Big Thompson River

2018–2019 Winter Monitoring Summary

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Background

In September 2013, a significant rain event triggered a 100-year flood event in the Big Thompson River, causing substantial damage to roads and infrastructure in the watershed. Highway 34, which is the primary route from northern Colorado to the Town of Estes Park and Rocky Mountain National Park, was heavily damaged in the flood. Although emergency repairs were completed quickly, long-term construction to repair and improve Highway 34 began in 2016 and was completed in early 2019 at an estimated cost of $280 million (some repairs are still ongoing).

Construction activities can have negative impacts on aquatic communities and water quality. A group of stakeholders met throughout the project to discuss construction activities and how to minimize and monitor for potential impacts. In 2017, stakeholders for the Highway 34 construction project agreed that additional monitoring in the Big Thompson River during winter months would be advantageous.

The City of Loveland maintains a real-time data collection station at Narrows Park (40°24'53.72"N, 105°15'2.26"W) from approximately mid-March through mid-November, depending on conditions. The data collection sonde is removed in mid-November because it is relatively expensive and can be damaged by ice during winter months. Additional monitoring efforts are performed by the Big Thompson Watershed Forum (Forum) in conjunction with the USGS; however, monthly sampling excludes December and January due to cost and logistical constraints. Therefore, other than permit-required sampling, no external water quality monitoring efforts take place during these months. Even if monthly sampling were to occur during these months, short-lived water quality events may be missed in the absence of continuously collected real-time data. This lack of information was concerning to the Forum, City of Loveland, and other stakeholders. The monitoring station upstream of the City of Loveland water intake provides information to help prepare for conditions that may require additional treatment or alternative water sources. For example, the City of Loveland needs to shut off the intake if turbidity reaches 100 NTU or more, because treating high turbidity means much higher chemical costs and potential violations of water quality parameters for drinking water. The intake also needs to be shut down for high or low pH events or other events that could be harmful to aquatic life.

Figure 1. USGS and City of Loveland real-time data collection stations

A sub-group of stakeholders specifically tasked with evaluating monitoring efforts, including representatives from the Forum, Colorado Department of Transportation (CDOT), Kiewit, Colorado Parks and Wildlife, the U.S. Forest Service, the U.S. Geological Survey (USGS), Northern Water, and the City of Loveland met on June 14, 2017, and endorsed the idea of real-time winter monitoring for the winter

of 2017–2018. This same group met again in the summer of 2018 and indicated that subsequent sampling during the winter of 2018–2019 was justified given continued—if less intense—construction activities during this time period.

The Federal Highway Administration and CDOT agreed to provide funds to establish and operate the real-time station. The Forum arranged for station operation and installation with funding from CDOT, funds remaining from the 2017–2018 effort, and matching funds from the USGS. The total cost to operate the station from mid-November 2018 through mid-March 2019 was $20,293 (this cost is lower than that of the previous winter because the station was already installed).

Site Selection

Prior to installing the sonde in 2017, USGS and Forum staff made two site visits to examine the City of Loveland location and other potential sites. Considerations included the availability of sunlight for solar power to be used for the heat tape to prevent freezing, access to the main channel of the river, and depth. The most optimal location was determined to be the Jasper Road bridge, which is owned by Larimer County. Forum staff contacted Larimer County to ask permission to install the equipment on the bridge but was informed that the bridge was scheduled for demolition and reconstruction in winter; therefore, consideration of the bridge site was abandoned. USGS staff then contacted a landowner (Dave Lorenz) who owned riverfront property with electricity at a trailer pad approximately 100 meters downstream of the bridge (Figure 2). The landowner agreed to host the station on his property and allow his electricity to be used when necessary. As a goodwill gesture, the Forum paid the landowner $400 for electricity and the use of his land in both 2017–2018 and 2018–2019. With the permission of the landowner, the station remained in place between the winters of 2017–2018 and 2018–2019. The station performed as good or better than expected in both years.

Figure 2. USGS real-time monitoring station with Jasper Road bridge in background.

Data Collection

Real-time data collection included four water quality parameters measured every 15 minutes: temperature, specific conductance, pH, and turbidity. Although these parameters are not all-inclusive, they are general enough to indicate potential issues that are directly or indirectly reflected by these parameters. In addition, the USGS website provided the opportunity to subscribe to "WaterAlert." This service sends an email or text to the user if any of the measured parameters are above user-defined limits. Data are available at https://waterdata.usgs.gov/co/nwis/current/?type=quality.

Figure 3. USGS real-time data station with Greg Smith, USGS (left), landowner Dave Lorenz (middle), and Andy Fayram, Forum (right).

The USGS winter sonde (Figure 3) was activated on 11/15/18 and began collecting data immediately. The station was scheduled to be deactivated on 3/15/19 per the agreement between the Forum and USGS. However, in early March 2019, Loveland staff contacted the Forum and indicated that they would not be able to install their sonde until the end of March 2019. The USGS agreed to continue the data collection through 4/1/19 pro bono in the interest of data coverage and the health of the river.

There were no unexpected or unusual temperature, specific conductance, or pH spikes during the time period when the station was operational (Figures 4, 5, and 6).

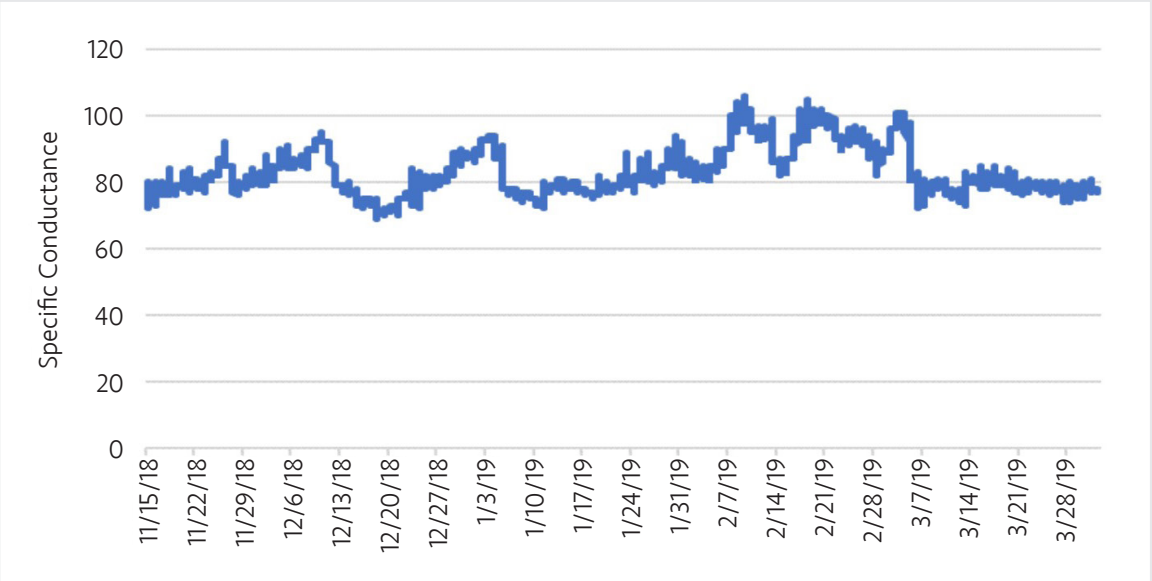

Figure 4. USGS real-time water quality sonde specific conductance data

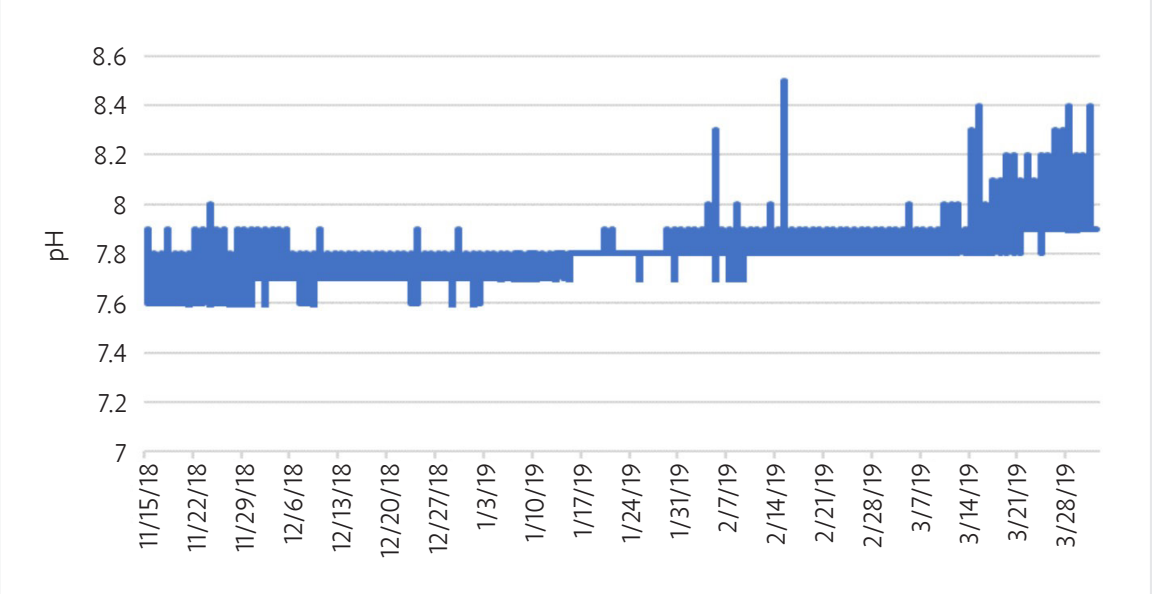

Figure 5. USGS real-time water quality sonde pH data

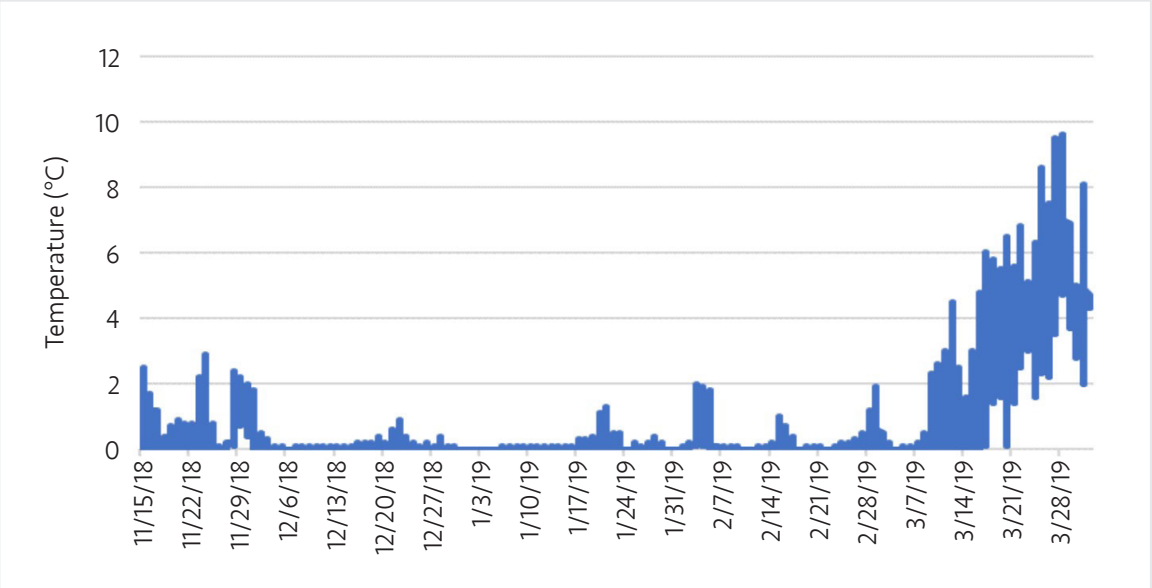

Figure 6. Comparable Loveland and USGS real-time water quality sonde temperature data

Turbidity continued to be elevated during winter 2018–2019 as a result of construction activities, including several occasions when turbidity was measured above 100 FNU (Figure 7). Turbidity ranged between 1.2 and 362, with an average of 10.0 FNU. However, turbidity levels during the winter of 2018–2019 were elevated less than during winter 2017–2018, when construction activity was more intense and turbidity levels were often above 400 FNU (Fayram 2018). Under normal conditions, average turbidity is in the range of 1–4 NTU (Jasby and Goldman 2003). These elevated values were almost certainly caused by construction activity, based on the return to normal turbidity levels during time periods of little or no construction (Figure 7).

Elevated turbidity has negative impacts on municipal water treatment plants and aquatic communities. Turbidity levels are positively associated with total organic carbon (TOC) levels (LeChevallier et al. 1981). Although TOC is not a direct human health hazard, the dissolved portion of the TOC can react with chemicals (chlorine and others) used for drinking water disinfection to form disinfection byproducts that are regulated as potential carcinogens (e.g., chloroform $CHCl_3$). As such, TOC levels are of concern to drinking water treatment facilities. Elevated turbidity can have direct negative effects on aquatic organisms, as well as indirect effects such as increasing the levels of some dissolved metals. Elevated turbidity and suspended sediment can have negative effects on density and species richness of macroinvertebrates (Al Shaw and Richards 2001). Growth of trout species, such as rainbow trout (*Oncorhynchus mykiss*), is negatively associated with increased turbidity (Al Shaw and Richardson 2001), and increased turbidity can lead to increased mortality of salmonids (Newcombe and Jensen 1996). Effects of elevated turbidity become more severe with longer exposure (Newcombe and Jensen 1996, Al Shaw and Richards 2001).

Results and Discussion

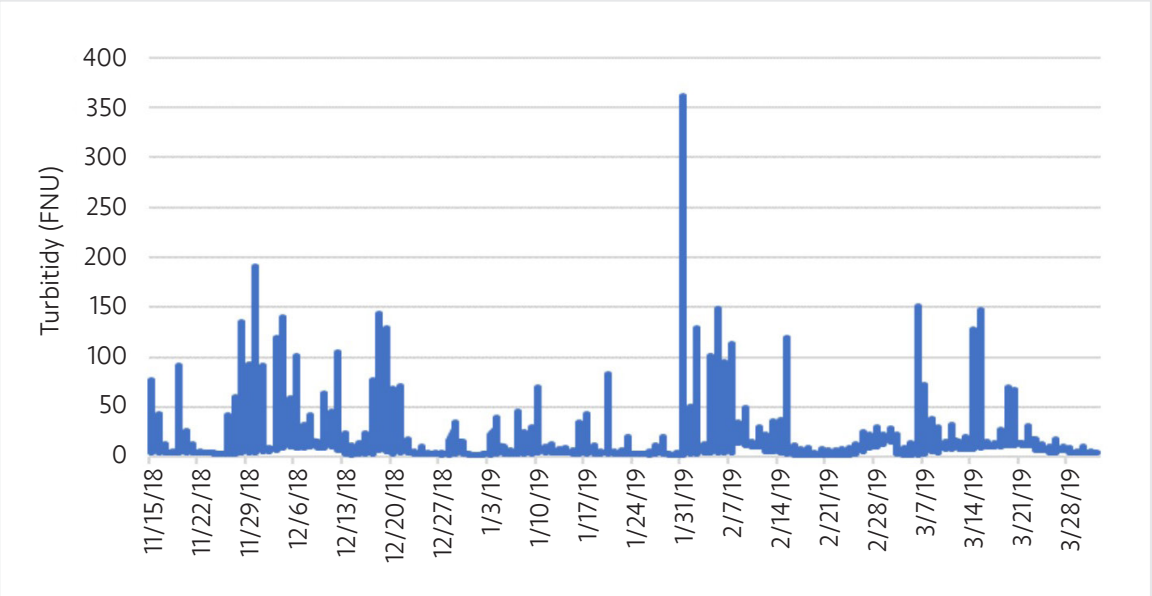

Figure 7. USGS real-time water quality sonde turbidity data

Acknowledgements

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References

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