# Upper Missouri River Basin
# December 2020 Calendar Year Runoff Forecast
**December 1, 2020**

**U.S. Army Corps of Engineers, Northwestern Division**
**Missouri River Basin Water Management**
**Omaha, NE**

## Calendar Year Runoff Forecast

### Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. The Calendar Year Runoff Forecast is available at http://www.nwd-mr.usace.army.mil/rcc/reports/runoff.pdf. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri Basin above Sioux City (upper Basin). The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

### Observed Runoff

November precipitation was generally drier than normal across much of the Basin, with 25 to 50% of normal precipitation or drier conditions observed in areas of every state in the Basin. The exceptions were northern Montana and eastern Nebraska, Kansas, and South Dakota, where portions of the states received 200% of normal or more precipitation. November runoff was 1.2 MAF (116% of average) in the upper Basin above Sioux City, and 1.2 MAF (123% of average) for the upper Basin above Gavins Point Dam. November runoff for the Basin above Sioux City was 0.4 MAF more than the November 1 forecast. November runoff was above average in the Fort Peck, Garrison, and Gavins Point reaches, and below average in the Oahe, Fort Randall, and Sioux City reaches.

### 2020 Calendar Year Forecast Synopsis

The 2020 calendar year runoff forecast for the upper Missouri Basin above Sioux City, IA is **30.6 MAF, 119% of average**. The 2020 calendar year runoff forecast for the Missouri Basin above Gavins Point is **25.0 MAF**, **107% of average**. Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next month, expected inflow could range from the 30.8 MAF upper basic forecast to the 30.5 MAF lower basic forecast. The upper and

lower basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively.

## Current Conditions

### Drought Analysis

The National Drought Mitigation Center's drought monitor for November 24, 2020 is shown in **Figure 1**. The drought monitor is available at http://droughtmonitor.unl.edu/. The U.S. Drought Monitor shows D3 "extreme drought" conditions are present in Colorado and areas of Wyoming and Nebraska. Larger areas of D2 "severe drought" are also present in those states, and in western Iowa, southwestern South Dakota, northern North Dakota, and eastern Montana. There are areas of D1 "moderate drought" and D0 "abnormally dry" conditions present in every state in the Basin. The National Weather Service (NWS) Climate Prediction Center's (CPC) Seasonal Drought Outlook in **Figure 2**, which extends through the end of February, shows the drought persisting in most states, with some improvement forecasted in Montana and worsening conditions forecasted in Kansas.

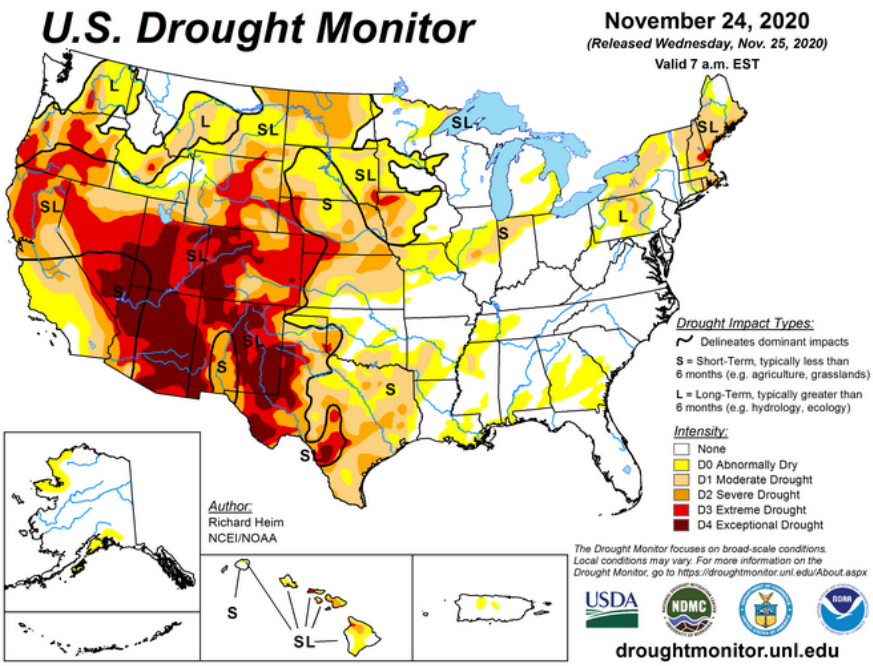


**Figure 1. National Drought Mitigation Center U.S. Drought Monitor for November 24, 2020.**

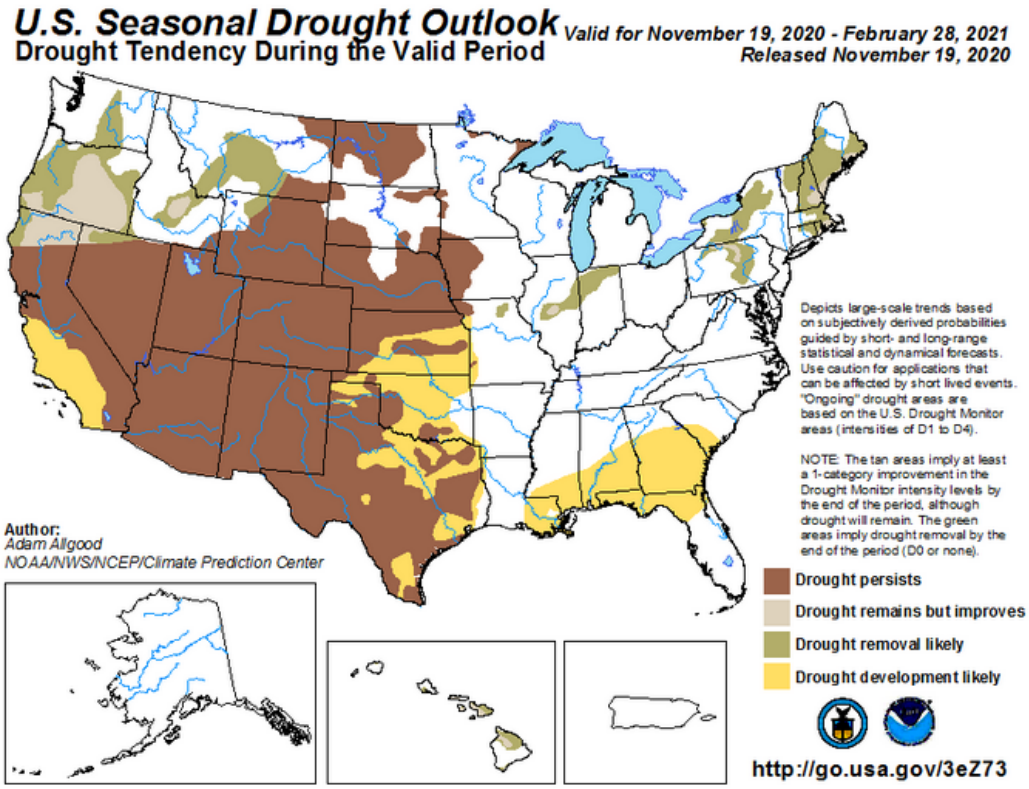


**Figure 2. NWS CPC Seasonal Drought Outlook.**

## Precipitation

Monthly precipitation accumulations are shown using High Plains Regional Climate Center images available at http://www.hprcc.unl.edu/. The November precipitation accumulation map is shown in **Figure 3** as a percent of normal precipitation. November precipitation was generally drier than normal across much of the Basin, with 25 to 50% of normal precipitation or drier conditions observed. The exceptions were northern Montana and eastern Nebraska, Kansas, and South Dakota, where portions of the states received 200% of normal or more precipitation.

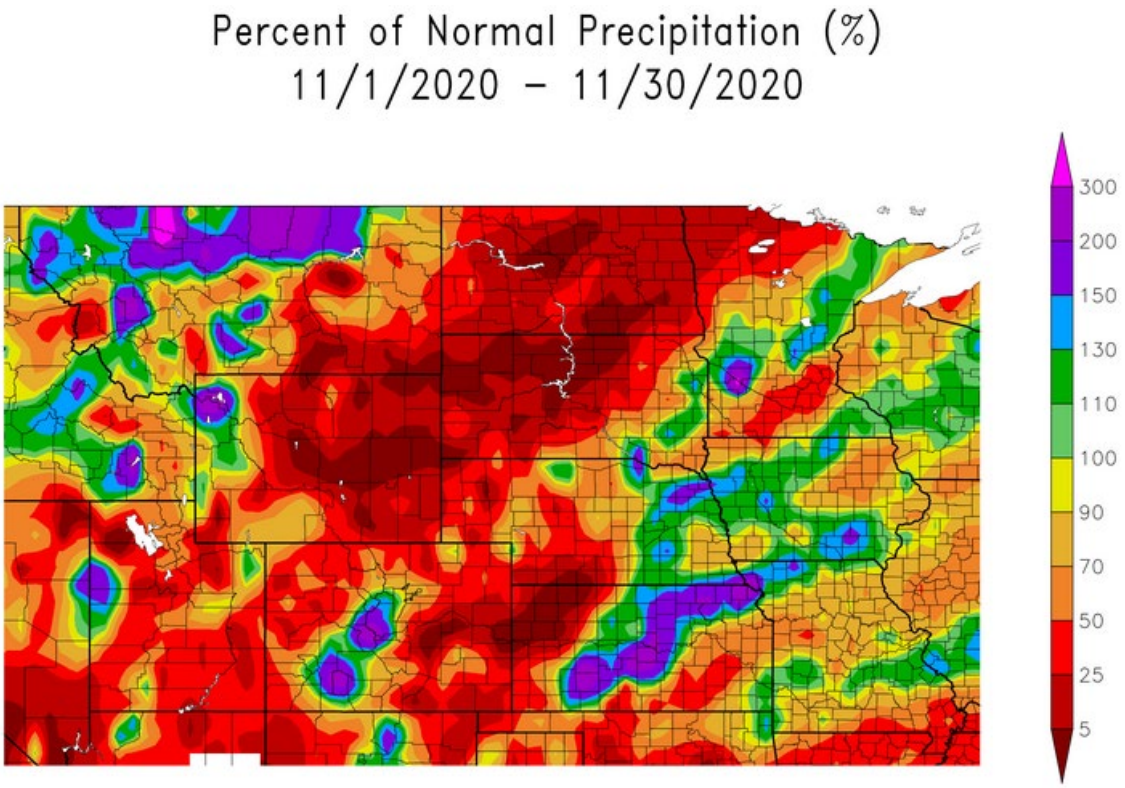


**Figure 3. November 2020 Percent of Normal Precipitation. Source: High Plains Regional Climate Center, http://www.hprcc.unl.edu/.**

Since September 1, most of the Basin has received below-normal precipitation (see **Figure 4**), with only areas in Montana receiving above-normal precipitation. Larger areas of 5-25 and 25-50 percent of normal precipitation have developed in Wyoming, Colorado, North Dakota, Nebraska, and Kansas.

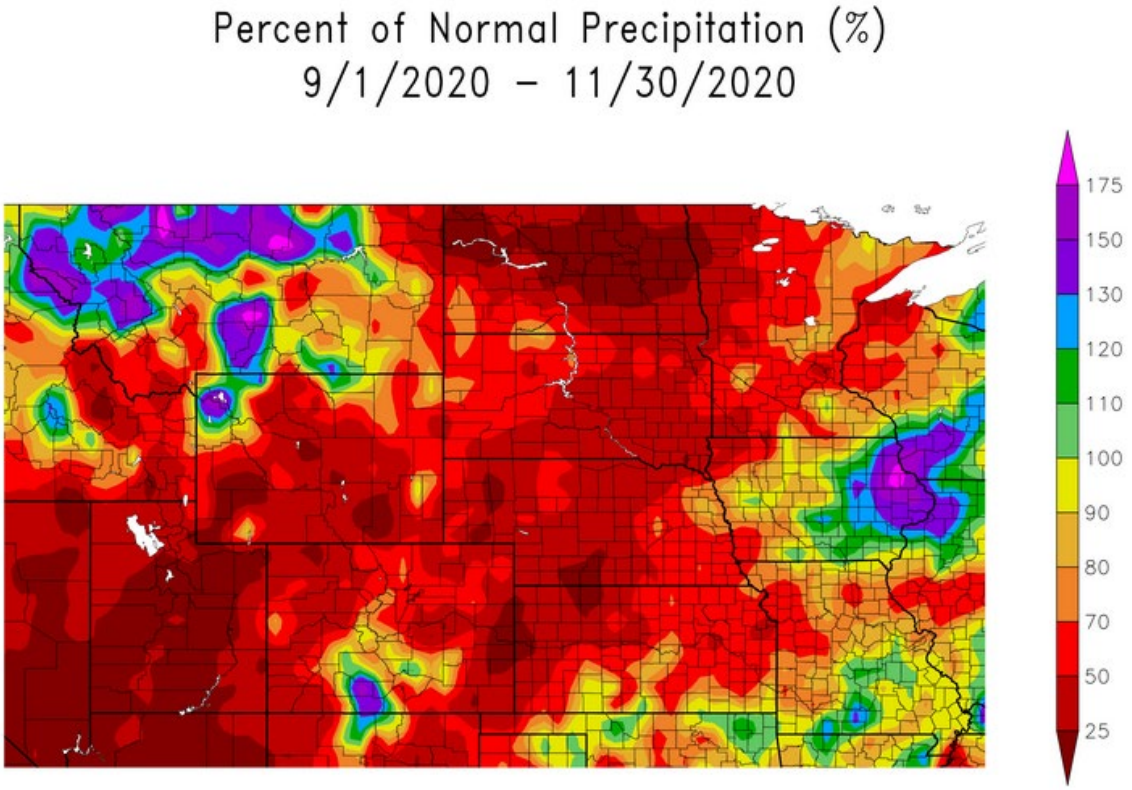


**Figure 4. September 1 – November 30 Percent of Normal Precipitation. Source: High Plains Regional Climate Center, http://www.hprcc.unl.edu/.**

## Temperature

November temperature departures in degrees Fahrenheit (deg F) in **Figure 5** were warmer than normal across the entire Basin, with areas of up to 10 degrees above normal in the central plains.

September-October-November temperature departures are shown in **Figure 6.** The past three month's temperature departures were generally near normal for the entire Basin with slightly warmer departures from normal temperatures in the western portion of the Basin compared to the eastern portion of the Basin.

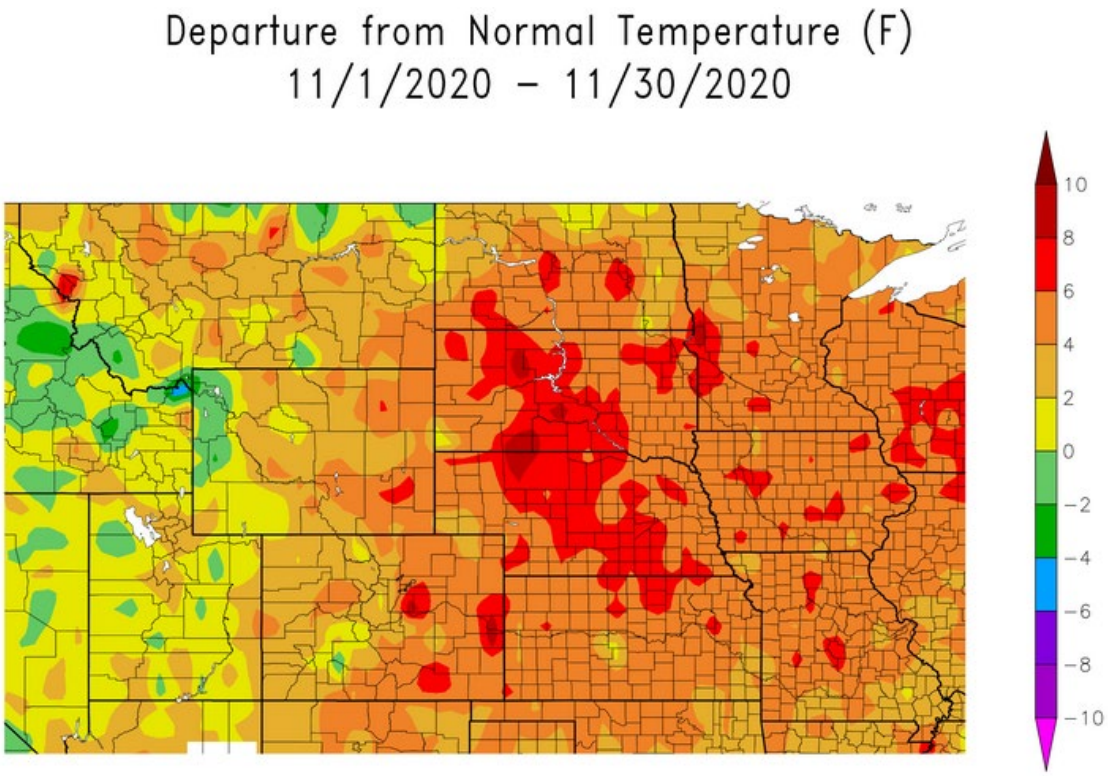


**Figure 5. November 2020 Departure from Normal Temperature (deg F). Source: High Plains Regional Climate Center, http://www.hprcc.unl.edu/.**

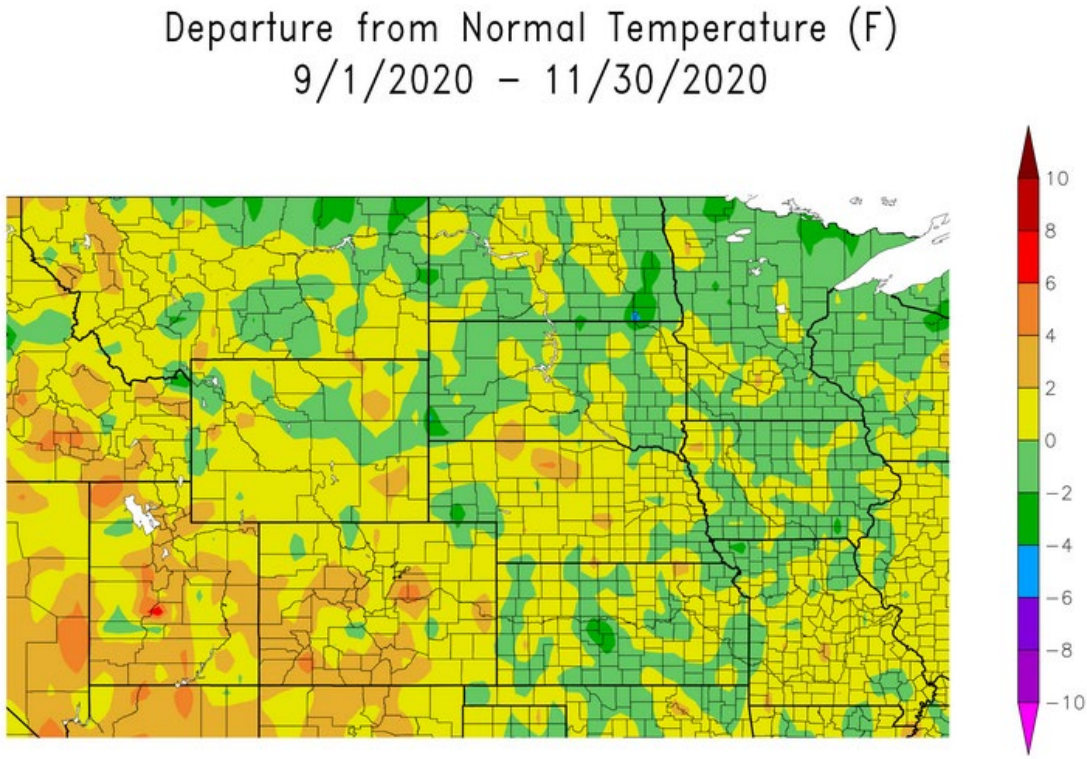


**Figure 6. September-October-November 2020 Departure from Normal Temperature (deg F). Source: High Plains Regional Climate Center, http://www.hprcc.unl.edu/.**

## Soil Moisture

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically, when soil moisture conditions are wet or greater than normal, rainfall and snowmelt runoff is greater than when soil moisture is dry or less than normal. Not only is soil moisture a physical parameter that influences runoff, it can be used as an indicator of future runoff.

Soil moisture percentiles on March 31 based on the CPC's soil moisture model ranged from the 70th to 99th percentile ranking. Much of eastern Montana, North Dakota, South Dakota and Nebraska soils ranked above the 95th percentile, indicating soil conditions were very wet. Since March 31, soils have dried out considerably (see **Figure 7**). Based on the CPC's soil moisture model, the soil moisture anomaly had decreased by 60 to 140 mm over most of the Basin by the end of June. Soil moisture rebounded some during July. Since the end of June, soil moisture has continued to dry over parts of the basin of the Basin. Currently, 1-5 percent ranking covers areas of Colorado, Wyoming, and Nebraska (see **Figure 8**). Larger areas with 5-10 and 10-30 soil moisture percentiles are present in Wyoming, Colorado, North Dakota, Nebraska, and Iowa.

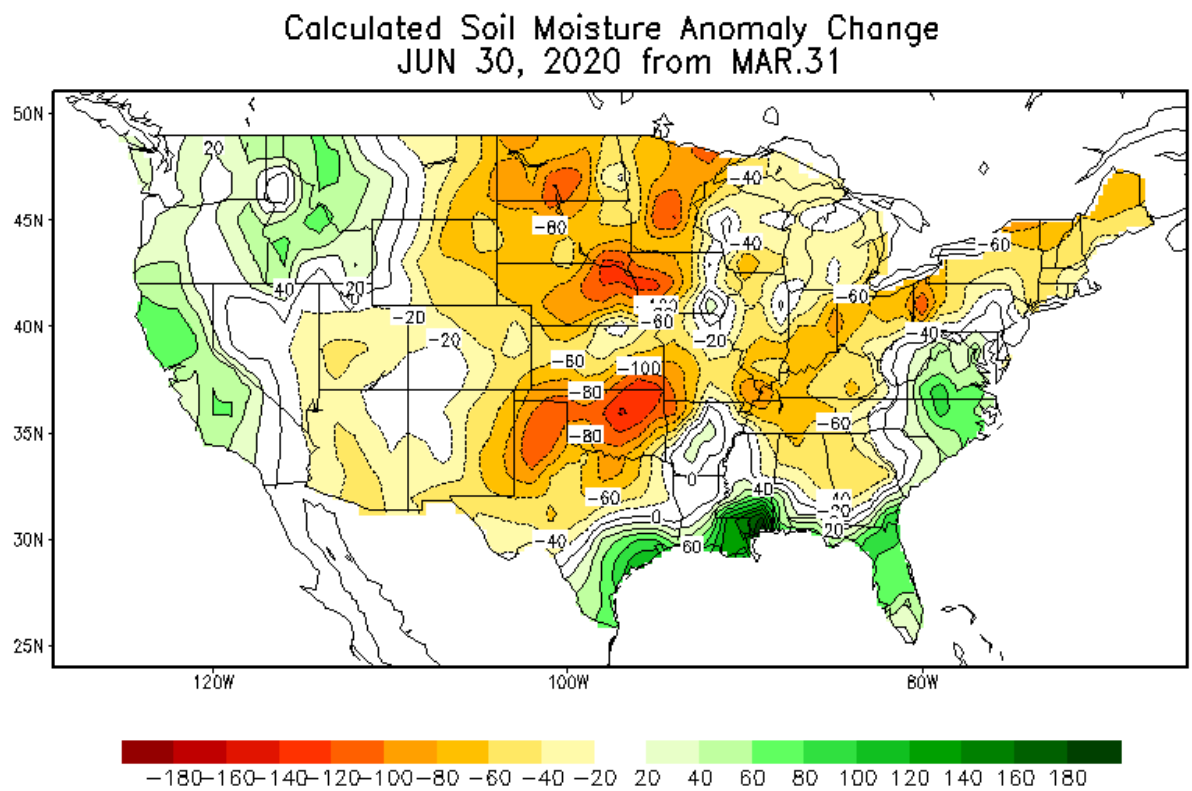


**Figure 7. NOAA CPC Soil Moisture Anomaly Change (mm) March 31 to June 30. Source:** https://www.cpc.ncep.noaa.gov/products/Soilmst_Monitoring/US/Soilmst/Soilmst.shtml

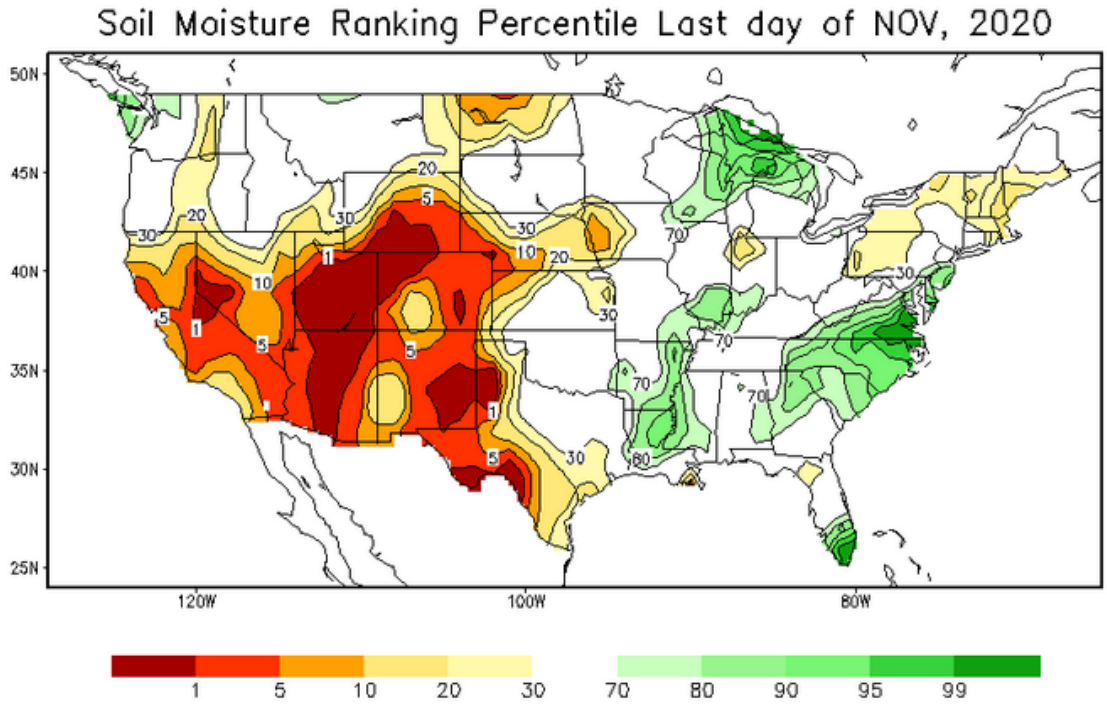


**Figure 8. Calculated soil moisture ranking percentile. Source:**
**https://www.cpc.ncep.noaa.gov/products/Soilmst_Monitoring/US/Soilmst/Soilmst.shtml**

### Mountain Snowpack

Mountain snowpack is the primary factor used to predict May, June and July runoff volumes in the Fort Peck and Fort Peck to Garrison reaches. As the date of peak snowpack accumulation, usually around April 15, approaches, the correlation between the level of mountain snowpack and May, June and July runoff increases. Mountain snowpack becomes a better predictor of Fort Peck and Garrison reach runoff once it reaches its peak. In December, the mountain snowpack accumulation period has only begun and is not used in the remaining forecast months of 2020.

## Climate Outlook

MRBWM participates in the monthly North Central U.S. Climate/Drought Outlook Webinar coordinated through NOAA, the regional climate centers, and the American Association of State Climatologists (AASC). These webinars provide updates on near-term climate outlooks and impacts including the ENSO climate pattern and its implications on winter temperature and precipitation patterns in the Basin.

### ENSO (El Niño Southern Oscillation)

The latest ENSO Outlook indicates that La Niña conditions are present and are likely to continue through the Northern Hemisphere winter and spring. During La Niña winters, the probability for a colder-than-normal and slightly wetter-than-normal weather pattern in the Northern Rockies and Northern Plains is higher.

## Temperature and Precipitation Outlooks

The CPC outlooks provide the forecasted probability (or chance) of occurrence of future weather conditions during periods ranging from 1 to 12 months into the future. The CPC outlooks are available at http://www.cpc.ncep.noaa.gov/.

The CPC temperature outlook for the forecast period from December 6-10 is shown in **Figure 9.** The outlook is indicating an increase in the chances for above-normal temperatures and below-normal precipitation over the entire Basin. During the month of December (**Figure 10**), the outlook is indicating increased chances for above-normal temperatures and below-normal precipitation across the entire Basin, except for Montana, which has equal chances for above-, below-, and normal precipitation.

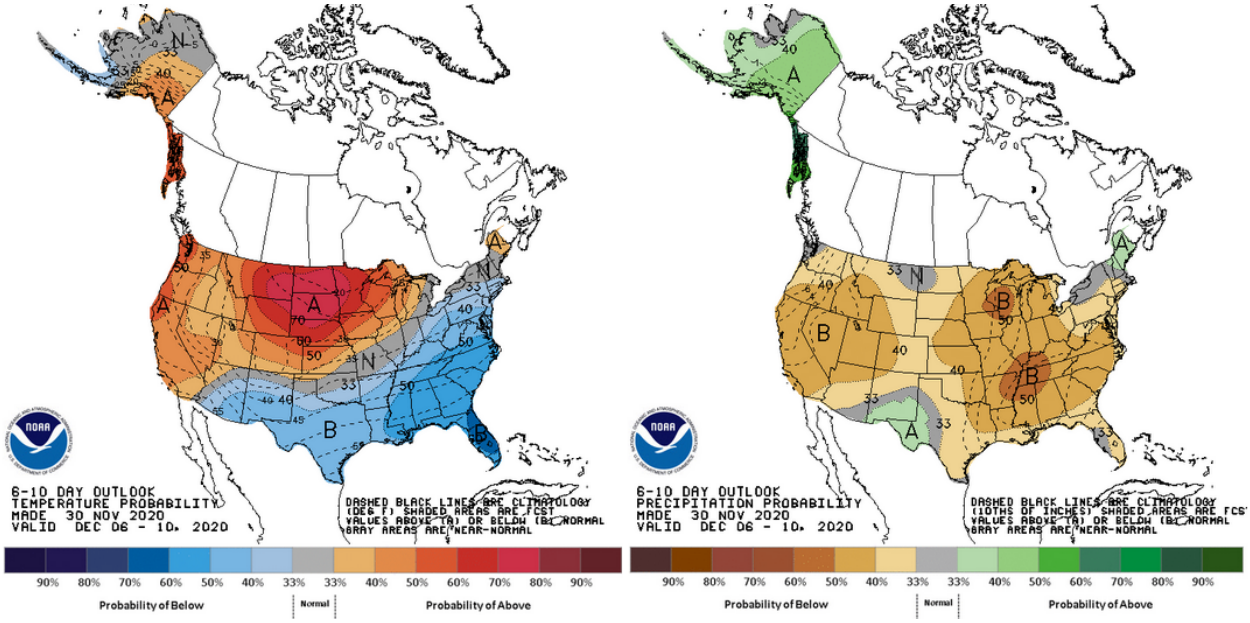


**Figure 9. CPC 6-10 Day temperature and precipitation outlooks through December 10, 2020.**

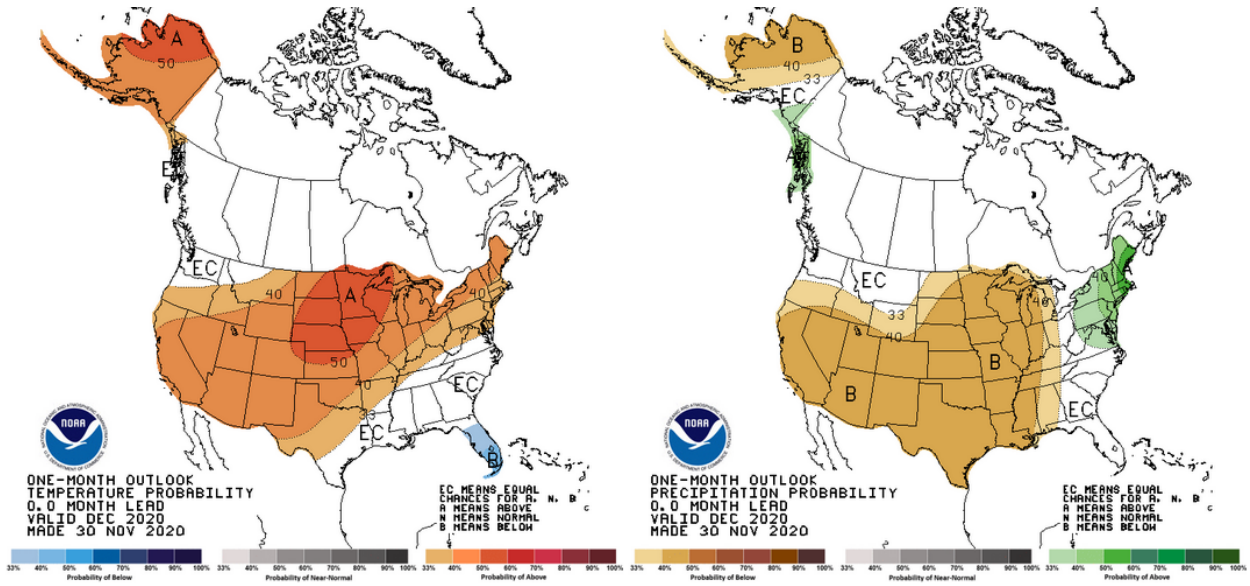


**Figure 10. CPC December 2020 temperature and precipitation outlooks.**

Three-month temperature and precipitation outlooks for the three-month periods from December 2020 through February 2021 are shown below in **Figure 11**. During December 2020-January 2021-February 2021, the CPC indicates increased chances for above-normal temperatures over southern portions of the Basin with equal chances in the middle portions and below-normal temperatures in the northern portions of the Basin. The CPC is also indicating a slight increase in chances for above-normal precipitation in Montana, North Dakota, and South Dakota and increased chances for below-normal precipitation in Colorado, Kansas, and southern Nebraska, with equal chances for precipitation elsewhere in the Basin.

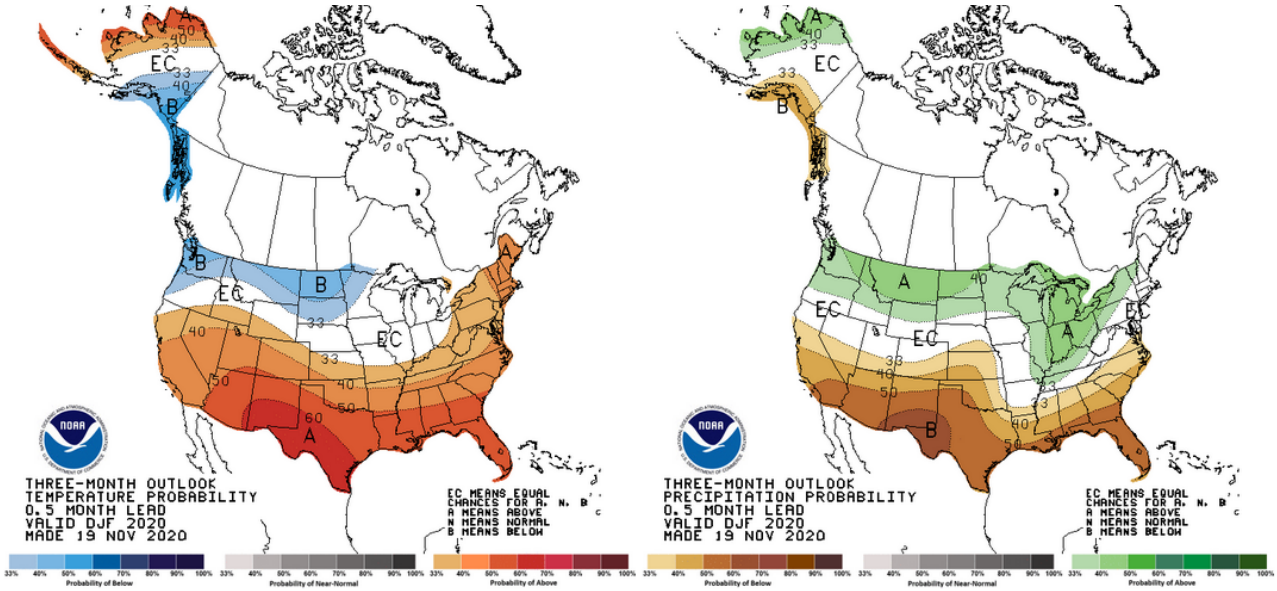


**Figure 11. CPC December 2020-January 2021-February 2021 temperature and precipitation outlooks.**

## Summary

In summary, the 2020 calendar year runoff forecast is **30.6 MAF** (**119%** of average). The December 1 calendar year runoff forecast is just below an upper quartile runoff volume.