## Drought Monitoring 101: Forecast Products

Presented by Wilson Water Group January 24, 2024 Upper Gunnison DCP Task Force Meeting





#### Overview

- Key question for Drought Contingency Planning: How will we recognize the next drought in the early stages?
- Drought Monitoring!
  - One of the Six Required Elements
- Establish a process for drought monitoring, and a framework for predicting the probability of future droughts or confirming an existing drought

#### **Drought Monitoring**

- Topics for today's presentation
- How do we measure drought?
- What forecast products are currently in use and how can the DCP leverage them?
- Identify gaps



#### Measuring Drought

- Streamflow
- Drivers:
  - Temperature
  - Precipitation
  - Snowpack
  - Soil moisture
  - Reservoir storage

Working definition: Drought – when the river has less water than average **and** the needs of the community and environment are not met.

#### Available Data





- → Snowpack SNOTEL purple dots
- → Snowpack ASO (not shown)
- → Streamflow active USGS gages yellow dots
- → Temperature & Precipitation -Climate Stations – orange dots
- → Reservoir storage Reclamation blue areas (Taylor Park & Aspinall Unit)



What drives drought in the Upper Gunnison?

- → Current conditions
- → Carry-over conditions
  - → Soil moisture levels
  - → Reservoir storage
- → Seasonally, drought can be predicated using April 1 – July 31 runoff because the Gunnison is a snow-melt dominated basin.
- → Monsoon impacts July September







- US Drought Monitor
- National Resources Conservation Service (NRCS)

Info

- Airborne Snow Observatory (David Gochis)
- Colorado Basin River Forecast Center (CBRFC)

#### **Information Examples**

Current	Maps	Data	Summary	About	Conditions & Outlooks	Ag in Drought	En Español	NADM
							<b>Map released: T</b> Data valid: January	<b>hurs. January 18, 202</b> 4 16, 2024 at 7 a.m. EST
						I	Intensity	
							None D0 (Abnormally D1 (Moderate I D2 (Severe Dro D3 (Extreme DI D4 (Exceptiona No Data No Data Authors Jnited States and I Adam Hartmar Pacific Islands and Anthony Artus	y Dry) Drought) rought) I Drought) I Drought) <b>Puerto Rico Author(s):</b> <u>1</u> , NOAA/NWS/NCEP/CPC <b>Virgin Islands Author(s):</b> <u>a</u> , NOAA/NWS/NCEP/CPC

→ Snap-shot of current conditions. Released every Thursday.

- → Blend of physical indicators
   (precipitation, streamflow, soil moisture) and drought impacts as observed by experts.
- → Understand existing drought conditions in the basin.
- → Use to identify potential year type based on how past years have unfolded.

## **Information Examples**



- → Snap-shot of current snow conditions.
- $\rightarrow$  Released daily.
- https://www.wcc.nrcs.usda.gov/ftpref/support/sta tes/CO/products/#state=co&element=wteq

- → Interactive plots comparing current SWE conditions to historical years.
- → Useful for identifying trends and drought risk.



#### Taylor River/East River System:

As of May 5 the ASO-assimilated snowpack from the WRF-Hydro model was approximately 122 kac-ft for the Taylor basin above Taylor Reservoir and 276 kac-ft for the East River above Almont. The bulk of the remaining snowpack in the throughout the region resided above 9,000 ft. Basin averaged soil saturation fractions for both systems was over 72%, indicating very wet conditions.

East and Taylor River Water Equivalent (SWE) Analysis and Forecasts

![](_page_9_Picture_4.jpeg)

<sup>0.02</sup> in 19.69

Taylor Basin Basin-averaged Snow Water Equivalent (SWE) Analysis and Forecasts

- Airborne Snow Observatory (ASO) cutting edge research and forecasts
- David Gochis lead for Gunnison WRF-Hydro model – detailed, gridded. Provides water supply forecasts for specific clients, can focus on unique situations.
- Inputs include sensors installed by David and Airborne Snow
   Observatory (ASO) measurements.
- Graphs is from May 10, 2023 forecast, showing gridded SWE in the East and Taylor River watersheds.

![](_page_10_Figure_1.jpeg)

- Soil moisture graphs
- Forecasts the Accumulated Runoff key indicator for Taylor Park Reservoir operations. Used extensively by TLUG.
  - At least monthly meetings March September, more frequently as needed
- Clients can contract with ASO for custom forecasts.
- ASO can extract modeled values at any location. Calibrated at gage locations.

![](_page_11_Figure_1.jpeg)

- Colorado Basin River Forecast Center – branch of the National Weather Service. Continuous operations, issue watches/warnings.
- Access via website or monthly webinars.
- Water Supply Forecast April through July volumes, useful longterm drought indicator.
- Available at some USGS gages

Observed Accumulation

••• Normal Accumulation - ESP 50

ESP 10–90 Official 10-90 Official 10

Official 30 Official 50 Official 70

Official 90

![](_page_12_Picture_1.jpeg)

Colorado Basin River Forecast Center River Forecast Center lational Weather Service

Snow • Water Supply • Peak Flow • Reservoirs • Weather • Climate • Help • About • News • Rivers -

Water Year 

Options 
Image 
Data 
Help

2023 Water Supply Forecast - Gunnison - Gunnison, Nr (GUSC2)

ESP is Unregulated and No Precipitation Forecast Included

Official 50% Forecast (2023-06-01): 505 kaf (144% Average, 160% Median), (73% of Years below forecast, 26 Highest Flow / 96 Total Years) ESP 50% Forecast (2023-07-30): 487 kaf (139% Average, 155% Median), (70% of Years below forecast, 29 Highest Flow / 96 Total Years) Observed Volume: 484 kaf (138% Average, 154% Median)

![](_page_12_Figure_8.jpeg)

- CBRFC Water Supply Forecast
- Graph from 2023 for Gunnison River Near Gunnison.
- April 1 July 31 Volume.
- **CBFRC** models input temperature, precipitation & streamflow automatically. Snowpack & soil moisture manual adjustment.
- Available at some USGS gage locations.

![](_page_13_Figure_1.jpeg)

Observed Accumulation

••• Normal Accumulation

- ESP 50

ESP 10–90

Official 50

Official 70

Official 90

Official 10-90
Official 10
Official 30

![](_page_13_Figure_2.jpeg)

ESP is Unregulated and No Precipitation Forecast Included Official 50% Fcst (2024-01-01): 270 kaf (77% Avg, 86% Med), (24% of Yrs Below Fcst, 74 Highest Flow / 97 Tot Yrs) ESP 50% Fcst (2024-01-23): 336 kaf (96% Avg, 107% Med), (44% of Yrs Below Fcst, 55 Highest Flow / 97 Tot Yrs) No Observed

![](_page_13_Figure_4.jpeg)

- CBRFC Water Supply Forecast
- 2024 for Gunnison River Near Gunnison.
  - Currently forecasting an "average" year, but the range is still very wide.

NOAA / Colorado Basin River Forecast Center / 2024-01-24 00:03Z

![](_page_14_Figure_1.jpeg)

- Erik Knight at Reclamation compiles streamflow forecast from CBRFC and plugs into Reclamations' Blue Mesa operational model.
- Figure is from May 25, 2023 forecast produced by Reclamation.
- Blue Mesa releases under the ROD are determined by forecasted inflow.
- Provided via email and monthly webinar.

![](_page_15_Picture_0.jpeg)

Month	Type of Forecast	Provider	Use
November -	Drought Monitor	US Drought Monitor	Current Conditions
January	Soil Moisture, Reservoir Storage	ASO, Reclamation	Carry-over Conditions
	Drought Monitor	US Drought Monitor	Current Conditions
February - July	SWE	NRCS	Current Conditions, Historical Range
	Seasonal Water Supply	CBRFC, ASO	Predict Conditions through Fall
	Drought Monitor	US Drought Monitor	Current Conditions
August - October	Near-Current Streamflow	CBRFC, ASO (if requested)	Monsoons

![](_page_16_Picture_0.jpeg)

## Additional Considerations

- Interplay between hydrological conditions and water rights administration
  - When do the calls start coming on? (early can indicate dry conditions)
- Anecdotal info
  - From ranchers Dry springs, dry stock water tanks, etc.
  - From municipalities Stress on distribution system
  - From rec users pics of dry-up
  - From anglers stressed fisheries

## **Identify Gaps**

- → We have lots of information but do we have the right information in the right locations?
  - Information by watershed

![](_page_17_Picture_3.jpeg)

![](_page_18_Picture_0.jpeg)

## By Sub-basin

- → Where does each subbasin have/need drought monitoring information?
- → Where are the info gaps?
  - → Ohio
  - → East/Slate
  - → Taylor
  - → Mainstem
  - → Tomichi
  - → Cebolla
  - → Lake Fork

![](_page_19_Figure_0.jpeg)

NGA, EPA

Snotel

Towns & Cities Ohio Creek Instreamflow Reach Irrigated Acres

10 Miles

- → Can be used to identify hydrologic year type.
- → Quantify drought by comparing historical streamflow and agriculture producer information.

![](_page_20_Picture_0.jpeg)

![](_page_20_Figure_1.jpeg)

- → Values are irrigation, M&I in the Crested Butte area, widely used for recreation.
- → Five USGS gages.
  - → CBRFC & ASO forecasts at mouth
  - → ASO forecast for Slate River nr Crested Butte & Coal Creek nr Crested Butte.
- → Drought impacts flows at snow making diversion (bypass requirements).
- → Flows impact type of recreation and recreation season length.
- → Low flows can impact environmental values, municipal supply (including augmentation).
- → Quantify drought by comparing historical streamflow, M&I, recreational use and agricultural producer information.

#### Taylor

![](_page_21_Picture_1.jpeg)

![](_page_21_Picture_2.jpeg)

- → Streamflow is regulated by Taylor Park Reservoir.
- → Values include flat water recreation, whitewater boating and fishing.
  - → Flooding can also be an issue.
- → Four USGS gages.
  - → ASO & CBRFC forecast Taylor Park inflow
  - → ASO for Taylor R. abv Taylor Res, Texas Crk abv Taylor Res, & Willow Crk abv Taylor Res
- → ASO forecasts used by TLUG to determine recreational operations.
- → Quantify drought by comparing historical streamflow, reservoir storage, and recreational use.
  - ➔ Boatable days study by American Whitewater
  - → https://ugrwcd.org/boatable-days-tool/

![](_page_22_Picture_0.jpeg)

![](_page_22_Figure_1.jpeg)

- → Values are irrigation, municipal (Gunnison), widely used for recreation.
- → Three USGS gages.
  - → Forecasts can be used to identify hydrologic year type.
- → Flows impact type of recreation and recreation season length.
- Blue Mesa Reservoir flat water recreation, harmful algae blooms, emergency releases to Lake Powell
- → Low flows can impact environmental values and municipal supply.
- → Quantify drought by comparing historical streamflow, recreational use, municipal concerns, and agricultural producer information.
  - → Boatable days for Gunnison @ Whitewater Park and Gunnison River to McCabes

#### Tomichi

![](_page_23_Picture_1.jpeg)

- → Primary value is agriculture.
- → Drought impacts crop yield.
- → Five USGS gages.
  - → CBRFC forecast at mouth.
  - → ASO forecast at Sargents
  - → Can be used to identify hydrologic year type.
- → Quantify drought by comparing streamflow and agriculture producer information.

![](_page_24_Picture_0.jpeg)

- → Values are irrigation and recreation including on-stream and fishing ponds.
- → No active streamflow gages, but Lake Fork gages can serve as a good predictor.
- → Can be used to identify hydrologic year type.
- → Flows impact fishing season length and ability to fill off-channel ponds.
- → Low flows can impact environmental values.

Cebolla

![](_page_25_Picture_0.jpeg)

### Lake Fork

![](_page_25_Picture_2.jpeg)

![](_page_25_Picture_3.jpeg)

- → Values are M&I agriculture, and recreation including on-stream and fishing ponds.
- → Three USGS gages.
- → CBRFC forecast for Lake Fork @ Gateway. Can be used to identify hydrologic year type.
- → Flows impact fishing season length and ability to fill off-channel ponds.
- → Low flows can impact environmental values, municipal supply (including augmentation).
- → Quantify drought by comparing streamflow and recreation information.

![](_page_26_Picture_0.jpeg)

# Info Gaps?

Discussion

- Ohio
- East/Slate
- Taylor

- Mainstem
- Tomichi
- Cebolla
- Lake Fork

![](_page_27_Picture_0.jpeg)

## **Next Steps**

- → Leverage existing products
- → Make relevant to local communities (by sub-basin?)
- → Develop stages of drought
  - → Tie historical years (2002, 2018, 2021) to drought metrics
- → Communicate with the public

## Thank you

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![](_page_28_Picture_4.jpeg)