CBRFC
Water Year 2022
Early Season Water Supply Outlook

December 15, 2021

Cody Moser
Hydrologist

Please mute your microphone until the question period

2022 Early Season Water Supply Outlook

Observed precipitation over the past several months

Soil moisture conditions entering winter

Current snow conditions

ESP method & water supply forecast evolution plot overview

2022 water supply - early season model guidance

Upcoming weather outlook & ENSO status

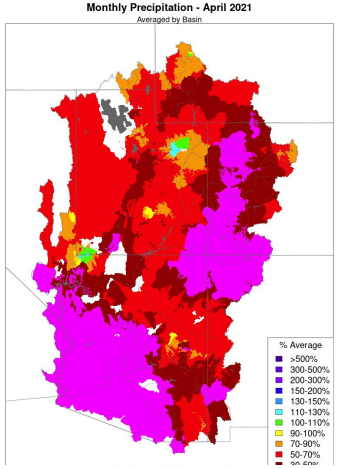
2022 water supply webinar schedule

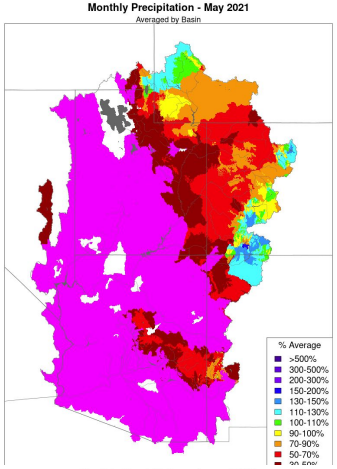
Forecast points of contact

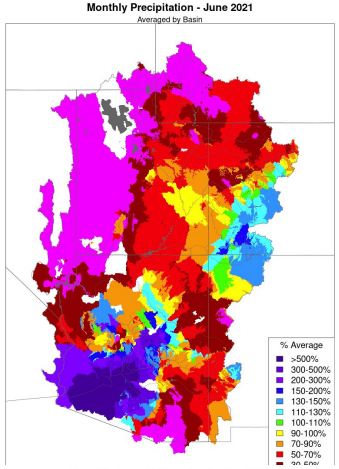
Webinar recording & slides will be made available on CBRFC webpage

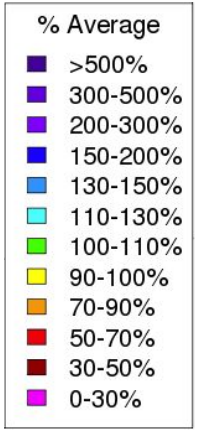
April-September 2021 Observed Monthly Precipitation Summary

Apr-Jun->

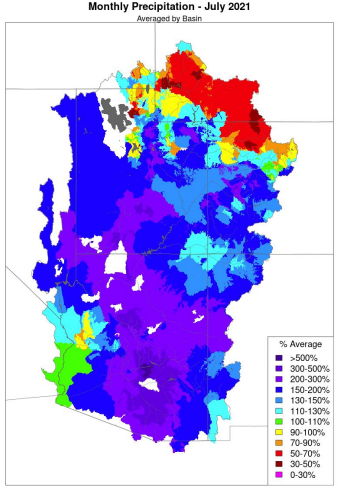


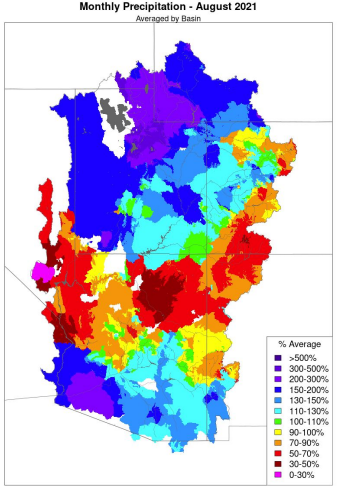


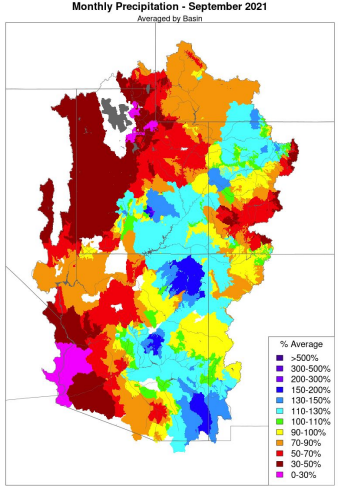




Jul-Sep->



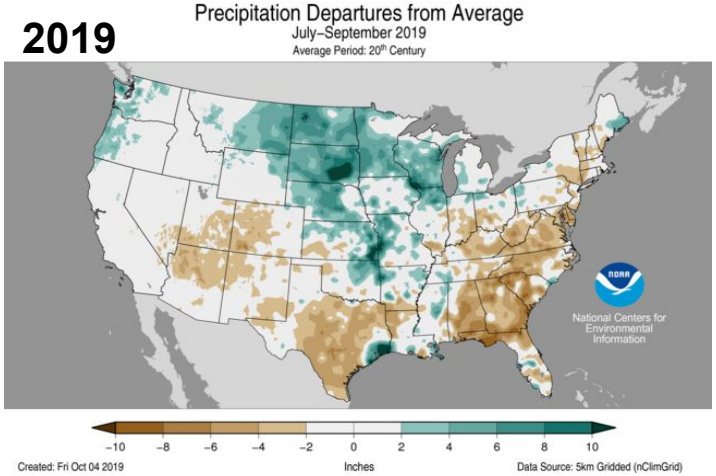




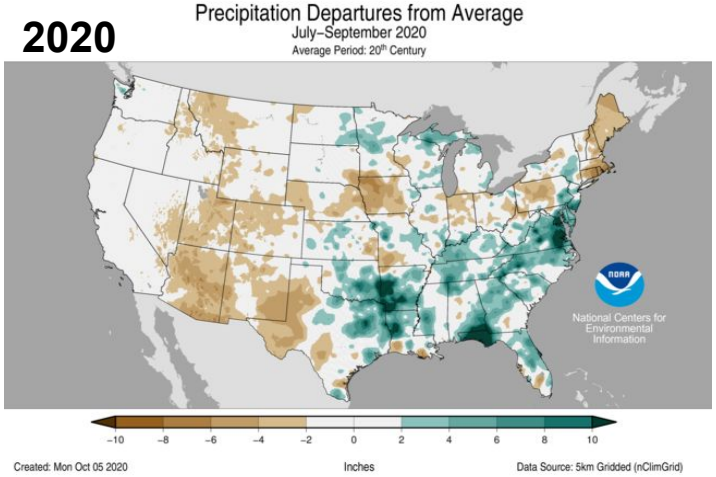
Poor spring runoff was followed by a wet monsoon season.

Monsoon: July-September Precipitation

2019



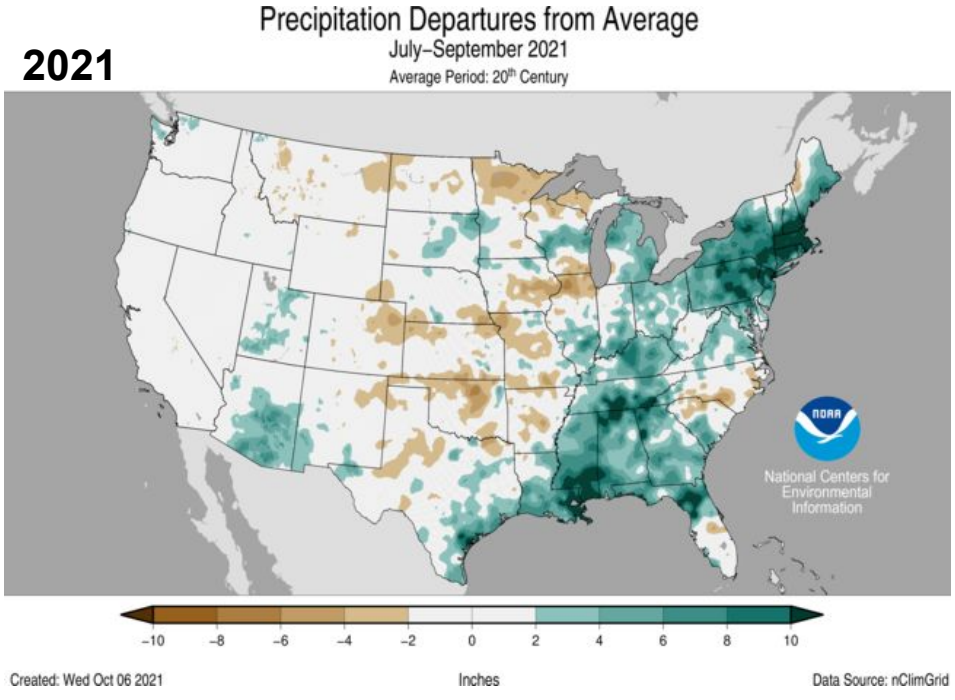
2020



The 2021 monsoon season was much wetter than recent years, especially across southern Arizona and central Utah.

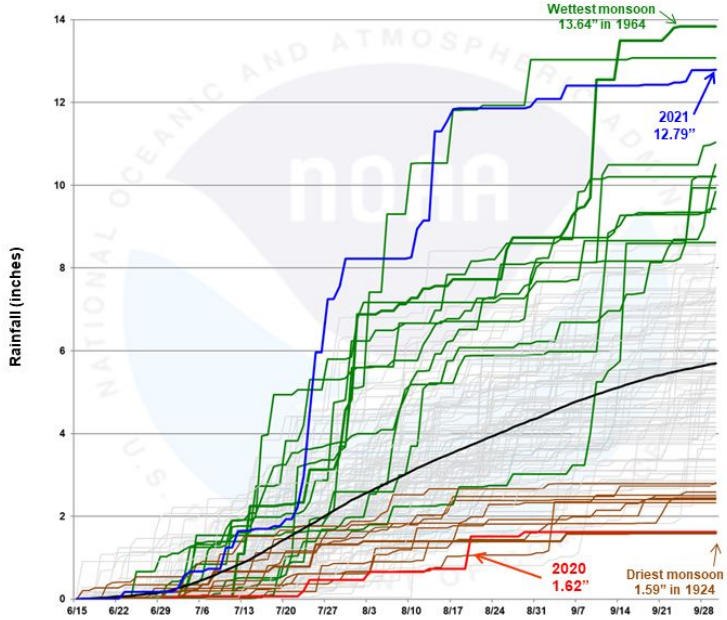
The precipitation also eased irrigation demand and benefited important fish reaches across the region, notably the 15-mile reach along the CO River mainstem.

2021



2021 Southwest Monsoon: Southern Arizona

Monsoon rainfall for Tucson (1895-2021)



The "Haywood plot" on the left shows the accumulated rainfall totals for each monsoon year recorded at the official site in Tucson.

Haywood plots are useful in tracking current season rainfall compared to the seasonal results from the past.

Top 10 wettest Monsoon in Green

Top 10 driest Monsoon in Brown

1981-2010 normal in Black

2021 in Blue
2020 in Red

Remaining years in Gray

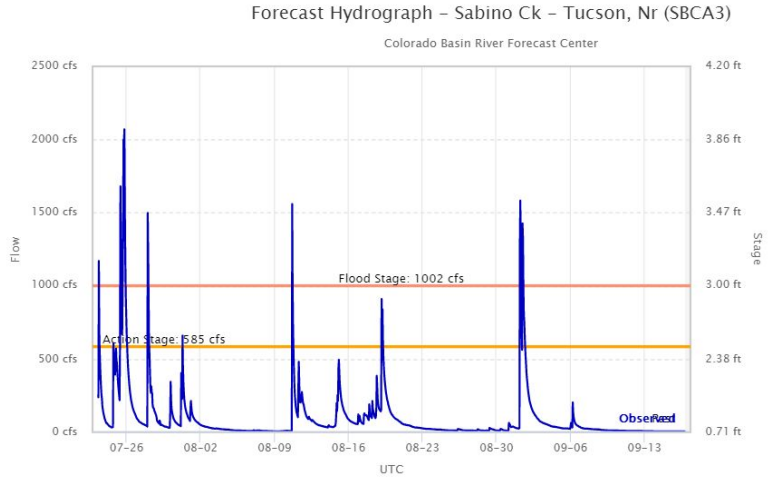
2021 total: 12.79"

3rd WETTEST Monsoon on record

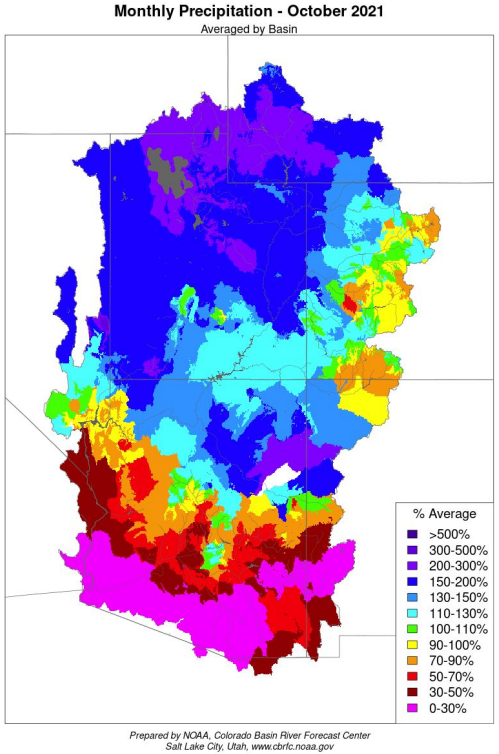
NWSTucson Monsoon 2021 weather.gov/tucson

Tucson, AZ recorded its 3rd wettest monsoon.

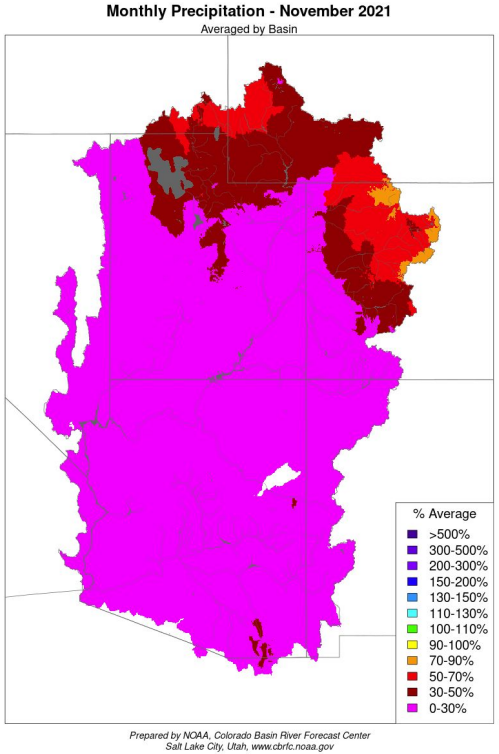
Monsoon season precipitation brought multiple high water events across southern Arizona.



October/November Precipitation



Snow started accumulating in mid-October across high elevation regions.

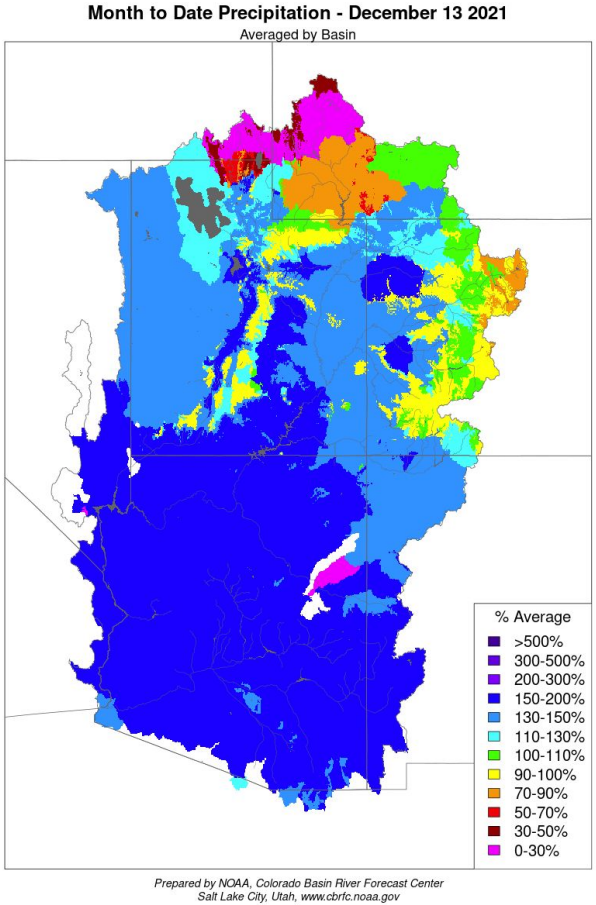


A few storm systems moved through the region during November, but they were mixed rain/snow events that did little to build the high elevation snowpack during the month.

Water Year 2022
Oct-Nov Precip Summary

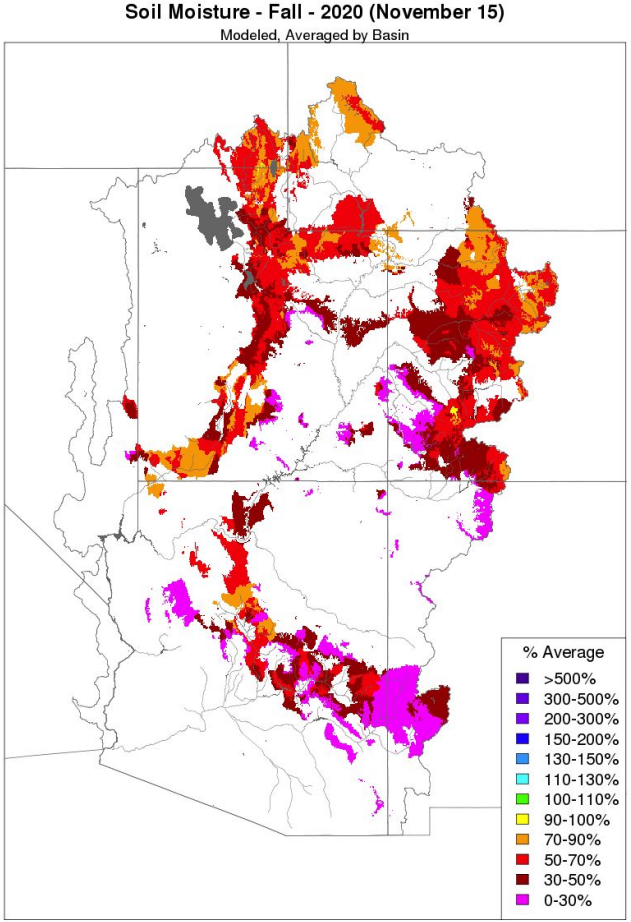
Basin	Precip (% Avg)
Upper Green	105%
Duchesne	105%
Price/San Rafael	110%
Yampa/White	100%
Upper CO Mainstem	80%
Gunnison	70%
Dolores	75%
San Juan	55%
Lake Powell	85%
Virgin	85%
Verde	50%
Salt	45%
Little Colorado	55%
Upper Gila	20%
Bear	115%
Weber	110%
Six Creeks	110%
Provo/UT Lake	105%

December-To-Date Precipitation



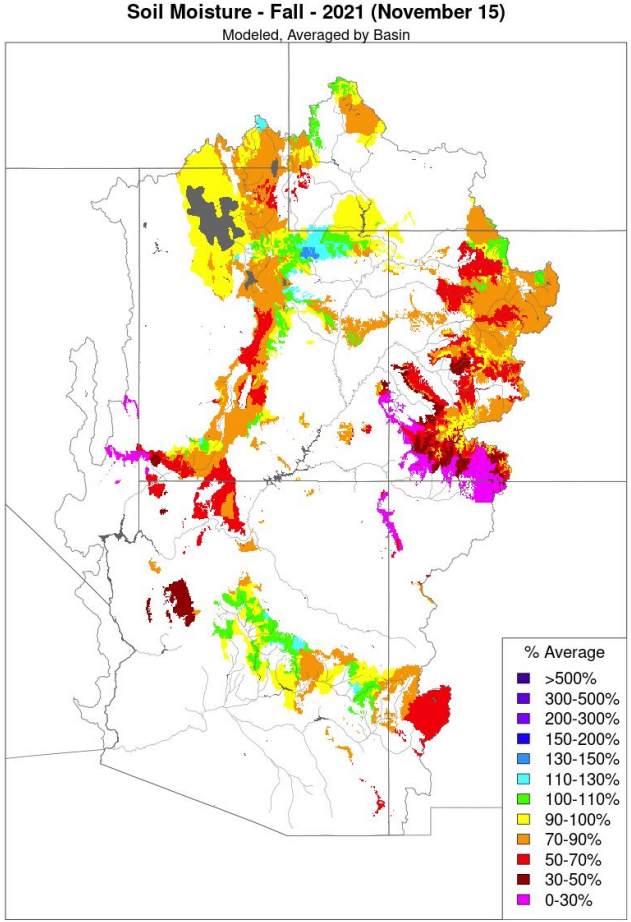
- December started dry
- Last week's storm system brought widespread precipitation to much of the region
  - 1-2" of SWE across UT/western CO
    - 2-3"+ at some SNOTELs
  - Northernmost basins (Green/Bear River Basins) saw less precipitation
- Widespread 0.5-1.5" of SWE across Utah past 24 hours
- Additional precipitation expected in the near future
  - More on that later

Fall Model Soil Moisture Conditions: 2020 vs. 2021

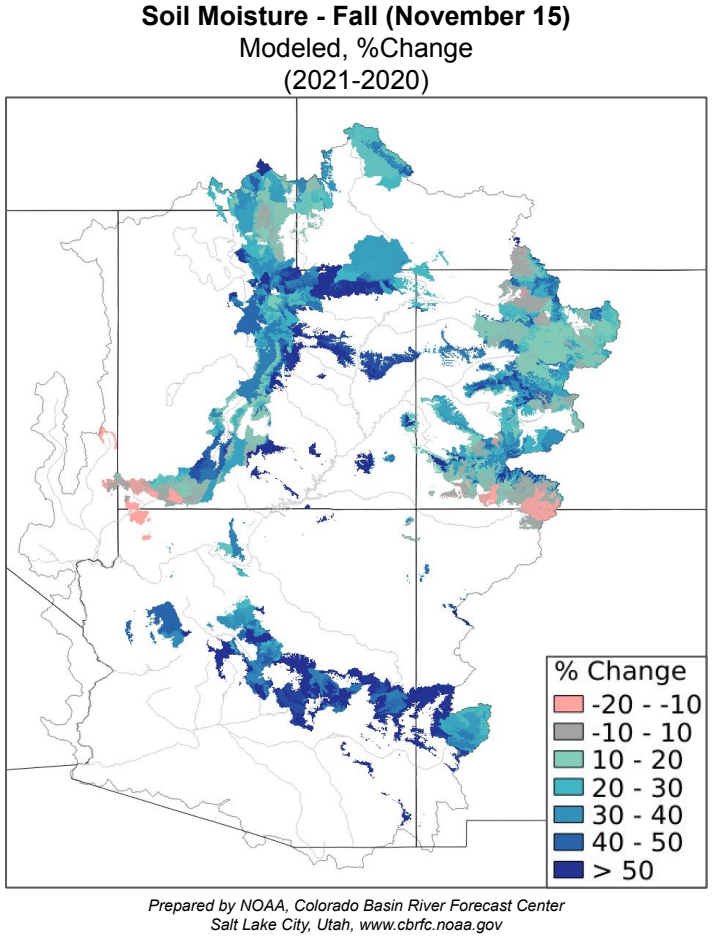


CBRFC model soil moisture conditions are improved from their record/near record dry levels a year ago but remain below to well below normal across many of the major runoff producing areas.

Above normal winter/spring precipitation will be needed to improve soil moisture deficits.



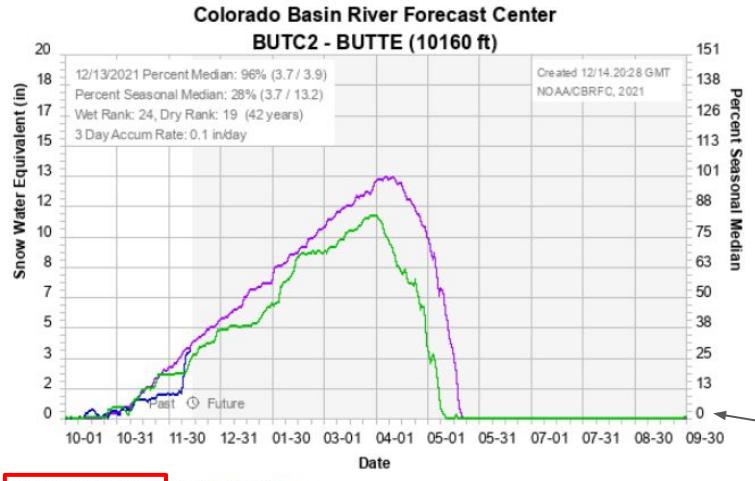
Fall Model Soil Moisture Conditions: 2020 vs. 2021



This is an experimental CBRFC soil moisture graphic.

Utah & Arizona model soil moisture conditions improved more compared to southwest Wyoming & western Colorado.

Current Observed Snow Conditions - SNOTEL (NRCS)



Select multiple years and/or stations. Be sure to use your systems key-click combination to avoid inadvertent deselection.

Years

median
2022
2021
avg
2020
2019
2018
2017
2016
2015
2014
2013
2012
2011
2010

Stations

BUTC2 BUTTE (10160 ft)
AGUU1 AGUA CANYON (8900 ft)
APSC2 APISHAPA (10000 ft)
ARPC2 ARAPAHO RIDGE (10960 ft)
ATAI1 ATLANTA SUMMIT (7580 ft)
BAMN5 BATEMAN (9300 ft)
BASI1 BANNER SUMMIT (7040 ft)
BBSA3 BAKER BUTTE SUMMIT (7700 ft)
BBSW4 BLIND BULL SUM (8650 ft)
BCVC2 BEAVER CK VILLAGE (8500 ft)
BCZU1 BUCK PASTURE SNOWCOURSE (9700 ft)
BECI1 BEAR CANYON (7900 ft)
BENU1 BEVANS CABIN SNOWC NR TOOELE (6430 ft)
BERN2 BEAR CK (8040 ft)
BFTU1 BLACK FLAT-U.M. CK (9462 ft)

Y axis

Percent Seasonal Median
Percent Median to Date

Similar/Historical Years

Off
Closest Pattern
Peak to Date
Current Observation
Highest Year
Lowest Year

☐ Show Tabular Data
☐ High Resolution

Apply

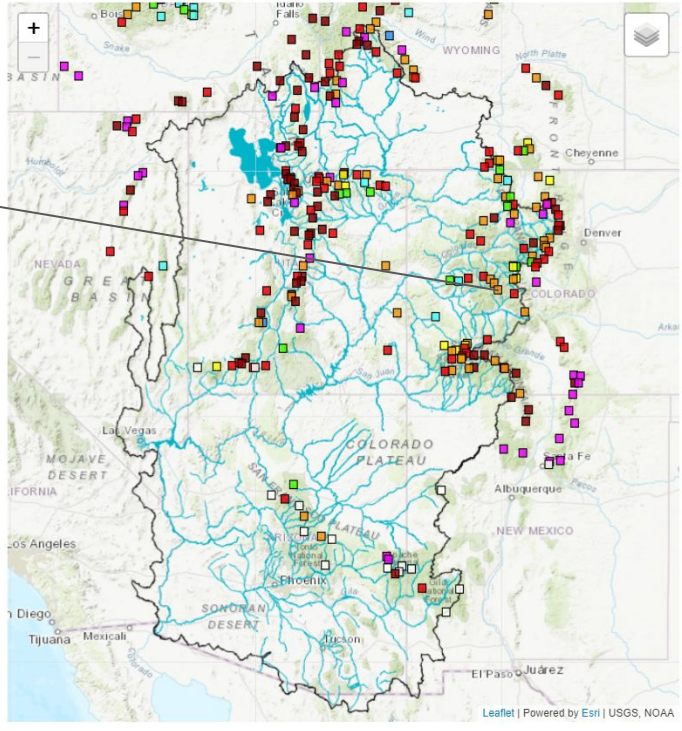
Raw SNOTEL data from NRCS.
Your query took 1 seconds to lookup and 0 seconds to plot.

Colorado Basin River Forecast Center
National Weather Service

Home | Rivers | Snow | Water Supply | Reservoirs | Weather | Climate | Help | About | News

Wednesday, December 15, 2021, 10:00 am MT, CBRFC Early Season Water Supply Outlook Webinar: Registration
2022 Water Supply Forecast Webinar Schedule and Registration: More Info...

Conditions Map Help



▸ River Conditions
▾ Snow Conditions

Points | Grids | Model

Data Updated: 2021-12-14 Help

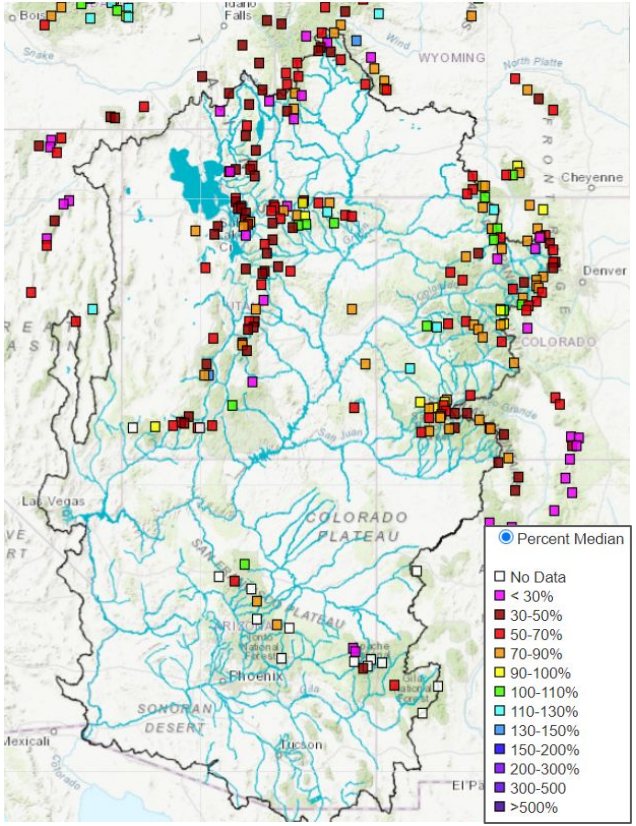
☑ Show Hide Other Types
☑ No Data
☐ No Average
☑ < 7000 ft
☑ 7000-8000 ft
☑ 8000-9000 ft
☑ 9000-10000 ft
☑ > 10000 ft

○ Percentiles
○ Percent Average
◉ Percent Median

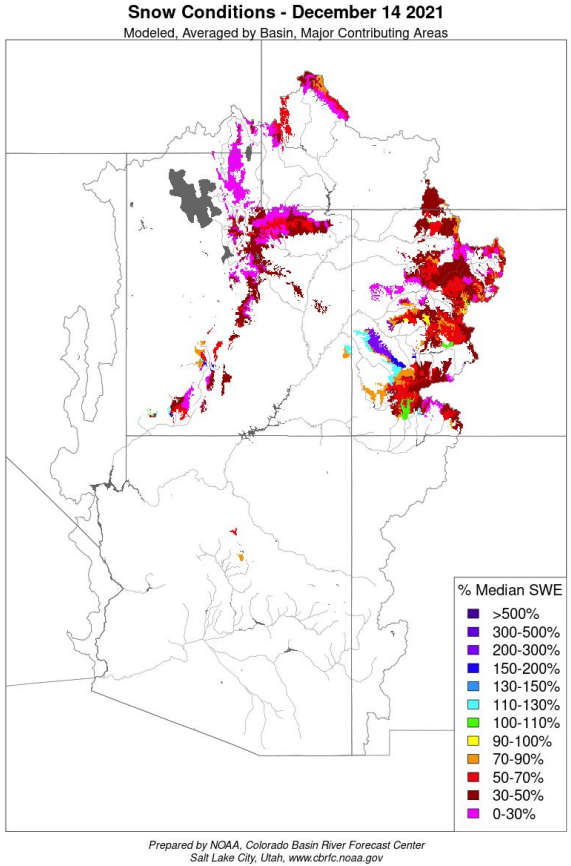
☐ No Data
■ < 30%
■ 30-50%
■ 50-70%
■ 70-90%
■ 90-100%
■ 100-110%
■ 110-130%
■ 130-150%
■ 150-200%
■ 200-300%
■ 300-500
■ >500%

Mid-December Snow Conditions

SNOTEL (Observed)



CBRFC (Model)



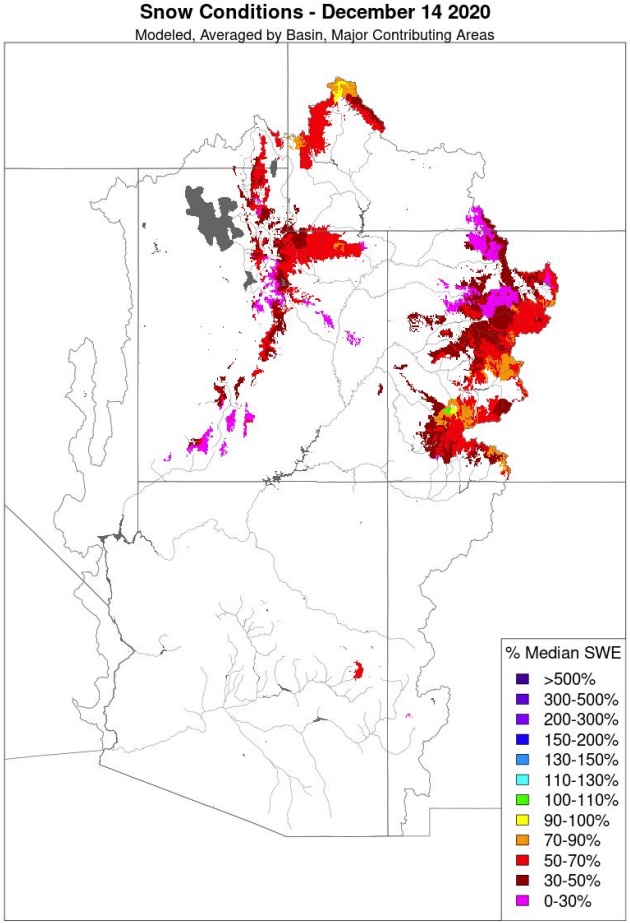
Dec 14 SWE Summary (SNOTEL)

Basin	SWE (% Median)
Upper Green	60%
Duchesne	80%
Price/San Rafael	50%
Yampa/White	80%
Upper CO Mainstem	70%
Gunnison	85%
Dolores	85%
San Juan	65%
Lake Powell	70%
Virgin	60%
Verde	90%
Salt	20%
Little Colorado	45%
Upper Gila	45%
Bear	50%
Weber	50%
Six Creeks	60%
Provo/UT Lake	50%

Some sites in bottom 5 of POR

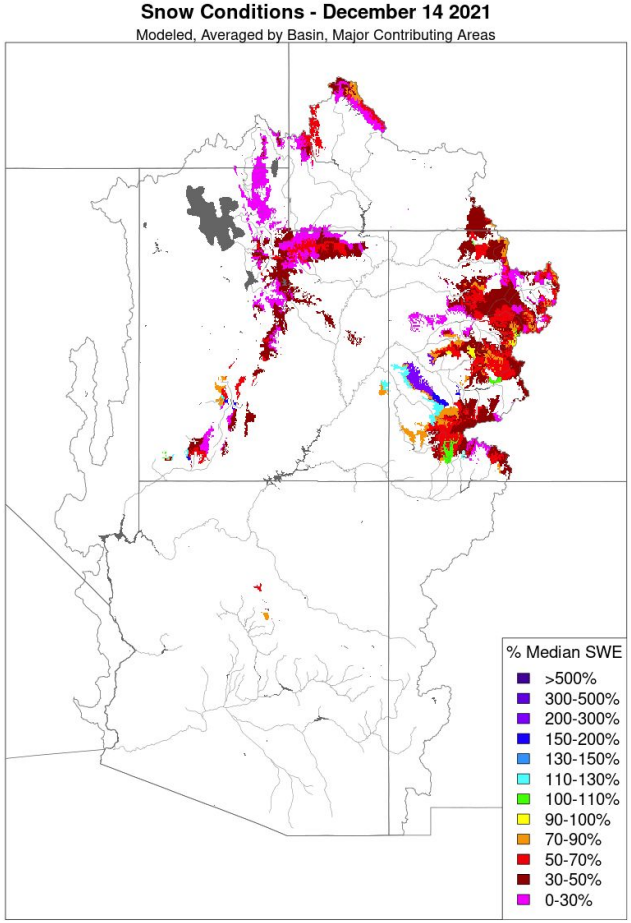
Many sites in bottom 3 of POR

Mid-December CBRFC Model Snow Conditions - 2020 / 2021 Comparison



Mid-December model snow off to a similar start compared to a year ago, with mostly below to much below average regional SWE conditions.

WY22 starting off with unfavorable soil moisture and SWE conditions.



Water Supply - Early Season Model Guidance

At this point in time…

- Ideally model soil moisture & snow states are accurate and representative of current conditions.
- ESP model guidance is still heavily influenced by soil moisture.
- Early season forecast errors are generally 20-40% and typically improve through the spring; the primary source of forecast uncertainty is future weather.
- Mid-December snowpack conditions
  - Typically around 30-35% of the seasonal snow has occurred by mid-December
  - Historical median (or normal) snowpack values are still small compared to later in the season
  - ESP more sensitive to SWE earlier in the season
    - A 2” SWE deficit is more impactful now compared to a 2” SWE deficit in April

Ensemble Streamflow Prediction (ESP) Overview

ESP Methodology: current hydrologic model states (soil moisture, snow)
-> future weather (precip/temp) scenarios based on historical (1991-2020) observations
= April-July streamflow volume

Example: Dillon Reservoir (Inflow) December 13, 2021 ESP Run

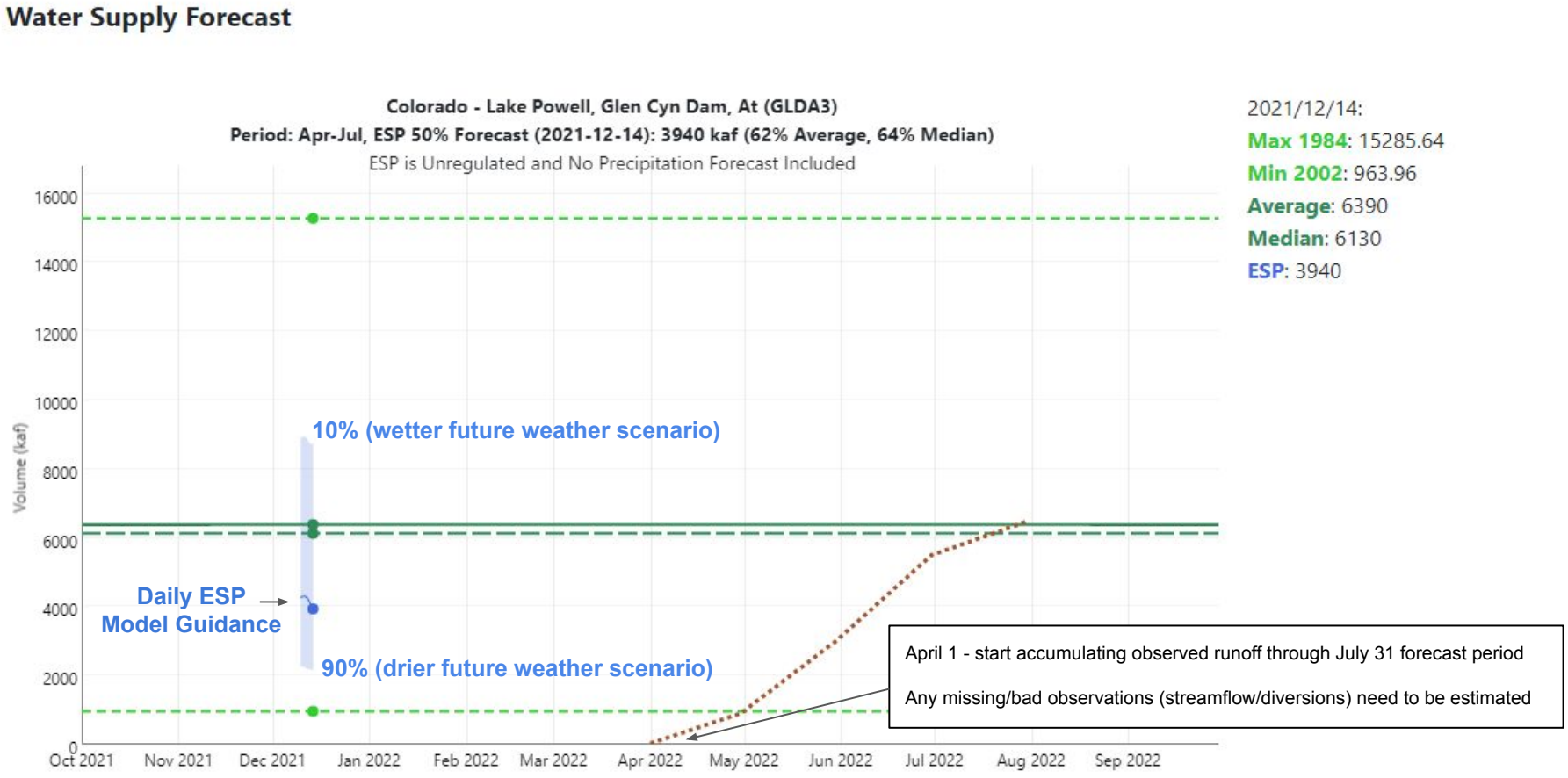
2021 current model states + 1991 weather = 227 kaf (thousand acre-feet)
2021 current model states + 1992 weather = 160 kaf
2021 current model states + 1993 weather = 310 kaf
.
.
.
2021 current model states + 2020 weather = 213 kaf

Final result is 30 different possibilities of April-July streamflow volume
-use statistical analysis to determine probabilistic outcomes:
-volume that has 50% chance of occurring (most probable) = 241 kaf
-volume that has 10% chance of occurring (less likely) = 325 kaf
-volume that has 90% chance of occurring (more likely) = 152 kaf

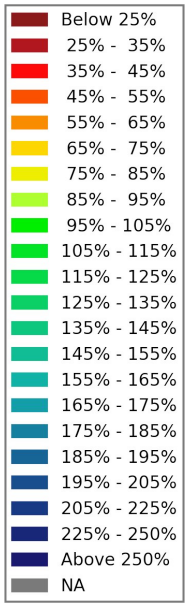
$$\%\text{Average} = \frac{\text{Most Probable Volume}}{\text{Average Observed Volume } (1991-2020)}$$

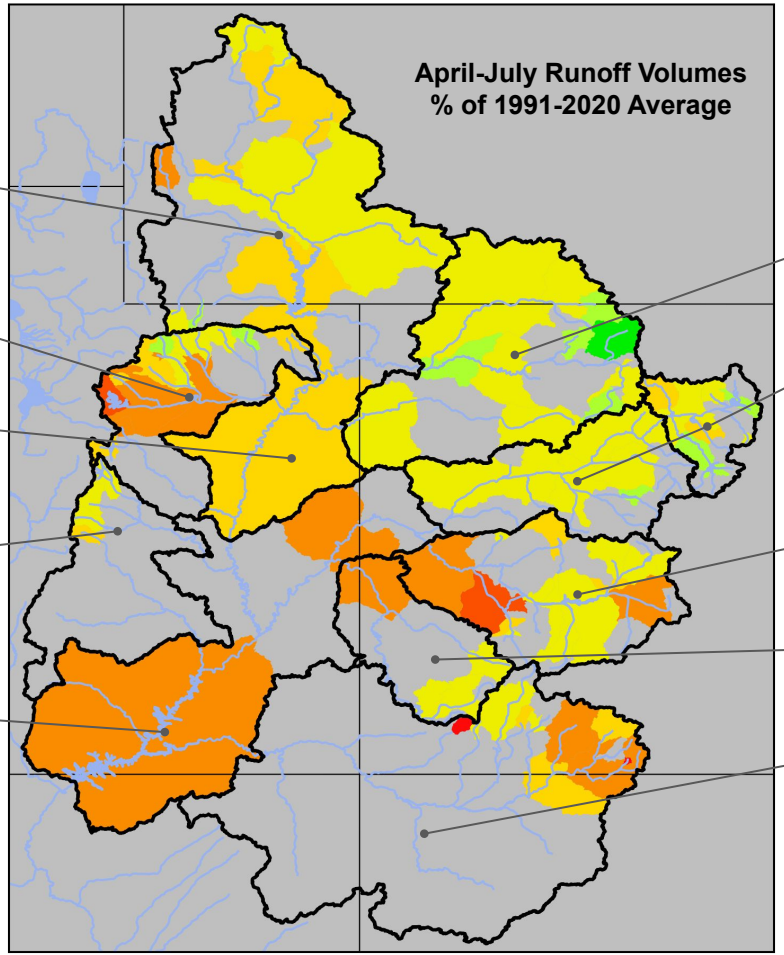
**Updated Daily*

Water Supply Forecast Evolution Plot Overview



ESP Model Guidance: Upper Colorado





Upper Green: 50-90%

Duchesne/Price: 45-90%

Lower Green: 55-85%

San Rafael/Dirty Devel: 60-90%

Lake Powell: 62%

Lake Powell summarizes the hydrologic conditions throughout the Upper Colorado River Basin.

White/Yampa: 70-100%

Upper CO: 60-90%

Gunnison: 45-90%

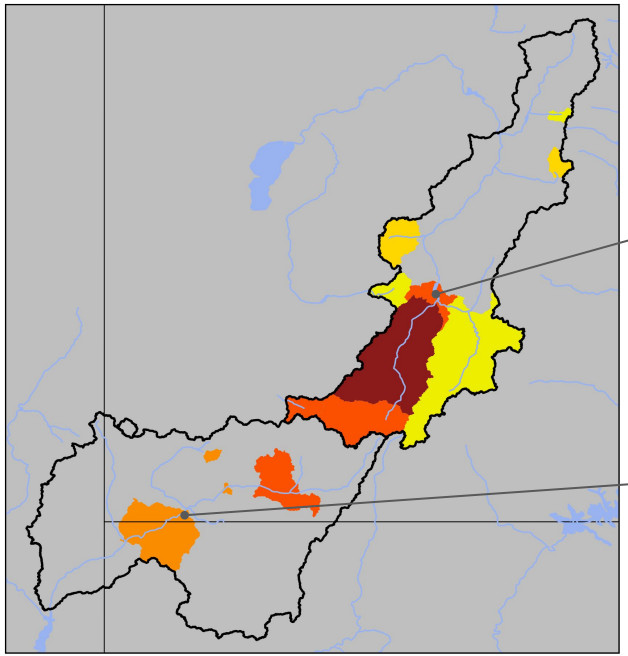
Dolores: 60-80%

San Juan: 40-80%

*Dec 14 / 0qpf

ESP Model Guidance: Sevier, Virgin, Lower Colorado

Sevier & Virgin
April-July Runoff Volumes
% of 1991-2020 **Average**



Sevier: 20-85%

Virgin: 45-65%

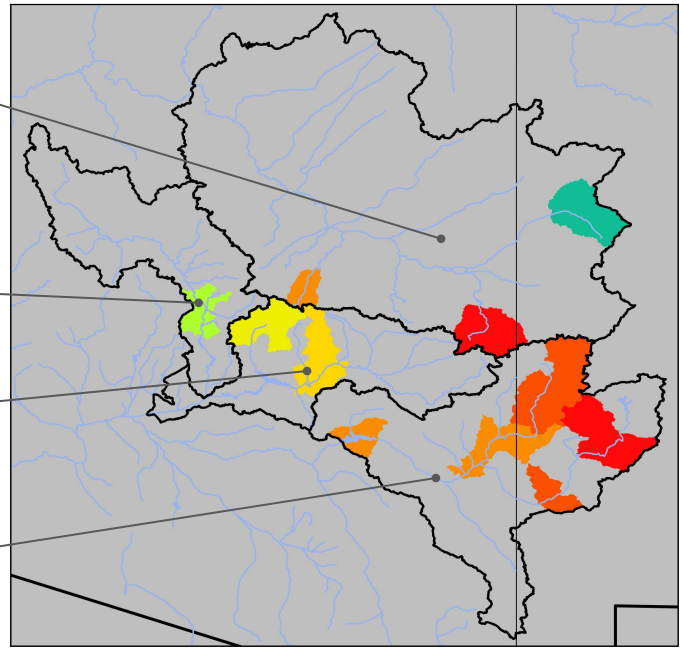
Lower Colorado
January-May Runoff Volumes
% of 1991-2020 **Median**

Little Colorado: 40-150%

Verde: 85%

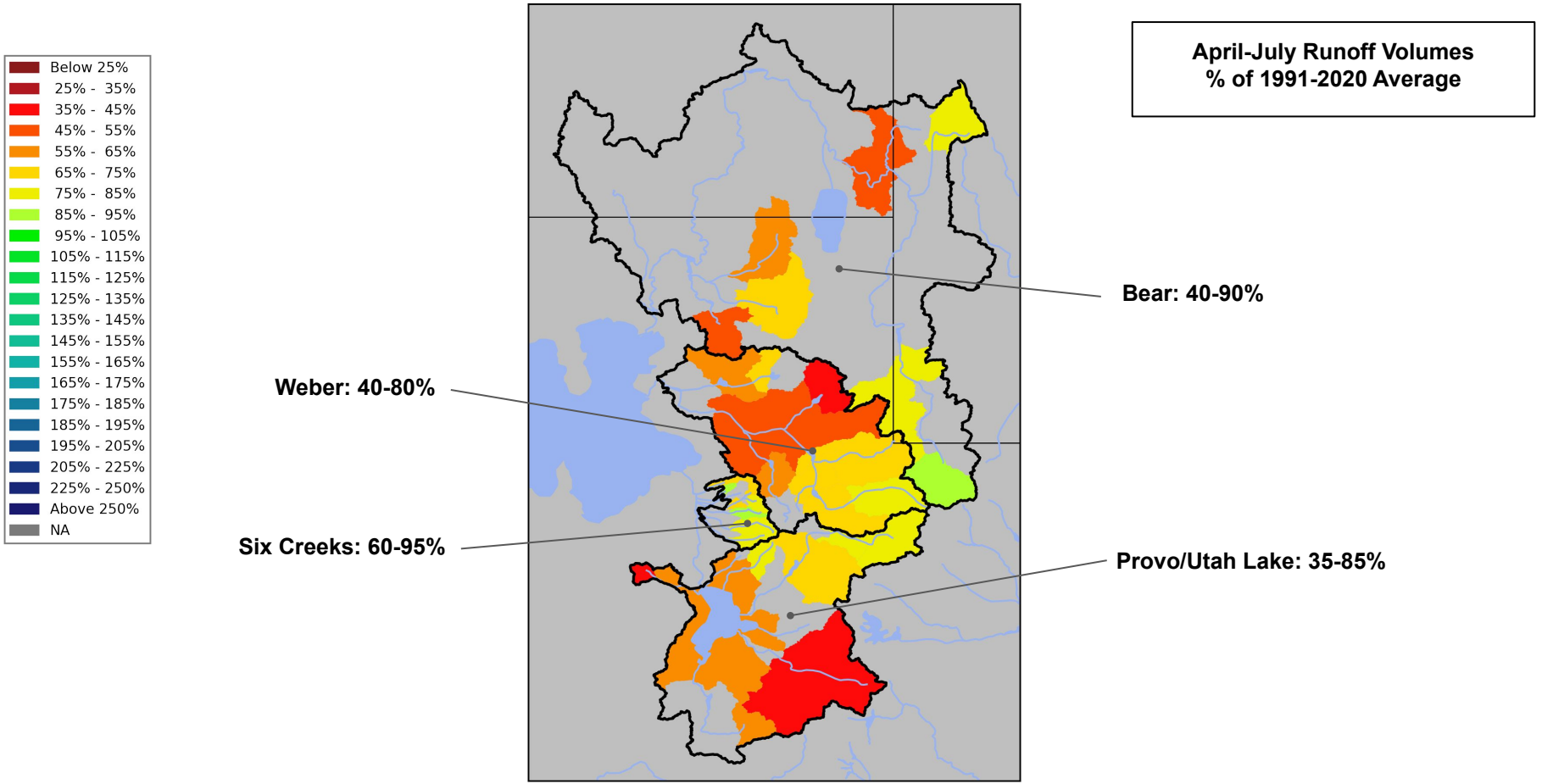
Salt: 70-85%

Upper Gila: 40-60%



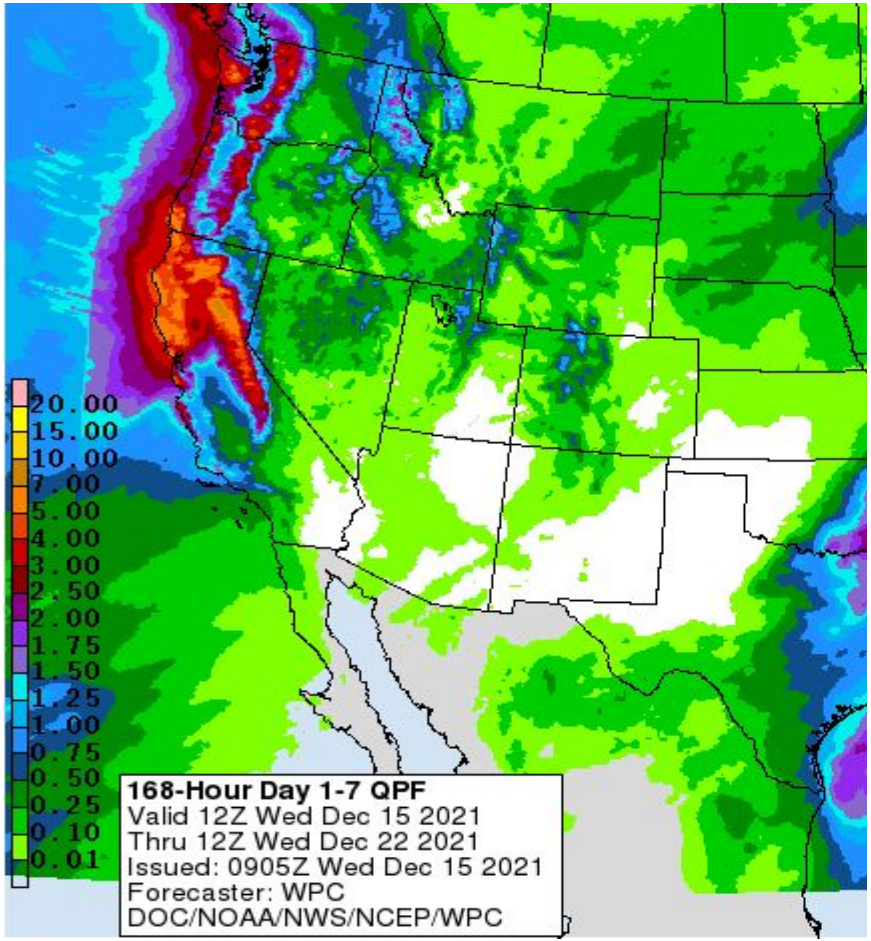
Dec 14 / 0qpf

ESP Model Guidance: Great Basin



Dec 14 / 0qpf

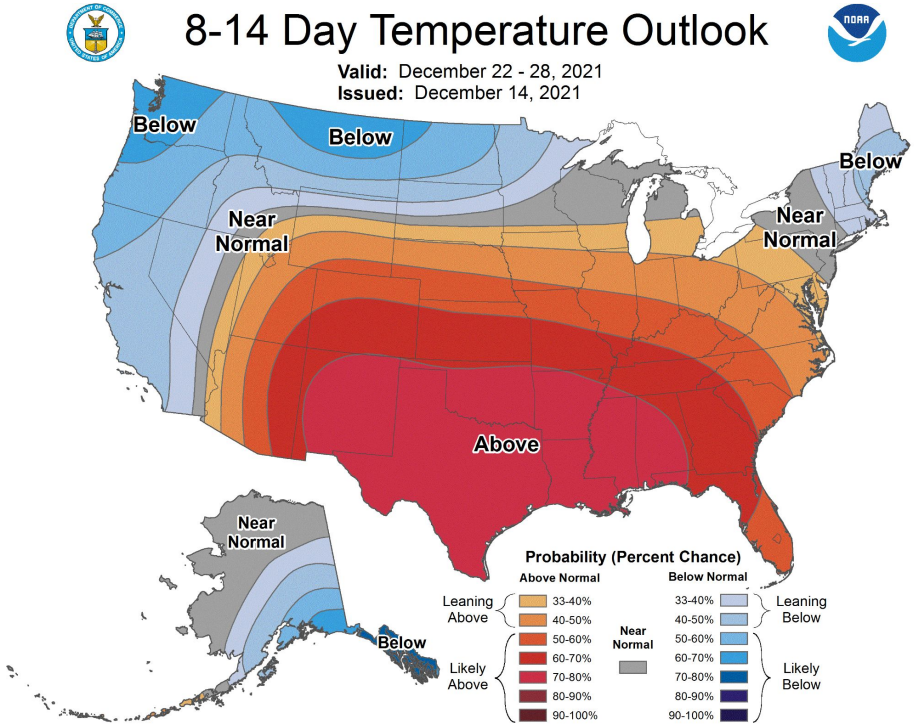
Upcoming Weather: Precipitation Outlook December 15-22

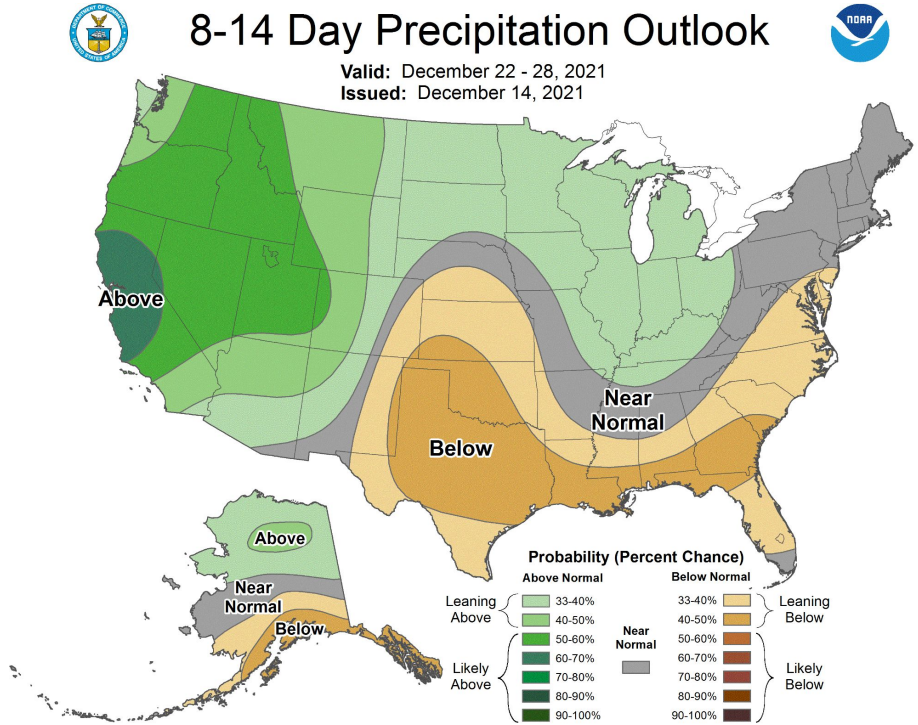


- A strong winter storm will bring around an inch of precipitation to high elevations across the region through tomorrow.
- Conditions will be dry and cold into the weekend.
- Another system is expected to bring precipitation to the area towards the middle of next week.

Upcoming Weather: 8-14 Day Outlook (December 22-28)

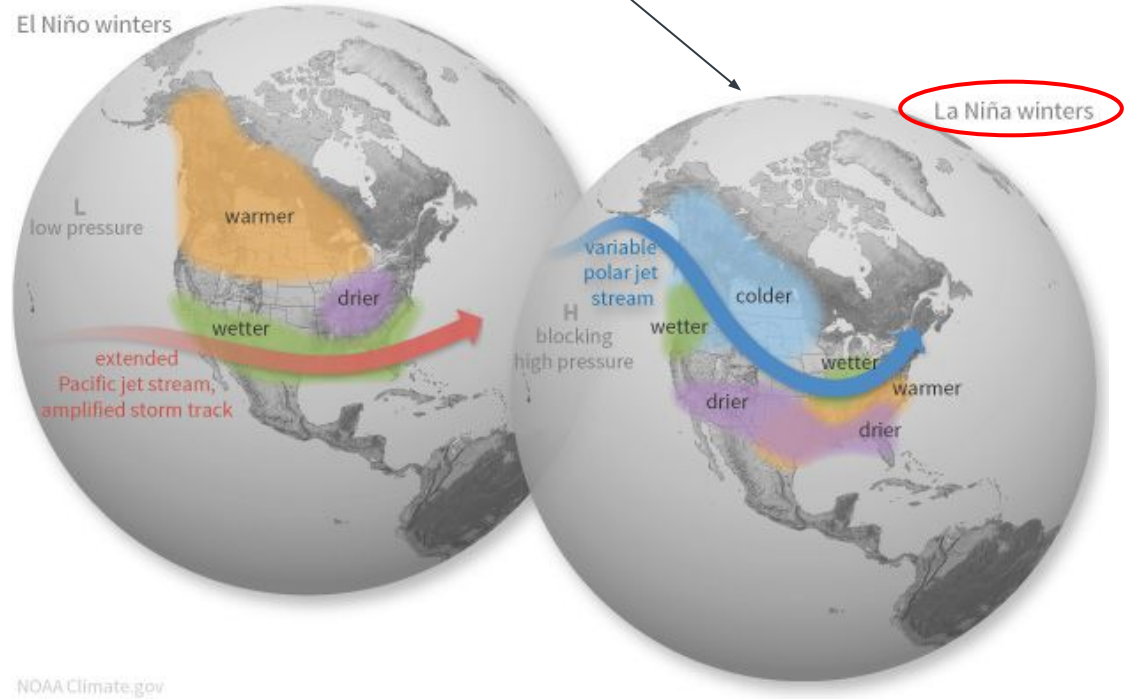
Increased probability of above normal temperatures and above normal precipitation.
Would expect ESP volume guidance to remain fairly steady through the end of the year.

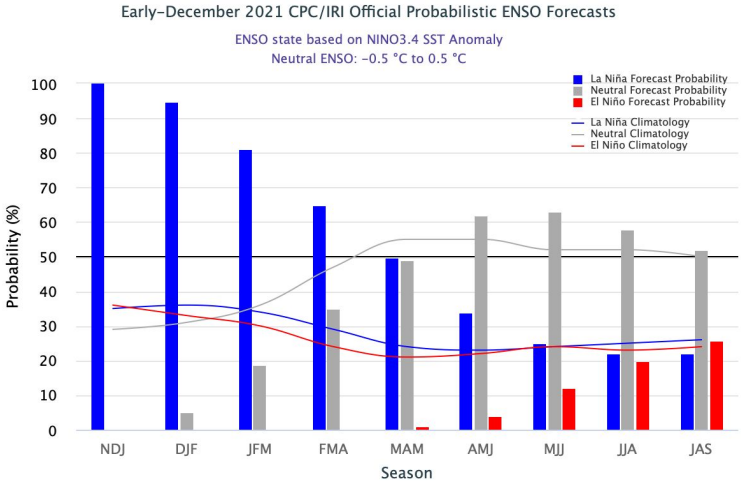


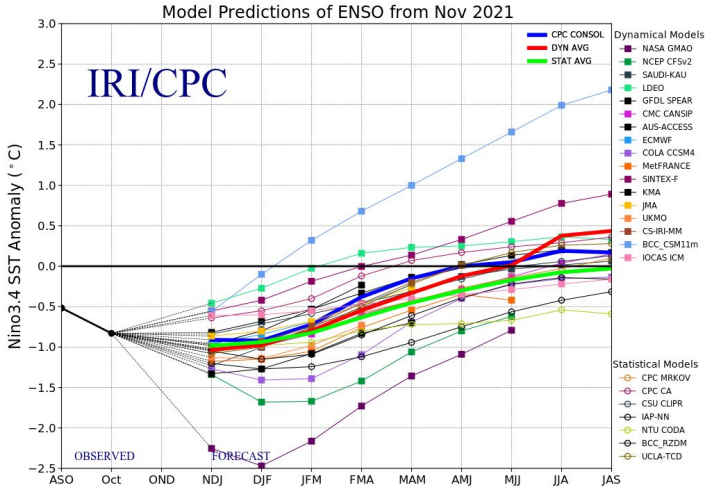


El Niño Southern Oscillation (ENSO) Status

- **La Niña** is favored to continue through the Northern Hemisphere winter 2021-22 (~95% chance) and transition to ENSO-neutral during the spring 2022 (~60% chance during April-June).
  - Very similar conditions to last year
  - Increased chances of drier winter weather in Arizona/LCRB
  - Much weaker correlation/winter weather signal elsewhere in basin





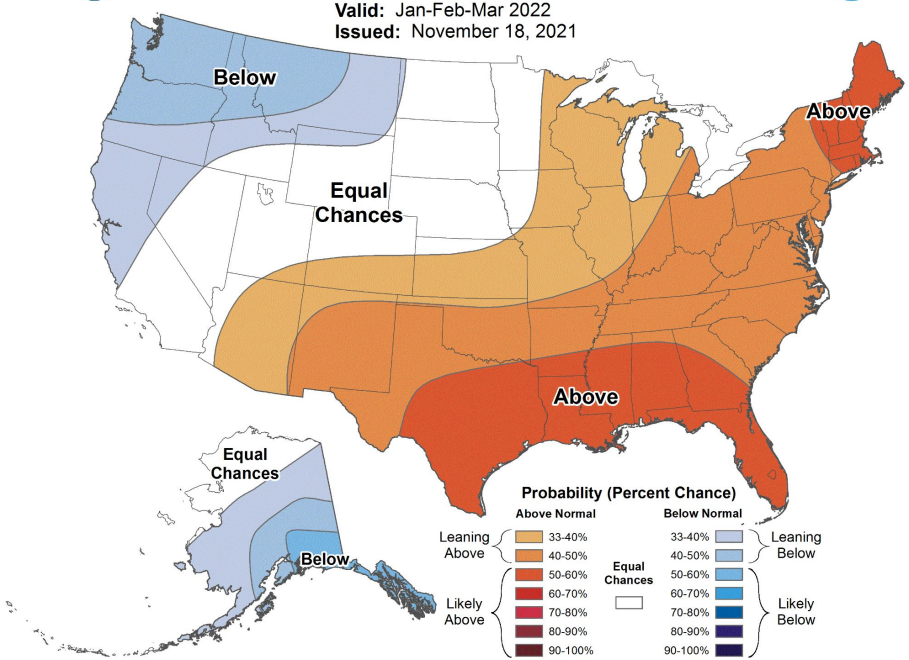


Climate Prediction Center Seasonal Outlook (JFM)

Increased chances of above normal temperatures across Arizona/Four Corners.
Increased chances of below normal precipitation across Arizona/Utah/western Colorado.
Equal chances for above and below normal precipitation across northwest Colorado/Wyoming.

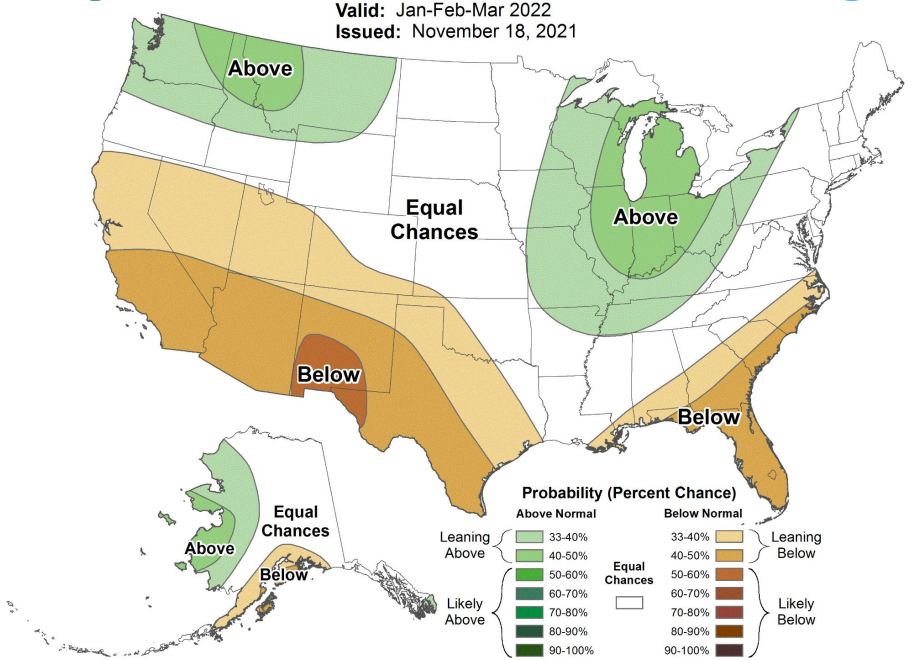
Seasonal Temperature Outlook

Valid: Jan-Feb-Mar 2022
Issued: November 18, 2021



Seasonal Precipitation Outlook

Valid: Jan-Feb-Mar 2022
Issued: November 18, 2021



Summary

- A wet monsoon season and mid-October snow accumulation provided a promising start to the season

- Fall (antecedent) soil moisture conditions (modeled) are improved from a year ago but remain below to well below normal across many of the major runoff producing areas
  - Considerable soil moisture deficits remain across much of western Colorado

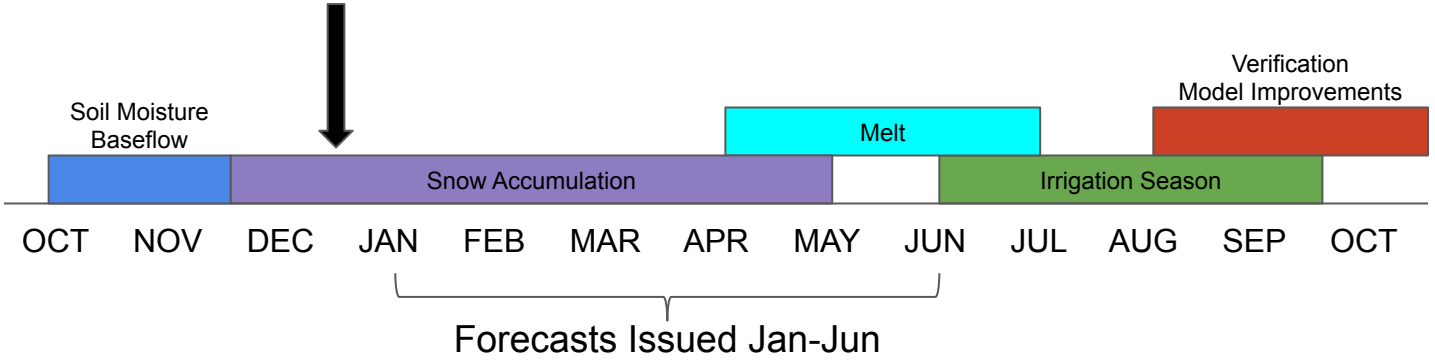
- Snowpack declined during a November that was warm and mostly dry
  - Early in snow season but SWE conditions have been falling behind
- Mid-December % of normal SWE conditions:
  - Upper CO: 50-85%
  - Great Basin: 50-60%
  - Lower CO: 20-90%

- Current (Dec14) water supply guidance is consistent with below normal soil moisture and SWE conditions:
  - Upper CO: 50-90%
  - Great Basin: 40-90%
  - Lower CO: 40-90%

- Active weather expected to continue over the next two weeks
- Increased chances of drier winter weather in Arizona/LCRB due to La Niña conditions

- Most likely going to need above average snowpack to see near average water supply volumes given the dry conditions. Spring weather is always a factor.

CBRFC Operational Timeline



- ESP model guidance will be available on our website (forecast evolution plots) in the next few days.
  - Water supply forecasts are issued starting early January
  - Water supply discussions/reports issued twice monthly starting early January
  - Peak flow forecasts issued twice monthly starting early March
- Currently, soil moisture states (also represented by baseflow) in the model have a larger influence on hydrologic guidance compared to later in the season.
- As we progress into the winter, snowpack conditions will have a larger impact on forecasts in the Upper Colorado and Great Basins.
- Winter rain events will have largest impacts on Lower Colorado River Basin forecasts.

2022 Water Supply Webinar Schedule

**All Times Mountain Time (MT)*

Colorado River Basin

Friday	Jan 7th	10 am
Monday	Feb 7th	10 am
Monday	Mar 7th	10 am
Thursday	Apr 7th	10 am
Friday	May 6th	10 am

Great Basin

Friday	Jan 7th	11:30 am
Monday	Feb 7th	11:30 am
Monday	Mar 7th	11:30 am
Thursday	Apr 7th	11:30 am
Friday	May 6th	11:30 am

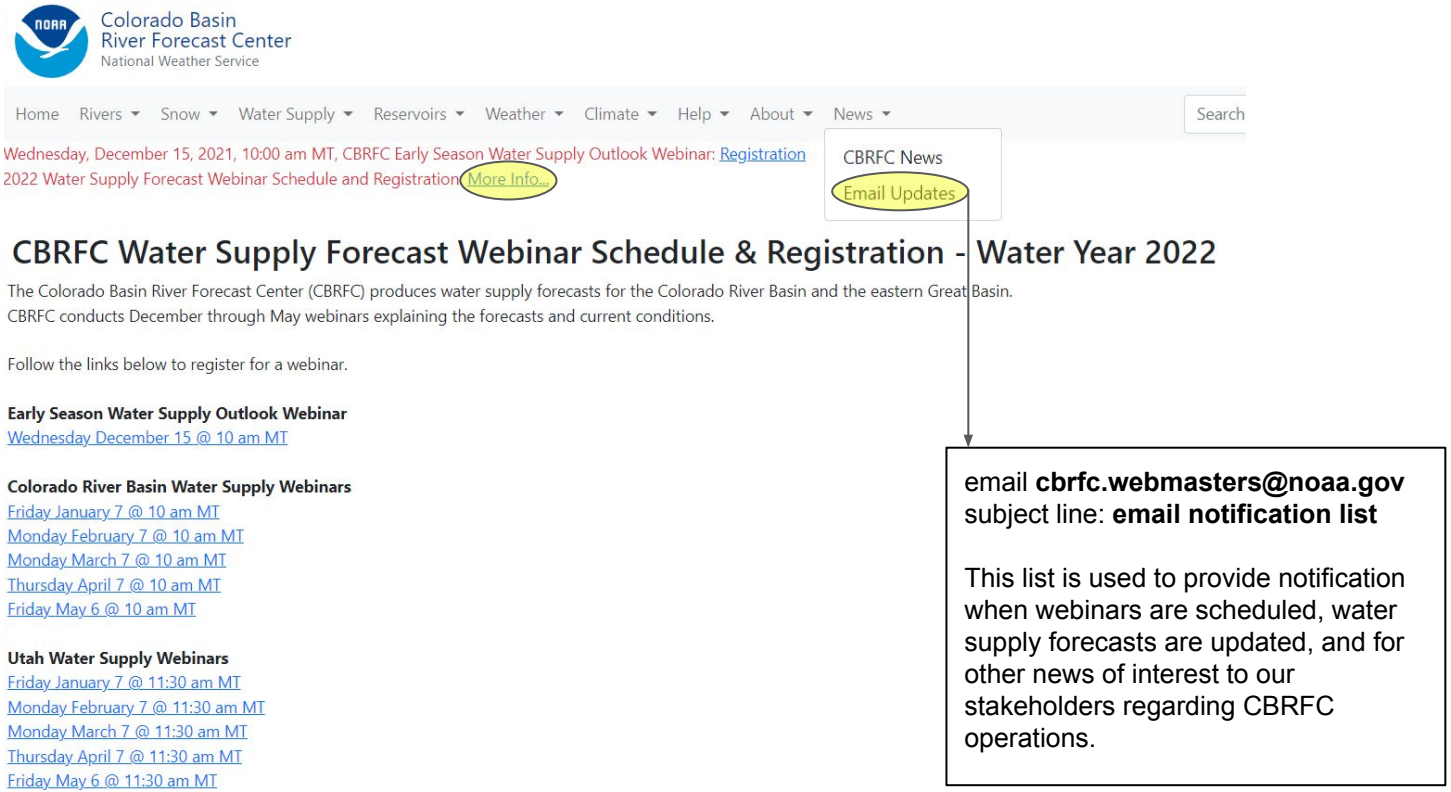
Peak flow forecast webinar Thursday, March 17th, 10 am MT

Additional briefings scheduled as needed

Webinar schedule & registration information has been posted to the CBRFC web page

https://www.cbrfc.noaa.gov/

CBRFC Webinar Registration & Email List



email **cbrfc.webmasters@noaa.gov**
subject line: **email notification list**

This list is used to provide notification when webinars are scheduled, water supply forecasts are updated, and for other news of interest to our stakeholders regarding CBRFC operations.

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CBRFC Water Supply Presentations
https://www.cbrfc.noaa.gov/present/present.php