

**Upper Missouri River Basin  
October 2015 Calendar Year Runoff Forecast  
November 2, 2015**

**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. 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 River reach above Sioux City. 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.

**2015 Calendar Year Forecast Synopsis**

The November calendar year runoff forecast for the Missouri Basin above Sioux City is **25.0 MAF** (99% of average). October runoff was **0.9 MAF** (78% of average). Observed October runoff was below average in all reservoir reaches except for the Gavins Point to Sioux City reach.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next 2 months, the range of expected inflow ranges from the 25.4 MAF (100% of average) upper basic forecast to the 24.7 MAF (98% of average) 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. Given that 2 months are being forecast for this November 1 forecast (10 months observed/2 months forecast), the range of wetter than expected (upper basic) and lower than expected (lower basic) is attributed to all 6 reaches for 2 months. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

# Current Conditions

## Drought Analysis

Drought conditions have persisted in the Missouri Basin during the fall. The drought conditions are shown in the National Drought Mitigation Center's drought monitor for October 27, 2015 (Figure 1) and September 29, 2015 (Figure 2). Extreme Drought (D3) and Severe Drought (D2) conditions have not changed in western Montana. Abnormally Dry (D0) conditions have persisted in eastern Montana, while D1 conditions have developed in eastern North Dakota, northeast Kansas and central Missouri. The U.S. Seasonal Drought Outlook in Figure 3 indicates drought will persist and likely intensify in western Montana and continue to develop in Montana, northern Wyoming and western North Dakota through January 31, 2016.

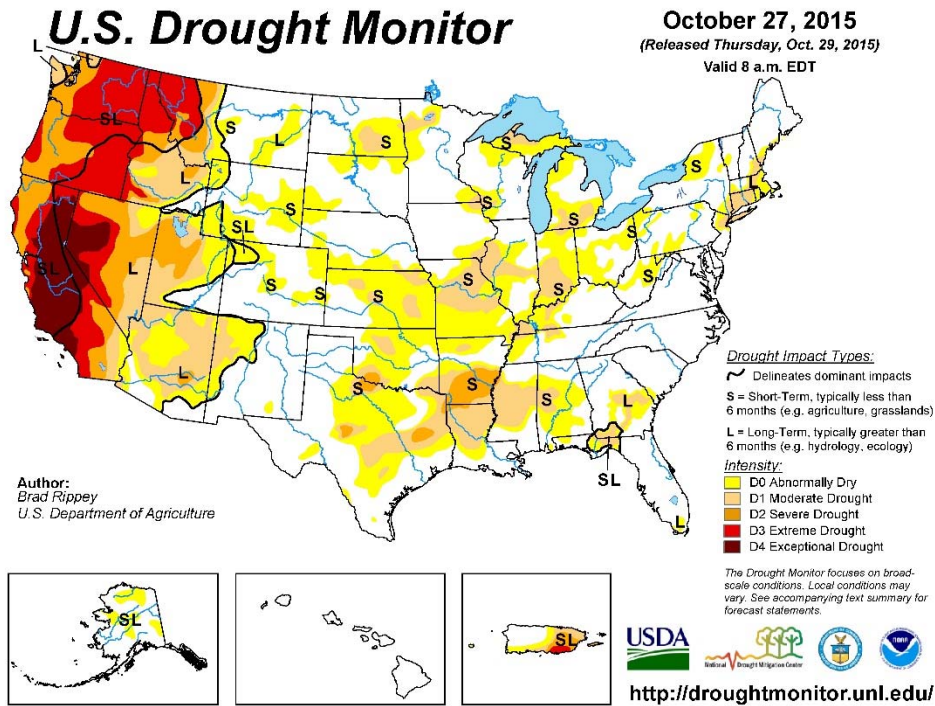


Figure 1. National Drought Mitigation Center U.S. Drought Monitor for October 27, 2015.

# U.S. Drought Monitor

September 29, 2015  
 (Released Thursday, Oct. 1, 2015)  
 Valid 8 a.m. EDT

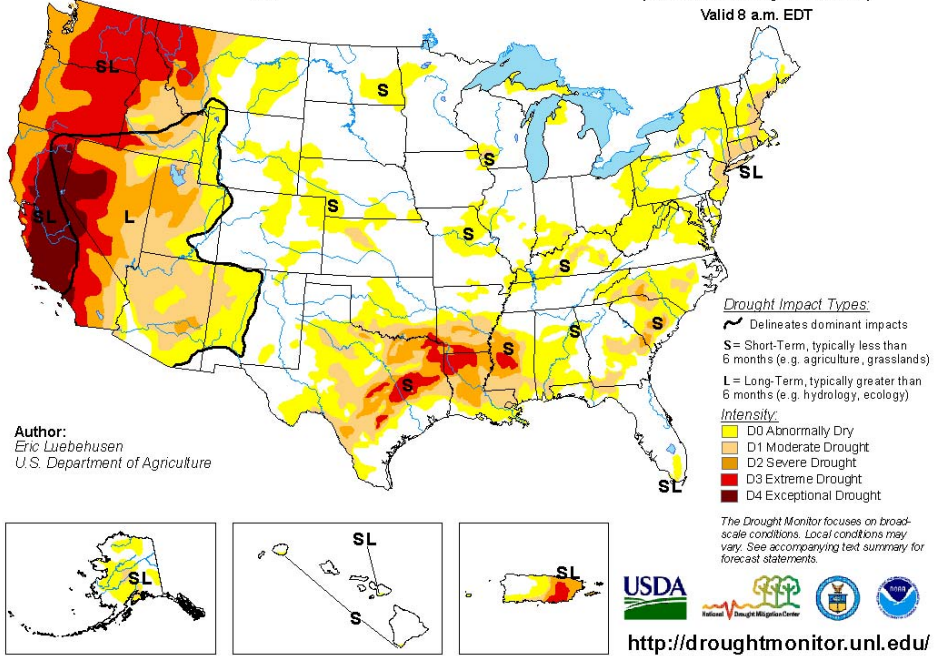


Figure 2. National Drought Mitigation Center U.S. Drought Monitor for September 29, 2015.

# U.S. Seasonal Drought Outlook

Drought Tendency During the Valid Period

Valid for October 15 - January 31, 2016  
 Released October 15, 2015

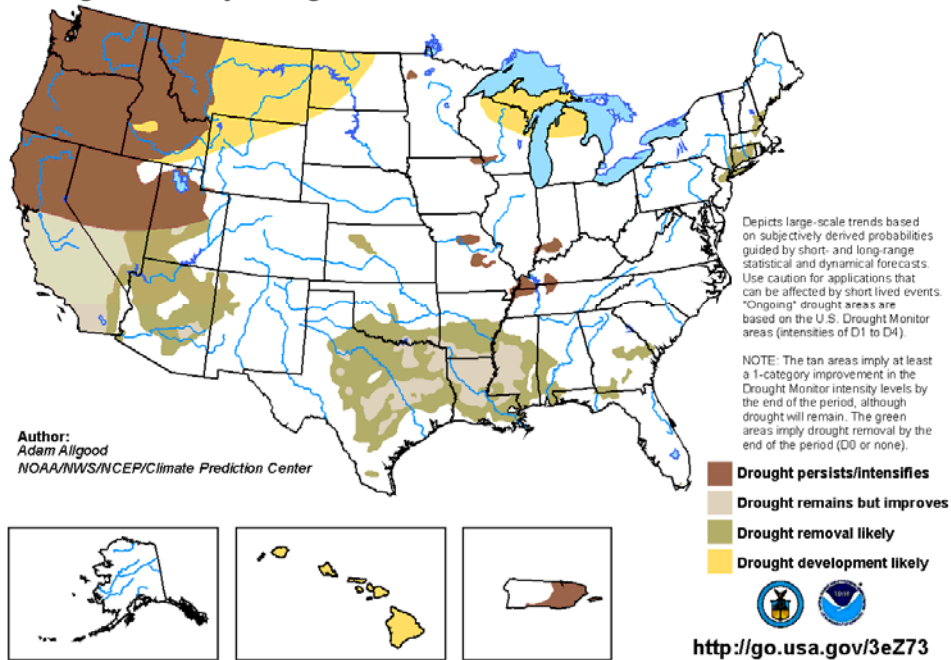
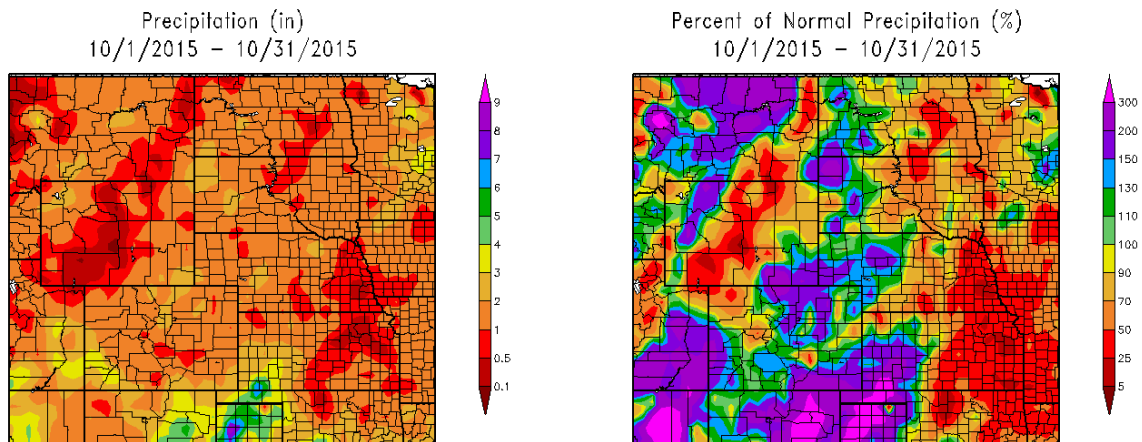


Figure 3. National Drought Mitigation Center U.S. Seasonal Drought Outlook, released October 15, 2015.

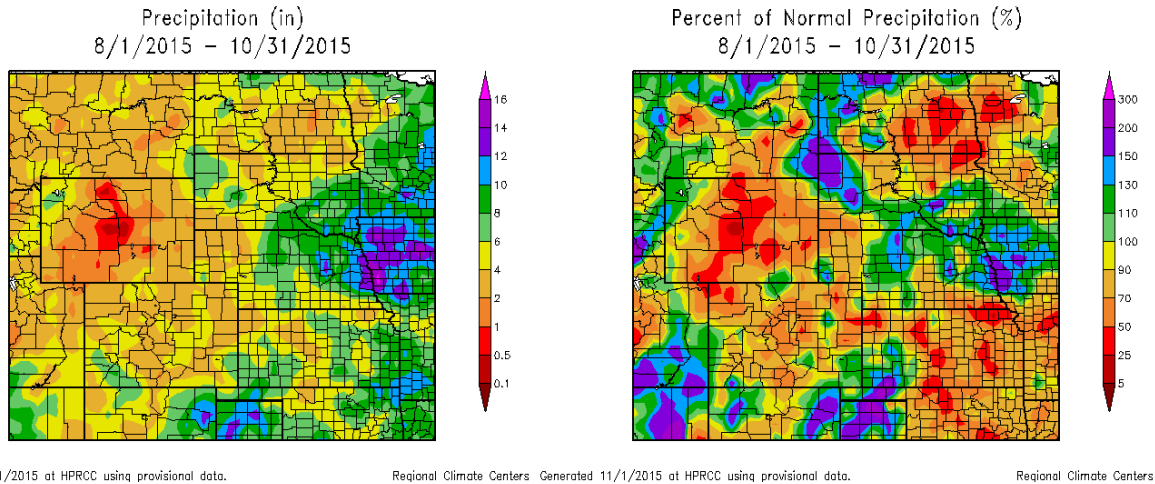
## Precipitation

October precipitation accumulations are shown in **Figure 4** as both inches of precipitation and percent of normal monthly precipitation. Precipitation was either much above or much below normal in the basin. Because normal October precipitation in the upper basin historically is quite low, one storm could result in above normal totals. While the percent of normal graphic (**Figure 4, right**) shows that above normal precipitation fell in central and northern Montana, western North Dakota, western South Dakota, western Nebraska, the precipitation total graphic (**Figure 4, left**) indicates that monthly totals in those areas ranged from 1 to 3 inches of precipitation. October precipitation was well below normal (70 percent or much less) across much of eastern North Dakota, eastern South Dakota, eastern Nebraska, western Iowa, eastern Kansas, and Missouri (**Figure 4, right**).

August-September-October precipitation accumulations are shown in **Figure 5**. The three-month accumulations reflect a dry pattern across much of the Missouri Basin with the exception of some areas that received 130 to 200 percent of normal precipitation. These areas include north central Montana, western North Dakota, northwest South Dakota, eastern Nebraska, and western Iowa. Dry areas in the Missouri Basin include Wyoming, eastern North Dakota, northern South Dakota, Kansas, and Missouri.



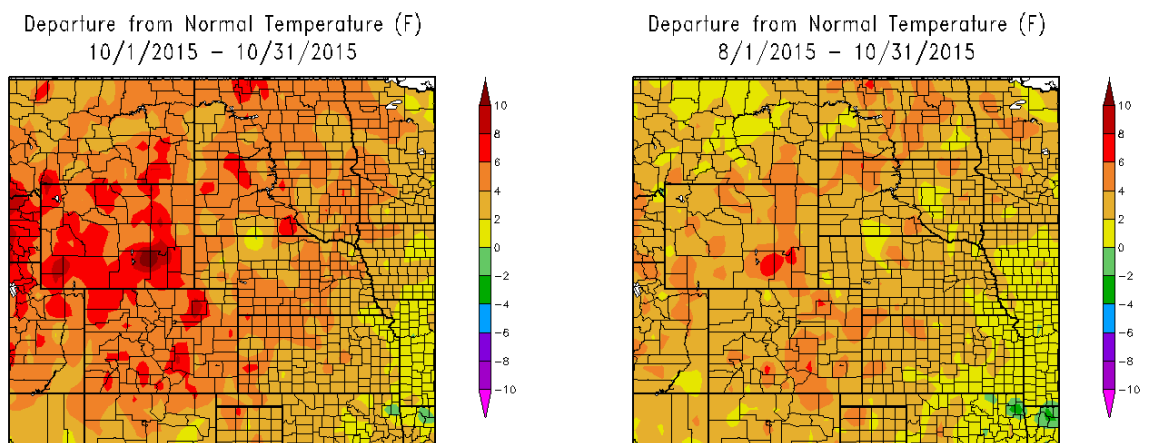
Generated 11/1/2015 at HPRCC using provisional data. Regional Climate Centers. Generated 11/1/2015 at HPRCC using provisional data. Regional Climate Centers  
**Figure 4. October 2015 Precipitation (inches) and Percent of Normal Precipitation. Source: High Plains Regional Climate Center, <http://www.hprcc.unl.edu/>.**



**Figure 5. August-October 2015 Precipitation (inches) and Percent of Normal Precipitation.** Source: High Plains Regional Climate Center, <http://www.hprcc.unl.edu/>.

## Temperature

October temperatures were generally 2 to 6 degrees Fahrenheit (deg F) warmer than normal over much of the Missouri Basin (**Figure 6, left**) and some of areas of the basin such as Wyoming experienced monthly temperatures 4 to 8 deg F warmer than normal. Temperatures were generally normal to 4 deg F above normal in the lower Missouri Basin. Three-month (August-September-October) temperature departures (**Figure 6, right**) show that most of the basin recorded temperatures 2 to 4 deg F above normal. Average temperatures in central Montana, Iowa, eastern Kansas, and Missouri ranged from normal to 2 deg F above normal (**Figure 6, right**).



**Figure 6. October 2015 and August-October 2015 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 monthly runoff.

**Figure 7** shows the NOAA NLDAS ensemble mean soil moisture percentiles on October 28, 2015 for the total modeled soil column, which is about 2 meters. The NLDAS soil moisture depiction is an average value for the soil moisture column. **Figure 7** indicates above normal soil moisture conditions throughout portions of the upper Basin including northern and central Montana, western North Dakota, western South Dakota, western Nebraska, and western Iowa. Drier-than-normal soil moisture conditions are indicated in western Montana, much of Wyoming, eastern North Dakota, eastern South Dakota, much of Kansas and Missouri.

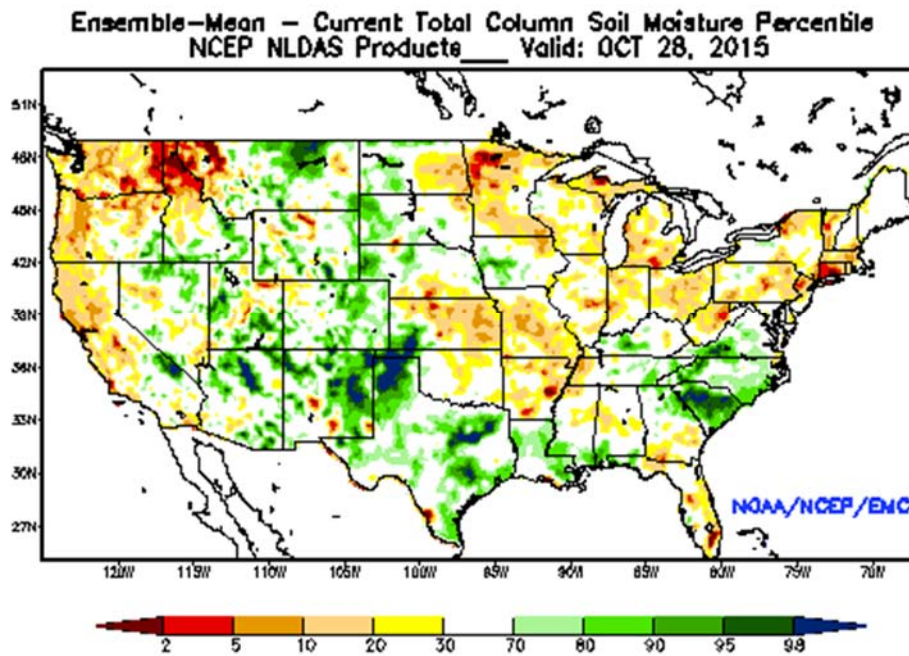


Figure 7. Total Column Soil Moisture Percentile on October 28, 2015. Source: NOAA NLDAS Drought Monitor Soil Moisture. <http://www.emc.ncep.noaa.gov/mmb/nldas/drought/>

## Streamflow Conditions

Missouri Basin streamflow conditions represented as percentile classes on November 1, 2015 are shown in **Figure 8**. These conditions are based on the ranking of the November 1, 2015 daily streamflow versus the historical record of streamflow for that date. Streamflow conditions have been much above normal (exceeding the 90<sup>th</sup> percentile) in the Black Hills of South Dakota, locations in western North Dakota, eastern Nebraska, and western Iowa. In contrast, streamflow is much below normal in western Montana and central Kansas (below the 10<sup>th</sup> percentile). Aside from those areas just mentioned, the rest of the basin streamflows are within the below-normal and above-normal range (25<sup>th</sup> to 75<sup>th</sup> percentile).

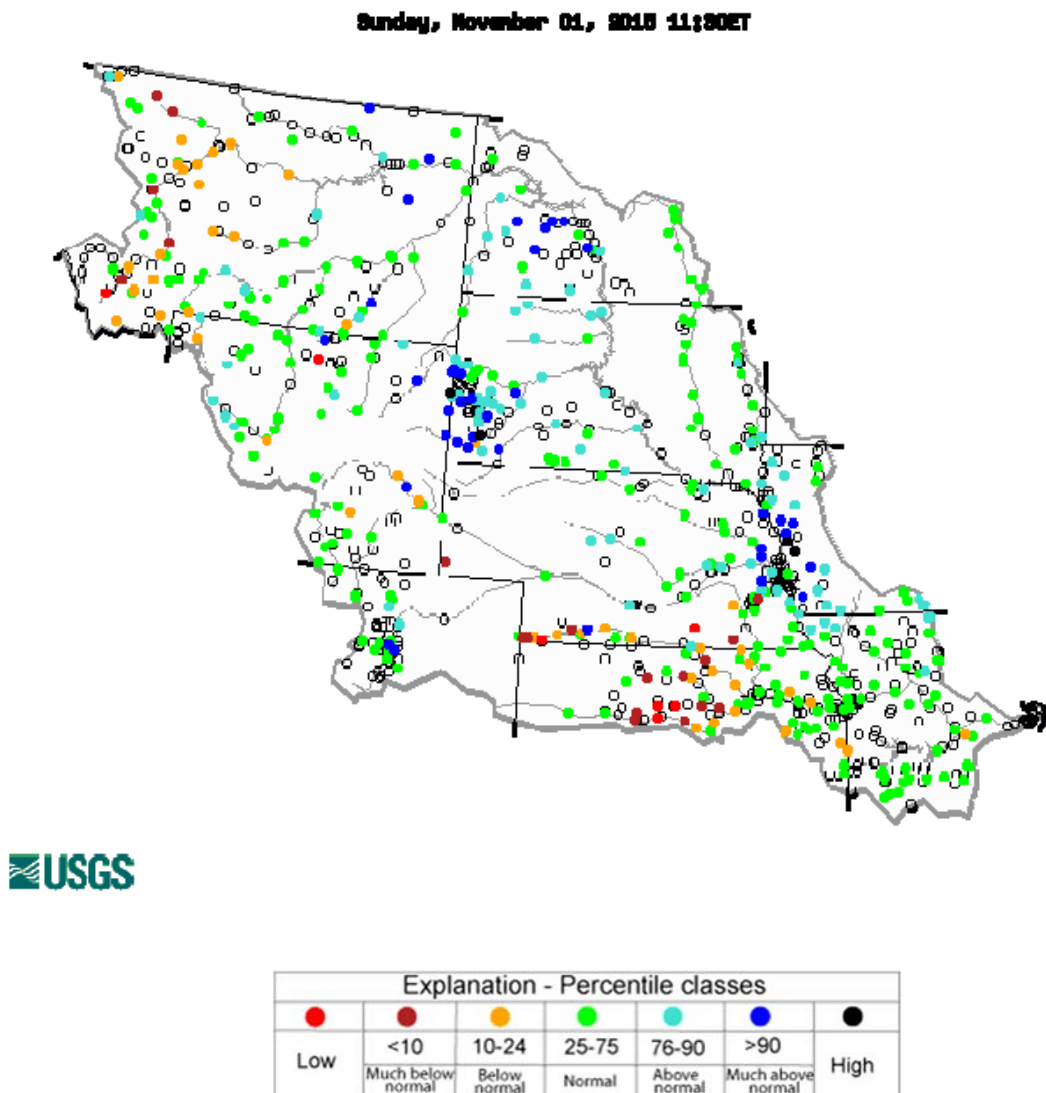


Figure 8. USGS Streamflow Conditions as a Percentile of Normal in the Missouri River Basin as of October 1, 2015. Source: USGS. <http://waterwatch.usgs.gov/index.php>

## Climate Outlook

### **ENSO (El Niño Southern Oscillation)**

According to the CPC's latest monthly update on October 26, 2015

([http://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/enso\\_advisory/ensodisc.pdf](http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.pdf)), *“there is an approximately 95% chance that El Niño will continue through Northern Hemisphere winter 2015-16, gradually weakening through spring 2016”*. CPC studies are predicting a strong El Niño event at its peak. El Niño winters have a tendency to be warmer and drier than normal in the upper Missouri Basin, and the influence of El Niño has been factored into the CPC's climate outlooks.

MRBWMD 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. These webinars provide updates on near-term climate outlooks and impacts including the El Niño climate pattern and its implications on late summer, fall and early winter temperature and precipitation patterns in the Missouri River Basin. The possible impacts of El Niño have been factored into the CPC climate outlooks described below.

### **Temperature and Precipitation Outlooks**

For October (**Figure 9**), the CPC climate temperature outlook indicates increased chances for above normal temperatures in most of the Missouri Basin. Equal chances for above normal, normal and below normal temperatures are indicated in central and western Wyoming and Colorado. With regard to precipitation, the CPC indicates that there are increased chances for above normal precipitation in southern Montana, Wyoming, western South Dakota, much of Nebraska, Kansas and Missouri in October. In the remainder of the Missouri Basin, there are equal chances for above normal, below normal and normal precipitation.

During November-December-January (**Figure 10**), the CPC is forecasting increased chances for above normal temperatures in the upper Basin and equal chances in Colorado, southern Nebraska, Kansas and Missouri. For precipitation, the CPC is showing increased chances for below normal precipitation in Montana, western North Dakota, and northwest Wyoming. There are increased chances for above normal precipitation over much of Colorado, southern Nebraska, and Kansas.



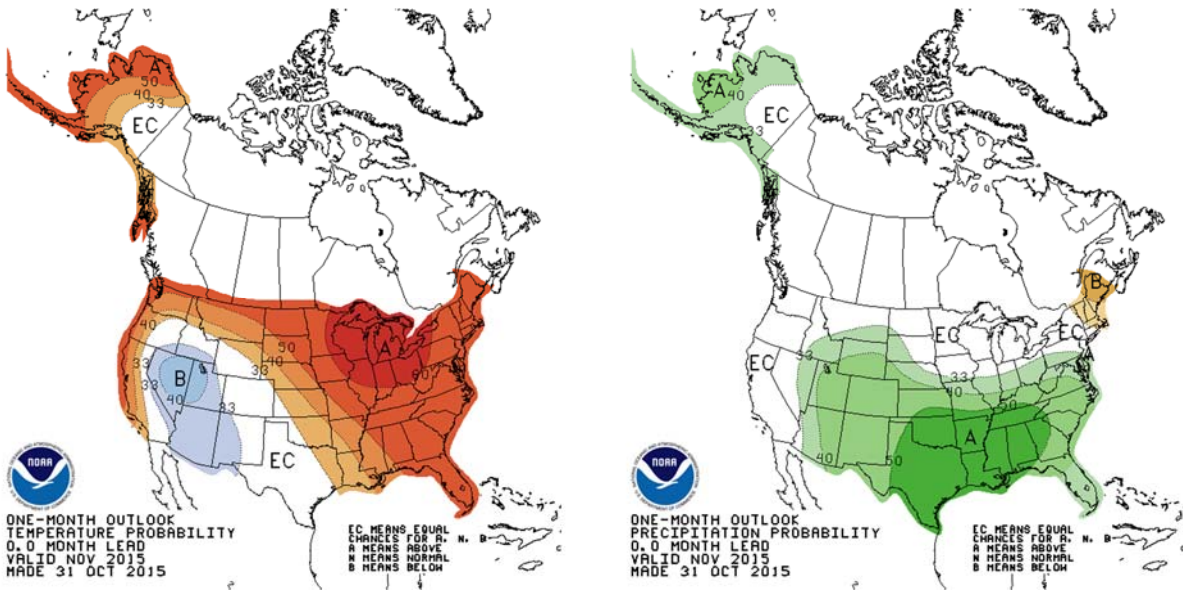


Figure 9. CPC November 2015 temperature and precipitation outlooks.

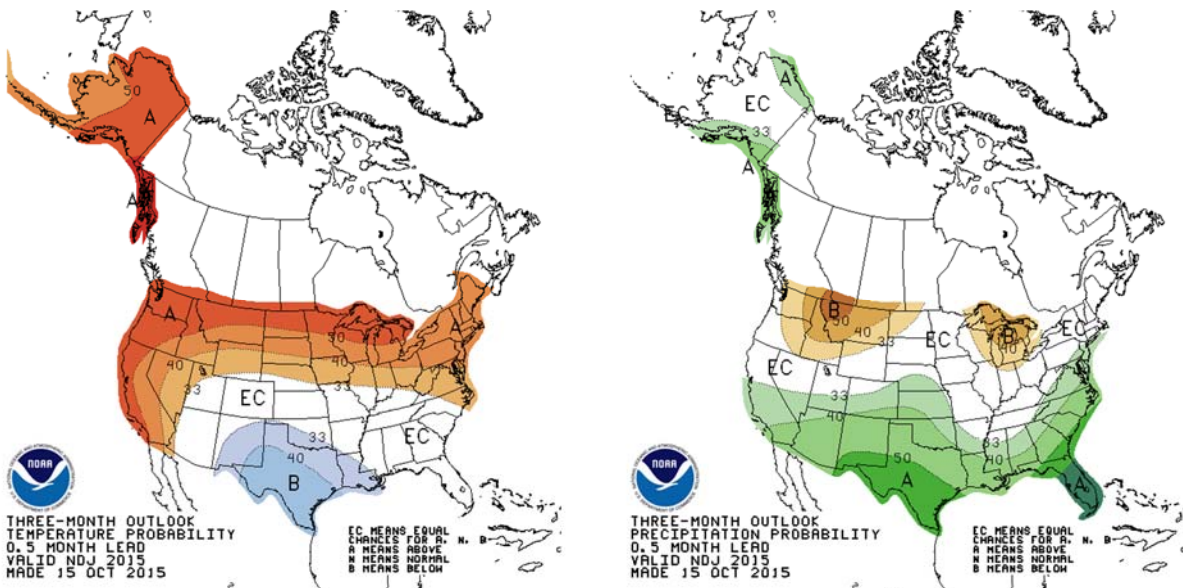


Figure 10. CPC November-December 2015-January 2016 temperature and precipitation outlooks.

## **November 2015 Calendar Year Runoff Forecast**

The October calendar year runoff forecast for the Missouri Basin above Sioux City is **25.0 MAF** (99% of average).

Observed October runoff was 0.9 MAF, 78% of average. Observed October runoff was lower than normal in all reaches except the Sioux City reach.

Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next 2 months, the range of expected inflow ranges from the 25.4 MAF (100% of average) upper basic forecast to the 24.7 MAF (98% of average) lower basic forecast.