



Stream stage, stream temperature, stream turbidity, stream conductivity, precipitation and air temperature for the Nisqually River at Longmire

Water year 2019

Water-Data Report NPS/MORA/WDR—2020/007





ABOVE

Equipment and battery enclosure, GOES antenna, solar panel, and air pressure/temperature sensor at the transmitter site for the Nisqually River at Longmire. Not visible behind the equipment is the tipping bucket rain gauge. Photo taken June 25, 2019 at 04:43 PM. Photograph by Scott Beason, Mount Rainier National Park

ON THE COVER

Nisqually River from Longmire near the gaging station, facing north. The data transmitter is visible on the left side of the photo. Photo taken August 1, 2018 at 03:23 PM. Photograph by Scott Beason, Mount Rainier National Park

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National Park Service
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Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

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Introduction

Mount Rainier is a 4,392 m (14,410 ft) volcano in southwestern Washington State. Braided rivers radiate away from the volcano and are generally glacially-sourced. Approximately 3.22 km³ (0.77 mi³) of glacial ice and perennial snows cover Mount Rainier in 29 named features (Beason, 2017; George and Beason, 2017). The mountain receives an average of 16.3 m (53.3 ft; 640 in) of snow at Paradise and melting snow causes high flows in spring and summer months (NPS, 2020). Fall and winter storms lead to periodic flooding and higher flows. Generally, the lowest river flows occur late in the summer prior to the onset of fall storms and in the middle of winter. Most streams in the park exhibit a braiding or anastomosing character due to their glacial source, however, several of the lower order streams that have non-glacial sources exhibit pool-riffle morphology with very coarse median grain sizes. Average stream gradient ranges from 1 to 4%.

The Nisqually River is one of six major stream networks that drain a significant portion of the volcano (the others being the Puyallup, Carbon, West Fork White, White, and Ohanapeosh). The Nisqually River watershed (Figure 1) begins at the Nisqually Glacier and ends at the Nisqually National Wildlife Refuge, emptying into the Puget Sound. The Nisqually River at Longmire has a watershed size of 48.7 km² (18.8 mi²), a mean basin elevation of 1,814 m (5,950 ft) and drains from the summit of Mount Rainier down to 853 m (2,800 ft) at Longmire (Table 1). The drainage basin includes three glaciers (Nisqually, Wilson and Van Trump Glaciers) and the permanent Muir Snowfield. Mean basin slope is 48.2% and has 39.0% canopy cover. Mean annual precipitation in the watershed is approximately 262 cm (103 in) (USGS Stream Stats, 2011). The Nisqually River's headwaters start at the terminus of the Nisqually Glacier, at approximately 1,585 m (5,200 ft). From there, the river cascades down a steep braided stream with very coarse sediment. The river character is a classic braided system with multiple debris flow inputs from Van Trump Creek and other small streams.

Stream gage data from the Nisqually River at Longmire within Mount Rainier National Park are presented for water year 2019 (WY2019; October 1, 2018 – September 30, 2019). The Longmire location is one of two year-round real-time gaging stations at the park; the other being on the White River at White River Bridge (see associated water-data reports for that location). Stream statistics are obtained via pressure transducers that are mounted within a stilling well at Longmire. Data from WY2019 was collected by a solar and battery-powered data collector and transmitted to the GOES West satellite where the data was then disseminated to a web-accessible database.

Stream gage data is useful for determining critical in-stream flows for aquatic habitats as well as showing the range of temperatures exhibited in park streams during the year.

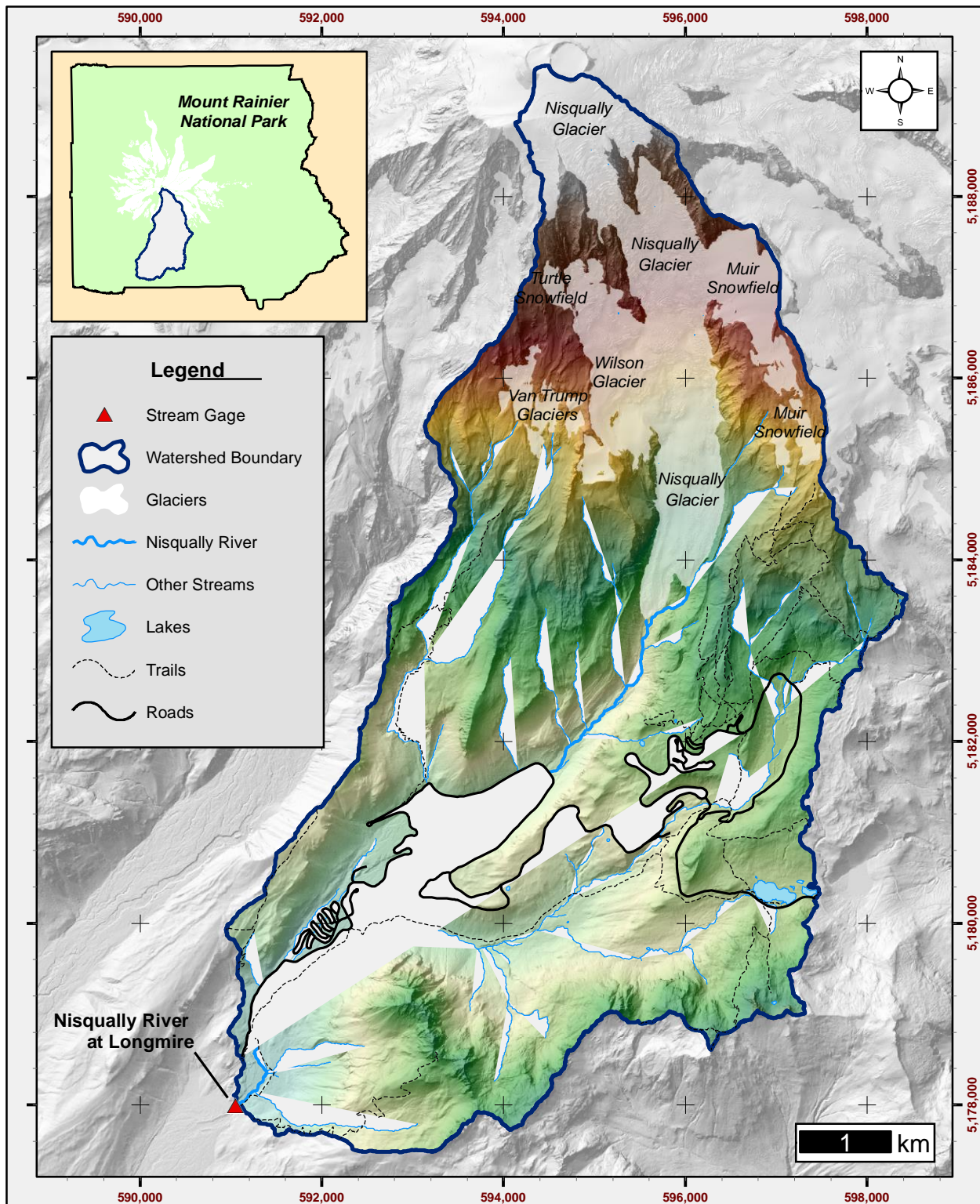


Figure 1: Overview map of the Nisqually River Watershed at Longmire showing major glaciers and snowfields, rivers, lakes, roads and trails. (Grid: NAD 1983 UTM Zone 10N, Meters; Scale: 1:65,000)

Table 1: Stream gage information for the Nisqually River at Longmire. Watershed data is derived from surveys, 2008 LiDAR basemap of park (Watershed Sciences, 2009) and GIS layers at Mount Rainier National Park.

Location Description:	NE ¼, NW ¼, Section 33, T15N, R08E, Pierce County, Washington. On bedrock of river-right bank, approximately 450 feet downstream of the Longmire Back-Gate Road suspension bridge.
Location:	<u>NAD 1983 UTM Zone 10 North, Meters</u> N: 5,177,877 meters E: 590,950 meters <u>Geographic, WGS1984</u> Latitude: 46° 44' 53.7072" (46.748252°) Longitude: -121° 48' 33.3432" (-121.809262°)
Elevation (Gage Cap):	2,772.080 feet (NAVD 1988) 844.930 meters (NAVD 1988)
Drainage Area:	18.80 square miles 48.69 square kilometers 12,032.72 acres 48,694,675.76 square meters
Period of Record:	October 1, 2018 to September 30, 2019, with noted outages in Table 2.
Recording Interval:	15 minutes
Gage Equipment (Stilling Wells):	Stage/Temperature/Conductivity: 2-inch by 5-foot slotted stainless-steel pipe with 0.010" slots mounted to bedrock. Turbidity: 4-inch by 5-foot slotted schedule 40 PVC pipe with 0.020" slots, mounted to bedrock. Both wells are mounted to bedrock exposure with expansion bolts and steel brackets. PVC well cap on the top locked with a padlock.
Gage Equipment (Pressure transducers):	Stage: In-Situ Aqua TROLL 200 pressure transducer hung approximately 5 feet from the cap, measuring water pressure, water conductivity and water temperature at 15-minute intervals. Barometric: Solinst Barologger Gold 1.5 meter/5 foot pressure transducer mounted at transmitter, measuring air pressure and air temperature at 15-minute intervals.
Measured Variables:	(1) Water Pressure (Automated pressure transducer measurement) (2) Water Temperature (Automated pressure transducer measurement) (3) Water Conductivity (Automated pressure transducer measurement) (4) Turbidity Level (5) Air Pressure (Automated pressure transducer measurement) (6) Air Temperature (Automated pressure transducer measurement) (7) Stage (Calculated, Variable 1 - Variable 5) (8) Precipitation
Landscape Types in Watershed:	<i>Glaciers and Permanent Snowfields:</i> 3.02 mi ² (7.82 km ²), 16.06% <i>Alpine:</i> 4.27 mi ² (11.05 km ²), 22.69% <i>Subalpine:</i> 4.89 mi ² (12.66 km ²), 25.99% <i>Forest:</i> 6.59 mi ² (17.08 km ²), 35.07% <i>Lakes:</i> 0.04 mi ² (0.09 km ²), 0.19%

Methods

Stage, Temperature and Conductivity Computation

Stream stage for the Nisqually River at Longmire is calculated by determining the height of water column above a mounted pressure transducer. Figure 2 shows the current in-water equipment. At the in-water field site, a 2-inch by 5-foot stainless-steel pipe is mounted to bedrock which serves as a stilling well and extends into the water column of the mainstem river. Inside this stilling well, an In-Situ Aqua TROLL 200 pressure transducer is hung from the top cap down to the bottom of the pipe. At 15-minute intervals, water pressure (which includes atmospheric pressure), water temperature and water conductivity are measured and sent to a data logger. At the data logger, a Solinst Barologger Gold 1.5-meter/5-foot pressure transducer measures air pressure and air temperature. Stage is calculated by subtracting atmospheric air pressure from the water pressure, and then converting the pressure differential into a water column equivalent.

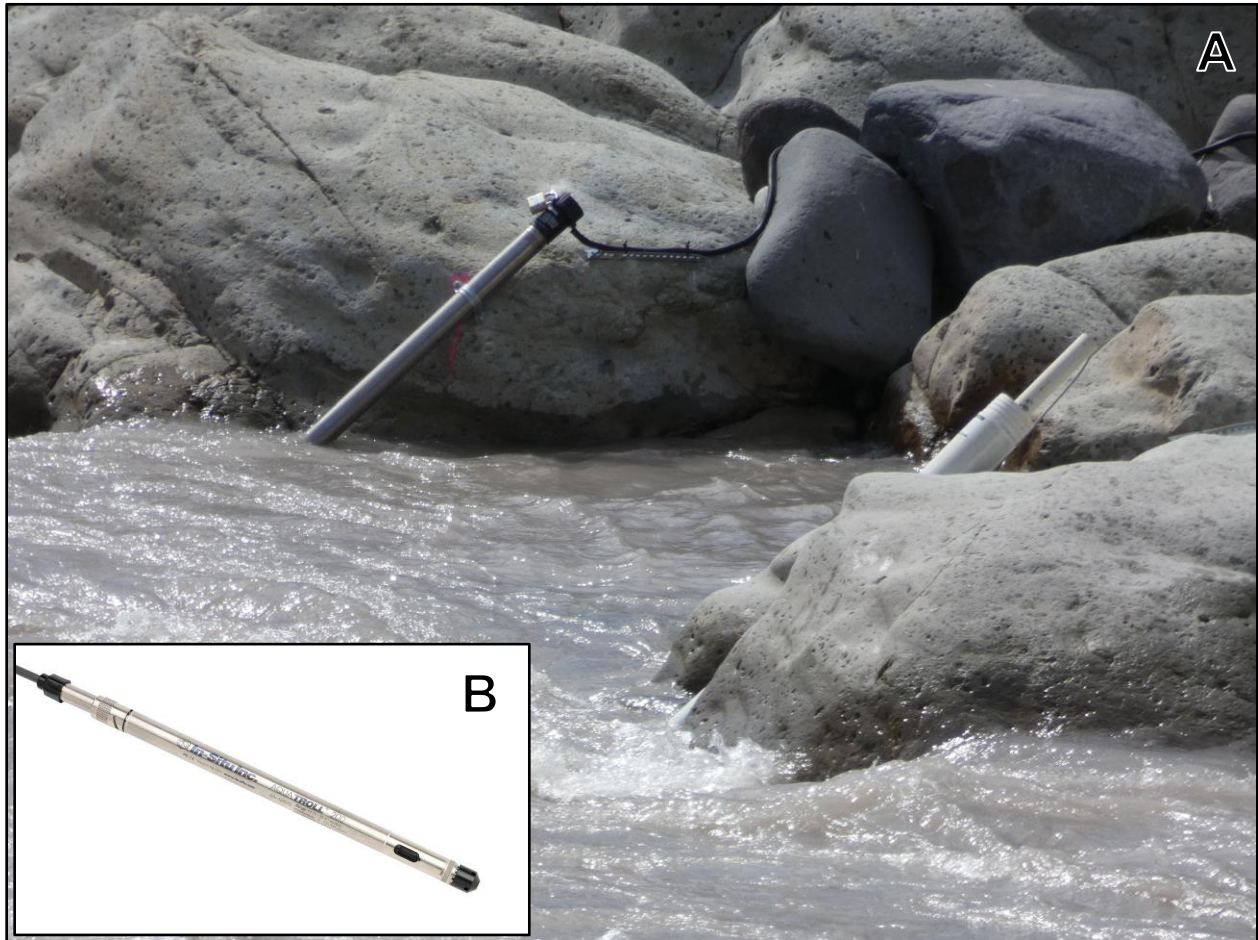


Figure 2: In-water stream gage equipment in the Nisqually River at Longmire. Photo (A) shows the 2" x 5' stainless steel stilling well that houses the In-Situ Aqua TROLL 200 pressure transducer and conductivity sensor on the left and 4" x 5' Schedule 40 PVC stilling well that houses the FTS DTS-12 turbidity sensor on the right. Photo (B) shows a detail photo of the In-Situ Aqua TROLL 200 sensor. Photo taken on August 1, 2018 at 3:23 PM (NPS/Scott Beason).

Turbidity

Turbidity is defined as the presence of suspended particles in water and measured in Nephelometric Turbidity Units (NTU). An FTS DTS-12 SDI-12 turbidity sensor (Figure 3) is mounted next to the stilling well mentioned previously (Figure 2). The sensor uses a laser diode light source and a coherent narrow near-infrared spectral beam to measure the number of suspended particles in the water column (FTS, 2020b), which is then calculated in NTU. The sensor also has a “wiper blade” that cleans the sensor face to reduce fouling. Turbidity levels were measured at the same rate/interval as water pressure and temperature measurements.



Figure 3: FTS DTS-12 SDI-12 digital turbidity sensor.

Precipitation

Precipitation was measured by a non-heated FTS RG-T tipping-bucket rain gauge (Figure 4). The equipment funnels and filters water into a mechanism that tips when 0.01 in (0.03 cm) of precipitation accumulates into the bucket (FTS, 2020c). A cable runs from the rain gauge to data collector and appends 0.01 to the previous precipitation measurement. At 15-minute intervals, the water year total precipitation is then logged and reported to the database. The more tips that occur in a 15-minute period, the higher the intensity of precipitation that is occurring. The sensor is un-heated which means that it cannot discriminate between melted and solid precipitation.

Additionally, in periods of frozen precipitation, it is extremely likely that measurements are not accumulating as would be expected in a heated sensor.



Figure 4: FTS RG-T tipping-bucket rain gauge.

Data Collection Platform

All sensors at this site are wired to communicate to a common data logger, which is currently the FTS Axiom H1RS data logger (FTS, 2020a) (See photo on inside cover). The H1RS data logger receives power from a 12-volt battery, has an on-board solar regulator and utilizes a 50-watt solar panel. The H1RS logs all data received from each remote sensor and transmits four 15-minute data packets to the GOES West geostationary satellite every hour. The data is then downloaded by an automated computer script from the GOES Wallops server, processed, and appended to a real-time, web-accessible database and website (<http://waterdata.morageology.com/station.php?g=4B300A32>).

15 minute stream stage - WY2019 - Longmire

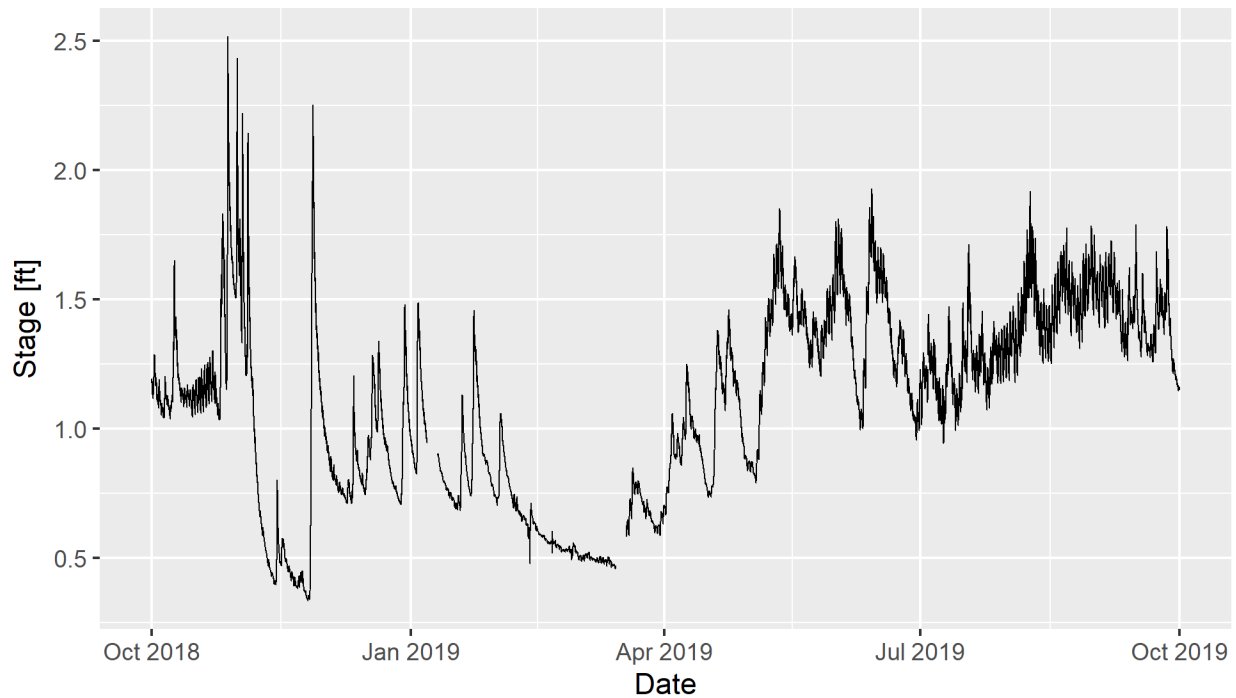


Figure 5: Stream stage during water year 2019 at Longmire.

Results

Stream Stage

Fifteen-minute stage heights were recorded in WY2019 and shown in Figure 5. Stage ranges from 0.3362 ft (0.1025 m) which occurred February 26, 2019 at 07:45 AM to 2.5158 ft (0.7668 m) which occurred August 28, 2019 at 03:45 PM. Rain events and small floods are clearly shown in the record, as well as diurnal increases in daily runoff in the spring to summer months associated with snowmelt. Daily minimum, mean and maximum stream stage for every day in WY2019 are shown in appendixes A-1, A-2 and A-3, respectively.

15 minute water temperature - WY2019 - Longmire

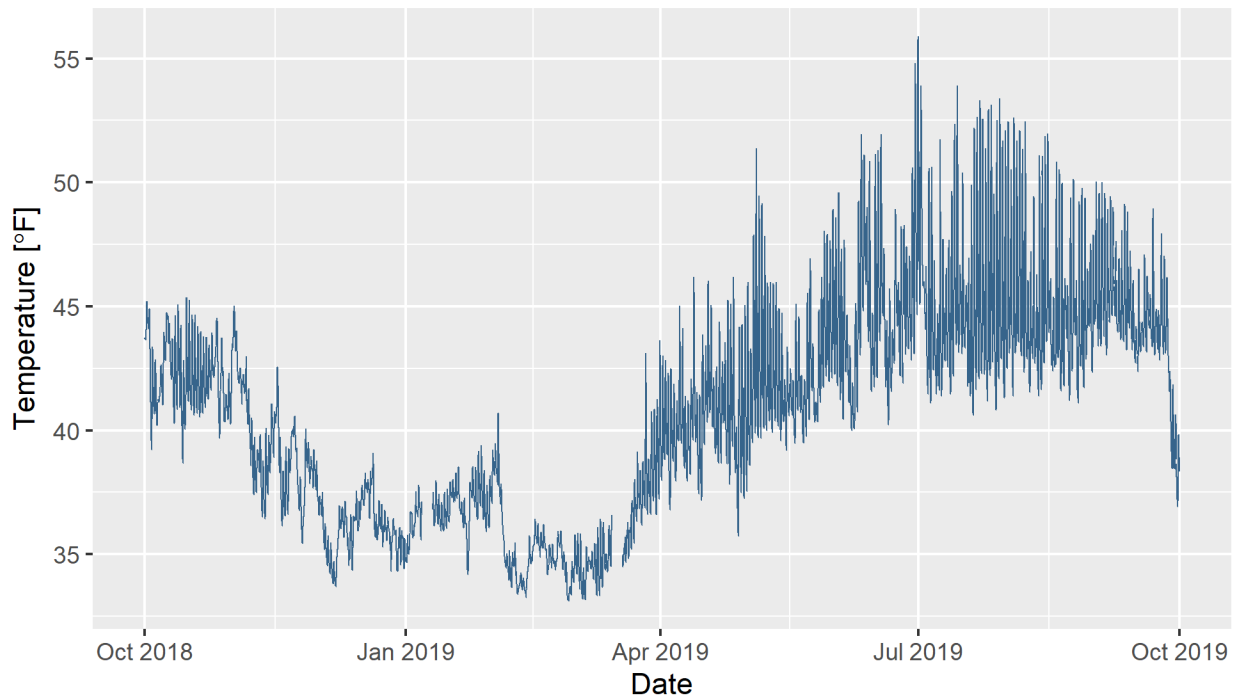


Figure 6: Stream temperature during water year 2019 at Longmire.

Stream Temperature

Figure 6 shows the 15-minute water temperatures during WY2019. The lowest water temperature recorded was 31.1304 °F (-0.6280 °C) on February 27, 2019 at 11:15 and 11:30 AM while the highest water temperature was 55.8860 °F (13.2700 °C) on June 30, 2019 at 07:45 PM. Daily minimum, mean and maximum water temperatures for every day in WY2019 are shown in appendixes B-1, B-2 and B-3, respectively.

15 minute air temperature - WY2019 - Longmire

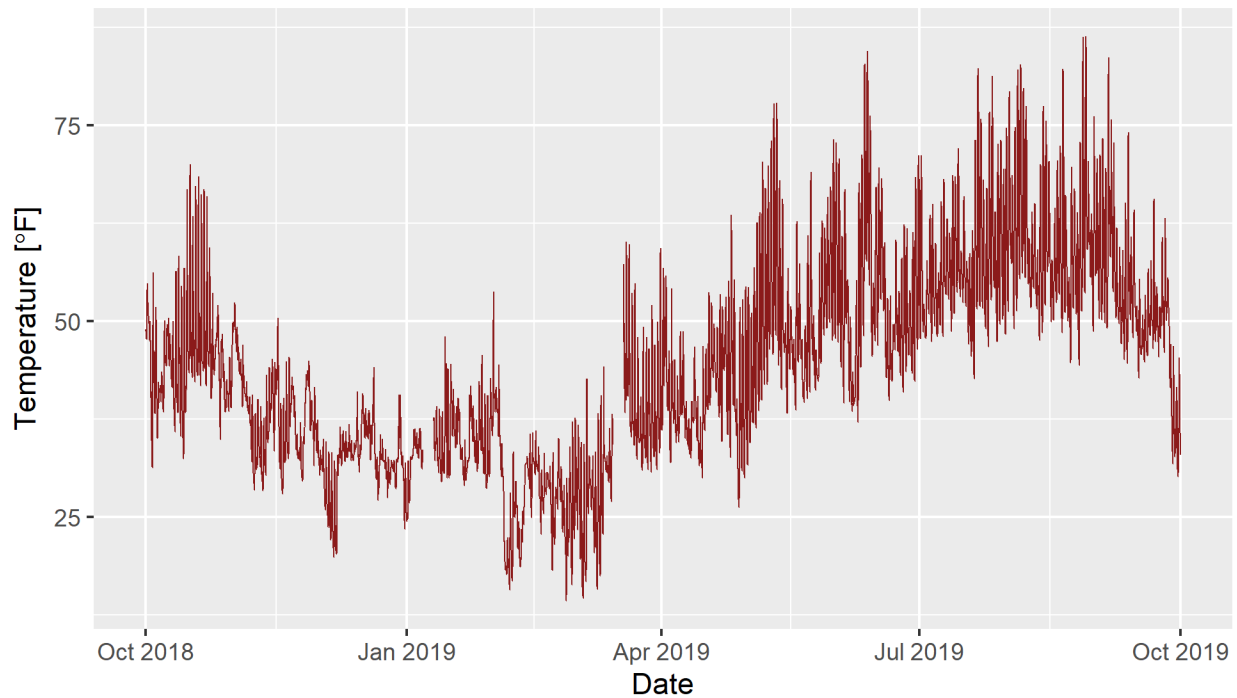


Figure 7: Air temperature during water year 2019 at Longmire.

Air Temperature

Figure 7 shows the 15-minute air temperature during WY2019. The daily, monthly and yearly range of air temperatures is much more variable than water temperatures. The minimum air temperature was 14.3168 °F (-9.8240 °C) on February 26, 2019 at 07:45 AM and the highest air temperature was 86.3384 °F (30.1880 °C) on August 28, 2019 at 3:45 PM. Daily minimum, mean and maximum air temperatures for every day in WY2019 are shown in appendixes C-1, C-2 and C-3, respectively.

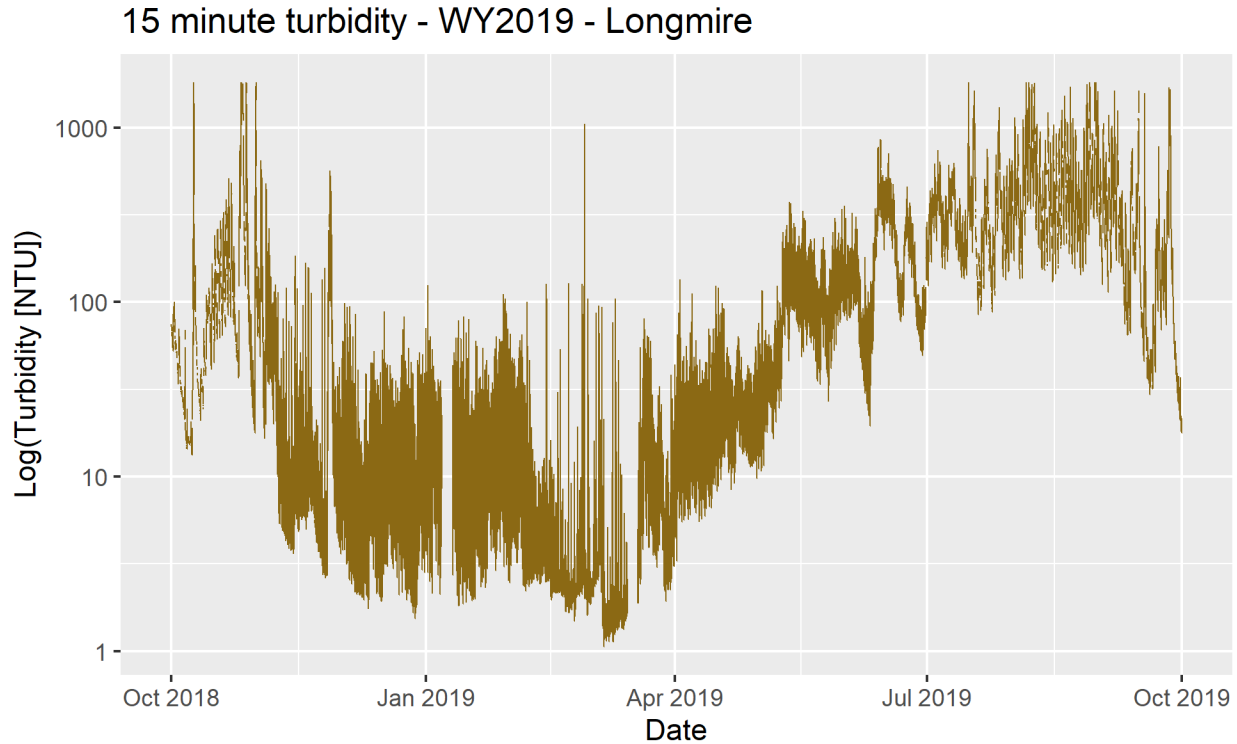


Figure 8: Turbidity during water year 2019 at Longmire.

Stream Turbidity

Figure 8 shows the 15-minute turbidity levels during WY2019 (y-axis is on log scale). Turbidity is highly variable depending on prevailing river stage and shows peaks during periods of high stage. The minimum turbidity level was 1.06 NTU (Nephelometric Turbidity Unit) which occurred on March 6, 2019 at 04:45 AM. The highest turbidity level was 1818.04 NTU (the sensor's maximum reporting level), which occurred 33 times during the water year, including 12 times in October 2018, 3 times in July 2019, and 18 times in August 2019. Daily minimum, mean and maximum turbidity levels for every day in WY2019 are shown in appendixes D-1, D-2 and D-3, respectively.

It should be noted that there were occasional outages in data transmitted from the turbidity sensor to the data logger outside of the data outages noted later in this section. A total of 529 such occurrences were present in WY2019 data and related to an issue with the timing of the SDI-12 commands to fetch and retrieve measurements. This issue was corrected in mid-September 2019.

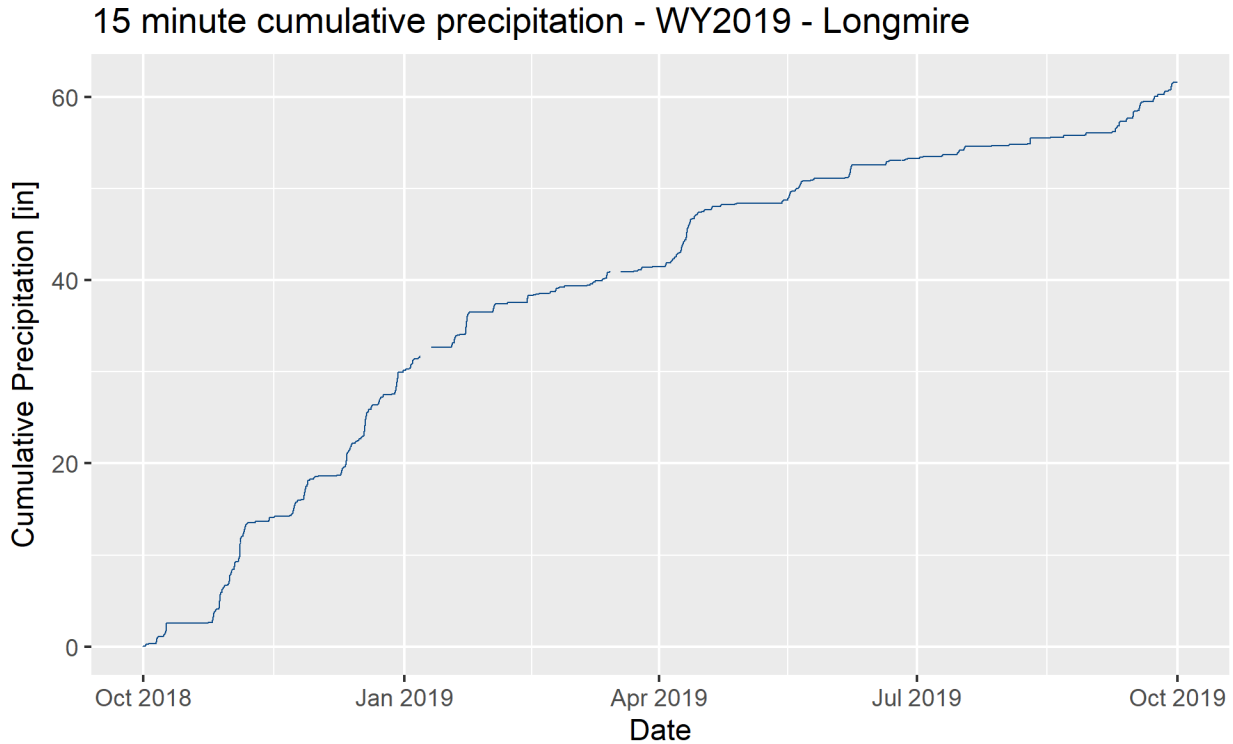


Figure 9: Cumulative precipitation during water year 2019 at Longmire.

Precipitation

Figure 9 shows the cumulative precipitation recorded in the tipping bucket rain gauge at the Longmire Stream Gage in WY2019. Overall, this sensor recorded a total of 61.58 in (156.41 cm) of precipitation. The most precipitation recorded during any day was 2.19 in (5.56 cm) on November 4, 2018. Daily precipitation totals for WY2019 are shown in appendix E-1.

It should be noted that this sensor is not heated and likely did not record precipitation during times of snow, hail, sleet, graupel, and other frozen precipitation types. The levels presented here are a minimum bound of the actual precipitation recorded in WY2019.

15 minute water conductivity - WY2019 - Longmire

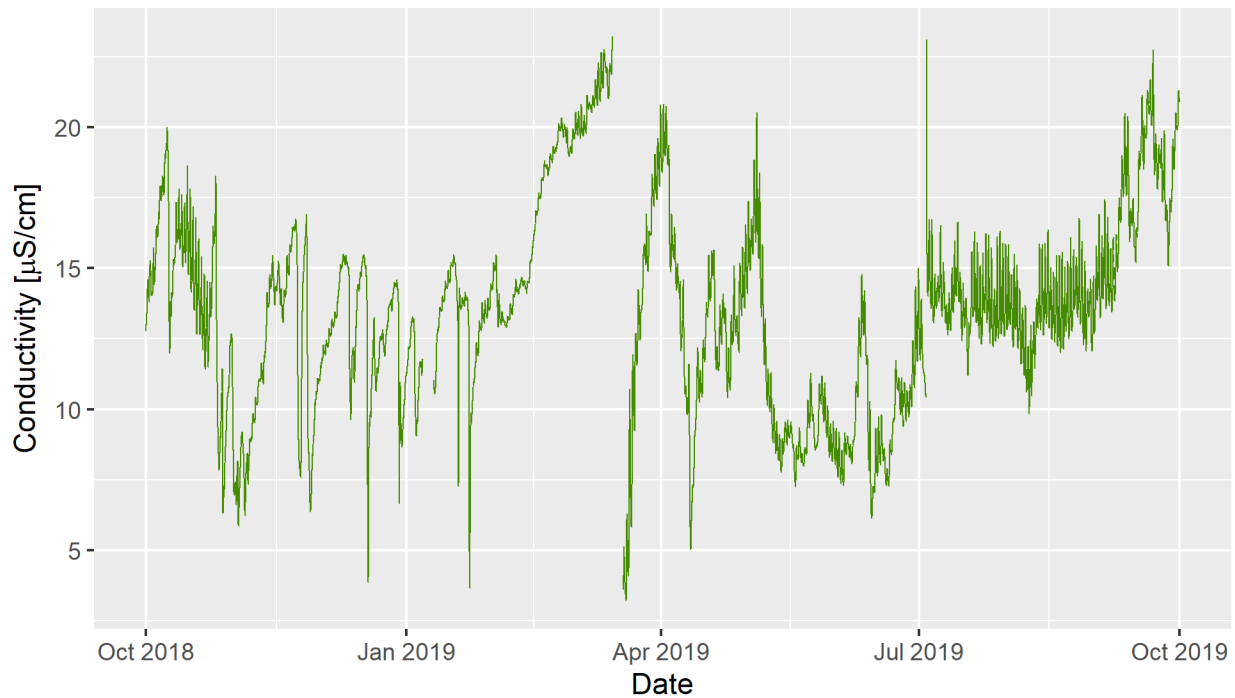


Figure 10: Stream conductivity during water year 2019 at Longmire.

Stream Conductivity

Figure 10 shows the 15-minute stream conductivity in micro-Siemens per centimeter ($\mu\text{S}/\text{cm}$) recorded at the Longmire Stream Gage in WY2019. The minimum conductivity was $3.2167 \mu\text{S}/\text{cm}$ on March 19, 2019 at 02:15 PM and the maximum conductivity was $23.2093 \mu\text{S}/\text{cm}$ on March 14, 2019 at 06:30 PM. Daily minimum, mean and maximum conductivity levels for every day in WY2019 are shown in appendixes F-1, F-2 and F-3, respectively.

Data Outages

During WY2019, data occasionally was not transmitted from the data logger to GOES West satellite and imported into the stream gage database. These outages are shown in Table 2. This occurred for a wide variety of reasons, from hourly transmit/import errors (which generally meant that a whole hour's worth of data (4 data points) would not be imported, to sensor or logger errors (including power-related failures) which resulted in several hours to days of outages (usually greater than 50 data points). Overall, a total of 385 of 35,040 data points are missing from WY2019, which equates to 1.10% of the data in the water year missing or not acquired correctly. If enough data points were missing from a date, the data is then excluded from analysis and tabulation in the appendixes.

Table 2: Data outages during WY2019 on the Nisqually River at Longmire. If significant data points were missing from a day, that day’s data was excluded from analysis and noted in the “Dates excluded from analysis” column.

Start Date	End Date	# Data Points	Data Affected	Dates excluded from analysis
2018-11-02 13:15	2018-11-02 14:30	6	All	-
2018-11-03 16:15	2018-11-03 16:45	3	All	-
2019-01-06 17:15	2019-01-10 10:45	357	All	2019-01-06 to 2019-01-10
2019-03-09 15:15	2019-03-09 15:45	3	All	-
2019-03-09 18:00	2019-03-09 18:45	4	All	-
2019-03-10 02:00	2019-03-10 02:45	4	All	-
2019-03-14 13:15	2019-03-14 13:15	1	All	-
2019-06-25 13:15	2019-06-25 14:15	5	All	-
2019-09-20 12:15	2019-09-20 12:15	1	All	-
2019-09-30 15:00	2019-09-30 15:00	1	All	-

Raw Data

Raw tabular data from this study is available as a Microsoft Excel file and includes two worksheets: “15 Minute Data” and “WY2019 Stats.” “15 Minute Data” includes the raw 15-minute data from WY2019 with the following columns (35,041 rows): Date/Time, Day of Water Year, Stage, Water Temperature, Air Temperature, Turbidity Level, Cumulative Precipitation and Water Conductivity. “WY2019 Stats” is the daily summary data of the 15 minute data for WY2019 and includes the following columns (366 rows): Date; Day of Water Year; Number of Measurements; Minimum, Average and Maximum Stage; Minimum, Average and Maximum Water Temperature; Minimum, Average and Maximum Air Temperature; Minimum, Average and Maximum Turbidity; Daily and Cumulative Precipitation; and Minimum, Average and Maximum Conductivity. The data is available as download at the following link or by contacting the author of this report: <https://irma.nps.gov/DataStore/Reference/Profile/2272246>.

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Appendix A: WY2019 stream stage data tables

Note: Dates marked with a single dash (-) indicate those days excluded from analysis in Table 2 and described in “Outages” section of report.

Appendix A-1: Minimum daily stream stage (in feet) recorded at the Longmire stream gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1.12	1.39	0.96	0.89	0.73	0.49	0.67	0.83	1.52	1.01	1.19	1.46
2	1.11	1.33	0.88	0.83	0.92	0.49	0.75	0.82	1.52	1.15	1.28	1.39
3	1.08	1.21	0.83	0.83	0.84	0.49	0.85	0.79	1.51	1.10	1.18	1.47
4	1.05	1.27	0.80	1.15	0.78	0.50	0.89	0.88	1.40	1.21	1.21	1.39
5	1.04	1.15	0.78	1.01	0.73	0.49	0.88	1.06	1.42	1.15	1.28	1.41
6	1.08	0.89	0.75	0.95	0.69	0.49	0.86	1.17	1.31	1.11	1.36	1.52
7	1.04	0.73	0.74	-	0.68	0.48	0.86	1.28	1.18	1.03	1.38	1.45
8	1.08	0.63	0.73	-	0.66	0.48	0.96	1.36	1.09	1.02	1.51	1.42
9	1.32	0.57	0.71	-	0.64	0.48	1.11	1.40	1.00	0.94	1.51	1.42
10	1.16	0.51	0.72	0.89	0.63	0.48	1.00	1.48	1.00	1.14	1.43	1.30
11	1.10	0.46	0.71	0.83	0.58	0.47	0.96	1.54	1.16	1.24	1.38	1.28
12	1.08	0.43	0.87	0.79	0.48	0.48	0.95	1.54	1.44	1.09	1.29	1.26
13	1.08	0.40	0.81	0.76	0.63	0.46	0.91	1.46	1.66	0.99	1.25	1.40
14	1.09	0.40	0.78	0.73	0.60	0.46	0.85	1.43	1.61	1.01	1.27	1.39
15	1.05	0.48	0.75	0.72	0.59	0.46	0.78	1.38	1.49	1.07	1.26	1.46
16	1.05	0.47	0.77	0.69	0.58	0.47	0.73	1.36	1.52	1.22	1.25	1.32
17	1.06	0.48	0.88	0.69	0.57	0.50	0.74	1.54	1.49	1.18	1.31	1.28
18	1.06	0.45	0.94	0.68	0.56	0.53	0.78	1.37	1.51	1.34	1.37	1.37
19	1.06	0.41	0.99	0.85	0.56	0.59	1.00	1.40	1.41	1.19	1.41	1.28
20	1.08	0.39	0.99	0.83	0.52	0.65	1.23	1.39	1.29	1.14	1.49	1.28
21	1.10	0.38	1.03	0.76	0.54	0.75	1.13	1.33	1.20	1.14	1.45	1.26
22	1.10	0.39	0.94	0.74	0.53	0.75	1.07	1.23	1.16	1.22	1.44	1.29
23	1.10	0.39	0.91	0.97	0.52	0.73	1.22	1.24	1.28	1.17	1.36	1.38
24	1.04	0.35	0.82	1.13	0.52	0.68	1.26	1.35	1.25	1.07	1.43	1.44
25	1.03	0.34	0.78	0.97	0.53	0.65	1.16	1.26	1.20	1.08	1.37	1.36
26	1.52	0.34	0.76	0.90	0.52	0.66	1.13	1.20	1.14	1.17	1.31	1.44
27	1.15	1.61	0.72	0.86	0.49	0.64	1.07	1.27	1.07	1.28	1.34	1.31
28	1.67	1.31	0.71	0.83	0.52	0.60	0.95	1.32	1.03	1.18	1.44	1.21
29	1.60	1.14	0.81	0.78	---	0.60	0.88	1.37	0.96	1.18	1.46	1.18
30	1.50	1.03	1.11	0.74	---	0.59	0.84	1.34	0.99	1.18	1.50	1.18
31	1.52	---	0.97	0.70	---	0.63	---	1.41	---	1.20	1.44	---
Minimum	1.03	0.34	0.71	0.68	0.48	0.46	0.67	0.79	0.96	0.94	1.18	1.18
Mean	1.17	0.71	0.84	0.84	0.61	0.56	0.95	1.28	1.29	1.14	1.36	1.35
Maximum	1.67	1.61	1.11	1.15	0.92	0.75	1.26	1.54	1.66	1.34	1.51	1.52

Appendix A-2: Mean daily stream stage (in feet) recorded at the Longmire stream gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1.17	1.62	0.99	0.93	0.88	0.51	0.71	0.86	1.66	1.16	1.31	1.54
2	1.20	1.66	0.92	0.86	0.99	0.50	0.79	0.85	1.67	1.22	1.37	1.52
3	1.13	1.29	0.86	1.23	0.88	0.50	0.94	0.83	1.60	1.24	1.32	1.56
4	1.09	1.61	0.82	1.26	0.81	0.51	0.94	0.95	1.50	1.27	1.33	1.52
5	1.09	1.23	0.80	1.08	0.76	0.51	0.92	1.12	1.47	1.24	1.39	1.53
6	1.12	1.01	0.77	0.99	0.72	0.50	0.91	1.25	1.37	1.20	1.48	1.59
7	1.07	0.81	0.76	-	0.70	0.49	0.95	1.38	1.23	1.11	1.56	1.55
8	1.17	0.68	0.74	-	0.68	0.49	1.04	1.43	1.12	1.08	1.64	1.51
9	1.43	0.60	0.75	-	0.66	0.49	1.19	1.49	1.05	1.06	1.65	1.50
10	1.23	0.54	0.75	0.90	0.65	0.49	1.04	1.59	1.10	1.22	1.61	1.38
11	1.14	0.48	0.88	0.85	0.62	0.49	1.00	1.67	1.31	1.33	1.48	1.35
12	1.13	0.44	0.93	0.81	0.63	0.49	0.97	1.67	1.58	1.17	1.39	1.38
13	1.13	0.42	0.86	0.78	0.65	0.48	0.94	1.55	1.76	1.10	1.38	1.48
14	1.13	0.55	0.80	0.75	0.62	0.47	0.88	1.48	1.69	1.10	1.38	1.44
15	1.11	0.51	0.77	0.74	0.60	0.48	0.81	1.44	1.60	1.17	1.36	1.58
16	1.13	0.54	0.86	0.71	0.59	0.50	0.76	1.44	1.61	1.31	1.38	1.38
17	1.13	0.51	0.93	0.71	0.58	0.53	0.75	1.61	1.58	1.34	1.44	1.40
18	1.15	0.46	1.17	0.73	0.57	0.59	0.82	1.44	1.56	1.52	1.49	1.43
19	1.14	0.44	1.08	1.01	0.56	0.65	1.21	1.45	1.47	1.27	1.54	1.32
20	1.16	0.42	1.15	0.88	0.56	0.74	1.30	1.45	1.37	1.23	1.61	1.32
21	1.19	0.39	1.11	0.79	0.56	0.78	1.19	1.40	1.25	1.24	1.59	1.32
22	1.19	0.41	0.98	0.78	0.55	0.78	1.13	1.29	1.22	1.31	1.54	1.45
23	1.16	0.42	0.93	1.27	0.54	0.76	1.34	1.32	1.35	1.26	1.50	1.45
24	1.09	0.37	0.86	1.22	0.53	0.71	1.34	1.39	1.33	1.17	1.51	1.51
25	1.25	0.35	0.80	1.04	0.53	0.69	1.23	1.34	1.28	1.18	1.45	1.44
26	1.69	0.79	0.77	0.92	0.53	0.69	1.17	1.27	1.19	1.27	1.44	1.57
27	1.32	1.90	0.74	0.88	0.53	0.65	1.13	1.34	1.11	1.33	1.47	1.41
28	2.03	1.43	0.73	0.85	0.54	0.62	1.00	1.41	1.06	1.27	1.56	1.26
29	1.69	1.22	1.14	0.80	---	0.62	0.91	1.47	1.03	1.29	1.55	1.21
30	1.54	1.09	1.25	0.76	---	0.63	0.87	1.47	1.08	1.29	1.64	1.21
31	1.88	---	1.03	0.73	---	0.67	---	1.56	---	1.31	1.58	---
Minimum	1.07	0.35	0.73	0.71	0.53	0.47	0.71	0.83	1.03	1.06	1.31	1.21
Mean	1.26	0.81	0.90	0.90	0.64	0.58	1.01	1.36	1.37	1.23	1.48	1.44
Maximum	2.03	1.90	1.25	1.27	0.99	0.78	1.34	1.67	1.76	1.52	1.65	1.59

Appendix A-3: Maximum daily stream stage (in feet) recorded at the Longmire stream gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1.25	1.81	1.04	0.97	1.06	0.53	0.77	0.88	1.81	1.26	1.45	1.61
2	1.29	2.22	0.96	0.89	1.06	0.51	0.85	0.88	1.77	1.29	1.47	1.67
3	1.19	1.45	0.90	1.49	0.92	0.52	1.06	0.90	1.77	1.44	1.45	1.63
4	1.14	2.14	0.86	1.39	0.84	0.52	1.05	1.13	1.57	1.36	1.52	1.68
5	1.20	1.36	0.82	1.15	0.79	0.52	0.98	1.25	1.53	1.35	1.55	1.68
6	1.18	1.16	0.79	1.03	0.75	0.51	0.96	1.40	1.48	1.33	1.65	1.73
7	1.10	0.89	0.78	-	0.74	0.50	1.04	1.50	1.31	1.20	1.77	1.68
8	1.34	0.73	0.75	-	0.69	0.50	1.25	1.50	1.19	1.17	1.92	1.62
9	1.65	0.63	0.81	-	0.67	0.51	1.24	1.68	1.10	1.15	1.79	1.57
10	1.34	0.57	0.79	0.92	0.67	0.50	1.11	1.71	1.27	1.33	1.74	1.54
11	1.18	0.51	1.21	0.88	0.64	0.50	1.05	1.85	1.55	1.47	1.61	1.41
12	1.16	0.46	1.02	0.83	0.71	0.51	1.00	1.84	1.86	1.28	1.50	1.56
13	1.17	0.43	0.92	0.79	0.67	0.49	0.98	1.70	1.93	1.18	1.54	1.62
14	1.15	0.80	0.83	0.77	0.64	0.48	0.92	1.55	1.82	1.22	1.48	1.51
15	1.17	0.58	0.80	0.75	0.61	0.51	0.85	1.52	1.70	1.46	1.48	1.79
16	1.19	0.58	0.97	0.73	0.59	0.53	0.78	1.58	1.70	1.49	1.56	1.47
17	1.20	0.55	0.97	0.74	0.59	0.59	0.78	1.67	1.69	1.66	1.60	1.60
18	1.23	0.48	1.28	0.85	0.58	0.65	0.99	1.57	1.64	1.71	1.65	1.57
19	1.25	0.46	1.21	1.13	0.57	0.73	1.38	1.54	1.57	1.37	1.68	1.36
20	1.26	0.44	1.34	0.95	0.60	0.85	1.38	1.53	1.45	1.32	1.71	1.37
21	1.28	0.41	1.23	0.83	0.57	0.83	1.27	1.47	1.31	1.37	1.78	1.40
22	1.30	0.45	1.04	0.96	0.56	0.80	1.23	1.37	1.29	1.46	1.65	1.69
23	1.22	0.45	0.95	1.46	0.55	0.80	1.46	1.44	1.42	1.37	1.65	1.56
24	1.14	0.39	0.91	1.31	0.54	0.73	1.44	1.45	1.40	1.24	1.59	1.58
25	1.60	0.36	0.82	1.13	0.54	0.73	1.30	1.42	1.37	1.32	1.55	1.53
26	1.83	1.73	0.78	0.97	0.55	0.71	1.23	1.40	1.27	1.37	1.60	1.78
27	1.65	2.25	0.76	0.90	0.56	0.68	1.19	1.42	1.16	1.42	1.68	1.59
28	2.52	1.64	0.81	0.88	0.55	0.64	1.08	1.54	1.11	1.37	1.72	1.31
29	1.83	1.32	1.48	0.83	---	0.63	0.95	1.55	1.11	1.39	1.68	1.25
30	1.60	1.16	1.46	0.79	---	0.68	0.89	1.60	1.23	1.40	1.78	1.25
31	2.43	---	1.12	0.74	---	0.71	---	1.80	---	1.41	1.75	---
Minimum	1.10	0.36	0.75	0.73	0.54	0.48	0.77	0.88	1.10	1.15	1.45	1.25
Mean	1.39	0.95	0.98	0.97	0.67	0.61	1.08	1.47	1.48	1.36	1.63	1.55
Maximum	2.52	2.25	1.48	1.49	1.06	0.85	1.46	1.85	1.93	1.71	1.92	1.79

Appendix B: WY2019 water temperature data tables

Note: Dates marked with a single dash (-) indicate those days excluded from analysis in Table 2 and described in “Outages” section of report.

Appendix B-1: Minimum daily water temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	43.65	43.33	36.58	34.67	38.19	33.86	37.99	37.53	42.27	45.08	42.49	44.27
2	42.25	42.09	36.07	35.00	37.80	34.21	38.82	38.59	41.79	45.81	43.11	43.40
3	39.22	41.90	35.13	35.65	36.79	33.60	38.27	39.51	41.22	42.69	41.37	43.40
4	40.65	41.06	34.53	36.04	34.80	33.21	36.79	39.89	40.45	41.45	43.11	43.79
5	40.19	41.11	34.20	36.50	34.45	33.17	38.74	39.70	42.36	41.09	43.55	43.03
6	41.15	40.01	33.81	35.57	33.95	34.31	37.95	39.69	41.11	42.45	43.00	44.36
7	41.03	38.58	33.70	-	33.66	34.41	39.58	40.10	39.98	41.45	42.34	44.63
8	42.83	37.41	35.24	-	34.13	33.97	39.48	39.98	40.05	41.62	42.62	44.38
9	43.21	37.49	36.03	-	33.38	33.33	38.45	40.38	40.75	41.38	41.54	43.95
10	42.06	38.31	35.69	36.07	33.69	33.32	37.94	39.90	43.03	42.81	42.73	43.66
11	40.28	36.49	34.55	36.15	33.57	33.67	38.24	40.38	44.82	42.55	42.70	43.58
12	40.83	36.42	34.78	36.21	33.26	34.36	39.60	40.17	45.54	41.46	41.38	43.23
13	40.92	37.41	34.36	35.93	34.28	34.28	39.51	39.56	43.58	42.19	41.64	44.13
14	38.66	38.29	36.34	35.95	34.61	34.52	37.43	40.34	41.57	43.45	42.72	43.24
15	40.03	38.90	35.94	36.05	35.29	34.58	37.18	39.19	41.73	43.13	43.58	42.74
16	41.17	40.30	36.39	36.31	35.41	34.74	39.41	40.59	42.13	43.07	42.63	42.37
17	40.80	38.10	36.96	37.16	34.89	34.64	40.32	40.57	43.61	43.31	42.40	43.17
18	40.60	36.14	37.49	37.10	35.23	34.48	40.70	39.47	44.61	41.76	42.64	43.37
19	40.68	36.55	36.45	37.09	34.19	34.66	40.16	40.81	41.75	41.39	42.52	43.17
20	40.52	36.61	36.10	36.60	34.18	34.82	39.05	40.46	40.21	40.60	41.60	44.08
21	40.70	38.29	35.58	36.06	34.43	35.22	38.67	39.50	41.56	41.64	41.81	43.37
22	40.92	39.74	35.62	34.23	34.36	35.45	38.68	39.75	42.69	42.08	42.50	43.02
23	41.24	37.78	35.30	34.19	34.54	36.32	40.30	40.42	44.20	42.29	41.20	42.95
24	41.61	36.75	35.41	37.27	35.27	36.85	38.66	41.60	42.20	42.25	42.39	42.84
25	42.13	35.45	35.55	36.89	34.38	36.17	37.81	40.32	41.91	41.17	41.73	43.06
26	41.69	36.51	34.31	36.40	33.45	36.88	39.34	40.35	43.05	42.22	41.09	43.11
27	39.67	38.49	35.00	36.95	33.13	36.62	37.82	41.14	43.29	41.86	42.59	40.32
28	40.47	37.84	34.34	36.40	33.36	36.62	35.74	41.75	42.82	40.82	41.73	38.45
29	40.35	37.66	34.30	35.91	---	37.16	37.49	42.18	43.10	42.08	42.85	38.29
30	40.42	37.32	34.56	36.06	---	36.61	37.26	41.97	44.66	42.01	43.95	38.29
31	40.25	---	34.41	37.05	---	37.23	---	42.10	---	41.31	42.34	---
Minimum	38.66	35.45	33.70	34.19	33.13	33.17	35.74	37.53	39.98	40.60	41.09	38.29
Mean	40.97	38.41	35.31	36.12	34.59	34.94	38.58	40.25	42.40	42.21	42.38	42.86
Maximum	43.65	43.33	37.49	37.27	38.19	37.23	40.70	42.18	45.54	45.81	43.95	44.63

Appendix B-2: Mean daily water temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	44.24	44.19	37.07	35.05	38.64	34.63	39.96	41.22	44.91	49.03	45.93	46.24
2	44.16	43.15	36.87	35.87	38.89	34.92	40.42	40.65	44.99	47.04	46.01	45.88
3	41.22	42.13	35.60	36.03	37.43	34.54	40.17	42.82	44.17	44.71	45.52	45.96
4	41.71	41.89	35.01	36.63	35.76	33.70	39.21	44.14	43.68	44.72	46.35	46.09
5	40.86	41.84	34.64	37.02	34.70	34.00	40.06	43.62	43.43	45.05	46.83	45.38
6	41.84	40.81	34.18	36.40	34.45	34.62	39.32	43.63	42.25	43.87	46.11	46.11
7	42.33	39.67	34.29	-	34.28	34.73	41.24	43.28	40.92	42.85	45.91	46.29
8	43.68	38.44	36.15	-	34.69	34.62	40.86	42.39	42.10	44.69	43.95	45.68
9	44.03	38.38	36.46	-	33.66	34.46	39.65	42.53	44.40	44.12	43.69	44.85
10	42.78	39.00	36.39	36.78	33.96	34.60	39.26	42.20	46.77	44.44	44.86	45.12
11	42.11	37.59	35.65	36.89	33.77	34.89	39.96	42.68	47.74	44.65	44.08	45.65
12	42.63	37.80	35.67	36.76	33.66	34.81	42.01	42.27	47.19	45.00	44.76	45.35
13	42.56	38.36	35.63	36.45	34.92	35.01	40.55	41.72	46.34	46.14	45.04	45.25
14	40.61	39.62	36.78	36.49	34.84	35.47	39.17	41.09	43.15	47.30	46.10	44.53
15	42.02	40.00	36.43	36.70	35.72	35.26	39.95	41.10	45.39	44.85	46.29	43.50
16	42.66	41.25	37.29	36.95	35.74	34.96	41.08	41.42	45.95	45.32	44.19	44.02
17	42.28	39.50	37.49	37.54	35.41	34.96	42.63	41.18	46.95	44.44	43.62	43.73
18	42.20	37.18	37.76	37.54	35.59	34.97	42.39	41.70	45.97	43.99	45.21	44.64
19	42.15	37.63	37.53	37.69	35.11	35.17	41.27	42.21	43.19	44.15	45.38	44.66
20	41.93	37.76	37.93	36.84	34.76	35.66	40.36	41.37	42.58	45.12	44.61	44.73
21	41.88	39.02	35.98	36.53	34.93	36.10	40.93	40.68	42.77	46.09	44.03	45.31
22	42.04	40.12	36.40	35.52	34.63	36.91	40.80	42.21	44.97	46.49	44.25	44.00
23	42.19	38.98	36.29	36.35	35.19	37.26	41.57	43.37	45.23	45.96	44.46	43.85
24	42.54	37.43	36.13	37.77	35.55	37.57	41.16	42.49	44.56	45.43	45.22	45.08
25	42.48	36.18	36.02	37.53	34.84	37.21	40.98	40.89	45.17	45.65	44.33	44.53
26	43.57	38.12	35.46	37.46	34.30	38.96	41.89	41.97	45.50	46.50	44.03	44.41
27	40.98	38.98	35.87	37.89	33.32	37.83	39.12	43.29	44.99	45.31	45.16	42.06
28	42.37	38.41	35.55	37.27	33.95	38.29	39.54	44.32	46.06	45.24	44.65	39.92
29	40.82	38.47	35.24	36.72	---	38.80	40.67	44.45	48.05	46.06	44.48	39.17
30	41.22	38.08	35.45	36.89	---	38.76	40.68	44.47	49.15	45.63	45.42	39.17
31	41.68	---	35.03	37.92	---	39.76	---	44.83	---	45.38	44.60	---
Minimum	40.61	36.18	34.18	35.05	33.32	33.70	39.12	40.65	40.92	42.85	43.62	39.17
Mean	42.25	39.33	36.07	36.84	35.10	35.92	40.56	42.46	44.95	45.33	45.00	44.37
Maximum	44.24	44.19	37.93	37.92	38.89	39.76	42.63	44.83	49.15	49.03	46.83	46.29

Appendix B-3: Maximum daily water temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	45.21	45.01	37.34	35.79	39.48	35.78	43.02	45.99	48.58	53.90	52.46	50.03
2	44.89	44.01	37.51	36.71	40.69	35.86	42.84	43.30	49.60	51.51	50.52	49.56
3	43.37	42.52	36.26	36.70	38.20	35.84	42.32	47.90	47.31	46.62	52.60	49.99
4	42.86	42.26	35.77	37.53	36.76	34.45	42.48	51.36	47.68	50.58	51.68	49.56
5	41.71	42.99	35.47	37.78	35.04	35.31	41.87	49.47	44.65	50.62	52.08	48.93
6	42.66	41.70	34.73	37.11	35.15	34.89	41.19	49.15	43.42	46.85	51.36	49.45
7	43.97	40.49	35.22	-	35.09	35.13	45.02	47.83	41.91	44.72	52.45	49.00
8	44.75	39.73	36.96	-	35.47	35.43	44.11	45.95	45.13	51.75	46.04	47.62
9	44.67	39.22	36.92	-	34.30	36.10	41.37	45.97	49.26	47.72	47.22	46.93
10	43.69	39.83	37.15	37.51	34.26	36.42	41.19	45.92	51.95	46.54	49.45	48.08
11	44.63	38.77	36.49	37.97	34.06	36.29	42.08	45.98	51.10	47.69	46.29	49.12
12	45.06	40.09	36.62	37.43	34.27	35.63	46.18	44.91	49.27	49.65	51.08	48.81
13	44.26	39.82	36.54	37.11	35.76	36.18	41.93	44.73	50.87	52.36	51.07	47.26
14	42.83	41.06	37.57	37.51	35.29	36.58	41.44	42.05	44.74	53.90	51.86	46.04
15	45.35	40.76	37.14	37.64	36.43	36.28	43.85	43.36	51.14	46.68	51.97	44.19
16	45.26	42.55	37.80	37.91	36.24	35.58	43.42	42.49	51.31	50.39	46.14	46.50
17	44.65	41.78	38.28	38.01	35.88	35.12	46.03	42.04	51.93	45.85	45.39	44.39
18	44.67	38.35	38.02	38.29	36.20	35.29	45.05	45.10	47.62	46.95	50.84	47.09
19	44.20	39.33	38.37	38.53	35.61	35.70	43.46	44.59	45.20	49.89	50.52	46.21
20	43.98	39.28	39.08	37.13	35.40	36.30	42.56	42.47	45.73	52.21	49.99	45.49
21	43.79	39.97	36.63	37.28	35.42	37.18	44.38	42.05	44.07	52.65	46.14	48.96
22	43.76	40.57	37.17	36.33	34.99	38.03	42.79	45.54	48.92	53.32	45.84	44.97
23	43.45	40.24	37.02	37.89	35.94	39.14	43.56	46.94	47.32	52.56	49.39	44.84
24	43.94	38.13	36.79	38.54	35.94	38.40	45.26	44.25	48.23	51.38	50.13	47.93
25	43.01	37.59	36.50	38.52	35.44	38.76	45.10	41.71	48.28	52.95	46.06	47.04
26	44.52	40.07	36.09	39.17	34.83	43.11	46.19	44.87	47.60	53.12	49.24	46.15
27	42.48	39.53	36.44	39.39	33.70	39.15	40.62	46.19	47.04	49.55	49.77	43.13
28	43.74	38.95	36.06	38.38	34.71	40.77	44.17	48.04	50.61	52.51	49.37	41.85
29	41.45	39.22	36.08	37.80	---	40.83	44.27	47.91	54.80	53.38	46.51	40.63
30	42.31	38.79	36.03	38.19	---	41.25	45.06	47.65	55.89	51.68	47.53	40.63
31	43.49	---	35.70	39.23	---	43.63	---	48.92	---	52.09	47.88	---
Minimum	41.45	37.59	34.73	35.79	33.70	34.45	40.62	41.71	41.91	44.72	45.39	40.63
Mean	43.83	40.42	36.77	37.76	35.73	37.24	43.43	45.63	48.37	50.37	49.32	46.68
Maximum	45.35	45.01	39.08	39.39	40.69	43.63	46.19	51.36	55.89	53.90	52.60	50.03

Appendix C: WY2019 air temperature data tables

Note: Dates marked with a single dash (-) indicate those days excluded from analysis in Table 2 and described in “Outages” section of report.

Appendix C-1: Minimum daily air temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	47.69	46.57	30.29	24.41	38.36	22.24	36.11	31.62	47.79	47.75	51.21	55.83
2	39.20	43.90	28.80	26.97	34.04	23.34	39.49	34.50	47.31	47.97	57.39	50.30
3	31.27	41.86	25.87	32.53	30.07	16.54	33.34	37.02	44.11	47.80	49.01	50.15
4	37.37	39.08	23.65	33.10	18.22	14.64	31.93	36.39	39.52	50.86	51.29	49.75
5	35.06	38.59	22.04	32.48	17.61	16.72	35.87	38.54	46.84	47.39	55.41	49.12
6	39.71	36.90	19.81	31.14	15.68	25.38	34.46	39.95	39.67	49.38	56.15	58.17
7	38.39	30.42	20.28	-	16.85	23.24	34.55	41.91	38.51	48.05	55.55	53.72
8	44.30	28.45	32.03	-	24.91	20.38	38.05	41.90	39.80	49.48	54.11	50.40
9	44.05	31.16	31.55	-	18.76	15.74	35.05	46.42	37.12	48.06	51.72	49.67
10	38.98	30.28	32.08	32.19	18.59	17.45	33.00	45.78	44.13	53.41	54.13	47.14
11	35.86	28.32	32.70	32.09	24.04	22.78	32.49	48.21	48.15	52.74	51.52	45.08
12	38.34	30.33	32.17	30.61	30.33	30.72	37.02	44.36	57.67	48.67	47.56	44.59
13	35.30	34.43	32.17	29.47	25.81	29.41	32.93	41.23	54.59	51.01	48.52	50.14
14	32.42	38.20	32.60	30.51	24.88	26.92	31.54	43.85	45.54	53.70	52.01	47.90
15	38.34	33.42	30.67	29.94	30.35	31.09	29.98	38.26	47.43	53.12	56.26	48.11
16	43.40	36.59	34.91	30.02	27.37	32.02	36.01	43.86	46.86	52.33	49.93	42.69
17	42.77	29.12	35.08	35.26	22.76	31.70	38.74	42.09	52.80	51.88	50.15	45.74
18	42.27	27.90	34.94	33.78	25.41	34.22	39.29	38.63	48.18	47.05	52.33	44.74
19	43.04	31.92	32.23	33.15	27.84	38.33	42.84	44.80	42.83	45.49	53.46	45.62
20	41.75	32.43	31.49	30.64	25.29	36.55	40.93	40.25	39.86	42.65	48.49	48.19
21	43.61	36.84	27.08	29.03	18.17	35.25	37.76	39.63	42.29	51.54	51.11	46.49
22	41.76	34.40	27.97	29.96	21.49	34.18	34.62	40.07	46.33	51.90	49.98	47.42
23	43.81	32.40	31.99	32.48	25.93	32.38	40.96	40.93	46.10	51.61	44.69	45.45
24	40.13	30.52	29.83	32.69	23.70	31.83	35.50	43.30	43.04	49.05	51.66	47.91
25	43.10	29.54	27.47	30.76	21.93	30.99	32.59	41.16	40.93	46.71	49.45	45.96
26	44.45	35.99	29.18	31.21	14.32	32.40	38.95	42.31	43.55	52.72	44.36	50.11
27	34.88	37.52	29.44	33.26	21.12	31.00	29.02	44.60	45.48	52.26	51.18	37.59
28	38.35	36.00	28.60	29.61	16.31	30.68	26.18	48.19	43.37	47.38	53.57	31.78
29	38.44	31.50	32.42	28.71	---	32.64	30.91	49.13	42.31	49.58	59.12	31.16
30	38.46	32.47	29.58	30.12	---	31.02	30.00	49.86	46.41	50.25	54.40	31.16
31	38.95	---	23.41	35.37	---	33.13	---	47.55	---	48.39	48.65	---
Minimum	31.27	27.90	19.81	24.41	14.32	14.64	26.18	31.62	37.12	42.65	44.36	31.16
Mean	39.85	34.24	29.43	31.12	23.58	27.90	35.00	42.14	44.95	49.68	51.75	46.40
Maximum	47.69	46.57	35.08	35.37	38.36	38.33	42.84	49.86	57.67	53.70	59.12	58.17

Appendix C-2: Mean daily air temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	50.56	49.69	32.11	27.24	39.85	28.85	44.66	43.08	59.47	58.75	64.61	61.37
2	46.99	46.24	31.84	30.97	38.21	29.27	47.92	40.88	58.51	50.12	61.34	60.19
3	40.96	43.52	28.54	34.18	32.05	25.10	40.52	45.64	52.45	52.04	61.44	60.50
4	43.15	42.69	26.98	34.27	23.22	21.74	38.93	48.32	53.55	56.49	65.68	59.08
5	39.18	40.28	25.92	34.49	19.50	26.57	39.40	50.46	51.46	55.17	68.18	63.01
6	41.66	38.51	24.17	32.87	20.95	29.55	37.32	53.80	43.96	53.92	67.39	63.57
7	43.35	35.66	26.10	-	24.01	27.74	40.57	53.66	40.07	51.45	65.54	59.29
8	46.90	32.38	33.78	-	26.41	25.51	41.69	53.98	45.52	56.11	57.06	54.11
9	46.33	34.70	33.91	-	21.75	24.59	37.24	57.77	51.66	56.55	56.94	52.34
10	43.92	33.70	33.42	35.36	21.19	26.34	35.05	59.25	57.61	57.80	58.11	51.42
11	43.02	32.13	34.16	34.99	27.32	29.82	36.42	60.93	64.26	56.65	54.22	53.35
12	45.57	35.20	33.25	33.50	31.79	31.67	40.17	54.83	68.70	58.18	58.16	56.03
13	43.22	38.03	33.26	32.56	30.36	31.76	37.26	52.17	64.52	59.17	61.73	54.77
14	40.93	41.39	35.48	36.74	31.07	31.79	33.12	47.14	50.21	61.49	62.87	54.79
15	47.81	39.42	32.77	35.25	32.38	34.45	36.75	46.75	56.50	56.25	62.07	50.75
16	50.56	43.33	38.16	36.70	30.82	36.37	39.92	47.73	57.95	58.34	54.75	48.30
17	50.00	33.66	36.39	36.93	27.68	36.47	43.58	44.76	59.90	54.88	55.92	47.49
18	50.19	32.69	36.66	35.59	28.24	44.80	44.61	49.75	54.57	52.75	59.87	48.59
19	49.67	36.20	34.85	37.02	29.50	45.58	45.59	48.93	46.87	52.59	60.70	49.92
20	49.50	36.96	37.87	32.58	29.03	46.05	43.89	44.74	45.38	57.04	63.16	51.08
21	50.41	40.69	30.56	30.75	25.10	40.88	44.50	44.04	45.88	64.85	57.53	54.41
22	49.48	38.44	31.22	31.62	25.66	38.65	43.15	49.27	51.49	63.75	53.10	51.00
23	48.86	33.58	32.78	38.40	29.83	38.01	47.00	53.80	49.17	57.58	56.54	48.56
24	44.87	33.18	31.78	36.16	28.50	35.63	43.57	47.12	49.33	56.47	58.14	53.10
25	45.40	32.51	30.27	33.66	24.90	37.23	46.42	43.24	51.50	60.80	55.66	52.49
26	48.39	40.93	30.87	35.99	21.06	36.94	46.13	47.34	50.10	65.43	56.69	52.32
27	42.74	42.19	31.12	36.82	26.59	38.33	36.04	53.34	48.74	58.35	64.98	44.03
28	43.31	37.58	30.77	33.73	25.01	38.26	36.44	54.73	51.63	59.59	67.44	37.39
29	40.24	36.75	36.31	32.68	---	37.52	39.59	56.27	54.81	61.00	61.98	36.13
30	41.31	35.06	31.91	35.44	---	37.97	41.60	57.75	58.03	59.07	59.07	36.13
31	44.78	---	26.94	40.11	---	41.15	---	59.65	---	61.15	59.88	---
Minimum	39.18	32.13	24.17	27.24	19.50	21.74	33.12	40.88	40.07	50.12	53.10	36.13
Mean	45.59	37.91	32.07	34.52	27.57	34.02	40.97	50.68	53.13	57.54	60.35	52.18
Maximum	50.56	49.69	38.16	40.11	39.85	46.05	47.92	60.93	68.70	65.43	68.18	63.57

Appendix C-3: Maximum daily air temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	54.79	52.34	33.56	32.15	41.57	37.65	56.81	54.32	72.81	71.15	79.33	70.78
2	50.60	49.26	34.93	32.69	44.44	36.74	55.81	51.07	70.71	53.02	68.63	71.25
3	56.17	45.14	34.60	36.25	34.39	34.54	46.22	56.83	60.88	57.78	74.77	73.28
4	51.76	46.93	33.31	35.79	30.22	34.27	54.16	62.58	66.83	63.53	82.08	69.55
5	42.25	42.29	33.24	36.33	22.34	42.62	45.11	63.86	55.31	64.93	82.76	83.67
6	43.52	40.34	32.15	35.94	28.11	32.80	43.03	70.33	50.54	60.00	79.72	75.70
7	50.09	40.60	32.96	-	33.31	32.87	48.66	66.99	43.52	56.21	77.41	72.77
8	49.57	38.21	36.55	-	29.59	33.35	48.71	69.83	55.25	65.29	60.65	61.91
9	50.38	40.05	35.99	-	26.38	38.25	39.78	73.05	67.62	68.17	63.93	59.49
10	50.03	39.09	35.97	38.15	25.53	40.48	37.61	77.78	71.22	63.04	65.01	59.06
11	56.38	37.66	36.83	39.12	31.81	44.22	39.77	77.88	82.82	61.30	59.17	65.10
12	58.34	43.15	34.81	38.80	32.76	32.85	46.71	68.00	84.51	68.66	69.99	74.11
13	54.47	44.14	34.48	38.47	35.59	36.35	40.42	65.61	76.23	68.49	77.42	60.81
14	56.81	45.19	41.04	48.05	35.79	38.18	37.81	49.85	54.86	72.02	75.55	64.24
15	66.83	44.73	34.93	43.97	35.99	41.78	46.81	56.80	67.09	58.95	70.44	53.04
16	70.01	50.38	40.77	44.54	33.95	51.60	46.46	51.88	69.60	65.97	58.05	55.36
17	63.41	39.52	38.91	41.33	31.08	45.26	53.67	47.68	68.25	57.64	64.45	50.82
18	67.25	40.22	38.62	39.15	33.18	58.01	52.35	62.72	60.04	58.67	70.51	53.34
19	68.45	44.86	36.97	40.15	30.70	60.11	49.70	57.35	52.95	61.58	72.39	56.69
20	66.18	45.39	44.13	33.94	31.57	59.80	49.23	47.91	53.23	73.10	82.20	57.80
21	66.83	42.91	32.68	34.86	33.21	53.57	53.41	49.39	49.62	82.28	66.11	65.61
22	65.92	41.36	35.53	32.38	28.87	54.79	51.86	60.96	60.36	75.79	55.94	54.38
23	59.37	35.59	35.00	41.73	35.01	47.95	53.06	69.02	53.82	68.08	69.65	51.89
24	53.58	37.08	33.65	39.20	31.48	40.32	55.12	50.71	58.08	67.01	66.93	60.71
25	47.72	35.86	32.67	37.45	29.09	49.22	63.52	46.32	62.50	76.74	63.87	63.17
26	52.00	43.73	32.26	42.35	29.95	47.92	55.31	58.70	61.88	81.30	72.86	55.55
27	47.98	44.93	32.26	45.64	33.96	46.46	40.11	62.83	53.90	63.96	86.27	50.12
28	48.34	39.90	32.59	40.76	37.19	52.02	51.77	61.96	61.32	72.60	86.34	46.79
29	42.58	41.61	40.63	40.55	---	46.99	52.81	65.82	68.36	73.11	70.41	41.58
30	45.39	37.43	34.05	42.72	---	49.89	54.40	67.15	71.15	69.42	63.73	41.58
31	49.88	---	31.96	53.74	---	59.30	---	73.17	---	74.67	76.14	---
Minimum	42.25	35.59	31.96	32.15	22.34	32.80	37.61	46.32	43.52	53.02	55.94	41.58
Mean	55.06	42.33	35.42	39.51	32.39	44.52	49.01	61.24	62.84	66.92	71.38	60.67
Maximum	70.01	52.34	44.13	53.74	44.44	60.11	63.52	77.88	84.51	82.28	86.34	83.67

Appendix D: WY2019 turbidity data tables

Note: Dates marked with a single dash (-) indicate those days excluded from analysis in Table 2 and described in “Outages” section of report.

Appendix D-1: Minimum daily turbidity (in NTU) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	52.27	62.19	3.60	2.81	4.17	1.85	3.29	11.10	83.33	123.74	172.12	208.68
2	50.93	48.67	3.78	2.51	3.19	2.04	5.78	10.73	78.37	169.81	277.84	126.56
3	33.66	16.47	3.14	2.14	3.21	2.41	5.48	13.92	81.53	249.80	135.87	198.32
4	28.47	20.05	2.55	3.28	2.94	2.55	5.63	17.87	90.06	223.38	136.87	113.82
5	21.20	33.84	2.41	2.73	2.20	1.38	5.69	24.91	95.53	313.77	242.59	148.16
6	14.37	19.94	2.19	2.12	2.42	1.06	6.00	16.53	47.88	157.51	358.24	269.37
7	15.08	18.95	2.10	-	2.34	1.13	7.43	20.45	41.02	154.30	342.10	172.83
8	13.29	5.35	2.02	-	2.44	1.21	6.17	24.62	29.89	171.37	354.12	167.59
9	62.81	5.08	1.96	-	2.63	1.12	5.48	27.11	22.33	272.63	259.65	138.98
10	28.78	4.66	2.03	2.72	2.53	1.24	5.69	64.75	19.44	388.18	204.78	75.01
11	20.81	4.26	1.74	2.86	2.42	1.32	5.93	61.39	50.67	199.64	153.51	64.66
12	24.20	3.86	2.94	1.82	2.75	1.35	6.58	45.61	133.07	170.64	151.60	66.55
13	38.06	3.76	2.64	2.42	2.49	1.33	6.70	89.91	254.24	138.40	161.70	161.92
14	75.40	3.59	2.13	1.86	2.52	1.48	6.63	77.08	276.68	135.57	167.33	146.10
15	41.03	4.85	1.93	1.89	1.95	1.59	8.94	67.25	199.58	143.39	130.97	161.30
16	45.10	4.98	2.02	2.21	2.14	1.72	8.26	48.64	282.20	258.76	144.05	65.30
17	61.02	5.63	3.15	1.94	2.14	1.78	9.61	51.77	239.18	192.96	155.94	45.90
18	61.84	4.97	3.03	1.97	2.07	1.88	12.84	56.34	202.46	176.76	202.28	36.37
19	64.06	5.81	3.13	3.43	2.04	2.41	15.99	62.34	160.91	84.85	213.66	29.48
20	72.50	6.34	2.95	2.31	1.68	3.81	10.48	58.70	86.83	89.20	216.61	31.90
21	84.10	5.07	2.63	2.48	1.65	4.61	8.41	45.93	77.06	119.31	188.51	39.80
22	82.24	4.01	2.10	2.32	1.72	3.91	9.09	35.34	84.31	213.86	165.22	88.30
23	73.92	3.41	2.16	2.95	1.48	4.63	18.08	33.66	207.87	151.26	156.04	69.10
24	46.59	2.72	1.96	3.74	1.79	3.53	14.81	55.29	166.42	87.86	193.46	90.30
25	36.76	2.61	2.13	3.62	2.06	3.01	13.39	39.10	138.81	108.89	142.67	73.80
26	292.80	2.71	1.89	2.89	2.11	4.05	13.12	26.81	98.52	255.28	149.51	233.50
27	123.71	68.96	1.53	3.70	1.99	2.33	11.89	41.81	69.37	342.04	165.19	94.80
28	76.63	6.70	1.65	4.17	1.60	1.93	11.32	52.63	52.96	139.40	241.38	41.60
29	32.75	4.70	2.62	3.03	---	2.24	11.57	57.14	49.33	133.62	340.21	26.20
30	18.69	3.93	2.91	2.52	---	2.25	9.75	76.46	69.55	149.81	299.99	26.20
31	17.74	---	2.81	2.45	---	3.06	---	87.65	---	191.11	302.42	---
Minimum	13.29	2.61	1.53	1.82	1.48	1.06	3.29	10.73	19.44	84.85	130.97	26.20
Mean	55.19	12.94	2.45	2.67	2.31	2.26	9.00	45.25	116.31	184.10	210.53	107.08
Maximum	292.80	68.96	3.78	4.17	4.17	4.63	18.08	89.91	282.20	388.18	358.24	269.37

Appendix D-2: Mean daily turbidity (in NTU) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	64.53	103.62	14.18	17.11	18.31	2.22	14.02	29.74	146.86	211.40	448.96	390.56
2	65.20	232.49	20.43	19.30	13.32	3.26	28.74	29.76	121.14	289.85	508.74	439.18
3	48.45	41.34	17.05	17.40	20.43	8.79	22.21	31.86	141.30	380.50	313.55	451.03
4	33.23	124.71	14.71	13.92	18.71	9.09	18.02	33.89	152.61	396.06	421.54	442.88
5	27.43	100.67	12.53	11.82	11.16	11.23	18.55	34.00	188.24	415.36	762.12	482.03
6	18.23	62.92	8.87	13.35	12.64	1.64	22.63	33.63	107.24	259.67	982.80	614.86
7	15.85	65.35	5.69	-	7.21	1.49	24.12	49.75	64.11	252.01	828.25	478.85
8	38.15	26.03	4.58	-	4.29	1.51	18.48	48.75	66.66	309.98	839.83	322.76
9	276.28	15.80	6.12	-	3.86	7.42	16.69	81.33	49.53	375.59	612.91	232.77
10	40.01	12.60	5.80	16.54	3.86	7.29	16.06	139.64	56.93	481.96	430.94	145.17
11	29.49	13.40	8.88	18.99	3.65	4.56	16.61	139.04	105.60	289.54	302.07	121.36
12	41.20	9.25	15.52	15.25	4.52	2.10	18.63	158.04	230.09	238.02	396.52	263.90
13	61.15	8.41	16.28	15.71	8.52	1.76	18.42	163.92	445.32	227.48	538.66	348.63
14	92.72	31.47	11.53	16.19	3.54	1.80	23.64	136.35	445.86	204.03	427.21	252.13
15	83.00	14.91	6.56	11.76	3.38	5.82	31.25	126.93	335.65	341.19	423.48	551.77
16	121.41	15.28	14.57	8.43	2.72	3.06	34.71	130.21	404.85	528.22	402.21	94.18
17	142.44	16.03	15.44	7.81	3.18	5.59	34.14	166.04	392.91	530.36	442.26	162.30
18	162.87	16.25	13.72	7.99	3.66	7.03	33.66	118.46	309.42	614.64	595.33	60.18
19	165.26	16.69	12.97	13.74	2.95	7.59	26.33	131.63	248.41	135.22	645.67	40.17
20	192.28	14.59	11.74	15.22	2.24	19.12	23.02	123.33	135.67	165.39	617.70	57.47
21	234.28	8.27	12.39	12.30	5.24	25.81	19.47	108.33	101.46	253.76	500.92	116.16
22	207.91	6.99	12.10	13.14	2.16	22.62	19.55	64.93	136.98	396.81	492.08	262.68
23	124.09	5.36	17.51	14.47	2.33	16.28	34.90	85.09	279.41	262.11	449.54	127.59
24	59.23	6.64	15.94	12.48	2.69	8.00	29.68	132.09	254.93	156.36	382.97	179.80
25	224.35	5.47	11.94	14.92	2.68	7.37	23.00	88.35	213.87	264.57	318.20	215.69
26	1404.54	59.73	11.03	15.85	9.60	12.46	21.75	69.58	145.48	572.45	424.91	837.52
27	342.71	233.35	6.80	21.73	125.92	7.32	20.85	96.94	88.35	576.86	667.34	236.63
28	506.68	28.36	6.89	22.89	8.80	3.68	19.95	136.15	72.21	305.14	903.05	60.56
29	61.51	14.36	14.83	25.47	---	3.36	22.52	140.13	74.84	300.95	597.97	32.60
30	30.03	13.87	14.13	21.40	---	6.80	26.39	143.11	128.78	331.00	975.52	32.60
31	318.39	---	15.41	15.58	---	9.19	---	155.02	---	396.39	855.37	---
Minimum	15.85	5.36	4.58	7.81	2.16	1.49	14.02	29.74	49.53	135.22	302.07	32.60
Mean	168.80	44.14	12.13	15.38	11.13	7.59	23.27	100.84	188.16	337.51	564.79	268.47
Maximum	1404.54	233.35	20.43	25.47	125.92	25.81	34.90	166.04	445.86	614.64	982.80	837.52

Appendix D-3: Maximum daily turbidity (in NTU) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	94.57	160.03	60.01	124.93	48.06	5.09	65.47	76.00	356.07	368.44	1145.76	667.57
2	100.62	649.83	98.47	63.51	35.88	16.06	135.45	116.52	212.31	450.55	916.98	1064.04
3	70.69	137.90	94.10	53.94	60.68	87.04	48.31	69.42	324.67	624.46	646.76	725.24
4	44.98	480.41	94.70	35.69	65.52	95.33	48.93	65.31	217.16	742.38	1120.27	1180.82
5	69.48	265.14	63.77	36.19	34.60	93.65	55.89	56.50	308.68	638.08	1814.75	1024.41
6	55.04	135.70	85.78	50.28	100.71	21.38	77.17	70.48	177.24	408.05	1817.72	1636.01
7	16.99	125.99	40.97	-	46.36	5.11	112.05	123.94	104.63	406.79	1774.20	1259.41
8	230.91	113.61	15.95	-	19.17	3.49	60.71	102.18	180.83	610.14	1801.60	650.91
9	1818.04	47.73	21.20	-	12.21	76.55	35.54	251.35	115.34	515.86	1050.76	438.52
10	62.07	80.60	39.07	43.37	10.77	104.98	46.97	239.97	131.78	626.95	950.09	372.07
11	41.78	120.67	31.06	62.56	9.11	46.45	45.32	277.05	218.77	466.13	565.56	202.91
12	71.15	78.13	45.03	78.78	12.78	11.82	45.49	376.23	347.92	394.14	852.63	646.99
13	110.61	72.95	52.35	62.21	127.74	6.16	70.17	283.06	776.94	313.19	1220.39	763.93
14	120.53	184.51	36.27	82.78	12.45	4.24	70.23	269.10	858.00	338.34	824.26	478.42
15	167.01	119.93	39.73	67.02	16.14	95.25	124.54	240.37	499.68	1818.04	1043.61	1628.68
16	241.32	51.73	88.73	79.95	10.35	35.31	121.12	264.75	626.92	1740.07	922.78	164.91
17	263.94	96.08	45.12	31.02	30.62	41.73	88.00	332.49	711.11	1279.02	991.23	1577.89
18	307.73	168.44	43.86	60.04	53.56	80.70	99.04	201.17	474.01	1629.58	1267.87	151.22
19	326.79	158.50	39.02	56.27	8.54	55.18	55.22	230.64	408.31	190.24	1526.99	53.67
20	388.30	112.86	35.53	37.26	5.70	80.69	48.86	223.64	243.46	305.65	1082.75	98.10
21	510.95	18.36	32.34	54.47	128.47	69.56	43.47	231.74	146.84	510.13	1711.57	262.30
22	483.30	21.29	37.06	46.58	9.22	63.32	39.28	138.42	245.80	785.14	1131.78	784.40
23	209.29	15.57	83.03	38.47	12.10	60.08	63.69	200.07	458.37	629.34	975.60	227.00
24	83.00	135.39	46.09	30.13	19.27	20.27	62.11	234.97	372.23	269.43	637.02	297.70
25	793.41	157.05	54.48	54.34	9.92	29.28	48.37	199.39	308.89	676.83	572.00	574.00
26	1818.04	257.68	45.34	63.90	127.40	32.87	35.80	155.72	242.98	1067.52	1002.52	1706.50
27	1189.15	568.14	39.14	61.34	1052.31	16.17	43.40	210.47	131.62	1308.53	1774.14	913.60
28	1818.04	111.04	46.62	110.96	105.08	12.66	39.30	303.14	96.46	528.85	1818.04	94.00
29	109.71	37.83	51.61	104.51	---	13.99	55.42	228.12	125.16	609.54	1002.83	43.30
30	55.97	42.27	50.40	86.16	---	38.30	52.81	251.00	288.83	665.75	1818.04	43.30
31	1818.04	---	71.18	66.01	---	43.84	---	340.71	---	649.60	1613.45	---
Minimum	16.99	15.57	15.95	30.13	5.70	3.49	35.54	56.50	96.46	190.24	565.56	43.30
Mean	435.21	157.51	52.52	62.24	78.03	44.08	64.60	205.29	323.70	695.70	1206.26	657.73
Maximum	1818.04	649.83	98.47	124.93	1052.31	104.98	135.45	376.23	858.00	1818.04	1818.04	1706.50

Appendix E: WY2019 precipitation data table

Notes:

Dates marked with a single dash (-) indicate those days excluded from analysis in Table 2 and described in “Outages” section of report.

Precipitation equipment at this site is unheated and will not record accurately during times of frozen precipitation.

Appendix E-1: Total daily precipitation (in inches) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	0.23	0.42	0.06	0.09	0.80	0.00	0.00	0.00	0.00	0.07	0.00	0.00
2	0.11	0.81	0.00	0.06	0.06	0.00	0.05	0.00	0.00	0.08	0.12	0.00
3	0.00	0.60	0.00	0.65	0.00	0.00	0.33	0.00	0.00	0.05	0.00	0.00
4	0.00	2.19	0.01	0.39	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
5	0.66	1.08	0.00	0.10	0.00	0.00	0.40	0.00	0.11	0.00	0.00	0.00
6	0.08	0.37	0.00	0.17	0.17	0.03	0.22	0.00	0.10	0.00	0.00	0.00
7	0.08	0.00	0.00	-	0.02	0.17	0.36	0.00	1.25	0.00	0.00	0.09
8	0.56	0.01	0.02	-	0.00	0.19	0.68	0.00	0.03	0.00	0.05	0.04
9	0.79	0.13	0.53	-	0.00	0.16	0.69	0.00	0.00	0.09	0.54	0.65
10	0.01	0.01	0.38	0.00	0.00	0.00	1.23	0.00	0.00	0.15	0.06	0.45
11	0.00	0.00	1.60	0.00	0.00	0.09	0.84	0.00	0.00	0.01	0.05	0.00
12	0.00	0.00	0.52	0.00	0.00	0.13	0.32	0.00	0.00	0.00	0.00	0.09
13	0.00	0.00	0.44	0.00	0.71	0.65	0.40	0.00	0.00	0.00	0.00	0.25
14	0.00	0.41	0.22	0.00	0.06	0.08	0.26	0.36	0.01	0.00	0.00	0.00
15	0.00	0.00	0.21	0.00	0.05	0.00	0.06	0.00	0.00	0.41	0.00	0.76
16	0.00	0.11	0.27	0.02	0.08	0.00	0.15	0.45	0.00	0.03	0.00	0.06
17	0.00	0.00	0.63	0.40	0.07	0.00	0.10	0.50	0.00	0.37	0.01	0.72
18	0.00	0.01	2.01	0.64	0.01	0.00	0.02	0.03	0.00	0.09	0.00	0.23
19	0.00	0.00	0.38	0.23	0.00	0.00	0.33	0.23	0.01	0.00	0.00	0.03
20	0.00	0.00	0.46	0.10	0.00	0.00	0.01	0.46	0.39	0.00	0.00	0.00
21	0.00	0.08	0.01	0.00	0.16	0.00	0.00	0.38	0.06	0.00	0.23	0.00
22	0.00	0.63	0.17	1.19	0.00	0.04	0.18	0.01	0.01	0.00	0.04	0.53
23	0.07	0.82	0.66	1.20	0.40	0.02	0.00	0.00	0.00	0.00	0.00	0.12
24	0.00	0.23	0.25	0.01	0.08	0.14	0.00	0.10	0.00	0.00	0.00	0.11
25	1.07	0.01	0.04	0.02	0.05	0.24	0.00	0.15	0.01	0.00	0.00	0.00
26	0.44	0.92	0.02	0.00	0.12	0.06	0.00	0.01	0.10	0.00	0.00	0.32
27	0.92	1.03	0.04	0.00	0.02	0.00	0.11	0.00	0.07	0.04	0.00	0.17
28	1.10	0.29	0.34	0.00	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.61
29	0.43	0.01	2.02	0.00	---	0.06	0.00	0.00	0.00	0.00	0.24	0.20
30	0.10	0.26	0.01	0.00	---	0.00	0.00	0.00	0.00	0.00	0.03	0.20
31	1.24	---	0.23	0.00	---	0.00	---	0.00	---	0.00	0.00	---
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean	0.25	0.35	0.37	0.19	0.10	0.07	0.23	0.09	0.07	0.04	0.04	0.19
Maximum	1.24	2.19	2.02	1.20	0.80	0.65	1.23	0.50	1.25	0.41	0.54	0.76

Appendix F: WY2019 stream conductivity data tables

Note: Dates marked with a single dash (-) indicate those days excluded from analysis in Table 2 and described in “Outages” section of report.

Appendix F-1: Minimum stream conductivity (in $\mu\text{s}/\text{cm}$) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	12.76	6.61	10.93	11.28	14.12	19.59	18.39	14.10	8.04	11.73	12.82	12.70
2	13.80	5.85	11.64	12.15	12.91	19.71	18.97	14.90	7.58	11.09	12.99	13.29
3	14.05	6.83	11.92	10.44	12.99	19.59	15.80	15.51	7.37	10.43	12.18	13.23
4	14.47	6.24	12.19	9.06	12.96	19.67	14.86	15.92	7.30	14.01	12.15	13.74
5	16.10	6.31	12.57	9.98	12.90	19.77	15.33	15.33	8.38	13.13	11.76	13.55
6	17.39	7.33	12.90	11.20	13.16	20.62	14.22	13.27	8.30	13.05	11.60	13.66
7	17.59	8.85	13.23	-	13.35	20.51	12.08	11.50	8.06	13.57	10.60	13.44
8	17.61	9.52	14.12	-	13.98	20.70	12.05	10.12	8.89	13.74	9.83	13.83
9	11.98	10.14	15.00	-	14.08	20.76	9.98	9.89	10.42	13.28	10.10	14.86
10	13.49	10.98	15.12	10.53	14.32	20.89	9.11	8.80	11.85	12.86	10.96	16.62
11	15.18	10.90	11.10	10.58	14.34	21.37	5.02	8.44	12.62	12.61	11.66	17.53
12	15.66	11.93	9.63	12.71	14.11	21.65	6.92	8.17	10.15	12.79	12.79	17.57
13	15.05	13.59	10.95	13.47	14.47	21.00	9.15	7.76	7.08	13.44	12.63	15.94
14	15.10	14.28	12.36	13.79	15.22	21.86	10.25	8.40	6.13	13.95	12.67	15.91
15	14.88	13.68	14.20	14.27	16.19	22.21	10.43	8.72	7.04	12.84	12.88	15.18
16	14.14	14.19	14.70	14.48	16.87	11.30	11.68	8.96	7.62	12.43	12.47	16.09
17	13.74	13.64	14.21	15.04	17.46	5.86	13.25	7.96	8.01	12.35	12.38	18.52
18	12.66	13.08	3.87	13.71	18.10	3.62	13.82	7.25	8.11	11.20	12.24	18.49
19	12.84	13.98	9.41	7.26	18.28	3.22	13.12	8.22	7.29	12.73	12.01	19.60
20	12.50	14.75	11.12	13.52	18.32	4.10	11.40	8.10	7.28	13.29	12.03	20.41
21	11.42	15.58	10.62	13.65	18.73	5.83	11.37	7.97	8.39	13.07	12.12	19.66
22	11.49	16.32	11.33	12.59	19.07	9.24	12.31	8.39	9.59	12.37	12.48	18.30
23	11.60	8.39	12.11	3.65	19.31	11.56	11.84	9.34	10.67	12.30	12.59	17.80
24	13.40	7.59	11.87	9.57	19.86	12.45	10.40	9.10	9.82	13.06	12.78	17.36
25	12.86	11.34	12.79	11.09	19.64	13.49	10.66	8.54	9.38	12.75	13.30	17.02
26	7.83	12.36	13.45	11.90	19.27	15.13	12.29	8.70	9.57	12.32	13.06	15.23
27	8.29	6.48	13.82	12.79	18.95	14.90	12.60	10.18	9.71	12.22	12.71	15.06
28	6.31	6.37	14.08	13.05	19.07	16.16	12.02	9.54	10.08	12.42	12.10	17.06
29	8.33	8.70	6.66	13.22	---	17.18	13.31	9.00	10.76	12.50	12.06	18.51
30	10.59	10.40	8.64	13.51	---	17.43	13.58	8.29	11.69	12.67	12.21	18.51
31	7.23	---	9.96	14.24	---	17.89	---	8.16	---	12.58	12.06	---
Minimum	6.31	5.85	3.87	3.65	12.90	3.22	5.02	7.25	6.13	10.43	9.83	12.70
Mean	12.91	10.54	11.82	11.88	16.14	15.78	12.21	9.95	8.91	12.67	12.14	16.29
Maximum	17.61	16.32	15.12	15.04	19.86	22.21	18.97	15.92	12.62	14.01	13.30	20.41

Appendix F-2: Mean stream conductivity (in $\mu\text{s}/\text{cm}$) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	13.85	7.08	11.26	11.79	14.94	19.98	19.35	15.49	8.59	12.77	13.95	14.15
2	14.60	7.09	11.95	12.68	13.53	20.08	19.68	15.66	8.29	11.70	13.66	14.90
3	14.59	8.30	12.15	12.77	13.20	20.08	18.54	16.79	7.94	13.14	13.49	14.50
4	15.61	7.89	12.50	9.59	13.10	19.95	15.77	17.60	8.09	15.09	13.53	15.39
5	16.74	7.75	12.85	11.09	13.09	20.31	15.80	16.57	8.70	14.49	12.99	14.94
6	17.79	8.37	13.16	11.50	13.39	20.76	14.69	14.45	8.55	13.79	12.47	14.45
7	18.26	9.35	13.58	-	13.68	20.78	13.83	12.42	8.47	14.12	12.00	14.65
8	19.22	9.91	14.72	-	14.26	21.16	13.13	10.78	9.79	14.63	11.19	14.88
9	13.54	10.57	15.25	-	14.22	21.37	10.84	10.44	11.53	14.23	11.36	16.09
10	14.56	11.26	15.24	10.94	14.54	21.63	10.39	9.48	13.04	13.44	12.23	17.60
11	16.02	11.38	14.41	11.66	14.46	22.01	6.17	9.02	13.41	13.31	13.05	18.81
12	16.46	12.99	10.85	13.17	14.36	22.12	8.00	8.60	11.91	13.79	13.93	18.72
13	16.28	14.07	11.68	13.69	14.85	21.52	10.64	8.26	8.80	14.47	13.91	16.86
14	15.95	14.82	13.66	14.10	15.66	22.41	10.90	8.99	6.70	14.98	14.00	16.80
15	16.48	14.19	14.54	14.52	16.61	22.54	11.26	9.17	7.92	14.05	14.27	15.80
16	15.84	14.68	15.23	14.80	17.27	17.83	12.39	9.22	8.49	13.30	13.65	17.60
17	15.18	14.13	14.98	15.23	17.80	8.27	14.07	8.75	8.77	13.33	13.46	19.67
18	14.48	13.57	8.30	14.66	18.42	4.67	14.49	7.93	8.43	12.17	13.65	19.33
19	14.26	14.54	10.35	12.23	18.58	4.26	14.89	8.65	7.63	13.83	13.43	20.38
20	13.51	15.16	12.21	13.72	18.70	6.43	11.88	8.34	7.94	14.32	13.48	20.93
21	12.93	16.00	11.09	13.85	18.99	8.00	12.32	8.28	8.89	14.08	13.26	20.87
22	12.78	16.49	12.10	13.75	19.19	10.79	13.16	9.17	10.40	13.52	13.78	19.05
23	13.12	13.01	12.54	7.92	19.70	12.56	13.17	10.19	10.94	13.57	13.92	18.58
24	15.02	8.32	12.26	10.53	20.05	13.22	11.26	9.78	10.43	14.28	13.96	18.69
25	16.03	14.29	13.26	11.82	19.88	14.53	11.81	8.71	10.21	14.10	14.34	18.23
26	9.45	15.89	13.72	12.46	19.72	15.85	13.34	9.62	10.19	13.63	14.48	16.70
27	9.64	8.52	14.24	13.17	19.12	15.57	12.92	10.62	10.23	13.14	14.07	16.45
28	7.92	7.48	14.39	13.38	19.47	16.96	13.42	10.17	11.02	13.76	13.37	18.33
29	9.62	9.60	10.57	13.50	---	17.95	14.41	9.51	12.19	13.98	13.37	19.60
30	11.48	10.79	9.15	13.89	---	18.41	14.83	8.87	12.98	13.93	13.65	19.60
31	10.97	---	10.67	14.62	---	19.02	---	8.74	---	13.86	13.12	---
Minimum	7.92	7.08	8.30	7.92	13.09	4.26	6.17	7.93	6.70	11.70	11.19	14.15
Mean	14.26	11.58	12.67	12.75	16.46	16.81	13.24	10.65	9.68	13.77	13.39	17.42
Maximum	19.22	16.49	15.25	15.23	20.05	22.54	19.68	17.60	13.41	15.09	14.48	20.93

Appendix F-3: Maximum stream conductivity (in $\mu\text{s}/\text{cm}$) recorded at the Longmire Stream Gage during water year 2019.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	14.58	7.43	11.66	12.21	15.47	20.55	20.82	17.36	9.33	13.93	15.83	15.80
2	15.28	8.16	12.29	13.22	14.24	20.55	20.75	16.74	9.19	13.18	14.77	16.92
3	15.73	9.18	12.46	13.29	13.47	20.81	19.44	18.84	8.55	23.11	15.51	16.17
4	16.50	9.19	12.87	10.42	13.26	20.43	16.92	20.52	9.17	16.73	15.12	17.43
5	17.81	8.45	13.22	11.70	13.29	21.13	16.46	18.38	9.05	16.72	14.28	16.82
6	18.26	8.95	13.46	11.78	13.73	20.91	15.28	15.83	8.82	14.79	13.60	15.70
7	19.07	9.86	14.13	-	14.07	21.12	14.64	13.54	8.90	14.73	13.69	16.10
8	20.00	10.43	15.13	-	14.63	21.68	14.61	11.44	10.98	16.53	12.23	16.21
9	17.51	11.06	15.50	-	14.36	22.28	12.26	11.30	13.26	15.21	12.98	17.49
10	15.32	11.64	15.45	11.94	14.69	22.66	11.60	10.16	14.77	14.46	13.09	19.00
11	17.35	11.93	15.21	12.75	14.57	22.77	8.91	9.57	14.22	14.14	13.92	20.50
12	17.82	14.15	12.08	13.63	14.54	22.47	9.22	9.11	13.34	15.03	15.87	20.37
13	17.62	14.77	12.32	14.02	15.29	22.27	12.18	8.96	10.29	15.97	15.85	18.52
14	17.33	15.45	14.44	14.56	16.18	23.21	11.76	9.57	7.27	16.63	15.90	17.49
15	18.62	14.72	14.86	14.93	17.03	22.99	12.46	9.63	9.32	14.87	16.36	16.43
16	17.81	15.24	15.48	15.20	17.67	22.15	13.80	9.55	9.73	14.49	15.02	19.15
17	17.19	14.89	15.43	15.48	18.21	11.24	15.47	9.32	9.80	13.94	14.86	21.13
18	16.80	14.24	14.12	15.20	18.82	5.85	15.61	8.71	8.88	13.08	15.46	20.28
19	16.05	15.45	11.60	14.29	18.68	6.30	15.64	9.37	8.08	15.59	15.46	21.31
20	15.42	15.85	13.25	13.95	19.06	10.71	13.03	8.86	8.92	16.30	15.57	21.67
21	14.79	16.46	11.46	14.17	19.32	11.93	13.72	8.66	9.64	15.92	15.05	22.73
22	14.56	16.75	12.60	13.99	19.30	12.69	14.09	10.33	11.73	15.10	15.25	19.76
23	14.50	16.66	12.84	12.40	20.13	14.25	13.70	11.28	11.37	15.54	16.10	19.38
24	16.50	11.21	12.78	11.07	20.32	14.00	12.19	10.61	11.12	16.23	15.67	19.60
25	18.28	15.64	13.69	12.38	20.10	15.87	13.34	9.10	10.97	16.18	15.38	19.87
26	12.74	16.91	13.91	13.15	19.99	16.94	15.09	10.90	10.78	15.74	16.78	17.24
27	11.43	12.14	14.51	13.79	19.31	16.31	13.32	11.17	10.87	14.29	15.95	17.48
28	11.43	8.68	14.59	13.86	19.95	18.34	15.20	10.95	12.43	16.12	15.24	19.59
29	10.58	10.39	14.16	13.93	---	19.04	15.75	10.13	14.35	16.31	14.29	20.51
30	12.52	11.10	9.94	14.46	---	19.62	16.54	9.49	14.99	15.89	14.61	20.51
31	12.68	---	11.28	15.20	---	20.79	---	9.58	---	15.86	14.73	---
Minimum	10.58	7.43	9.94	10.42	13.26	5.85	8.91	8.66	7.27	13.08	12.23	15.70
Mean	15.87	12.57	13.44	13.46	16.77	18.12	14.46	11.58	10.67	15.57	14.98	18.70
Maximum	20.00	16.91	15.50	15.48	20.32	23.21	20.82	20.52	14.99	23.11	16.78	22.73

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