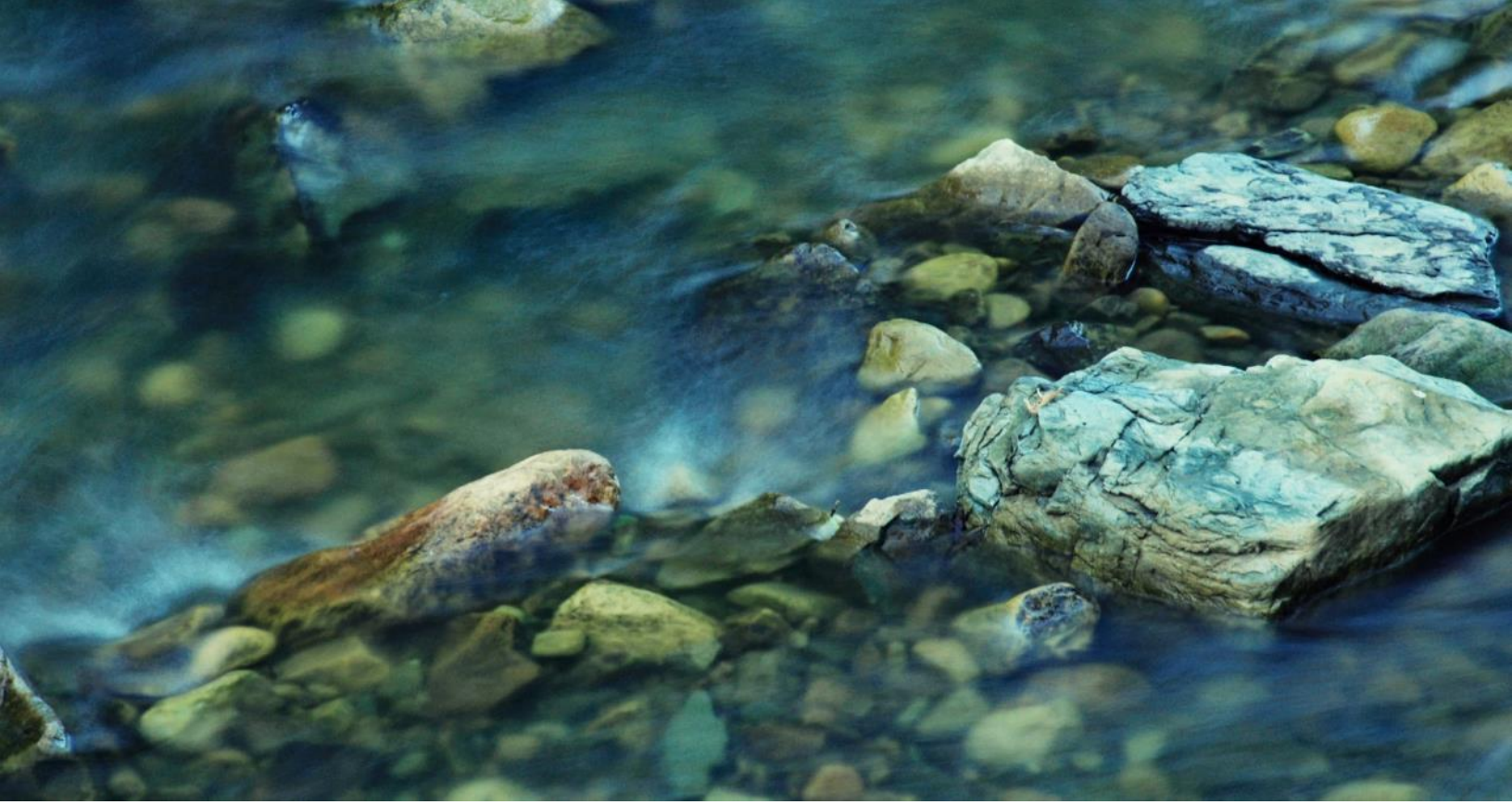

October 2019

USACE Walla Walla District Biological Services

McNary Dam Annual Temperature Report, 2019

Prepared for U.S. Army Corps of Engineers

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Prepared for
U.S. Army Corps of Engineers
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Project Number: 181163-01.01

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ABBREVIATIONS

JFF	Juvenile Fish Facility
kcfs	kilo cubic feet per second
mph	miles per hour
Onset	Onset Computer Corporation

1 Introduction

McNary Dam, located at river mile 292, is the first dam encountered by Columbia River fall Chinook salmon originating from the Hanford Reach and Priest Rapids Hatchery. These fish comprise the largest component of subyearling fall Chinook salmon migrating through McNary Dam, though smaller numbers of Endangered Species Act-listed Snake River fall Chinook salmon also navigate the dam.

The migration of juvenile fall Chinook salmon typically peaks in summer months when water temperatures are the highest of the season. High water temperatures may have adverse effects on migrating salmonids. High rates of juvenile salmonid mortality have been associated with high water temperatures at McNary Dam in the past.

During the summer, forebay surface temperatures are warmed by solar radiation and warm air temperatures, though deeper forebay water may remain cooler. Moderate wind speeds (greater than 3 miles per hour [mph]) can mix water in the forebay and decrease surface water temperature. Warm, windless days are typically experienced in July and August and allow surface water to warm unabated.

A portion (0.5% to 25%) of the juvenile salmonids passing McNary Dam are collected and held for examination to determine species composition and condition, and then released to the tailrace. Fish entering the bypass system from the forebay are guided into turbine gatewells (3 gatewells for each of the 14 turbines, totaling 42 gatewells) and away from turbine intakes by extended-length submersible bar screens. In the gatewells, 12-inch orifices lead into the collection channel and the full-flow bypass system that delivers fish to the Juvenile Fish Facility (JFF) during sampling under secondary bypass operations. Water from the collection channel is diverted over the wet separator at the JFF where smolts and smaller fish are separated from adults and larger fish. While in secondary bypass, most of the separated fish are passed through the JFF system and returned to the river via the JFF outfall pipe.

High water temperatures in the juvenile bypass system can be mitigated through powerhouse operations. Using a turbine operational strategy that balances the turbines in operation and those in standby across the powerhouse can decrease the magnitude of the temperature and temperature gradients. Turbines in operation draw in warmer surface water while turbines in standby allow cooler, deeper water at orifice depth to passively enter the gatewells. This warm water turbine management pattern can decrease the temperature of water along bypass routes.

The objective of the 2019 Temperature Monitoring Program at McNary Dam was to monitor water temperature patterns in juvenile salmonid passage areas, including the powerhouse, gatewells, collection channel, the JFF, and the JFF outfall pipe. The daily temperatures were analyzed in these

areas to identify temperature conditions that might contribute to increased mortality for fish passing through the juvenile bypass system (JBS).

Thank you to the staff at the McNary Dam JFF for their advice and support. Bobby Johnson, Denise Griffith, and the U.S. Army Corps of Engineers staff at the Juvenile Fish Facility provided invaluable assistance during each phase of this work. Thank you to Thomas VanNice and Kathleen Carter of Pacific States Marine Fisheries Commission for providing suggestions and assisting with equipment deployment. Thank you also to Anchor QEA, LLC, staff Kristi Geris and Celia Baker for their advice and support over the season.

2 Methods

Water temperatures were measured at 0.5-hour intervals (0000 and 0030) from 0700 hours on June 15 to 0700 hours on August 31, 2019. Measurements were taken using Onset Computer Corporation (Onset) HOBO U22-001 data loggers with an accuracy of ±0.38°F and a precision of 0.04°F. A total of 330.5 (0.6%) hours of water temperature data were lost during the 2019 temperature monitoring season due to 4 loggers completely failing in the field and additional lost hours due to slight logger malfunctions (Appendix A). The data for the adult fishway temperature monitoring program can be found online at the Fish Passage Center website (http://www.fpc.org/river/Q_ladderwatertempgraph_multipleyears.php).

The temperature probes were deployed at 27 locations throughout the McNary Dam Project including the forebay, gatewells, collection channel, and the JFF as follows:

- Powerhouse forebay (referred to herein as forebay), near elevation 335 feet in the trolley pipes fitted to the "C" pier nose of Units 1, 3, 5, 7, 8, 10, 12, and 14 (8 total); submerged to a depth of approximately 10 feet below the forebay water surface
- Gatewells, in the center of each "B" slot at each unit (14 total); submerged to a depth of approximately 3 feet below the water surface in the gatewell
- Collection channel, downstream of gatewell orifices 12B and 8B, and upstream of the incline dewatering screen south of Unit 1; submerged to a depth of approximately 2 feet below the water surface in the collection channel
- JFF, in the fish separator underneath the bars in the "B" section and in the "B" sample tank; submerged to a depth of 2 feet below the water surface

Prior to 2017, water temperature loggers were deployed along the spillway and in the tailrace at Units 1 and 14, on the transportation barge dock, and the tailrace navigation lock wing wall. In 2017 the tailrace loggers at Units 1 and 14 and the transportation barge dock were incorporated into the adult fishway temperature monitoring program. A logger placed at the JFF outfall pipe has replaced the tailrace navigation lock wing wall since 2016; however, the JFF outfall pipe was not accessible this year due to damage from high flows. The spillway has not been monitored since 2016.

Daily water temperatures were also recorded at 0700 hours in sample tank "B" using a Fluke 52-2 digital thermometer with a precision of 0.1°F and an accuracy of ±0.54°F. The daily temperature value was reported to McNary Dam biologists as part of the Smolt Monitoring Program. The temperatures recorded at 0700 hours are considered a minimum daily temperature and do not reflect any diurnal fluctuation that may occur.

Weather data was obtained from a Davis Vantage Vue data station positioned at the JFF near the separator and installed before temperature monitoring began. The station recorded average air temperature, wind velocity over a 0.5-hour period, wind direction, and maximum 0.5-hour wind

velocity. The anemometer at the JFF periodically became fouled with spider webs after August 13, which caused it to stop recording wind data. The data recorded was average wind velocities (Table 1 and Figure 1) and the count of days with wind velocities above 3 mph (Table 1).

Daily temperature reports were compiled using water temperatures and weather data collected from 0700 hours of the previous day to 0700 hours of the current day. This time frame coincided with sampling activities at the JFF. Subsequent dates in this report refer to data collected in 2019 unless noted otherwise.

3 Results

3.1 Weather Conditions

The air temperature peaked between 1800 and 2030 hours daily. The daily minimum air temperatures (Table 1) were measured between 0700 and 0900 hours. The maximum air temperature, 102.7°F, was measured at 16:30 hours on August 6 (Figure 1).

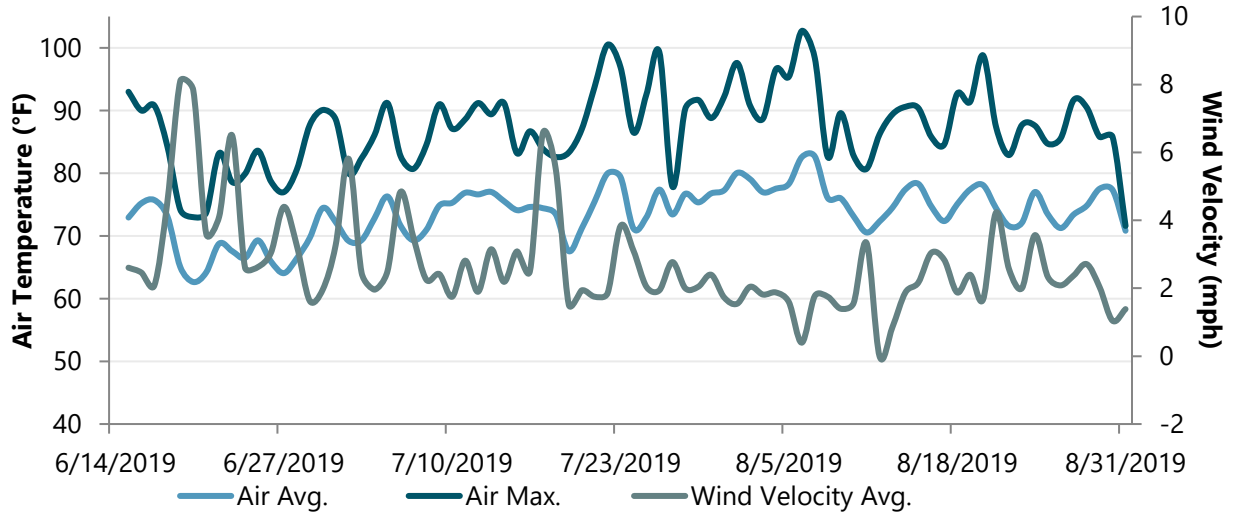
Wind velocity was highly variable throughout the day. June experienced the highest average wind velocity. August had the lowest average wind velocity. The highest average daily wind velocity was July 1 with a daily average wind speed of 17.1 mph.

Table 1
Air Temperatures and Wind Velocity at McNary Dam from 0700 on June 14 to 0700 on August 31, 2019

Month	Daily Avg. (°F)	Daily Max. Avg. (°F)	Daily Min. Avg. (°F)	Max. Range (°F)	Min. Range (°F)	Days >90°F*	Wind Avg. (mph)	Days >3 mph**
June†	69.1	83.8	58.8	71.8–96.7	52.2–68.7	3	3.11	17
July	74.2	94.0	63.6	75.9–107.4	52.1–70.6	22	2.69	31
August	75.4	88.9	63.9	64.8 - 102.7	54.3 - 69.6	12	2.01	27

Notes:
* Count of days with highs exceeding 90°F
** Days with at least one 0.5-hour period with wind velocity exceeding 3 mph
† Monitoring occurred June 15 to June 30

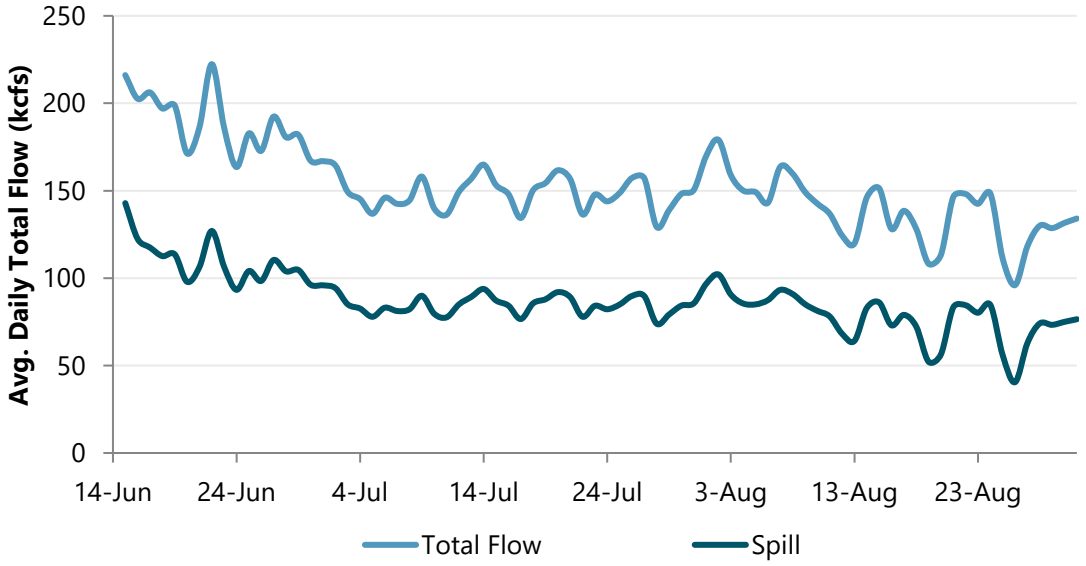
Figure 1
Average and Maximum Daily Air Temperatures and Average Wind Velocity from 0700 on June 14 to 0700 on August 31, 2019



3.2 River Flow and Spill

Total river flow during the monitoring period from June 15 to August 31 averaged 153.1 kilo cubic feet per second (kcfs). The peak average daily total river flow (222.4 kcfs) was recorded on June 22. The minimum average daily total river flow (96.0 kcfs) was recorded on August 26 (Figure 2). Monthly average total river flow over the monitoring period in June, July, and August was 189.2 kcfs, 149.0 kcfs, and 138.6 kcfs, respectively. Monthly average spill for the same period in June, July, and August was 109.9 kcfs, 84.9 kcfs, and 77.5 kcfs, respectively. Spill constituted 58.1%, 57.0%, and 55.9% of total flow for June, July, and August, respectively.

Figure 2
Total River Flow and Spill from 0700 on June 14 to 0700 on August 31, 2019



3.3 Powerhouse Forebay and Gatewell Temperatures

Daily water temperature patterns in the forebay and gatewells trended with air temperatures and wind velocity. Daily maximum average forebay water temperatures were recorded between 1430 and 1800 hours and most frequently recorded at 1730 hours. Daily minimum average forebay water temperatures were recorded between 0830 and 1100 hours and most frequently recorded at 0930 hours.

Average forebay water temperatures reached 68°F at 1930 hours on June 15 at Unit 12. The average water temperature across the forebay reached 68°F on June 15 for short periods of time (Figure 3). The forebay average was consistently above 68°F starting on June 29. McNary Dam began warm water turbine operations on July 14. The forebay reached seasonal maximum average water temperatures on July 7. The maximum water temperature recorded in the forebay was 79.5°F at 1700 hours on August 7 at Unit 10. The average forebay water temperature was 77.7°F at that time. The maximum average forebay water temperature of 77.7°F was recorded at 1700 hours on August 7 (Table 2).

The average water temperature gradient across the forebay was 2.1°F from June 15 to August 31 (Figure 4) and ranged from 0.1°F to 12.5°F. The largest gradients across the forebay formed between 1630 and 2030 hours daily. The largest water temperature gradient across the forebay was 12.5°F at 1700 hours on June 15.

Figure 3
Average Water Temperatures of 8 Forebay and 14 Gatewell Locations from 0700 on June 14 to 0700 on August 31, 2019

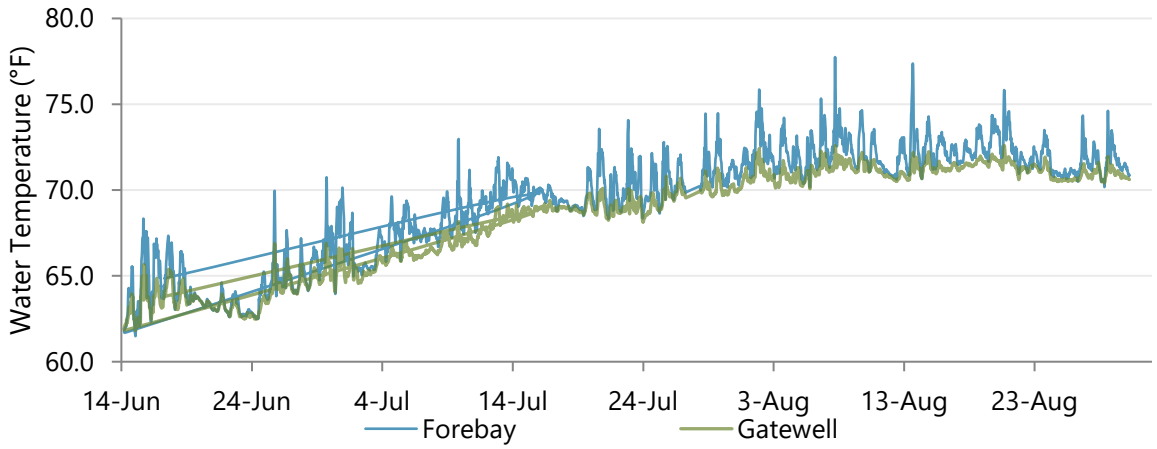
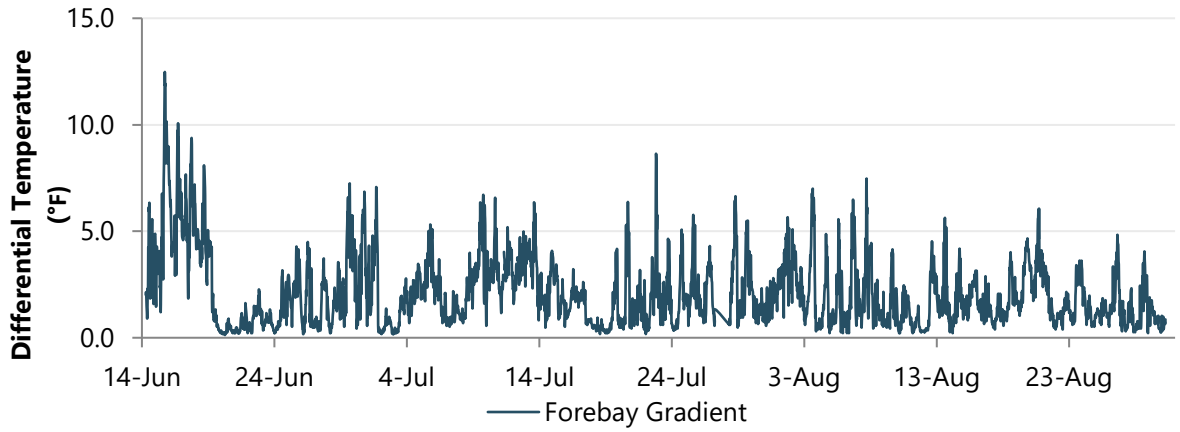


Table 2
Average Forebay and Gatewell Water Temperatures in June, July, and August 2019

Location	June*	July	August
Forebay	64.6	69.2	72.1
Gatewell	63.9	68.1	71.2

Note:
* June 15 to June 30

Figure 4
Temperature Gradient Between Minimum and Maximum Water Temperatures Recorded Across Eight Forebay Positions for Each 0.5-Hour Period from 0700 on June 14 to 0700 on August 31, 2019



Gatewell water temperatures trended with forebay water temperatures but did not reach the same extremes observed in the forebay. The average gatewell water temperatures reached 68°F on July 9 for short periods of time, and gatewell water temperatures were consistently above 68°F after July 12. The gatewell reached a seasonal maximum average water temperature of 72.6°F on August 7. The maximum water temperature recorded in the gatewells was 76.7°F at 1800 hours on August 7 at Unit 12. The forebay at Unit 12 was 78.2°F at that time. The average temperature gradient across the gatewells was 2.9°F from June 15 to August 31 (Figure 5) and ranged from 0.2°F to 9.5 F. The largest temperature gradient across the gatewell was 9.5°F at 1900 hours on June 15.

The water temperature between the forebay and gatewells differed 1.1°F on average (Figure 6). The forebay was warmer than the corresponding gatewell on average for each unit from June 15 to August 31. The largest water temperature differences between the forebay and gatewell were observed when units were in stand-by. The maximum water temperature differential was 8.6°F at 1700 hours on June 29 at Unit 5. The number of units in stand-by increased once warm water turbine operation began on July 14.

Figure 5
Temperature Gradient Between Minimum and Maximum Water Temperatures Recorded Across 14 Gatewell Positions for Each 0.5-Hour Period from 0700 on June 14 to 0700 on August 31, 2019

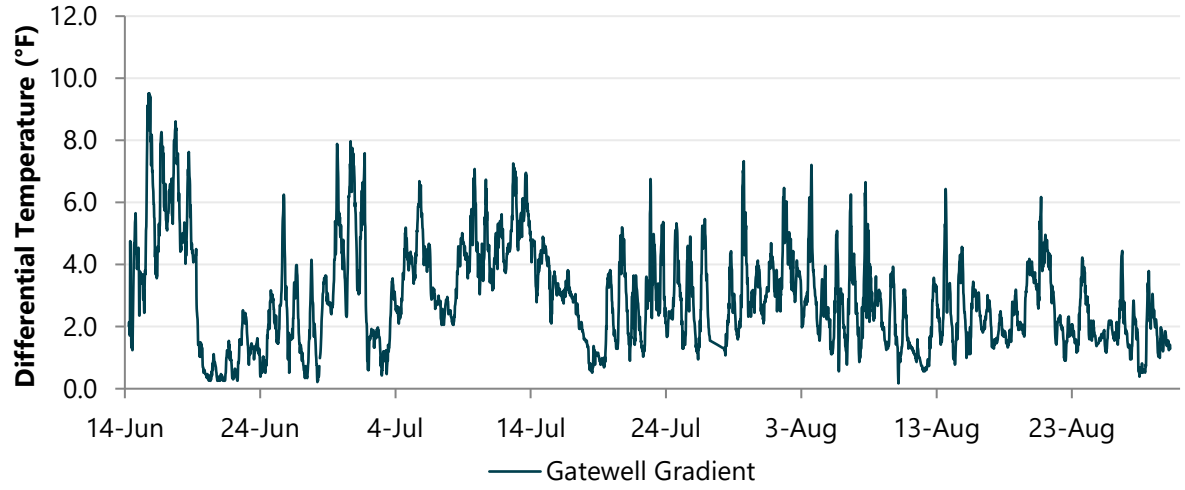
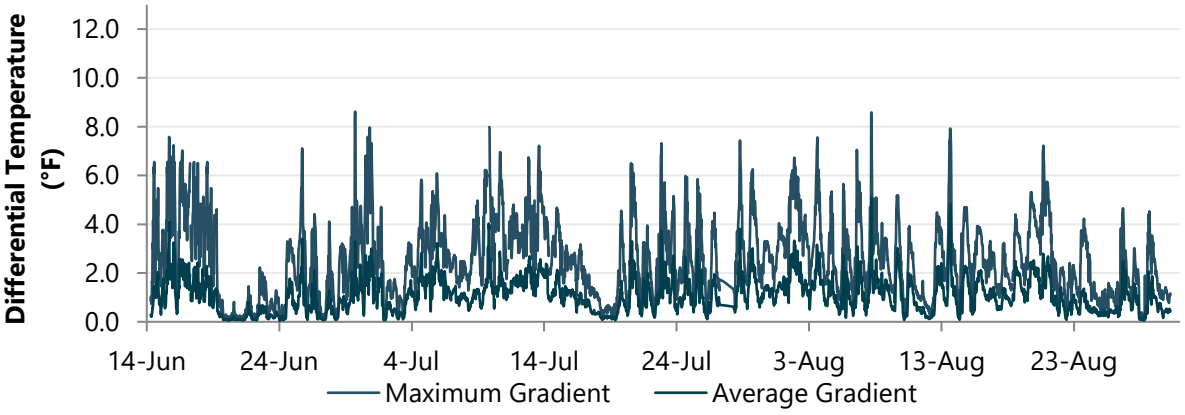


Figure 6
Maximum and Average Water Temperatures Gradient Recorded Between the Forebay and Gatewells for Each 0.5-Hour Period from 0700 on June 14 to 0700 on August 31, 2019



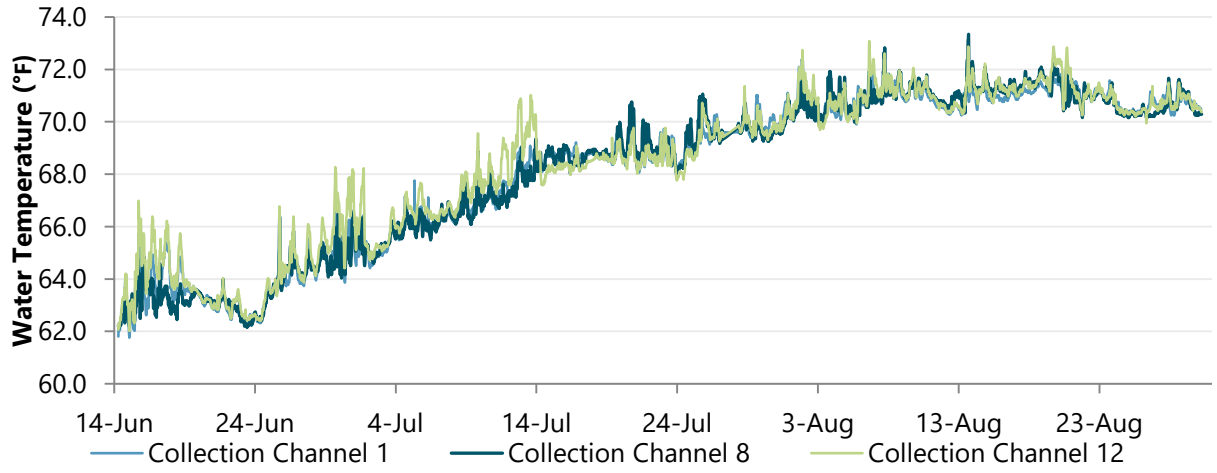
3.4 Collection Channel

Water temperatures in the collection channel were less variable than in the forebay and gatewells. Water temperatures across the collection channel averaged 68.2°F from June 15 to August 31 (Table 3). Collection channel water temperatures reached an average of 68°F on July 11 for short periods of time and were continuously exceeding 68°F after July 12 (Figure 7). The maximum water temperature of 73.3°F was measured at 1700 hours on August 13 at Unit 8.

Table 3
Water Temperatures in the Collection Channel from 0700 on June 14 to 0700 on August 31, 2019

Seasonal Average (°F)	Seasonal Maximum (°F)	Date of Maximum
68.2	73.3	August 13

Figure 7
Water Temperatures for Three Collection Channel Locations from 0700 on June 14 to 0700 on August 31, 2019



The average water temperature gradient between the gatewells and the collection channel was 1.0°F from June 15 to August 31 (Figure 8) and ranged from 0.04°F to 3.9°F. Typically, the gatewell was warmer than the collection channel at Unit 1, Unit 8, and Unit 12. The maximum water temperature differential was 6.2°F at 1630 hours on June 15 at Unit 1, with the collection channel being cooler than the gatewell. The average water temperature differential between the collection channel at Unit 12 and Unit 1 was 0.4°F from June 15 to August 31 (Figure 9). The maximum water temperature gradient between the collection channel at Unit 12 and Unit 1 was 2.0°F at 0000 hours on June 30, 1600 hours on July 1, 1900 and 2030 on July 12 and 1630 hours on July 13, with the water at Unit 12

being warmer than at Unit 1. On average, the collection channel was warmer at Unit 12 than at Unit 1. Differences between the water temperatures at the two locations reached but did not exceed 2.0°F on 4 days between June 15 and August 31 for short periods of time, typically between 1600 and 0000 hours.

Figure 8
Water Temperature Gradient Recorded Between Three Gatewells and Corresponding Collection Channel Locations (Gatewell Minus Collection Channel) for Each 0.5-Hour Period from 0700 on June 14 to 0700 on August 31, 2019

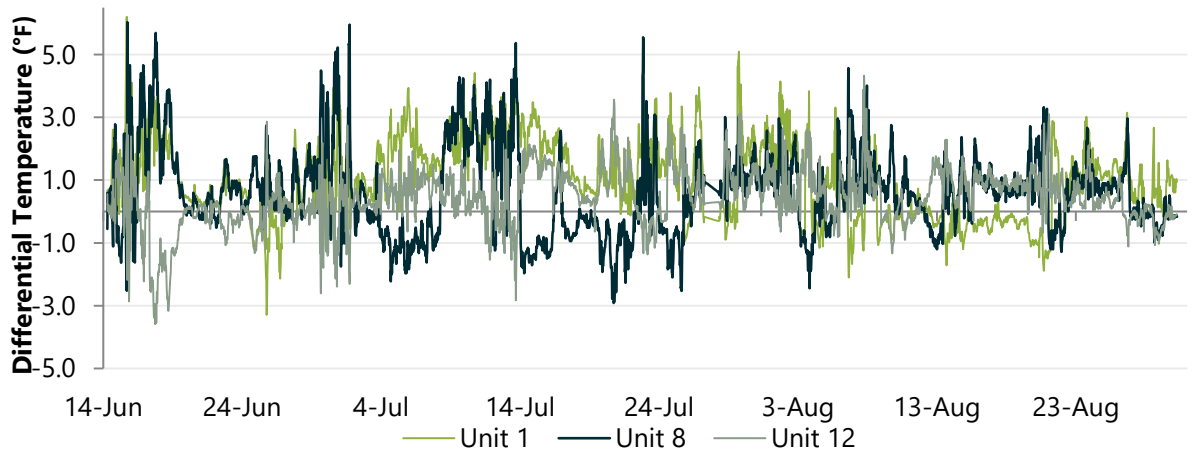
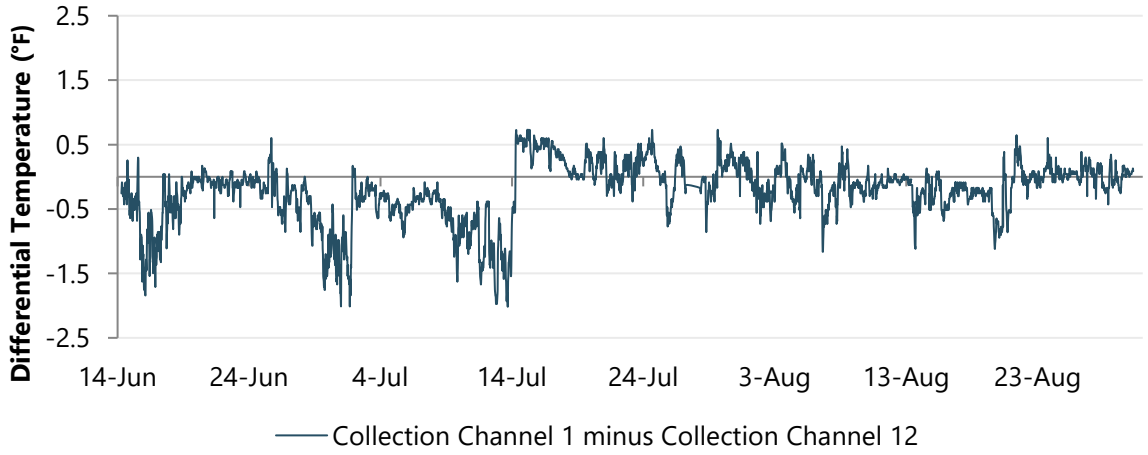


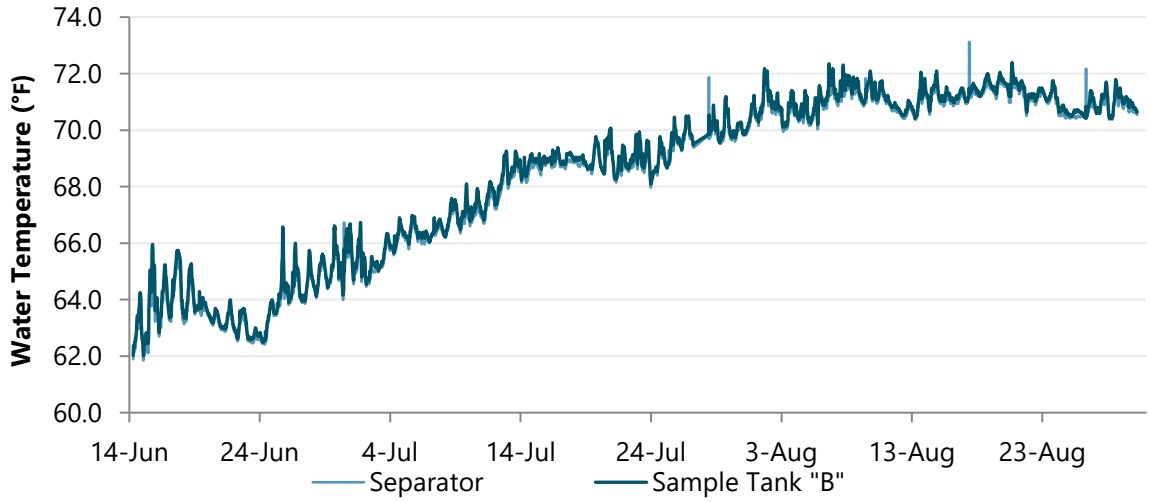
Figure 9
Gradient Recorded Between Water Temperatures at Collection Channel 1 and Collection Channel 12 from 0700 on June 14 to 0700 on August 31, 2019



3.5 Juvenile Fish Facility

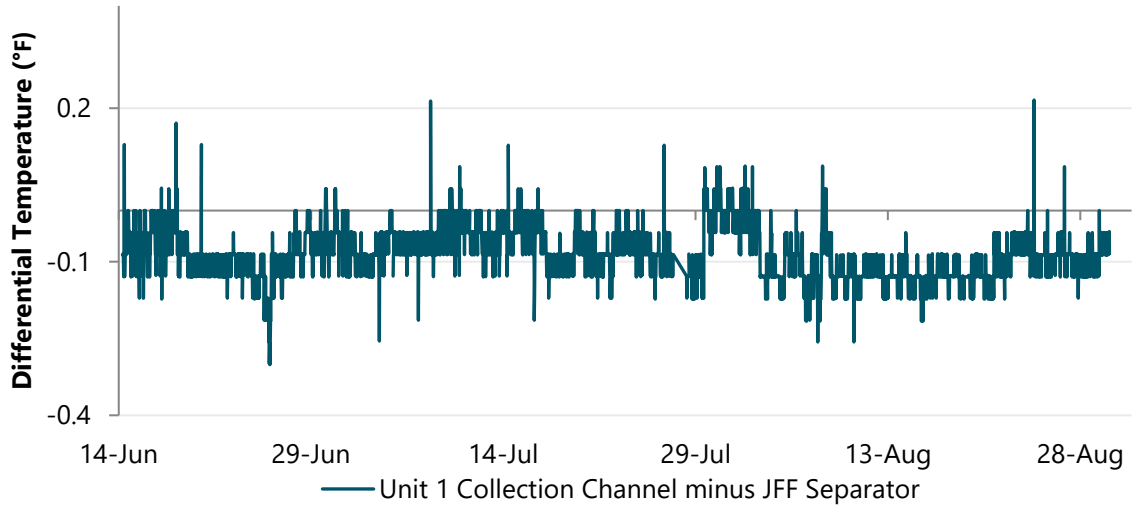
The average water temperature at the JFF from June 15 to August 31 was 68.3°F. Average water temperatures reached 68°F on July 9 (Figure 10) for short periods of time during the day. Water temperatures continuously exceeded 68°F after July 12. The maximum temperature of 72.4°F was measured at 1630 hours on August 20 at the sample tank "B."

Figure 10
Average Water Temperatures for Two Juvenile Fish Facility Locations from 0700 on June 14 to 0700 on August 31, 2019



The temperature gradient between the collection channel at Unit 1 and the separator at the JFF averaged 0.09°F and ranged from 0.2°F to 2.2°F (Figure 11). The separator was typically warmer than the collection channel. The temperature gradient across the separator and sample tank "B" averaged 0.15°F. The maximum difference between the two JFF locations 1.64°F at 0900 hours on August 17 when sample tank "B" was cooler than the separator.

Figure 11
Water Temperature Gradient Recorded Between the Collection Channel at Unit 1 and Juvenile Fish Facility Separator from 0700 on June 14 to 0700 on August 31, 2019



3.6 Outfall Pipe

The outfall pipe was inaccessible for the entire 2019 temperature monitoring season. The outfall pipe water temperature data would generally be displayed in Figures 12 (outfall water temperature over time), 13 (temperature gradient between water at the forebay and the outfall pipe), and 14 (temperature gradient between water at the separator and the outfall pipe). The last year data were collected was 2017.

3.7 Fish Passage and Mortality

A total of 162,401 juvenile salmonids passed McNary Dam during the monitoring period from June 15 to August 31. Subyearling Chinook salmon was 97% of the total during this period. The majority of these fish passed McNary Dam in June (Table 4). By July 17, 90% of fish migrating during the monitoring period had bypassed the dam. In previous years, high juvenile mortality at McNary Dam has been correlated with high (68°F) water temperatures and large (93.6°F), temperature gradients along juvenile bypass routes through the powerhouse and JFF. Mortality was low during this monitoring period. Total facility mortality for subyearling Chinook salmon alone and for all salmon species combined was 0.03% of bypassed fish over the monitoring period (subyearling Chinook salmon, 41 mortalities; all species combined, 43 mortalities).

The sample mortality rate may or may not be an indicator of the health status of the total population bypassing the facility since these fish are held for up to 24 hours and then go through the sampling process. Sample mortalities for subyearling Chinook salmon alone was 0.9% of sampled fish during the monitoring period (subyearling Chinook salmon, 29 sample mortalities; all species combined, 31 mortality).

Table 4
Collection, Mortality, and Passage for Juvenile Salmonids in 2018 and 2019

Year	System			Sample			Passage			
	Collection	Mortality	% Mortality	Sample	Sample Mortality	% Mortality	25%	50%	75%	90%
2019	162,401	43	0.03%	3,125	31	1.0%	21-Jun	25-Jun	29-Jun	17-Jul
	Sample Tank "B" Temperature (°F)*						63	63.4	64.5	68.7
2018**	665,460	64	0.01%	5,266	33	0.6%	25-Jun	3-Jul	11-Jul	19-Jul
	Sample Tank "B" Temperature (°F)*						64.4	64.4	67.2	69.8

Notes:
* Sample tank temperature was taken at 0700 daily.
** Values for 2018 include data recorded June 15 to August 31.

4 Recommendations

Continue to employ the warm water turbine operation strategy. Turbine operation continues to be an effective tool in mitigating high water temperatures and temperature gradients in fish passage routes through the powerhouse and the JFF. This operation plan is most effective in reducing high water temperatures from the forebay in the early season because deeper forebay water has not been warmed by prolonged high air temperatures.

Consider moving the port-a-potty from the Unit 10 "C" pier of the forebay (station F10) to another "C" pier, without a logger, such as F09 or F11. The port-a-potty makes it much more difficult to access the trolley pipe to deploy and collect data from the HOBO data logger.

Onset loggers' data loss in the last 2 years has been due to aging units and potentially rough handling of units. Suggest closely monitoring the expected lifespan of each unit, including anticipating the need to purchase additional units, and implement routine refreshers on proper handling techniques of the data loggers to help promote continuous data collection throughout the duration of the temperature monitoring season.

Appendix A
Temperature Logger Problems

Appendix A: Temperature Logger Problems

Anchor QEA obtained 34 HOBO U22-001 submersible temperature loggers in 2017. During the 2017 temperature monitoring season, two of the loggers purchased from Onset stopped functioning and were replaced under warranty in July 2017 (6.7% failure rate) and six other loggers purchased from Onset had errors while collecting data (e.g., failed to collect data after offloading). Of these loggers, 30 were purchased from Onset Computer Corporation (Onset) in April 2017 and four were previously used loggers obtained from the U.S. Army Corps of Engineers Walla Walla District office. During water temperature monitoring, 28 loggers continuously log temperature data throughout the McNary Dam Project (27 when the JFF outfall pipe is not accessible) leaving up to six spare temperature loggers as replacements.

During the 2018 temperature monitoring season, 10 of the remaining 30 loggers purchased from Onset in 2017 and one of the loggers obtained from the Walla Walla District office had battery failures in the field or did not function at the start of the season (a 32.4% failure rate in 2018). Nine of the failed loggers purchased in 2017 were replaced under one-year warranty by Onset and the tenth may be replaced after the loggers returned to Onset are assessed by their technical team (note: in 2019, after review of records, it is unclear whether this tenth logger was replaced). As a result of temperature logger malfunctions, 168.5 hours (0.3%) of water temperature data in 2018 were lost between June 15 and August 31. None of the lost data have been recovered by Onset as of September 18, 2018. Additionally, out of the remaining 18 loggers purchased from Onset, five had data collection errors. This may have been user error due to rough handling or inexperience with connecting the shuttle and initiating the probe. Two loggers recorded "bad headers" when offloaded, one had an optical misread that caused it to begin a different logging interval, and one had its battery reset. All five of these loggers began to work normally after they were re-launched.

At the end of the 2018 temperature-monitoring season, Anchor QEA had 30 functioning HOBO U22-001 temperature loggers.

During the 2019 temperature monitoring season, 2 of the remaining 20 loggers purchased from Onset in 2017 had battery failures in the field or did not function at the start of the season (a 10% failure rate in 2019; Table A–1). Two loggers purchased in 2018 also failed and were replaced under warranty by Onset. As a result of temperature logger malfunctions and errors, 330.5 hours of water temperature data in 2019 were lost between June 14 and August 31 (Table A–2).

At the end of the 2019 temperature-monitoring season, Anchor QEA has 28 functioning HOBO U22-001 temperature loggers (Table A–3). There is a possibility of obtaining additional extra loggers from the district office at the beginning of the 2020 season.

Table A–1
Water Temperature Loggers (HOBO U22-001) That Have Failed in the 2019 Season

Serial Number	Date Obtained	Date failed	Replaced?	Notes
20105955	04/01/2017	07/29/2019	No	Recorded incorrect dates/times. Could not be reset. Outside of warranty.
20434501	08/16/2018	07/08/2019	Yes	Failed to connect to Shuttle. Sent to Onset for warranty replacement.
20444522	08/30/2018	07/10/2019	Yes	Failed to connect to Shuttle. Sent to Onset for warranty replacement.
10420513	Obtained from district office 2017	08/22/2019	No	Failed to record data. Outside of warranty.

Note:
Two loggers have been replaced by Onset Computer Corporation under warranty.

Table A–2
Data Loss in Hours by HOBO Logger in 2019

Date	Time	G1 20105948	G2 20105950	G2 20444520	G6 20105955	G11 20105960	F3 10420513	F8 10420515	F12 20434501	F12 20444522	F12 20434504
6/17	0700–0800					1					
6/22–6/24	1300–1200					21					
6/24–6/25	0930–0930		24								
6/26	0700–1230			5							
7/6–7/9	0830–1000								22.5		
7/9–7/10	0800–1130				27.5					56	
7/10	0700–0800, 0930–1130										3
7/11	0700–0800										1
7/12	0700–0800										1
7/13	0700–0800										1
7/15	0930–1000	0.50									
8/20–8/22	0800–0900						51				
8/23–8/24	1000–0930							23.5			

Date	Time	G1 20105948	G2 20105950	G2 20444520	G6 20105955	G11 20105960	F3 10420513	F8 10420515	F12 20434501	F12 20444522	F12 20434504
8/27–8/31	1000–0700							92.5			
Total time loss		0.50	24.00	2.50	27.50	22.00	51.00	116.00	22.50	56.00	6.00
Overall time loss		330.50									

Table A–3
HOBO Probe Record

Purchased	Serial Number	In Storage Drawer as of 9/16/2019	Location During 2019 Season	Deployment Date	Retrieval Date	Notes	Contacted Onset?
4/1/2017	20105054	lost?	N/A	Do not have a box or probe	Do not have a box or probe	Notes from 2018 indicate that this logger exists; not found in 2019	Not reported
4/1/2017	20105957	N/A – returned 2017	N/A – returned 2017	N/A – returned 2017	N/A – returned 2017	None	Not reported
4/1/2017	20105976	N/A – returned 2017	N/A – returned 2017	N/A – returned 2017	N/A – returned 2017	None	Not reported
4/1/2017	20105949	N/A – returned 2018	N/A – returned 2018	6/9/2018	8/20/2018	None	8/20/2018 (Case Number 00061056)
4/1/2017	20105951	N/A – returned 2018	N/A – returned 2018	6/9/2018	8/28/2018	None	8/28/2018

Purchased	Serial Number	In Storage Drawer as of 9/16/2019	Location During 2019 Season	Deployment Date	Retrieval Date	Notes	Contacted Onset?
4/1/2017	20105953	N/A – returned 2018	N/A – returned 2018	6/9/2018	8/25/2018	None	8/27/2018
4/1/2017	20105964	N/A – returned 2018	N/A – returned 2018	Not deployed 2018	Not deployed 2018	None	7/8/2018 (Case Number 00059029)
4/1/2017	20105965	N/A – returned 2018	N/A – returned 2018	6/9/2018	6/24/2018	None	7/8/2018 (Case Number 00059029)
4/1/2017	20105968	N/A – returned 2018	N/A – returned 2018	Not deployed 2018	Not deployed 2018	None	7/8/2018 (Case Number 00059029)
4/1/2017	20105969	N/A – returned 2018	N/A – returned 2018	6/9/2018	6/24/2018	None	7/8/2018 (Case Number 00059029)
4/1/2017	20105970	N/A – returned 2018	N/A – returned 2018	6/9/2018	7/21/2018	None	8/20/2018 (Case Number 00061081)
4/1/2017	20105977	N/A – returned 2018	N/A – returned 2018	6/9/2018	8/4/2018	Likely a dead battery (David MacDonald, Onset Technical Support, 8/14/2018)	8/9/2018 (Case Number 00060585)
8/16/2018	20434501	N/A returned 2019	Formerly F12	6/9/2019	7/8/2019	Working inconsistently	Yes. Returned to Onset 8/13/2019. Case Number 00075709
8/30/2018	20444522	N/A returned 2019	Formerly F12	7/8/2019	7/10/2019	NOT WORKING	Yes. Returned to onset 8/13/2019. Case Number 00075709
4/1/2017	20105948	Yes, in box	G01	6/9/2019	9/1/2019	None	Not reported

Purchased	Serial Number	In Storage Drawer as of 9/16/2019	Location During 2019 Season	Deployment Date	Retrieval Date	Notes	Contacted Onset?
4/1/2017	20105952	Yes, in box	G04	6/9/2019	9/1/2019	None	Not reported
4/1/2017	20105955	Yes, in box	Formerly G06	6/9/2019	7/29/2019	Recorded incorrect dates/times on 7/9, 7/10, and 7/29. Malfunction lasted 24 hours, then resumed working.	Not under warranty
4/1/2017	20105956	Yes, in box	G07	6/9/2019	9/1/2019	None	9/3/2018
4/1/2017	20105958	Yes, in box	G09	6/9/2019	9/1/2019	None	8/15/2018
4/1/2017	20105960	Yes, in box	Formerly G11	6/9/2019	6/23/2019	Failed on 06/23 after being deployed at G11. Out of warranty	No, out of warranty
4/1/2017	20105961	Yes, in box	G12	6/9/2019	9/1/2019	None	Not reported
4/1/2017	20105962	Yes, in box	G13	6/9/2019	9/1/2019	None	Not reported
4/1/2017	20105963	Yes, in box	G14	6/9/2019	9/1/2019	None	Not reported
4/1/2017	20105966	Yes, in box	G08	6/9/2019	9/1/2019	None	7/8/2018 (Case Number 00059029)
4/1/2017	20105971	Yes, in box	F14	6/9/2019	9/1/2019	None	Not reported
4/1/2017	20105972	Yes, in box	C01	6/9/2019	9/1/2019	None	Not reported
4/1/2017	20105973	Yes, in box	C08	6/9/2019	9/1/2019	None	Not reported
4/1/2017	20105974	Yes, in box	C12	6/9/2019	9/1/2019	None	Not reported
4/1/2017	20105975	Yes, in box	SEP	6/9/2019	9/1/2019	None	Not reported
No record from 2017, but likely recorded as S/N 20105054 in 2017	20105954	Yes, in box	SMP	6/9/2019	9/1/2019	None	Not reported

Purchased	Serial Number	In Storage Drawer as of 9/16/2019	Location During 2019 Season	Deployment Date	Retrieval Date	Notes	Contacted Onset?
Obtained from district office 2017	10873510	Yes, in box	Not deployed	N/A	N/A	Not working	No
Warranty replacement received July 2017	20171665	Yes, in box	F05	6/9/2019	Not reported	Likely an optic misread (David MacDonald, Onset Technical Support, 8/14/2018)	8/9/2018 (Case Number 00060585)
Warranty replacement received July 2017	20171666	Yes, in box	F10	6/9/2019	9/1/2019	None	Not reported
Warranty replacement received July 2019	20659675	Yes, in box	Not deployed	N/A	N/A	None	Warranty replacement received July 2019
Warranty replacement received July 2019	20659676	Yes, in box	Not deployed	N/A	N/A	None	Warranty replacement received July 2019
4/1/2017	20105959	Yes, in box	G10	6/9/2019	9/1/2019	None	Not reported
4/1/2017	20105950	Yes, in box	Formerly G02	6/9/2019	6/25/2019	Failed on 6/25 after being deployed at G02/ out of warranty	No, out of warranty
4/1/2017	20105967	Yes, in box	F07	Not reported	Not reported	Won't offload/collect new data	9/3/2018
8/16/2018	20434502	Yes, in box	G05	6/9/2019	9/1/2109	None	Not reported
8/16/2018	20434503	Yes, in box	G03	6/9/2019	9/1/2109	None	Not reported

Purchased	Serial Number	In Storage Drawer as of 9/16/2019	Location During 2019 Season	Deployment Date	Retrieval Date	Notes	Contacted Onset?
8/16/2018	20434504	Yes, in box	F12	7/10/2016	9/1/2019	Did not collect data for a few hours on 7/10, 7/11, 7/12, and 7/13. Otherwise functional from 7/13 to 9/01	No
8/28/2018	20444464	Yes, in box	G11	6/23/2019	9/1/2019	Reset twice; recording data inconsistently. Otherwise functional.	No
8/30/2018	20444520	Yes, in box	G02	6/25/2019	9/1/2019	5 hours of data not collected on 6/26/2019; however, data collection was continuous during the remainder of the season	No
8/30/2018	20444521	Yes, in box	F07	6/6/2019	9/1/2019	None	No
8/30/2018	20444523	Yes, in box	F01	6/13/2019	9/1/2019	None	No
No record from 2017	10420520	Yes, in box	Not deployed	N/A	N/A	None	No
Obtained from district office 2019	10629235	Yes, in box	G06	7/29/2019	9/1/2019	None	No
Obtained from district office 2017	10420513	Yes, in box	F03	6/9/2019	8/22/2019	Failed to record data. Out of warranty	No

Purchased	Serial Number	In Storage Drawer as of 9/16/2019	Location During 2019 Season	Deployment Date	Retrieval Date	Notes	Contacted Onset?
Obtained from district office 2017	10420515	Yes, in box	F08	6/9/2019	9/1/2019	Failed for 2 days then worked again. Completely failed on 8/28. Maybe dead battery?	No, out of warranty.
Obtained from district office 2017	10420516	Yes, in box	Not deployed	N/A	N/A	None	No