



G R A N D C O U N T Y

LEARNING BY DOING

2022 ANNUAL OPERATIONS REPORT

December 31, 2022

Introduction

Learning By Doing (LBD) Operations Guidelines require that each year the Operations Subcommittee submit an Operations Report to the LBD Management Committee. This report summarizes 2022 LBD-related operations, including:

- Denver Water’s Moffat Collection System spill bypasses¹ totaling approximately 200 acre-feet (af) in August to mitigate high water temperatures.
- River District’s Woford bypass and release from storage of approximately 500 af to mitigate high water temperatures in July.
- Municipal Subdistrict’s release of 400 af from Windy Gap Reservoir during the construction drawdown.
- Release of 5,412 af from the Endangered Fish Pool in Granby Reservoir for the Upper Colorado River Endangered Fish Recovery Program (Recovery Program).
- Grand County releases totaling approximately 1300 af in August and September from Granby Reservoir delivered to Grand Valley Irrigators.

The LBD Cooperative Effort is a commitment by LBD entities to restore or enhance the condition of the aquatic environment, where possible, in Grand County. The Cooperative Effort Area (CEA) includes the Colorado, Fraser, and Williams Fork River basins, upstream of the Colorado River confluence with the Blue River. A map of the Fraser River Collection System (**Attachment A**), a map of the Colorado River from Granby Reservoir to the Williams Fork River (**Attachment B**), and a list of LBD water sources and quantities offering flexibility (**Attachment C**) can be found at the end of this report.

2022 Snowpack, Soil Moisture and Water Supply Forecasts

Figure 1 is a map depicting NRCS April 20, 2022 Snow Water Equivalent (SWE) for SNOTEL sites in Colorado. A graph of the 2022 Snow Water Equivalent versus time at SNOTEL sites above Kremmling, as compared to recent years, is shown in **Figure 2**. SWE above Kremmling in 2022 was similar to 2018 and 2021. The Colorado Basin River Forecast Center (CBRFC) April 1, 2022 Most Probable Runoff Forecast at Kremmling was 84 percent of average (730 thousand acre-feet [kaf], see evolving forecast graph, **Figure 3**).

¹ “Voluntary/environmental bypasses” are releases pursuant to the CRCA; “required bypasses” are releases pursuant to a permit or ROD; “maintenance bypasses” are releases to allow for maintenance; “spill bypasses” are releases as a result of a full reservoir or system constraint (full East Slope reservoirs).

The actual runoff at Kremmling was 89 percent of average (771 kaf). Inflow into Lake Granby was 98 percent of average (221 kaf), and runoff into Wolford and Willow Creek Reservoirs reflected very different conditions at 66 and 134 percent of average, respectively.

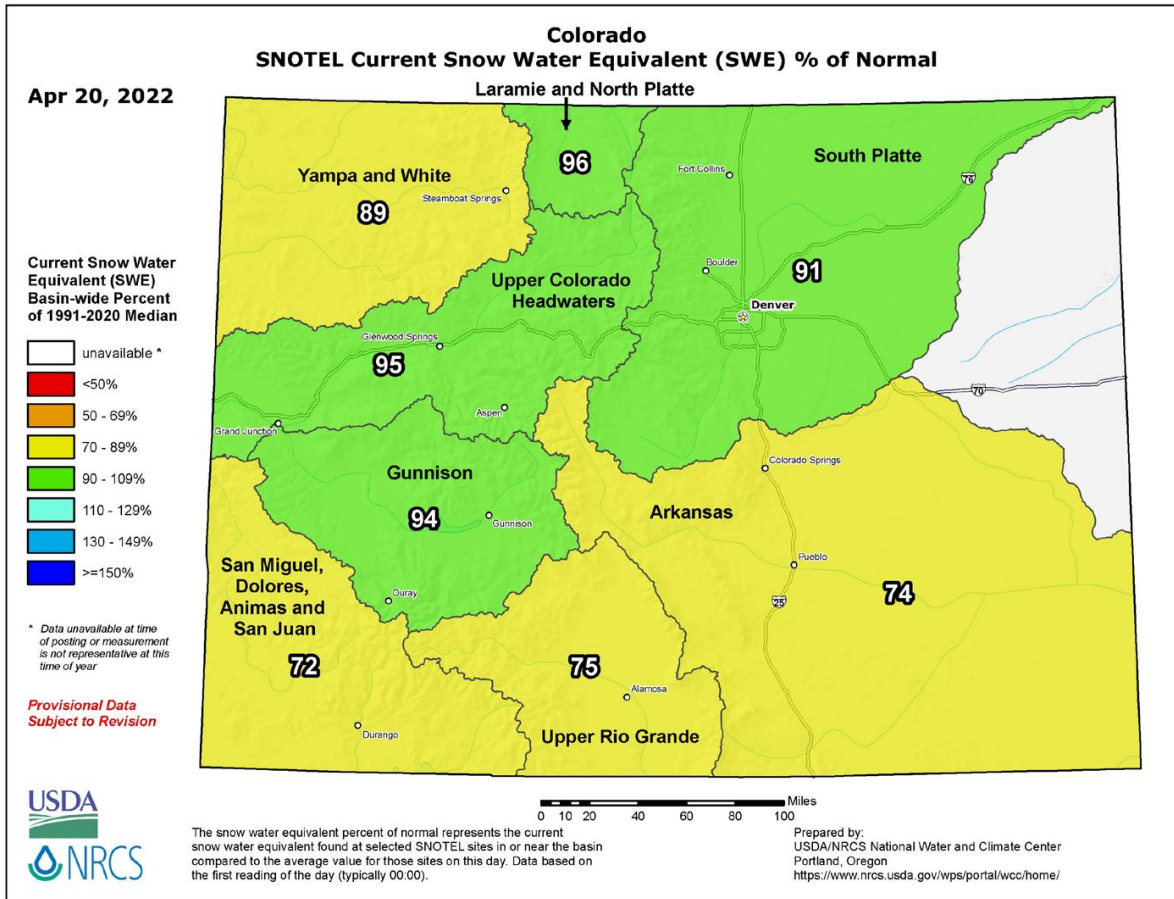


Figure 1: NRCS April 20, 2022 Snowpack Summary for Colorado

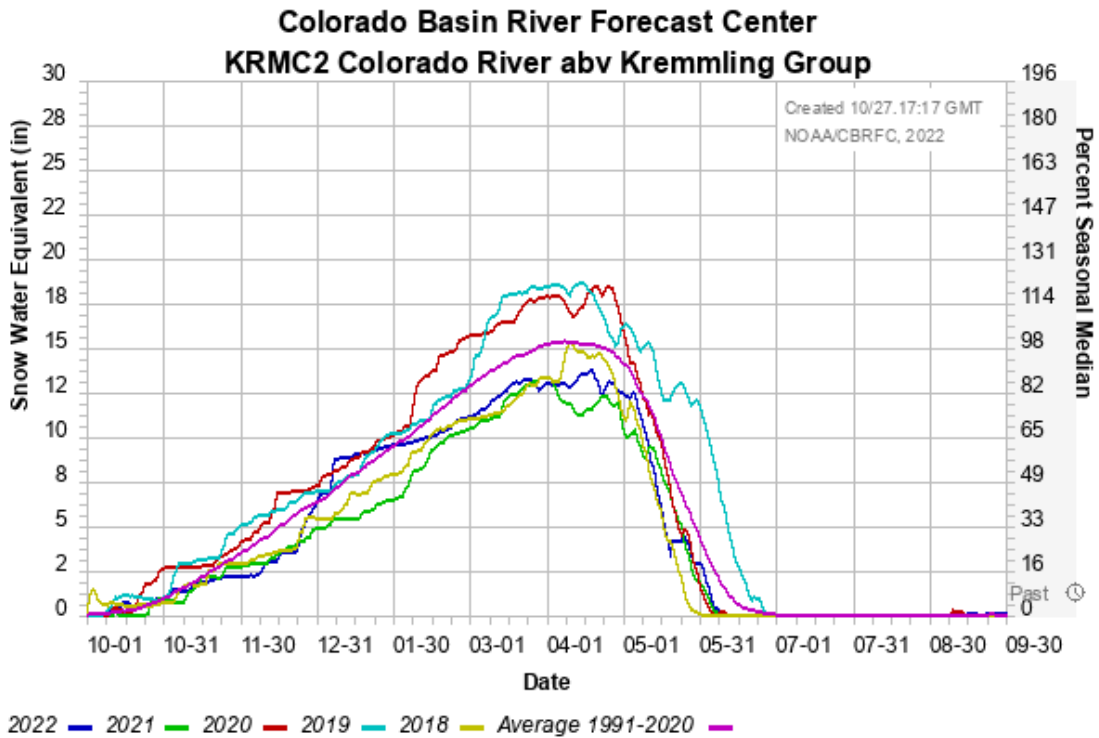


Figure 2: CBRFC 2021 Evolving Snowpack (Snow Water Equivalent) above Kremmling

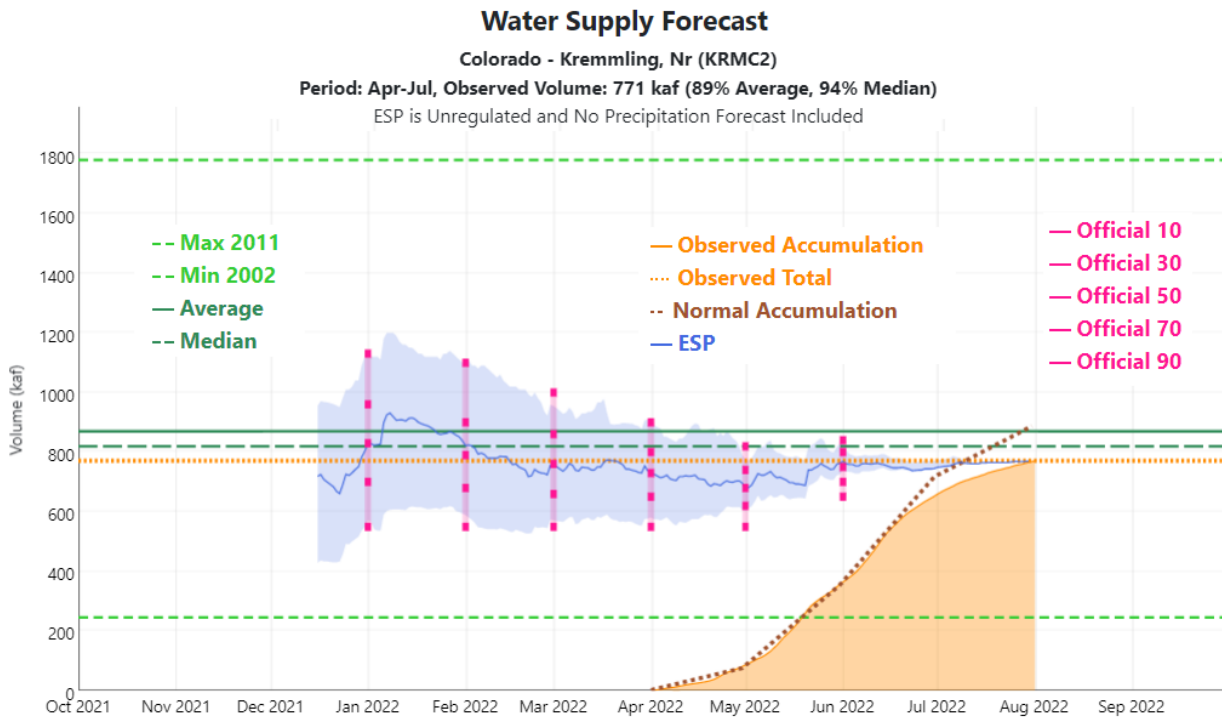


Figure 3: CBRFC 2022 Evolving Water Supply Forecast at Kremmling

In the bigger picture, CBRFC April 1 forecasts in the Upper Colorado River Basin (UCRB) above Lake Powell were generally below average as well, and dry conditions in April and May contributed to reduced June 1 forecasts, see **Figure 4**. April-July inflow into Lake

Powell was only 59 percent of average (3750 kaf), reflecting the poor snowpack and runoff conditions to the south and west of the LBD CEA.

Modeled Soil Moisture Conditions entering the 2021-22 Winter Season showed some improvement compared to November 2020, see **Figure 5**. The November 2021 map on the right reflects a relatively high soil moisture condition in the Willow Creek basin entering the 2021-22 snowpack building season. The anomalous runoff conditions in 2022 may have been due to the effects of the 2020 East Troublesome wildfire, which scarred nearly all of the Willow Creek drainage.

The UCRB experienced another above-average monsoon season in summer 2022. Maps depicting monthly precipitation as a percent of average in the CRB are shown in **Figure 6**. The early monsoonal rains in June benefited the San Juan basin and New Mexico and Arizona. Locally intense rain events in July and especially August benefited the LBD CEA, reducing demands and extending storage.

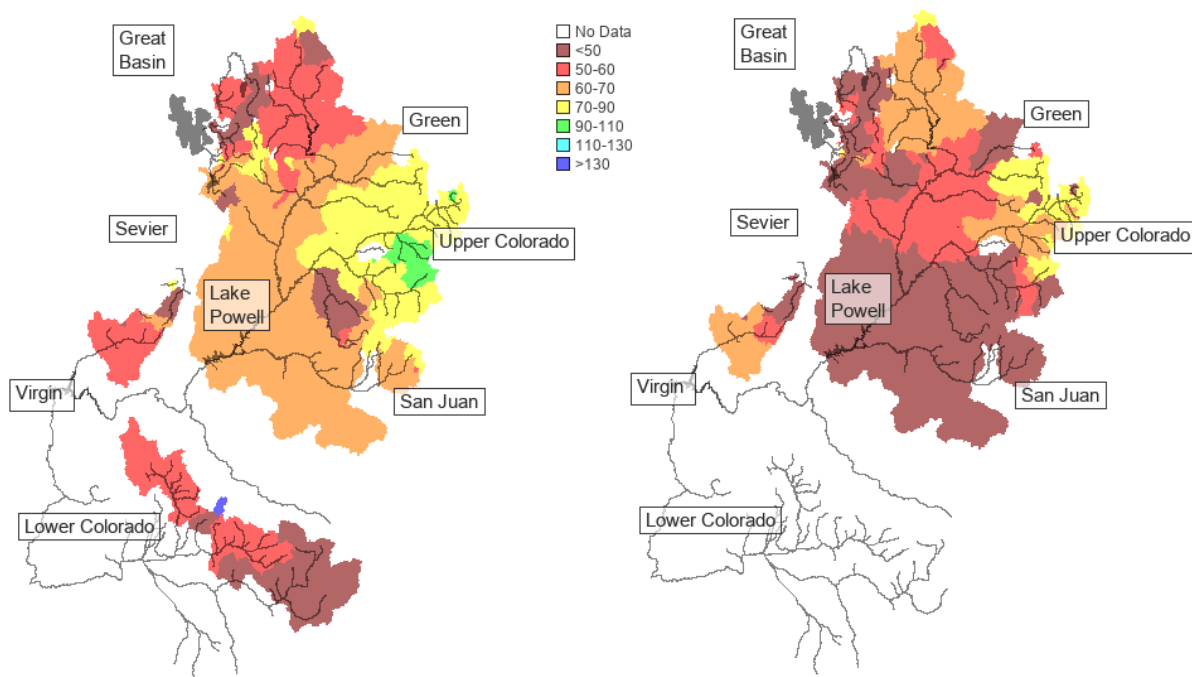


Figure 4: CBRFC April 1 and June 1, 2022 Water Supply Forecasts for the Colorado River Basin as a Percent of Average

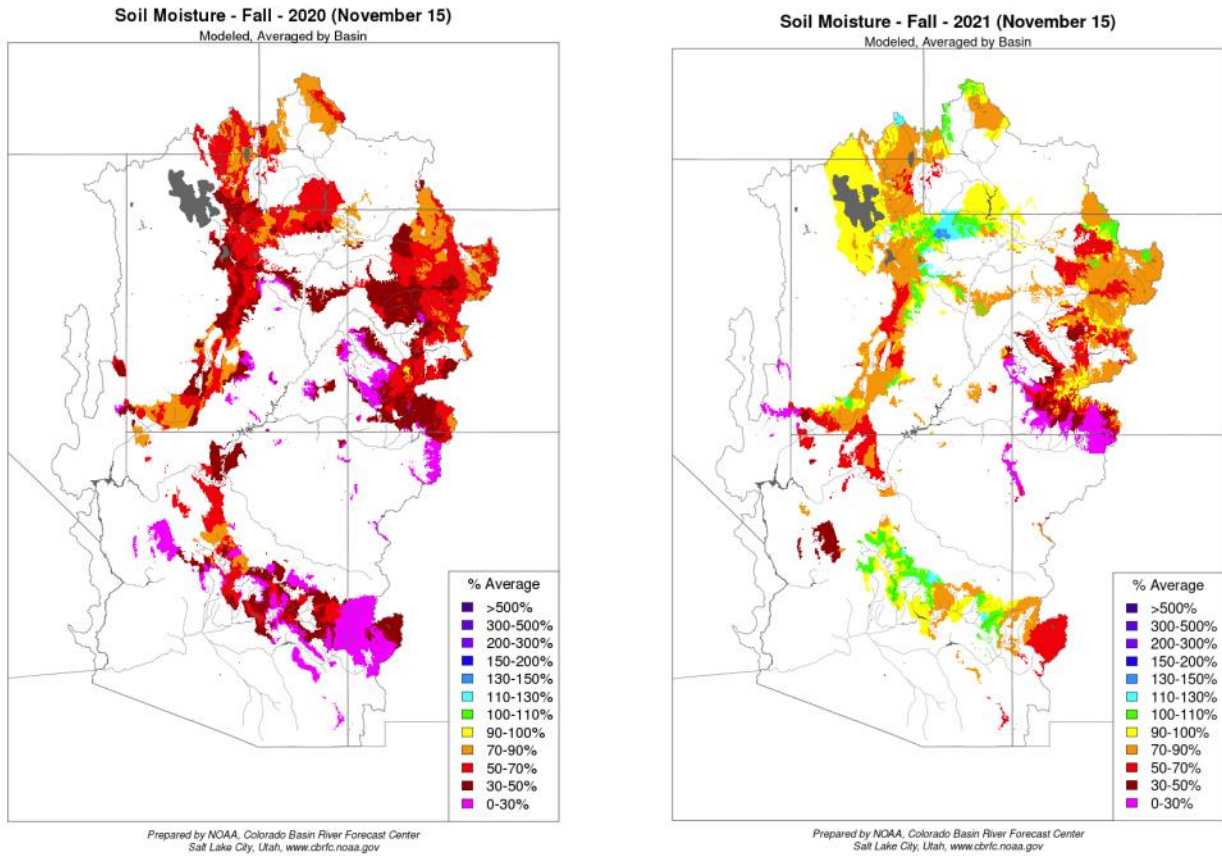


Figure 5: Comparison of November 2020 and November 2021 CBRFC Modeled Soil Moisture Conditions in the Colorado River Basin entering the Winter Season

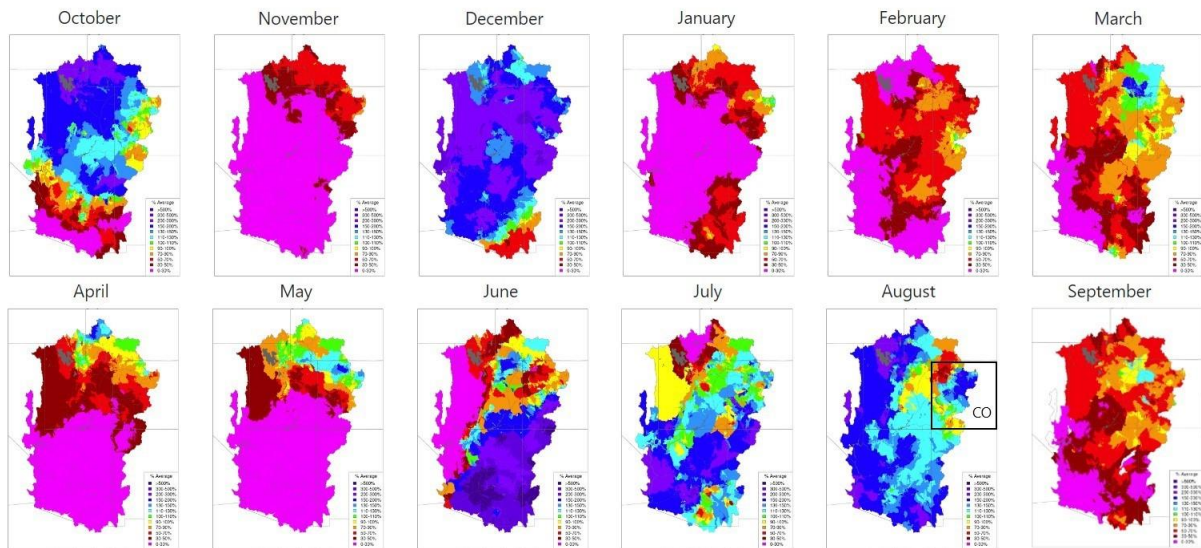


Figure 6: Maps showing Average Monthly Precipitation October 2021 through September 2022 in the Colorado River Basin

Runoff Operations

The LBD Operations Subcommittee held weekly teleconference calls to discuss runoff operations beginning June 1st, 2022. The initial operations call was delayed in part due to above average streamflow conditions in the LBD CEA for most of May, as well as limited operational flexibility leading up to the Technical and Management Committee meeting on May 25th. Discussion at that meeting focused on the challenges brought about by multiple factors, including a two week-long outage at the Shoshone Power Plant, below average snowpack, the prospect of minimum releases from a depleted Green Mountain Reservoir impacting Colorado River streamflow and water temperature in the Wild and Scenic reach below Kremmling, and the likelihood of another Green Mountain Reservoir Substitution year.

Shoulder season water temperature standard exceedances were reported in both the Fraser River Basin and in the Colorado River below Kremmling. The Colorado River at Kremmling experienced chronic exceedances throughout July.

Northern Water and Subdistrict Operations

Early May streamflow in the Upper Colorado River benefited from high runoff in the Willow Creek Basin (greater runoff efficiency due to the impacts of the 2020 fire), coupled with unplanned releases from Willow Creek Reservoir due to a pump outage, see **Figures 7 and 8**. However, pumping at Windy Gap commenced mid-April and continued through mid-June, resulting in reduced streamflow below Windy Gap Reservoir as shown in **Figure 9**. June 1st streamflow forecasts into the Three Lakes System increased by 10 to 20 percent due to a wet May.

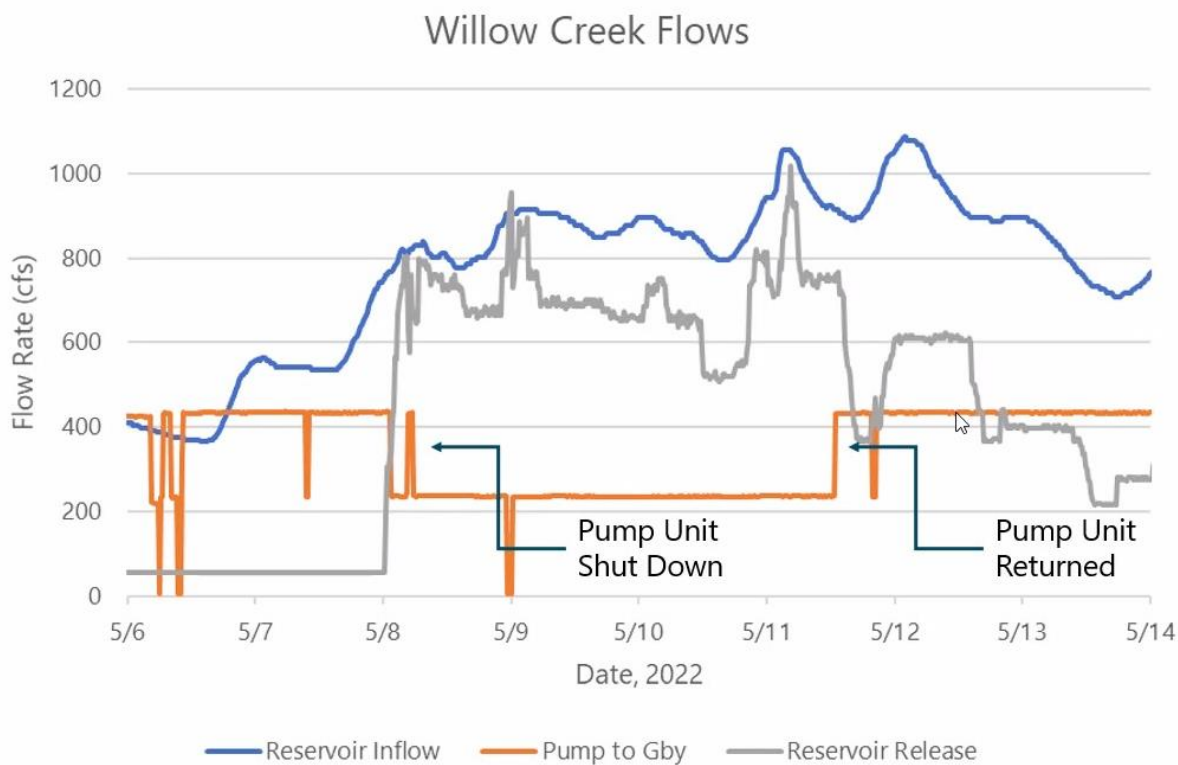


Figure 7: Graph of Willow Creek Reservoir Inflows, Releases, and Pumping

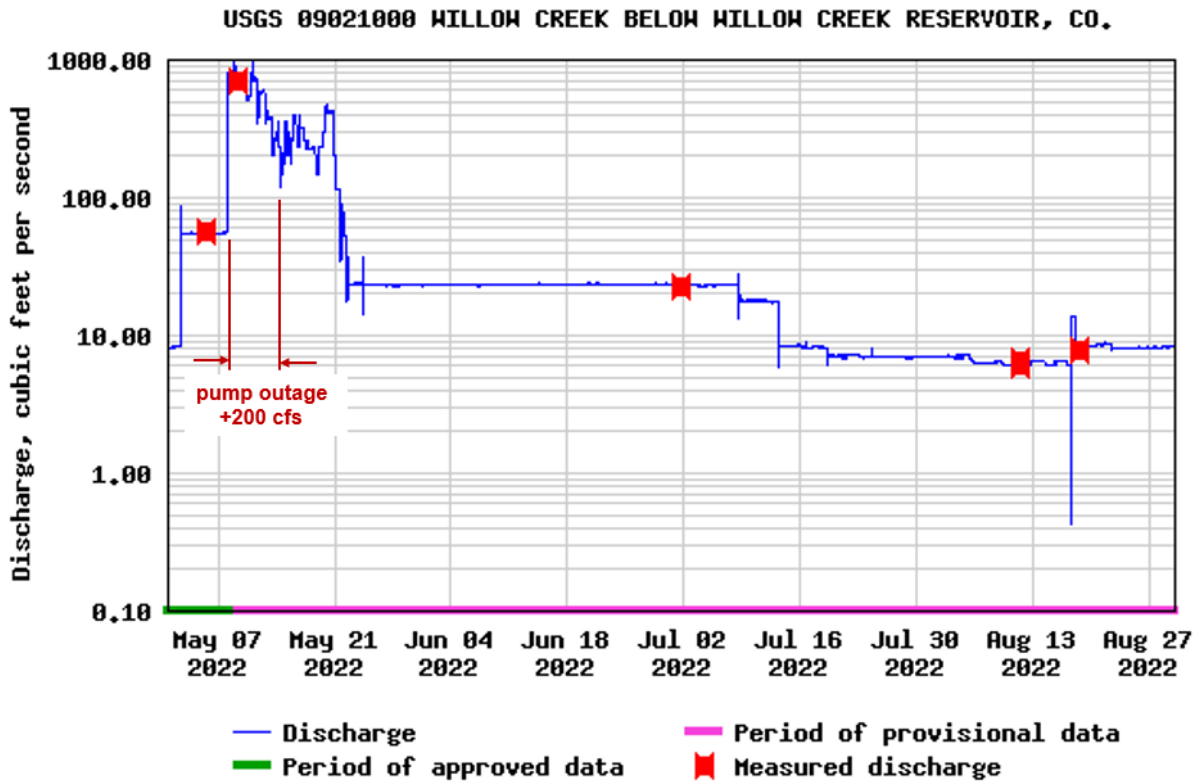


Figure 8: Graph of May through August Willow Creek below Willow Creek Reservoir Discharge

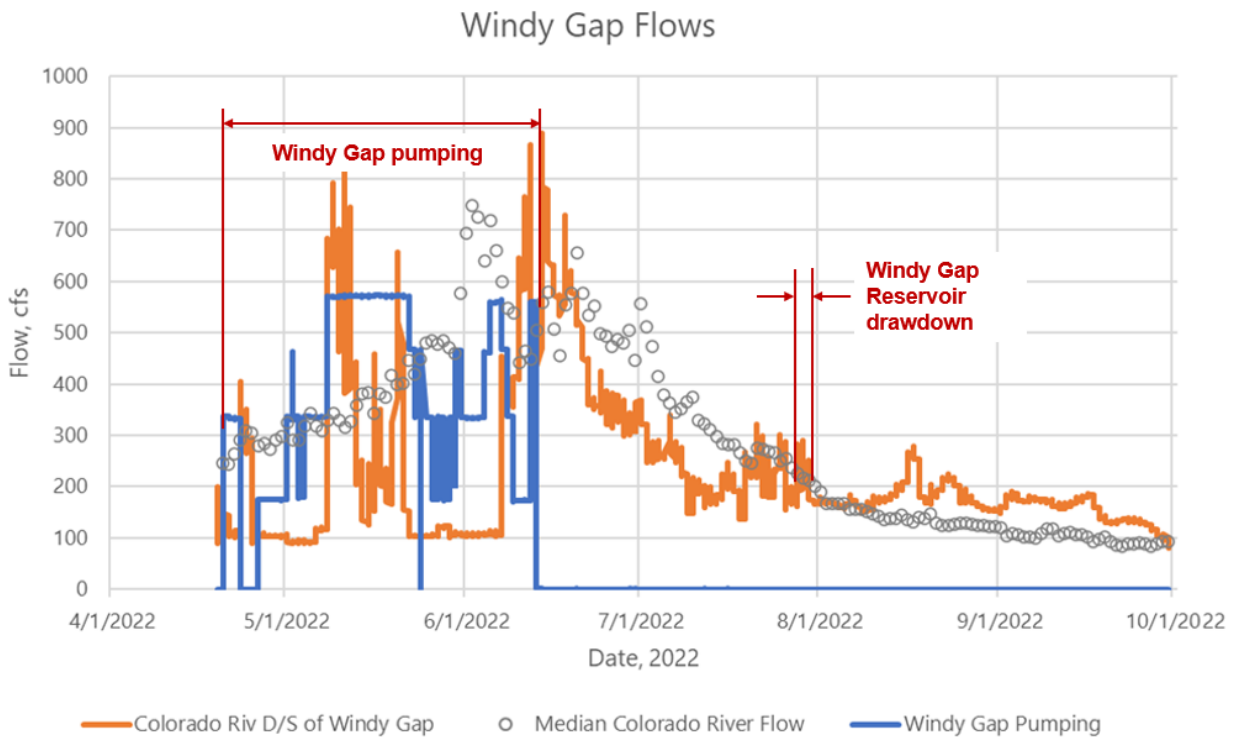


Figure 9: Graph of April to June 2022 Windy Gap Pumping to Granby Reservoir

Denver Water Operations

In early June, Gross Reservoir was near the restricted elevation for construction activities, and therefore Denver Water held the Moffat Tunnel in the 175-225 cfs range from late June into July, see **Figure 10**. Flows on lower Ranch Creek are shown in **Figure 11**, including Gross construction bypasses and Ranch Creek voluntary bypass of 200 af in late August. In May the Upper Williams Fork was bypassing all water and Williams Fork Reservoir was about a week from full, see **Figure 12**. A full review of Denver Water Operations can be found in Attachment D.

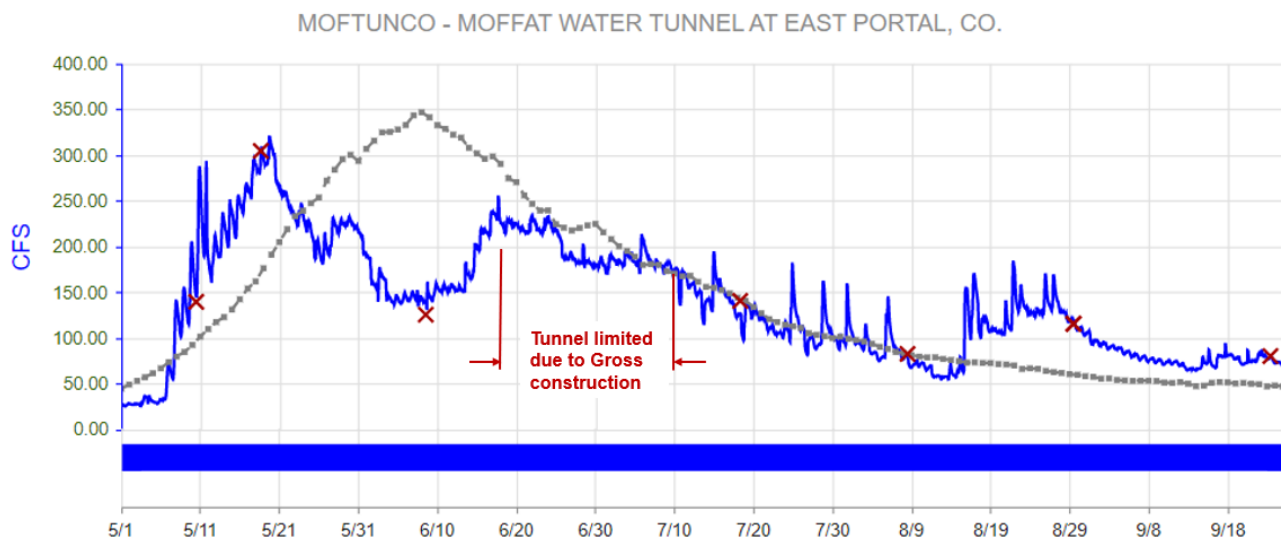


Figure 10: 2022 Moffat Tunnel Diversions

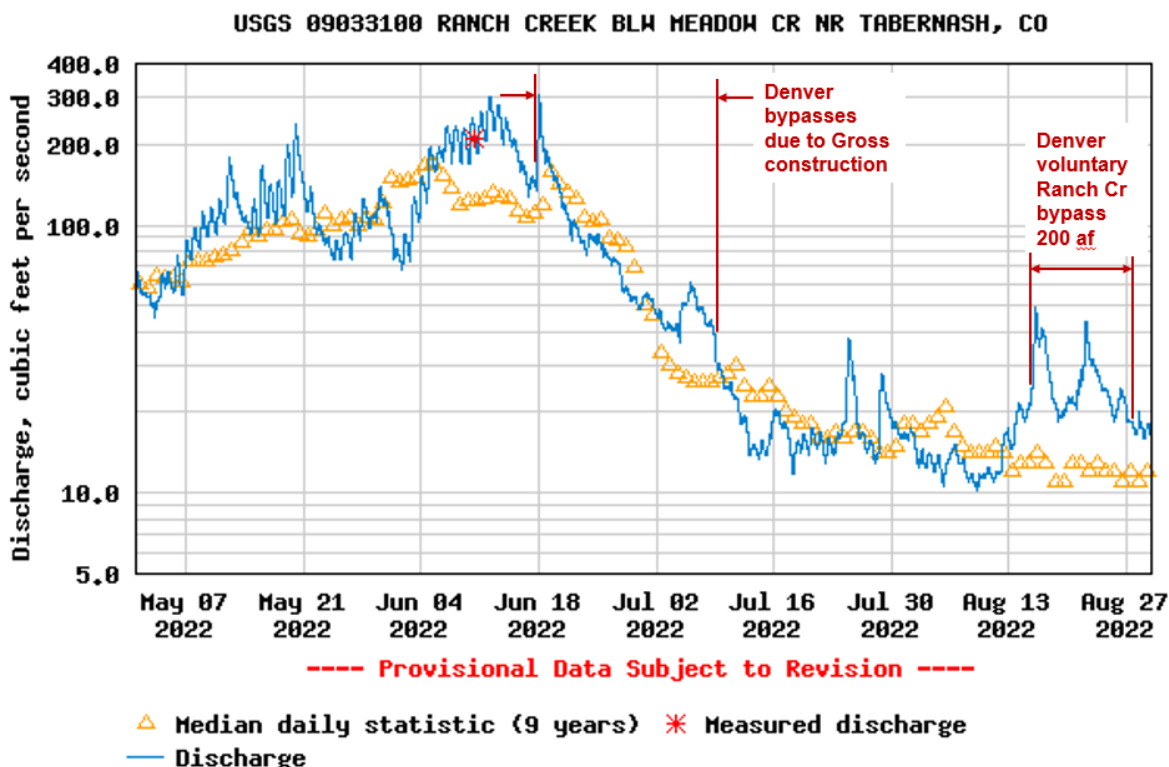


Figure 11: Graph of Streamflow at the USGS gage at Ranch Creek below Meadow Creek Reservoir

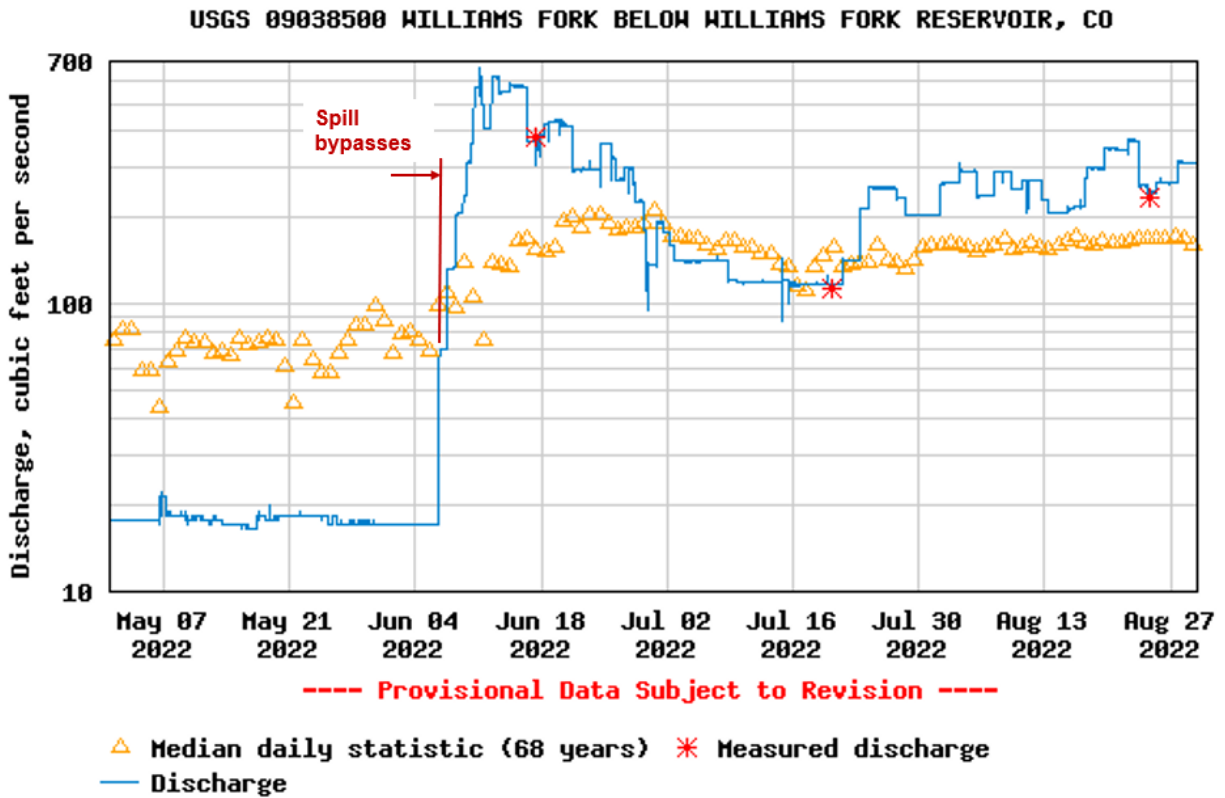


Figure 12: Graph of Streamflow at the USGS gage at Williams Fork below Williams Fork Reservoir

Green Mountain Reservoir Operations

Green Mountain Reservoir operations are shown in **Figure 13**. As in 2021, conservative operations kept releases at a minimum of 60 cfs (plus contract releases) during fill season until administration of the Shoshone Outage Protocol (ShOP) began on July 11th.

River District Operations

The River District bypassed about 500 af from July 7th to 19th at Wolford Reservoir to mitigate high water temperatures in the Colorado River below Kremmling, see **Figure 14**. Timing of releases relative to streamflows and water temperatures is shown at the Colorado River near Kremmling gage in **Figures 15 and 16**.

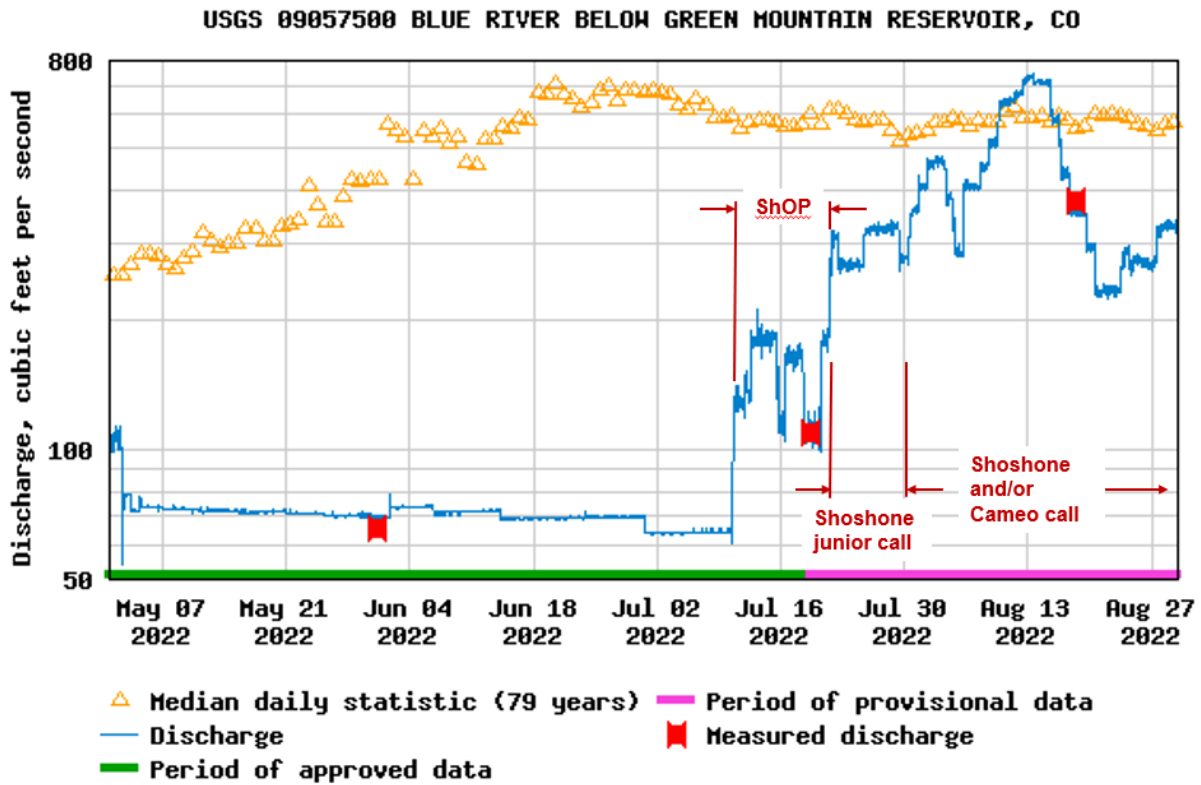


Figure 13: Graph of Streamflow at the USGS gage at Blue River below Green Mountain Reservoir

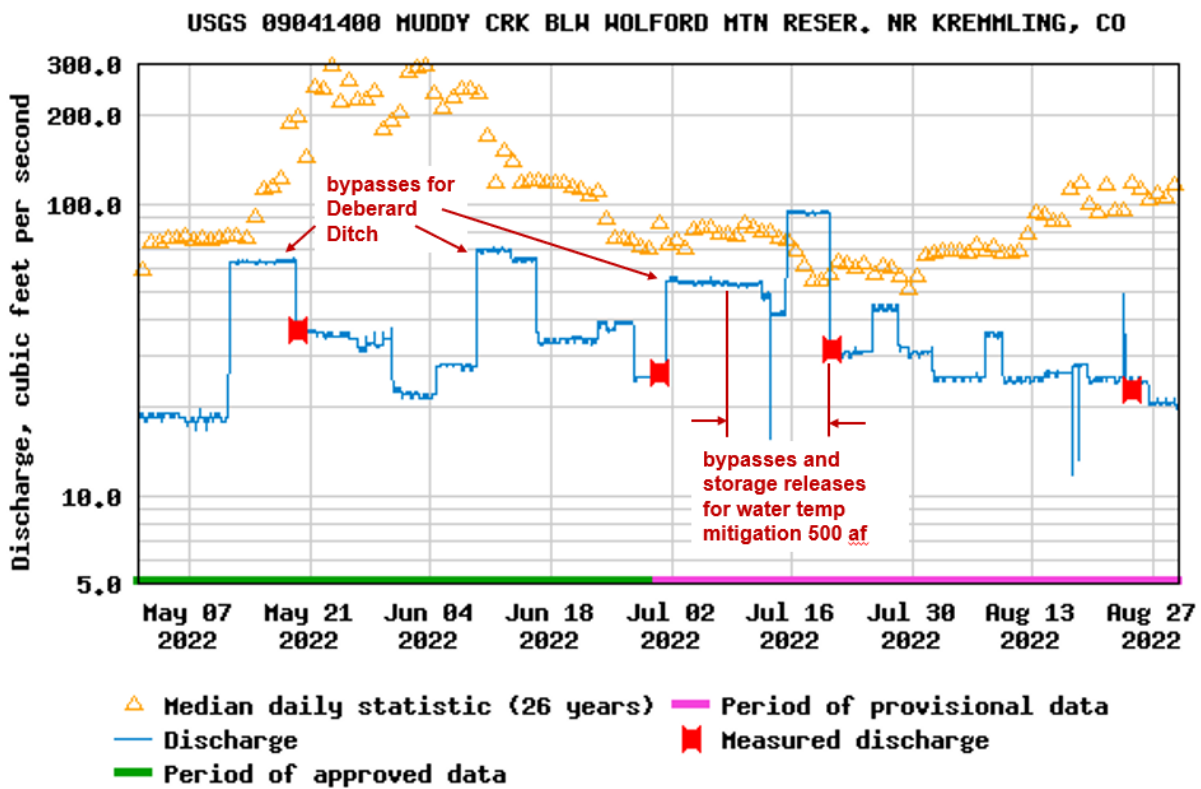


Figure 14: Graph of Streamflow at the USGS gage at Muddy Creek below Wolford Mountain Reservoir

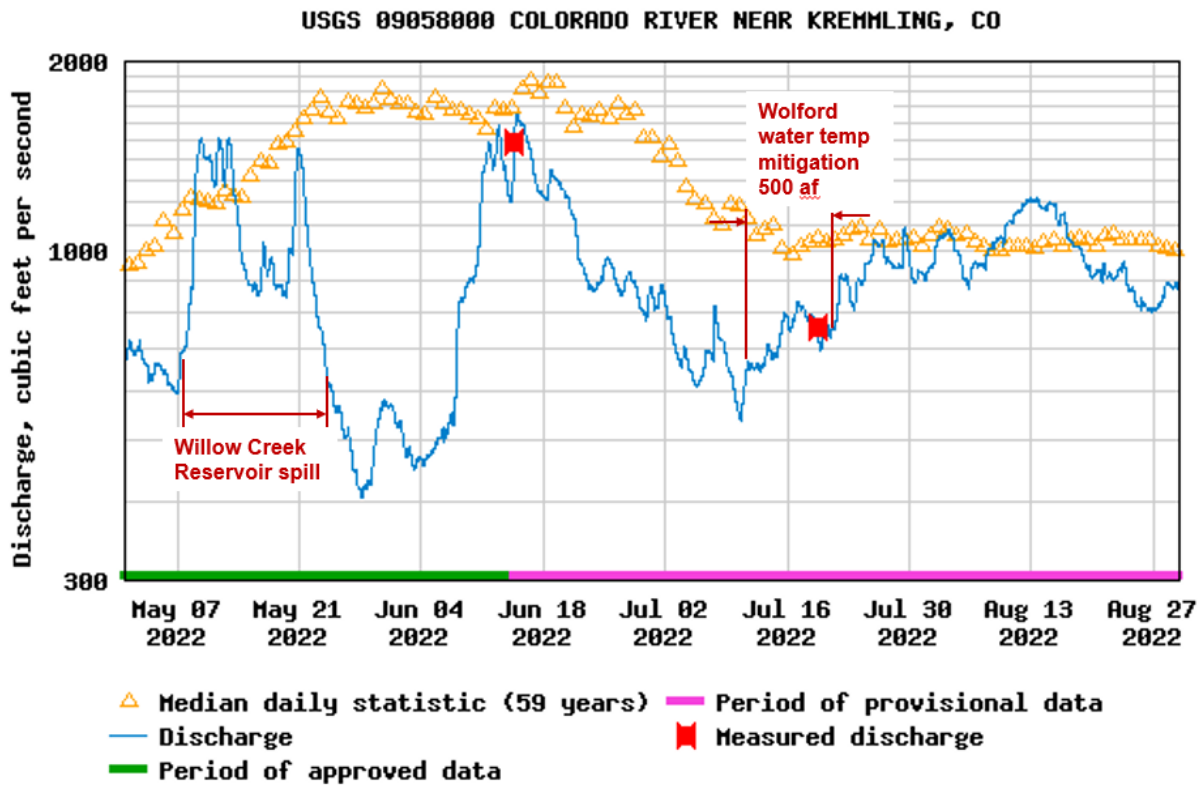


Figure 15: Graph of Streamflow at the USGS gage at Colorado River near Kremmling

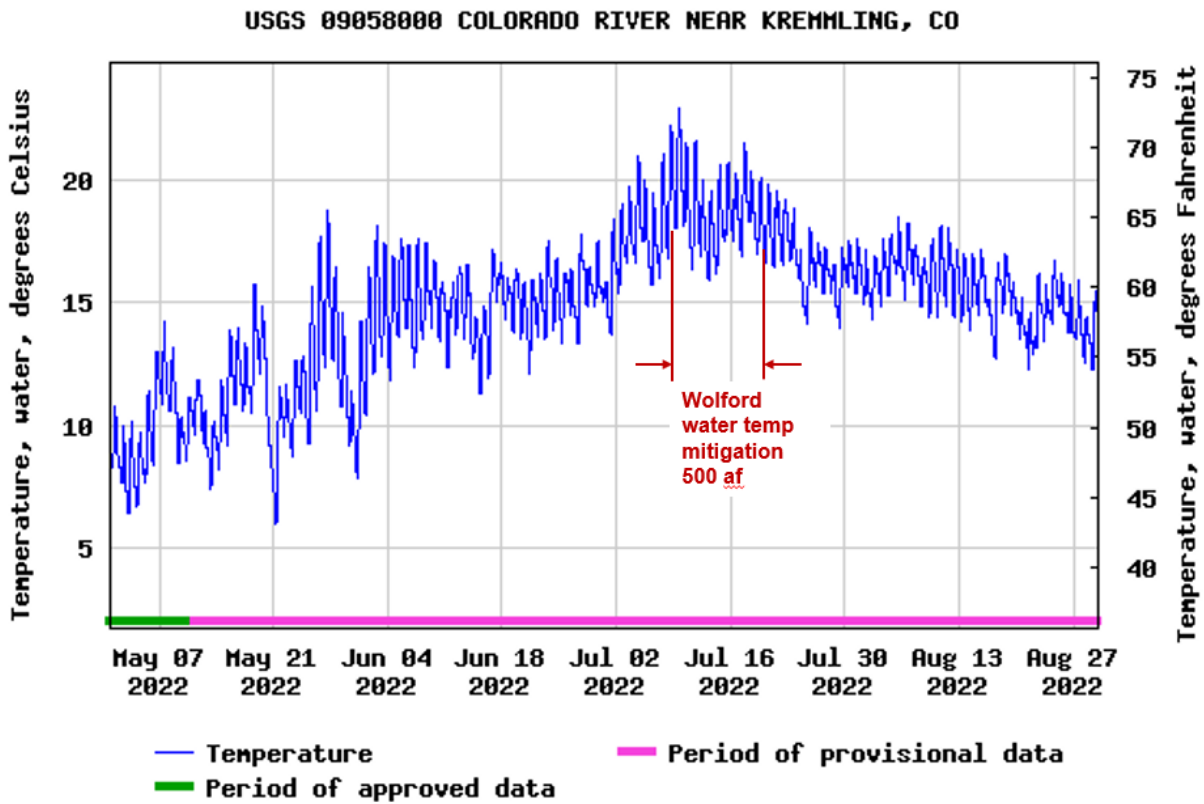


Figure 16: Graph of Water Temperatures at the USGS gage at Colorado River near Kremmling

Moffat Bypass Prioritization

Except for 2012, Moffat Collection System spill bypasses occurred in every year since 2005 (**Figure 17**). In 2016 and 2017, the Operations Subcommittee targeted Cabin, Vasquez, and Trail Creeks for voluntary spill bypasses. Trail Creek was chosen because it had fewer spill bypasses in the recent past. 2018 voluntary spill bypasses targeted Big Vasquez, St Louis, and Trail Creeks. In 2019 spill bypasses targeted Ranch and St Louis Creeks. In 2020 Moffat spill bypasses began in Cabin, Hurd, and Hamilton Creeks. In 2021 spill bypasses targeted Ranch Creek and tributaries and St Louis Creek. In 2022, Ranch Creek and tributaries, St Louis Creek and the Upper Fraser River were targeted. Also in 2022, Cabin Creek was targeted for flushing flows. In terms of prioritization of spill bypasses on Ranch Creek tributaries, all else being the same, it makes sense to spill bypass higher up in the valley. Cabin Creek makes more sense geographically than Trail Creek because Ranch Creek starts its slow, flat section where Cabin Creek joins Ranch Creek. Cabin Creek also contains a conservation population of Colorado River Cutthroat Trout downstream of the diversion that would benefit from the additional water. **Figure 18** shows Moffat System maintenance, spill, and voluntary bypasses in 2022.

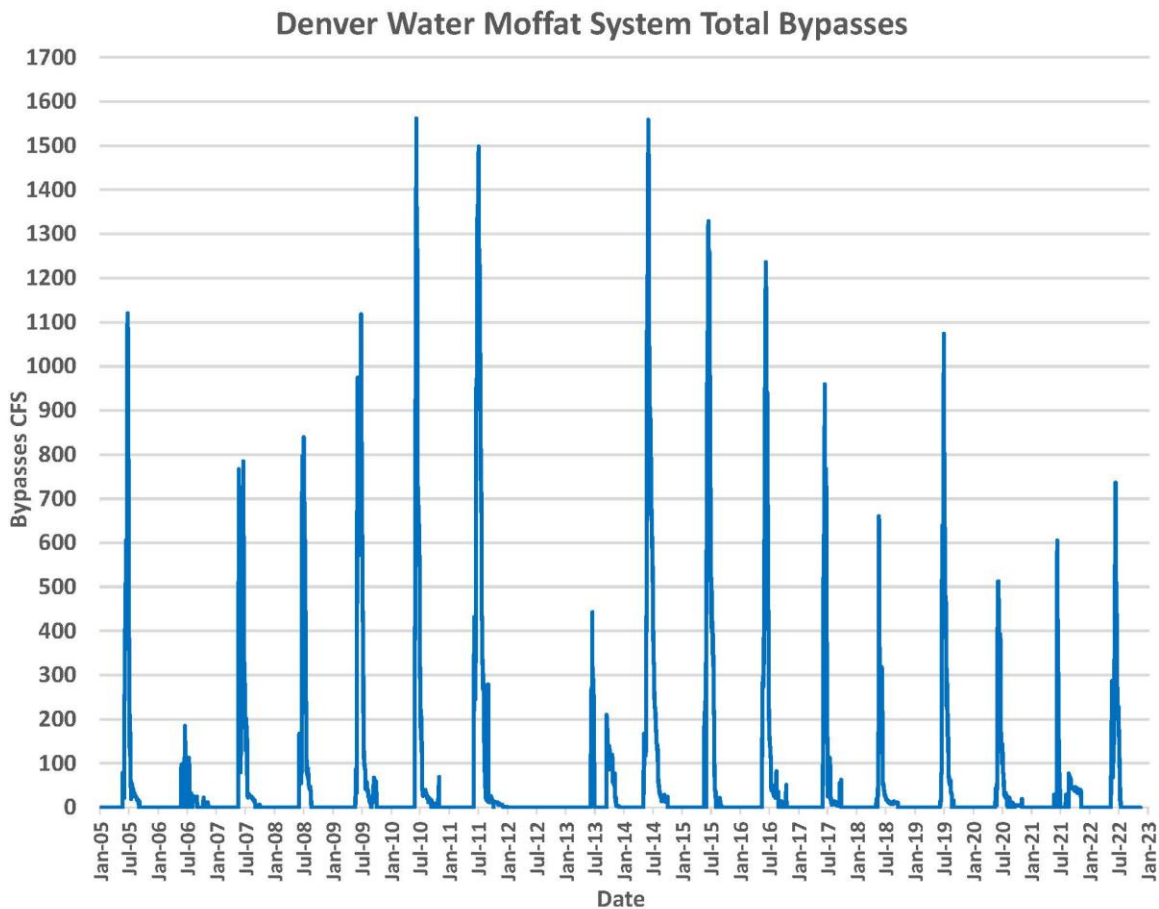


Figure 17: Historical Moffat System Bypasses from 2005 to 2022

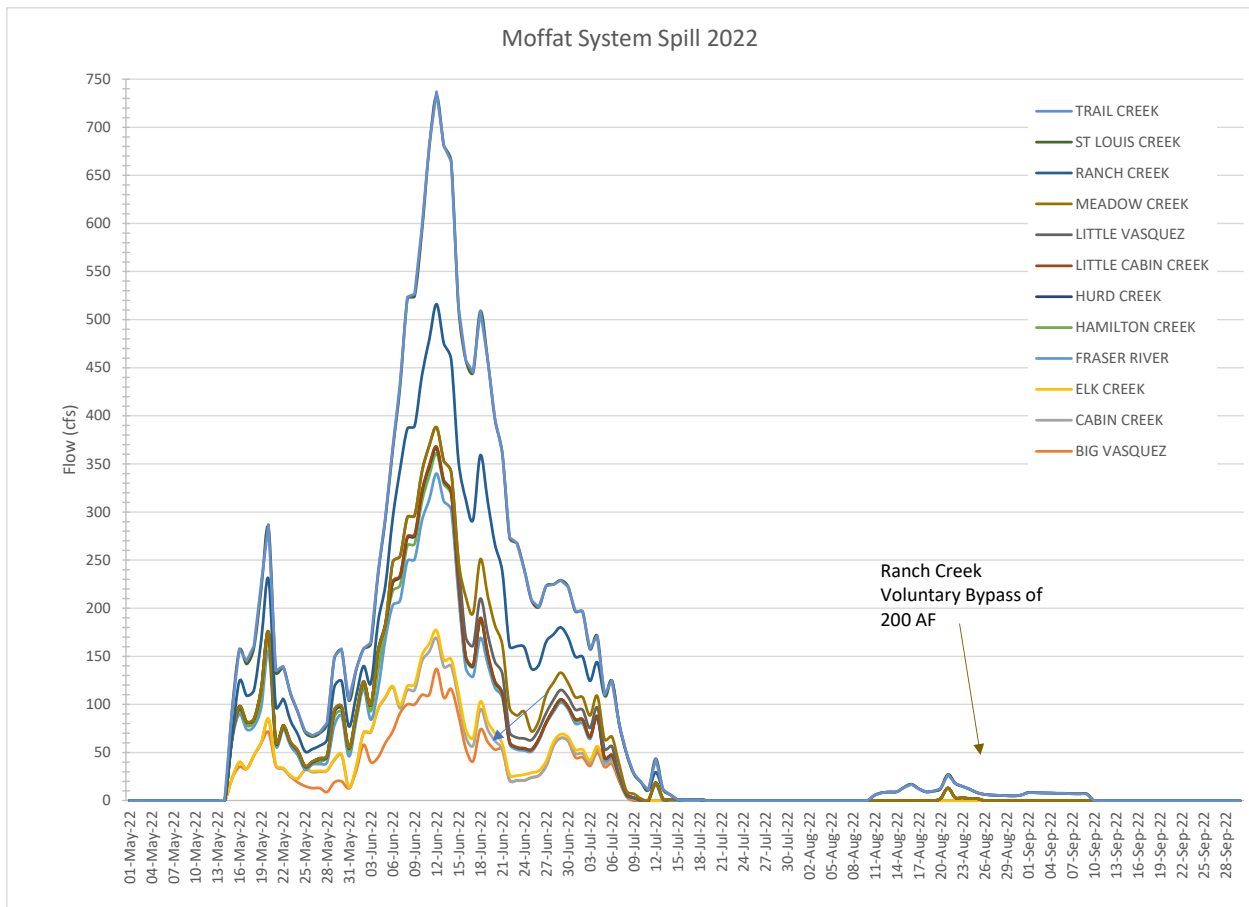


Figure 18: Denver Water Moffat System Bypasses (Maintenance and Spill) in 2022

The Grand County Stream Management Plan recommended flushing flows at different points in the Fraser River basin: Fraser River (80 cfs), St. Louis Creek (70 cfs), Vasquez Creek (50 cfs), and Ranch Creek (40 cfs). At the request of the U.S. Forest Service, a flushing flow was added on Cabin Creek (40 cfs). These flows were made conditions of the 404 Permit for the Moffat Project. Flushing flow targets were achieved at all locations except Cabin Creek. Ultimately, assessment of the effectiveness of these spill bypasses and prioritization of spill bypass locations requires a quantitative analysis based on field studies. LBD is considering implementing sediment sampling to monitor sediment transport. Denver Water provided flushing flow information (i.e., location, flow rate, duration) corresponding with each stream that has a permit-required flushing flow (**Attachment D**).

Coordinated Reservoir Operations (CROS)

As part of the Recovery Program, when the projected Cameo peak flow is above 12,700 cfs and below the flood capacity of about 25,500 cfs, Denver Water, the River District, and the Bureau of Reclamation (Reclamation) participate in Coordinated Reservoir Operations (CROS) to benefit the Endangered Fish in the Grand Valley area by augmenting peak runoff, generally in June. In early May the 2021 peak flow in the Grand Valley was projected to be about 10,500 cfs (see evolving peak forecast plot, **Figure 19**). The peak forecast was below the level that would trigger CROS, therefore no peak flow augmentation occurred.

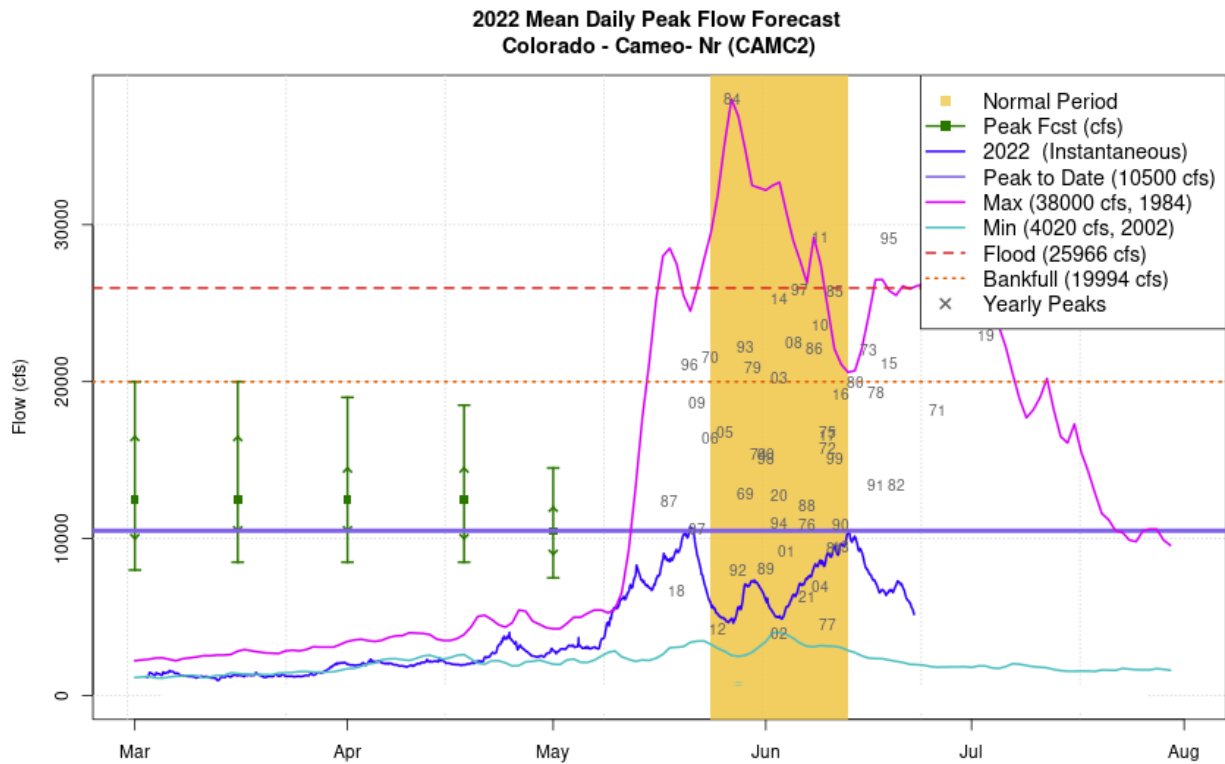


Figure 19: 2022 CBRFC Peak Flow Forecast, Yearly Peaks and Record Year Data for Cameo

Granby Fill and Windy Gap Pumping Operations

The 2022 Colorado Big Thompson Annual Operating Plan (CBT AOP) April 1 Most Probable Forecast model predicted that Granby Reservoir would not fill under any scenario. Historically, Granby Reservoir spilled in 2011, 2014, 2015, 2016, 2017, and again in 2019, but not in 2020, 2021 or 2022, see **Figure 20**. Under the April 1 CBT AOP Most Probable scenario, Windy Gap was predicted to pump 30,000 af into Granby Reservoir; actual 2022 Windy Gap pumping totaled 40,172 af. On July 8, the Shoshone Power Plant, a frequent calling structure just upstream of Glenwood Springs, went offline. From July 9th through July 15th, the Municipal Subdistrict of Northern Water released 1,368 af more than their required bypass. These releases fall under the category of voluntary releases for Shoshone Outage Protocol (ShOP). Starting on July 16, the Subdistrict is required to participate in ShOP. The Municipal Subdistrict also released approximately 400 af from July 20 through July 30, coordinating with DNR to make sure this water was on top of the current river call, to boost flows in the reach below Windy Gap. Willow Creek Reservoir was kept at a lower elevation than in past years to provide room for potential high storm runoff peaks due to the East Troublesome Fire. Granby Reservoir reached its peak contents of approximately 530,270 af on July 9, which is approximately 9,488 af from full.

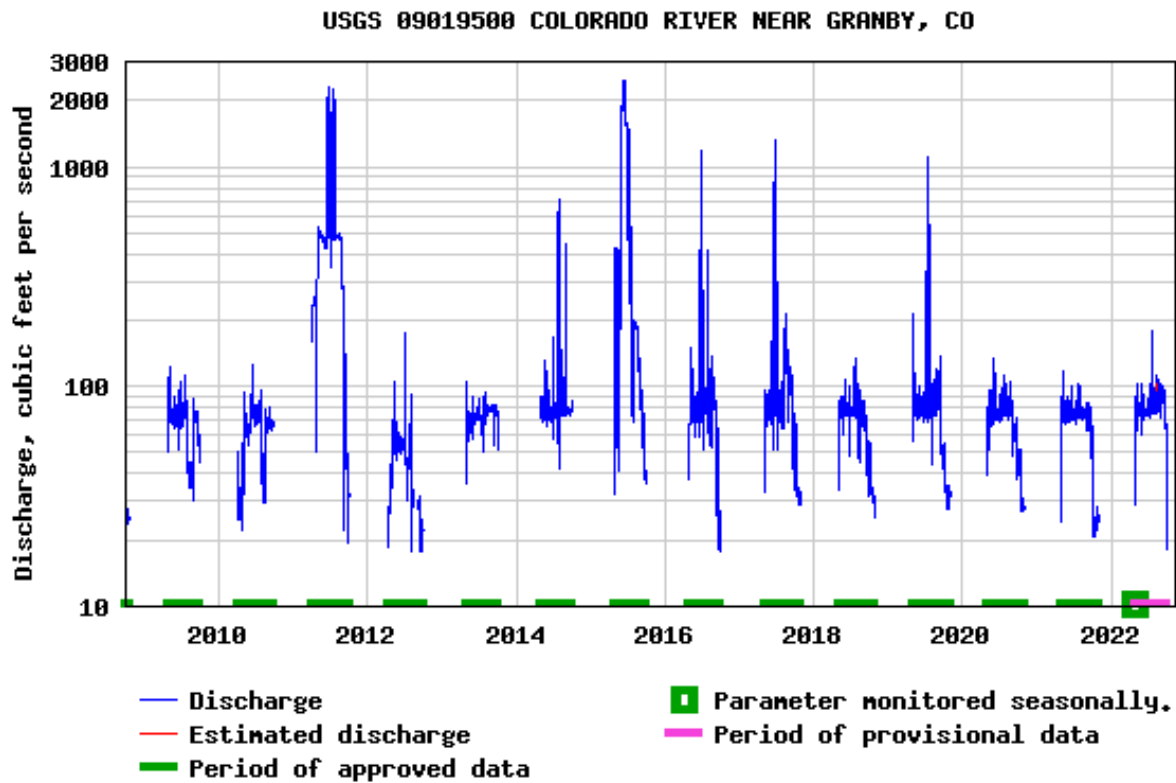


Figure 20: USGS Streamflow Colorado River near Granby 2009 to 2022

In-Season Operations

The LBD Operations Subcommittee held weekly teleconference calls to discuss in-season operations from June 1, 2022 through September 14, 2022. Each week prior to the LBD operations call, the River District prepared river flow forecasts and graphs of discharge within and downstream of the CEA., Grand County prepared Maximum Daily Temperature (MDT) and Weekly Average Temperatures (WAT) water temperature charts for review. In total, water temperature data are collected at 67 sites throughout the CEA, but only data at 10 key locations are assessed and compared to temperature standards for the weekly operations calls. These 10 locations are the most critical for making recommendations for operational adjustments such as bypass water. Comprehensive stream temperature assessments for all the temperature data for prior years can be obtained from the LBD website at: <https://www.grandcountylearningbydoing.org/reports.html>.

Real-time water temperature data are available at a few USGS sites and three mainstem Colorado River sites maintained by Northern Water. Data from multiple sites can be plotted together to reflect temperature increases in gaged reaches. **Figures 21 through 24** show exceedances of the Water Quality Control Division chronic and acute temperature standards for aquatic life at various nodes within and below the LBD CEA. Northern Water’s water temperature data at stream gages below Windy Gap Reservoir, at Hot Sulphur Springs and at Parshall are compared to chronic and acute water temperature standards, see **Figure 25**.

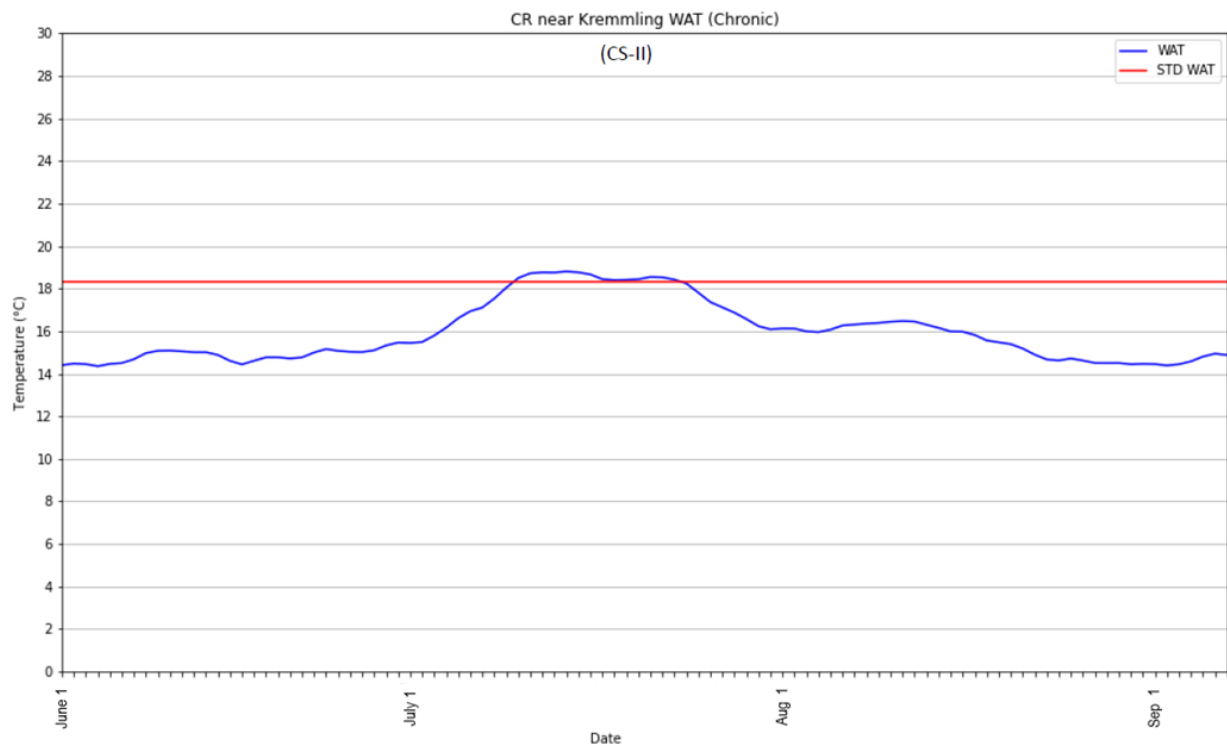


Figure 21: Graph of Weekly Average Temperatures (WAT) at Colorado River near Kremmling, showing exceedances of the Water Quality Control Division Chronic Temperature Standard

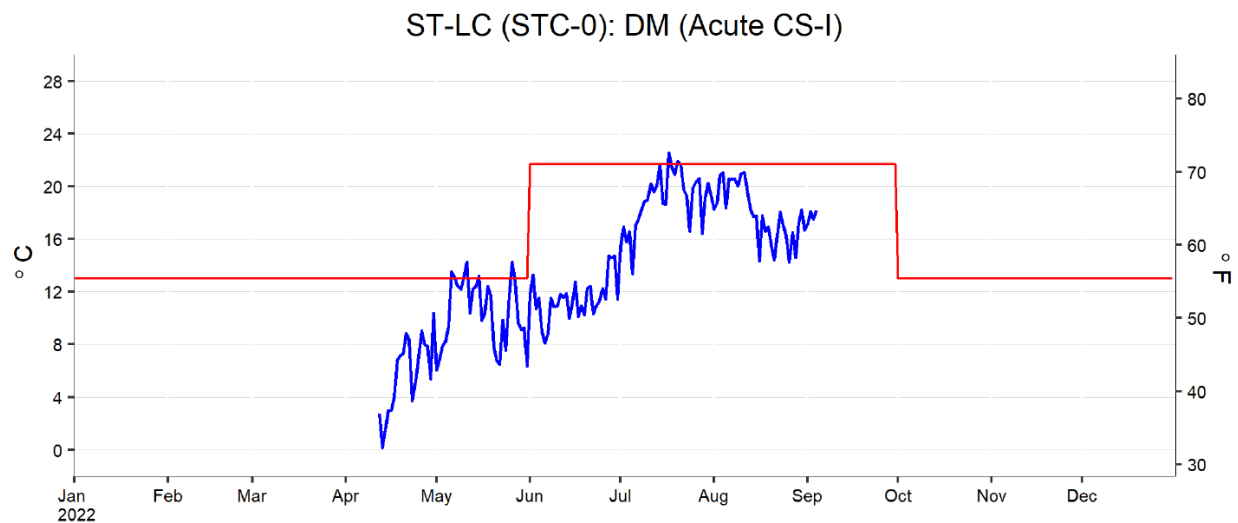


Figure 22: Graph of Daily Maximum Temperatures (DMT) at St. Louis Creek near Fraser, showing exceedances of the Water Quality Control Division Acute Temperature Standard

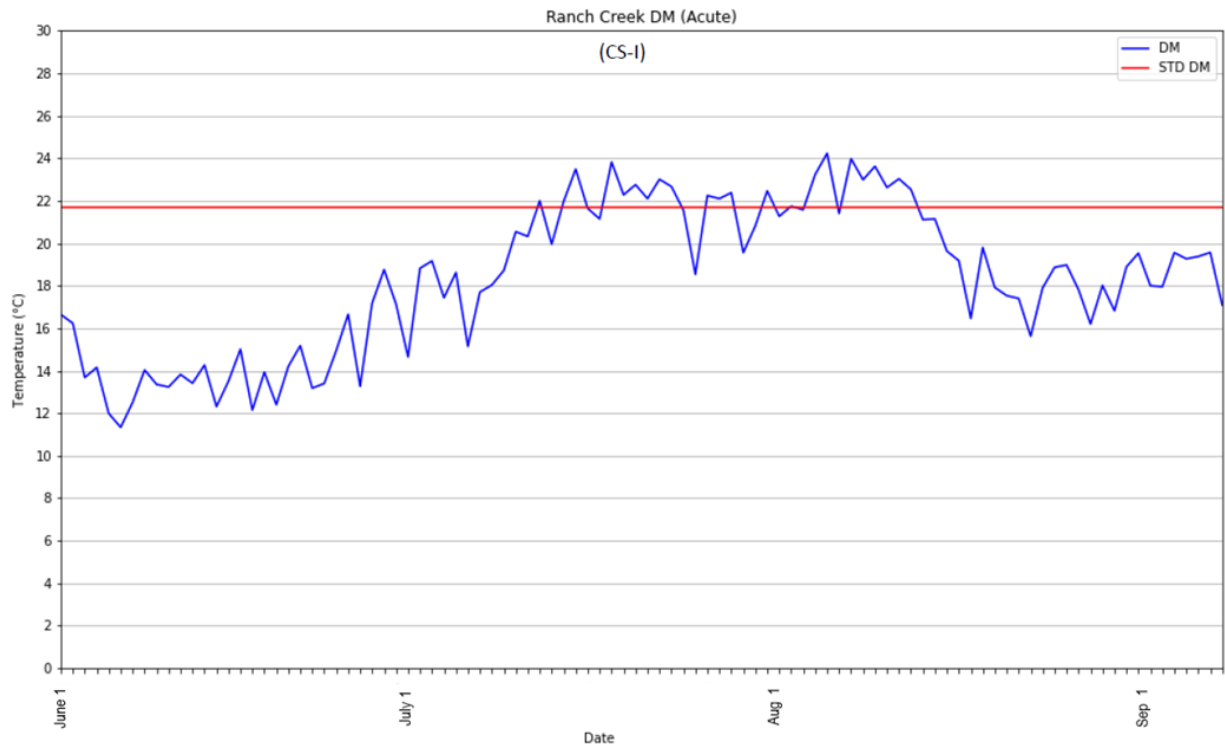


Figure 23: Graph of DMT at Ranch Creek near Fraser, showing exceedances of the Water Quality Control Division Acute Temperature Standard

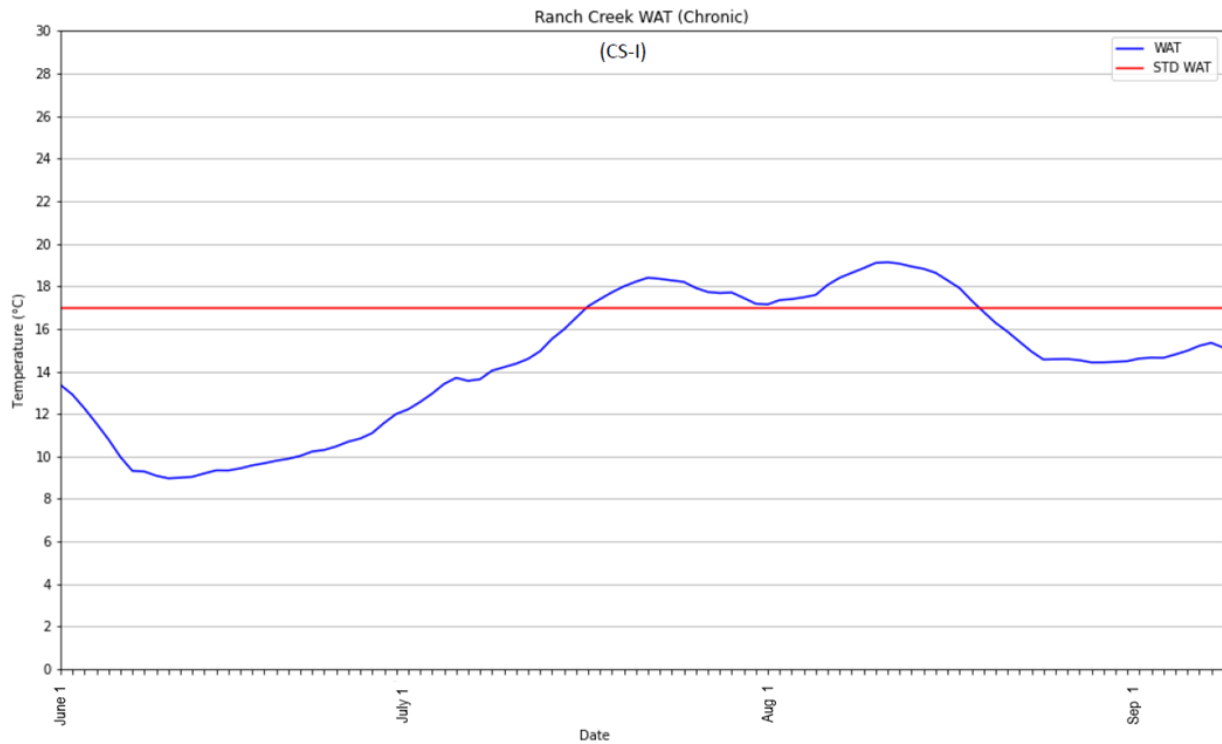


Figure 24: Graph of WAT at Ranch Creek near Fraser, showing exceedances of the Water Quality Control Division Chronic Temperature Standard

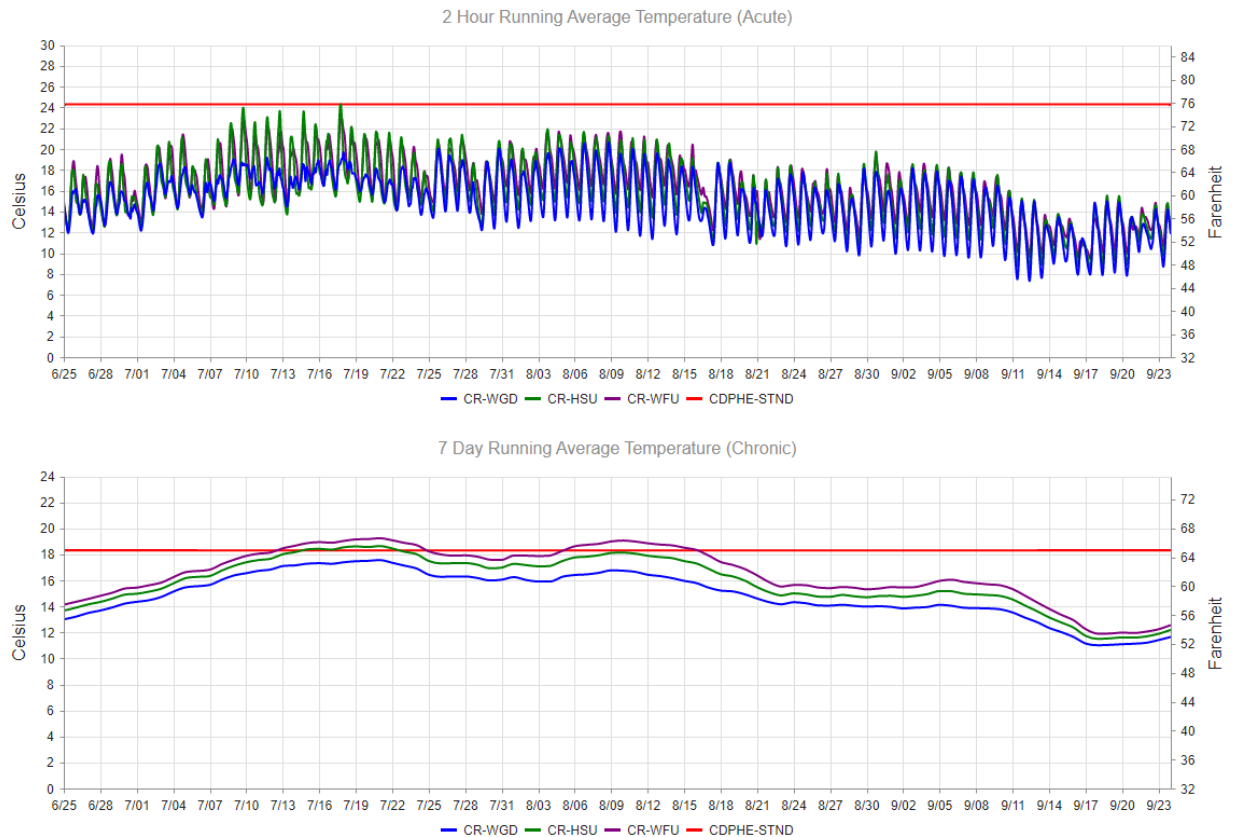


Figure 25: Graphs of MDT (top) and WAT (bottom) at the Colorado River below Windy Gap (CR-WGD), Hot Sulphur Springs (CR-HSU) and at Williams Fork (CR-WFU)

Denver Water Operations

Pursuant to the 2012 Colorado River Cooperative Agreement (CRCA), each year beginning in the year Denver Water’s Moffat Collection System Project (a.k.a. Gross Reservoir Expansion Project or Moffat Project) becomes operational, Denver Water will commit to releasing 1,000 af of water from its Moffat Collection System to streams in Grand County for the purposes of benefiting the aquatic environment.

Although the Moffat Project is not yet operational, in 2015, 2016, 2017, 2021 and 2022, Denver Water worked with Grand County and LBD to coordinate voluntary bypasses (“Voluntary Water”) from its Moffat Collection System to benefit the aquatic environment, targeting Ranch Creek and tributaries. No voluntary water was made available to LBD in 2018, 2019 or 2020 due to planned maintenance bypass operations, which increased bypasses without the need to trigger voluntary water releases. Denver Water’s 2022 LBD in-season operations are summarized in **Attachment D**.

Mainstem Colorado River Calls

The Shoshone Power Plant experienced a maintenance outage from April 4th through April 18th, and an unplanned outage from July 8th through July 20th 2022, which in both cases triggered the Shoshone Outage Protocol (SHOP). In late April the Shoshone Power Plant called for 2 days with its junior right, and came back online to place a call July 21st after the

summer SHOP operations. The Cameo administrative call came on July 30th, and subsequently either the Shoshone or Cameo call was administered in the LBD CEA through October 23rd, 2022, when Xcel took Shoshone offline again for inspection of the dam and intake.

Granby Reservoir Operations

Releases below Granby Reservoir are dictated by the 1961 Operating Principles. Late season water supply flexibility is provided below Granby through the availability of 5,412 af (5412 water) to the Recovery Program. During wet years, 5412 water can be released from Granby Reservoir and exchanged after August 1st into Green Mountain, Williams Fork and/or Wolford Mountain Reservoirs for later release to the 15-mile reach in the Grand Valley to benefit the Endangered Fish. The 5412 releases aid in maintaining a 75 cfs flow at the USGS Granby gage in August and September for the benefit of the cold-water fishery. The release schedule is determined by the US Fish and Wildlife Service, with input from other entities, including Grand County, Northern Water, and LBD.

In 2022, dry conditions dictated a brief mid-July release of 55 cfs from the 5412 water in Granby Reservoir to benefit the 15-mile reach, see **Figure 26**. 5412 releases helped maintain 75 cfs in August tapering through mid-September below Granby Reservoir. Grand County water totaling about 1300 af was released from Granby Reservoir intermittently beginning in mid-August, which benefited the Colorado River down to the Grand Valley, where it was delivered for irrigation purposes. Williams Fork, Wolford Mountain, and Green Mountain Reservoir operations are shown in **Figures 14 through 16**.

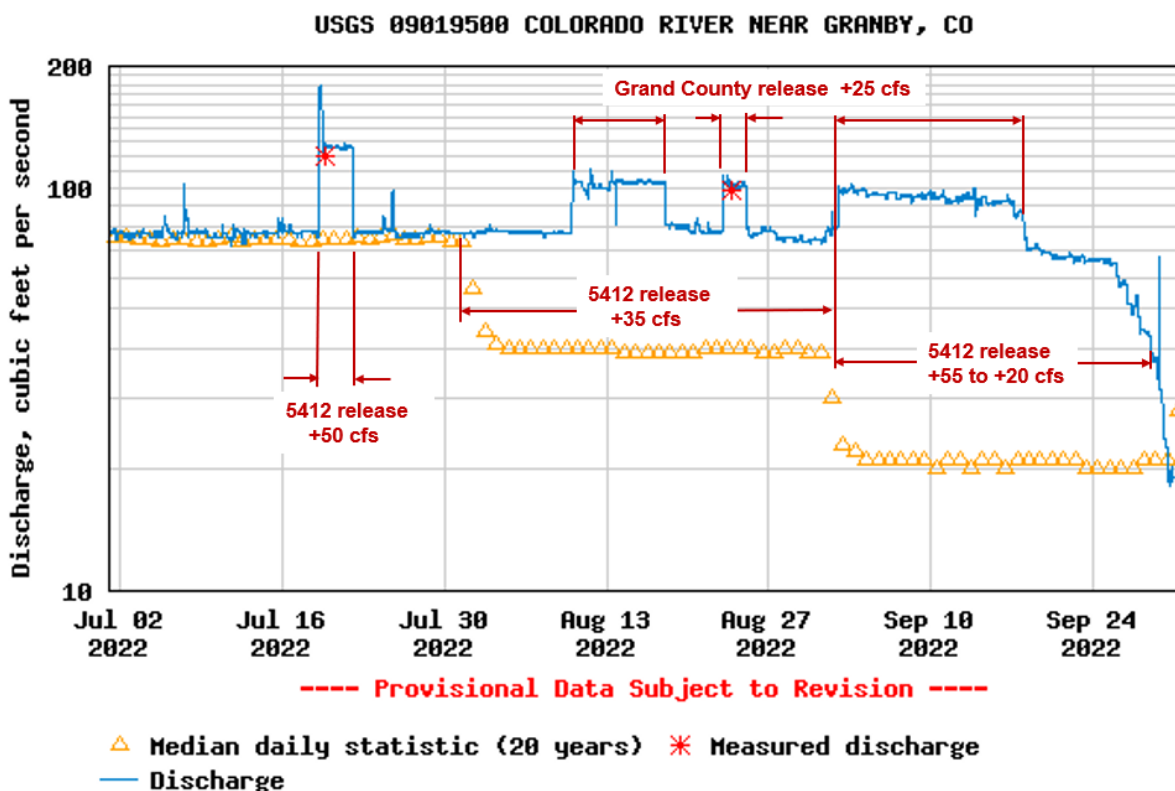


Figure 26: Graph of July through September Colorado River below Granby Reservoir Streamflows

Grand Lake Clarity and Operations in the Three Lakes

The Grand Lake Clarity season extends from July 1 to September 11. At the start of the clarity season, Adams Tunnel diversions were kept low to maintain a positive hydraulic gradient from Grand Lake to Shadow Mountain Reservoir. On July 8, a collective decision was made to resume pumping at the Farr Pump Plant and the associated increase in Adams Tunnel diversions to cool Shadow Mountain Reservoir. This decision was based on a balance of maximizing the settling period in Grand Lake, keeping the flow direction from Grand Lake to Shadow Mountain Reservoir for as long as possible, utilizing skim water on the East Slope for power generation, and avoiding spill at Lake Granby. Unlike previous years, there was not a consistent Farr pumping pattern (**Figure 27**). Pumped flows were generally higher during the week and lower on weekends, but this varied depending on maintenance and operations within the C-BT system and discussions on water temperature in Shadow Mountain Reservoir and Grand Lake.

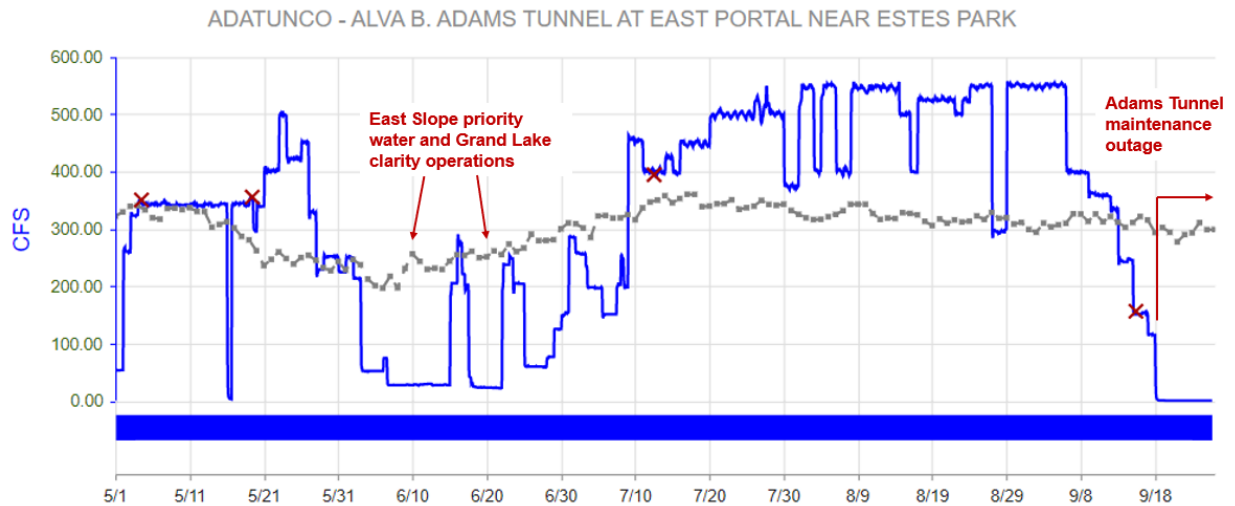
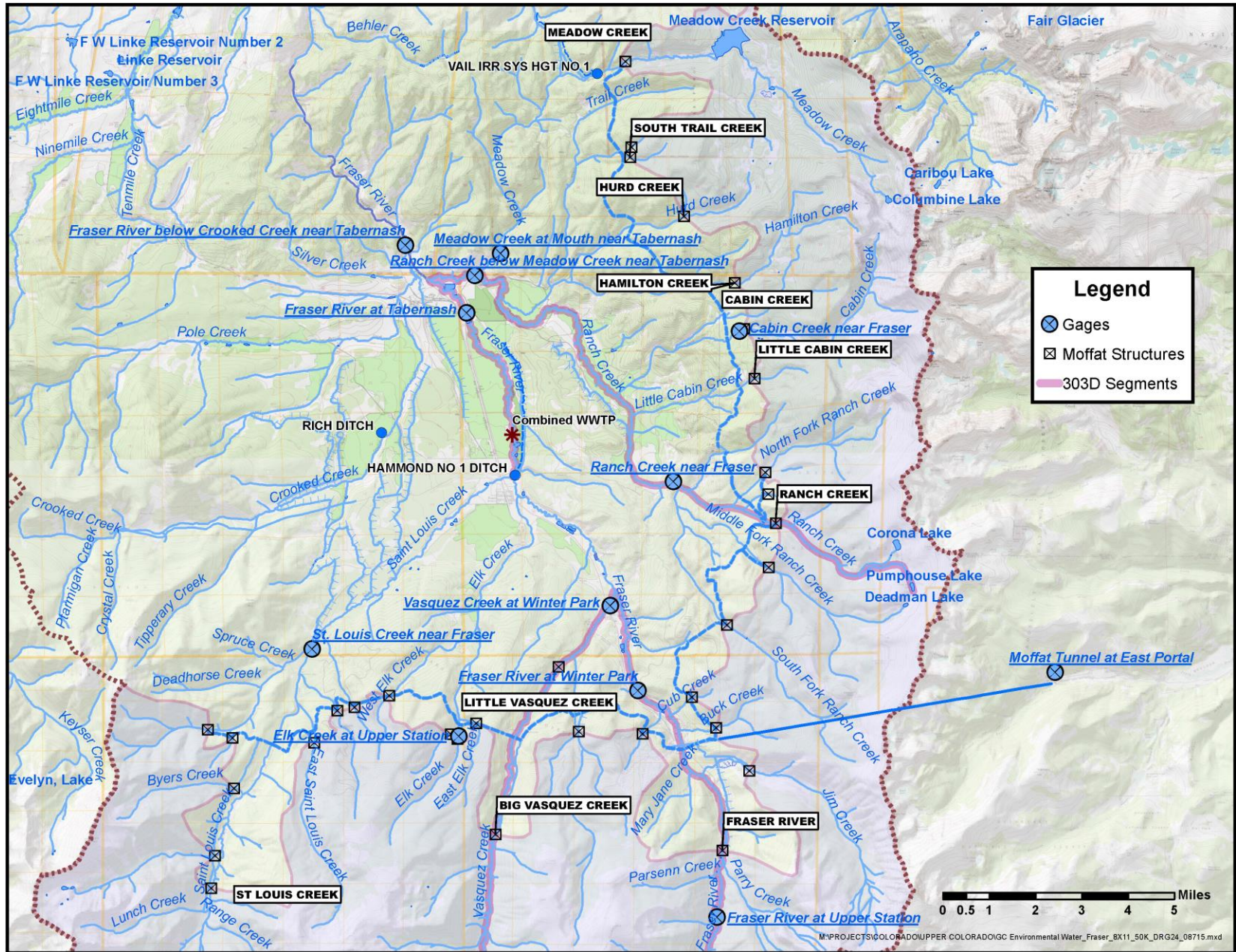
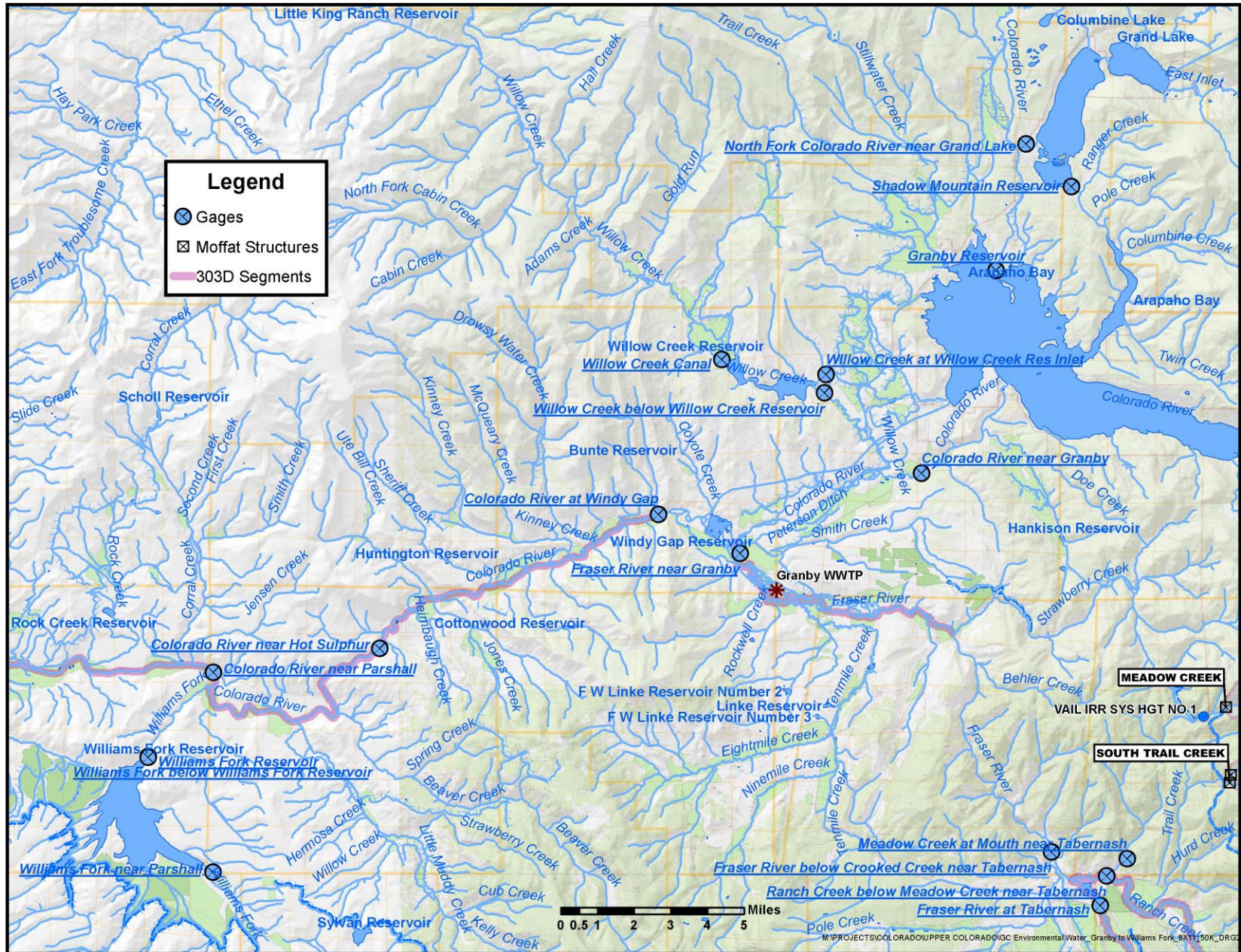


Figure 27: 2022 Adams Tunnel Diversions

Attachment A: Map of Fraser River Collection System



Attachment B: Map of Colorado River from Granby Reservoir to Williams Fork



Attachment C

LBD Water Sources and Quantities Offering Flexibility

1. Moffat Collection System Voluntary/Enhancement Water

- 1,000 af environmental bypass
- Surplus water not needed in a given year by Denver Water

2. Northern/Subdistrict Water

- Grand County's Water Supply
 - Variable Supply - 3.8% of Windy Gap Pumping in excess of 15,000 af, up to 1,500 af, after WGFP Completion
 - MPWCD transfer water – Potential August 1 transfer equal to unused portion of Middle Park's Annual Water Supply (up to 2,300 af) from prior Windy Gap accounting year (only half of the unused water available for transfer prior to completion of Chimney Hollow Reservoir)
 - After WGFP Completion, end of year pumping if Subdistrict pumping is complete, must pay power costs for pumping (DW allocated \$1M pumping fund)
 - Storage capacity:
 - Before Chimney Hollow completion – 7,500 af, if unused capacity available
 - Grand County's Carryover Balance limitation is reduced to 6,000 af after Chimney Hollow completion and until the WGFP water stored reaches 85% of active storage
 - After Chimney Hollow's active storage reaches 85% WGFP water, Grand County's Carryover Balance Limitation is reduced to 4,500 af in Granby Reservoir, if unused capacity available, with ability to share MPWCD's storage if both agree
- MPWCD's Water Supply
 - The first 3,000 af of Windy Gap pumping if Middle Park continues to operate under the 80 and 85 agreements. One year after completion, Middle Park can elect to start operating under the IGA water supplies
 - Variable Supply - 3.8% of Windy Gap Pumping in excess of 15,000 af, up to 1,500 af (estimated long-term average yield of 700 af)

- Carryover storage capacity of 3,000 af in Granby Reservoir, if unused capacity available, after Chimney Hollow completion
- After Chimney Hollow completion, Middle Park may elect to receive 850 af, plus the ratio of Windy Gap water in Chimney Hollow and Granby relative to 32% of the constructed capacity of Chimney Hollow, multiplied by 1,450 acre-ft, not to exceed 1,450 acre-ft

3. Endangered Fish Water

- 5,412.5 af for endangered fish. US Fish and Wildlife Service (FWS) can call for this water. The water may be released from Granby after August 1st during wet years, and exchanged into Green Mountain, Williams Fork and/or Wolford Reservoir, until FWS asks for the release to the 15-mile reach. Releases depend on the type of hydrologic year and the targeted streamflow in the Colorado River in the 15-mile reach. These releases are coordinated with Grand County and other interested parties during the HUP calls, benefiting the stream segment below Granby Reservoir. The typical release schedule aids in maintaining a 75 cfs flow at USGS Granby gage from Aug 1 through mid-September

4. Williams Fork Reservoir Storage

- 1,000 af environmental water (CRCA) stored when 1,000 af environmental water is bypassed during a mainstem Colorado River Call. 2,500 af maximum carryover, first to spill, notification of anticipated spill

ATTACHMENT B

Learning By Doing Operations

2022 Summary of Denver Water's Water Releases to Benefit the Fraser River Basin

April 1st runoff projections were less than optimistic for the Colorado and South Platte River Basins. Snowpack conditions were below normal throughout Denver Water's collection system. South Platte River snowpack was 71% of normal and Colorado River snowpack was 85% of normal. The April 1, 2022, most probable runoff estimate forecast at Kremmling was 84% and the actual runoff was 89% of average. Reservoir storage was 80% full (April 4, 2022), average for April is 79% full. Forecasted peak reservoir storage ranged from 86% full in dry conditions to 96% full in wetter conditions with 92% full being most probable (May 2022). Given the below average runoff and reservoir forecast, Denver Water predicted that many of its reservoirs would have limited extra water for spills¹ (un-diverted flows). Therefore, in May Denver Water projected very limited opportunities for spills on the Moffat Collection System and no water would be available for voluntary pilot projects designed to evaluate the relationship between stream temperature and stream flow as required in Denver Water's 401 certification for the Gross Reservoir Expansion Project.

The drought conditions deteriorated slightly on the Front Range and eastern plains, and the west slope had no change in drought conditions as the year progressed. All watersheds within Denver Water's collection system were in some level of drought, ranging from abnormally dry to moderate drought. The May weather forecast was predicting equal chances for below to average precipitation and above normal temperatures.

Williams Fork Reservoir (63% full vs 85% average) and Dillon Reservoir (77% full vs 97% average) were not projected to fill and a Substitution was anticipated based on the May 2022 operations update. The last time a Substitution occurred was 2021 (see Table 5 below). Denver Water started construction activities at Gross Reservoir in April 2022 which reduced the capacity during construction to about 60% of capacity. While this increases the amount of water not diverted, it reduces Denver Water's system flexibility within the Moffat Collection System. No other construction activities were planned that would impact operations of the Moffat Tunnel Collection System.

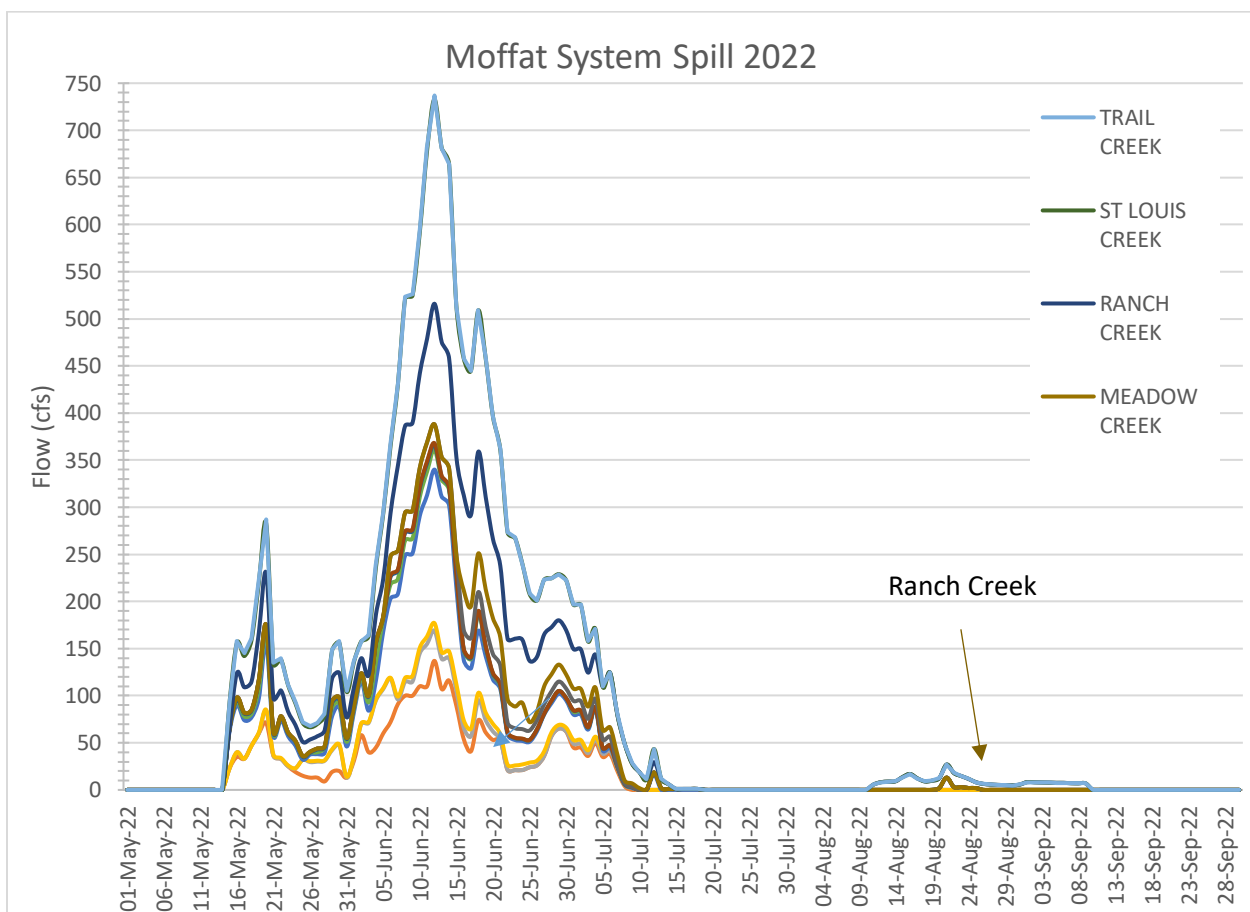
Ironically, the initial Learning By Doing (LBD) Operations calls were delayed due to above average streamflow conditions for most of May. By early June, stream temperatures in the Colorado River at and below Kremmling were observed to be near or above the state's stream temperature standards for aquatic life, stream flows were at historic lows, and ambient temperatures were at all-time highs.

Despite above average streamflow in May, lower-than-average runoff resulted in 2022 being a substitution year. While summer rains brought some relief, Denver Water owed approximately 18,200 acre-feet (AF) and Colorado Springs Utilities owed approximately 2,000 AF to the Green Mountain Reservoir first fill. The substitution amount was finalized in August 2022 and releases Wolford Mountain and Williams Fork reservoirs began on September 6, 2022. Subsequent releases were made from Ruedi, Homestake, and Upper Blue reservoirs. Appendix 4 shows the releases and dates from each of the reservoirs.

¹ Denver Water classifies "un-diverted" water as a "spill". This water is not diverted and allowed to pass downstream of the diversion point. Table 1 of this report list the different types of spills Denver Water experiences during operation of the water collection system.

Following LBD Operations calls in the spring, the first official LBD Operations Subcommittee call of 2022 was held on June 1, 2022 and discussion included expected spring operations and forecasted spills. In addition to the releases made prior to filling Gross and Ralston reservoirs, Denver Water began spilling the Moffat Collection System on May 15 starting with Fraser River, Ranch Creek, Hurd Creek, Hamilton Creek, St. Louis Creek and Vasquez Creek diversions. Cabin Creek and Trial Creek soon followed. Gross and Ralston² reservoirs filled in early June and Denver Water matched water diversions to water demands in its Moffat Collection System. Approximately 29,500 AF was spilled from the Moffat Collection System between May 15 and July 16. As the year transitioned from Spring runoff to Summer flows, precipitation decreased and air temperature increased, and drought conditions began settling in across Colorado. This led to decreased flows throughout the collection system during the summer.

Early projections did not show Williams Fork Reservoir filling in 2022. Outflow was set near the minimum flow of 15 cfs when the call came off the river on April 19, 2022. Better than anticipated inflow had Williams Fork outflow increase in early June as the storage in Williams Fork approached full.



For a second time during, during the summer of 2022, water management entities involved in the LBD Operations Subcommittee were engaged in actions to address stream flows and high-water temperatures in Grand County. LBD partners tracked a rise in water temperature on Ranch Creek, a

² The capacity of Gross Reservoir was limited in 2022 due to the start of the Gross Reservoir Expansion Project.

tributary of the Fraser River near Tabernash. In response, beginning August 11, Denver Water voluntarily bypassed 200 AF of water. The bypass was halted on August 24, 2022, due to cooler and wetter weather and resumed between August 31 and September 10, 2022, at the request of LBD.

When planning for the 2022 runoff and summer operations in early spring, Denver Water anticipated a below average runoff and limits on its operational flexibility due to the start of the Gross Reservoir Expansion Project. Therefore, DW made the decision that no voluntary water releases would be made in 2022.³

Table 1. 2021 Summary of Denver Water’s additional bypass flows for: Spills, Voluntary/Enhancement, and Construction flows.

Dates	Duration	DW Diversion Location	Total Amount of Water Bypassed (AF) ¹
5/15/2022 to 7/14/2022 ²	61 days	Moffat Collection System (i.e., Cabin Creek, Hurd Creek, Hamilton Creek, Ranch Creek, St. Louis Creek, Vasquez Creek, and the Fraser River)	29,500
8/11/2022 to 8/24/2022, 8/31/2022 to 9/10/2022 ²	27 days	Ranch Creek	199
TOTAL			29,699

1 – Does not include USFS-required bypass flows at Denver Water’s diversions

2 – In cooperation with LBD, impacted by Gross Reservoir Expansion project operations.

³ Denver Water bypasses or spills water for the following reasons: 1. Lack of storage and water demand on the East Slope; 2. The Moffat Collection System (piping) is at capacity; 3. Maintenance projects; 4. Voluntary releases for environmental benefit; and 5. Downstream water rights, fish flows, or delivery obligations (CRCA).

Table 2 shows Voluntary/Environmental bypasses, Construction bypasses, and Spill bypasses from 2015 to 2022. Compared to other years, 2021 voluntary/environmental and construction bypass flows were the highest while total spills were the lowest since 2015.

Table 2. Summary of additional bypass flows from 2015 through 2022.

Year	Voluntary/Environmental	Construction	Spill
2015	500	---	41,000
2016	119	1,279	64,000
2017	613	1,050	39,000
2018	---	950	17,000
2019	---	100	42,000
2020	---	1,939	21,000
2021	768	7,104	11,000
2022	199	---	23,500 ¹

1 – This includes the 13,457 AF Denver Water did not divert due to construction activities associated with the Gross Reservoir Expansion Project.

FLUSHING FLOWS

The Grand County Mitigation and Enhancement Coordination Plan (MECP), U.S. Forest Service (USFS) Off-license Agreement, and Section 404 Permit for the Moffat Project (a.k.a., Gross Reservoir Expansion Project) all have flushing flow requirements. In 2021, these flows were met or exceeded at Fraser River, Vasquez Creek, St. Louis Creek, Ranch Creek, Steelman Creek, Bobtail Creek and McQueary Creek (see table “Attachment 1 – 2021 Flushing Flow Monitoring Report”). In 2021, flushing flows were not achieved at Cabin Creek although priority was given for it. A comparison to past years’ data collected since 2018 is shown in the table “Cumulative Flushing Flow Monitoring Report” in Attachment 2.

In 2023 Denver Water will use system flexibility to target a flushing flow on Cabin Creek. Secondly, the upper Williams Fork will be targeted.

FRASER SEDIMENT POND

Denver Water, Colorado Department of Transportation (CDOT), and Grand County entered into a participation agreement to remove accumulated sediment from the Fraser River Diversion structure in 2011 (DW Contract 500441). Table 3 shows sediment removal at this location for each year since 2013, which was the first year of sediment removal activities. Reduced sediment removal was expected in subsequent years following 2013 as a large amount of sediment had built up at the inlet to the diversion pond prior to sediment removal. Additionally, the year-to-year amount of sediment removed will vary based on hydrology conditions and the amount of traction sand applied each winter.

Table 3. Truck Loads and Amount of Sediment (Tons) removed each year from the Fraser River Diversion.

Year	Truck Loads	Sediment Removed (Tons)
2013	68	680
2014	69	690
2015	55	550
2016	37	370
2017	32	320
2018	29	290
2019	33	330
2020	18	180
2021	18	180
2022	9	90
Total	332	3,500

2021 DENVER WATER DIVERSIONS

In the future, bypass (un-diverted) water will be available every year for LBD to use. The graph and table shown in Attachments 3(a) and (b) depict Denver Water diversions based on gaged flows in the Moffat Collection System for 2021. Flows in 2022 will be provided in next year’s summary. However, this historic information can be useful to LBD in order to plan where additional bypass water may be available as it shows where in the Moffat Collection System that Denver Water diverted water for a given year. A summary of 2021 Denver Water diversions is shown in Table 4. For detailed information, refer to Attachments 3(a) and (b). As described in the 2021 LBD report, Denver Water shut the Moffat Tunnel off in late August and September for construction activities.

Table 4. Moffat Collection System 2021 Diversions (based on canal gages).

Location	Total Volume Diverted 7/1/2021-9/30/2021 (AF)	July Average Daily Diversion Rate (cfs)	August Average Daily Diversion Rate (cfs)	September Average Daily Diversion Rate (cfs)
Jones Pass to Vasquez Creek	0	0	0	0
Vasquez Diversion	2,400	24	15	0
St. Louis Creek to Elk Creek Diversion	2,080	26	8	0
Little Vasquez and Cooper Creek Diversions	916	9	5	0
Meadow Creek Direct Diversion	0	0	0	0
Meadow Creek Storage Release	746	0	12	0
Trail Creek to Little Cabin Creek Diversion	589	5	4	0
North Ranch to Buck Creek Diversion	1,280	15	6	0
Fraser River and Jim Creek Diversions	2,732	29	15	0

2022 GREEN MOUNTAIN SUBSTITUTION

Prior to 2022, there were five substitution years (2002, 2003, 2012, 2013, and 2021) with 2021 being the second largest amount of water at almost 40,000 AF (Table 5). The timing and location of water releases made for the substitution can benefit streams in Grand County. In 2022 10,000 AF was released from Williams Fork Reservoir (September 6 to October 14), and 6,219 AF from Wolford Mountain Reservoir (September 6 to October 3). Attachment 4 shows the release dates and amount of water each reservoir contributed to the 2022 substitution.

Table 5. Total Substitution (Denver Water and Colorado Springs Utilities) amounts by Year.

Year	Amount (AF)
2002	31,747
2003	30,320
2012	39,786
2013	8,487
2021	37,818
2022	18,228

Attachment 1 – 2021 Flushing Flow Monitoring Report

**Fraser and Upper Williams Fork River Basins
ANNUAL FLUSHING FLOW MONITORING – 2022**

Report Date: November 1, 2022

Year Type: **DRY**

Waterbody	Measuring Location	Flushing Flow Mean Daily Discharge (cfs)	Dates Flow was at or above Flushing Flow Target	Flushing Flow (mean daily flow) Achieved for a Minimum of 72 Hours?
Fraser River Basin				
Fraser River at Winter Park	USGS 0902400	80	6/15-6/18	YES
Vasquez Creek at DW Diversion	broad-crested weir on diversion	50	6/2/-6/30	YES
Ranch Creek near Fraser	USGS 09032000	40	5/18-5/21, 6/4-6/27	YES
Cabin Creek near Fraser	USGS 09032100	40	6/4-6/6	YES
St. Louis Creek near Fraser	USGS 09026500	70	6/4-6/23	YES
Williams Fork River Basin				
Steelman Creek	Williams Fork below Steelman Creek – USGS 09035500	At least 35 cfs	6/10-6/13 (above 140 cfs all diversion spilling)	YES
Bobtail Creek		At least 80 cfs	6/10-6/13 (above 140 cfs all diversion spilling)	YES
McQueary Creek		At least 25 cfs	6/10-6/13 (above 140 cfs all diversion spilling)	YES

Attachment 2 – Cumulative Flushing Flow Monitoring Report

Fraser and Upper Williams Fork River Basins

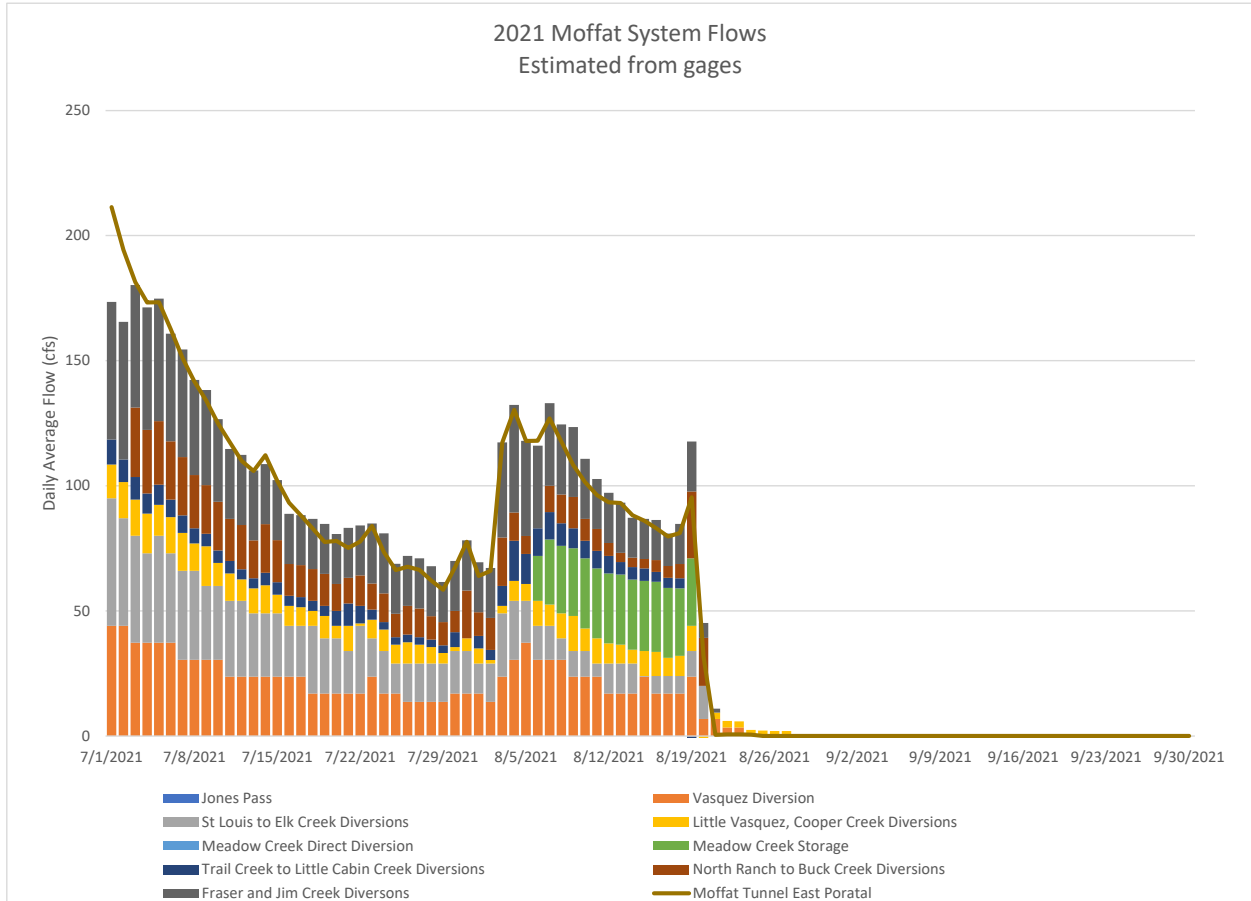
FLUSHING FLOW MONITORING (2018-2022)

Cumulative Reporting (Target: 4 out of 10 years)

Waterbody	Flushing Flow Mean Daily Discharge (cfs)	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Summary
		Flushing Flow Achieved?											
Year Type		Dry	Wet	Norm	Dry	Dry							
Fraser River Basin													
Fraser River at Winter Park	80	YES	YES	YES	YES	YES							5 of 5 years
Vasquez Creek at DW Diversion	50	YES	YES	YES	YES	YES							5 of 5 years
Ranch Creek near Fraser	40	YES	YES	YES	YES	YES							5 of 5 years
Cabin Creek near Fraser	40	NO	YES	NO	NO	YES							2 of 5 years
St. Louis Creek near Fraser	70	YES	YES	YES	YES	YES							5 of 5 years
Williams Fork River Basin													
Steelman Creek	At least 35	YES	YES	NO	YES	YES							4 of 5 years
Bobtail Creek	At least 80	YES	YES	NO	YES	YES							4 of 5 years
McQueary Creek	At least 25	YES	YES	NO	YES	YES							4 of 5 years

Attachment 3(a) – Daily Denver Water Diversions from several locations in the Moffat Collection System (July 1, 2021 to September 30, 2021)

2021Moffat Collection System Estimated Diverted Flows



Attachment 3(b) – Daily Denver Water Diversions from several locations in the Moffat Collection System (July 1, 2021 to September 30, 2021) Note – some of these values are calculated based upon diversion at other locations.

Date	Jones Pass	Vasquez Creek	St. Louis Creek to Elk Creek	Little Vasquez, Cooper Creeks	Meadow Creek Direct	Meadow Creek Storage Release	Trail Creek to Little Cabin Creek	North Ranch to Buck Creek	Fraser River and Jim Creek	East Portal Moffat Tunnel
7/1/2021	0	44	51	14	0	0	10	0	55	174
7/2/2021	0	44	43	15	0	0	9	0	55	166
7/3/2021	0	37	43	15	0	0	9	28	49	180
7/4/2021	0	37	36	16	0	0	8	25	49	171
7/5/2021	0	37	43	12	0	0	8	25	49	175
7/6/2021	0	37	36	15	0	0	7	23	43	161
7/7/2021	0	30	36	15	0	0	7	23	43	155
7/8/2021	0	30	36	11	0	0	6	21	38	142
7/9/2021	0	30	30	16	0	0	5	19	38	138
7/10/2021	0	30	30	9	0	0	5	19	33	127
7/11/2021	0	24	30	11	0	0	5	17	28	115
7/12/2021	0	24	30	9	0	0	4	18	28	112
7/13/2021	0	24	25	10	0	0	4	15	28	106
7/14/2021	0	24	25	11	0	0	5	19	24	109
7/15/2021	0	24	25	8	0	0	5	17	24	102
7/16/2021	0	24	20	8	0	0	4	13	20	89
7/17/2021	0	24	20	8	0	0	4	13	20	88
7/18/2021	0	17	27	6	0	0	4	13	20	87
7/19/2021	0	17	22	9	0	0	4	13	20	85
7/20/2021	0	17	22	5	0	0	6	11	20	81
7/21/2021	0	17	17	10	0	0	9	10	20	83
7/22/2021	0	17	27	1	0	0	7	12	20	84
7/23/2021	0	24	15	8	0	0	4	10	24	85
7/24/2021	0	17	17	9	0	0	3	11	24	81
7/25/2021	0	17	12	8	0	0	3	9	20	69
7/26/2021	0	14	15	9	0	0	3	11	20	72
7/27/2021	0	14	15	8	0	0	3	11	20	71
7/28/2021	0	14	15	7	0	0	3	9	20	68
7/29/2021	0	14	15	4	0	0	3	9	16	62
7/30/2021	0	17	17	2	0	0	6	8	20	70
7/31/2021	0	17	17	5	0	0	0	19	20	78

Attachment 3(b) – Daily Denver Water Diversions from several locations in the Moffat Collection System (July 1, 2021 to September 30, 2021) Note – some of these values are calculated based upon diversion at other locations.

Date	Jones Pass	Vasquez Creek	St. Louis Creek to Elk Creek	Little Vasquez, Cooper Creeks	Meadow Creek Direct	Meadow Creek Storage Release	Trail Creek to Little Cabin Creek	North Ranch to Buck Creek	Fraser River and Jim Creek	East Portal Moffat Tunnel
8/1/2021	0	17	12	6	0	0	5	9	20	69
8/2/2021	0	14	15	1	0	0	4	13	20	67
8/3/2021	0	24	25	3	0	0	8	19	38	117
8/4/2021	0	30	24	8	0	0	16	11	43	132
8/5/2021	0	37	17	7	0	0	12	7	38	118
8/6/2021	0	30	14	10	0	18	11	0	33	116
8/7/2021	0	30	14	9	0	26	11	10	33	133
8/8/2021	0	30	9	10	0	27	9	11	28	124
8/9/2021	0	24	10	14	0	27	8	12	28	123
8/10/2021	0	24	10	9	0	28	7	9	24	111
8/11/2021	0	24	5	10	0	28	7	9	20	103
8/12/2021	0	17	12	8	0	28	7	5	20	97
8/13/2021	0	17	12	8	0	28	5	4	20	93
8/14/2021	0	17	12	6	0	28	5	4	16	87
8/15/2021	0	24	0	10	0	28	5	4	16	87
8/16/2021	0	17	7	10	0	28	4	5	16	86
8/17/2021	0	17	7	7	0	28	4	5	13	81
8/18/2021	0	17	7	8	0	27	4	6	16	85
8/19/2021	0	24	10	10	0	27	2	27	20	119
8/20/2021	0	7	13	5	0	0	0	19	6	50
8/21/2021	0	7	0	3	0	0	0	0	2	11
8/22/2021	0	3	0	3	0	0	0	0	0	6
8/23/2021	0	3	0	2	0	0	0	0	0	6
8/24/2021	0	0	0	2	0	0	0	0	0	2
8/25/2021	0	0	0	2	0	0	0	0	0	2
8/26/2021	0	0	0	2	0	0	0	0	0	2
8/27/2021	0	0	0	2	0	0	0	0	0	2
8/28/2021	0	0	0	0	0	0	0	0	0	0
8/29/2021	0	0	0	0	0	0	0	0	0	0
8/30/2021	0	0	0	0	0	0	0	0	0	0
8/31/2021	0	0	0	0	0	0	0	0	0	0
9/1/2021	0	0	0	0	0	0	0	0	0	0
9/2/2021	0	0	0	0	0	0	0	0	0	0
9/3/2021	0	0	0	0	0	0	0	0	0	0
9/4/2021	0	0	0	0	0	0	0	0	0	0
9/5/2021	0	0	0	0	0	0	0	0	0	0
9/6/2021	0	0	0	0	0	0	0	0	0	0

Attachment 3(b) – Daily Denver Water Diversions from several locations in the Moffat Collection System (July 1, 2021 to September 30, 2021) Note – some of these values are calculated based upon diversion at other locations.

Date	Jones Pass	Vasquez Creek	St. Louis Creek to Elk Creek	Little Vasquez, Cooper Creeks	Meadow Creek Direct	Meadow Creek Storage Release	Trail Creek to Little Cabin Creek	North Ranch to Buck Creek	Fraser River and Jim Creek	East Portal Moffat Tunnel
9/7/2021	0	0	0	0	0	0	0	0	0	0
9/8/2021	0	0	0	0	0	0	0	0	0	0
9/9/2021	0	0	0	0	0	0	0	0	0	0
9/10/2021	0	0	0	0	0	0	0	0	0	0
9/11/2021	0	0	0	0	0	0	0	0	0	0
9/12/2021	0	0	0	0	0	0	0	0	0	0
9/13/2021	0	0	0	0	0	0	0	0	0	0
9/14/2021	0	0	0	0	0	0	0	0	0	0
9/15/2021	0	0	0	0	0	0	0	0	0	0
9/16/2021	0	0	0	0	0	0	0	0	0	0
9/17/2021	0	0	0	0	0	0	0	0	0	0
9/18/2021	0	0	0	0	0	0	0	0	0	0
9/19/2021	0	0	0	0	0	0	0	0	0	0
9/20/2021	0	0	0	0	0	0	0	0	0	0
9/21/2021	0	0	0	0	0	0	0	0	0	0
9/22/2021	0	0	0	0	0	0	0	0	0	0
9/23/2021	0	0	0	0	0	0	0	0	0	0
9/24/2021	0	0	0	0	0	0	0	0	0	0
9/25/2021	0	0	0	0	0	0	0	0	0	0
9/26/2021	0	0	0	0	0	0	0	0	0	0
9/27/2021	0	0	0	0	0	0	0	0	0	0
9/28/2021	0	0	0	0	0	0	0	0	0	0
9/29/2021	0	0	0	0	0	0	0	0	0	0
9/30/2021	0	0	0	0	0	0	0	0	0	0

Attachment 4 – Summary of 2022 Substitution Releases.

Water Source	Release Dates	Total Amount (AF)
Wolford Mountain Reservoir	9/6-10/3/2022	6,219
Williams Fork Reservoir	9/6-10/14/2022	10,000
Homestake Reservoir	---	0
Upper Blue Reservoir	10/12-11/19/2022	1,934
Dillon Reservoir	11/4/2022-3/31/2022	1,000
Total		19,153
Ruedi Reservoir	9/8-10/3, 10/11-10/17/2022	1,579

1 – Amount owed, Denver Water 18,228 AF and Colorado Springs Utilities 2,041 AF.

2 – Amount released, Denver Water 17,219 AF plus 1,009 from Ruedi Reservoir and Colorado Springs Utilities 1,934 AF plus 82 AF from Ruedi Reservoir.

3 – Denver Water exchanged from Williams Fork Reservoir on Upper Blue Releases.