

MEMORANDUM

TO: Wild and Scenic Stakeholder Group Monitoring Committee

FROM: Bill Hoblitzell, Lotic Hydrological

DATE: Tuesday, February 28, 2023

SUBJECT: Temperature monitoring data review for Upper Colorado River 2022 field season

1 SEASON SUMMARY

Lotic Hydrological performed end-of-season analysis and graphical visualizations for stream temperature monitoring sites associated with Wild and Scenic Management Plan segments 4-7 of the Upper Colorado River. The Wild and Scenic (W&S) Stakeholder Group (SG) monitors Outstandingly Remarkable Values (ORVs) described in the management plan (Table 1). Water temperature is an ORV Resource Guide that contributes to the group's understanding of whether natural climatic variations coupled with regional water administration and/or cooperative management actions continue to support values and goals tied to recreational fishing and water quality in segments 4-7.

The 2022 season was notable for low peak flows and warm air temperatures. An inconsistent monsoon season delivered ample summer rains to southwest Colorado but was not especially wet in the Upper Colorado region. Widespread temperature concerns for area fisheries persisted in July and August for the Upper Colorado River and tributaries like the Eagle. All reaches of the Upper Colorado (W&S segments 4-7) experienced water temperature conditions that exceeded the state's chronic water temperature standard for aquatic life for extended periods in July and August. Upstream segments like Gore Canyon experienced these conditions for 1 – 2 weeks in July, while segments near Dotsero and in Glenwood Canyon experienced them for upwards of 6 - 8 weeks between early July and late August.

After applying the state's Warming Event criteria¹ to screen exceedances, chronic standards (MWAT) remained unmet from State Bridge downstream through the Glenwood Canyon site (W&S segments 6 and 7). This analysis did not perform a regulatory-level assessment using the state's additional criteria for other climatic and hydrologic excursions, and tallied shoulder season warming events separately from summer season warming events. A full excursion assessment may result in a different or additional number of exceedances being counted. Accordingly, these results should not be understood as a legal standards analysis, which is only performed by the Water Quality Control Division. Much of this technical memorandum adopts information formatting and language used previously for the SG's annual monitoring reports in 2018 and 2019.

¹ Appendix C, Section 303d Listing Methodology 2022 Listing Cycle
<https://drive.google.com/file/d/1jlgq37fgFV5MpUC3HPA5misOmvhKeMrZ/view>

ORV Resource Guide	Measure/Metric	2022 Status
Water Temperature	Daily Maximum (DM)	No dates with observed exceedances on WS reaches Frequent observed exceedances on Blue River in May prior to the change to summer water quality standards.
	Maximum Weekly Average Temperature (MWAT)	Exceedances of the standards throughout the region from above Gore Canyon to Glenwood Canyon from 1 to 8 weeks in duration. Exceedance accounting for WQCD Warming Event criteria that are <i>likely</i> to meet the regulatory chronic temperature threshold for impairment occurred from State Bridge downstream to Glenwood Springs. Extended Blue River exceedances appear driven or exacerbated by reservoir controls on spring stream flows in May – June. Limited duration exceedances also present during early July.

Table 1. Resource guide summary for 2022 season.

2 BACKGROUND

Stream Temperature Regulatory Framework

The W&S Resource Guide for water temperature is based on the Colorado Water Quality Control Division’s (WQCD; or, the Division) standard for segment COUCUC03 covering the Colorado River from the outlet of Lake Granby to the confluence with the Roaring Fork, set biannually in Regulations 31 and 33.² The temperature standards framework classification for the segment is Cold Stream Tier 2, with a site specific standard providing additional shoulder season criteria due to the presence of Mountain Whitefish spawning and early life stages. Regulations 31 and 33 provide both numeric and narrative guidance, stating that “temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no increase in temperature of a magnitude, rate, and duration deemed deleterious to the resident aquatic life.”

Table 2 shows the current numeric temperature standards for segment COUCUC03. Attainment of chronic temperature standards is based on the maximum of the Weekly Average Temperatures (MWAT), which is defined by taking the maximum value of a seven-day moving mean of observations. Attainment of the acute temperature standard is based on a Daily Maximum (DM), which is defined as the highest two-hour average water temperature in each 24-hour period. Temperature data are evaluated against numerical standards for chronic (MWAT) and acute (DM) seasonal maxima.

Standards Tier	Applicable Months	MWAT (Celsius)	DM (Celsius)
Cold Stream Tier II, CS-2	Jun 1 – Sep 30	18.3	23.9
	Nov 1 – Mar 31	9.0	13.0
	Apr 1 – May 31 & Oct 1 – Oct 31	16.9	21.2

Table 2. Temperature standards for Colorado River segment COUCUC03, covering the Wild and Scenic management reaches.

² Colorado Department of Public Health and Environment, Water Quality Control Commission 5 CCR 1002-31
Colorado Department of Public Health and Environment, Water Quality Control Commission 5 CCR 1002-33

In 2022, the W&S Monitoring Committee reported water temperature data throughout segments 4-7 from three stakeholder group-sponsored sites, four USGS sites, and two BLM monitoring sites (Table 3). USGS data is publicly archived and hosted online via an automated web service API.³ W&SSG and BLM data is archived courtesy of Grand County Water Information Network (GCWIN) staff in the Colorado Data Sharing Network Ambient Water Quality Monitoring System (CDSN AWQMS) database, also available via a webservice API.⁴

Site ID	Description	Segment	Latitude	Longitude	Operator
BL-abvCOR	Blue River above Colorado River confluence	--	40.0333	-106.3924	BLM
09058000	COLORADO RIVER NEAR KREMMLING, CO	4	40.0366	-106.4400	USGS
COR-Pumphouse	Colorado River at Pumphouse	5	39.9899	-106.5084	BLM
COR-Rad	Colorado River at Radium	5	39.95467	-106.55	BLM
UPCO-SB	Upper Colorado River upstream of State Bridge	6	39.8555	-106.6445	WSSG
09060799	COLORADO RIVER AT CATAMOUNT BRIDGE, CO	6	39.8911	-106.8317	USGS
UPCO-RD	Upper Colorado River downstream of Red Dirt Creek	6	39.8005	-106.9740	WSSG
UPCO-DOT	Upper Colorado River upstream of Dotsero	6	39.6479	-107.0629	WSSG
09070500	COLORADO RIVER NEAR DOTESERO, CO	7	39.64461	-107.078	USGS
09071750	COLORADO RIVER ABOVE GLENWOOD SPRINGS, CO	7	39.5588	-107.2909	USGS

Table 3. Monitoring site location information.

2022 Climate and Hydrologic Context

Water temperature in the Upper Colorado River is strongly influenced by fluctuations in air temperature and streamflow. It is useful to place the seasonal water temperature monitoring within the context of weather and streamflow conditions experienced in the region during 2022. The April 1 Snow Water Equivalent (SWE) value for NRCS remote snowpack monitoring stations in Colorado Basin headwaters registered at 94% of the 30 year median peak of 16.0 inches.⁵

At the statewide level, the state Climate Center at CSU ranked 2022 as Colorado's 35th driest and 6th warmest year in the 127 year period of record.⁶ Due once again to cumulative effects of warm temperatures and low soil moisture levels from the preceding fall and summer, the 2022 snowpack melted early and converted poorly to surface runoff. Streamflows in the Colorado River headwaters ranked comparatively low in the historical record as a result. The Upper Colorado River had no natural hydrograph peak this season, as upstream reservoirs struggled to replenish diminished storage for 2021 and achieved only partial fills without spilling during regional runoff periods in May/June/July. During the rising/ascending limb of the spring hydrograph, reservoir operators engaged in fill operations to secure summer storage while senior rights lower in the basin could be met by natural flows from lower tributaries like the Eagle and Roaring Fork. Mean August flows ranked 23rd lowest out of 62 years at the Kremmling gauge and mean July flows ranked as the 10th lowest in the record. While a strong monsoon season buffered streamflows and eased

³ <https://nwis.waterservices.usgs.gov/rest/IV-Test-Tool.html>

⁴ https://www.awqms.com/files/AWQMS_Training/AWQMS%20Web%20Services%20User%20Guide.pdf

⁵ https://www.nrcs.usda.gov/Internet/WCIS/AWS_PLOTS/basinCharts/POR/WTEQ/assocHUCco_8/colorado_head_waters.html

⁶ https://climate.colostate.edu/reports/wy2022_climate_summary.pdf



temperatures in the southwest portion of the state, summer rains in the upper Colorado provided less relief. The peak flow for the season of just over 1600 cfs occurred on June 14th. In early July, near or around July 10, flows again began increasing from reservoir releases to meet downstream water calls, beginning a concurrent improvement in water temperature conditions.

3 2022 DATA REVIEW

The 2022 temperature data displays the typical natural downstream warming trend between Kremmling and Glenwood Springs (Figures 1-3). During peak runoff periods, a smaller differential between the most-upstream and downstream sites is observable than compared to later in the summer. The reach gains heat consistently during late summer and early fall periods between Gore Canyon and Glenwood Springs, with lackluster flows in the Eagle River providing little cooling influence this year at Dotsero. The No Name site in Glenwood Canyon is often cooler than upstream sites during early season due to influences from the Eagle River and local tributaries below the Blue River during snowmelt runoff. Once peak flows have subsided and the Eagle and other tributaries provide less cooling influence, this reach (characterized by the monitoring sites 09070500 below Dotsero and at No Name 09071750) often faces the most persistent late summer concerns.

All sites exceeded the MWAT summer temperature standards in 2022, and sites from State Bridge downstream exceeded it for extended periods of time (Figures 2, 3, Table 4). After application of the Water Quality Control Division's Warming Event criteria to the summer season, all sites from State Bridge downstream exceeded standards for one or multiple weeks.

Water temperature conditions are driven by multiple factors, with air temperature and flow conditions contributing strongly to daily and seasonal patterns. The USGS Water Year Summary data report at the USGS Kremmling gauge site (09058000) reported an annual total flow of 249,300 af for the 2022 WY. This qualifies flow in the W&S segments under the W&S SG Management Plan criteria as a 'driest 25th percentile' year (< 454,500 af) resulting from a slightly below or near-average snow year followed by the dry/warm summer.

Temperature concerns existed for fisheries on the Upper Colorado during significant portions of the warm season, with voluntary closure requests from Colorado Parks and Wildlife on various combinations of segments between Kremmling and Glenwood Canyon in effect from July 15 through Aug 24th. Air temperatures reached 90 deg F during several periods in June, July, and August (Figure 4).

The lower Blue River displays a unique pattern compared to the Colorado, facing frequent temperature concerns during the late spring shoulder season in May. During this period, Dillon and Green Mountain Reservoirs are filling, attenuating or fully eliminating the natural spring rise, peak, and recession of cold snowmelt flows. The hydrograph for the lower Blue River is essentially 'inverted' from a natural snowmelt regime from the second week of April until early July. The extremely low flows (~30-40cfs) coupled with warming early summer temperatures and the wide, shallow channel geometry of the Blue near its confluence with the Colorado contribute to rapid daily warming during late May. Exceedances of both the DM and MWAT standards were extended during this period in 2022. These exceedances occurred during the shoulder season between spring and summer, when temperatures would naturally be rising to some degree, and follow the correct direction of temperature change for the time of year, which may attenuate the severity of potential impacts to cold water fisheries to a degree.

DM, All temperature sites, Wild and Scenic segments 4-7

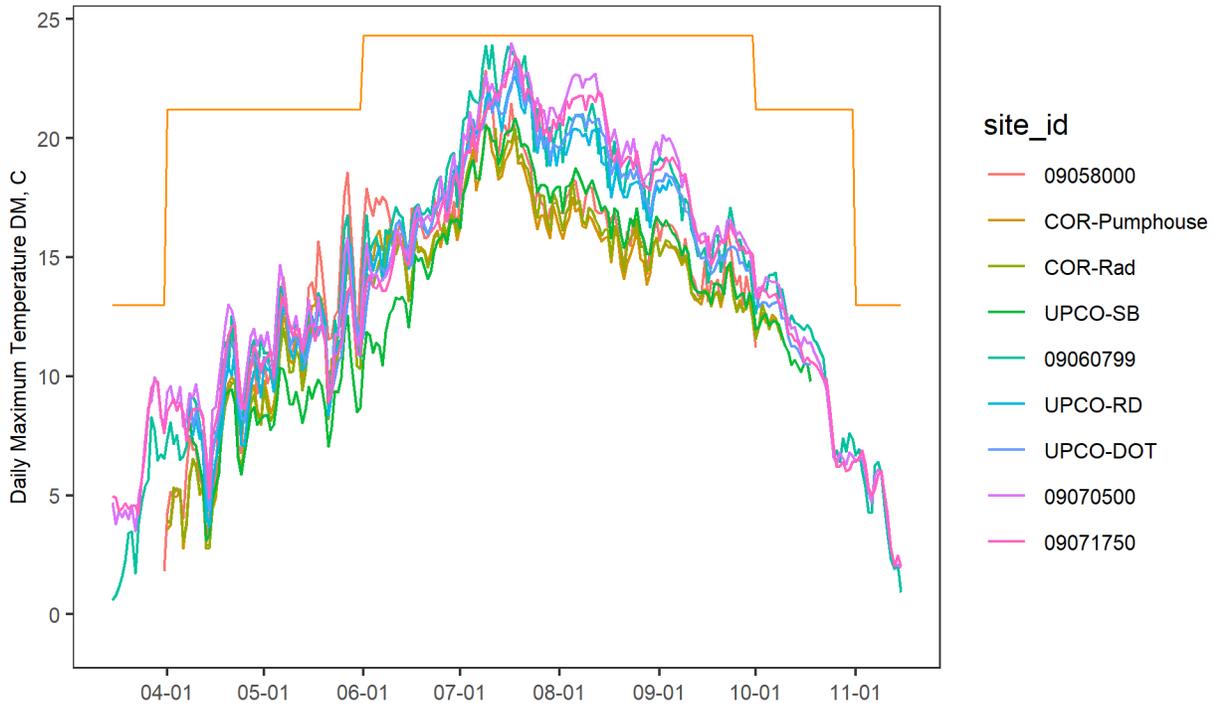


Figure 1. Daily Maximum temperatures (DM) in 2022 and the applicable summer, shoulder, and winter season standards. The Blue River is not included for figure clarity, as it has a different WQ standard.

MWAT, All temperature sites, Wild and Scenic segments 4-7

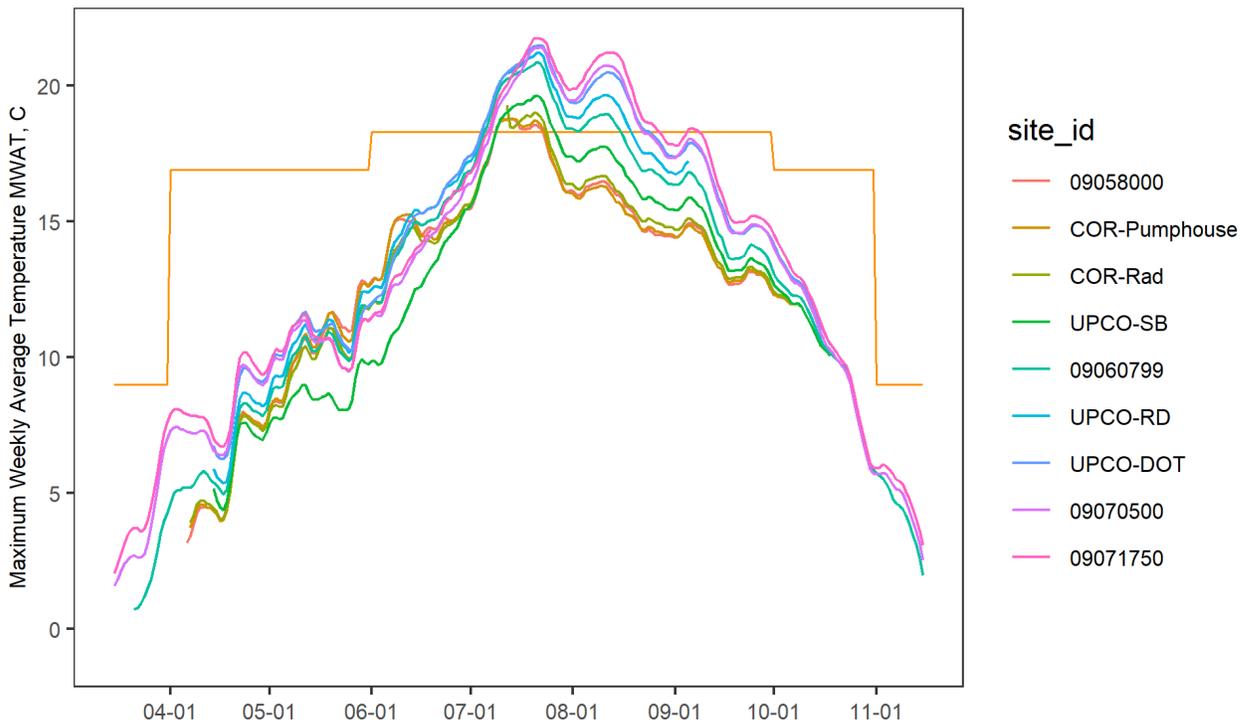


Figure 2. Weekly Average Temperature (WAT) in 2022 and the applicable summer, shoulder, and winter season MWAT standards. Blue River is not included for figure clarity, as it has a different WQ standard applied.



MWAT, All temperature sites, Wild and Scenic segments 4-7

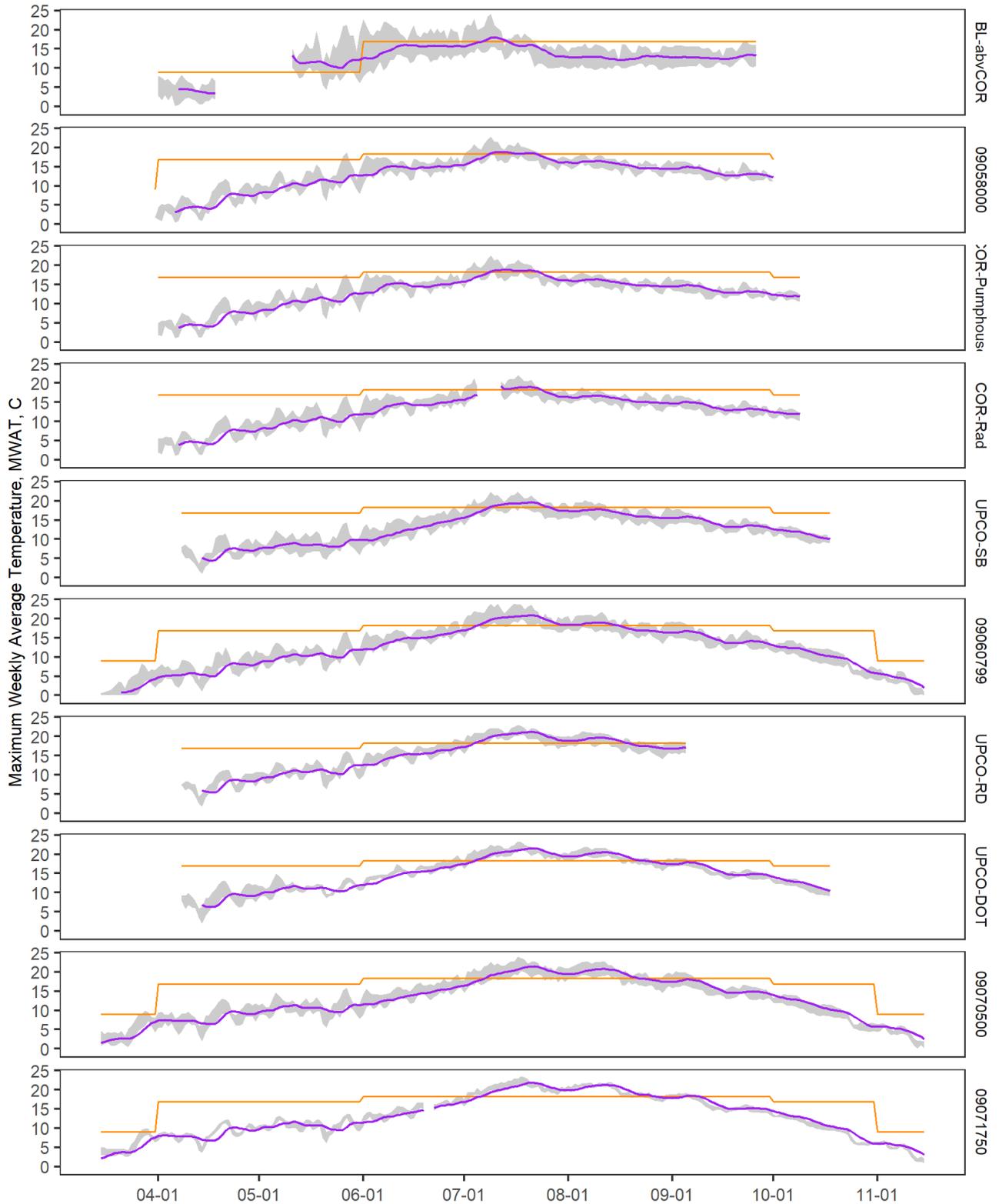


Figure 3. MWAT for all sites on W&S reach in 2022, with standards overlay. Warming events were accumulated separately for summer and winter seasons in this analysis.

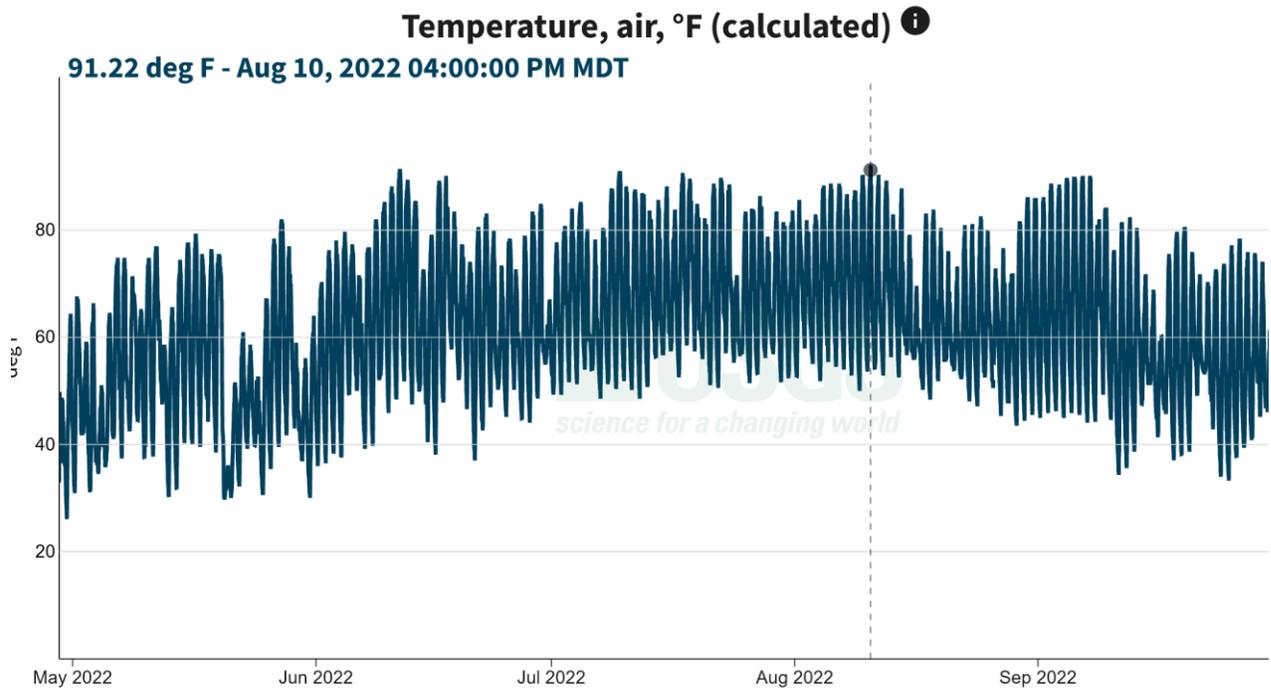


Figure 5. Air temperatures at Catamount during May-September, figure from USGS Catamount NGOS gauge website.

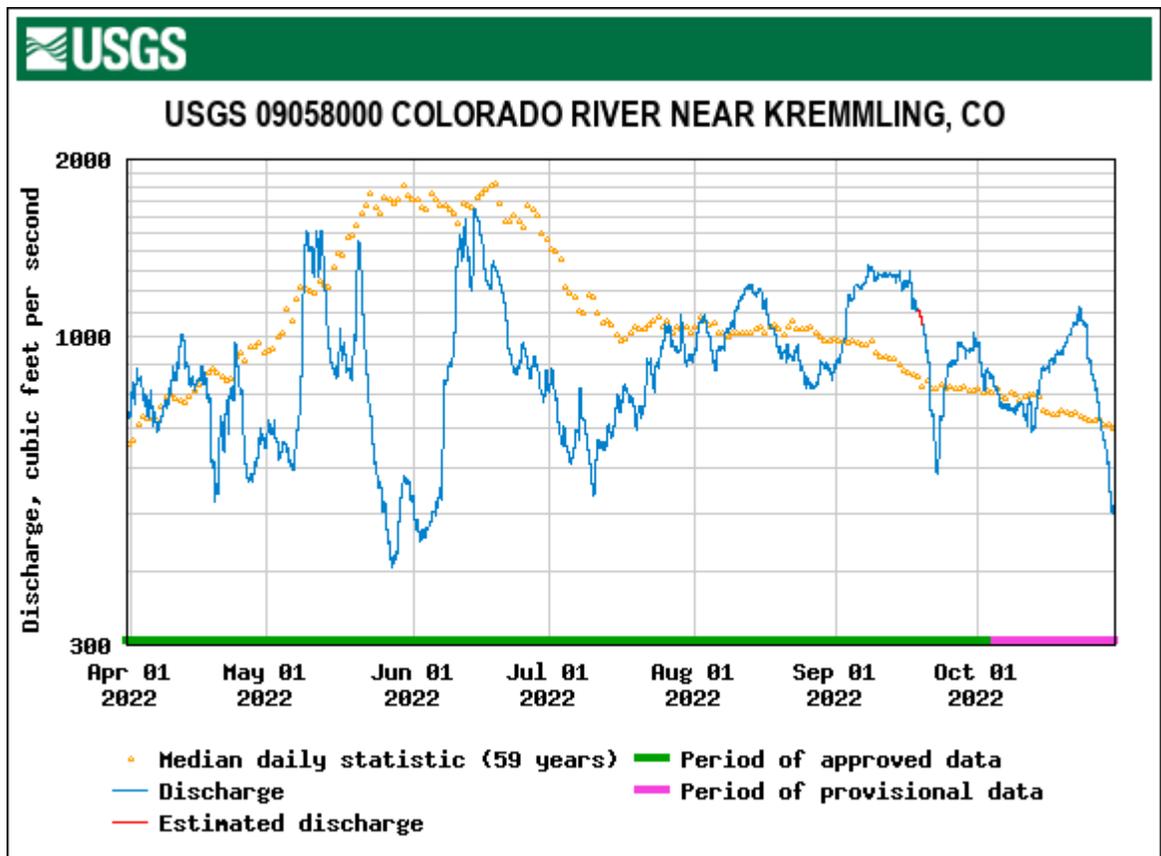


Figure 6. 2022 summer streamflows at Kremmling/Gore Canyon gauge site.

Site	Year	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Annual_total
BL-abvCOR	2022		0	3	0	0	0	0	0	3
09058000 (below Kremmling)	2022	0	0	0	0	0	0	0	0	0
COR-Pumphouse	2022		0	0	0	0	0	0	0	0
COR-Rad	2022		0	0	0	0	0	0	0	0
UPCO-SB	2022		0	0	0	1	0	0	0	1
09060799 (Catamount)	2022	0	0	0	0	3	2	0	0	5
UPCO-RD	2022		0	0	0	3	3	0		6
UPCO-DOT	2022		0	0	0	3	3	0	0	6
09070500 (blw Dotsero)	2022	0	0	0	0	3	3	0	0	6
09071750 (near No Name)	2022	0	0	0	0	3	4	1	0	8

Table 4. MWAT site regulatory exceedance summary by month (estimated number of weeks exceeding standards criteria after a warming event analysis has been applied). Empty cells indicate months with no reported data.

Site	Year	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Annual_total
BL-abvCOR	2022		0	13	0	0	0	0		13
09058000 (below Kremmling)	2022	0	0	0	0	0	0	0	0	0
COR-Pumphouse	2022		0	0	0	0	0	0	0	0
COR-Rad	2022		0	0	0	0	0	0	0	0
UPCO-SB	2022		0	0	0	0	0	0	0	0
09060799 (Catamount)	2022	0	0	0	0	0	0	0	0	0
UPCO-RD	2022		0	0	0	0	0	0		0
UPCO-DOT	2022		0	0	0	0	0	0	0	0
09071750	2022	0	0	0	0	0	0	0	0	0
09070500	2022	0	0	0	0	0	0	0	0	0

Table 5. DM site regulatory exceedance summary by month (number of days exceeding standards criteria after a warming event analysis has been applied). Empty cells indicate months without data.

4 ADDITIONAL DELIVERABLES

Individual site analysis reports and plots.

Compiled and formatted datasets