

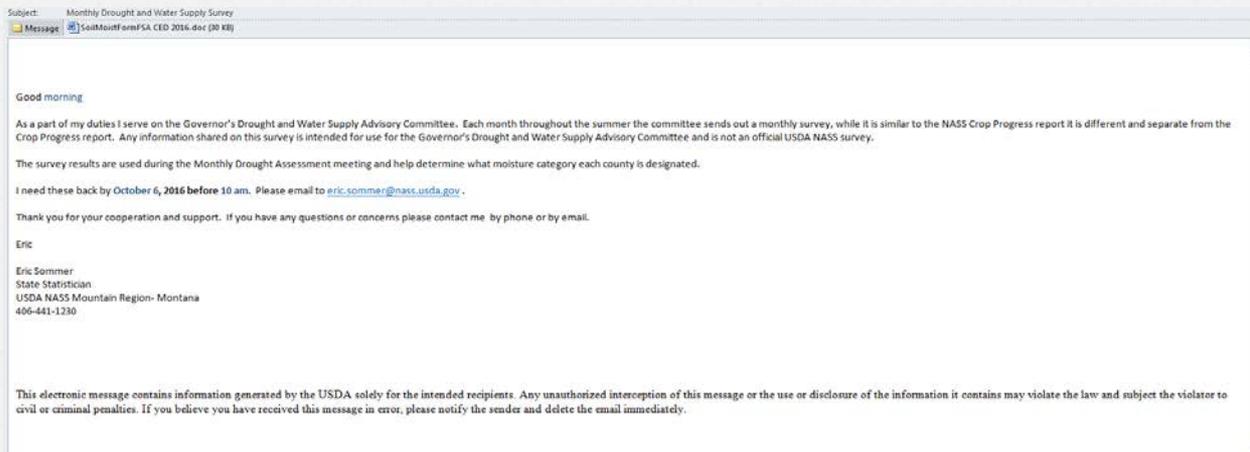
Montana Drought
Management Plan
(MDMP)

Update Process

Impact Report Survey

Previous Process

- o Farm Service Agency (FSA) and National Agricultural Statistics Service (NASS)
- o Monthly emailed surveys
- o Reply rate



Survey Questions

Please use (modified) FSA Guidelines for ranking Top and Sub-Soil Moisture: (with top-soil defined as the top 6 inches; and subsoil as 6 inches below the surface to a depth of 3 to 4 feet) – you can color or highlight the moisture and crop descriptions that fit your county best.

Very Short - Soil very dry. Under these conditions, plants will quickly suffer irreparable damage.

Short - Soil dry. Normal crop growth and development would be curtailed.

Adequate - Soil moist. Crop growth and development would be normal or unhindered.

Surplus - Soil wet. Fields may be muddy and unable to absorb additional moisture.

County: **Date:** **Director:**

Do you think the condition of your county is better, same, or worse than last month? ___Better ___Same ___Worse

Are conditions uniform across your county? Yes ___, No ___
If not, please explain:

Please change the numbers below accordingly to reflect current conditions in your county:

Topsoil Moisture (Sum must = 100)

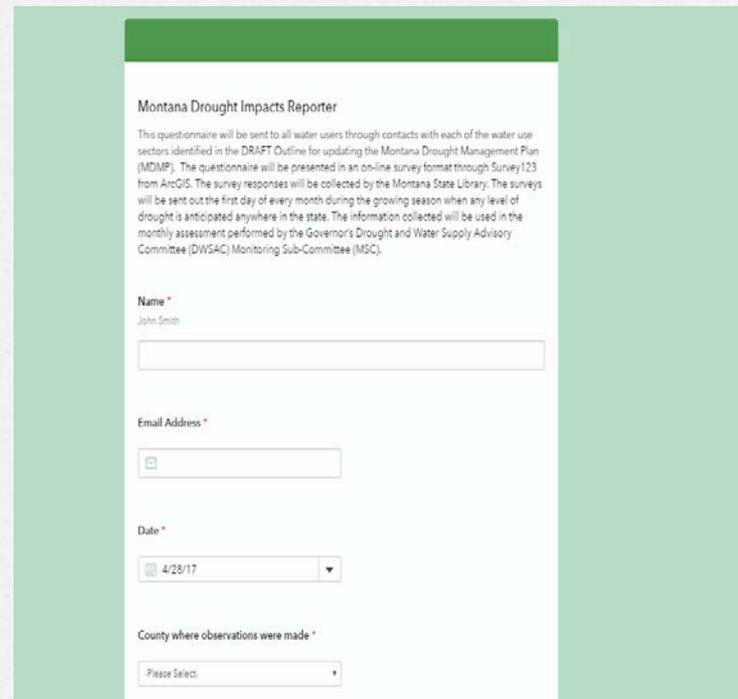
Very Short ___
Short ___
Adequate ___
Surplus ___

Subsoil Moisture (Sum must = 100)

Very Short ___
Short ___
Adequate ___
Surplus ___

New Approach

- o Automated, GIS-based survey
- o Survey all types of water users



Montana Drought Impacts Reporter

This questionnaire will be sent to all water users through contacts with each of the water use sectors identified in the DRAFT Outline for updating the Montana Drought Management Plan (MDMP). The questionnaire will be presented in an on-line survey format through Survey123 from ArcGIS. The survey responses will be collected by the Montana State Library. The surveys will be sent out the first day of every month during the growing season when any level of drought is anticipated anywhere in the state. The information collected will be used in the monthly assessment performed by the Governor's Drought and Water Supply Advisory Committee (DWSAC) Monitoring Sub-Committee (MSC).

Name *
John Smith

Email Address *

Date *
4/28/17

County where observations were made *
Please Select:

Developing New Questions

- Working with the National Drought Mitigation Center (NDMC)
- Drought Impact Reporter
- Stakeholder Working Group to review questions



Questions?

www.drought.mt.gov

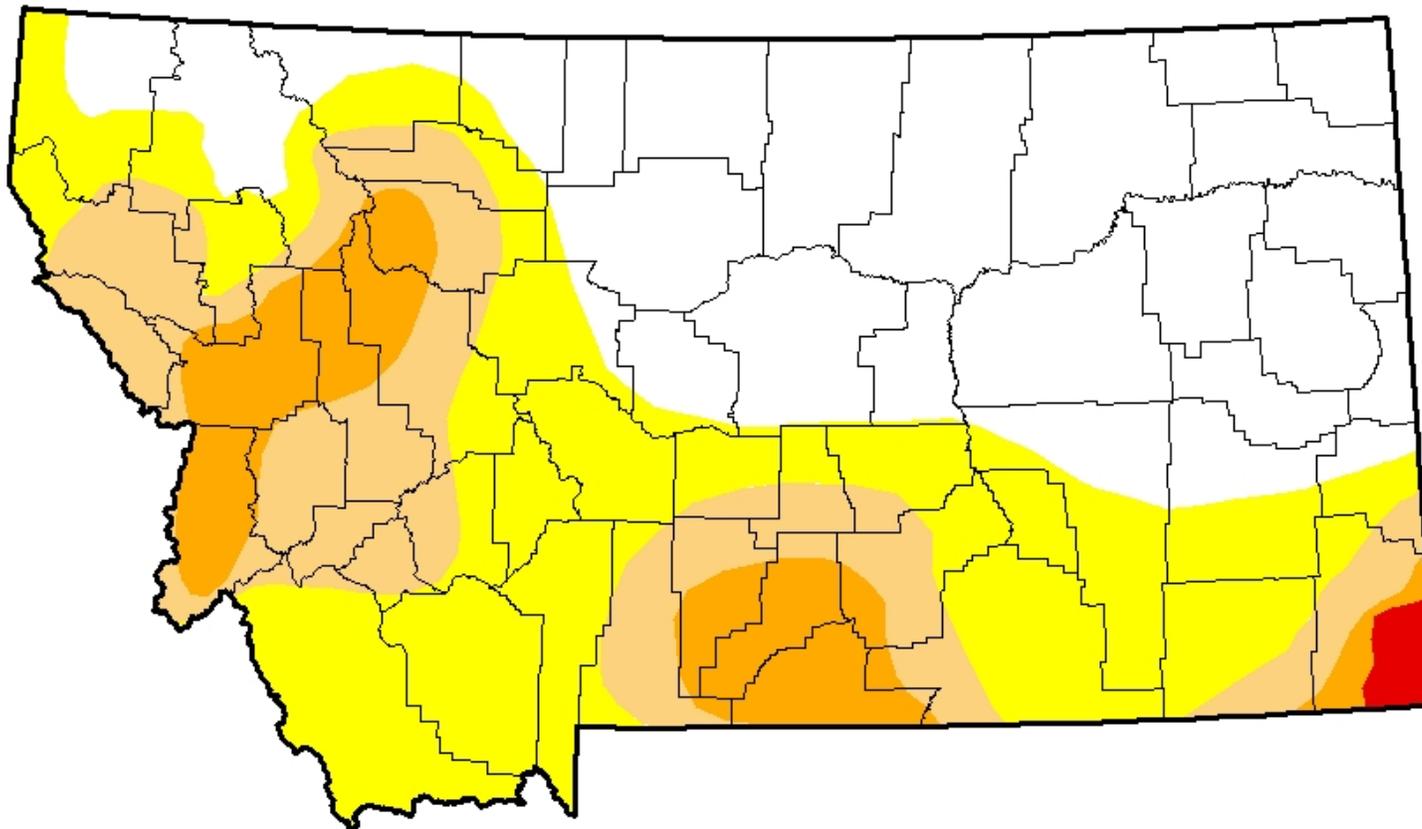
Ada Montague

amontague@mt.gov

(406) 444-6628

U.S. Drought Monitor Montana

August 16, 2016
(Released Thursday, Aug. 18, 2016)
Valid 8 a.m. EDT



Intensity:

-  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. See accompanying text summary for forecast statements.

Author:

David Miskus
NOAA/NWS/NCEP/CPC



<http://droughtmonitor.unl.edu/>



National Preparedness Goal

*First Edition
September 2011*



Homeland
Security

Mission Areas and Core Capabilities

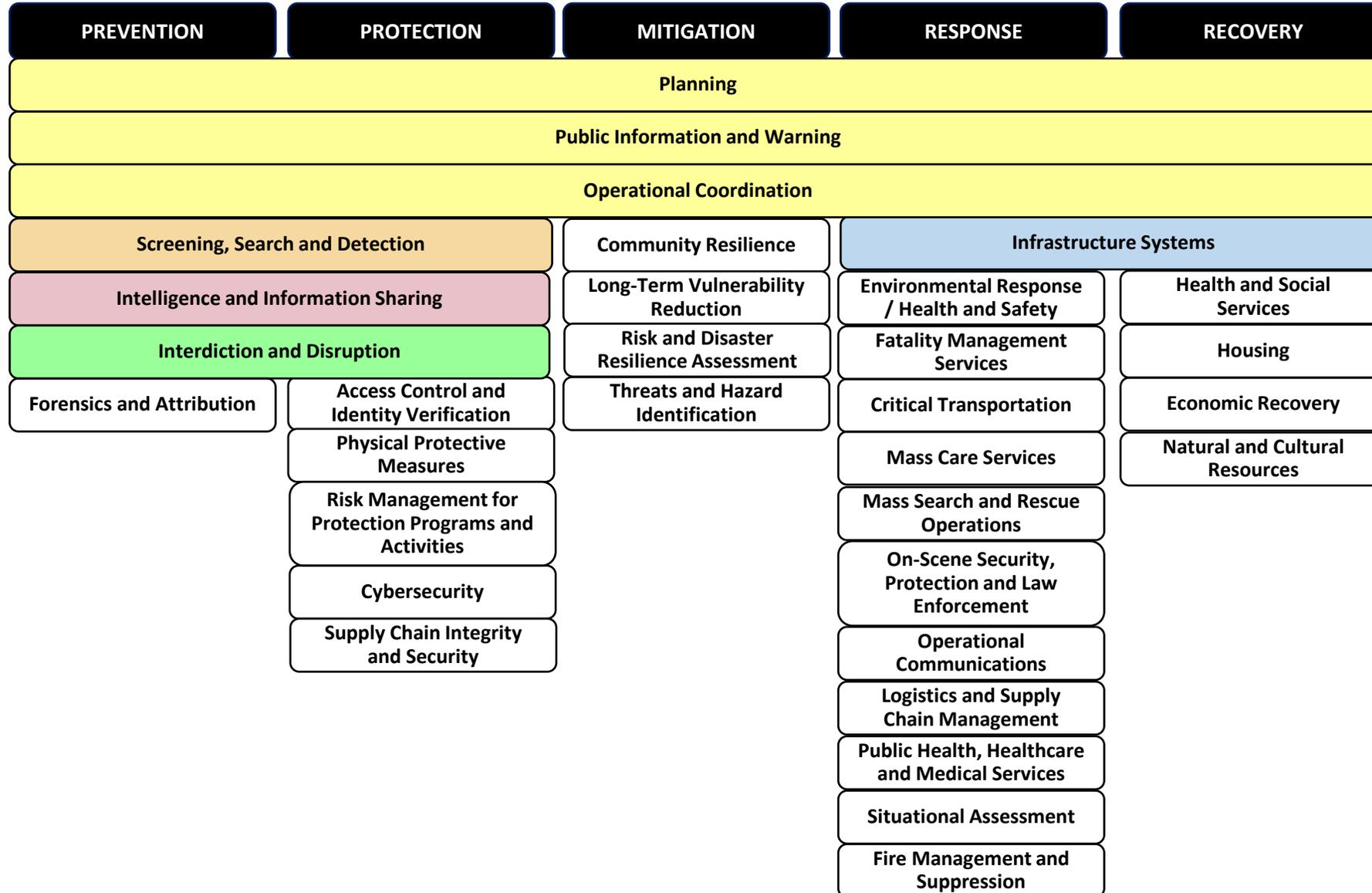




Figure 1: The THIRA Process

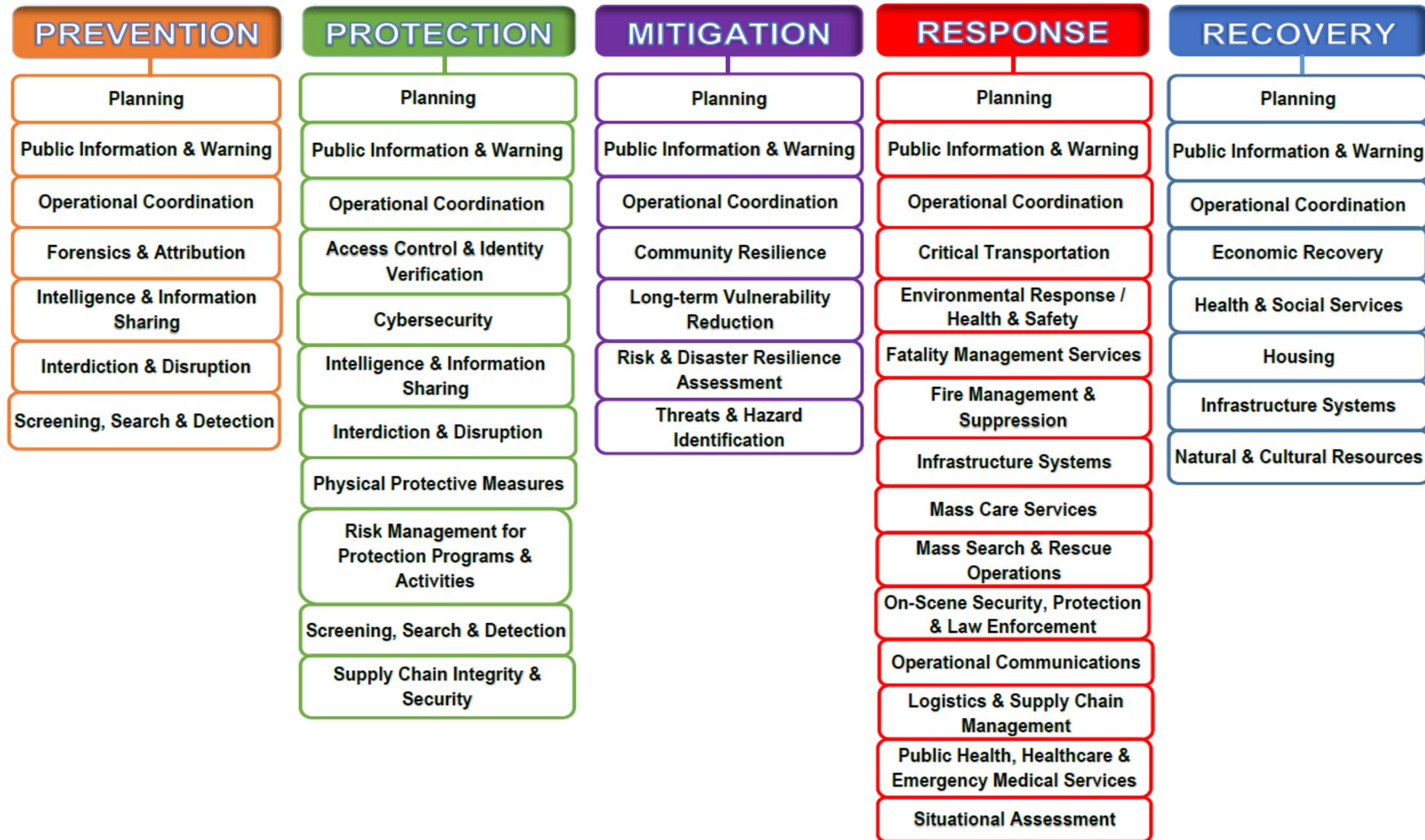
DRAFT Montana Drought Classification Scheme

Drought Level	Drought Impacts	Drought Response
No D (white)	- No immediate impacts, but drought conditions anticipated on a decadal scale anywhere in Montana.	- Research and implement long-term drought mitigation strategies/ local drought planning
D0 (yellow)	- Short-term dry period - CPC soil moisture: 21 to 30 - Precip Anomaly: 70-90% - Temp Anomaly: 1 to 2°F - SPEI: -0.8 to -0.5 - SWE: 70-90% - PDSI: -2 to -1 - Streamflow percentiles: 21 to 30	- Communication with drought-related partners at the county level.
D1 (beige)	- 1 month dry period - CPC soil moisture: 11 to 20 - Precip Anomaly: 50-70% - Temp Anomaly: 2 to 3°F - SPEI: -1.3 to -0.8 - SWE: 50-70% - PDSI: -3 to -2 - Early season runoff - Streamflow percentiles: 11 to 20 - Reservoirs below average	- Communication with drought-related partners at the county level ongoing. - DWSAC recommends counties in D1 form Local Drought Advisory Committees to monitor conditions and collect impact reports.
D2 (Orange)	- 3+ month dry period - CPC soil moisture: 6 to 10 - Precip Anomaly: 25-50% - Temp Anomaly: 3 to 4°F - SPEI: -1.5 to -1.3 - SWE: 25-50% - PDSI: -4 to -3 - Early season runoff - Streamflow percentiles: 6 to 10 - Reservoirs below average	- Local Drought Advisory Committees collect impact reports and provide them to the DWSAC. - If conditions warrant, DWSAC makes recommendation to Governor for disaster declaration (or removal if coming out of drought).
D3 (Red)	- 6+ month dry period - CPC soil moisture: 3 to 5 - Precip Anomaly: 5-25% - Temp Anomaly: 4 to 5°F - SPEI: -2.0 to -1.5 - SWE: 10-25% - PDSI: -5 to -4 - Early season runoff - Streamflow percentiles: 3 to 5 - Reservoirs below average	- Local Drought Advisory Committees continue to collect impact reports and provide them to the DWSAC. - DWSAC requests Governor to declare a state of emergency (or removal if coming out of drought) and investigate available funding sources. - DWSAC assists counties to apply for funding based on impact reports.
D4 (Purple)	- 12+ months no precipitation - CPC soil moisture: 0 to 2 - Precip Anomaly: 0-5% - Temp Anomaly: >5°F - SPEI: -2.0 or less - SWE: <10% - PDSI: -5 or less - Early season runoff - Streamflow percentiles: 0 to 2 - Reservoirs below average	- DWSAC requests Governor to declare a state of emergency (or removal if coming out of drought) and activate (or deactivate) rainy day fund.



Figure 1: The THIRA Process

Core Capabilities within their Mission Areas





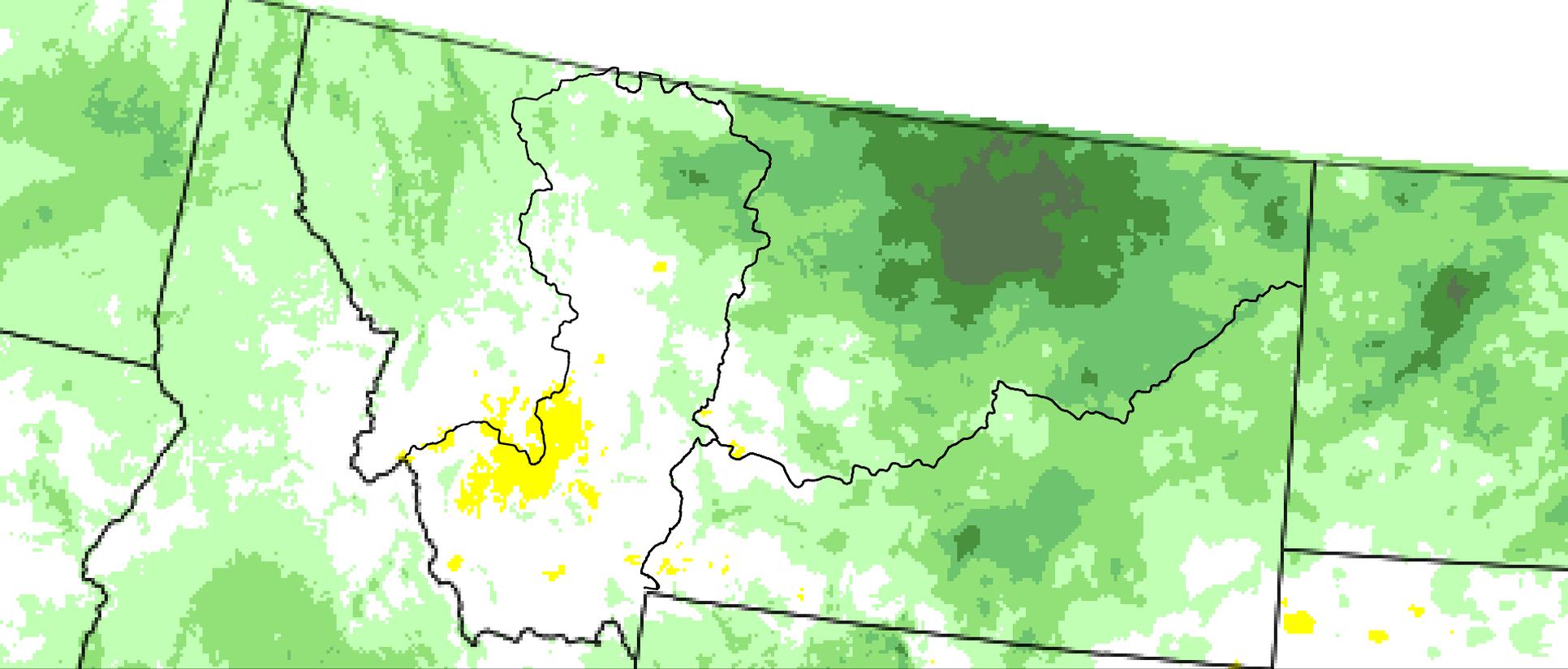
Montana DWSAC Briefing



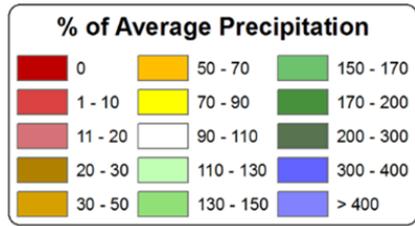
April 28, 2017

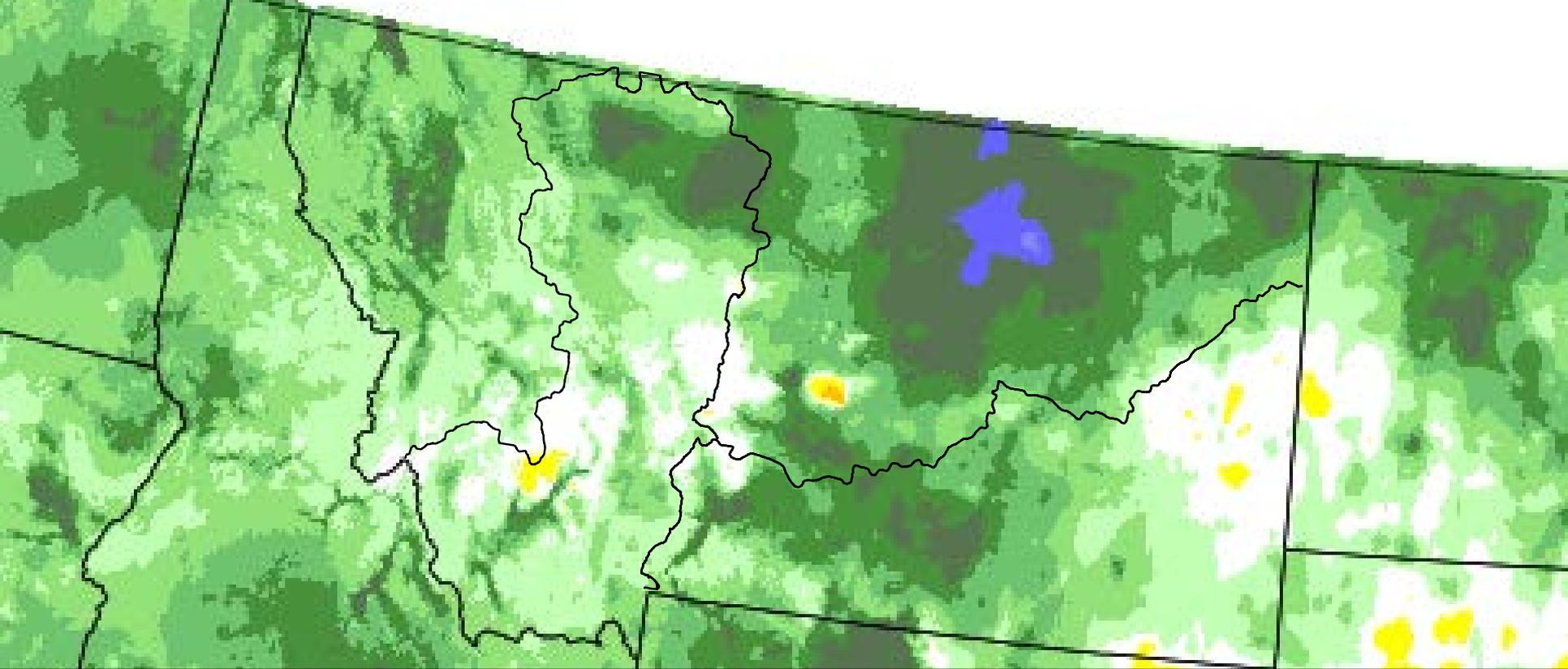


Weather-Ready Nation
National Oceanic and Atmospheric Administration

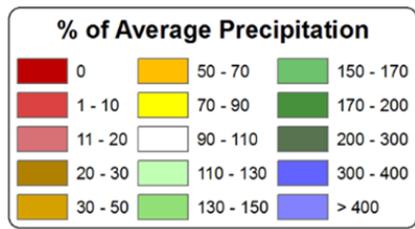


Apr 16 – Mar 17 Precip Anomaly



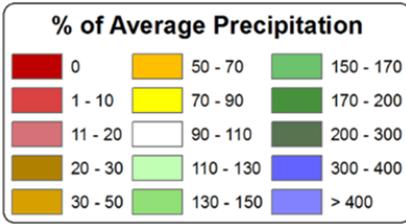
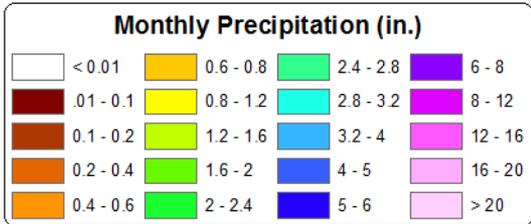
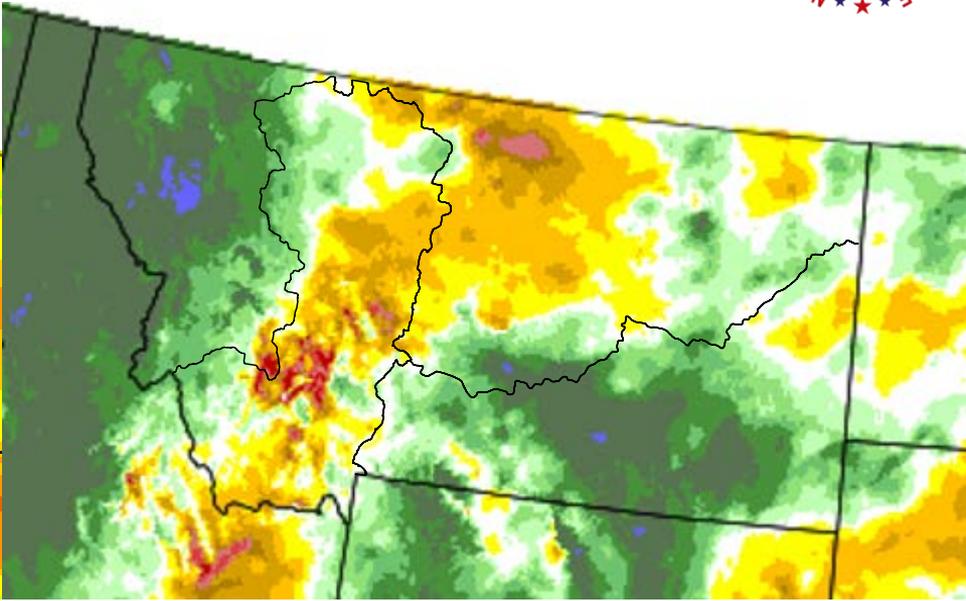
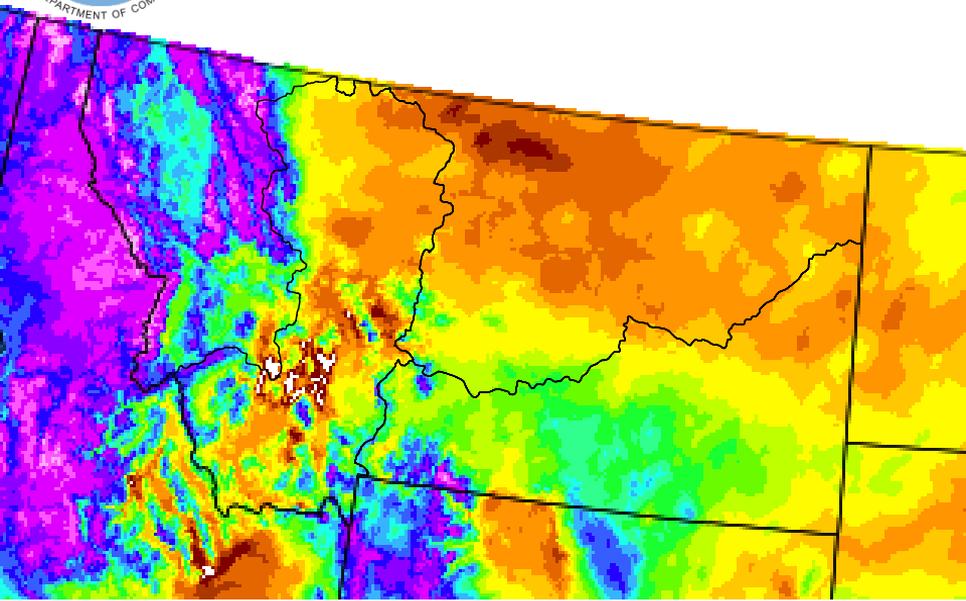


Water Year 2017 Precip Anomaly





March 2017 Precip vs Anomaly





Montana: Apr 2016 – Mar 2017

20th Warmest on Record

Avg Temp	20 th Century Average	Departure
43.2°F	41.2°F	2.0°F

9th Wettest on Record

Precip	20 th Century Average	Departure
22.62"	18.67"	3.95"

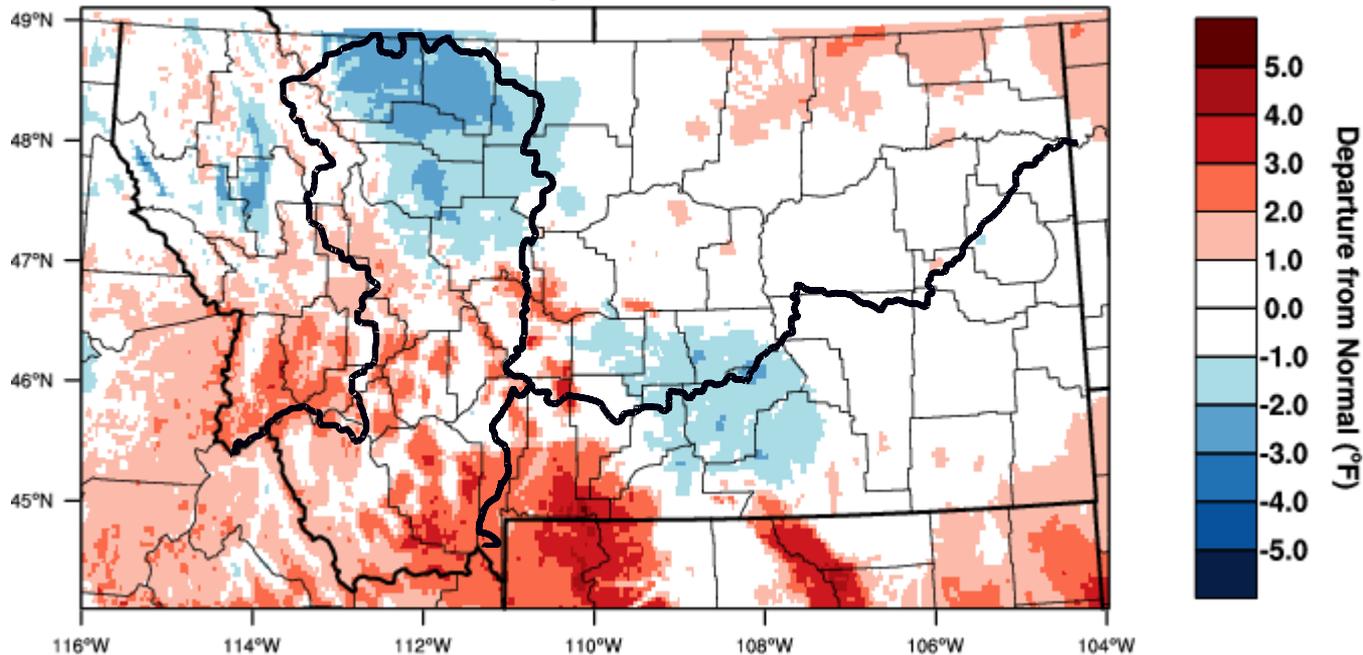


Mean Temperature

Water Year 2017

Montana - Mean Temperature

October-March 2017 Departure from 1981-2010 Normal



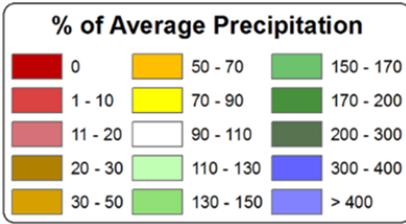
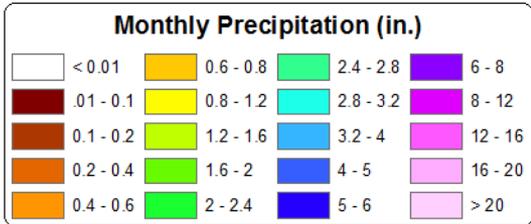
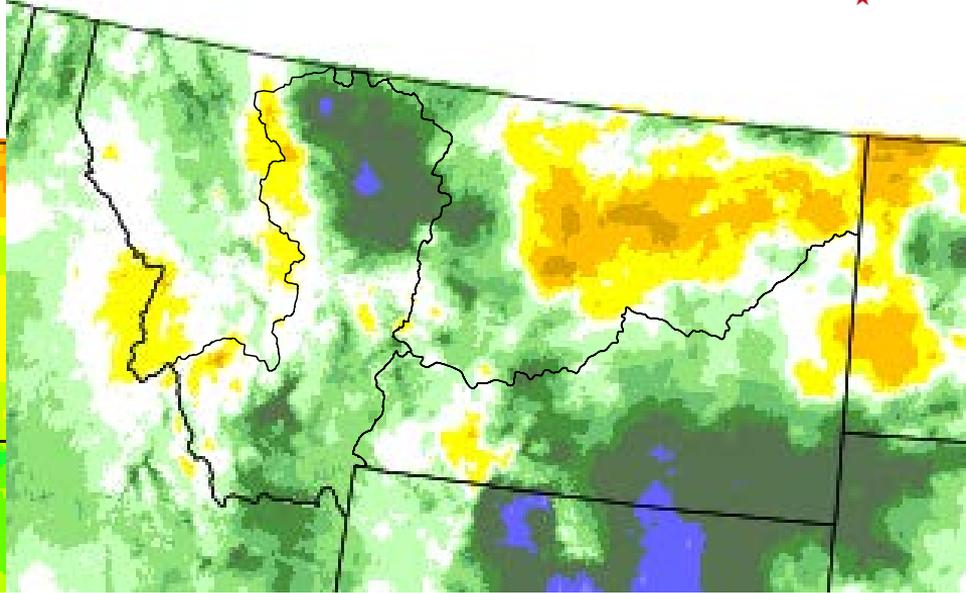
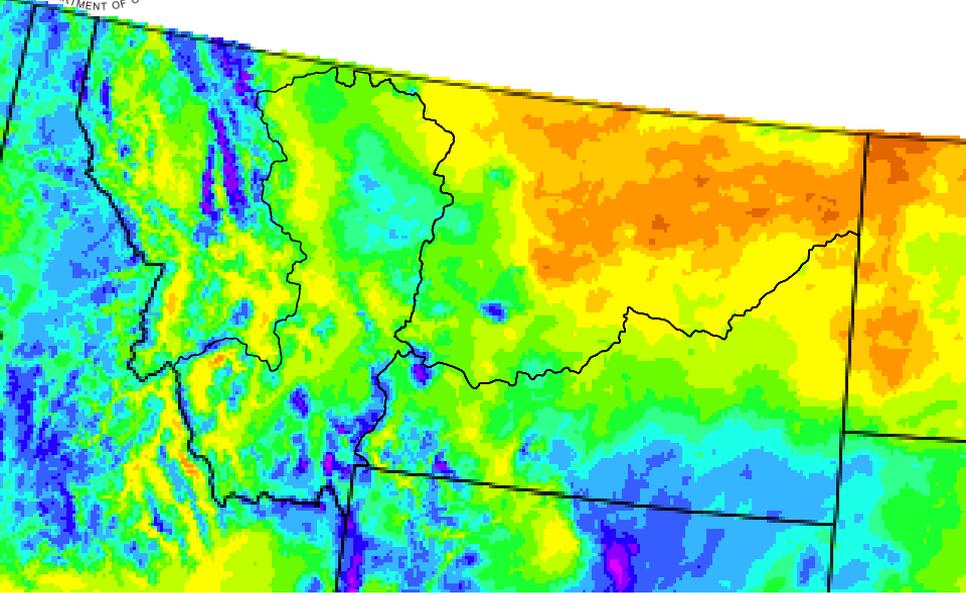
116°W 114°W 112°W 110°W 108°W 106°W 104°W

WestWide Drought Tracker, U Idaho/WRCC Data Source: PRISM (Prelim), created 16 APR 2017



April 2017 Precip vs Anomaly

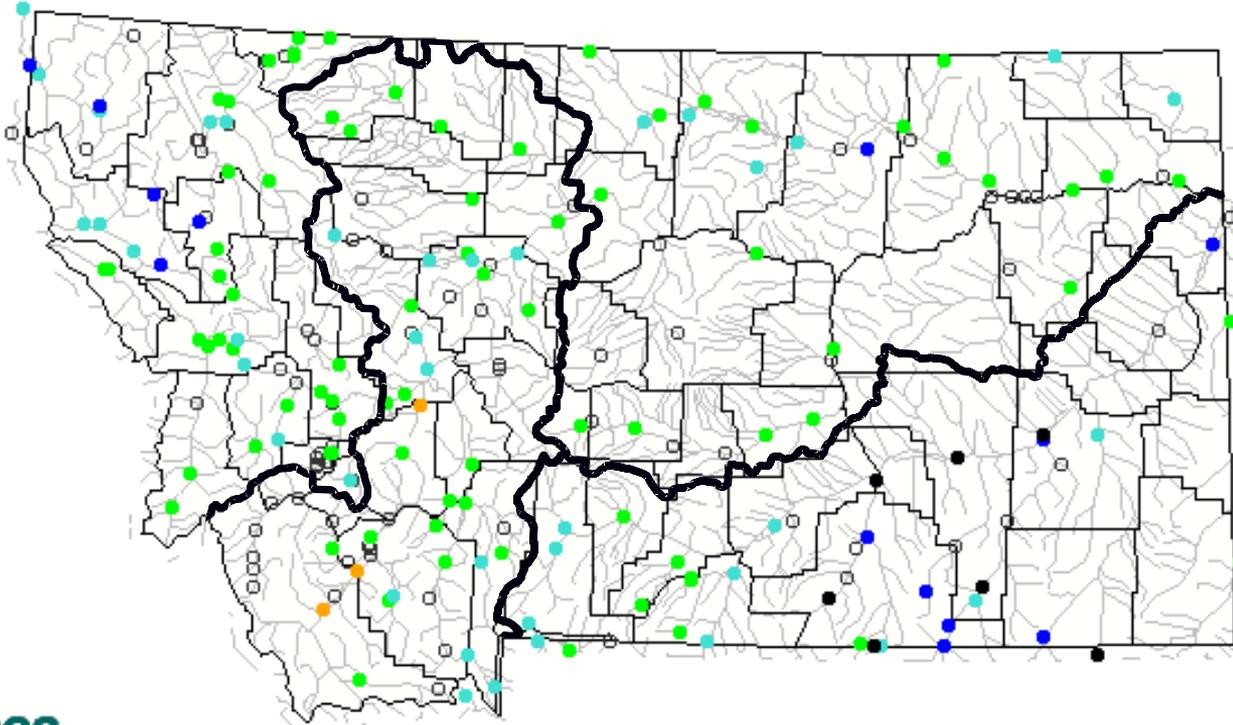
As of April 27, 2017





Stream Gauges

April 27, 2017



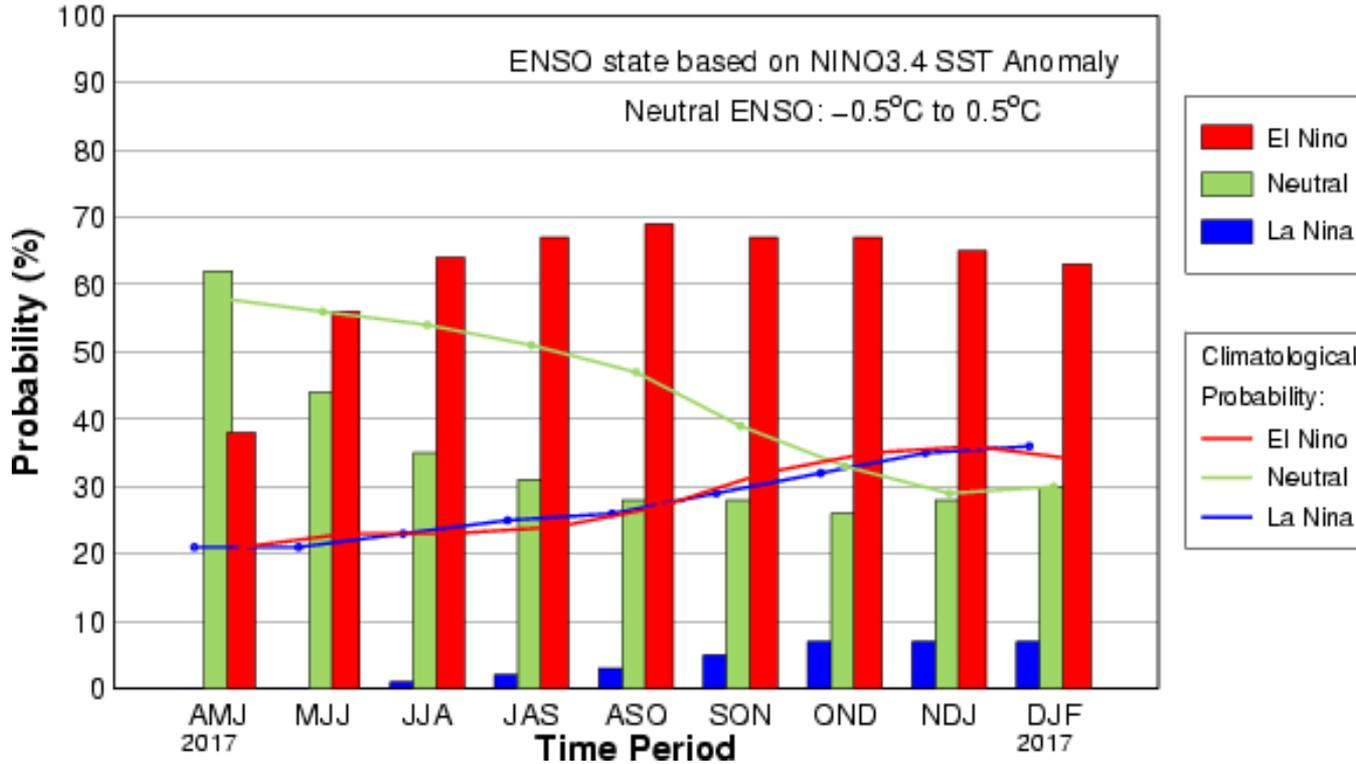
●	Low
●	<10
●	10-24
●	25-75
●	76-90
●	>90
●	High
○	NR



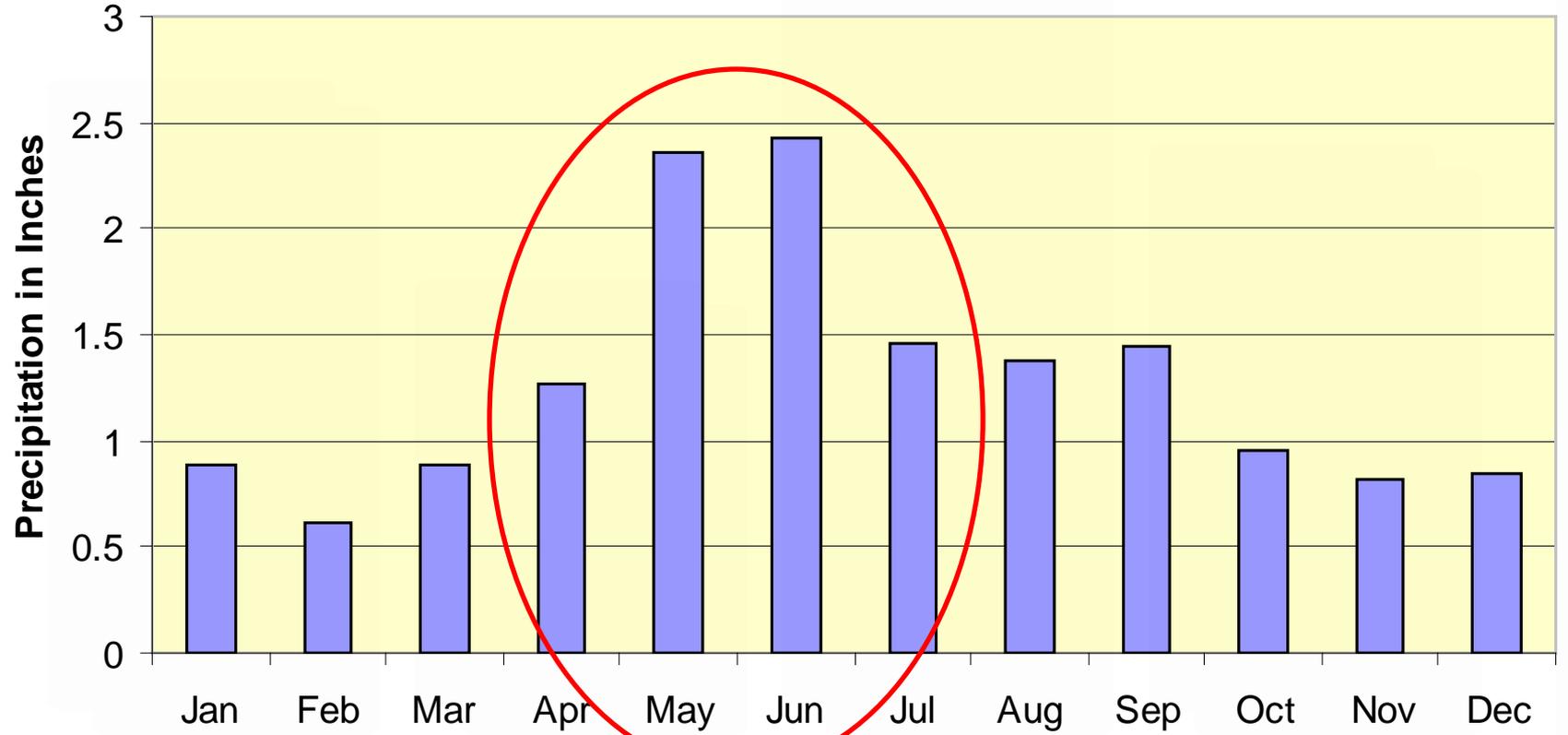
ENSO

El Niño Likely to Return

Mid-Apr IRI/CPC Model-Based Probabilistic ENSO Forecast



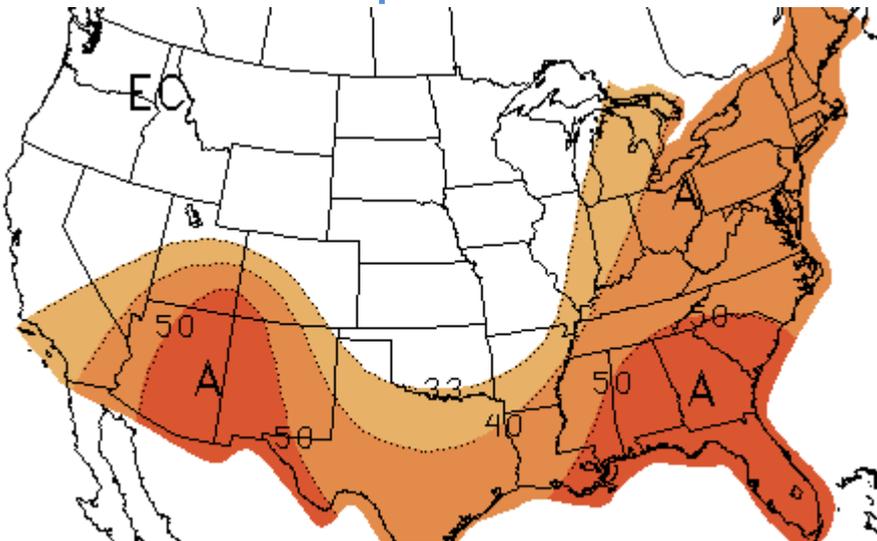
Statewide Average Precip



May Outlook

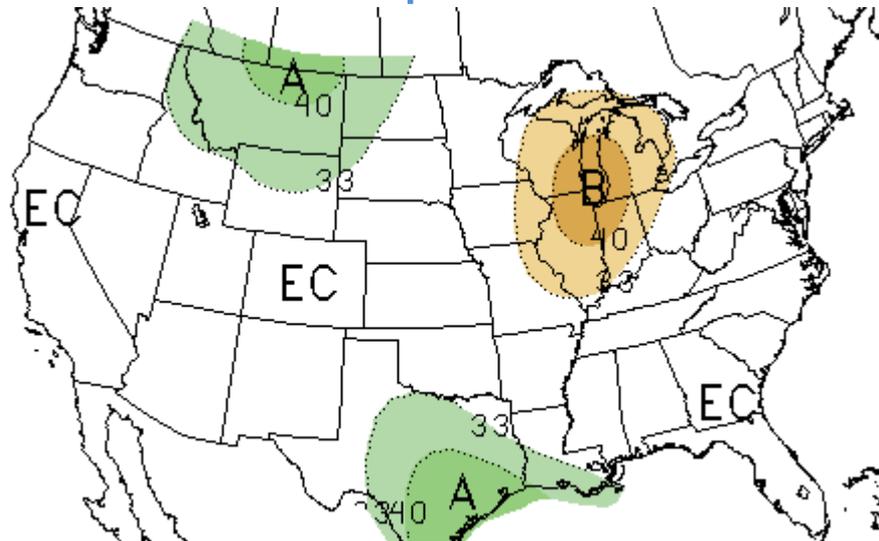
Created April 20

Temperature



Equal chances for above normal or below temperatures over Montana

Precipitation

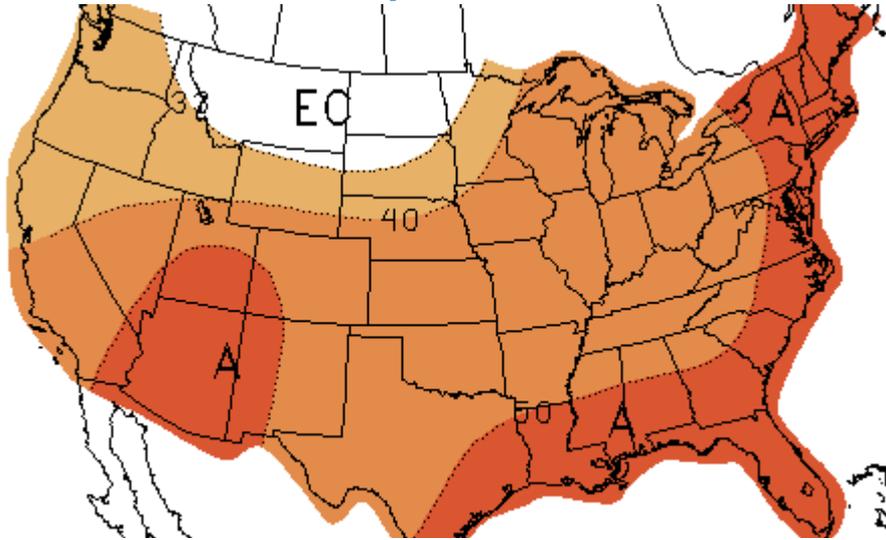


> 33% chance of above normal precipitation over Montana, but 40% chance of above precipitation extreme over northeast Montana

May – July Outlook

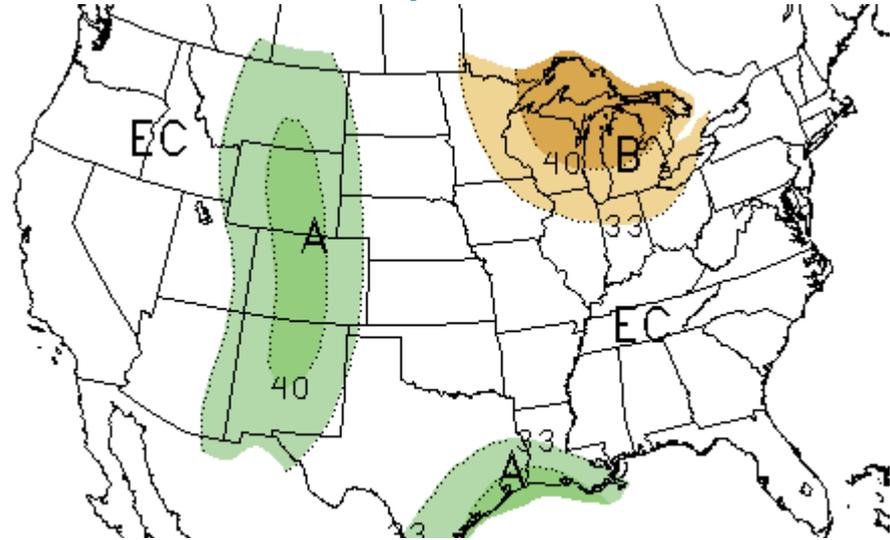
Created April 20

Temperature



Equal chances for above normal or below normal temperatures over most of Montana

Precipitation



> 33% chance of above normal precipitation over most of Montana

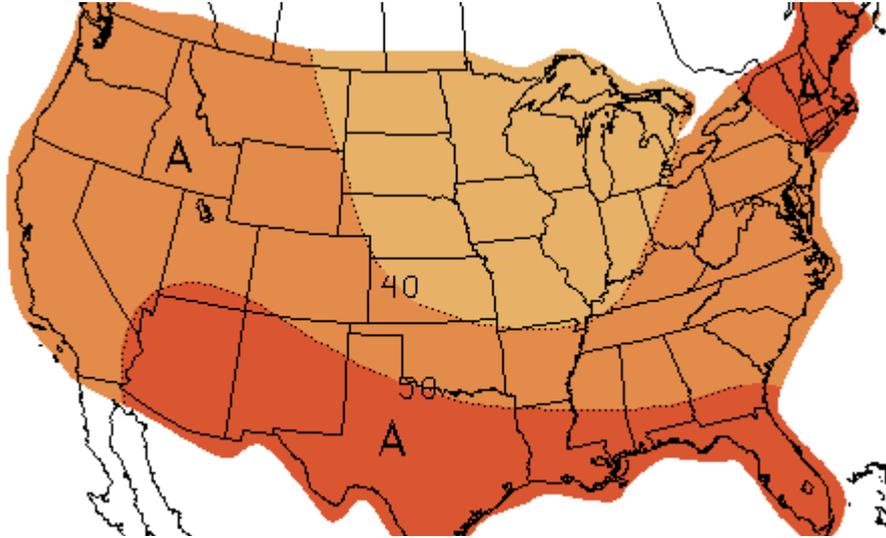


August – October Outlook

Created April 20

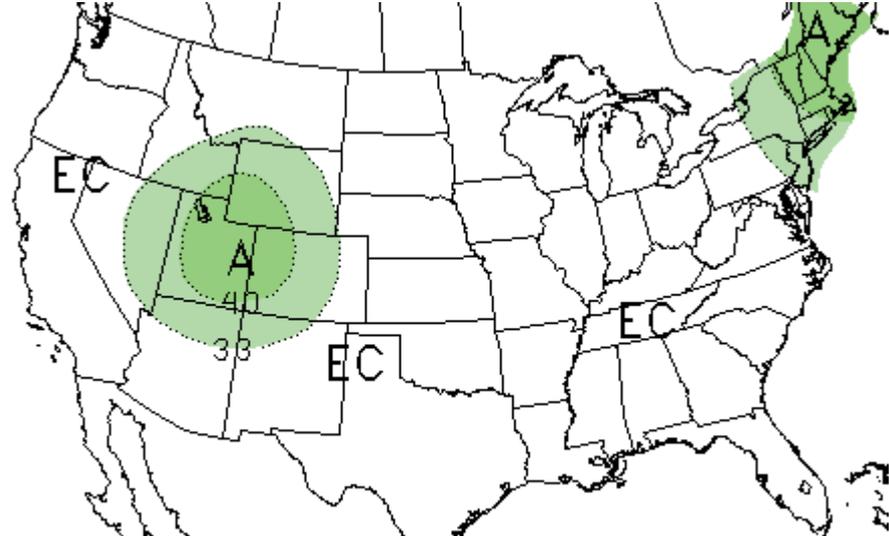


Temperature



40% chance of above normal temperatures over most of Montana

Precipitation



Equal chances of above or below normal precipitation over most of Montana

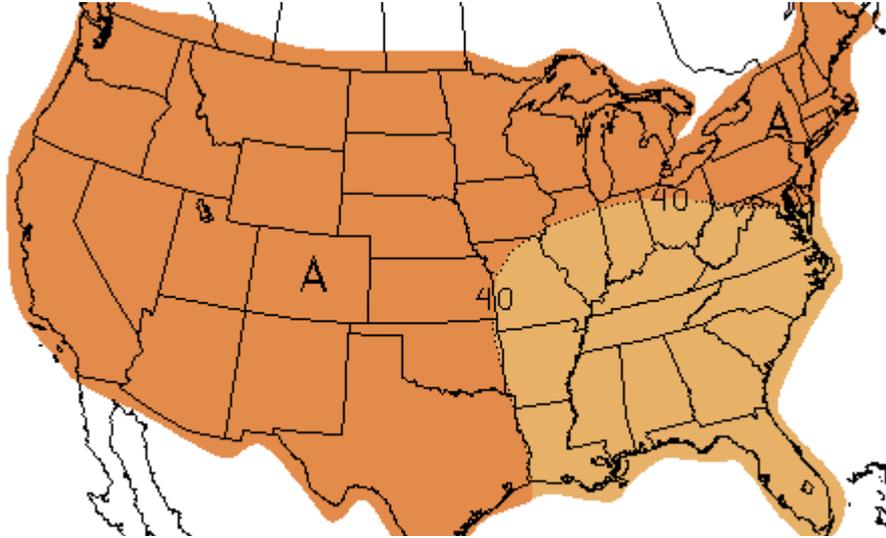


November – January Outlook



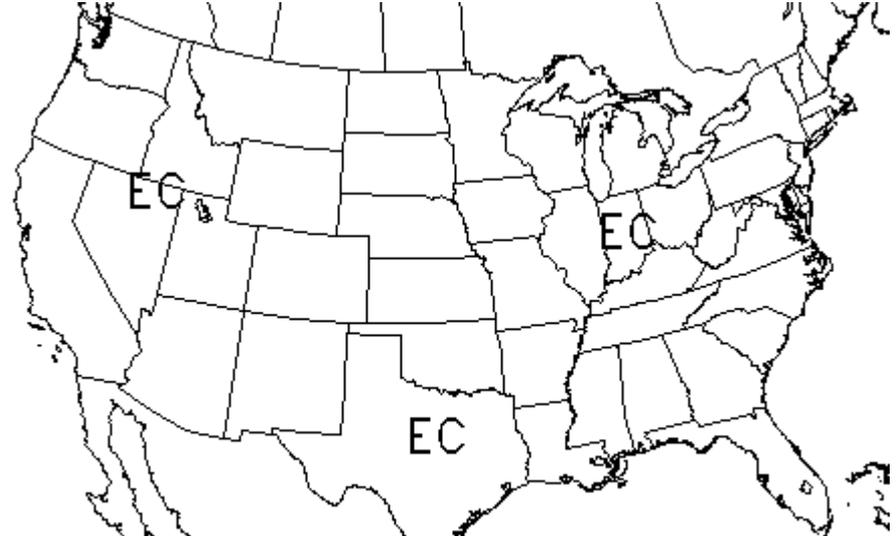
Created April 20

Temperature



33% chance of above normal temperatures statewide

Precipitation



Equal chances of above or below normal precipitation statewide



weather.gov

weather.gov/billings

weather.gov/glasgow

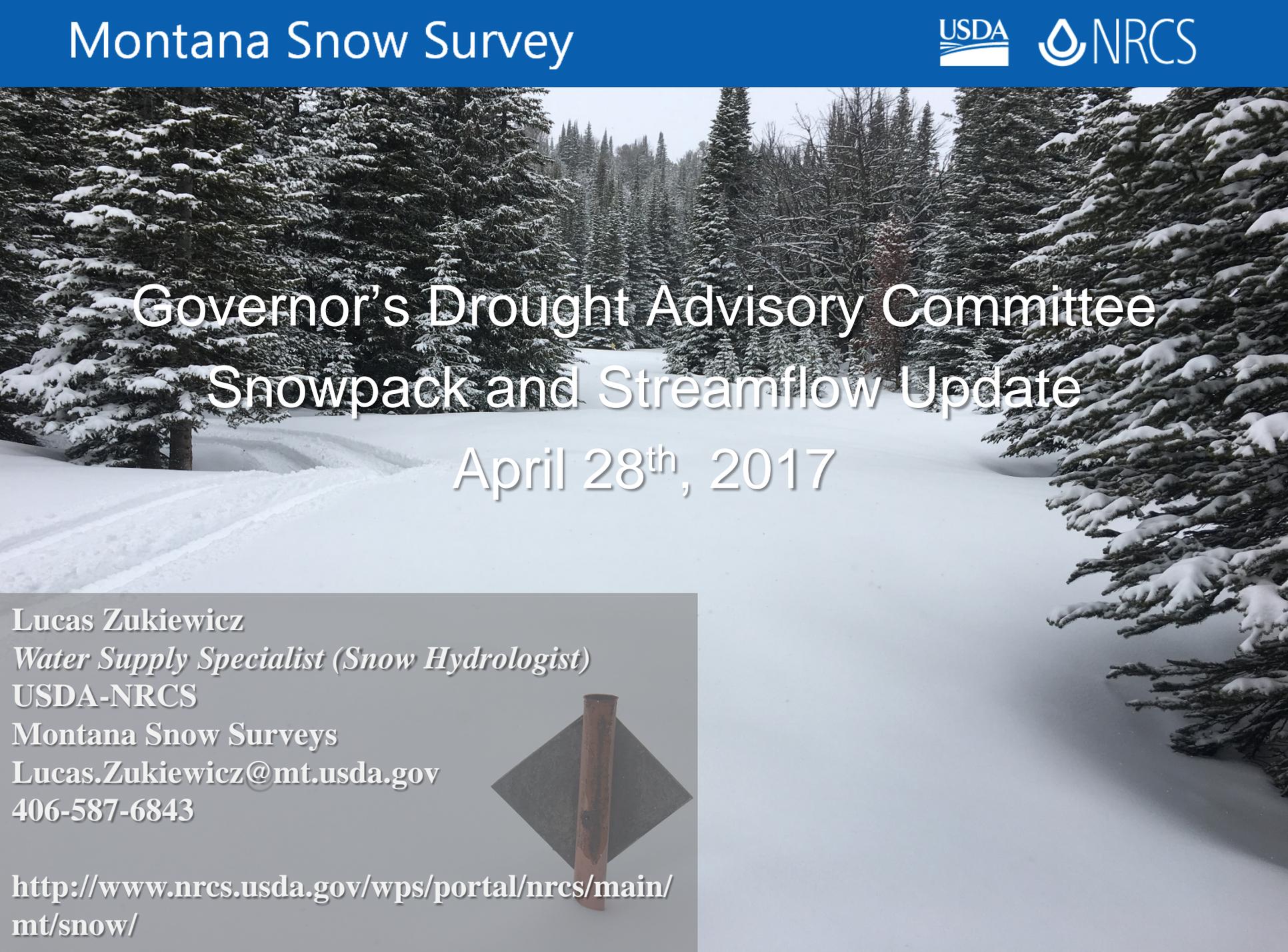
weather.gov/missoula

weather.gov/greatfalls



Weather-Ready Nation

National Oceanic and Atmospheric Administration



Governor's Drought Advisory Committee Snowpack and Streamflow Update April 28th, 2017

Lucas Zukiewicz

Water Supply Specialist (Snow Hydrologist)

USDA-NRCS

Montana Snow Surveys

Lucas.Zukiewicz@mt.usda.gov

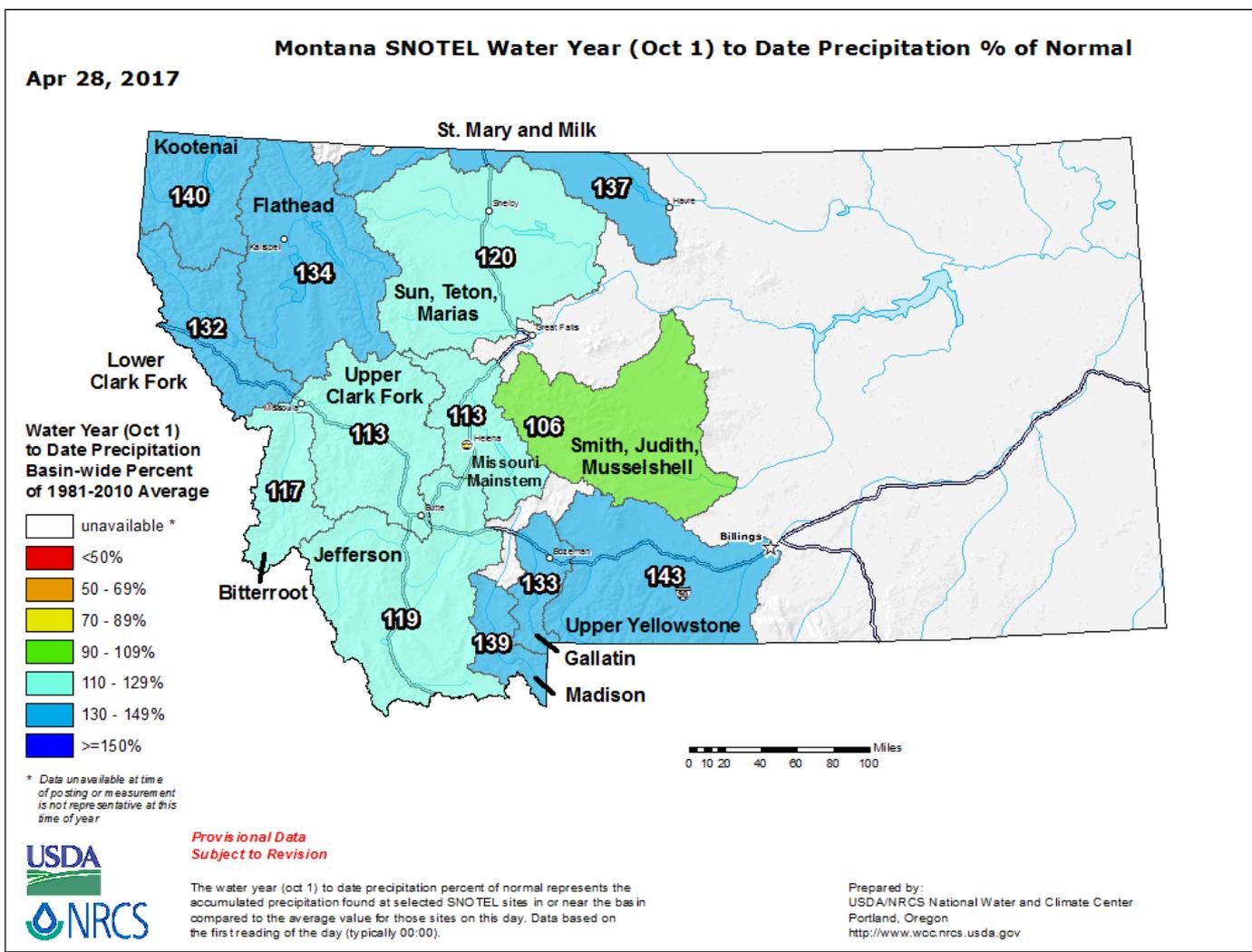
406-587-6843

[http://www.nrcs.usda.gov/wps/portal/nrcs/main/
mt/snow/](http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/)

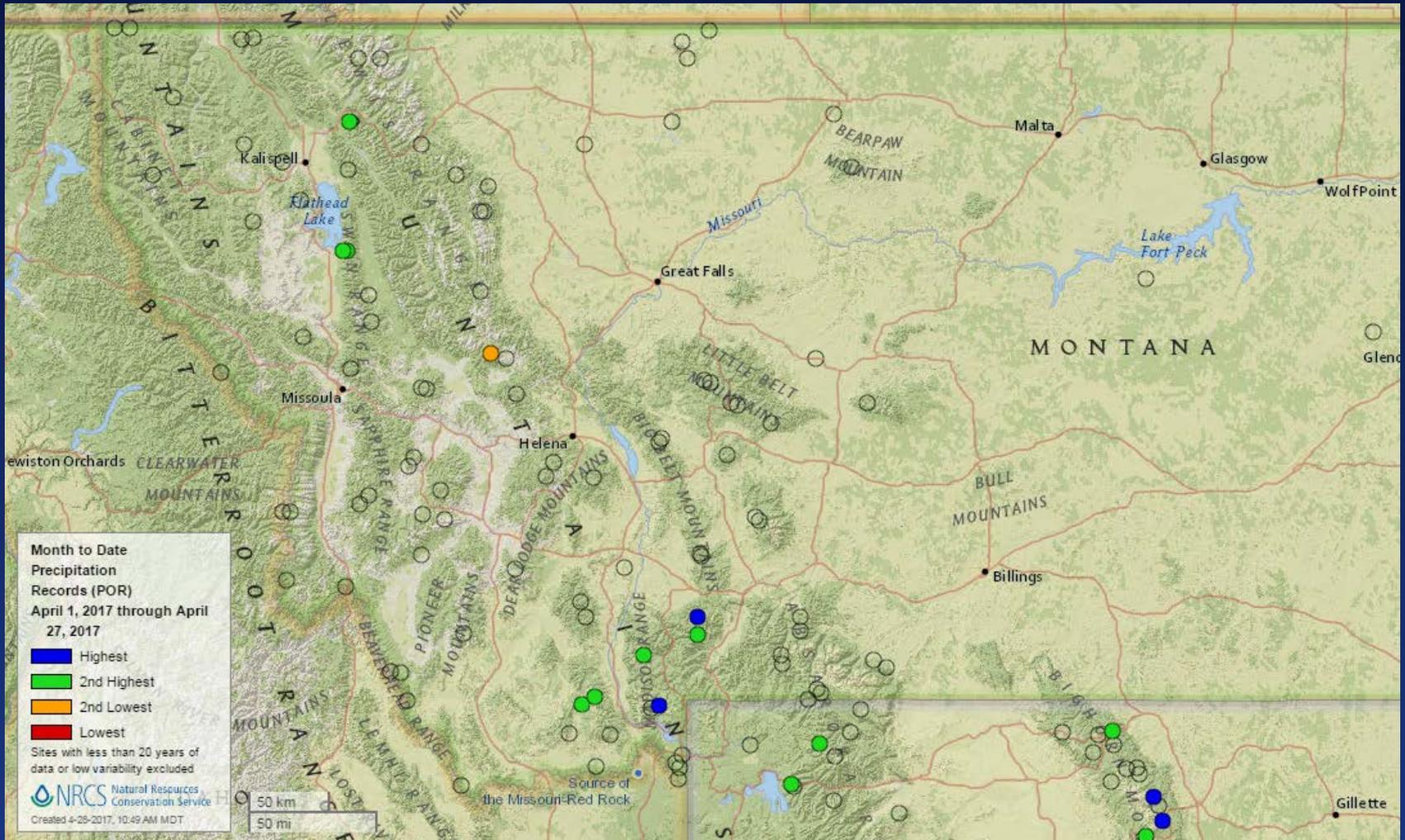


Mountain Precipitation

Water Year-to-Date Mountain Precipitation April 28th, 2017



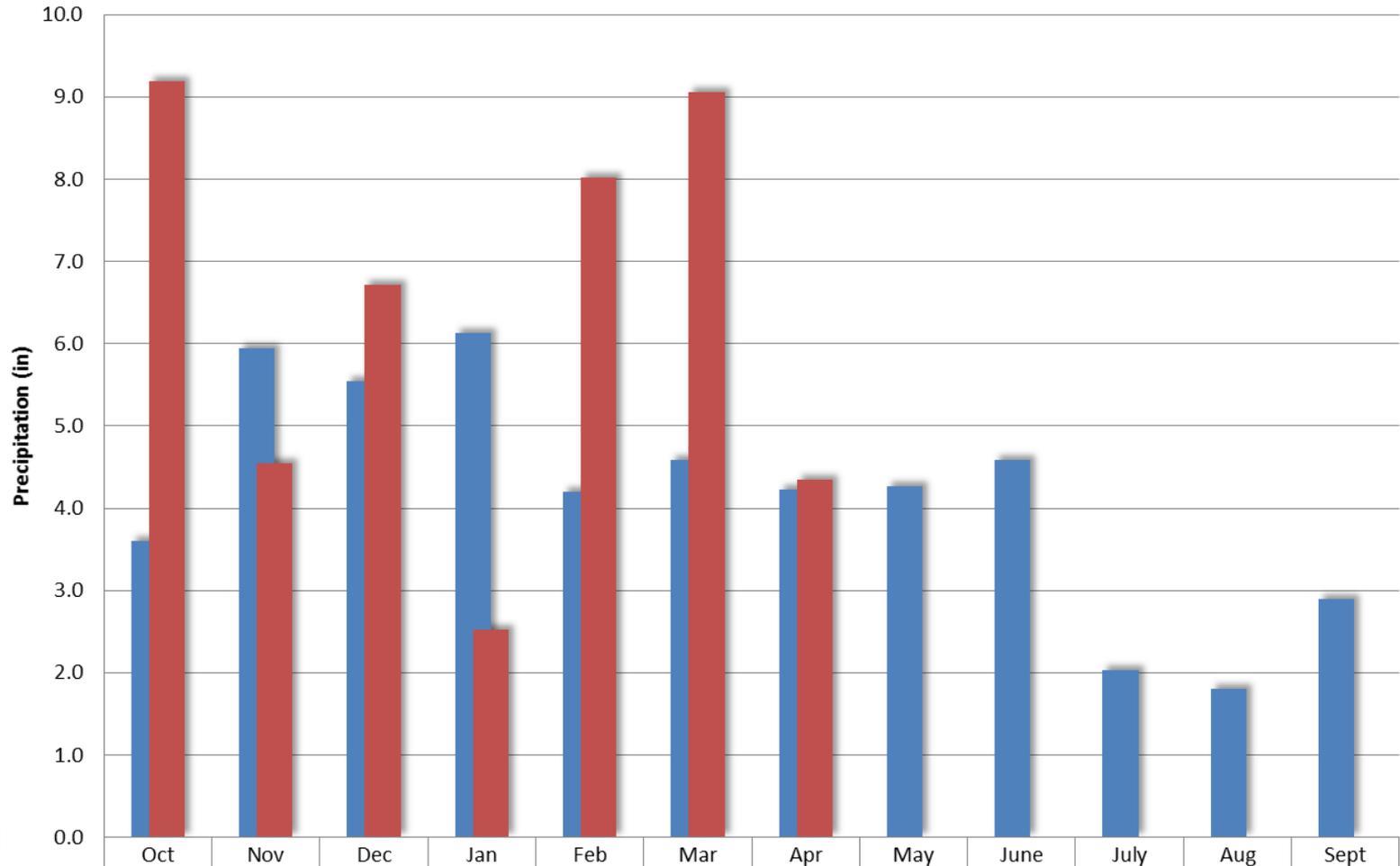
Month-to-Date Mountain Precipitation April 28th, 2017



Flathead in Montana

SNOTEL Monthly Precipitation

4/26/2017 9:22



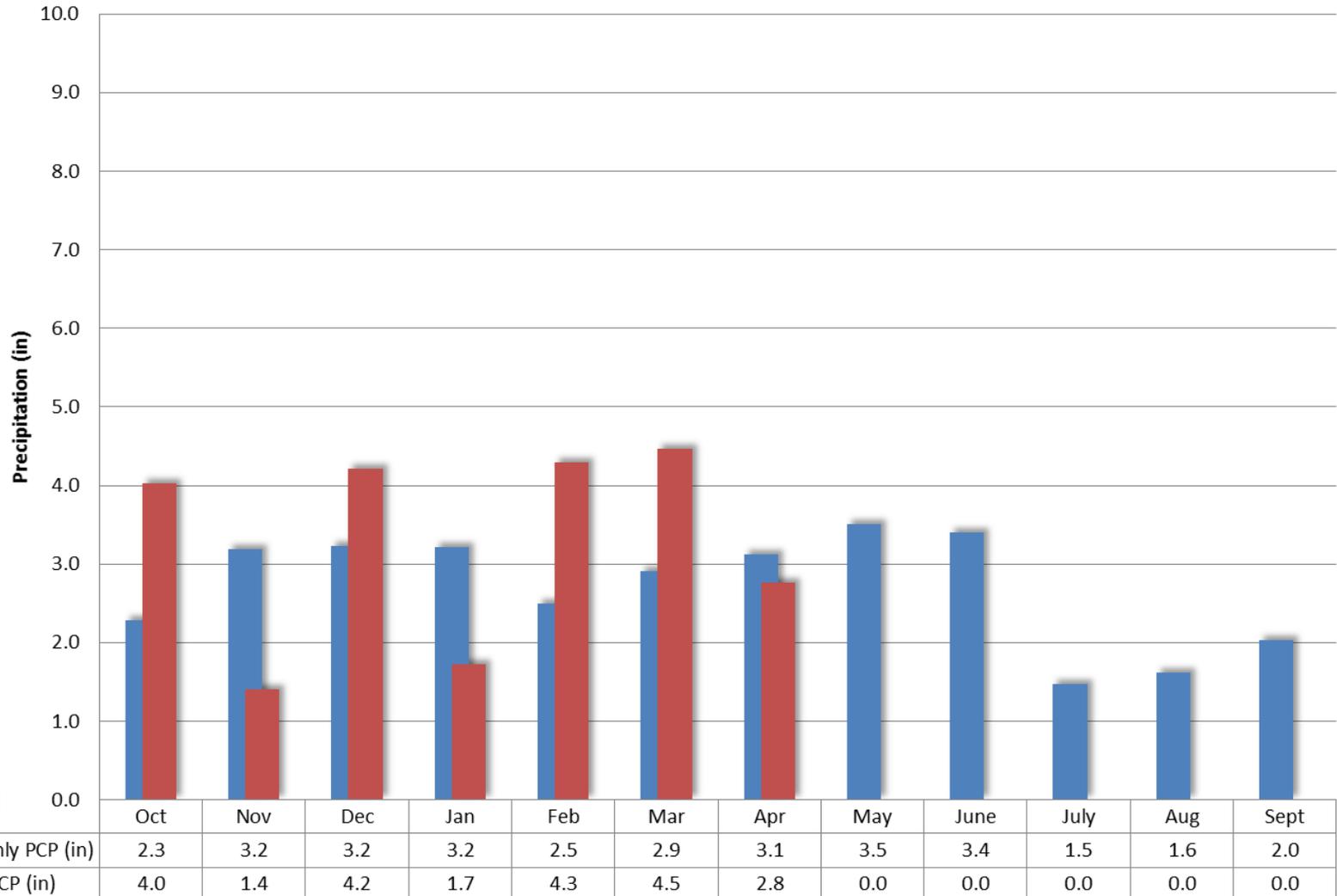
■ Avg Monthly PCP (in)
■ Monthly PCP (in)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Avg Monthly PCP (in)	3.6	6.0	5.5	6.1	4.2	4.6	4.2	4.3	4.6	2.0	1.8	2.9
Monthly PCP (in)	9.2	4.5	6.7	2.5	8.0	9.1	4.3	0.0	0.0	0.0	0.0	0.0

Upper Clark Fork Basin

SNOTEL Monthly Precipitation

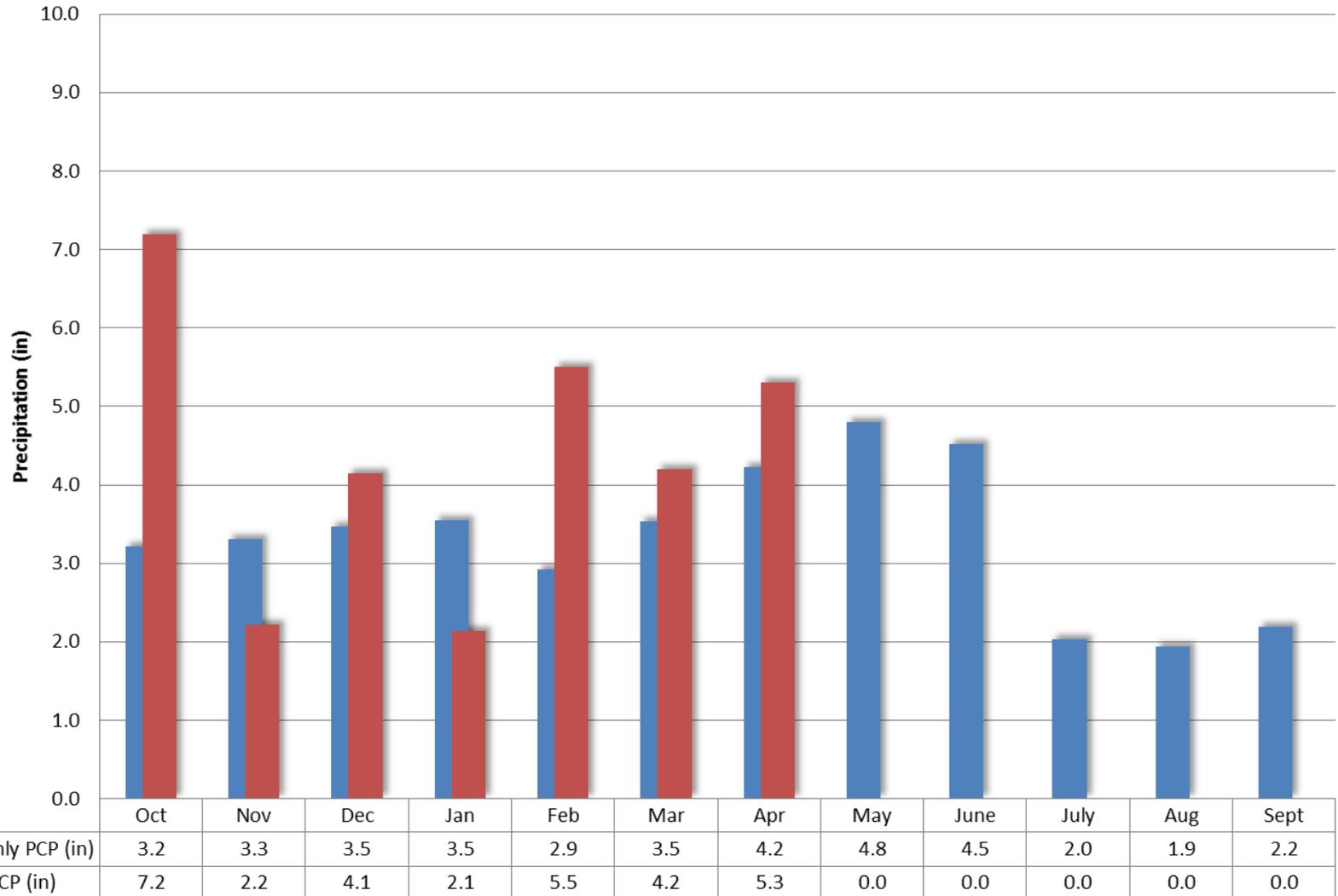
4/26/2017 9:22



Gallatin River Basin

SNOTEL Monthly Precipitation

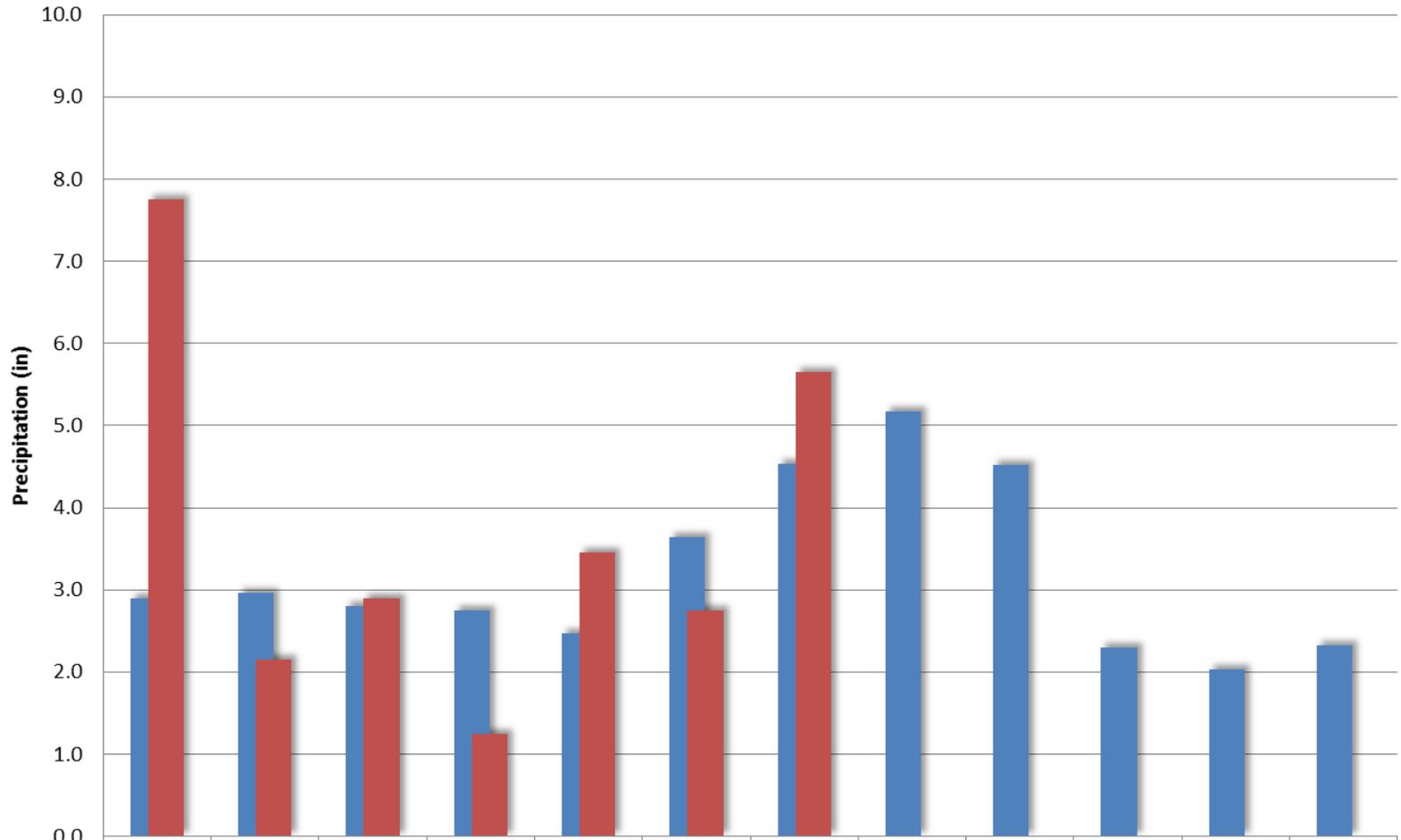
4/26/2017 9:22



Hyalite

SNOTEL Monthly Precipitation

4/26/2017 9:22

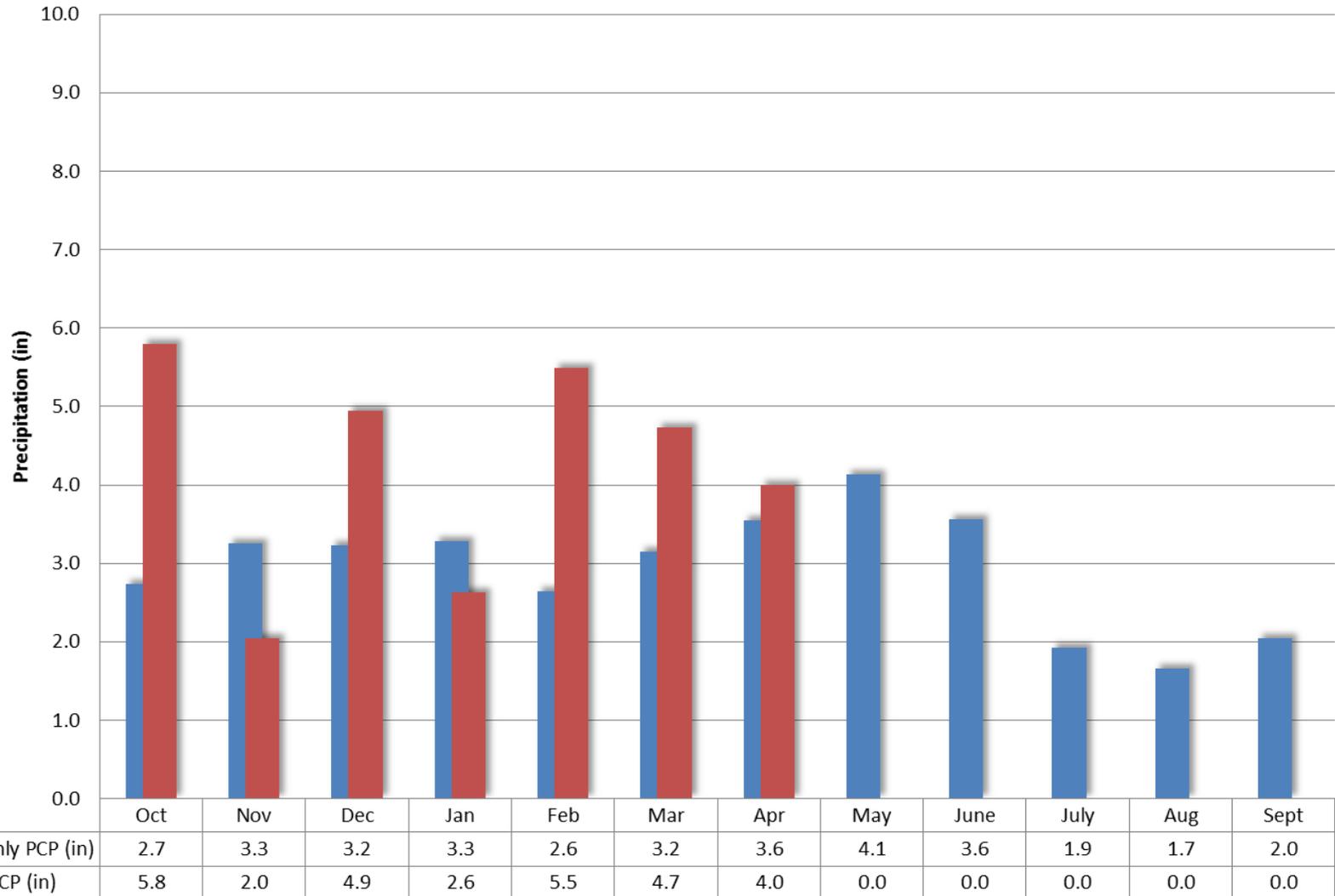


■ Avg Monthly PCP (in)	2.9	3.0	2.8	2.8	2.5	3.6	4.5	5.2	4.5	2.3	2.0	2.3
■ Monthly PCP (in)	7.8	2.2	2.9	1.3	3.5	2.8	5.7	0.0	0.0	0.0	0.0	0.0

Upper Yellowstone

SNOTEL Monthly Precipitation

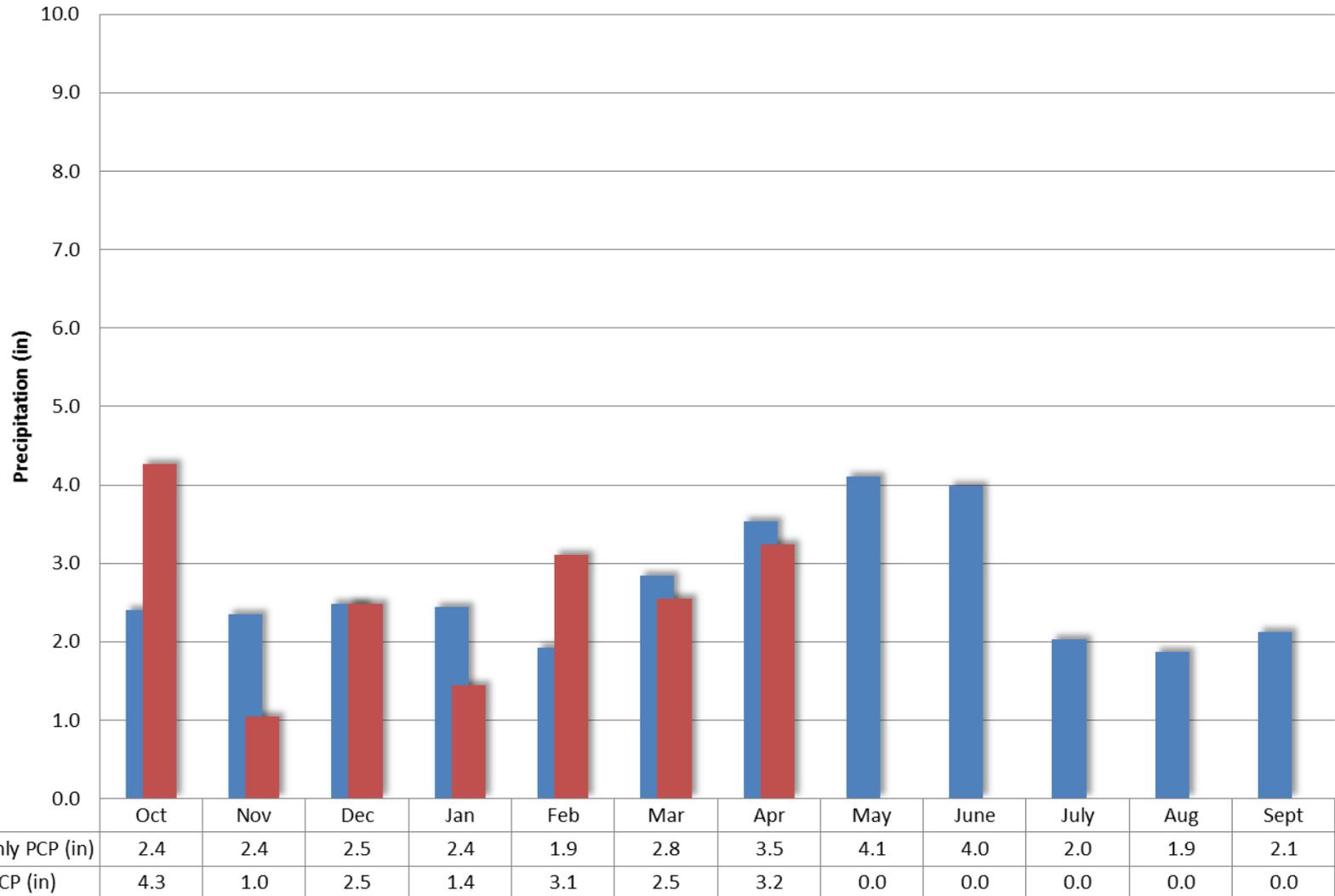
4/26/2017 9:22



Smith-Judith-Musselshell

SNOTEL Monthly Precipitation

4/26/2017 9:22

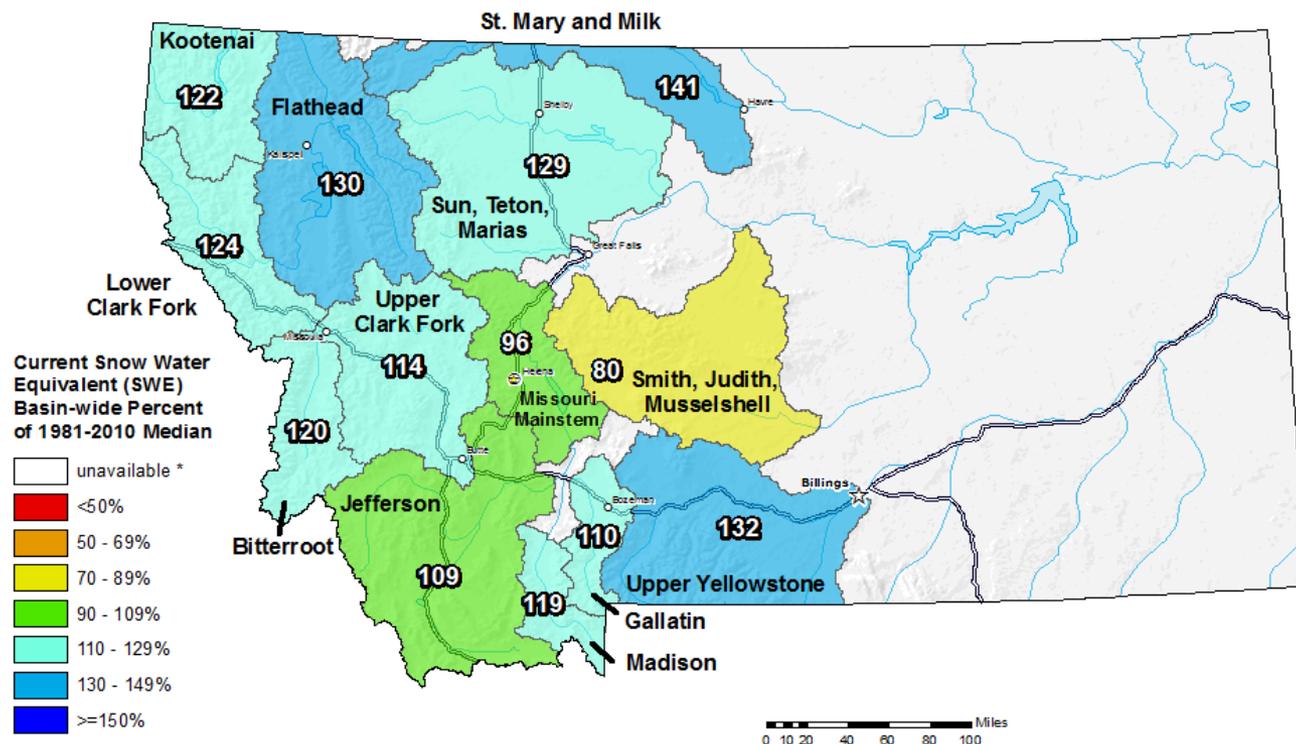


Snowpack

Snowpack Percentages April 28th, 2017

Apr 28, 2017

Montana SNOTEL Current Snow Water Equivalent (SWE) % of Normal



* Data unavailable at time of posting or measurement is not representative at this time of year

*Provisional Data
Subject to Revision*

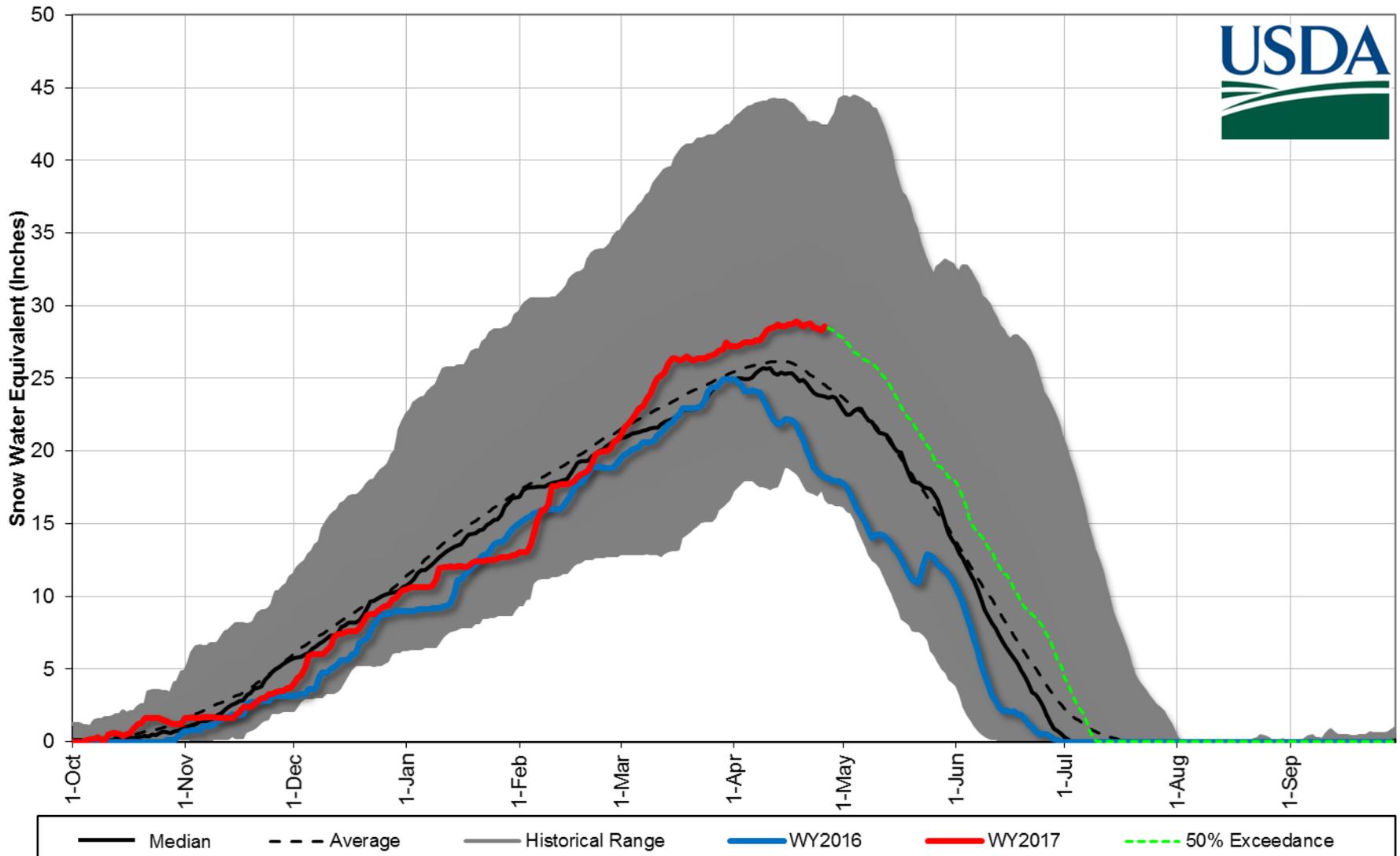


The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

Prepared by:
USDA/NRCS National Water and Climate Center
Portland, Oregon
<http://www.wcc.nrcs.usda.gov>

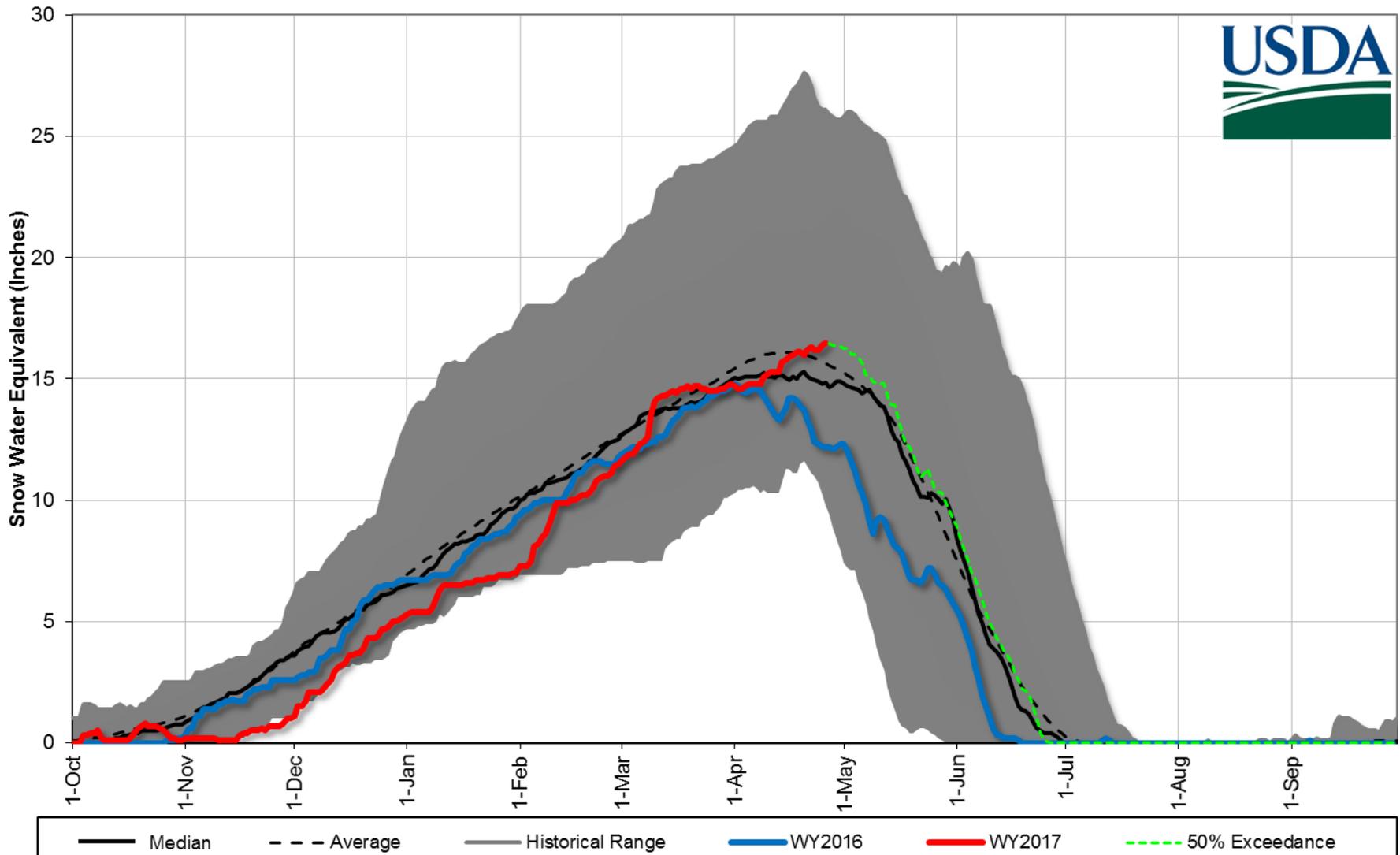
Flathead River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTEL daily data as of 4/26/2017



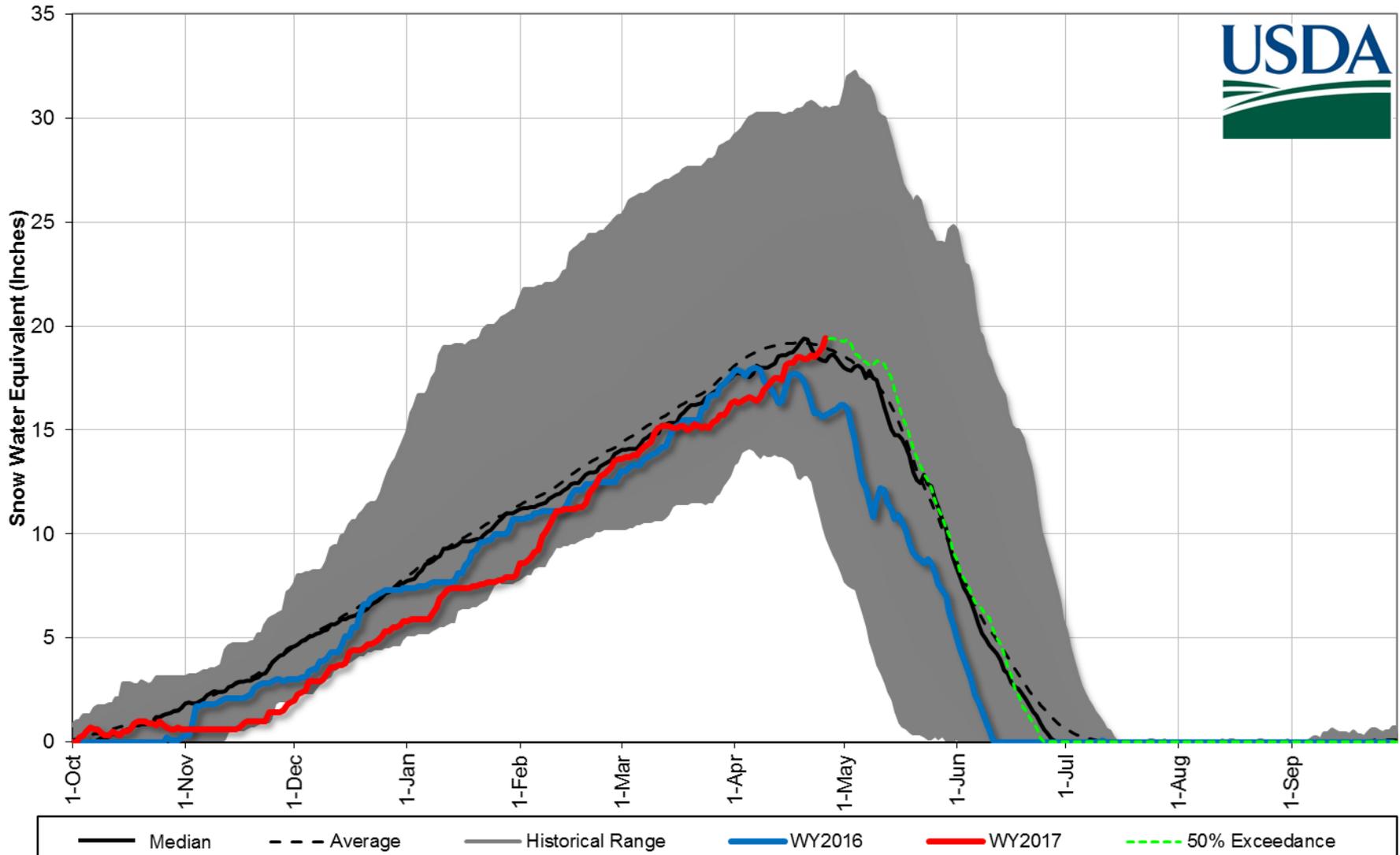
Upper Clark Fork River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTEL daily data as of 4/26/2017



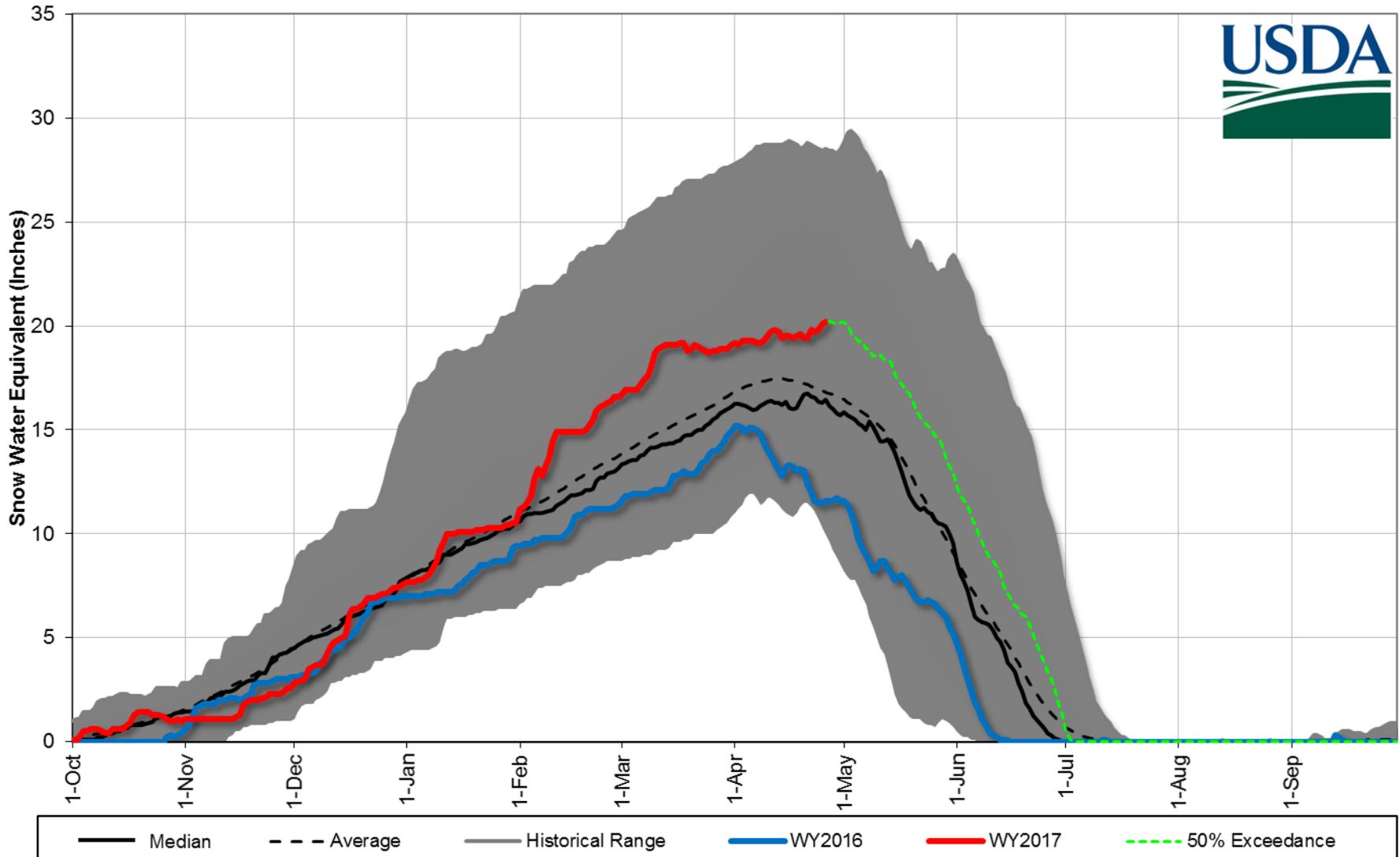
Gallatin River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTEL daily data as of 4/26/2017



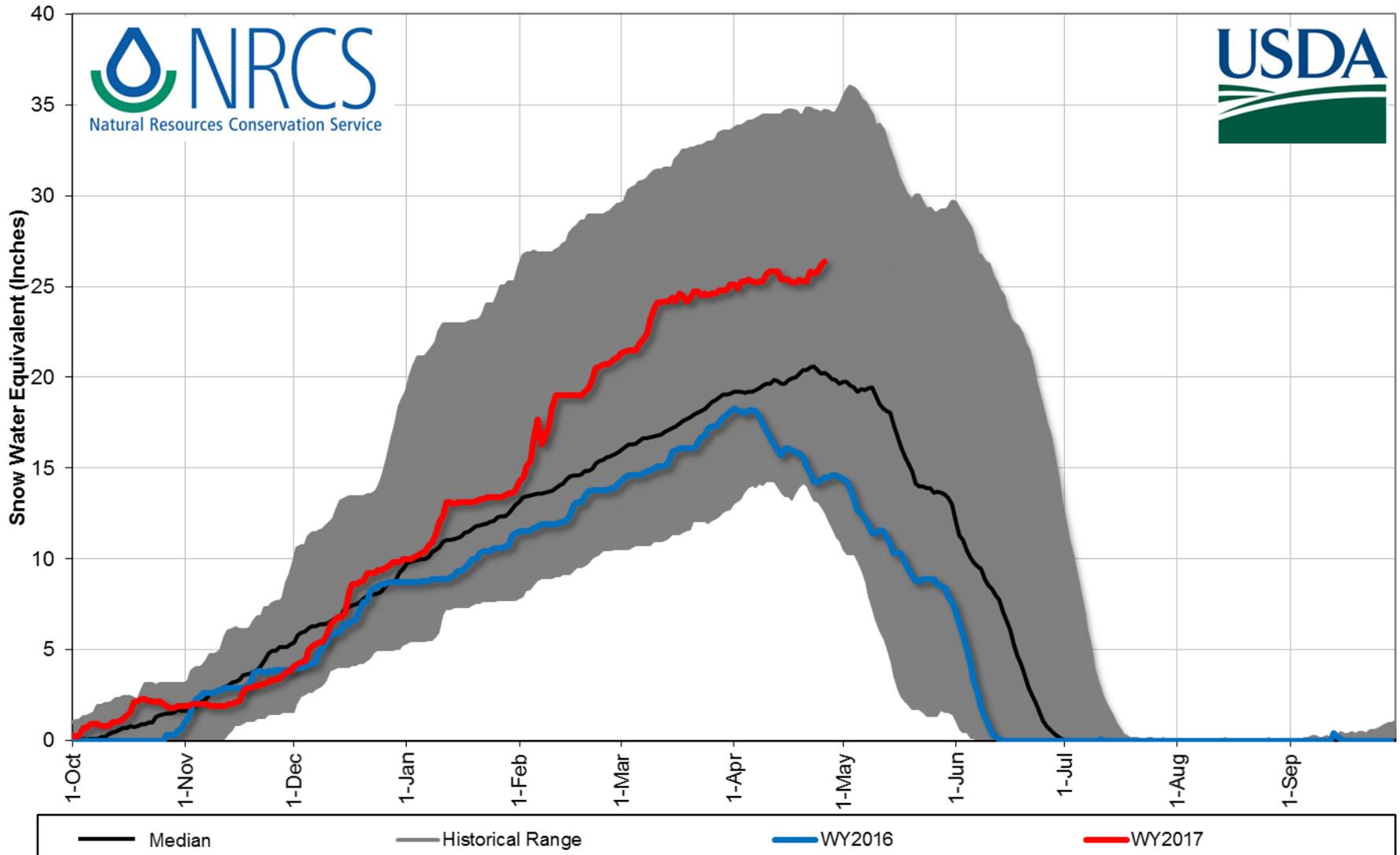
Upper Yellowstone River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTEL daily data as of 4/26/2017



Upper Yellowstone River Basin above Livingston, MT Snowpack with Non-Exceedence Projections

Based on SNOwpack TELemetry (SNOTEL) daily data as of 4/26/2017



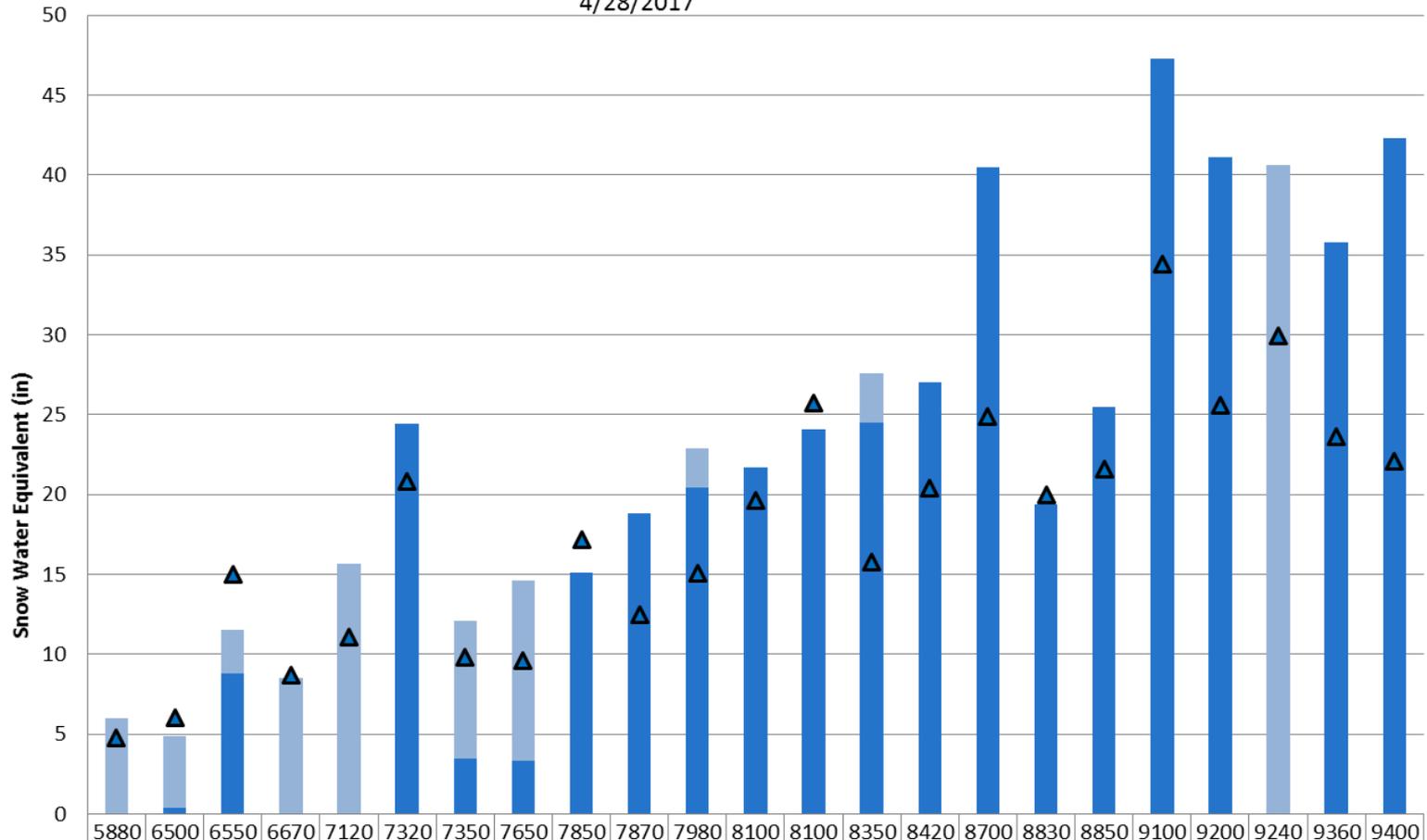
Montana Snow Survey



Upper Yellowstone

Percent Remaining Snowpack

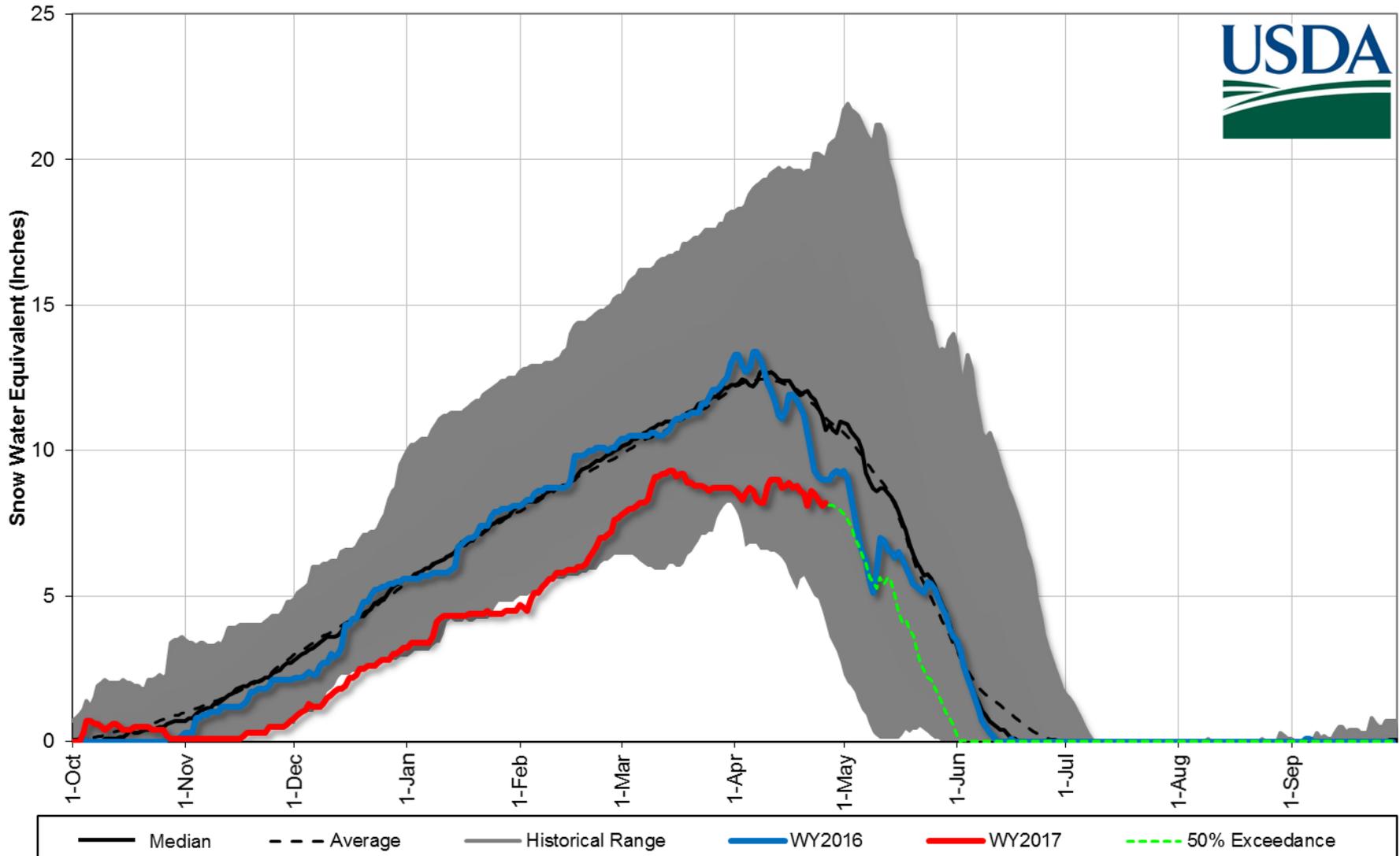
4/28/2017



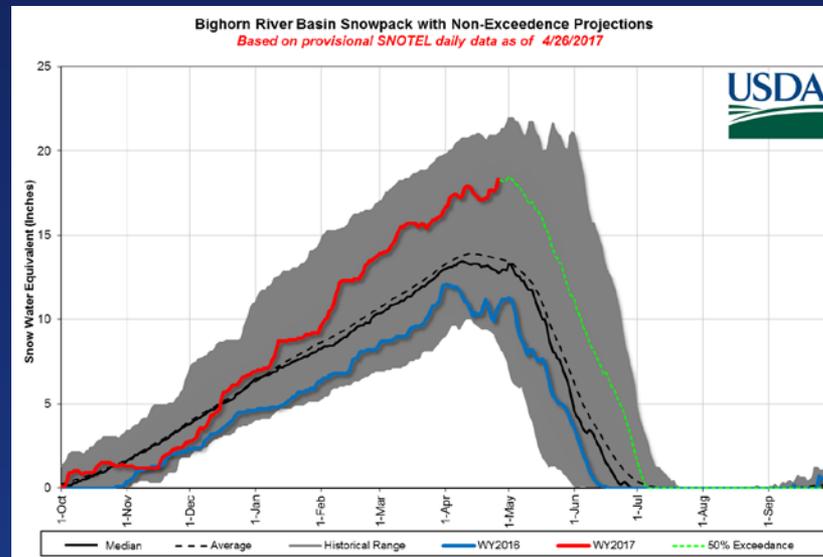
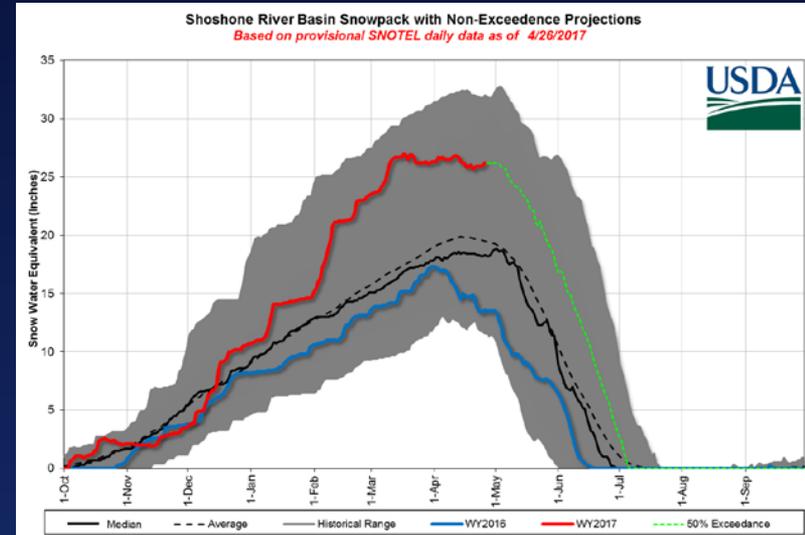
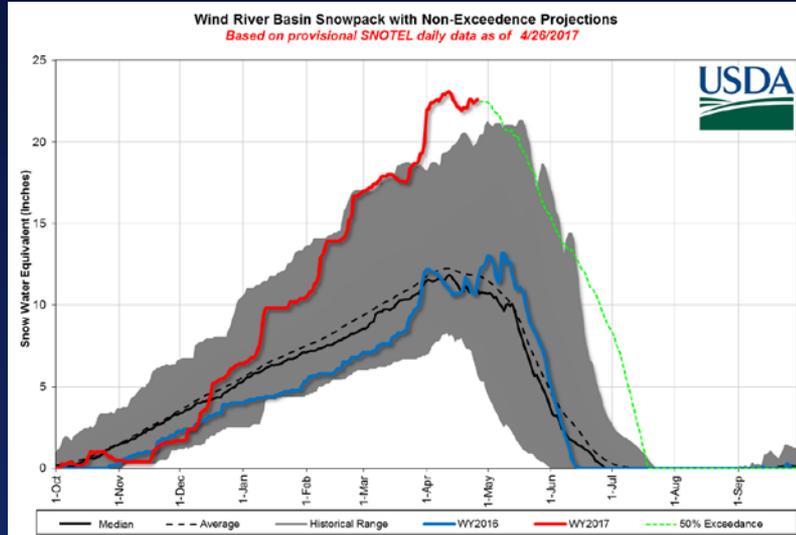
■ Peak SWE	6	4.9	11.5	8.5	15.7	24.4	12.1	14.6	15.1	18.8	22.9	21.7	24.1	27.6	27	40.5	19.4	25.5	47.3	41.1	40.6	35.8	42.3
■ Current SWE	0	0.4	8.8	0	0	24.4	3.5	3.3	15.1	18.8	20.4	21.7	24.1	24.5	27	40.5	19.4	25.5	47.3	41.1		35.8	42.3
▲ Normal Peak	4.8	6.0	15.0	8.7	11.1	20.8	9.8	9.6	17.2	12.5	15.1	19.6	25.7	15.8	20.4	24.9	20.0	21.6	34.4	25.6	29.9	23.6	22.1
Percent Remaining	0%	8%	77%	0%	0%	100%	29%	23%	100%	100%	89%	100%	100%	89%	100%	100%	100%	100%	100%	100%		100%	100%
Percent of Normal		27%	76%	0%	0%	120%	80%	79%	93%	166%	149%	121%	101%	161%	133%	170%	109%	123%	143%	166%		154%	195%

Smith-Judith-Musselshell River Basin Snowpack with Non-Exceedence Projections

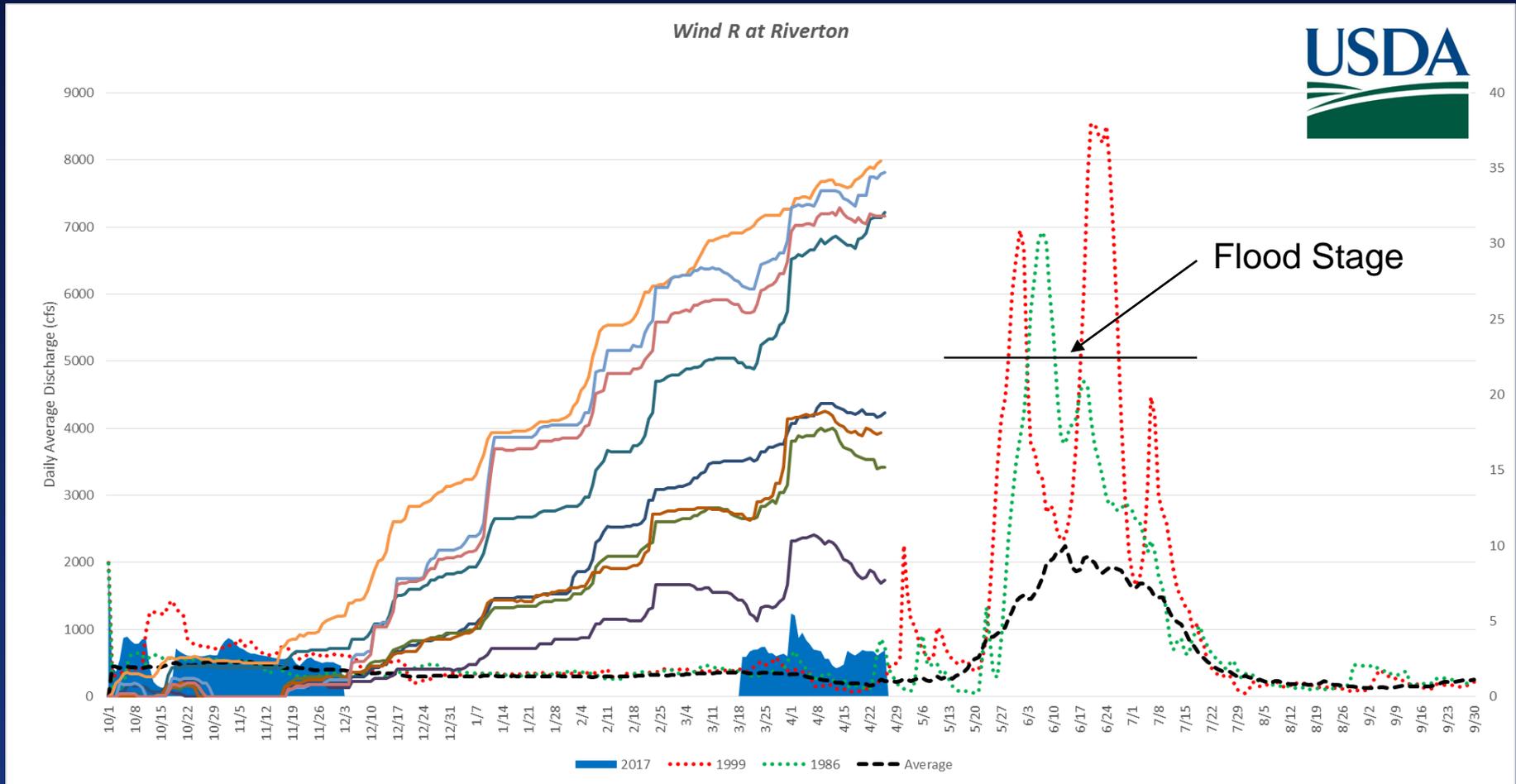
Based on provisional SNOTEL daily data as of 4/26/2017



Lower Yellowstone: Snowpack Very High or at Record Levels



Wind River: Snowpack at Record Levels



Water Supply

Montana Snow Survey



	APR-JUL 50 % Exceedance Forecasts		
<i>River Basin</i>	Highest Point Forecast*	Lowest Point Forecast**	Basin Avg Forecast***
<i>Columbia River Basin</i>	153%	97%	113%
Kootenai River Basin	137%	107%	124%
Flathead River Basin	153%	104%	120%
Upper Clark Fork	111%	97%	103%
Bitterroot River Basin	110%	101%	107%
Lower Clark Fork	117%	109%	112%
<i>Missouri River Basin</i>	117%	62%	97%
Jefferson	116%	73%	93%
Madison	108%	97%	102%
Gallatin	93%	82%	88%
Headwaters Mainstem	101%	93%	97%
Smith Judith Musselshell	80%	62%	73%
Sun Teton Marias	117%	94%	113%
St Mary	117%	115%	116%
<i>Yellowstone River Basin</i>	222%	76%	127%
Upper Yellowstone	158%	76%	120%
Lower Yellowstone	222%	102%	134%

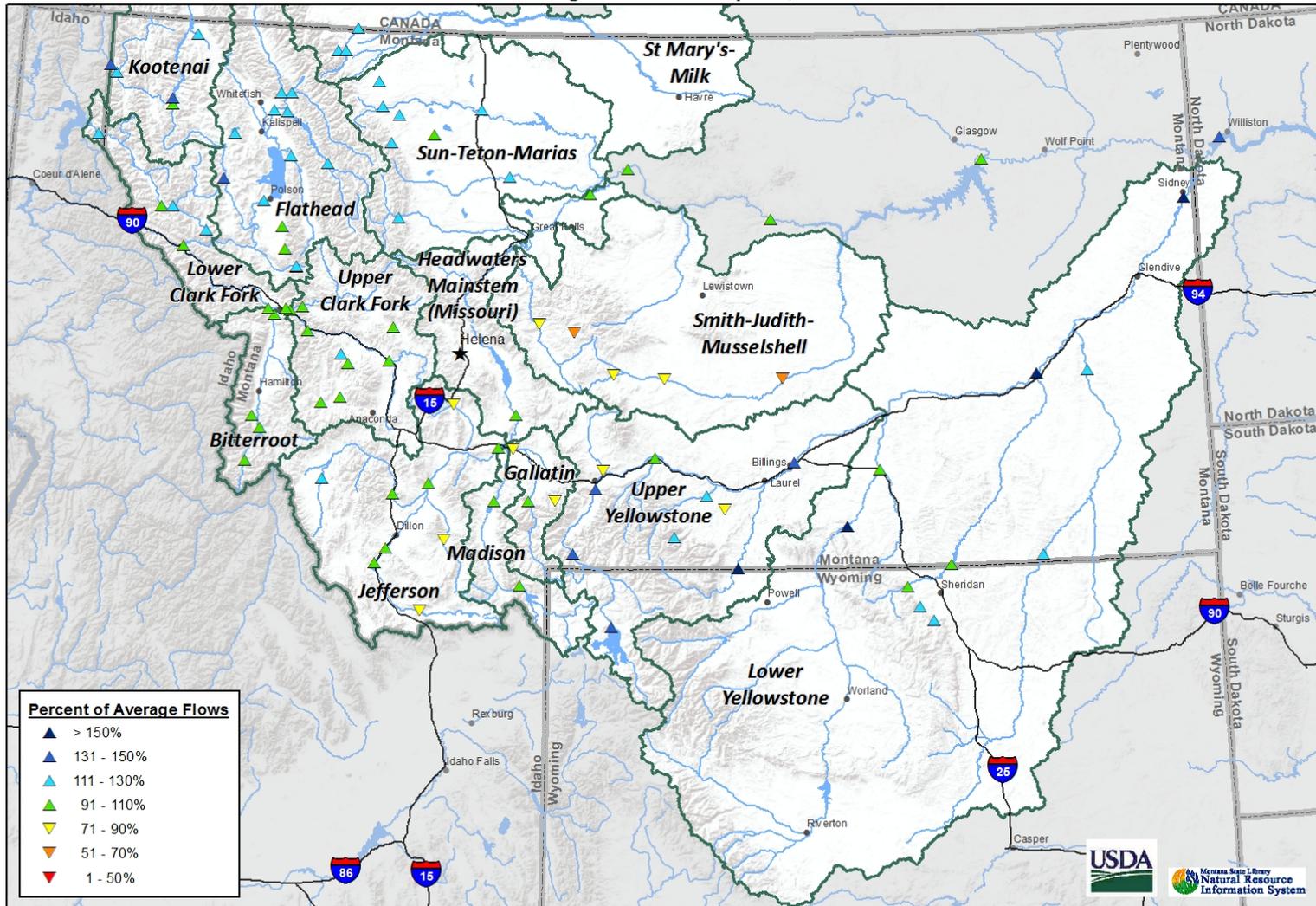
NOTE: Streamflow forecasts are issued for multiple points on rivers and streams within a major river basin and are given as a range of exceedance probabilities. Consult the individual river basin of interest to see the range of values for streams of interest.

*Highest point forecast is the highest 50% forecast of all forecast points within the basin

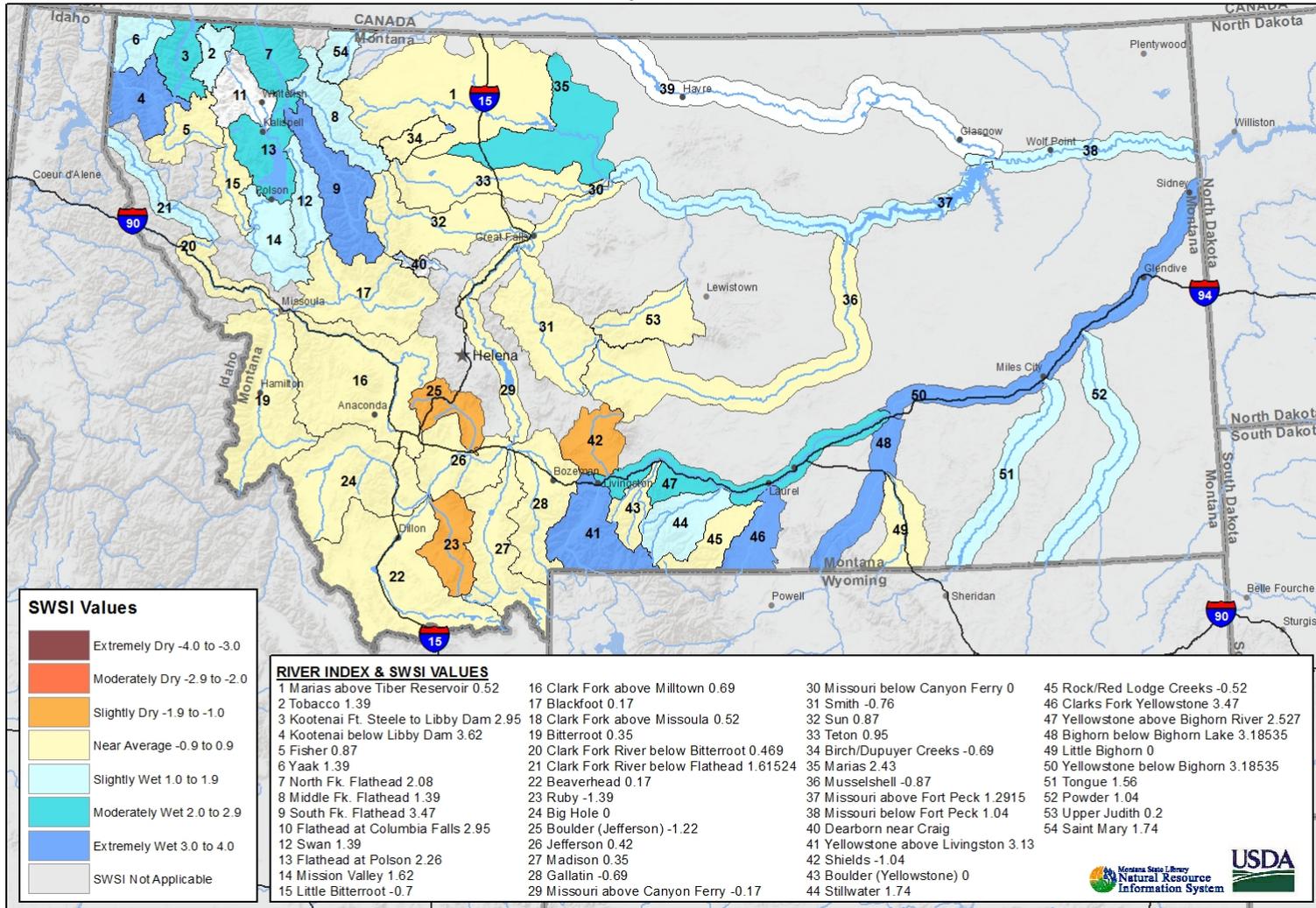
**Lowest point forecast is the lowest 50% forecast of all forecast points within the basin

***Basin Average Forecast is an average of all 50% forecasts within the basin

Montana Data Collection Office Streamflow Forecast Percentage of Normal - April 1, 2017



**Montana Data Collection Office
Surface Water Supply Index (SWSI)
April 1, 2017**

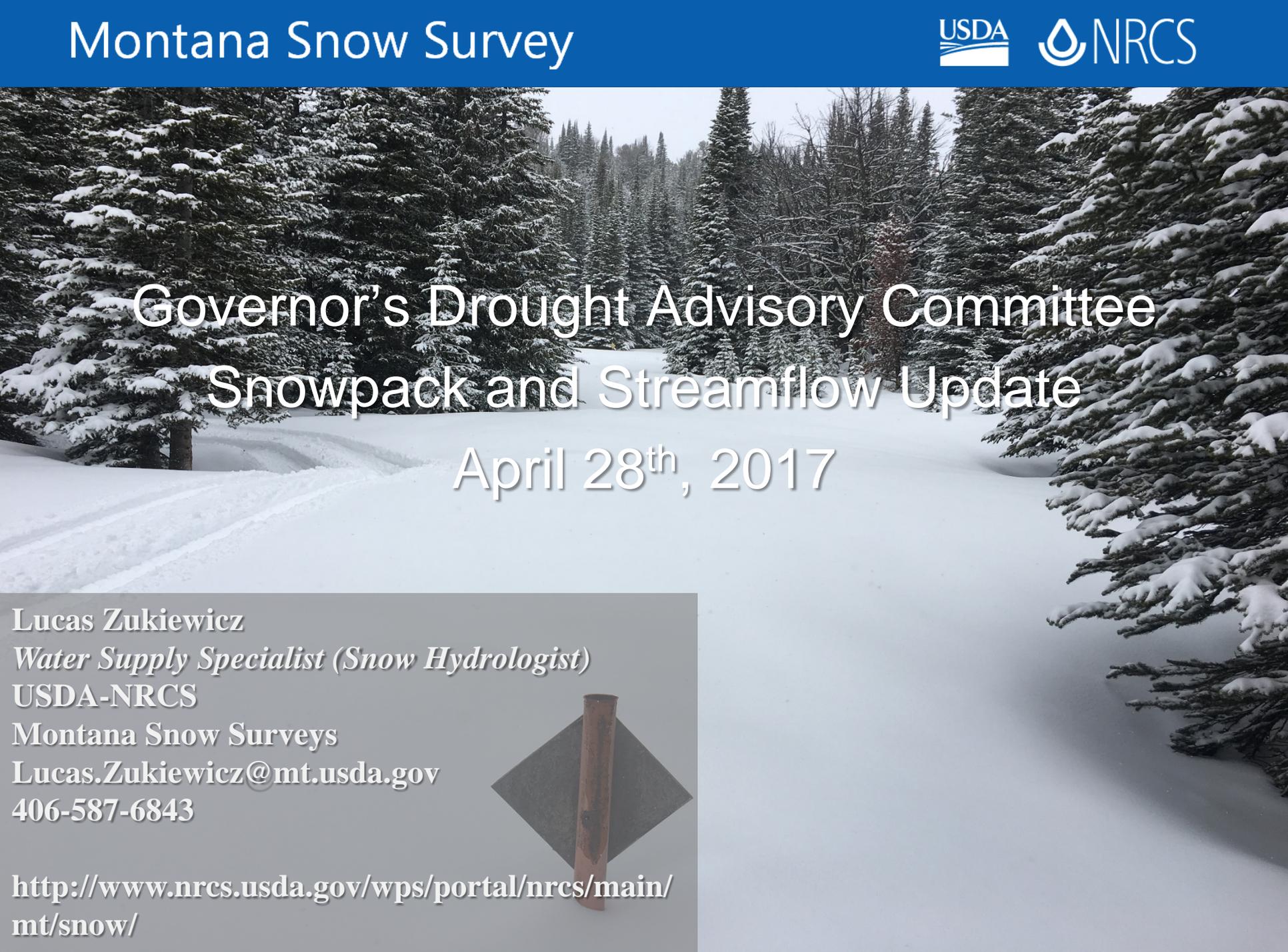


Note: Data used to generate this map are PROVISIONAL and SUBJECT TO CHANGE



Summary

- Water year mountain precipitation (Oct 1st – Current) remains above to well above average at mountain locations across the state. October, December and February precipitation was well above average for all mountain locations.
- Snowpack is near to above normal for this date in many basins, and below normal in a few basins in the northern and southern parts of the state. Only one basin is well below normal for snowpack, the Smith-Judith-Musselshell River basin.
- Snowmelt has been confined to the lowest mountain elevations over the course of April, little melt occurred during the month at upper elevations. The bulk of the water is still waiting up there.
- Streamflow forecasts as of March 1st indicate near to above average seasonal river volumes for the May 1st – July 31st time period, only a few central river basin forecasts indicate below average flows.



Governor's Drought Advisory Committee Snowpack and Streamflow Update April 28th, 2017

Lucas Zukiewicz

Water Supply Specialist (Snow Hydrologist)

USDA-NRCS

Montana Snow Surveys

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406-587-6843

[http://www.nrcs.usda.gov/wps/portal/nrcs/main/
mt/snow/](http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/)



USGS Flood Information for Montana



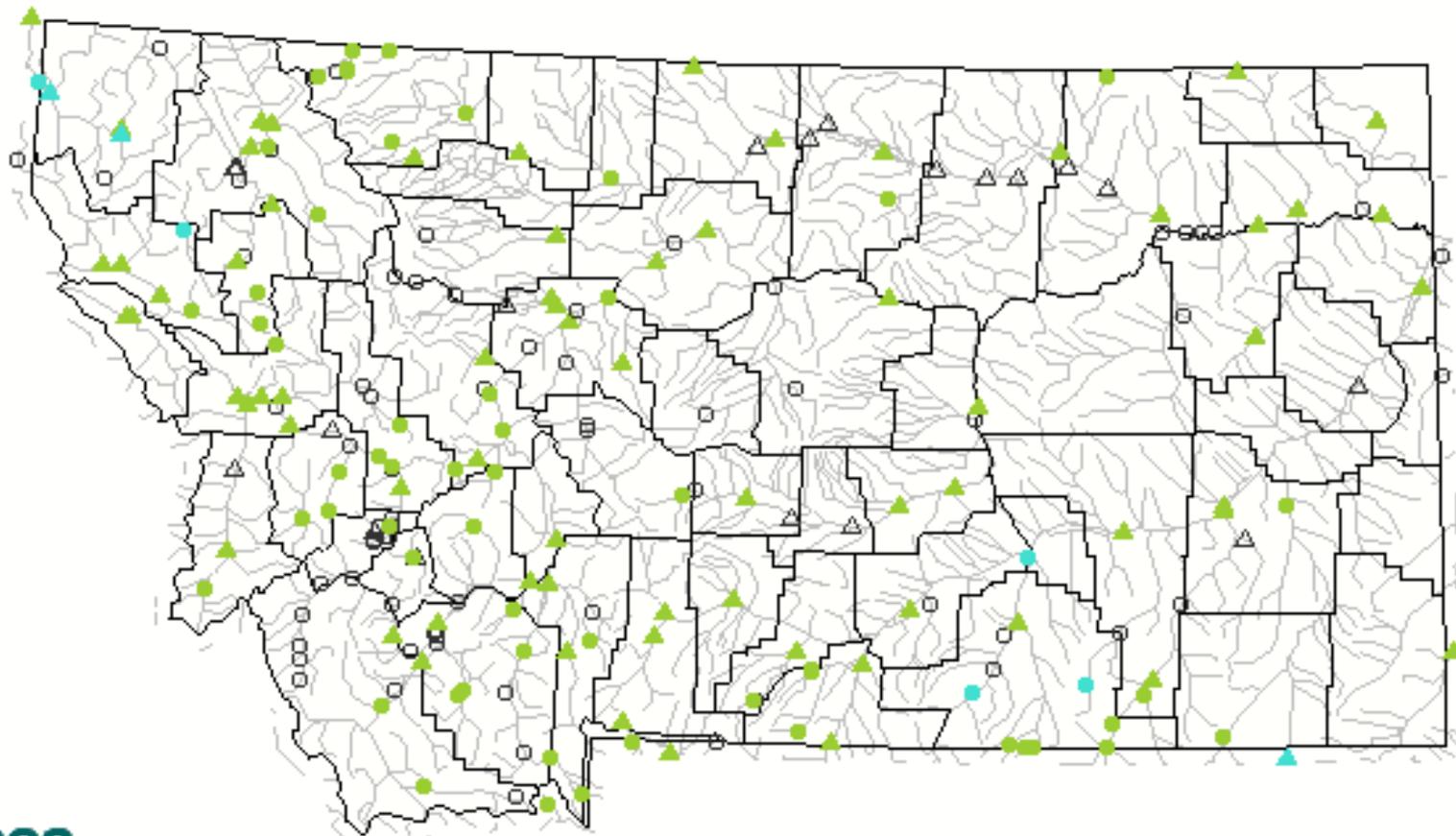
06140000 Milk @ Havre, MT April 1952

Governor's Drought and Water Supply Advisory Committee April 28, 2017

Map of Flood and High Flow Conditions

Explanation - Percentile classes				
				
<95	95-98	>= 99	River above flood stage	Not ranked
 Streamgauge with flood stage		 Streamgauge without flood stage		

Thursday, April 27, 2017 11:31ET



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[Pacific Creek near Farson, WY](#) is usually small enough to jump across. Streamflow on March 20, 2017 was 373 cfs.

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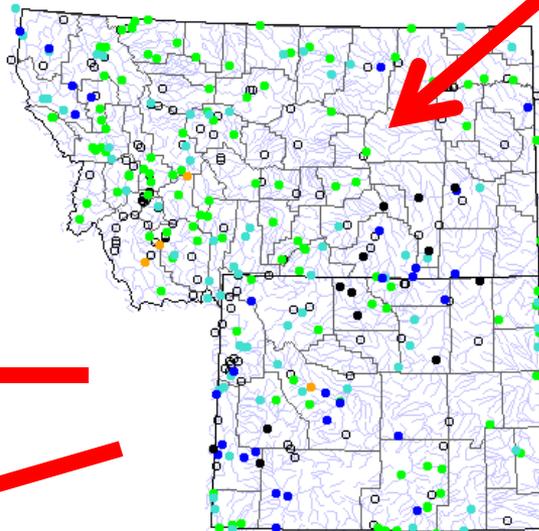
Water Resources of Wyoming and Montana

Welcome to the USGS Wyoming-Montana Water Science Center. These pages are your source for water-resource information collected and interpreted by the U.S. Geological Survey in Wyoming and Montana. Here you'll find information on Wyoming's and Montana's rivers and streams. You'll also find information about ground water, water quality, and many other topics. The USGS operates the most extensive satellite network of stream-gaging stations in the state, many of which form the backbone of flood-warning systems.

Wyoming and Montana Water Data and Information

Current Streamflow Conditions

Thursday, April 27, 2017 11:30ET



News and Highlights

We have crews out all across Wyoming and Montana to repair and maintain streamgages, ensuring data on the web is accurate. High flows make working in the river difficult. The video below shows work conducted at the [Mill Creek above Bassoo Creek near Niarada, Montana](#) streamgage to install temporary equipment and repair high-water damage.



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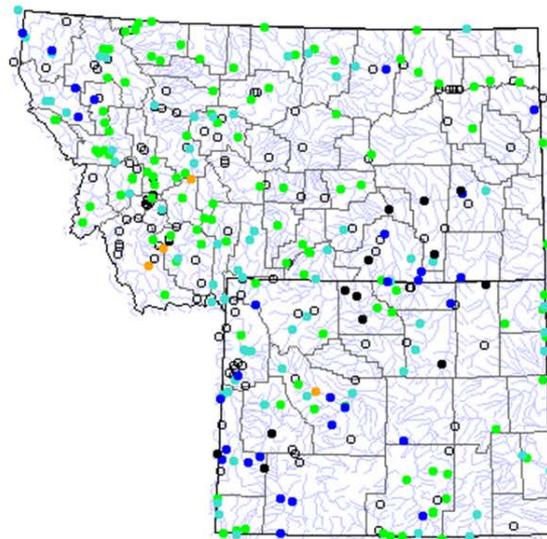
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We have crews out all across Wyoming and Montana to repair and maintain streamgages, ensuring data on the web is accurate. High flows make working in the river difficult. The video below shows work conducted at the [Mill Creek above Bassoo Creek near Niarada, Montana](#) streamgage to install temporary equipment and repair high-water damage.



Recent Publications

[Estimating current and future streamflow characteristics at ungaged sites, central and eastern Montana, with application to evaluating effects of climate change on fish populations](#)

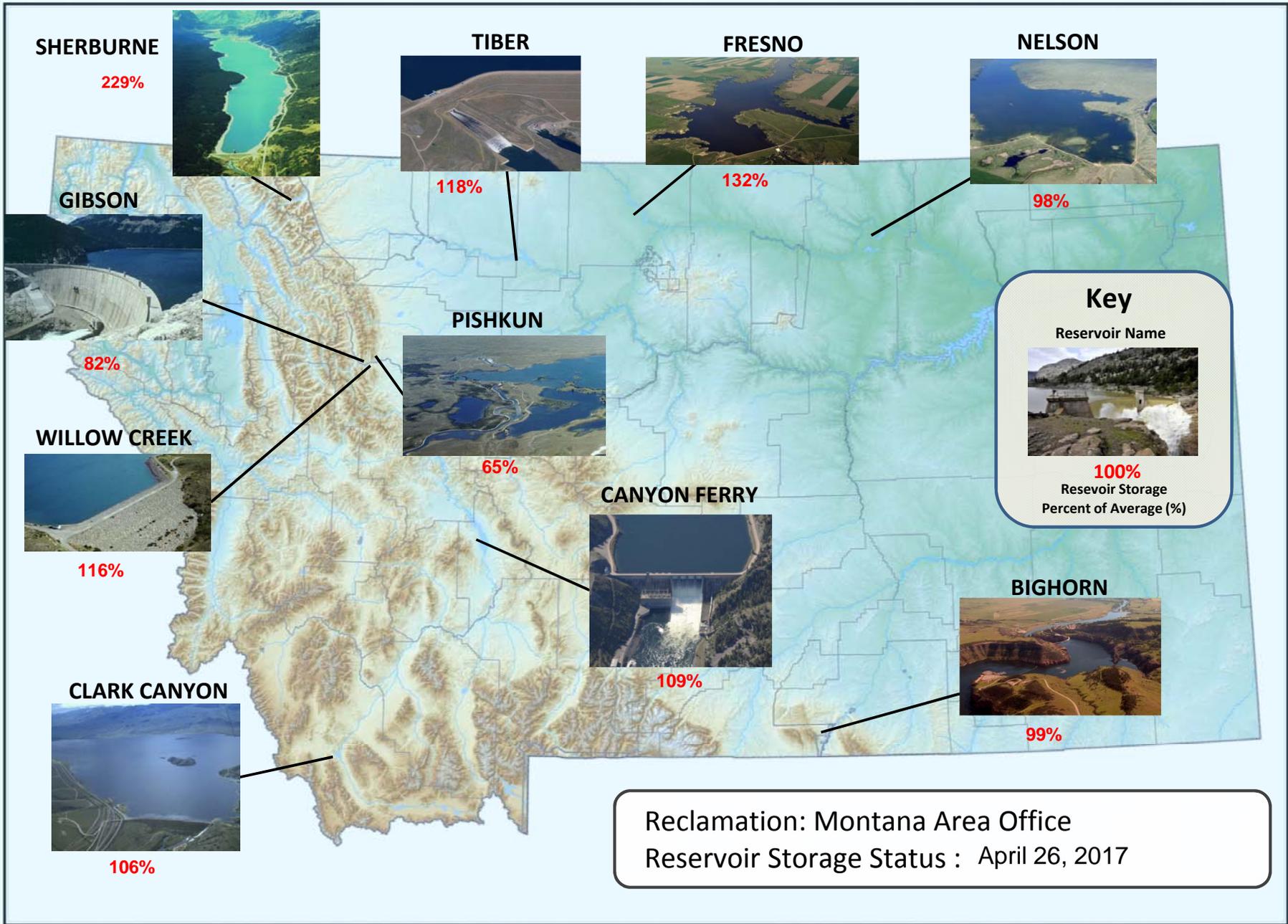


A relatively new technique was used to predict historical and future streamflows under different climate scenarios at 1,707 fish sampling sites across central and eastern Montana. Historical streamflow was predicted at sites near USGS streamgages to determine the accuracy of the model. Comparison between predicted flow in the past and the historical streamflow data recorded at those USGS streamgages had acceptable agreement, indicating confidence in predicting future streamflow scenarios. Fisheries biologists are using the streamflow predictions and fish sample information to understand how climate change might affect fish in small central and eastern Montana streams.

[Enhanced coal-dependent methanogenesis coupled with algal biofuels: Potential water recycle and carbon capture](#)



Many coal beds contain microbial communities that can convert coal to natural gas (coalbed methane). Native microorganisms were obtained from Powder River Basin (PRB) coal seams with a diffusive microbial sampler placed



WATERSHED PLANNING IN THE MADISON

