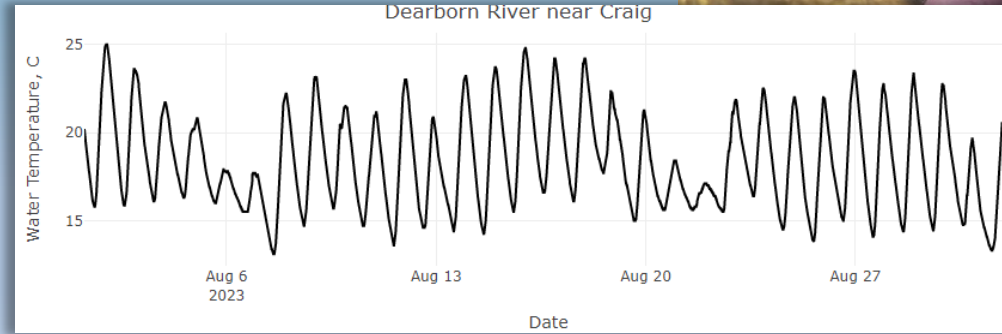


USGS Water Temperature Data in Montana – Collection, Access, and Application

Montana AWRA Conference

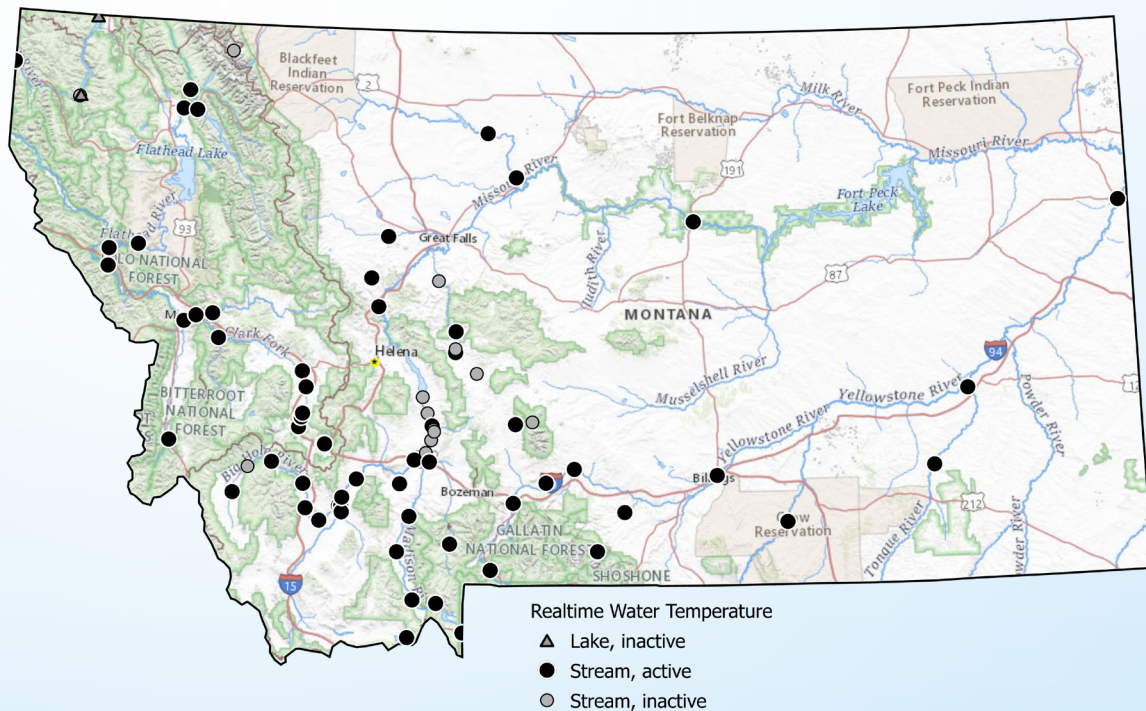
October 11, 2023

Seth Siefken, PE
U.S. Geological Survey
Helena, Montana



USGS Water Temperature Collection

- Realtime water temperature collected at more than 2000 sites in the United States
 - ~2300 stream sites
 - 77 lake sites
- 66 locations in Montana (all streams currently)
- Some seasonal, some year-round
- Montana sites maintained in cooperation with other agencies (many with Montana Fish, Wildlife, and Parks)



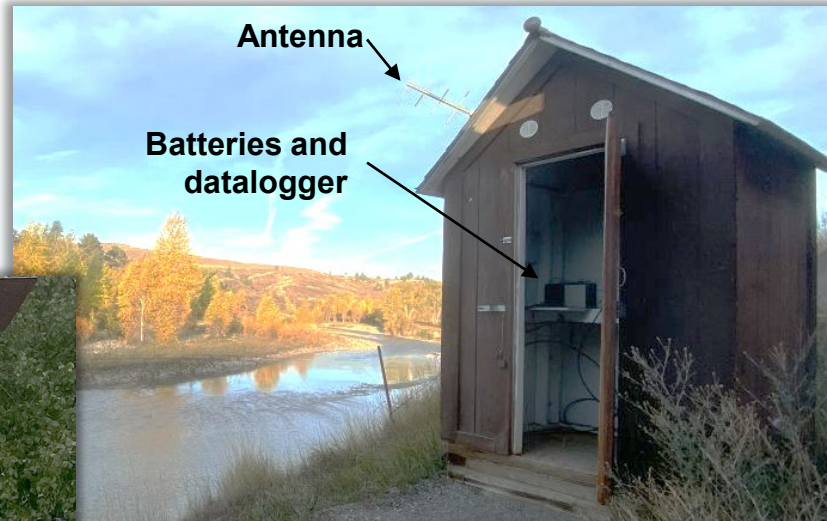
USGS Water Temperature Collection – Rivers and Streams

- For streams, temperature is measured in a single location at a site with a temperature probe affixed in the stream
- Ideal location represents flow in entire channel
- Temperature measured every 15 minutes and transmitted to the internet



Stand alone temperature monitor

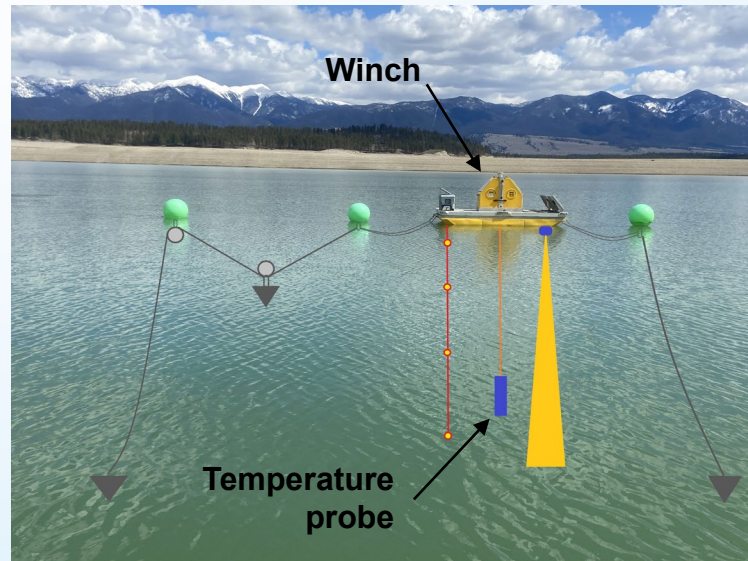
Multiparameter sonde with water temperature



USGS gage house with data logging and transmitting equipment

USGS Water Temperature Collection – Lakes

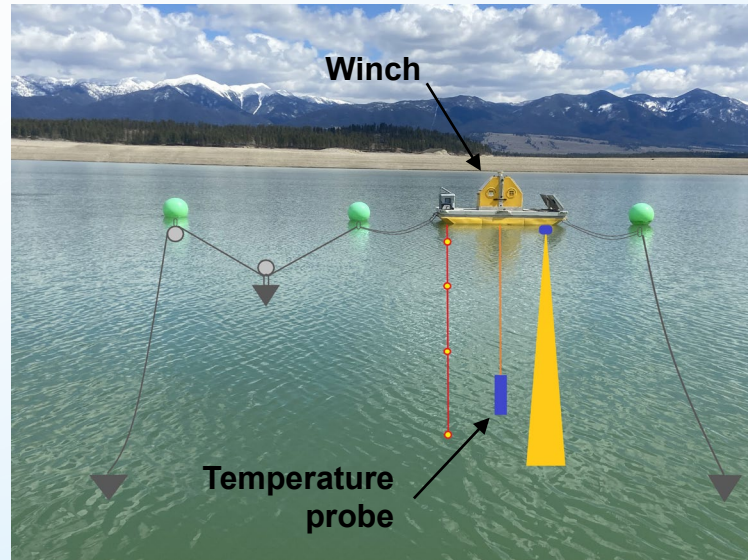
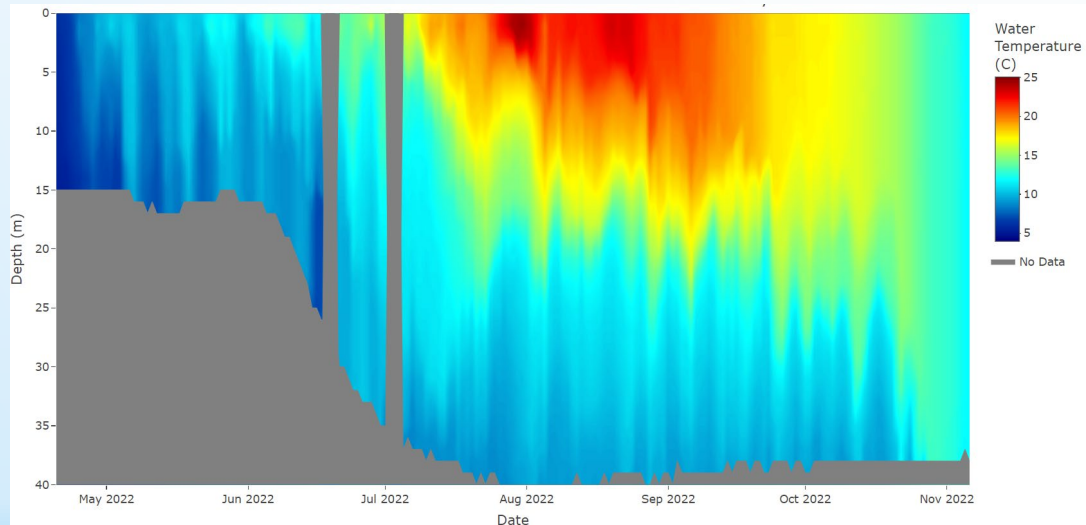
- Temperature measured at multiple vertical locations using moveable sensor
- Depth of measurement logged with water temperature



*Lake temperature collection platform
(Photo credit: Chad Reese)*

USGS Water Temperature Collection – Lakes

- Temperature measured at multiple vertical locations using moveable sensor
- Depth of measurement logged with water temperature



Lake temperature collection platform
(Photo credit: Chad Reese)

USGS Water Temperature Collection – Quality Control

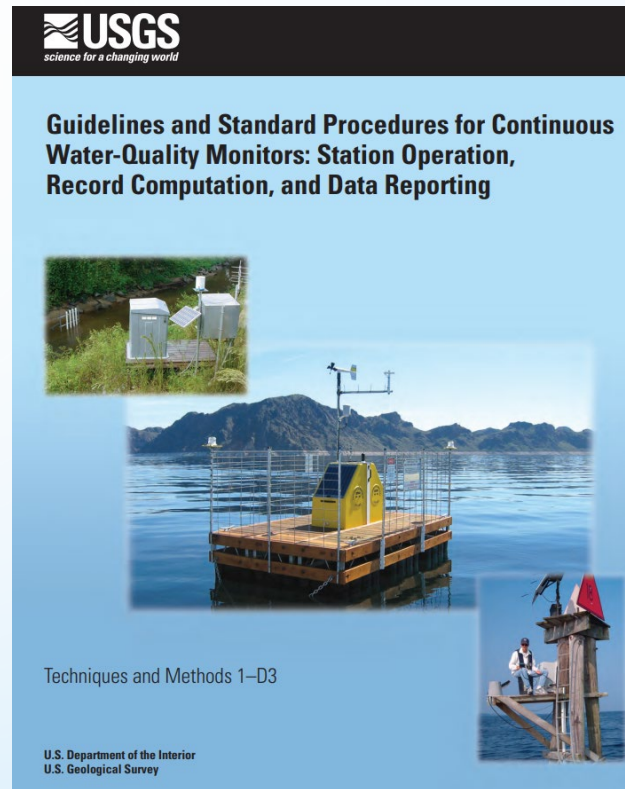
- **Site visits (~6 weeks) verify temperature is within 0.2 C of independent reading**
- **5-point temperature check (covering expected range of temperature) to National Institute of Standards and Technology certified thermometer for:**
 - **Field probes prior to deployment**
 - **Independent temperature probes annually**
- **Cross sections of temperature (10 or more points across the width of the channel) measured twice per year for river sites**
 - **Done at different seasons and stream conditions**



*Cailey Philmon measuring temperature and discharge at a stream cross section
(Photo credit: Jennifer Walgrave)*

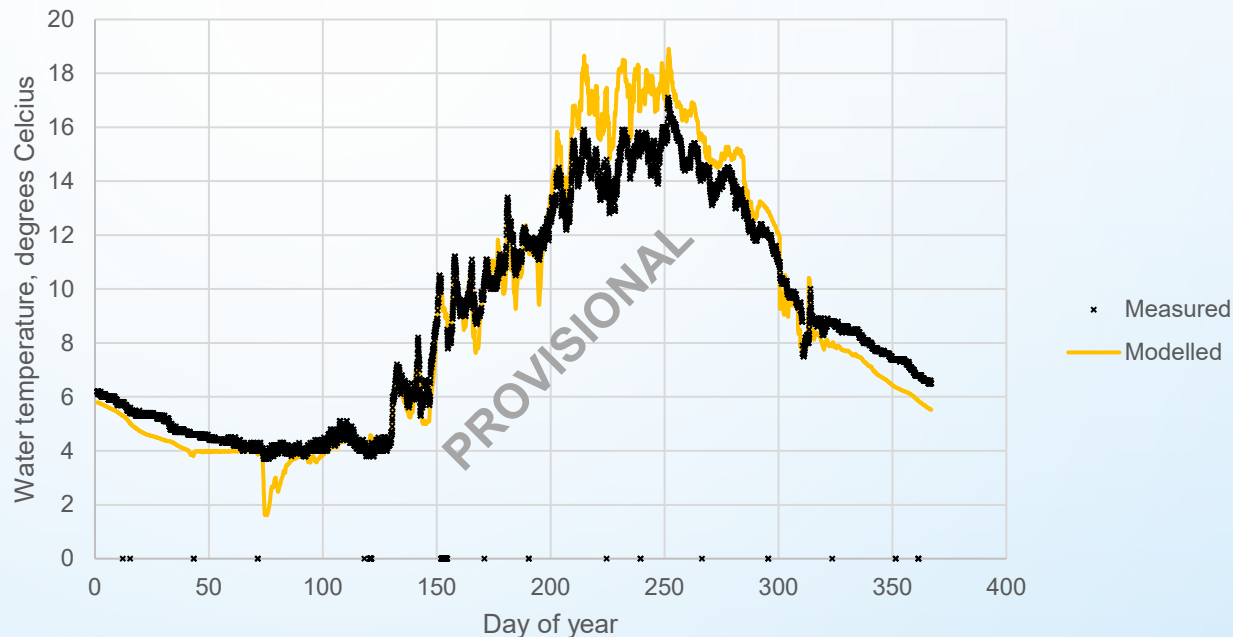
USGS Water Temperature Collection – Quality Control

- Details of temperature collection and quality control methods are documented in: <https://pubs.usgs.gov/tm/2006/tm1D3/>



USGS Water Temperature Applications

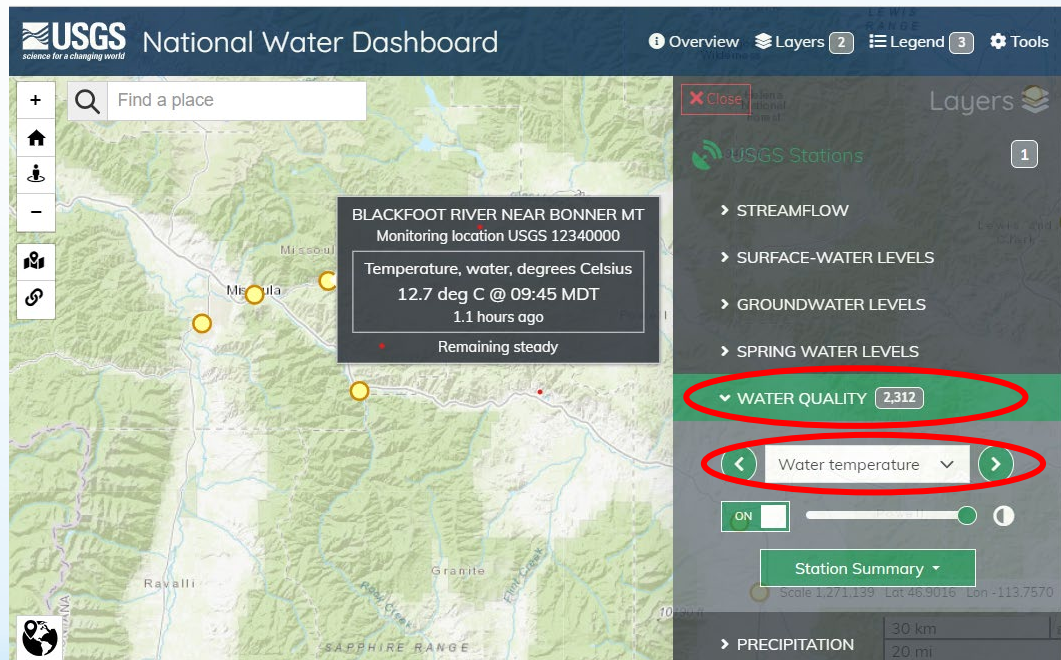
- Aquatic health monitoring
 - fishing restrictions
- Water quality modeling
 - CE-QUAL-W2 model of Lake Kootcanusa and the Kootenai River
- River ice conditions (mostly USGS internal use)
- Recreation



Measured versus modelled discharge at Kootenai River below Libby Dam for 2020

Accessing USGS Water Temperature Data – Web Browser

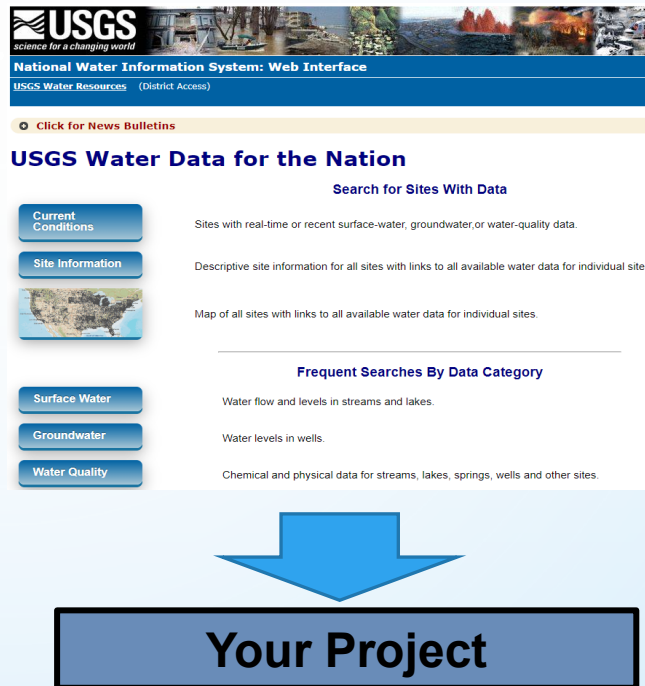
- National Water Dashboard: <https://dashboard.waterdata.usgs.gov/>



Accessing USGS Water Temperature Data – R

dataRetrieval Package

- Published by USGS, provides easy access to USGS water data
- Installs with:
`install.packages("dataRetrieval")`
- Use `readNWISuv()` function to access unit value (usually 15-minute) water temperature data
- Water temperature is parameter code 00010



The screenshot displays the USGS National Water Information System (NWIS) Web Interface. At the top, the USGS logo is visible with the tagline "science for a changing world". Below the logo, the page title is "National Water Information System: Web Interface" and the subtitle is "USGS Water Resources (District Access)". A navigation bar contains a link for "Click for News Bulletins". The main heading is "USGS Water Data for the Nation" with a sub-heading "Search for Sites With Data". On the left side, there are five blue buttons: "Current Conditions", "Site Information", "Surface Water", "Groundwater", and "Water Quality". The "Water Quality" button is highlighted. To the right of these buttons, there are three text blocks: "Sites with real-time or recent surface-water, groundwater, or water-quality data.", "Descriptive site information for all sites with links to all available water data for individual sites.", and "Map of all sites with links to all available water data for individual sites.". Below these blocks, there is a section titled "Frequent Searches By Data Category" with three sub-sections: "Water flow and levels in streams and lakes.", "Water levels in wells.", and "Chemical and physical data for streams, lakes, springs, wells and other sites.". A large blue arrow points from the "Water Quality" button down to a box labeled "Your Project".

Accessing USGS Water Temperature Data – R

```
library(dataRetrieval)

Wtemp <- readNWISuv(
  siteNumbers = c("12388700", #Flathead River at Perma
                 "12354700"), #Clark Fork near Paradise
  parameterCd = "00010", #Parameter code for water temperature
  startDate = "2023-08-01",
  endDate = "2023-08-31")

Wtemp <- renameNWISColumns(Wtemp) #Rename columns for easier use
```

*Download data for
selected sites*

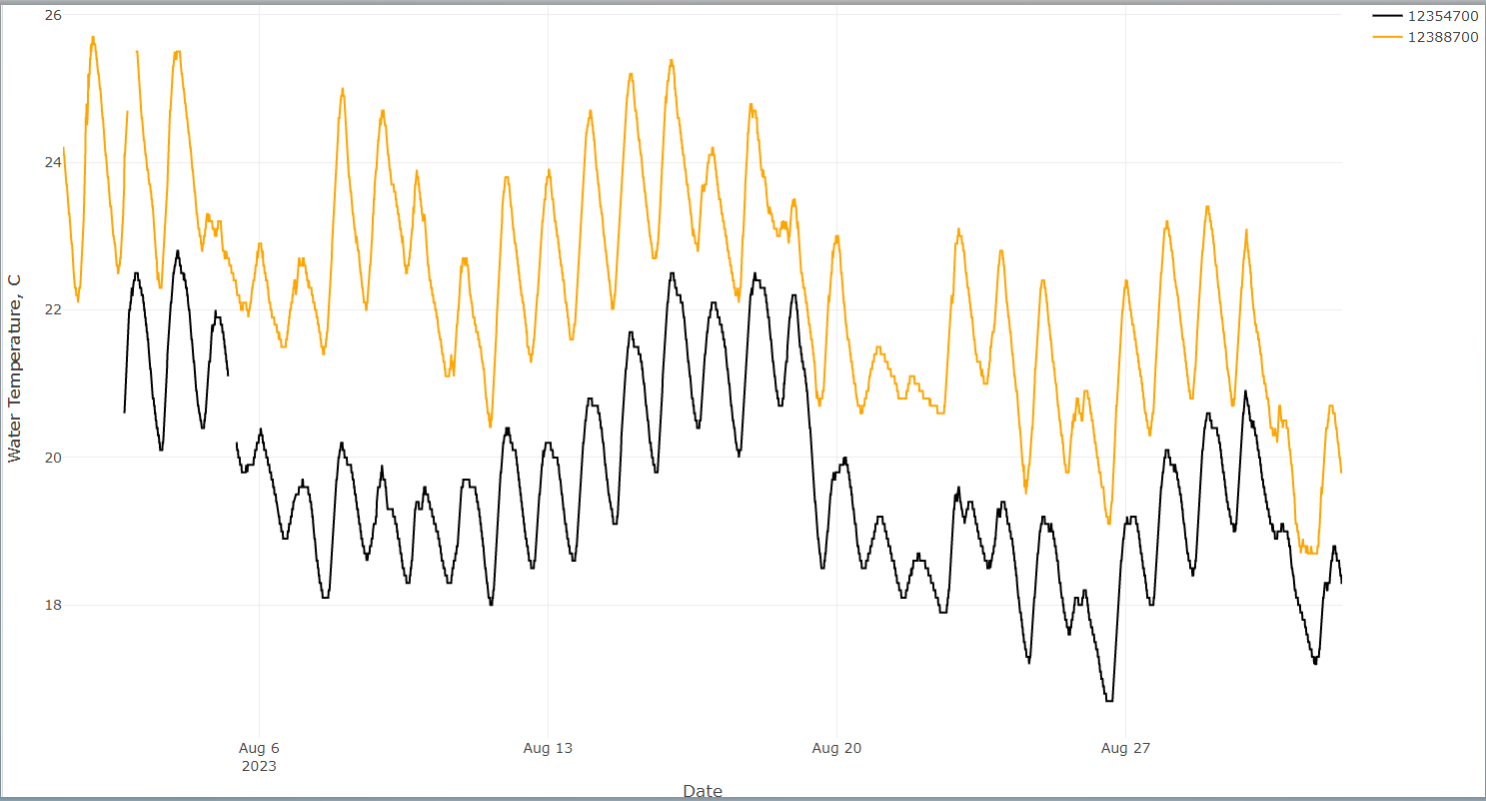
```
library(plotly)

p <- plot_ly(Wtemp, x = ~dateTime, y = ~Wtemp_Inst, color = ~site_no,
             type = "scatter", mode = "lines") %>% layout(xaxis = list(title = 'Date'),
             yaxis = list(title = 'Water Temperature, C'))

print(p)
```

Plot Data

Accessing USGS Water Temperature Data – R



***Thanks to USGS hydrographers
who maintain real-time data
collection!***



Chad Reese preparing to deploy monitoring platform on Lake Kooconusa



Chad Reese preparing to deploy monitoring platform on Lake Kooconusa

Questions?

ssiefken@usgs.gov