Colorado-Big Thompson and Windy Gap Baseline Water Temperature Monitoring Program

Water Quality Department

The following describes Northern Water's Colorado-Big Thompson (C-BT) and Windy Gap projects Baseline Water Temperature Monitoring Program. This program began in 2007.

The objectives of this program are to:

- Provide a continuous, high-quality dataset.
- Track changes in water temperature over time.
- Undertand the impacts of C-BT and Windy Gap project operations downstream of reservoirs and in streams above and below release points.
- Assess compliance with state water temperature standards.
- Maintain compliance with permit requirements for the Windy Gap Firming Project.

MONITORING LOCATIONS

Monitoring locations are in streams influenced by the C-BT, Windy Gap and Windy Gap Firming projects in the West Slope collection systems and the East Slope distribution systems.

East Slope Monitoring Locations

Monitoring locations on the East Slope are in the Big Thompson, Little Thompson and Poudre Rivers, and tributaries to the South Platte River. Monitoring sites are located at points of release of Project water. Each tributary has two sampling locations, one upstream and one downstream of the canal release point (*Table 1, Figure 1*). These sites are maintained by Northern Water.

Table 1 - East Slope C-BT Project temperature monitoring sites.

Station	Description	Latitude	Longitude
BT-HFCD	Big Thompson River downstream of Hansen Feeder Canal	40.4213	-105.2215
BT-HFCU	Big Thompson River upstream of Hansen Feeder Canal	40.4220	-105.2269
LT-SVSCD	Little Thompson River downstream of Saint Vrain Supply Canal	40.2166	-106.2596
LT-SVSCU	Little Thompson River upstream of Saint Vrain Supply Canal	40.2173	-105.2597
PR-HSCU	Poudre River upstream of Hansen Supply Canal	40.6601	-105.2094
PR-HSCD	Poudre River downstream of Hansen Supply Canal	40.6606	-105.2032

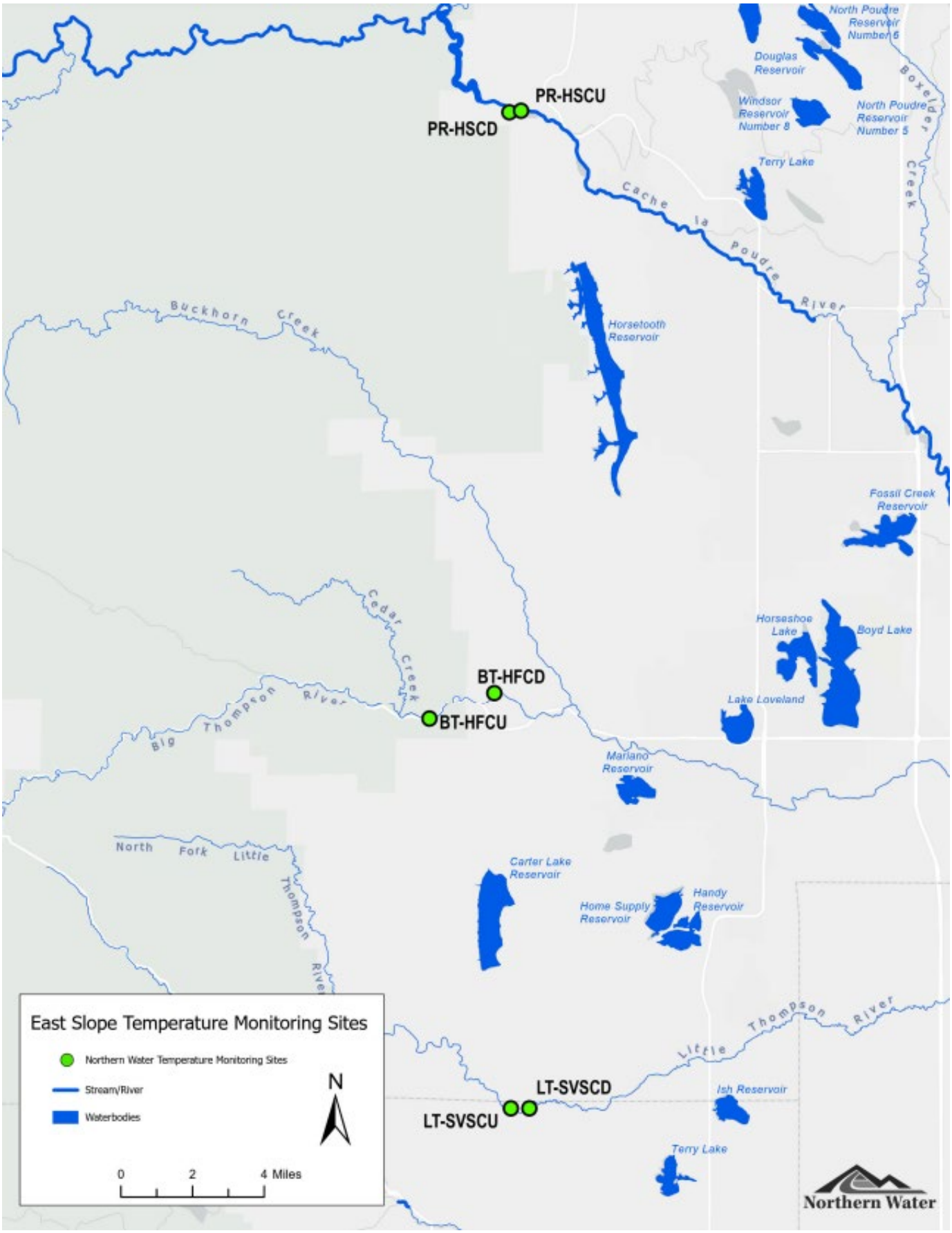

Figure 1 - East Slope C-BT Project temperature monitoring sites.

West Slope Monitoring Locations

The C-BT and Windy Gab Baseline Water Temperature Monitoring Program includes monitoring locations within the Colorado River and its tributaries, the Fraser River, Willow Creek and inputs to Grand Lake. Monitoring extends from the North Inlet of Grand Lake to the Colorado River just upstream of the confluence with the Williams Fork (*Table 2*). The sites on the Colorado River upstream of Williams Fork (CR-WFU), upstream of Hot Sulphur Springs (CR-HSU) and downstream of Windy Gap Reservoir (CR-WGD) are real time sites required by the Fish and Wildlife Mitigation and Enhancement Plan, and 401 Certification for the Windy Gap Project.

Along with sites maintained by Northern Water, data is collected several sites in the lower segment of the Colorado River, below Windy Gap Reservoir to the confluence with the Blue River, as part of the Grand County Water Information Network's (GCWIN) stream temperature monitoring network.

Table 2 - West Slope C-BT Project temperature monitoring sites.

Station	Description	Latitude	Longitude	Sensor Type
EI-GLU	East Inlet upstream of Grand Lake	40.2369	-105.8010	Aquatroll
NI-GLU	North Inlet upstream of Grand Lake	40.2507	-105.8148	Aquatroll
AC-GRU	Arapahoe Creek at Monarch Lake outlet upstream of Lake Granby	40.1128	-105.7497	Aquatroll
RF-GRU	Roaring Fork inlet upstream of Lake Granby	40.1308	-105.7671	Aquatroll
CR-SMU	North Fork of Colorado River upstream of Shadow Mountain Reservoir	40.2190	-105.8577	YSI EXOII
CR-SMD	Colorado River downstream of Shadow Mountain Reservoir	40.2059	-105.838	Hobo
CR-GRU	Colorado River upstream of Lake Granby	40.1945	-105.8265	Hobo
CR-GRD	Colorado River downstream of Lake Granby	40.1444	-105.8672	Hobo
CR-YGAGE	Colorado River downstream of Lake Granby at flow gage	40.1211	-105.9007	Hobo
WC-WCRD	Willow Creek directly downstream Willow Creek Reservoir	40.1456	-105.9404	Hobo
FR-WGU	Fraser River upstream of Colorado River confluence	40.0984	-105.9727	Hobo
CR-WGU	Colorado River upstream Windy Gap/Fraser River confluence	40.1001	-105.9732	Hobo
CR-WGB	Colorado River at Windy Gap Bypass	40.1087	-105.984	Hobo
CR-WGC	Colorado River at confluence of Windy Gap Reservoir Spillway and Bypass	40.1078	-105.9881	Hobo
CR-WGD	Colorado River downstream of Windy Gap Reservoir	40.1082	-106.0037	Campbell 109
CR-HSU	Colorado River upstream of Hot Sulphur Springs	40.0773	-106.1040	Campbell 109
CR-WFU	Colorado River upstream of confluence with Williams Fork	40.0503	-106.1725	Campbell 109

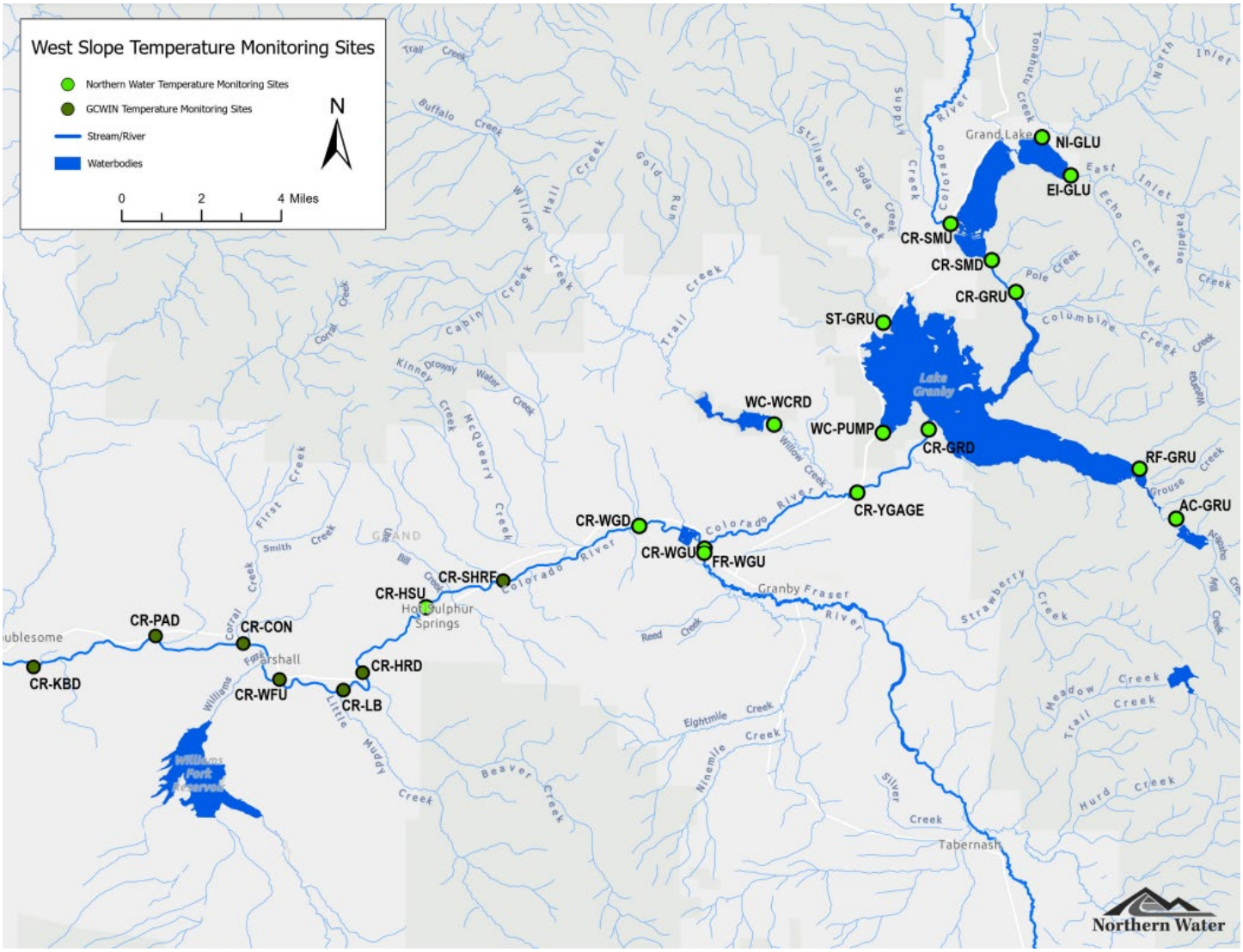

Figure 2 - West Slope C-BT Project temperature monitoring sites.

STATION OPERATION AND MAINTENANCE

Northern Water utilizes HOBO Pro v2 temperature loggers at sites where the data are not transmitted in real-time. The HOBO loggers record temperature at 15-minute intervals, 24 hours a day, year-round. Each station is equipped with two HOBO data loggers: a primary and a secondary logger. The redundancy provides validation of the recorded temperature data and guards against gaps in the data set in case of sensor malfunction. Where possible, the logger is placed in the thalweg of the stream per Northern Water's Standard Operation Procedure (SOP).

Northern Water's Field Services staff visit the HOBO temperature monitoring sites once a month (or as conditions allow) to download the data, take a manual water temperature measurement for comparison, and clean and inspect the equipment. The data are processed and uploaded into Northern Water's WISKI database. All the data are then validated and finalized during the winter following the sampling season and are available upon request.

Data at CR-WGD, CR-HSU and CR-WFU are collected and transmitted in real-time using Campbell Scientific Model 109 Temperature Probes connected to Campbell dataloggers. The Campbell datalogger records temperature data from the 109 Temperature Probe at one-minute intervals and averages the one-minute data every 15 minutes, 24 hours a day, year-round. These data are collected and transmitted in real-time via telemetry to Northern Water's website. The real-time data are provisional. These data are validated in Northern Water's WISKI database during the winter and are available upon request.

Figure 3 - Temperature monitoring equipment.

APPENDIX 1 - HISTORY OF PROGRAM CHANGES

Year	Description of Change
2012	ST-GRU site moved from upstream of Highway 34 to downstream of Highway 34 as there was no longer access to private property at the upstream site.
2014	HOBO logger removed and Cambell 109 Temperature Probe installed at CR-WGD to transmit data in real time.
2014	Hobo logger removed and multi-parameter sonde installed at CR-SMU to transmit temperature, pH, turbidity, and conductivity data in real-time.
2015	GCWIN stops using Onset UTBI-001 TidbiT v2 loggers and begins using Hobo Pro v2 loggers.
2015	ST-GRU site is removed because of property access and site location issues
2015	Northern Water takes over maintenance of CR-SMU site from GCWIN.
2018	CR-WFU and CR-HSU real-time sensors installed. GCWIN previously maintained sensors at these locations beginning in 2007.
2018	The CR-GRD site was removed due to the construction of a new flume below Granby Dam in September 2018.
2020	Site IDs for eight East Slope sites were updated to match Northern Water naming conventions. The locations of these sites were not changed. The new site names are BT-HFCD (HFC-BTD), BT-HFCU (HFC-BTU), PR-HSCD (HSC-PRD), PR-HSCU (HSC-PRU), LT-SVSCD (SVSC-LTD), LT-SVSCU (SVSC-LTU), SV-SVSCD (SVSC-SVD), and SV-SVSCU (SVSC-SVU).
2020	SV-SVSCU and SV-SVSCD were sites removed due to the construction of a kayak park. The sites will not be reinstalled.
2020	CR-GRD site reinstalled in January 2020 after the completion of the Granby Dam flume replacement.


Northern Water