

Project Name | Weather Station Monitoring Program

Date | 02/03/2023

To / Contact info | BCWD Board of Managers

Cc / Contact info | Karen Kill, District Administrator

From / Contact info | Mike Majeski, Conservation Biologist

Regarding | 2022 Weather Summary

Background

The BCWD Weather Station Monitoring Program was initiated in the spring of 2011 and has been in operation since 2012. Each season the weather station is installed on top of the vegetated berm at the Stillwater Public Works Facility and collects the following data: precipitation, air temperature, relative humidity, dew point, solar radiation, wind speed, gust speed, and wind direction. The weather station is programmed to collect data from spring through fall of each season and is removed during the winter months. This information is being collected to support a variety of District programs such as hydrologic and hydraulic model upgrades and calibration (which require 15-minute precipitation data), thermal modeling efforts, and other projects including the Settlers Glen iron-enhanced sand filter, THPP, and the Biological Monitoring Program. The weather station data is also routinely shared with the Washington Conservation District (WCD).

The objective of this memorandum is to summarize temperature and precipitation data recorded in 2022 and how the data relates to water temperatures in Brown's Creek, particularly in the Brown's Creek gorge where coolwater and coldwater species occur including rainbow darters, brown trout, and macroinvertebrates that have specific thermal and dissolved oxygen requirements to survive.

2022 Weather Summary

The BCWD weather station was installed at the Stillwater Public Works Facility (latitude: 45°03'49.86", longitude: 92°51'21.05") on March 28, 2022 and was removed on November 10, 2022. From March 28 to November 10, a total of 21.18 inches of precipitation was recorded, including five rain events over 1" (Figure 1). Above average monthly precipitation occurred in April (4.86"), May (4.30") and August (5.91"). However, for the second consecutive year, a significant drought occurred during most of the growing season, with the greatest departures from normal occurring in June (-3.14"), July (-3.22"), September (-2.72"), and October (-2.01"). Notable dry periods over the course of the monitoring season included: May 31-June 12 (0.13" in 13 days), July 5-July 22 (0.31" in 18 days), Aug 30-Sept 19 (0.21" in 21 days), and Sept 25-Oct 11 (0.05" in 17 days).

Air temperatures recorded at the weather station fluctuated above and below the average high and low temperatures throughout the monitoring season, with 16 days when the maximum air temperature exceeded 90° F (Table 1 and Figure 2). From June 17 to August 6 (51 days), the daily maximum air temperature exceeded 81° F for 44 of those days with 12 days exceeding 90° F. However, over the same time period, water temperatures recorded in Brown's Creek at the WOMP station remained relatively cool, with only one day when the maximum water temperature exceeded 70° F (71.22° F on June 20), which is below the critical temperature for brown trout (75° F). Below

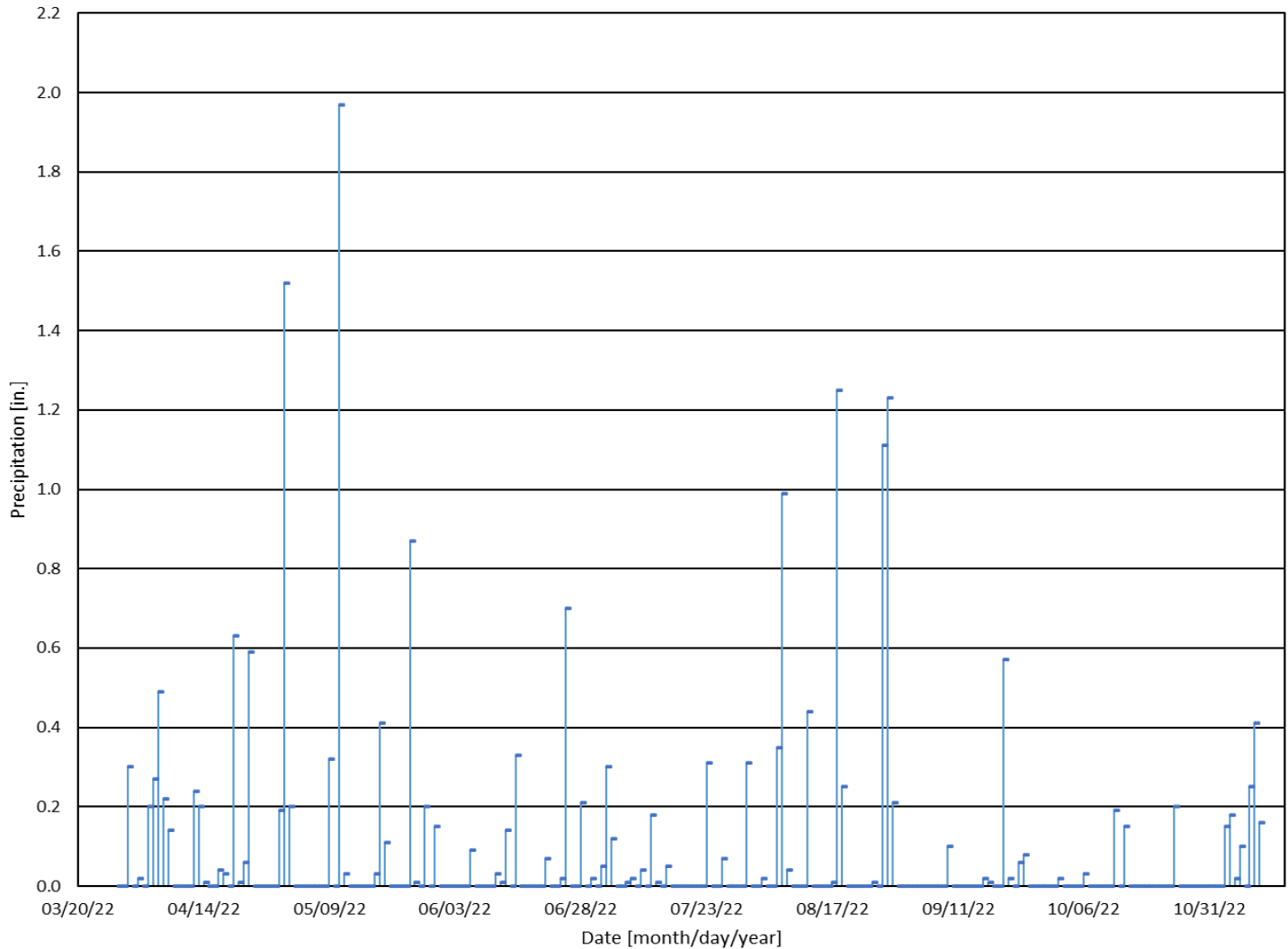


Figure 1. Daily precipitation recorded by the BCWD weather station (Mar 28-Nov 10).

average precipitation during this warm spell likely influenced the recorded water temperatures, with cool groundwater discharge supporting the majority of stream flow during this timeframe. There are multiple factors that influence instream temperatures that require detailed analysis beyond the scope of this project; however, the data summarized in Table 1 suggest that a combination of warm air temperatures with concurrent precipitation events appear to have a greater effect on instream temperatures compared to warm air temperatures alone. Since 2012, 2021 had the greatest number of days above 90° F and the warmest nights (nights when the low air temperature was above the average low), yet there was only one day when water temperatures exceeded 70° F at the WOMP station. 2021 was also the driest year since the weather station was installed in 2012. 2022 was relatively warm with 16 days when the air temperature exceeded 90° F but was also a very dry year like 2021.

Table 1. Air and water temperature trends at Brown's Creek during warm weather months (May 1-September 1, 2012-2022)

Year	# days with max. air temp above 90° F	# nights with low air temp above average low [°F]	Average low air temp. above average low [°F]	# days when WOMP water temp. exceeded 70° F	Total precip. May 1-Sept 1 [in.]	Total precip. on days when WOMP water temp. exceeded 70° F
2012	20	43	5.10	21	17.26	5.28
2013	12	34	4.74	11	17.31	2.12
2014	0	25	4.64	7	21.28	0.10
2015	2	25	3.37	4	21.14	1.55
2016	12	38	3.79	10	20.80	4.96
2017	9	16	3.27	0	17.12	0
2018	18	45	4.58	8	15.84	3.10
2019	5	15	2.02	1	22.93	0.83
2020	15	42	4.20	8	21.68	3.14
2021	34	33	7.03	1	12.14	0
2022	16	30	4.69	1	13.30	0

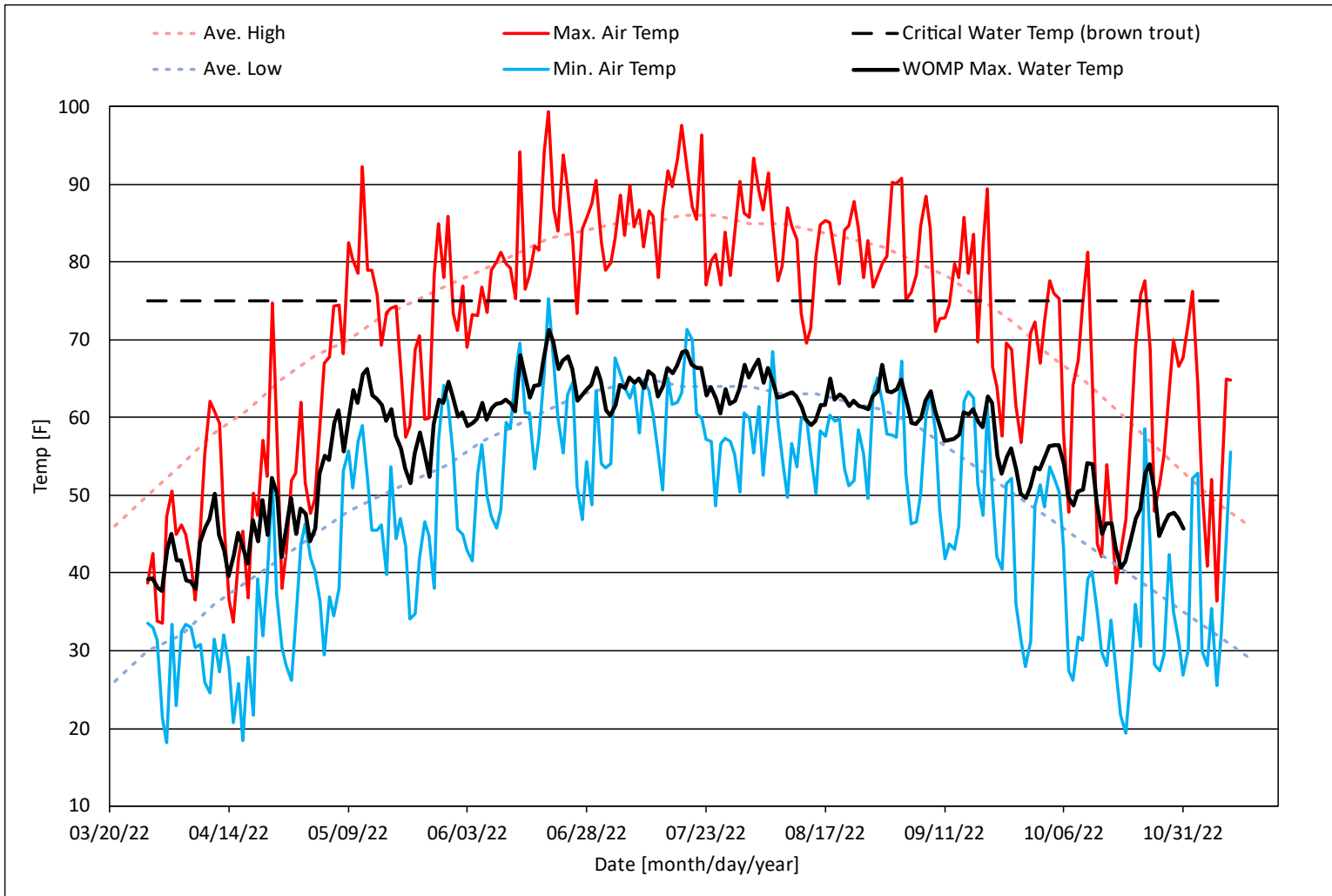


Figure 2. Daily maximum and minimum temperatures recorded by the BCWD weather station and WOMP daily maximum water temperatures recorded by the WCD/ Met Council. Average air temperature data source: <https://weather.com/weather/monthly/1/45.067273,-92.854033>

Weather Station Maintenance

Prior to equipment installation, the precipitation gauge was calibrated to a simulated one-inch rain event per the manufacturer’s specifications. During the monitoring season, the weather station was visited periodically to download data and check for sensor fouling. All weather sensors were inspected in the fall of 2022 and no upgrades or replacements are needed at this time.

2023 Scope of Services

The following scope identifies the costs associated with equipment preparation, precipitation gauge calibration, data collection, and reporting for the 2023 monitoring season (March to November). All data collected in 2023 will be forwarded to the Washington Conservation District and other entities as requested.

Task	Hours	Estimated Cost
Precipitation Calibration & Installation of Weather Station	5	\$745
Monthly Download of Data	7	\$938
End of Season Equipment Removal	3	\$447
Data QA/QC & Report, Data Storage, & Distribution to the WCD	8	\$1,192
Expenses	N/A	\$320*
TOTALS	23	\$3,622

* Includes the cost for sensor replacement (temp/ humidity or pyranometer sensor (if needed) during the 2023 monitoring season)

Requested Action

1. Approve this scope of services from account number 957-0000. All tasks including the annual report will be completed by February 15, 2024.