Thompson Falls Project No. 1869
Water Quality Monitoring Report

2019-2021

Final Version – July 2022

NorthWestern Energy

Delivering a Bright Future

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Abbreviations and Acronyms

<	less than
BED	Baseline Environmental Document
DO	dissolved oxygen
EPT species	*Ephemeroptera*, *Plecoptera*, and *Tricoptera*
FERC	Federal Energy Regulatory Commission
mg/L	milligrams per liter
Montana DEQ	Montana Department of Environmental Quality
Montana FWP	Montana Fish Wildlife and Parks
ng/kg	nanograms per kilogram
NO_3+NO_2	Nitrate+Nitrite
NorthWestern Energy	NorthWestern Corporation, a Delaware corporation, d/b/a NorthWestern Energy
NTU	nephelometric turbidity unit
PCB	Polychlorinated Biphenyl
Project	Thompson Falls Hydroelectric Project
QA/QC	quality assurance and quality control
SKQ	Seli'š Ksanka Qlispe'
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	total equivalence
Thompson Falls Project	Thompson Falls Hydroelectric Project
TN	Total Nitrogen
TP	Total Phosphorus
U.S.	United States
USGS	U.S. Geological Survey

Section 1.0 – Background

The Thompson Falls Hydroelectric Project (Thompson Falls Project or Project) is located on the Clark Fork River in Sanders County, Montana. Preliminary development of the Thompson Falls Project began in June 1912, by the Thompson Falls Power Company. Construction commenced in May 1913 and the first generating unit was placed in service on July 1, 1915. The sixth generating unit was placed in service in May 1917. The Project has been operating continuously since 1915.

Non-federal hydropower projects in the United States (U.S.) are regulated by the Federal Energy Regulatory Commission (FERC) under the authority of the Federal Power Act. Montana Power Company acquired the Thompson Falls Project in 1929. The original license for the Thompson Falls Project was issued effective January 1, 1938 and expired on December 31, 1975. The current FERC License was issued to the Montana Power Company in 1979. The Project was purchased by (and FERC License transferred to) PPL Montana in 1999 and then purchased by (and FERC License transferred to) NorthWestern Corporation, a Delaware corporation, d/b/a NorthWestern Energy (NorthWestern) in 2014. An order amending the License was issued in 1990 allowing for construction of an additional powerhouse and generating unit, which was subsequently completed in 1995. With the addition of this new (second) powerhouse, the Project has a total generating capacity of 92.6 megawatts. The current FERC License is scheduled to expire December 31, 2025.

In preparation for renewal of the FERC License for the Project, NorthWestern developed a plan to collect baseline water quality data on the Project (NorthWestern, 2019, 2020, 2021). This resulting data will serve as a water quality baseline for the new FERC license period and enable NorthWestern to track water quality trends over time. The Project is located in the lower portion of the Clark Fork watershed (**Figure 1-1**) with two dams upstream of the Project on the Flathead River, a major tributary of the Clark Fork River, and two dams downstream of the Project on the Clark Fork River. The Flathead River is a regulated system with the flow regime being manipulated by the operations of Hungry Horse and Seli'š Ksanka Qlispe' (SKQ) Dams. The Clark Fork River upstream of the confluence with the Flathead River is not regulated by dams, and therefore is more representative of a natural river system in regard to its hydrograph. The Clark Fork River downstream of Thompson Falls Dam runs for approximately 3.2 miles (5.1 km) before it reaches the impounded area of Noxon Rapids Dam.

In 2018, a Baseline Environmental Document (BED) was developed for the Project to describe existing and relevant information about Project hydro facilities and operation, area water quantity and quality, fisheries, wildlife, vegetative, aesthetic, socioeconomic, cultural and public recreation resources (NorthWestern, 2018). Water quality data gaps were identified in the BED, and subsequent water quality data collected in 2019, 2020, and 2021 to fill data gaps and provide an overall picture of existing water quality conditions.

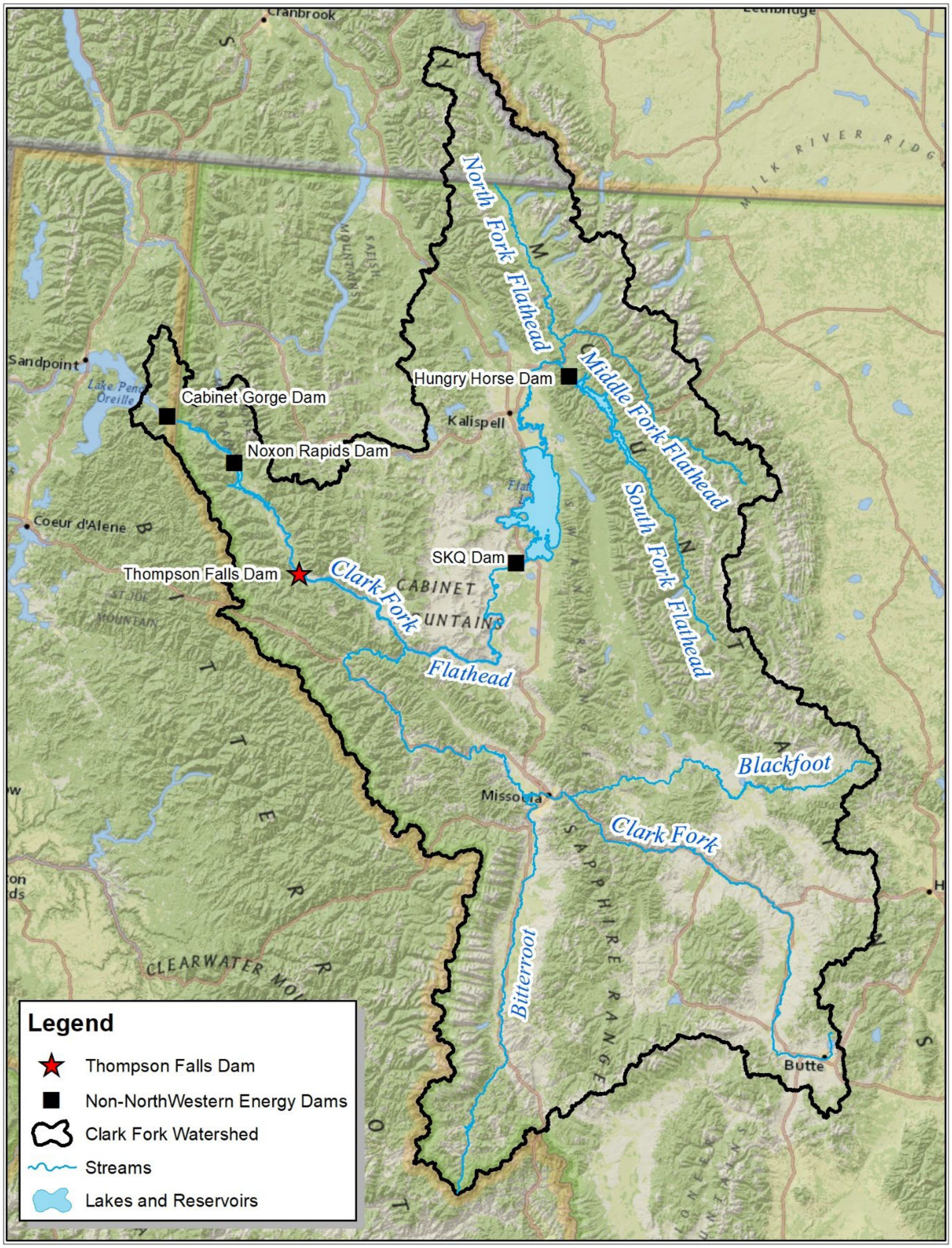

Figure 1-1. Map showing the location of Thompson Falls Dam in the Clark Fork River watershed.

Thompson Falls Reservoir is approximately 12 miles (19.3 km) long with a maximum width of about 1,800 feet. The shoreline length of the reservoir is approximately 25 miles (40.2 km). Active storage capacity of Thompson Falls Reservoir is approximately 15,000 acre-feet between crest El. 2,380 feet and normal full pool El. 2,396 feet, 1 foot below the Project boundary El. of 2397 feet. At the normal full pool reservoir El. 2,396 feet, the reservoir surface area is approximately 1,446 acres. Thompson Falls Reservoir has a maximum depth in excess of 45 feet (Montana Power Company, 1982). At full powerhouse flow (23,000 cfs) the available storage (15,000 acre-feet) can be discharged in about 8 hours.

The monthly fluctuation of average residence time (flushing rate) for Thompson Falls Reservoir is displayed in **Figure 1-2**. The results indicate that water residence time in Thompson Falls Reservoir is very short, particularly in the spring when residence time is, on average, less than 4 hours. The residence time ranges from less than 4 hours (June) to approximately 17 hours (September). It is not uncommon for residence times in lakes to range from months to years.

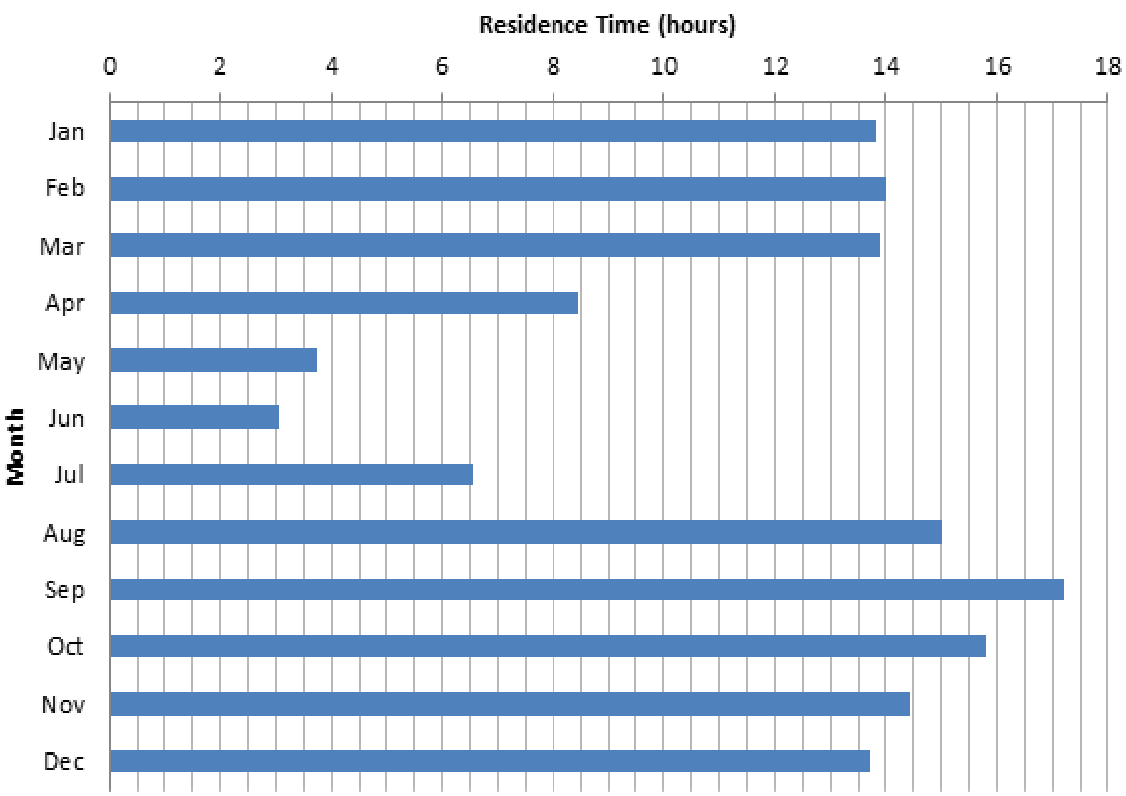

Figure 1-2. Estimated average monthly residence time in Thompson Falls Reservoir.

Flows in the Clark Fork River are gaged near Plains, MT, which is approximately 30 miles (48 km) upstream of the Thompson Falls Project. There is only one tributary with significant flow between the Plains gage station and the Project, the Thompson River. The Thompson River joins the Clark Fork River approximately 6 miles (9.7 km) upstream of the dams and contributes on average 2.0 percent of the flow in the Clark Fork River with a range of 0.7 percent up to 5.4 percent. The U.S. Geological Survey (USGS) also maintains a gage on the Thompson River. Therefore, the most accurate available flow statistics were derived by combining USGS gages on Clark Fork River at Plains, Montana (USGS gage 12389000) with the Thompson River near Thompson Falls (USGS gage 12389500), to calculate streamflow in Clark Fork River at the Project (**Figure 1-3**).

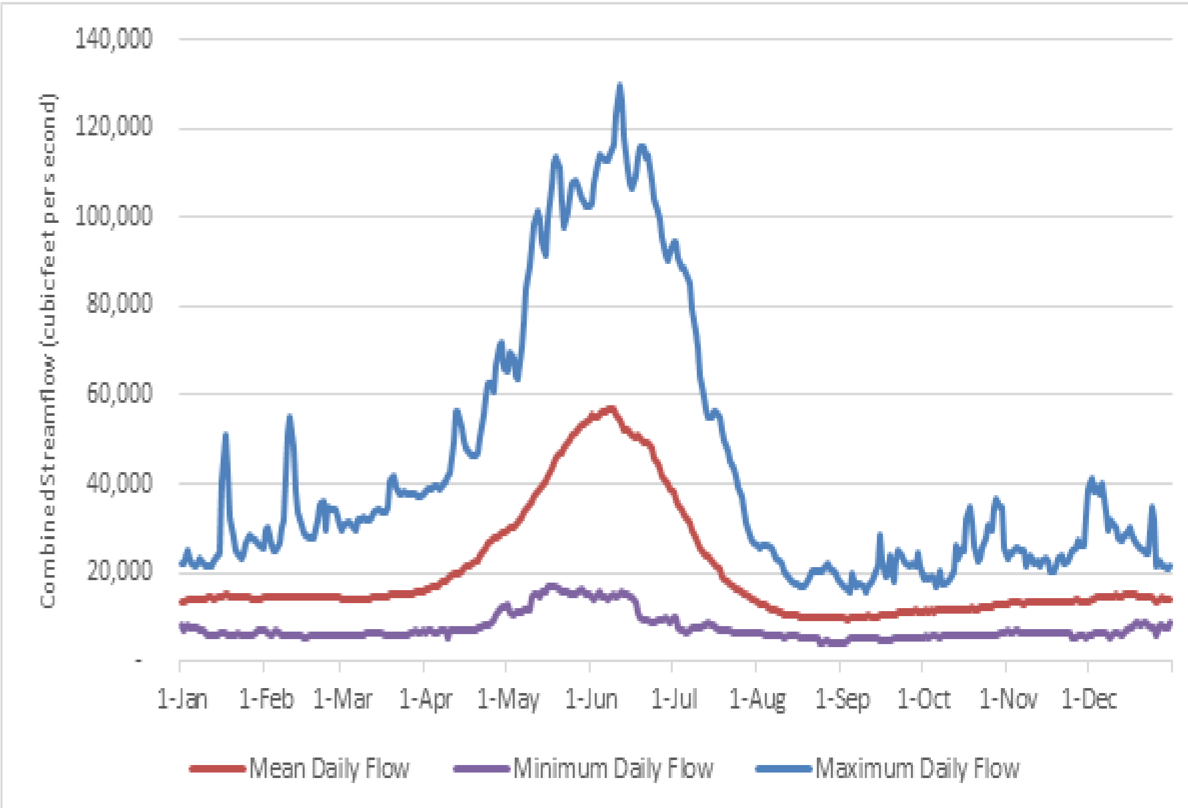

Figure 1-3. Daily minimum, maximum, and mean streamflow at Thompson Falls Project from April 1, 1956 to present.

Mean daily streamflow data were recorded at the USGS gage on the Clark Fork River at Plains from October 1, 1910 to present. The Thompson River near Thompson Falls flow data were recorded from March 1 to September 29, 1911 and from April 1, 1956 to present. To ensure that the hydrograph is representative of current conditions, **Figure 1-3** represents the minimum, maximum, and mean daily flows from April 1, 1956 to present. This period of record allows complete datasets for both USGS gages (Clark Fork River at Plains and Thompson River near Thompson Falls) to be analyzed and, also, provides representative data of upstream flows since the construction of upstream dams on the Flathead River. The ascending limb of the hydrograph begins between mid- and late March, peaks between late May and mid-June, and descends to base flow levels around mid-August (**Figure 1-3**).

Section 2.0 – Water Quality Monitoring

Water quality monitoring was conducted at the Thompson Falls Project in 2019, 2020, and 2021. Data collected provide a characterization of existing water quality conditions at the Project, and include water chemistry and field parameters, sediment chemistry, and biological data. **Figure 2-1** is a map showing the location of the water quality monitoring sites and **Table 2-1** provides a description of each monitoring site.

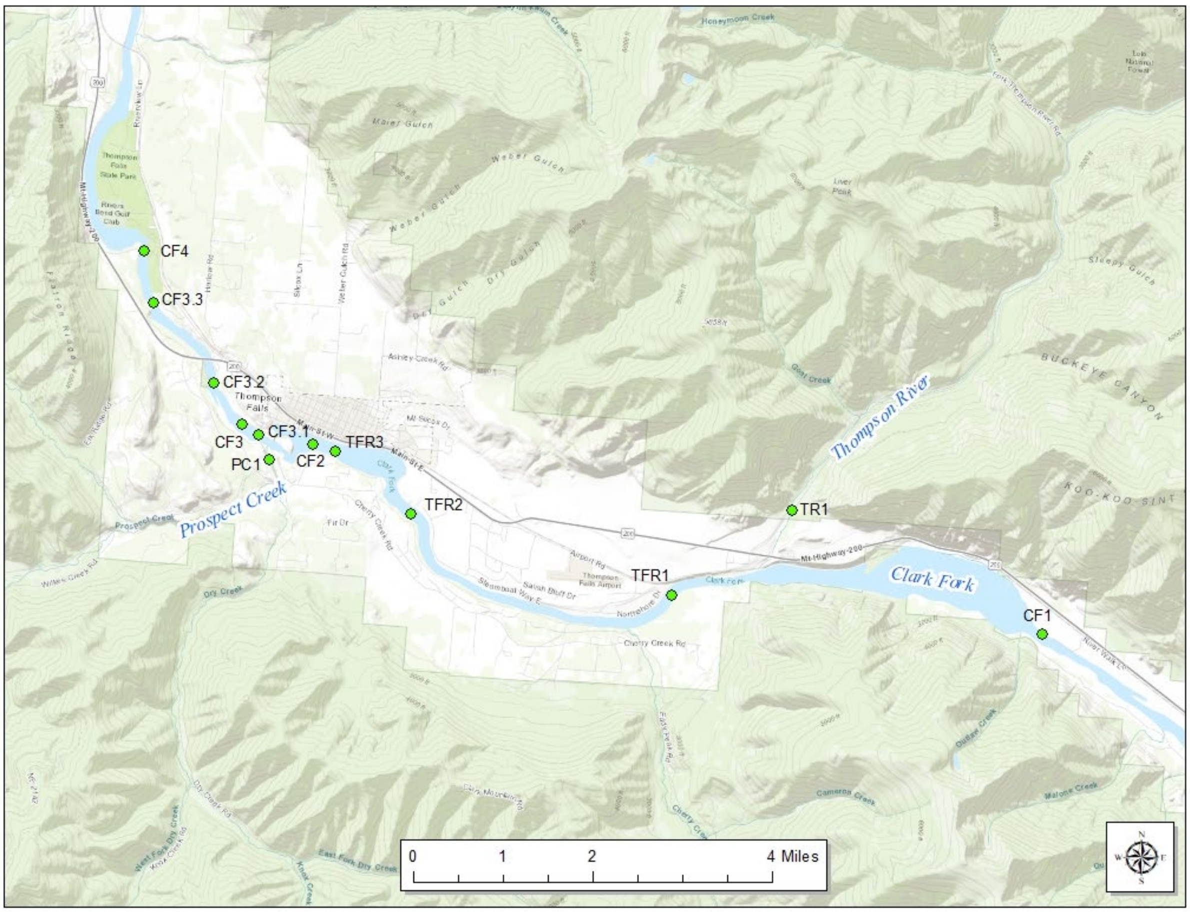

Figure 2-1. Map showing the location of the 2019-2021 Thompson Falls water quality monitoring sites.

Each monitoring site was chosen to provide spatial representation throughout the Project, bracket powerhouse infrastructure, and provide information on significant tributaries. Data collected at the monitoring sites listed in **Table 2-1** and shown in **Figure 2-1** differed from site to site depending on the purpose a particular site was selected.

Table 2-1. Descriptions and locations of biological and water quality monitoring sites.

Site Name	Site Description	Latitude	Longitude
CF1	Clark Fork River upstream of Thompson Falls Reservoir	47.569187	-115.167518
CF1*	*Biological sampling location for CF1	47.569904	-115.175776
CF2	Clark Fork River upstream of dam in Thompson Falls Reservoir	47.593502	-115.353699
CF3	Clark Fork River downstream of old powerhouse	47.594303	-115.362777
CF3*	*Biological sampling location for CF3	47.594984	-115.365869
CF3.1	Clark Fork River downstream of new powerhouse	47.592967	-115.358745
CF3.2	Clark Fork River near HWY 200 Bridge	47.601154	-115.372673
CF3.3	Clark Fork River near Thompson Falls State Park	47.612526	-115.388294
CF4	Clark Fork River at Birdland Bay Bridge	47.621436	-115.391592
TR1	Thompson River near mouth	47.587434	-115.232969
PC1	Prospect Creek near mouth	47.590124	-115.358559
TFR1	Thompson Falls Reservoir, upper	47.572973	-115.259564
TFR2	Thompson Falls Reservoir, mid-reservoir	47.578977	-115.320398
TFR3	Thompson Falls Reservoir, lower	47.591410	-115.344833

Note:
*Biological sampling sites were not in the same, exact location as the correlating water quality monitoring sites.

Section 2.1 – Water Chemistry and Field Parameters

Water chemistry was sampled at multiple monitoring sites around the Project to characterize the incoming water quality from the Clark Fork River and the outgoing water quality downstream of the Project. Parameter groups analyzed included nutrients, metals, inorganics, and physical properties. Field parameters collected in-situ were also measured.

Section 2.1.1 – Monitoring Sites and Methods

Water chemistry was monitored at nine sites in and around the Project from 2019 through 2021 (**Table 2-2**). These nine sites included four recurring monitoring sites on the Clark Fork River, three additional sites downstream of Project infrastructure for source assessment purposes, and two tributary sites. The tributary monitoring sites were located on the Thompson River, which enters Thompson Falls Reservoir near the upstream end of the Project, and Prospect Creek, which enters the Clark Fork River downstream of Project infrastructure.

The water quality sampling consisted of the collection of either single point depth integrated samples, or depth integrated equal width increment composites at each monitoring location. Grab samples were collected from the bank in a well-mixed portion of the river, or from a bridge at equal width increments and composited in a Teflon churn splitter. The sampling methodology described above conforms to current standard operating procedures used by the Montana Department of Environmental Quality (Montana DEQ) (Makarowski, 2019). A list of analytes monitored are shown in **Table A-1** in **Appendix A**.

Chlorophyll-*a* samples were collected in 2019 using the whole-rock method. Six replicate transects were conducted at each chlorophyll-*a* monitoring site, with each transect containing five to six rocks per sample. The rocks were then placed in a cooler on ice and transported to the laboratory for chlorophyll-*a* analysis of the sample.

Field parameters were collected at each sampling site using a laboratory calibrated Hydrolab HL7 sonde. A list of field parameters monitored in this study can be found in **Table A-2** in **Appendix A**. Continuous water temperature monitoring also occurred at various locations across the Project in 2019 and 2021.

Table 2-2. Description of purpose, methods, and parameters measured at water chemistry monitoring sites.

Site Name	Site Purpose	Sampling Method	Analyte Groups
CF1	Incoming water quality to the Project	Single point grab sample, Hydrolab HL7 Sonde, Onset Thermograph	Nutrients, Metals, Physical Properties, Inorganics, Field Parameters, Temperature, Chlorophyll-*a*
CF2	Water quality leaving the reservoir, upstream of the powerhouses	Equal width increment composite sample, Hydrolab HL7 Sonde, Onset Thermograph	Nutrients, Metals, Physical Properties, Inorganics, Field Parameters, Temperature
CF3	Water quality downstream of the old powerhouse	Single point grab sample, Hydrolab HL7 Sonde, Onset Thermograph	Nutrients, Metals, Physical Properties, Inorganics, Field Parameters, Temperature, Chlorophyll-*a*
CF3.1	Water quality downstream of the new powerhouse (Metals source assessment)	Single point grab sample	Metals
CF3.2	Water quality near the HWY 200 bridge (Metals source assessment)	Single point grab sample	Metals
CF3.3	Water quality near Thompson Falls State Park (Metals source assessment)	Single point grab sample	Metals
CF4	Water quality leaving the Project	Equal width increment composite sample, Hydrolab HL7 Sonde	Nutrients, Metals, Physical Properties, Inorganics, Field

Site Name	Site Purpose	Sampling Method	Analyte Groups
			Parameters, Temperature
TR1	Water quality of the Thompson River	Single point grab sample, Hydrolab HL7 Sonde, Onset Thermograph	Nutrients, Metals, Physical Properties, Inorganics, Field Parameters, Temperature
PC1	Water quality of Prospect Creek	Single point grab sample, Hydrolab HL7 Sonde	Nutrients, Metals, Physical Properties, Inorganics, Field Parameters

Data quality assurance and quality control (QA/QC) were accomplished using methods described in the standard operating procedures used by the Montana DEQ (Makarowski, 2019). These methods include:

1. Validation: reviewing analytical laboratory techniques including lab duplicate, matrix spikes, blanks, and surrogate recoveries to determine if the methods are within acceptable limits.
2. Replicates: each sampling event will include the collection of one replicate sample. Replicate variability will be analyzed using standard methods with objective of obtaining Relative Percent Differences (also known as RPDs) within 10% for values greater than 5 times the method detection limit.
3. Splits: Splits will be collected using a churn splitter to achieve equal aliquots, and samples will be analyzed for the full suite of parameters.
4. Field methodology: field blanks will be collected for each water quality event to monitor field methodology. Methods and field sampling forms will be reviewed to assure consistency.
5. Individual data which fails to achieve QA/QC objectives will be flagged with appropriate qualifiers in the database.
6. If QA/QC review suggests widespread problems with QA/QC for a sampling run, the sampling run (or individual samples) may be repeated at the discretion of the project manager.

Quality control measures were also employed for any statistical analyses. These measures included:

1. Testing the data for normality and adjusting for seasonal and flow effects.
2. For water quality, assigning one-half the detection limit to non-detect values and evaluating the methodology/detection limits to assure the analyses are valid.
3. Addressing missing values and trend analyses in a consistent manner that avoids biasing the results.

Section 2.1.2 - Water Chemistry and Field Parameter Results

Section 2.1.2.1 - Nutrients

Nutrients within the Thompson Falls Project are generally low in concentration, which is reflected in both the water chemistry data as well as the biological data. Water chemistry samples were collected throughout the year, so nutrient concentrations may reflect conditions outside of the summertime window of July 1 through September 1 when most of the biological growth is occurring in the waterbody. Outside of this summertime window, nutrient concentrations in the water column are typically higher because they are not being consumed by biological growth as readily.

Total Nitrogen

Total nitrogen (TN) concentrations remained consistent throughout the Clark Fork monitoring sites (CF1, CF2, CF3, and CF4), but were lower at the two tributary monitoring sites (PC1 and TR1) (**Figure 2-2**). There are relatively few nitrogen inputs between the upstream end of the Project boundary (CF1) and the upstream end of Noxon Reservoir (CF4), which is reflected in the data.

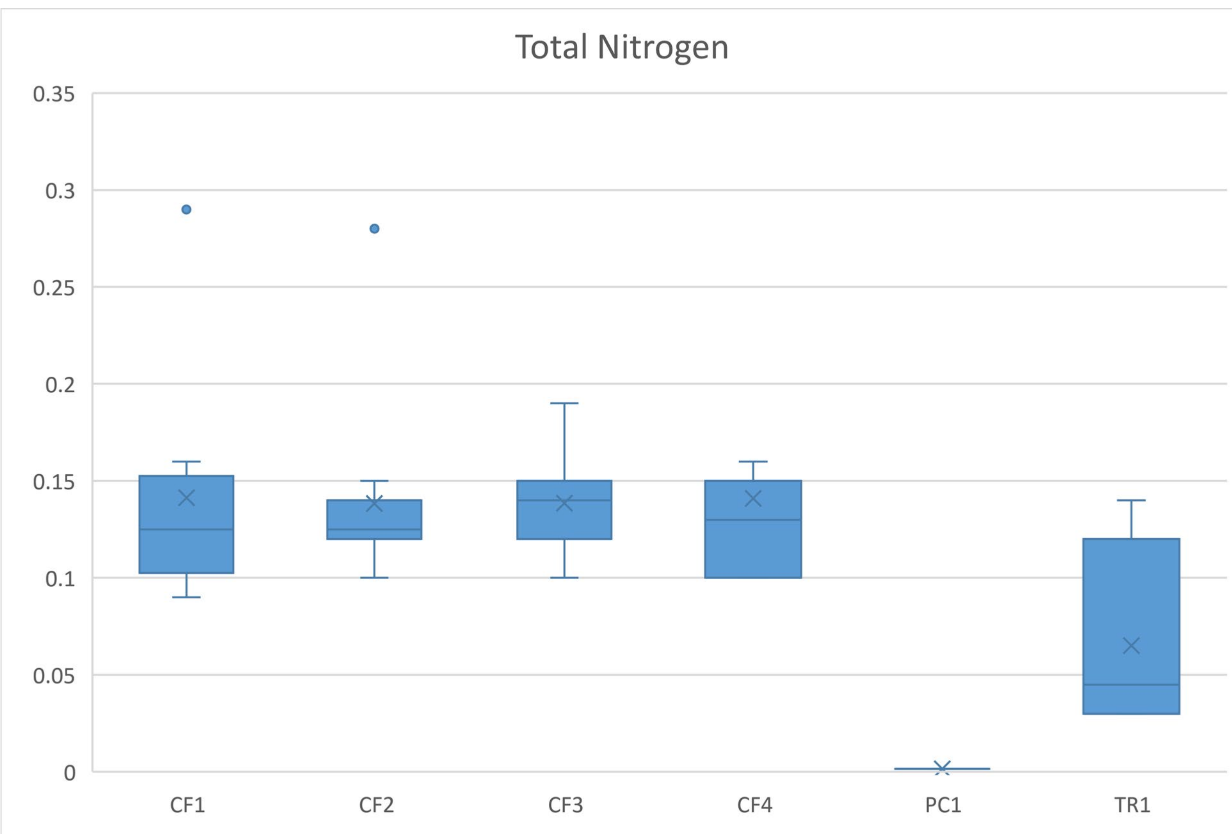

Figure 2-2. Total nitrogen concentrations across all water quality monitoring sites (**in mg/L**).

Nitrate+Nitrite

Nitrate+Nitrite (NO_3+NO_2) concentrations show a similar pattern to TN concentrations, with little to no change across the Clark Fork monitoring sites (CF1, CF2, CF3, and CF4). As with TN, the tributary sites (PC1 and TR1) also showed lower concentrations of NO_3+NO_2. **Figure 2-3** below shows the NO_3+NO_2 concentrations across all monitoring sites.

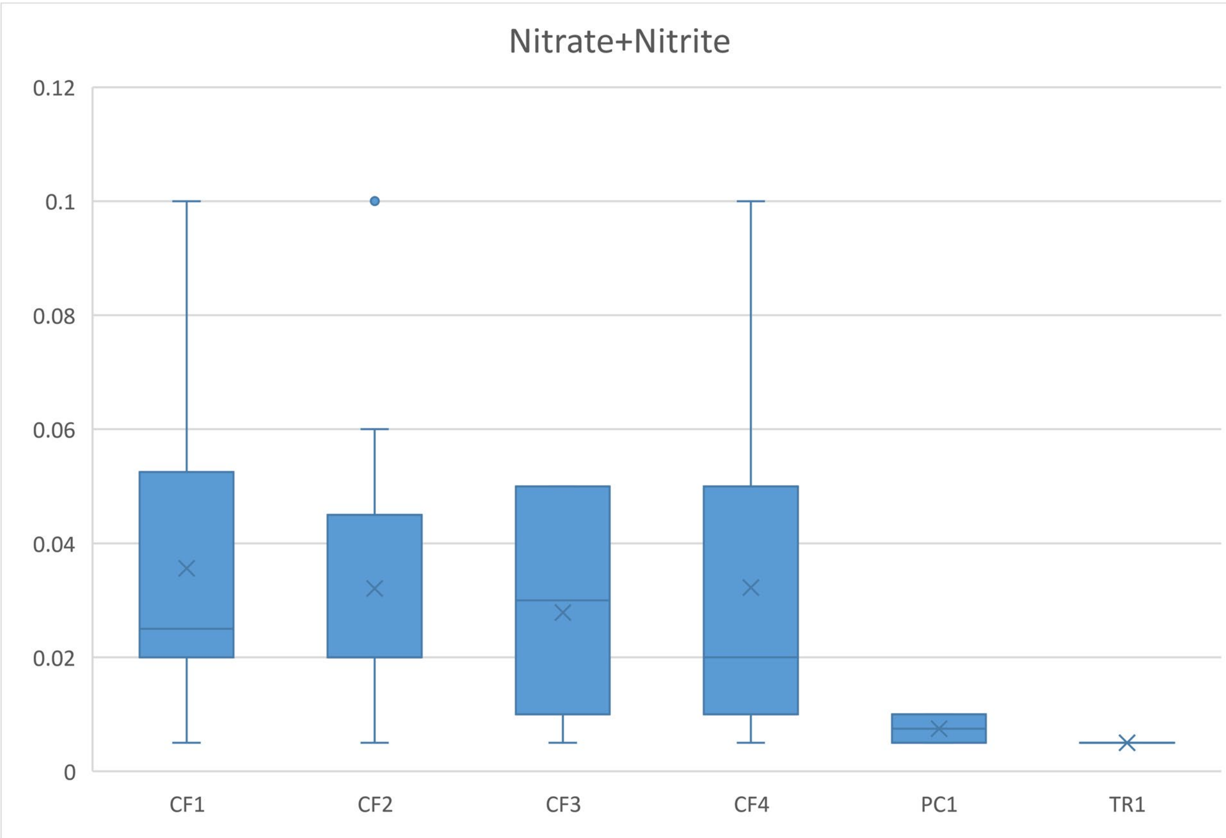

Figure 2-3. Nitrate+Nitrite concentrations across all water quality monitoring sites (in mg/L).

Total Phosphorus

Total phosphorus (TP) concentrations follow a similar pattern to TN and NO_3+NO_2 concentrations across the Project. The lowest TP concentrations on the Clark Fork sites (CF1, CF2, CF3, and CF4) were found at sites CF2 and CF3, which are located just upstream and downstream of the dams and powerhouses respectively (**Figure 2-4**). Phosphorus has a tendency to bind tightly to soil particles, many of which settle out in the reservoir and are consumed by biological growth in the reservoir, which would explain the slightly lower TP concentrations found at sites CF2 and CF3 as compared to site CF1, which is located at the upstream end of the reservoir. As with TN and NO_3+NO_2, the concentrations of TP were found to be lower at the tributary sites (PC1 and TR1) than at the Clark Fork sites.

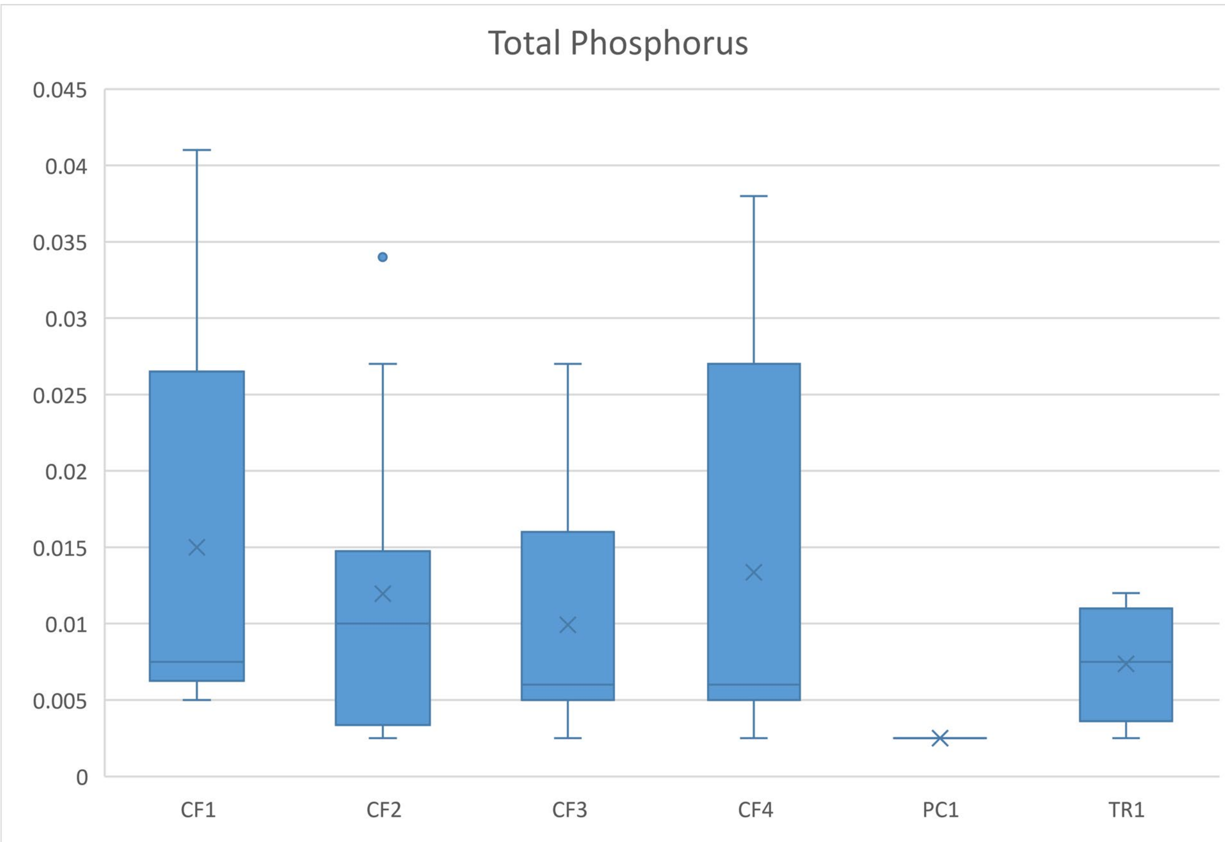

Figure 2-4. Total phosphorus concentrations across all water quality monitoring sites (**in mg/L**).

Chlorophyll-a

Chlorophyll-*a* samples were collected at two locations in 2019; site CF1 to represent conditions upstream of Thompson Falls Reservoir and site CF3 to represent conditions downstream of Thompson Falls Reservoir. Upstream chlorophyll-*a* concentrations were found to be higher at site CF1 versus the downstream chlorophyll-*a* concentrations at site CF3 (**Figure 2-5**). This likely indicates that some nutrient uptake and attenuation is occurring in Thompson Falls Reservoir, and therefore less nutrients are available downstream to be consumed by phytoplankton.

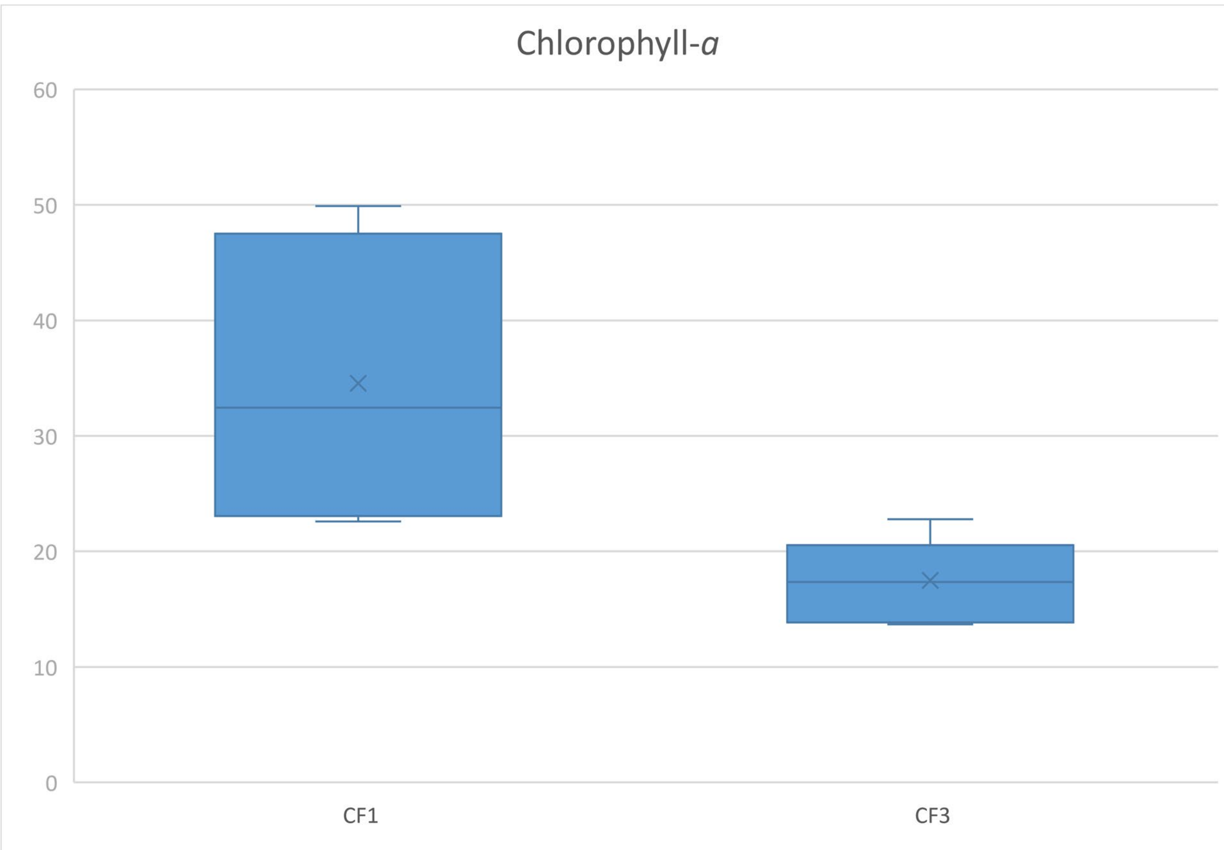

Figure 2-5. Chlorophyll-*a* concentrations upstream and downstream of Thompson Falls Reservoir (in mg/m^2).

Section 2.1.2.2 - Metals

Generally, aqueous metal concentrations within the Project are meeting water quality standards at all sites with the exception of three samples from Birdland Bay Bridge (site CF4) which showed lead levels exceeding the water quality standard for chronic aquatic life. Site CF4 is located downstream of the Project and is used to characterize the water quality as it enters Noxon Reservoir. These three samples were collected during both high and low flow periods, and the source of the lead is unknown because all other sites had low or non-detectable concentrations of lead. Additional source assessment sampling for lead was conducted in the fall of 2020 and detailed in this section below. All other metals analyzed were found to be at concentrations below water quality standards.

Arsenic

Arsenic concentrations at all sites were below water quality standards and remain fairly consistent throughout the Clark Fork monitoring sites (CF1, CF2, CF3, and CF4), with a greater variation in sample concentrations found at sites CF1 and CF4 (**Figure 2-6**). Tributary site (PC1 and TR1) arsenic concentrations were found to be at non-detectable levels.

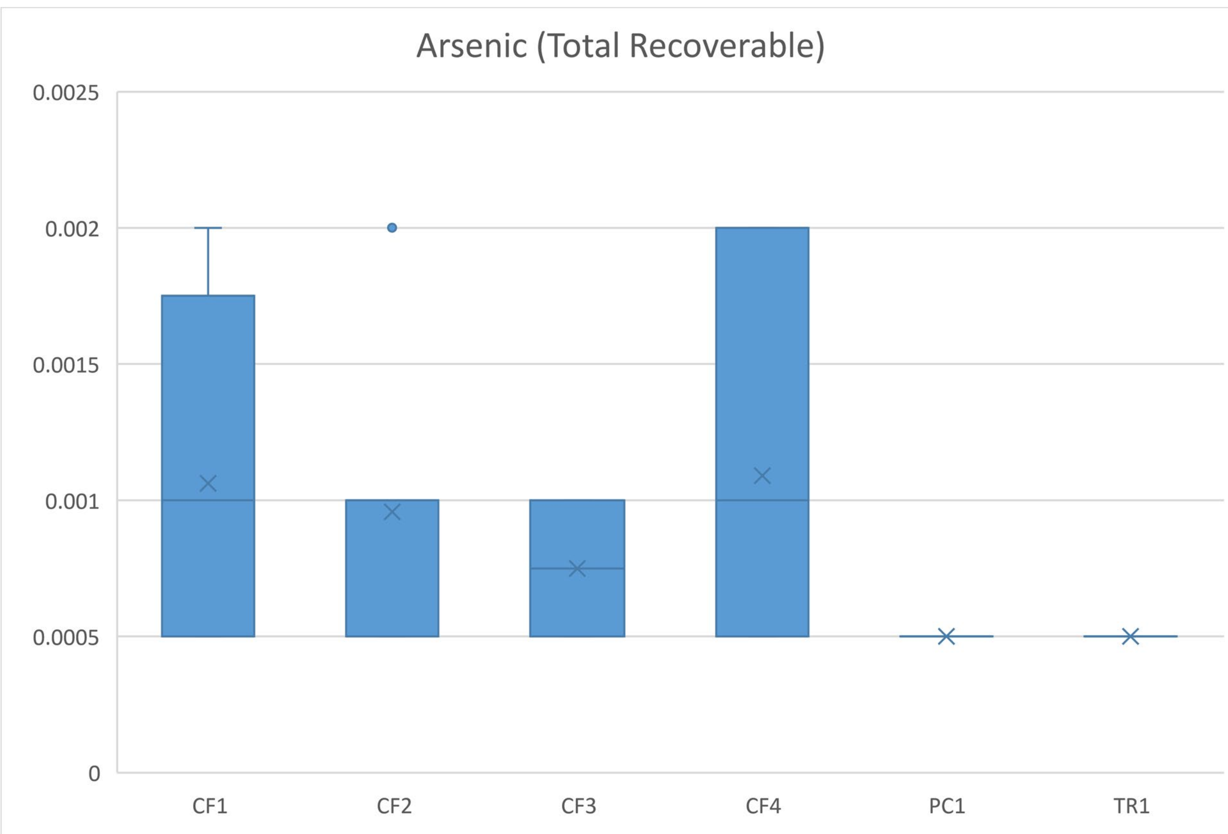

Figure 2-6. Arsenic concentrations across all water quality monitoring sites (in mg/L).

Cadmium

Cadmium concentrations at all Clark Fork sites (CF1, CF2, CF3, and CF4) were below water quality standards and remain fairly consistent throughout the Clark Fork monitoring sites. All of the Clark Fork samples, with the exception of two samples at site CF2, were found to be at non-detectable concentrations of cadmium (**Figure 2-7**). Cadmium toxicity is dependent on water hardness, and when the hardness of the Clark Fork River is factored in, the two cadmium detections at site CF2 were below water quality standards for aquatic life.

Cadmium concentrations in the Thompson River were non-detectable, but cadmium concentrations in Prospect Creek exceeded the water quality standard for chronic aquatic life when the water hardness of Prospect Creek is factored in. Prospect Creek has a history of mining in the watershed, so mining activity is a potential source of cadmium in Prospect Creek. Prospect Creek enters the Clark Fork River downstream of the Main Channel Dam, and therefore has no influence on the water quality of Thompson Falls Reservoir.

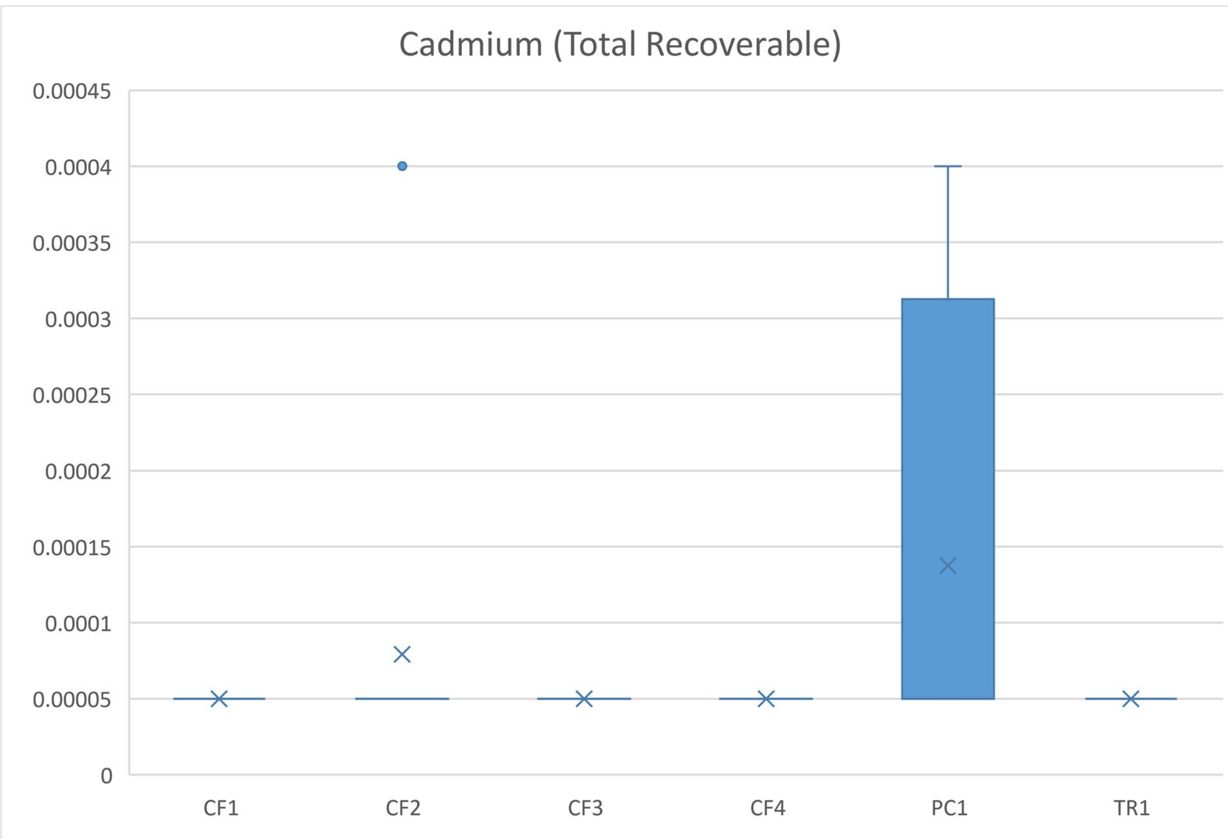

Figure 2-7. Cadmium concentrations across all water quality monitoring sites (**in mg/L**).

Copper

Copper concentrations remain fairly consistent throughout the Clark Fork monitoring sites (CF1, CF2, CF3, and CF4), with the lowest concentrations found at site CF3, downstream of the old powerhouse (**Figure 2-8**). Copper toxicity is dependent on water hardness, and when the hardness is factored in, the copper concentrations at all sites were below water quality standards for aquatic life. Tributary site (PC1 and TR1) copper concentrations were found to be at non-detectable levels.

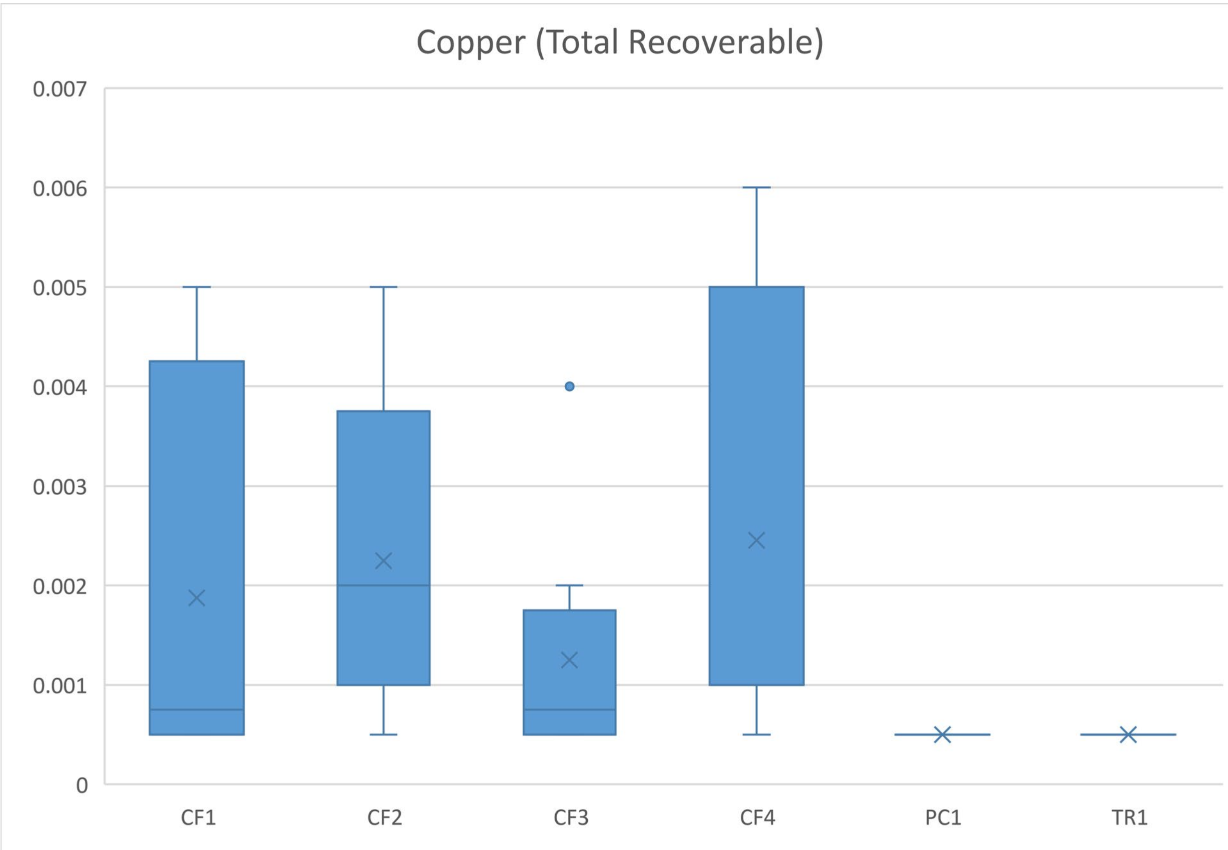

Figure 2-8. Copper concentrations across all water quality monitoring sites (in mg/L).

Iron

Iron concentrations at all sites were below water quality standards and remain fairly consistent throughout the Clark Fork monitoring sites (CF1, CF2, CF3, and CF4) (**Figure 2-9**). Tributary site (PC1 and TR1) iron concentrations were also found to be at low levels, with the Thompson River having slightly higher concentrations of iron than Prospect Creek.

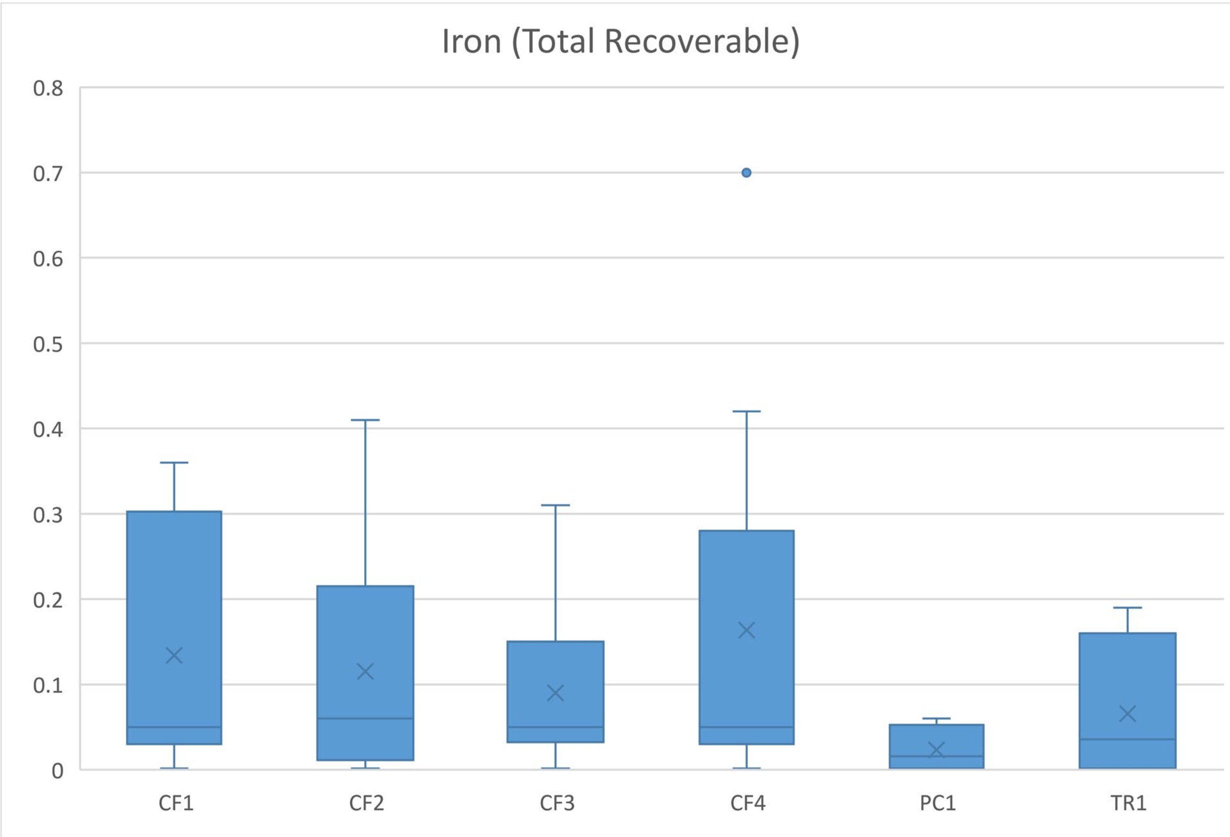

Figure 2-9. Iron concentrations across all water quality monitoring sites (in mg/L).

Lead

Lead concentrations were at low to non-detectable levels at all sites except site CF4 (**Figure 2-10**). Lead toxicity is dependent on water hardness, and when the hardness of the Clark Fork River is factored in, three lead samples at site CF4 were above water quality standards for chronic aquatic life. Site CF4 is downstream of the Project.

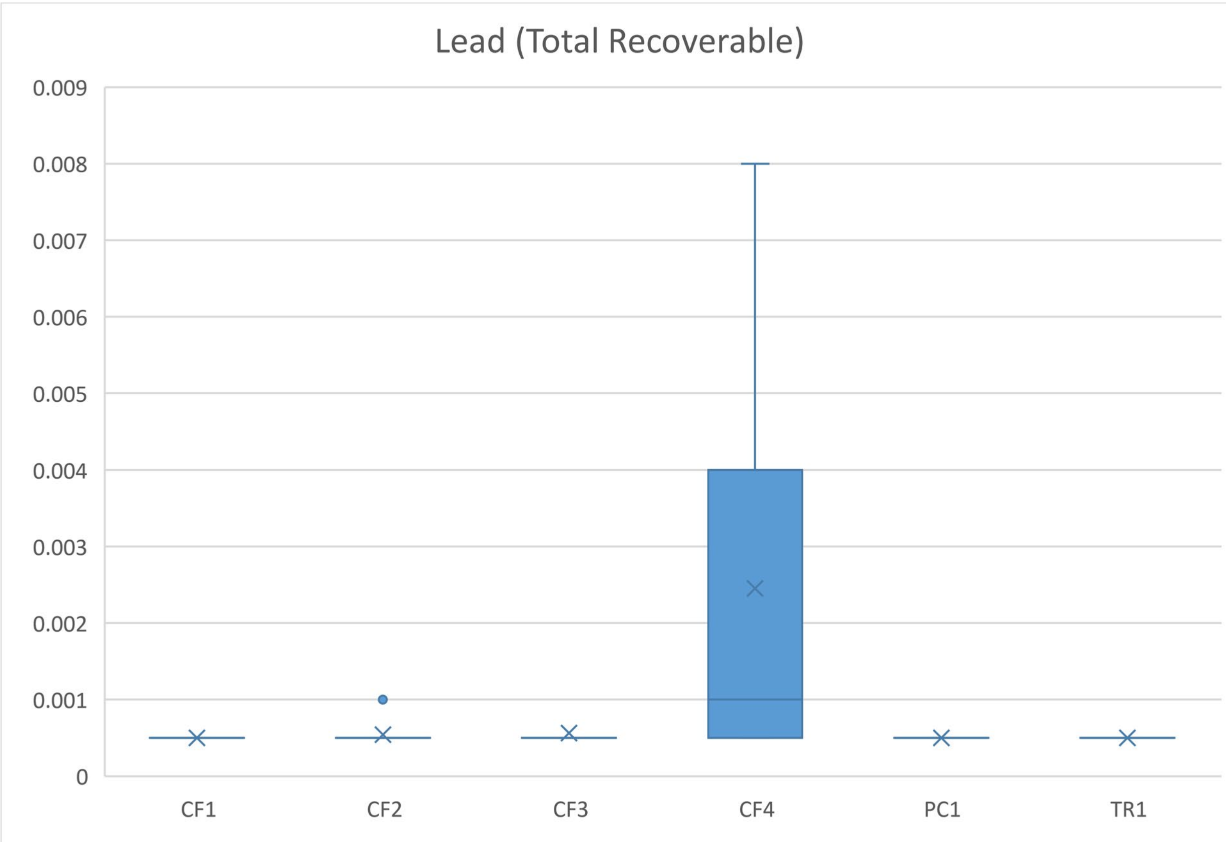

Figure 2-10. Lead concentrations across all water quality monitoring sites (in mg/L).

In response to the initial lead detection in 2019, additional monitoring sites were added at Prospect Creek (PC1) and downstream of the old powerhouse (CF3) for the 2020 monitoring season. With continued lead detections at site CF4 in 2020, and no clarity on potential lead sources, a synoptic monitoring event was conducted in October 2020 to provide information for a more detailed source assessment. This monitoring event included samples at site CF2 (above the dam), site PC1 (Prospect Creek), site CF3 (below the old powerhouse), site CF3.1 (below the new powerhouse), site C3.2 (near the Highway 200 bridge), site CF3.3 (near Thompson Falls State Park), and site CF4 (Birdland Bay Bridge). The results of this monitoring event showed that lead was found at non-detectable concentrations at all sites except site CF4 (**Figure 2-11**). The potential source of lead at site CF4 still remains unknown but has been isolated to the area between Birdland Bay Bridge and upstream 0.65 mile. This source area is located outside of the Project, and the source of lead at site CF4 is not related to the Project or Project operations.

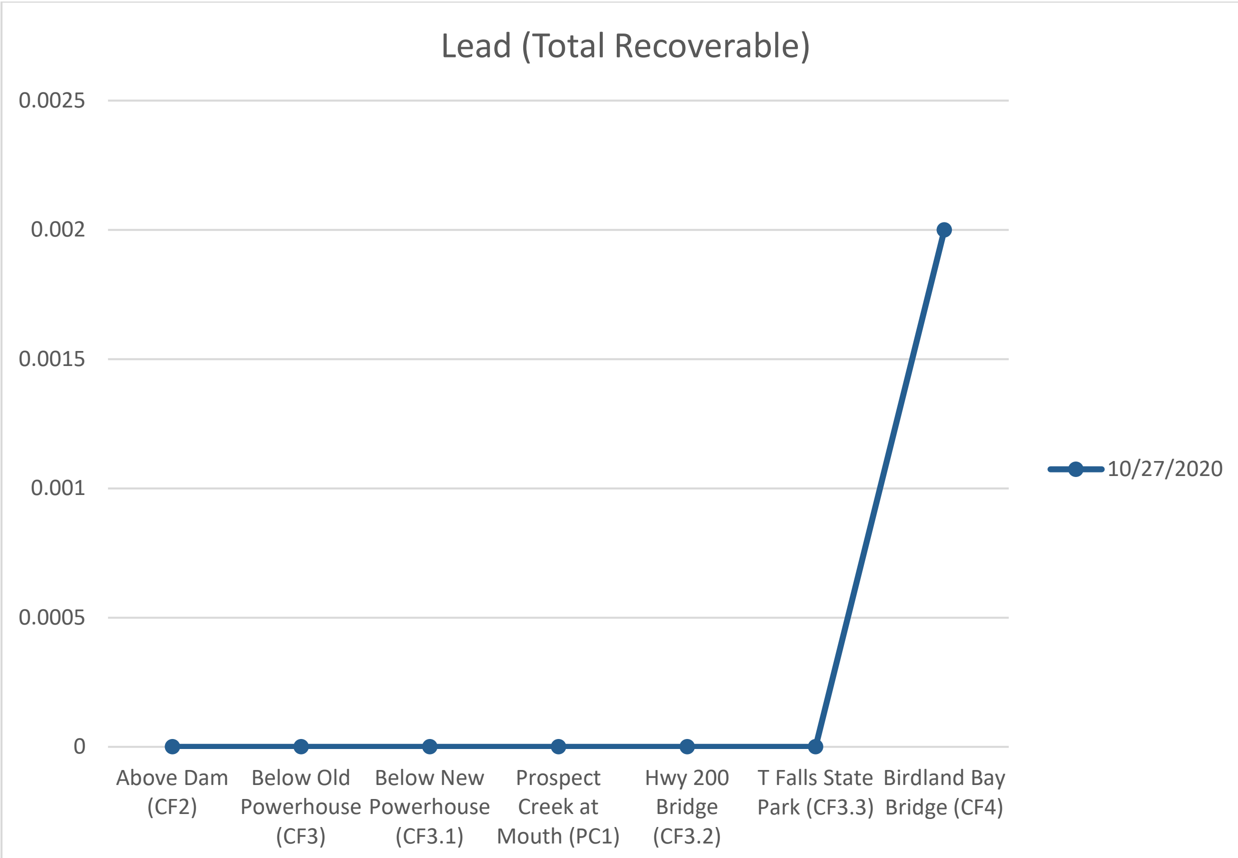

Figure 2-11. Lead concentrations from an upstream to downstream orientation for the synoptic monitoring event on October 27, 2020 (in mg/L).

Zinc

Zinc concentrations in the Project were at low to non-detectable levels at all monitoring sites (**Figure 2-12**). Zinc toxicity is dependent on water hardness, and when the hardness is factored in, all samples containing detectable concentrations of zinc were below water quality standards for aquatic life.

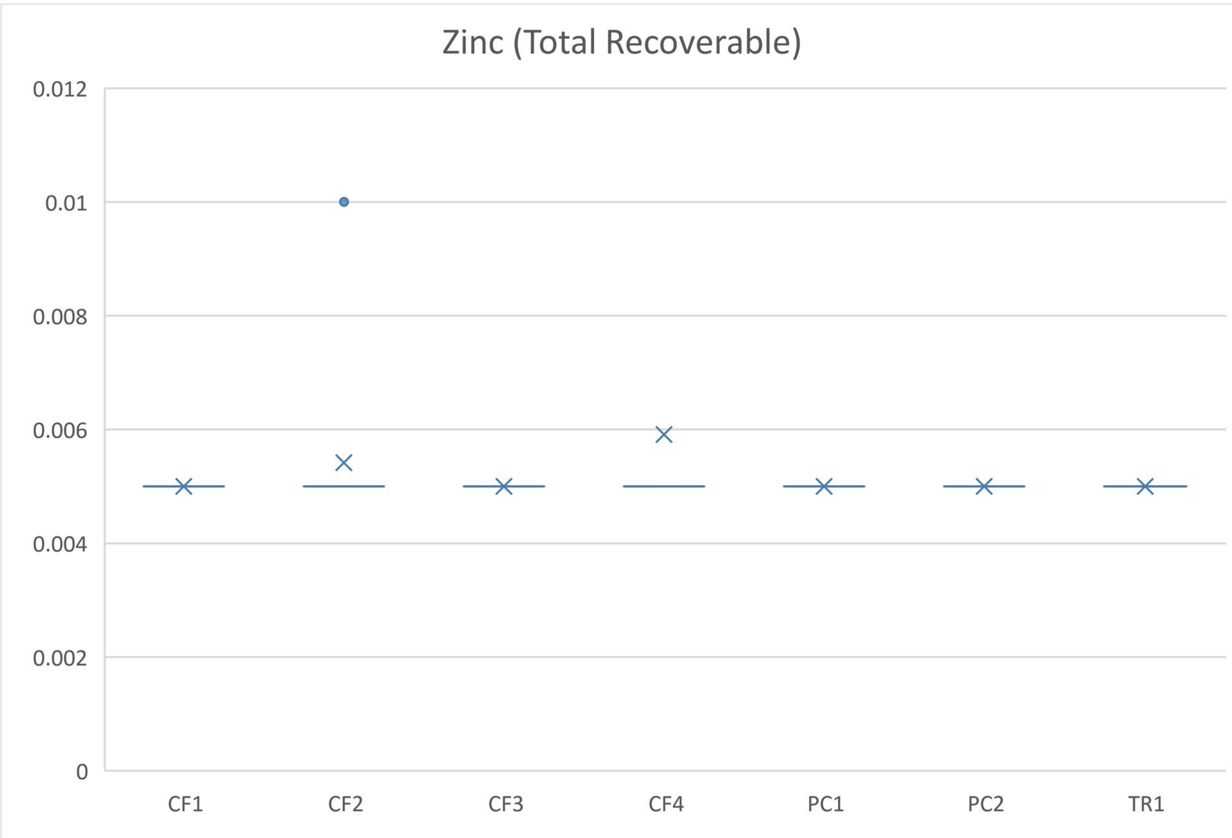

Figure 2-12. Zinc concentrations across all water quality monitoring sites (in mg/L).

Section 2.1.2.3 – Field Parameters

Field parameters were collected during each water chemistry monitoring event using a Hydrolab HL7 sonde as a part of the overall site characterization. Parameters measured included depth, water temperature, specific conductivity, pH, turbidity, and dissolved oxygen. The Hydrolab sonde was laboratory calibrated prior to each monitoring event to ensure instrument accuracy. Total dissolved gas (TDG) monitoring was also conducted in 2021 as a separate FERC approved study. The results of the 2021 TDG study can be found in the Initial Study Report, Total Dissolved Gas Study that was submitted to FERC in April 2022 (NorthWestern, 2022).

Specific Conductivity

Specific conductivity changed very little across the Clark Fork sites (CF1, CF2, CF3, and CF4) (**Figure 2-13**), but was significantly lower at the tributary sites (PC1 and TR1). Prospect Creek had the lowest conductivity values of all sites, and the conductivity of the Thompson River was slightly lower than the Clark Fork sites.

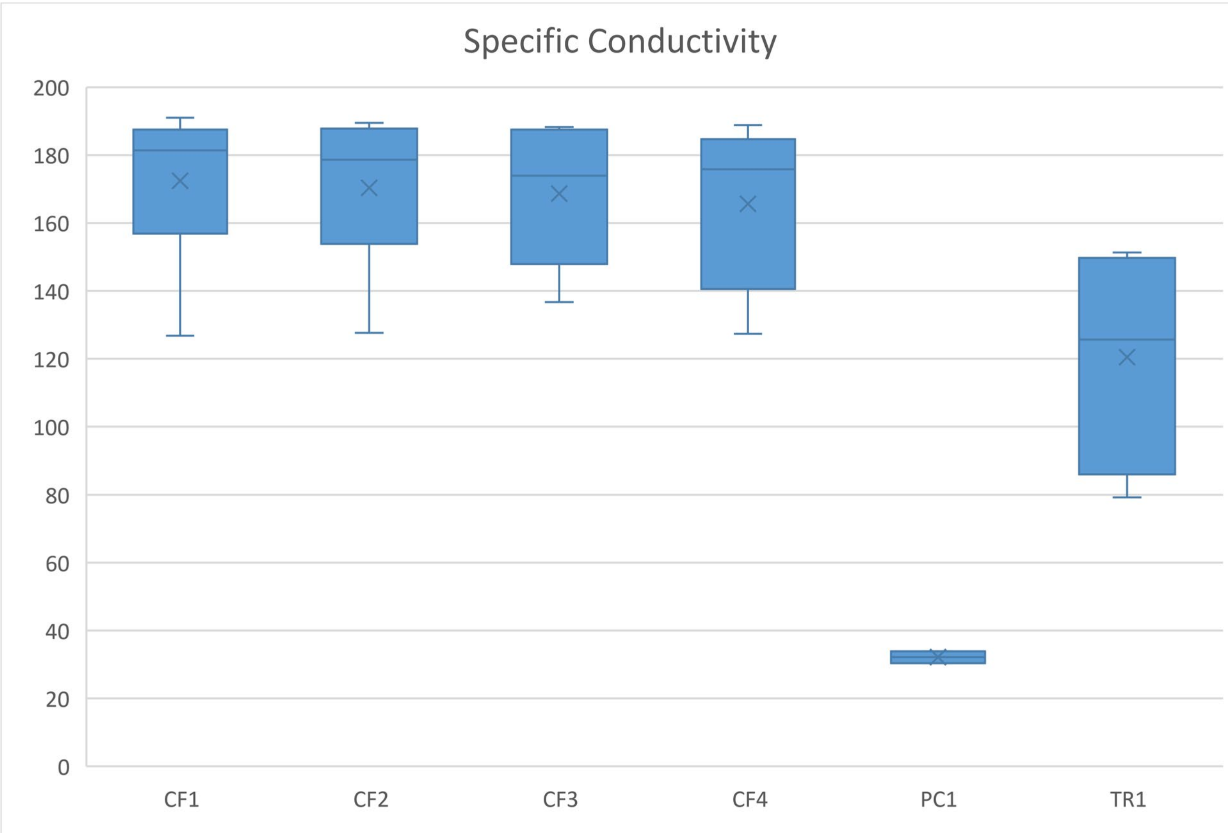

Figure 2-13. Specific conductivity across all water quality monitoring sites (**in µS/cm**).

pH

The measurement of pH at the Clark Fork sites (CF1, CF2, CF3, and CF4) showed relatively little change in pH from site to site, but the pH of Prospect Creek was significantly lower than the Clark Fork sites, and the pH of the Thompson River was more similar to the pH of the Clark Fork sites (**Figure 2-14**). The pH of Prospect Creek is closer to a neutral pH of 7, whereas all other sites have a high pH generally falling in the 8-8.5 range.

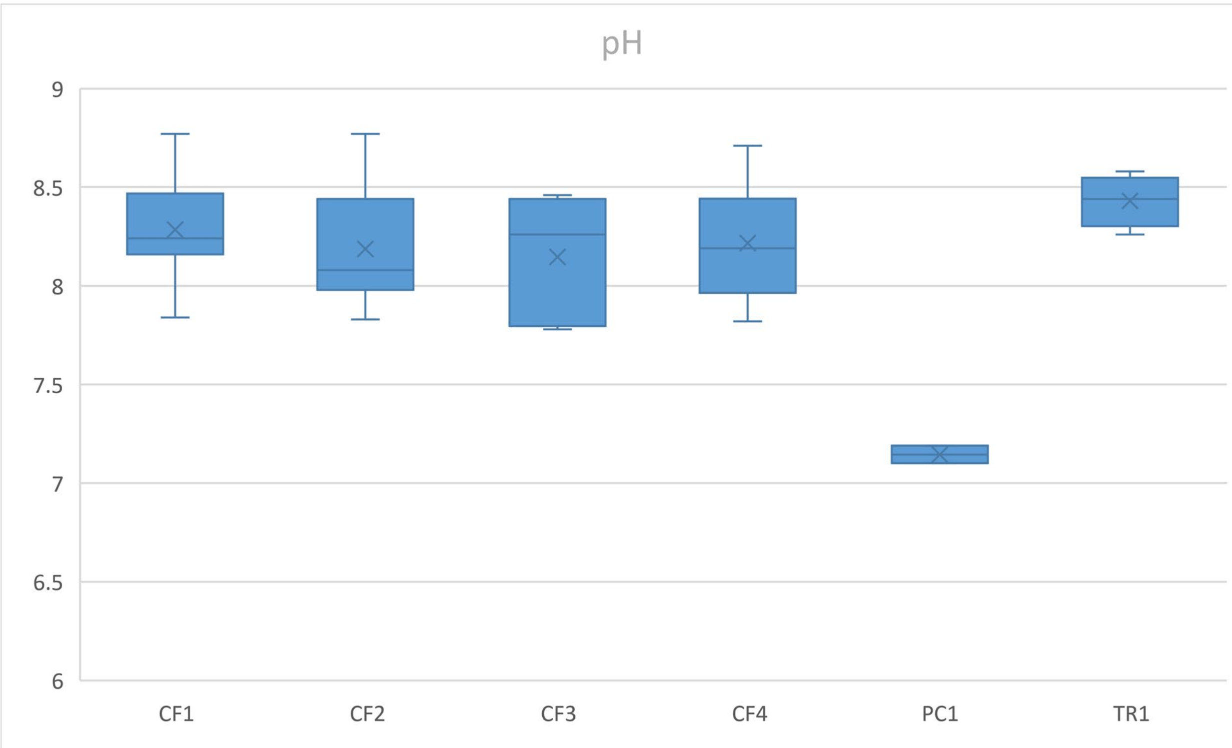

Figure 2-14. pH measurement across all water quality monitoring sites (**in units**)**.**

Turbidity

Turbidity, or the measure of relative clarity in water, remained fairly consistent throughout the Clark Fork sites (CF1, CF2, CF3, and CF4) with elevated turbidity (~20 nephelometric turbidity unit [NTU]) occurring during the spring runoff period, and low to no turbidity (<1 NTU) occurring throughout the rest of the year (**Figure 2-15**). Turbidity measurements in Prospect Creek and the Thompson River remained low (<5 NTU) throughout the entire monitoring period.

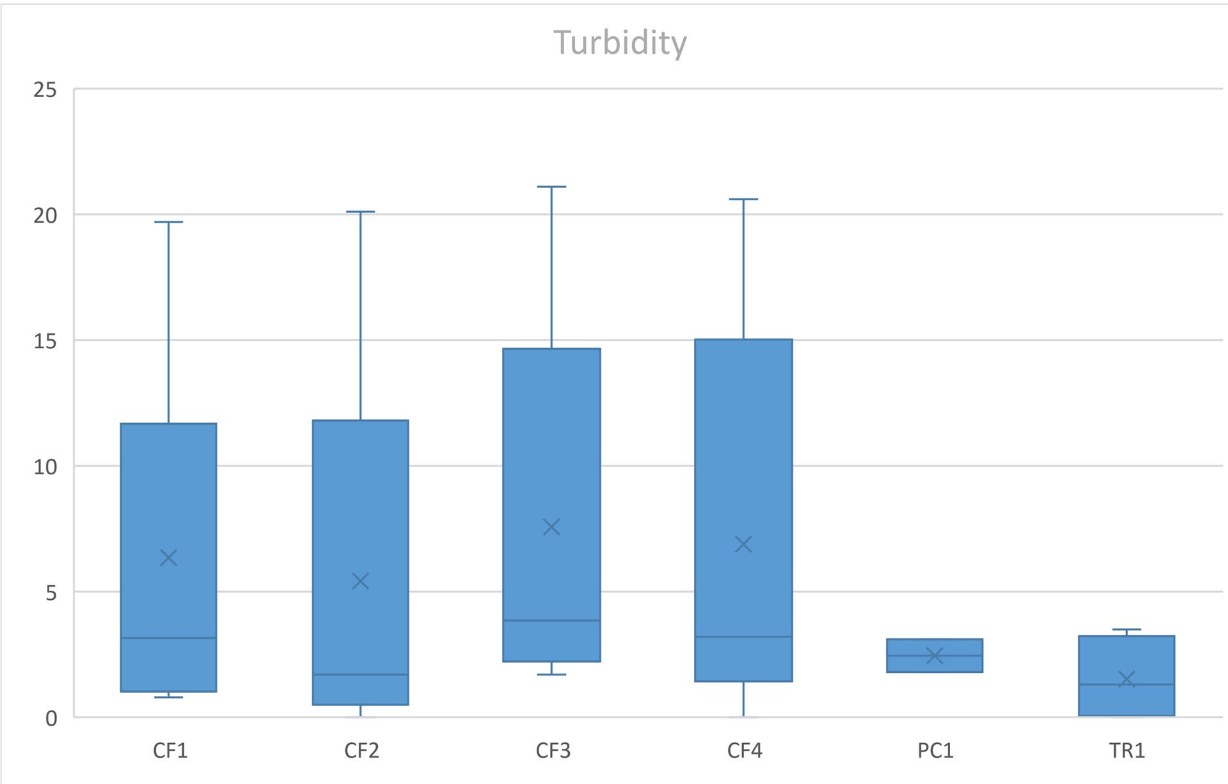

Figure 2-15. Turbidity measurement across all water quality monitoring sites (in NTU).

Dissolved Oxygen

Dissolved oxygen (DO) is measurement of the amount of oxygen that is present in water and can be represented as a concentration (in milligrams per liter [mg/L]) or as a saturation percentage. Concentrations of DO showed little change across the Clark Fork sites (CF1, CF2, CF3, and CF4), while DO concentrations in the Thompson River were slightly higher than the other sites, and Prospect Creek DO concentrations were similar to those of the Clark Fork sites (**Figure 2-16**). DO percent saturation values showed a similar pattern to the measured DO concentrations except the range of DO percent saturation at site CF4 was much greater than the other sites (**Figure 2-17**). This is likely due to the influence of spillway water during periods of high flow.

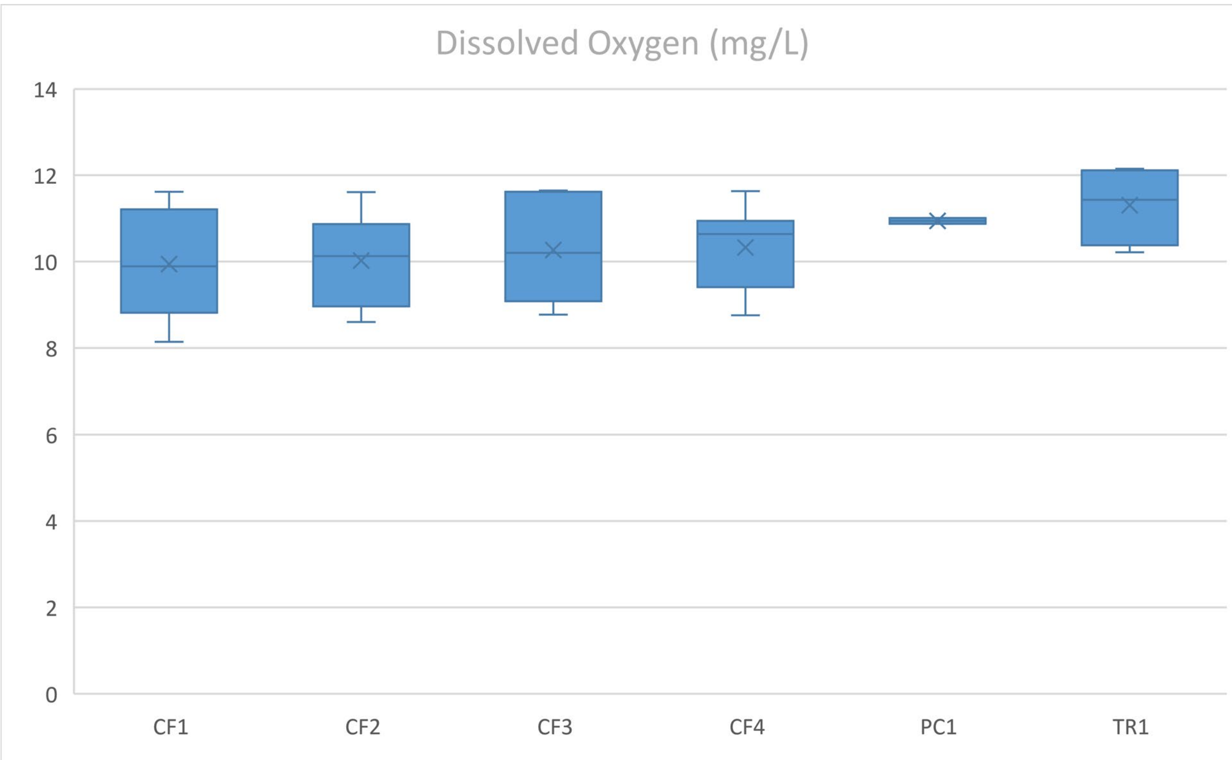

Figure 2-16. Dissolved oxygen concentration across all water quality monitoring sites (in mg/L).

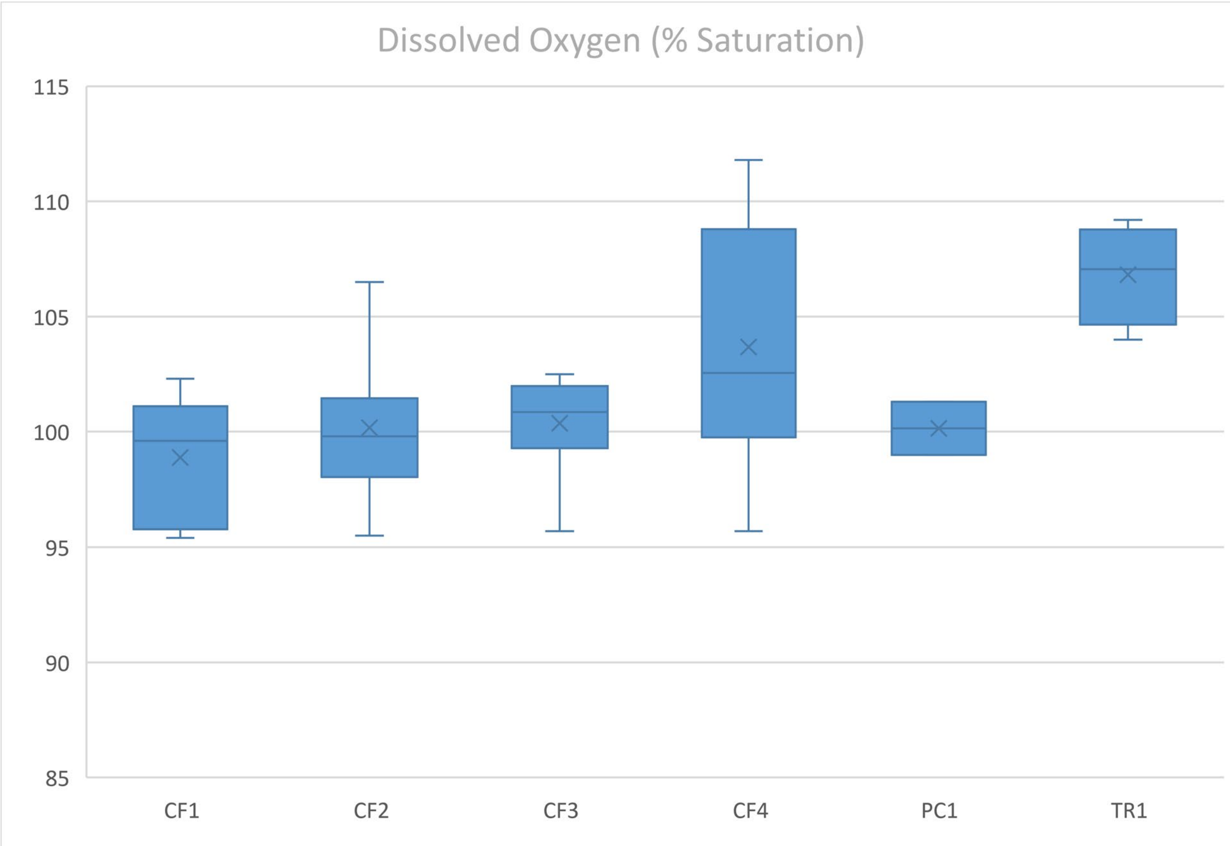

Figure 2-17. Dissolved oxygen percent saturation across all water quality monitoring sites (in %).

Section 2.1.2.4 – Water Temperature

In 2019 and 2021, water temperature data were collected at multiple locations throughout the Project to characterize the existing thermal regime of the reservoir, its inputs and outputs. After high river flows receded, thermographs were placed at four locations in 2019 (**Table 2-3**) and seven locations in 2021 (**Table 2-4**) across the Project and monitored water temperature at 15-minute intervals throughout the summer months. Instantaneous maximum water temperatures were reported as the warmest instantaneous measurement for the dataset. 7-Day maximum water temperatures were calculated and reported as an average of the daily maximum temperatures for the seven warmest consecutive days.

The instantaneous and 7-day maximum water temperatures in the Clark Fork River upstream of Thompson Falls Reservoir were just slightly higher than the comparable measurements collected downstream of the Project at the Birdland Bay Bridge (**Table 2-3, Figures 2-18 and 2-19**). Water temperature in the Thompson River is cooler than water temperature in the Clark Fork River, with the 7-day maximum water temperature being significantly lower than the comparable measurement in the Clark Fork River (**Table 2-3**). This pattern was consistent throughout the summer of 2019, with the Thompson River being cooler than the Clark Fork River from late June until early October (**Figure 2-18**). In addition, the three measurement sites on the Clark Fork River all had very similar water temperature from late June until early October

(**Figure 2-18**). These data support the conclusion that water temperature is consistent from upstream to downstream of the Project.

Monitoring in 2021 included the same sites as 2019, but data were also collected at additional sites as a part of the FERC approved Thompson Falls Relicensing Operations Study. The additional monitoring sites included a site at the furthest upstream extent of the Project boundary, a site located in the island complex downstream of site CF1, and site CF3, which is located directly downstream of the old powerhouse (**Table 2-4**). Similar to 2019, water temperatures remained relatively stable throughout the Clark Fork monitoring sites and the Thompson River was significantly cooler than the Clark Fork River (**Table 2-4, Figures 2-20 and 2-21**).

Table 2-3. Summary of 2019 water temperature data.

Site Name	Site Description	Date of Sample	Variable	Temperature (°F)	Temperature (°C)
CF1	Clark Fork River upstream of Thompson Falls Reservoir	8/8/19	Instantaneous Maximum Temperature	74.79	23.77
		8/3/19-8/9/19	7-Day Maximum	73.93	23.29
CF2	Clark Fork River upstream of dam in Thompson Falls Reservoir	8/9/19	Instantaneous Maximum Temperature	73.75	23.19
		8/3/19-8/9/19	7-Day Maximum	73.33	22.96
CF4	Clark Fork River at Birdland Bay Bridge	8/7/19	Instantaneous Maximum Temperature	73.47	23.04
		8/3/19-8/9/19	7-Day Maximum	73.15	22.86
TR1	Thompson River at mouth	8/3/19	Instantaneous Maximum Temperature	65.85	18.81
		8/1/19-8/7/19	7-Day Maximum	65.00	18.33

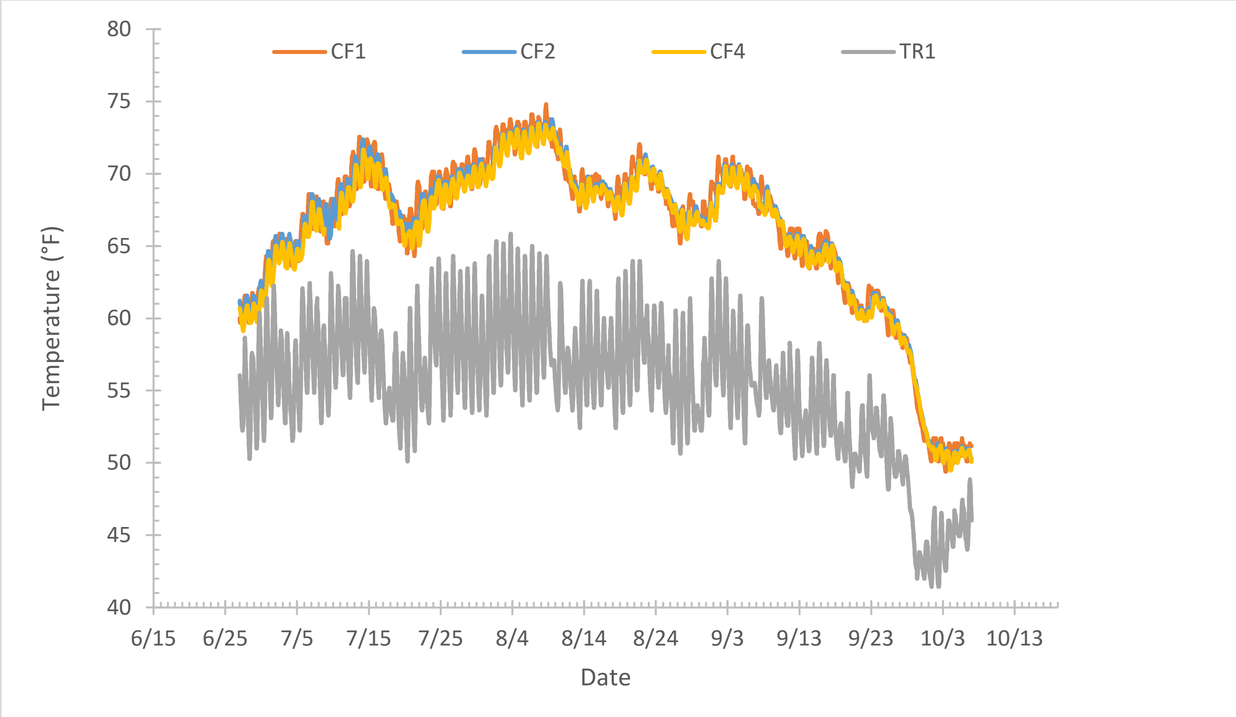

Figure 2-18. Thompson Falls Project water temperatures from June 27 through October 6, 2019.

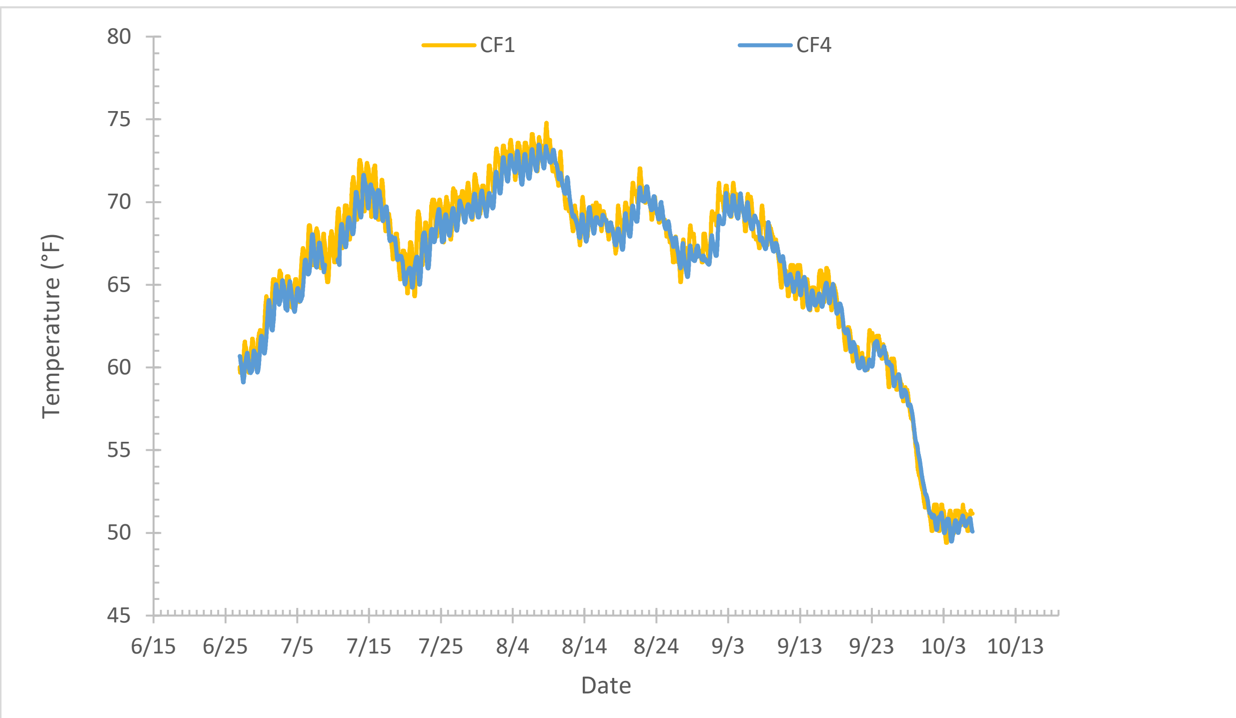

Figure 2-19. Upstream and downstream water temperature comparison from June 27 through October 6, 2019.

Table 2-4. Summary of 2021 water temperature data.

Site Name	Site Description	Date of Sample	Variable	Temperature (°F)	Temperature (°C)
Upstream Project Boundary	Clark Fork River at the edge of the upstream Project boundary	7/31/21	Instantaneous Maximum Temperature	77.28	25.16
		7/29/21-8/4/21	7-Day Maximum	76.53	24.74
CF1	Clark Fork River upstream of Thompson Falls Reservoir	7/31/21	Instantaneous Maximum Temperature	77.28	25.16
		7/29/21-8/4/21	7-Day Maximum	76.28	24.60
Island Complex	Clark Fork River in the Island complex downstream of CF1	7/31/21	Instantaneous Maximum Temperature	77.10	25.06
		7/29/21-8/4/21	7-Day Maximum	76.20	24.56
CF2	Clark Fork River upstream of dam in Thompson Falls Reservoir	8/1/21	Instantaneous Maximum Temperature	76.88	24.93
		7/30/21-8/5/21	7-Day Maximum	75.93	24.41
CF3	Clark Fork River downstream of old powerhouse	7/31/21	Instantaneous Maximum Temperature	77.28	25.16
		7/29/21-8/4/21	7-Day Maximum	76.28	24.60
CF4	Clark Fork River at Birdland Bay Bridge	8/1/21	Instantaneous Maximum Temperature	76.40	24.67
		7/30/21-8/5/21	7-Day Maximum	75.51	24.17
TR1	Thompson River at mouth	7/29/21	Instantaneous Maximum Temperature	65.55	18.64
		7/29/21-8/4/21	7-Day Maximum	63.78	17.66

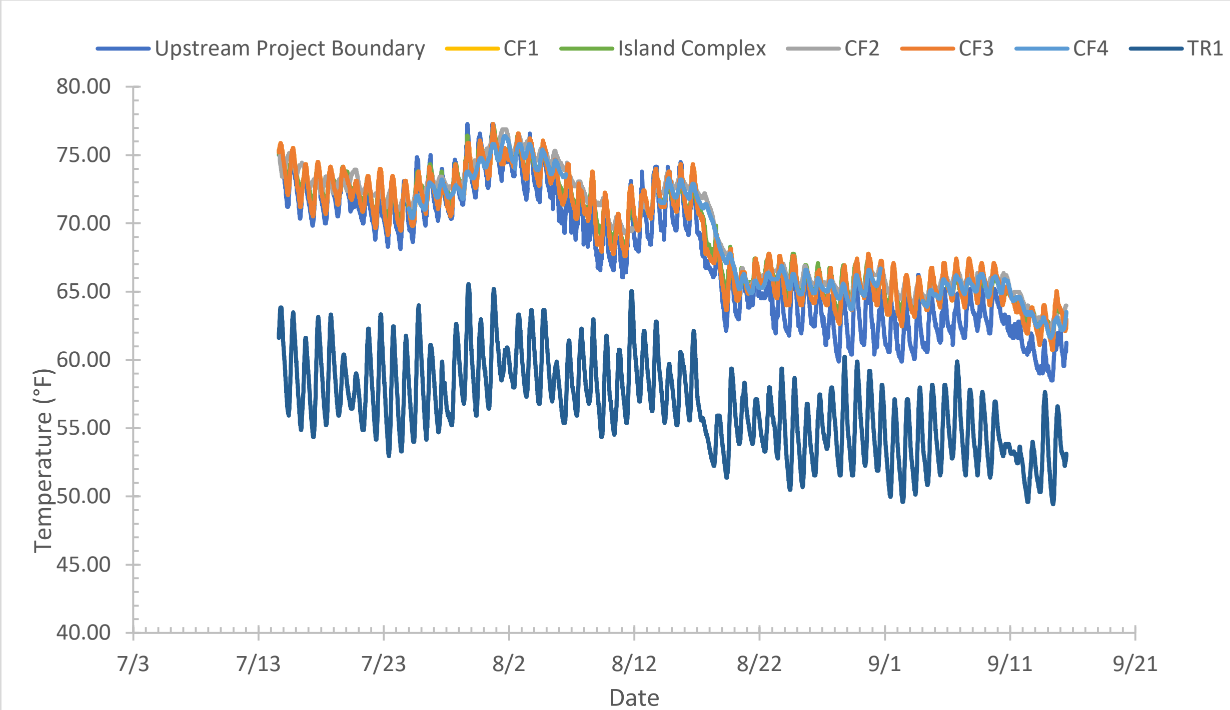

Figure 2-20. Thompson Falls Project water temperatures from July 15 through September 15, 2021.

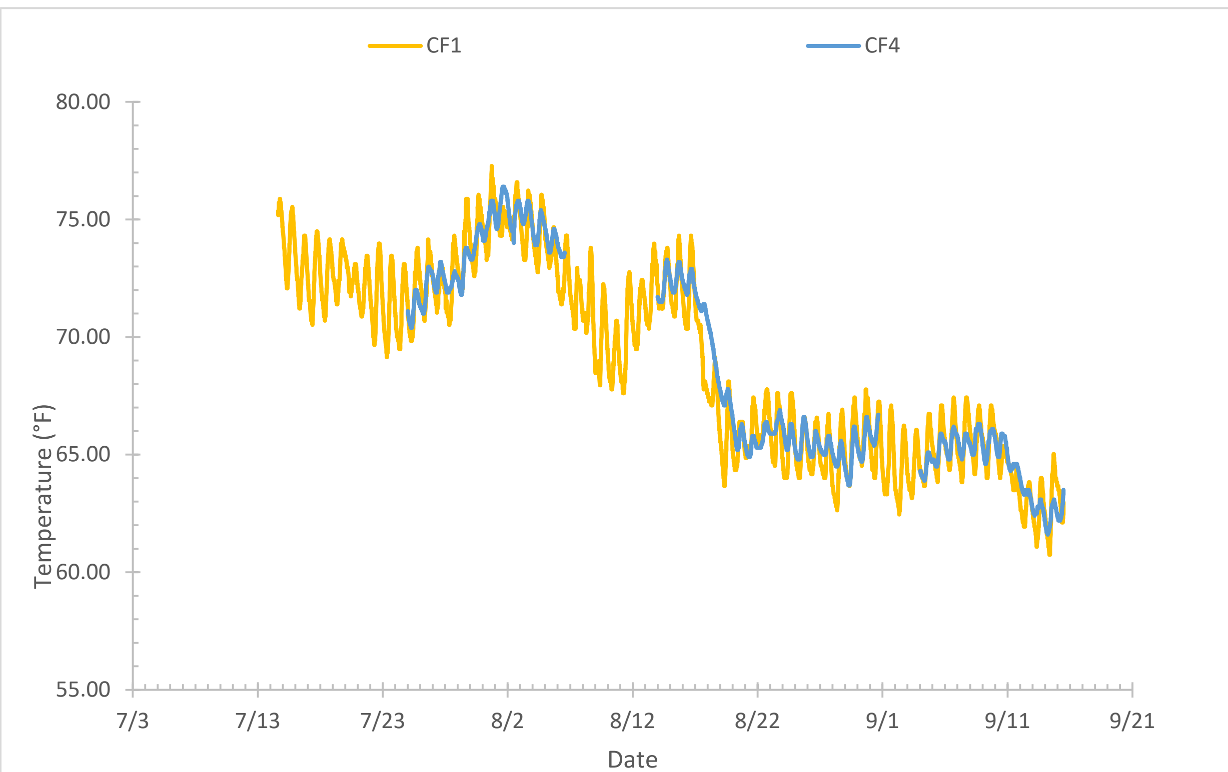

Figure 2-21. Upstream and downstream water temperature comparison from July 15 through September 15, 2021.

Section 2.2 – Sediment Chemistry

Four sediment bars were sampled in the lower portion of Thompson Falls Reservoir on July 13, 2020, using a core sampler to characterize the sediment in the lower reservoir. The reservoir was drafted 12 inches down that day to assist in accessing the sediment deposits via boat, and an attempt was made to sample the maximum possible depth of sediment at each location. Sediment sample depths were generally limited by substrate hardness and composition. Each sediment bar was sampled at three locations and those three samples were composited into one representative sample for each sediment bar, which were analyzed by Energy Laboratories and Pace Analytical for Metals, PCBs, and Dioxins.

Table 2-5 provides the location details and characteristics for each core sample, including the depth of the sample and the depth of water above the substrate at the sample location. This information is useful in determining the pond elevation in which that substrate becomes exposed.

Table 2-5. Locations and characteristics of Thompson Falls Reservoir sediment cores collected on 7/13/20.

Sediment Bar	Sample Number	Sample Depth (ft)	Water Depth (ft) After 12" Reservoir Draft	Latitude	Longitude
1	1	2.5	1.5	47.59211	-115.34028
1	2	2.5	1.5	47.59206	-115.34108
1	3	2.5	0.8	47.59230	-115.34370
2	1	1.0	1.0	47.58980	-115.34135
2	2	1.0	1.1	47.58969	-115.34044
2	3	1.5	0.0	47.58952	-115.33917
3	1	2.0	1.0	47.58947	-115.33701
3	2	1.3	0.5	47.59066	-115.33594
3	3	1.0	1.8	47.58933	-115.33310
4	1	2.0	1.0	47.59074	-115.33001
4	2	3.0	0.0	47.58842	-115.32886
4	3	1.5	1.4	47.58995	-115.32819

Figure 2-22 is a map showing the locations of each core sample from the lower reservoir in relation to the Town of Thompson Falls. The aerial imagery in **Figure 2-22** is from 2018 when the reservoir elevation was down to replace the stanchions on the dam and is not representative of the day that these samples were collected. This imagery was selected to show the extent of the sediment deposits in the lower reservoir; under normal full-pool reservoir elevations, the locations of these sample sites are underwater.

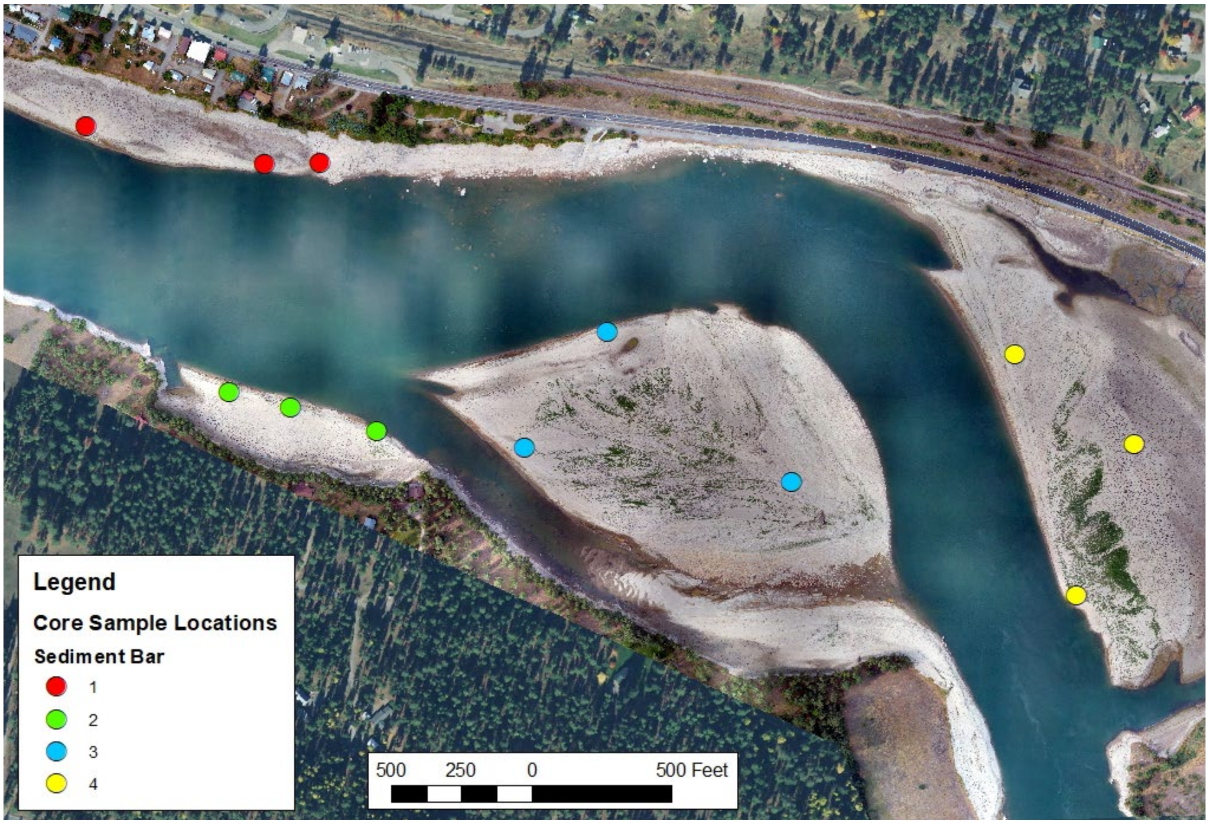

Figure 2-22. Sediment core sample locations in Thompson Falls Reservoir on 7/13/20.

Analytical results from the sediment core samples are shown in **Table 2-6 through Table 2-8**, below. **Table 2-6** shows the results of the Toxicity Characteristic Leaching Procedure (TCLP) metals analysis for each composite sample. TCLP is an analysis used to determine the potential for the leaching of a toxic substance from soil particles and is useful in understanding the toxic risk associated with a particular sediment sample. All sample results reported were below detectable levels for TCLP metals.

Table 2-6. TCLP metals analysis results from Thompson Falls Reservoir sediment cores collected on 7/13/20.

Metals TCLP Extractable (mg/L)								
Sediment Bar Sample	**Mercury**	**Arsenic**	**Barium**	**Cadmium**	**Chromium**	**Lead**	**Selenium**	**Silver**
Bar 1	ND	ND	ND	ND	ND	ND	ND	ND
Bar 2	ND	ND	ND	ND	ND	ND	ND	ND
Bar 3	ND	ND	ND	ND	ND	ND	ND	ND
Bar 4	ND	ND	ND	ND	ND	ND	ND	ND

Note:
ND = that the sample result was not found at a detectable concentration

Table 2-7 shows the results from the Polychlorinated Biphenyl (PCB) analysis conducted on each composite sediment sample. All samples were reported to be at non-detectable levels for PCBs.

Table 2-7. PCB analysis results from Thompson Falls Reservoir sediment cores collected on 7/13/20

Polychlorinated Biphenyls (PCBs) (mg/kg-Dry)									
Sediment Bar Sample	**Arochlor 1016**	**Arochlor 1221**	**Arochlor 1232**	**Arochlor 1242**	**Arochlor 1248**	**Arochlor 1254**	**Arochlor 1260**	**Arochlor 1262**	**Arochlor 1268**
Bar 1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bar 2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bar 3	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bar 4	ND	ND	ND	ND	ND	ND	ND	ND	ND

Note:
ND = that the sample result was not found at a detectable concentration

Each sample was also analyzed for dioxins, which are a group of toxic compounds that are generally found to originate from industrial activities. The two dioxin compounds of concern are 1,2,3,7,8,9-HxCDD and 2,3,7,8-TCDD, with 2,3,7,8-TCDD being the most toxic compound. Sample analysis results for both 1,2,3,7,8,9-HxCDD and 2,3,7,8-TCDD were at non-detectable levels (**Table 2-8**) for all samples.

Since 2,3,7,8-TCDD is the most toxic dioxin compound, all other remaining dioxins are grouped together and a total equivalence (TEQ) to 2,3,7,8-TCDD is calculated. For example, if a particular dioxin compound is 10 percent as toxic as 2,3,7,8-TCDD, then the measured concentration of that compound in nanograms per kilogram (ng/kg) is weighted by a factor of 0.1 and that number is added to the calculated toxic equivalencies of the other remaining dioxin compounds to calculate the overall TEQ for the sample.

The TEQ is used as a way to look at the combined toxicity of the remaining dioxin compounds, since all have varying levels of toxicity. The TEQ calculations for each composite sample were calculated by Pace Analytical, and the results can be found in **Table 2-8**. TEQ results for each composite sediment sample were well below the TEQ screening level of 22 ng/kg.

Table 2-8. Dioxin analysis results from Thompson Falls Reservoir sediment cores collected on 7/13/20.

Dioxin Screening (ng/kg)			
Sediment Bar Sample	**1,2,3,7,8,9-HxCDD**	**2,3,7,8-TCDD**	**TEQ**
Screening Level	*470*	*22*	*22*
Bar 1	ND	ND	0.52
Bar 2	ND	ND	0.59
Bar 3	ND	ND	0.51
Bar 4	ND	ND	0.57

Notes:
ND = the sample result was not found at a detectable concentration
TEQ = (Total 2,3,7,8-TCDD Equivalence) calculated by Pace Analytical

Based on the analytical results of the sediment core samples collected from the lower portion of Thompson Falls Reservoir on July 13, 2020, there does not appear to be any indication of toxicity related to the sediment collected at these sites. The sampling locations and core depths were representative of sediment deposits in the lower reservoir that might either be exposed and/or mobilized during normal reservoir operations.

Section 2.3 – Biological Monitoring

Biological indicators are an important part of monitoring the overall ecological health of a waterbody. These biological indicators typically respond to changes in water quality and can be studied to see a response to changing water quality conditions.

Aquatic macroinvertebrates and periphyton, the assemblage of aquatic organisms that attach to substrate, are strong bioindicators of stream health. Healthy streams support diverse macroinvertebrate communities of mayflies (*Ephemeroptera*), stoneflies (*Plecoptera*), caddisflies (*Trichoptera*), true flies (*Diptera*), beetles (*Coleoptera*), and many others. Macroinvertebrate and periphyton assemblages reflect cumulative impacts of all pollutants, such as toxic substances, organic pollution, or excessive sediment loading.

Zooplankton found in a lake or reservoir can be an important food source for fish and other aquatic organisms. Their presence and species composition can be used as an indicator of biological community health of a lake or reservoir.

Fish species can accumulate environmental contaminants in their muscle tissue over time through bioaccumulation. Typically, top trophic level predator species have the highest concentrations of contaminants, while lower trophic level prey species have the lowest concentrations of contaminants. Monitoring and tracking the concentrations in fish tissue contaminants over time can be used as an indicator of the environmental health of a waterbody.

Section 2.3.1 – Monitoring Sites and Methods

Biological monitoring occurred at two sites for macroinvertebrate and periphyton collection, three sites for zooplankton collection, and a reservoir-wide sampling effort for fish tissue biocontaminants. (**Table 2-9**).

In 2019, macroinvertebrate and periphyton samples were collected at sites CF1 and CF3 to determine if there were any changes in the biological community upstream and downstream of the reservoir (refer to **Figure 2-1**). Macroinvertebrate sampling methods used were consistent with NorthWestern's large river macroinvertebrate sampling methodologies. Sites CF1 and CF3 were chosen because the riffle habitat at these sites was the only appropriate habitat available in the Project area that meets the large river sampling criteria.

In addition to the macroinvertebrate and periphyton samples collected upstream and downstream of the reservoir, zooplankton samples were also collected at three sites on the reservoir, TFR1, TFR2, and TFR3 to determine the existing species composition and densities (refer to **Figure 2-1**). These sites were chosen to be representative of the upper, middle, and lower areas of Thompson Falls Reservoir. Vertical plankton tows were collected using an 80 µm (micron, or micrometer) mesh Wisconsin plankton net, and tow lengths were from the reservoir bed to the water surface.

Fish tissue samples were collected in the fall of 2019 as a part of NorthWestern's Thompson Falls Reservoir fisheries surveys. Gillnets were placed at multiple locations in the reservoir to capture representative fish populations throughout the reservoir. An attempt was made to analyze tissue from multiple species including both predator species and bottom-dwelling prey species. Multiple fish were collected of each species and each predator fish (Rainbow Trout and Northern Pike) was filleted and the fillets were composited by species to run as one representative composite sample per species. Bottom-dwelling prey species (Largescale Sucker) were processed whole and composited for one representative sample for that species.

Table 2-9. Description of methods and parameters measured at water chemistry monitoring sites.

Site Name	Site Purpose	Sampling Method	Samples Collected
CF1	Biological communities upstream of the reservoir	Kicknet, Scrape method	Macroinvertebrates, Periphyton
CF3	Biological communities downstream of the reservoir	Kicknet, Scrape method	Macroinvertebrates, Periphyton
TFR1	Upper reservoir sampling site	Wisconsin plankton net	Zooplankton
TFR2	Middle reservoir sampling site	Wisconsin plankton net	Zooplankton
TFR3	Lower reservoir sampling site	Wisconsin plankton net	Zooplankton
Thompson Falls Reservoir	Representative fish community sample	Gillnet	Fish tissue

Section 2.3.2 – Biological Monitoring Results

Section 2.3.2.1 - Aquatic Macroinvertebrates

Macroinvertebrate data were collected upstream (site CF1) and downstream (site CF3) of Thompson Falls Reservoir in 2019 to compare the biological communities and look at any effects on those communities from the Project. **Table 2-10** shows a comparison of the macroinvertebrate data collected at monitoring sites CF1 and CF3. The 2019 biological monitoring found that the Clark Fork River upstream (CF1) and downstream of Thompson Falls (CF3) support very similar macroinvertebrate benthic densities. Late-July density estimates at

CF3 reported 5,560 (±563) benthic macroinvertebrates per square meter (1,390 per sample), while upstream (CF1) densities averaged 5,115 (±950) per m^2.

In years of higher-than-normal discharge, macroinvertebrate densities are typically lower due to the flushing effect of high flows. Higher flows can reduce benthic macroinvertebrate densities by directly removing less velocity tolerant organisms (scuds, snails) or by removing silt in the gravels that favor midges and aquatic worms. Although higher than normal flows were observed in 2018 and 2019, midges (Diptera family: Chironomidae) still dominated the samples at both sites (Montana Biological Survey/Stag Benthics, 2019).

Table 2-10. Mean macroinvertebrate values for 8 metrics used in the bioassessment scores for 2019 samples.

Metric	CF1	CF3
Taxa Richness	37	38.4
EPT Richness	16.4	19.6
Shannon Diversity (log2)	3.6	3.4
Biotic Index	5.3	5.0
% EPT	36%	44%
% Chironomidae	40%	48%
% Filterers	49%	67%
EPT/EPTC	47%	48%
Mean Densities (per m^2)	5,115 (± 956)	5,568 (± 563)
Metals Tolerance Index	2.5	2.9

Note:
An average of 37 benthic macroinvertebrate taxa, including 16 EPT (*Ephemeroptera*, *Plecoptera*, and *Tricoptera*) species were collected per sample upstream of Thompson Falls, while 38 total taxa and 20 EPT taxa were collected downstream in 2019**.**

Macroinvertebrate community composition was also fairly similar upstream and downstream of Thompson Falls Dam except for a higher relative abundance of non-insect taxa reported at the CF1 site (**Figure 2-23**). The large non-insect taxa component at CF1 was largely comprised of *Lymnaeidae* and *Physidae* snails in the genera *Fossaria* and *Physella*, respectively. Dipterans accounted for 40 and 52 percent of the benthic community composition for CF1 and CF3 in 2019, respectively; this was largely composed of the midges, *Chironomidae*. Riffle beetles (*Coleoptera*: family *Elmidae*) made up a small, but not insignificant, component of the benthic community at each Clark Fork River site (Montana Biological Survey/Stag Benthics, 2019).

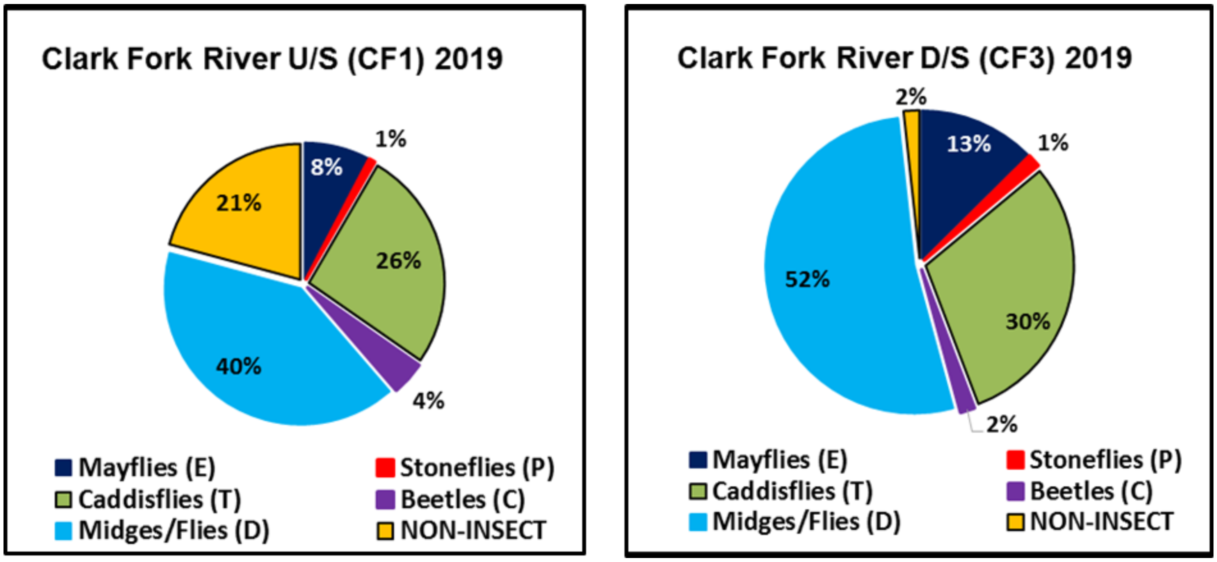

Figure 2-23. Macroinvertebrate community composition for sites CF1 and CF3.

Mayflies and caddisflies are important components of the Clark Fork River benthic community and to the bioassessment metrics, while Stoneflies represent a relatively small component (~1%) (**Figure 2-23**). Caddisflies were the most abundant of the EPT taxa in the Clark Fork River samples collected in 2019, representing 26 and 30 percent of the upstream (CF1) and downstream (CF3) communities, respectively. Of the 11 species of caddisflies collected at these sites, populations of three net-spinning caddisflies (*Cheumatopsyche, Hydropsyche occidentalis* and *H. morosa gr.*) were most abundant below the dam at site CF3, while the net-spinner, *Cheumatopsyche* and the long-horned caddisflies, *Ceraclea* and *Oecetis* were most abundant upstream of the reservoir at site CF1 (Montana Biological Survey/Stag Benthics, 2019).

Mayflies were the third most abundant invertebrate group at the downstream site (CF3) in 2019, while upstream (CF1) they were the fourth most abundant group (**Figure 2-23**). Of the 13 species of mayflies reported at site CF3, the most common were Tricos (mayflies in the genera *Tricorythodes*), *Tricorythodes minutus,* Blue-winged Olives *Acentrella and Baetis tricaudatus* and *Macaffertium* in the family *Heptageniidae*. A few *Attenella margarita* have been collected at this site. Site CF1 reported 8 species of mayflies with the dominant being Tricos, two *Heptageniidae* species, *Macaffertium* and *Heptagenia* and *Attenella margarita* (Montana Biological Survey/Stag Benthics, 2019).

Section 2.3.2.2 – Periphyton

In the periphyton assemblage, there were two predominant taxa found upstream and downstream of the reservoir, *Achnanthidium minutissimum* and *Achnanthidium subatomus*. These two species comprised of 57.17 percent of the upstream sample and 55.97 percent of the downstream sample. There was little change between the upstream and downstream metric scores, which ranged from good to excellent (**Table 2-11**).

Table 2-11. 2019 Clark Fork periphyton metric scores upstream and downstream of Thompson Falls Reservoir.

Site Name	Site Description	Date of Sample	Metric	Value	Rating
CF1	Clark Fork River upstream of Thompson Falls Reservoir	7/31/19	Shannon H	3.394	Excellent
			Species Richness	44	Excellent
			Dominant Taxon Percent	40.82%	Good
			Siltation Taxa Percent (Sediment)	11.24%	Excellent
			Pollution Index (Nutrients)	2.792	Excellent
			Disturbance Taxa Percent (Metals)	40.82%	Good
			Abnormal Cells Percent (Metals)	0.00%	Excellent
			Bioindex (Montana DEQ Mountains)	N/A	Good
CF3	Clark Fork River downstream of Old Powerhouse	7/31/19	Shannon H	3.670	Excellent
			Species Richness	52	Excellent
			Dominant Taxon Percent	30.22%	Good
			Siltation Taxa Percent (Sediment)	9.83%	Excellent
			Pollution Index (Nutrients)	2.729	Excellent
			Disturbance Taxa Percent (Metals)	30.22%	Good
			Abnormal Cells Percent (Metals)	0.00%	Excellent
			Bioindex (Montana DEQ Mountains)	N/A	Good

Section 2.3.2.3 - Zooplankton

Zooplankton were collected at three sites in Thompson Falls Reservoir in July 2019, using a vertical plankton tow. Results of the zooplankton tows are displayed in **Table 2-12**. Zooplankton concentrations in the reservoir were quite low, which is not surprising given the short residence time of water in the reservoir. Reservoir residence times of greater than 18 days are generally required to support a sustainable zooplankton population (Brook and Woodward, 1956). This time is needed for the zooplankton to successfully reproduce before being flushed downstream. Typical residence times of water in Thompson Falls Reservoir range from less than 4 hours in June to approximately 17 hours in September (refer to **Figure 1-2**).

Table 2-12. Zooplankton data collected from Thompson Falls Reservoir in 2019.

Taxon		Site TFR1 (Upstream end of TF Reservoir) 2019		Site TFR2 (Mid TF Reservoir) 2019		Site TFR3 (Downstream end of TF Reservoir) 2019	
		Count	Cells / ml	Count	Cells / ml	Count	Cells / ml
Cladocera	Chydoridae	0	0	0	0	1	0.00000161
Copepoda	Cyclopoida	1	0.00000189	4	0.00000821	5	0.00000804
Copepoda	Harpacticoida	0	0	1	0.00000205	0	0
Rotifera	Conochilus	0	0	2	0.00000411	0	0
Rotifera	Euchlanis	3	0.00000568	9	0.00001848	6	0.00000965
Rotifera	*Filinia longiseta*	2	0.00000378	0	0	0	0
Rotifera	*Filinia terminalis*	0	0	4	0.00000821	7	0.00001126
Rotifera	*Gastropus hyptopus*	1	0.00000189	0	0	1	0.00000161
Rotifera	*Kellicottia longispina*	9	0.00001703	3	0.00000616	4	0.00000643
Rotifera	*Keratella cochlearis*	5	0.00000946	1	0.00000205	4	0.00000643
Rotifera	*Keratella testudo*	9	0.00001703	0	0	7	0.00001126
Rotifera	Lecane	0	0	0	0	2	0.00000322
Rotifera	Monostyla lunaris	0	0	0	0	1	0.00000161
Rotifera	Pompholyx	0	0	2	0.00000411	3	0.00000483
Rotifera	Rotifera	4	0.00000757	6	0.00001232	8	0.00001287
Rotifera	Synchaeta	1	0.00000189	0	0	0	0
Rotifera	*Trichotria tetractis*	1	0.00000189	0	0	0	0

Section 2.3.2.4 - Fish Tissue Biocontaminants

In the fall of 2019, fish tissue samples were collected in Thompson Falls Reservoir for the purpose of quantifying concentrations of biocontaminants in fish. Eleven fish in total were collected as a part of this effort. Lengths and weights were recorded for each fish, and the fish from each species were composited into a single representative sample for the species (**Table 2-13**). Two predator species were represented in this sampling, Northern Pike and Rainbow Trout, and one bottom-dwelling prey species was represented, Largescale Sucker for a total of three representative composite samples.

Table 2-13. Individual fish length and weight data for composited fish tissue samples collected in 2019.

Fish Species	Length (mm)	Weight (g)
Largescale Sucker	230	140
Largescale Sucker	265	222
Largescale Sucker	260	218
Largescale Sucker	250	196
Northern Pike	720	3238
Northern Pike	640	2592
Northern Pike	625	2138
Northern Pike	530	908
Northern Pike	495	723
Rainbow Trout	420	1098
Rainbow Trout	460	1080

Results of the fish tissue analysis are shown below in **Table 2-14**. These data were provided to Montana Fish Wildlife and Parks (Montana FWP) to supplement their fish consumption advisory dataset. Montana FWP samples Thompson Falls Reservoir once every 5 years to maintain and update any fish consumption advisories that may be in place. Currently, there are fish consumption advisories for Northern Pike, Rainbow Trout, Smallmouth Bass, and Yellow Perch from Thompson Falls Reservoir due to the presence of Mercury (Montana FWP, 2021).

Table 2-14. 2019 Fish tissue biocontaminant analysis results by species.

Analyte	Rainbow Trout	Northern Pike	Largescale Sucker
Strontium	ND	0.8	26.2
Copper	1	1	4
Manganese	ND	2	36
Nickel	ND	ND	ND
Zinc	17	18	61
Arsenic	ND	ND	0.4
Cadmium	ND	ND	ND
Chromium	ND	ND	0.4

Analyte	Rainbow Trout	Northern Pike	Largescale Sucker
Selenium	0.9	0.6	0.7
Mercury	0.32	0.57	ND
Aluminum	ND	ND	47
Iron	30	17	115
Lead	ND	ND	ND

Notes:
ND = that the sample result was not found at a detectable concentration
All results are presented in mg-kg dry

Section 3.0 – Summary and Discussion

The Thompson Falls Project is the first impoundment in a series of three dams in the lower Clark Fork River and is the furthest upstream dam on the Clark Fork River (refer to **Figure 1-1**). NorthWestern collected a wide array of water quality data to characterize the current water quality conditions of the Project. Data were collected in 2019, 2020, and 2021 as a part of this effort, and included water chemistry and field parameters, water temperature, sediment chemistry, and biological data.

Water chemistry changes very little across the Project from upstream to downstream. This is mostly due to the very short residence time of the reservoir (3-17 hours) (refer to **Figure 1-2**). Nutrient concentrations remain low throughout the Clark Fork sites (CF1, CF2, CF3, and CF4) as well as the tributary sites on the Thompson River and Prospect Creek. Metals concentrations were generally low throughout the Clark Fork sites with the exception of lead concentrations at site CF4, which is downstream of the Project at Birdland Bay Bridge. Synoptic source assessment monitoring conducted in October 2020 was able to determine that the source of lead was occurring somewhere between Thompson Falls State Park (Site CF3.3) and Birdland Bay Bridge (site CF4). This lead source occurs outside of the Project, and the actual source remains unknown at this point. Prospect Creek, a tributary that enters the Clark Fork River downstream of Thompson Falls Dam, was found to contain high concentrations of cadmium, but it appears to be diluted by the time the water reaches site CF4 on the Clark Fork River.

Specific conductivity, pH, and turbidity remain relatively consistent throughout the Clark Fork sites, and dissolved oxygen saturation increases slightly downstream of the Project at site CF4 during the high flow season when the spillway is in use. Water temperatures show a slight decrease moving downstream through the Project, and the water temperature of the Thompson River is significantly cooler than that of the Clark Fork River.

Sediment chemistry samples collected in the lower portion of Thompson Falls Reservoir showed TCLP metals and PCBs were all at non-detectable concentrations. Dioxin analysis results for both 1,2,3,7,8,9-HxCDD and 2,3,7,8-TCDD were at non-detectable levels for all samples, and the calculated TEQs for all samples were found to be well below the screening level.

Macroinvertebrate taxa richness, EPT taxa richness, percent EPT taxa, and mean densities were higher downstream of Thompson Falls Reservoir than they were upstream of the reservoir, but percent *Chironomidae* were also higher downstream and were the dominant taxa at both monitoring sites. Periphyton metric scores were similar at both the upstream and downstream sites and had ratings of “good” or “excellent” for all metrics. Zooplankton were collected at three sites in Thompson Falls Reservoir, but due to the low residence time of the water in the reservoir, the reservoir does not support much of a zooplankton community. Fish consumption advisories have historically been in place for Thompson Falls Reservoir due to mercury, and 2019 fish tissue analysis confirmed the presence of mercury in both the Rainbow Trout and Northern Pike specimens that were sampled, but not in bottom-dwelling fish like Largescale Suckers.

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Appendix A

Table A-1. List of water chemistry analyses performed for water samples.

Analyte Group	Analyte	Method	Reporting Limit
Physical Properties	pH	A4500-H B	0-0.1 s.u.
Physical Properties	Total Dissolved Solids	A2540 C	10 mg/L
Physical Properties	Total Suspended Solids	A2540 D	10 mg/L
Inorganics	Alkalinity	A2320 B	4 mg/L
Inorganics	Anions by Ion Chromatography	E300.0	1 mg/L
Nutrients	Nitrogen, Nitrate+Nitrite	E353.2	0.01 mg/L
Nutrients	Nitrogen, Total Persulfate	A4500 N-C	0.01 mg/L
Nutrients	Phosphorus, Total	E365.1	0.005 mg/L
Metals, Dissolved	Arsenic	E200.7_8	0.001 mg/L
Metals, Dissolved	Cadmium	E200.7_8	0.0001 mg/L
Metals, Dissolved	Calcium	E200.7_8	1 mg/L
Metals, Dissolved	Copper	E200.7_8	0.001 mg/L
Metals, Dissolved	Iron	E200.7_8	0.03 mg/L
Metals, Dissolved	Lead	E200.7_8	0.001 mg/L
Metals, Dissolved	Magnesium	E200.7_8	1 mg/L
Metals, Dissolved	Manganese	E200.7_8	0.001 mg/L
Metals, Dissolved	Potassium	E200.7_8	1 mg/L
Metals, Dissolved	Sodium	E200.7_8	1 mg/L
Metals, Dissolved	Zinc	E200.7_8	0.01 mg/L
Metals, Total Recoverable	Arsenic	E200.7_8	0.001 mg/L
Metals, Total Recoverable	Cadmium	E200.7_8	0.0001 mg/L
Metals, Total Recoverable	Copper	E200.7_8	0.001 mg/L
Metals, Total Recoverable	Iron	E200.7_8	0.03 mg/L
Metals, Total Recoverable	Lead	E200.7_8	0.001 mg/L
Metals, Total Recoverable	Manganese	E200.7_8	0.001 mg/L
Metals, Total Recoverable	Zinc	E200.7_8	0.01 mg/L

Table A-2. List of water chemistry field parameters collected.

Analyte Group	Analyte	Method
Field Parameters	pH	Hydrolab HL7 Sonde
Field Parameters	Turbidity	Hydrolab HL7 Sonde
Field Parameters	Dissolved Oxygen	Hydrolab HL7 Sonde
Field Parameters	Temperature	Hydrolab HL7 Sonde
Field Parameters	Specific Conductance	Hydrolab HL7 Sonde
Field Parameters	Depth	Hydrolab HL7 Sonde