WESTERN RESOURCE ADVOCATES

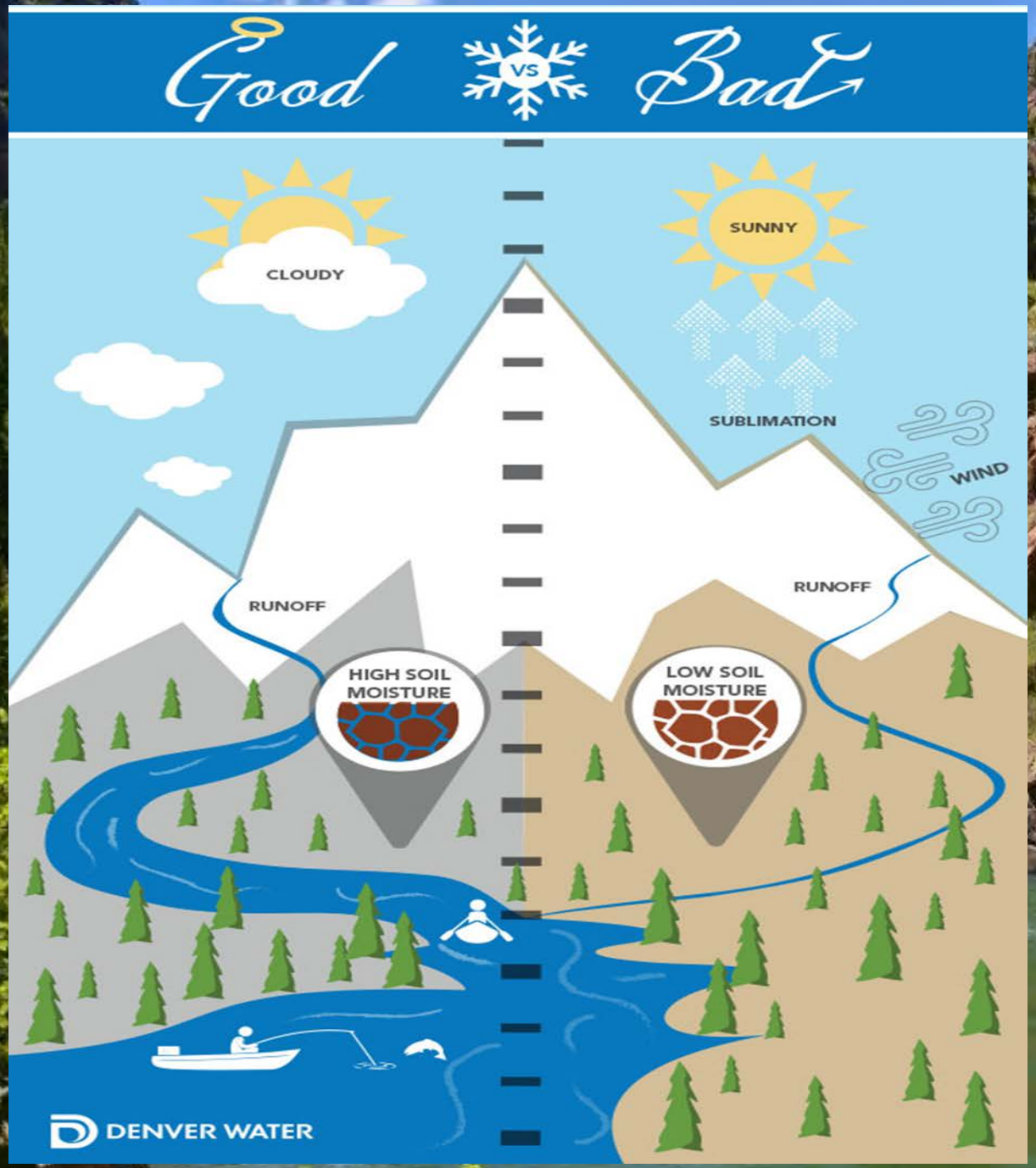
Celebrating 30 Years

Snowpack and River Health: The Impacts of Climate Change

March 26, 2019

Why is snowpack important?

- Colorado River Basin
  - Growing demands
  - Shrinking supply
- Water Supply
  - Healthy Rivers
  - Recreation
  - Tourism
  - Habitat
  - Reservoirs
  - Drinking Water
- Critical Factors
  - Amount
  - Type
  - Wind
  - Evaporation
  - Soil Moisture

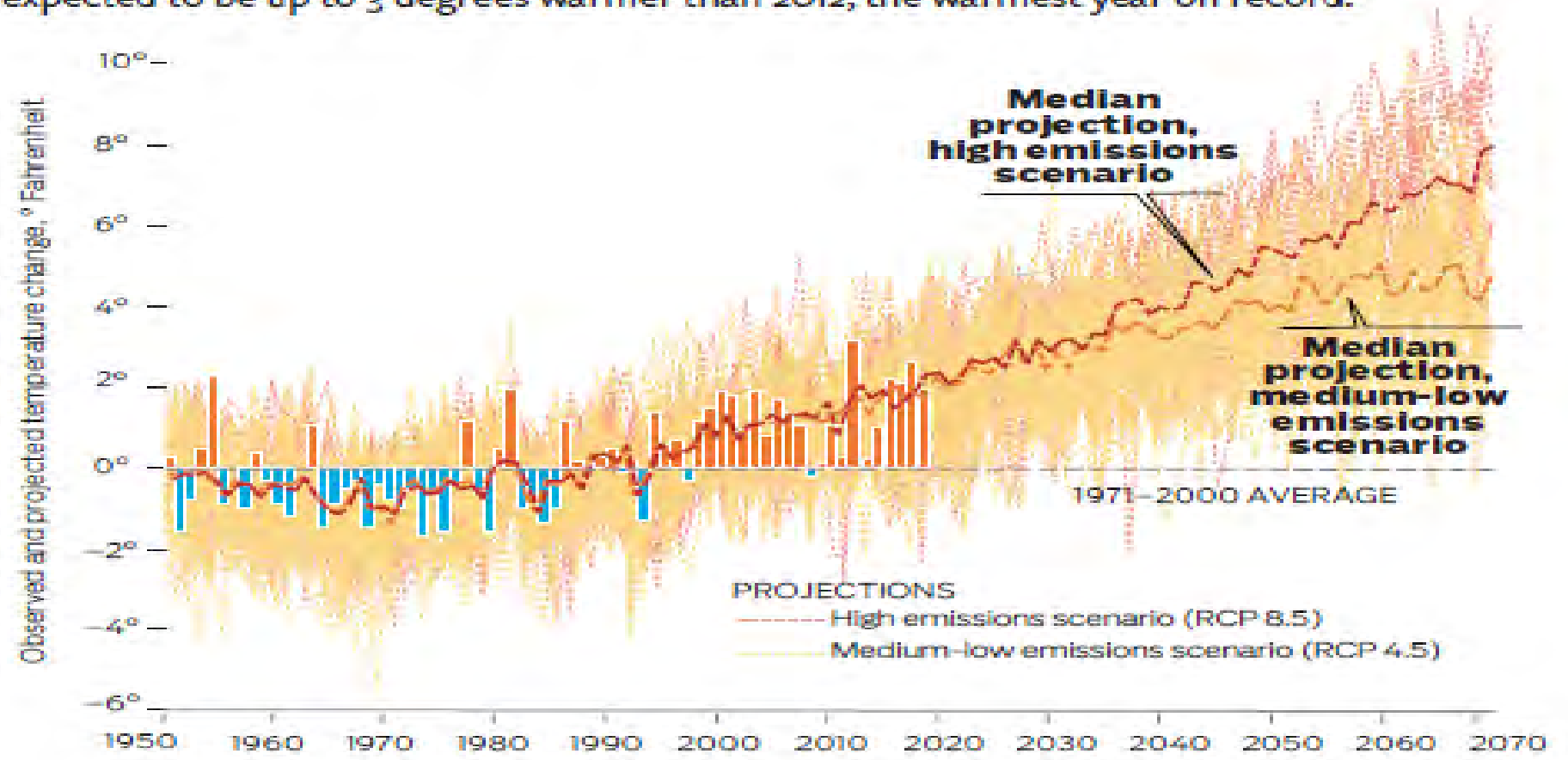

Good
VS
Bad
CLOUDY
SUNNY
SUBLIMATION
WIND
RUNOFF
RUNOFF
HIGH SOIL MOISTURE
LOW SOIL MOISTURE
DENVER WATER

Long Term Trends

- Climate Change
  - Temperature changes
  - Snowpack
    - Since 1915 average snowpack decline 15-30% (NPJ CAS 2018)
- Impacts
  - Timing and Amount of Run-Off 2000-2014 Colorado River flows averaged 19% below 1906-1999 average (Udall/ Overpeck)
  - Water Demands
  - Dust on Snow
  - Dense Forest
  - Fire Risk
  - Post Fire Impacts

Observed and Projected Colorado Average Annual Temperatures, 1950–2070

Observed temperatures through 2018 (bars) reveal that Colorado's climate has warmed about 2 degrees over the past 30 years. Projected temperatures through 2070 from 36 global climate models under a medium-low emissions scenario and a high emissions scenario all show further substantial warming. By 2050, a "normal" year in Colorado is expected to be up to 3 degrees warmer than 2012, the warmest year on record.

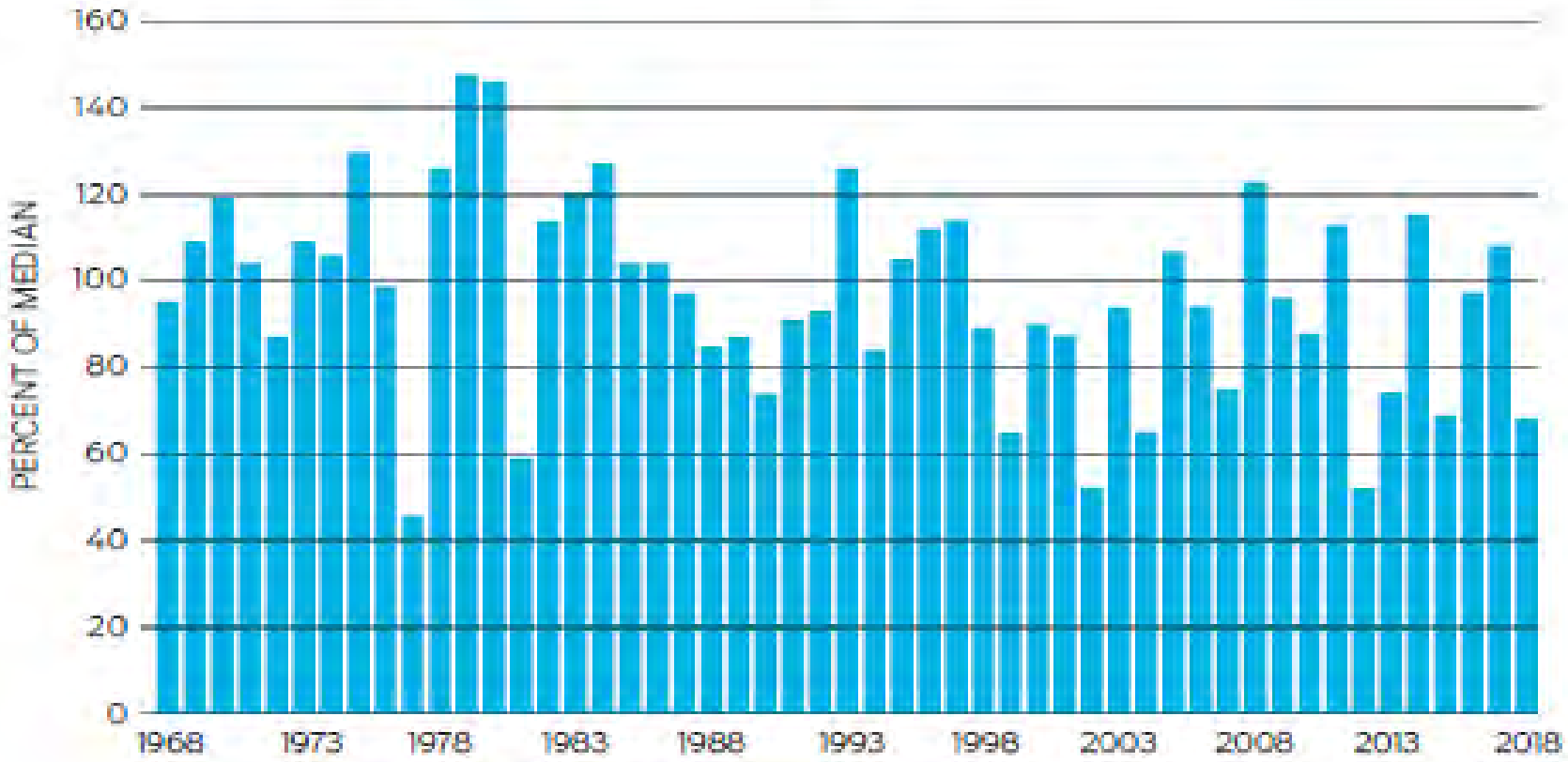


Source: Adapted and updated from Lukas et al., Climate Change in Colorado, 2014 Observed data: NOAA NCEI; http://www.ncdc.noaa.gov/cag/; Model data: https://gdo-dcp.ucllnl.org

Water Education Colorado

Colorado April 1 Snow-Water Equivalent, 1968–2018

There is an apparent long-term declining trend in spring snowpack; in the 21 years from 1998 to 2018, 16 years were below the long-term median.



Source: NRCS Colorado Snow Survey, https://www.nrcs.usda.gov/wps/portal/nrcs/main/co/snow/

Water Education Colorado

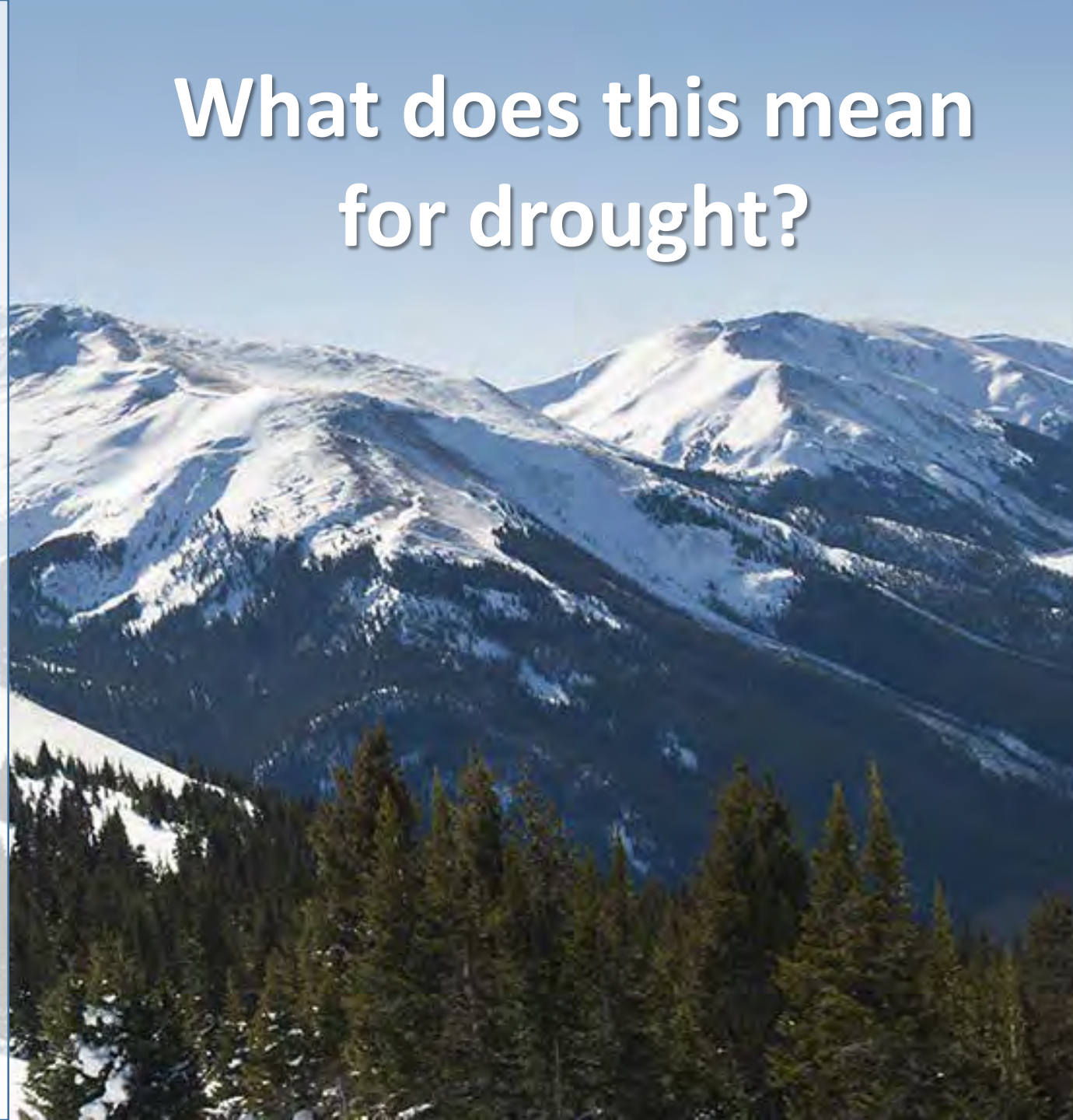
Local Conditions

Yampa Basin

- **2018**
  - Snowpack ~89%
  - Streamflow ~61% (at Maybell)
  - Hot, dry summer
  - Low and warm flows
  - River Closure Steamboat Springs
  - First “Call” on the Yampa River
- **2019**
  - Snowpack 125% (3/26/19)
  - Streamflow projected 105% (3/1/19)

What does this mean for drought?

- Run-Off, Weather, Climate
- Less snow, more rain
- Growing aridity
- Droughts indicate water scarcity
- One good winter won't be enough
  - Snowpack and drought recovery
  - Dry soil
  - Snowpack vs. streamflow



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

Oct 01, 2018

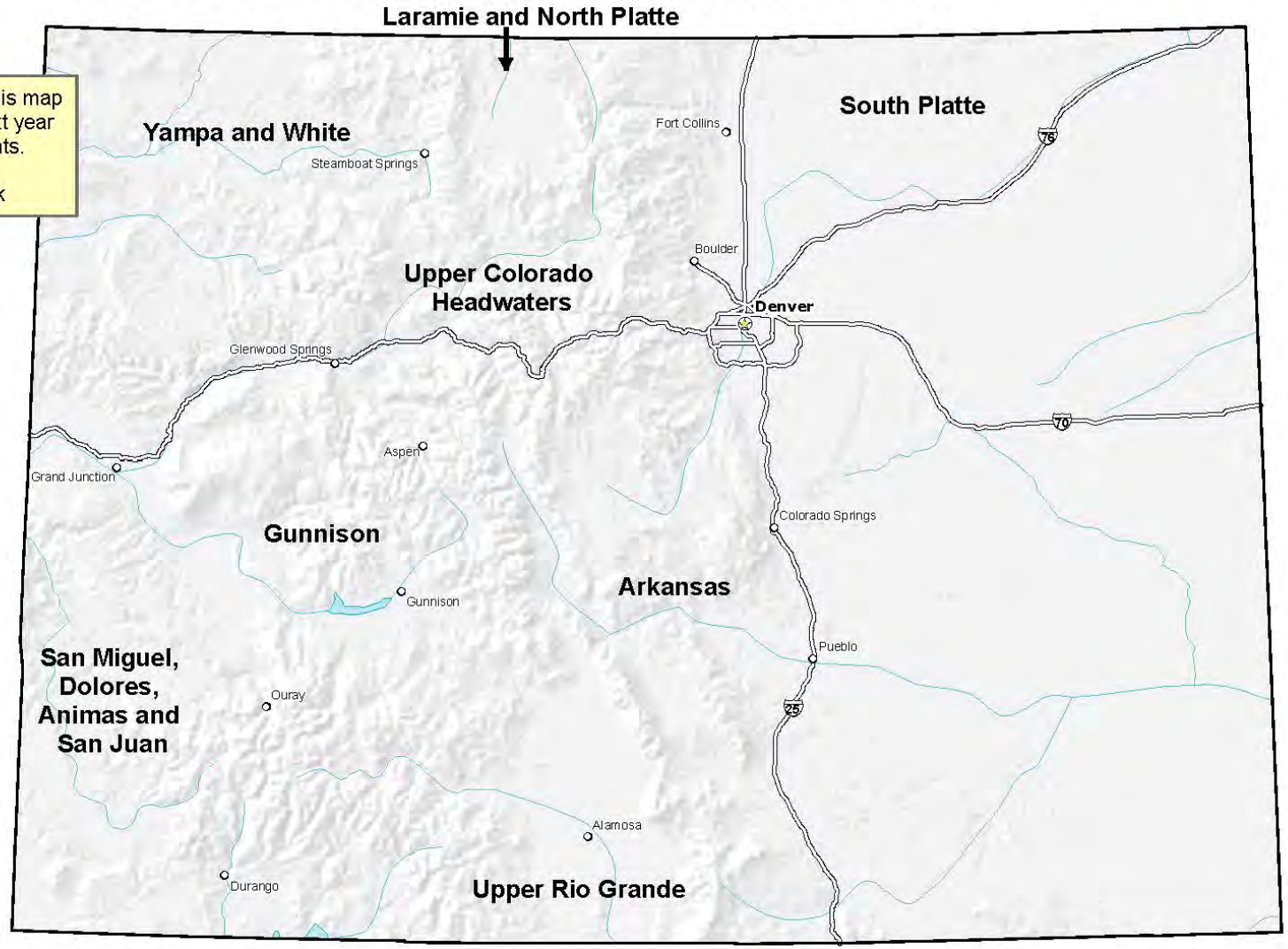
Notice: We anticipate this map will not be available next year due to staffing constraints. Alternate maps: https://go.usa.gov/xnzxk

Current Snow Water Equivalent (SWE) Basin-wide Percent of 1981-2010 Median

- unavailable *
- <50%
- 50 - 69%
- 70 - 89%
- 90 - 109%
- 110 - 129%
- 130 - 149%
- >=150%

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

Provisional Data Subject to Revision



0 10 20 40 60 80 100 Miles

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

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Nov 01, 2018

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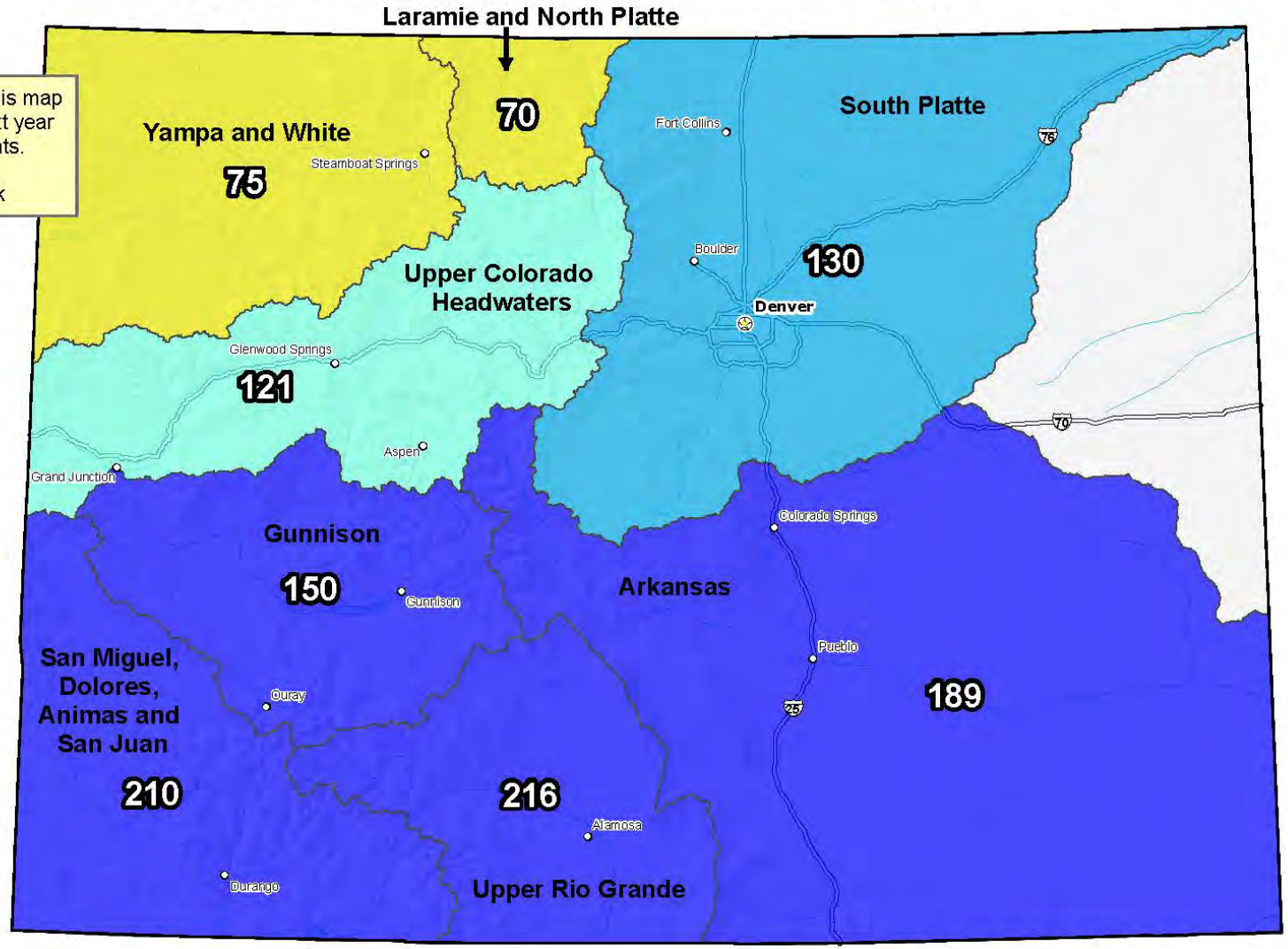

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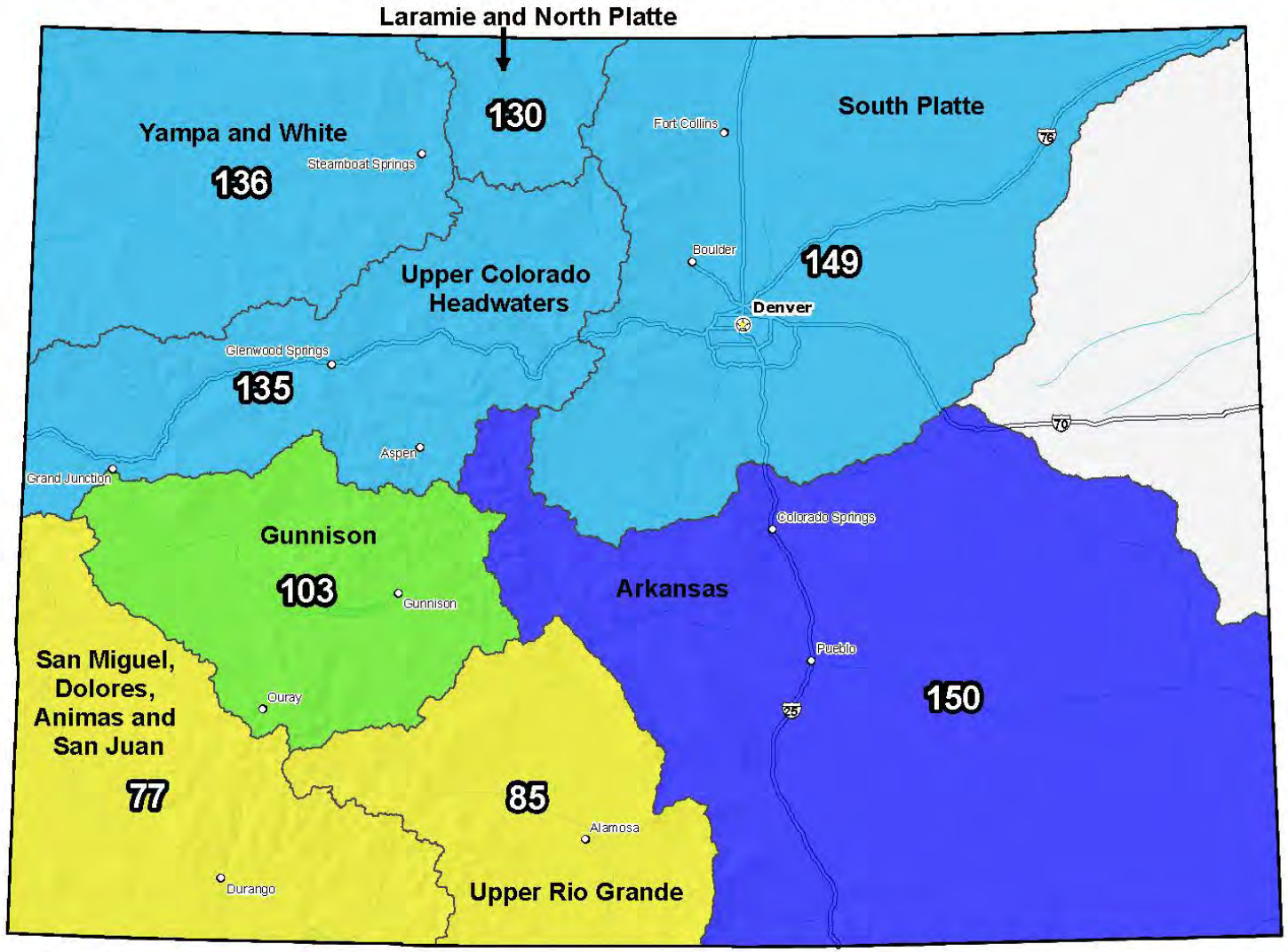
Dec 01, 2018



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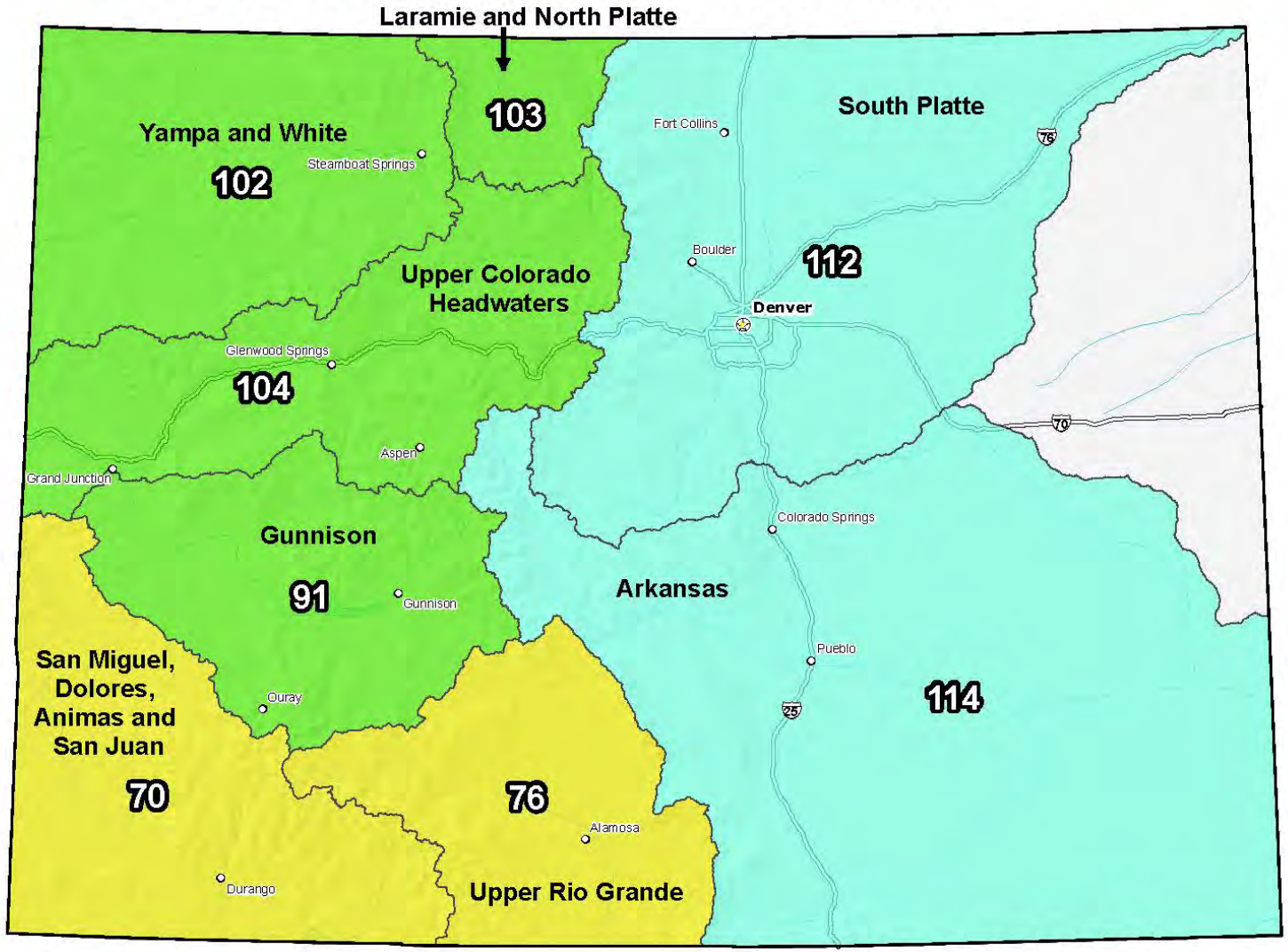
Jan 02, 2019



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Colorado
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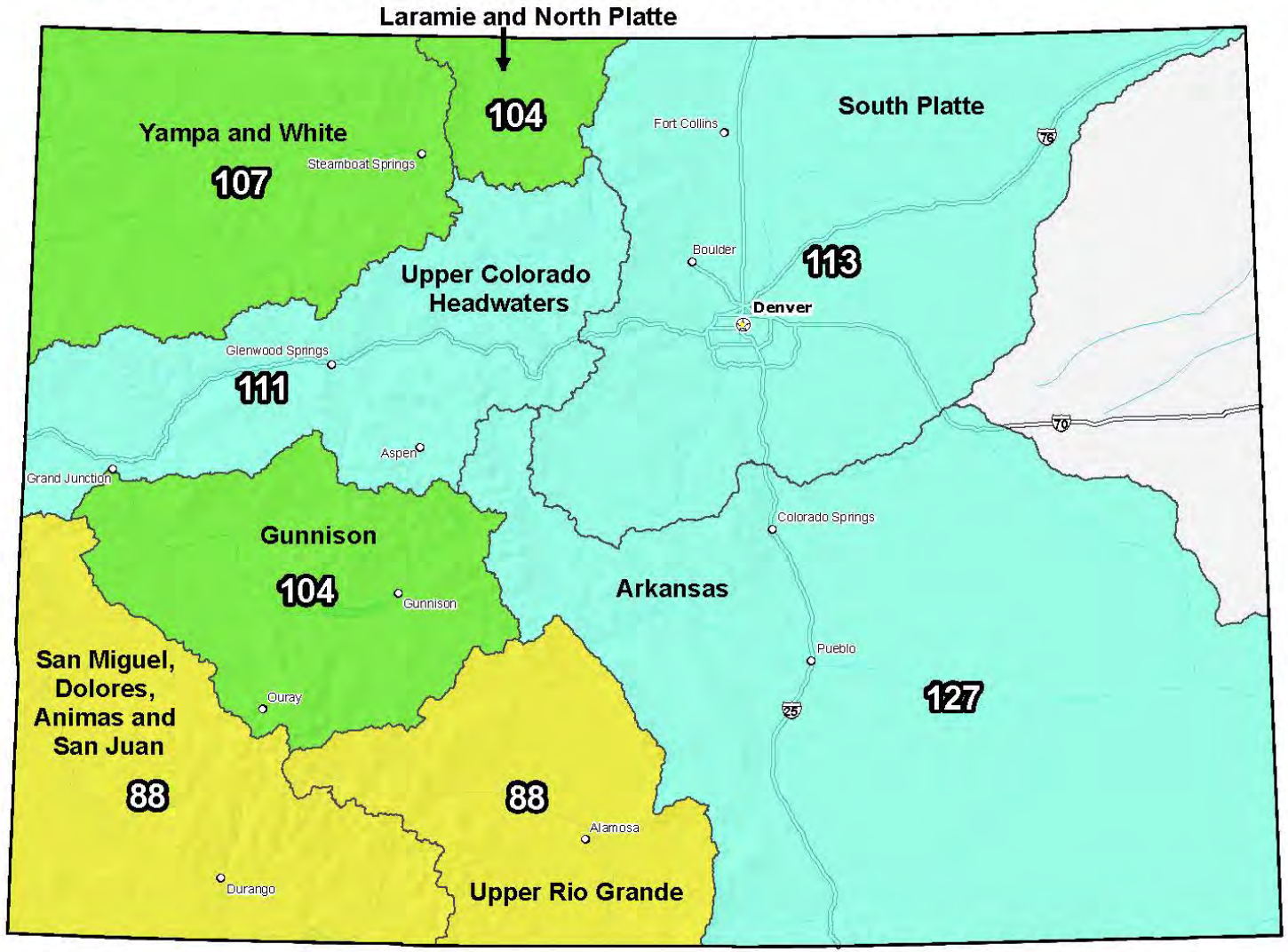
Feb 01, 2019



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Colorado
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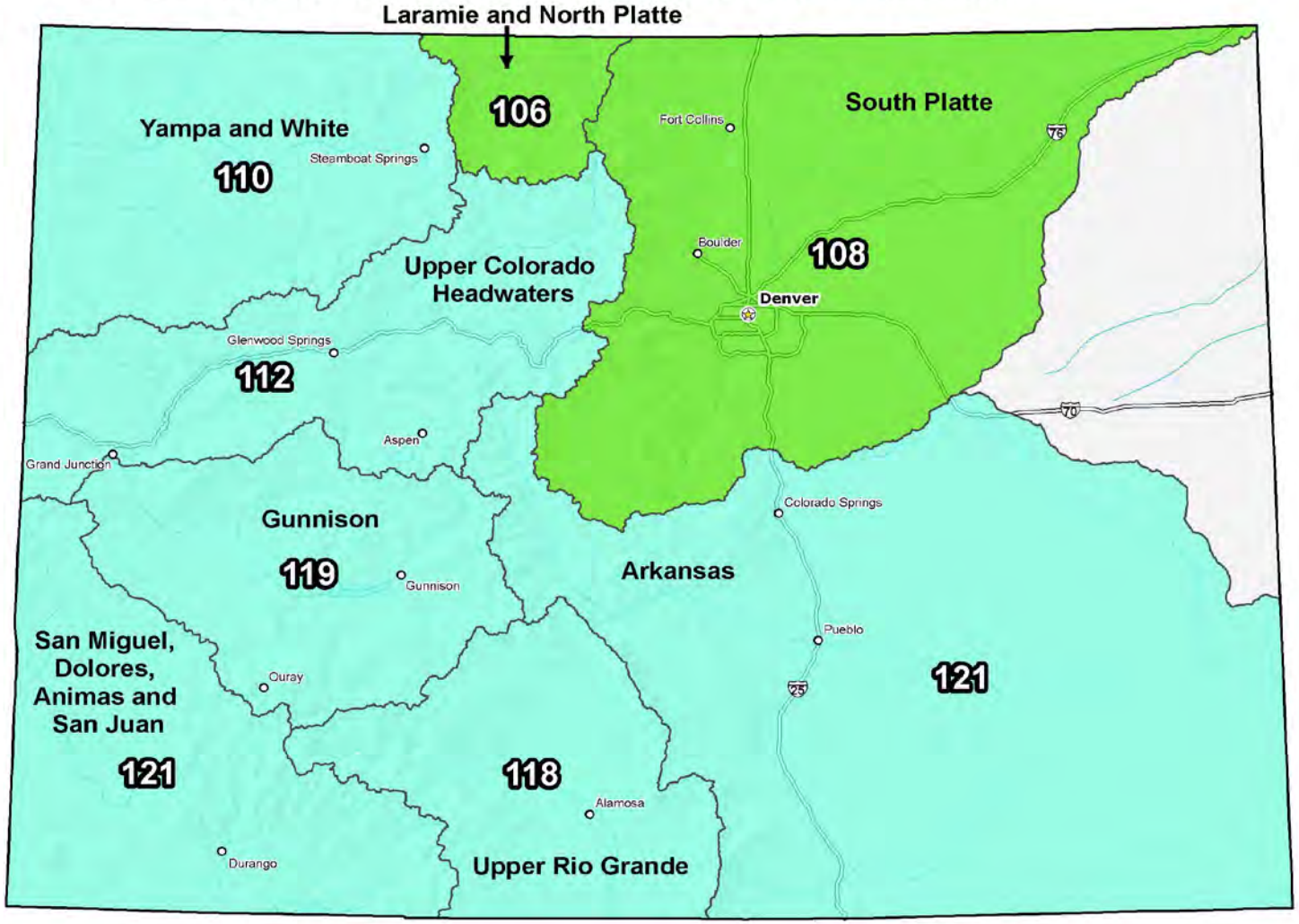
Mar 01, 2019



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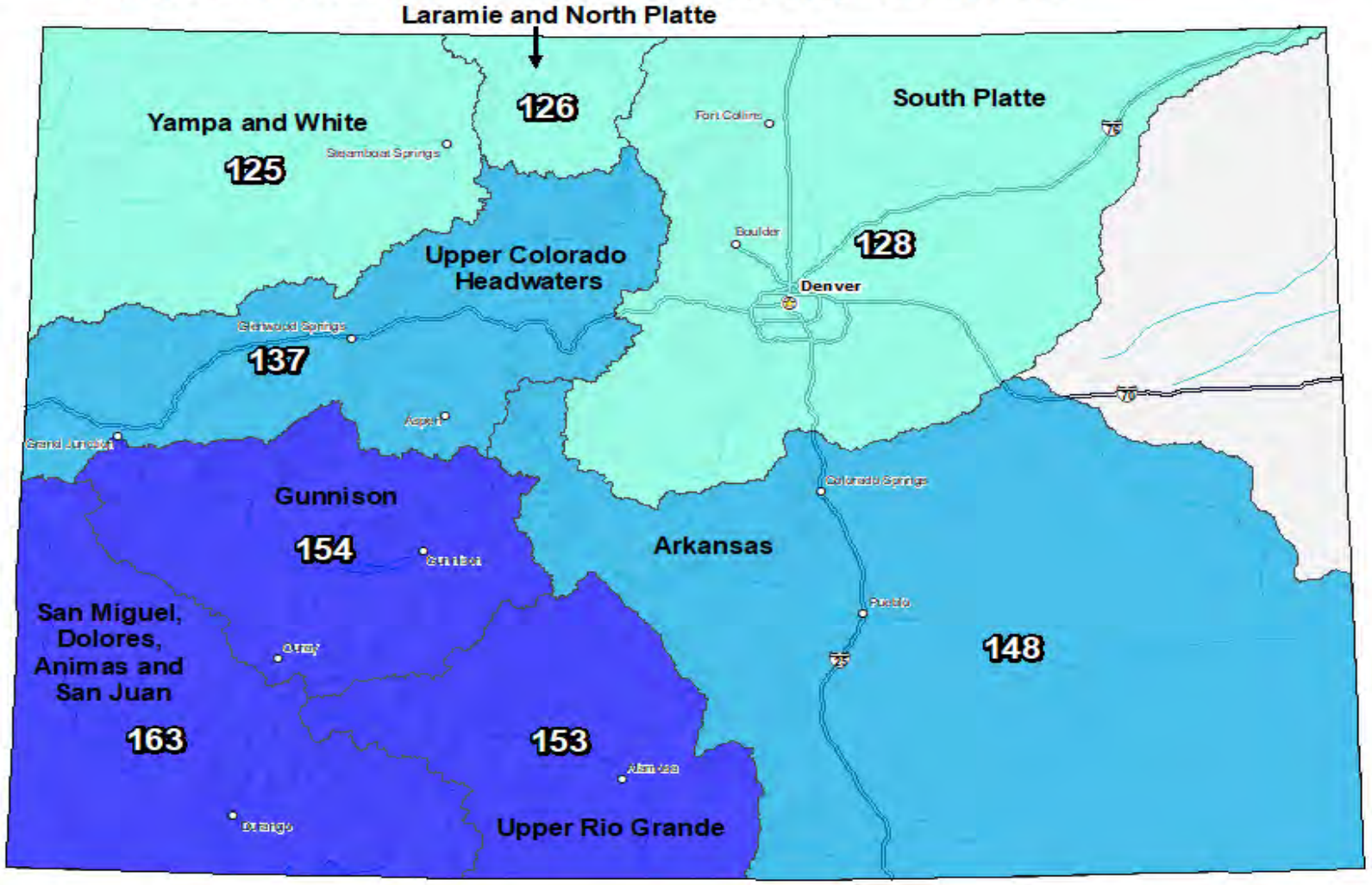
Colorado
SNOTEL Current Snow Water Equivalent (SWE) % of Normal

Mar 25, 2019



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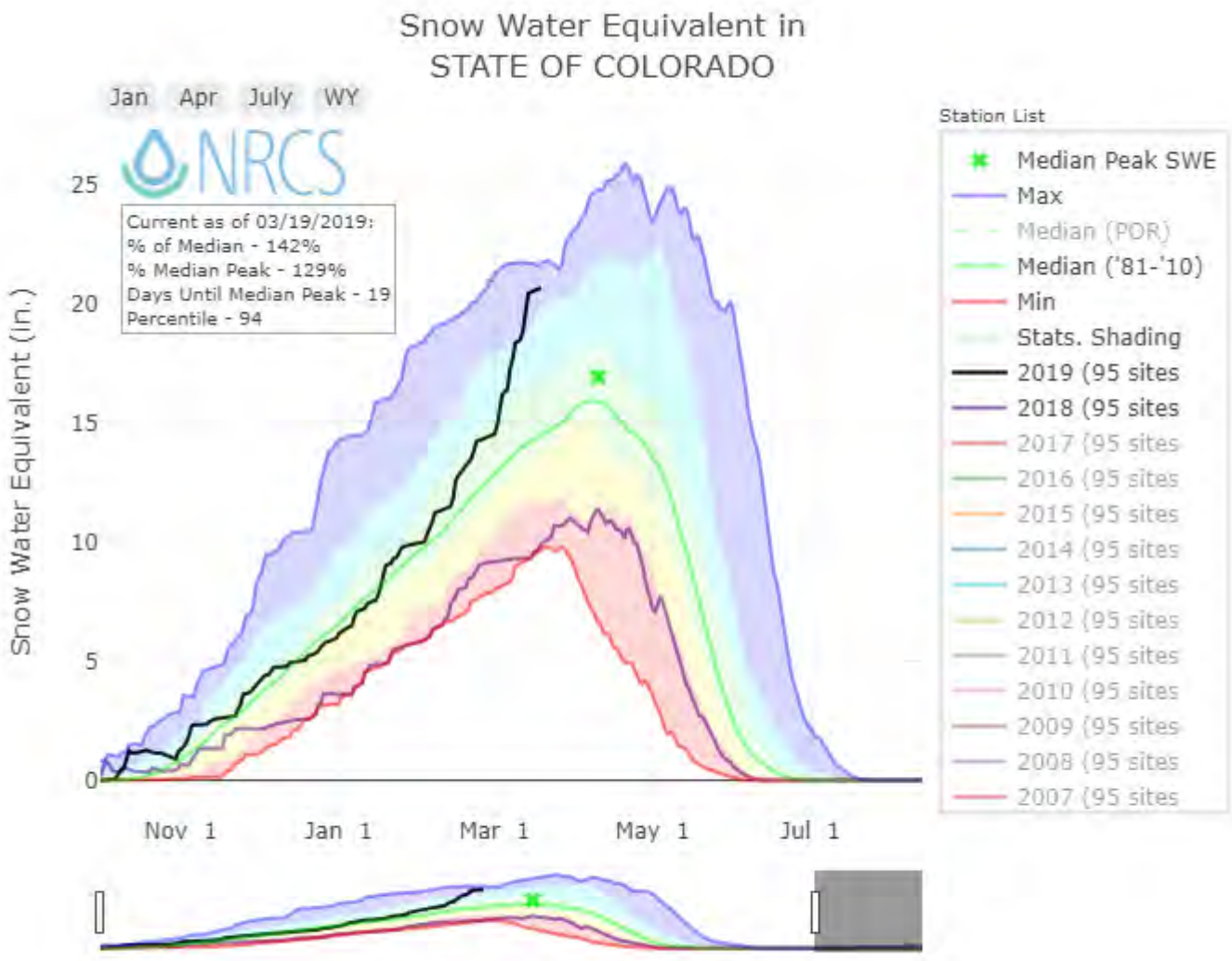
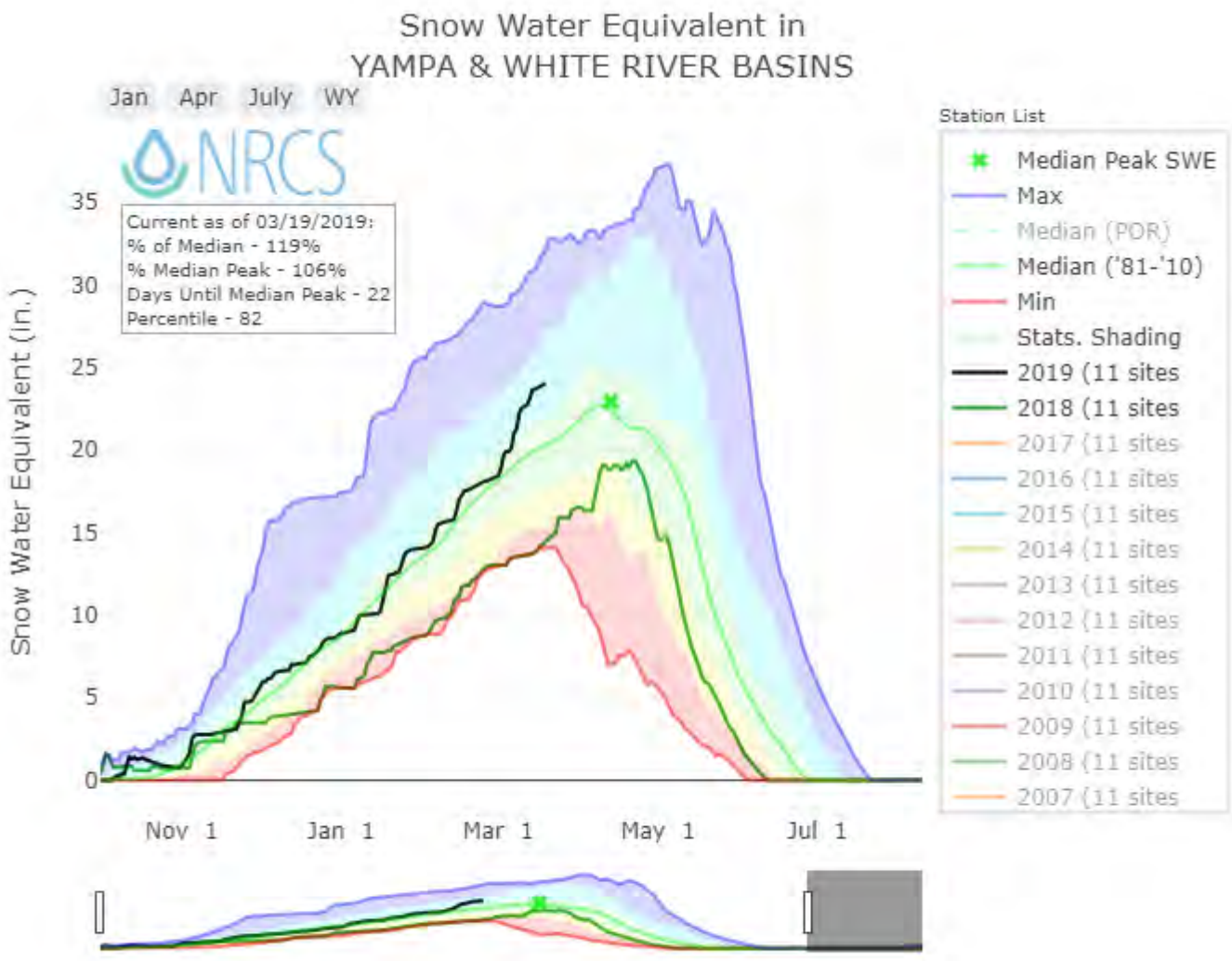


Statistical shading breaks at 10th, 30th, 50th, 70th, and 90th Percentiles.

For more information visit: 30 year normals calculation description.



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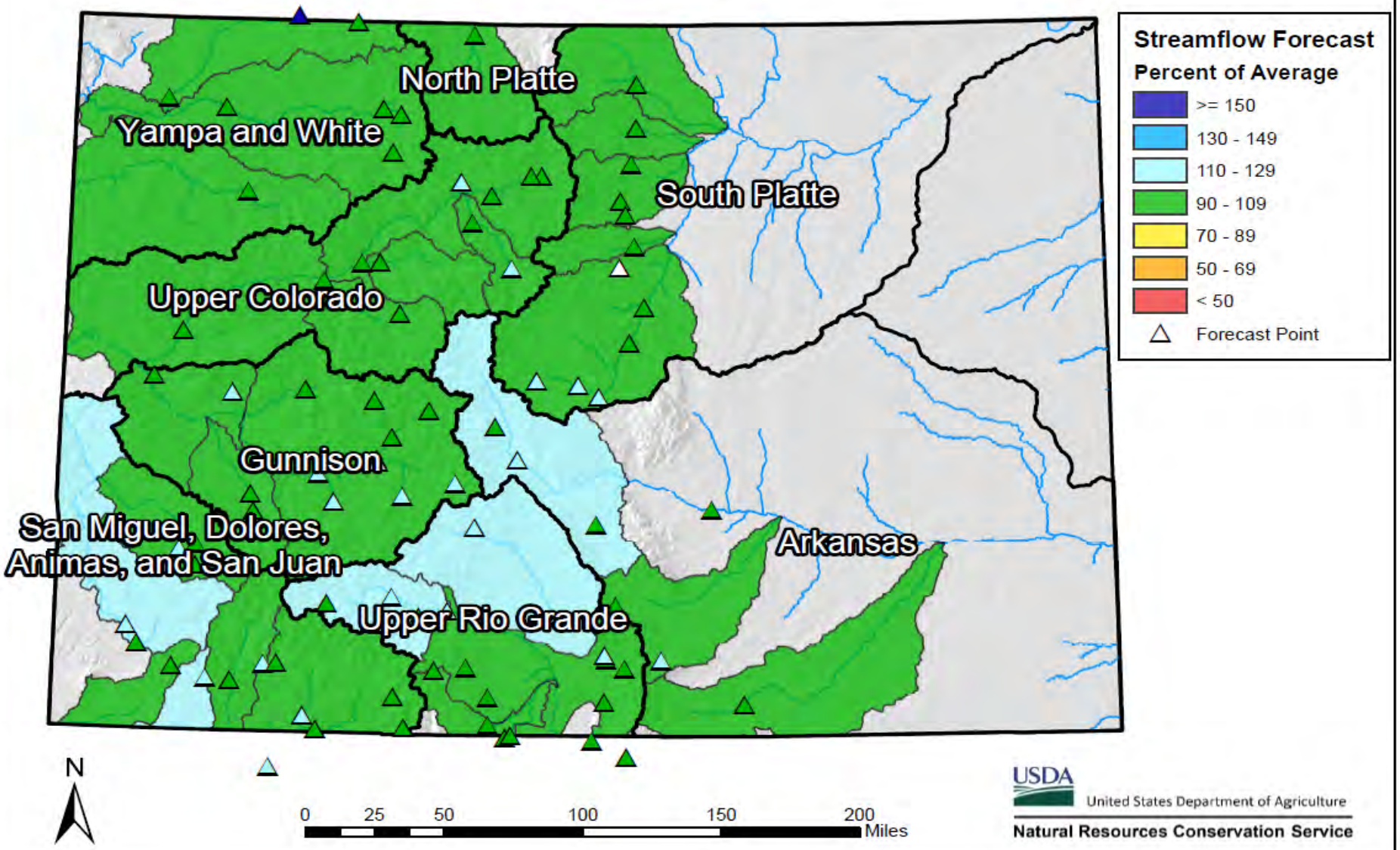
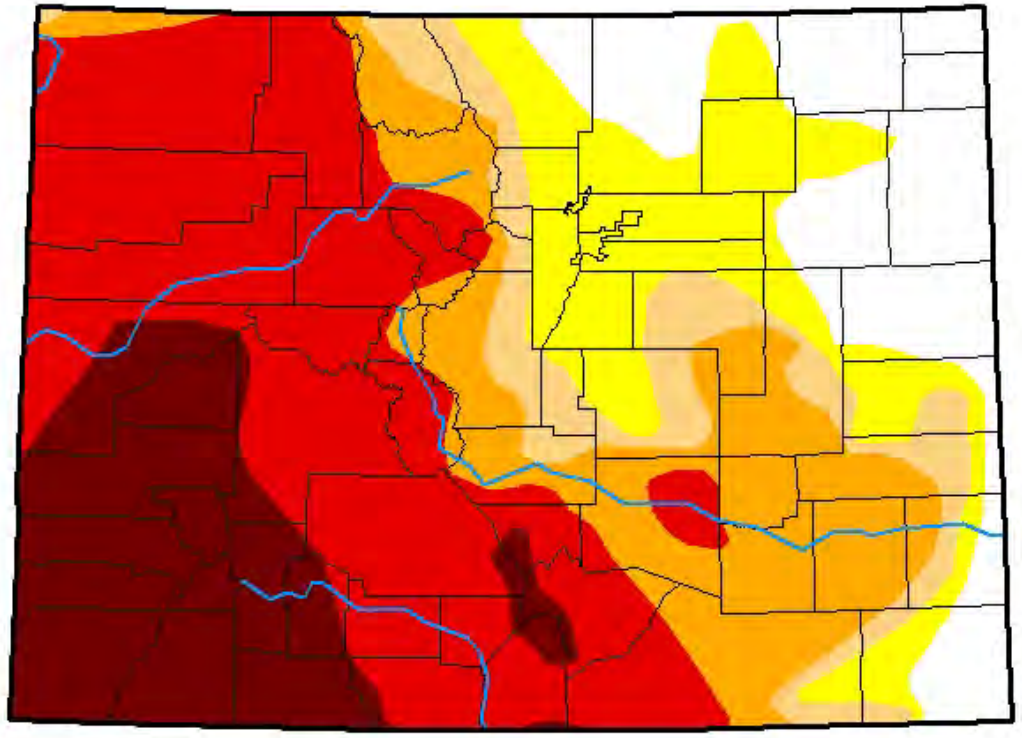
Colorado Streamflow Forecasts Summary
March 1, 2019



U.S. Drought Monitor

Colorado



October 2, 2018

(Released Thursday, Oct. 4, 2018)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	14.19	85.81	72.30	64.41	48.47	16.21
Last Week *09-25-2018*	14.19	85.81	72.30	64.41	48.47	16.21
3 Months Ago *07-03-2018*	20.46	79.54	67.30	52.31	36.46	8.81
Start of Calendar Year *01-02-2018*	6.57	93.43	33.53	7.27	0.00	0.00
Start of Water Year *09-25-2018*	14.19	85.81	72.30	64.41	48.47	16.21
One Year Ago *10-03-2017*	70.54	29.46	3.70	0.00	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

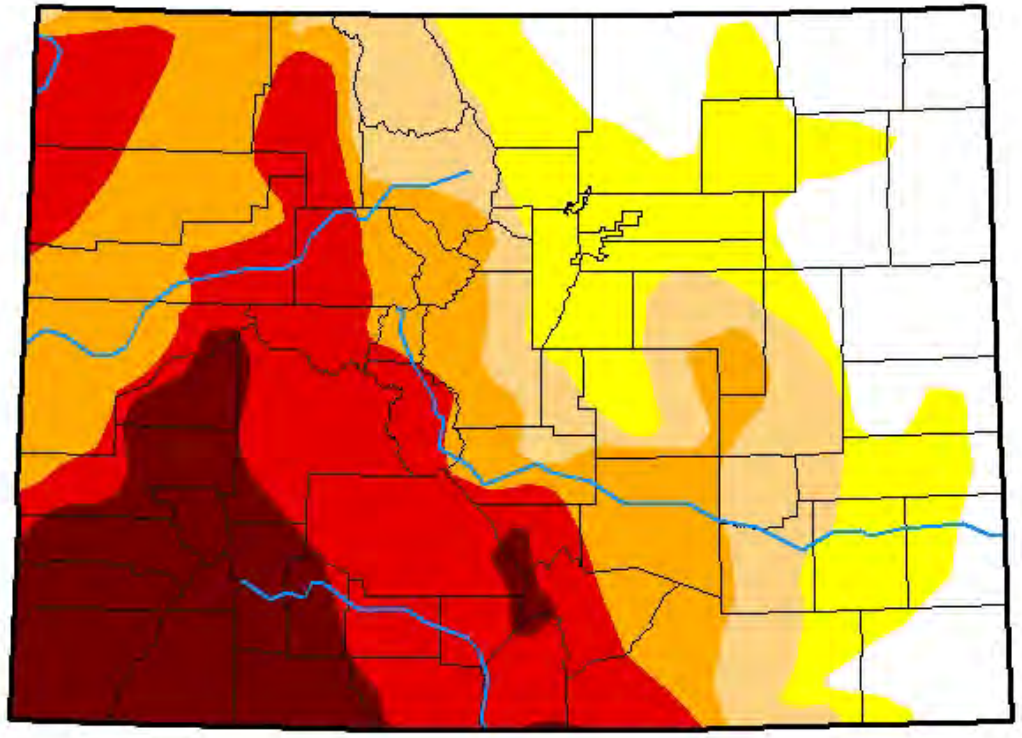
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
David Miskus
NOAA/NWS/NCEP/CPC

http://droughtmonitor.unl.edu/

U.S. Drought Monitor

Colorado



November 6, 2018

(Released Thursday, Nov. 8, 2018)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	16.64	83.36	66.80	54.82	35.19	13.37
Last Week *10-30-2018*	16.64	83.36	66.80	57.07	37.48	13.64
3 Months Ago *08-07-2018*	18.20	81.80	75.86	64.65	35.10	8.50
Start of Calendar Year *01-02-2018*	6.57	93.43	33.53	7.27	0.00	0.00
Start of Water Year *09-25-2018*	14.19	85.81	72.30	64.41	48.47	16.21
One Year Ago *11-07-2017*	71.26	28.74	1.22	0.00	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

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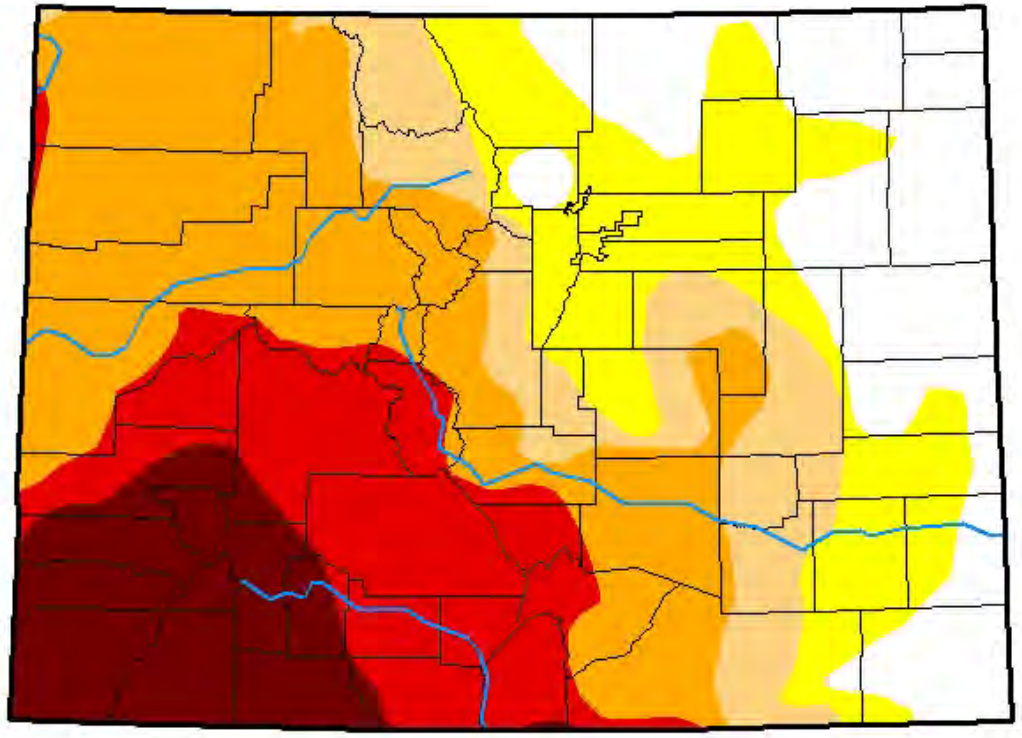
Author:
David Simeral
Western Regional Climate Center

http://droughtmonitor.unl.edu/

U.S. Drought Monitor

Colorado



December 4, 2018

(Released Thursday, Dec. 6, 2018)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	17.10	82.90	66.26	54.82	27.11	11.22
Last Week *11-27-2018*	17.10	82.90	66.26	54.82	33.46	13.35
3 Months Ago *09-04-2018*	19.99	80.01	71.39	63.93	44.30	9.72
Start of Calendar Year *01-02-2018*	6.57	93.43	33.53	7.27	0.00	0.00
Start of Water Year *09-25-2018*	14.19	85.81	72.30	64.41	48.47	16.21
One Year Ago *12-05-2017*	66.96	33.04	15.99	0.00	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

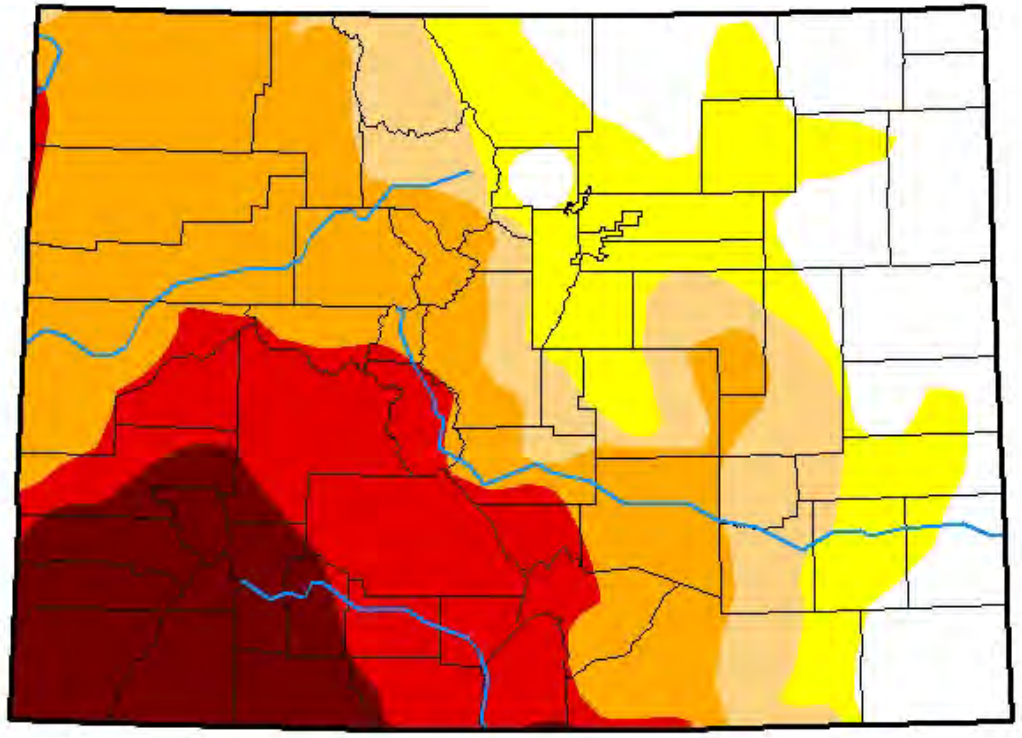
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Deborah Bathke
National Drought Mitigation Center

http://droughtmonitor.unl.edu/

U.S. Drought Monitor

Colorado



January 1, 2019

(Released Thursday, Jan. 3, 2019)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	17.94	82.06	66.26	54.91	27.11	11.22
Last Week *12-25-2018*	15.88	84.12	66.26	54.91	27.11	11.22
3 Months Ago *10-02-2018*	14.19	85.81	72.30	64.41	48.47	16.21
Start of Calendar Year *01-01-2019*	17.94	82.06	66.26	54.91	27.11	11.22
Start of Water Year *09-25-2018*	14.19	85.81	72.30	64.41	48.47	16.21
One Year Ago *01-02-2018*	6.57	93.43	33.53	7.27	0.00	0.00

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U.S. Drought Monitor

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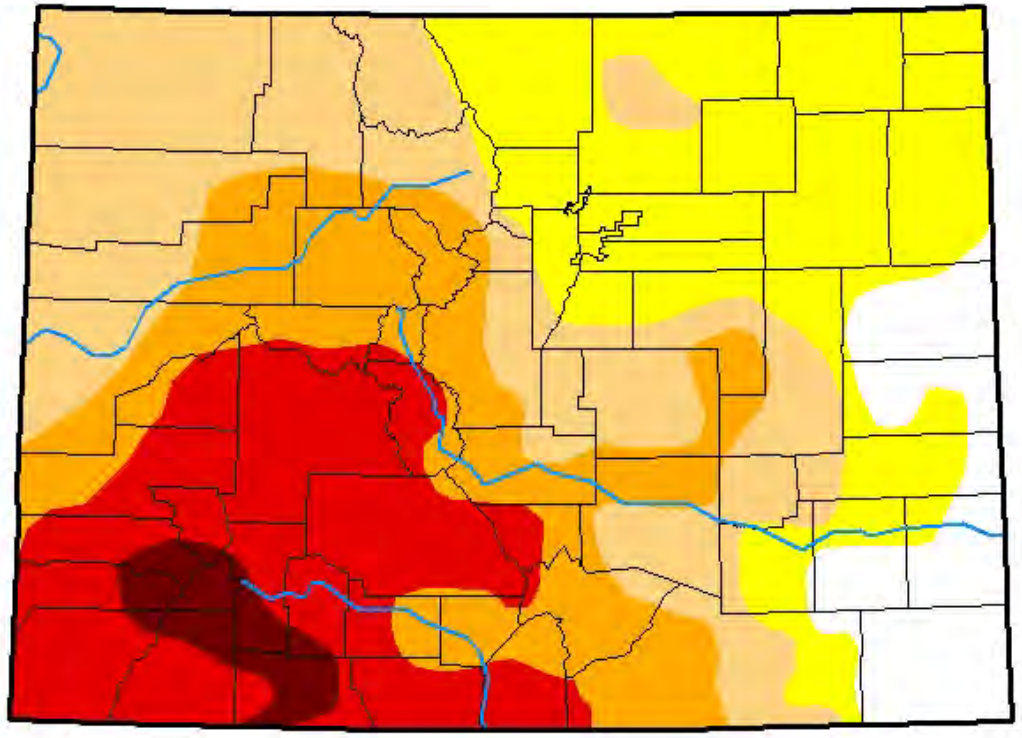

February 5, 2019

(Released Thursday, Feb. 7, 2019)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	8.14	91.86	67.16	40.83	22.05	2.96
Last Week *01-29-2019*	15.91	84.09	66.35	41.02	22.04	2.79
3 Months Ago *11-06-2018*	16.64	83.36	66.80	54.82	35.19	13.37
Start of Calendar Year *01-01-2019*	17.94	82.06	66.26	54.91	27.11	11.22
Start of Water Year *09-25-2018*	14.19	85.81	72.30	64.41	48.47	16.21
One Year Ago *02-06-2018*	0.59	99.41	71.90	31.82	0.00	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
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Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

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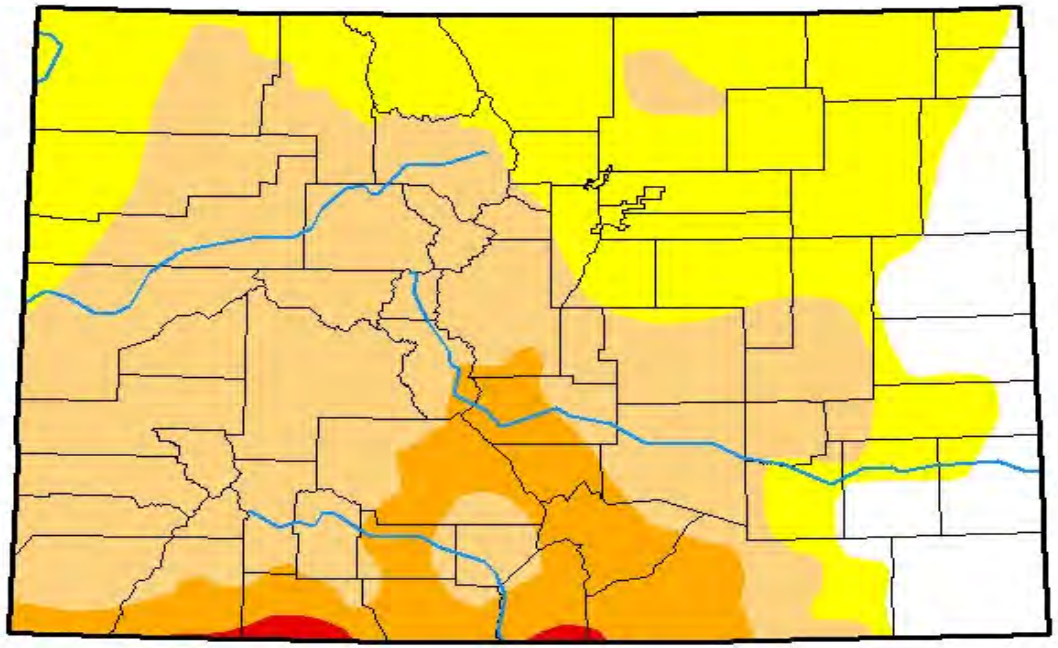

March 5, 2019
(Released Thursday, Mar. 7, 2019)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	10.64	89.36	58.05	12.08	0.58	0.00
Last Week *02-26-2019*	10.64	89.36	62.26	35.26	0.59	0.00
3 Months Ago *12-04-2018*	17.10	82.90	66.26	54.82	27.11	11.22
Start of Calendar Year *01-01-2019*	17.94	82.06	66.26	54.91	27.11	11.22
Start of Water Year *09-25-2018*	14.19	85.81	72.30	64.41	48.47	16.21
One Year Ago *03-06-2018*	10.16	89.84	70.89	45.80	9.28	0.00

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
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Author:
Eric Luebehusen
U.S. Department of Agriculture

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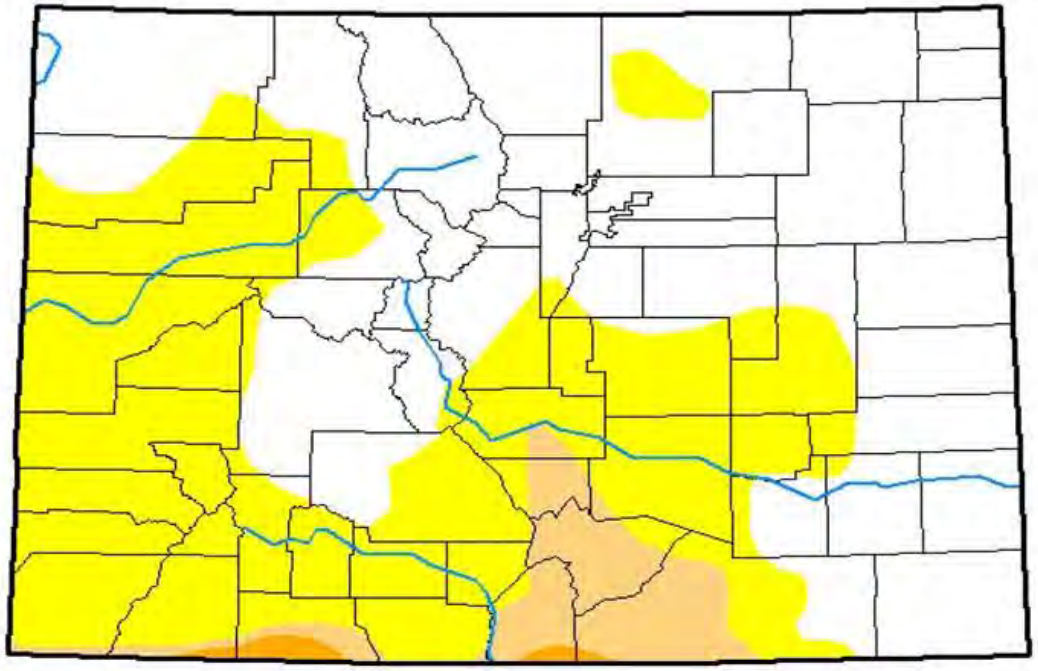

March 19, 2019
(Released Thursday, Mar. 21, 2019)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	53.87	46.13	6.39	0.63	0.00	0.00
Last Week *03-12-2019*	17.00	83.00	25.44	6.26	0.58	0.00
3 Months Ago *12-18-2018*	17.10	82.90	66.26	54.82	27.11	11.22
Start of Calendar Year *01-01-2019*	17.94	82.06	66.26	54.91	27.11	11.22
Start of Water Year *09-25-2018*	14.19	85.81	72.30	64.41	48.47	16.21
One Year Ago *03-20-2018*	9.65	90.35	74.31	50.29	19.99	0.00

Intensity:

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- D1 Moderate Drought
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NCEI/NOAA

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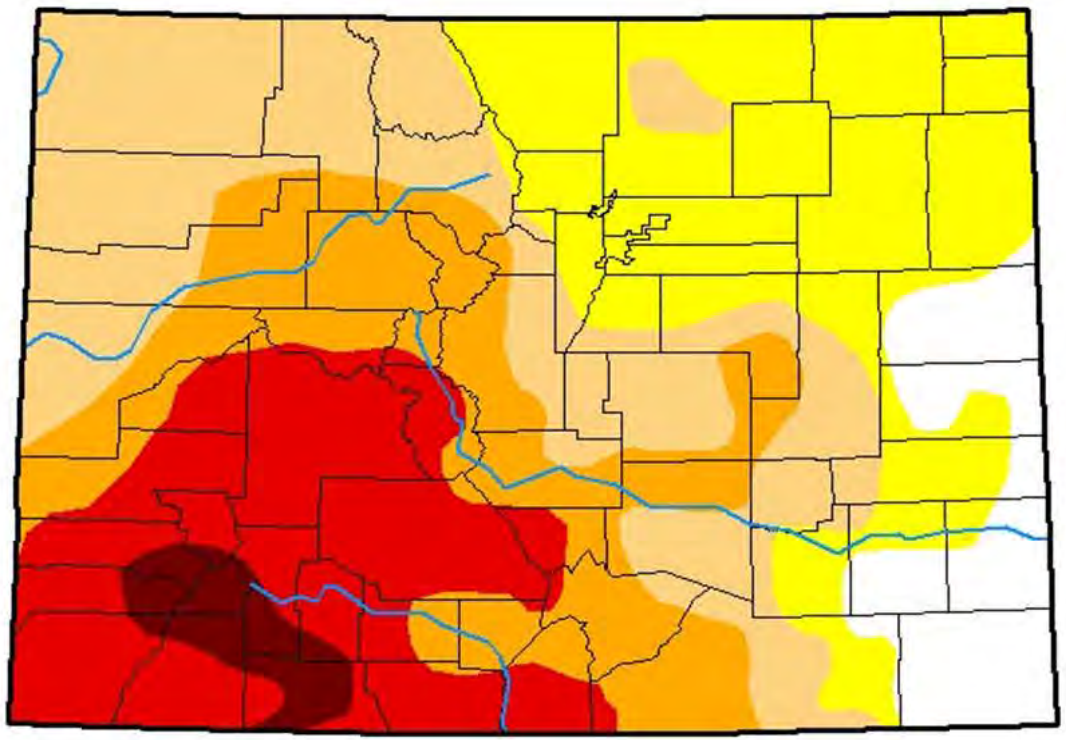
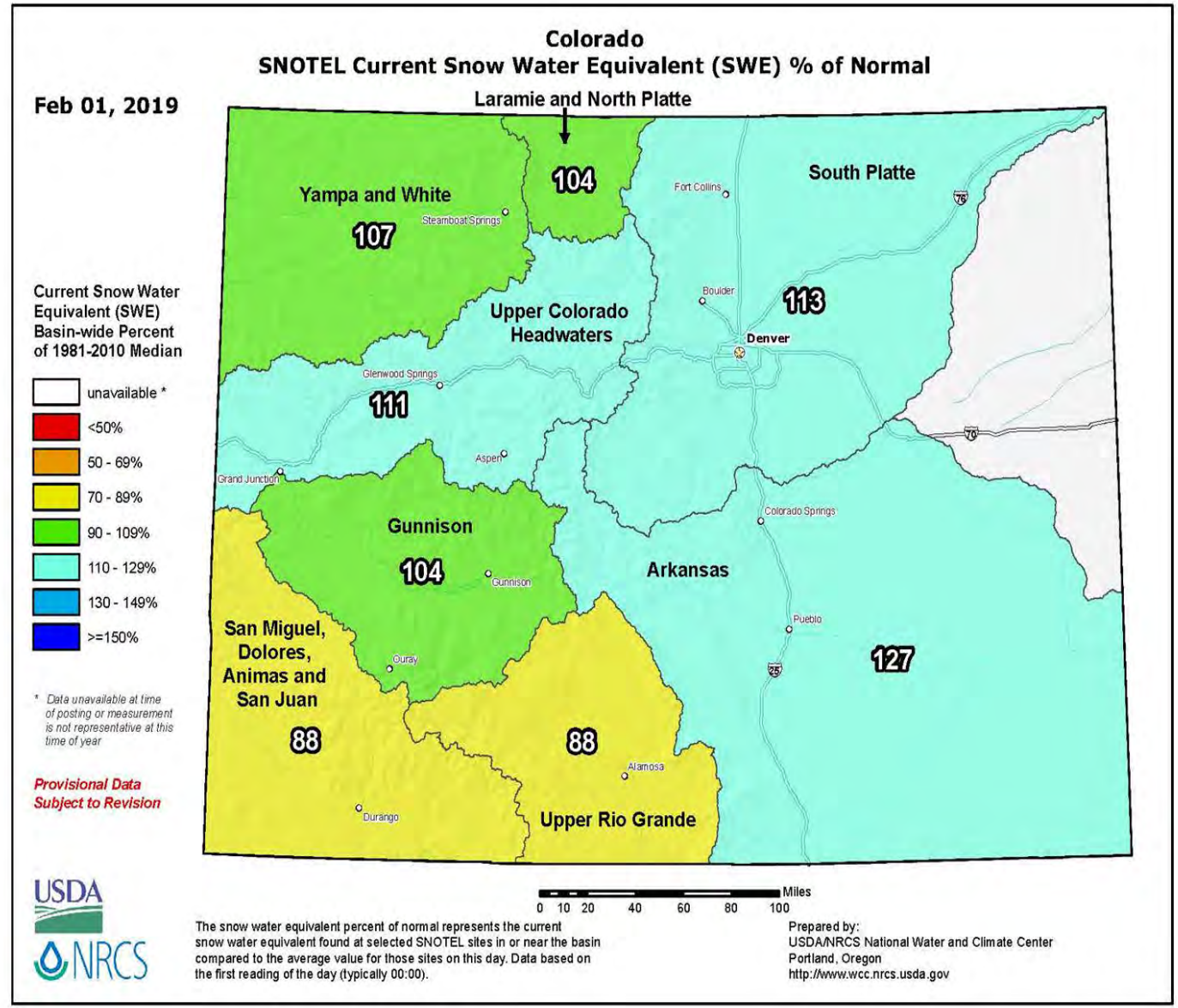
U.S. Drought Monitor
Colorado

February 5, 2019
(Released Thursday, Feb. 7, 2019)
Valid 7 a.m. EST





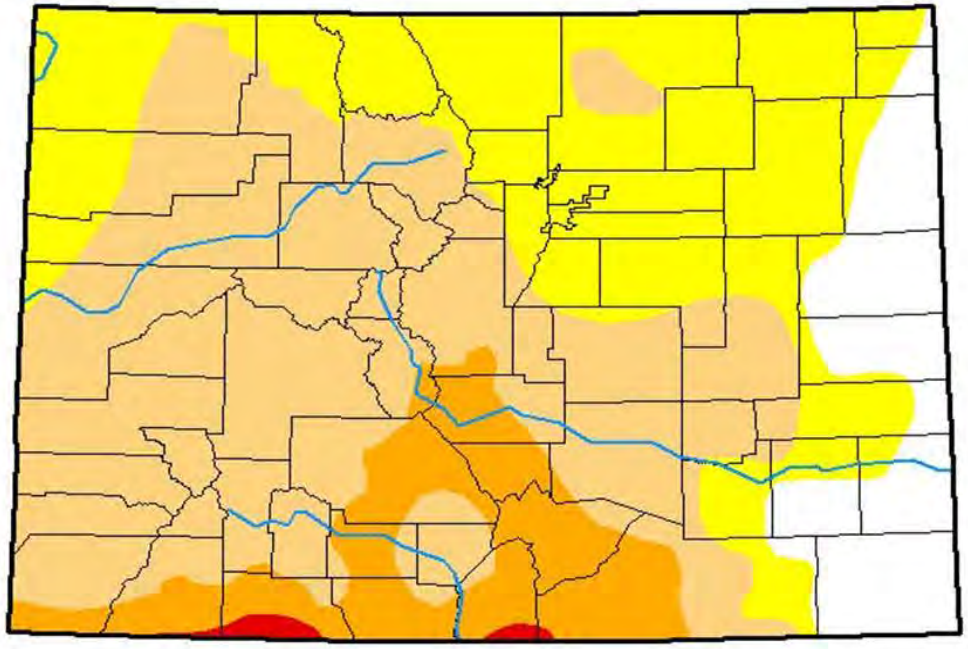
U.S. Drought Monitor

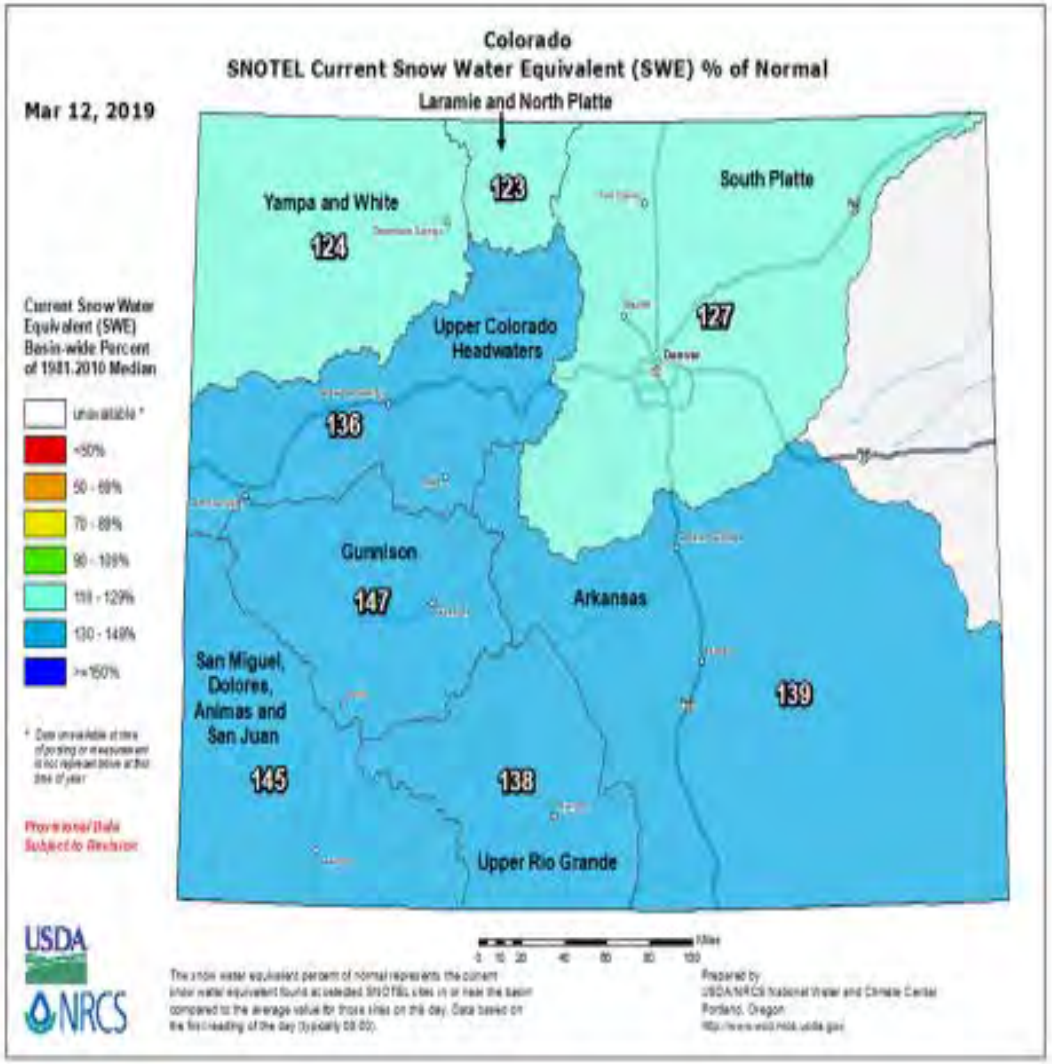
Colorado

March 5, 2019

(Released Thursday, Mar. 7, 2019)

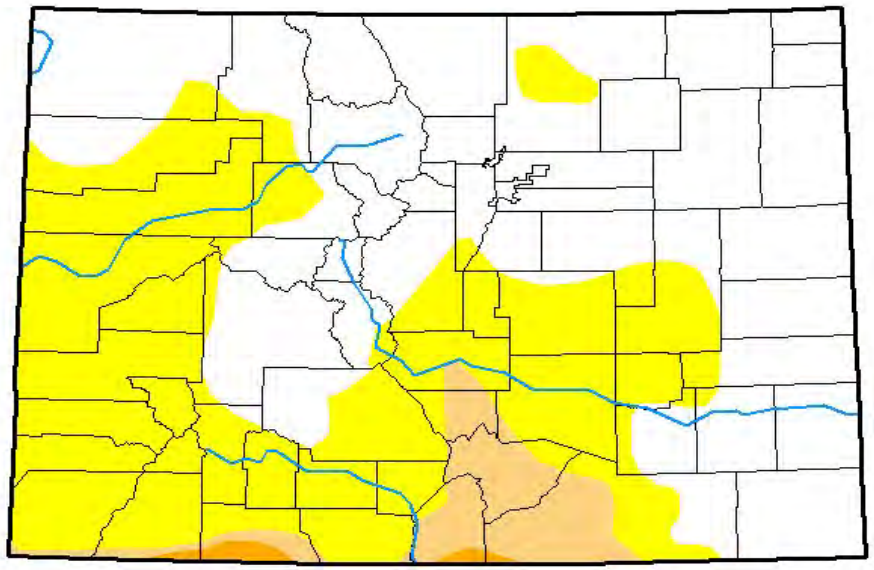
Valid 7 a.m. EST

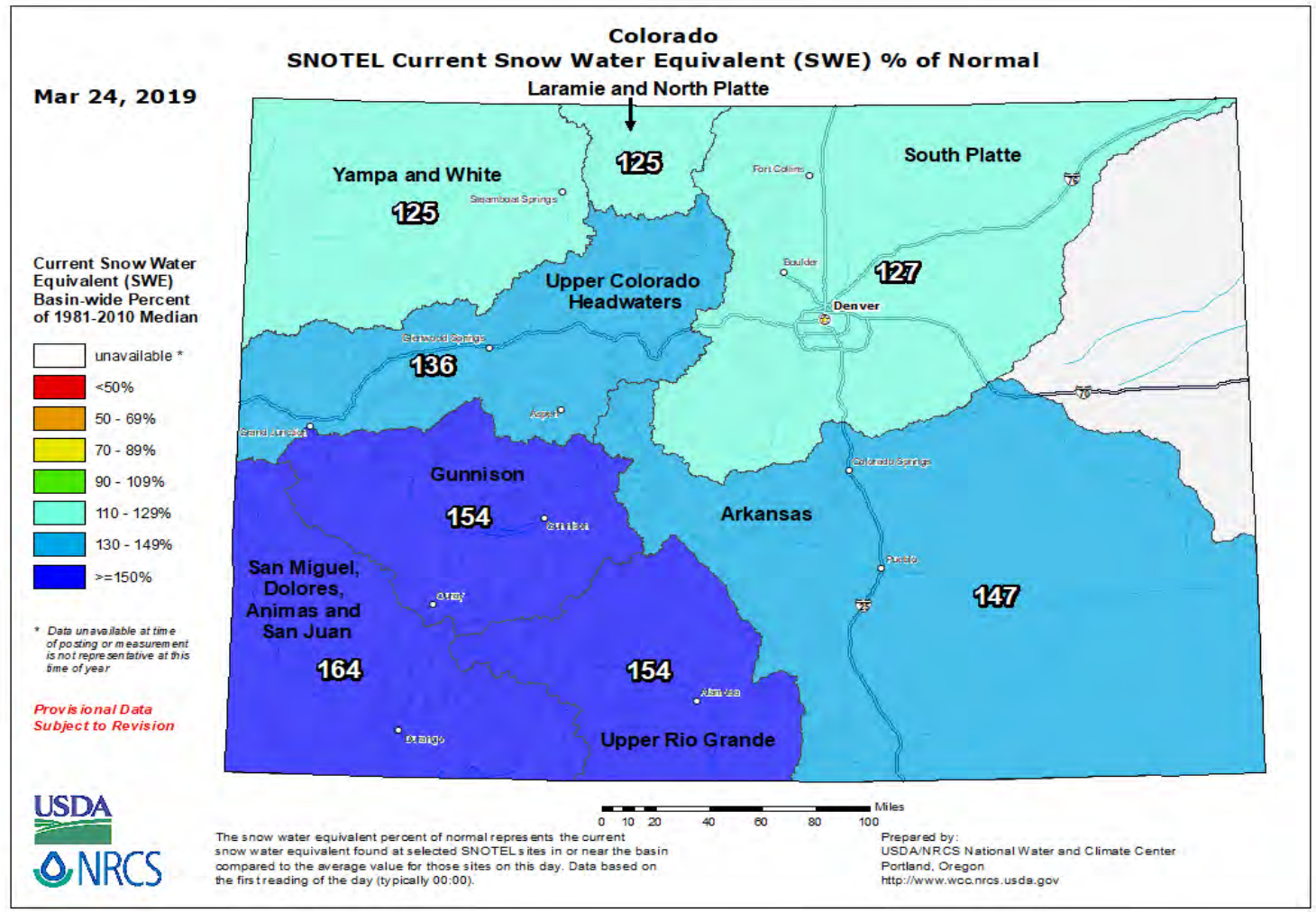




U.S. Drought Monitor
Colorado

March 19, 2019
(Released Thursday, Mar. 21, 2019)
Valid 8 a.m. EDT





Colorado River Basin

Colorado River Issues

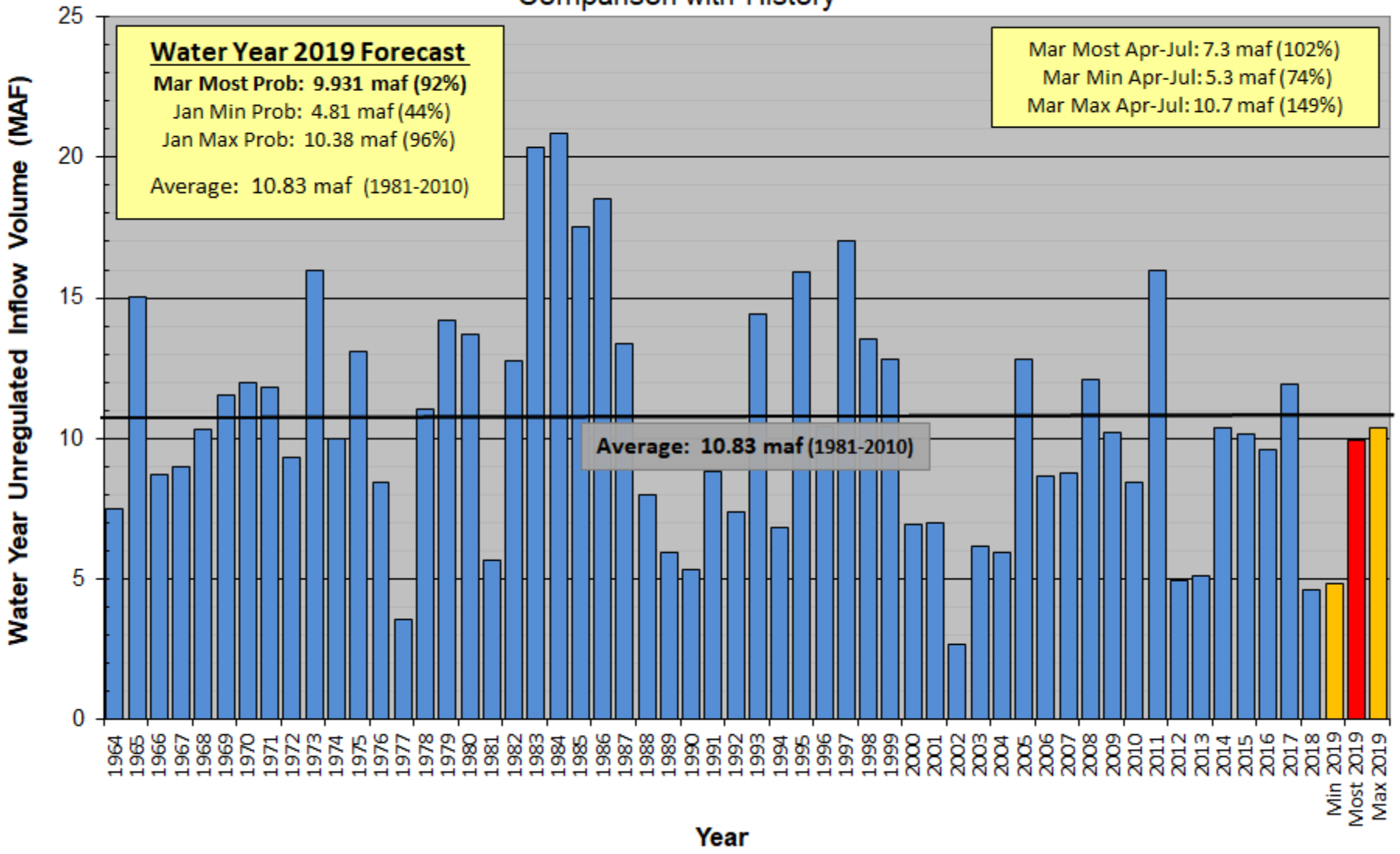
- Lake Powell
  - 38% Full (3/1/19)
  - Snowpack 138% (3/18/19)
  - Projected inflow 2019 WY 9.931 MAF (92% of normal)
  - Inflow 2018 WY 4.6 MAF (43% of normal), 3rd driest year on record (2002, 1977)
  - Projected Release 9 MAF
  - Lake Mead 41% Full (3/1/19)

- State of the River, April 3rd, Colorado River District

Lake Powell Unregulated Inflow

Water Year 2019 Forecast *(issued March 1)*

Comparison with History




Questions?

River Health

What does this mean for river health?

What can be done locally?

Kelly!