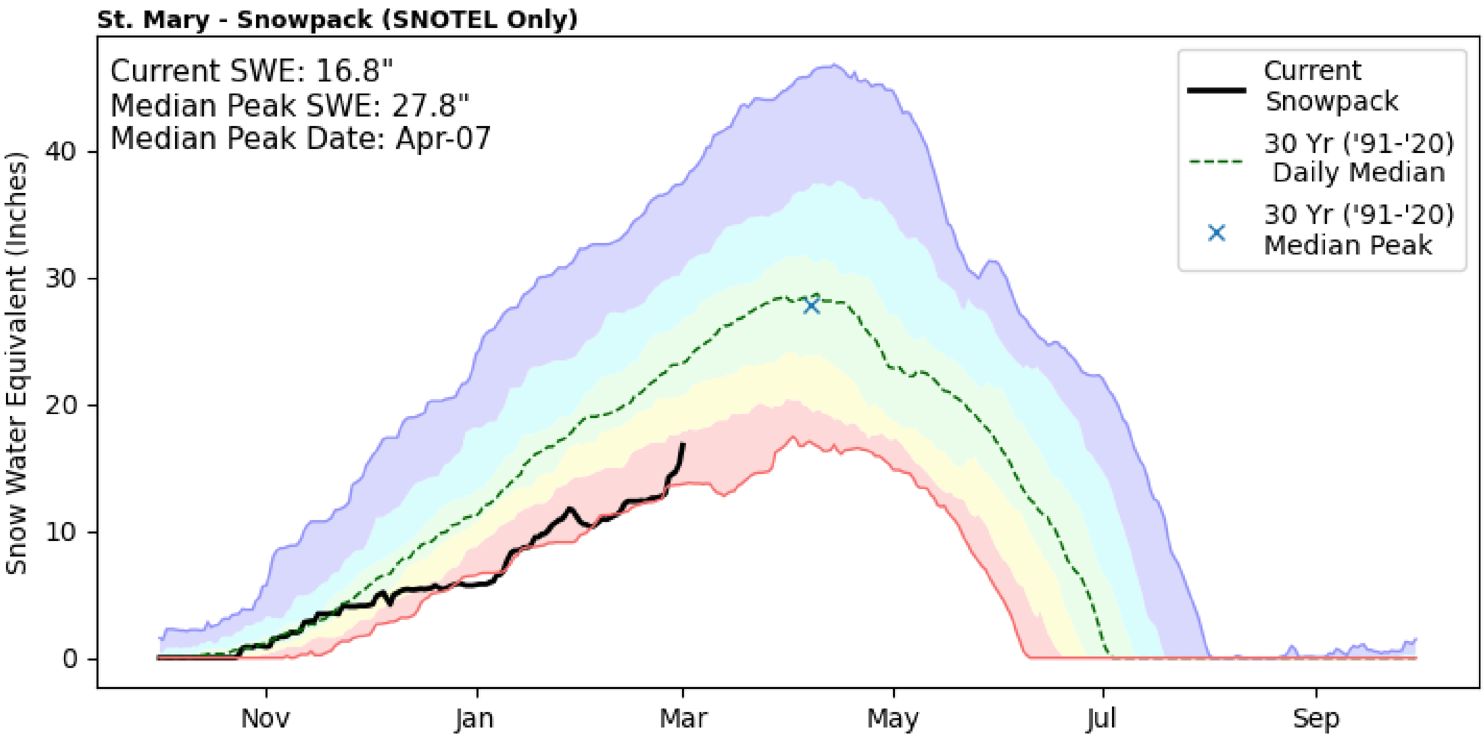


Basin Overview

St. Mary

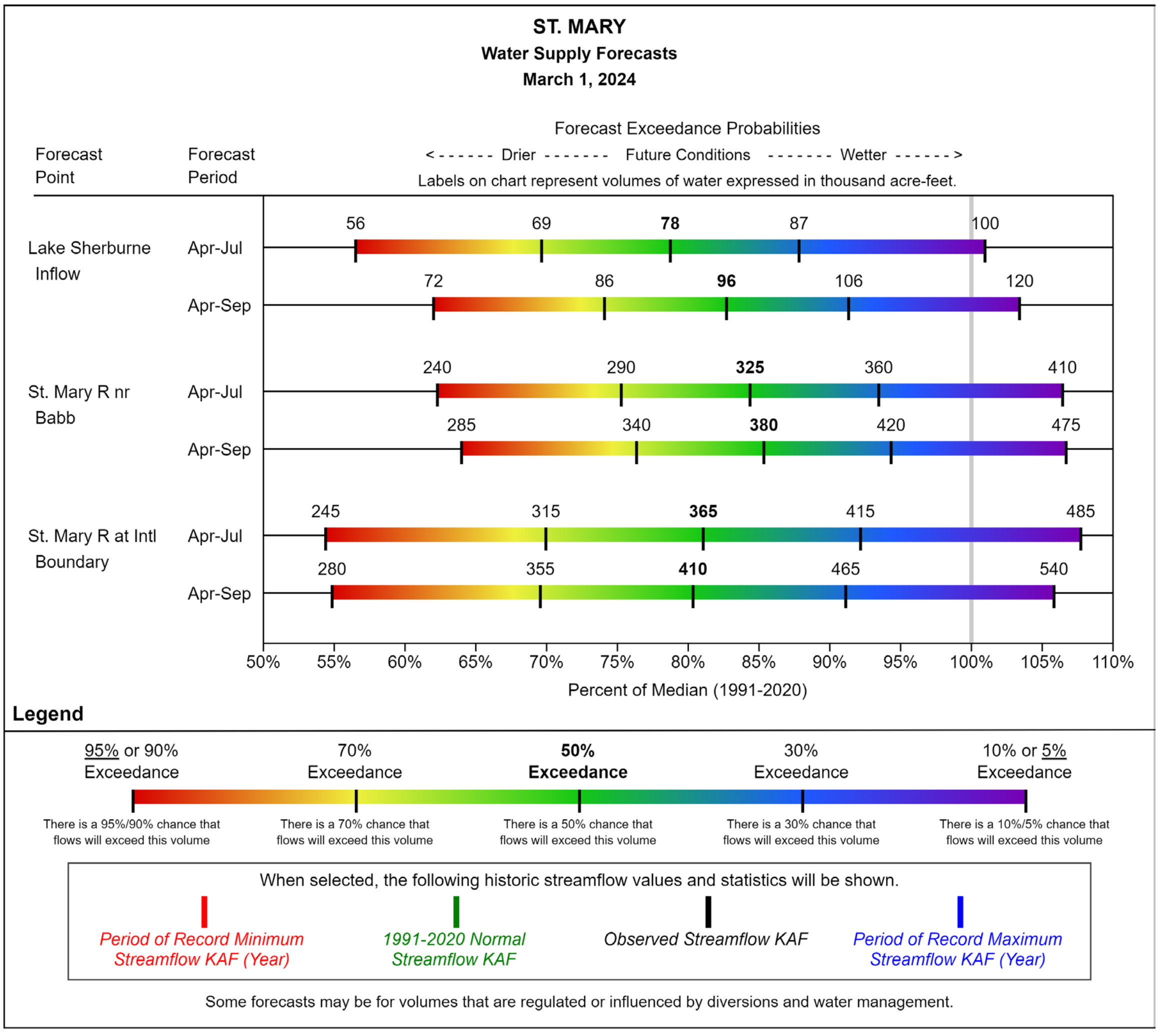
Precipitation in February was well above normal at 125%, which brings the seasonal accumulation (October-February) to 81% of median. The snowpack in the St. Mary is well below normal at 72% of median, compared to 96% at this time last year.





Basin Overview

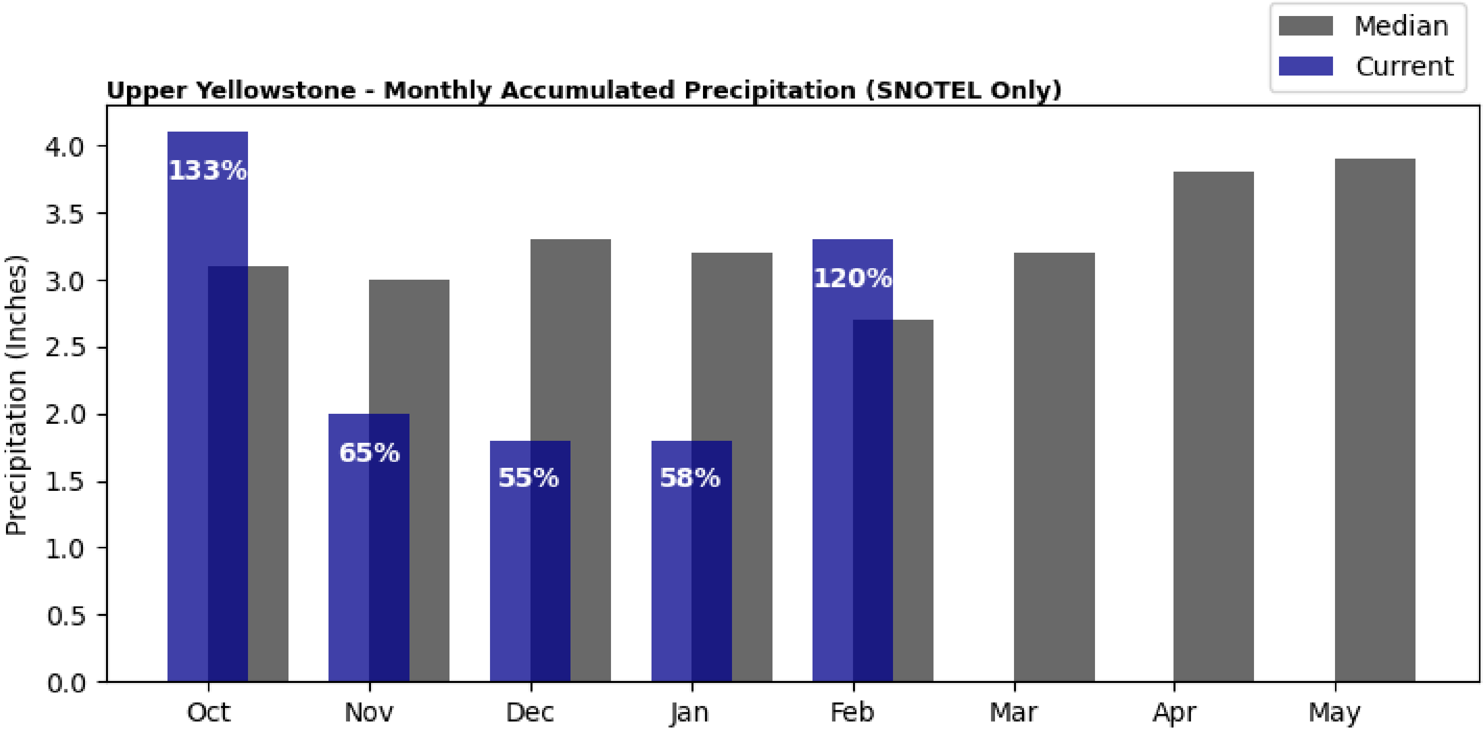
St. Mary (Continued)

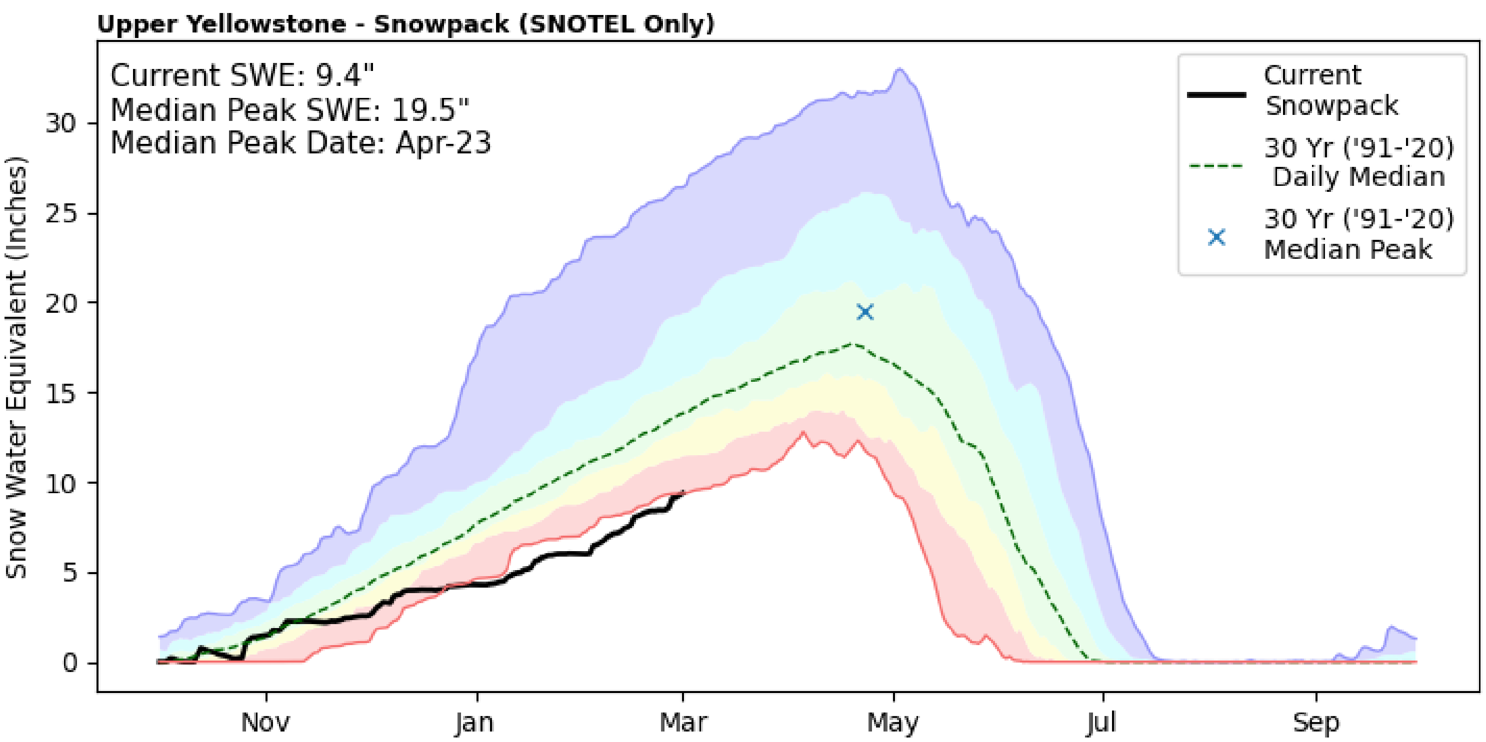


Basin Overview

Upper Yellowstone

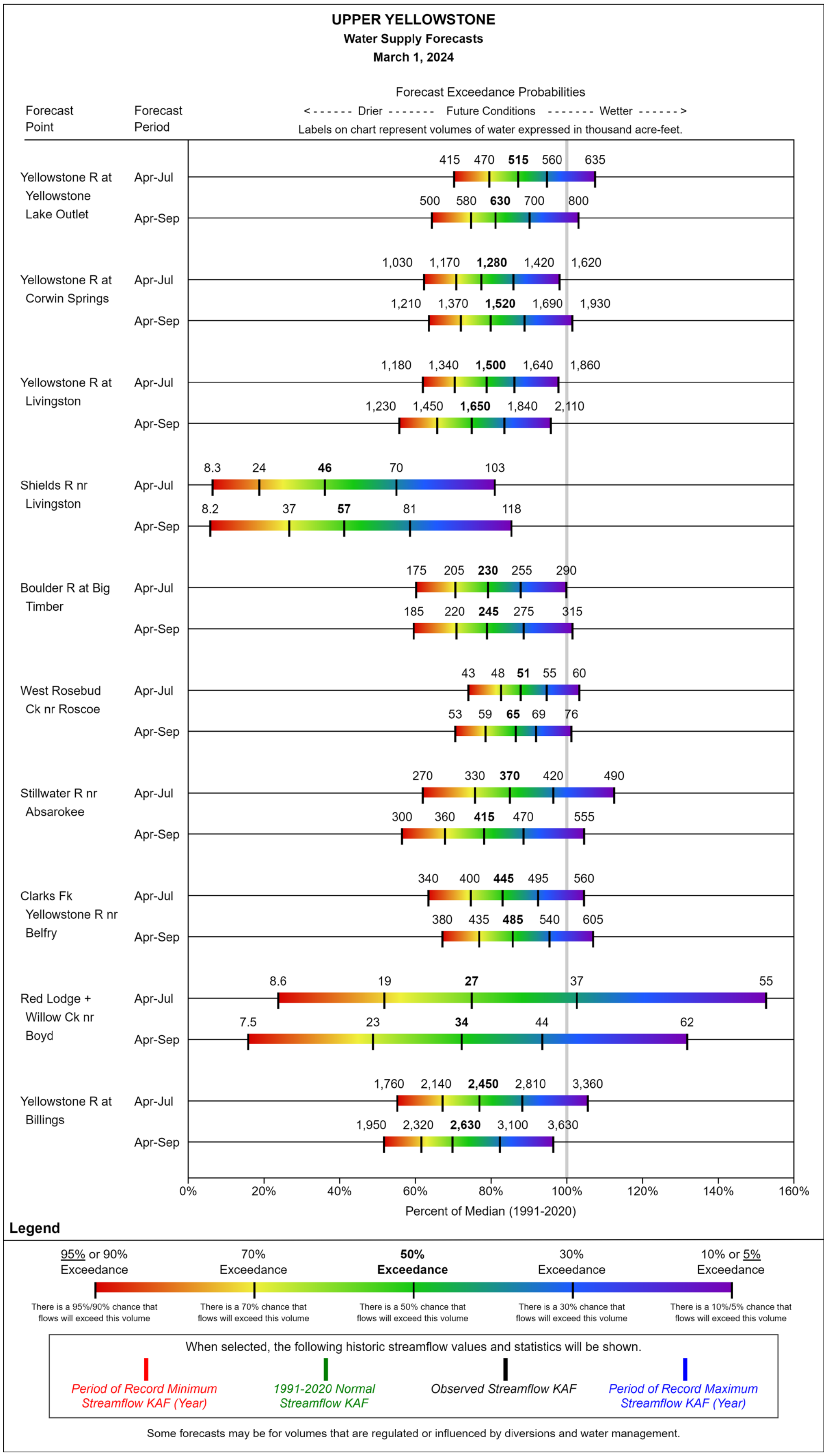
Precipitation in February was above normal at 120%, which brings the seasonal accumulation (October-February) to 83% of median. The snowpack in the Upper Yellowstone is well below normal at 65% of median, compared to 105% at this time last year.





Basin Overview

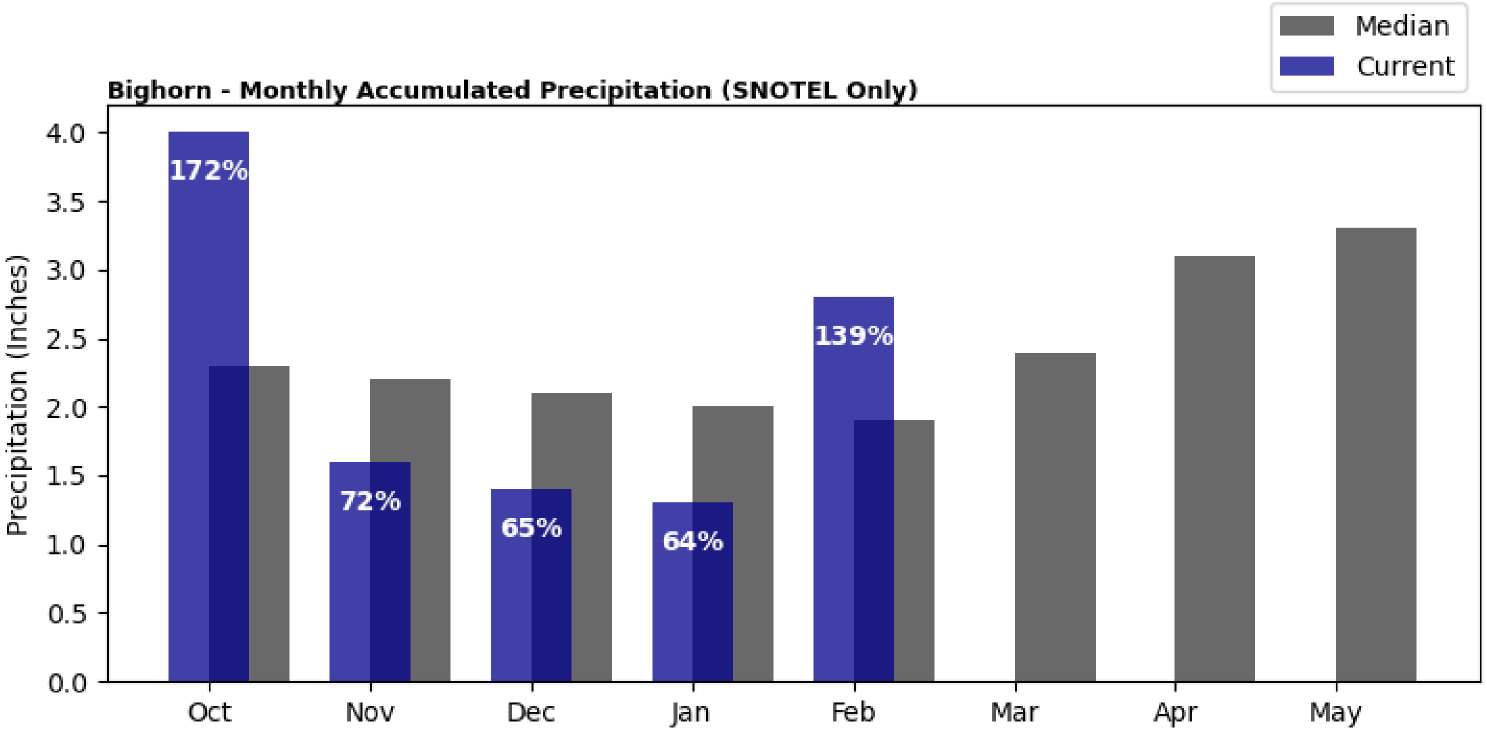
Upper Yellowstone (Continued)

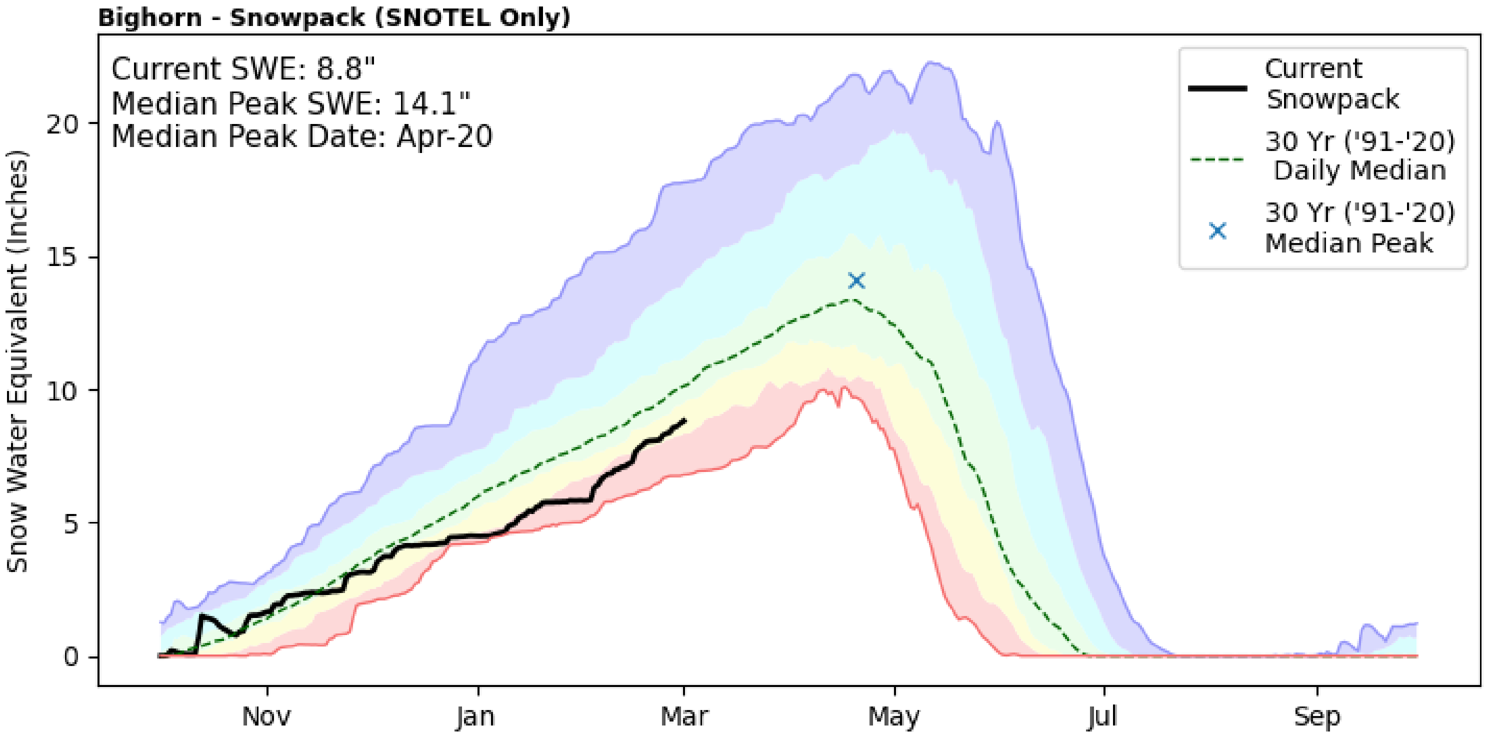


Basin Overview

Bighorn

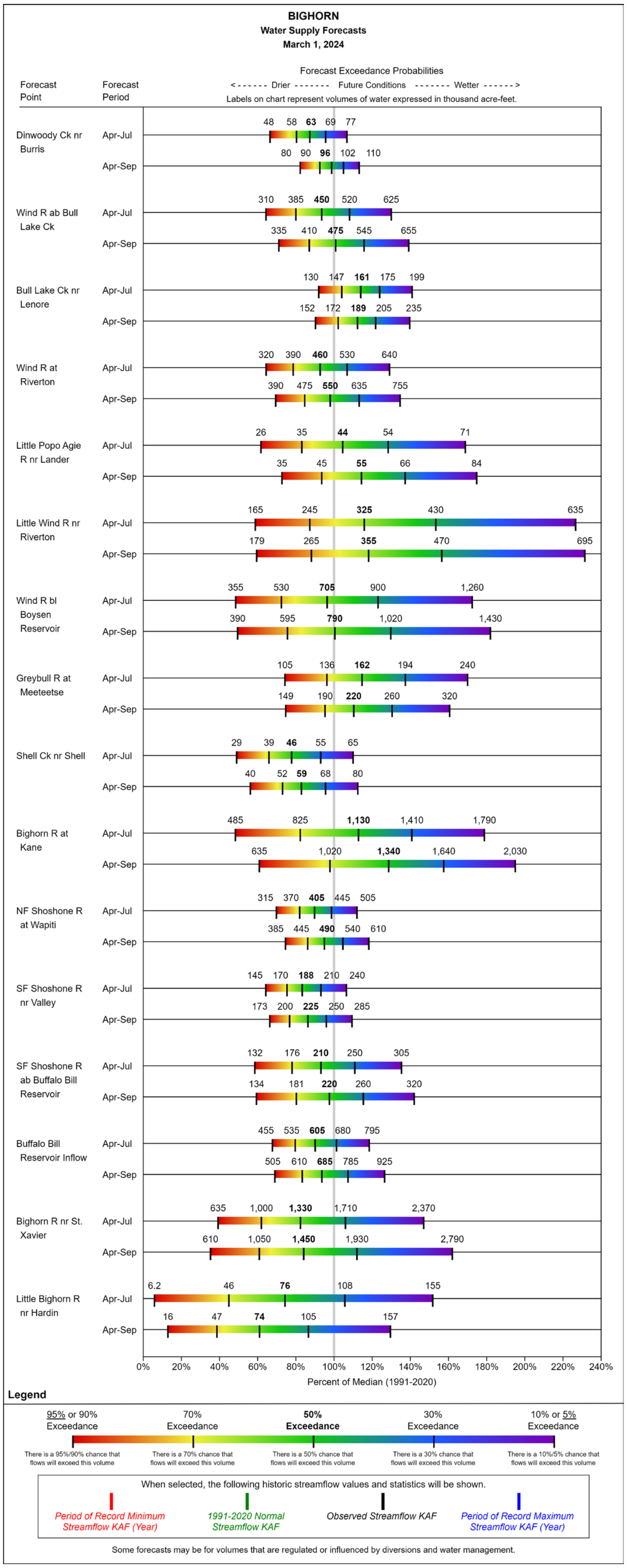
Precipitation in February was well above normal at 140%, which brings the seasonal accumulation (October-February) to 101% of median. The snowpack in the Bighorn is below normal at 85% of median, compared to 114% at this time last year.





Basin Overview

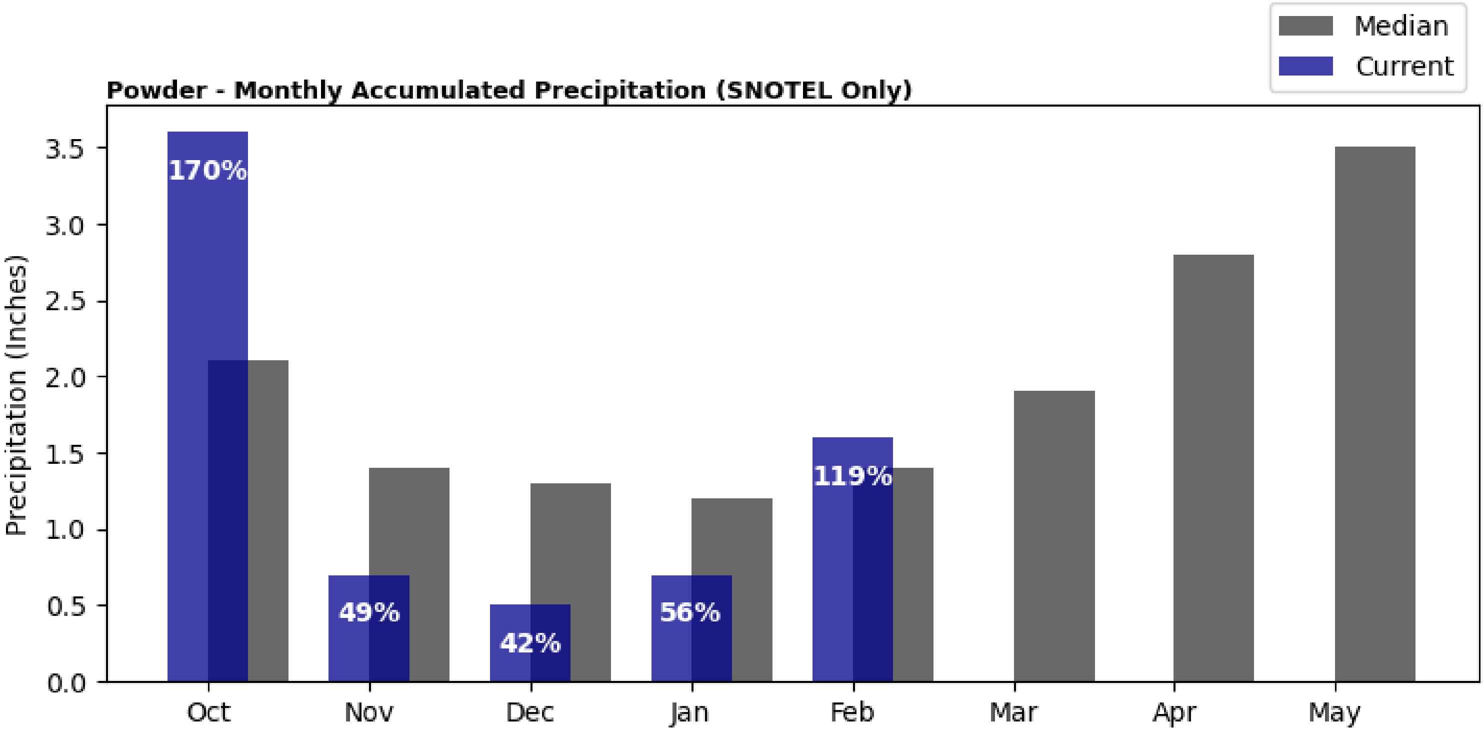
Bighorn (Continued)

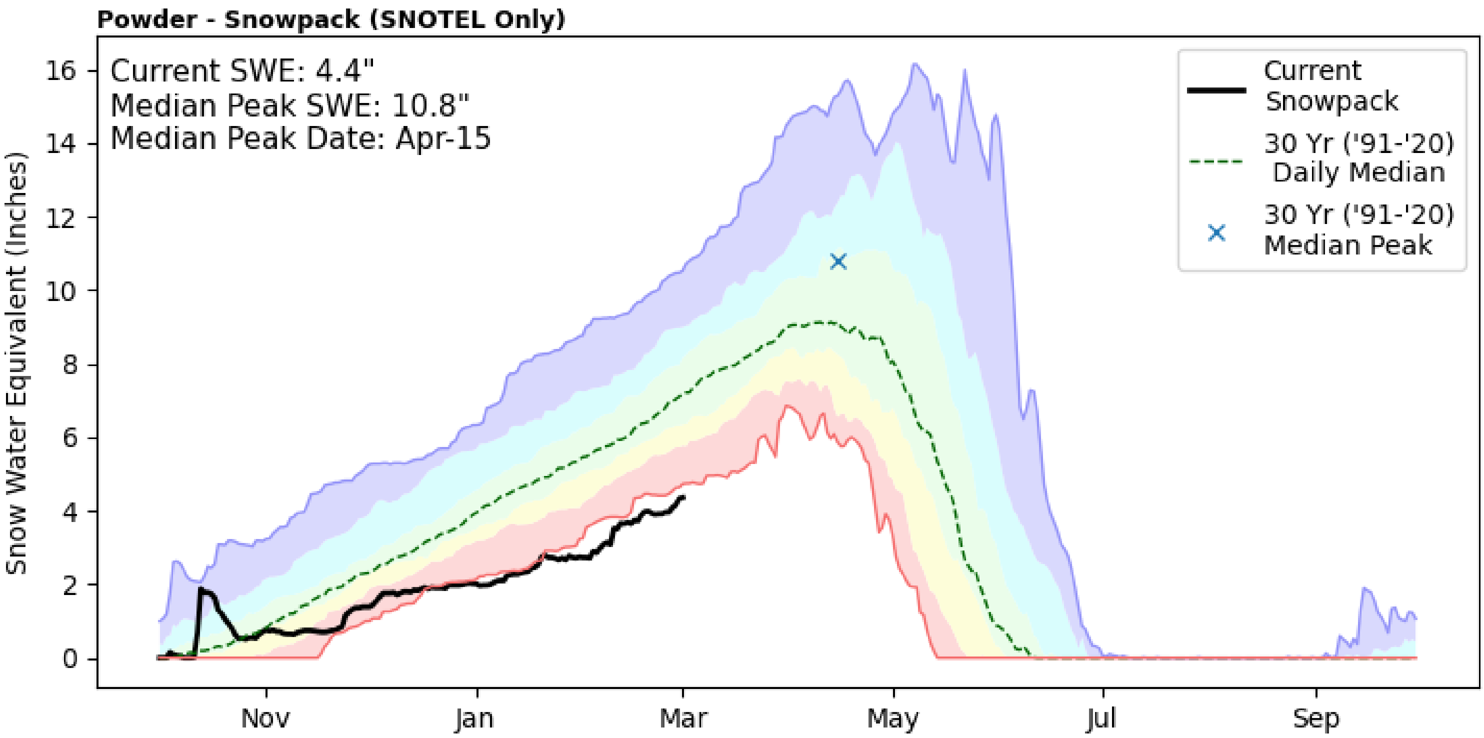


Basin Overview

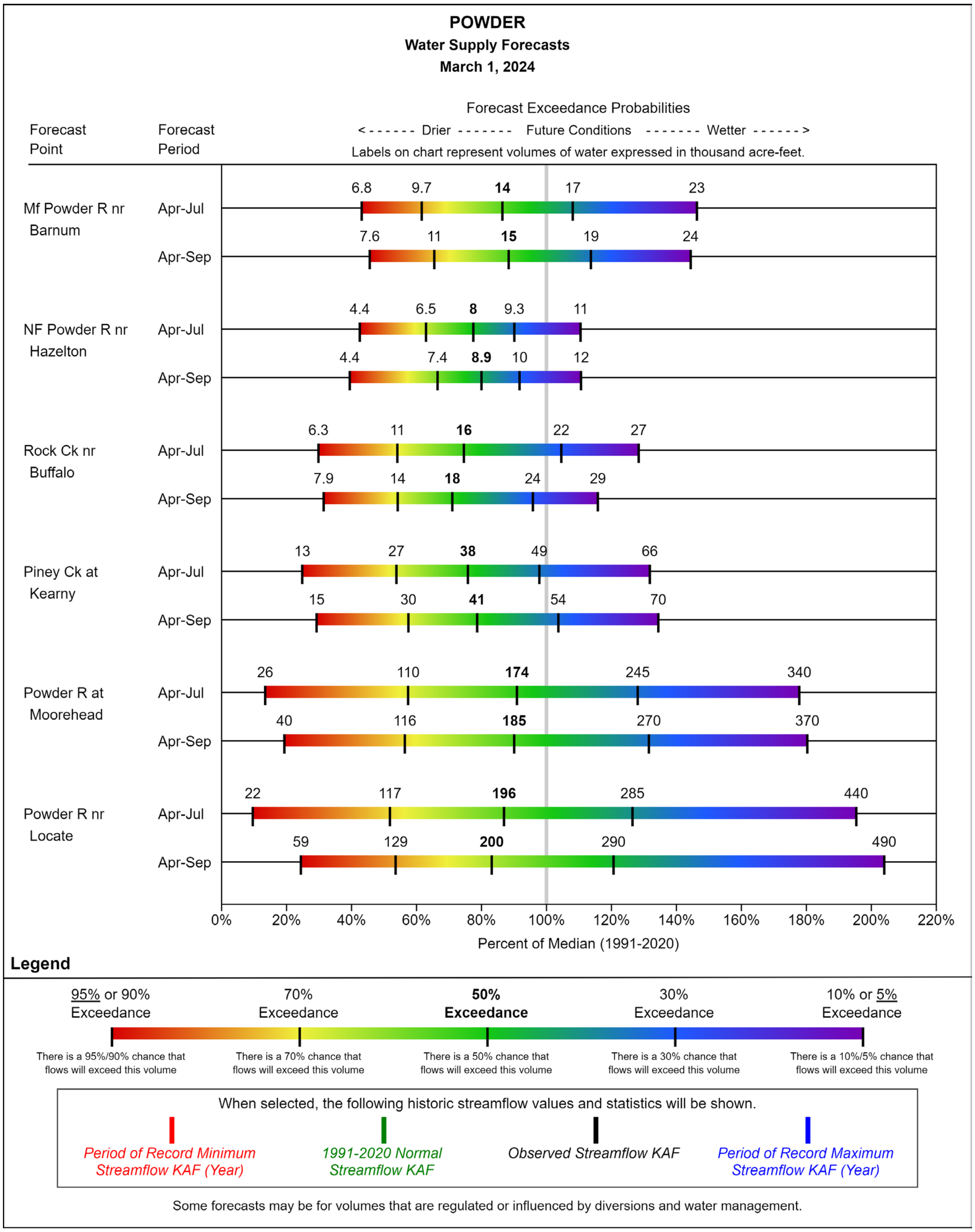
Powder

Precipitation in February was above normal at 119%, which brings the seasonal accumulation (October-February) to 94% of median. The snowpack in the Powder is well below normal at 63% of median, compared to 117% at this time last year.





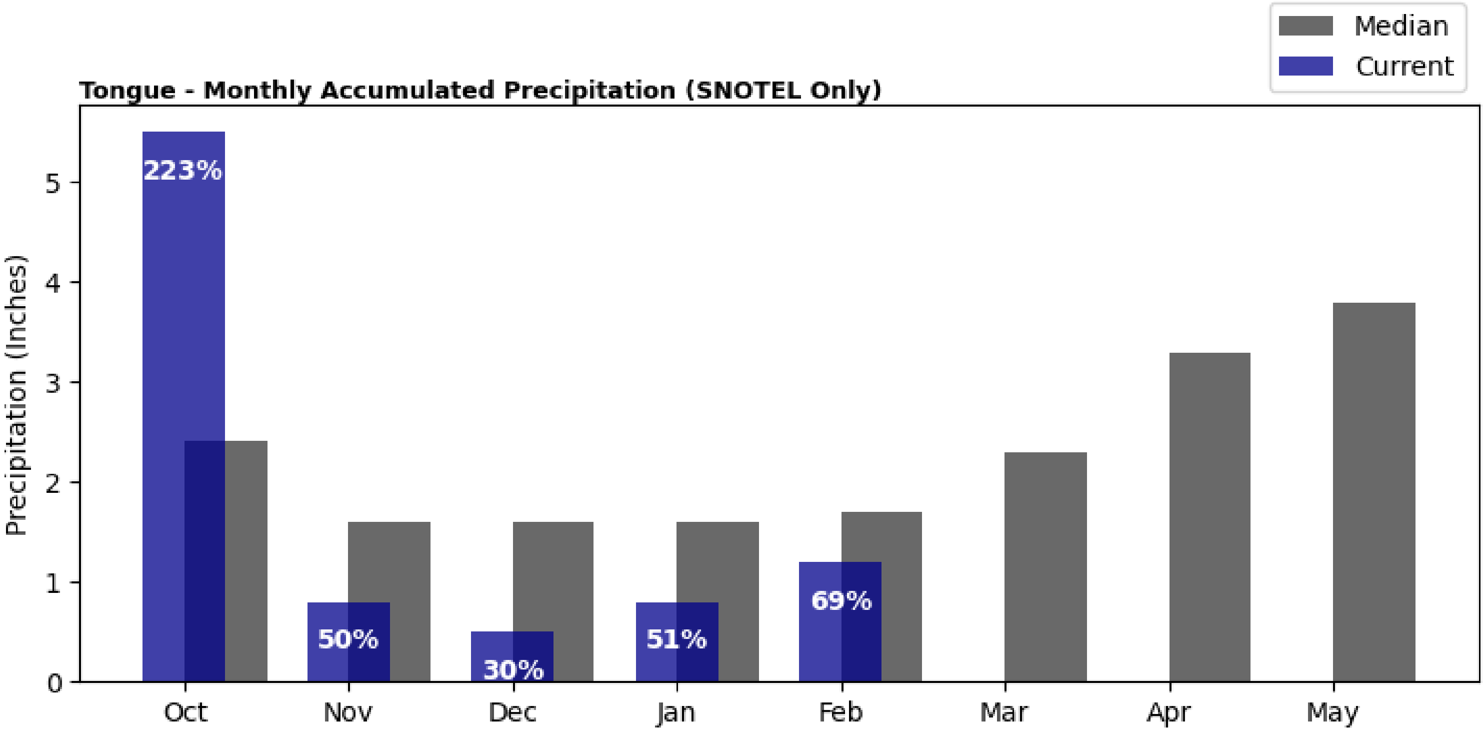
Powder (Continued)

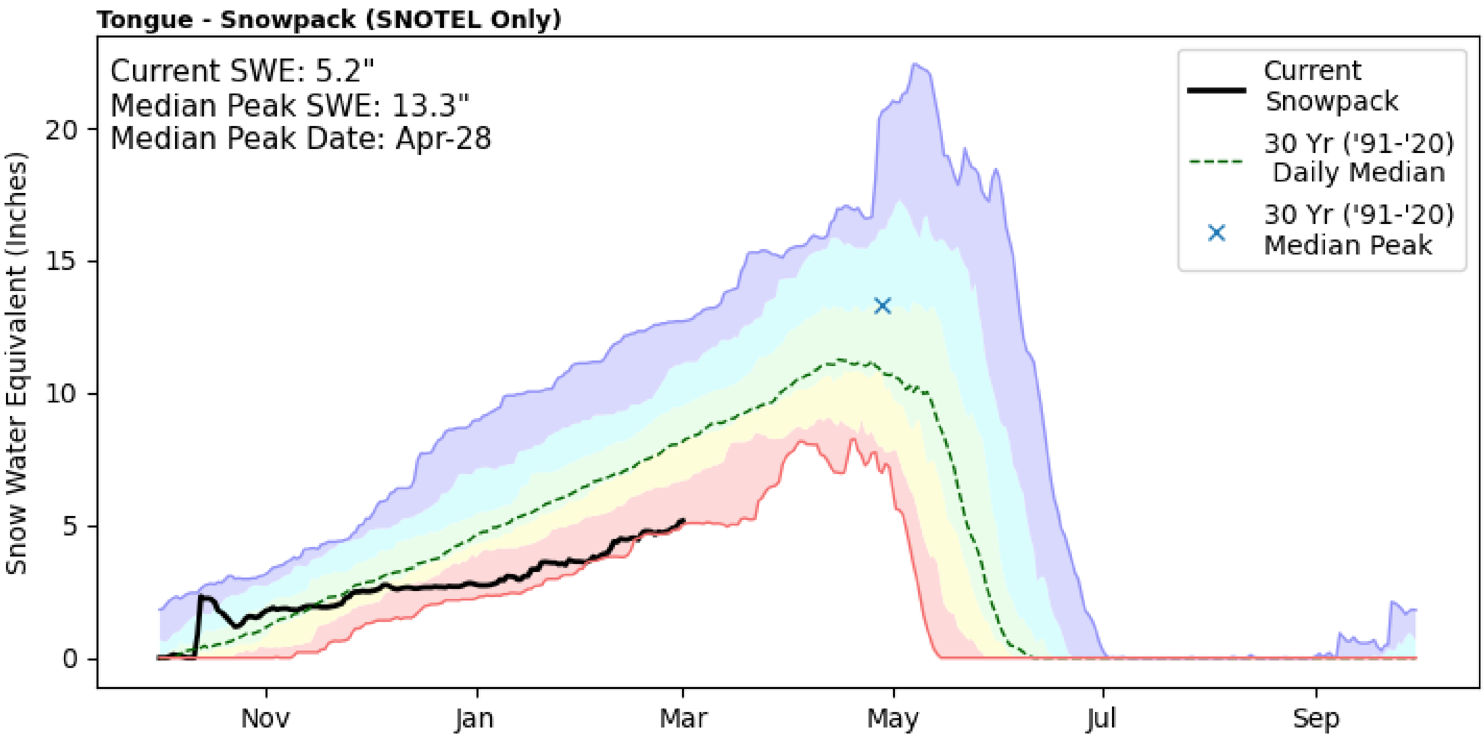


Basin Overview

Tongue

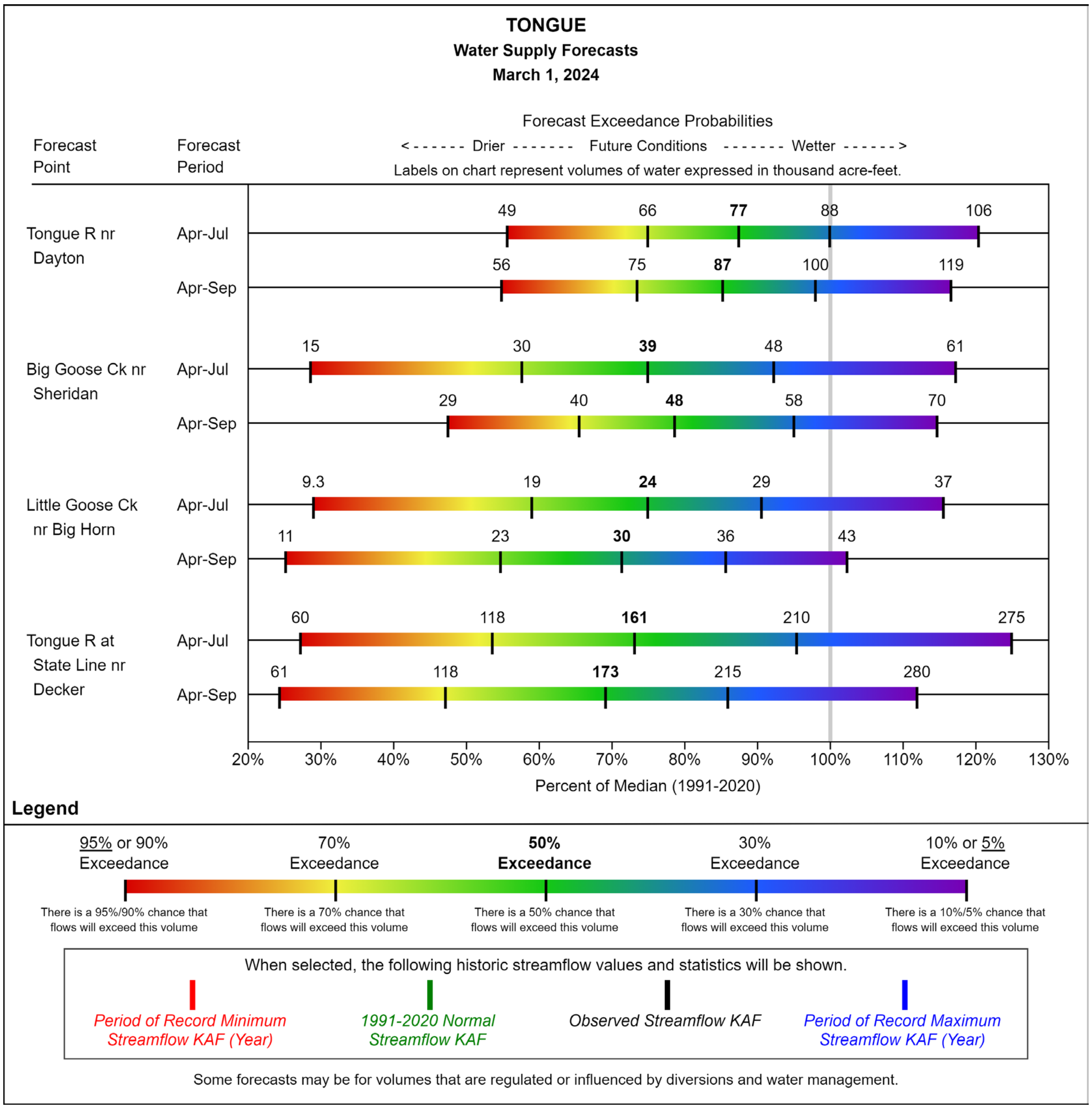
Precipitation in February was well below normal at 70%, which brings the seasonal accumulation (October-February) to 91% of median. The snowpack in the Tongue is well below normal at 65% of median, compared to 115% at this time last year.





Basin Overview

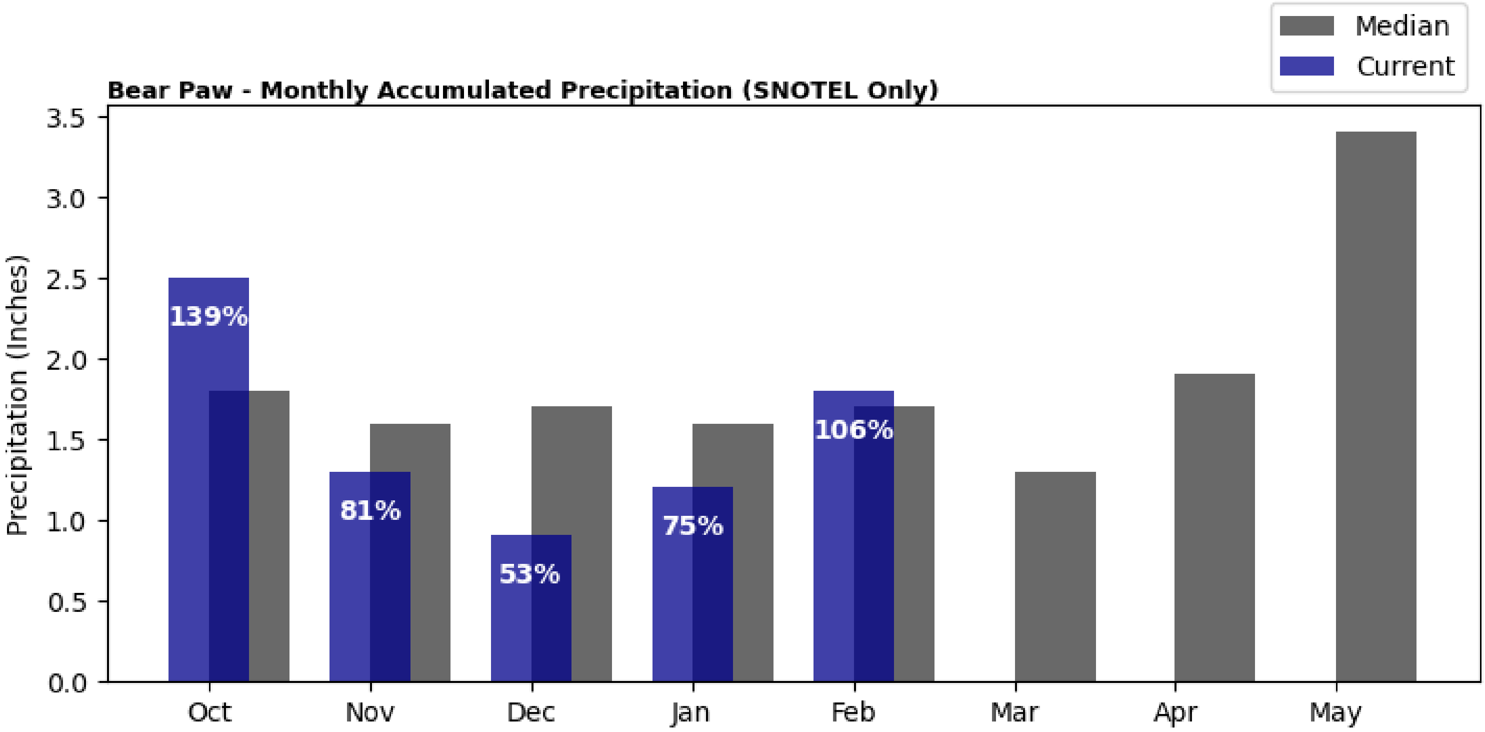
Tongue (Continued)

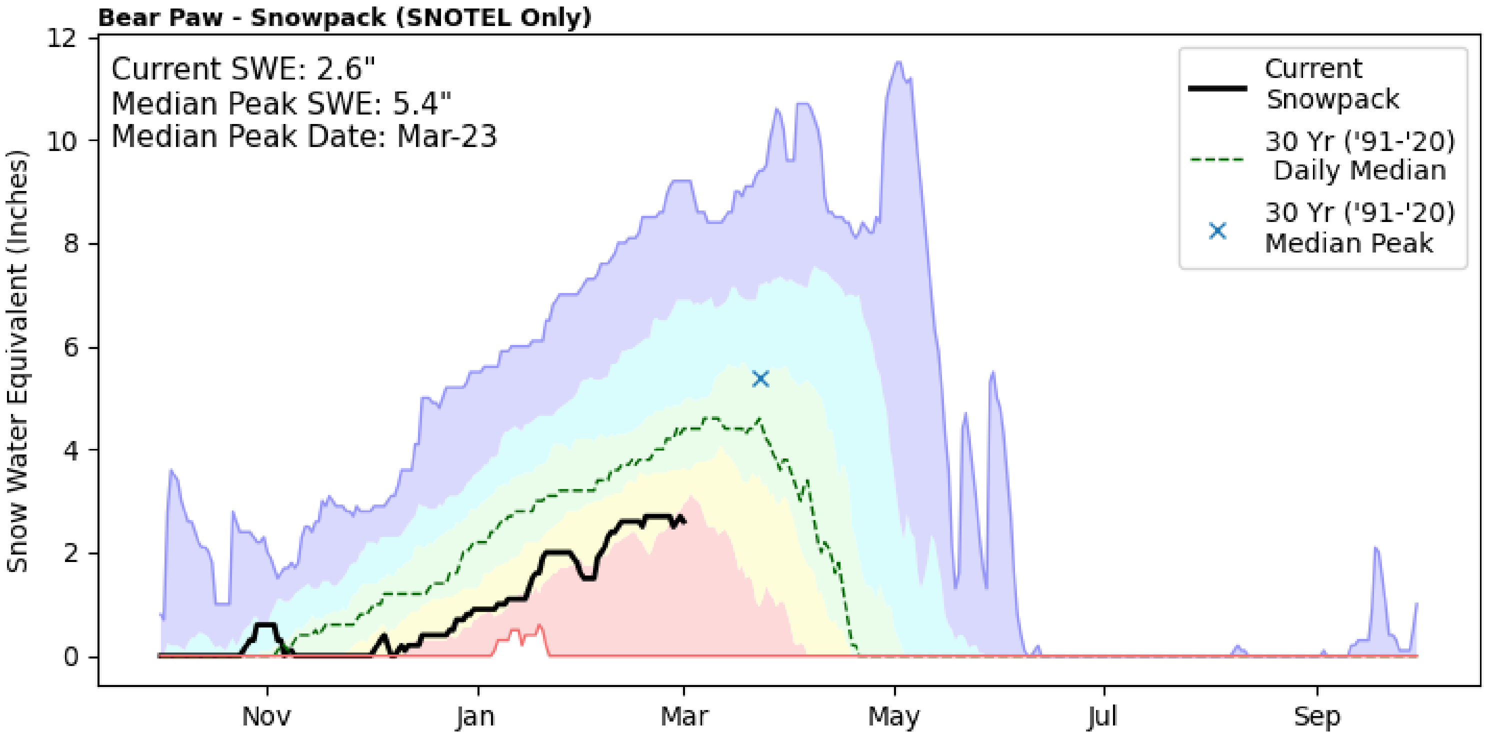


Basin Overview

Bear Paw

Precipitation in February was above normal at 106%, which brings the seasonal accumulation (October-February) to 89% of median. The snowpack in the Bear Paw is well below normal at 50% of median, compared to 167% 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.

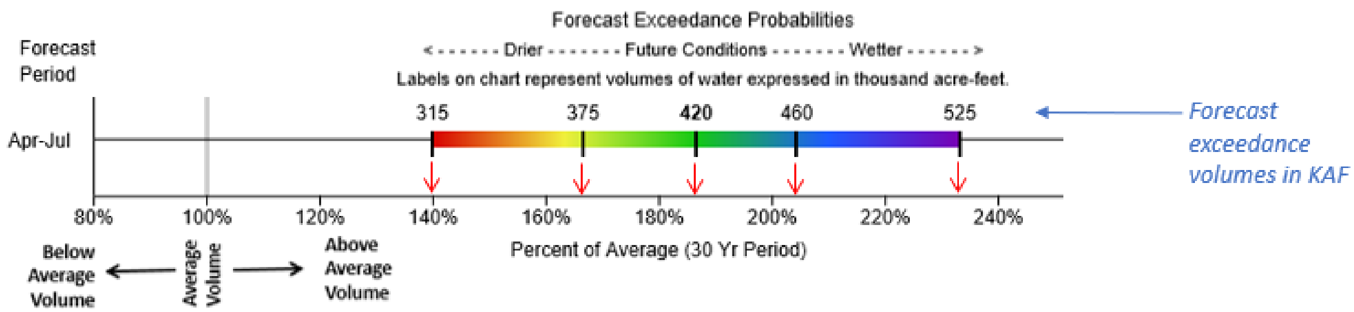
Interpreting Water Supply Forecast Charts

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.



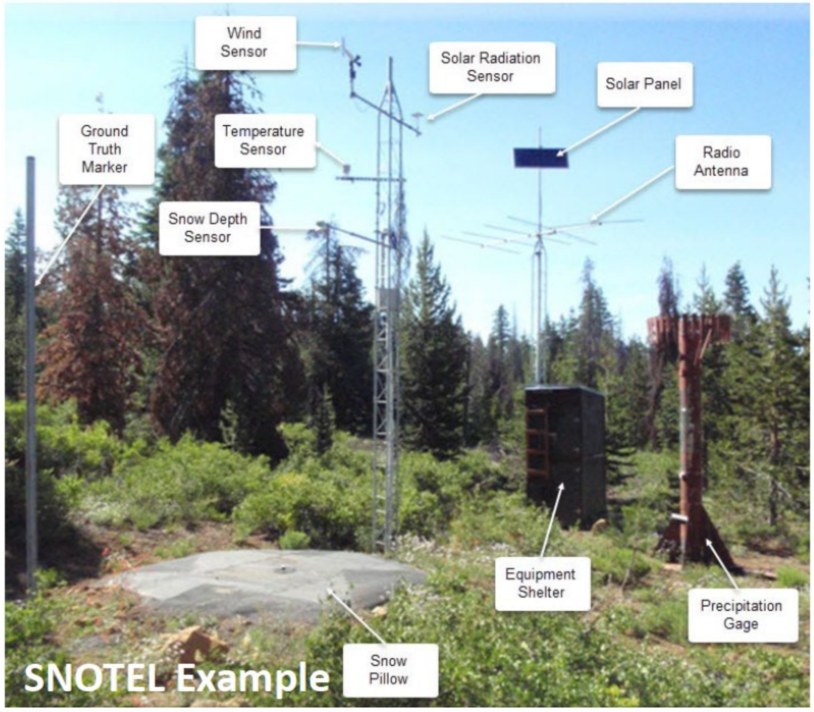
In the example, the entire forecast bar is shifted right of the gray line indicating a forecast for above normal streamflow. The 50% exceedance is represented by the black line in the green portion of the colored bar. This represents a forecast volume of 420KAF which is ~185% of average. If drier than 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.



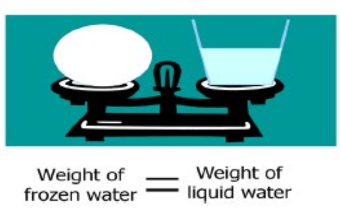
Snow Course

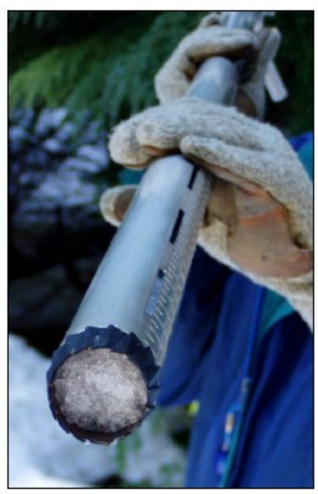
Snow courses are measurement transects where snow tubes are used by snow surveyors during the winter season to determine the depth and water content of the snowpack. Hollow snow tubes are used to vertically core the snowpack. The tubes are then weighed to determine the water content of the snow. Generally, 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 inches of SWE melted instantaneously, there would be a puddle of water 12 inches 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.





Snow core inside snow tubes

Appendix

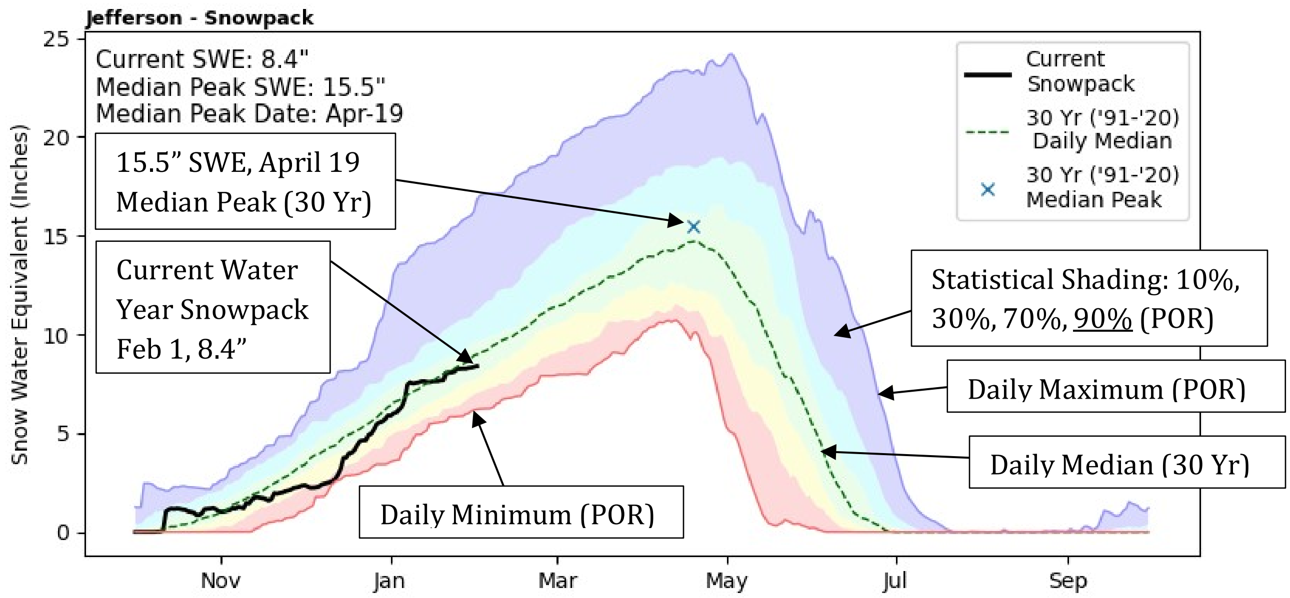
Additional Information

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

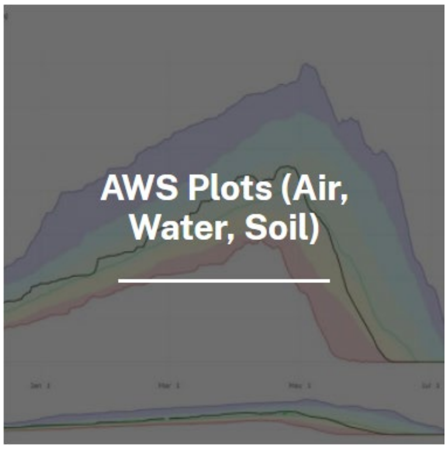
Snowpack charts displayed in this report are created using daily (midnight) snow water equivalent (SWE) values at SNOTEL sites determined to represent the basin. Snow Course data is not included. Plotted lines are the average of each SNOTEL's individual values. For example, the "Current Snowpack" on 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

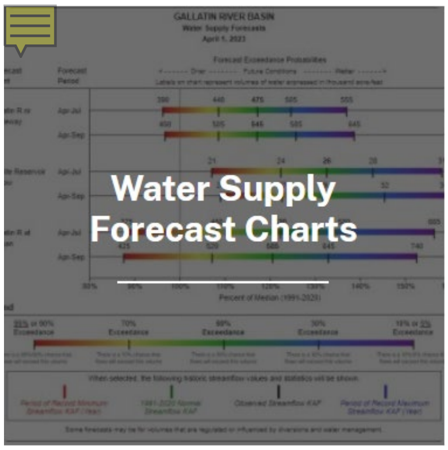


Appendix

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**

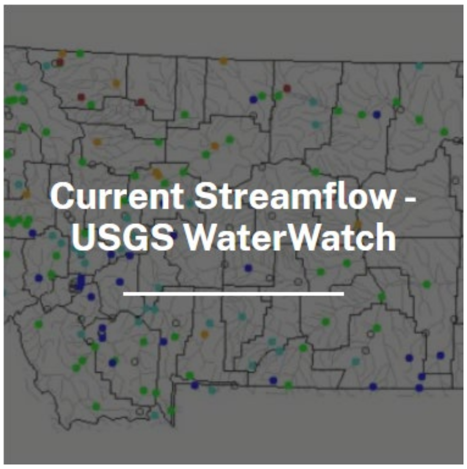
Other

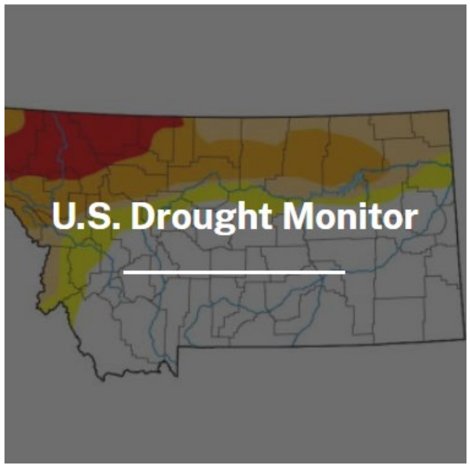
- Snow Water Equivalent > Daily > Compared to POR > **Stations**
- Snow Water Equivalent > End of Previous Month (SNOTEL and Snow Course) > Percentile > **Stations**
- Water Year-to-Date Precipitation > Daily > Compared to POR > **Stations**

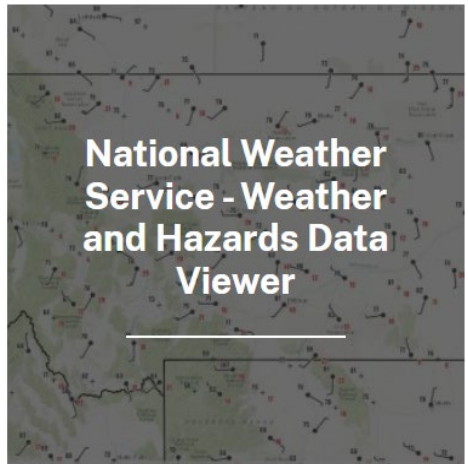
Appendix

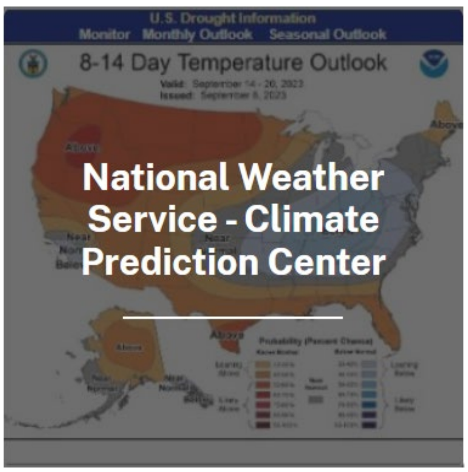
Links and Resources (Continued)

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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Montana
Water Supply Outlook
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Natural Resources Conservation Service