2020 Upper Clark Fork River Basin Surface Water Monitoring Report

NRDP Contract 90022-TO 2.1

Prepared by the Clark Fork Coalition

Abstract

The purpose of this task order is to seasonally monitor water temperature and streamflow conditions on the upper Clark Fork River and tributaries where existing data is lacking. Flow measurements also occurred to monitor in-stream flow projects, and assist with monitoring related to remediation and restoration projects.

These flow studies assist in implementing projects identified in the Natural Resource Damage Program's *Final Upper Clark Fork River Basin Aquatic and Terrestrial Restoration Plans* (Restoration Plans), updated and approved February 2019. Group 1 Projects that may supply instream flows to the area of the Clark Fork River between Galen and Deer Lodge are the highest priority. Second in priority are Group 2 projects that supply flow to Priority 1 tributaries and third in priority are Group 3 projects that supply flow to Priority 2 tributaries. In the 2019 revision to the Restoration Plan it was determined that all projects in Group 1, Group 2, and Group 3 will be investigated at the same time.

The overarching goal of the project is to better understand summer streamflow and water temperature conditions in the Upper Clark Fork River Basin. The stretch of the mainstem of the Clark Fork River between Galen and Deer Lodge and tributaries that feed it face chronic dewatering issues and typically experience the lowest flows during periods of peak demand in late July and early August. The data collected for this task order is integral to the understanding of surface water and groundwater dynamics in the most dewatered portion of the upper Clark Fork Basin.

Introduction

In accordance NRDP Contract 90022-TO 2.1, for the 2020 field season the Clark Fork Coalition (CFC) managed 14 flow and temperature monitoring sites described in Table 1. These target streams have been monitored by the CFC for multiple seasons and provide valuable data on severely dewatered systems. The purpose of the monitoring is to provide information that quantifies the impacts of low flows and high water temperatures on aquatic ecosystems in the upper Clark Fork Basin.

Upper Clark Fork River Basin Monitoring Sites	
Stream	**Site**
Mill Creek	School and Dziak Spring (temp only)
Lost Creek	Below Beckstead Ditch
Cottonwood Creek	Above Applegate Upper Diversion (Sherm's Corral Bridge)
	Cottonwood Creek in Deer Lodge
Dry Cottonwood Creek	Below East Side Road
Clark Fork River	Galen Road
	Below West Side Ditch
	Above Valiton ditch
	Sager Lane
Racetrack Creek	Outflow from Reservoir
	Above all Diversions (USFS)
	Below Cement Ditch
	Edge Bridge

Table 1- Locations of primary monitoring sites managed by the CFC in the upper Clark Fork Basin.

The individual monitoring sites are identified in the map (Figure 14). At each CFC monitoring site, a continuous data logger (HOBO) recorded both stream stage and water temperature data at 30 minute or 60 minute intervals. The primary purpose of these data collection efforts was to quantify the magnitude and timing of water conditions on the upper Clark Fork River and priority tributaries. Water temperature data was also collected to determine if water temperatures exceeded threshold levels considered sustainable for salmonids.

In addition to the continuously monitored sites described above, the CFC also recorded data at other potential project locations in the upper Clark Fork Basin (Table 13).

1. Spot flow measurements of discharge on the Alvi Beck ditch located on Dry Cottonwood Creek Ranch. A staff gage was installed at this location on the outlet of the fish screen.
2. Spot flow measurements occurred on the Valiton Ditch near the headgate and below the last pump to continue quantifying irrigation use at that site.
3. Spot measurements occurred on Cottonwood Creek at 3 locations in order to monitor the Applegate instream flow project.
4. A flow measurement was taken in the underground tile or spring network that drains to Mill Creek on the Dziak property to assess future flow and habitat restoration opportunities.

This report provides a narrative of streamflow and water temperature conditions observed at each of monitoring sites funded by the NRDP, as well additional pertinent locations funded by the CBWTP. The monitoring sites are summarized in Tables 1 above and are displayed in the map in Figure 14.

Methods

At each of the continuously monitored locations, streamflow and water temperature was manually measured every 2-4 weeks between June and September by CFC staff. These measurements were used to develop a rating curve for the continuous hydrographs. Individual flow measurements were tabulated using a Hach or Ott digital flow meter following standards established by the USGS (http://pubs.usgs.gov/wsp/ wsp2175/). To assure data reliability, the flow meters were calibrated monthly throughout the field season (and more frequently if needed). In accordance with the USGS measurement protocols, no individual velocity measurements in a stream cross section represented more than 10% of the total observed flow.

River stage and water temperature data was collected using data loggers that remotely recorded data at 30 or 60 minute intervals. Hobo data loggers were used at all sites during the 2020 field season.

River stage data from the HOBOs loggers was correlated to flow by developing a stage-discharge rating curve for each site. The rating curves were produced by plotting the flow measurement data against the river stage data and calculating a power function from the plotted data. Using the equation from the rating curves, river stage data was extrapolated to develop a continuous hydrograph for each site. Although the locations of monitoring sites typically remain the same from season to season, small changes to a stream's cross sectional geometry (caused by natural morphological processes) may significantly impact the accuracy of previous years rating curves. Because of this, new rating curves were generated at all of the sites for the 2020 data.

The hydrographs and thermographs contained in appendix A were constructed from the extrapolated flow data and water temperature recordings from the data loggers. Streamflow data represents daily averages; maximum daily water temperature represents the highest individual daily reading. Meteorological data was retrieved from the National Climatic Data Center (https://www.ncdc.noaa.gov/climate-information) and Montana Climate Office (https://climate.umt.edu/).

Results

Streamflow and water temperature graphs for the 2020 monitoring season are provided in Figures 2-12.

After 2019's abundant water supply conditions, the upper Clark Fork Basin experienced slightly above normal snowpack during the 2020 water year that was followed by above average precipitation in June that contributed to high flows that persisted throughout most of the summer and fall. March 31st peak snowpack measured at 108% of average according to the NRCS SNOTEL report, and high baseflow conditions that carried over from 2019's plentiful water year, the upper Clark Fork River maintained above average flows throughout the 2020 runoff season.

Analysis & Conclusions

Clark Fork River
Figures 2 & 3

The Clark Fork River experienced above normal discharge in 2020, with the lowest flow occurring at the Racetrack Bridge site below West Side Ditch of 97.1 cfs on August 6th and 68.3 cfs at the USGS Perkins Lane Gage on September 6th. For comparison, in 2016 flows dropped to 2.6 cfs at the location below West Side Ditch on August 4th. Above normal snowpack contributed to these unusually high streamflows in 2020, in addition to above average precipitation through mid-July. Due to high streamflows and dangerous wading/monitoring conditions, we were not able to safely deploy most of our monitoring equipment until August 4, 2020 in the mainstem Clark Fork River. Irrigation influence on the hydrograph of the mainstem sites became apparent by August 10th and persisted until September 19th.

Water temperatures tracked fairly consistently across the monitoring locations although there were significant differences in the magnitude of temperatures recorded (Figure 3). Temperatures at all locations peaked in early to mid-August when thermal inputs were at a maximum. The maximum water temperature for 2020 was 21.9 degrees Celsius on August 9th below Sager Lane. Water temperatures generally decreased after August 10th following a number of precipitation events, shorter days and cooler nights.

Racetrack Creek
Figures 4 & 5

During the 2020 field season, Racetrack Creek followed a flow pattern that was similar to other area streams. After a typical snowmelt driven runoff, natural flows on Racetrack Creek began a recession toward irrigation influenced baseflow levels in mid to late July. Unlike the mainstem Clark Fork River that maintained relatively stable flows throughout the summer, Racetrack Creek was completely dewatered above the Edge Bridge by July 23rd (much later than usual), while flows at the USFS gage (above all diversions) remained above 100 cfs. With the addition of our telemetry site at the outflow of Racetrack Lake, we were able to more accurately track flow releases that occurred between August 8th and September 1st. A noticeable 3 cfs increase in flow occurred starting August 9th below the Cement Ditch site, the day after the release from Racetrack Lake was initiated. Flows persisted below the Cement Ditch until September 1st, which coincides when storage water from Racetrack Lake was exhausted. Flows below the Cement Ditch generally remained depressed or at baseflow levels through late September when fall precipitation augmented flows on Racetrack Creek.

Cottonwood Creek
Figures 6, 7 & Table 13

Flows were monitored in Cottonwood Creek at five locations for the purposes of ensuring instream flow from the Applegate flow enhancement project were maintained. An instream flow rate of 4.76 cfs was

maintained from May 16th to July 14th and 1.7 cfs from July 15th to September 15th. Flows in Cottonwood Creek remained in compliance with the DNRC Change of Use Authorization, with steady flow at both sites above 4.76 cfs until July 14th and flows greater than 1.7 cfs from July 15th-Sept. 15th, aside from 3 days at the end of July where flows dipped down to 0.4 cfs above the Applegate upper diversion. Spot measurements were also taken above and below the Applegate upper diversion after July 15th to ensure compliance. Flows remained elevated through June up until mid-July in lower Cottonwood Creek and remained low but stable through the summer.

Dry Cottonwood Creek
Figures 8 & 9

This site is situated on the CFC's Dry Cottonwood Creek Ranch (DCCR) just below East Side Road in Dry Cottonwood Creek, downstream of the last diversion. Flows in Dry Cottonwood Creek were strong in 2020 and extended much longer than usual (until August 16th). This was partially due to the DCCR's careful use of Dry Cottowood Creek irrigation water for flood irrigation, which ceased on July 1st. CFC is currently in the process of trying to convert 4.3 cfs of irrigation rights to instream flow in Dry Cottonwood Creek. On August 17th, the day after the creek stopped flowing, CFC staff observed 85 fish (mostly brown trout) stranded in the last remaining pool below East Side road where the flow gage was located.

Lost Creek (below Beckstead Ditch)
Figures 10 & 11

Flow measurements below the Beckstead ditch on lower Lost Creek were conducted to ensure compliance with the Lampert Ranch split-season lease, which requires that 1.93 cfs be left instream from July 1st- August 31st of each year. Flows in excess of 20 cfs were recorded at this location for the entire summer, with one small dip down to 19.9 cfs on July 30th, before steadily increasing through the remainder of the summer and fall.

Valiton Ditch at Headgate and Below Last Broken Circle Pump
Table 13

This is the third year of monitoring by the CFC on Valiton Ditch, which withdraws water from the Clark Fork River above Sager Lane and below Racetrack. Three spot measurements were conducted below the headgate in July, August and September and ranged from 1.4 to 4.6 cfs. In 2018, diverted flow ranged from 6-11 cfs at the headgate. A spot measurement of 0.58 cfs was taken past the last Clark Fork River Ranch pump station on July 29, 2020. A culvert replacement near the headgate coupled with deep mud and thick aquatic vegetation made for challenging measurement conditions. The purpose of this effort was to better understand the magnitude of irrigation use at this location and assist with future planning and design for diversion improvements at this location.

Mill Creek at Beaverdam School and Dziak Spring Temperature Monitoring
Figure 12 & Table 13

Hobo temperature loggers were deployed in Mill Creek near the Beaverdam School and in the underground spring that is used to irrigate the Dziak property. The purpose of this effort was to compare water temperature differences between these two sources and evaluate the potential flow and habitat restoration opportunities that might be possible with this spring if a connection could be established with the creek. Flows from the Dziak spring were between 10-11 degrees Celsius, while temperatures were much higher in the creek until about mid-September. This suggest there could be some thermal benefits to connecting this spring to the creek if there is enough flow to make a noticeable difference and if other water quality parameters are similar. There are currently some flow problems with this Dziak spring associated with a clogged underground pipe that impeded any discharge measurements from being conducted. A spot measurement was taken on another underground drain tile on the Dziak property that yielded a total discharge of 0.2 cfs.

Alvi Beck Ditch
Table 13

This ditch is operated by the Dry Cottonwood Ranch and the monitoring location was just down the ditch from the pump site, which withdraws a maximum of 1.8 cfs. The majority of the remaining ditch water is used for flood irrigation, although there is one pivot further down the ditch on a neighboring property (Jacobson) that is an active user. Three spot measurements were collected downstream of the pump station for the pump station for the purpose of characterizing diverted flows and calibrating a staff gage that was installed on the back of the fish screen.

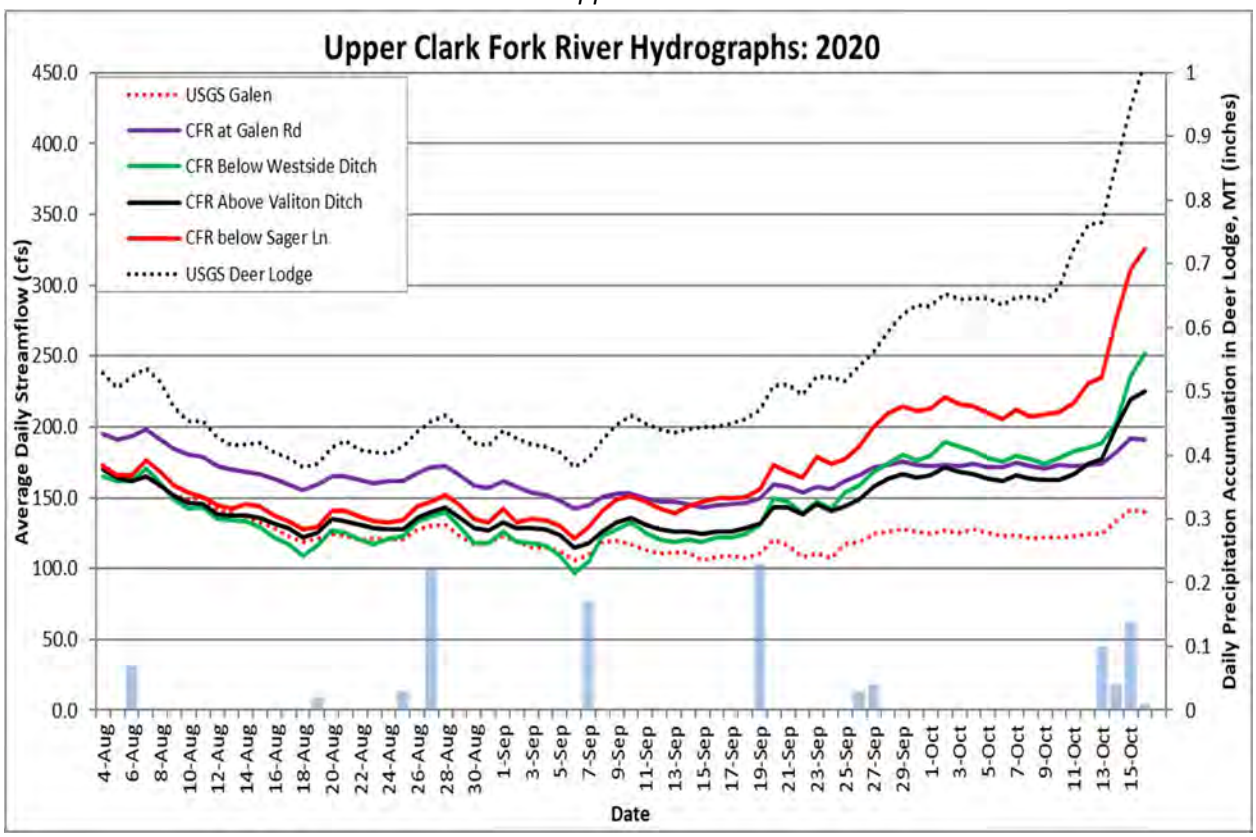

Figure 2- Upper Clark Fork average daily hydrographs for the 2020 irrigation season.

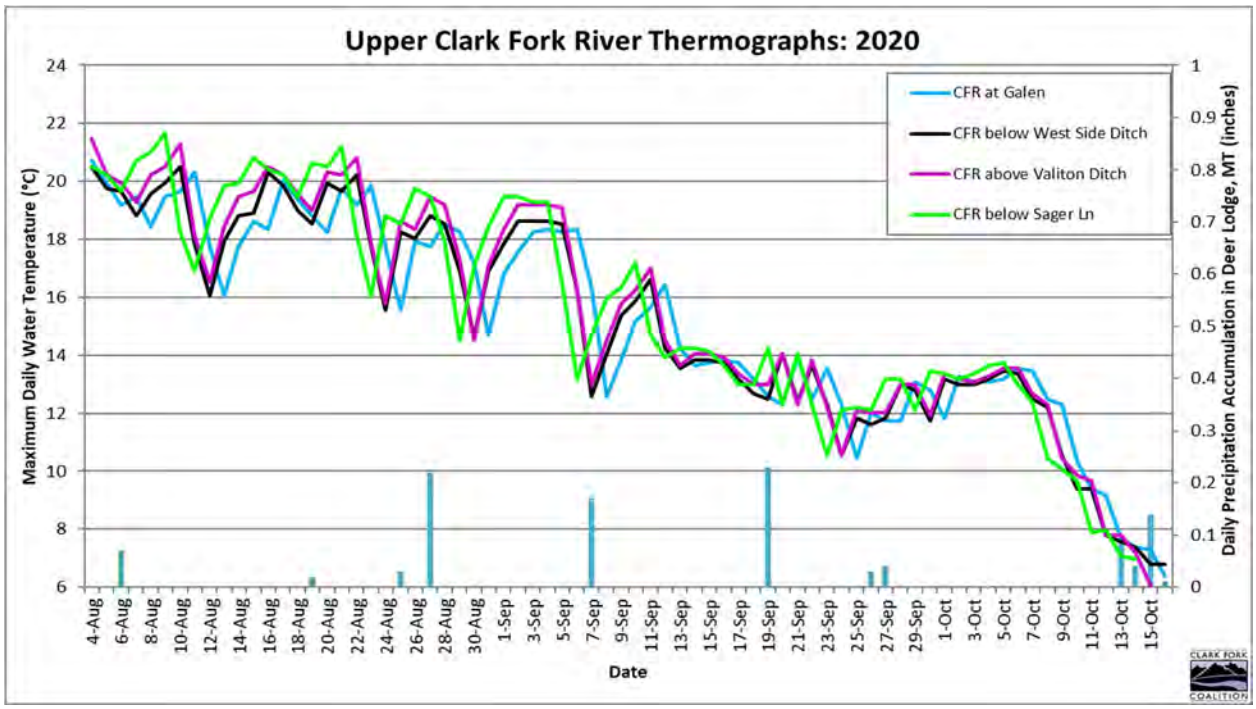

Figure 3- Upper Clark Fork maximum daily thermographs for the 2020 irrigation season.

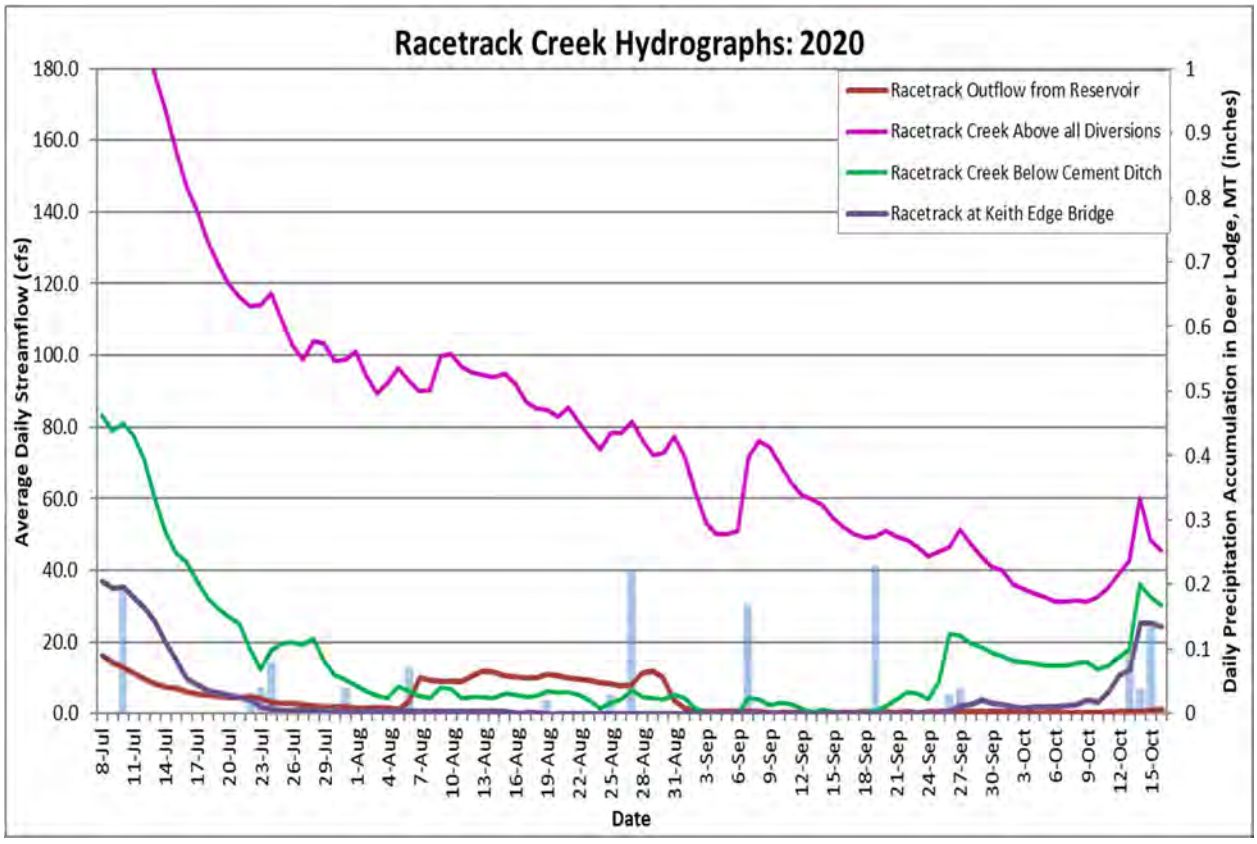

Figure 4- Racetrack Creek average daily hydrographs for the 2020 irrigation season.

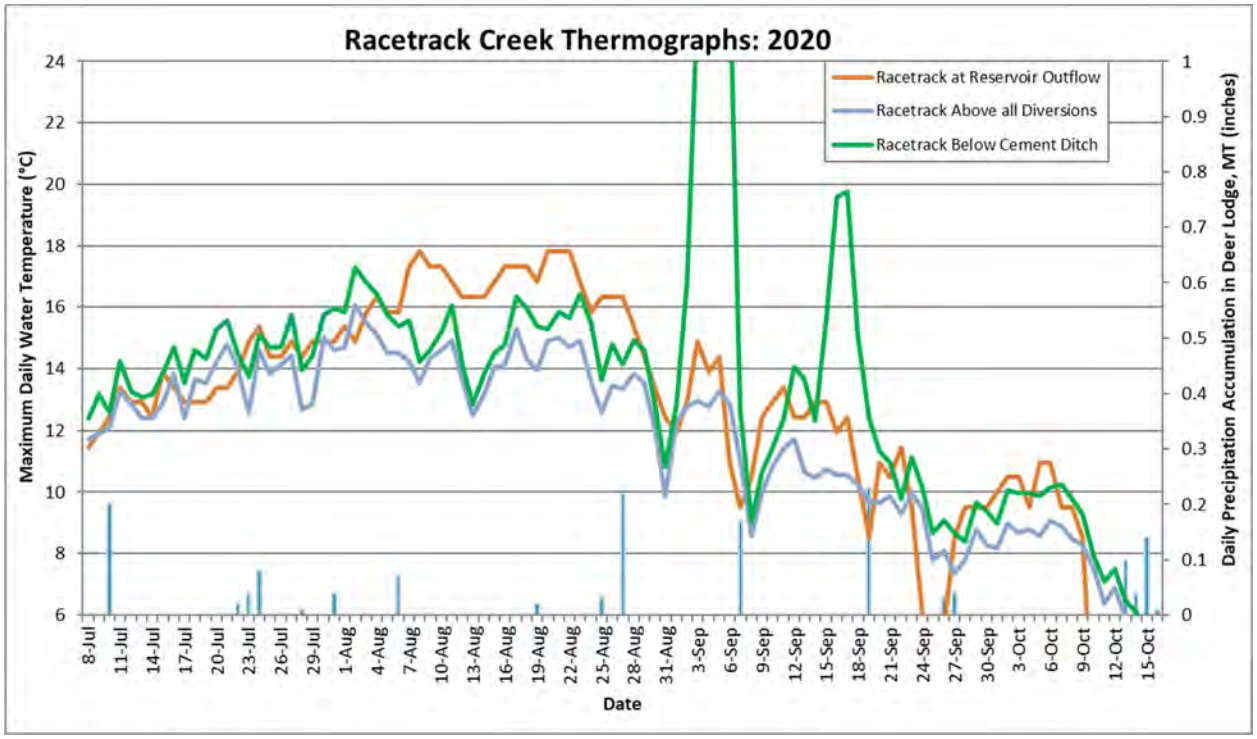

Figure 5- Racetrack Creek average maximum daily thermographs for the 2020 irrigation season.

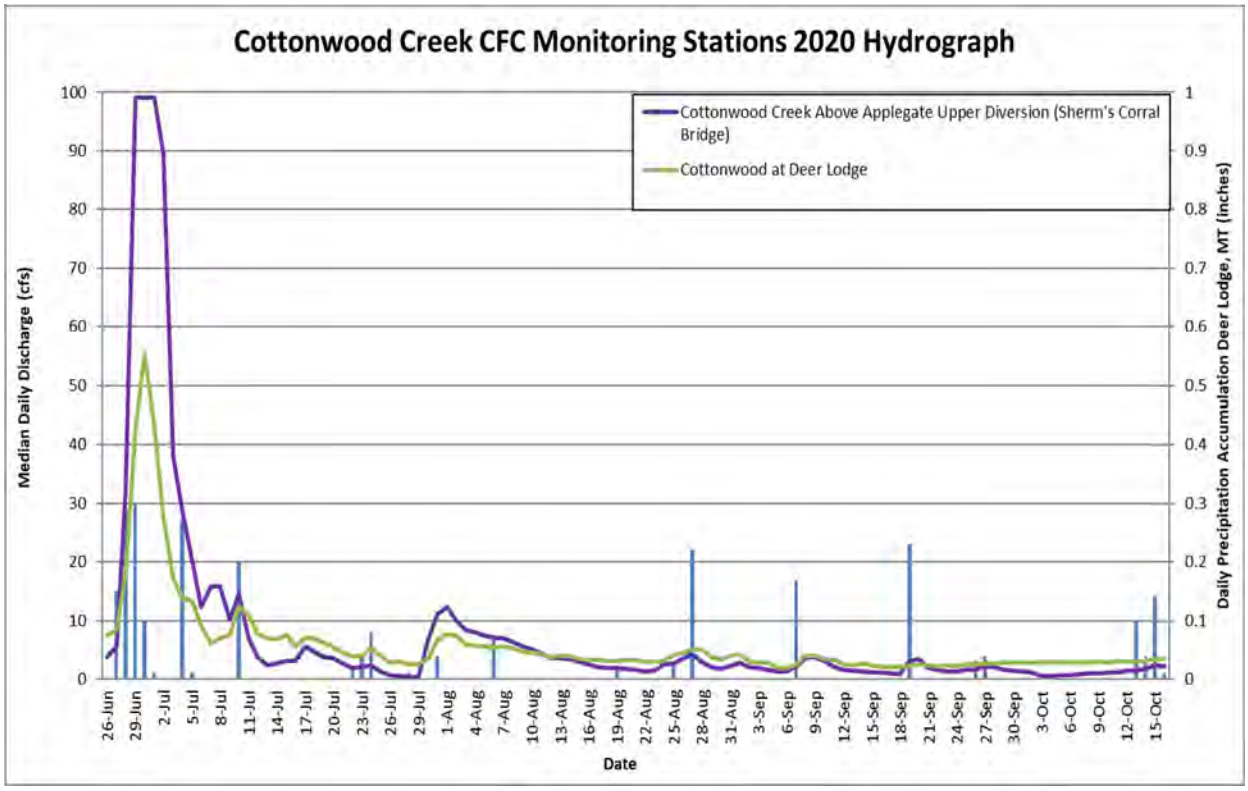

Figure 6- Cottonwood Creek average daily hydrographs for the 2020 irrigation season.

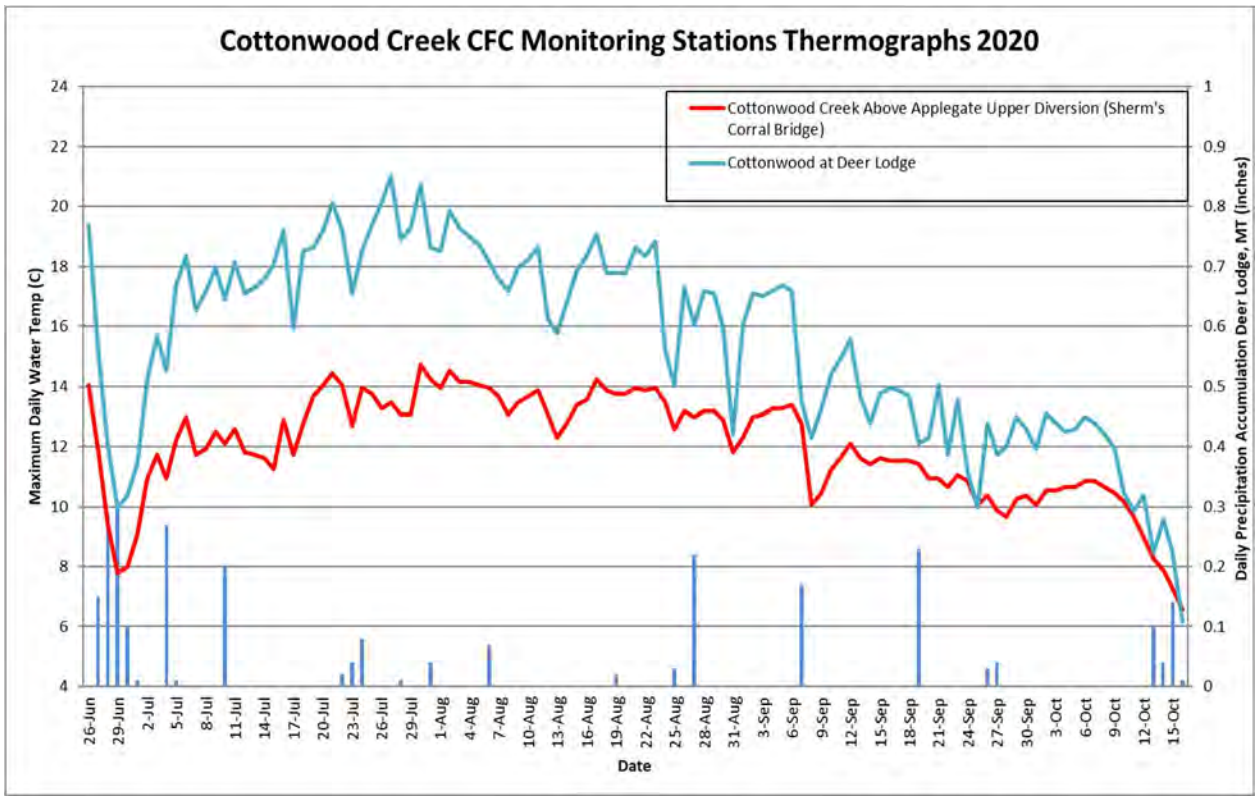

Figure 7- Cottonwood Creek maximum daily thermographs for the 2020 irrigation season.

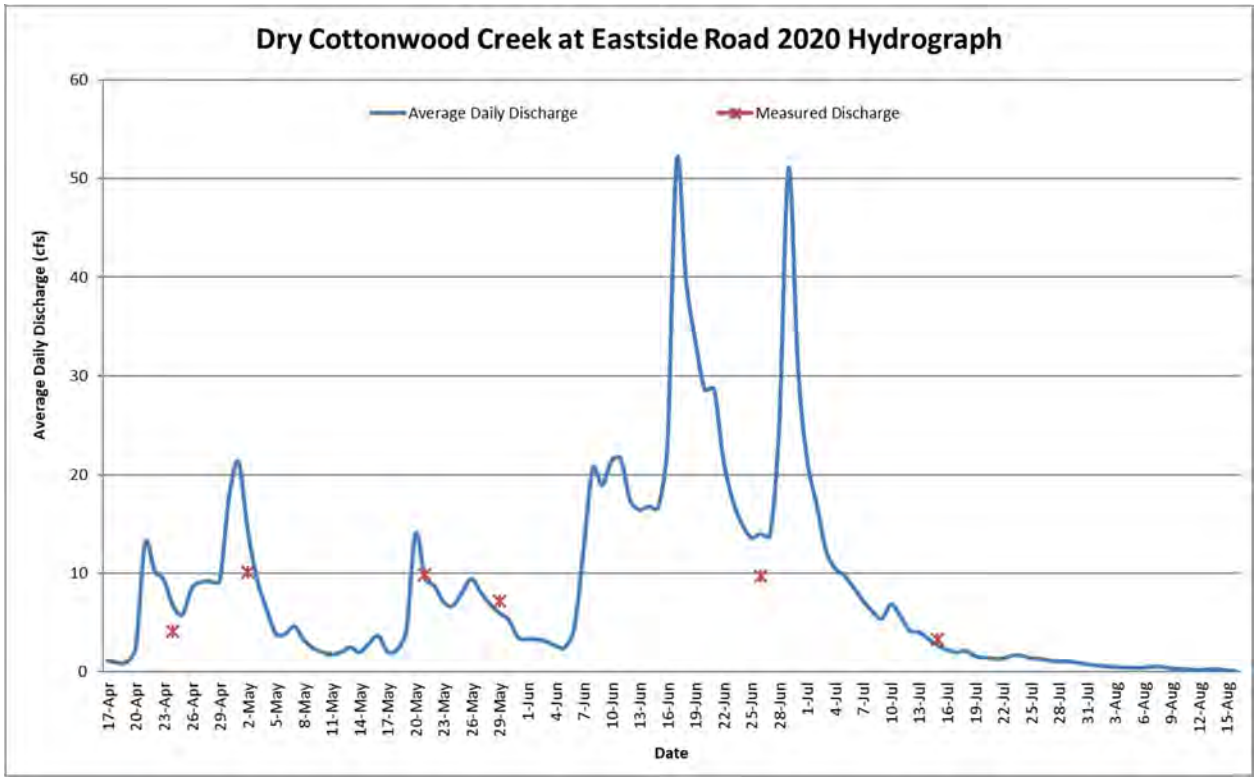

Figure 8- Dry Cottonwood Creek average daily hydrograph for the 2020 irrigation season.

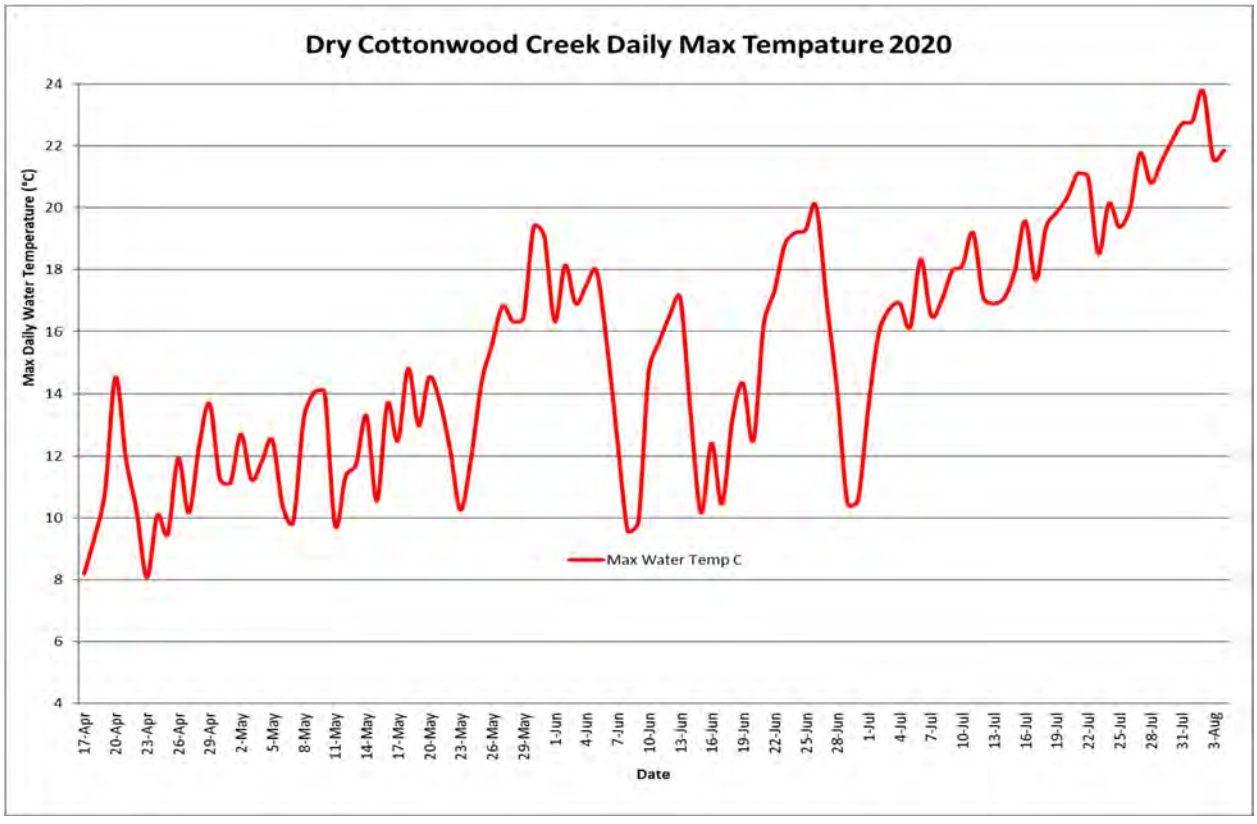

Figure 9- Dry Cottonwood Creek maximum daily thermograph for the 2020 irrigation season.

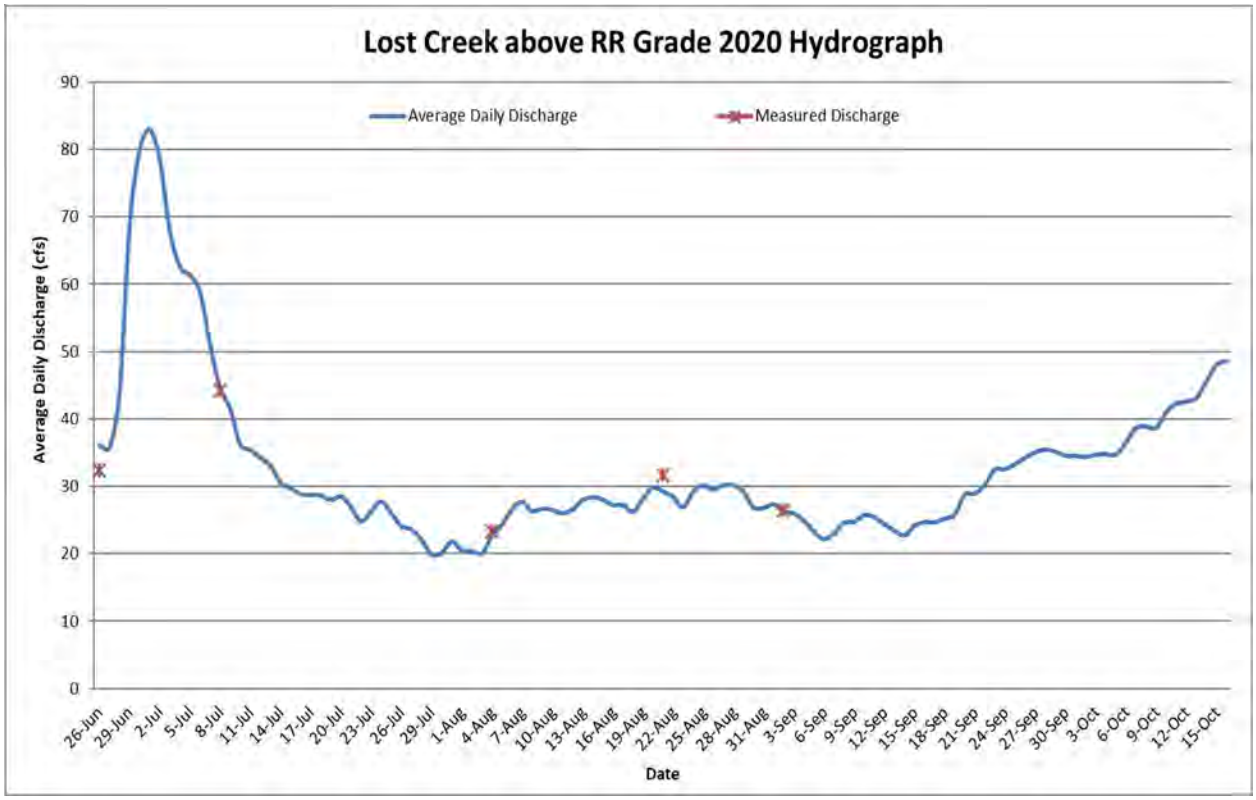

Figure 10- Lost Creek average daily hydrograph for the 2020 irrigation season.

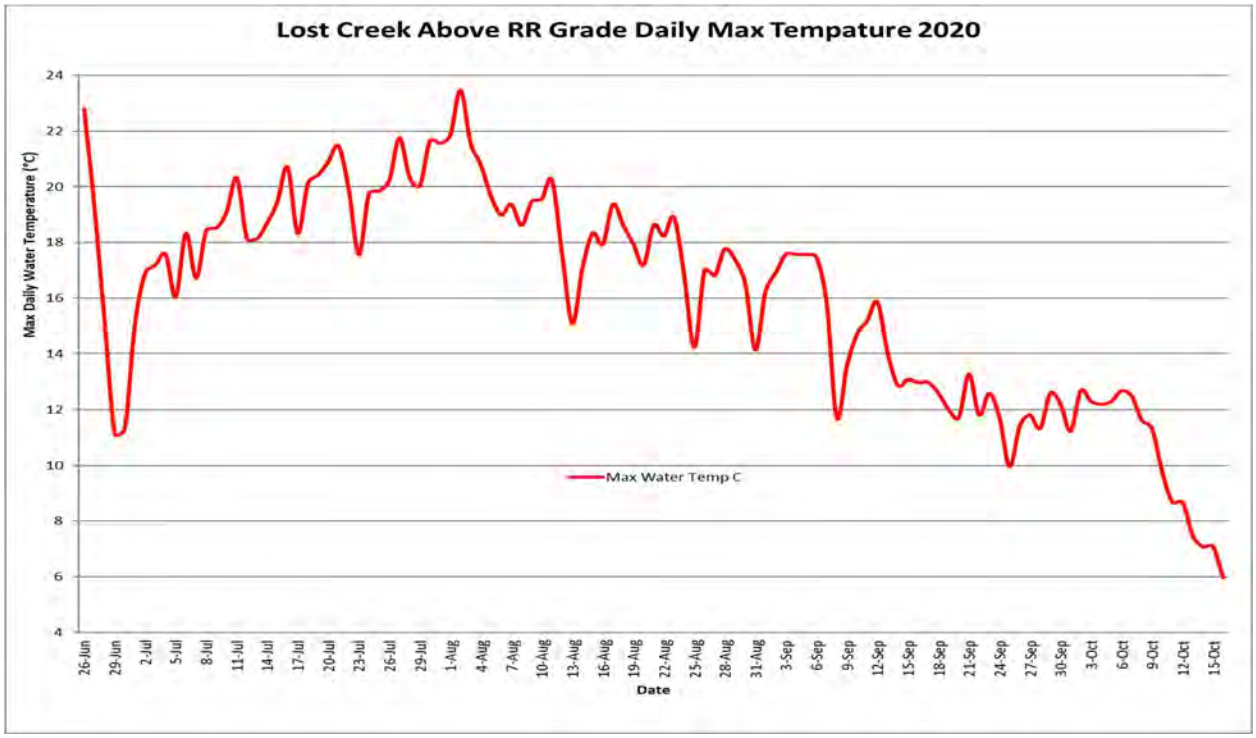

Figure 11- Lost Creek maximum daily thermograph for the 2020 irrigation season.

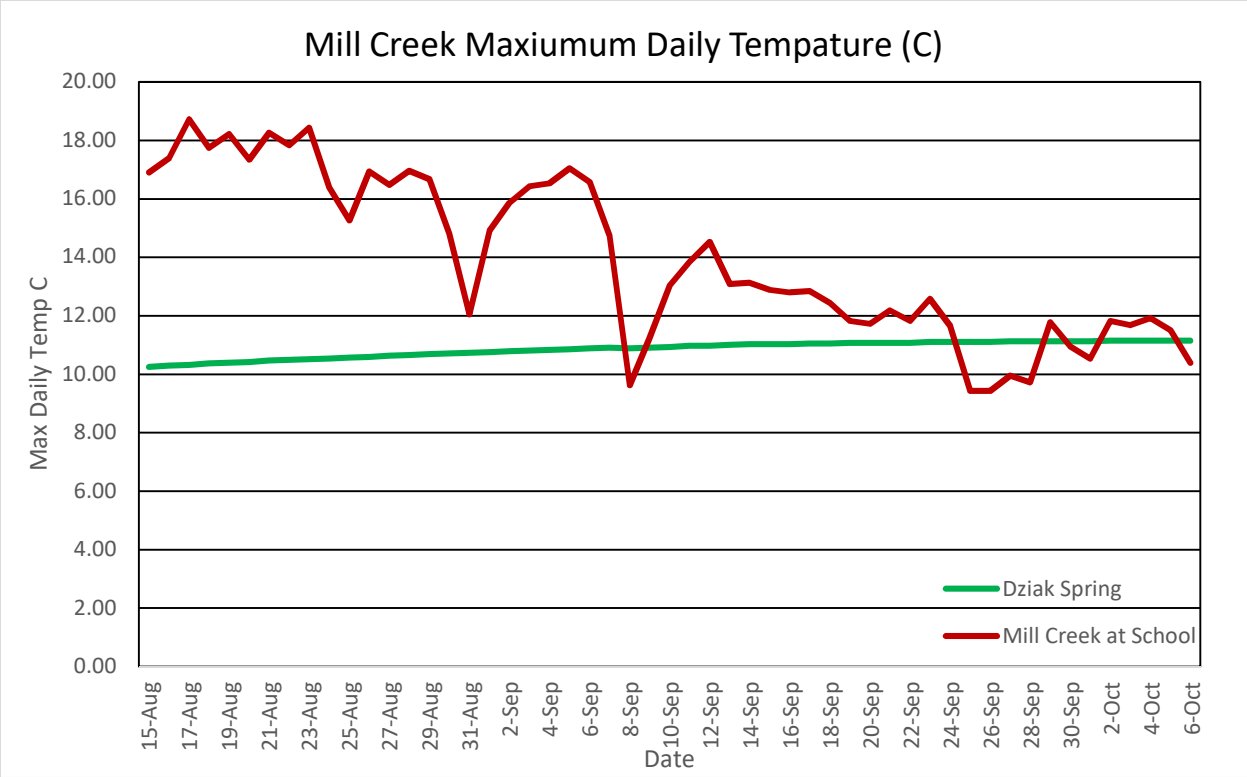

Figure 12-Mill Creek at School maximum daily thermograph versus Dziak Spring maximum daily thermograph for 2020.

Upper Clark Fork - 2020 Manual Discharge Measurements

Alvi Beck Ditch at DCCR

Date	Time of Measurement	Discharge
8/19/2020	2:15 PM	1.4
11/2/2020	5:00 PM	6.1
11/2/2020	5:20 PM	9.6

Cottonwood Creek Below Applegate Upper Diversion (Above Burt Diversion)

Date	Time of Measurement	Discharge
7/16/2020	1:25 PM	5.2
9/23/2020	11:00 AM	2.4

Cottonwood Creek above Applegate Lower Diversion

Date	Time of Measurement	Discharge
7/16/2020	12:15 PM	2.4
8/12/2020	11:15 AM	4.1
9/23/2020	10:45 AM	too low to measure

Cottonwood Creek below Applegate Lower Diversion

Date	Time of Measurement	Discharge
7/16/2020	12:38 PM	2.3
8/12/2020	11:43 AM	3.6
9/23/2020	10:18 AM	2.7

Mill Creek Spring

Date	Time of Measurement	Discharge
10/6/2020	9:30 AM	0.2

Valiton Ditch- headgate

Date	Time of Measurement	Discharge
7/29/2020	2:36 PM	4.6
8/25/2020	3:30 PM	3.7
9/2/2020	1:35 PM	4.3

Valiton Ditch- below CFRR pump

Date	Time of Measurement	Discharge
7/29/2020	2:29 PM	0.6

Table 13- Spot measurements for the 2020 irrigation season.

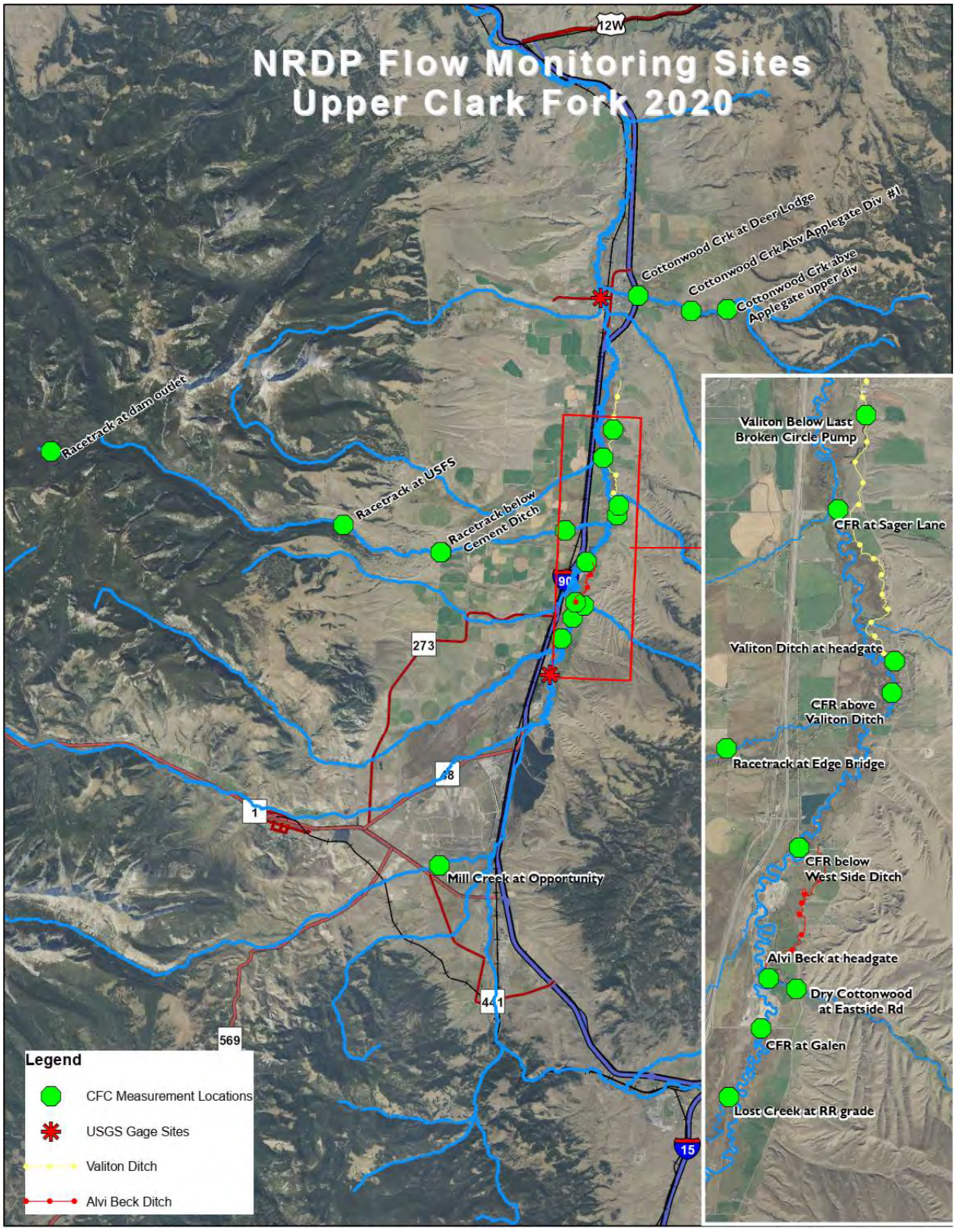

Figure 14- Map of measurement locations for the 2020 irrigation season.