

# Yampa River Basin Soil Moisture Monitoring Network

**Madison Muxworthy**

Yampa Valley Sustainability Council



*Photo Credit: Chris Hylan*

State of the River – Upper Yampa  
March 23, 2023



Center for Western Weather  
and Water Extremes  
SCRIPPS INSTITUTION OF OCEANOGRAPHY  
AT UC SAN DIEGO



# Yampa River Basin Soil Moisture Monitoring Network

## Project Team



**Center for Western Weather  
and Water Extremes**  
SCRIPPS INSTITUTION OF OCEANOGRAPHY  
AT UC SAN DIEGO

F. Martin Ralph, PhD. (PI), Anna Wilson, PhD.,  
Ellen Knappe, PhD., Kerstin Paulsson, M.S.,  
Ming Pan, PhD., Edwin Sumargo, PhD.  
Rob Hartman, M.S.



**YAMPA VALLEY  
SUSTAINABILITY  
COUNCIL**

Michelle Stewart, PhD., Tim Sullivan, M.S.,  
Madison Muxworthy, Nicole Pepper



**COLORADO  
MOUNTAIN COLLEGE**

Nathan Stewart, PhD.

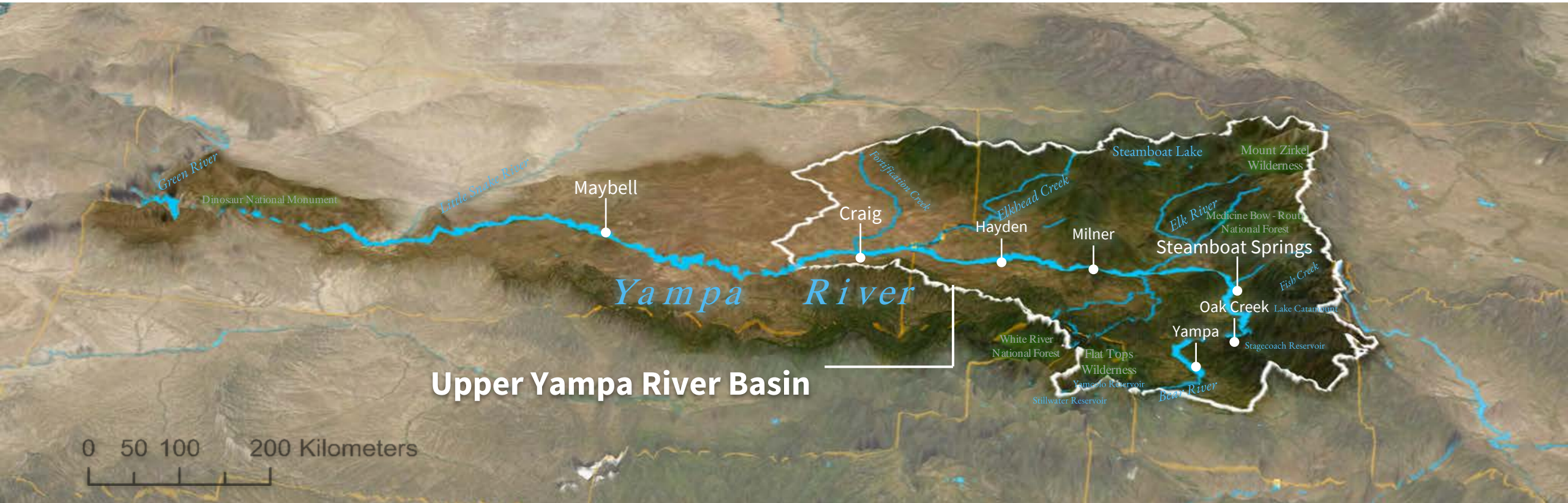


**UPPER YAMPA WATER**  
—CONSERVANCY DISTRICT—

Andy Rossi



# Yampa River Basin Soil Moisture Monitoring Network



Map by: Nicole Pepper (YWSC)



# Yampa River Basin Soil Moisture Monitoring Network



Photo Credit: CPR News



# Yampa River Basin Soil Moisture Monitoring Network

## Soil Moisture

*The amount of water in the soil at any given time*

It provides insight into:

- Informing reservoir operations and decision-making by water users
- Understanding water resources, i.e., potential translation from snowpack to streamflow
- Drought
- Impacts of extreme weather events
- Fire risk
- Plant survival



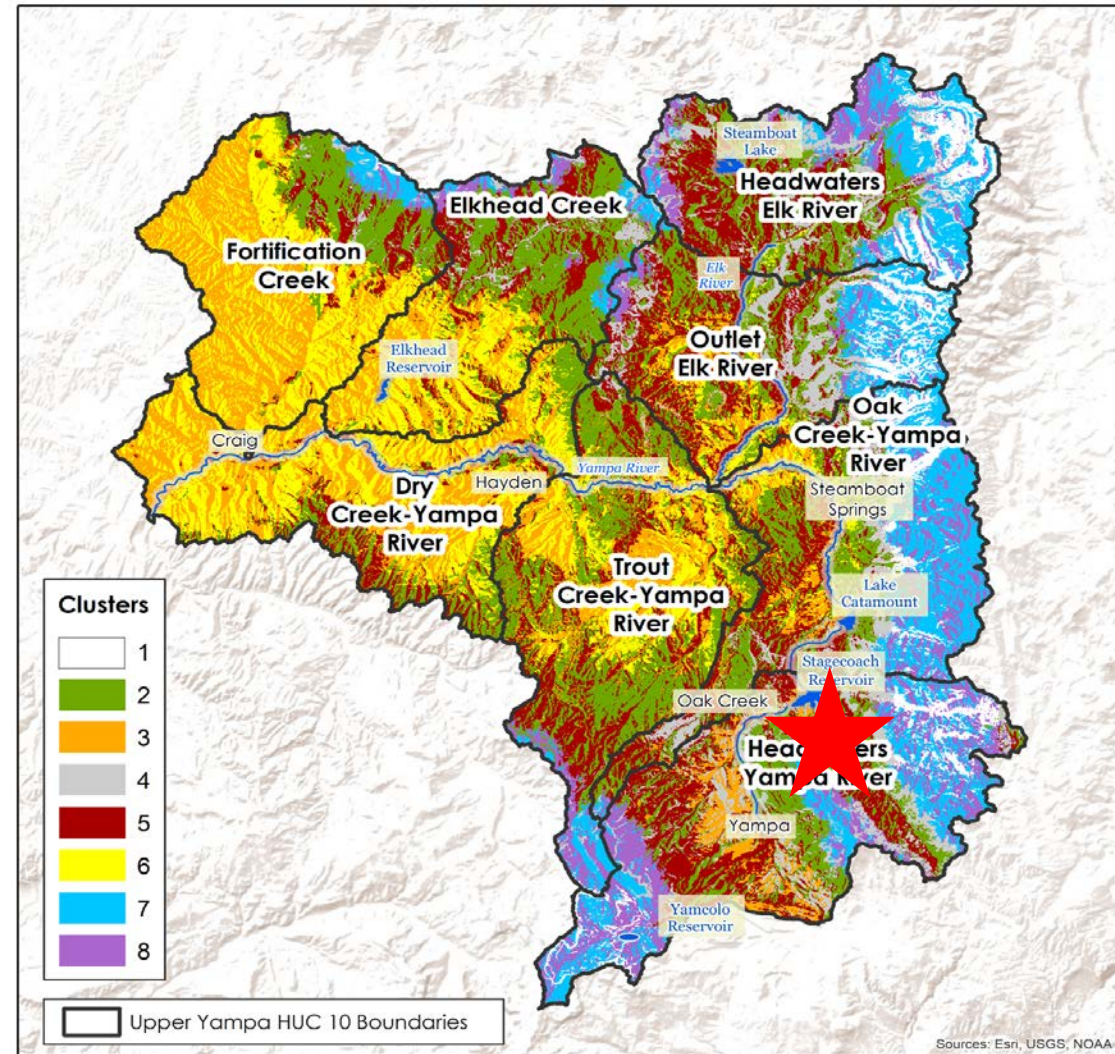
# Yampa River Basin Soil Moisture Monitoring Network

## Project Goal

Establish new long-term soil moisture measurements to provide data and scientific insight on the reduction of runoff by dry soils, provide a continuous record of changing landscape conditions with a changing climate, and support operational model and forecast improvements.



# Yampa River Basin Soil Moisture Monitoring Network



0 5 10 20 Miles

Map by: Nicole Pepper (YVSC)



# Yampa River Basin Soil Moisture Monitoring Network

**Location:** Upper Yampa Headwaters  
40.22171, -106.86308

**Elevation:** 9488 ft/ 2982m

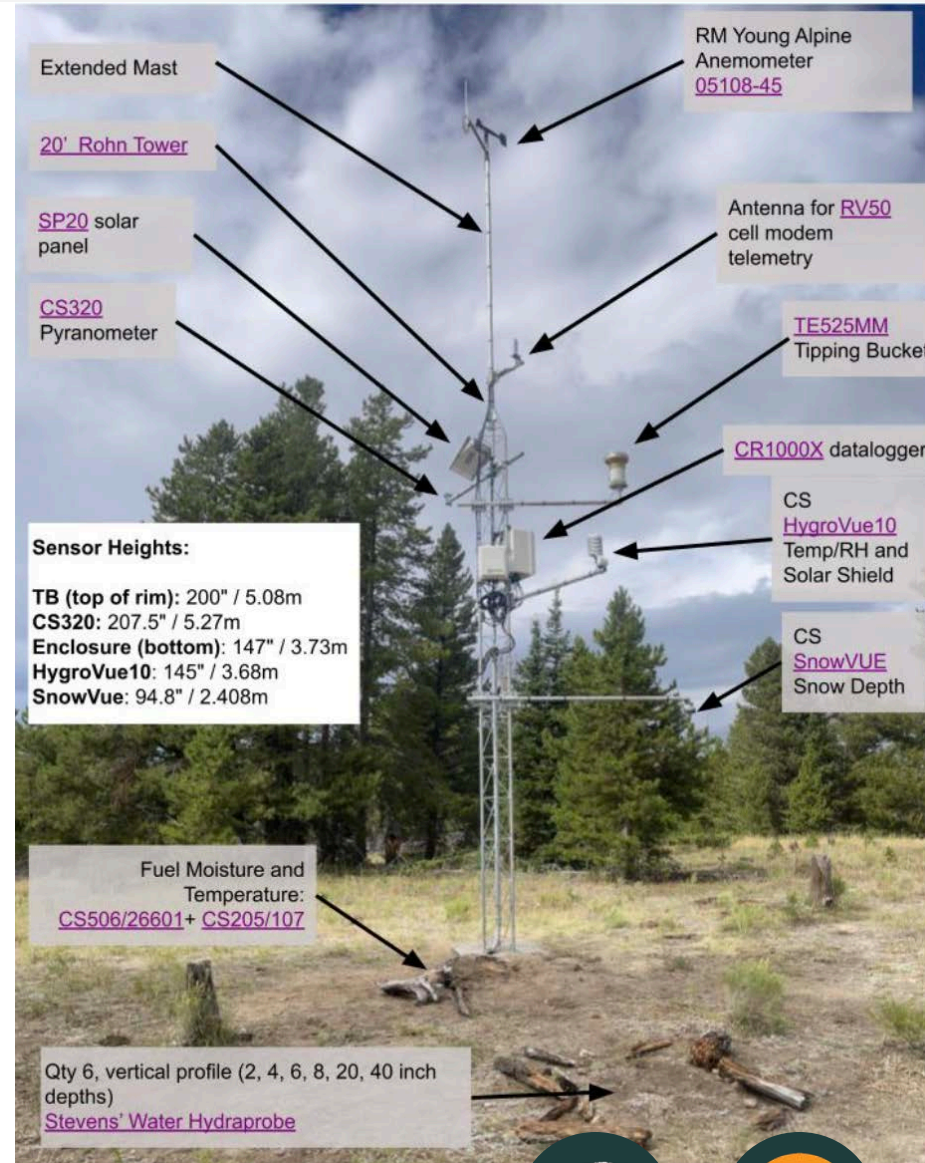
## Measured Variables:

### 2-minute data

- Soil Temp and Moisture at 6 depths:
  - 2, 4, 6, 8, 20, 40 inches
- Air Temperature
- Relative Humidity
- Solar Radiation
- Precipitation
- Wind Speed and Direction at 10m
- Air Pressure
- Fuel Temperature and Moisture

### 15-minute data

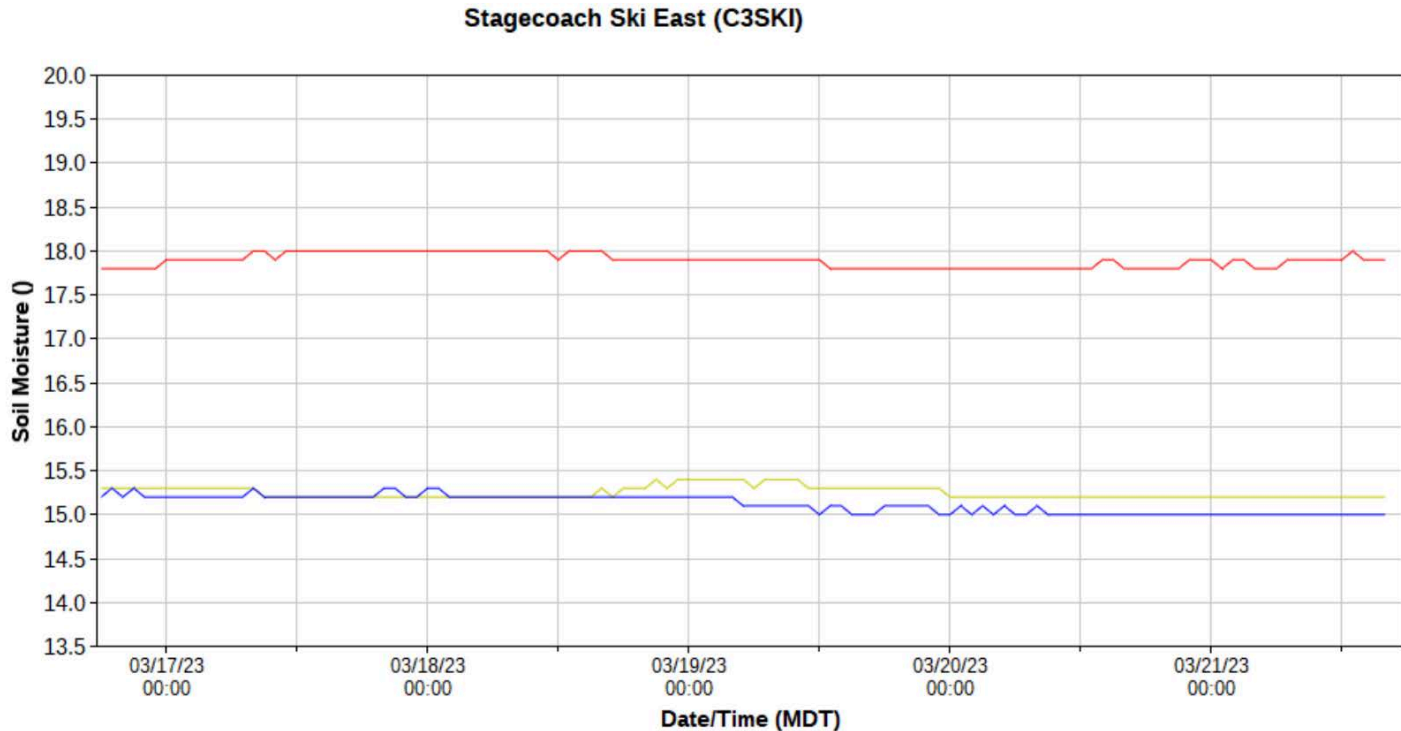
- Snow Depth





# Yampa River Basin Soil Moisture Monitoring Network

■ -0.50m Soil Moisture  
■ -0.15m Soil Moisture  
■ -0.05m Soil Moisture



### Weather Conditions for C3SKI

Current Time: 03/20/2023 14:07 MDT  
 Most Recent Weather Conditions at: 03/20/2023 12:00 MDT

Graphical Links	12:00	Max Since 0:00 (MDT)
<a href="#">Temperature</a>	25.7° F	25.7 at 12:00
<a href="#">Dew Point</a>	19.5° F	19.5 at 12:00
<a href="#">Wet bulb temperature</a>	23.3° F	23.3 at 12:00
<a href="#">Relative Humidity</a>	77%	83 at 8:00
<a href="#">Wind Speed</a>	3.8 mph	11.5 at 7:00
<a href="#">Wind Gust</a>	7.4 mph	14.5 at 8:00
<a href="#">Wind Direction</a>	SSW	-
<a href="#">Pressure</a>	20.91 in	20.99 at 0:00
<a href="#">Altimeter</a>	29.81 in	29.93 at 0:00
<a href="#">Solar Radiation</a>	77.4 W/m²	77.4 at 12:00
<a href="#">Fuel Temperature</a>	31.1° F	31.2 at 7:00
<a href="#">Fuel Moisture</a>	32 gm	32 at 12:00
<a href="#">-1.0m Soil Temperature</a>	35.8° F	35.8 at 12:00
<a href="#">-0.50m Soil Temperature</a>	34.4° F	34.4 at 12:00
<a href="#">-0.20m Soil Temperature</a>	33.4° F	33.4 at 12:00
<a href="#">-0.15m Soil Temperature</a>	33.2° F	33.2 at 12:00
<a href="#">-0.10m Soil Temperature</a>	33.1° F	33.1 at 12:00
<a href="#">-0.05m Soil Temperature</a>	32.8° F	32.8 at 12:00
<a href="#">-1.0m Soil Moisture</a>	19.30%	19.40 at 11:00
<a href="#">-0.50m Soil Moisture</a>	15.00%	15.10 at 8:00
<a href="#">-0.20m Soil Moisture</a>	20.50%	20.50 at 12:00
<a href="#">-0.15m Soil Moisture</a>	17.80%	17.80 at 12:00
<a href="#">-0.10m Soil Moisture</a>	20.70%	20.80 at 10:00
<a href="#">-0.05m Soil Moisture</a>	15.20%	15.20 at 12:00

- Data is publicly available at:
  - <https://cw3e.ucsd.edu/cw3e-surface-meteorology-observations/>
  - [https://mesowest.utah.edu/cgi-bin/droman/meso\\_base\\_dyn.cgi?stn=C3SKI&unit=0&time=LOCAL&product=&year1=&month1=&day1=00&hour1=00&hour\\_s=24&graph=1&past=0&order=1](https://mesowest.utah.edu/cgi-bin/droman/meso_base_dyn.cgi?stn=C3SKI&unit=0&time=LOCAL&product=&year1=&month1=&day1=00&hour1=00&hour_s=24&graph=1&past=0&order=1)

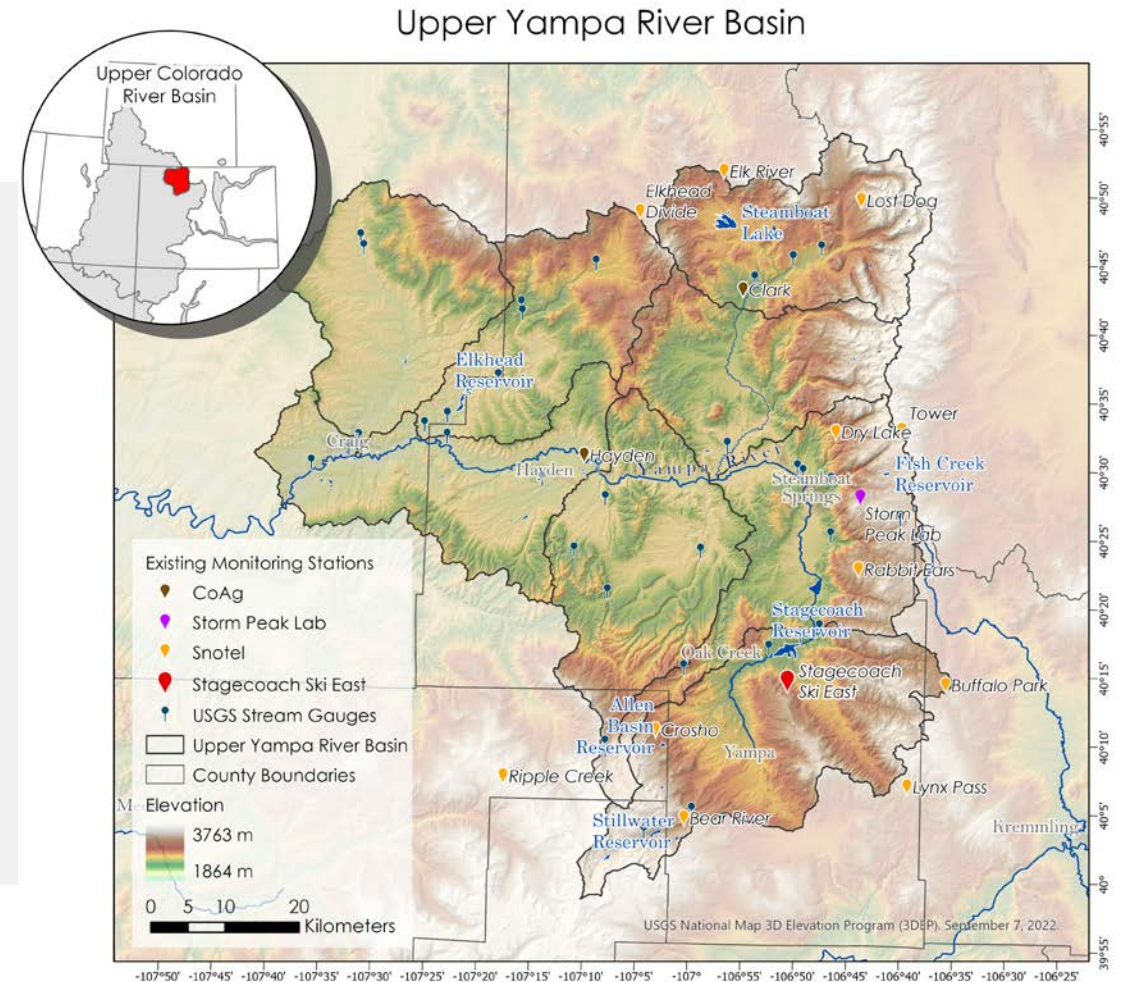
Estimated Accumulated Precipitation	
Precipitation 1hr	



# Yampa River Basin Soil Moisture Monitoring Network

## 2026 View

- 8 new stations in the basin
- New instrumentation co-located at existing sites
- Data dashboard
- 3 Yampa basin research interns



Map by: Nicole Pepper (YVSC)



# Yampa River Basin Soil Moisture Monitoring Network

## Partnerships: Network coordination and summer research internship (2020-current)

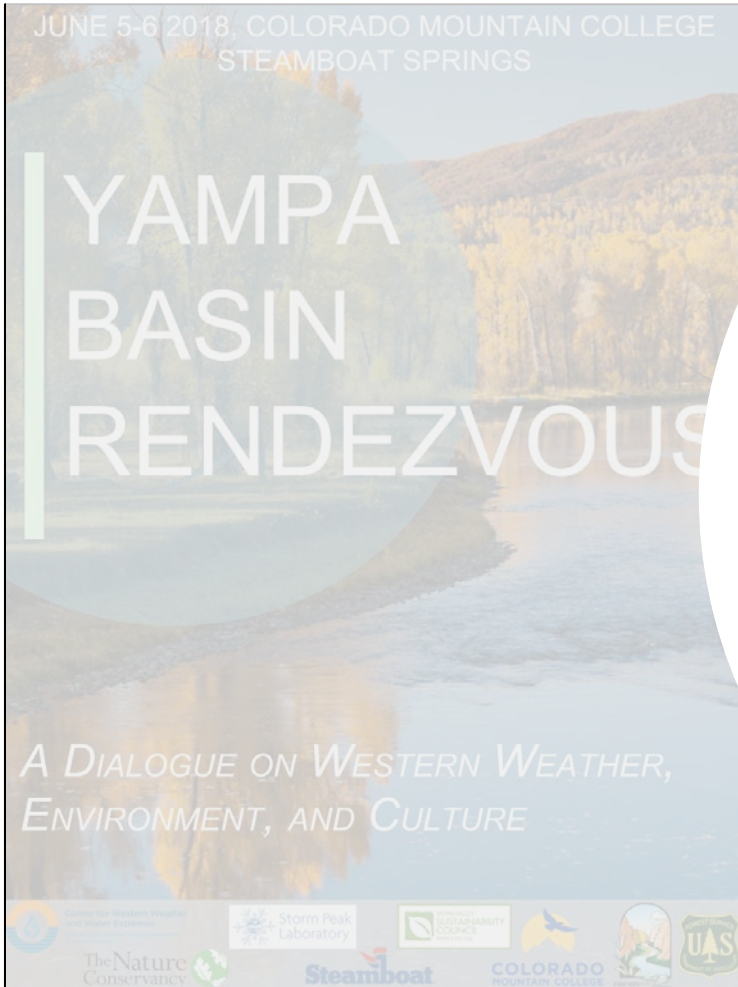
Partnering with Aspen Global Change Institute (AGCI) to coordinate and learn from ACGI's Roaring Fork Observation Network (iRON) that has been operating for 10 years.

Also partnering with AGCI, Center for Western Weather and Water Extremes (CW3E), and Colorado Mountain College to co-host two summer research interns annually that work on projects related to these networks.



# Yampa River Basin Soil Moisture Monitoring Network

## Partnerships: Yampa Basin Rendezvous (2018-current)



Save the date for 2023 **Yampa Basin Rendezvous: *Snows, Flows, and Drought: Managing for Western Water Resilience***

**June 1-2, at Colorado Mountain College, Steamboat Springs**

## 2022 YAMPA BASIN RENDEZVOUS

*Enhanced Observations for Water Resilience in the Yampa River Basin*

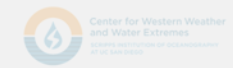
Thursday, September 22 | 9 a.m. – 4 p.m. MDT  
Friday, September 23 | 8 a.m. – 4 p.m. MDT

Colorado Mountain College, Allbright Auditorium, Steamboat Springs, CO

The Yampa River is one of the wildest remaining major tributaries of the Colorado River and supports a rich ecosystem, local agriculture and ranching, and a robust recreation industry. It also provides crucial water supplies to local stakeholders and locations as far removed as Arizona and Southern California. However, warming temperatures, rising snowlines, and increased drought occurrence and severity pose serious risks to the alpine, upland, and riparian ecosystems of the Yampa River Basin. **How are we, as a community, observing changes in our water cycle and working to build resilience in the face of those changes?** This question will be at the forefront of the 2022 Yampa Basin Rendezvous.

This two-day event will provide an overview of the current state of, and future planning for, water resources in the Yampa River Basin. It will also include a discussion of the role of economic, environmental, and cultural factors that influence water cycle observations for resource and resilience planning. The overarching goal is to provide a venue that encourages a community-centered approach to creating informed, adaptive, proactive, and science-based management strategies for the Yampa Valley's natural resources and communities.

### ORGANIZED BY



**Thank you!**

**Madison Muxworthy**

*Soil Moisture, Water and Snow Program Manager*

Yampa Valley Sustainability Council

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*Photo Credit: Chris Hysten*

