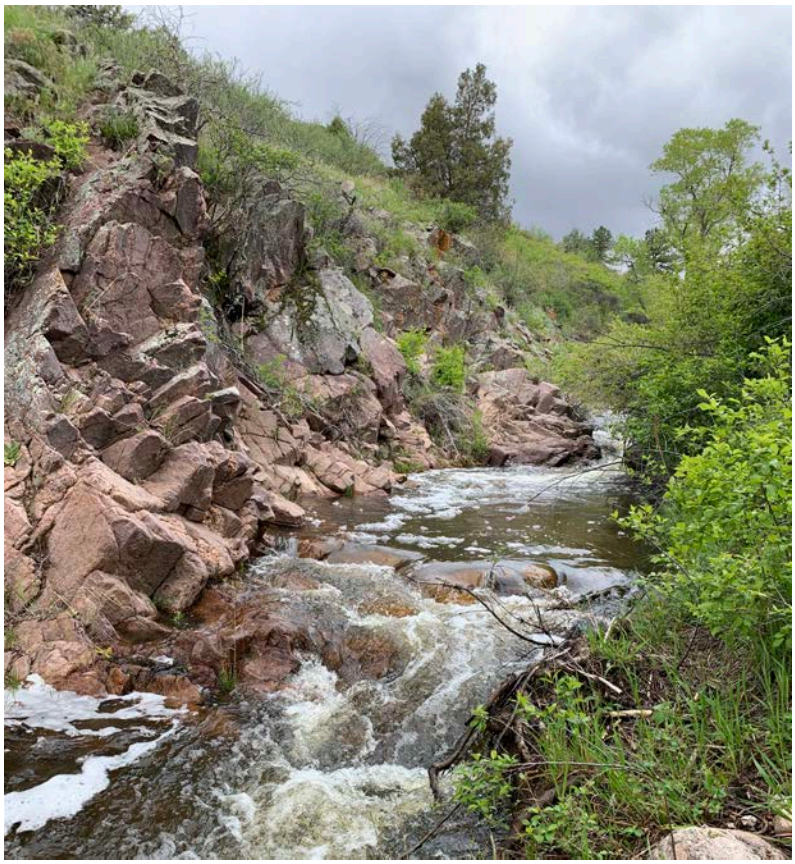
North Fork Little Thompson River Executive Summary



CWCB STAFF INSTREAM FLOW RECOMMENDATION
January 25-26, 2021

UPPER TERMINUS:	confluence Hell Canyon Creek UTM North: 4465680.11 UTM East: 473124.37
LOWER TERMINUS:	confluence Little Thompson River UTM North: 4461361.09 UTM East: 474370.33
WATER DIVISION:	1
WATER DISTRICT:	4
COUNTY:	Larimer
WATERSHED:	Big Thompson
CWCB ID:	18/1/A-002
RECOMMENDER:	Colorado Parks and Wildlife, Larimer County Department of Natural Resources (CPW, LCDNR)
LENGTH:	3.77 miles
FLOW RECOMMENDATION:	5 cfs (04/25 - 06/10) 2 cfs (06/11 – 06/30)

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Introduction

Colorado's General Assembly created the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment" (see 37-92-102 (3), C.R.S.). The statute vests the Colorado Water Conservation Board (CWCB or Board) with the exclusive authority to appropriate and acquire instream flow (ISF) and natural lake level water rights (NLL). Before initiating a water right filing, the Board must determine that: 1) there is a natural environment that can be preserved to a reasonable degree with the Board's water right if granted, 2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation to be made, and 3) such environment can exist without material injury to water rights.

Colorado Parks and Wildlife (CPW) and Larimer County Department of Natural Resources (LCDNR) recommended that the CWCB appropriate an ISF water right on a reach of the North Fork Little Thompson River because it has a natural environment that can be preserved to a reasonable degree. The proposed reach extends from the confluence with Hell Canyon Creek downstream to the confluence with the Little Thompson River. The North Fork Little Thompson River is located within Larimer County (See Vicinity Map), and originates about four miles east of Lake Estes at an elevation of approximately 8,600 feet. It flows in a southeasterly direction for 12 miles where it joins the Little Thompson River at an elevation of 5,900 feet. One hundred percent of the land on the 3.77 mile proposed reach is privately owned, but Larimer County holds a conservation easement that covers a large portion of this land (See Land Ownership Map).

The information contained in this Executive Summary and the associated supporting data and analyses form the basis for staff's ISF recommendation to be considered by the Board. This Executive Summary provides sufficient information to support the CWCB findings required by ISF Rule 5i on natural environment, water availability, and material injury. Additional supporting information is located at: https://cwcb.colorado.gov/2021-isf-recommendations.

Natural Environment

CWCB staff relies on the recommending entity to provide information about the natural environment. In addition, staff reviews information and conducts site visits for each recommended ISF appropriation. This information is used to provide the Board with a basis for determining that a natural environment exists.

The channel of the North Fork Little Thompson River is mainly single-thread, with a mixture of riffles, runs, glides and pools. The 2013 floods significantly altered the channels, causing erosion and bank degradation that are still apparent in 2020. The substrate ranges from sand to boulders, with sections of exposed bedrock. In some areas, bedrock outcroppings and woody debris form large deep pools that can hold water year round.

The riparian community is well established and includes cottonwood, narrow-leaf willow, and peachleaf willow, which provide abundant shade and cover for the stream. In addition, the upland contributing basin is comprised of a healthy ecosystem including ponderosa pine, mountain mahogany, and sage brush.

North Fork Little Thompson River provides a suitable variety of aquatic habitat with large woody debris contributions. Large pools and shade provided by the riparian community present refuge for fish during periods with little to no streamflow. Rainbow trout, creek chub, and longnose sucker were identified in the reach during the 2020 survey conducted by CPW. Fish, including trout and creek chub, have also been regularly observed in the large pools by the CWCB staff during site visits. Crawfish and macroinvertebrate populations include two species of caddisfly, mayfly, diptera, and black worms. A wide range of wildlife has been observed by local residents including muskrats, mink, beaver, mountain lion, black bear, fox, and numerous bird, amphibian, and reptile species.

Table 1. List of species identified in North Fork Little Thompson River.

Species Name	Scientific Name	Protection Status
rainbow trout	*Oncorhynchus mykiss*	None
creek chub	*Semotilus atromaculatus*	None
longnose sucker*	*Catostomus catostomus*	None
cottonwood	*Populus spp.*	None
narrowleaf willow	*Salix exigua*	None
peachleaf willow	*Salix amygdaloides*	None
caddisfly	*Tricoptera*	None
mayfly	*Ephemeroptera*	None
aquatic fly larvae	*Diptera*	None
black worm	*Lumbriculus variegatus*	None

*indicates state species native to Colorado (East slope)

ISF Quantification

CWCB staff relies upon the biological expertise of the recommending entity to quantify the amount of water required to preserve the natural environment to a reasonable degree. CWCB staff performs a thorough review of the quantification analyses completed by the recommending entity to ensure consistency with accepted standards.

Quantification Methodology

CPW and LCDNR staff used the R2Cross methodology to develop the initial ISF recommendation. The R2Cross method is based on a hydraulic model and uses field data collected in a stream riffle (Espegren, 1996). Riffles are a stream habitat type that are most easily visualized as sections of the stream that would dry up first should streamflow cease. The data collected consists of a streamflow measurement, survey of channel geometry and features at a single transect, and survey of the longitudinal slope of the water surface.

The field data is used to model three hydraulic parameters: average depth, average velocity, and percent wetted perimeter. Maintaining these hydraulic parameters at adequate levels across riffle habitat types also will maintain aquatic habitat in pools and runs for most life stages of fish and aquatic macroinvertebrates (Nehring, 1979). CPW, and LCDNR staff interpret the model results to develop an initial recommendation for summer and winter flows. The summer flow recommendation is based on meeting 3 of 3 hydraulic criteria. The winter flow

recommendation is based on meeting 2 of 3 hydraulic criteria. The model's suggested accuracy range is 40% to 250% of the streamflow measured in the field. Recommendations that fall outside of the accuracy range may not give an accurate estimate of the hydraulic parameters necessary to determine an ISF rate.

The R2Cross methodology provides the biological amount of water needed for summer and winter periods. The recommending entity uses the R2Cross results and its biological expertise to develop an initial ISF recommendation. CWCB staff then evaluates water availability for the reach typically based on median hydrology (see the Water Availability section below for more details). The water availability analysis may indicate less water is available than the initial recommendation. In that case, the recommending entity either modifies the magnitude and/or duration of the recommended ISF rates if the available flows will preserve the natural environment to a reasonable degree, or withdraws the recommendation.

Data Analysis

CPW collected R2Cross data at 3 transects for this proposed ISF reach (Table 2). Results obtained at more than one transect are averaged to determine the R2Cross flow rate for the reach of stream. The R2Cross model results in a winter flow of 8.46 cfs, which meets 2 of 3 criteria and is within the accuracy range of the R2Cross model. The R2Cross model results in a summer flow of 14.15 cfs, which meets 3 of 3 criteria and is within the accuracy range of the R2Cross model. R2Cross field data and model results can be found in the appendix to this report.

Table 2. Summary of R2Cross transect measurements and results for North Fork Little Thompson River.

Date, Xsec #	Top Width (feet)	Streamflow (cfs)	Accuracy Range (cfs)	Winter Rate (cfs)	Summer Rate (cfs)
05/29/2019, 1	32.76	10.75	4.30 - 26.88	4.42	Out of range
05/29/2019, 2	33.97	11.59	4.64 - 28.98	Out of range	11.95
04/28/2020, 3	48.39	14.04	5.62 - 35.10	12.49	16.34
			Mean	8.46	14.15

ISF Recommendation

CPW and LCDNR recommend the following flows based on R2Cross modeling analyses, biological expertise, and staff's water availability analysis.

5.0 cfs is recommended from April 25 through June 10. This flow rate is limited by water availability. Although this flow rate will not maintain velocities of 1 ft/s, it will provide adequate wetted perimeter and depth to support fish passage during the spring to early summer, enabling larger-bodied trout to move to pools for the remainder of the year. Because the stream supports trout approximately 6 inches and smaller, as well as smaller-bodied native species, average depth greater than approximately 0.2 feet should be sufficient in this case.

2.0 cfs is recommended from June 11 through June 30. This flow rate is limited by water availability, but will allow protection during the receding limb of the hydrograph after the high flow period. This will allow fish to continue to move to larger pools as streamflow recedes after

the snowmelt runoff. Average depths between 0.15 to 0.25 feet over the surveyed cross-sections will facilitate this migration for the resident fish populations.

CPW and LCNDR do not recommend a base flow rate outside of the spring to early-summer period due to water availability.

Water Availability
CWCB staff conducts hydrologic analyses for each recommended ISF appropriation to provide the Board with a basis for making the determination that water is available.

Methodology
Each recommended ISF reach has a unique flow regime that depends on variables such as the timing, magnitude, and location of water inputs (such as rain, snow, and snowmelt) and water losses (such as diversions, reservoirs, evaporation and transpiration, groundwater recharge, etc). Although extensive and time-consuming investigations of all variables may be possible, staff takes a pragmatic and cost-effective approach to analyzing water availability. This approach focuses on streamflows and the influence of flow alterations, such as diversions, to understand how much water is physically available in the recommended reach.

Staff's hydrologic analysis is data-driven, meaning that staff gathers and evaluates the best available data and uses the best available analysis method for that data. Whenever possible, long-term stream gage data (period of record 20 or more years) will be used to evaluate streamflow. Other streamflow information such as short-term gages, temporary gages, spot streamflow measurements, diversion records, and StreamStats will be used when long-term gage data is not available. StreamStats, a statistical hydrologic program, uses regression equations developed by the USGS (Capesius and Stephens, 2009) to estimate mean flows for each month based on drainage basin area and average drainage basin precipitation. Diversion records will also be used to evaluate the effect of surface water diversions when necessary. Interviews with water commissioners, landowners, and ditch or reservoir operators can provide additional information. A range of analytical techniques may be employed to extend gage records, estimate streamflow in ungaged locations, and estimate the effects of diversions. The goal is to obtain the most detailed and reliable estimate of hydrology using the most efficient analysis technique.

The final product of the hydrologic analysis used to determine water availability is a hydrograph, which shows streamflow and the proposed ISF rate over the course of one year. The hydrograph will show median daily values when daily data is available; otherwise, it will present mean-monthly streamflow values. Staff will calculate 95% confidence intervals for the median streamflow if there is sufficient data. Statistically, there is 95% confidence that the true value of the median streamflow is located within the confidence interval.

Basin Characteristics
The drainage basin of the proposed ISF on North Fork Little Thompson River is 27.90 square miles, with an average elevation of 7,558 feet and average annual precipitation of 19.06 inches (See the Hydrologic Features Map). The stream's hydrology is driven by melt from low elevation snowpack, causing peak flows to typically occur in the late spring. CWCB staff observed some ground water seeps feeding the stream during spring snow melt. As the water table recedes in early to mid-summer, CPW and CWCB staff observed little to no streamflow at times. Sporadic

events of significant rainfall in mid to late summer and early fall have been observed to return streamflow. There are no significant decreed surface water diversions in the proposed reach. However, a portion of the Bureau of Reclamation (BOR) Colorado-Big Thompson (C-BT) Project can impact streamflow in the headwaters of the North Fork Little Thompson River.

A portion of the C-BT Project transports water through the Olympus Tunnel at Lake Estes to the Pole Hill Tunnel, before continuing to Pinewood Reservoir via Rattlesnake Tunnel and then to Flatiron Reservoir, Carter Lake, and Horsetooth Reservoir. The Pole Hill Power Plant is located in the North Fork Little Thompson Creek drainage approximately 1.7 miles north of the proposed upper terminus. This power plant generates hydroelectric power as part of the C-BT Project. Under typical operation, approximately 550 cfs from the Pole Hill Tunnel goes through the penstocks to generate power, then continues to the power plant's afterbay and back into the system through Rattlesnake Tunnel. During times of maintenance or emergency shut off, the system has the ability to "bypass" the penstock by rerouting water into the North Fork Little Thompson River (through Little Hells Canyon). Bypass in this context refers to routing water around the penstocks, it does not refer to bypassing native flow. This water is then recaptured by a diversion structure (referred to as "rediversion structure") that spans the width of the North Fork Little Thompson. The rediversion structure can be adjusted using stop-logs. The recaptured water is then routed into the Pole Hill Power Plant afterbay and back into the C-BT system.

BOR's rediversion structure is manually operated and generally not adjusted more than a few times a year. For the majority of the year, the rediversion structure is set to allow typical North Fork Little Thompson flows to pass through the structure. However, when the North Fork Little Thompson River is running high, particularly after a rainfall or snowmelt event, some of the native flow of the North Fork Little Thompson River is inadvertently captured by the rediversion structure and routed into the C-BT system. The stop-logs are usually only lowered all the way down during maintenance periods, which usually occur once a year for approximately one month. When the stop-logs are all the way down and the system is routing project water through Little Hells Canyon, the rediversion structure captures all water (both native North Fork Little Thompson and C-BT water) except for some water that leaks through the rediversion structure and continues down the North Fork Little Thompson. In recent years, the timing of the maintenance period has shifted from late fall to spring.

Figure 1. Downstream of the North Fork Little Thompson Rediversion Structure. Image was captured by BOR during a bypass event in August of 2020.

Data Analysis

CWCB Gage Data

There are no current or historic gages on the proposed ISF reach. Due to limited available data, CWCB staff installed a temporary streamflow gage on the North Fork Little Thompson River in July of 2017 at a bridge approximately 0.5 miles upstream from the lower terminus. This gage was operated between July 27, 2017 and March 16, 2018. This location did not provide a good hydraulic control and was impacted by accumulation of leaf debris in the fall and winter. On March 22, 2018, the gage was moved upstream approximately 1 mile. This location is where the stream flows through a bedrock channel and provides a stable hydraulic control. The gage has a drainage area of 25.7 square miles, 7,650 feet average basin elevation, and 19.09 inches of average basin annual precipitation. There are no surface water diversions affecting the gage other than the BOR operations described above.

Due to the short period of record at the gage, staff examined a nearby streamgage, Little Thompson River at Canyon Mouth near Berthoud, CO (LYCANYCO) to assess how 2018 through 2020 compared hydrologically to a longer record. The Little Thompson River gage is located 5.8 miles southeast of the proposed lower terminus. The gage recorded data between 1961 to 1969, 1993 to 2013, and 2017 to present for a total of 33 years of record. This gage is affected by diversions but is one of the few long-term gages in proximity to the CWCB gage. The Little Thompson gage is a seasonal gage with an inconsistent amount of days where data was recorded each year, so an assessment of the total annual streamflow could not be done. However, Staff computed median flows at the Little Thompson gage and compared them to flows from 2018-2020. In comparison to historical flows, 2018 was extremely dry and experienced below median flows for the entirety of the year. 2019 was an exceptionally wet year and experienced above

median flows for the majority of the year. 2020 experienced an early and above median peak, but a dry spring and summer and flows fell much below average starting in late May.

Pole Hill Power Plant Data
Staff has coordinated with BOR staff regarding this ISF recommendation. The BOR provided staff with information about the timing of power plant operations. At times, routing C-BT water through the upper reaches of the North Fork Little Thompson appeared to coincide with short spikes of higher flows at the CWCB gage, suggesting that this operation provided additional water to the proposed ISF reach. However, at other times, these operations did not appear to result in higher flows at the CWCB gage.

The drainage basin of the North Fork Little Thompson that could potentially be captured in the rediversion structure is approximately 6.59 square miles, which is about 23.4% of the total drainage basin for the proposed ISF. The exact amount of native water inadvertently captured cannot be directly measured, but the loss of this water is reflected in the CWCB gage data. At this time, staff has concluded that no more analysis or data collection is necessary.

Representative Gage Analysis
Because the Little Thompson at Canyon Mouth gage has a longer period of record, it was also used to estimate streamflow on the North Fork Little Thompson River. The Little Thompson River gage has a drainage basin of 100 square miles, an average elevation of 7,503 feet, and average precipitation of 19.6 inches. There are approximately 11 cfs of decreed water rights and 1,900 AF of decreed storage in the basin. This gage is likely to be more heavily impacted by water use than North Fork Little Thompson. The use of this gage in the analysis likely under-estimates streamflow on North Fork Little Thompson.

The area-precipitation method was used to scale the Little Thompson River gage to the lower terminus of North Fork Little Thompson. The method estimates streamflow based on the ratio of the precipitation weighted drainage area. The scaling factor for North Fork Little Thompson at the lower terminus is 0.27. Median streamflow and 95% confidence intervals for median streamflow were calculated.

Landowner Comments
In addition to the CWCB gage data and streamflow measurements, staff has been in contact with a local landowner who has owned and resided on land adjacent to the North Fork Little Thompson since 1989. During their time in the area, they have observed a range of hydrologic conditions on the River. The landowner has kept record of the presence of water at their property since 1991. In the 1990s, they often experienced water year-round, but since 2000, years with year-round flow have been rare. From the landowner's records, flow was fairly consistent between April and the end of June.

CWCB Staff Measurements
CWCB staff made 21 streamflow measurements to support development of a rating curve for the temporary gage and provide additional information.

Table 3. Summary of Streamflow Measurement Visits and Results for North Fork Little Thompson River.

Visit Date	Flow (cfs)	Collector
07/27/2017	0.05	CWCB
08/07/2017	2.00	CWCB
09/13/2017	0.01	CWCB
09/29/2017	0.53	CWCB
10/18/2017	0.63	CWCB
12/06/2017	0.17	CWCB
03/02/2018	0.12	CWCB
03/16/2018	0.16	CWCB
03/16/2018	0.15	CWCB
03/22/2018	0.17	CWCB
04/23/2018	0.43	CWCB
04/30/2018	2.78	CWCB
04/15/2019	0.76	CWCB
05/29/2019	11.17	CWCB
07/15/2019	3.38	CWCB
09/19/2019	0.06	CWCB
05/13/2020	4.92	CWCB
05/13/2020	2.82	CWCB
05/19/2020	2.82	CWCB

Water Availability Summary

The Complete Hydrograph shows streamflow data, streamflow measurements, the prorated Little Thompson gage daily median flows with 95% confidence intervals, and the proposed ISF. Due to the variability of hydrologic conditions during the period of record of the CWCB gage, the Little Thompson gage likely provides the best indication of seasonality of the North Fork Little Thompson. Additionally, information from the landowner indicates that flows typically occur during April through July on the North Fork Little Thompson. With the exception of 2018, the temporary gage data demonstrates that the recommended flow rates occur during these time frames. Based on measurements at the gage, the prorated Little Thompson gage and information from the long-term landowner, Staff has concluded that water is available for a seasonal ISF.

Material Injury
Because the proposed ISF on North Fork Little Thompson River is a new junior water right, the ISF can exist without material injury to other water rights. Under the provisions of section 37-92-102(3)(b), C.R.S. (2020), the CWCB will recognize any uses or exchanges of water in existence on the date this ISF water right is appropriated.

Citations
Capesius, J.P. and V.C. Stephens, 2009, Regional regression equations for estimation of natural streamflow statistics in Colorado, Scientific Investigations Report 2009-5136.

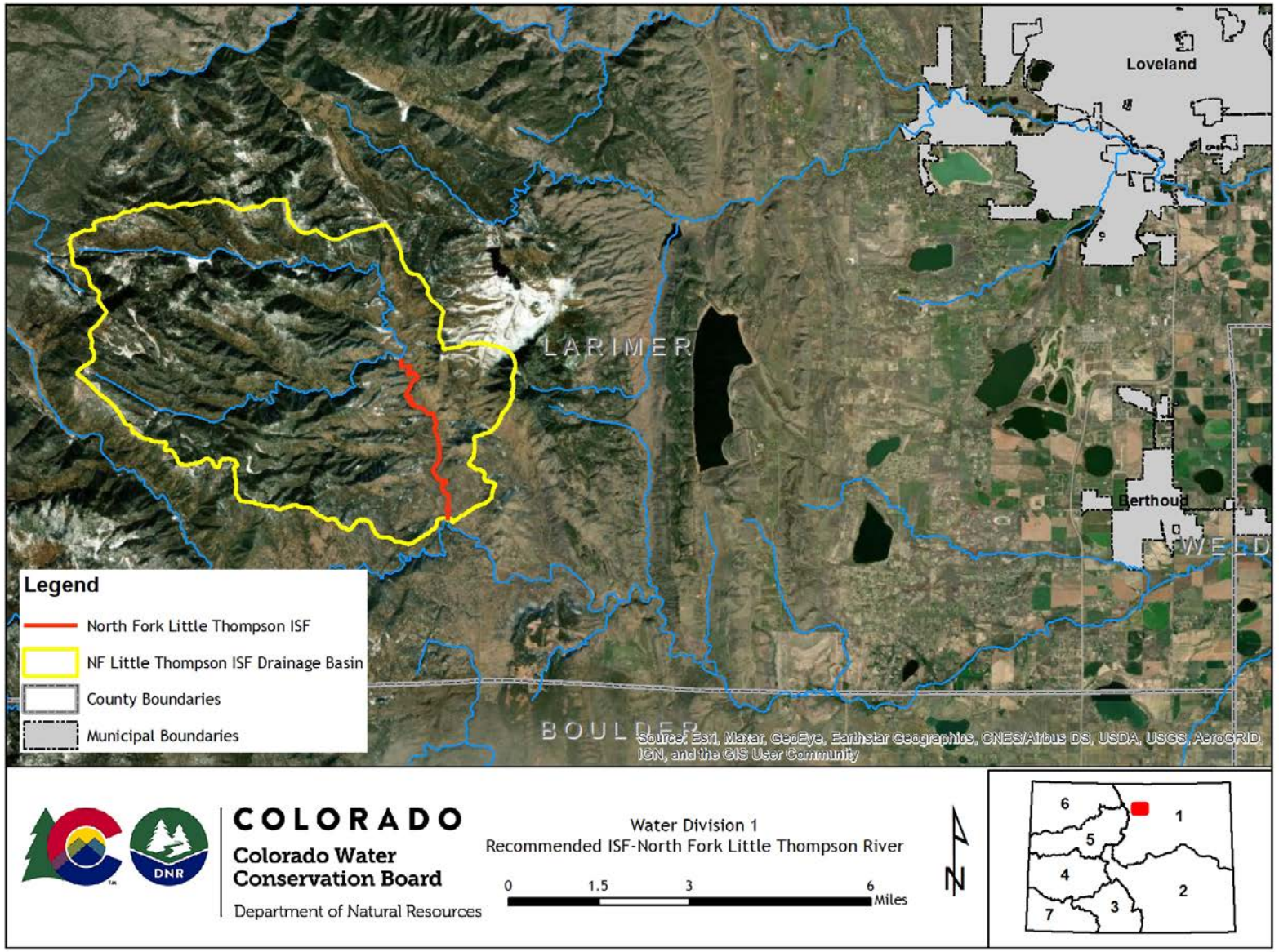
Espegren, G.D., 1996, Development of Instream Flow Recommendations in Colorado Using R2CROSS, Colorado Water Conservation Board.

Nehring, B.R., 1979, Evaluation of Instream Flow Methods and Determination of Water Quantity Needs for Streams in the State of Colorado, Colorado Division of Wildlife.

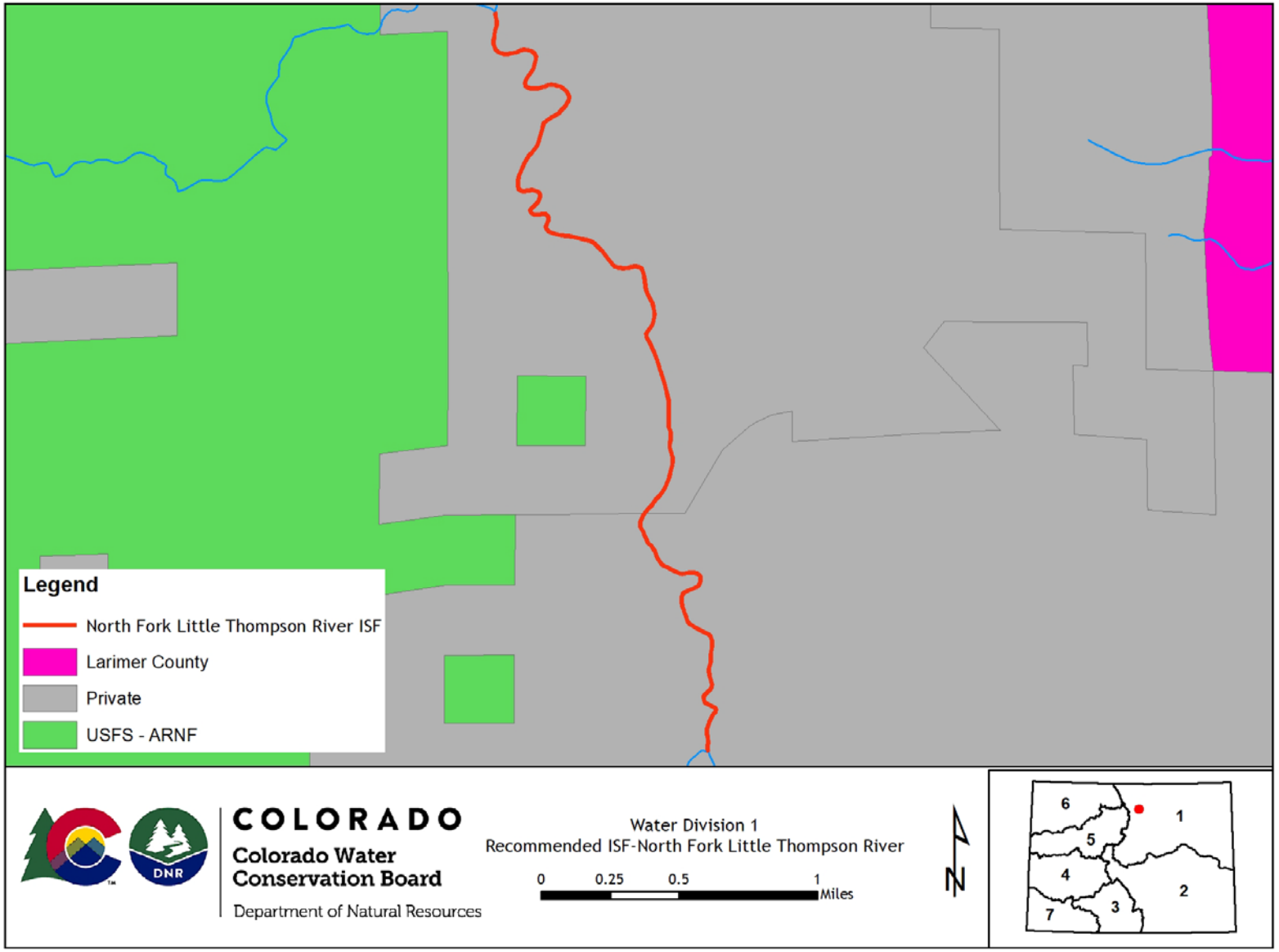
Metadata Descriptions
The UTM locations for the upstream and downstream termini were derived from CWCB GIS using the National Hydrography Dataset (NHD).

Projected Coordinate System: NAD 1983 UTM Zone 13N.

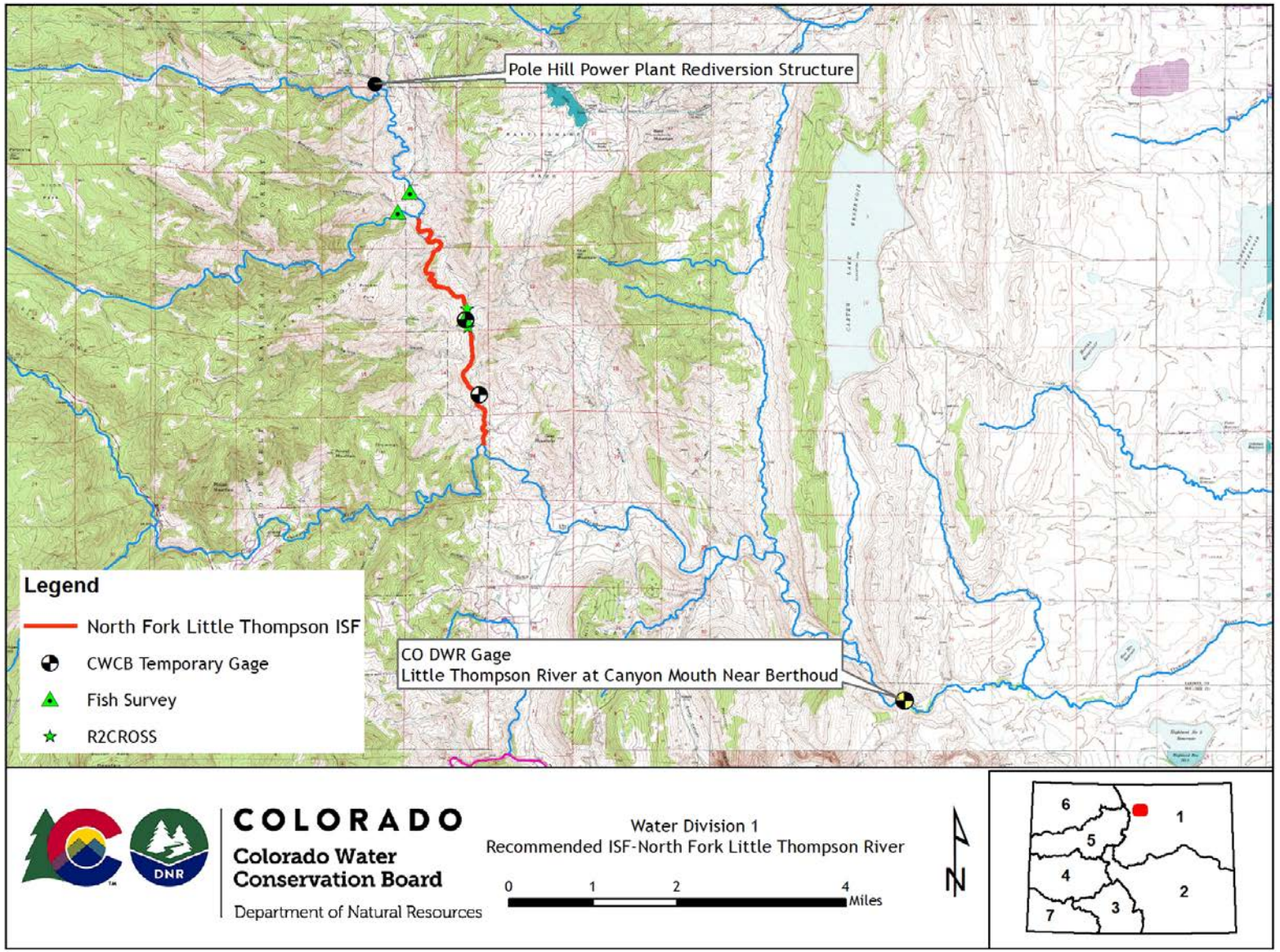
VICINITY MAP



LAND OWNERSHIP MAP



HYDROLOGIC FEATURES MAP



COMPLETE HYDROGRAPH