Final

McNary Dam Annual Temperature Report, 2025

Prepared for

US Army Corps of Engineers

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Acronyms and Abbreviations

°F	degrees Fahrenheit
EAS	Environmental Assessment Services, LLC
JFF	Juvenile Fish Facility
kcfs	kilo cubic feet per second
MCN	McNary Dam
mph	miles per hour

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Introduction

McNary Dam (MCN), located at river mile 292 (470 kilometers), is the first dam encountered by downstream-migrating juvenile Columbia River fall Chinook (*Oncorhynchus tshawytscha*) originating from the Hanford Reach and Priest Rapids Hatchery. These fish represent the majority of subyearling fall Chinook salmon passing MCN, although smaller numbers of Endangered Species Act-listed Snake River fall Chinook salmon also pass the dam.

Juvenile fall Chinook migration generally peaks from June through July, when water temperatures are increasing. Elevated water temperatures have been associated with reduced salmonid survival, and high juvenile mortality has previously been observed at MCN during periods of elevated temperature.

Forebay surface temperatures are influenced by solar radiation and air temperature, while deeper forebay waters typically remain cooler. Moderate wind speeds (>13 miles per hour [mph]) promote vertical mixing and can reduce surface water temperatures. In contrast, calm conditions during July and August allow surface water to warm without interruption.

At MCN, a proportion of juvenile salmonids (0.5%–25%) is sampled to determine species composition and condition before release to the tailrace. Fish entering the bypass system are diverted from turbine intakes by extended-length submersible bar screens located in the turbine gatewells (three gatewells per turbine, 14 turbines total). Twelve-inch orifices in the gatewells lead to the collection channel and full-flow bypass system, which direct fish to the Juvenile Fish Facility (JFF) under secondary bypass operations. At the JFF wet separator, smolts and smaller fish are separated from larger individuals. During secondary bypass, most fish are routed through the JFF system and returned to the river via the JFF outfall pipe.

Bypass water temperatures can be reduced through powerhouse operational strategies. Operating turbines entrain warmer surface water, while standby turbines allow cooler, deeper water to enter the gatewells. Balancing operating and standby turbines across the powerhouse can lower bypass temperatures.

The objective of the 2025 Temperature Monitoring Program at MCN was to characterize temperature conditions during the juvenile salmonid passage season. Monitoring occurred at the powerhouse, gatewells, collection channel, and the JFF. Temperatures were recorded at 30-minute intervals to identify patterns that could contribute to increased mortality of fish passing through the bypass system.

Acknowledgments

Environmental Assessment Services, LLC (EAS) thanks the MCN JFF staff for their assistance. Bobby Johnson, Paul Bertschinger, and the United States Army Corps of Engineers staff at the JFF provided critical support during all phases of this work. Contributions from Thomas VanNice, Wes Stonecypher, Izzy Levy, and Brett Troutman of the Pacific States Marine Fisheries Commission are also gratefully acknowledged.

Methods

Water temperatures were recorded at 30-minute intervals (0000 and 0030) from 0700 hours on June 14 through 0700 hours on August 31, 2025. Measurements were collected using Onset Computer Corporation HOBO U22-001 data loggers with a stated accuracy of ±0.38 degrees Fahrenheit (°F) and a precision of 0.04°F. At each monitoring location, data loggers were suspended from the handrail using paracord.

A total of 203.5 hours (0.43%) of temperature data were lost during the 2025 monitoring season. Most of these losses occurred when the collection channel and JFF were drained and flow was diverted from the primary bypass due to water level fluctuations. Additional data loss occurred when four loggers produced corrupted data files. Half an hour of data loss was occasionally caused by downloading right at the hour or the half hour interval.

Upon discovery of a failed data logger, the unit was removed and replaced with a logger that was cleared and set for relaunch. Data loss times and durations are provided in Appendix A.

The loggers were deployed at 25 locations throughout MCN—8 in the forebay, 12 in the gatewells, three in the collection channel, and two in the JFF, detailed as follows:

- The powerhouse forebay (hereafter referred to as "forebay") was at an elevation of approximately 335 feet. Trolley pipes were used to house each data logger for the season. A total of eight data loggers were installed at the pier noses of Units 1, 3, 5, 7, 8, 10, 12, and 14, each submerged to a depth of approximately 10 feet below the forebay water surface.
- Gatewells at Units 1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 14 (12 total) had data loggers installed for the monitoring period. Each logger was placed in the “B” slot of the respective gatewell and submerged to a depth of approximately 3 feet below the gatewell water surface. No temperature loggers were deployed at Units 3 and 4 due to ongoing work in the area and the gatewell plates being covered for the season.
- The collection channel, downstream of gatewell orifices 12B and 8B, and upstream of the incline dewatering screen south of Unit 1 (3 total). Each logger was submerged approximately 2 feet below the water surface.
- The JFF in the fish separator underneath the bars in the “B” section, submerged to a depth of approximately 1 foot, and in the “B” sample tank, submerged to a depth of 2 feet below the water surface (2 total).

Prior to 2017, water temperature loggers were deployed along the spillway, in the tailrace at Units 1 and 14, on the transportation barge dock, and on the tailrace navigation lock wing wall; however, monitoring at the spillway and outfall pipe ceased in 2017.

Smolt Monitoring Program personnel also recorded daily water temperatures 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. These temperatures were recorded once daily and reported to the MCN biologists.

Ambient air temperature, along with wind speed and direction, was monitored during the temperature monitoring season using a Davis Vantage Pro2 Precision Weather Station located on the east side of the JFF. In previous years, weather data was obtained from the Hermiston Airport, National Oceanic and Atmospheric Administration weather station, and from a HOBO temperature monitoring device located outside and under the entrance of the McNary JFF separator booth.

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 timeframe coincided with sampling activities at the JFF.

Results

Weather Conditions

Maximum air temperatures were typically recorded between 1330 and 1830 hours. Minimum temperatures occurred between 0230 and 2330 hours, most frequently between 0300 and 1000 hours (Table 1). The highest air temperature recorded during the monitoring season was 103.4°F, measured at 1700 hours on July 13. The lowest temperature (53.5°F) was recorded at 0430 hours on June 21 (Figure 1).

Wind velocity was highly variable throughout the day. The highest daily average wind velocity was in July and the lowest was in August. The highest singular wind velocity measurement was 13 mph on July 15 at 0300 hours.

Table 1. Air Temperatures and Wind Velocity at McNary Dam from 0700 Hours on June 15 to 0700 Hours on August 31, 2025

Month	Daily Avg. (°F)	Daily Max. Avg. (°F)	Daily Min. Avg. (°F)	Max. Range (°F)	Min. Range (°F)	Days >90°F[a]	Daily Wind Avg. (mph)	Days >3 mph[b]
June[c]	70.91	82.51	59.04	67.6 – 90.7	53.5 – 67.6	2	1.85	1
July	78.50	91.54	66.50	73.1 – 103.4	61.8 – 73.5	21	1.86	2
August	76.93	89.49	66.20	79.7 – 98.7	57.7 – 73.3	13	1.57	0

Notes:
a Count of days with highs exceeding 90°F
b Days with a daily average wind velocity exceeding 3 mph
c Monitoring occurred June 15 to June 30
°F = degrees Fahrenheit; mph = miles per hour

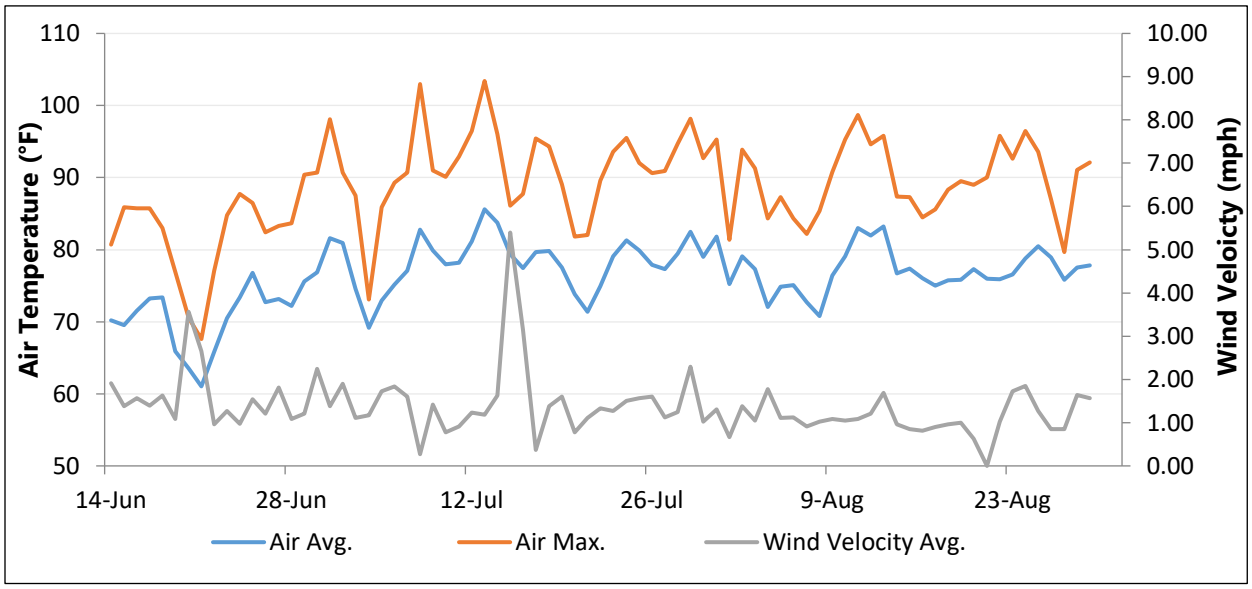

Figure 1. Average and Maximum Daily Air Temperatures and Average Wind Velocity from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

River Flow and Spill

Total river flow from June 14 to August 31 averaged 125.1 kilo cubic feet per second (kcfs). The peak average daily total river flow (172.3 kcfs) was recorded on June 15. The minimum average daily total river flow (92.4 kcfs) was recorded on August 5 (Figure 2). The monthly average total river flow over the monitoring period in June, July, and August was 148.9, 121.7, and 115.4 kcfs, respectively. Monthly average spill for June, July, and August was 87.1, 63.2, and 19.9 kcfs, respectively, with spill constituting 58.4%, 51.6%, and 17.3% of the total flow for June, July, and August.

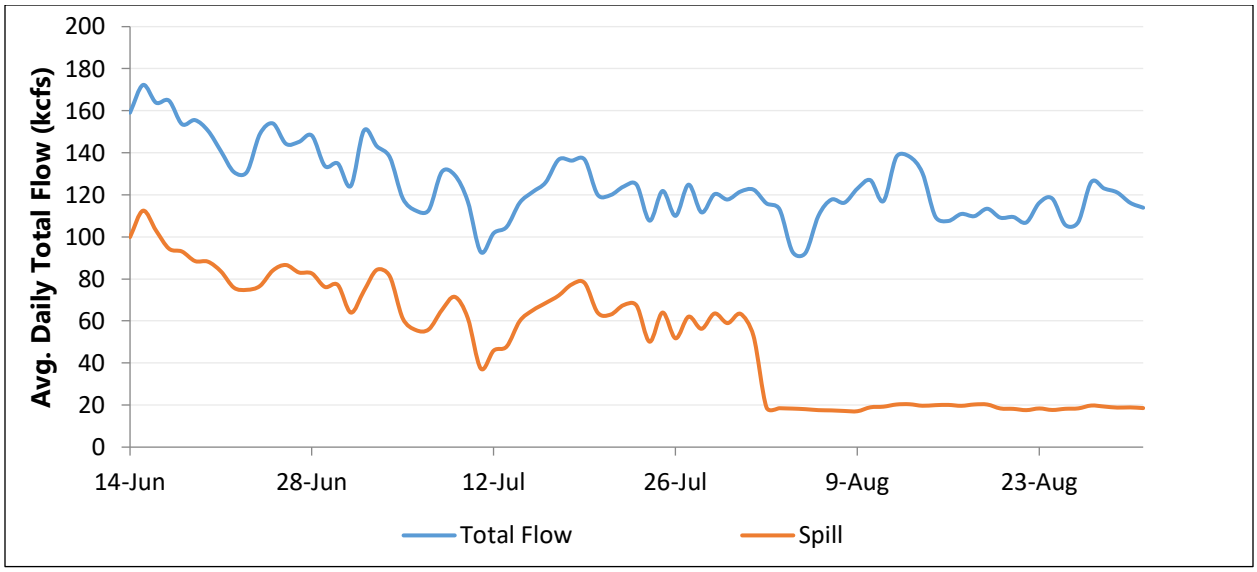

Figure 2. Daily Average Total River Flow and Spill from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

Powerhouse Forebay and Gatewell Temperatures

Forebay and gatewell water temperatures corresponded closely with air temperature and wind velocity. Daily maximum forebay temperatures were generally recorded between 1145 and 2330 hours, most frequently at 1630 hours. Minimum daily temperatures occurred primarily between 0000 and 1145 hours, with the most frequent minimum recorded at 1020 hours.

Average forebay temperatures first exceeded 68°F on June 15 and remained consistently above this threshold from July 7 through the end of the season.

Warm water turbine operations began on July 3 at 0600 hours, with units operating in a sawtooth pattern. This operating strategy remained in effect through the end of the season.

The seasonal maximum average forebay temperature across all units was 77.9°F, observed at 1600 hours on August 11. The highest recorded forebay temperature was 81.7°F at Unit 1 at 1530 hours on August 11, when the average across all probes was 77.4°F. Average monthly forebay and gatewell temperatures are presented in Table 2.

From June 14 to August 31, the mean temperature gradient across the forebay was 2.0°F, ranging from 0.1°F to 10.4°F. The largest gradients occurred between 1520 and 2300 hours, with the maximum gradient of 10.4°F recorded on June 15 (Figure 3). Daily average forebay and gatewell temperatures are shown in Figure 4.

Table 2. Daily Average Forebay and Gatewell Water Temperatures Across all Probes in June, July, and August 2025

Location	June[a]	July	August
Forebay	65.7	71.5	72.8
Gatewell	64.9	70.2	72.4

Note:
[a] June 14 to June 30

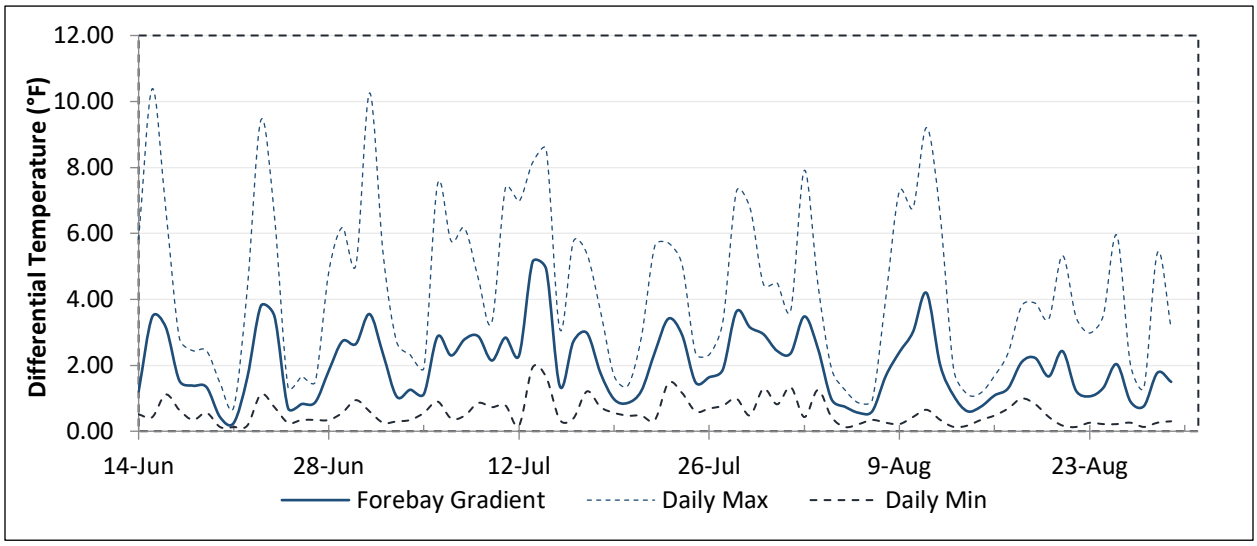

Figure 3. Temperature Gradient between Daily Minimum and Maximum Water Temperatures Recorded Across 8 Forebay Positions from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

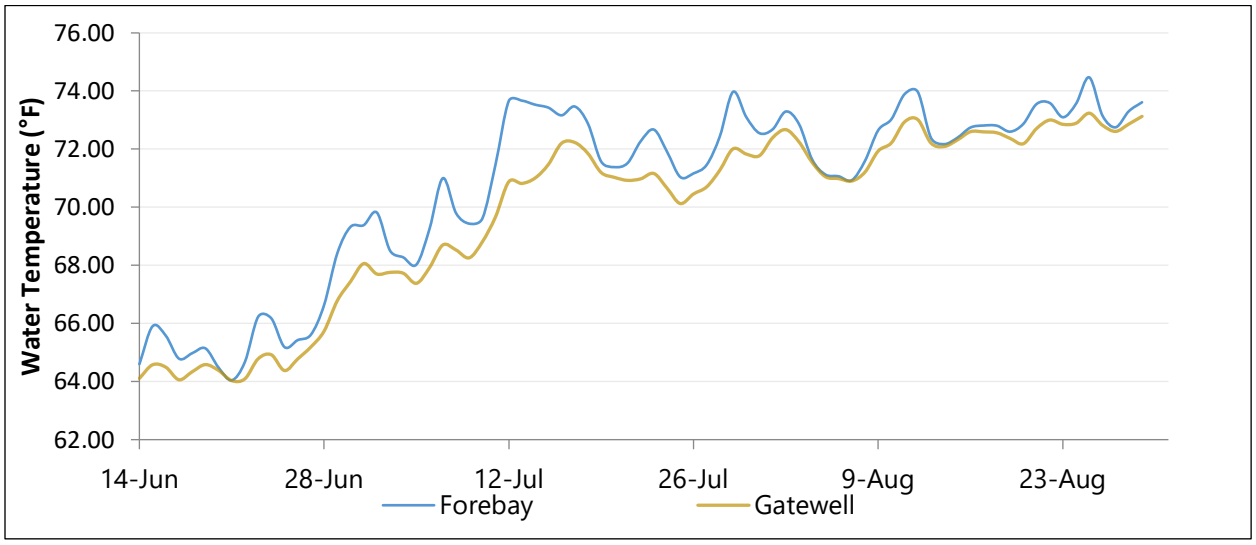

Figure 4. Daily Average Water Temperatures of Eight Forebay and 12 Gatewell Locations from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

Gatewell water temperatures were positively correlated with forebay temperatures but did not reach the same extremes (Figure 4). Average gatewell temperatures reached 68°F on June 29 and remained consistently above 68°F after July 10. The maximum recorded temperature in the gatewells was 77.5°F at Unit 11 at 1730 hours on August 11. From June 14 to August 31, the average temperature gradient across the gatewells was 2.8°F, with the largest gradient of 8.0°F observed on June 29 (Figure 5).

The average temperature gradient between forebay and gatewell water temperatures was 1.0°F from June 14 to August 31, with the forebay consistently warmer than the corresponding gatewell at each unit (Figure 6). The maximum observed gradient at a single unit was 10.7°F at Unit 12 at 1700 hours on June 15. On July 8, the sawtooth operating strategy was implemented, increasing the number of units placed on standby.

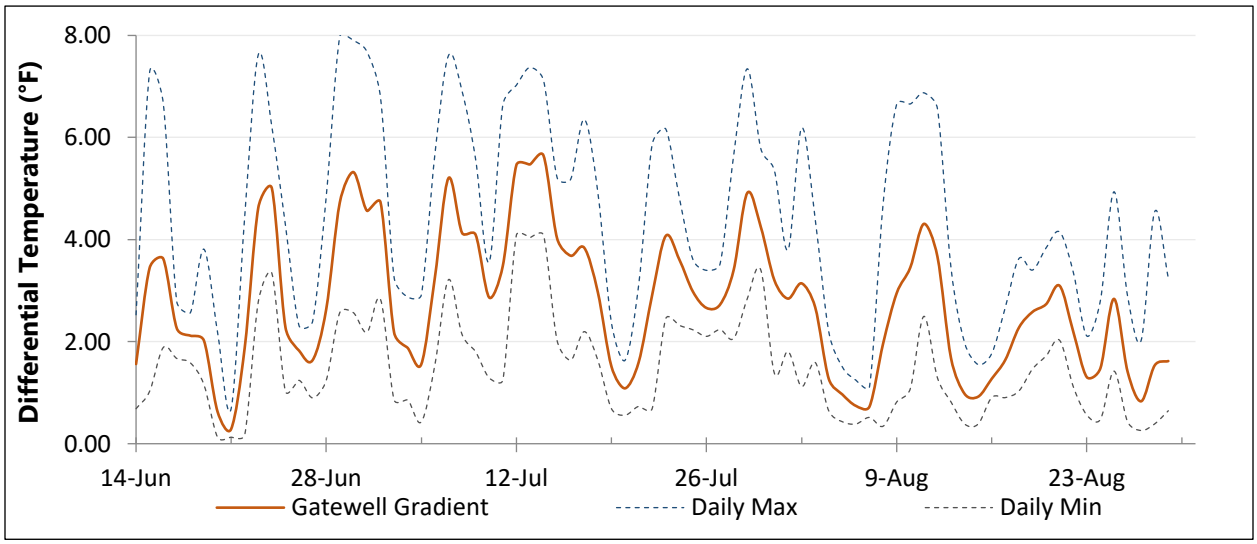

Figure 5. Temperature Gradient between Daily Average Minimum and Maximum Water Temperatures Recorded Across 12 Gatewell Positions from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

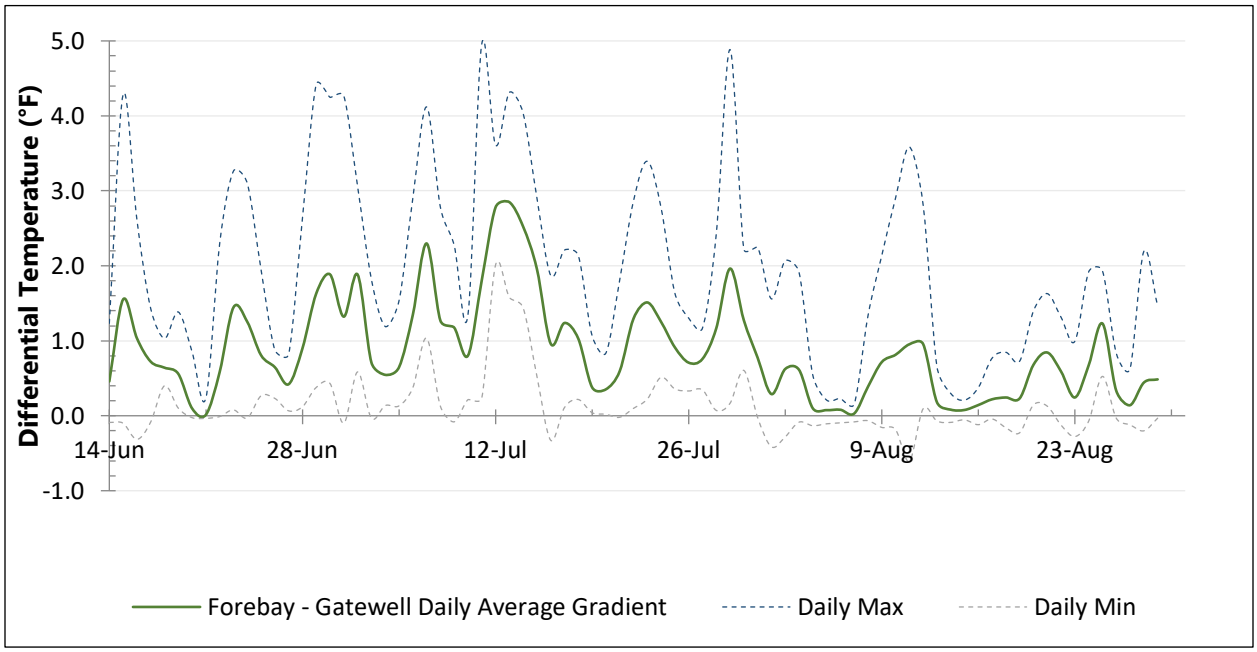

Figure 6. Daily Average and Maximum Water Temperature Gradient Recorded between the Forebay and Gatewells for each 24-Hour Period from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

Collection Channel

Water temperatures in the collection channel exhibited less variability compared to the forebay and gatewells. From June 14 to August 31, the average collection channel temperature was 69.9°F (Table 3). Temperatures reached an average of 68°F on June 29 and remained consistently above 68°F after July 10 (Figure 7). The highest recorded temperature (75.9°F) occurred at Unit 12 at 1800 hours on August 2.

Table 3. Water Temperatures in the Collection Channel from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

Seasonal Average (°F)	Seasonal Maximum (°F)	Date of Maximum
69.9	75.9	2 Aug

°F = degrees Fahrenheit

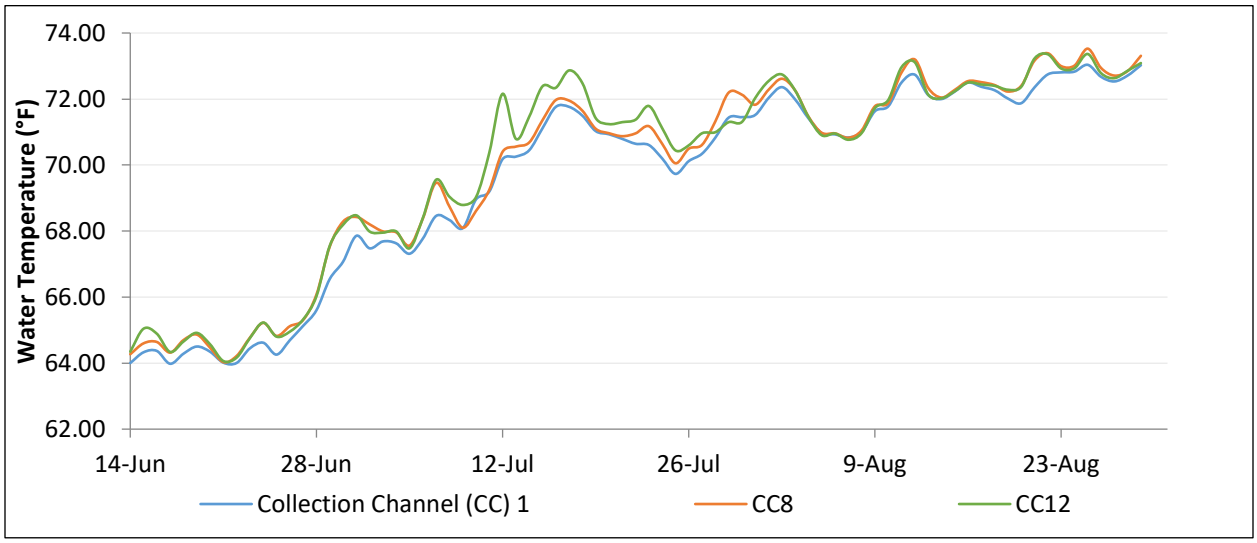

Figure 7. Daily Average Water Temperatures for Three Collection Channel Locations from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

From June 14 to August 31, the average water temperature gradient between the gatewells and the collection channel was -0.15°F (Figure 8), with values ranging from -1.4°F to 1.98°F. On average, the collection channel was warmer than the gatewells at Units 8 and 12, while the gatewell at Unit 1 was slightly warmer than the collection channel. The largest recorded temperature gradient (5.2°F) occurred at 1900 hours on July 13 at Unit 1, where the gatewell temperature exceeded that of the collection channel.

During the same period, the average temperature gradient between collection channel locations was 0.58°F (Figure 9). The maximum recorded gradient between collection channel sites was 3.3°F, observed at 0830 hours on June 27, with Unit 12 being warmer than Unit 1. Overall, collection channel temperatures were generally higher at Unit 1 and lower at Units 8 and 12.

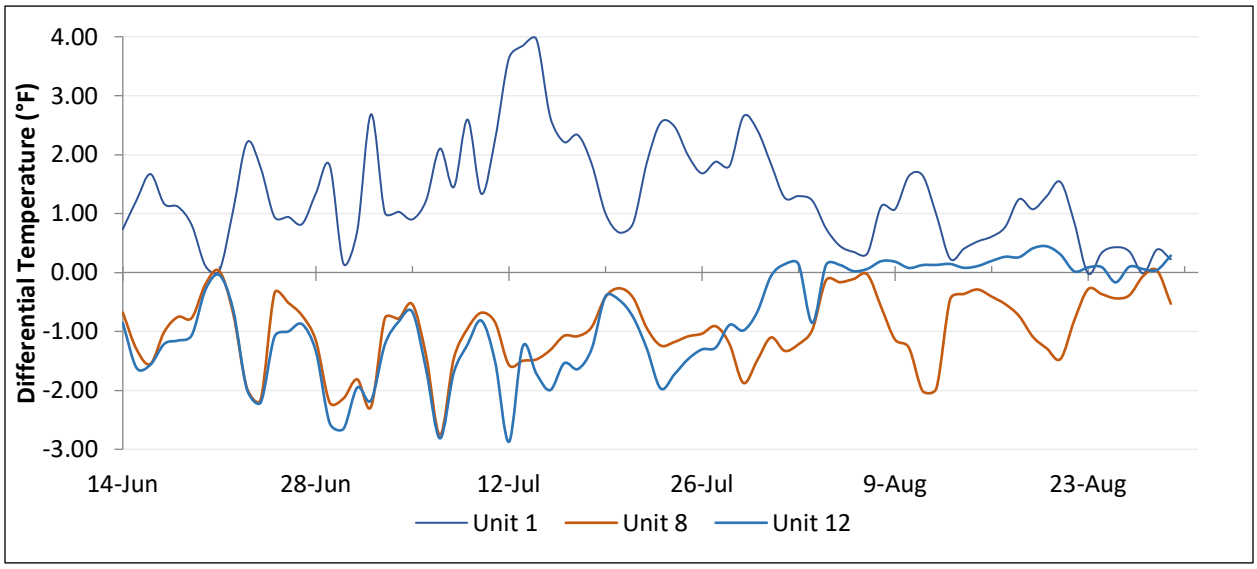

Figure 8. Daily Average Water Temperature Gradient Recorded between three Gatewells and Corresponding Collection Channel Locations (Gatewell Minus Collection Channel) from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

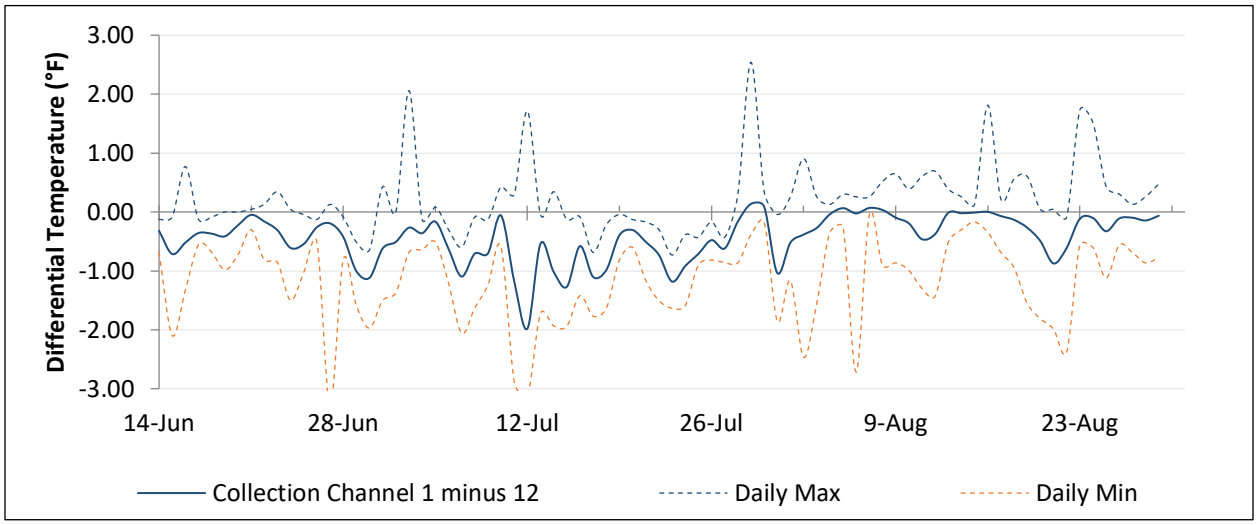

Figure 9. Daily Average Gradient Recorded between Water Temperatures at Collection Channel 1 and Collection Channel 12 from 0700 on June 14 to 0700 on August 31, 2025

Juvenile Fish Facility

The daily average water temperature at the JFF from June 14 to August 31 was 69.7°F. The average water temperature reached 68°F for the first time at 2030 hours on June 28, and water temperatures continuously exceeded 68°F after August 10 (Figure 10). The maximum singular temperature reading (74.3°F) was measured at 0930 hours on August 11 at sample tank "B."

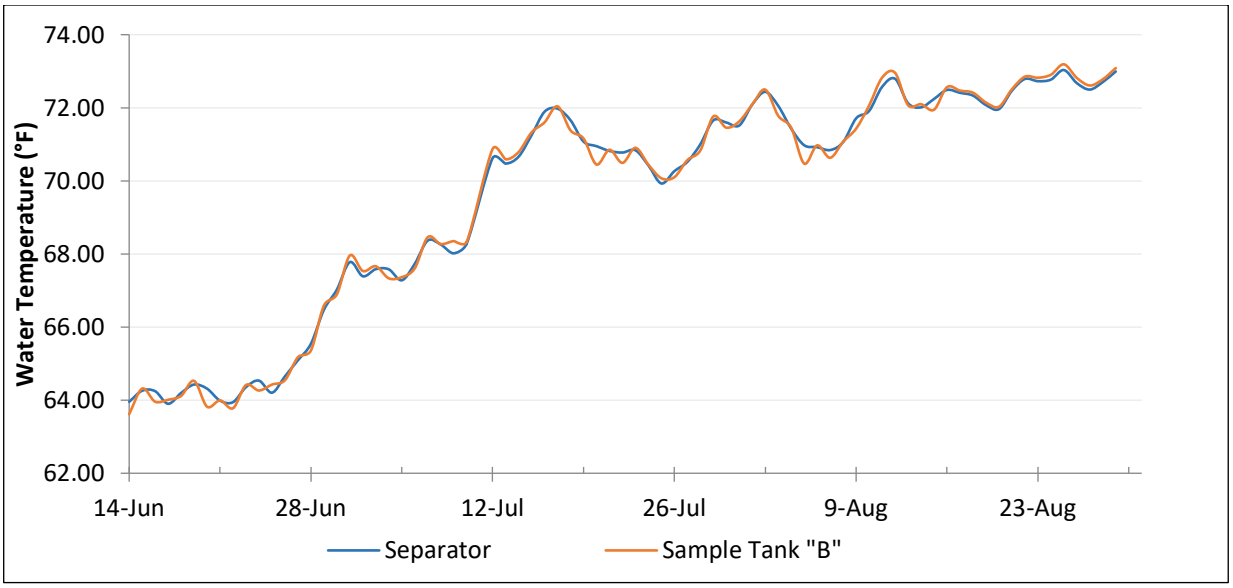

Figure 10. Daily Average Water Temperatures for the Two Juvenile Fish Facility Locations from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

The temperature gradient average between the collection channel at Unit 1 and the separator at the JFF was 0.22°F, and the daily averages ranged between 0.0°F and 0.12°F; the singular temperature range was broader, between -0.6 and 2.5 (Figure 11). The daily average temperature gradient across the separator and sample tank "B" was 0.0°F (Figure 10). The singular maximum difference recorded between the two JFF locations (8.0°F) occurred at 0700 hours on August 5. The sample tank was cooler.

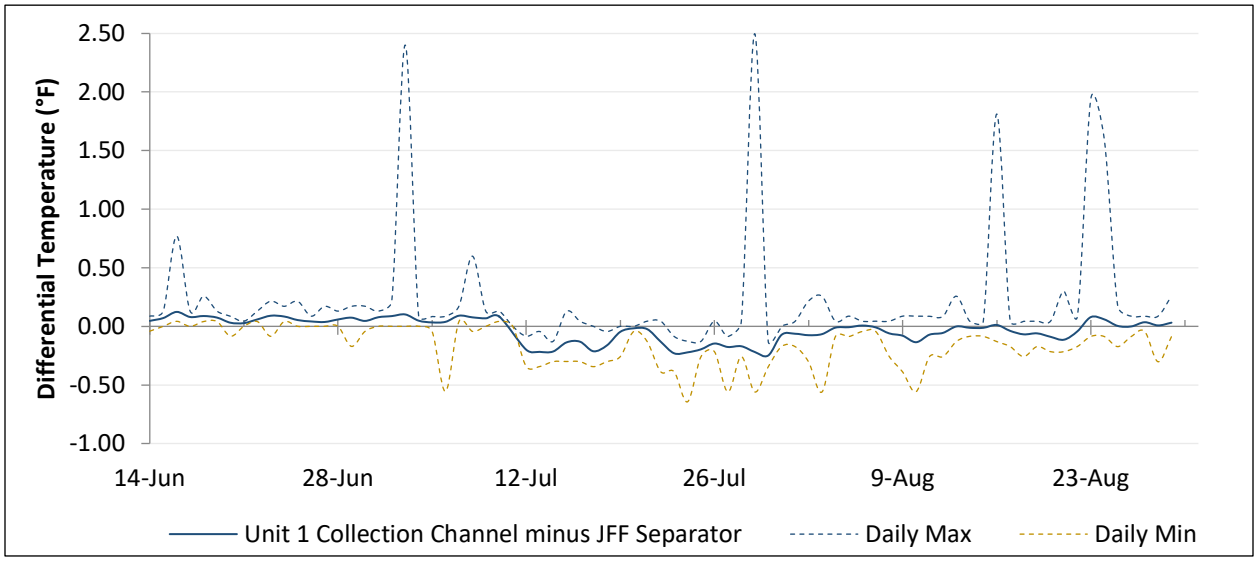

Figure 11. Daily Average Water Temperature Gradient Recorded Between the Collection Channel at Unit 1 and Juvenile Fish Facility Separator from 0700 Hours on June 14 to 0700 Hours on August 31, 2025

Fish Passage and Mortality

At the MCN JFF, fish were sampled every other day, and collection estimates were derived from these sample counts. These estimates do not include fish that passed MCN on non-sample days. During the June 14–August 31 temperature monitoring period, an estimated 91,792 juvenile salmonids were collected (Table 4). Subyearling Chinook salmon comprised the majority of the collection (99.1%). By June 28, 90% of fish migrating during the monitoring period had passed the dam. After August 15, the sampling effort was reduced due to water level fluctuations within the collection channel and separator.

In previous years, elevated juvenile mortality at MCN has been associated with forebay temperatures exceeding 68°F and pronounced temperature gradients along bypass routes through the powerhouse and the JFF. During the 2025 monitoring period, there were 35 facility mortalities, corresponding to a 0.04% mortality rate, compared to 120 mortalities (0.13%) during the 2024 monitoring period (Table 4).

Sample mortality, which may reflect the overall health status of fish bypassing the facility, is based on individuals held for up to 24 hours prior to condition sampling. During the 2025 monitoring period, sample mortalities were primarily subyearling Chinook salmon (17 of 18 sample related mortalities). The sample mortality rate was 0.64% for subyearling Chinook salmon and 0.67% for all species combined.

Table 4. Collection, Mortality, and Passage for Juvenile Salmonids from June 14 to August 31 in 2025 and 2024

Year	System			Sample			Passage			
	Collection	Mortality	% Mortality	Sample	Sample Mortality	% Mortality	25%	50%	75%	90%
2025	91,792	35	0.04%	2,692	18	0.67%	18 Jun	20 Jun	24 Jun	28 Jun
	Sample Tank "B" Temperature (°F)[a]						64.12	63.82	64.26	65.36
2024	95,552	120	0.13%	3,863	53	1.37%	20 Jun	26 Jun	2 Jul	1 Aug
	Sample Tank "B" Temperature (°F)[a]						61.01	64.11	64.96	70.11

Notes:
a The sample tank temperature was taken at 0700 hours daily.
°F = degrees Fahrenheit

Recommendations

High water temperature at MCN is currently managed by modifying turbine operations. Operating turbines in an alternating standby pattern reduces elevated water temperatures and minimizes temperature gradients in fish passage routes through the powerhouse and the JFF. This operational strategy is particularly effective in the early season, when deeper forebay water remains cooler prior to prolonged exposure to high air temperatures. It is recommended that MCN continue implementing this strategy.

Additional recommendations include:

- **Temperature Monitoring:** Continue to monitor water temperatures at strategic sites used by juvenile fish to ensure effective evaluation of fish passage conditions.

- **Collection Channel Evaluation:** The collection channel has consistently shown higher temperatures than the gatewells. Coupled with fluctuations in water levels, this may warrant further investigation. Potential contributing factors include the proliferation of freshwater sponges.

Appendix A Temperature Logger Problems

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Appendix A Temperature Logger Problems

During the 2025 temperature monitoring season, a total of 203.5 hours (0.43% of the season) of data were lost due to probe malfunctions or inaccessibility during dam maintenance activities. Malfunctions were infrequent and generally lasted approximately 24 hours. In addition, no temperature data were collected at Collection Channel Unit 1 or at the Juvenile Fish Facility (JFF) when flow was diverted from the primary bypass. Table A-1 summarizes the dates and times of data loss, duration of outages, and HOBO logger locations.

Table A-1. 2025 Season Monitoring Hours Lost Due to Temperature Logger Failures or Inaccessibility (HOBO U22-001)

Date / Time	G11	F01	F07	F10	F12	C01	C08	C12	SEP	SMP
06/14 0700 – 06/14 0930				2.5						
06/14 0930 – 06/14 1000							0.5			
06/14 0930 – 06/14 1000								0.5		
06/15 1130 – 06/16 0930			22							
06/18 0800 – 06/18 0830					0.5					
07/02 0730 – 07/03 0800		24.5								
07/10 0800 – 07/10 1000							2			
07/10 0800 – 07/10 1000								2		
07/10 0800 – 07/12 0930									49.5	
07/10 0800 – 07/12 0930										49.5
07/10 0830 – 07/10 0930						1				
07/30 0930 – 07/31 0830						23				
07/30 0930 – 07/31 1030	25									
08/15 0900 – 08/15 1000									1	
Total	**25**	**24.5**	**22**	**2.5**	**0.5**	**24**	**2.5**	**2.5**	**50.5**	**49.5**

SEP = separator; SMP = Sample Tank B