National Park Service
U.S. Department of the Interior

Mount Rainier National Park

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

Water year 2011

Water-Data Report NPS/MORA/WDR—2017/002

ON THE COVER
Nisqually River at Longmire, looking upstream from the Longmire Suspension Bridge on June 15, 2011 at 3:06 PM
Photograph by: Scott Beason, Mount Rainier National Park

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U.S. Department of the Interior
National Park Service
Mount Rainier National Park

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 4.17 km^3 (1.0 mi^3) of ice and perennial snows cover Mount Rainier (Driedger and Kennard, 1986). The mountain receives an average of 16.3 m (53.4 ft) of snow at Paradise and melting snow causes high flows in spring and summer months (NPS, 2011). 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 Ohanapecosh). 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 km^2 (18.8 mi^2), 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 2011 (October 1, 2010 – September 30, 2011). The Longmire location is currently the only year-round stream gaging station in the park. Stream statistics are obtained via pressure transducers that are mounted within a stilling well at Longmire. Data were obtained at 15 minute intervals. Data were not available starting at 2:45 PM on December 3, 2010 – June 8, 2011, due to a stream gage malfunction. Data were obtained again on June 8, 2011 at 2:15 PM and have a continuous period of recording until the end of the water year.

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.

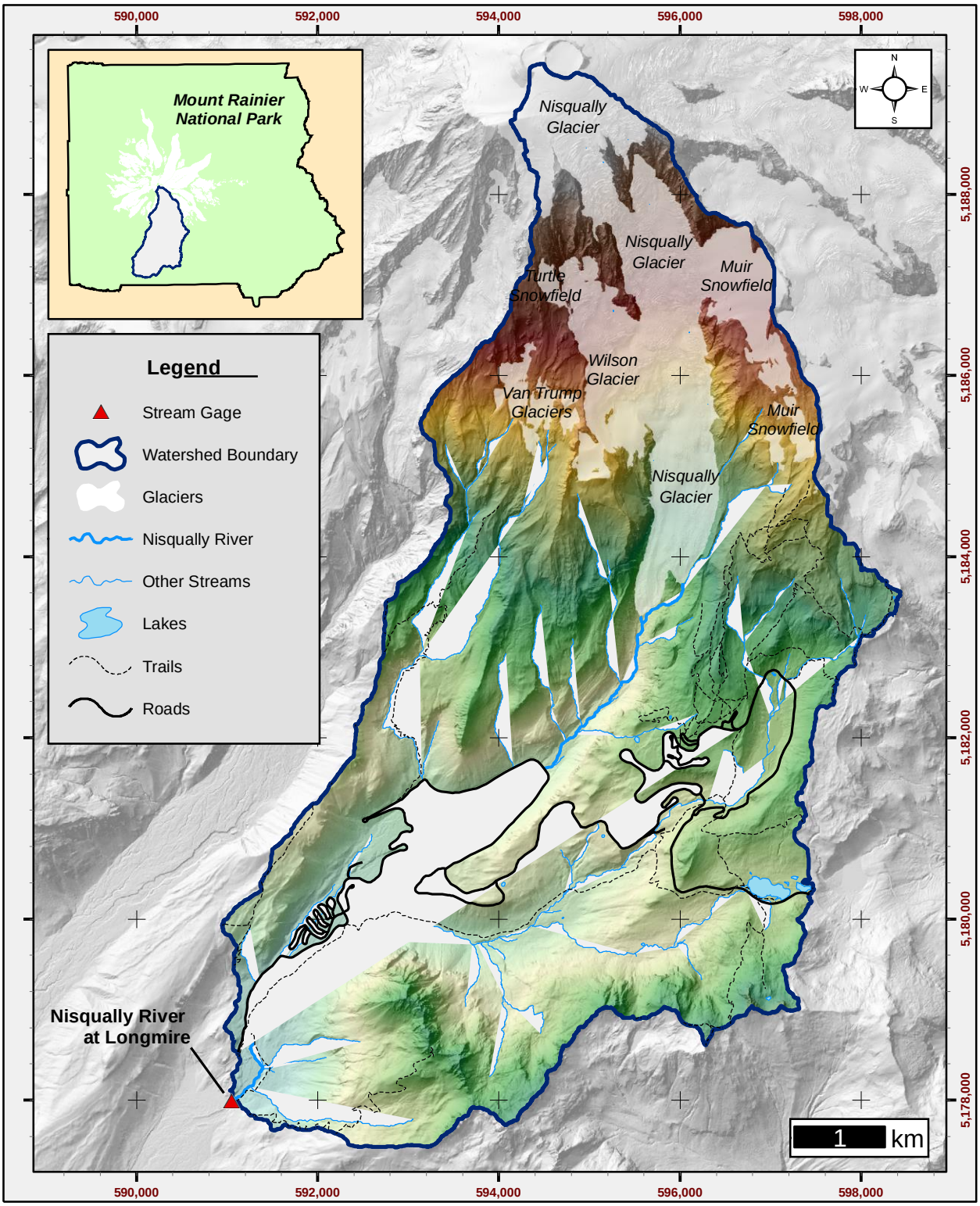

Figure 1: Overview map of the Nisqually River Watershed at Longmire showing major glaciers and snowfields, rivers, lakes, roads and trails. (Grid: NAD 1983 UTM Zone 10N, Meters; Scale: 1:65,000)

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 15 feet upstream of the Longmire Back-Gate Road suspension bridge.
Location:	NAD 1983 Washington State Plane Coordinate System, South Zone, US Survey Feet: N: 519,055.200 feet E: 1,312,570.088 feet NAD 1983 UTM Zone 10 North, Meters N: 5,177,989 meters E: 591,050 meters Geographic, WGS1984 Latitude: 46º 44' 57.30405" (46.7492511º) Longitude: -121º 48' 28.55694" (-121.8079325º)
Elevation *(Gage Cap)*:	2,795.849 feet (NAVD 1988) 852.175 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 28, 2009 3:45 PM – December 3, 2010 2:30 PM June 8, 2011 2:15 PM – September 30, 2011 11:45 PM
Recording Interval:	15 minutes
Gage Equipment *(Stilling Well)*:	15 foot total height in three 5-foot sections: (1) White 5 foot by 2 inch schedule 40 PVC pipe with 0.020" slots. (2 and 3): White 5 foot by 2 inch schedule 40 PVC riser pipe. Mounted to bedrock exposure with expansion bolts and steel brackets. PVC well cap on the top locked with a National Park Service/Mt. Rainier 17-2 padlock.
Gage Equipment *(Pressure transducers)*:	Stage: Solinst® Levelogger® Gold 10 meter/30 foot pressure transducer hung approximately 15 feet from the cap, measuring water pressure and water temperature at 15-minute intervals. Barometric: Solinst® Barologger® Gold 1.5 meter/5 foot pressure transducer hung approximately 1 foot from the cap, 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) Air Pressure (Automated pressure transducer measurement) (4) Air Temperature (Automated pressure transducer measurement) (5) Stage (Calculated, Variable 1 - Variable 4)
Landscape Types in Watershed:	*Glaciers and Permanent Snowfields:* 3.02 mi^2 (7.82 km^2), 16.06% *Alpine:* 4.27 mi^2 (11.05 km^2), 22.69% *Subalpine:* 4.89 mi^2 (12.66 km^2), 25.99% *Forest:* 6.59 mi^2 (17.08 km^2), 35.07% *Lakes:* 0.04 mi^2 (0.09 km^2), 0.19%

Methods

Stage Computation

Stage heights were calculated with a Solinst® Levelogger® Gold 10 meter/30 foot pressure transducer mounted in the stream bed, above the low flow stage height. The pressure transducer measures the weight of the column of air and water above the transducer. A Solinst® Barologger® Gold 1.5 meter/5 foot pressure transducer mounted above the high water line records air pressure and corrects the water pressure transducer to the effects of changing air pressure. A photo of the completed stream gage site and pressure transducers used in this study is shown in Figure 2.

During the field season and when the equipment was removed, the pressure transducers were downloaded. Barometric compensation was performed to remove the variable of changing air pressure to arrive at the true stage height.

Figure 2: (A) Nisqually River stream gage (stilling well) at Longmire and (B) Solinst® Levelogger® and Barologger® pressure transducers used in this study.

Air and Water Temperatures

Air and water temperatures are recorded automatically by the mounted pressure transducers in the stilling well. Air temperature is recorded by the barometric pressure transducer mounted approximately 1 foot from the top of the well. Water temperature is recorded by the stage transducer which is mounted at the base of the stilling well. This data is recorded at the same time as pressure measurements and is an inherent function of the Solinst® pressure transducers.

Results

Stream stage

Fifteen minute stage heights were recorded during two continuous periods during Water Year 2011 (WY2011) and shown in Figure 3. Stage ranges from 0.7957 ft (0.2425 m) which occurred September 26, 2011 at 5:30 AM to 3.7075 ft (1.1300 m) which occurred November 15, 2010 at 9:00 PM. Rain events and small floods are clearly shown in the record, as well as increases in daily runoff in the spring to summer months associated with snowmelt. Daily minimum, mean and maximum stream stage for every day in WY2011 are shown in appendixes A-1, A-2 and A-3, respectively.

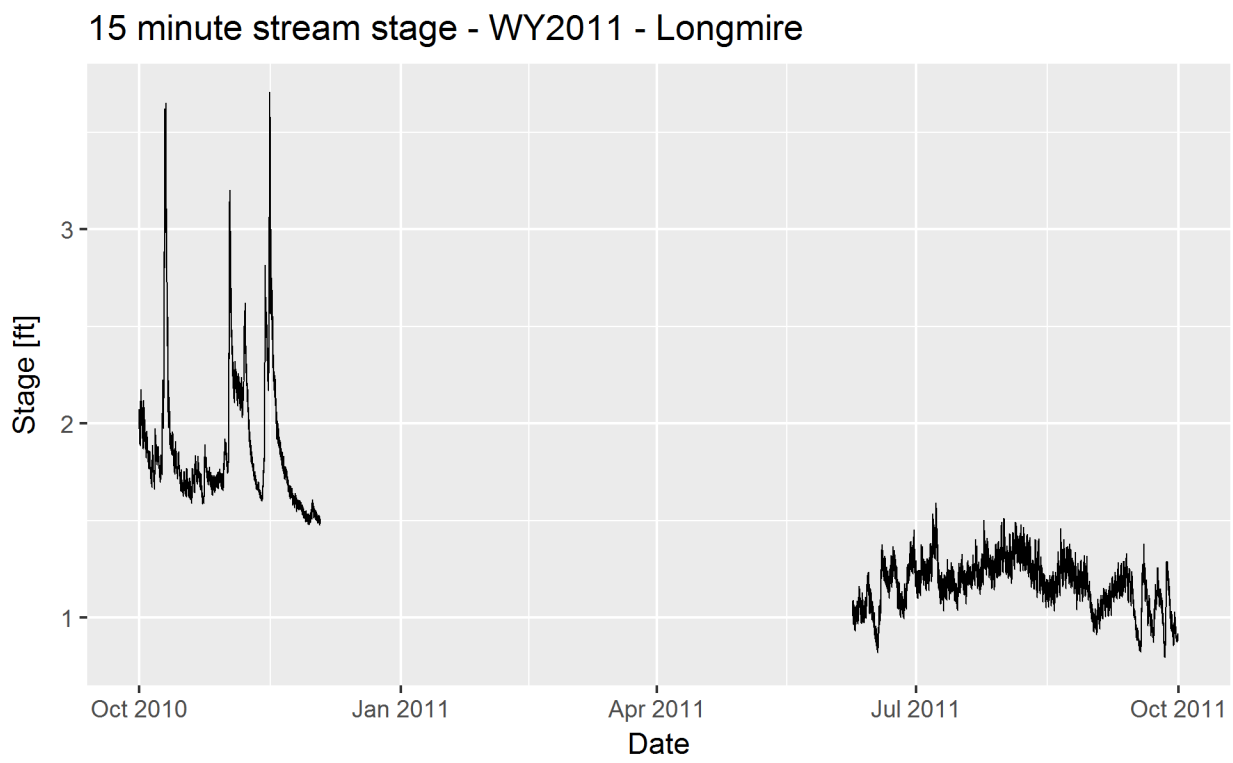

Figure 3: Stream stage during water year 2011 at Longmire.

Stream temperature

Figure 4 shows the 15-minute water temperatures during WY2011. The lowest water temperature recorded was 32.3528 ºF (0.1960 ºC) on November 24, 2010 at 5:15 AM while the highest water temperature was 51.2258 ºF (10.6800 ºC) on August 27, 2011 at 3:45 PM. Daily minimum, mean and maximum water temperatures for every day in WY2011 are shown in appendixes B-1, B-2 and B-3, respectively.

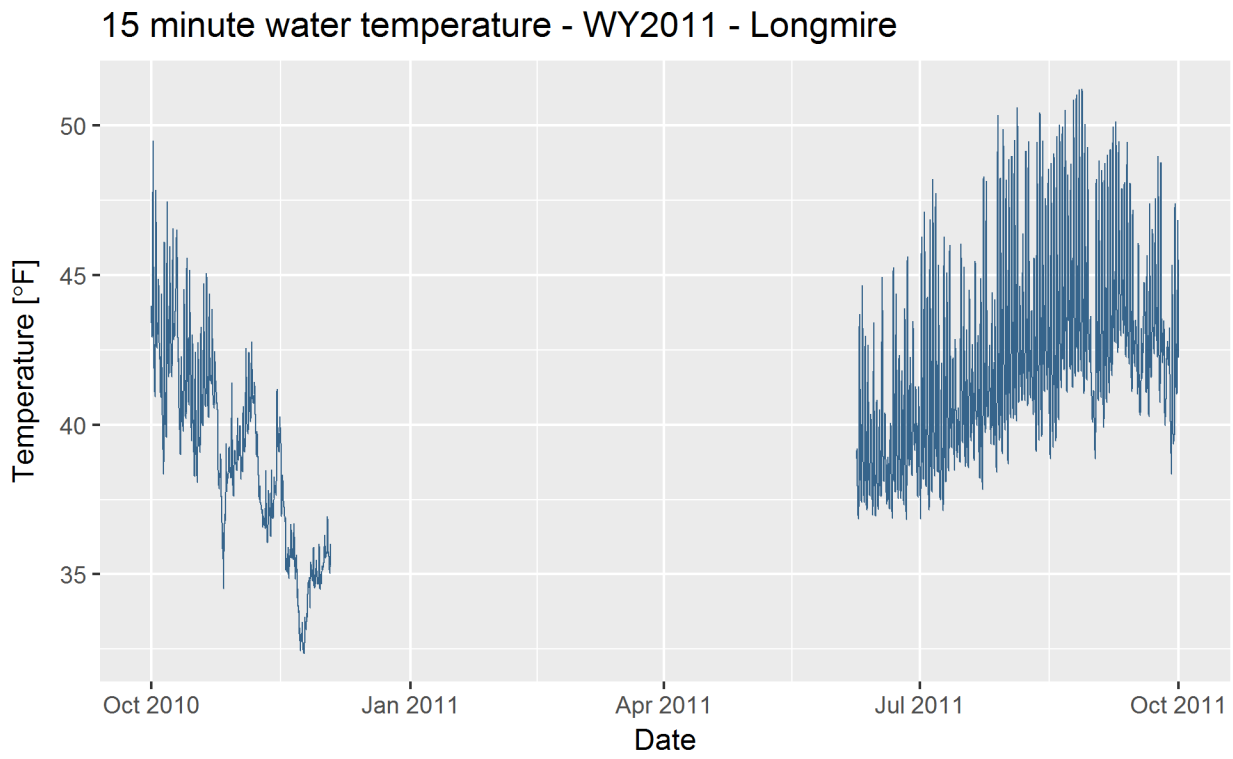

Figure 4: Stream temperature during water year 2011 at Longmire.

Air Temperature

Figure 5 shows the 15-minute air temperature during WY2011. The daily, monthly and yearly range of air temperatures is much more variable than water temperatures. The minimum air temperature was 16.4354 ºF (-8.6470 ºC) on November 24, 2010 at 6:30 AM and the highest air temperature was 94.2188 ºF (34.5700 ºC) on September 11, 2010 at 2:30 PM. Daily minimum, mean and maximum air temperatures for every day in WY2011 are shown in appendixes C-1, C-2 and C-3, respectively.

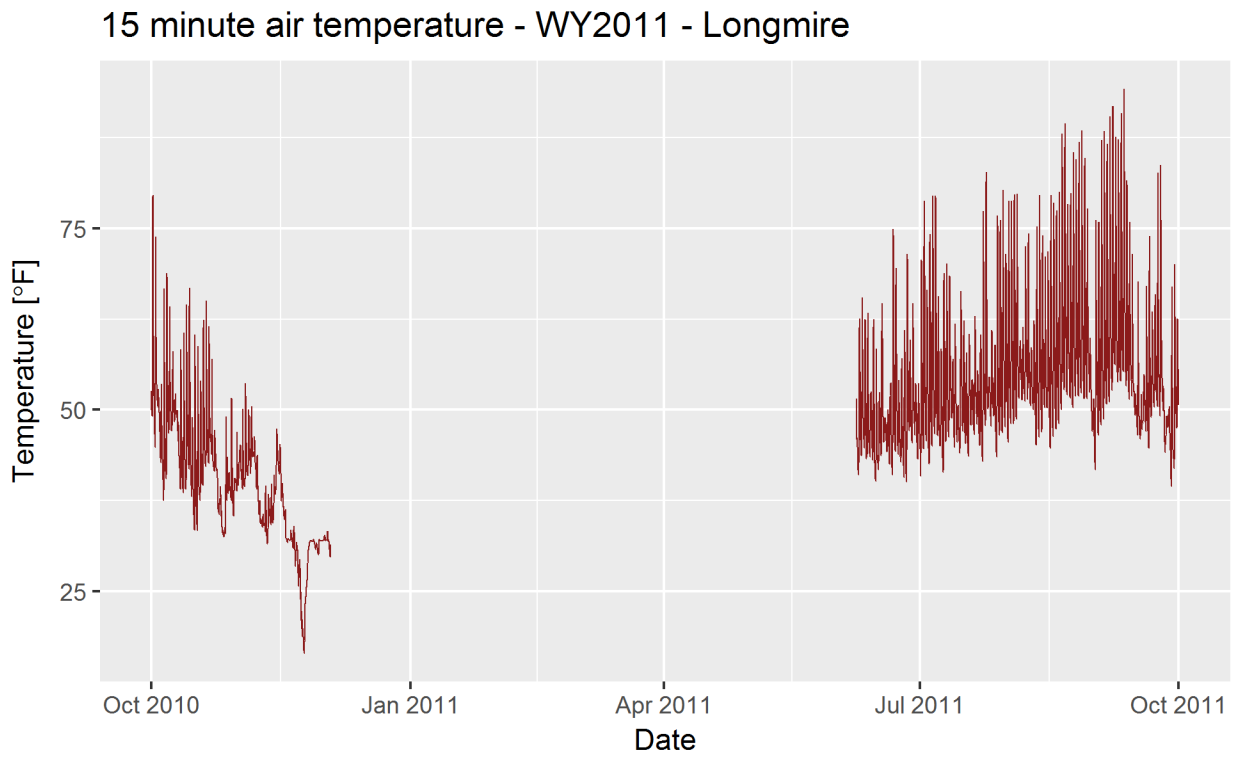

Figure 5: Air temperature during water year 2011 at Longmire.

Raw Data

Raw tabular data from this study is available as a Microsoft Excel file and includes two worksheets: "15 Minute Data" and "WY2011 Stats." "15 Minute Data" includes the raw 15-minute data from WY2011 with the following columns (35,041 rows): Date/Time, Day of Water Year, Stage, Water Temperature and Air Temperature. "WY2011 Stats" is the daily summary data of the 15 minute data for WY2011 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; and Minimum, Average and Maximum Air Temperature. 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/2247931.

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Appendix A: WY2011 stream stage data tables

Note: There is no data available for the period of December 4, 2010 – June 7, 2011, due to a stream gage malfunction. December 3, 2010 and June 8, 2011 only have a partial record (from 00:00-14:30 and 14:15-23:45, respectively) and are not included in the computation of daily minimum, average and maximum values for the following tables.

Appendix A-1: Minimum daily stream stage (in feet) recorded at the Longmire stream gage during water year 2011.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	1.88	1.74	1.51	-	-	-	-	-	-	1.10	1.22	0.92
2	1.87	2.24	1.49	-	-	-	-	-	-	1.11	1.20	0.91
3	1.82	2.11	-	-	-	-	-	-	-	1.16	1.17	0.94
4	1.76	2.09	-	-	-	-	-	-	-	1.14	1.25	1.00
5	1.67	2.07	-	-	-	-	-	-	-	1.14	1.28	1.00
6	1.66	2.03	-	-	-	-	-	-	-	1.19	1.24	1.01
7	1.79	2.15	-	-	-	-	-	-	-	1.30	1.24	1.01
8	1.70	1.88	-	-	-	-	-	-	-	1.14	1.24	1.08
9	1.74	1.76	-	-	-	-	-	-	0.93	1.07	1.21	1.10
10	2.40	1.69	-	-	-	-	-	-	0.97	1.03	1.16	1.10
11	1.88	1.65	-	-	-	-	-	-	0.97	1.09	1.14	1.11
12	1.83	1.61	-	-	-	-	-	-	0.97	1.09	1.10	1.13
13	1.74	1.60	-	-	-	-	-	-	1.00	1.12	1.12	1.08
14	1.72	1.85	-	-	-	-	-	-	1.02	1.08	1.08	1.06
15	1.65	2.17	-	-	-	-	-	-	0.97	1.04	1.05	0.98
16	1.62	2.35	-	-	-	-	-	-	0.85	1.13	1.05	0.88
17	1.62	2.06	-	-	-	-	-	-	0.82	1.12	1.06	0.82
18	1.62	1.88	-	-	-	-	-	-	0.96	1.07	1.04	0.89
19	1.59	1.81	-	-	-	-	-	-	1.19	1.17	1.10	1.08
20	1.64	1.72	-	-	-	-	-	-	1.15	1.15	1.11	0.96
21	1.69	1.69	-	-	-	-	-	-	1.10	1.16	1.16	0.91
22	1.64	1.61	-	-	-	-	-	-	1.16	1.15	1.15	0.87
23	1.59	1.58	-	-	-	-	-	-	1.20	1.12	1.17	1.04
24	1.72	1.56	-	-	-	-	-	-	1.04	1.17	1.15	1.06
25	1.68	1.55	-	-	-	-	-	-	1.00	1.22	1.12	0.90
26	1.63	1.55	-	-	-	-	-	-	0.99	1.21	1.04	0.80
27	1.64	1.51	-	-	-	-	-	-	1.05	1.15	1.08	1.06
28	1.66	1.49	-	-	-	-	-	-	1.18	1.14	1.08	0.92
29	1.67	1.48	-	-	---	-	-	-	1.23	1.20	1.11	0.86
30	1.65	1.49	-	-	---	-	-	-	1.16	1.21	1.09	0.88
31	1.77	---	-	-	---	-	---	-	---	1.23	0.98	---
Minimum	**1.59**	**1.48**	**1.49**	**-**	**-**	**-**	**-**	**-**	**0.82**	**1.03**	**0.98**	**0.80**
Mean	**1.73**	**1.80**	**1.50**	**-**	**-**	**-**	**-**	**-**	**1.04**	**1.14**	**1.14**	**0.98**
Maximum	**2.40**	**2.35**	**1.51**	**-**	**-**	**-**	**-**	**-**	**1.23**	**1.30**	**1.28**	**1.13**

Appendix A-2: Mean daily stream stage (in feet) recorded at the Longmire stream gage during water year 2011.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	2.02	2.26	1.55	-	-	-	-	-	-	1.17	1.32	0.98
2	1.99	2.54	1.52	-	-	-	-	-	-	1.23	1.29	0.99
3	1.91	2.23	-	-	-	-	-	-	-	1.26	1.30	1.02
4	1.82	2.20	-	-	-	-	-	-	-	1.22	1.35	1.07
5	1.77	2.17	-	-	-	-	-	-	-	1.24	1.36	1.08
6	1.79	2.17	-	-	-	-	-	-	-	1.32	1.35	1.08
7	1.83	2.35	-	-	-	-	-	-	-	1.40	1.34	1.12
8	1.76	2.02	-	-	-	-	-	-	-	1.31	1.32	1.15
9	2.25	1.83	-	-	-	-	-	-	1.01	1.15	1.29	1.17
10	3.03	1.74	-	-	-	-	-	-	1.04	1.15	1.25	1.18
11	2.10	1.68	-	-	-	-	-	-	1.06	1.17	1.23	1.19
12	1.90	1.64	-	-	-	-	-	-	1.03	1.18	1.23	1.22
13	1.82	1.70	-	-	-	-	-	-	1.10	1.19	1.22	1.18
14	1.78	2.44	-	-	-	-	-	-	1.13	1.15	1.17	1.16
15	1.73	2.62	-	-	-	-	-	-	1.05	1.13	1.14	1.05
16	1.68	2.70	-	-	-	-	-	-	0.94	1.21	1.13	0.92
17	1.68	2.23	-	-	-	-	-	-	0.90	1.22	1.15	0.86
18	1.67	1.98	-	-	-	-	-	-	1.13	1.19	1.14	1.16
19	1.68	1.88	-	-	-	-	-	-	1.27	1.22	1.19	1.17
20	1.73	1.80	-	-	-	-	-	-	1.21	1.21	1.24	1.05
21	1.75	1.74	-	-	-	-	-	-	1.18	1.25	1.28	0.98
22	1.70	1.67	-	-	-	-	-	-	1.25	1.24	1.26	0.98
23	1.63	1.64	-	-	-	-	-	-	1.27	1.21	1.30	1.14
24	1.79	1.60	-	-	-	-	-	-	1.15	1.27	1.26	1.12
25	1.73	1.59	-	-	-	-	-	-	1.07	1.31	1.22	1.01
26	1.69	1.58	-	-	-	-	-	-	1.07	1.29	1.17	0.96
27	1.69	1.55	-	-	-	-	-	-	1.14	1.24	1.19	1.19
28	1.71	1.52	-	-	-	-	-	-	1.26	1.25	1.18	1.00
29	1.72	1.51	-	-	---	-	-	-	1.31	1.28	1.19	0.94
30	1.72	1.54	-	-	---	-	-	-	1.29	1.31	1.15	0.90
31	1.85	---	-	-	---	-	---	-	---	1.35	1.05	---
Minimum	**1.63**	**1.51**	**1.52**	**-**	**-**	**-**	**-**	**-**	**0.90**	**1.13**	**1.05**	**0.86**
Mean	**1.84**	**1.94**	**1.53**	**-**	**-**	**-**	**-**	**-**	**1.13**	**1.24**	**1.23**	**1.07**
Maximum	**3.03**	**2.70**	**1.55**	**-**	**-**	**-**	**-**	**-**	**1.31**	**1.40**	**1.36**	**1.22**

Appendix A-3: Maximum daily stream stage (in feet) recorded at the Longmire stream gage during water year 2011.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	2.17	3.20	1.59	-	-	-	-	-	-	1.25	1.44	1.05
2	2.12	3.07	1.54	-	-	-	-	-	-	1.38	1.43	1.10
3	1.97	2.32	-	-	-	-	-	-	-	1.37	1.44	1.12
4	1.88	2.28	-	-	-	-	-	-	-	1.31	1.49	1.15
5	1.89	2.24	-	-	-	-	-	-	-	1.38	1.48	1.15
6	1.97	2.48	-	-	-	-	-	-	-	1.53	1.48	1.18
7	1.89	2.62	-	-	-	-	-	-	-	1.59	1.47	1.21
8	1.84	2.19	-	-	-	-	-	-	-	1.57	1.43	1.23
9	3.18	1.90	-	-	-	-	-	-	1.07	1.23	1.43	1.28
10	3.65	1.79	-	-	-	-	-	-	1.16	1.22	1.37	1.27
11	2.58	1.71	-	-	-	-	-	-	1.15	1.30	1.40	1.29
12	1.96	1.69	-	-	-	-	-	-	1.10	1.25	1.40	1.33
13	1.91	1.87	-	-	-	-	-	-	1.23	1.28	1.41	1.27
14	1.86	2.82	-	-	-	-	-	-	1.24	1.25	1.26	1.25
15	1.81	3.71	-	-	-	-	-	-	1.14	1.26	1.22	1.17
16	1.75	3.45	-	-	-	-	-	-	1.03	1.30	1.20	1.00
17	1.77	2.39	-	-	-	-	-	-	1.06	1.33	1.24	0.91
18	1.72	2.13	-	-	-	-	-	-	1.35	1.28	1.24	1.38
19	1.77	1.95	-	-	-	-	-	-	1.38	1.29	1.34	1.31
20	1.84	1.86	-	-	-	-	-	-	1.31	1.32	1.46	1.12
21	1.83	1.78	-	-	-	-	-	-	1.27	1.40	1.40	1.05
22	1.75	1.73	-	-	-	-	-	-	1.37	1.37	1.36	1.16
23	1.75	1.68	-	-	-	-	-	-	1.35	1.30	1.38	1.26
24	1.89	1.64	-	-	-	-	-	-	1.26	1.50	1.35	1.23
25	1.78	1.63	-	-	-	-	-	-	1.18	1.41	1.34	1.11
26	1.75	1.60	-	-	-	-	-	-	1.18	1.39	1.28	1.29
27	1.73	1.58	-	-	-	-	-	-	1.26	1.32	1.30	1.29
28	1.75	1.55	-	-	-	-	-	-	1.38	1.38	1.32	1.12
29	1.77	1.53	-	-	---	-	-	-	1.40	1.39	1.32	1.03
30	1.85	1.61	-	-	---	-	-	-	1.45	1.49	1.24	0.96
31	1.92	---	-	-	---	-	---	-	---	1.51	1.14	---
Minimum	**1.72**	**1.53**	**1.54**	**-**	**-**	**-**	**-**	**-**	**1.03**	**1.22**	**1.14**	**0.91**
Mean	**1.98**	**2.13**	**1.57**	**-**	**-**	**-**	**-**	**-**	**1.24**	**1.36**	**1.36**	**1.18**
Maximum	**3.65**	**3.71**	**1.59**	**-**	**-**	**-**	**-**	**-**	**1.45**	**1.59**	**1.49**	**1.38**

Appendix B: WY2011 water temperature data tables

Note: There is no data available for the period of December 4, 2010 – June 7, 2011, due to a stream gage malfunction. December 3, 2010 and June 8, 2011 only have a partial record (from 00:00-14:30 and 14:15-23:45, respectively) and are not included in the computation of daily minimum, average and maximum values for the following tables.

Appendix B-1: Minimum daily water temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2011.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	42.17	38.17	35.24	-	-	-	-	-	-	36.85	38.70	38.86
2	40.93	38.42	35.67	-	-	-	-	-	-	38.18	40.24	40.80
3	42.41	39.09	-	-	-	-	-	-	-	37.95	40.21	40.90
4	40.30	39.69	-	-	-	-	-	-	-	37.14	40.12	39.91
5	38.34	40.09	-	-	-	-	-	-	-	37.75	40.74	40.74
6	39.58	40.05	-	-	-	-	-	-	-	38.28	40.80	41.07
7	41.60	38.55	-	-	-	-	-	-	-	38.34	40.81	41.64
8	41.60	37.31	-	-	-	-	-	-	-	37.50	40.63	42.76
9	42.91	36.57	-	-	-	-	-	-	36.84	37.13	40.89	42.41
10	40.16	36.54	-	-	-	-	-	-	37.41	38.10	40.33	42.97
11	39.01	36.05	-	-	-	-	-	-	37.41	38.45	39.12	42.84
12	39.78	36.27	-	-	-	-	-	-	37.15	39.23	39.48	42.26
13	40.20	36.86	-	-	-	-	-	-	37.62	38.47	39.61	42.03
14	40.65	37.65	-	-	-	-	-	-	36.98	38.90	41.10	41.11
15	39.40	39.10	-	-	-	-	-	-	36.95	38.74	41.17	41.93
16	38.27	36.94	-	-	-	-	-	-	37.17	39.39	38.85	41.02
17	38.08	35.11	-	-	-	-	-	-	37.59	38.60	39.25	40.32
18	39.07	34.86	-	-	-	-	-	-	38.12	38.56	39.46	41.57
19	39.96	35.26	-	-	-	-	-	-	37.34	39.47	40.16	41.08
20	40.61	35.37	-	-	-	-	-	-	37.19	38.79	41.23	40.27
21	40.24	34.19	-	-	-	-	-	-	36.87	39.47	41.83	41.57
22	40.89	32.44	-	-	-	-	-	-	37.75	38.21	41.07	42.36
23	40.54	32.44	-	-	-	-	-	-	37.53	37.84	41.86	42.06
24	37.96	32.35	-	-	-	-	-	-	37.53	39.73	41.25	40.74
25	37.53	33.29	-	-	-	-	-	-	37.33	40.25	41.62	40.51
26	34.53	33.88	-	-	-	-	-	-	36.83	39.36	41.78	39.97
27	36.62	34.61	-	-	-	-	-	-	38.62	39.33	41.80	40.45
28	38.15	34.54	-	-	-	-	-	-	38.30	38.41	41.05	38.34
29	37.97	34.50	-	-	---	-	-	-	38.69	39.48	41.49	39.34
30	37.62	34.63	-	-	---	-	-	-	37.58	39.03	41.33	41.01
31	38.48	---	-	-	---	-	---	-	---	39.81	40.08	---
Minimum	**34.53**	**32.35**	**35.24**	**-**	**-**	**-**	**-**	**-**	**36.83**	**36.85**	**38.70**	**38.34**
Mean	**39.53**	**36.16**	**35.46**	**-**	**-**	**-**	**-**	**-**	**37.49**	**38.60**	**40.58**	**41.09**
Maximum	**42.91**	**40.09**	**35.67**	**-**	**-**	**-**	**-**	**-**	**38.69**	**40.25**	**41.86**	**42.97**

Appendix B-2: Mean daily water temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2011.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	44.70	39.22	35.67	-	-	-	-	-	-	40.56	42.68	42.41
2	43.21	39.22	35.88	-	-	-	-	-	-	41.48	43.52	43.68
3	43.36	40.32	-	-	-	-	-	-	-	40.38	43.72	43.59
4	41.83	40.64	-	-	-	-	-	-	-	40.78	44.00	43.33
5	41.09	41.13	-	-	-	-	-	-	-	41.26	42.31	43.70
6	42.13	40.93	-	-	-	-	-	-	-	41.62	42.86	43.84
7	43.17	39.24	-	-	-	-	-	-	-	40.62	43.79	44.42
8	43.11	37.69	-	-	-	-	-	-	-	39.12	43.90	45.10
9	44.01	36.96	-	-	-	-	-	-	39.43	40.77	42.10	45.03
10	43.13	37.06	-	-	-	-	-	-	39.84	40.89	42.31	45.02
11	40.41	36.88	-	-	-	-	-	-	39.34	41.30	43.18	44.70
12	41.47	37.18	-	-	-	-	-	-	39.15	40.45	43.72	44.85
13	42.08	37.45	-	-	-	-	-	-	38.74	40.48	43.51	44.18
14	42.28	39.14	-	-	-	-	-	-	39.21	39.65	43.36	43.21
15	40.69	39.53	-	-	-	-	-	-	38.33	41.78	43.45	42.63
16	39.78	37.70	-	-	-	-	-	-	38.48	41.19	42.90	42.72
17	39.74	36.60	-	-	-	-	-	-	40.36	40.19	42.98	41.30
18	40.61	35.37	-	-	-	-	-	-	39.02	41.13	43.19	43.30
19	41.49	35.85	-	-	-	-	-	-	38.14	40.79	43.82	43.01
20	41.95	35.98	-	-	-	-	-	-	38.58	41.27	44.44	42.73
21	41.64	34.99	-	-	-	-	-	-	40.11	40.91	45.05	43.39
22	41.85	33.40	-	-	-	-	-	-	40.16	40.76	44.01	44.18
23	41.24	32.86	-	-	-	-	-	-	39.27	41.92	44.70	44.37
24	39.91	32.92	-	-	-	-	-	-	39.16	42.64	44.53	43.38
25	38.26	34.11	-	-	-	-	-	-	39.88	41.09	44.89	42.47
26	36.12	34.88	-	-	-	-	-	-	40.26	41.28	45.15	41.26
27	37.63	35.06	-	-	-	-	-	-	39.98	41.10	45.09	42.17
28	38.55	34.95	-	-	-	-	-	-	40.12	42.45	44.34	40.83
29	39.01	35.03	-	-	---	-	-	-	39.84	42.97	44.19	41.99
30	38.49	35.02	-	-	---	-	-	-	38.99	43.13	42.57	43.05
31	38.96	---	-	-	---	-	---	-	---	43.09	40.71	---
Minimum	**36.12**	**32.86**	**35.67**	**-**	**-**	**-**	**-**	**-**	**38.14**	**39.12**	**40.71**	**40.83**
Mean	**41.03**	**36.91**	**35.77**	**-**	**-**	**-**	**-**	**-**	**39.38**	**41.20**	**43.58**	**43.33**
Maximum	**44.70**	**41.13**	**35.88**	**-**	**-**	**-**	**-**	**-**	**40.36**	**43.13**	**45.15**	**45.10**

Appendix B-3: Maximum daily water temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2011.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	49.48	39.97	36.31	-	-	-	-	-	-	46.29	48.87	48.21
2	47.85	40.62	36.93	-	-	-	-	-	-	47.11	48.98	48.83
3	44.87	42.55	-	-	-	-	-	-	-	44.28	49.50	48.50
4	44.37	42.42	-	-	-	-	-	-	-	46.85	50.60	48.73
5	46.11	42.77	-	-	-	-	-	-	-	48.21	44.63	49.02
6	47.46	41.42	-	-	-	-	-	-	-	47.75	46.39	49.20
7	45.96	40.00	-	-	-	-	-	-	-	45.34	49.16	49.96
8	46.56	38.50	-	-	-	-	-	-	-	42.07	49.47	50.14
9	46.26	37.31	-	-	-	-	-	-	43.70	46.28	43.83	49.47
10	46.51	38.48	-	-	-	-	-	-	44.66	45.08	45.57	47.88
11	42.29	37.82	-	-	-	-	-	-	42.97	46.01	49.44	48.10
12	44.53	38.49	-	-	-	-	-	-	42.66	42.23	50.43	49.45
13	45.57	38.25	-	-	-	-	-	-	40.36	42.86	49.50	48.08
14	45.17	41.20	-	-	-	-	-	-	43.41	40.57	47.57	47.19
15	43.01	40.27	-	-	-	-	-	-	40.83	46.05	48.55	43.50
16	42.43	39.40	-	-	-	-	-	-	40.50	45.27	48.74	46.07
17	42.74	37.38	-	-	-	-	-	-	44.94	43.18	49.05	43.23
18	43.27	35.91	-	-	-	-	-	-	40.41	44.50	49.65	44.75
19	44.72	36.68	-	-	-	-	-	-	38.92	42.69	50.03	45.65
20	45.06	36.71	-	-	-	-	-	-	40.05	45.47	49.96	47.40
21	44.37	35.66	-	-	-	-	-	-	45.25	42.99	50.53	46.53
22	43.87	34.40	-	-	-	-	-	-	44.37	44.89	48.35	47.57
23	42.45	33.40	-	-	-	-	-	-	42.32	48.30	48.73	48.99
24	41.30	33.57	-	-	-	-	-	-	41.81	48.14	50.86	48.77
25	39.04	34.80	-	-	-	-	-	-	43.89	42.66	51.03	43.48
26	37.46	35.42	-	-	-	-	-	-	45.61	44.42	51.20	42.80
27	39.36	35.90	-	-	-	-	-	-	42.27	44.18	51.23	43.25
28	39.27	35.47	-	-	-	-	-	-	43.46	50.34	50.06	45.33
29	41.40	36.02	-	-	---	-	-	-	41.27	48.26	49.27	47.40
30	39.14	35.29	-	-	---	-	-	-	41.28	49.87	43.63	46.85
31	40.22	---	-	-	---	-	---	-	---	48.19	41.29	---
Minimum	**37.46**	**33.40**	**36.31**	**-**	**-**	**-**	**-**	**-**	**38.92**	**40.57**	**41.29**	**42.80**
Mean	**43.62**	**37.87**	**36.62**	**-**	**-**	**-**	**-**	**-**	**42.50**	**45.49**	**48.58**	**47.14**
Maximum	**49.48**	**42.77**	**36.93**	**-**	**-**	**-**	**-**	**-**	**45.61**	**50.34**	**51.23**	**50.14**

Appendix C: WY2011 air temperature data tables

Note: There is no data available for the period of December 4, 2010 – June 7, 2011, due to a stream gage malfunction. December 3, 2010 and June 8, 2011 only have a partial record (from 00:00-14:30 and 14:15-23:45, respectively) and are not included in the computation of daily minimum, average and maximum values for the following tables.

Appendix C-1: Minimum daily air temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2011.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	49.20	40.27	32.00	-	-	-	-	-	-	40.88	45.55	41.79
2	44.86	39.09	31.88	-	-	-	-	-	-	44.67	48.10	46.55
3	47.36	39.43	-	-	-	-	-	-	-	45.76	48.07	47.92
4	42.72	40.92	-	-	-	-	-	-	-	42.50	48.69	48.71
5	37.53	41.21	-	-	-	-	-	-	-	45.05	51.65	50.80
6	40.50	42.48	-	-	-	-	-	-	-	46.73	51.37	51.09
7	46.74	37.73	-	-	-	-	-	-	-	46.39	51.15	52.71
8	47.09	34.38	-	-	-	-	-	-	-	45.02	51.43	56.23
9	48.35	33.82	-	-	-	-	-	-	41.08	41.42	50.59	53.87
10	43.39	32.54	-	-	-	-	-	-	43.67	45.66	49.57	53.99
11	39.13	31.55	-	-	-	-	-	-	44.40	46.24	45.21	55.30
12	38.58	34.21	-	-	-	-	-	-	43.24	48.86	46.26	53.29
13	39.08	34.42	-	-	-	-	-	-	43.51	44.83	46.99	51.45
14	41.84	38.48	-	-	-	-	-	-	43.04	45.52	50.29	51.85
15	36.85	41.16	-	-	-	-	-	-	40.16	44.08	50.28	49.24
16	33.47	36.49	-	-	-	-	-	-	41.77	47.02	44.77	46.51
17	33.35	32.12	-	-	-	-	-	-	43.73	45.28	46.34	46.01
18	37.51	31.70	-	-	-	-	-	-	45.58	43.62	47.36	47.65
19	39.63	32.00	-	-	-	-	-	-	44.21	47.90	48.13	47.07
20	42.22	30.91	-	-	-	-	-	-	42.53	46.62	50.06	44.73
21	42.63	28.44	-	-	-	-	-	-	41.01	47.66	52.77	49.02
22	42.76	23.83	-	-	-	-	-	-	44.35	45.06	52.04	50.37
23	41.55	18.35	-	-	-	-	-	-	43.84	42.90	51.64	50.49
24	35.90	16.44	-	-	-	-	-	-	42.85	47.82	50.31	49.20
25	35.34	25.03	-	-	-	-	-	-	40.72	50.15	51.87	45.55
26	32.46	31.26	-	-	-	-	-	-	40.07	47.75	51.88	44.16
27	32.96	31.56	-	-	-	-	-	-	47.15	47.02	52.34	45.15
28	38.51	30.75	-	-	-	-	-	-	45.49	43.51	51.54	39.46
29	37.13	30.06	-	-	---	-	-	-	45.83	46.52	51.53	41.97
30	35.39	31.93	-	-	---	-	-	-	43.26	46.85	50.99	47.44
31	38.83	---	-	-	---	-	---	-	---	47.67	46.31	---
Minimum	**32.46**	**16.44**	**31.88**	**-**	**-**	**-**	**-**	**-**	**40.07**	**40.88**	**44.77**	**39.46**
Mean	**40.09**	**33.09**	**31.94**	**-**	**-**	**-**	**-**	**-**	**43.25**	**45.71**	**49.52**	**48.65**
Maximum	**49.20**	**42.48**	**32.00**	**-**	**-**	**-**	**-**	**-**	**47.15**	**50.15**	**52.77**	**56.23**

Appendix C-2: Mean daily air temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2011.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	57.59	42.84	32.23	-	-	-	-	-	-	52.78	58.20	54.49
2	54.07	41.46	32.27	-	-	-	-	-	-	57.52	59.11	57.16
3	50.86	43.24	-	-	-	-	-	-	-	53.46	59.44	59.74
4	46.71	44.18	-	-	-	-	-	-	-	54.75	59.71	61.79
5	46.75	44.99	-	-	-	-	-	-	-	57.79	55.47	62.40
6	49.34	44.37	-	-	-	-	-	-	-	58.89	55.61	63.12
7	51.41	40.61	-	-	-	-	-	-	-	53.11	58.26	64.99
8	50.76	35.90	-	-	-	-	-	-	-	50.05	58.24	65.79
9	50.01	34.65	-	-	-	-	-	-	49.12	52.51	54.31	64.46
10	47.23	35.21	-	-	-	-	-	-	51.13	54.80	54.32	65.56
11	44.74	34.72	-	-	-	-	-	-	50.26	54.88	55.90	67.12
12	45.14	36.13	-	-	-	-	-	-	49.77	52.46	57.97	62.86
13	47.08	37.12	-	-	-	-	-	-	47.86	51.44	56.55	58.97
14	48.81	42.78	-	-	-	-	-	-	49.24	47.86	56.17	57.07
15	41.78	42.97	-	-	-	-	-	-	44.04	53.57	56.65	50.88
16	41.05	38.06	-	-	-	-	-	-	46.43	52.42	57.14	52.38
17	41.19	34.77	-	-	-	-	-	-	52.20	49.06	58.32	47.75
18	43.03	32.08	-	-	-	-	-	-	47.50	51.34	57.87	51.06
19	45.90	32.40	-	-	-	-	-	-	46.93	51.06	59.01	52.69
20	48.31	32.36	-	-	-	-	-	-	48.07	53.14	62.65	53.31
21	48.01	30.30	-	-	-	-	-	-	53.28	50.97	65.23	54.15
22	46.23	27.54	-	-	-	-	-	-	53.24	51.24	61.37	55.66
23	43.57	21.02	-	-	-	-	-	-	47.22	55.24	61.29	59.06
24	39.66	20.55	-	-	-	-	-	-	46.73	59.53	62.18	59.66
25	37.14	28.36	-	-	-	-	-	-	49.45	52.40	63.11	51.41
26	33.21	31.83	-	-	-	-	-	-	52.39	53.42	63.57	46.77
27	37.47	31.91	-	-	-	-	-	-	51.45	52.09	63.72	48.19
28	39.89	31.20	-	-	-	-	-	-	51.77	55.63	62.66	47.66
29	40.58	31.17	-	-	---	-	-	-	49.83	56.92	59.83	51.26
30	38.57	31.97	-	-	---	-	-	-	47.28	58.72	54.59	53.24
31	40.45	---	-	-	---	-	---	-	---	56.84	48.96	---
Minimum	**33.21**	**20.55**	**32.23**	**-**	**-**	**-**	**-**	**-**	**44.04**	**47.86**	**48.96**	**46.77**
Mean	**45.05**	**35.22**	**32.25**	**-**	**-**	**-**	**-**	**-**	**49.33**	**53.74**	**58.63**	**56.69**
Maximum	**57.59**	**44.99**	**32.27**	**-**	**-**	**-**	**-**	**-**	**53.28**	**59.53**	**65.23**	**67.12**

Appendix C-3: Maximum daily air temperature (in degrees Fahrenheit) recorded at the Longmire Stream Gage during water year 2011.

Date	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1	79.56	45.22	32.77	-	-	-	-	-	-	70.69	78.79	76.09
2	73.88	50.09	33.28	-	-	-	-	-	-	78.79	78.77	75.83
3	52.90	53.68	-	-	-	-	-	-	-	66.53	79.63	87.13
4	53.56	50.08	-	-	-	-	-	-	-	74.20	79.76	88.38
5	66.71	50.48	-	-	-	-	-	-	-	79.49	59.57	86.62
6	68.82	46.32	-	-	-	-	-	-	-	79.47	61.42	90.37
7	64.22	43.82	-	-	-	-	-	-	-	65.65	72.50	91.82
8	58.08	37.57	-	-	-	-	-	-	-	58.44	74.27	87.56
9	52.27	35.64	-	-	-	-	-	-	62.54	68.83	58.56	87.26
10	49.93	39.51	-	-	-	-	-	-	65.44	70.14	62.30	90.82
11	58.33	38.38	-	-	-	-	-	-	62.45	68.48	75.24	94.22
12	60.58	39.81	-	-	-	-	-	-	63.39	57.04	79.58	81.60
13	64.46	41.01	-	-	-	-	-	-	52.50	61.88	74.00	75.84
14	66.81	47.43	-	-	-	-	-	-	62.47	50.68	71.12	71.50
15	48.96	45.28	-	-	-	-	-	-	58.40	66.31	71.77	52.57
16	60.34	41.35	-	-	-	-	-	-	52.40	62.29	79.54	67.69
17	58.74	36.38	-	-	-	-	-	-	64.64	57.93	78.48	52.16
18	54.01	32.29	-	-	-	-	-	-	48.89	60.42	77.44	54.86
19	62.41	33.44	-	-	-	-	-	-	50.03	54.15	80.02	67.01
20	65.04	33.98	-	-	-	-	-	-	53.74	62.90	88.08	73.90
21	61.46	31.76	-	-	-	-	-	-	74.90	55.45	89.45	63.49
22	56.96	29.41	-	-	-	-	-	-	69.52	60.35	78.36	65.87
23	47.24	24.90	-	-	-	-	-	-	54.09	77.36	79.87	82.65
24	42.94	24.94	-	-	-	-	-	-	57.11	82.74	85.46	83.74
25	39.45	31.25	-	-	-	-	-	-	60.98	54.50	84.46	55.55
26	35.54	32.03	-	-	-	-	-	-	71.50	60.99	86.90	49.17
27	49.09	32.13	-	-	-	-	-	-	59.66	58.93	88.51	50.49
28	43.22	31.72	-	-	-	-	-	-	64.71	76.78	84.71	66.94
29	51.63	32.14	-	-	---	-	-	-	53.66	76.09	77.71	70.02
30	40.59	32.03	-	-	---	-	-	-	53.64	80.27	59.91	62.60
31	46.98	---	-	-	---	-	---	-	---	71.42	51.56	---
Minimum	**35.54**	**24.90**	**32.77**	**-**	**-**	**-**	**-**	**-**	**48.89**	**50.68**	**51.56**	**49.17**
Mean	**55.96**	**38.14**	**33.02**	**-**	**-**	**-**	**-**	**-**	**59.85**	**66.75**	**75.73**	**73.46**
Maximum	**79.56**	**53.68**	**33.28**	**-**	**-**	**-**	**-**	**-**	**74.90**	**82.74**	**89.45**	**94.22**

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

National Park Service
U.S. Department of the Interior

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