City of Boulder
Utilities

January 24, 2023

Rob Viehl, Section Chief
Stream and Lake Protection Section
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, CO 80203

Dear Rob:

The City of Boulder is providing this annual report to the Colorado Water Conservation Board (CWCB), pursuant to paragraph 14 of the July 20, 1990 Agreement between the CWCB and Boulder regarding instream flows on Boulder Creek. This report addresses the period of November 1, 2022 to October 31, 2023, and summarizes Boulder Creek conditions, water rights used to support instream flows, measurement and administration issues. The program is administered over three segments, summarized below.

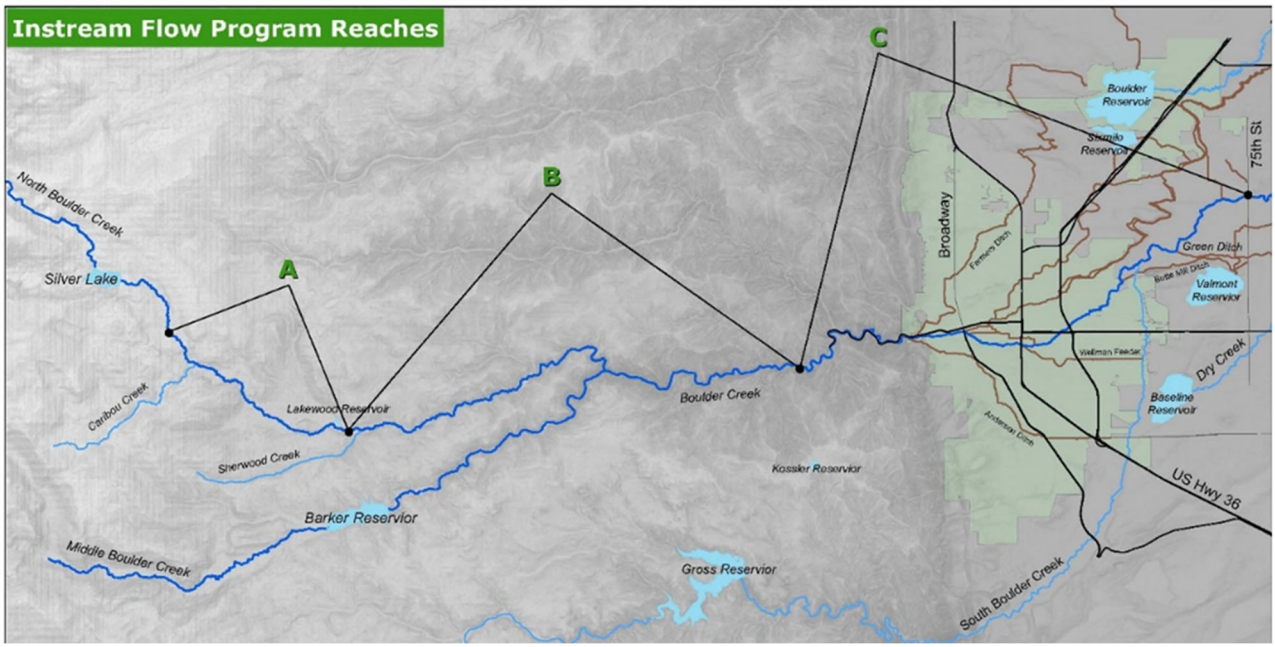


Figure 1. Instream Flow Program Segments A-C. Segment A encompasses North Boulder Creek from the Silver Lake Pipeline intake to the Lakewood diversion. Segment B covers North Boulder Creek at the Lakewood diversion to Boulder Creek at the Orodell gage. Segment C is the reach of Boulder Creek from the Orodell gage to 75th Street.

Streamflow conditions and program summary

Snow water equivalent (SWE) throughout the winter season was generally at or above the median, with snowmelt occurring on time compared to historical trends (Figure 2). Creek flows started increasing from snowmelt in late April, with runoff conditions picking up in May. On average, annual flows at the Nederland gage on Boulder Creek (BOCMIDCO) were slightly lower than average (93%), however the flows were distributed differently throughout the year. During winter and prior to runoff, flows were around or just below average. Once snowmelt started, combined with higher-than-average precipitation in early summer, May flows were higher than average (113%). With fewer precipitation events in late summer and early fall, flows dropped below average for the rest of the year. Peak flow during runoff occurred June 7, 2023 with a flow rate of 361 cubic feet per second (cfs) (near average) at the Middle Boulder Creek at Nederland gage (BOCMIDCO) (Figure 3).

Instream flow rights, either from reservoir releases or bypass rights, were used throughout the winter season. Prior to mid-December and after early April, when water was actively being diverted from the creek, the instream flow rights maintained minimum flows in Boulder Creek, around 1.5 cfs. During the winter months, Boulder Creek flows were slightly higher, around 10 cfs, since there were no active diversions from the creek.

During the irrigation season, diversions from the creek were not as high as usual because the soil was already moist from the early summer rains and much of the early season irrigation demand was met by that precipitation. As a result, instream flow conveyed rights were not needed until mid-August for two days, then consistently from early September through the end of the irrigation season as late season precipitation and conditions dried out.

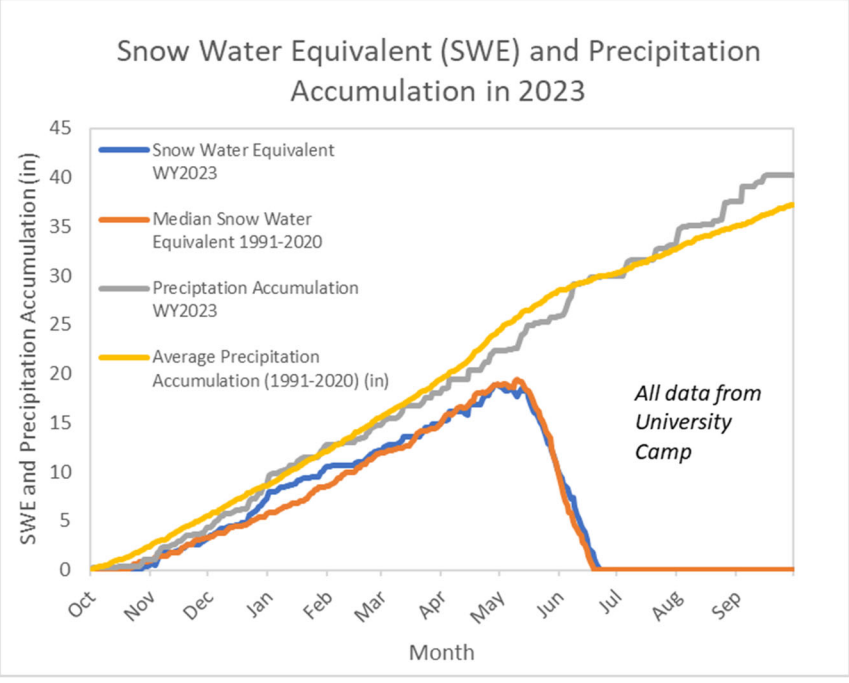


Figure 2. Snow Water Equivalent (SWE) and precipitation accumulation for Water Year 2023 compared with historical averages, University Camp SNOTEL.

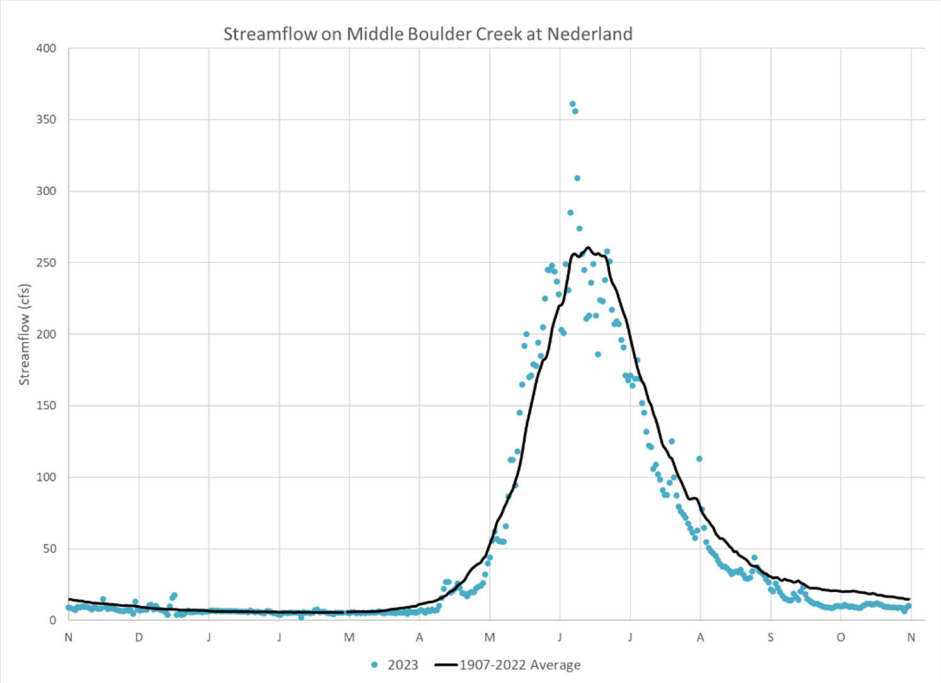


Figure 3. Streamflows on Middle Boulder Creek at Nederland (BOCMIDCO), Water Year 2023 compared with average.

Instream flows attributable to the CWCB/Boulder donation agreements and the 90CW193 decree are shown in Figures 4 through 6, and can be described as follows:

- In North Boulder Creek from Silver Lake Pipeline Inlet to the Lakewood Pipeline Inlet (Segment A) in periods from November through April, and in October.
- In North Boulder Creek from the Lakewood Pipeline Inlet to Orodell (Segment B) in periods from November through April, and in October.
- In Boulder Creek between Orodell and 75th street (Segment C) in periods from November through April, and from August through October.

The total use of the water rights subject to the Agreements and the 90CW193 decree between the CWCB and Boulder for instream flow and municipal purposes is summarized in Table 1.

Releases from Silver Lake Reservoir

Under the Boulder/CWCB donation agreements and pursuant to the 90CW193 decree, from October 1 through April 30, Boulder may release water assigned to the CWCB from Silver Lake Reservoir to maintain up to 0.5 cfs in Segment A and up to 1.5 cfs in Segment B. At its discretion, Boulder may also release water from Silver Lake Reservoir during this period to maintain up to 15 cfs in Segment C.

In Water Year 2023, Boulder used releases from Silver Lake Reservoir to maintain 0.5 cfs in Segment A, up to 1.5 cfs in Segment B, and to support flows in Segment C from November 14 – December 15, April 4 – April 12, and October 16 – October 31.

1904 Boulder City Pipeline Water Right Bypassed Water

Under the Boulder/CWCB donation agreements and pursuant to the 90CW193 decree, from November 1 through April 30, Boulder may bypass water assigned to the CWCB and available to the 1904 Boulder City Pipeline water right to maintain up to 1.5 cfs in Segment B. Such bypassed water may also be used during this period to maintain up to 15 cfs in Segment C.

In Water Year 2023, Boulder bypassed water available to the 1904 Boulder City Pipeline water right when it was in priority to supplement flows in Segments B and C, bypassing 1.5 cfs from December 16 – April 3, and April 13 – April 30.

Releases from Barker Reservoir

Under the Boulder/CWCB donation agreements and pursuant to the 90CW193 decree, Boulder may release water assigned to the CWCB from Barker Reservoir to maintain up to 15 cfs in Segment C. Boulder did not make use of such releases in Water Year 2023.

Conveyed Rights

Under the Boulder/CWCB donation agreements and pursuant to the 90CW193 decree, from May 1 through September 30 (and through October 15 for Smith & Goss), water available to the Anderson, Harden, McCarty and Smith & Goss Ditch conveyed rights may be bypassed to maintain up to 0.5 cfs in Segment A, up to 1.5 cfs in Segment B and up to 15 cfs in Segment C. Water available to the Farmers Ditch conveyed rights may be bypassed from May 1 through September 30 to maintain up to 15 cfs in Segment C. The conveyed rights were used to supplement flows in Segment C, discussed in the next section, but were not needed in Segments A or B because other flows available to the CWCB 1994 instream flow rights were generally sufficient to maintain at least 0.5 cfs and 1.5 cfs, respectively, in Segments A and B during the conveyed rights season.

Segment C Flow Summary

The flows through Segment C varied throughout the year based on creek conditions, call conditions, and protectable instream flow rights available. Boulder protected 1.5 cfs throughout the winter, as shown in Figure 6. Throughout the winter months of November through April, flows through Segment C varied depending on when others were actively diverting from Boulder Creek. From mid-November to mid-December and early April to end of April when there were active diversions from the creek, Boulder Creek flows were around 1.5 – 2 cfs, maintained primarily by the protected instream flow rights including Silver Lake Reservoir releases and/or Boulder City Pipeline bypass. Once there were no active diversions from the creek, i.e. Boulder & White Rock Ditch Company had finished filling their reservoirs, flows were generally around 10 cfs from mid-December to early April. Segment C flows started increasing significantly from runoff at the end of April and remained high during the early summer months due to numerous precipitation events. Boulder Creek in Segment C peaked on June 8 at approximately 617 cfs at the Broadway gage (BOCBROCO), one day after the peak at the Nederland gage on Boulder Creek (BOCMIDCO). The instream flow conveyed rights were used as available and as needed for municipal purposes under the decree until mid-August, when they were used to protect and maintain creek flows for two days; they were used for instream flow again more consistently from early September through the end of the season as available based on priority.

Status of Downstream Leasing Program

Reusable instream flow water was not leased in Water Year 2023.

Water Rights Accounting

City staff maintains daily water rights accounting and tracking of streamflow conditions. Daily accounting forms for Water Year 2023 are available upon request.

Water Rights Administration

District 6 transitioned to a new Water Commissioner in 2022, with several staff and organizational changes since then. Throughout the year, city staff coordinated as needed with the Water Commissioners involved in District 6 (Tributary Operations Coordinator and Lead Water Commissioner) regarding instream flow sources and amounts to ensure flows were protected throughout Segments A, B, and C.

Division of Water Resources (DWR) staff continue to administer instream flow based on daily average flow, rather than instantaneous flow. This current administrative practice sometimes yields flows within a 24-hour period that are below the protected amount, even though the daily average may equal or exceed the protected amount.

City and DWR staff have discussed which gages in Segment C are most useful for administration of the instream flow right, and will continue these conversations, with consultation with the CWCB as needed.

The city also continues to support the Boulder & White Rock Ditch Company regarding their automated headgate installed in 2022. The ditch company is working with a contractor on further upgrades that would enable automatic adjustments to the headgate based on flows at the BOCBROCO gage. The city will continue to coordinate with other entities as needed to manage the instream flow program.

Status of Measuring Devices

North Boulder Creek at the Silver Lake Diversion Structure (Segment A)

Segment A flows can be measured one of two ways depending on whether or not ice conditions exist at the measurement structures. Flows are either measured as 1) flows through the constant head orifice plus flows over the adjacent weir (winter months) or 2) flows at the eight-foot Parshall flume upstream of the Silver Lake diversion structure minus the flow diverted into the Silver Lake Pipeline (warmer months). In water year 2023, the first method was used from November through mid-May, and the second method was used mid-May through October. Staff has generally found good agreement between the two methods. Staff will continue to refine measurement in Segment A in the coming years and will continue to verify measurements with operational adjustment records and regular operator checks.

North Boulder Creek at the Lakewood Inlet (Segment B)

Similarly, Segment B measurement approaches vary depending on ice conditions in the creek. Segment B flows from mid-May through late October are based on readings of twin 5’ Parshall flumes just above the Lakewood diversion structure minus Lakewood diversion structure flows. Prior to mid-May and again in late October when the flumes were iced over, flows were based on operator reports and an estimation methodology that uses measured flows at the top of Segment A, modeled gains through

Segment A, and Lakewood diversion structure flows. This estimation methodology correlates well with Parshall flume measurements and operator reports, particularly at the low end.

Boulder Creek at Orodell (Segment B-C transition)

The State continues to operate this gage and is performing appropriate maintenance to ensure the instrument's accuracy. The State made numerous flow measurements at this site, including in the winter months when this site can be ice affected.

Boulder Creek (Segment C)

Because of the number of irrigation ditch diversions in Segment C, flows in that reach are measured at five separate gages and the minimum flow of those gages is used for administration. Some sites are equipped with real-time instrumentation and others are monitored using staff gages. Updates and current status of specific gages are detailed below, moving from upstream to downstream.

Boulder Creek below Anderson Ditch (Segment C) Flow at this site is measured with staff gage readings. City staff did not take any streamflow measurements during Water Year 2023, but periodically read the staff gage. During a site visit on October 19, city staff discovered that the staff gage initially installed in 2014 had been washed away, presumably during sustained high flows earlier in the season. Historically, the minimum flow through Segment C rarely occurs at this site. City staff is working on replacing this staff gage as needed.

Boulder Creek below Broadway Diversion Dam (Segment C) In 2022, DWR installed new instrumentation at this site, and has since maintained the rating curve. In the fall of 2023, some repairs were needed as a result of vandalism. City and DWR staff worked in coordination on this repair, which required digging a new trench for the cables, rewiring and burying the cables, and calibrating the instrument. This station was fully operational again in late October 2023. Flow data is available on the state's website under the station name Boulder Creek below Broadway Street (BOCBROCO).

Boulder Creek below Wellman Canal (Segment C) DWR installed and will continue to maintain new instrumentation at this site which started reporting flows in real-time in April 2023. Flow data for this site is available on the state's website under the station name Boulder Creek below Wellman Ditch (BOCWLMCO).

Boulder Creek below Butte Mill Ditch (Segment C) Flow at this site is measured with staff gage readings. City staff did not take any streamflow measurements during Water Year 2023, however did take several staff gage readings. Historically, the rating curve at this site has been relatively stable.

Boulder Creek below Green Ditch (Segment C) Flow at this site is measured with a pressure transducer (maintained by an outside contractor) and staff gage readings. City staff took seven streamflow measurements during Water Year 2023 and adjusted the rating curve based on observations and measurements. This site has historically been subject to shifts due to debris accumulation and sediment transport, requiring active maintenance of the transducer and rating curve. During August 2023, the instrumentation stopped reporting. After coordinating with the outside contractor, it was assumed that the malfunction was due to lightning and instrumentation would need to be repaired or replaced. Boulder and DWR have had discussions regarding the relevance of real-time measurement at this

specific site, compared to alternative methods. DWR has suggested that streamflow at this site could be calculated based on other existing and future measurement structures, including BOCWLMCO, Green Ditch diversions, and a proposed new South Boulder Creek flow measurement site. Further internal and external discussion is required to determine the best path forward for monitoring flows at this site.

Please contact me with any questions about how the water available under the Agreement between the CWCB and the city was used to maintain instream flow in North Boulder and Boulder Creeks.

Sincerely,

Isabelle Lheritier
Source Water Administrator
City of Boulder

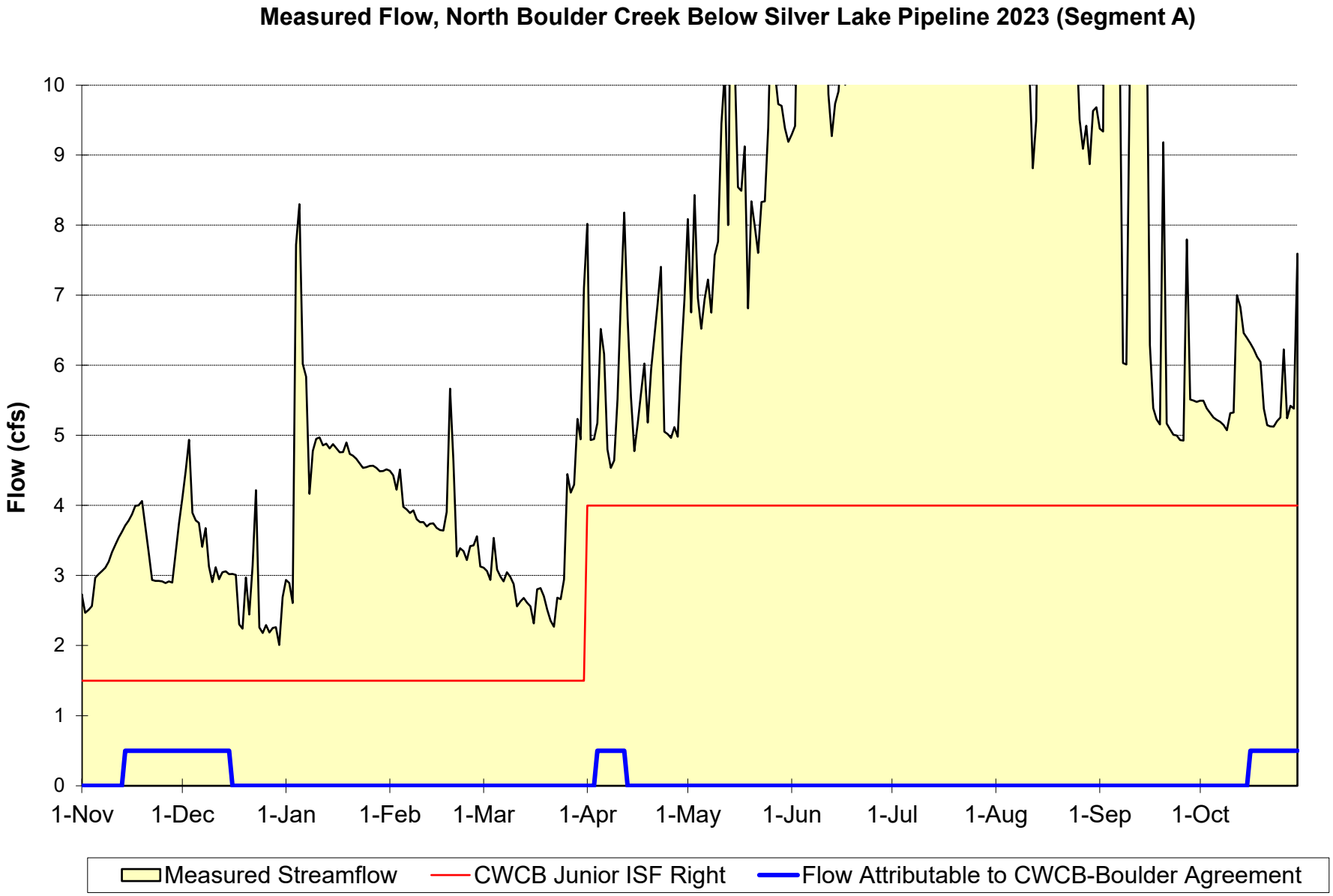
cc: Jason Smith, Will Horan, Michael Hein, Eric Johnson, Darroll Meddaugh, Kim Hutton, Laila Parker, Emily McMurtrey, Lee Rozaklis, Michelle Johnson, Cristy Radabaugh

Attachments:
Table 1
Figures 4, 5, 6

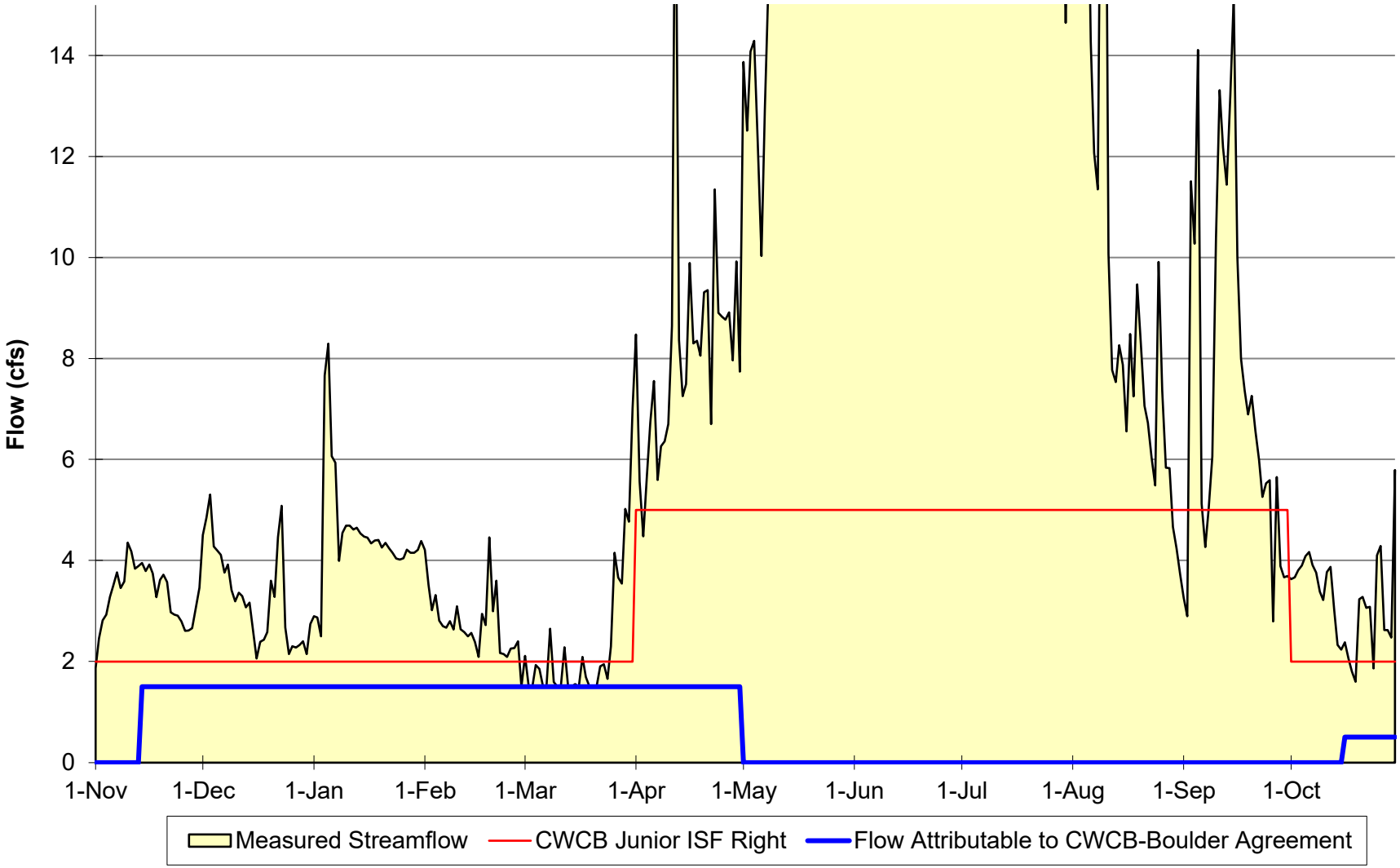
Table 1
Summary of Use of Water Rights Subject to Boulder/CWCB Instream Flow Agreement
Water Year 2023
(All values reported in acre-feet)

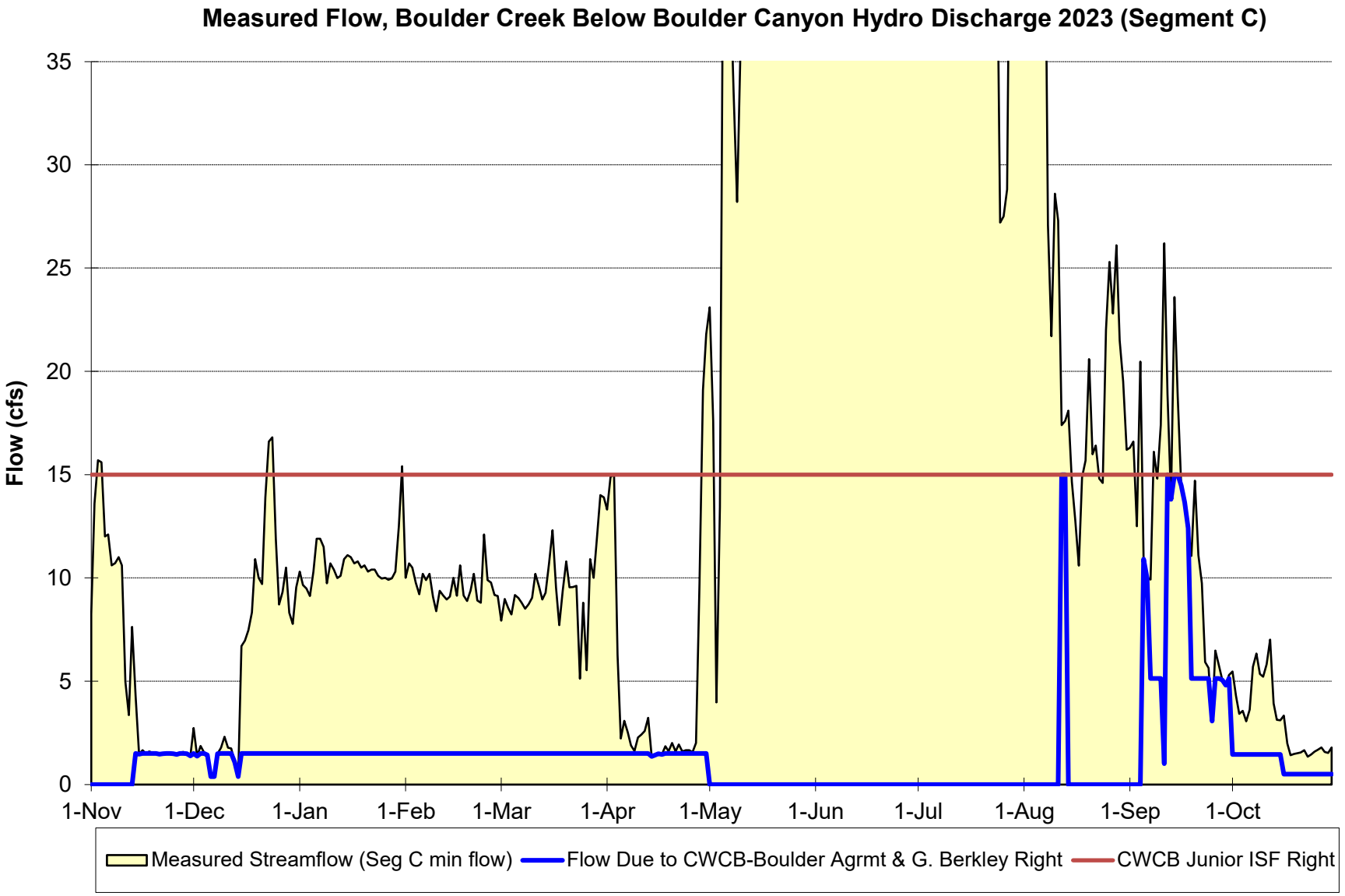
	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL
Silver Lake ISF Releases	50.6	44.6	0.0	0.0	0.0	26.8	0.0	0.0	0.0	0.0	0.0	15.9	137.9
Barker ISF Releases	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Conveyed Rights													
Anderson Ditch													
Municipal	-	-	-	-	-	-	19.1	-	55.7	58.4	4.9	-	138.1
ISF	-	-	-	-	-	-	-	-	-	-	61.0	-	61.0
Harden Ditch													
Municipal	-	-	-	-	-	-	32.1	-	46.4	54.7	7.1	-	140.3
ISF	-	-	-	-	-	-	-	-	-	2.9	89.3	-	92.2
McCarty Ditch													
Municipal	-	-	-	-	-	-	-	-	16.6	23.9	2.6	-	43.1
ISF	-	-	-	-	-	-	-	-	-	2.6	31.9	-	34.4
Smith Goss Ditch													
Municipal	-	-	-	-	-	-	8.1	-	11.6	17.0	1.8	-	38.5
ISF	-	-	-	-	-	-	-	-	-	1.8	22.4	13.4	37.6
Farmers Ditch													
Municipal	-	-	-	-	-	-	55.7	234.9	265.9	68.9	-	-	625.3
ISF	-	-	-	-	-	-	-	-	-	48.3	168.9	-	217.1
Boulder City Pipeline													
Municipal	-	10.0	11.3	78.6	99.1	-	-	-	-	-	15.8	130.9	345.8
ISF	-	47.6	92.2	83.3	92.2	62.5	-	-	-	-	-	-	377.9
Totals													
Municipal	-	10.0	11.3	78.6	99.1	-	115.0	234.9	396.2	222.9	32.2	130.9	1331.2
ISF	50.6	92.2	92.2	83.3	92.2	89.3	-	-	-	55.5	373.4	29.3	958.0
Leasable Flows													
Total Eligible ISF	-	47.6	92.2	83.3	92.2	62.5	-	-	-	55.5	373.4	13.4	820.2
Percent Leasable	0%	0%	0%	0%	0%	21%	39%	48%	53%	48%	34%	17%	
Leasable Amount	-	-	-	-	-	13.1	-	-	-	26.7	126.9	2.3	169.0
Amount Leased	-	-	-	-	-	-	-	-	-	-	-	-	0.0

Notes: All values are in acre-feet
Total eligible ISF equals Total ISF minus Silver Lake ISF releases.
Leasable Amount is equal to the minimum of Total Eligible ISF times Percent Leasable and the actual flow below Broadway.


Measured Flow, North Boulder Creek Below Silver Lake Pipeline 2023 (Segment A)
Flow (cfs)
10
9
8
7
6
5
4
3
2
1
0
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
Measured Streamflow
CWCB Junior ISF Right
Flow Attributable to CWCB-Boulder Agreement

Estimated and Measured Flow, North Boulder Creek Below Lakewood Inlet 2023 (Segment B)




Measured Flow, Boulder Creek Below Boulder Canyon Hydro Discharge 2023 (Segment C)
Flow (cfs)
35
30
25
20
15
10
5
0
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
1-Oct
Measured Streamflow (Seg C min flow)
Flow Due to CWCB-Boulder Agrmt & G. Berkley Right
CWCB Junior ISF Right