Water Supply Presentation

Clark's Fork Yellowstone Conditions, Spring 2024

This water supply report was compiled by staff at the Montana Department of Natural Resources and Conservation (DNRC) for the Clark's Fork Yellowstone Partnership. This document summarizes data produced by the Natural Resources Conservation Service (NRCS), US Geological Survey (USGS), DNRC, National Weather Service (NWS), and other sources. All sources of data are identified and cited in the following descriptions and graphics, for further information please follow any links or citations to the original data source. Also note that data used to summarize current hydrologic conditions are mostly provisional and subject to change. Please consider the uncertainty associated with making planning or management decisions based on provisional data. Statements for provisional data use can be found for individual data sources by following links or citations in this document.

Prepared by:

Montana Department of Natural Resources and Conservation
Water Resources Division

Todd Blythe – Surface Water Section Supervisor .... Water Sciences Bureau

How Streamflow is Produced

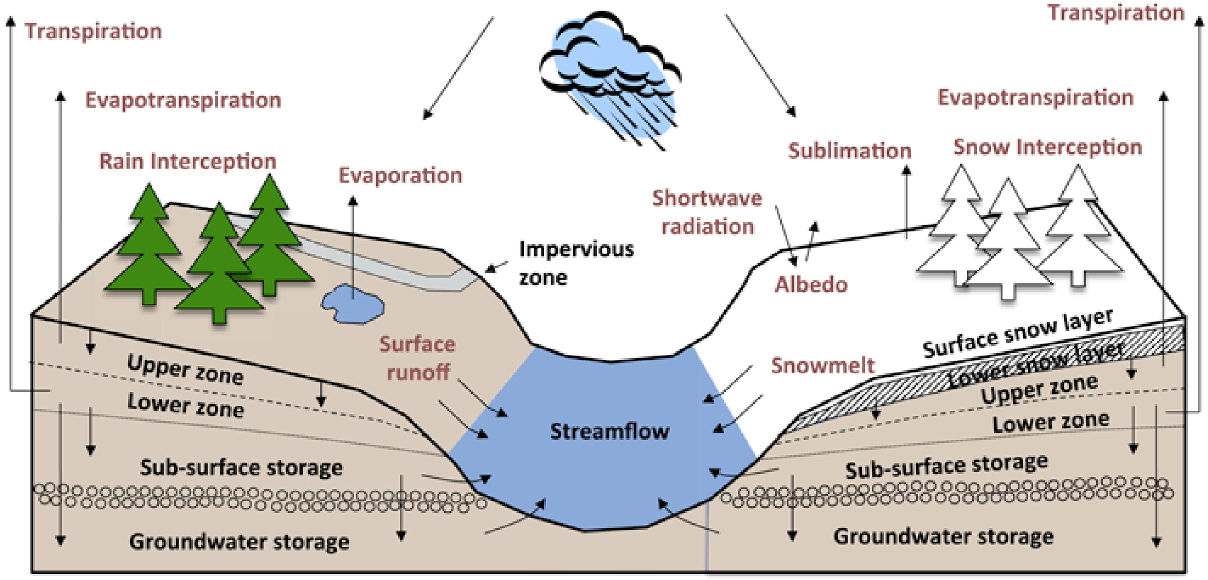

Figure 1. Diagram summarizing how streamflow is generated from excess precipitation runoff after passing through various storage zones and undergoing processes associated with the water cycle. Source is USGS Open-File Report 2012-1274; Figure 7 (https://pubs.usgs.gov/of/2012/1274/figure7.html).

Why Predicting Water Supply is Difficult

Predicting water supply depends on understanding 2 pieces of information:

1. Past and Present Conditions (also called antecedent conditions).
    a. Understanding these conditions requires measurement of water as it passes through the landscape (like in the diagram above), as well as how much is retained in or on the land at a given time.
    b. Measuring these pieces of the water cycle are difficult but possible, however, we often can't get an accurate measurement across a whole watershed from a single point.
    c. I've provided one example (of potentially many) below of how we miss things with our monitoring networks.
2. Future Weather.
    a. We cannot directly measure this (or least we haven't figured out how to yet).
    b. This depends on our ability to model the future based on what we observe right now (which is tough, and usually not exact).

Example of Elevation Bias in Snow Monitoring

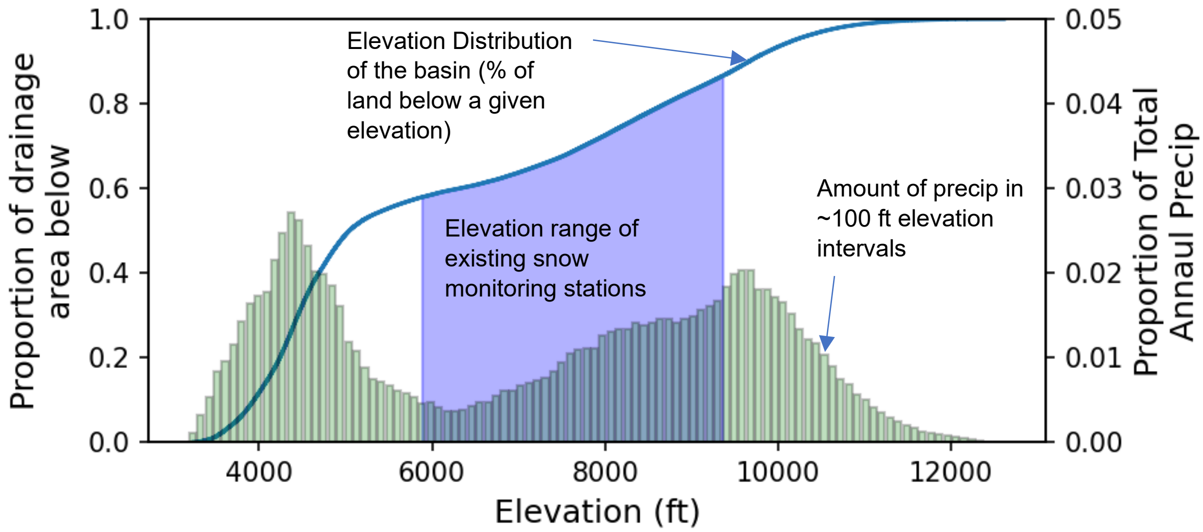

Figure 2. Graph showing elevation distribution of the Clark's Fork Basin with the range of elevations captured by existing snow monitoring (shaded area), and the proportion of the total basin, annual precipitation for 100 ft intervals (bars). This shows how current snow monitoring misses a lot of the elevation gradient in the basin, and particularly the portions that produce a lot of water.

- Current monitoring network elevation range measures only 36% of precip.
- 33% of all precipitation in the basin falls above 9000 ft.

Water Supply Resources

- Natural Resources and Conservation Service (NRCS) SNOTEL (https://nwcc-apps.sc.egov.usda.gov/imap/) – View current measured snow conditions.
- NRCS Water Supply Forecasts (https://nwcc-apps.sc.egov.usda.gov/forecast-plots/) – View water supply forecasts by state and basin.
- National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center (https://www.cpc.ncep.noaa.gov/) – View forecasted weather across the US.
- NOAA Office of Water Prediction Map (https://water.noaa.gov/) – View forecasts from NOAA's River Forecast Center.
- Montana Climate Office (MCO) Drought Indicators Website (https://drought.climate.umt.edu/#standardized-snow-water-equivalent-snodas-hypsome-swe) – View a lot of useful information used for categorizing drought across Montana.
- MCO Mesonet Dashboard (https://mesonet.climate.umt.edu/dash/) – View weather data at MCO's Mesonet weather stations across Montana, has some Ag specific tools as well.
- US Drought Monitor (https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?MT) – View broad-scale drought conditions.
- United States Geological Survey (USGS) Stream Gage Data (https://dashboard.waterdata.usgs.gov/app/nwd/en/?region=lower48&aoi=default) – View flow data at all of the USGS sites.

Clark's Fork Current and Projected Conditions

Precipitation

Cumulative annual precipitation based on weather stations is at **89% of normal for April 1**. This has largely improved since January/early February. When looking at the 30-day accumulated precipitation across the whole basin, lower elevations are above average while higher elevations are 70-90% of average.

Snow Water Equivalent

Current snowpack based on NRCS sites – **78% of normal.**

Snowpack based on all elevations from NOAA SNODAS model – **95% of normal.** This information can be seen on the Montana Climate Office dashboard listed earlier.

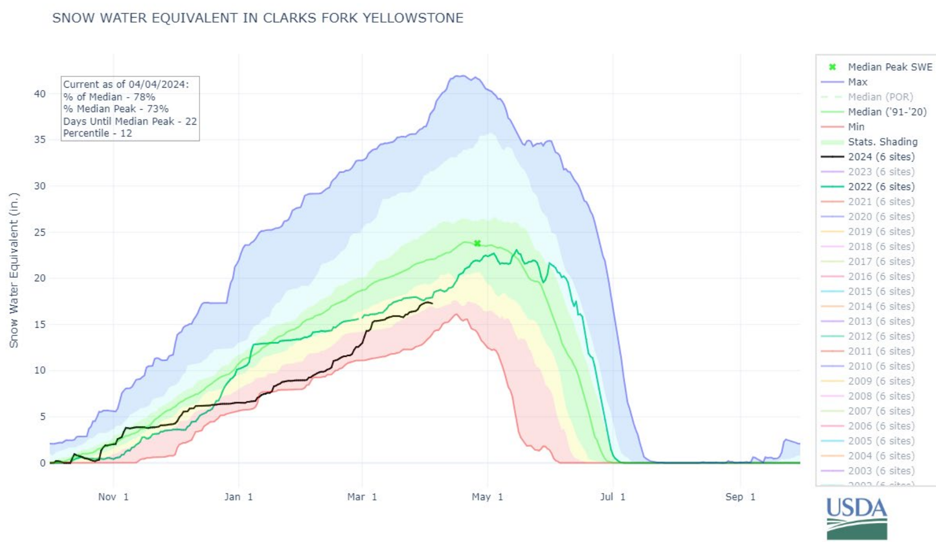

Figure 3. Current snow water equivalent (SWE) for the basin from NRCS.

Drought Conditions

Currently, the Clark's Fork Yellowstone is categorized as D1 Drought by the US Drought Monitor. This is a large-scale regional look across the state. Local conditions show that most of the basin is not under drought conditions. Drought Indicators incorporate many factors and current status of water retention in the basin. Although snow and precipitation are not looking good right now, soil moisture is looking great, particularly in the valleys and at lower elevations. Temperatures have been above average though and that may start to dry out the soil if we don't get precipitation. Cooney Reservoir is currently ~91% full. Streamflow for Rock Cr, Red Lodge Cr, Willow Cr, and Clark's Fork are all average or above average for this time of year.

Future Projections for 2024

Weather

Short range weather forecasts across the basin show a drop in temps with a storm cycle moving through over the weekend (4/5 – 4/8) that could produce significant precip. After this event though, there is a swift return to above average temps. The two week forecast for the area shows above average temps and below average precip. Multiple forecast sources are predicting 1-month and 3-month precip to be about normal, but for temperatures to be warmer than normal.

Streamflow

The 4-month water supply forecasts from the NRCS (April 1 – July 31 volume of water in acre-feet) have not been released for Clark's Fork stations for the April 1 forecast. The March 1 forecast is predicting below average water supply this year.

- Clark's Fork near Belfry = 83% of normal (error range: 74% - 103%)
- Red Lodge + Willow Cr abv Cooney = 75% (error range: 24% - 153%)

NOAA's Office of Water Prediction is similarly forecasting below average flows for Rock Creek and the Clark's Fork for a 3-month period. These predictions are less drastic than the NRCS ones though because they do use models that incorporate soil moisture conditions.

DNRC Activity in the Clark's Fork

The DNRC Stream Gage Program operates 1 real-time stream gage in the Clark's Fork Yellowstone basin:

1) West Fork Rock Creek near Red Lodge, MT (ID: 43D 01900) has operated seasonally since 2018.

Please visit DNRC's Stream and Gage Explorer (StAGE) for up to date streamflows at all DNRC gage locations!
StAGE (mt.gov) [https://gis.dnrc.mt.gov/apps/StAGE/]

In other basins, we support drought mitigation and planning activities through water measurement, educational resources, or scientific studies. Currently DNRC Water Sciences Bureau does not have any studies or projects ongoing in the Clark's Fork Yellowstone; however, we would be happy to continue attending meetings, providing any needed technical services, or collaborating on water related projects.

MSU Department of Earth Sciences Snow Measurement Grant

- Grant awarded by Bureau of Reclamation's Snow Water Supply Forecasting Program, a new program started last year (2023) that provides $3 million in grant funds to projects that are:
    - Demonstrating emerging snow monitoring technologies.
    - Improving existing snow monitoring technologies.
    - Deploying snow monitoring in poorly monitored areas.
    - Improving the use of snow monitoring data to enhance water supply forecasts.
- MSU received $1 million for their project "Emerging UAV gamma-ray and LiDAR snow observations for improved water supply modeling in the Missouri headwaters."
- Project will look at these emerging technologies for measuring snow versus the old "pillow" style (used by NRCS SNOTEL sites).
- Their study area is the Tenderfoot Creek Experimental Forest, which is in the Lewis and Clark NF, Little Belt Mountains. Tenderfoot Creek is a tributary of the Smith River. Elevations of the Tenderfoot Watershed are primarily less than 8,000 ft.
- Unknown what method they will use to model snowpack/streamflow or forecast water supply.
- Grant is funding a PhD student so likely it will be a 3-4 year study.
- Bureau of Reclamation has not released their grant materials yet, but I'm sure you could contact Eric Sproles at MSU for more details.