Beaver Creek Hydrology [DRAFT]

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# Preface

In Spring 2022, the United States Geological Survey (USGS) initiated a partnership with Kenai Watershed Forum (KWF) with support from the [Alaska Climate Action Science Center](https://akcasc.org/) (AK CASC). The project will investigate hydrological conditions in the Beaver Creek watershed, a lowland tributary of the Kenai River. The project will use present-day data on water temperature, discharge, and landscape characteristics to model future conditions under future scenarios of climate conditions and groundwater usage.

This document is a draft in progress and is for use only in disseminating information among the research team. All data is preliminary and has not been approved for use in publications by USGS or any other entity.

The research team includes the following personnel:

* [Dr. Joshua Koch](https://www.usgs.gov/staff-profiles/joshua-c-koch)- USGS Alaska Science Center
* [Megan Haserodt](https://www.usgs.gov/staff-profiles/megan-j-haserodt)- USGS Upper Midwest Water Science Center
* [Andrew Leaf](https://www.usgs.gov/staff-profiles/andrew-t-leaf) - USGS Upper Midwest Water Science Center
* [Benjamin Meyer](https://www.kenaiwatershed.org/contact-our-staff/)- Kenai Watershed Forum

For more details visit <https://www.kenaiwatershed.org/water-research-news/usgs-beaver-creek/>.

# 1. Methods

## 1.1 Water Temperature Loggers

### 1.1.1 Locations

Our project includes water temperature data from a total of fifteen locations throughout the Beaver Creek watershed. In summer 2022 we established thirteen new sites to monitor water temperature with HOBO TempPro v2 loggers, in addition to the one site previously established by Kenai Watershed Forum. The USGS Alaska Science Center also established a real-time gauging station in the lower reach, which records water temperature in addition to discharge (station # 15266500). These data are available online at <https://waterdata.usgs.gov/monitoring-location/15266500/>.

Site locations and other metadata are available for download in the link below.

An ArcGIS Online map of site locations is displayed below. The map may also be accessed at <https://arcg.is/0ySarv1>.

View larger map

### 1.1.2 Water Temperature Logger QA/QC Checks

#### 1.1.2.1 Pre-deployment

Prior to deployment, all water temperature loggers undergo a QA/QC check using ice-water and room temperature water as described in (Mauger et al. 2015).

#### 1.1.2.2 Site Checks

Content TBD here.

#### 1.1.2.3 Post-deployment

##### 1.1.2.3.1 Fall 2022 Site Visits

We downloaded data from all loggers in September/October 2022, and reviewed it in Spring 2023. Each logger’s time series was visually inspected in an R Shiny plot for data that is non-representative of stream channel conditions, such as exposure to air or burial in sand.

Segments of each time series that were identified as non-representative were flagged in a separate csv file, then applied in order to remove these segments.

An example plot for one logger is shown below, with flagged data in red and retained data in black.

Records for time periods flagged for individual loggers are recorded and available to view at the download below.

##### 1.1.2.3.2 Spring / Summer 2023 Site Visits

All water temperature logger sites were revisited in Spring / Summer 2023, and log files were downloaded from each logger. The process QA/QC described from Fall 2022 was applied in an identical fashion. QA/QC files are available in the project’s GitHub repository.

### 1.1.3 Download Preliminary Water Temperature Data

Water temperature will be applied as part of ongoing watershed-scale modeling efforts. At a later stage, it will be housed in a public repository such as AKTEMP (<https://aktemp.uaa.alaska.edu>) and others.

Preliminary water temperature files are available for download at the link below.

[NOTE: the long-term KWF logger site, also labeled “beaver\_creek\_usgs\_temp\_3” in this download, has a pair of twin loggers at one location.]

# 2. Summary

Content TBD

# 3. Discussion

Discussion among the research team is currently in progress on the following topics:

## 3.1 Water Temperature Metrics and Anadromous Habitat

Hydrology model outputs from this project will provide spatially explicit projections of possible future discharge and temperature conditions for Beaver Creek under scenarios of climate change and groundwater withdrawal. We anticipate that discharge and temperature will vary by scenario in ways meaningful to aquatic habitat throughout Beaver Creek. We intend to evaluate these predictions against criteria found in the literature to help understand potential effects on fish, particularly anadromous (e.g. salmonid) species.

The following is a discussion of potentially relevant water temperature metrics. Depending on the time scale of model outputs, some metrics may be more applicable than others.

### 3.1.1 Water Temperature Metrics

A suite of over fifty distinct temperature metrics may be calculated using an existing R script published in Appendix B of 2013 USGS report focused on cold-water streams in the Nevada desert [Falke, Dunham, and Mills (2013)][[1]](#footnote-41).

The list of 52 metrics each fall in to one of the following five categories:

* Magnitude
* Variation
* Frequency
* Duration
* Timing

From this list, researchers in (Mauger et al. 2017) chose three specific metrics to evaluate when considering regional-scale variations of lotic freshwater thermal regimes in the Cook Inlet region:

“We selected three metrics to describe aspects of the summer temperature regimes in the 48 streams: mean July temperature, maximum weekly average temperature (MWAT), and maximum weekly maximum temperature (MWMT). We chose mean July stream temperature because this is typically the hottest month in southcentral Alaska. We calculated mean July temperature only for site-years when at least 90% of the days were captured (>27 days). We used MWAT and MWMT because they represent an intermediate time period over which transient high temperatures may affect fitness in aquatic organisms.

Researchers focusing on stream temperatures in the nearby Mat-Su valley region used a cluster analysis to characterize thermal regimes using a different subset of descriptors (Shaftel et al. 2020):

[We used] … metrics that represent the magnitude, variability, frequency, duration, and timing of temperature events related to salmon life histories. We used cluster analysis to characterize thermal regimes present in the Matanuska-Susitna (Mat-Su) Basin based on 10 nonredundant temperature metrics and identified the most important drivers of our thermal regimes using random forests.

Both of these manuscripts focused on southcentral Alaska temperature regimes are relevant to our work focused on Beaver Creek, but are focused on distinguishing and decribing thermal regimes rather than specifically on biological effects on anadromous species.

Meyer et al. used a bioenergetics modeling approach to evaluate potential effects of water temperature and food consumption on summer growth rates of juvenile Chinook and coho salmon in the Kenai River watershed (Meyer et al. 2023).

#### 3.1.1.1 State and Federal Water Temperature Mangement Criteria

* ADEC Values
* EPA values

A basic potential approach – for each stream segment under each scenario (climate/flow/time period), evaluate the total proportion of time spent above state & federal criteria value. Likely to see meaningful spatial variation.

[Work in progress here.]

# References

Falke, J A, Jason B Dunham, and Amy Mills. 2013. “Variability in Summer Stream Temperatures in Nevada: Implications for Monitoring and Assessment.” Carson City, NV.

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Mauger, Sue, Rebecca Shaftel, E Jamie Trammell, Marcus Geist, and Dan Bogan. 2015. “Stream Temperature Data Collection Standards for Alaska: Minimum Standards to Generate Data Useful for Regional-Scale Analyses.” *Journal of Hydrology: Regional Studies* 4, Part B (September): 431–38. <https://doi.org/10.1016/j.ejrh.2015.07.008>.

Meyer, Benjamin E., Mark S. Wipfli, Erik R. Schoen, Daniel J. Rinella, and Jeffrey A. Falke. 2023. “Landscape Characteristics Influence Projected Growth Rates of Stream-Resident Juvenile Salmon in the Face of Climate Change in the Kenai River Watershed, South-Central Alaska.” *Transactions of the American Fisheries Society* 152 (2): 169–86. <https://doi.org/10.1002/tafs.10397>.

Shaftel, Rebecca, Dustin Merrigan, Leslie Jones, and Sue Mauger. 2020. “Stream Temperature Models and Applications in the Anchor, Kenai and Deshka River Watersheds.”

1. <https://paperpile.com/app/p/c29b459f-89c7-03ee-ad79-c4c9c9cfd817> [↑](#footnote-ref-41)