USDA United States Department of Agriculture

Natural Resources Conservation Service

Montana Water Supply Outlook Report

April 1, 2024

Cabin Creek snow course in the Rocky Mountain Front west of Choteau had very little snow remaining at the end of March when it was surveyed. With only 9% of its normal April 1 snowpack, it joins a long list of snow courses and SNOTELs in Montana that have major SWE deficits going into peak snowpack season. A handful of stations at lower elevations were already snow-free on April 1. Without a significant shift in weather patterns, Montana water users should prepare for below normal water supplies this spring and summer. (Photo: Ian Bardwell 3/26/2024)

Table of Contents

For more water supply information, contact:

Eric Larson
Water Supply Specialist
USDA NRCS Montana Snow Survey
eric.larson@usda.gov

Statewide Overview

Summary

Given the lack of precipitation from November through much of January in Montana, above normal precipitation was needed over the last couple of months to begin to catchup on snowpack and precipitation. February provided well above normal precipitation to nearly all of Montana. Basins such as the Jefferson and Upper Missouri received over 150% of normal precipitation during February and those weather patterns continued into the first week of March across much of Montana. What seemed to be the beginning of a potential recovery tapered off after the first week of March in many basins. Overall precipitation was above normal in southwest and southern Montana, but mostly below normal elsewhere.

All basin wide snowpack percentages have increased from last month except the Bitterroot, which decreased slightly. Unfortunately, all increases were minimal except in part of southern Montana. Currently snowpack percentages range from 57% of normal in the Sun-Teton-Marias to 95% of normal in the Bighorn River basin. Keep in mind that the lowest April 1 snowpack percentages since 1991 are about 50-70% of normal. One example is the Smith-Judith-Musselshell, where the lowest April 1 snowpack percentage since 1991 was 65% in 2017, very similar to the snowpack this season.

In an ideal year, the snowpack peaks anywhere from mid-April to early-May. Much later and there is risk of rapid snowmelt from warm weather or rain. Much earlier and there is risk of early runoff and lower water supply later in the summer. This year, we are already starting to see some lower elevation sites that are starting to melt out. The snow water equivalent deficits as of April 1 are 10-13 inches below normal at the highest mountain elevations. It is not likely those deficits will be recovered this season with approximately a month remaining until typical peak snowpack. Of the 281 snow monitoring stations measured for April 1, 46 are currently the second lowest or lowest on record. While that is an improvement from the beginning of February, 111 of them are still reporting a snowpack in the 10th percentile or less.

The full effect of the current below average snowpack will be largely determined by spring weather. While the recent warm and sunny weather might be enjoyable, more winter weather is needed. April 1, 2024 NRCS water supply forecasts are overall below normal, with a couple locations on the Rocky Mountain Front forecasted to have near record low runoff. Pockets of southern and northwest Montana have had closer to normal water year precipitation and water supply forecasts are near normal. Given the widespread low forecasts, above normal precipitation over the next couple of months and a slow melt of the snowpack would be most beneficial for the upcoming summer. Additionally, a wet summer could help to sustain streamflows later in the season.

The following table shows April 1, 2024, snowpack percentages compared to the lowest year since 1991.

Basin	April 1, 2024, SWE % Median (91-20)	Lowest April 1 SWE % Median (91-20)	Year of Lowest April 1 SWE % Median (91-20)
Sun-Teton-Marias	57	52	2015
Smith-Judith-Musselshell	67	65	2017
Powder	67	67	2024
Upper Clark Fork	67	61	2005
Lower Clark Fork	73	48	2015
Bitterroot	72	57	2005
Tongue	73	72	2001
Upper Missouri	73	72	2015
Flathead	75	65	2005
Gallatin	76	73	2001
Upper Yellowstone	79	65	2001
Bear Paw	67	0	2017, 2015
Kootenai	78	58	2001
St. Mary	79	49	2015
Jefferson	80	71	2005
Madison	85	60	2015
Bighorn	95	65	2001

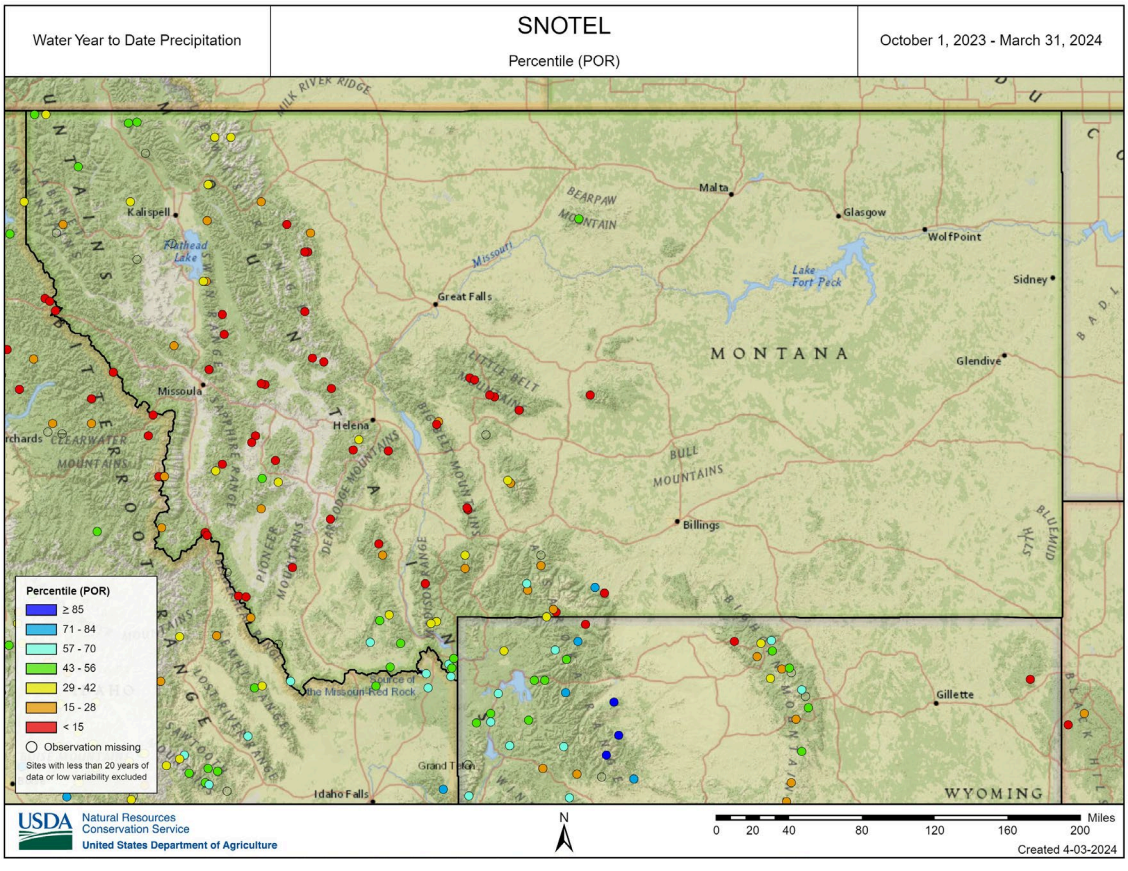
Statewide Overview

Precipitation

Active weather during February continued into the first week of March and brought significant precipitation to Montana. From February 24 to March 7 SNOTEL stations across Montana received 2-5 inches of precipitation. Accumulation during those two weeks was greater at the higher mountain elevations in both northwest Montana and the greater Yellowstone area, where 6-10 inches of precipitation was reported at SNOTEL sites. The rest of March weather was relatively inactive until the last week when 1-2 inches of precipitation fell in western Montana. Driven by the early March storm, total monthly precipitation was above normal in southern Montana, ranging from about 110% of normal in the Jefferson to 135% in the Bighorn. Other regions were not as favored by the March storms, the Tongue and Powder received about 105% of normal precipitation, while the Sun-Teton-Marias and Smith-Judith-Musselshell only received 60-65% of normal precipitation during March. West of the Continental Divide basins received about 75-85% of normal precipitation, except for the Kootenai which was near normal.

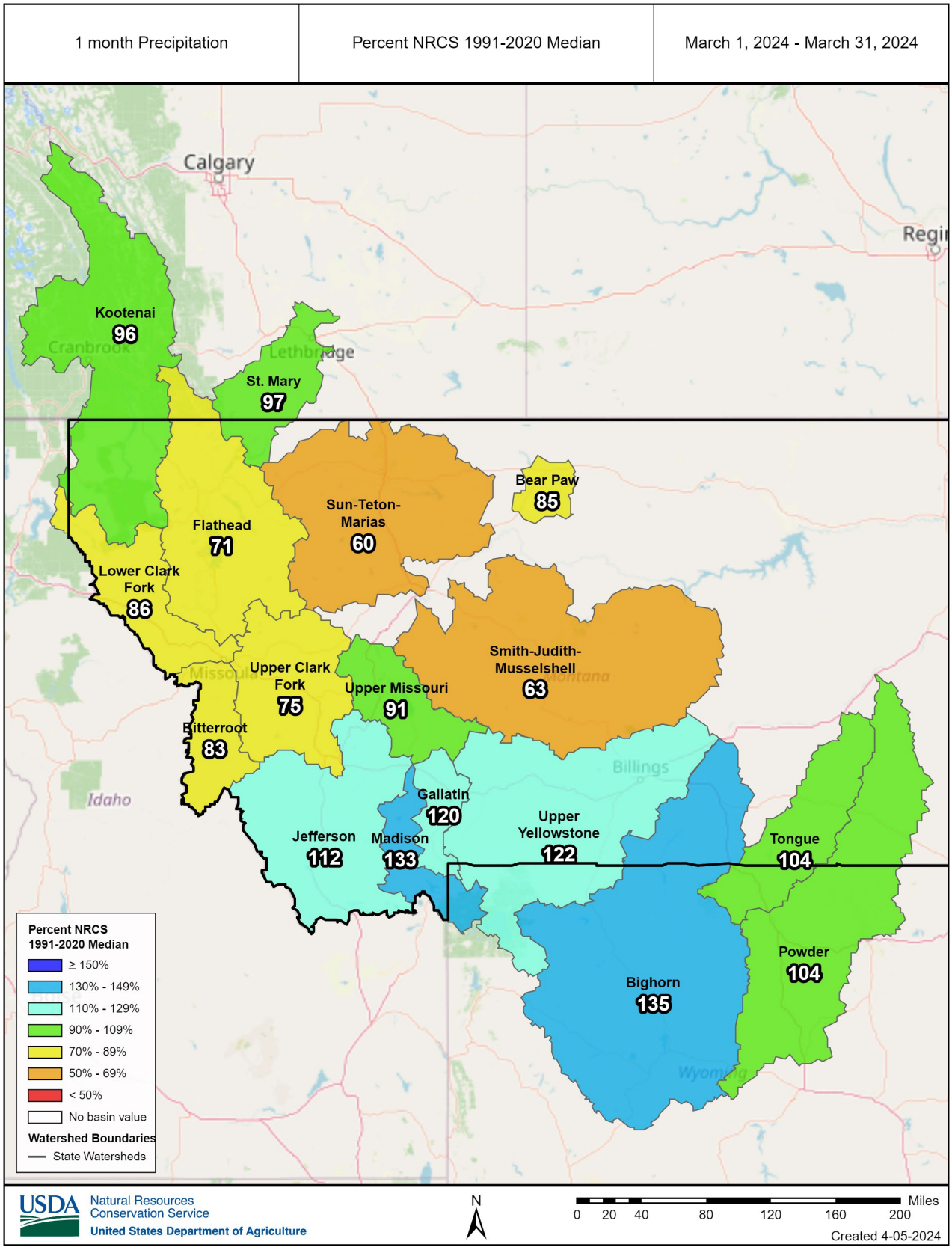
The significant amount of precipitation during February and part of March was not enough to offset the lack of precipitation from November through January. Currently water year precipitation is below normal in all but the Bighorn River basin. Elsewhere, precipitation has been about 70-90% of normal. The upper end of that range includes northwestern Montana and the West Yellowstone region. The lower end of that range extends from western Montana to central Montana. Many SNOTEL sites in the Big Hole, Bitterroot, Clark Fork, Blackfoot, Upper Missouri, northern Gallatin, Sun-Teton-Marias, and Smith-Judith-Musselshell are reporting total water year precipitation in the 15th percentile or less. The following SNOTEL sites (per county) are reporting lowest precipitation since October 1 on record: Stuart Mountain (Missoula), NF Elk Creek (Powell), Combination (Granite), Onion Park (Meagher), and Stringer Creek (Meagher).

The following map shows total precipitation this water year at SNOTEL stations compared to the period of record as a percentile. Red indicates less than the 15th percentile. April, May, and June are climatologically some of the wettest months in basins east of the divide. Hopefully that remains true this year.



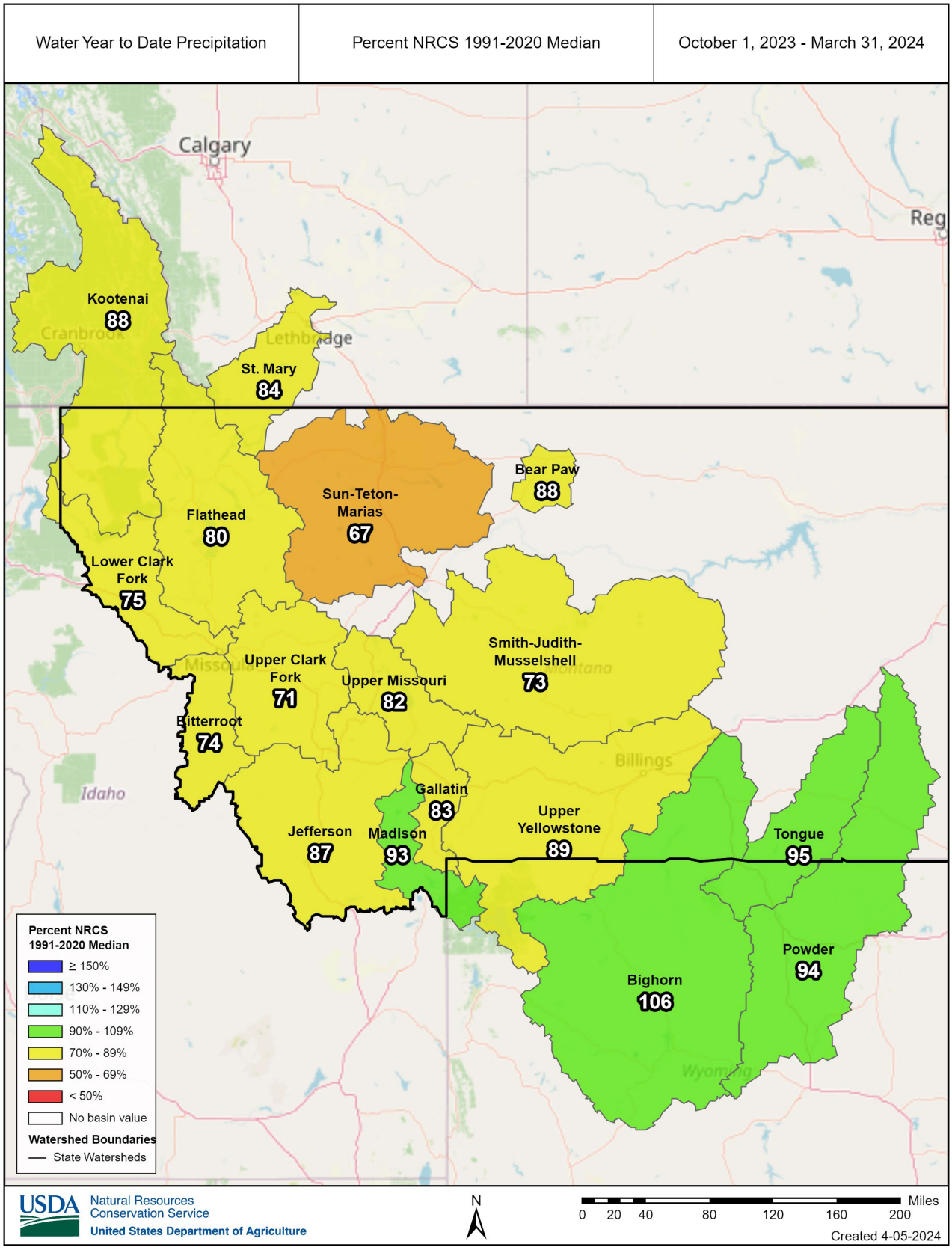
Statewide Overview

Precipitation (Continued)



Statewide Overview

Precipitation (Continued)



Statewide Overview

Snowpack

With snowmelt season just around the corner, or already here in some cases, snowpack levels this time of the year are crucial. Overall, the snowpack did make some improvement over the last couple months, however more snow is needed. Currently the snowpack percentages are below normal in all major river basins. As mentioned in the summary, snowpack percentages can be misleading. One example is the Gallatin. While 76% of normal snowpack on April 1 might not seem that low, note that the Gallatin snowpack ranks in about the 5th percentile. This is currently the case for most basins across Montana. Exceptions include the Bighorn, Madison, St. Mary, Kootenai which have experienced significantly lower snow years.

Snowpack peaks generally occur mid-April at lower mountain elevations and early-May at the highest elevations. There is some variation in those dates. During 2011 and 2022 the snowpack peaked as late as early June. In contrast, years such as 2015, 2005, and 2004 had the highest elevation snowpack peak in early April. As of April 1, 2024, some SNOTEL sites have seen significant melt including Calvert Creek (Deer Lodge), Rocky Boy (Hill), Hand Creek (Flathead), Combination (Granite), Sylvan Road (YNP), Twelvemile Creek (Ravalli). All snow monitoring stations in the Lubrecht Experimental Forest are melted out. There is potential for additional accumulation in the coming months, but the given the low snow year it has been, loss of snowpack this early is not ideal.

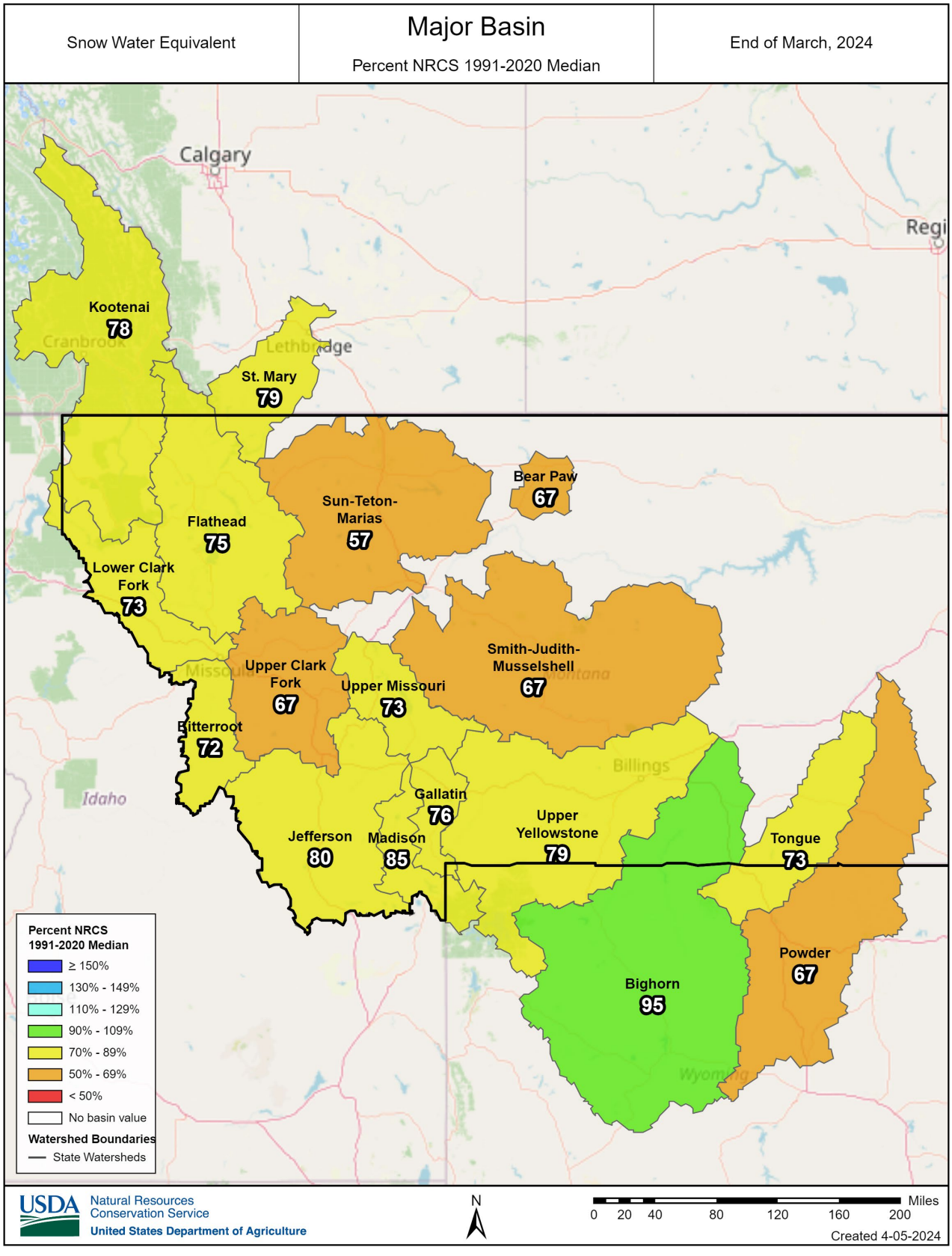
Current snow water equivalent departure from normal is most pronounced at the highest elevation SNOTEL sites. The following sites are currently 10-13 inches of SWE behind normal (county, current departure from median 91-20 peak): Twin Lakes (Ravalli, 16.0”), North Fork Jocko (Missoula, 16.2”), Badger Pass (Pondera, 16.2”), Stuart Mountain (Missoula, 14.8”), Hoodoo Basin (Mineral, 14.2”), Lookout Pass (Shoshone, ID, 11.6”), Poorman Creek (Lincoln, 12.2”). The highest mountain elevation snowpack will likely not reach normal peak levels this season but could be supplemented by a wet and cool spring. In terms of percentile, roughly 65% of snow stations are in the 25th percentile or less. The good news is, about 30 stations are in the 50th percentile or higher. Those include stations in the southern Absaroka and Wind River range of the Bighorn River basin. Elsewhere, above normal snow accumulation will be needed in April make gains on the current snowpack deficit.

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	77	78	-	-
Flathead	67	63	53	65	71	75	-	-
Upper Clark Fork	116	37	36	44	66	67	-	-
Bitterroot	144	35	50	60	73	72	-	-
Lower Clark Fork	90	58	47	55	66	73	-	-
Jefferson	91	48	51	55	73	80	-	-
Madison	86	58	54	57	73	85	-	-
Gallatin	81	52	54	53	65	76	-	-
Upper Missouri	125	41	33	41	71	73	-	-
Smith-Judith-Musselshell	116	63	49	51	65	67	-	-
Sun-Teton-Marias	121	48	26	34	53	57	-	-
St. Mary	77	72	51	55	65	79	-	-
Upper Yellowstone	103	60	55	55	65	79	-	-
Bighorn	117	85	75	74	85	95	-	-
Powder	93	60	51	51	63	67	-	-
Tongue	154	92	66	64	65	73	-	-
Bear Paw	-	-	41	31	50	67	-	-

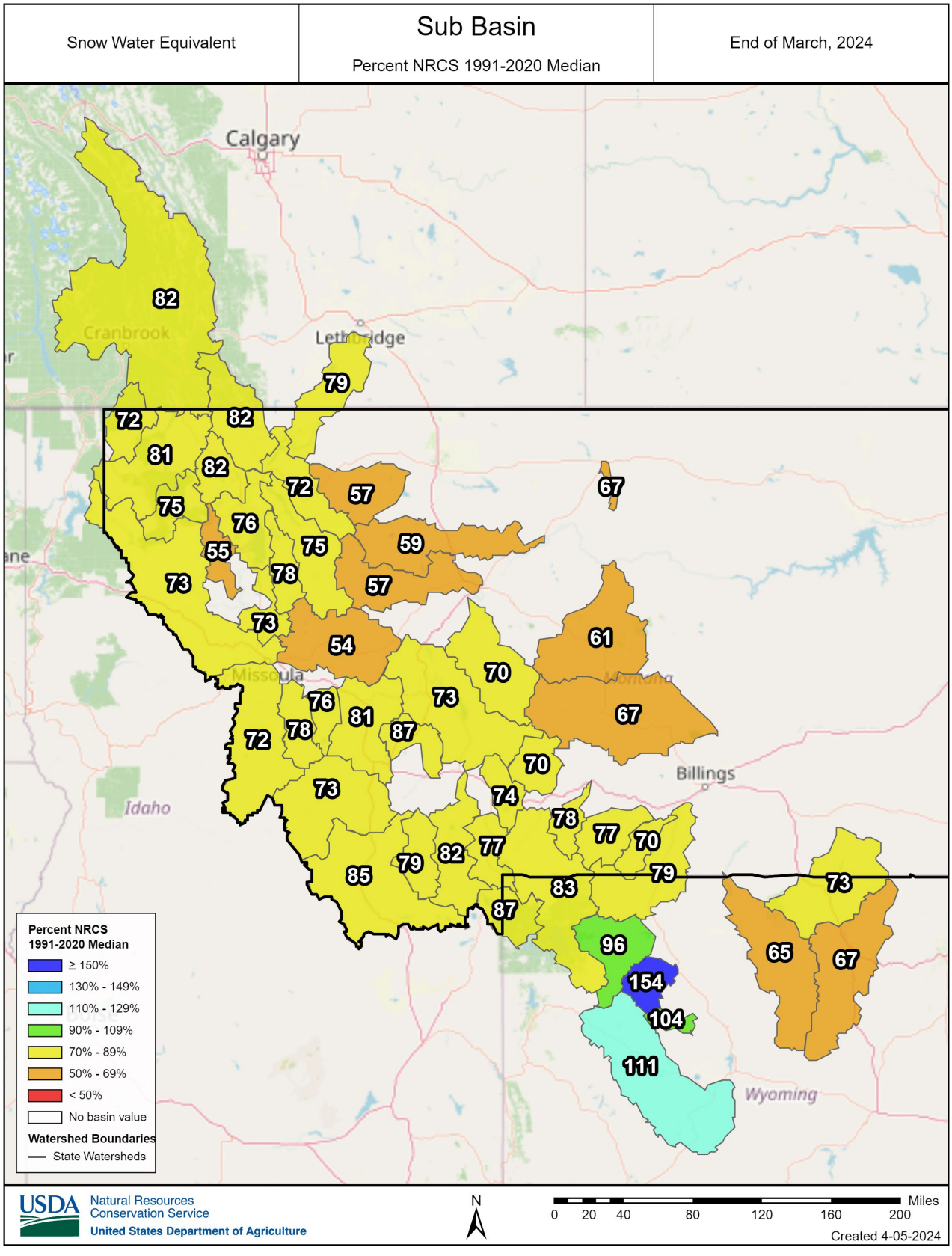
Statewide Overview

Snowpack (Continued)



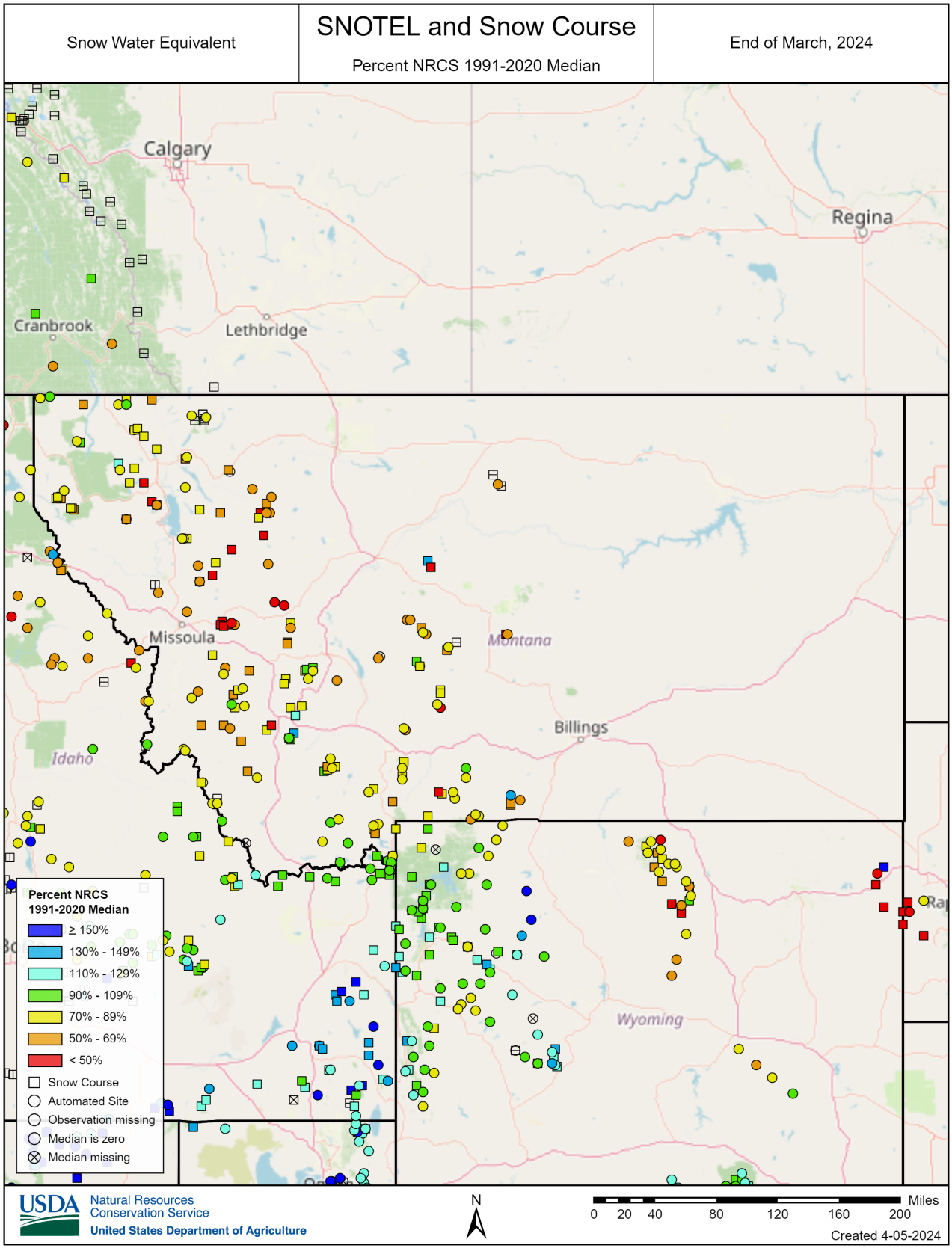
Statewide Overview

Snowpack (Continued)



Statewide Overview

Snowpack (Continued)



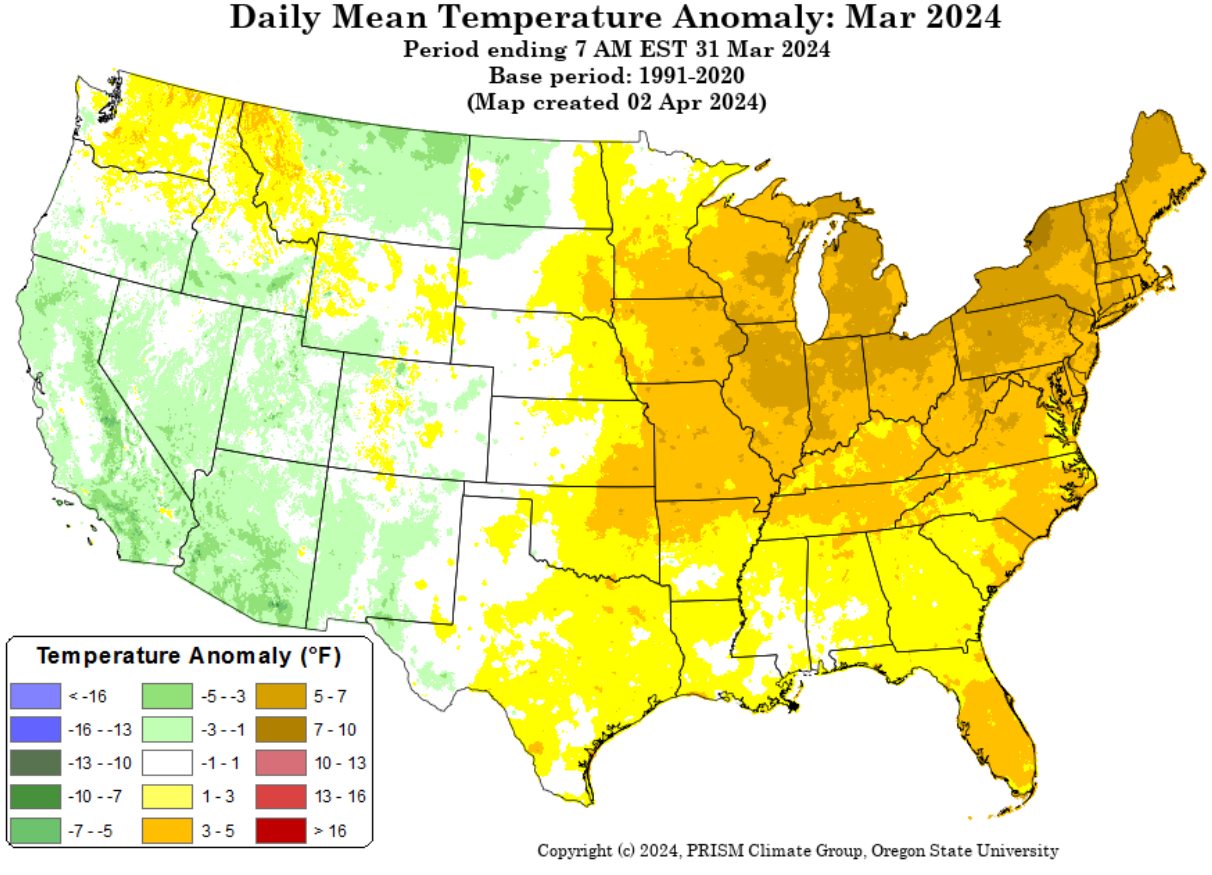
Statewide Overview

Temperature

March temperatures in Montana were above normal in the western part of the state and below or near normal in the eastern half. In the northwest Montana, temperatures reached to 3-5 °F above normal. In northeast Montana, temperatures were down to 3–5 °F below normal. Montana SNOTEL sites oscillated between above and below normal temperatures throughout March. SNOTEL sites recorded below normal temperatures from March 2-9. This was followed by above normal temperatures from March 9-12. From March 12-15 there was a short period of colder than normal temperatures. During March 15-22 warmer than normal temperatures returned. This was the warmest part of the month with daily average temperatures of around 10 °F above normal. Colder than normal temperatures were observed through March 22-26. However, temperatures returned to near normal for the remainder of the month.

Compared to February, daily average temperatures were closer to normal and varied across the state. The short periods of colder than normal temperatures lowered the daily average temperatures for the month. Which could explain why the above normal temperatures might not have ranged as high as expected.

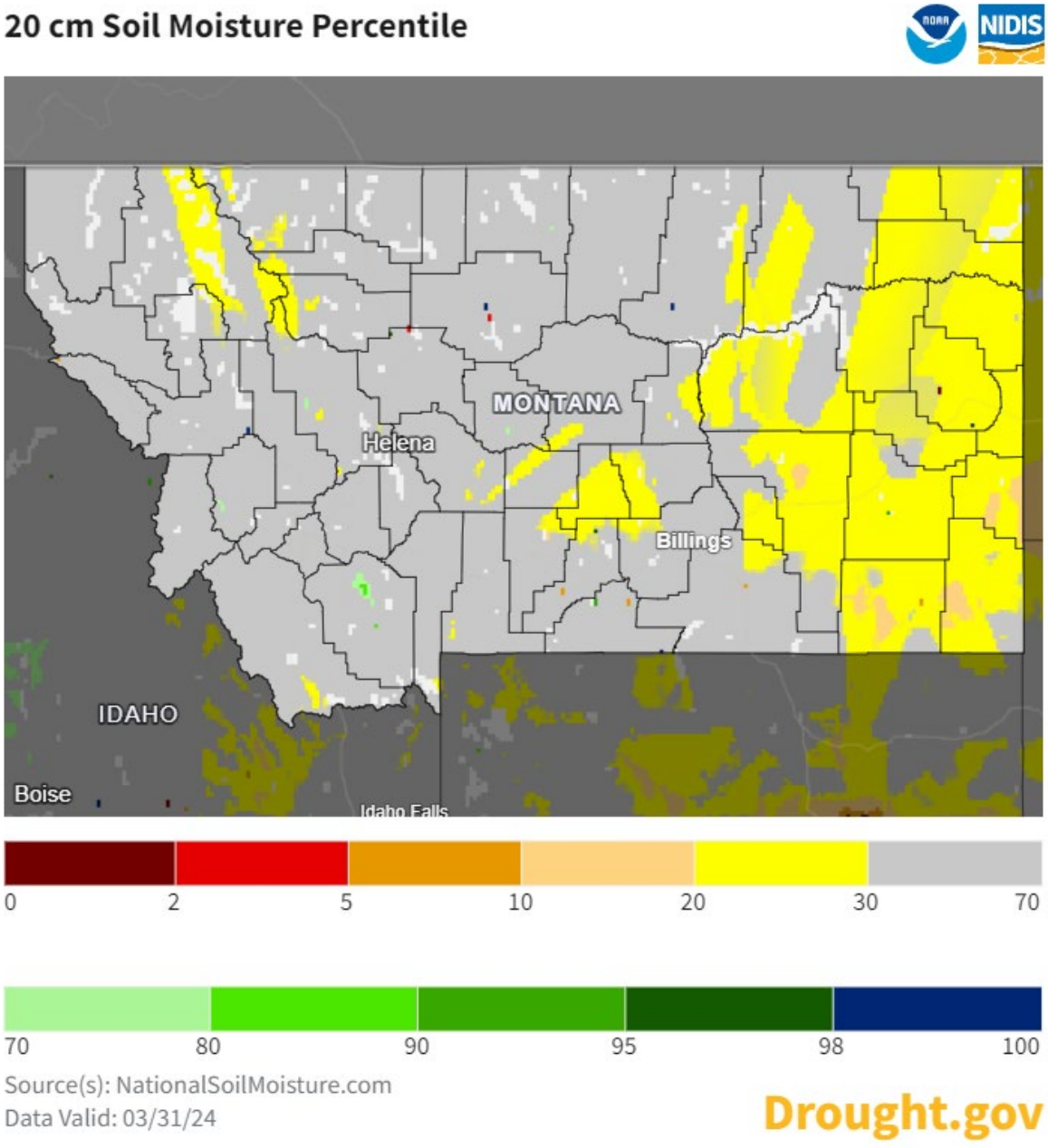
The above normal temperatures in the mountainous part of the state impacted lower and mid elevation snowpacks. Many areas in the valleys and lower elevations had snowmelt as a result of the warm temperatures. Melting has been observed in some lower and mid elevation SNOTELs. Higher elevation snowpacks haven't had widespread melting yet. However, the warm temperatures are starting to affect the snowpack in these areas. Many SNOTELs have observed snow density increases that are indicative of a warming snowpack during the past month.



Statewide Overview

Soil Moisture

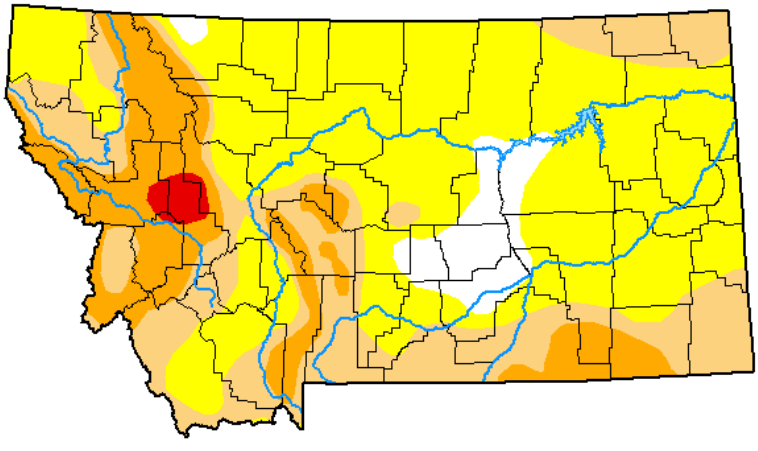
Most of the state is near normal soil moisture in the 30th to 70th percentile. Areas in the eastern and northwest parts of the state have soil moisture in the 20th to 30th percentile. In the southeast corner there are some small areas in the 10th to 20th percentile. This contrasts last month when there were widespread areas with soil moisture in the 70th to 80th percentile. Soil moisture in the top 20 cm across Montana has decreased since last month. To reverse the trend of decreasing soil moisture, more precipitation will be essential this spring.



Statewide Overview

Drought Monitor

The U.S. Drought monitor map, released on Thursday, April 4, 2024, classified 41% of Montana as moderate (D1) to extreme (D3) drought. While not an official drought classification, it is worth noting that an additional 53% of the state falls into the abnormally dry or D0 category, indicating that conditions such as precipitation and soil moisture are lacking in those areas. No areas of Montana fall into the exceptional (D4) drought category and just 1% of the state, a small section of Powell, Missoula and Granite counties, falls into the extreme (D3) category. Over the last month beneficial precipitation and snow accumulation have allowed for small improvements in drought categories in many counties in northwest Montana. D3 classification was completely removed from Flathead, Glacier, Pondera, & Teton counties. The majority of Lincoln County was downgraded to D0 conditions, and most of Sanders County was moved from D2 to D1. Improvements were also made in southwest Montana with a large swath across Beaverhead and Madison counties improving 1-2 categories. Precipitation in the coming weeks and antecedent soil moisture will be critical metrics in determining how Montana is fairing ahead of the growing season.



U.S. Drought Monitor

Montana

April 2, 2024

(Released Thursday, Apr. 4, 2024)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	5.76	94.24	41.30	16.51	1.00	0.00
Last Week 03-26-2024	5.76	94.24	41.30	16.51	1.00	0.00
3 Months Ago 01-02-2024	39.20	60.80	21.30	2.68	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 04-04-2023	18.94	81.06	44.04	10.04	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

Author:

Brad Pugh

CPC/NOAA

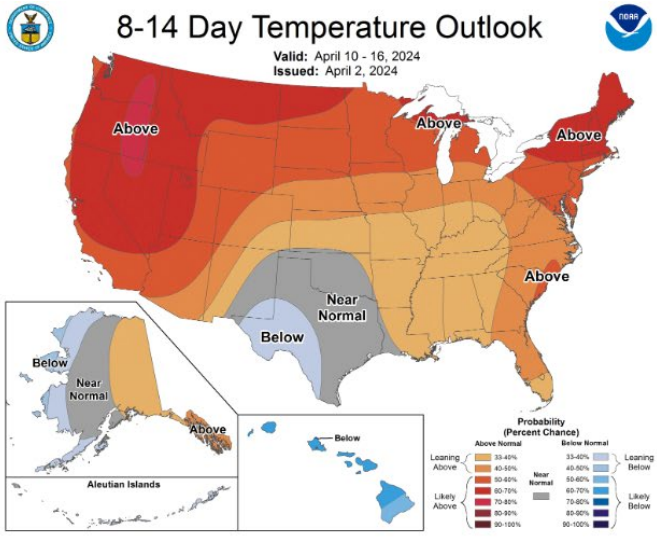
droughtmonitor.unl.edu

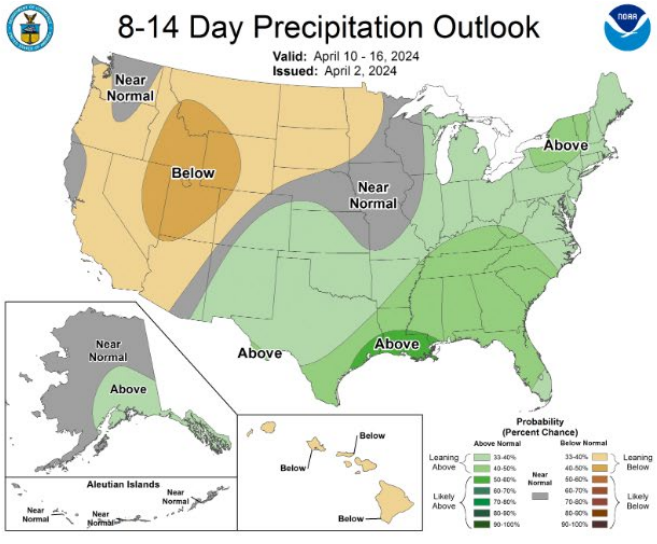
Statewide Overview

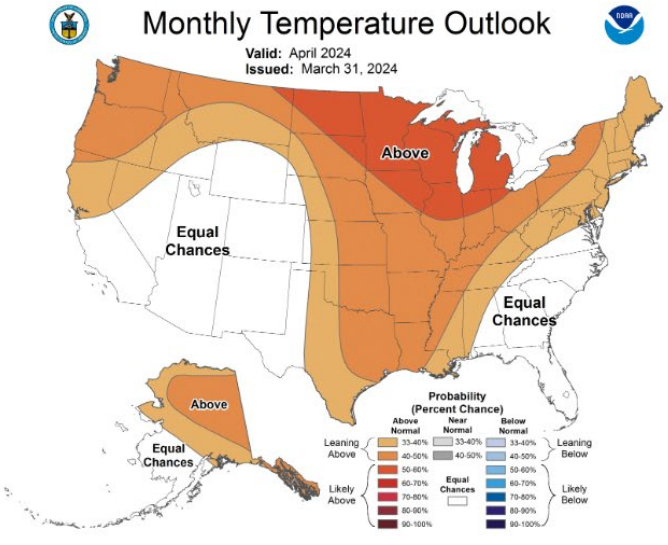
Weather Outlook

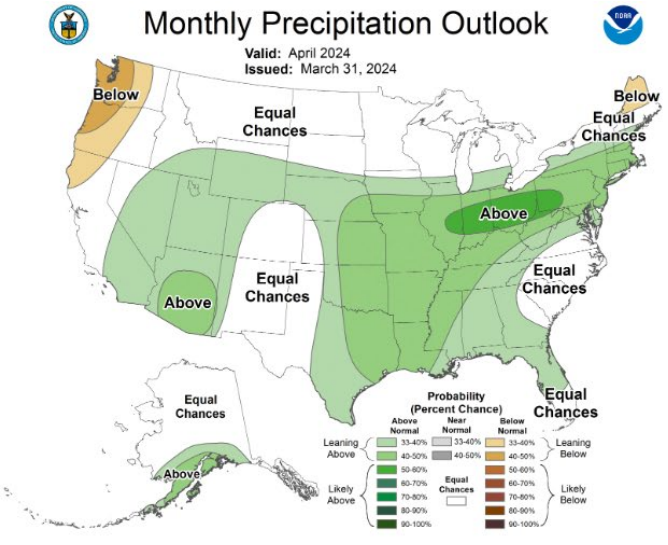
NOAA's Climate Prediction Center weather outlook indicates that Montana will most likely experience above normal temperatures over the next 8-14 days. Precipitation is projected to be below normal during that time as well. The southwest portion of the state has the highest probability of below normal precipitation.

The monthly outlook is not much better. There are equal chances of either above normal or below normal precipitation. Monthly temperature probabilities lean towards above normal temperatures across Montana, with the highest likelihood of above normal temperatures in the northern portion of the state. Unfortunately, the weather outlook is not favorable for improving snowpack conditions in the remaining weeks before typical peak snowpack in late April or early May.





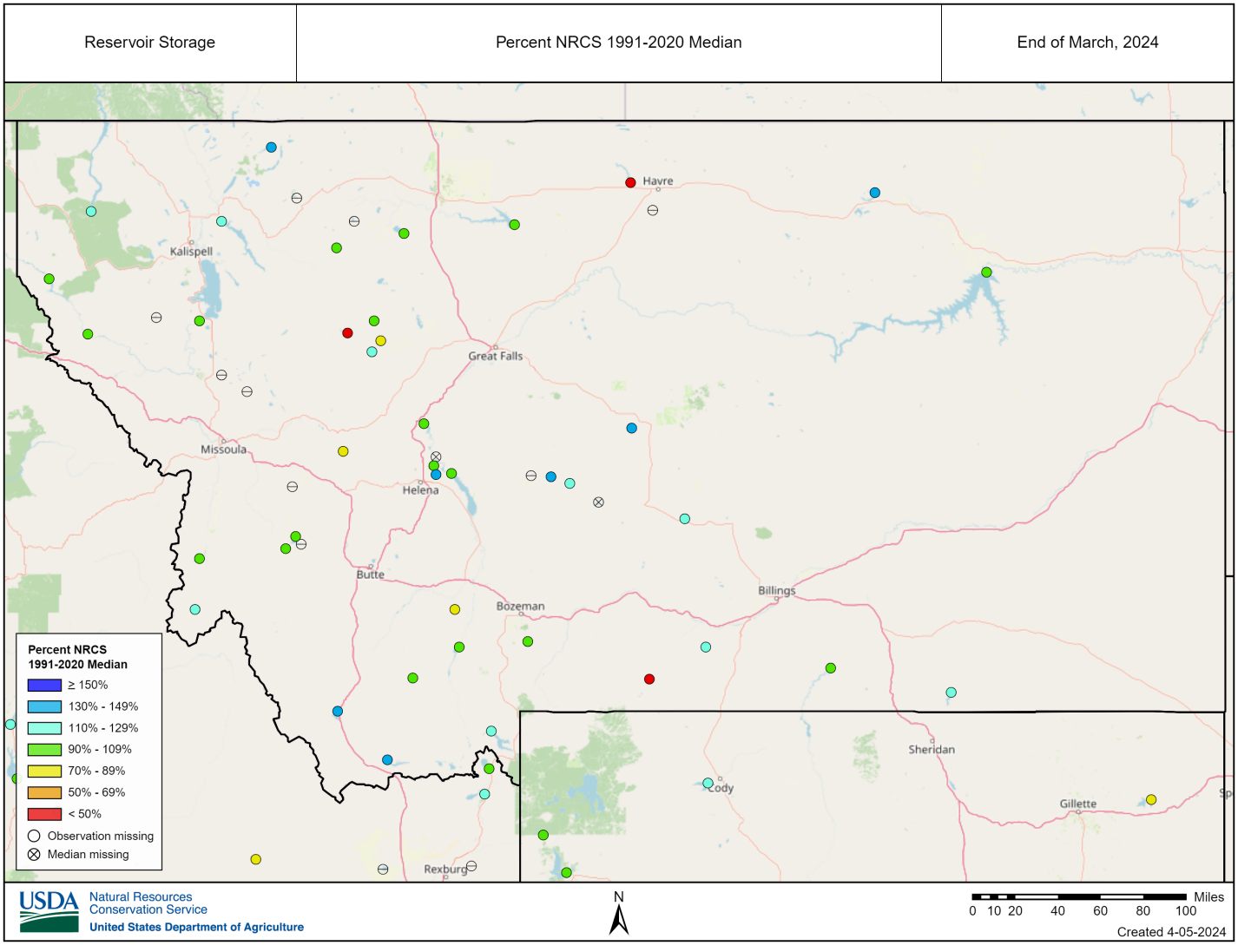




Statewide Overview

Reservoirs

End of March storage levels for many Montana reservoirs are above normal. Lake Koocanusa, Hungry Horse, Lake Sherburne, Painted Rocks, Clark Canyon, Lima, Hebgen, Nilan, Helena Valley, Nelson, Smith River, Bair, Ackley, Deadmans, Cooney, and Tongue River Reservoir are all over 110% of normal for this time of year. Mystic Lake, Fresno, and Gibson Reservoir which are well below normal for this time of the year. The remaining reservoirs across the state are reporting storage at near normal levels.



Statewide Overview

Reservoirs (Continued)

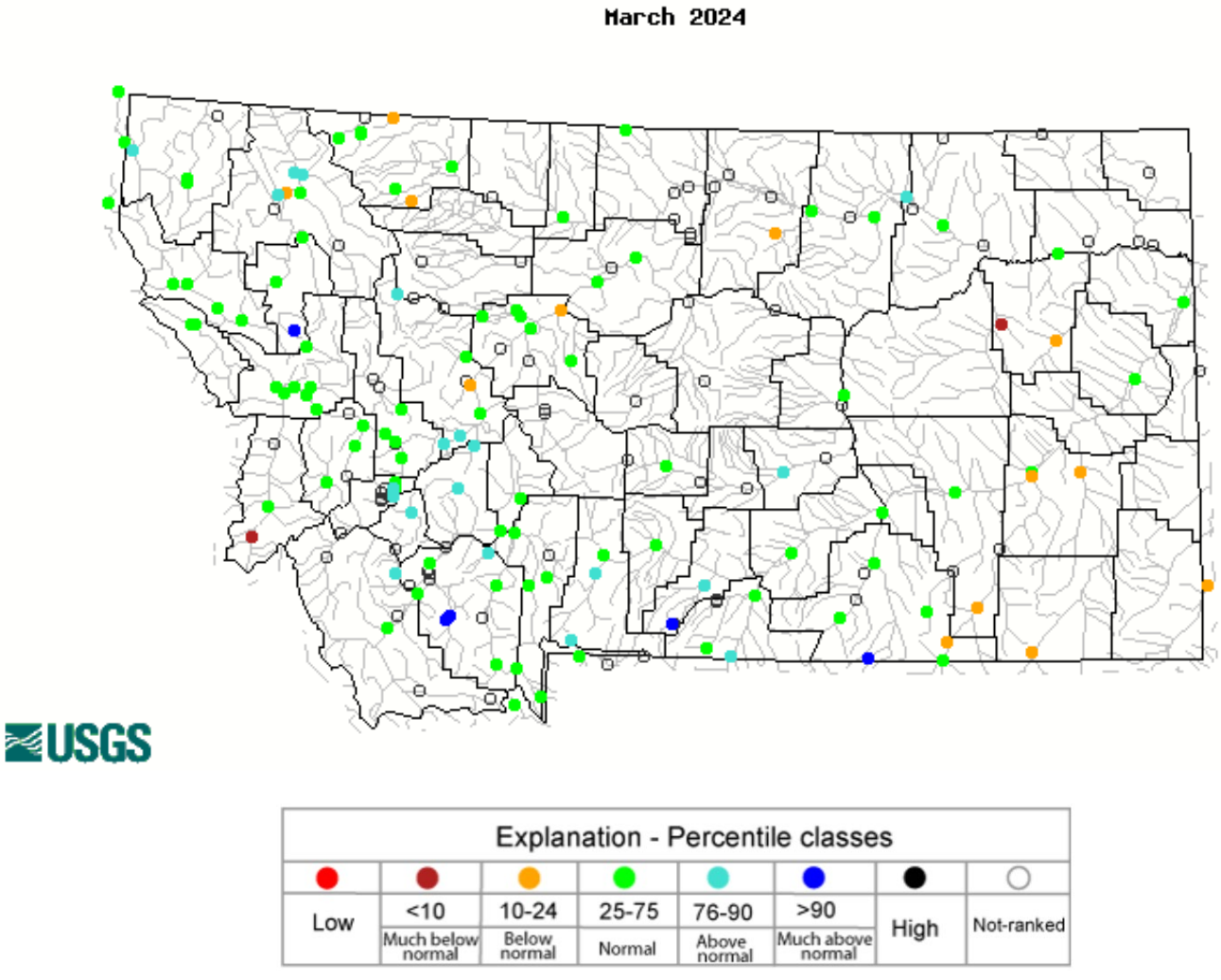
End of March - Reservoir Storage Percent of Capacity

Reservoir	Basin	Current % Capacity	Last Year % Capacity	Median % Capacity
Smith River Res	Smith-Judith-Musselshell	91	-	67
Deadman's Basin Res	Smith-Judith-Musselshell	90	59	78
Bair Res	Smith-Judith-Musselshell	72	26	60
Swift Res	Sun-Teton-Marias	52	56	57
Lake Frances	Sun-Teton-Marias	46	34	48
Lake Elwell (Tiber)	Sun-Teton-Marias	51	51	54
Gibson Res	Sun-Teton-Marias	15	10	36
Cooney Res	Upper Yellowstone	94	77	78
Ruby River Reservoir	Jefferson	84	89	80
Lima Reservoir	Jefferson	77	31	54
Clark Canyon Res	Jefferson	67	42	51
Painted Rocks Lake	Bitterroot	40	24	33
Lake Como	Bitterroot	45	29	46
Bull Lake	Bighorn	47	50	53
Buffalo Bill	Bighorn	75	70	67
Boysen	Bighorn	98	89	91
Bighorn Lake	Bighorn	59	57	59
Lake Helena	Upper Missouri	78	78	86
Holter Lake	Upper Missouri	99	99	99
Helena Valley Reservoir	Upper Missouri	70	65	52
Canyon Ferry Lake	Upper Missouri	76	66	71
Lake Koocanusa	Kootenai	68	60	55
Hungry Horse Lake	Flathead	83	69	68
Flathead Lake	Flathead	44	42	41
Nelson Res	Milk	79	33	57
Fresno Res	Milk	24	29	51
Noxon Rapids Reservoir	Lower Clark Fork	93	93	96
Fort Peck Lake	Lower Missouri	76	65	73
Nevada Creek Res	Upper Clark Fork	56	40	68
Georgetown Lake	Upper Clark Fork	93	90	91
Tongue River Res	Tongue	71	65	61
Lake Sherburne	St. Mary	69	33	48
Hebgen Lake	Madison	86	75	73
Ennis Lake	Madison	77	75	72
Middle Creek Res	Gallatin	57	53	59

Statewide Overview

Streamflow

Streamflow was near normal across most of Montana during March. A handful of gages recorded above normal flows for the month, mostly in basins where lower elevations received rain instead of snow during precipitation events. Cooler temperatures and additional moisture during the last week of March staved off snow melt in the lower elevations and kept substantial runoff into stream systems at bay.

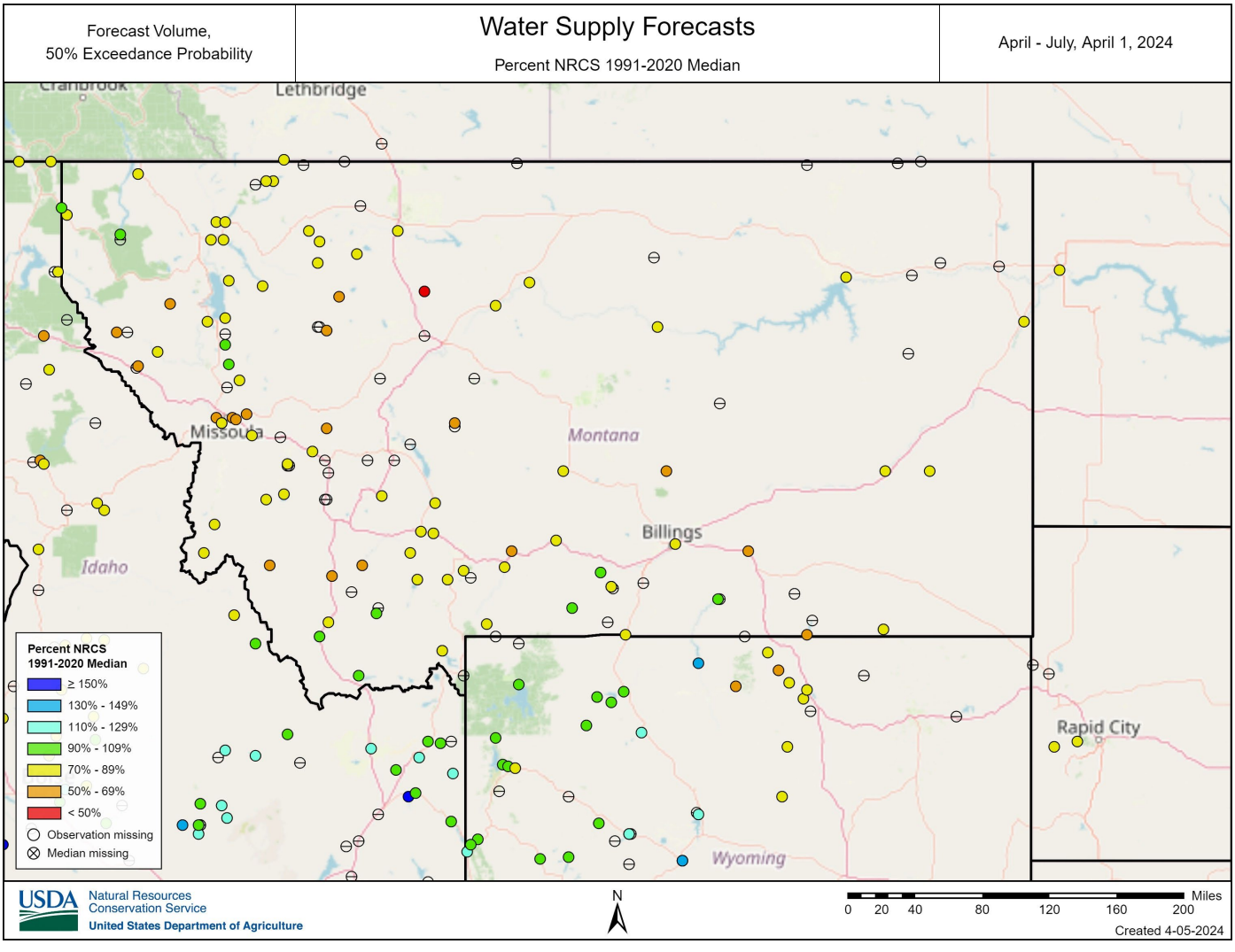


Statewide Overview

Water Supply Forecasts

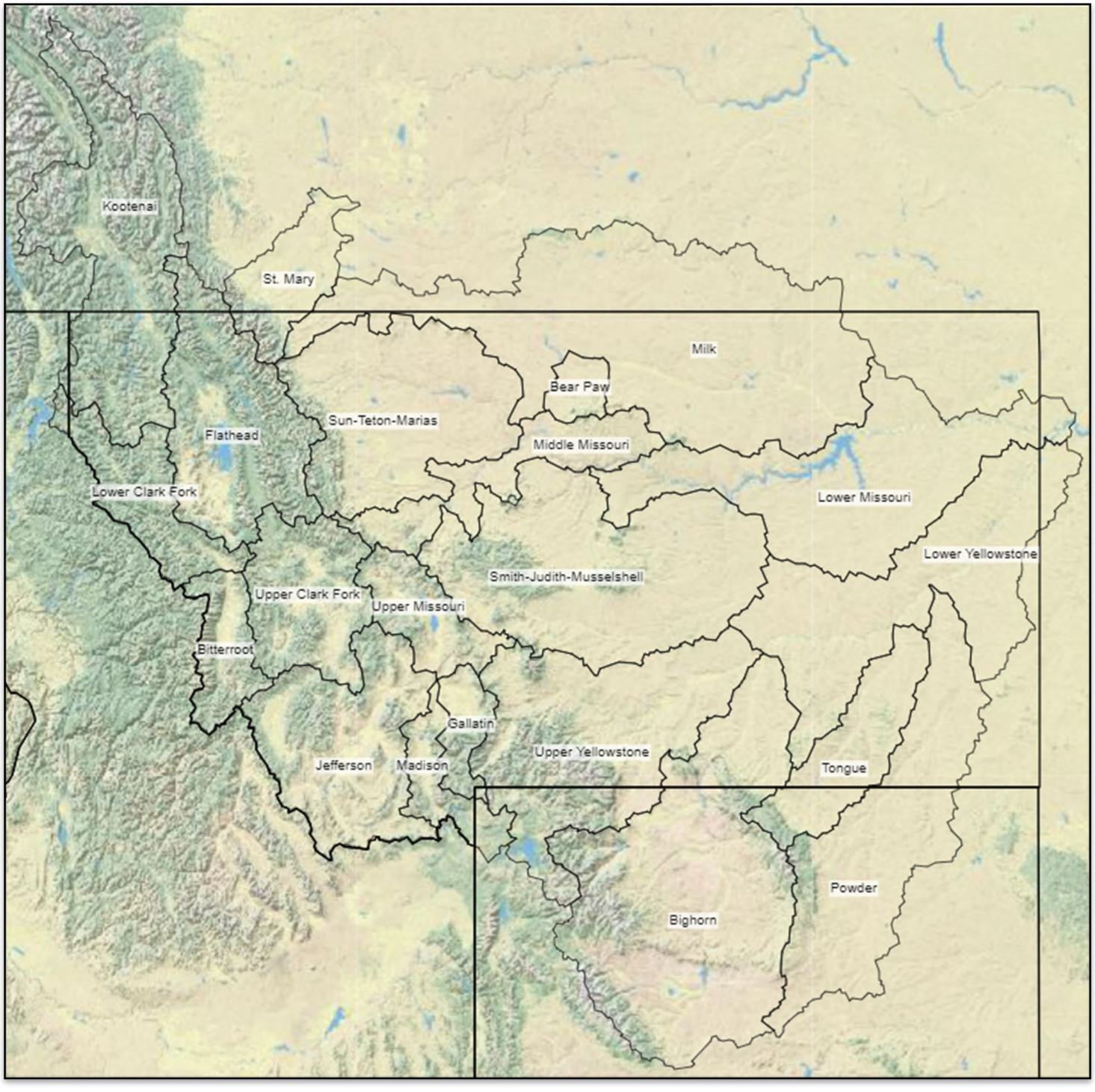
April 1 water supply forecasts currently trend with water year precipitation and the resulting snowpack. Given both are currently below normal at most locations, so are most forecasts. April-July streamflows are forecasted to be about 70-85% of normal in Montana. However, forecasts are near to above normal in a couple pockets of northwest, southwest, and southern Montana where water year precipitation has been closer to normal. Locations of greatest concern include the Teton, Shields, Nevada Creek, Bighole, Musselshell, Little Bighorn, Blackfoot, Smith, Sun, Clark Fork and Tongue River, which are forecasted to have less than 65% of normal total runoff volume during the April through July time period.

It is not likely a full recovery to normal snowpack conditions will occur by May 1 this year across most of Montana. Below normal snowpack conditions on May 1 could be supplemented by above normal spring and summer precipitation, assuming snowpack deficits aren't too large. Best case scenario would be a return to cooler weather and above normal precipitation for the next several months. It is worth noting that water supply forecasts predict a range of probable volumes dependent on future weather conditions. The 50% exceedance volume is reflective of normal weather conditions and runoff, while the 30% and 10% exceedance volumes are reflective of a wetter, cooler spring, and the 70% and 90% exceedance volumes could be reflective of a warmer, drier spring.



Basin Overview

Montana River Basin Definitions

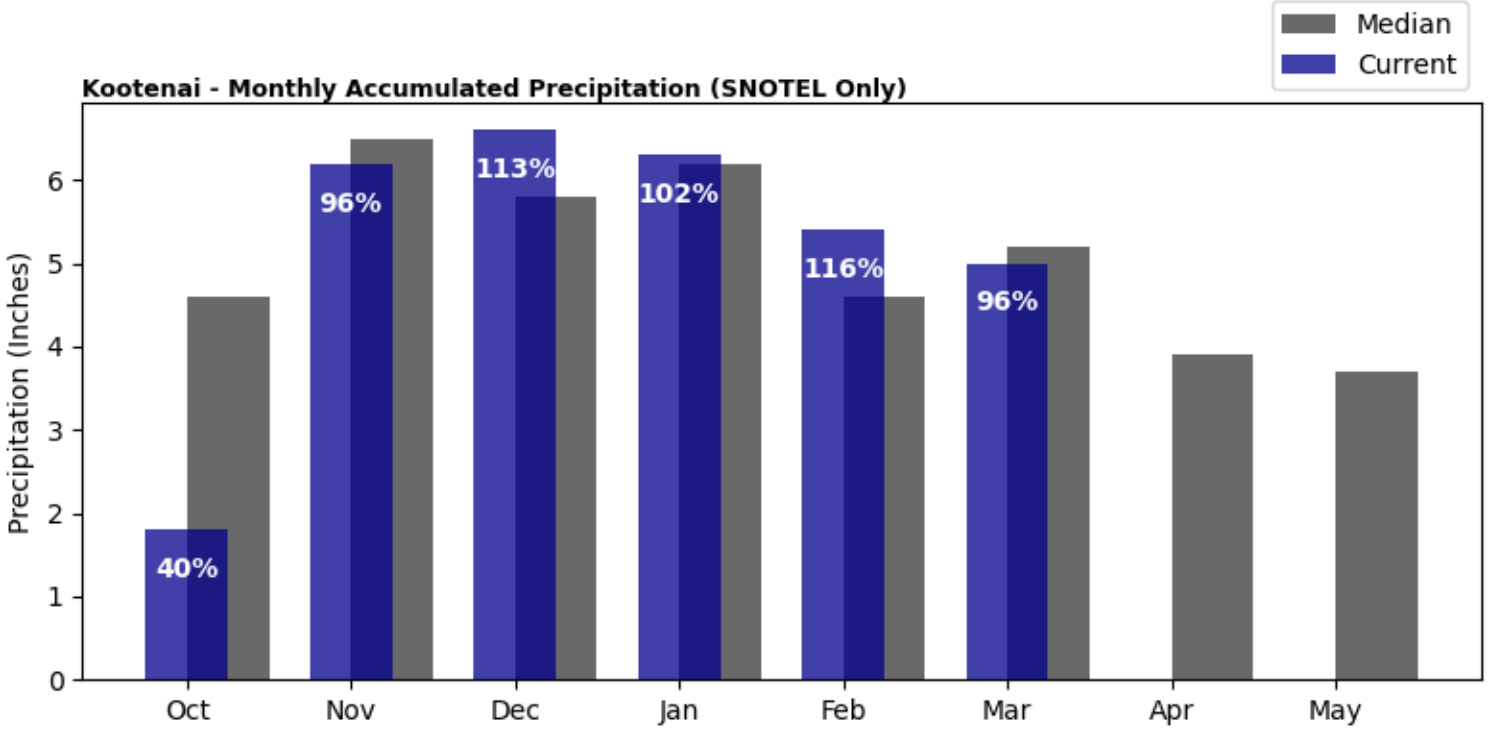


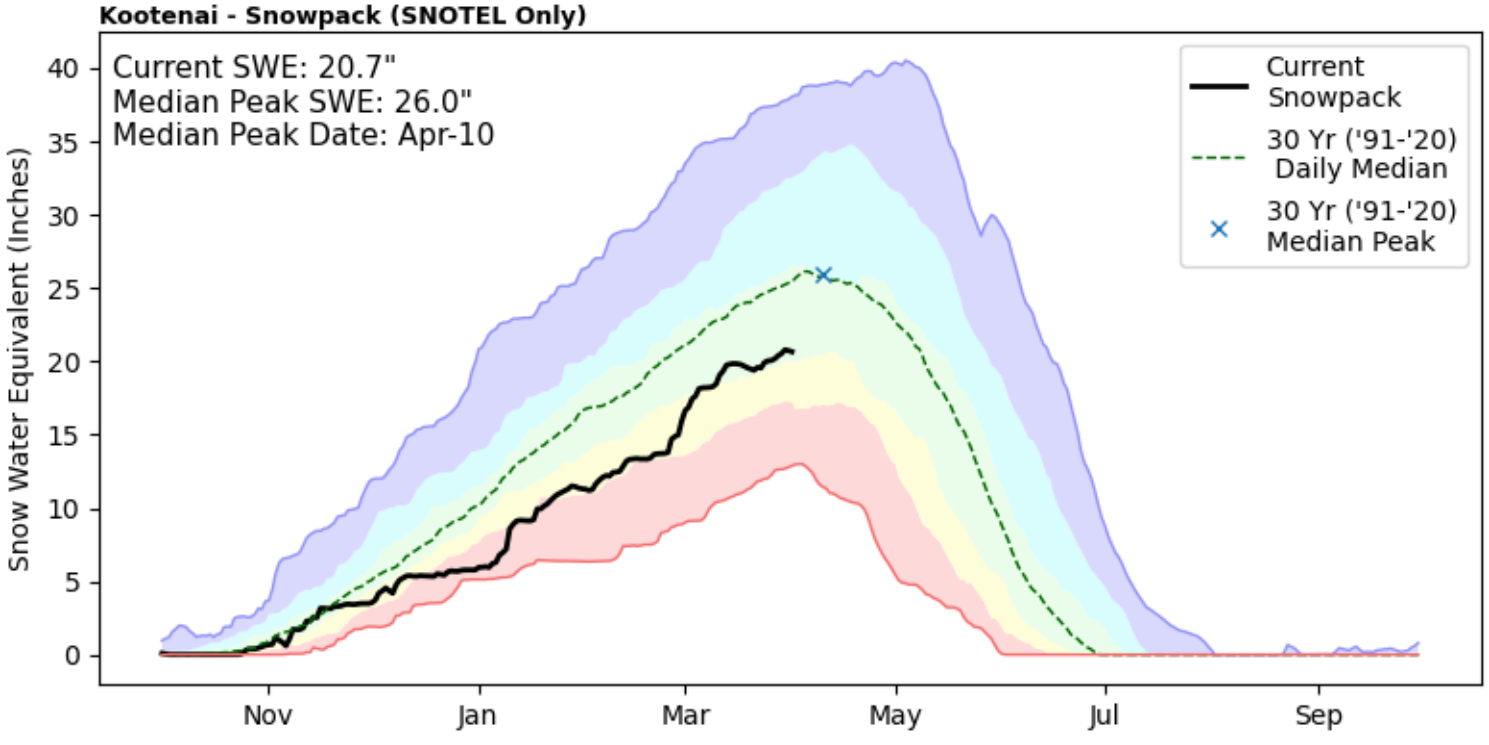
The following basin overview sections only include basins that have SNOTEL sites. For example, there is no basin overview for the Lower Yellowstone, because there are no SNOTEL sites associated with that basin. Water supply information for basins not included in the following sections can be found at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

Basin Overview

Kootenai

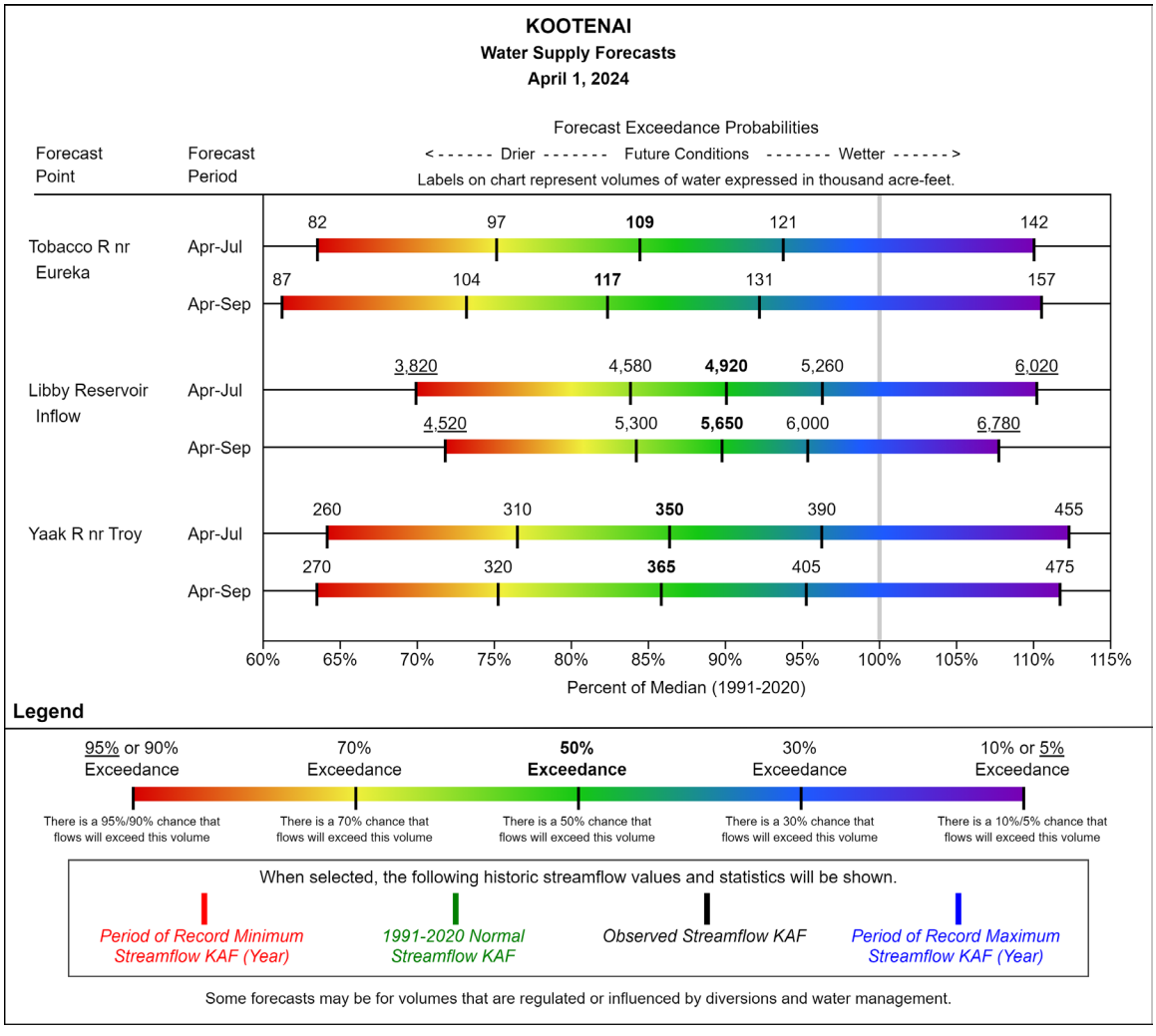
Precipitation in March was near normal at 96%, which brings the seasonal accumulation (October-March) to 88% of median. The snowpack in the Kootenai is well below normal at 78% of median, compared to 85% at this time last year.





Basin Overview

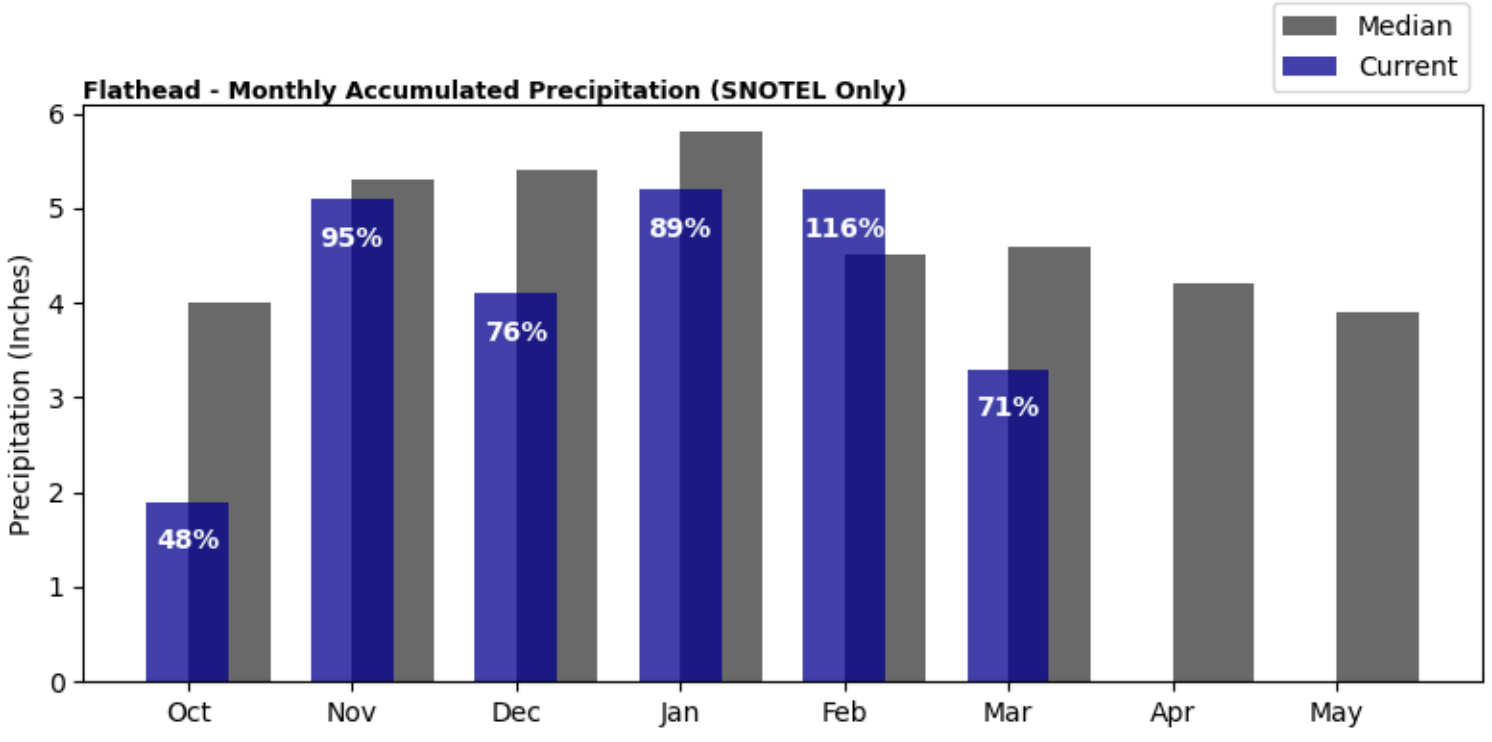
Kootenai (Continued)

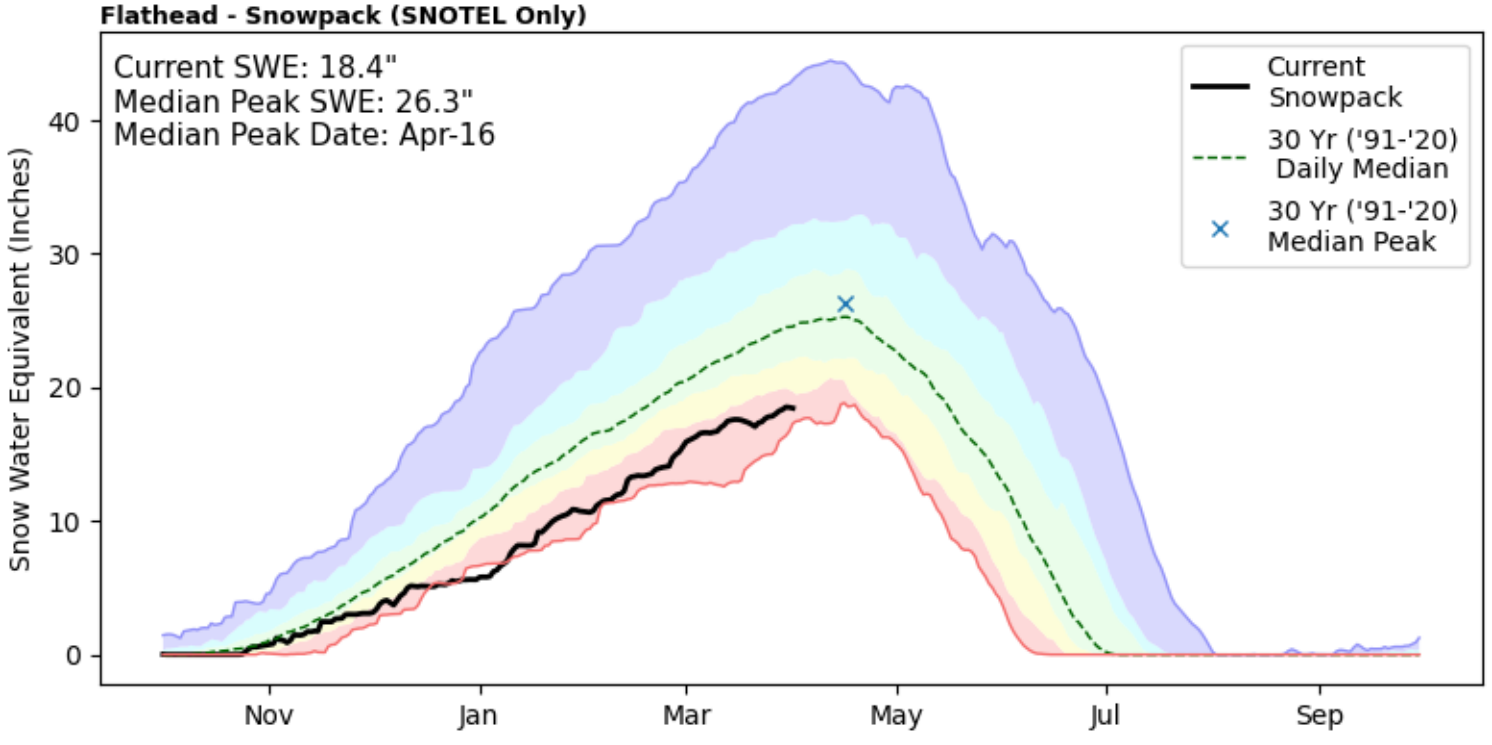


Basin Overview

Flathead

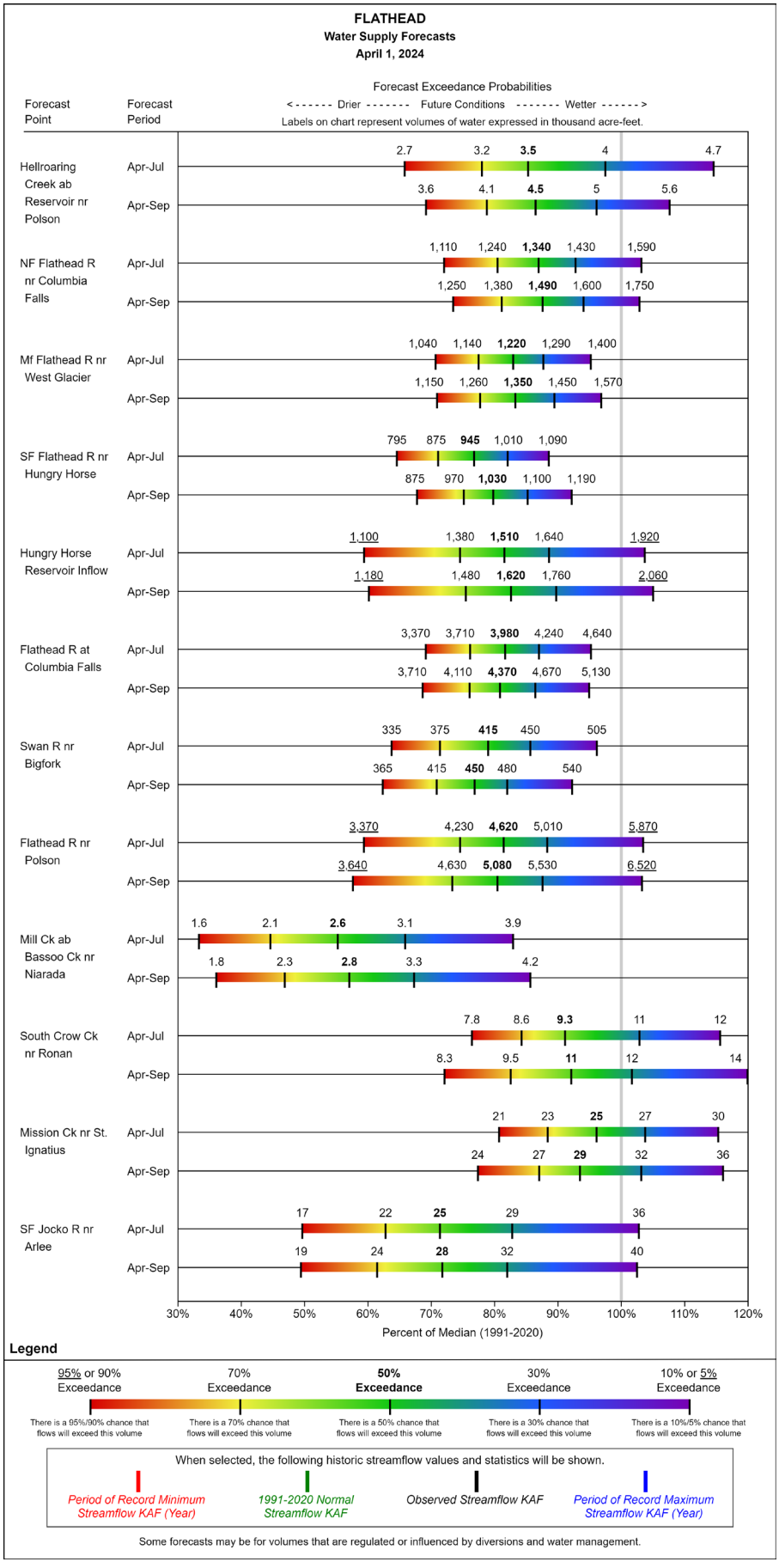
Precipitation in March was well below normal at 71%, which brings the seasonal accumulation (October-March) to 80% of median. The snowpack in the Flathead is well below normal at 75% of median, compared to 92% at this time last year.





Basin Overview

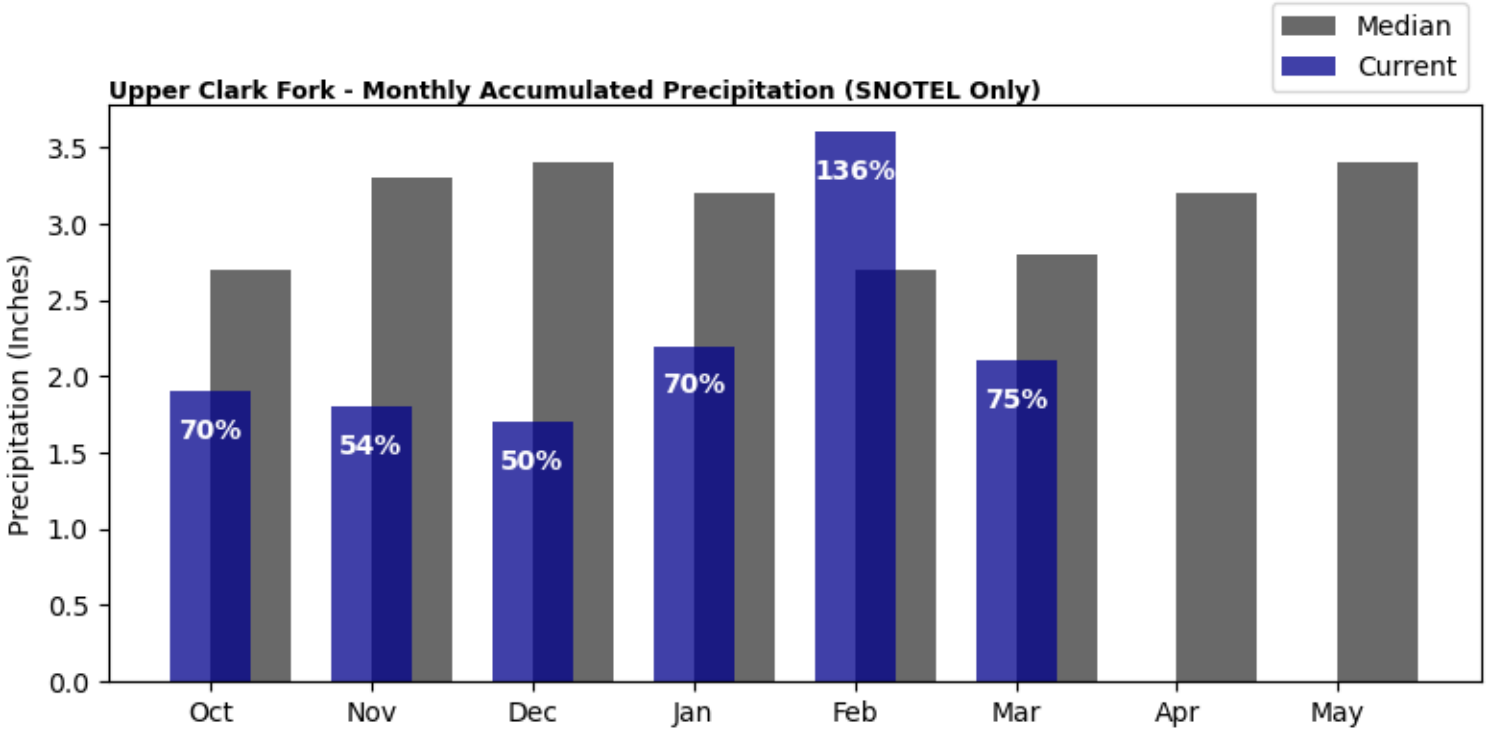
Flathead (Continued)

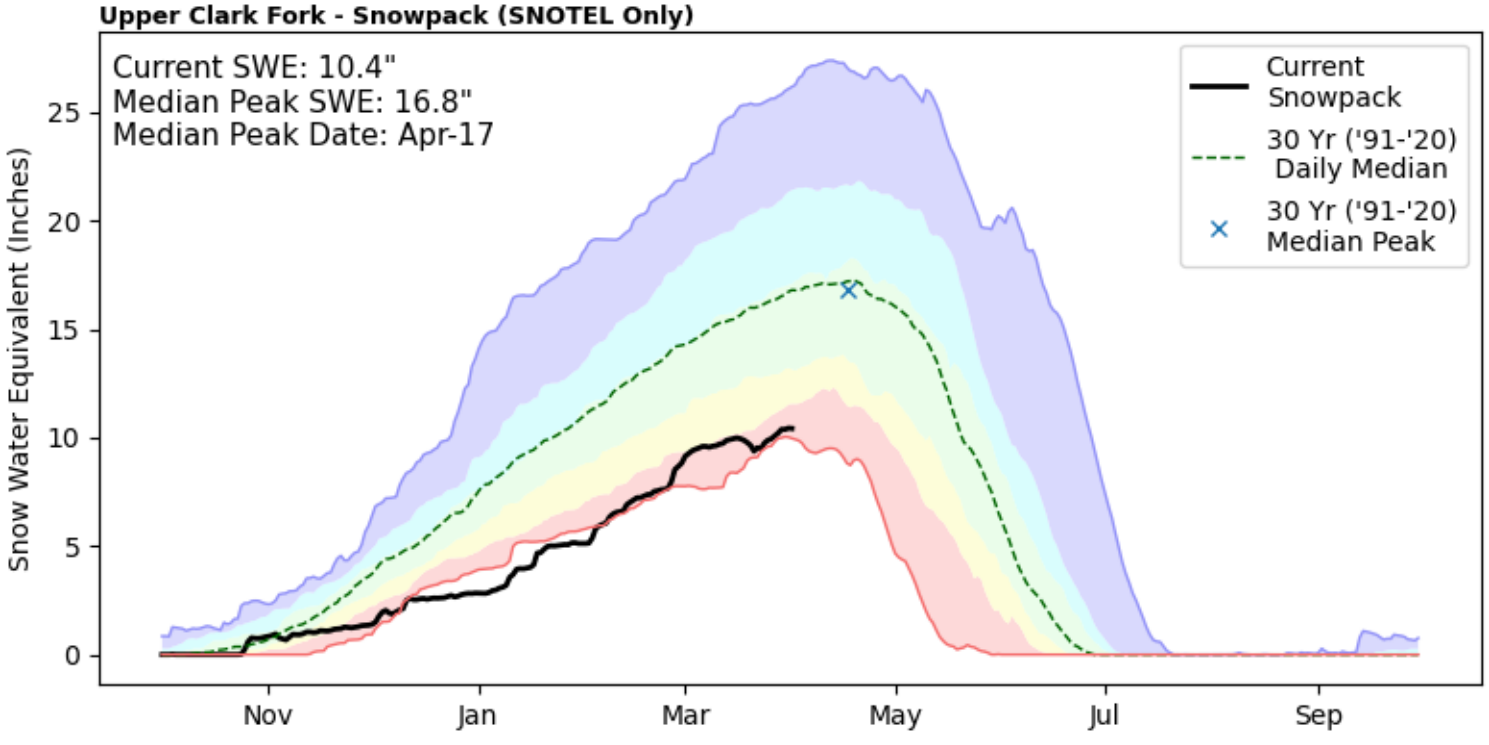


Basin Overview

Upper Clark Fork

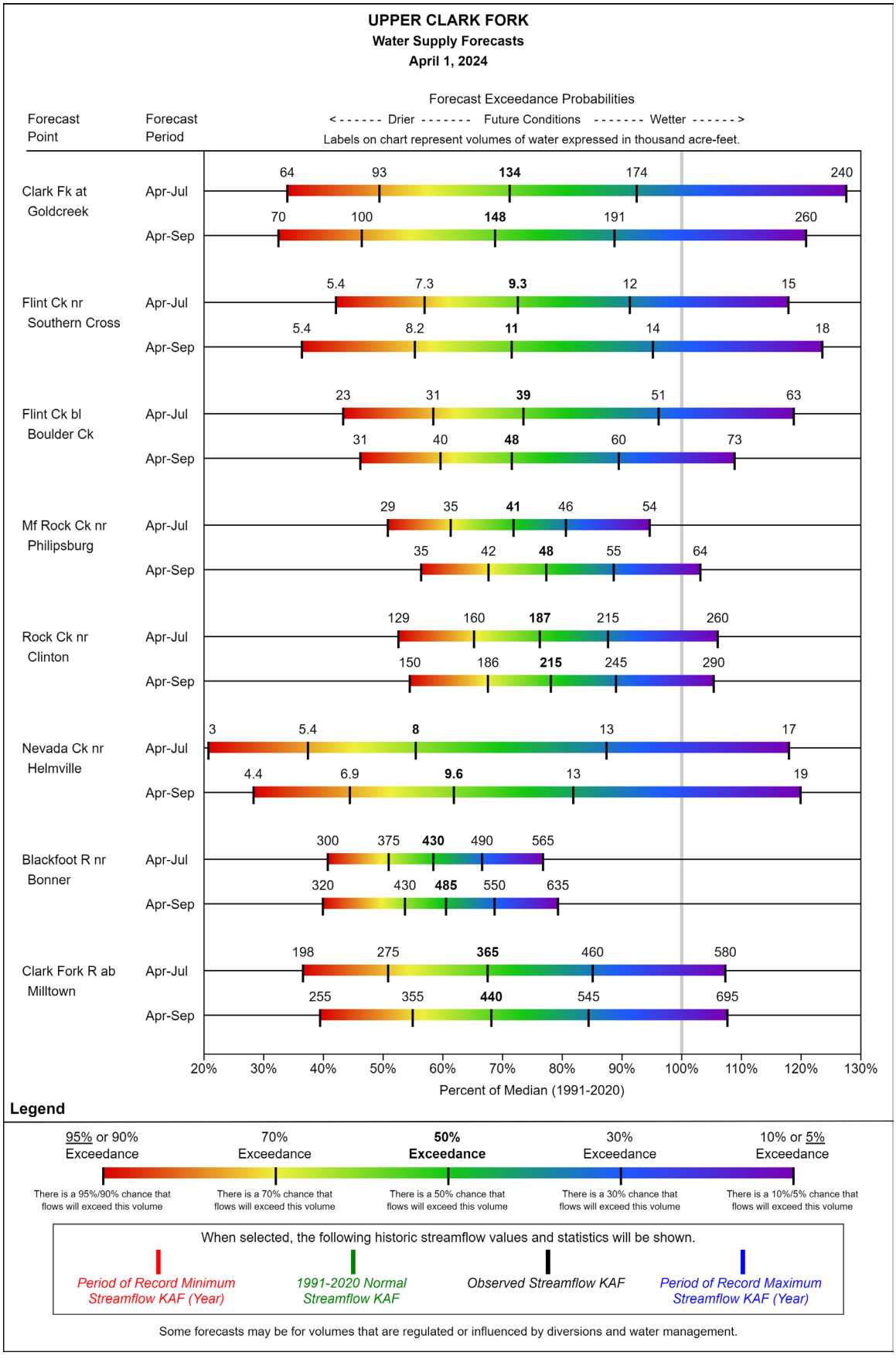
Precipitation in March was well below normal at 75%, which brings the seasonal accumulation (October-March) to 71% of median. The snowpack in the Upper Clark Fork is well below normal at 67% of median, compared to 114% at this time last year.





Basin Overview

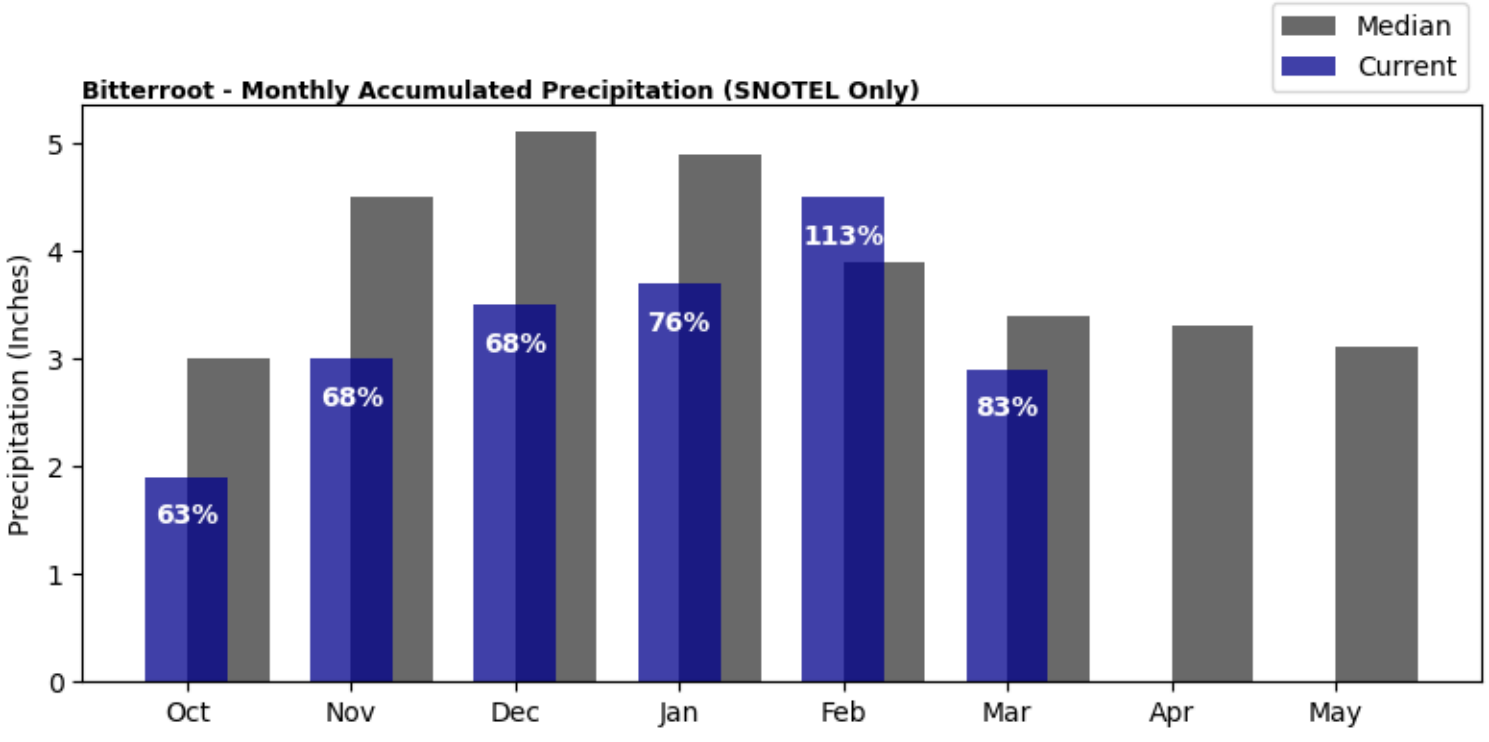
Upper Clark Fork (Continued)

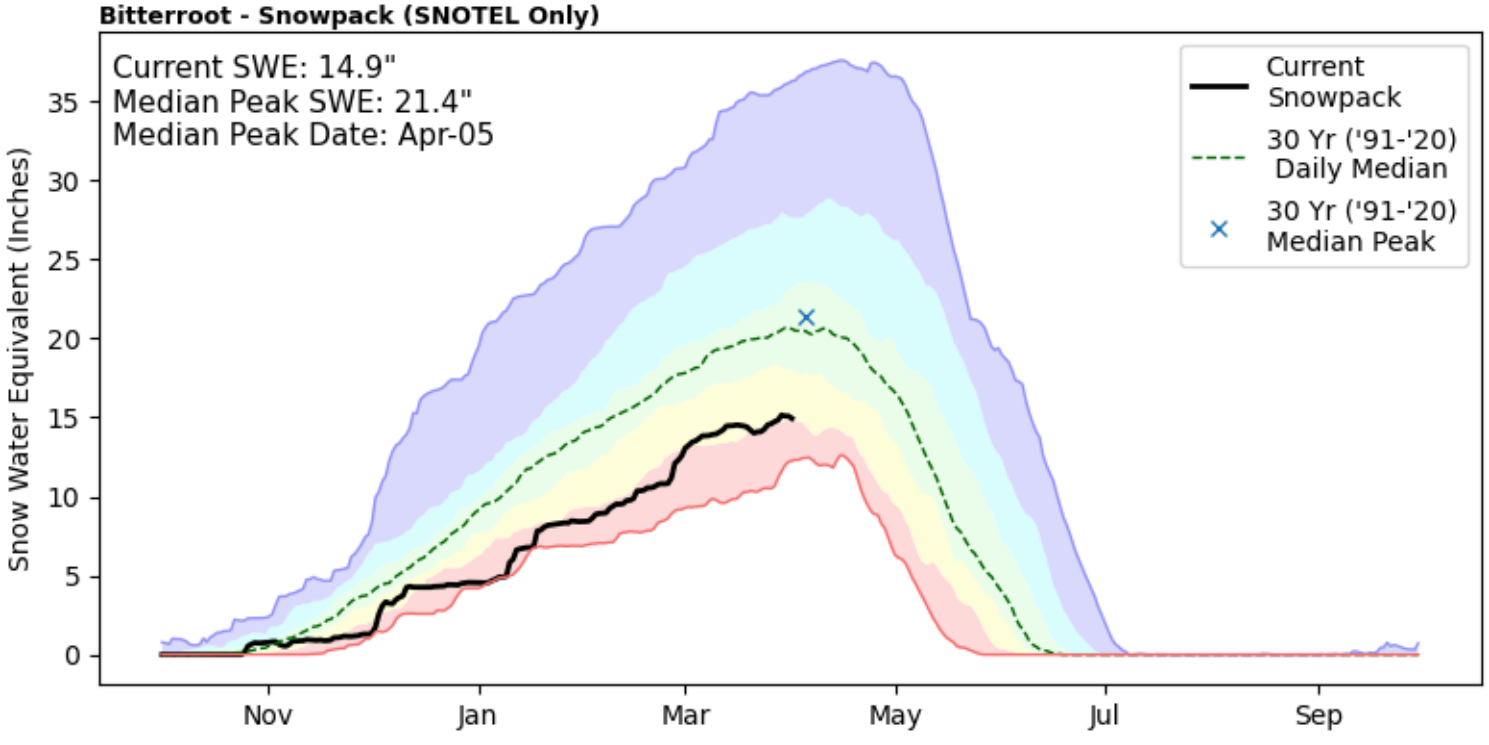


Basin Overview

Bitterroot

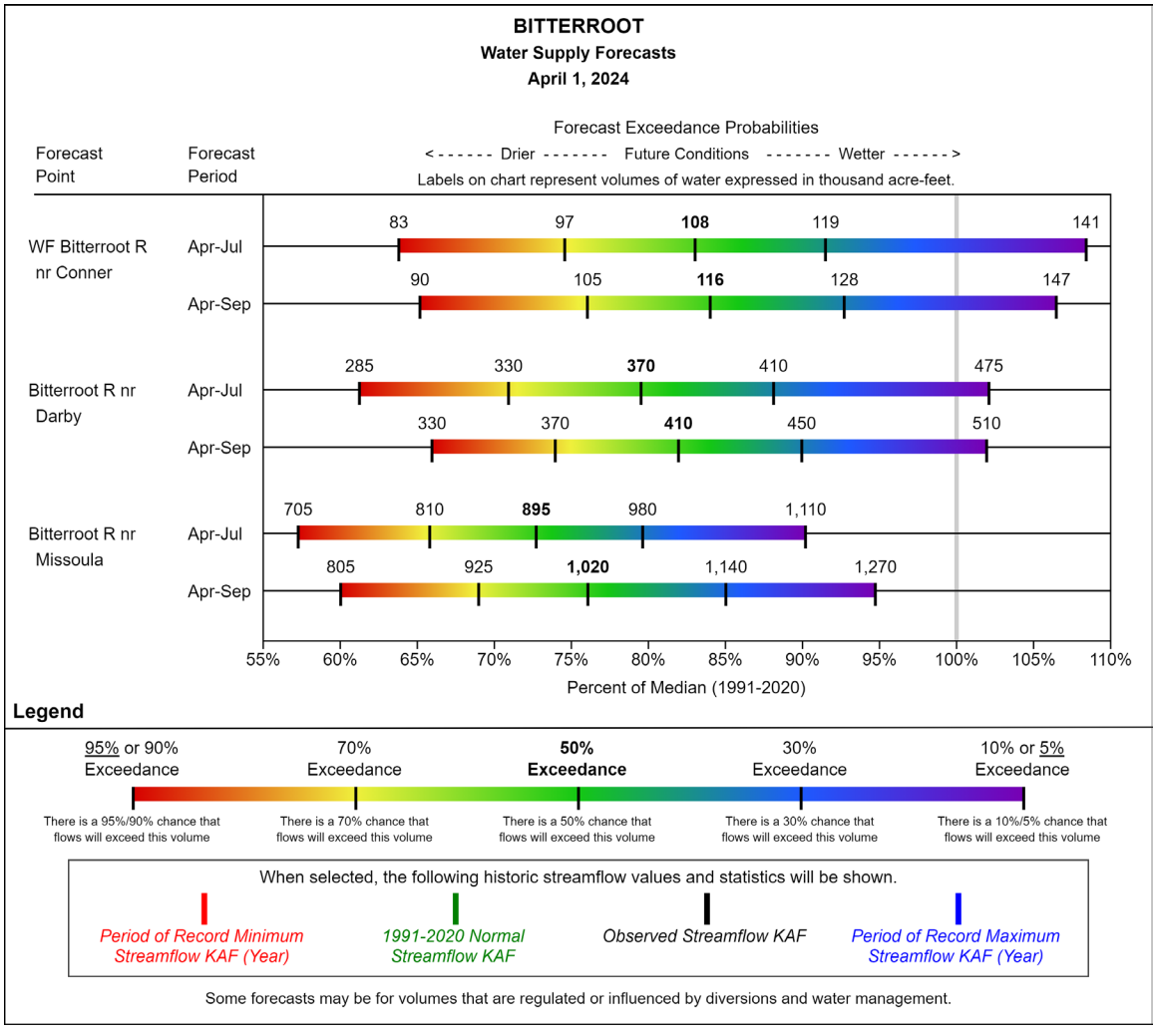
Precipitation in March was below normal at 83%, which brings the seasonal accumulation (October-March) to 74% of median. The snowpack in the Bitterroot is well below normal at 72% of median, compared to 96% at this time last year.





Basin Overview

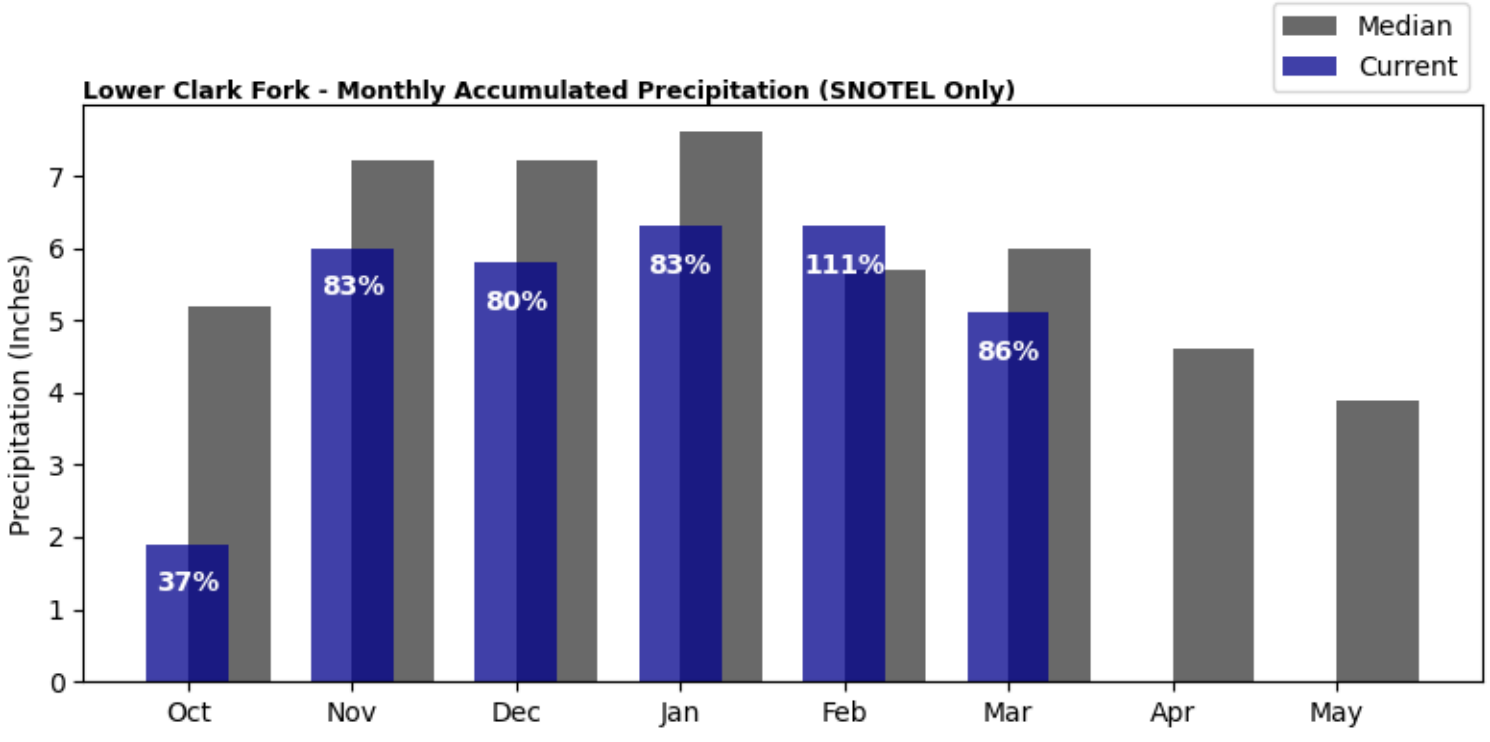
Bitterroot (Continued)

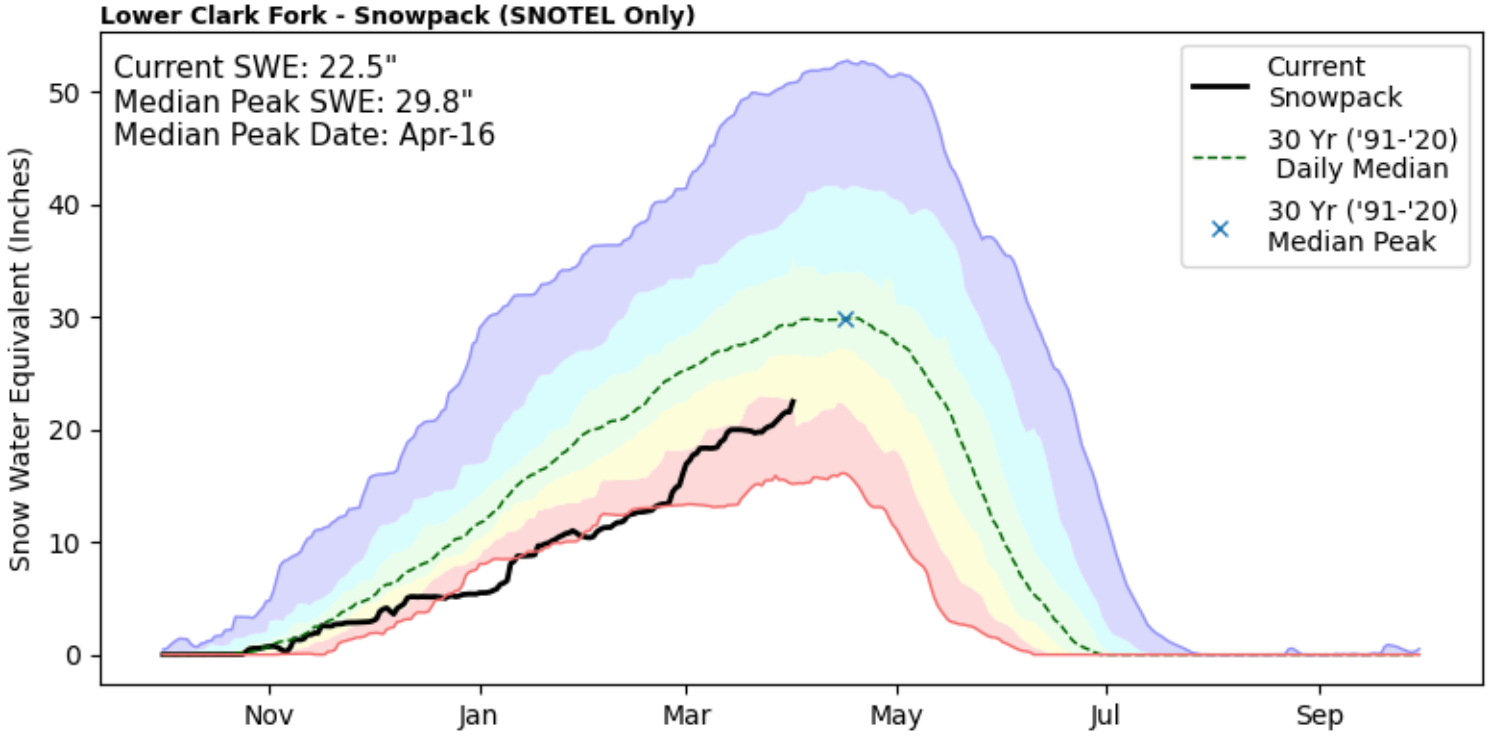


Basin Overview

Lower Clark Fork

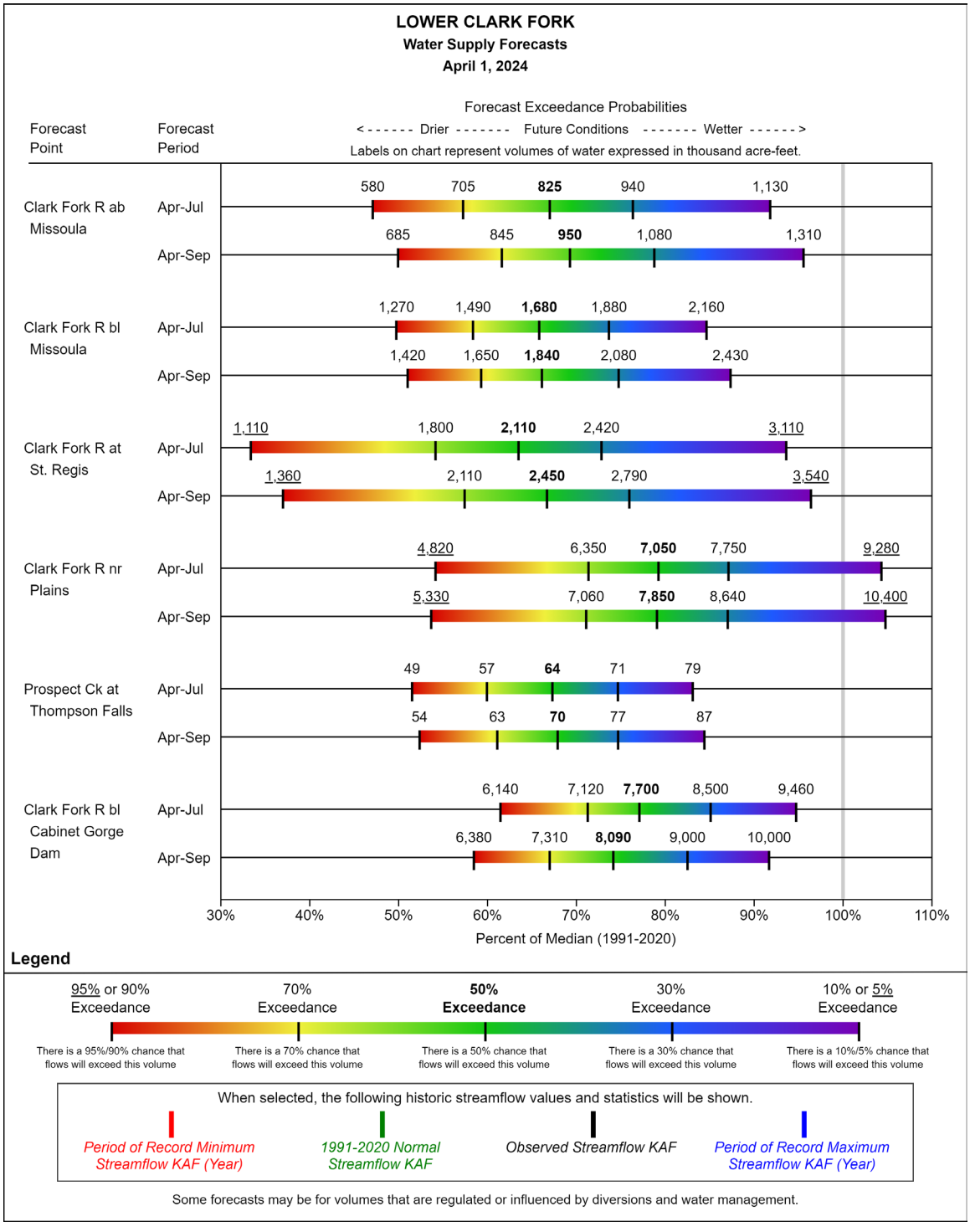
Precipitation in March was below normal at 86%, which brings the seasonal accumulation (October-March) to 75% of median. The snowpack in the Lower Clark Fork is well below normal at 73% of median, compared to 90% at this time last year.





Basin Overview

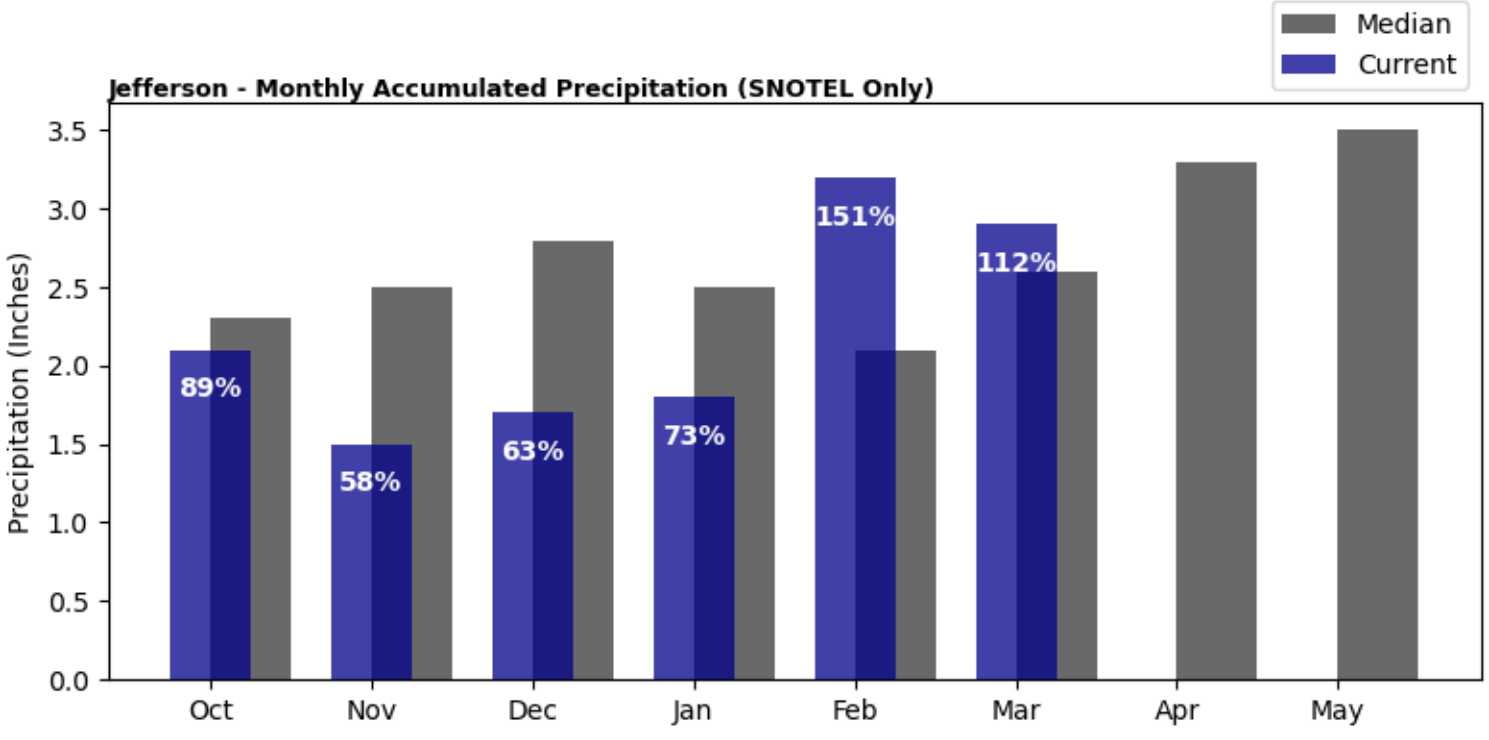
Lower Clark Fork (Continued)

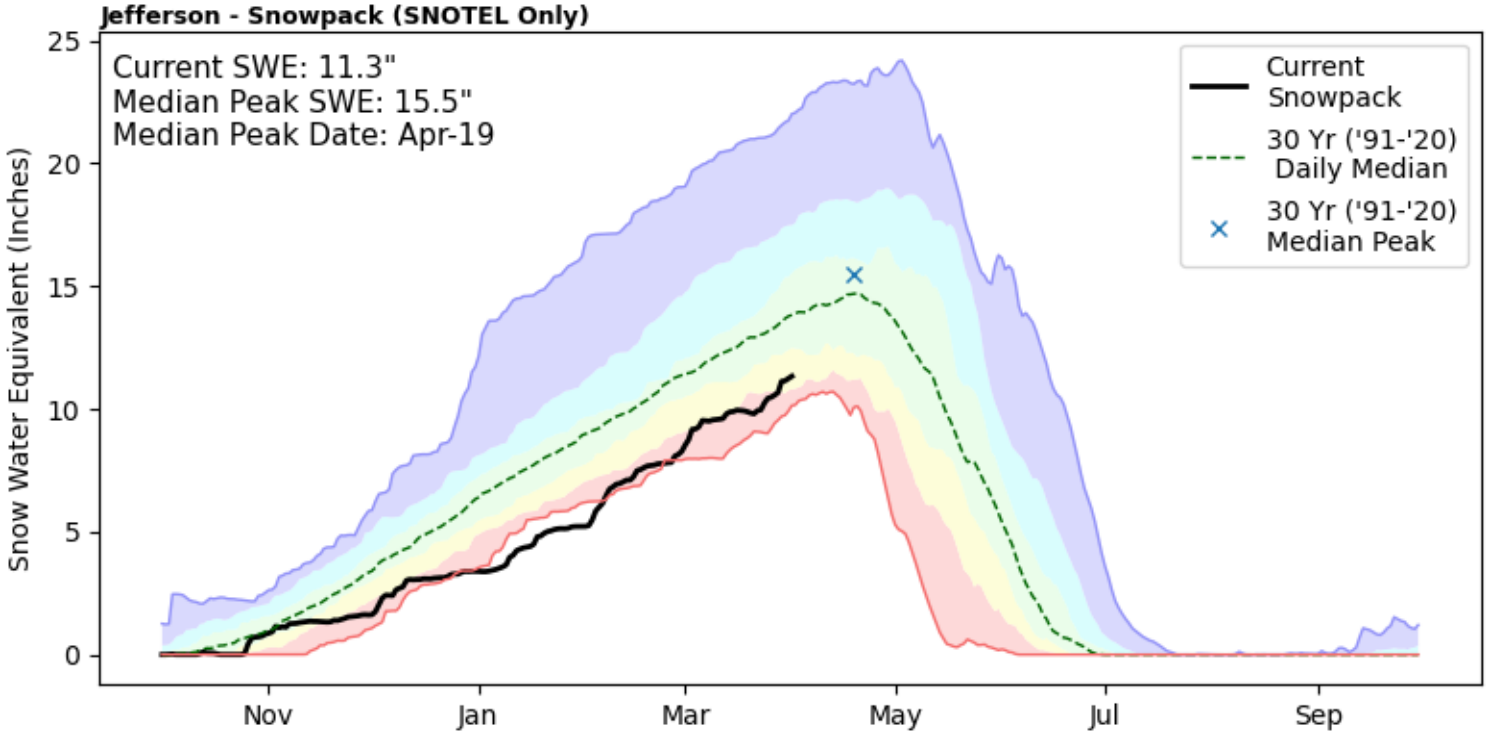


Basin Overview

Jefferson

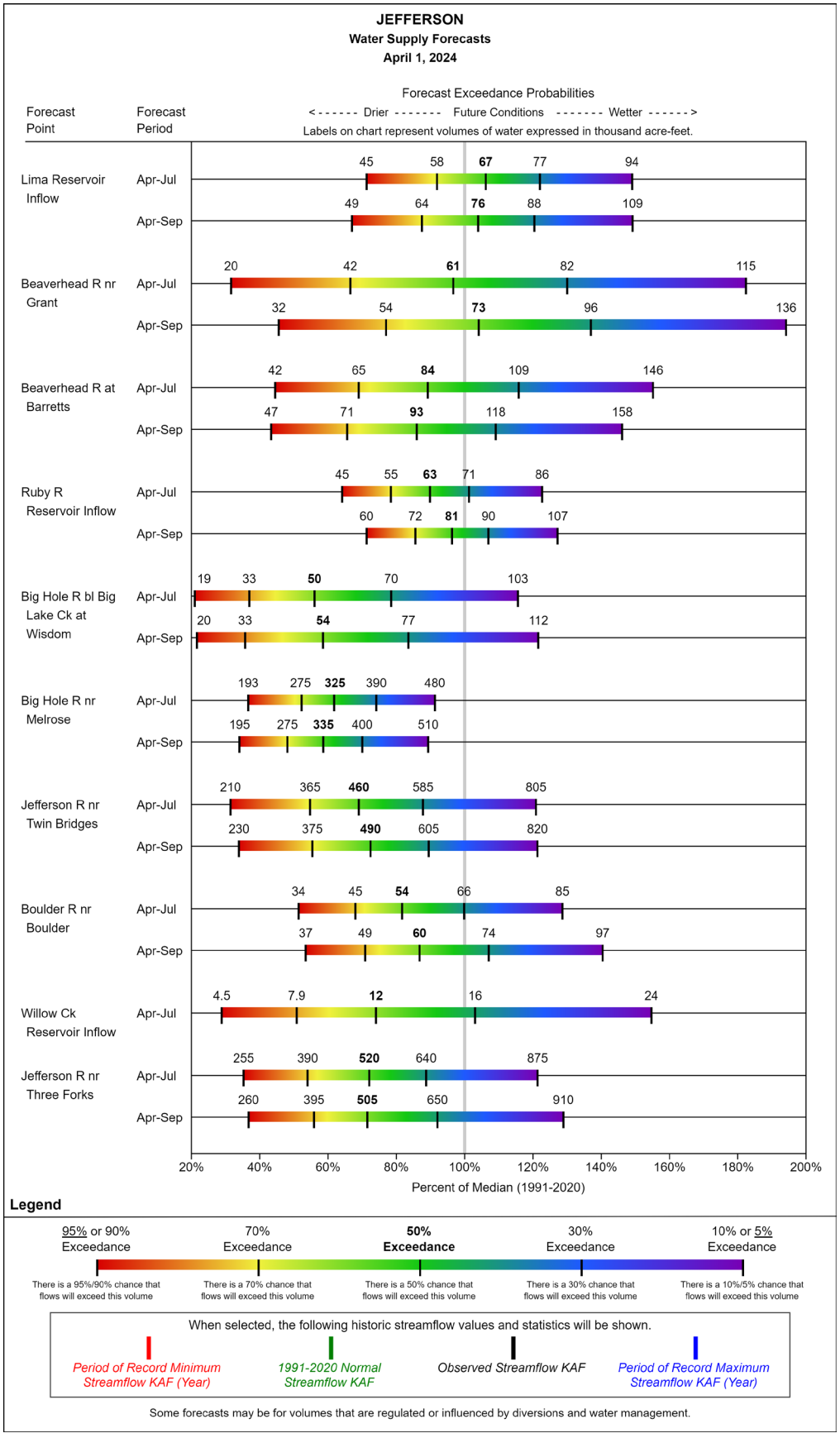
Precipitation in March was above normal at 112%, which brings the seasonal accumulation (October-March) to 87% of median. The snowpack in the Jefferson is below normal at 80% of median, compared to 117% at this time last year.





Basin Overview

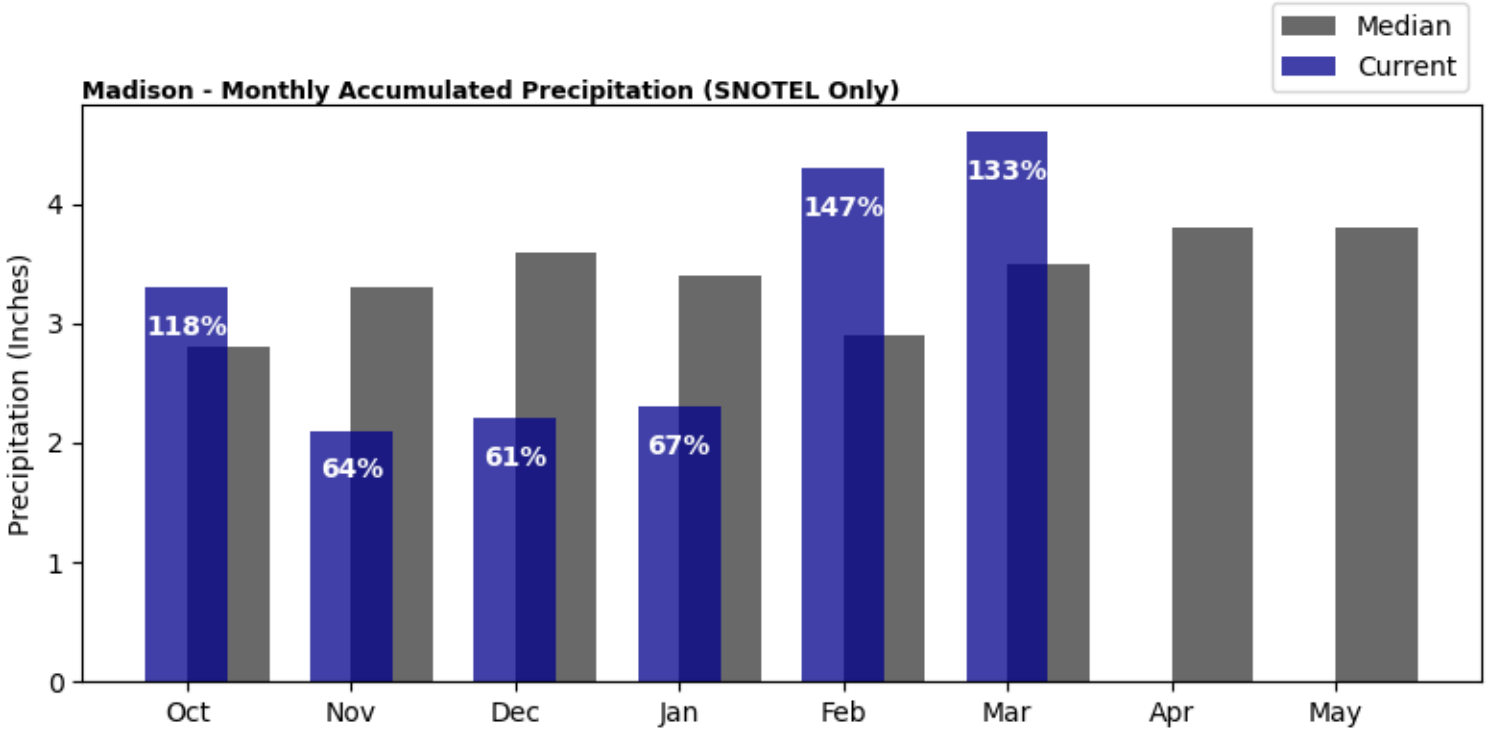
Jefferson (Continued)

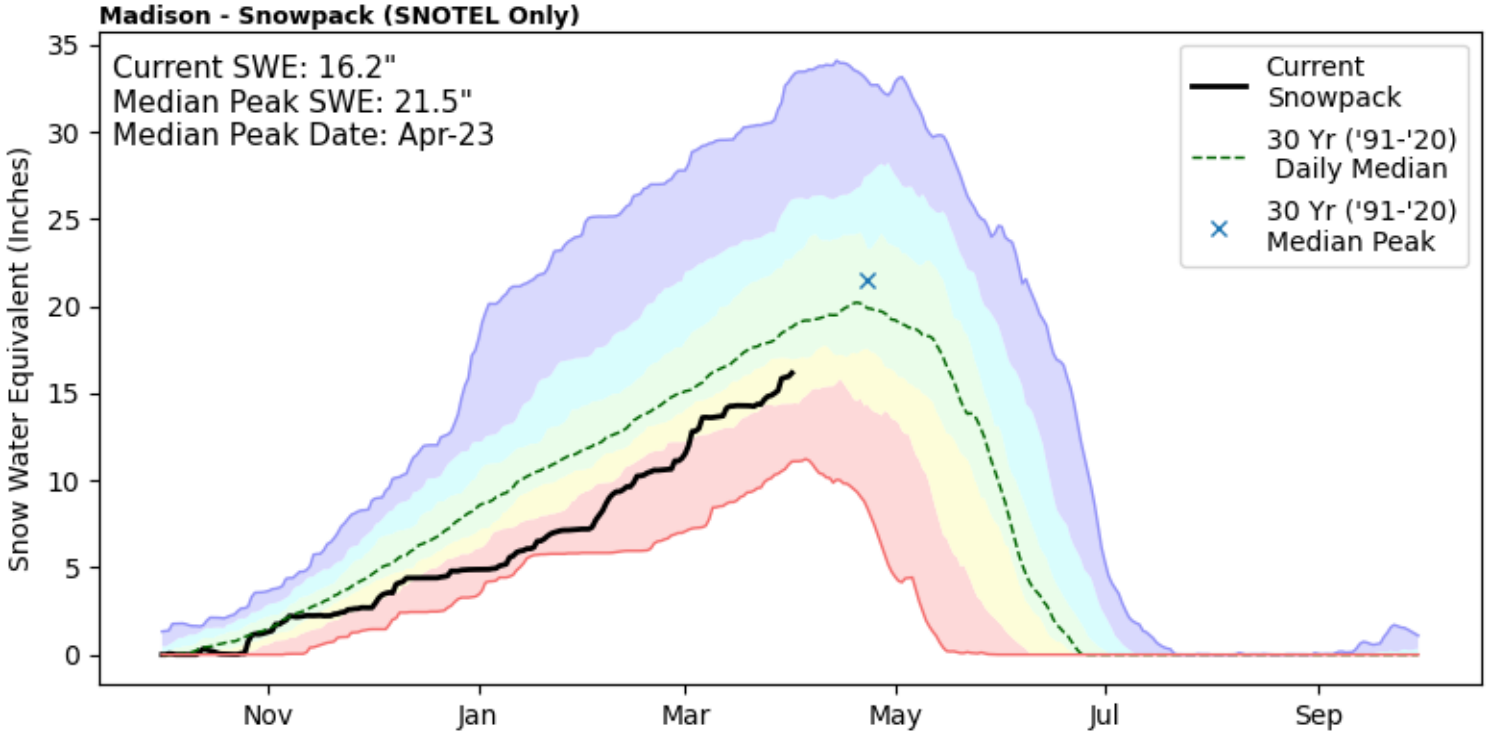


Basin Overview

Madison

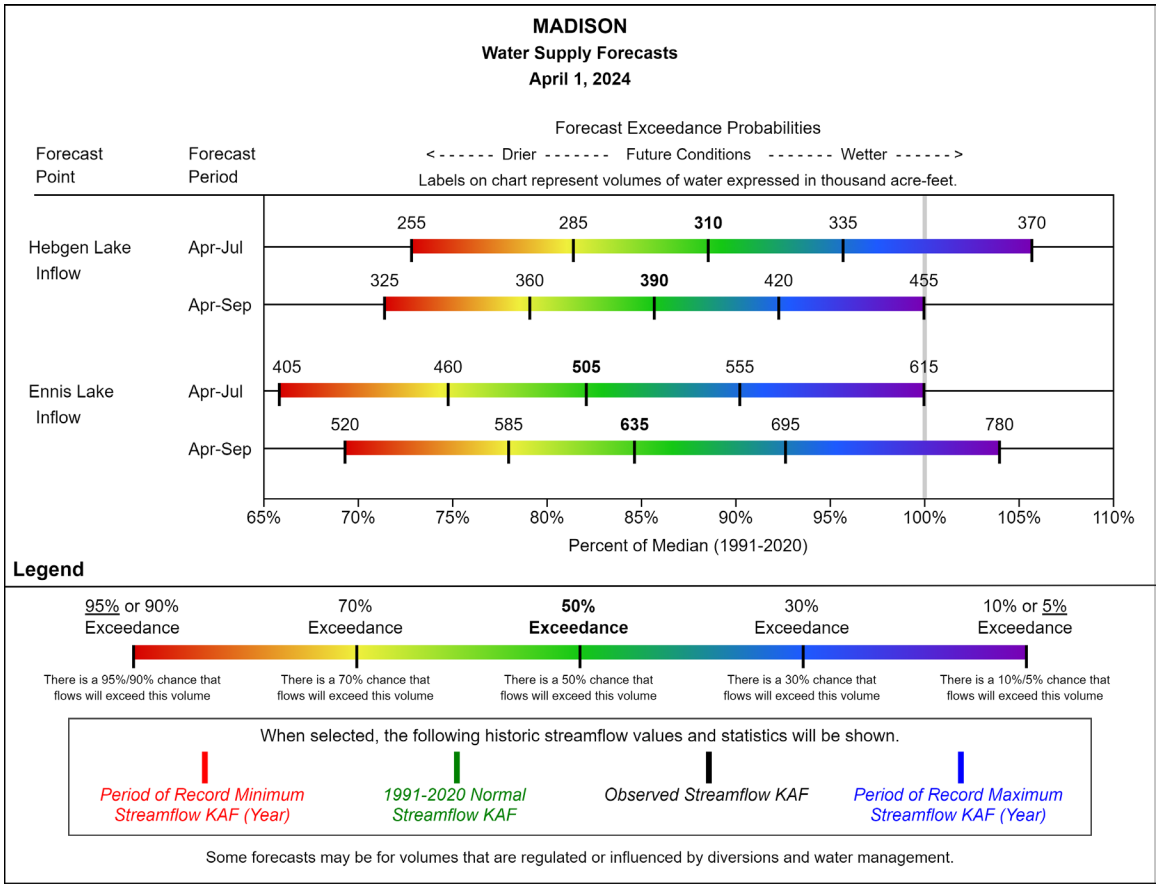
Precipitation in March was well above normal at 133%, which brings the seasonal accumulation (October-March) to 93% of median. The snowpack in the Madison is below normal at 85% of median, compared to 129% at this time last year.





Basin Overview

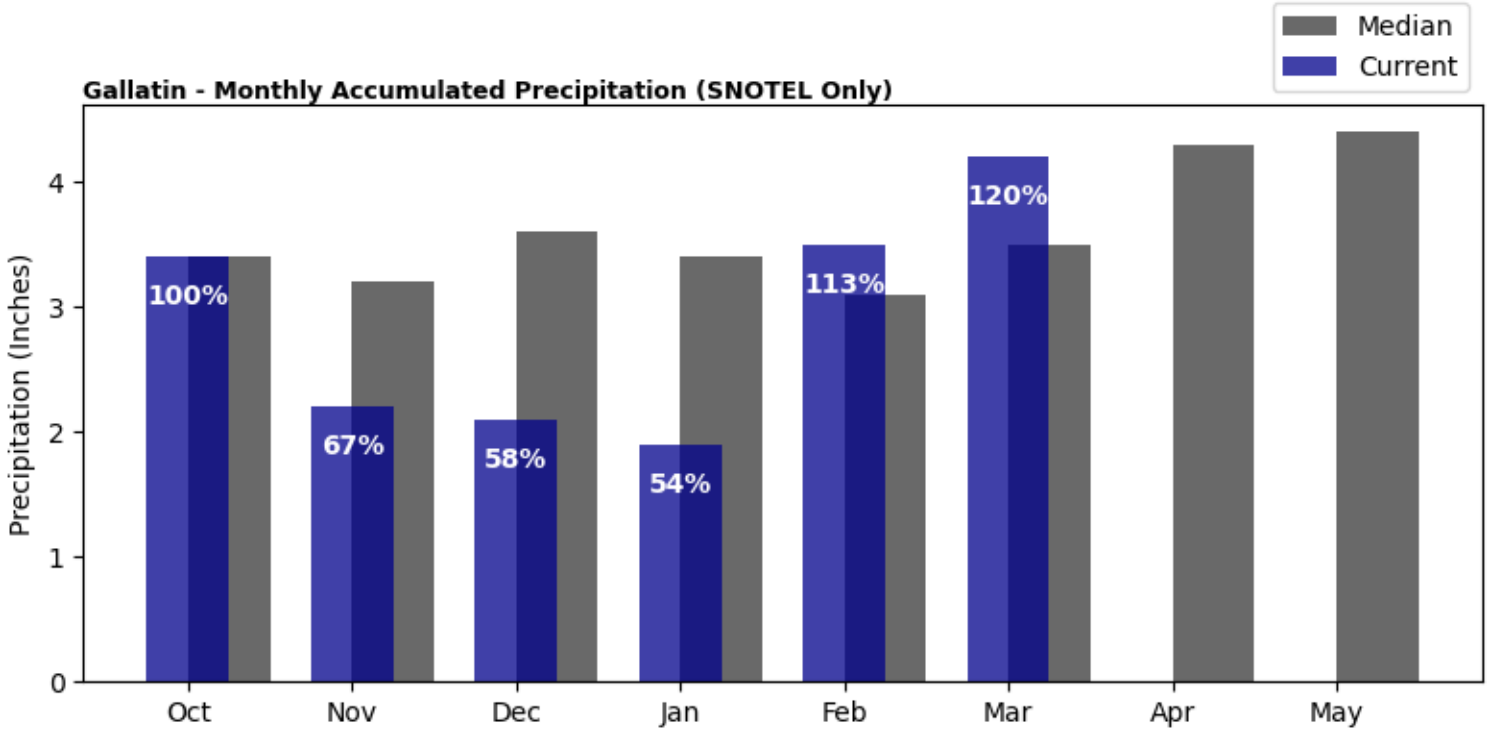
Madison (Continued)

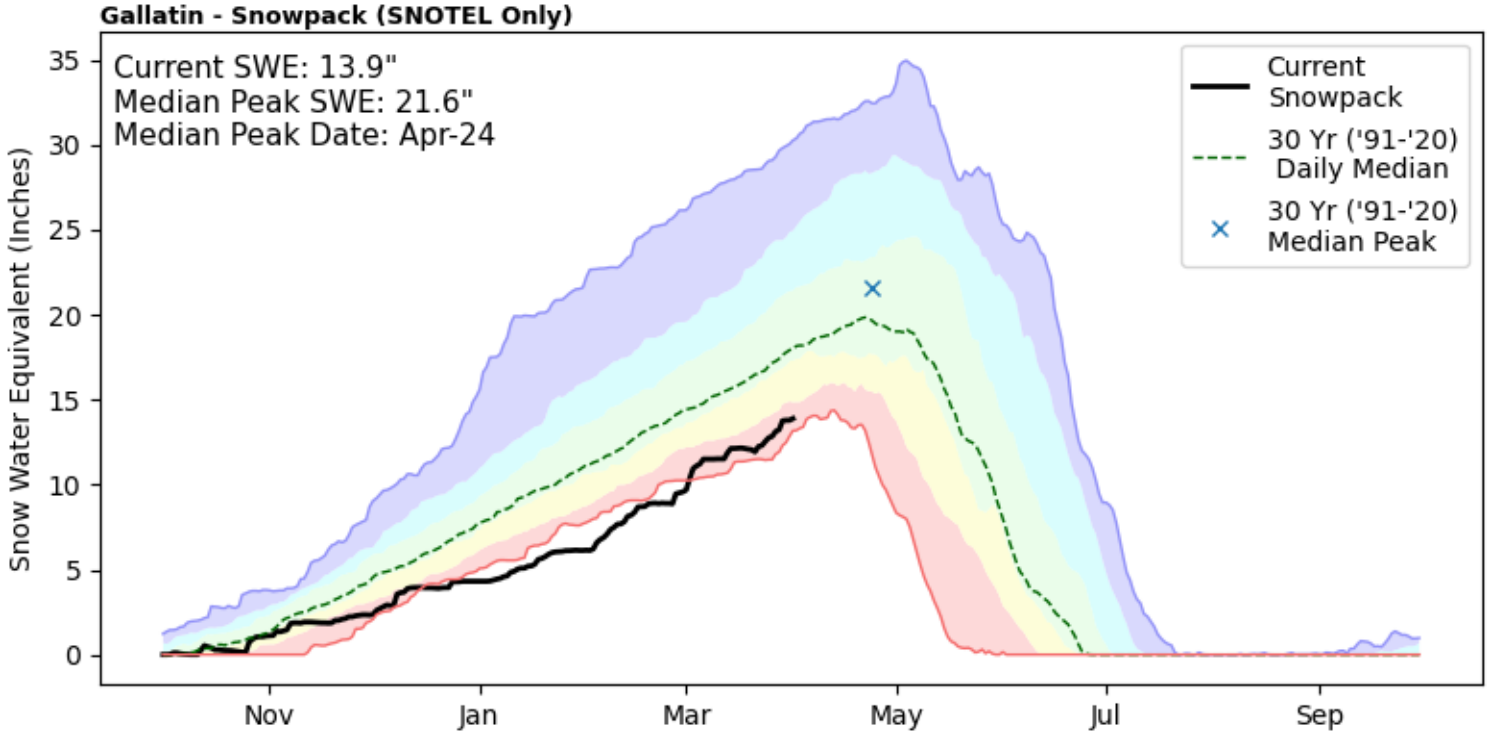


Basin Overview

Gallatin

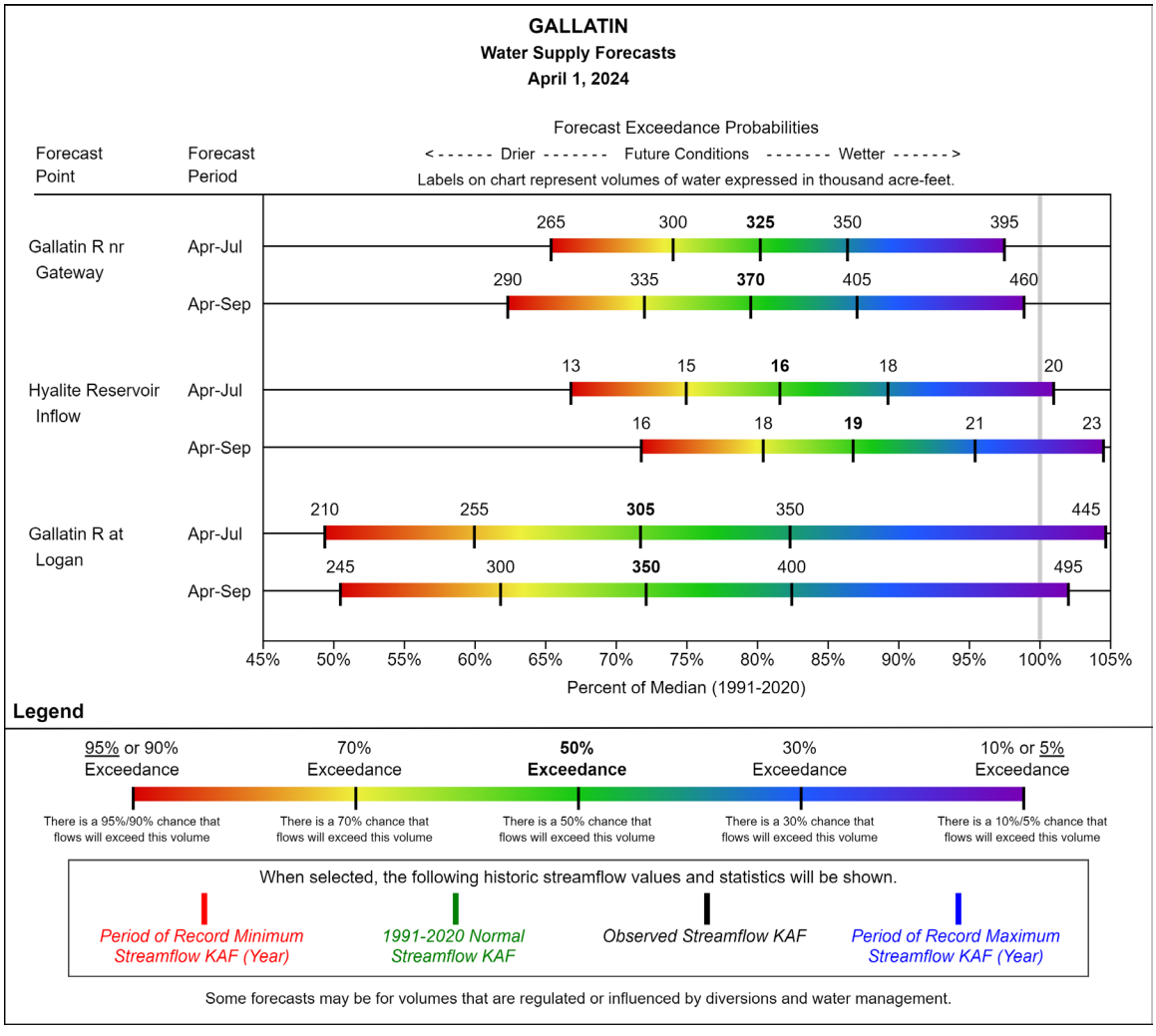
Precipitation in March was None at 120%, which brings the seasonal accumulation (October-March) to 83% of median. The snowpack in the Gallatin is well below normal at 76% of median, compared to 123% at this time last year.





Basin Overview

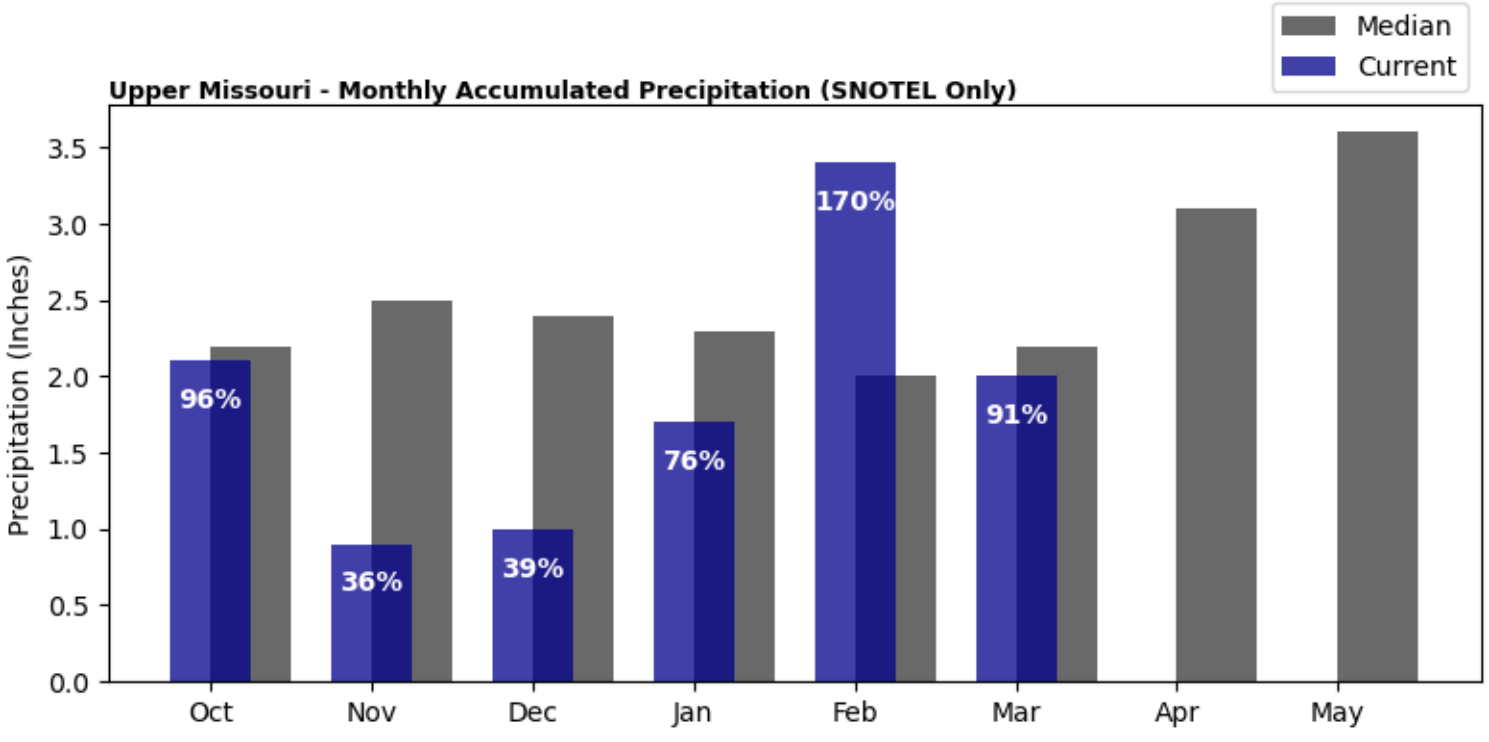
Gallatin (Continued)

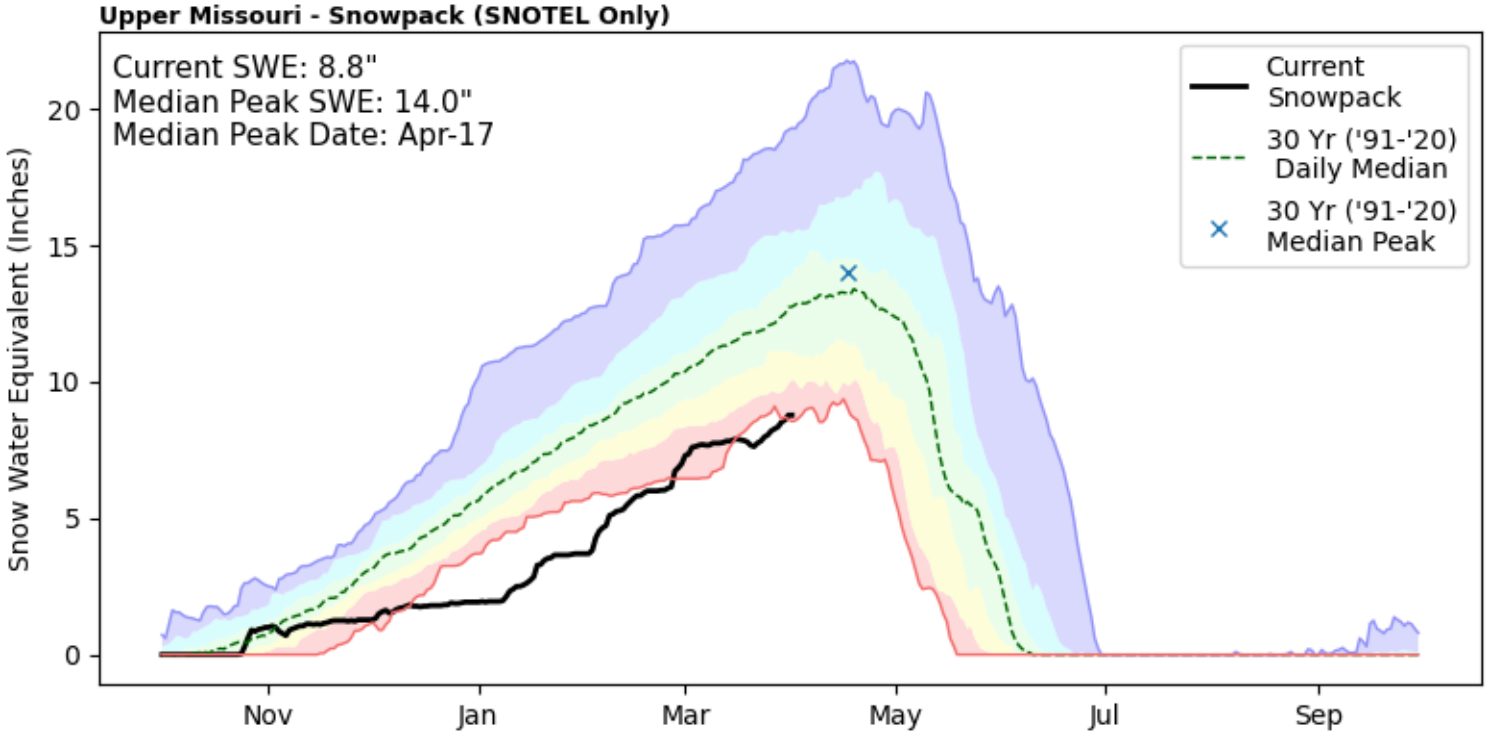


Basin Overview

Upper Missouri

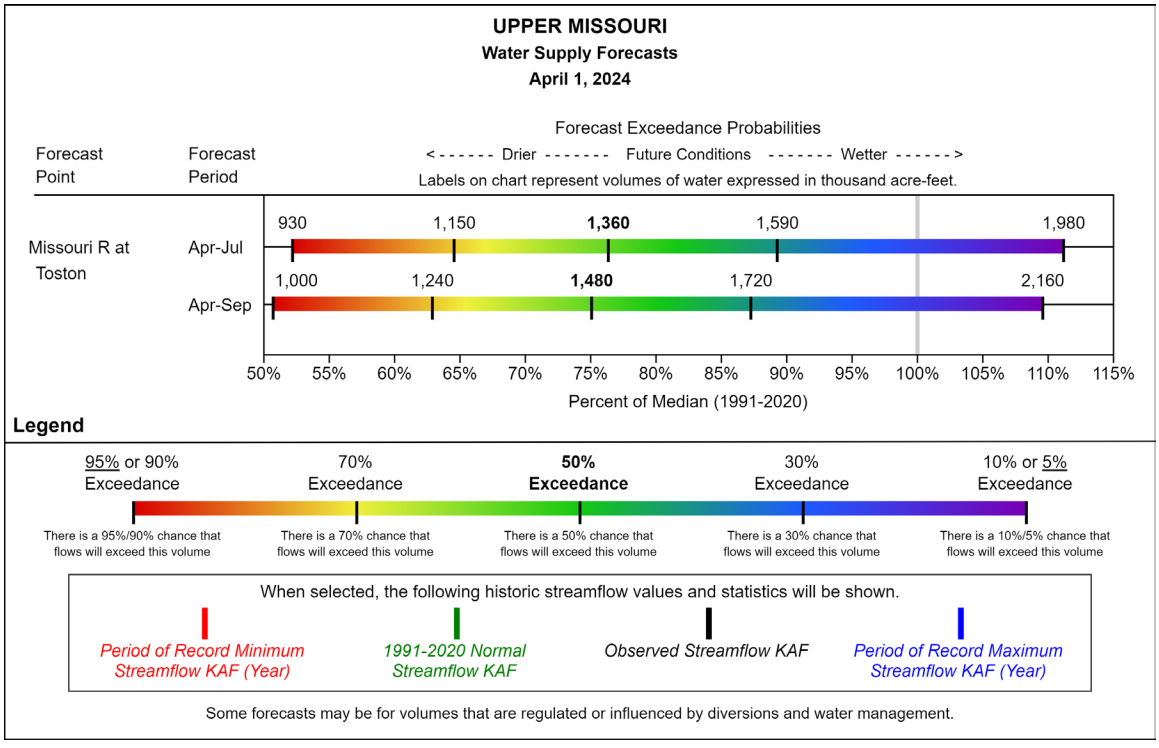
Precipitation in March was below normal at 91%, which brings the seasonal accumulation (October-March) to 82% of median. The snowpack in the Upper Missouri is well below normal at 73% of median, compared to 137% at this time last year.





Basin Overview

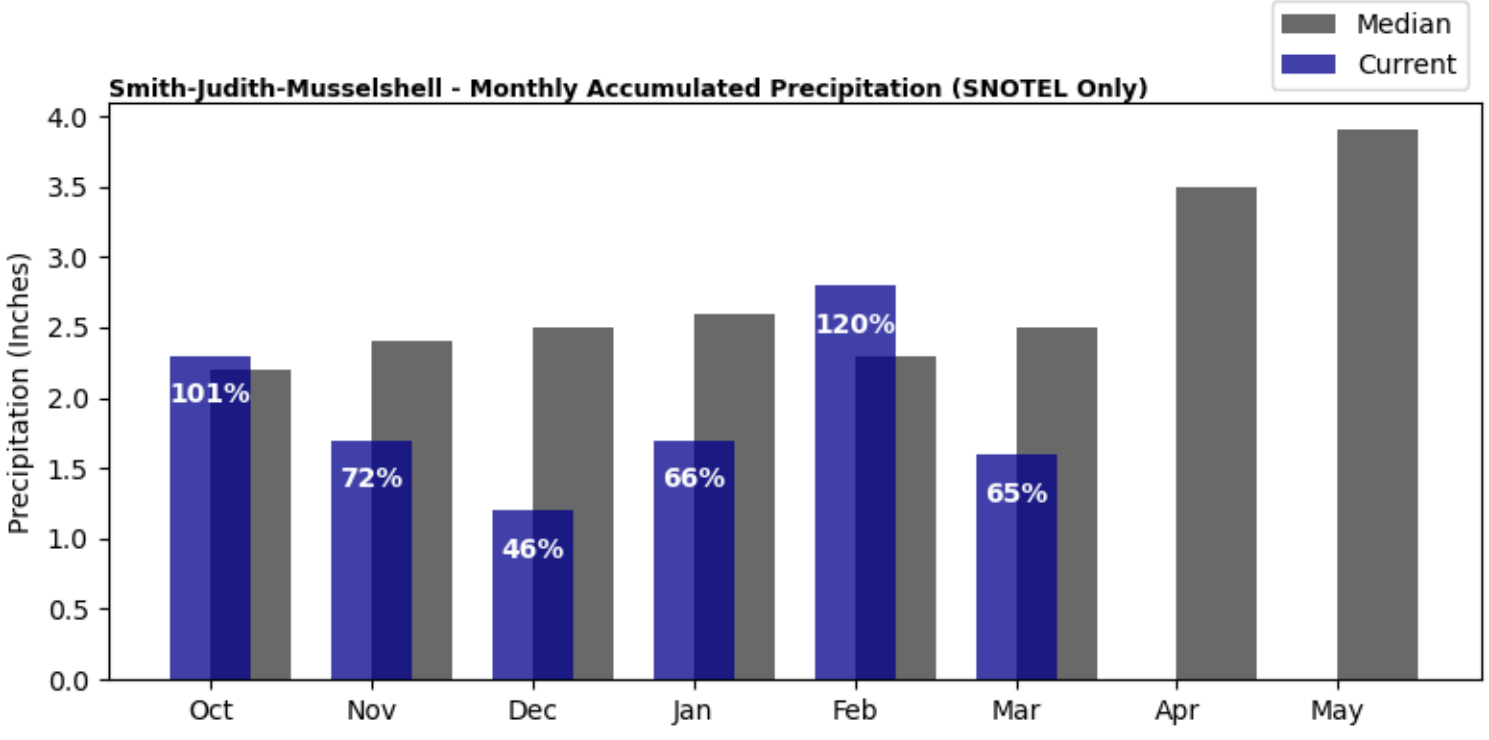
Upper Missouri (Continued)

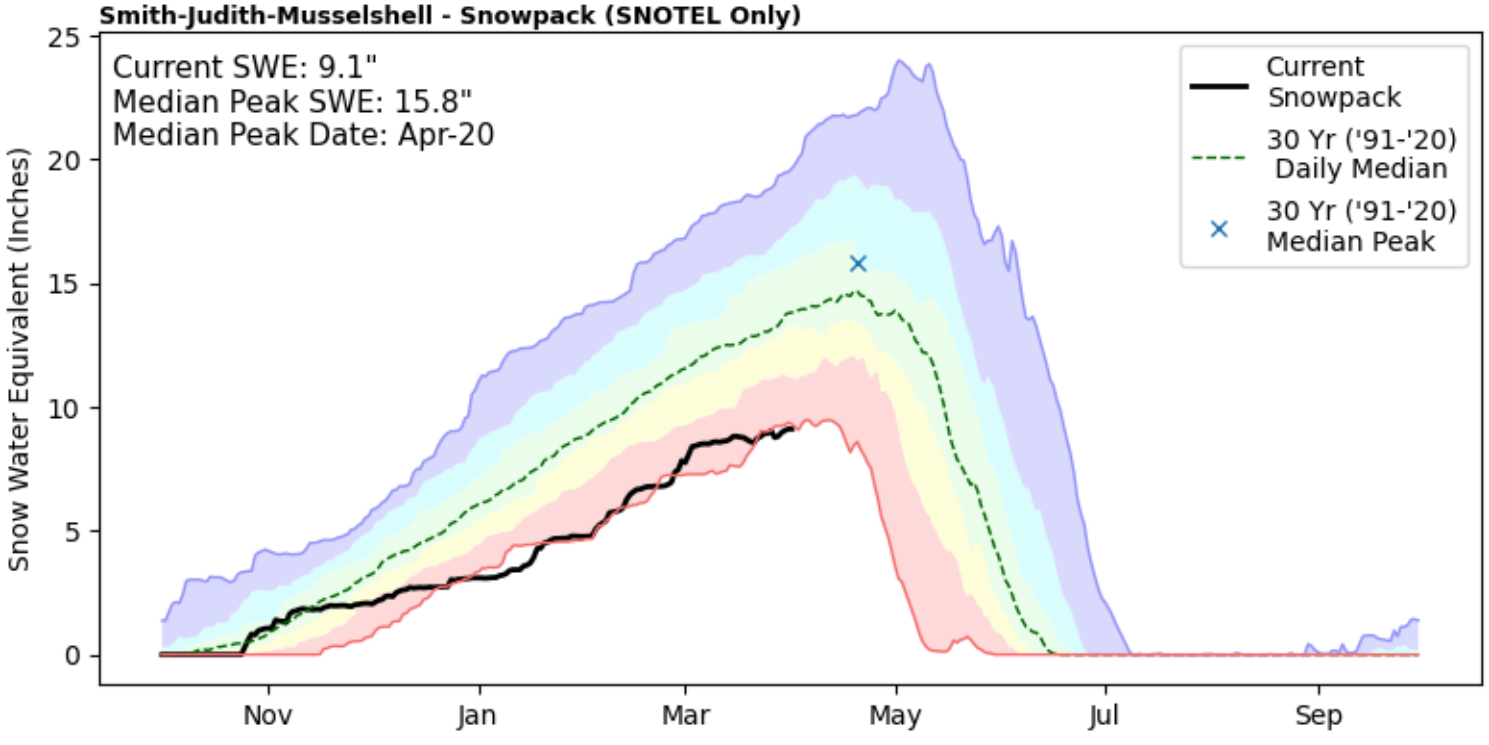


Basin Overview

Smith-Judith-Musselshell

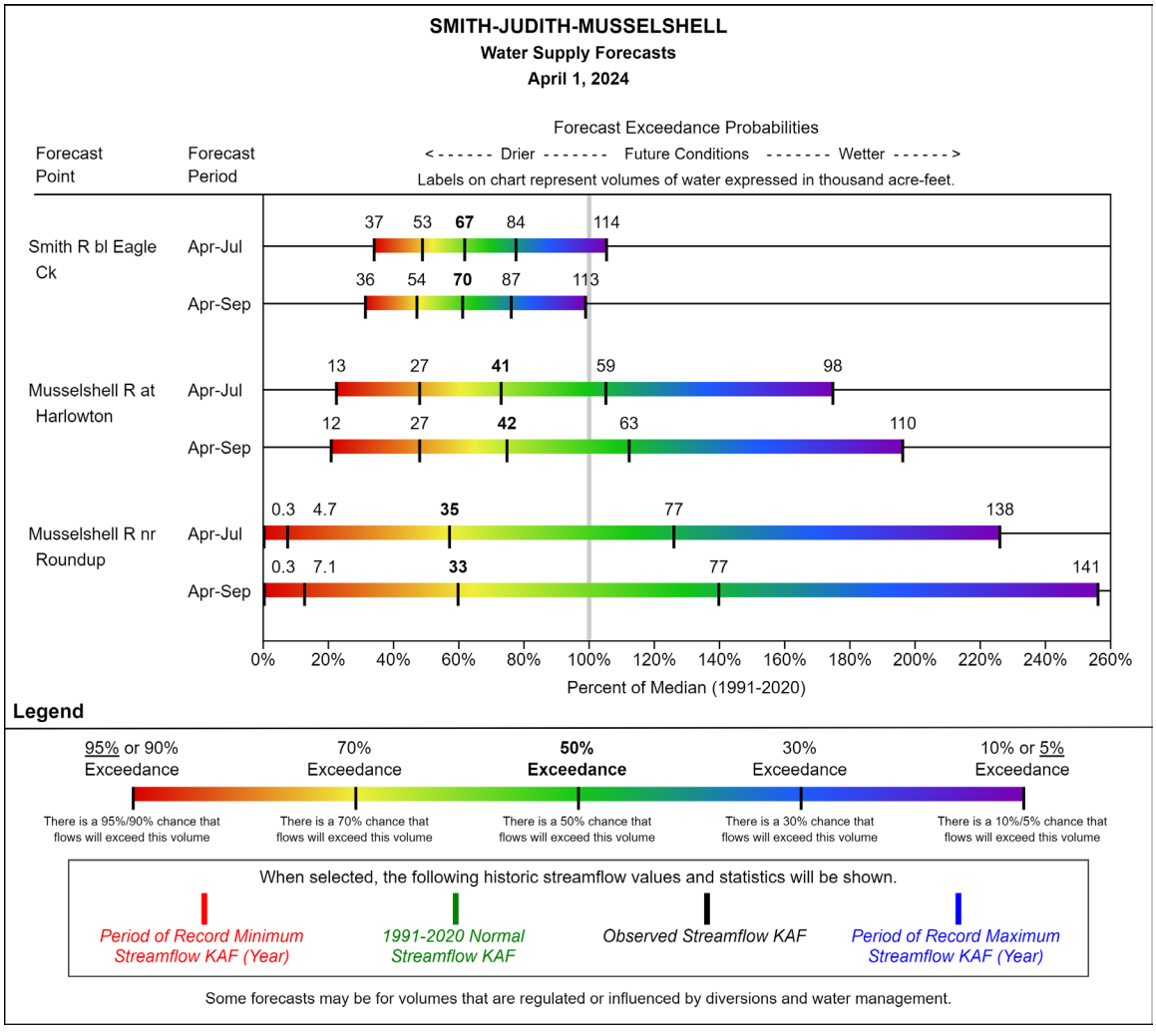
Precipitation in March was well below normal at 63%, which brings the seasonal accumulation (October-March) to 73% of median. The snowpack in the Smith-Judith-Musselshell is well below normal at 67% of median, compared to 135% at this time last year.





Basin Overview

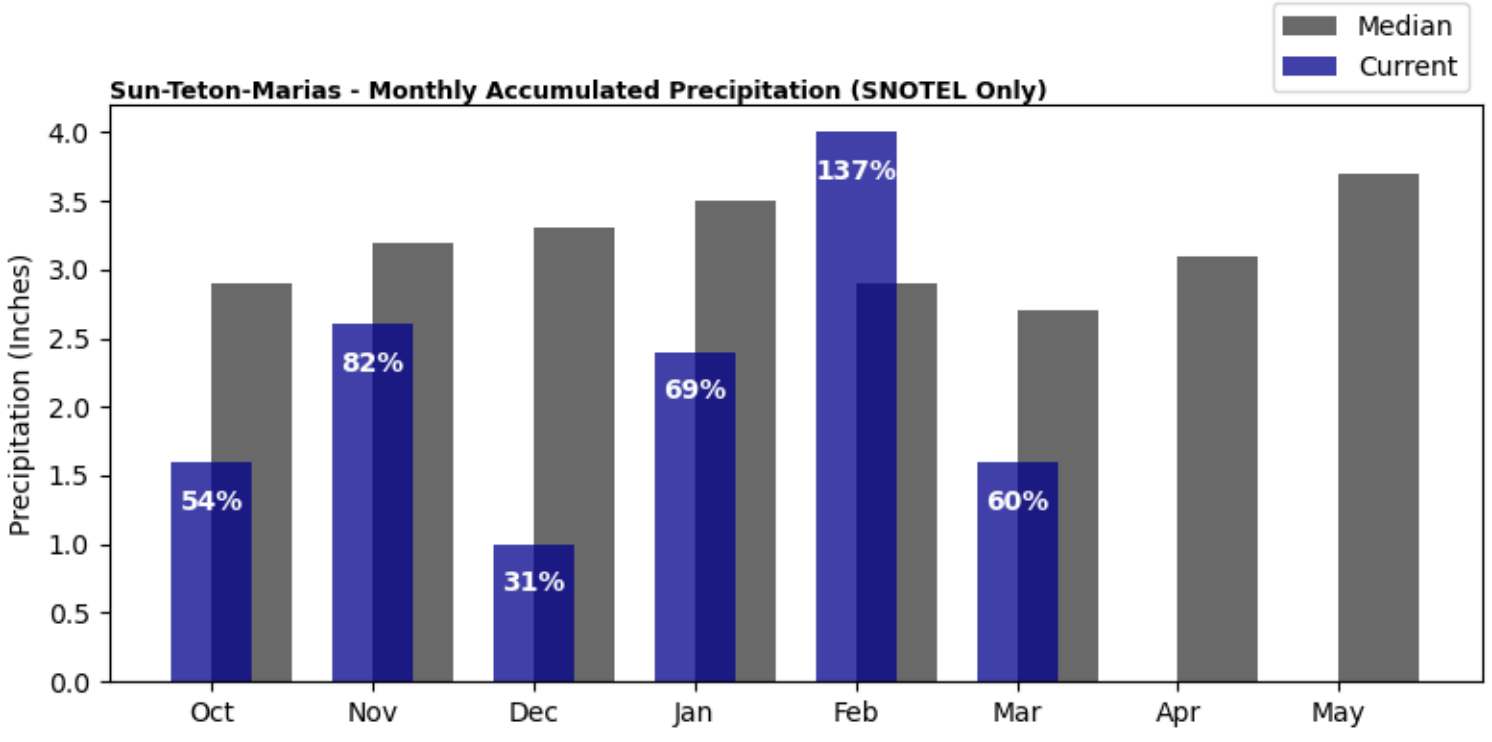
Smith-Judith-Musselshell (Continued)

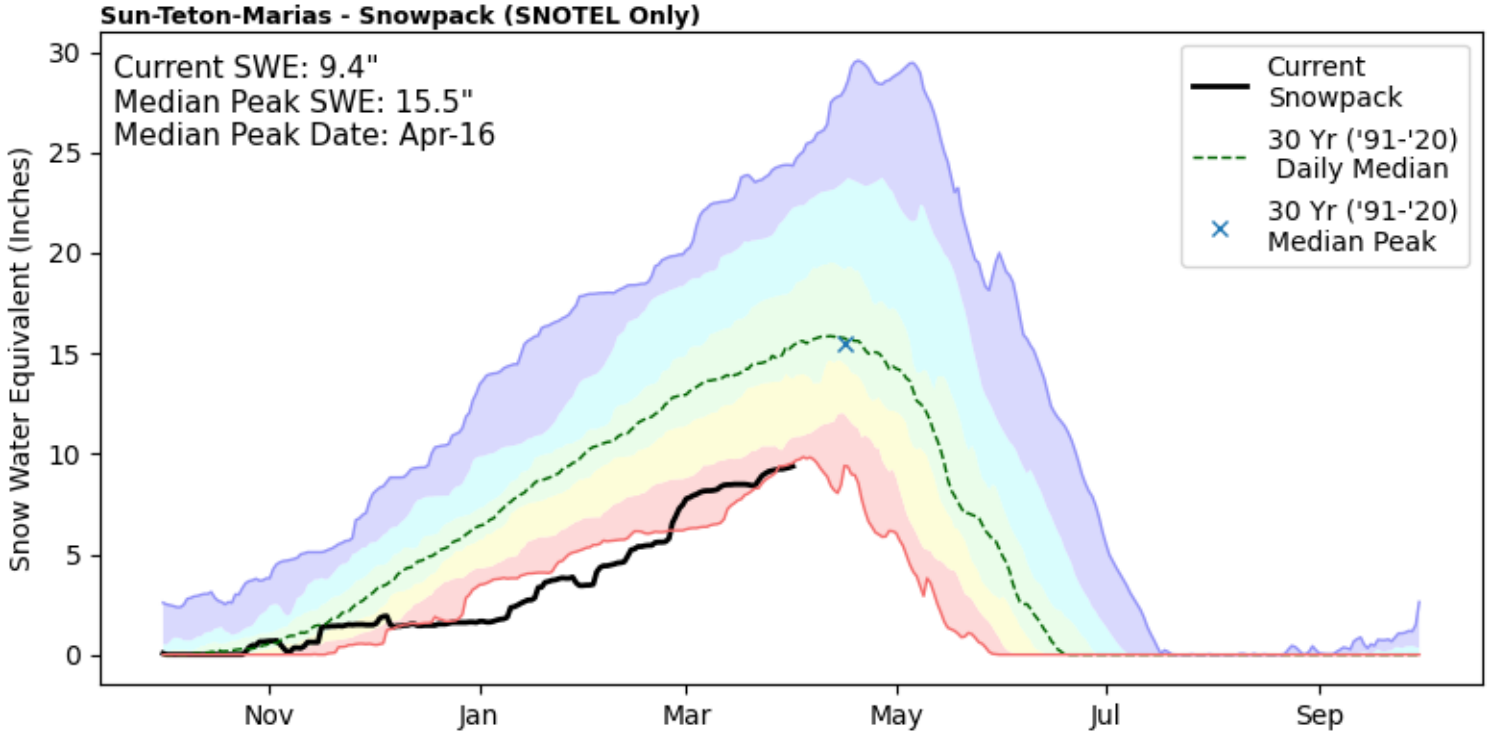


Basin Overview

Sun-Teton-Marias

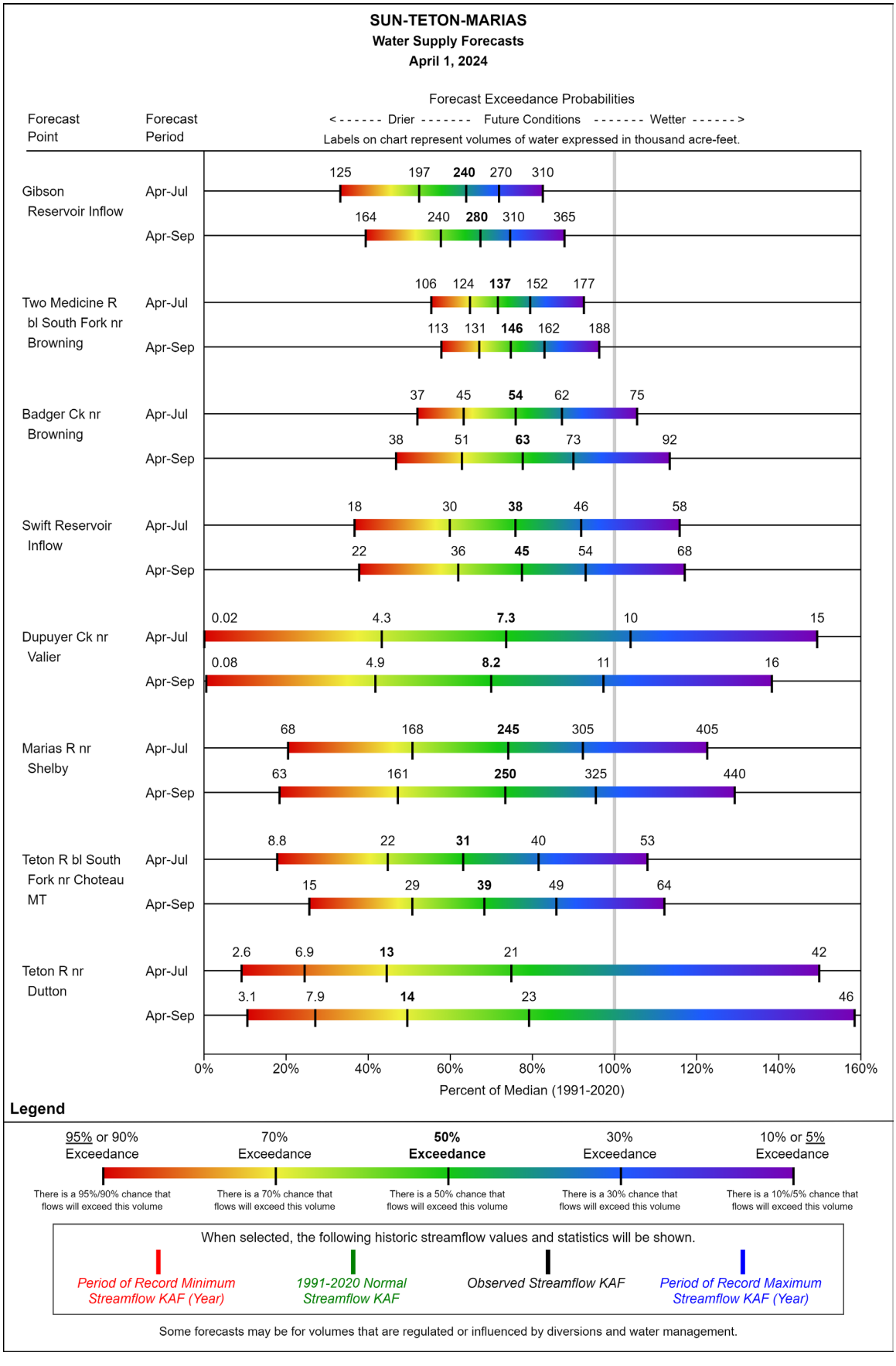
Precipitation in March was well below normal at 60%, which brings the seasonal accumulation (October-March) to 67% of median. The snowpack in the Sun-Teton-Marias is well below normal at 57% of median, compared to 95% at this time last year.





Basin Overview

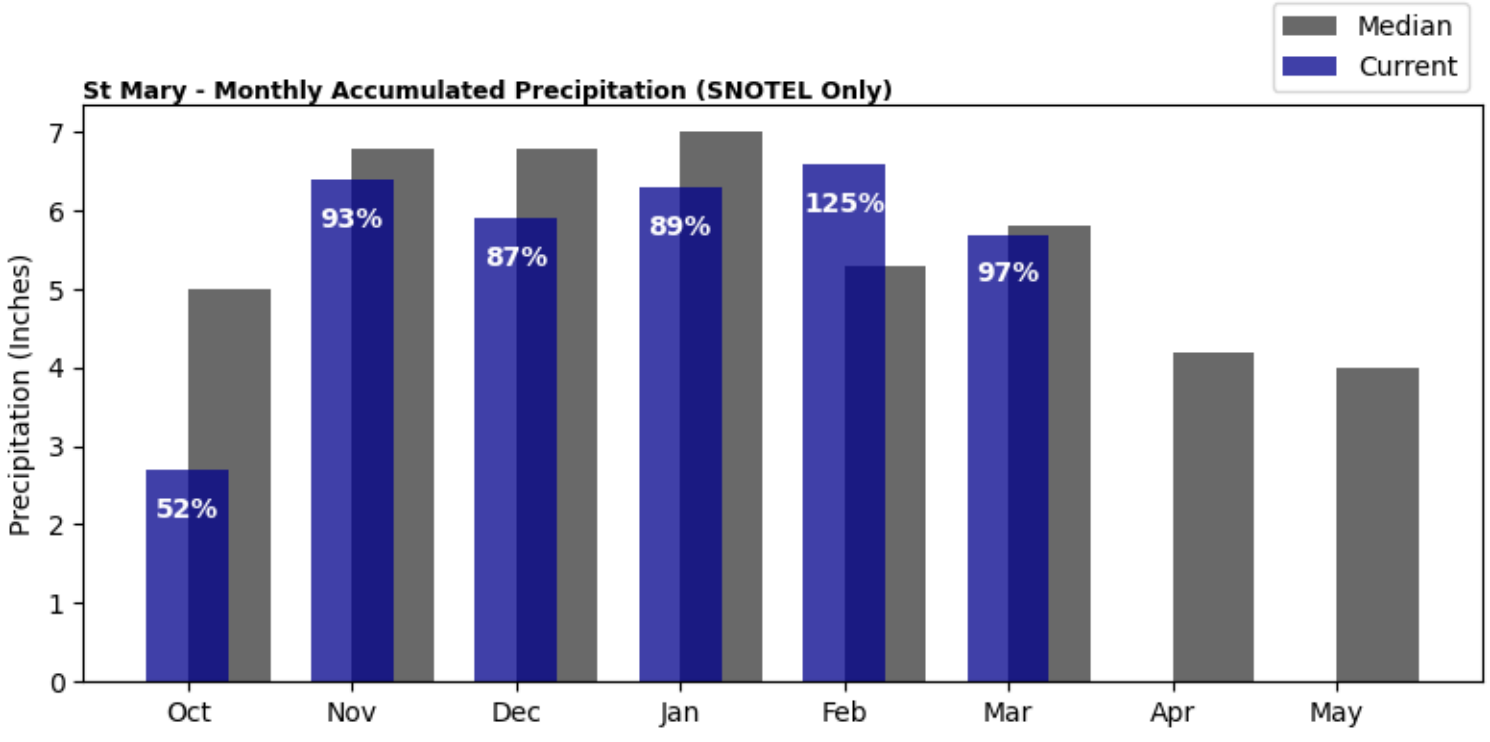
Sun-Teton-Marias (Continued)

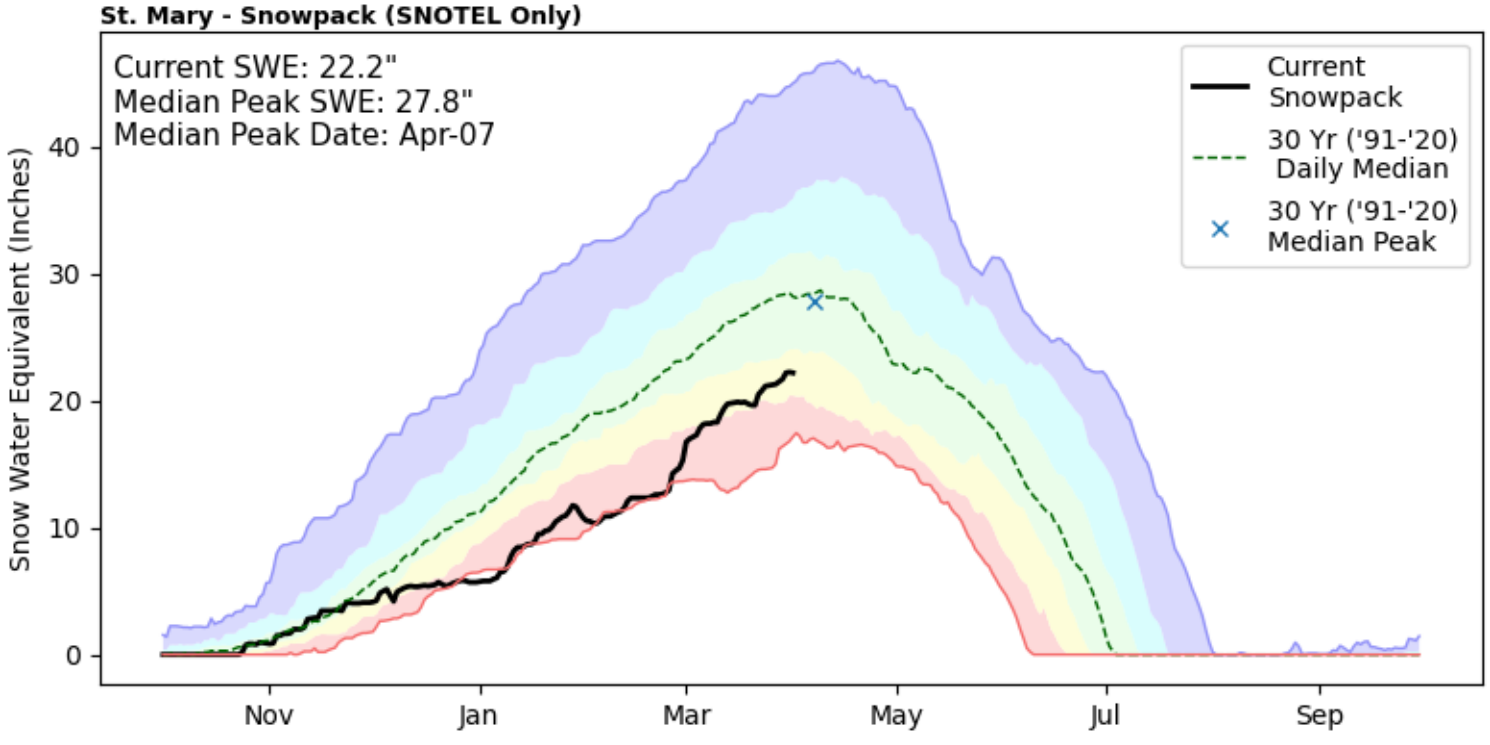


Basin Overview

St. Mary

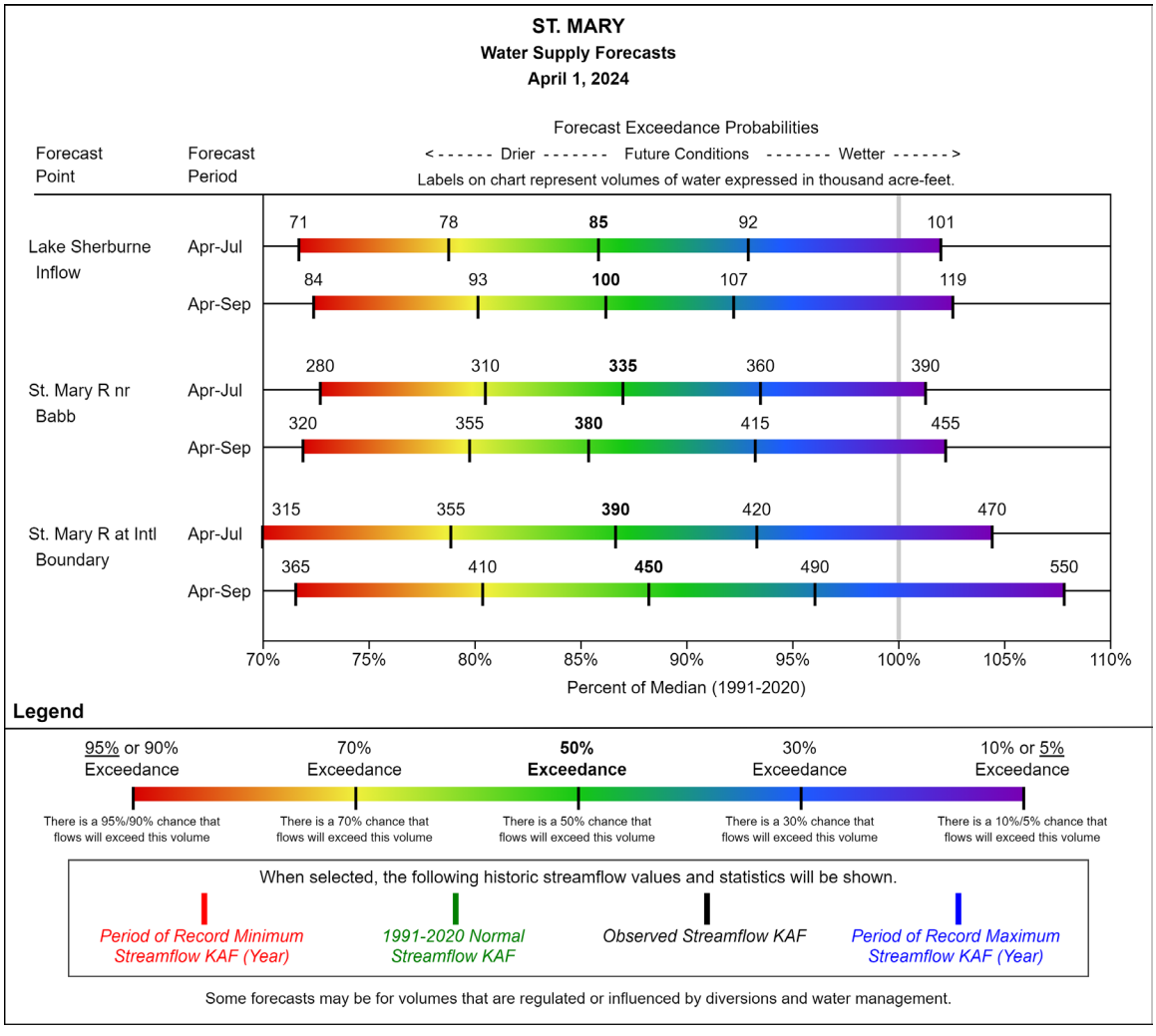
Precipitation in March was near normal at 97%, which brings the seasonal accumulation (October-March) to 84% of median. The snowpack in the St. Mary is well below normal at 79% of median, compared to 91% at this time last year.





Basin Overview

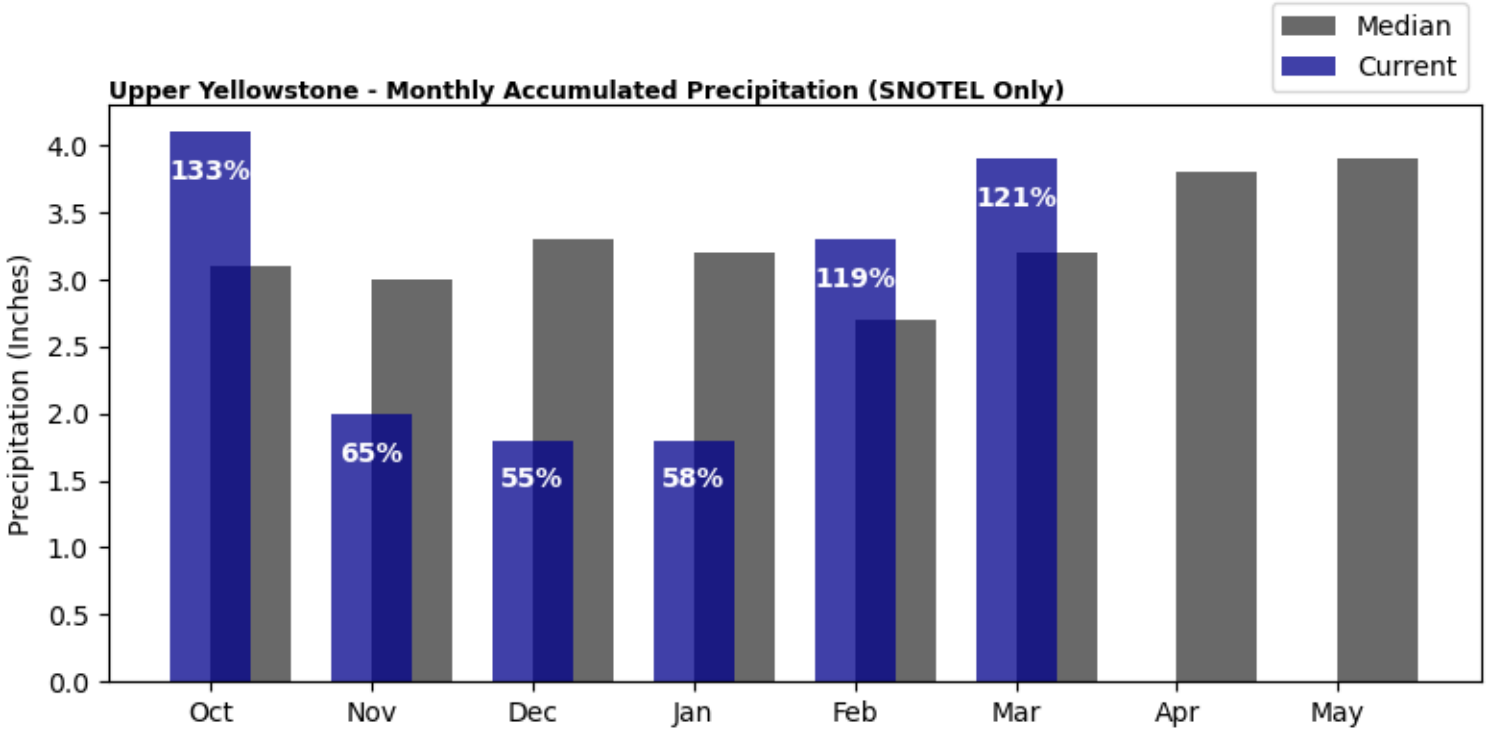
St. Mary (Continued)

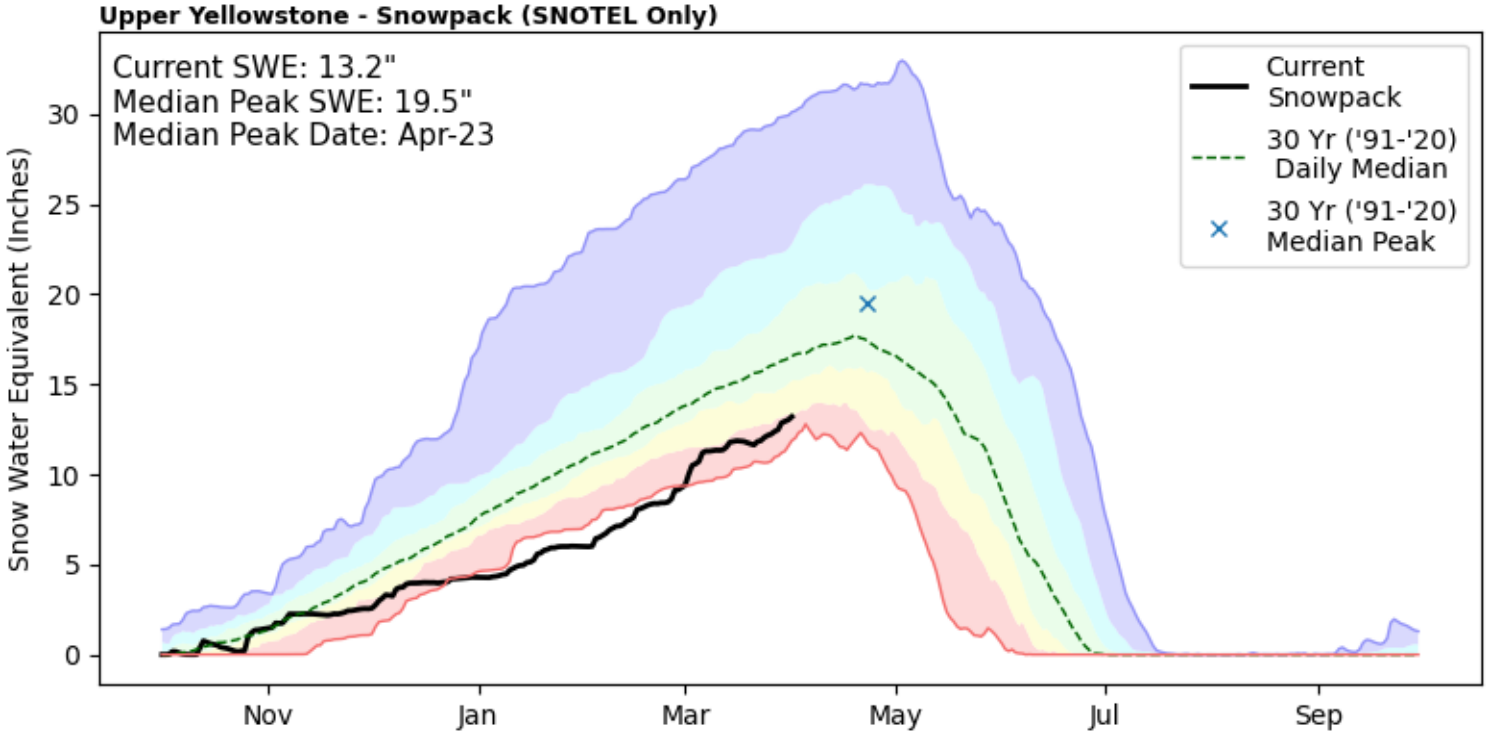


Basin Overview

Upper Yellowstone

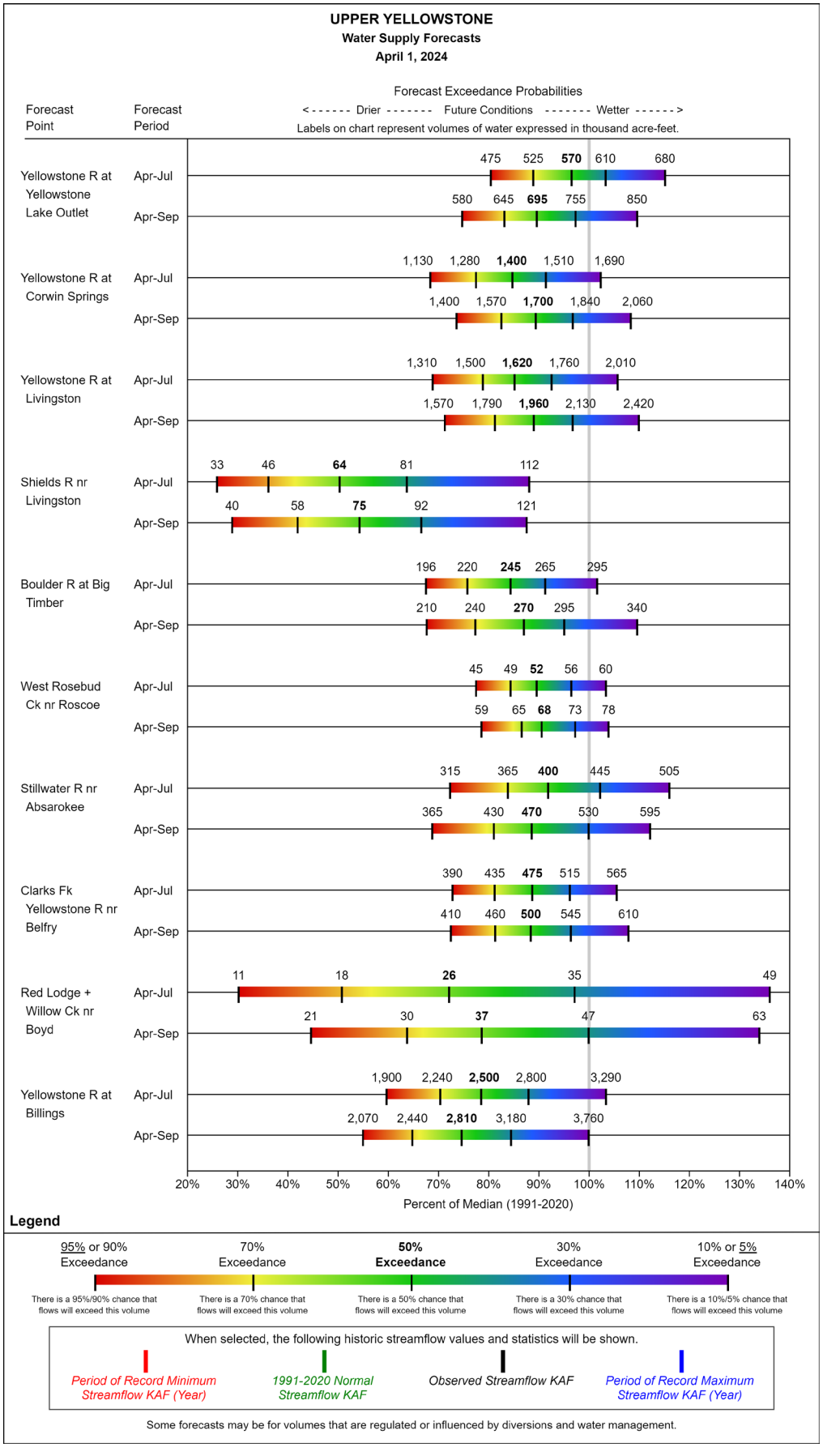
Precipitation in March was well above normal at 122%, which brings the seasonal accumulation (October-March) to 89% of median. The snowpack in the Upper Yellowstone is well below normal at 79% of median, compared to 116% at this time last year.





Basin Overview

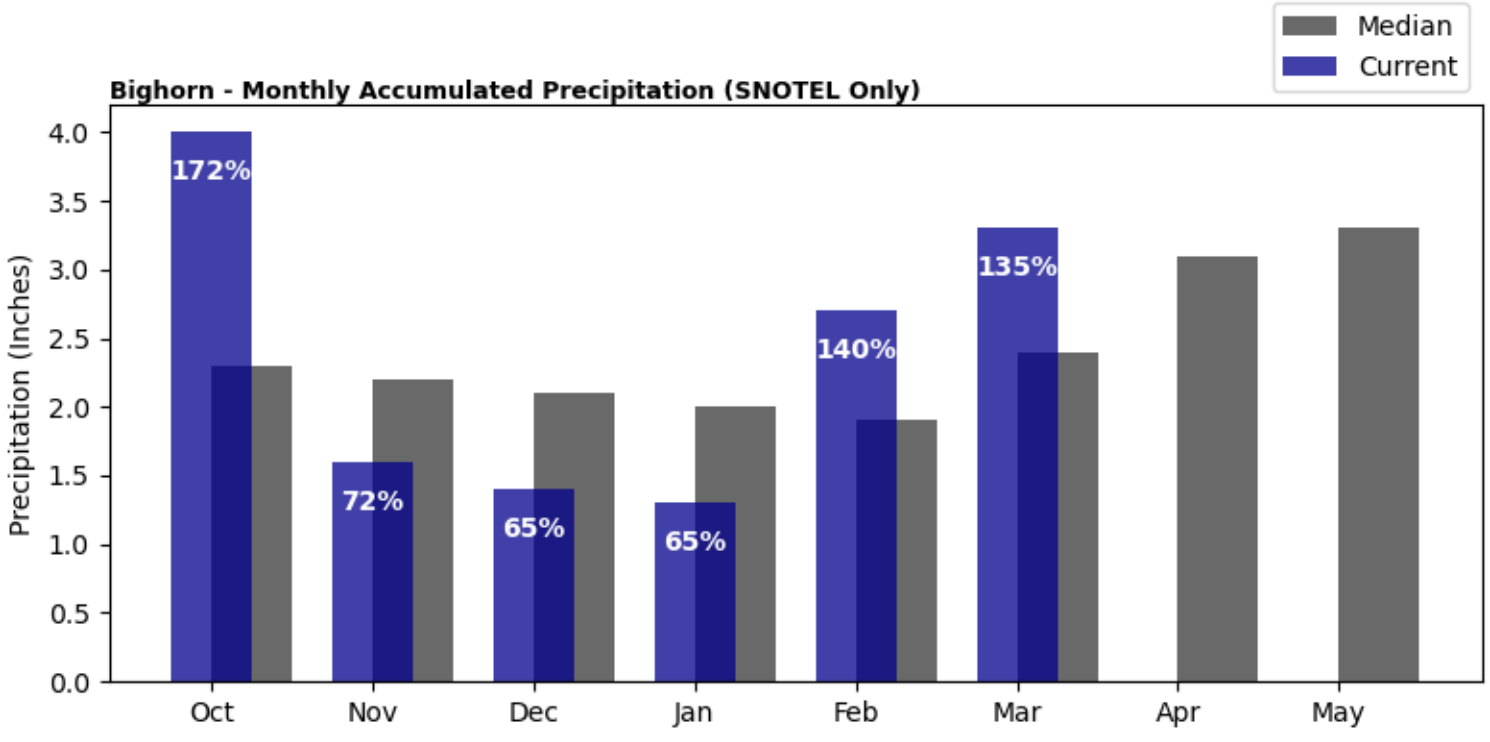
Upper Yellowstone (Continued)

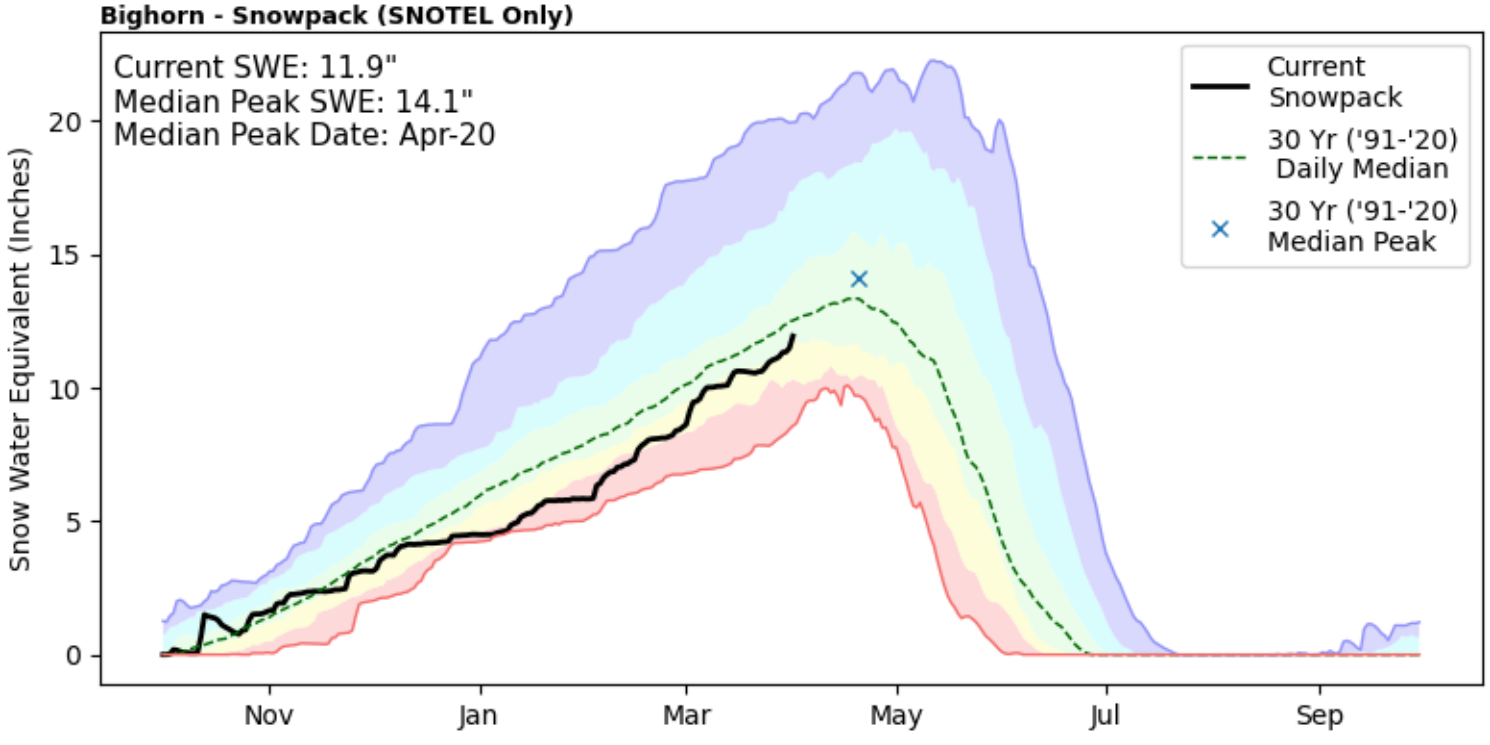


Basin Overview

Bighorn

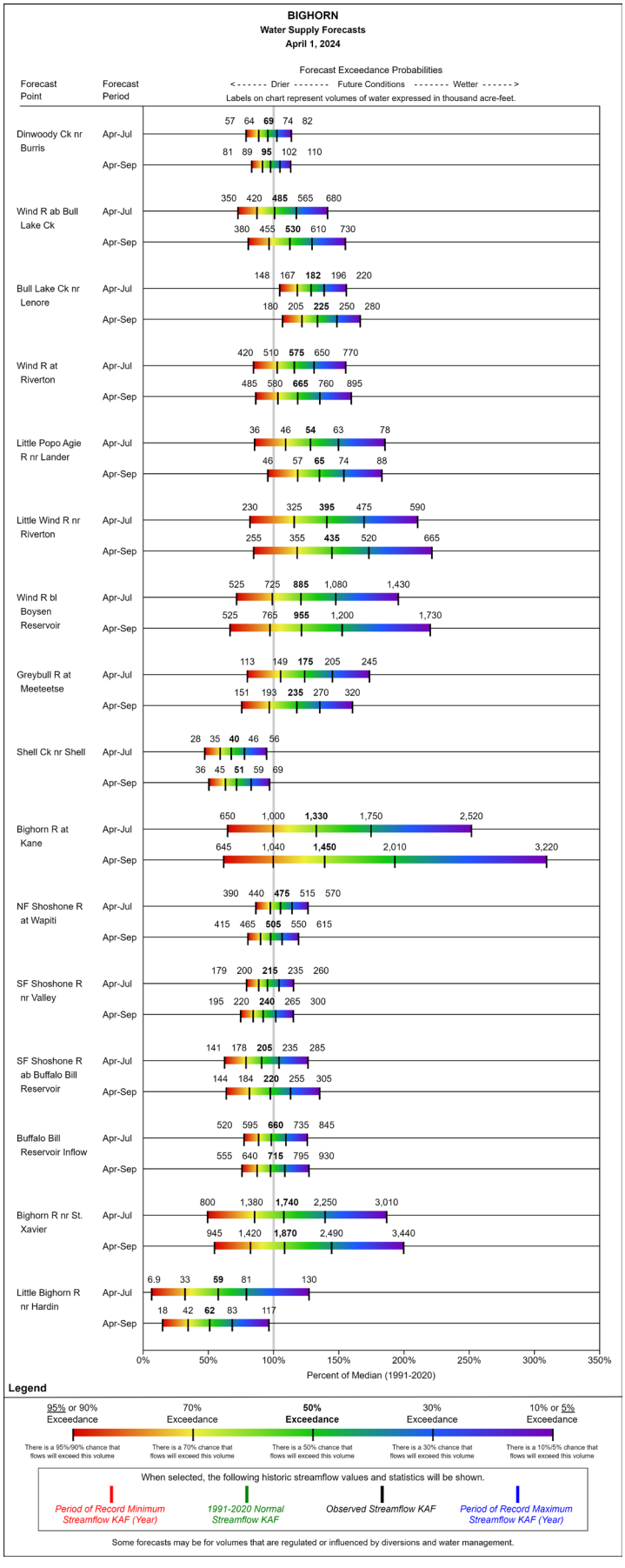
Precipitation in March was well above normal at 135%, which brings the seasonal accumulation (October-March) to 106% of median. The snowpack in the Bighorn is near normal at 95% of median, compared to 114% at this time last year.





Basin Overview

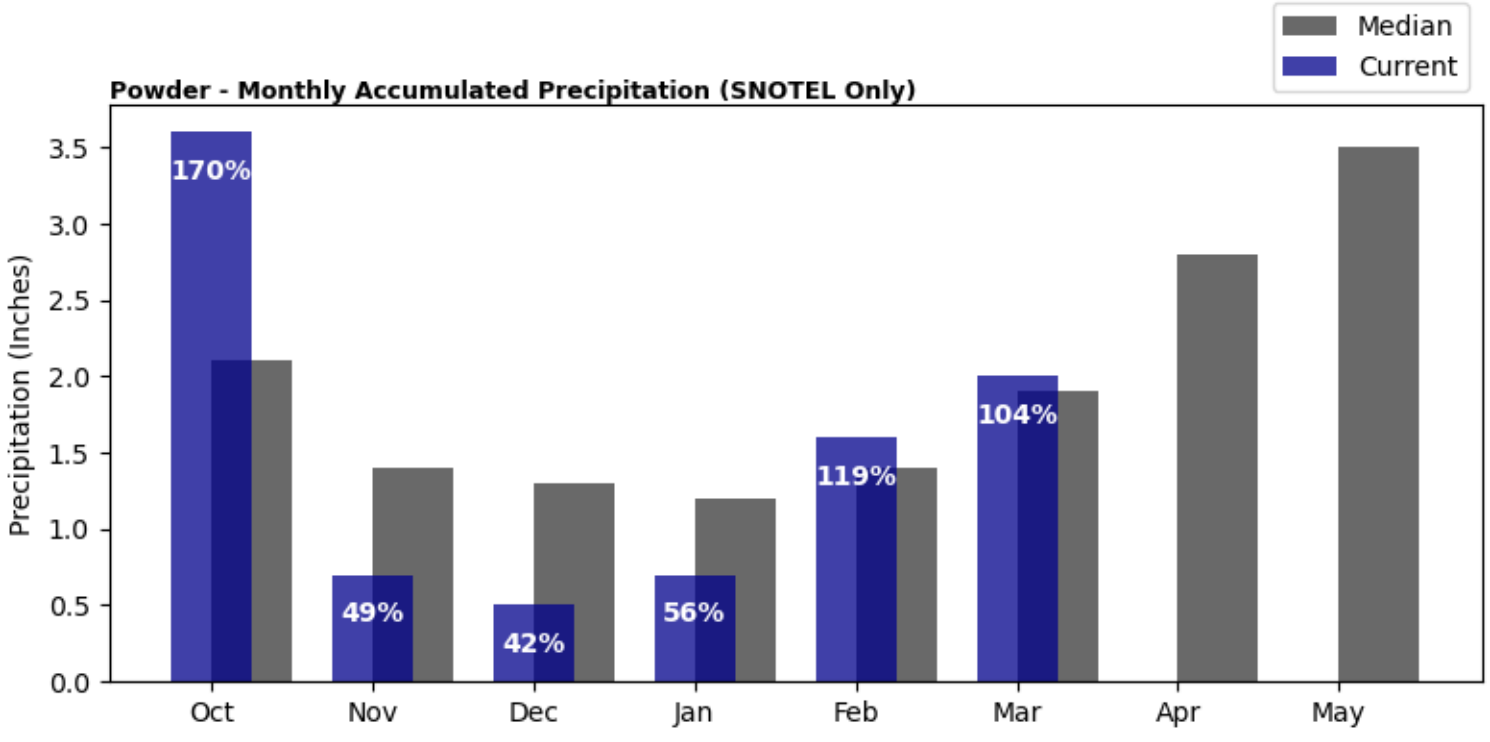
Bighorn (Continued)

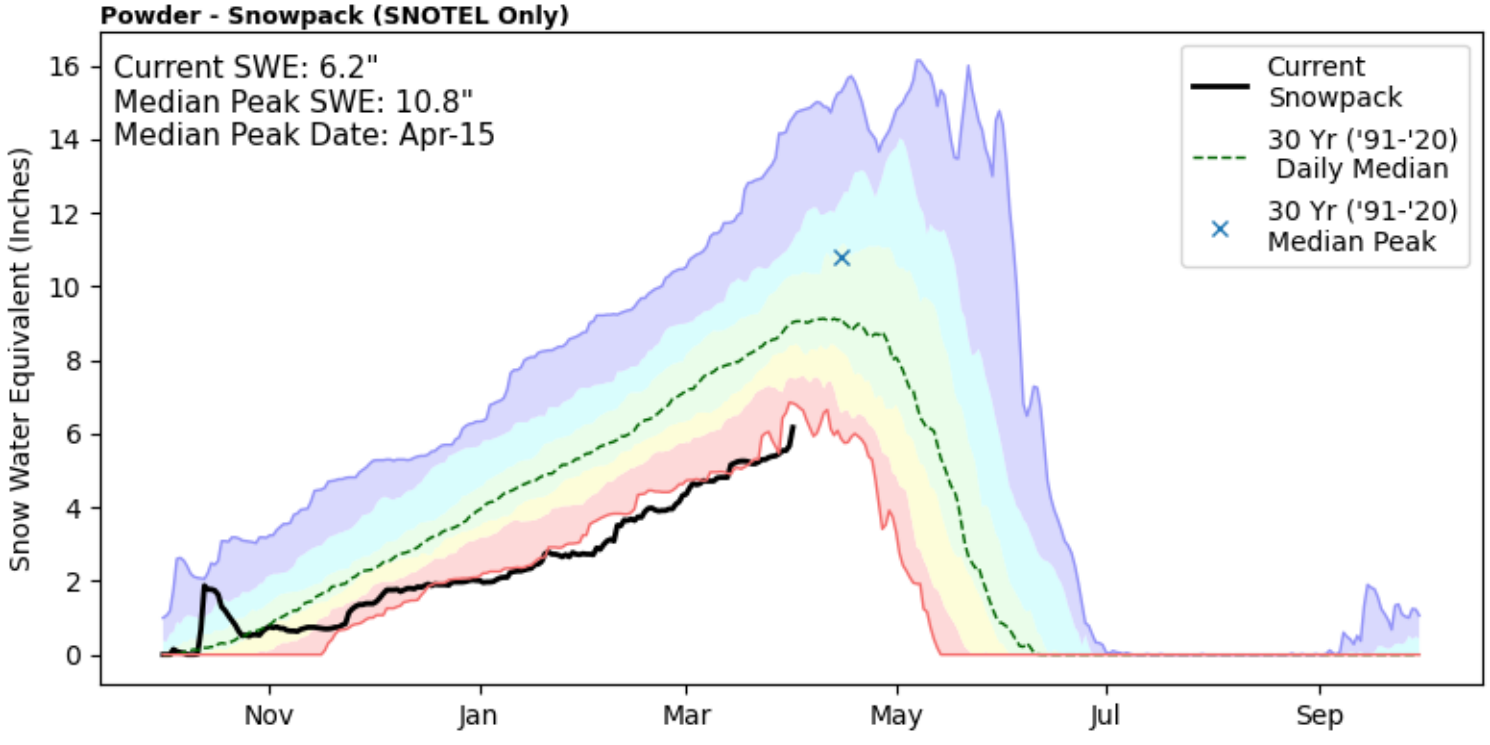


Basin Overview

Powder

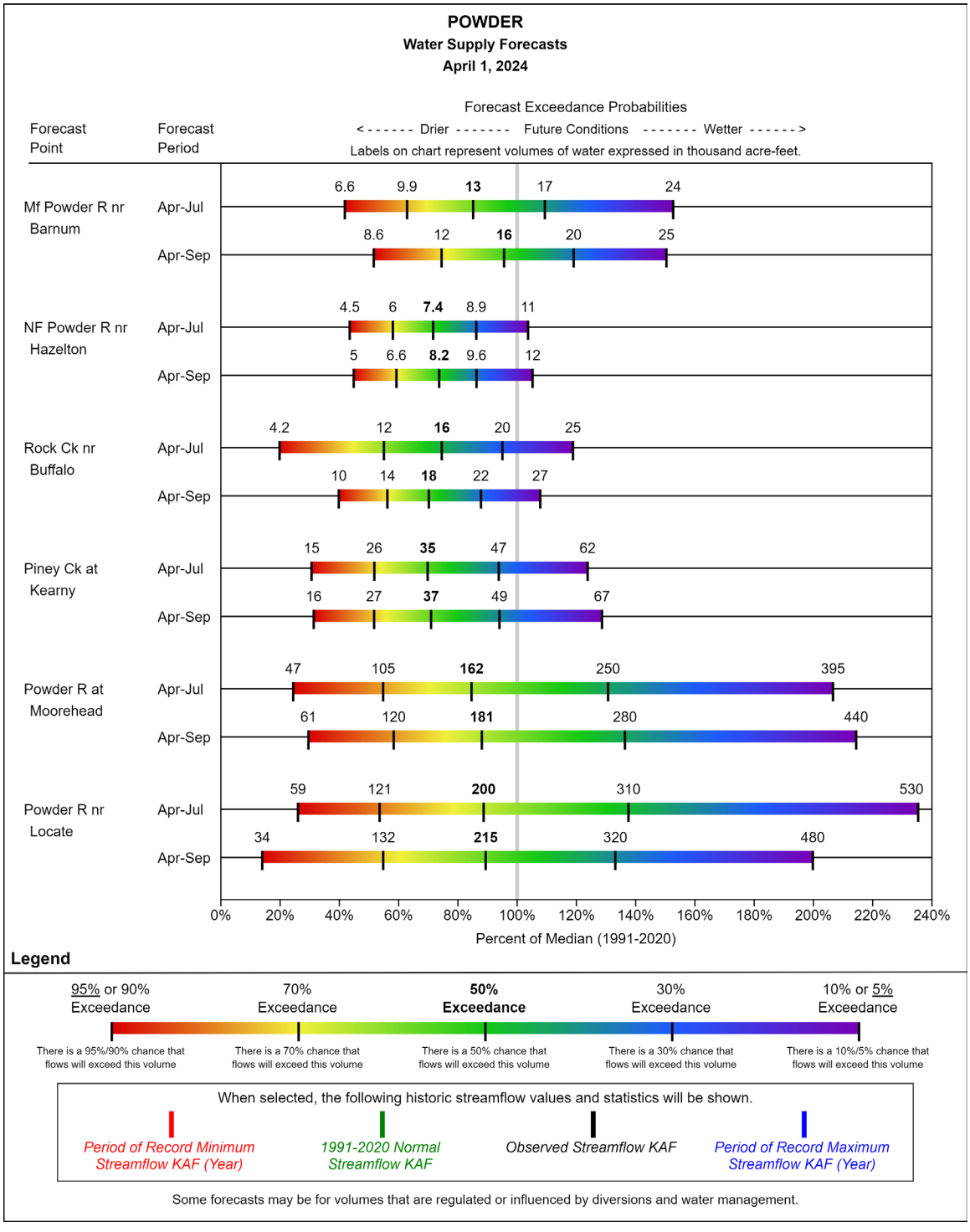
Precipitation in March was near normal at 104%, which brings the seasonal accumulation (October-March) to 94% of median. The snowpack in the Powder is well below normal at 67% of median, compared to 118% at this time last year.





Basin Overview

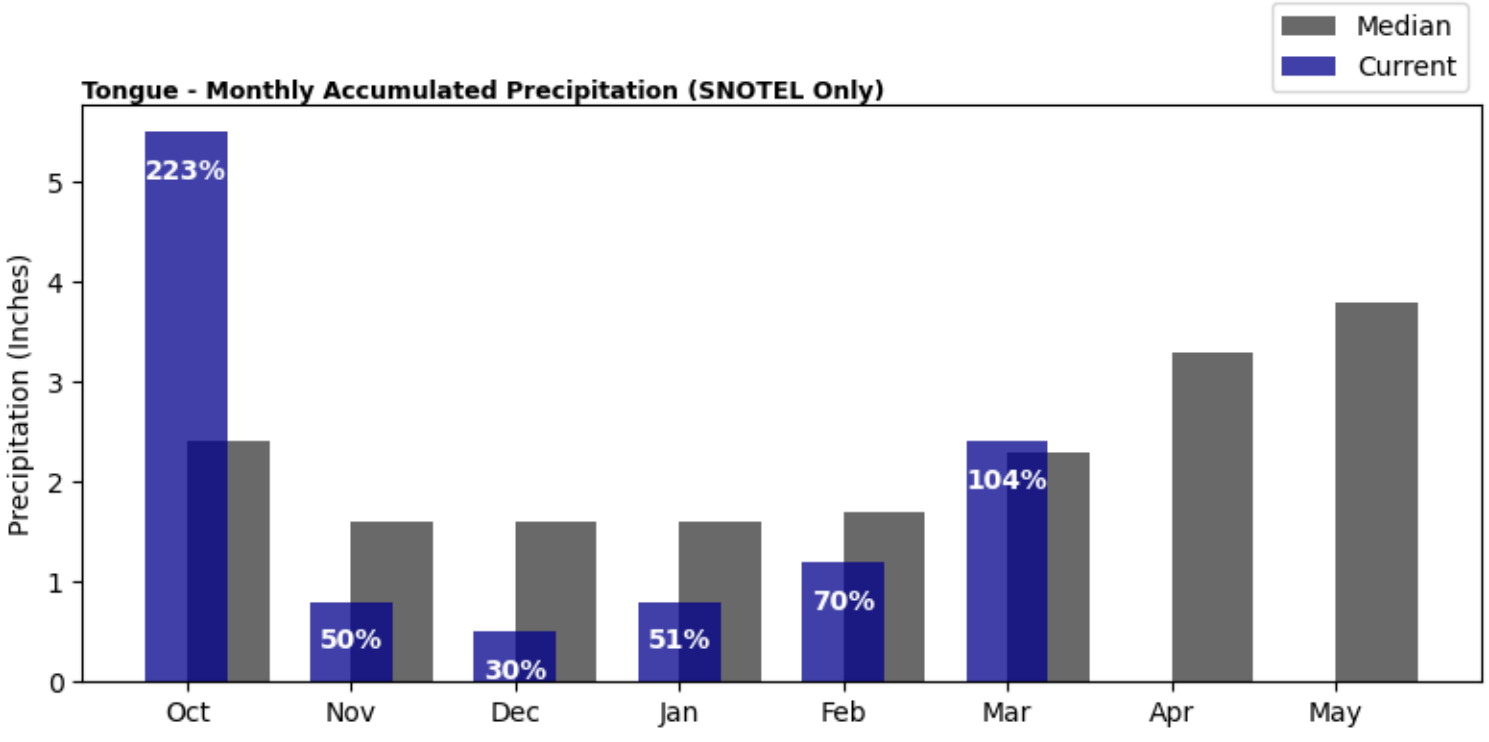
Powder (Continued)

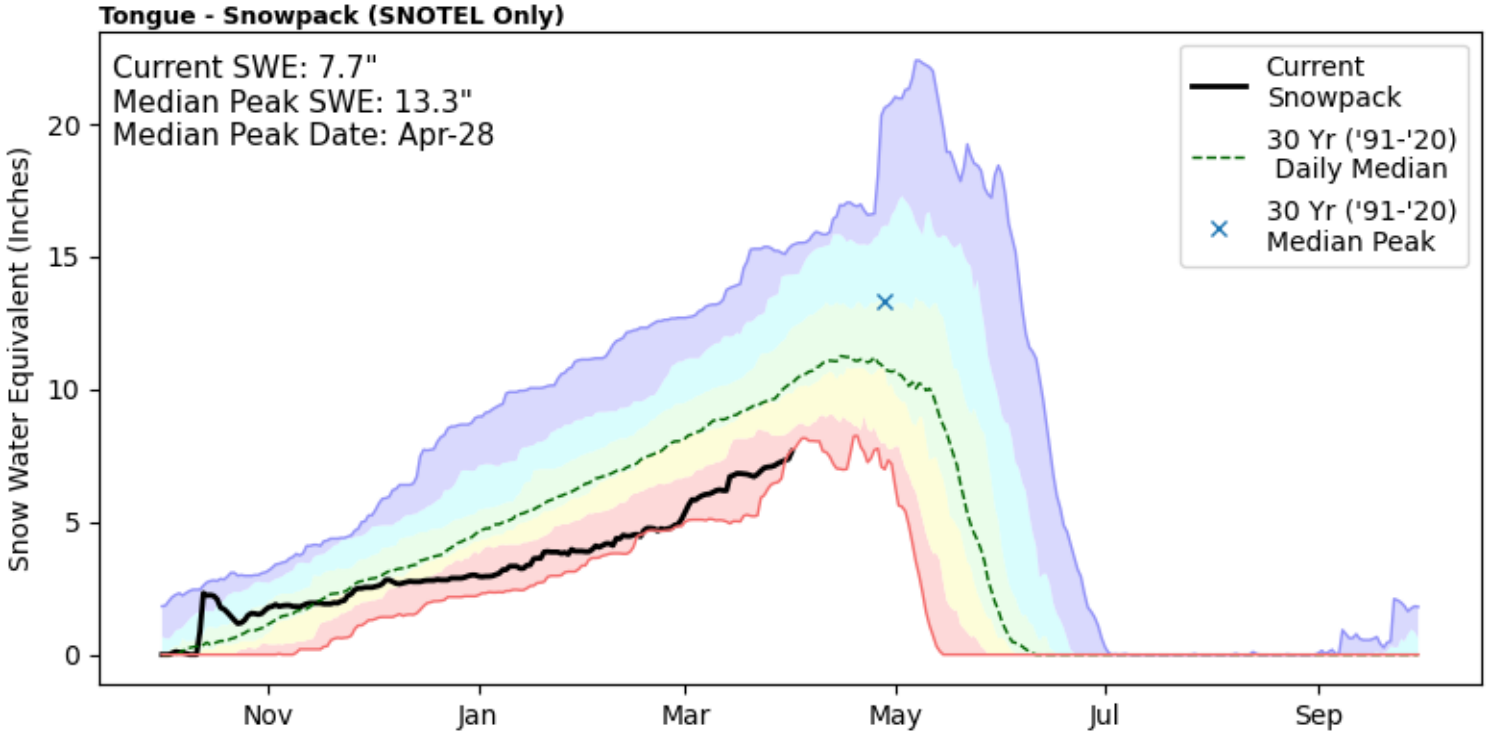


Basin Overview

Tongue

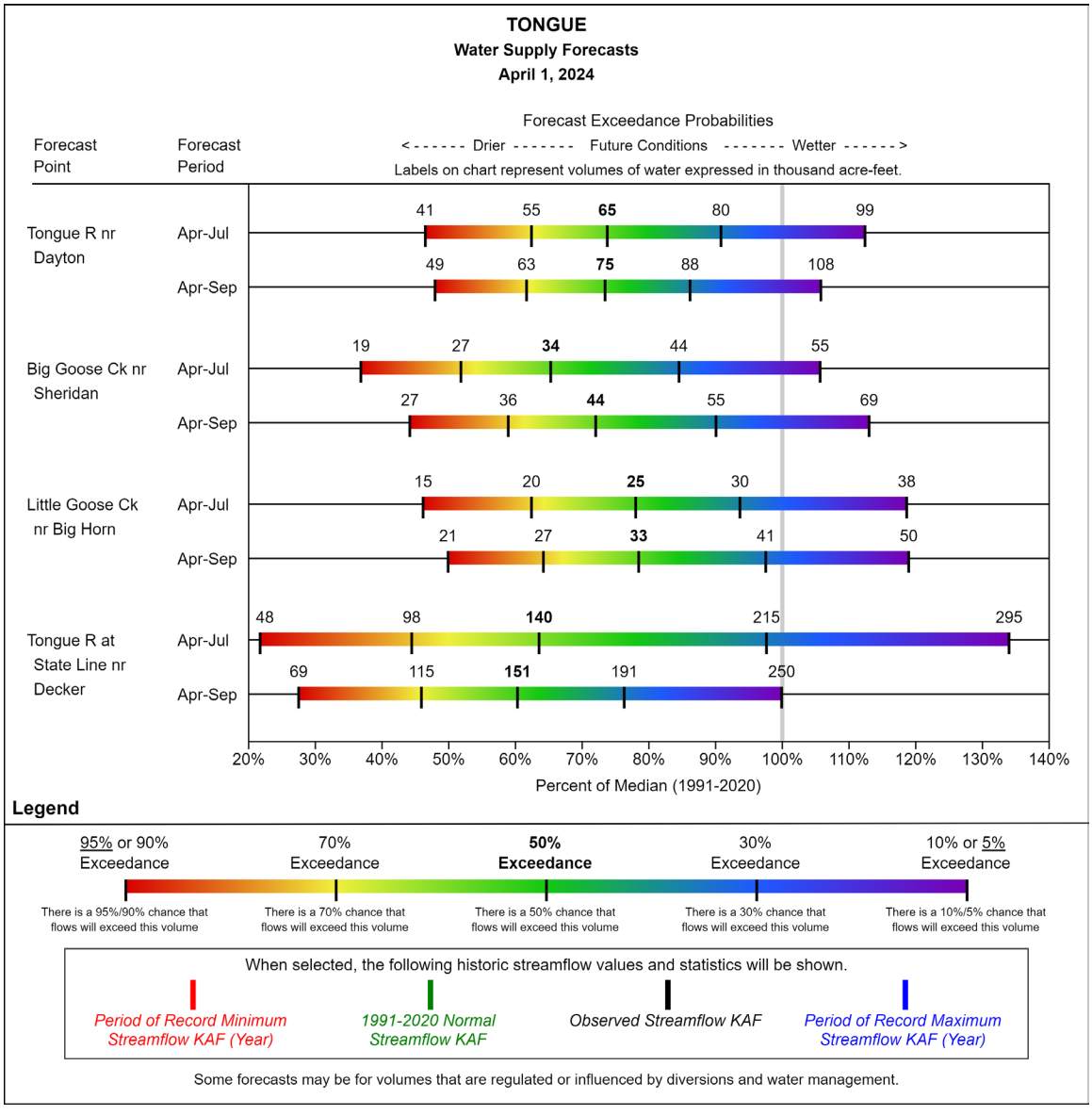
Precipitation in March was near normal at 104%, which brings the seasonal accumulation (October-March) to 95% of median. The snowpack in the Tongue is well below normal at 73% of median, compared to 117% at this time last year.





Basin Overview

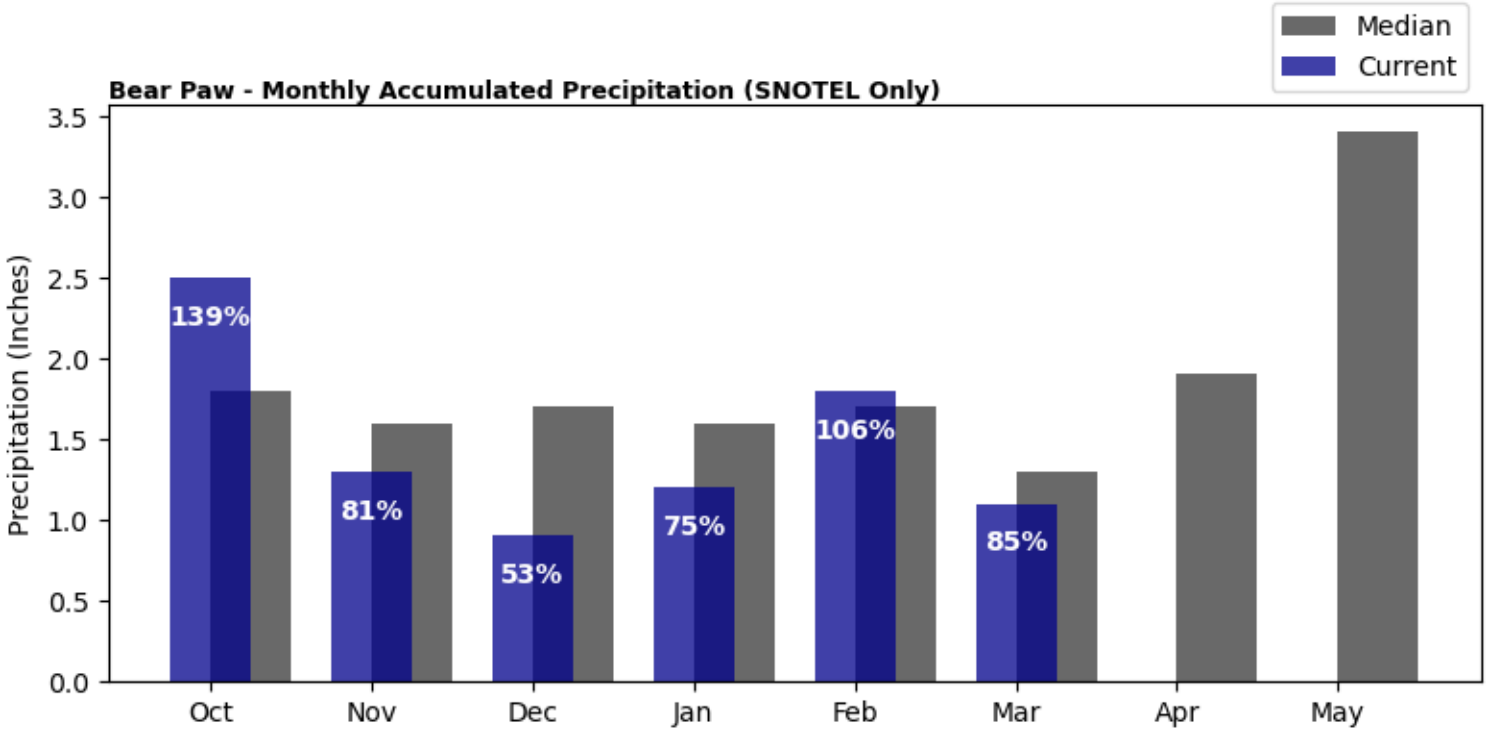
Tongue (Continued)

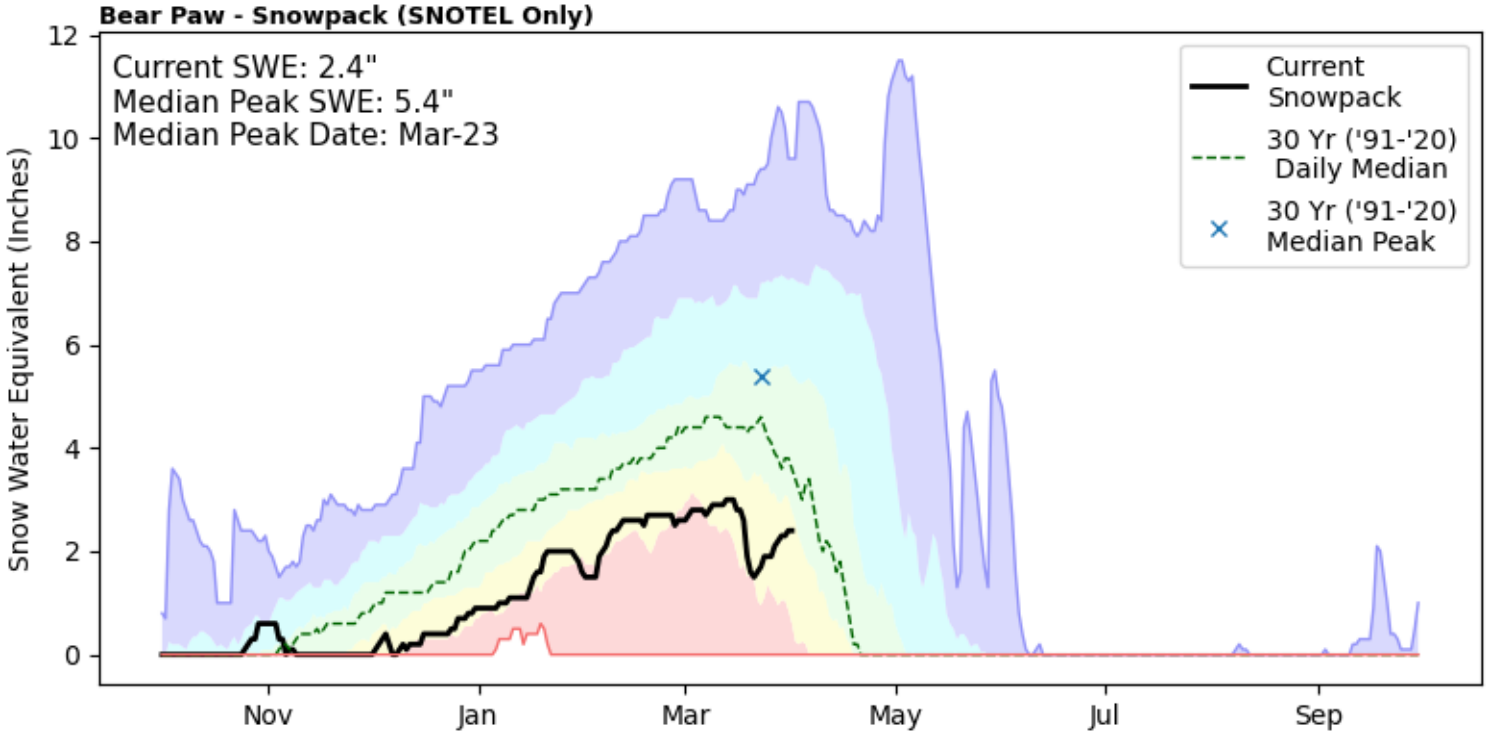


Basin Overview

Bear Paw

Precipitation in March was below normal at 85%, which brings the seasonal accumulation (October-March) to 88% of median. The snowpack in the Bear Paw is well below normal at 67% of median, compared to 252% 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.

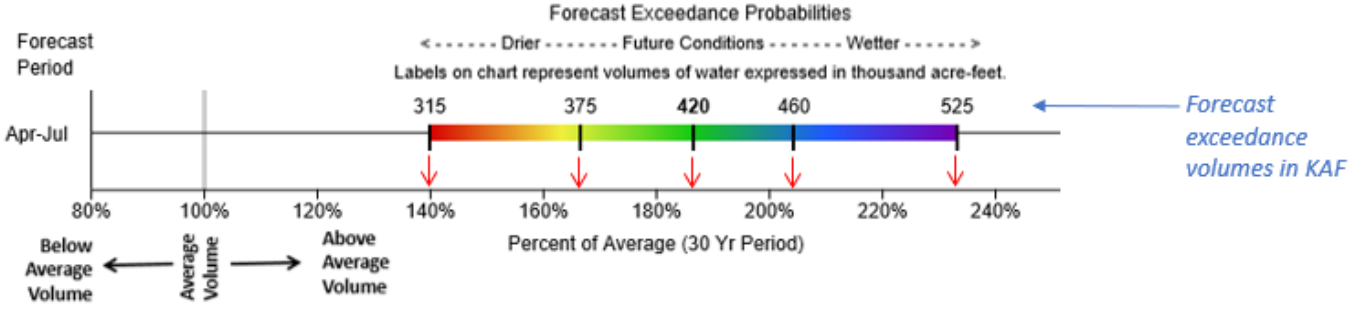
Forecast uncertainty originates from two sources: (1) uncertainty of future hydrologic and climatic conditions, and (2) error in the forecasting procedure. To express the uncertainty in the most probable forecast, four additional forecasts are provided. The actual streamflow can be expected to exceed 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.



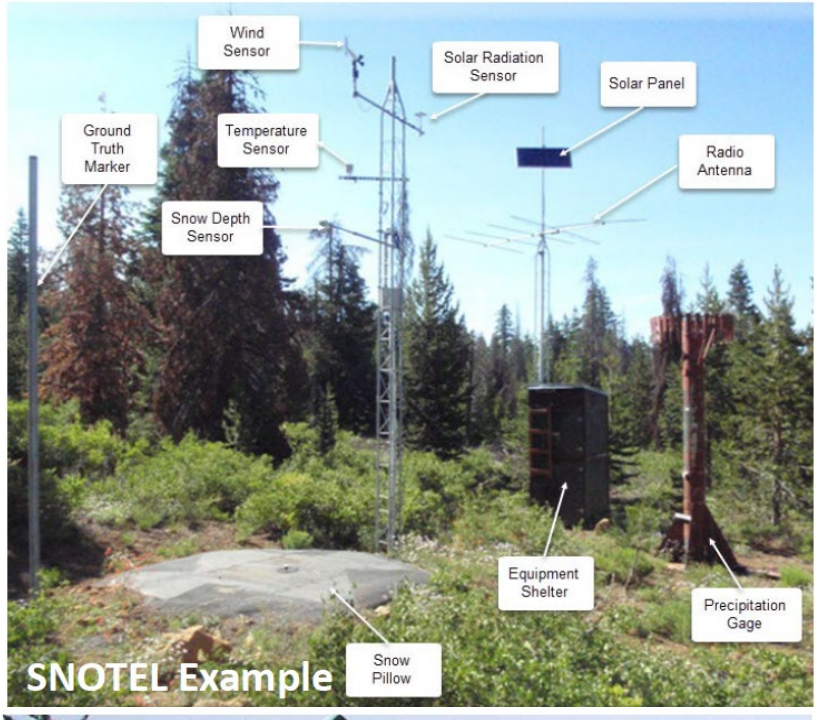
In the example, the entire forecast bar is shifted right of the gray line indicating a forecast for above normal streamflow. The 50% exceedance is represented by the black line in the green portion of the colored bar. This represents a forecast volume of 420KAF which is ~185% of average. If drier than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



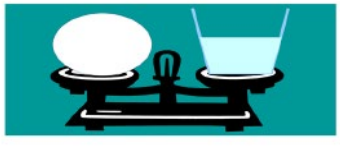
Snow Course

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.



Weight of frozen water = Weight of liquid water

Snow core inside snow tubes

Appendix

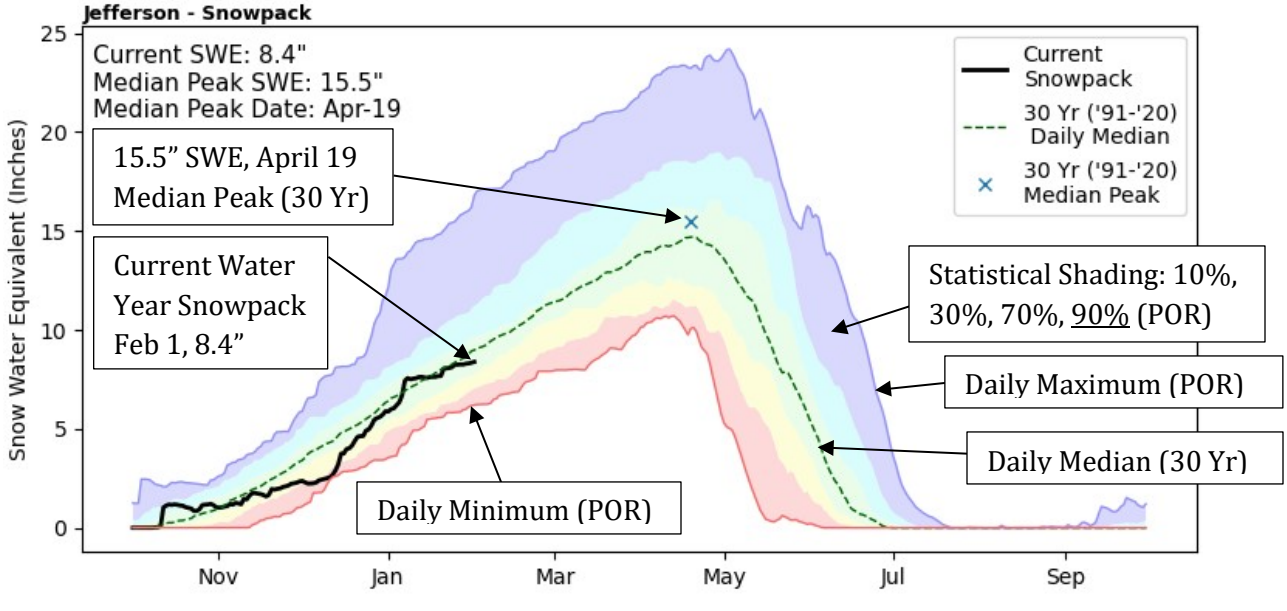
Additional Information

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

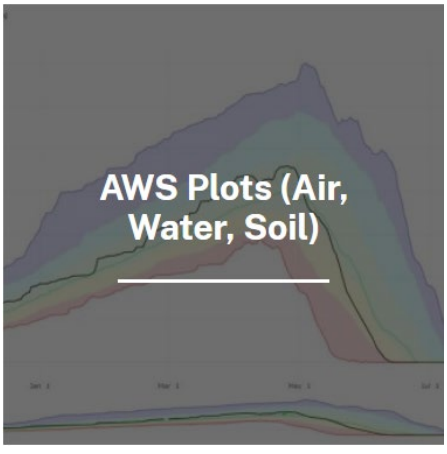
Snowpack charts displayed in this report are created using daily (midnight) snow water equivalent (SWE) values at SNOTEL sites determined to represent the basin. Snow Course data is not included. Plotted lines are the average of each SNOTEL's individual values. For example, the "Current Snowpack" on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

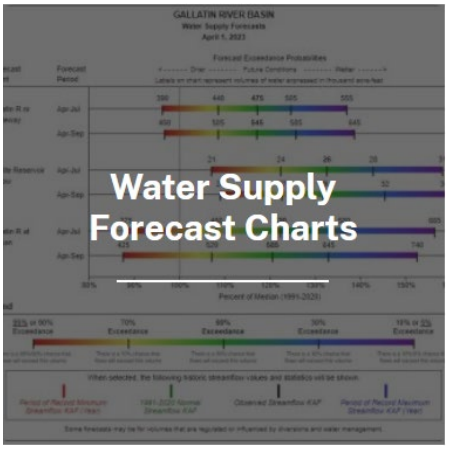


Appendix

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**

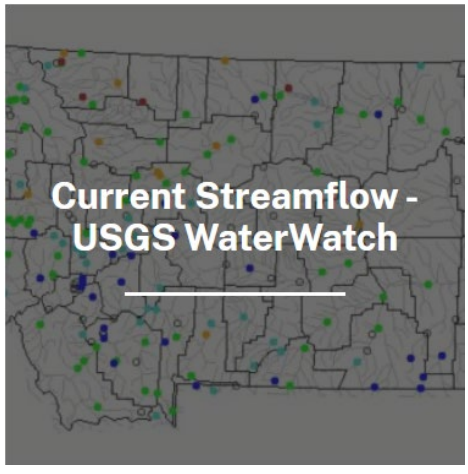
Other

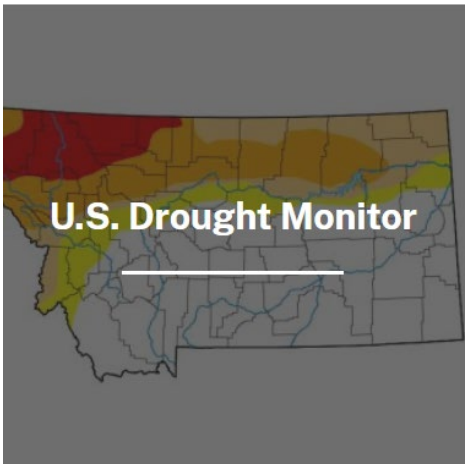
- Snow Water Equivalent > Daily > Compared to POR > **Stations**
- Snow Water Equivalent > End of Previous Month (SNOTEL and Snow Course) > Percentile > **Stations**
- Water Year-to-Date Precipitation > Daily > Compared to POR > **Stations**

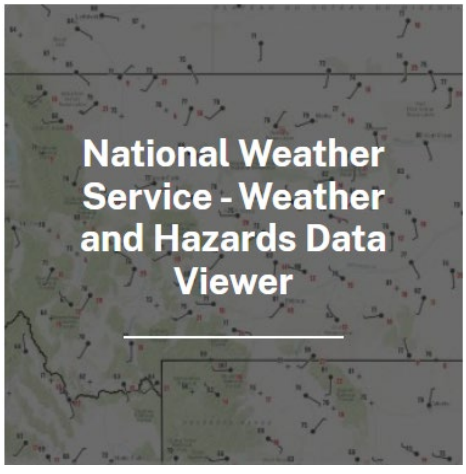
Appendix

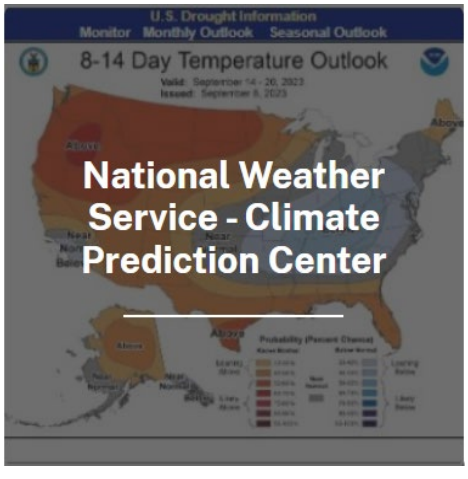
Links and Resources (Continued)

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)

Issued by:

Terry Cosby

Chief

Natural Resources Conservation Service

U.S. Department of Agriculture

Released by:

Tom Watson

State Conservationist

Natural Resources Conservation Service

Bozeman, Montana

Report Created by:

Montana Snow Survey Staff

Bozeman, Montana

mt-nrcs-snow@usda.gov

https://www.nrcs.usda.gov/montana/snow-survey