Shasta River

ANNUAL TMDL MONITORING REPORT

2025

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SHASTA VALLEY
RESOURCE CONSERVATION DISTRICT

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The North Coast Regional Water Quality Control Board (NCRWQCB) lists the Shasta River in the Shasta Total Max Daily Load (TMDL) for elevated temperature and low dissolved oxygen (DO). The NCRWQCB identifies agricultural activities (livestock impacts, impoundments, and diversions) as sources contributing to these impairments (NCRWQCB 2007). Surface water diversions from the Shasta River and tailwater, or excess irrigation return flows, to the river system degrade water quality and impact the *beneficial uses*, which include: 1) cold freshwater habitat (COLD) that supports migration, spawning and rearing (MIGR, SPWN) of salmonids including Chinook, steelhead and state and federally ESA-listed coho (RARE), 2) drinking water (MUN), 3) recreation (REC-1 & 2), 4) agricultural supply (AGR) and 5) groundwater recharge (GWR) (NCRWQCB 2007).

Under the protocols established in the Monitoring Plan, Quality Assurance Project Plan (QAPP) and Project Assessment and Evaluation Plan (PAEP) approved by the State Water Resource Control Board (SWRCB), the Shasta Valley Resource Conservation District (SVRCD) monitors water quality on the Shasta River and its tributaries. The goals of this monitoring effort are to assess progress in meeting TMDLs (temperature and DO) by monitoring Shasta River water quality and to identify locations where the restoration or alteration of riparian habitat, land management actions and practices would likely improve water quality in the Shasta River and its tributaries.

This report summarizes and discusses meteorological data and the impact on the Shasta River watershed, as well as temperature and DO monitoring data at 31 sites, twelve of which also recorded DO, on the Shasta River and tributaries Parks Creek and Yreka Creek. Access to monitoring locations is acquired by private landowners through landowner agreements.

TEMPERATURE TMDL

The Shasta River TMDL temperature load allocation sources are riparian vegetation (shade), tailwater return flows, and surface water flow. The temperature water quality compliance scenario, as modeled by the NCRWQCB, included increased riparian shade to represent site potential riparian conditions on a river-reach scale, modified temperature regime of tailwater return flows such that return flows do not cause heating of the receiving water, Big Springs Creek temperatures reduced by 4°C from baseline, Parks Creek temperatures reduced by 2°C from baseline, and fifty percent (50%) increase in Shasta River flows downstream of the Big Springs Creek confluence, an increase of 45 ft^3/second (cfs) (NCRWQCB, 2006).

Juvenile salmonids are known or suspected to rear in the following reaches of the Shasta River: Grenada Irrigation District pumps to Highway A-12, near Breceda Lane, and in the Shasta River canyon at a side channel known as “Salmon Heaven”. Based on this information, the following locations are considered temperature compliance locations, as they are at or near the downstream end of these critical summer rearing locations (NCRWQCB, 2006). The name and River Mile (RM) are:

- “Salmon Heaven,” RM 5.6
- Montague-Grenada Road, RM 15.5
- Highway A-12, RM 24.1

For the modeled water quality compliance scenario, reductions in maximum water temperatures compared to the August baseline water temperatures at RM 5.6, RM 15.5, and RM 24.1 are 4.82°C, 4.92°C, and 4.71°C, respectively. The 5-day average daily maximum temperatures for the compliance scenario at RM 5.6, RM 15.5, and RM 24.1 are 18.9°C, 17.5°C, and 16.7°C, respectively (NCRWQCB, 2006).

For a full analysis and description of the load allocations, model conditions, calibration data, and modeled scenario outputs, please refer to the 2006 *Staff Report for the Action Plan for the Shasta River Watershed Temperature and Dissolved Oxygen Total Maximum Daily Loads*.

DISSOLVED OXYGEN TMDL

The dissolved oxygen water quality compliance scenario was developed using a process that separately evaluated components identified in the dissolved oxygen source and linkage analysis that affect dissolved oxygen concentrations in the Shasta River. They include photosynthetic and respiration rates, sediment oxygen demand rates, dissolved oxygen and nitrogenous oxygen demand concentrations of Lake Shastina outflow, key tributaries, tailwater return flows, riparian shade, and Shasta River flow. The water quality compliance scenario consists of the baseline condition with key modifications including, reduced photosynthetic and respiration rates, reduced sediment oxygen demand (SOD) behind minor impoundments, reduced nitrogenous oxygen demand, NBOD input concentrations, modified dissolved oxygen concentrations at key locations, increased riparian shade (represented as decreased percent transmittance on a river reach scale), and increased Shasta River flow. This appears to result in attainment of the Basin Plan biostimulatory substance's objective, as nutrient load reductions result in attainment of dissolved oxygen objective and non-nuisance level growth of aquatic plants (NCRWQCB, 2006).

For a full analysis and description of the load allocations, model conditions, calibration data, and modeled scenario outputs, please refer to the 2006 *Staff Report for the Action Plan for the Shasta River Watershed Temperature and Dissolved Oxygen Total Maximum Daily Loads*.

MONITORING LOCATIONS

Temperature and DO were measured from April 1st through October 1st, 2025, at 31 locations on the Shasta River and its tributaries (Table 1), including year-round at twelve DO and Temperature sites, and two year-round temperature sites. The study area spans over 40 river miles from Dwinnell Reservoir to the mouth of the Shasta River at its confluence with the Klamath River (Figure 1).

TABLE 1. REACH, SITE ID, RIVER MILE, EQUIPMENT, AND MEASURED METRICS DURING THE 2024 IRRIGATION SEASON.

Reach	Reach Name	Site ID	River Mile	Equipment	Measurement
6	Dwinnell Reservoir Outlet to Parks Creek	105SRHVRPOD	41.6	TidbiTs®	Temperature
		105SRHVSPL	40.8	TidbiTs®	Temperature
		105SRHVRALC	40.6	TidbiTs®	Temperature
		105SRHVDSSPG	40.5	TidbiTs®	Temperature
		105SRU0IT	40.4	TidbiTs®	Temperature
		105SR7163	39.6	TidbiTs®	Temperature
		105SRU2DO	39.3	Onset DO Logger	DO/Temperature
		105SRBS1T	36.6	TidbiTs®	Temperature
5	Parks Creek to Big Springs Creek	105SRLB1T	35.4	TidbiTs®	Temperature
		105SRBS5T	35.8	TidbiTs®	Temperature
		105SRBS4T	36.3	TidbiTs®	Temperature
		105SRBS3T	36.4	TidbiTs®	Temperature
		105SRBS2T	36.5	TidbiTs®	Temperature
		105SRP1DO*	SR 33.9; PC 0.04**	InSitu AquaTroll	DO/Temperature
4	Big Springs Creek to Willow Creek	105SRN1DO	33.4	Onset DO Logger	DO/Temperature
		105SRN01T	31.4	TidbiTs®	Temperature
		105SRV1DO	28.0	Onset DO Logger	DO/Temperature
		105SRV4AT	27.3	TidbiTs®	Temperature
		105SRV4BT	26.1	TidbiTs®	Temperature
3	Willow Creek to Little Shasta River	105SRT1DO	24.8	Onset DO Logger	DO/Temperature
		105SRS1DO	18.0	Onset DO Logger	DO/Temperature
2	Little Shasta River to Yreka Creek	105SRM1DO	15.7	Onset DO Logger	DO/Temperature
		105SR400T	13.2	TidbiTs®	Temperature
		105SRA1DO	12.7	Onset DO Logger	DO/Temperature
		105SRA01T	11.0	TidbiTs®	Temperature
		105SRG01T	8.1	TidbiTs®	Temperature
1	Yreka Creek to Shasta River Mouth	105YCA01T*	SR 7.3; YC 0.6**	TidbiTs®	Temperature
		105SRTM01DO	5.7	Onset DO Logger	DO/Temperature
		105SRTM02T	5.7	TidbiTs®	Temperature
		105SRP01T	2.9	TidbiTs®	Temperature
		105SRL1DO	0.6	Onset DO Logger	DO/Temperature

* Site was located on tributary to Shasta River
** River miles are provided both for where the tributary meets the mainstem as well as tributary river mile for the monitoring site.

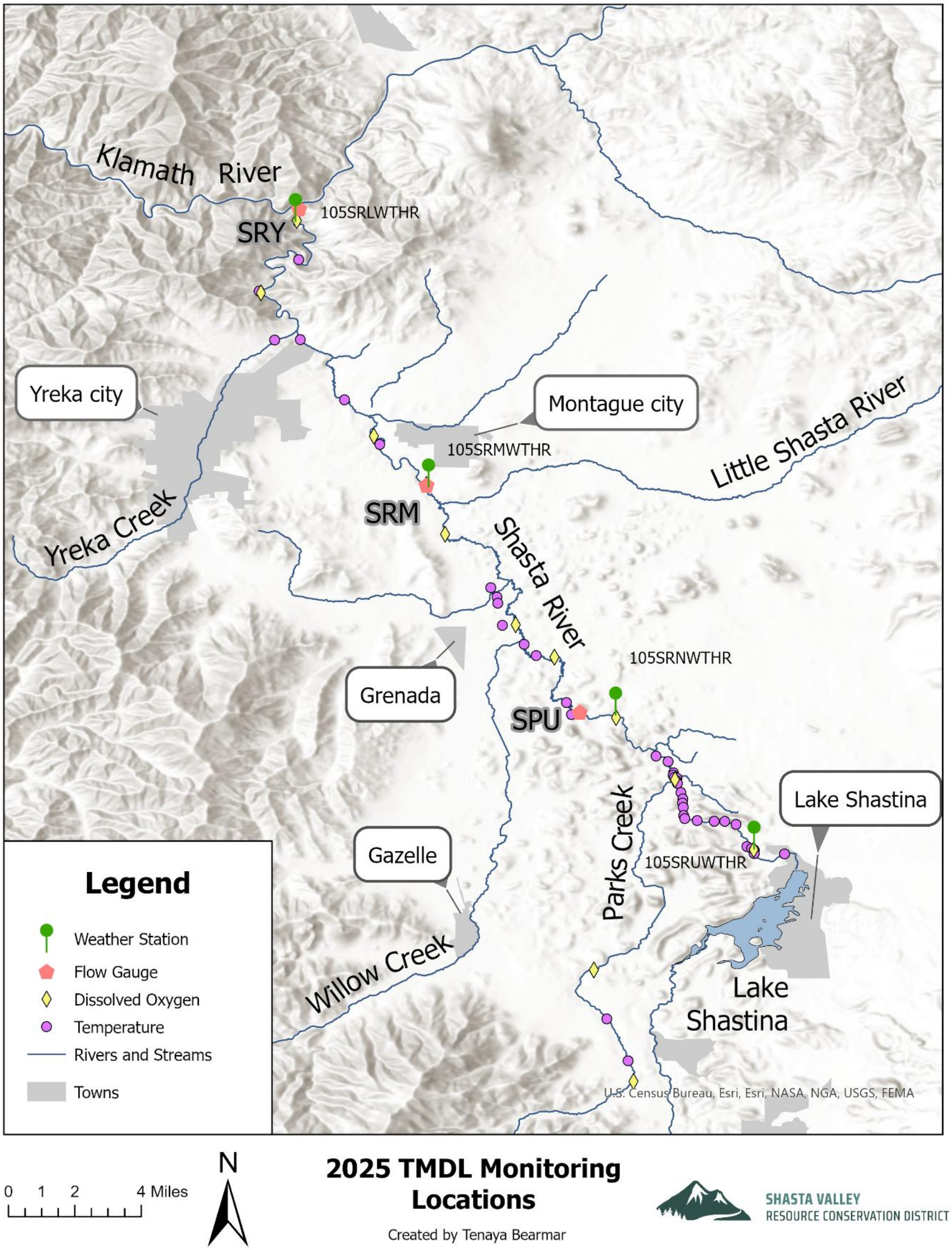


FIGURE 1. MAP OF 2025 TEMPERATURE, DO, FLOW, METEOROLOGICAL AND CDEC MONITORING LOCATIONS.

METHODS

DISSOLVED OXYGEN SAMPLING

Dissolved Oxygen (DO) and temperature were measured at 10 sites (Table 1; Figure 1) using a combination of InSitu AquaTroll 600 and Onset HOBO U26 Dissolved Oxygen Loggers. Both sensor types use optical fluorescence sensing elements to measure DO in liquids. These DO loggers were housed in custom made canisters that were suspended on an H shaped brace designed to suspend the logger about 6 inches to 1 foot above the riverbed in the benthic zone, and to maintain a stationary position in the river in high flow.

Where possible, DO loggers were placed in runs or pool tail-outs and within the thalweg or deepest part of the cross-section. AquaTroll 600 and Onset HOBO U26 loggers were calibrated immediately prior to deployment and initialization of the RDO Cap, which expires seven months after initialization. Onset HOBO U26 loggers were downloaded and cleaned of bio-fouling every three weeks. Independent measurements of DO and temperature were made at the monitoring locations with a handheld YSI ODO Meter each time the sensors were downloaded.

TEMPERATURE SAMPLING

Temperature loggers were deployed at 21 sites (Table 1; Figure 1) in sets of two (paired for quality control) and housed in custom made canisters to protect them from direct sunlight. Where possible, temperature loggers were placed in runs or pool tail-outs and within the thalweg or deepest part of the channel cross-section.

In 2025, temperatures were recorded at 15-minute intervals (U26 loggers, AquaTroll 600, and Onset Tidbits) at temperature monitoring locations as identified in Table 1 and on Figure 1.
The 7-day average daily maximum (7DAD Max) temperature is calculated by averaging the daily maximum water temperatures over a rolling 7-day period. Each reported date represents the midpoint of this period, with the average derived from the maximum temperatures of the three days before and three days after the target date.

In addition to the 7-DAD Maximum temperature graphs, an analysis of the Maximum Weekly Average Temperatures (MWAT) and Maximum Weekly Maximum Temperatures (MWMT) for each site was calculated. The use of MWAT values was first proposed by the National Academy of Sciences (NAS) in 1972 as a long-term standard for preventing chronic sub-lethal effects for a variety of fish species. However, the MWAT is not calculated consistently by all researchers and agencies. The MWAT, as reported by Carter (2005), is the highest single value of the seven-day moving average temperature. Likewise, the MWMT is the highest seasonal or yearly value of the daily maximum temperatures over a running seven-day consecutive period. This methodology for calculating MWAT and MWMT was followed in this report and calculated for the entire irrigation season. The absolute maximum is calculated as the highest daily maximum temperature for the entire irrigation season.

The objective of the MWAT index is to provide an upper temperature standard that is protective of juvenile salmonids during the summer rearing period. MWAT is a common measure of chronic (i.e., sub-lethal) exposure; the absolute maximum is a measure of acute (i.e., lethal) exposure, and the MWMT is a common measure of both chronic and acute effects (Carter 2005). The MWMT describes the maximum temperatures in a stream, but the value is not overly influenced by the maximum temperature of a single day. Table 3 describes the MWMT for the Shasta River during various life stages of coho salmon (Carter 2005). Refer to Carter (2005) for additional information regarding temperature effects on various life stages of Chinook and steelhead salmonids.

Temperature loggers at eight monitoring sites experienced equipment failure during the 2025 irrigation season, resulting in incomplete datasets for these sites. These sites are marked with an asterisk in Table 2. Because the standard percent-exceedance metric is calculated relative to the full 183-day irrigation season, incomplete records would artificially deflate exceedance values at these sites. To account for this, an adjusted exceedance value is reported for these sites, calculated as the number of days exceeding 18°C divided by the total number of days with valid temperature data, rather than the full 183-day season. This adjusted value is noted in the "% adjusted" column in multiple tables throughout the report and should be interpreted as the exceedance rate observed during the monitored portion of the season. Where equipment functioned throughout the full irrigation season, only the standard "% Days Exceeded 18°C" value is reported.

TABLE 3. MWMT FOR DIFFERENT LIFE STAGES OF COHO SALMON (REPRODUCED FROM CARTER 2005).

Coho Life Cycle						
	Adult Migration	**Spawning**	**Egg Incubation**	**Fry Emergence**	**Juvenile Rearing**	**Juvenile Out-migration**
Coho Periodicity	Sept 15 – Jan 31	Nov 1 – Jan 31	Nov 1 – Mar 31	Feb 1 – Apr 15	Jan 1 – Dec 31	Feb 15 – July 15
MWMT Criterion (°C)	20	13	13	13	18	18

In addition to water temperature and dissolved oxygen sampling, meteorological and discharge data were collected and used to inform and evaluate water temperature and dissolved oxygen sampling, ambient air temperature, precipitation, and solar radiation data were retrieved from four field meteorological stations, located along the Shasta River between Dwinnell Reservoir and the Klamath River, to inform water temperature and DO results in this study.

RESULTS AND DISCUSSION

METEOROLOGICAL CONDITIONS

Meteorological data is measured at several locations throughout the Shasta River watershed. Regional snowpack and snow water content are measured annually as part of the Department of Water Resources Statewide Monitoring Network, which partners with more than 50 state, federal, and private agencies. The cooperating agencies take snow and water content measurements in January, February, and March. The USFS continues to collect monthly data for April and May. Results from each monthly survey at a given site are tabulated and form an average of a region's annual snowpack and water content, which gives forecasters and resource managers the ability to make important management decisions. The data is also compared against a running historical average for each site and month. Regional data is summarized annually by the US Forest Service Shasta-Trinity National Forest and is presented on the California Data Exchange Center website. Those data are presented in

Table 4. The upper watershed areas have received significantly less snowpack in recent years, apart from 2025, which was an above average year of snowfall.

TABLE 4. REGIONAL SNOW DEPTH AND WATER CONTENT FOR THE MONTH OF APRIL OF 2025, 2024, AND 2023

Course	Elevation (ft. asl)	2025 Snow (in)	2025 Water (in)	2024 Snow (in)	2024 Water (in)	2023 Snow (in)	2023 Water (in)	Historic Avg Snow (in)	Historic Avg Water (in)
Little Shasta*	6200	72	22	50	25	73	20	47.38	n/a
Horse Camp	7900	170	79	92	27.3	156.5	46.5	92.58	51.6
Sand Flat	6800	113.5	48.5	100	32	110	25	82.54	38.3
North Fork	6900	79.5	29	72	29.6	111	29.6	61.00	23.6
Grey Rocks	6200	143.5	44	130	52.5	138	37	-	44.6
Sweetwater	5850	62.5	21	38	12	74	26.5	37.17	13.5
Parks Creek	6700	111	34	75	26	120	45	76.49	32.6
Average of Courses Sampled (in)		**107.43**	**39.64**	**84**	**30.1**	**117**	**35.9**	**82.84**	**34.03**
Percent of Historic Average		**137%**	**116%**	**102%**	**89%**	**143%**	**106%**		

*Little Shasta site is managed by the Goosenest Ranger District, Klamath National Forest, and is not part of the average or percent of historic average calculation of all courses. Sites within Shasta River watershed are highlighted in light blue. https://cdec.water.ca.gov/cgi-progs/snowQuery_ss

In 2019, the SVRCD utilized Prop 1 funds through the DWR Sustainable Groundwater Planning (SGWP) grant program to implement two Hydrologic Data Acquisition System (HyDAS) stations in the upper Shasta River watershed. The stations are located on the north flank of Mt. Shasta, and the Goosenest. These stations provide snow depth and snow water content in real time. However, these stations do not have established snow courses, and their small sample size prevents comparison to a historical site average.

SVRCD also utilized SGWP funds in 2019 to implement two California Irrigation Management Information System (CIMIS) stations. CIMIS stations collect and utilize meteorological data to provide accurate estimates of Evapotranspiration (ET) for a reference crop like alfalfa or grass. Through 2021, the SVRCD staff maintained the CIMIS station monthly. In addition to co-operating the CIMIS stations, the SVRCD co-operated and maintained four meteorological stations donated by the North Coast Regional Water Quality Control Board (NCRWQCB). These stations are located within the riparian corridor of the Shasta River between Dwinnell Reservoir and the confluence with the Klamath River. These four stations are not used to estimate ET but to record accurate air temperature and precipitation measurements adjacent to the Shasta River. Where available, annual precipitation and ET totals from the CIMIS stations, and precipitation totals from the NCRWQCB meteorological stations, are presented for the entire year of 2025 and the irrigation season in Table 4.

TABLE 5 . METEOROLOGICAL TOTALS FOR SVRCD COOPERATED CIMIS AND WEATHER STATIONS.

Station ID	Station Name or Reach	Elevation (ft. asl) *	WY2025 Total Precipitation (in)	WY2025 Total ET (in)	4/1/25 - 9/30/25 Total Precipitation (in)	4/1/25 - 9/30/25 Total ET (in)
105SRLWTHR	Reach 1	2050	23.35	-	3.56	-
260	Montague	2265	12.14	50.11	3.47	39.92
105SRMWTHR	Reach 2	2465	10.65	-	3.06	-
105SRNWTHR	Reach 4	2555	24.04	-	3.75	-
105SRUWTHR	Reach 6	2665	21.14	-	4.02	-
261	Gazelle	2745	11.9	47.44	3.77	37.66

*WGS-84 Datum

Note: CIMIS Stations are highlighted in light blue

Ambient air temperatures recorded at the CIMIS and NCRWQCB meteorological stations were examined to assist with analysis of seasonal and inter-annual river temperature and dissolved oxygen trends. As air temperatures increase into the summer, water temperatures in the Shasta River generally increase while dissolved oxygen levels decrease. An exception to this trend is in the upper Shasta River and Big Springs Creek where extensive macrophyte growth during mid and late summer minimizes increases in water temperature (Jeffres et al. 2009), although it is not clear if this exception is dependent on a normal water year. Additionally, tailwater returns to the river via overland flows are greatly affected by air and ground surface temperatures and can subsequently have an impact on instream temperature and dissolved oxygen demands.

Temperature, rainfall, and reference evapotranspiration data from CIMIS station 260 – Montague is shown in

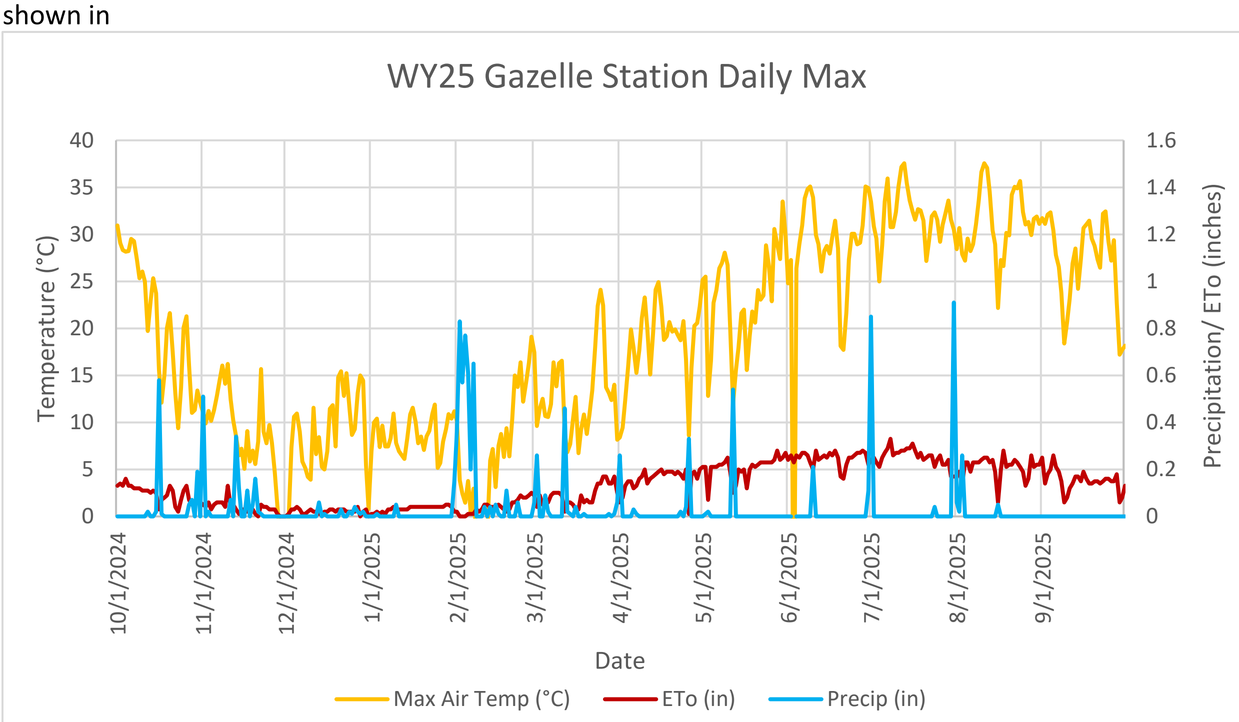


Figure 32, and CIMIS station 261 – Gazelle in Figure 3. Meteorological data display warm-dry weather during the summer season and cooler temperatures and increased precipitation during the winter months, typical of a Mediterranean climate. Evapotranspiration is limited in the winter months when cloud cover is heavy and prevalent, and days are shorter. During the summer months higher evapotranspiration coincidence with longer days and increased daily maximum air temperatures. Precipitation events at these locations demonstrate the large variability in seasonal precipitation and microclimates within the Shasta Valley.

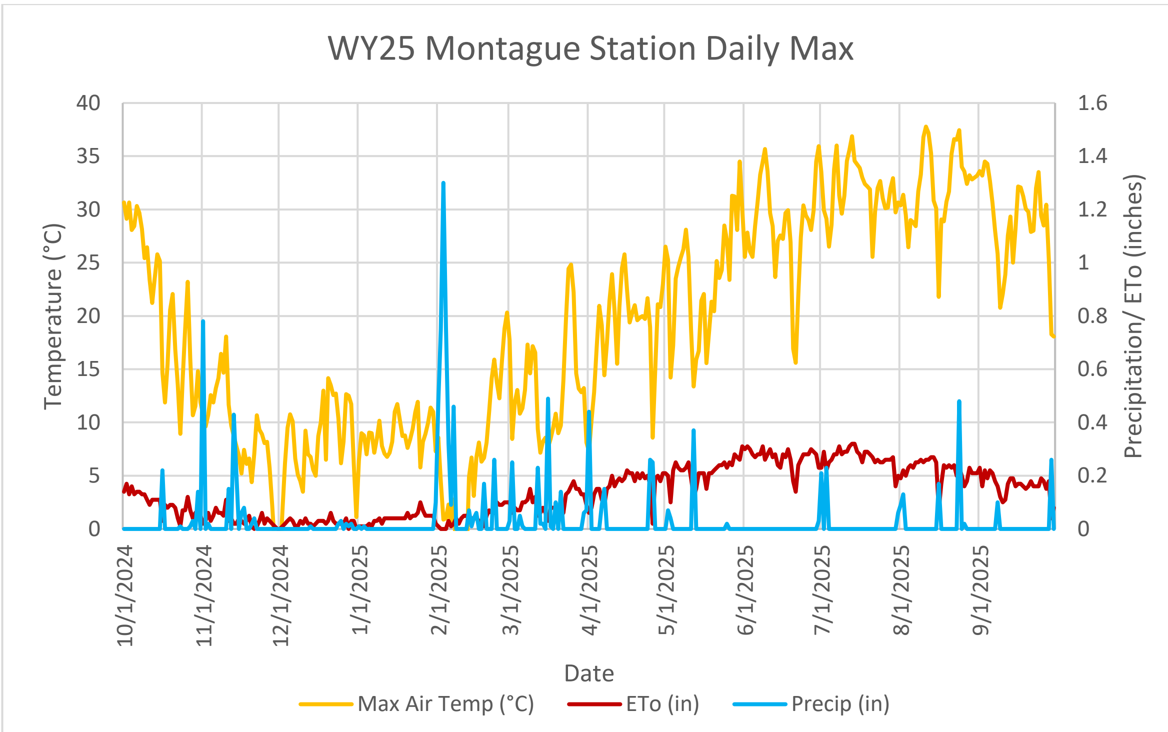


FIGURE 2. DAILY MAX AIR TEMP, ET, AND PRECIPITATION FOR CIMIS STATION 260 – MONTAGUE FOR WY 25.

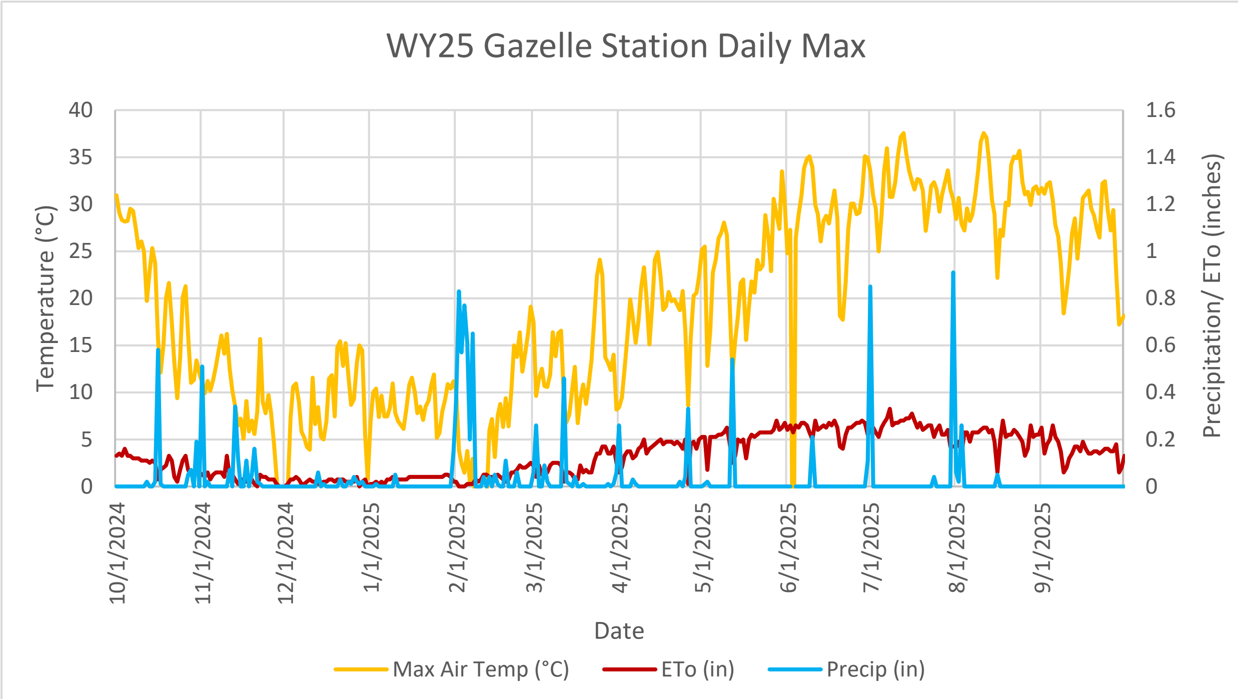


FIGURE 3. DAILY MAX AIR TEMP, ET, AND PRECIPITATION FOR CIMIS STATION 261 – GAZELLE FOR WY 25.

SHASTA RIVER FLOW

Publicly available flow data recorded at fifteen-minute intervals at US Geologic Survey rated stream gauge sites near the cities of Montague and Yreka, and Department of Water Resources rated stream gauge downstream of Big Springs Creek (see Figure 1) is shown in Figure 4. WY 2025 continuous Shasta River discharge and SWRCB minimum instream flow criteria.Figure 4 and displays discharge of the Shasta River in cubic feet per second. Due to persistent drought conditions within the region, on May 10, 2021, California Governor Gavin Newsome declared a drought emergency for 41 counties, including Siskiyou County. Despite voluntary reductions in water use by stakeholders within the Shasta Valley, on August 17, 2021, the State Water Board adopted an emergency regulation which became effective on August 30, 2021. Upon readoption of minimum in-stream flow requirements the California Water board issued the following statement.

> *"Assembly Bill (AB) 263 passed on September 26, 2025, and the and extends the adopted Scott River and Shasta River Emergency Regulation until January 1, 2031, or until permanent rules establishing and implementing long-term instream flow requirements are adopted for those watersheds, whichever occurs first."*

This emergency legislation establishes emergency drought minimum flows in the Shasta River watershed as measured at the Shasta River gauge near Yreka. The corresponding monthly emergency flow volume is shown in Figure 4 as a red line and given in Table 6. To meet the emergency drought minimum flow volumes set forth in the legislation, the State Water Board is curtailing certain water rights.

TABLE 6. SHASTA RIVER EMERGENCY DROUGHT MINIMUM MONTHLY FLOW REQUIREMENTS FOR SRY, WY 2025.

Shasta River Emergency Drought Minimum Flow Requirements													
JAN	FEB	MAR 1-24	MAR 25-31	APR	MAY	JUN	JUL	AUG	SEP 1-15	SEP 16-30	OCT	NOV	DEC
125	125	125	105	70	50	50	50	50	50	75	105	125	125

Note: Values are in cubic feet per second and measured at the Shasta River Gauge near Yreka.

Typically, between the months of October through March, the SRY gauge consistently records greater discharge than the SRM gauge (the location of these two gauges is shown in Fig. 1). Between the months of April through September, this relationship inverts, and the SRM gauge consistently reports higher flows than the SRY gauge. Though summers are warm and dry, significant reductions in flow volumes at both SRM and SRY gauges occur on April 1 coinciding with the onset of irrigation season and surface water diversion. Flow volumes typically increase significantly on October 1, coinciding with the end of irrigation season and the return of cooler days and increased precipitation. In WY2025, flow volumes rebounded strongly following an above-average water year characterized by substantial winter precipitation and snowpack across the upper watershed. Flow volumes outside of irrigation season were notably higher than in recent drought-affected years, and emergency flow targets were more readily met throughout the season, although the annual low was similar to previous curtailment years. This is consistent with the above-average snowpack recorded across regional snow courses in April 2025, which reached 116% of the historic average water content. According to USGS data, flows at SRY reached an annual low of 36 cfs on August 21 and an annual high of 2,658 cfs on February 4, 2025. Total discharge measured at the Shasta River gauges near Montague, Yreka, and downstream of Big Springs Creek is presented in Table 7 .

TABLE 8. SHASTA RIVER ANNUAL DISCHARGE AND IRRIGATION SEASON DISCHARGE TOTALS FOR WY 2025.

Gauge	Total Discharge (af) 10/1/24 – 9/30/25	Total Discharge (af) 4/1/25 – 9/30/25	Total Emergency Minimum Discharge (af) 10/1/24 – 9/30/25	Total Emergency Minimum Discharge (af) 4/1/25 – 9/30/25
SPU	132,564	65,026	-	-
SRM	149,876	51,141	-	-
SRY	204,720	60,456	63,716	20,073

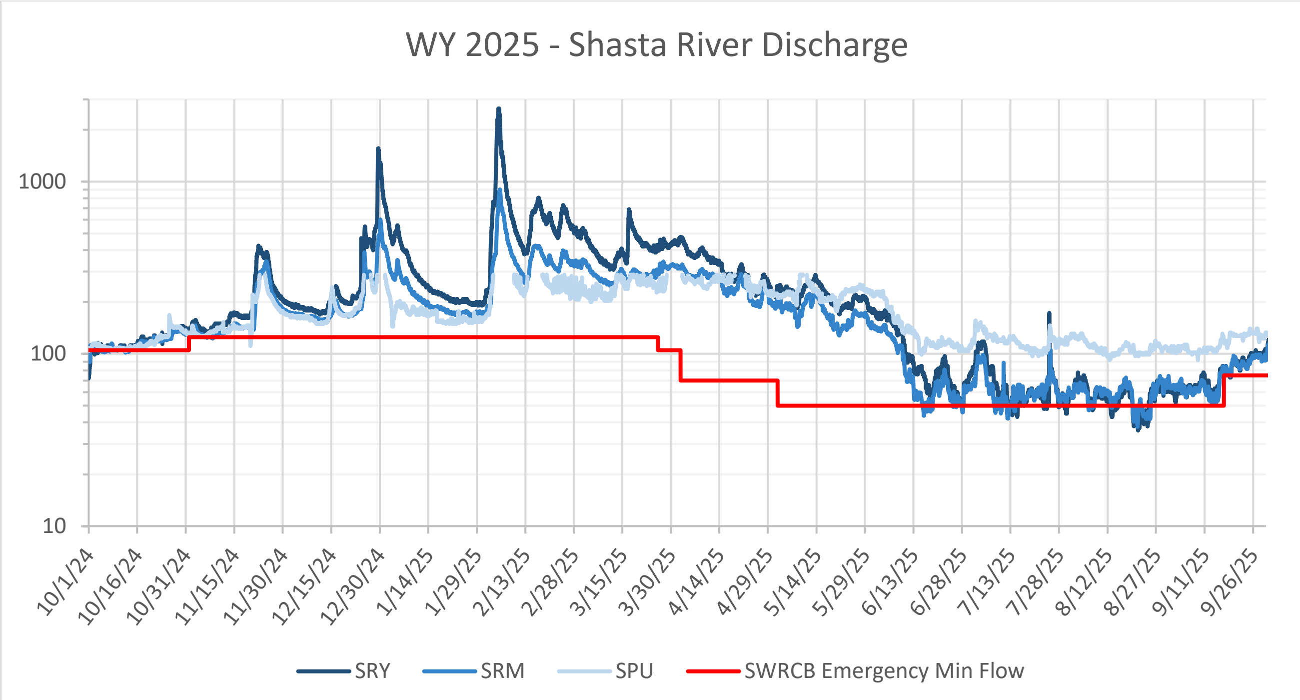


FIGURE 4. WY 2025 CONTINUOUS SHASTA RIVER DISCHARGE AND SWRCB MINIMUM INSTREAM FLOW CRITERIA.

TEMPERATURE RESULTS

Temperature was measured at 31 sites on the Shasta River and its tributaries in 2025. Temperatures in the Shasta River and its tributaries fluctuate daily and are moderate in comparison to air temperatures due to the high specific heat capacity of the water.

Table 9 summarizes 2025 MWMT, MWAT, and Absolute Maximum temperatures recorded over the course of the period monitored at each site in the Shasta River, Parks Creek, and Yreka Creek. A percentage has been calculated for each site corresponding to the number of days where the site exceeded the juvenile coho criterion of 18°C. The general trend of 7-DAD Max temperatures among all sites measured is a continuous rise that appears to correlate with seasonal warming, and late season decreases that correlate with cooling temperatures and decreased solar radiation from regional wildfires and/or increased instream vegetation. All sites saw a peak in 7-DAD Max temperatures in July.

TABLE 9. 2025 SHASTA RIVER MWMT, MWAT, ABSOLUTE MAX TEMP, AND PERCENT OF DAYS EXCEEDED 18°C.

Site ID	Reach	MWMT (°C)	MWAT (°C)	Abs. Max Temp (°C)	% Days Exceeded 18°C	**% Days Exceeded 18°C (adj.)
105SRHVRPOD	6	20.70	18.24	21.15	63.39	--
105SRHVRSPL	6	19.10	19.10	23.81	70.49	--
105SRHVRALC	6	13.38	13.98	14.24	0	--
105SRHVDSSPG	6	20.01	17.04	20.32	51.37	--
105SRU01T	6	20.33	17.35	20.65	56.83	--
105SR7163	6	22.33	18.25	22.99	69.40	--

*105SRU2DO	6	22.67	18.42	23.36	64.48	69.01
105SRBS1T	5	22.09	19.04	23.14	60.11	--
*105SRP1DO	5	25.78	22.95	26.26	35.52	52.23
105SRBS2T	5	23.93	21.34	24.68	73.77	--
105SRBS3T	5	23.66	21.14	24.39	75.41	--
105SRBS4T	5	23.16	20.78	23.83	65.57	--
105SRBS5T	5	23.43	21.12	24.03	73.77	--
105SRLB1T	5	23.64	21.27	24.22	65.57	--
105SRN1DO	4	22.93	19.60	23.68	69.40	--
105SRN01T	4	22.01	19.96	23.09	65.57	--
105SRV1DO	4	21.98	20.74	22.60	61.20	--
105SRV4AT	4	21.77	21.04	22.44	61.75	--
105SRV4BT	4	22.04	21.23	22.61	59.56	--
*105SRT1DO	3	22.56	21.42	23.16	56.28	59.20
*105SRS1DO	3	25.60	22.66	26.18	57.92	67.09
105SRM1DO	2	25.69	23.23	26.64	71.04	--
105SR400T	2	25.19	23.67	26.06	72.68	--
105SRA1DO	2	25.12	23.73	25.88	73.22	--
*105SRA01T	2	25.38	23.82	26.01	63.39	94.31
105SRG01T	2	26.25	24.37	26.73	73.22	--
105YCA01T	1	21.23	19.15	21.75	44.26	--
*105SRTM01DO	1	26.38	24.27	26.96	59.02	67.92
105SRTM01T	1	21.02	19.81	22.51	53.01	--
*105SRP01T	1	26.62	24.57	27.16	69.40	76.05
*105SRL1DO	1	24.90	22.84	25.46	56.28	74.10072

*Site is missing key data from irrigation season, reducing the percentage of days monitored where the juvenile coho criterion was exceeded.

** % Days Exceeded 18°C (adj.) – Adjusted value of percent exceedance of the TMDL to account only for days monitored, which was not the entire irrigation season. More information on the derivation of this value can be found in the "Temperature Sampling" section of this report.

Longitudinal Analysis

MAX WEEKLY MAX TEMPERATURE

Longitudinal MWMT data from 2017 to 2025 is shown below. In 2024 105SRU1DO does not appear because the sensor was moved to a different site. In 2022, the sensor at 105SR400T was buried and data subsequently omitted as it did not accurately record the MWMT. In 2021, 105SRN1DO was not monitored, and data is not reported for that year. Additionally, in 2019, the data from points 105SRTM01DO and 105SRS1DO is not available.

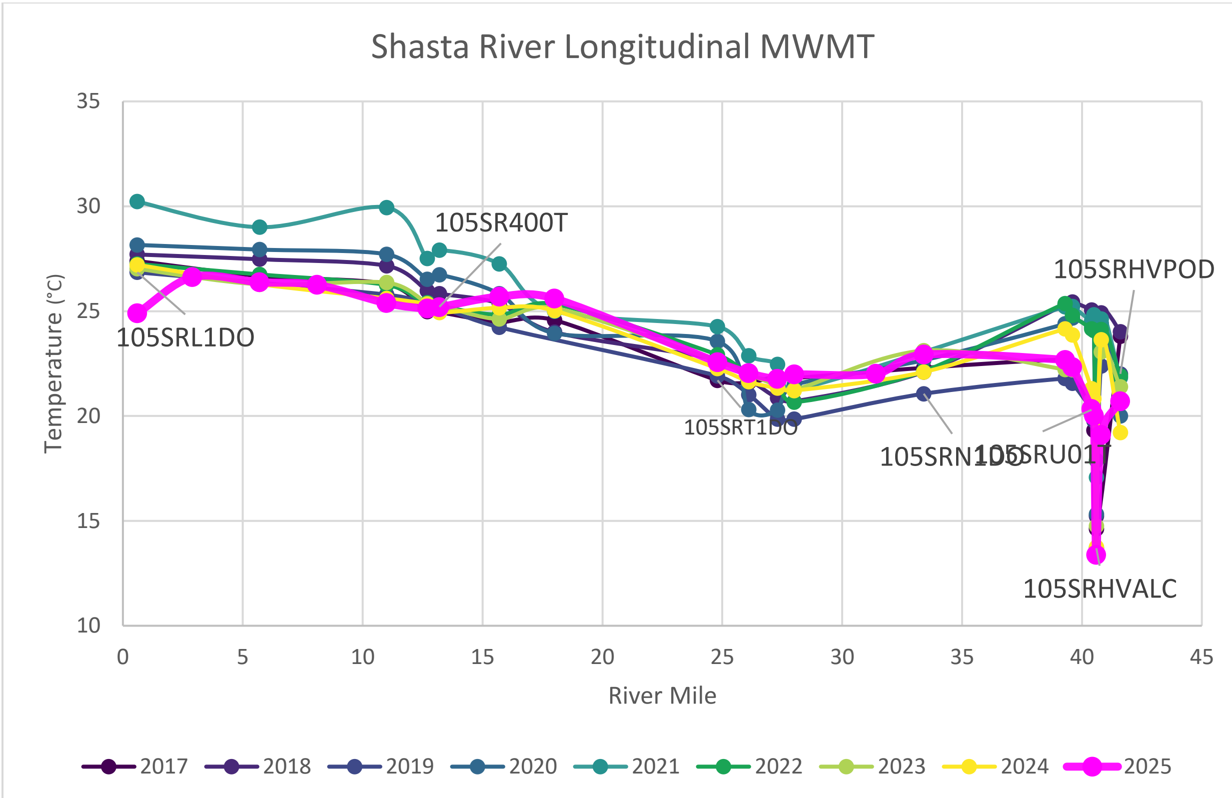


FIGURE 5. LONGITUDINAL MWMT DATA FOR LONG TERM SHASTA RIVER TEMPERATURE SITES BETWEEN 2017-2024.

Site code	L1DO	TM01DO	A01T	A1DO	400T	M1DO	S1DO	T1DO	V4BT	V4AT	V1DO	N1DO	U2DO	7163	U01T	HVDSSPG	U1DO	HVRALC	HVRSPL	HVRPOD
2025	24.90	26.38	25.38	25.12	25.19	25.69	25.60	22.56	22.04	21.77	21.98	22.93	22.67	22.33	20.33	20.01		13.38	19.10	20.70
2024	27.21	26.28	25.61	25.33	24.94	25.16	25.03	22.27	21.63	21.33	21.21	22.10	24.15	23.87	21.30	20.81		13.74	23.64	19.21
2023	27.02	26.28	26.36	25.36	25.28	24.62	25.15	22.62	21.99	21.46	21.25	23.12	22.22	22.20	20.78	20.01	21.33	14.76	23.05	21.39
2022	27.25	26.75	26.25	25.41		24.83	25.34	22.92	21.96	21.54	20.66	22.14	25.36	24.80	24.16	24.08	24.13	17.88	24.13	21.91
2021	30.22	29.00	29.94	27.51	27.91	27.25	25.00	24.26	22.87	22.46	21.25		25.21	25.22	24.53	24.82	24.62	17.07	24.63	21.83
2020	28.16	27.93	27.71	26.53	26.74	25.83	23.95	23.56	20.31	20.28	21.47	22.66	24.40	24.67	24.22	24.09	24.44	15.32	24.44	20.00
2019	26.85		25.79		25.21	24.23		21.91	21.01	19.85	19.85	21.06	21.79	21.56	20.30	19.78	21.68	13.70	22.39	22.01
2018	27.70	27.47	27.16	25.97	25.83	25.36	23.99	22.69	21.76	20.86	20.70	22.10	25.32	25.43	25.05	24.82	24.70	15.23	24.91	24.01
2017	27.39	26.67	26.29	24.97	24.95	24.48	24.57	21.70	21.60	21.89	21.82	22.30	22.68	22.23	20.28	19.32	18.28	14.62		23.81

Scale: 13.38 30.22

FIGURE 6. HEAT MAP OF LONGITUDINAL MWMT SITES FOR LONG TERM SHASTA RIVER TEMPERATURE SITES BETWEEN 2017-2025

MAX WEEKLY AVERAGE TEMPERATURE

Longitudinal MWAT data from 2017 to 2025 are shown below. In 2024 105SRU1DO does not appear because the sensor was moved to a different site. In 2022, the sensor at 105SR400T was buried and subsequent data was omitted as it did not accurately record the MWAT. In 2021, 105SRN1DO was not monitored. Additionally, in 2019, the data from sites 105SRTM01DO and 105SRS1DO are not available because they were not monitored.

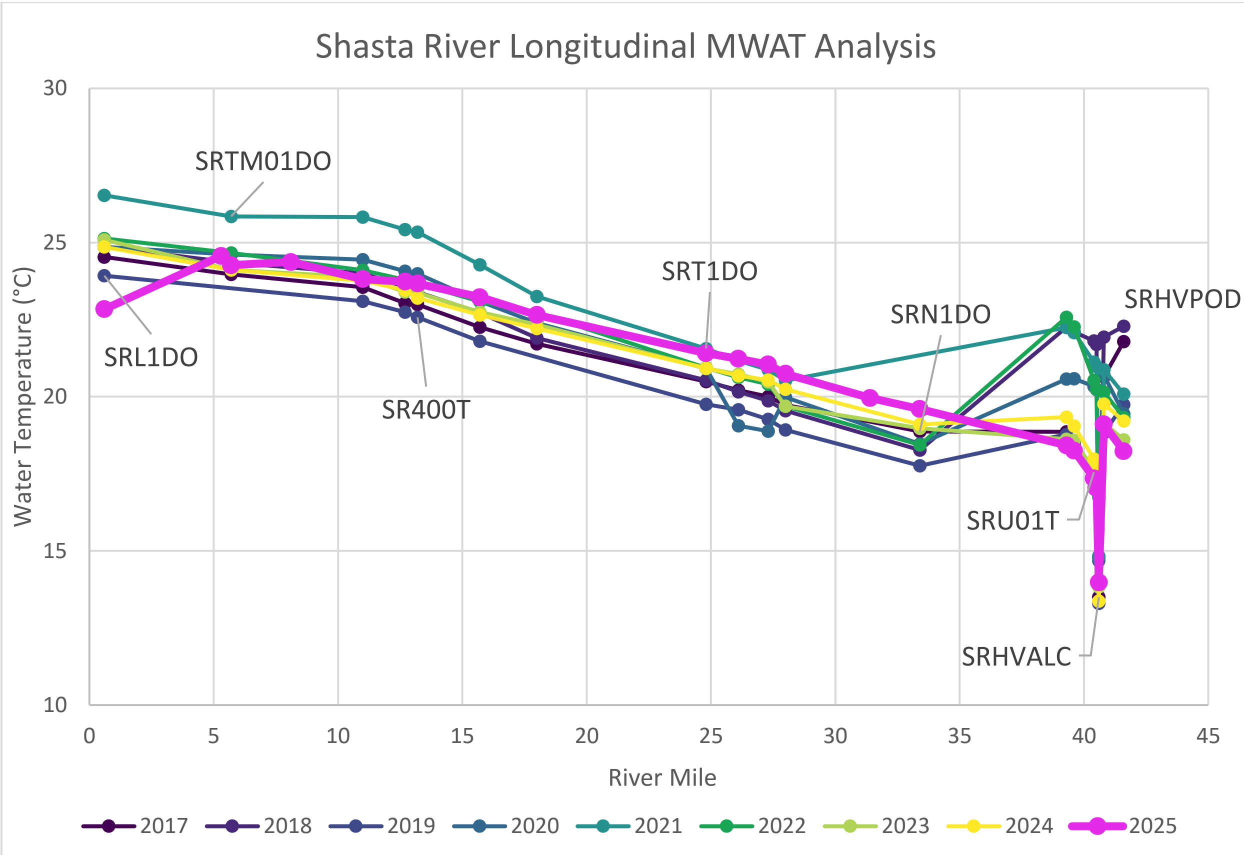


FIGURE 7. LONGITUDINAL MWAT DATA FOR LONG TERM SHASTA RIVER TEMPERATURE SITES BETWEEN 2017-2025.

Site code	L1DO	TM01DO	A01T	A1DO	400T	M1DO	S1DO	T1DO	V4BT	V4AT	V1DO	N1DO	U2DO	7163	U01T	HVDSSPG	U1DO	HVRALC	HVRSPL	HVRPOD
2025	22.84	24.27	23.82	23.73	23.67	25.69	22.66	21.42	21.23	21.04	20.74	19.6	18.42	18.25	17.35	17.04		13.98	23.42	18.23604
2024	24.86	24.12	21.84	23.46	23.21	22.65	22.21	20.93	20.68	20.54	20.24	19.10	19.34	19.05	17.98	17.71		13.37	19.77	19.21
2023	25.09	24.11	23.88	23.40	23.38	22.74	22.34	20.92	20.73	20.48	19.69	18.98	18.62	18.59	17.61	17.00	18.17	13.83	19.15	18.60
2022	25.13	24.66	24.11	23.79		23.09	22.72	20.93	20.63	20.41	19.69	18.44	22.58	22.27	20.53	20.24	20.05	16.75	20.15	19.32624
2021	26.53	25.85	25.82	25.43	25.34	24.29	23.26	21.57	21.17	20.88	20.52		22.25	22.08	21.13	20.98	20.73	14.84	20.87	20.09092
2020	24.86	24.61	24.44	24.07	23.99	23.1	22.39	20.92	19.06	18.88	19.99	18.47	20.57	20.58	20.34	20.23	20.38	14.68	20.7	19.44044
2019	23.93		23.1	22.74	22.58	21.8		19.75	19.58	19.27	18.93	17.77	18.78	18.43	17.61	17.32	18.46	13.29	18.83	19.74388
2018	24.86	24.35	24	23.56	23.4	22.73	21.91	20.53	20.16	19.87	19.55	18.28	22.26	22.11	21.81	21.7	21.6	14.79	21.94	22.28484
2017	24.54	23.97	23.55	23.04	22.99	22.26	21.72	20.5	20.21	20	19.73	18.87	18.86	18.52	17.55	17.06	15.84	13.5	20.65	21.78591

Scale: 13.29 … 26.53

FIGURE 8. HEAT MAP OF LONGITUDINAL MWAT SITES FOR LONG TERM SHASTA RIVER TEMPERATURE SITES BETWEEN 2017-2025

ABSOLUTE MAXIMUM TEMPERATURE

Longitudinal Max Temp Data from 2017 to 2025 is shown below. In 2024 105SRU1DO does not appear because the sensor was moved to a different site. In 2022, the sensor at 105SR400T was buried and subsequent data was omitted as it did not accurately record the Absolute Max temperature. In 2021, 105SRN1DO was not monitored. Additionally, in 2019, the data from sites 105SRTM01DO and 105SRS1DO are not available because they were not monitored.

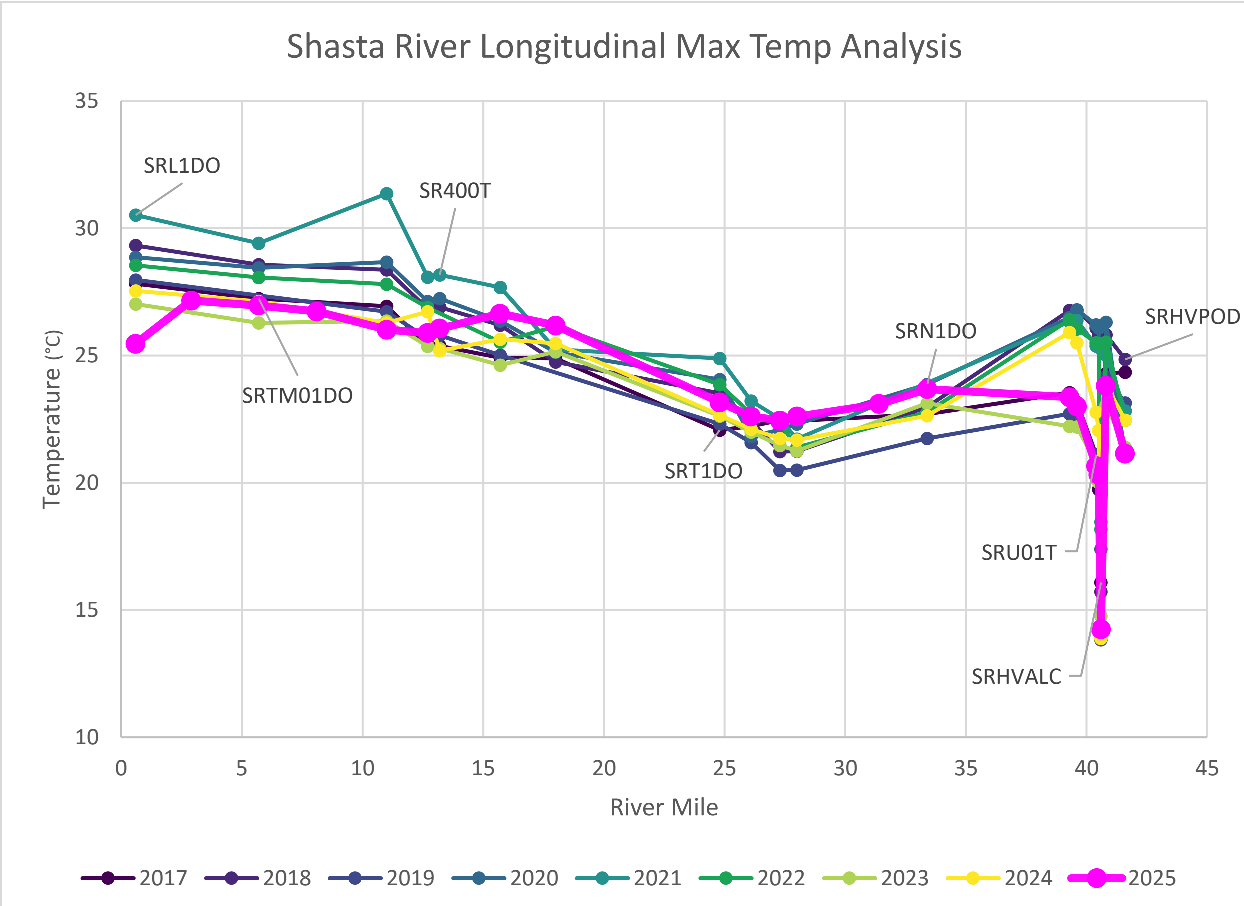


FIGURE 9. LONGITUDINAL ABSOLUTE MAX TEMPERATURES FOR LONG TERM SHASTA RIVER TEMPERATURE SITES 2017-2024.

Site code	L1DO	TM01DO	A01T	A1DO	400T	M1DO	S1DO	T1DO	V4BT	V4AT	V1DO	N1DO	U2DO	7163	U01T	HVDSSPG	U1DO	HVRALC	HVRSPL	HVRPOD
2025	25.46	26.96	26.01	25.88	26.06	26.64	26.18	23.16	22.61	22.44	22.60	23.68	23.36	22.99	20.65	20.32		14.24	23.81	21.15
2024	27.54	27.12	26.28	26.72	25.19	25.64	25.48	22.66	22.11	21.75	21.68	22.64	25.90	25.50	22.78	22.06		13.88	23.86	22.47
2023	27.02	26.28	26.36	25.36	25.28	24.62	25.15	22.62	21.99	21.46	21.25	23.12	22.22	22.20	20.78	20.01	21.33	14.76	23.05	21.39
2022	28.54	28.07	27.80	26.89		25.53	26.14	23.86	22.71	22.35	21.39	22.77	26.40	26.04	25.50	25.48	27.70	18.18	25.53	22.47
2021	30.52	29.41	31.36	28.08	28.17	27.68	25.24	24.89	23.21	22.51	21.72		26.33	26.38	25.38	25.33	25.06	18.46	25.02	22.82
2020	28.86	28.44	28.67	27.12	27.24	26.36	25.13	24.05	21.82	22.08	22.31	23.87	26.50	26.79	26.21	26.09	26.14	17.39	26.30	21.03
2019	27.97		26.72	25.66	25.79	25.01		22.31	21.58	20.48	20.50	21.74	22.71	22.54	21.10	20.58	22.67	13.83	24.17	23.14
2018	29.32	28.57	28.37	26.83	26.89	26.19	24.75	23.51	22.42	21.22	21.24	22.98	26.77	26.77	26.09	25.79	25.66	15.72	25.82	24.85
2017	27.82	27.24	26.94	25.39	25.38	24.91	24.89	22.07	22.23	22.47	22.43	22.70	23.55	23.16	21.10	19.75	18.96	16.08	24.29	24.34

13.83		31.36

FIGURE 10. HEAT MAP OF LONGITUDINAL MAX TEMP SITES FOR LONG TERM SHASTA RIVER TEMPERATURE SITES BETWEEN 2017-2025

Reach 1

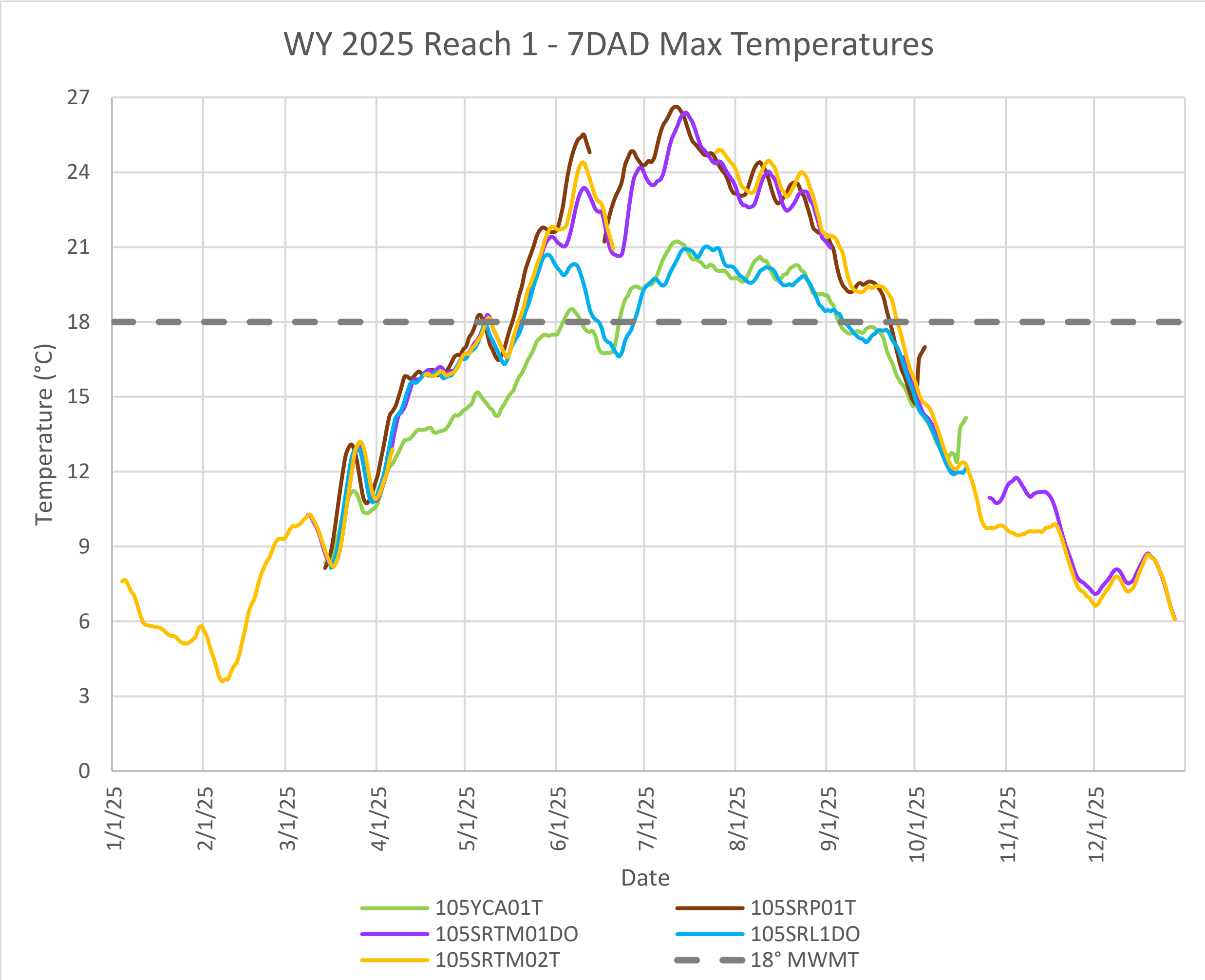


Figure 11. WY 2025 7DAD Maximum temperatures at Reach 1 (Shasta River and Yreka Creek sites).

Figure 12 displays MWMT criterion for juvenile coho salmon rearing and 7-DAD Max water temperatures at a site within the tributary Yreka Creek (105YCA01T) and sites downstream of the confluence of Yreka Creek within Shasta River Reach 1. In water year (WY) 2025, temperature and DO data were collected year-round at 105SRL1DO. There were 44 days not recorded in irrigation season at this site due to sensor failure. 7-DAD Maximum temperatures at Yreka Creek are consistently cooler than all other sites within Reach 1 throughout the monitored period. The temperature gap between Yreka Creek and the Shasta River in Reach 1 widens substantially from mid-May through mid-August when Reach 1 7-DAD Maximum temperatures reach their highest levels. Despite the overall increase in 7-DAD max temperatures throughout summer, 7-DAD Maximum temperatures at 105SYCA01T exceeds juvenile coho criterion for a sustained period of approximately four weeks, or roughly half the time of the Shasta River mainstem. 7-DAD Maximum temperatures throughout Reach 1 are generally consistent with each other, increasing only slightly in the downstream direction.

REACH 2

Figure 13 displays MWMT criterion for juvenile coho salmon rearing and 7-DAD Maximum water temperatures at sites within Shasta River Reach 2. These sites are located on the mainstem of the Shasta River between the confluences of Little Shasta River and Yreka Creek. In WY 2024, temperature and DO data were collected year-round at 105SRM1DO and 105SRA1DO. 7-DAD Maximum temperatures at all sites within Reach 2 are generally consistent with one another with 7-DAD Maximum temperatures increasing slightly in the downstream direction.

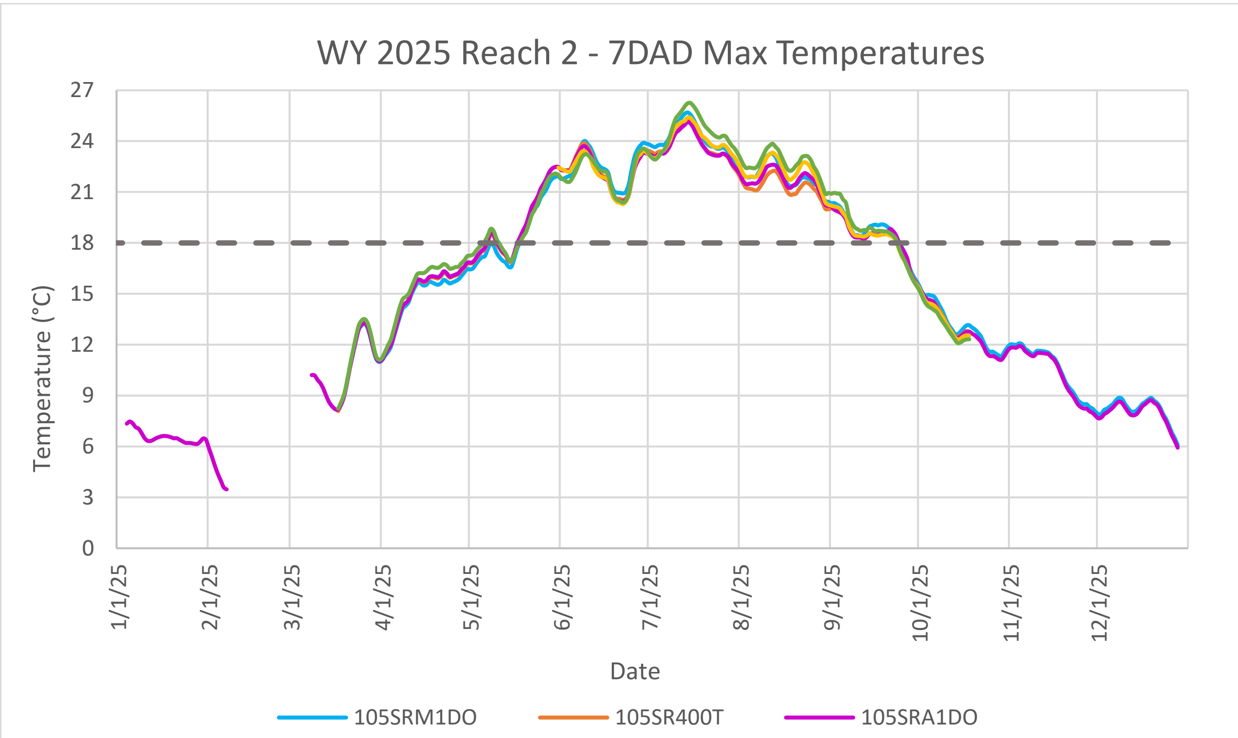


FIGURE 13. WY 2024 7-DAD MAXIMUM TEMPERATURES FOR REACH 2, SHASTA RIVER.

REACH 3

Figure 14 displays MWMT criterion for juvenile coho salmon rearing and 7-DAD Maximum water temperatures at sites within Shasta River Reach 3. These sites are located on the mainstem of the Shasta River between the confluences of Willow Creek and Little Shasta River. In WY 2024, temperature and DO data were collected year-round at 105SRT1DO AND 105SRS1DO. 7-DAD Maximum temperatures increased in the downstream direction through all sites in this reach. During the warmest part of the year, 7-DAD Maximum temperatures were nearly 3°C between the upstream and downstream sites, apart from 105SRHS1T_US. This sensor does not exceed MWMT criterion for juvenile coho salmon rearing because it is positioned near a spring that releases cool water year-round. Despite the other sensors exceeding the MWMT criterion for juvenile coho salmon for a sustained period at approximately the same time in mid-May, 7-DAD Maximum temperatures at 105SRT1DO drop below the criterion approximately three weeks sooner than the downstream site within this reach.

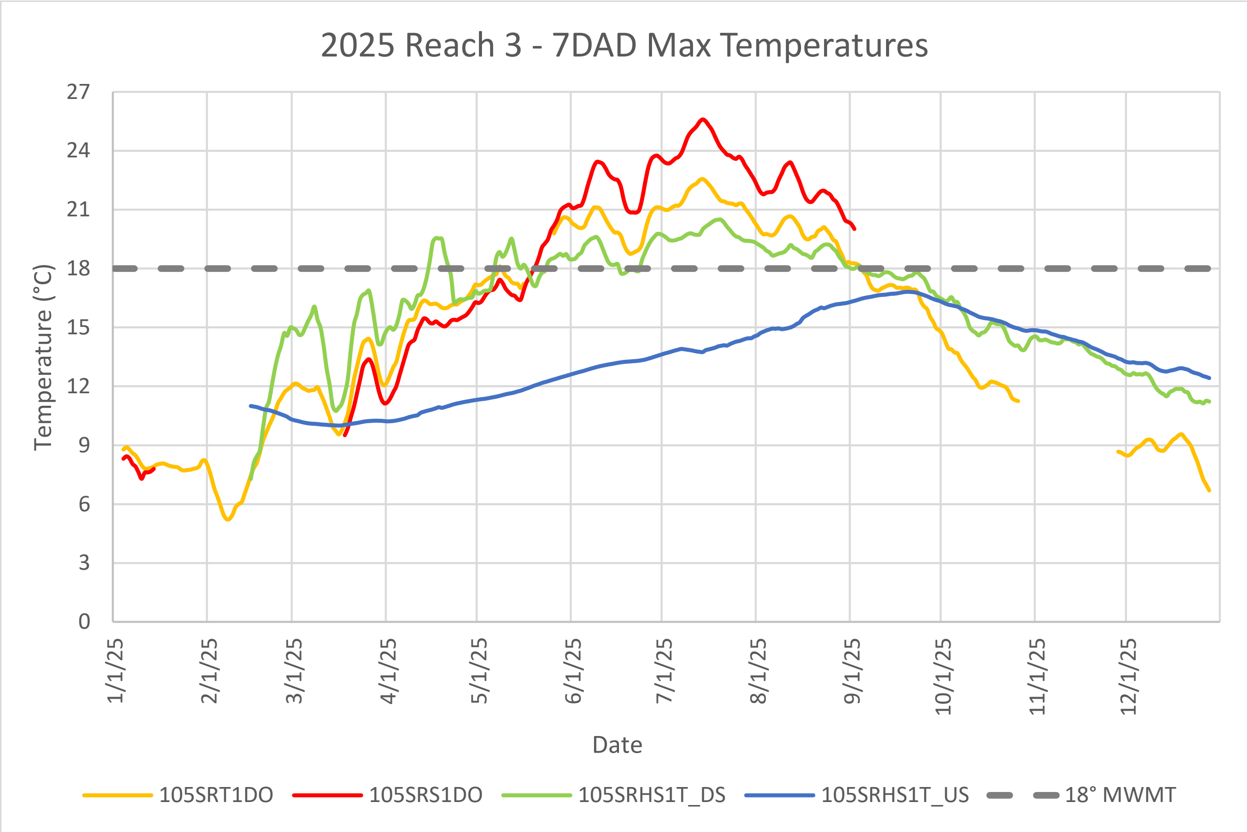


FIGURE 14. 2025 7-DAD MAX TEMPERATURES FOR SHASTA RIVER, REACH 3.

REACH 4

Figure 15 displays MWMT criterion for juvenile coho salmon rearing and 7-DAD Maximum water temperatures at sites within Shasta River Reach 4. These sites are located on the mainstem of the Shasta River between the confluences of Big Springs Creek and Willow Creek. In WY 2024, temperature and DO data were collected year-round at all sites within Reach 4, except 104SRN01T, which was launched on April 2nd. Big Springs Creek adds a large volume (52 cfs average during July and August) of cold water to the Shasta River (Nichols et al. 2010). Consequently, 7-DAD Maximum water temperatures within this reach are consistently cooler throughout irrigation season than in all other reaches within the Shasta River. 7-DAD Maximum temperatures at the farthest upstream site, while still relatively cool, are consistently warmer than at the next downstream site. Like previous years, this reach experiences a downstream cooling effect from 105SRN1DO to 105SRV4AT and then a warming trend again from 105SRV4AT to 105SRV4BT. This cooling effect is likely related to subsurface accretion related to the Big Springs complex. Additional water may come into the Shasta from basalt conduit downstream of Big Springs Creek. 7-DAD Maximum temperatures exceed the MWMT juvenile coho criterion for a sustained period beginning in mid-May through mid-late August.

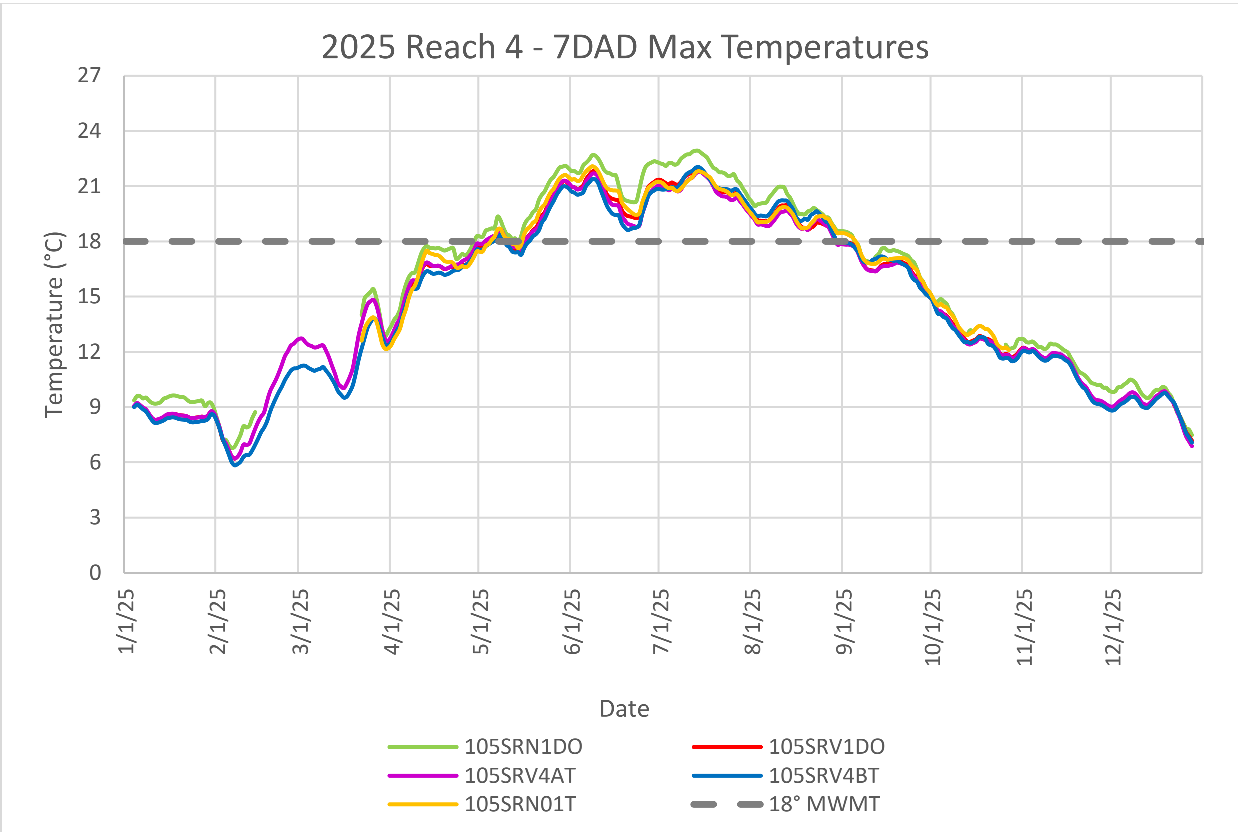


FIGURE 15. 2025 7-DAD MAX TEMPERATURES FOR SHASTA RIVER, REACH 4.

REACH 5

Figure 16 displays MWMT criterion for juvenile coho salmon rearing and 7-DAD Maximum water temperatures at sites within Shasta River Reach 5. Reach five spans the mainstem of the Shasta River between the confluences of Parks Creek and Big Springs Creek, and includes sites located on Parks Creek. In WY 2024, temperature and DO data were collected year-round at site 105SRP1DO. The Shasta River is supplemented by flows from Parks Creek and Hole in the Ground Creek in Reach 5. Coho salmon utilizes Parks Creek for migration, spawning and juvenile rearing (Chesney et al. 2009). Recent projects on Parks Creek, including the SVRCD's completion of the Parks Creek Fish Passage Project at the Interstate-5 bridge and the Parks Creek Riparian Improvement Project upstream of the Interstate-5 bridge, are expected to improve water quality, habitat, and the mobility of aquatic species. Monitoring sites on Parks Creek span nearly twelve river miles. 7-DAD maximum temperatures show a downstream warming trend throughout irrigation season. The furthest downstream site, 105PCFPDO, records the highest 7-DAD maximum temperatures, peaking for two months during the irrigation season. In contrast, the furthest upstream site, 105SRBS5T, maintains the lowest temperatures throughout the season. Temperatures at 105PCB1DO may be affected by changing flow patterns in the braided channel at this location. Additionally, there are several springs between 105PCFPDO and 105SRP1DO which may influence temperature variations.

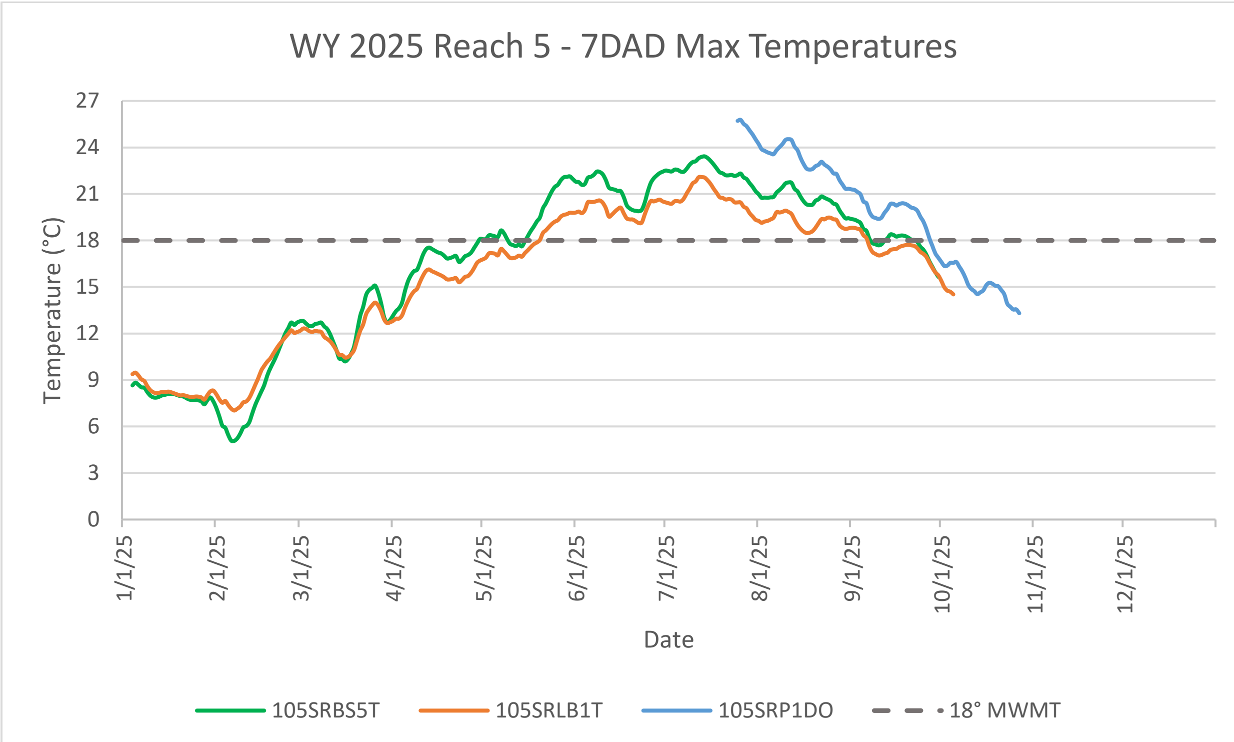


Figure 16. 2025 7-DAD Max temperatures at Parks Creek Reach 5. All sites are on Parks Creek.

Reach 6

Figure 17 displays MWMT criterion for juvenile coho salmon rearing and 7-DAD Maximum water temperatures at sites within Shasta River Reach 6. These sites are located on the mainstem of the Shasta River between Parks Creek and the outlet of Dwinnell Reservoir. 7-DAD Maximum temperatures at most sites consistently exceeded the MWMT juvenile coho criterion beginning late-May through mid-September. 7-DAD Maximum temperatures generally increased downstream in this reach, except 105SRHVRALC, which is adjacent to a cold spring and records the outlet of cold-water inputs to the Shasta River. All 7-DAD Maximum temperatures at sites downstream of the spring pipeline connection project are cooler than the 7-DAD Maximum temperature at the site immediately upstream of it.

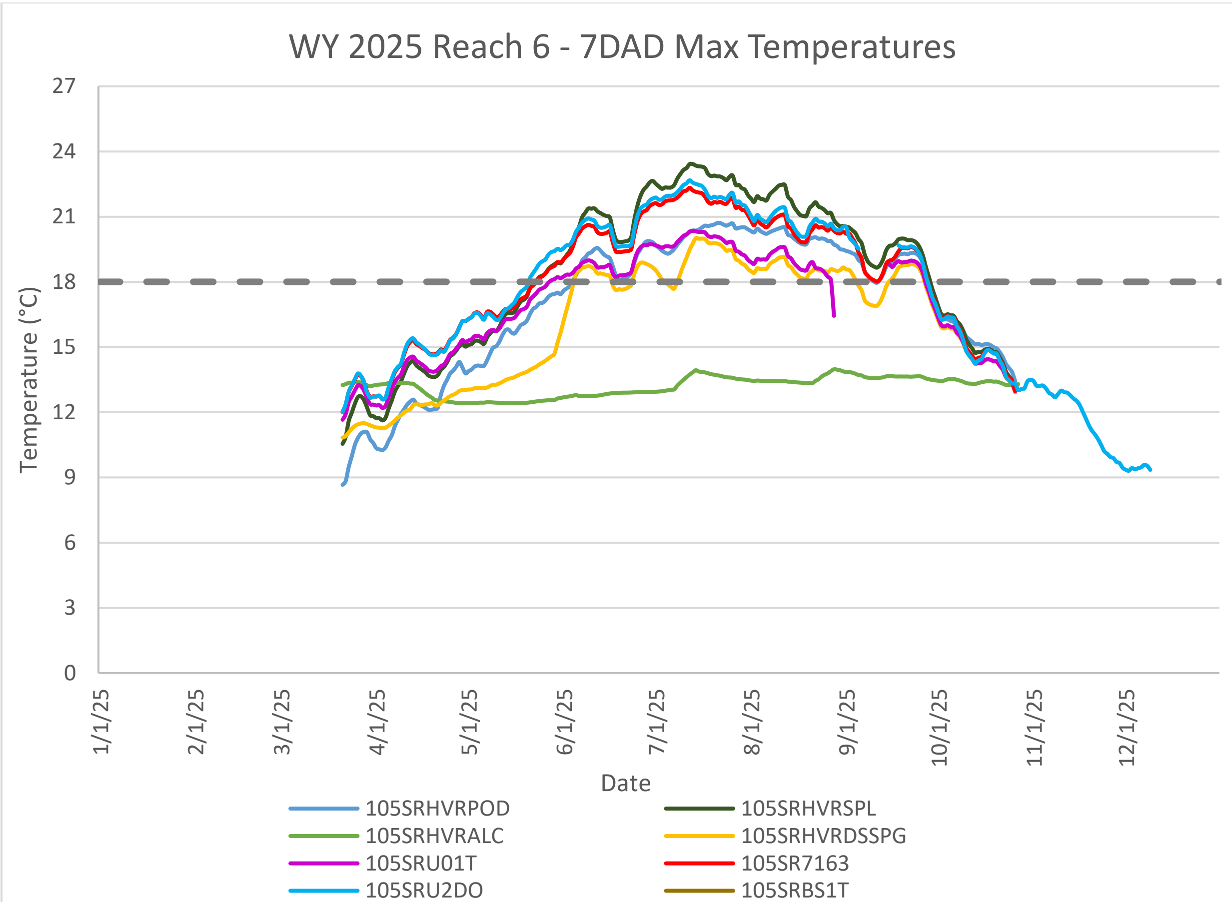
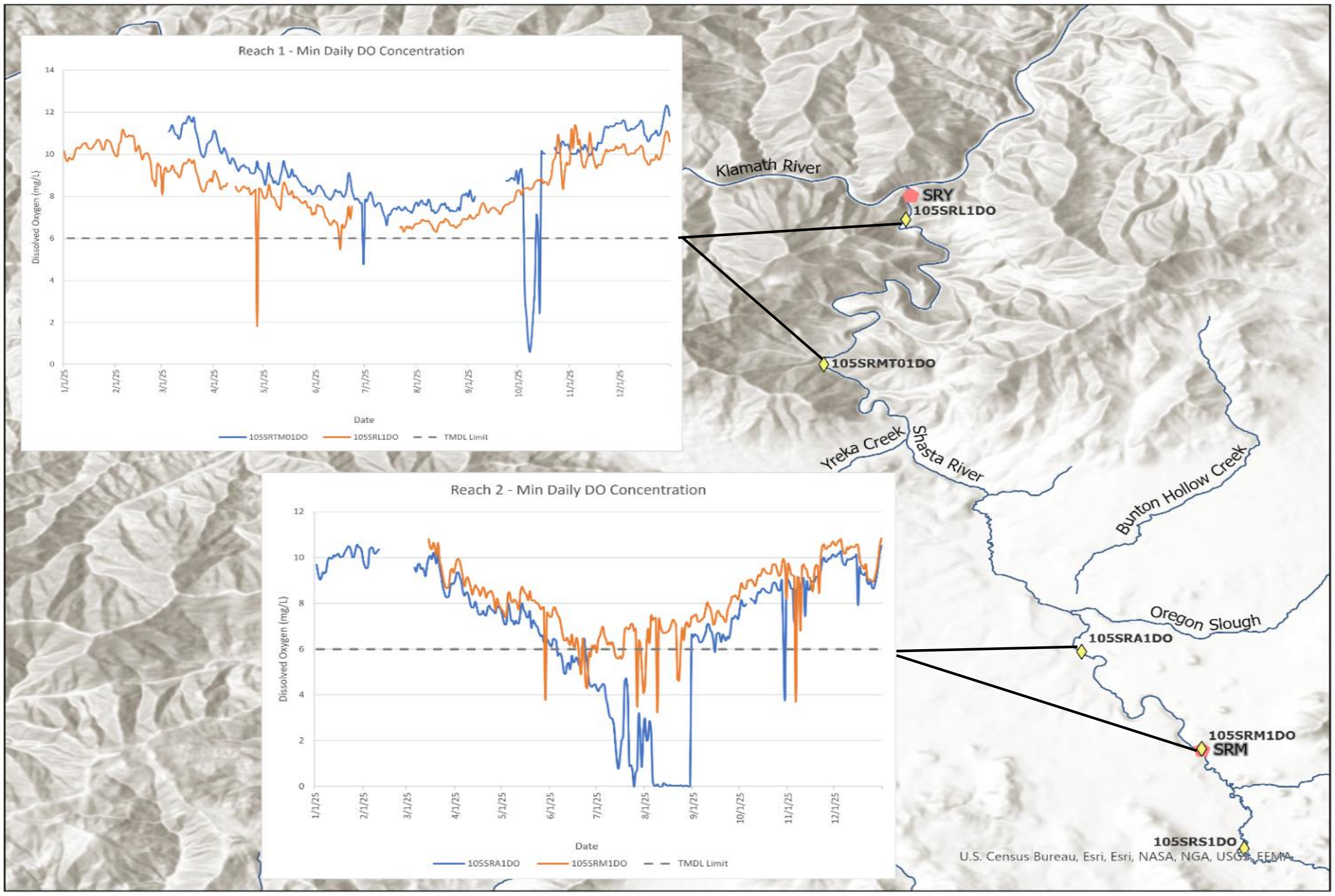


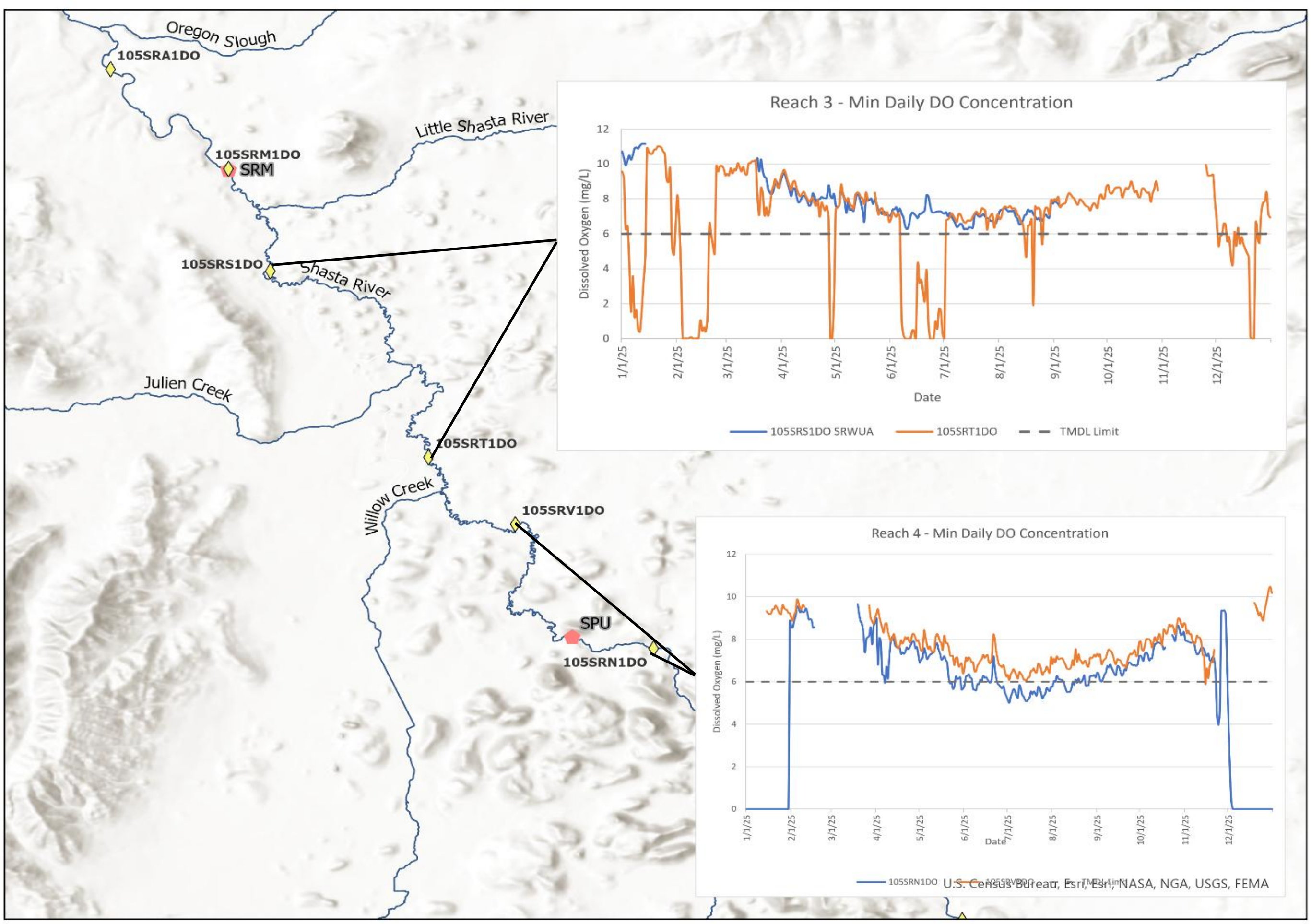
FIGURE 17. 2025 7-DAD MAX TEMPERATURES AT MONITORING LOCATIONS IN THE SHASTA RIVER AT REACH 6.

DISSOLVED OXYGEN RESULTS

Dissolved oxygen (DO) levels in surface waters are not constant but change throughout the day as oxygen is added (by photosynthesis and reaeration) and removed (by carbonaceous and nitrogenous deoxygenation, sediment oxygen demand, and respiration) from the water. Salmonids such as coho and Chinook salmon are particularly sensitive to low DO concentrations as DO regulates metabolic activity in these and many fish species (Fry 1971). The 2015 North Coast Water Quality Control Plan states that the minimum dissolved oxygen concentration in the Shasta River should not fall below 6 mg/L.

Diurnal DO fluctuations were recorded at ten monitoring sites on the Shasta River and its tributaries. Lowest concentrations of DO were between 23:00 and 7:00 when respiration occurs without photosynthesis, while the highest concentrations of DO were between 12:00 and 15:00 when peak photosynthesis occurs.


Reach 1 - Min Daily DO Concentration
Dissolved Oxygen (mg/L)
Date
105SRTM01DO
105SRL1DO
TMDL Limit
Reach 2 - Min Daily DO Concentration
Dissolved Oxygen (mg/L)
Date
105SRA1DO
105SRM1DO
TMDL Limit
Klamath River
SRY
105SRL1DO
105SRMT01DO
Yreka Creek
Shasta River
Bunton Hollow Creek
Oregon Slough
105SRA1DO
105SRM1DO
SRM
105SRS1DO
U.S. Census Bureau, Esri, Esri, NASA, NGA, USGS, FEMA


Oregon Slough
105SRA1DO
Little Shasta River
105SRM1DO
SRM
105SRS1DO
Shasta River
Julien Creek
105SRT1DO
Willow Creek
105SRV1DO
SPU
105SRN1DO
Reach 3 - Min Daily DO Concentration
Dissolved Oxygen (mg/L)
Date
105SRS1DO SRWUA
105SRT1DO
TMDL Limit
Reach 4 - Min Daily DO Concentration
Dissolved Oxygen (mg/L)
Date
105SRN1DO
U.S. Census Bureau, Esri, Esri, NASA, NGA, USGS, FEMA

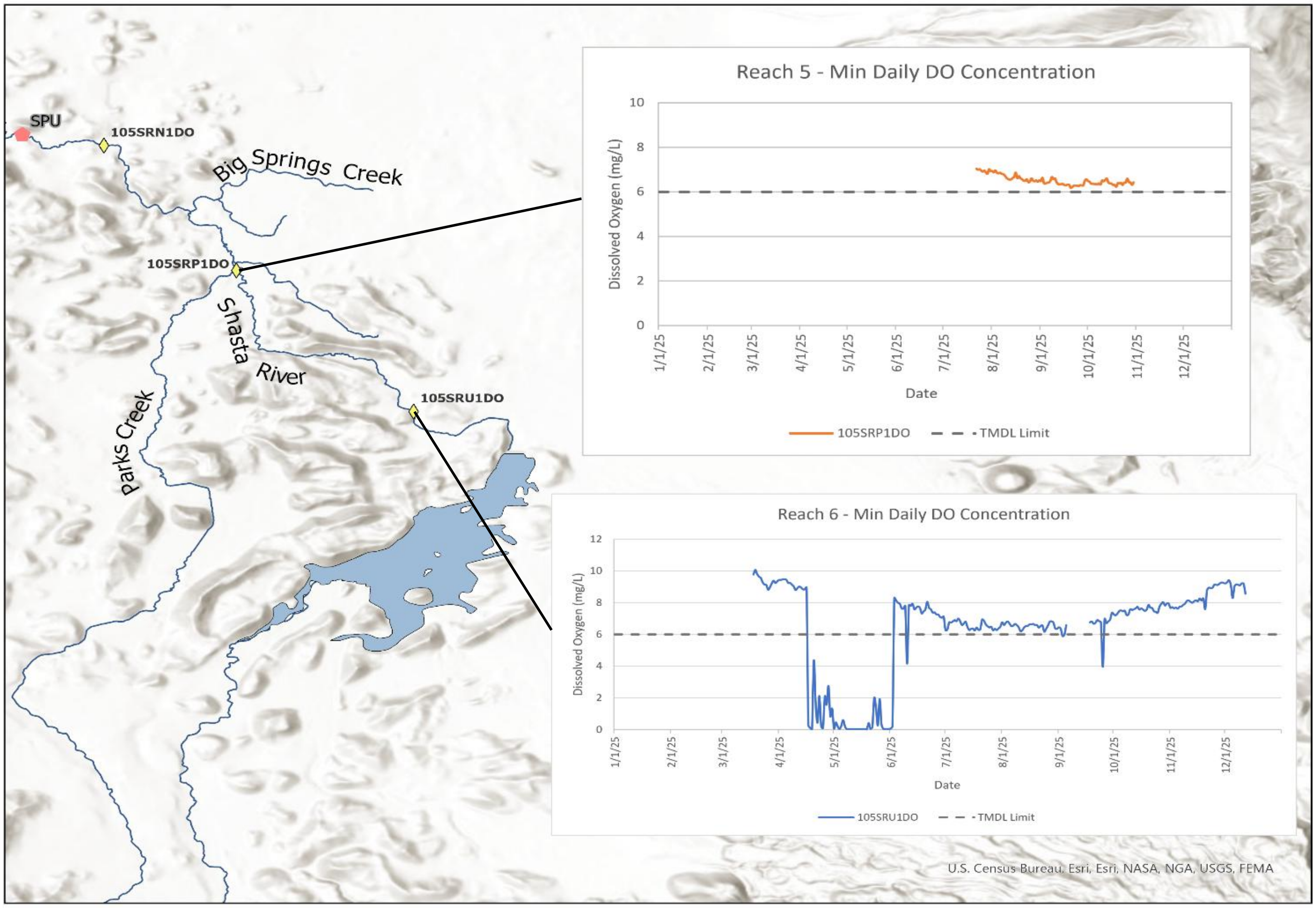


FIGURE 18. WY 2025 DAILY MINIMUM DO AT ALL SHASTA RIVER SITES, SHOWN BY REACH, GEOGRAPHICALLY OVERLAYED THROUGHOUT THE REGION THEY ARE MONITORED IN THE SHASTA VALLEY.

Figure 1818 displays the daily dissolved oxygen minimums by geographic reach for WY 2025 at all sites on the Shasta River. The general trend was an increase in DO at all sites with maximums occurring around December and January followed by a continuous reduction in the daily minimum DO from early April through late July due to seasonal warming and associated increased Biological Oxygen Demand (BOD). This general trend is also observed in all Parks Creek sites, with a slight increase in daily minimum DO from the beginning of the period of record through the end of April. The slight increase is likely from decreased temperatures and reduced BOD. This peak around December and January is followed by a steep reduction in the daily minimum DO level from the end of April through late July and August due to seasonal warming and increased BOD. Noteworthy is the reduction in daily minimum DO decline at sites farther upstream on Parks Creek. More upstream monitoring sites on Parks Creek are likely to be less nutrient rich and have proportionately less BOD. General trends for all Shasta River and Parks Creek sites are characterized by increasing DO levels from late July and August through early October due to cooling temperatures, decreased solar radiation from regional wildfires, and increased production of instream vegetation (e.g., macrophytes).

Table 10 displays the percentage of days that each site fell below the TMDL (6 mg/L) during the 2025 irrigation season. Mid River sites and Parks Creek experienced a significant percentage of days below the TMDL. The upper river and canyon reach experienced more consistent levels above 6 mg/L with few depressions throughout the irrigation season and some triggered by seasonal storms. Persistent drivers of dissolved oxygen demand within the Shasta River Watershed are all exacerbated by drought conditions, although 2025 was not considered a drought year.

TABLE 10. PERCENTAGE OF DAYS MONITORED WHERE DO FELL BELOW 6 MG/L.

Reach	DO Monitoring Site	% of Days DO below 6 mg/L	**% of Days DO below 6 mg/L (adj.)	Days of Quality Data
1	105SRL1DO*	18.58	24.46	139
	105SRTM01DO*	10.38	11.95	159
2	105SRA1DO	46.45	--	183
	105SRM1DO***	12.02	--	183
3	105SRS1DO*	0	0	158
	105SRT1DO*	19.13	20.11	174
4	105SRV1DO	0.55	--	183
	105SRN1DO	36.61	--	183
5	105SRP1DO*	0	0	68
6	105SRU2DO*	34.43	36.84	171

*Sensor has a reduced number of days of quality data due to burial or defective equipment

** **% of Days DO below 6 mg/L (adj.)** – Adjusted value of percent exceedance of the TMDL to account only for days monitored, which was not the entire irrigation season. More information on the derivation of this value can be found in the “Temperature Sampling” section of this report.

***Some DO crashes likely from debris hitting sensor and not indicative of a true DO Crash

REACH 1

Daily maximum temperature, daily minimum DO, and the juvenile coho DO criterion for site 105SRL1DO is shown in Figure 19. DO and temperature equipment were deployed between January 1, 2025 and December 31, 2025. There are 44 days of missing data during irrigation season due to sensor failure. DO levels fell below the juvenile coho DO criterion of 6 mg/L in 34 of the 139 days for which quality DO data was recorded during the 2025 irrigation season.

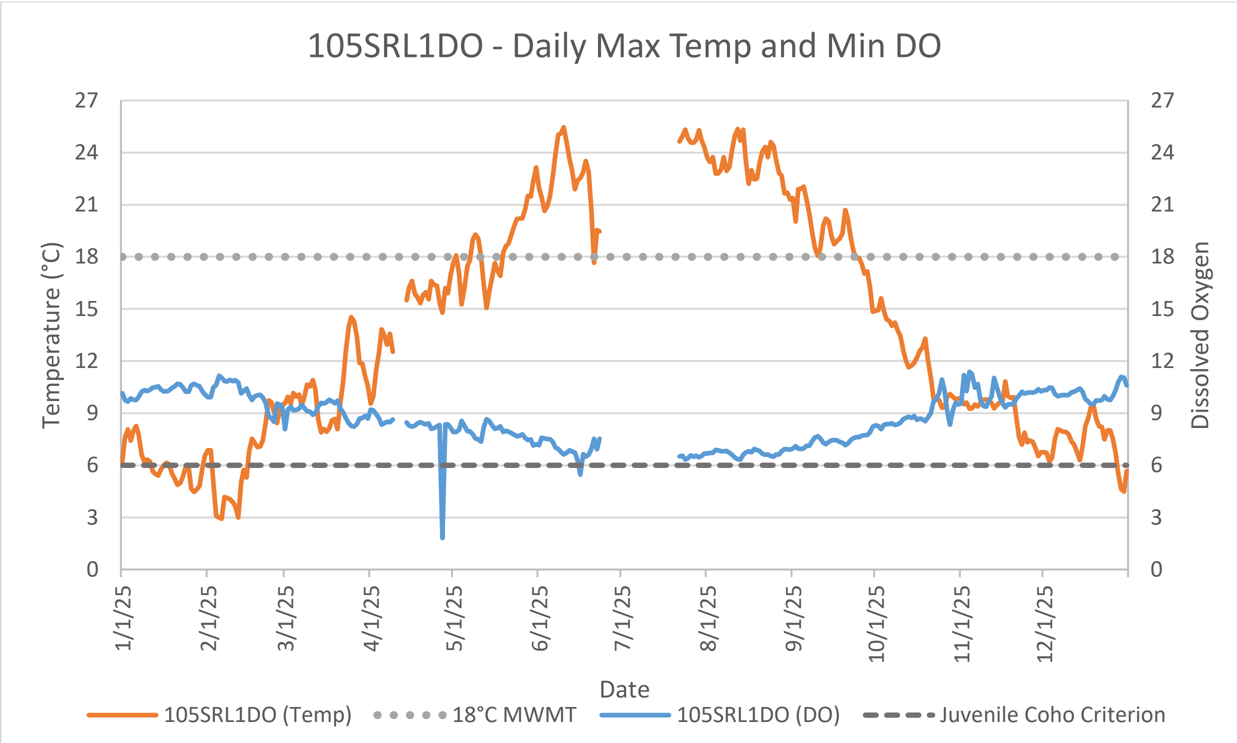


FIGURE 20. 2025 DAILY MAXIMUM TEMPERATURE AND DAILY MINIMUM DO AT 105SRL1DO, SHASTA RIVER.

Daily maximum temperature, daily minimum DO, and the juvenile coho DO criterion for site 105SRTM01DO is shown in Figure 22. DO and equipment was deployed between March 8, 2025 and December 31, 2025. DO data is missing from September 3rd to the 19th because of sensor failure. DO levels fell below the juvenile coho DO criterion of 6 mg/L in 19 of the 159 days for which quality DO data was recorded during the 2025 irrigation season.

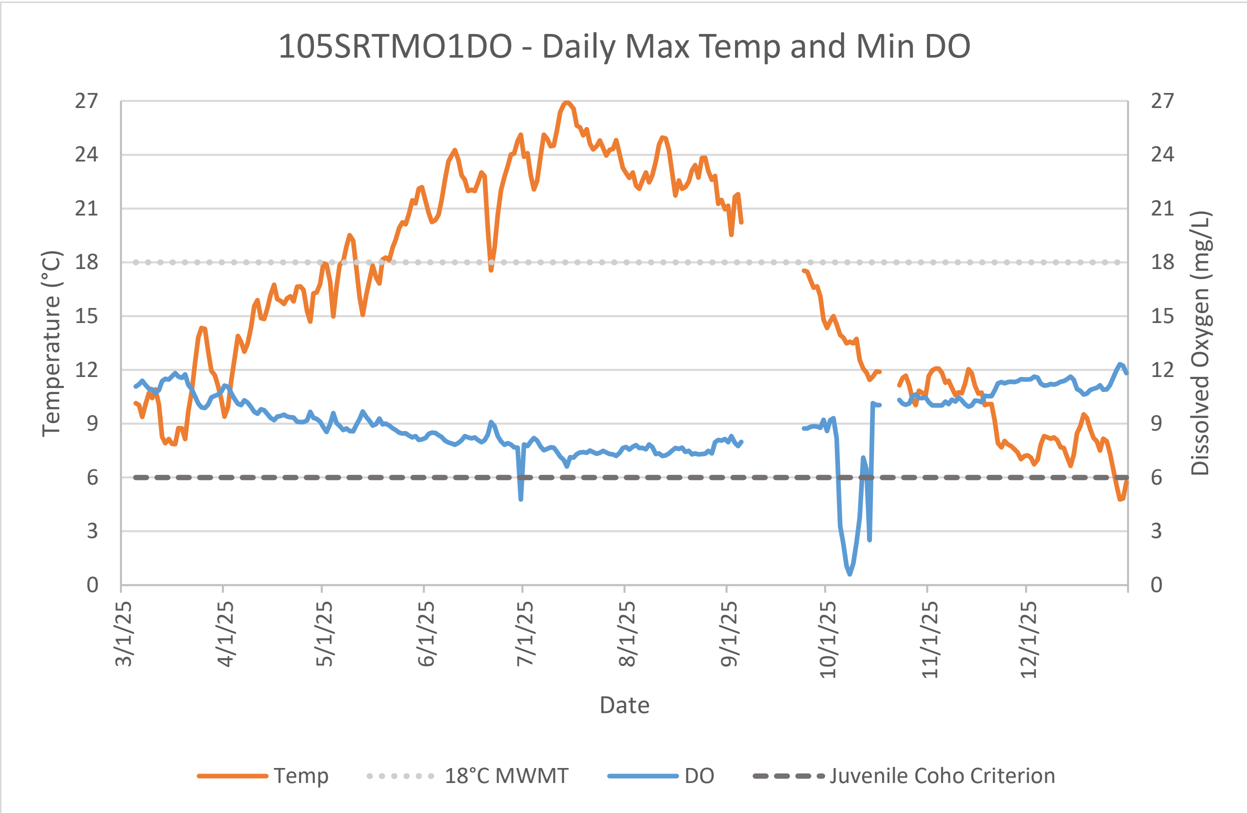


FIGURE 22. 2025 DAILY MAXIMUM TEMPERATURE AND DAILY MINIMUM DO AT 105SRTM01DO, SHASTA RIVER.

REACH 2

Daily maximum temperature, daily minimum DO, and the juvenile coho DO criterion for site 105SRA1DO is shown in Figure 23. DO and temperature equipment were deployed for 365 days, between January 1 and December 31, 2025. DO fell below the juvenile coho DO criterion of 6 mg/L in 85 of the 183 days of irrigation season for which quality DO data was recorded during the entire season.

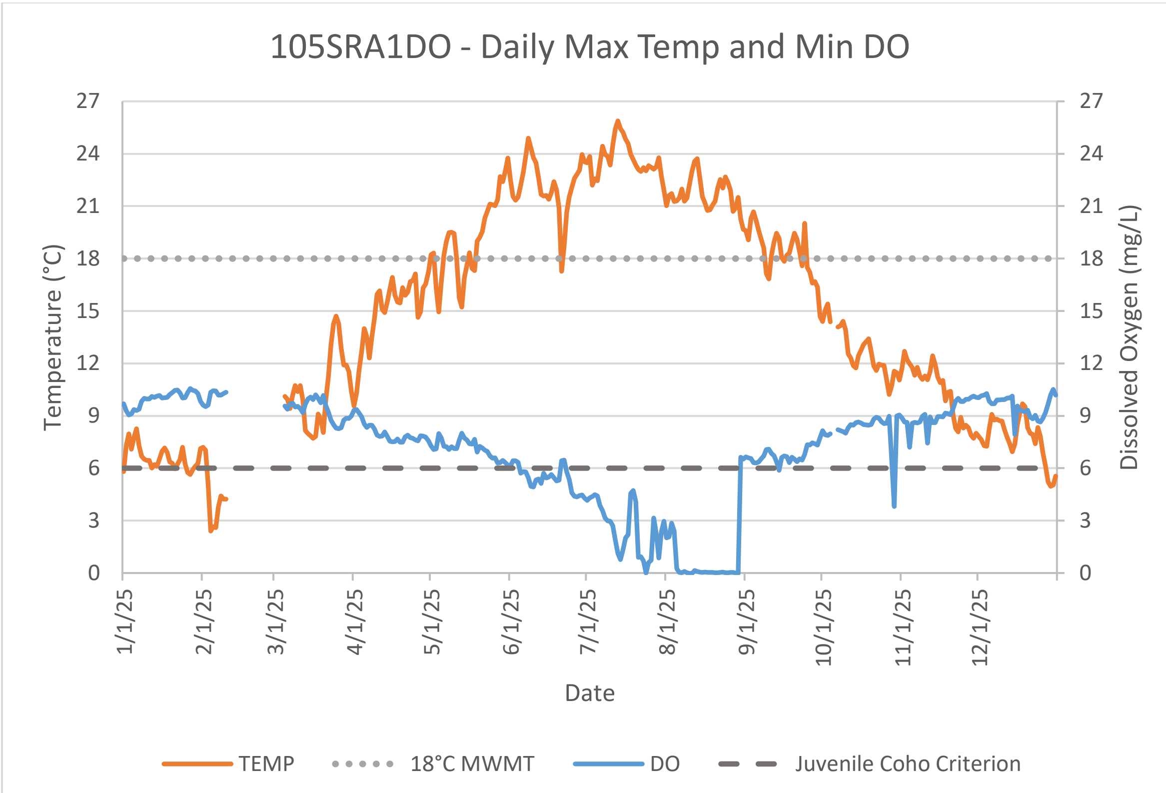


FIGURE 24. 2025 DAILY MAXIMUM TEMPERATURE AND DAILY MINIMUM DO AT 105SRA1DO, SHASTA RIVER.

Daily maximum temperature, daily minimum dissolved oxygen (DO), and the juvenile coho DO criterion for site 105SRM1DO are shown in Figure 25. DO equipment was deployed from March 14 through December 31, 2025, capturing the full irrigation season. DO fell below the juvenile coho criterion of 6 mg/L on 22 of the 183 days for which quality-controlled DO data were recorded during the 2025 irrigation season. Although the QA/QC data displays all apparent DO crashes, some brief events are likely attributable to debris contacting the sensor rather than true DO crashes, as they lasted less than one hour and were not observed concurrently at other sites across the river system.

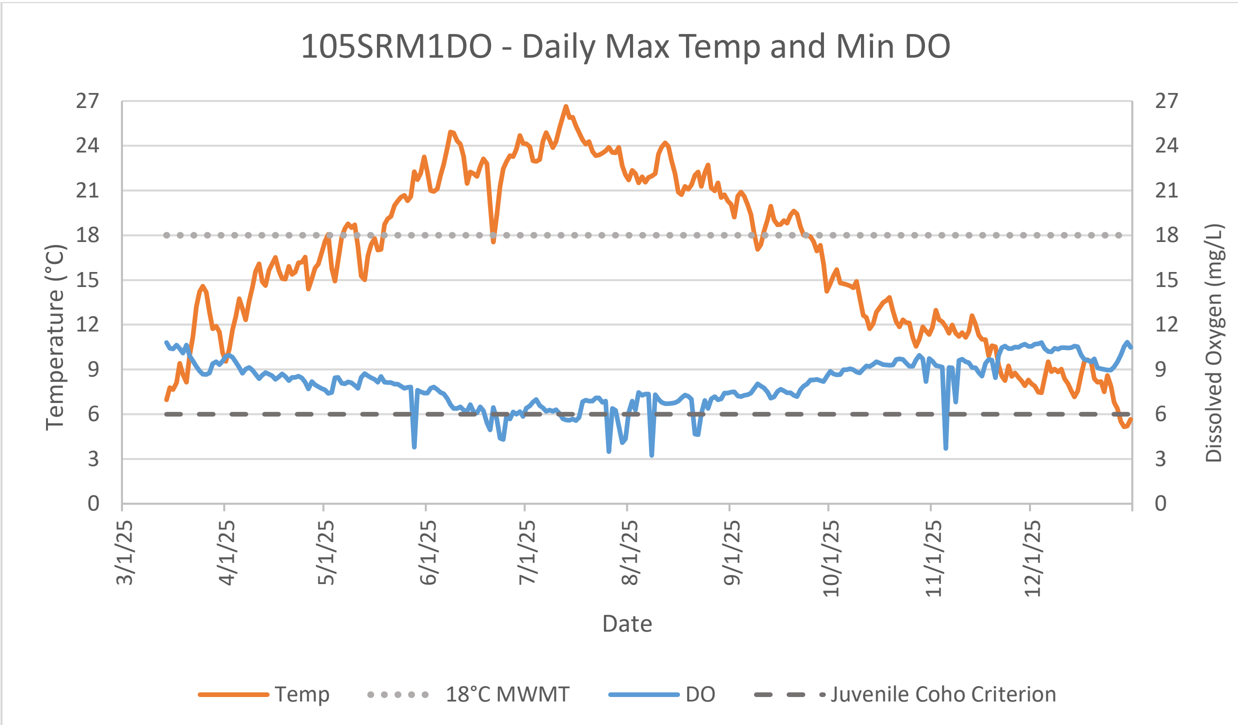


FIGURE 26. 2025 DAILY MAXIMUM TEMPERATURE AND DAILY MINIMUM DO AT 105SRM1DO, SHASTA RIVER.

REACH 3

Daily maximum temperature, daily minimum DO, and the juvenile coho DO criterion for site 105SRS1DO is shown in Figure 27. DO equipment was deployed between January 1 and September 2nd, 2025. 158 days were monitored in the irrigation season. Equipment was pulled early due to sensor failure. DO fell below the juvenile coho DO criterion of 6 mg/L in 0 of the 158 days for which quality DO data was recorded during the 2025 irrigation season.

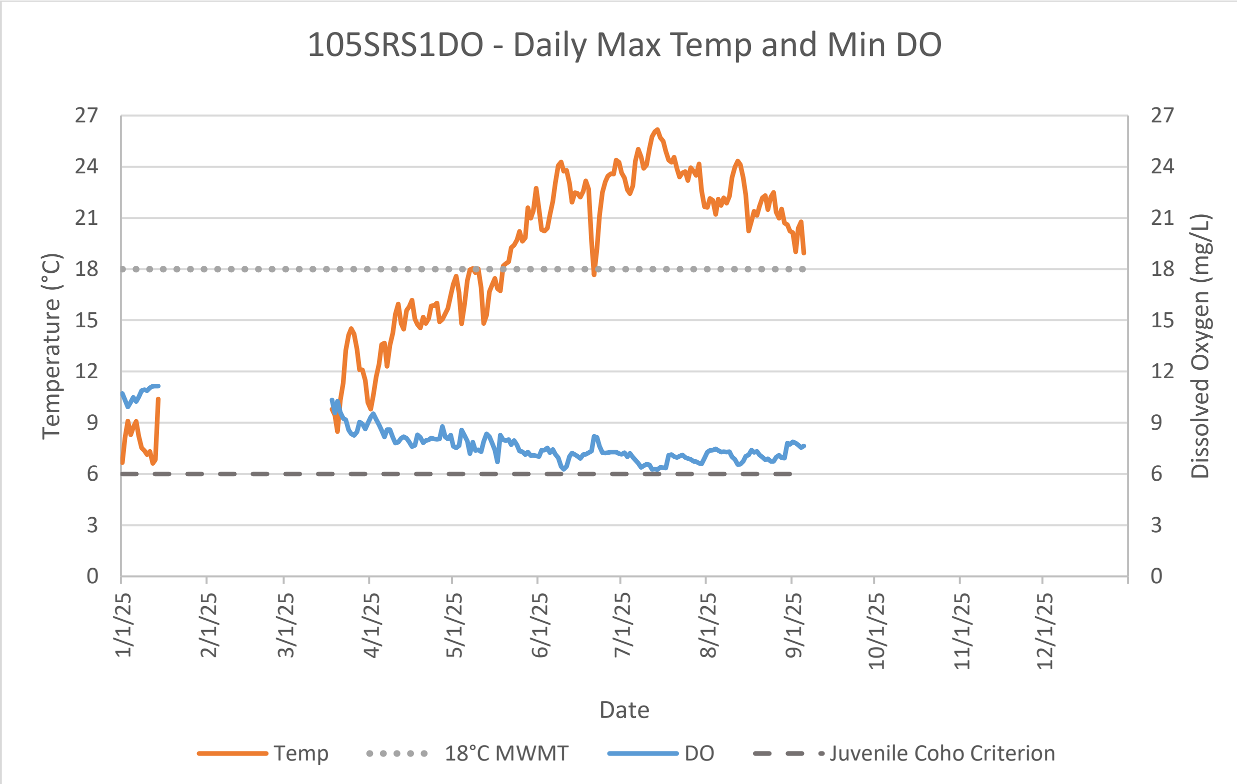


Figure 28. 2025 daily maximum temperature daily minimum DO at 105SRS1DO, Shasta River.

Daily maximum temperature, daily minimum DO, and the juvenile coho DO criterion for site 105SRT1DO shown in Figure 29. DO equipment was deployed between January 1 and December 31, 2025. DO fell below the juvenile coho DO criterion of 6mg/L in 35 of the 174 days for which quality DO data was recorded during the 2025 irrigation season. It is possible that DO crashes of multiple days are a result of the sensor getting buried in sediment and are not indicative of the true state of the DO in this reach of the river. DO data is missing between May 17 – 25th because of sensor burial, and October 27th – November 27th due to sensor failure.

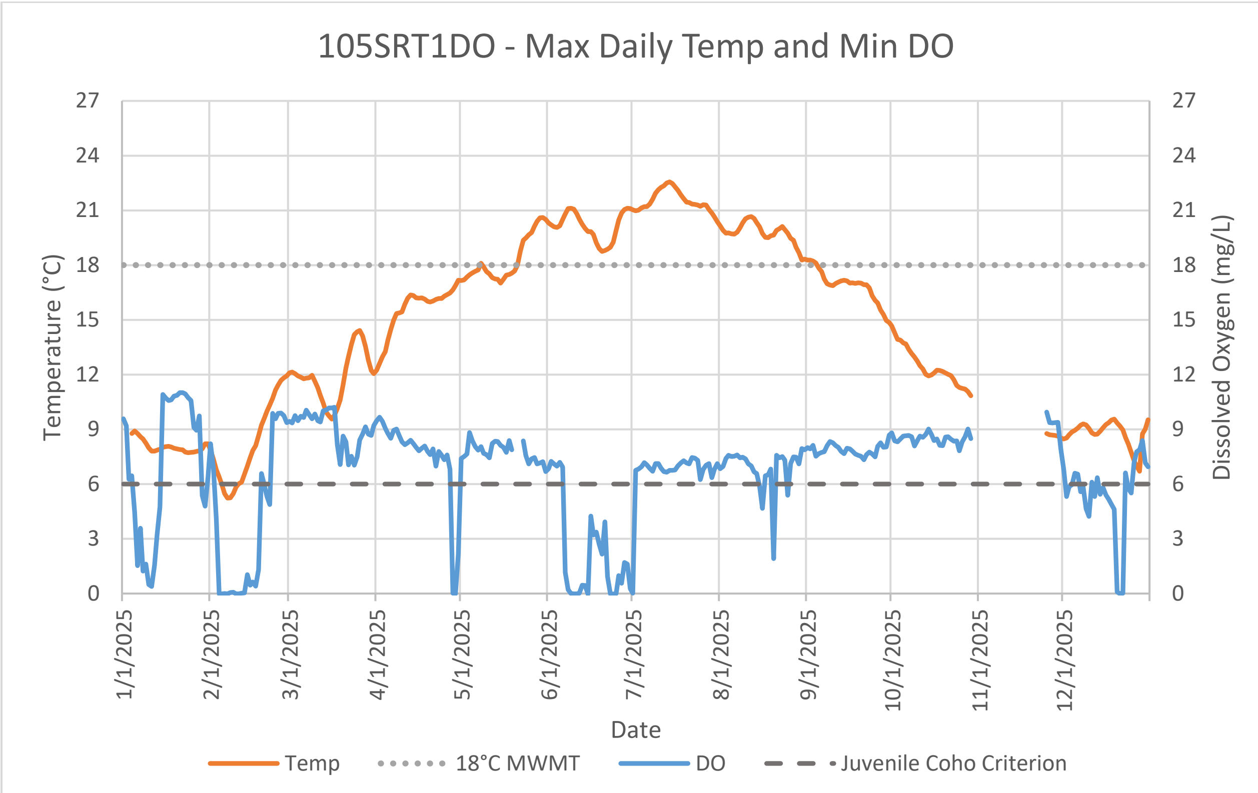


FIGURE 30. 2025 DAILY MAXIMUM TEMPERATURE AND DAILY MINIMUM DO AT 105SRT1DO, SHASTA RIVER.

REACH 4

Daily maximum temperature, daily minimum DO, and the juvenile coho DO criterion for site 105SRV1DO are shown in Figure 31. DO equipment was deployed between January 1 and December 31, 2025. DO levels fell below the juvenile coho DO criterion of 6 mg/L in 1 of the 183 days for which quality DO data was recorded during the 2025 irrigation season.

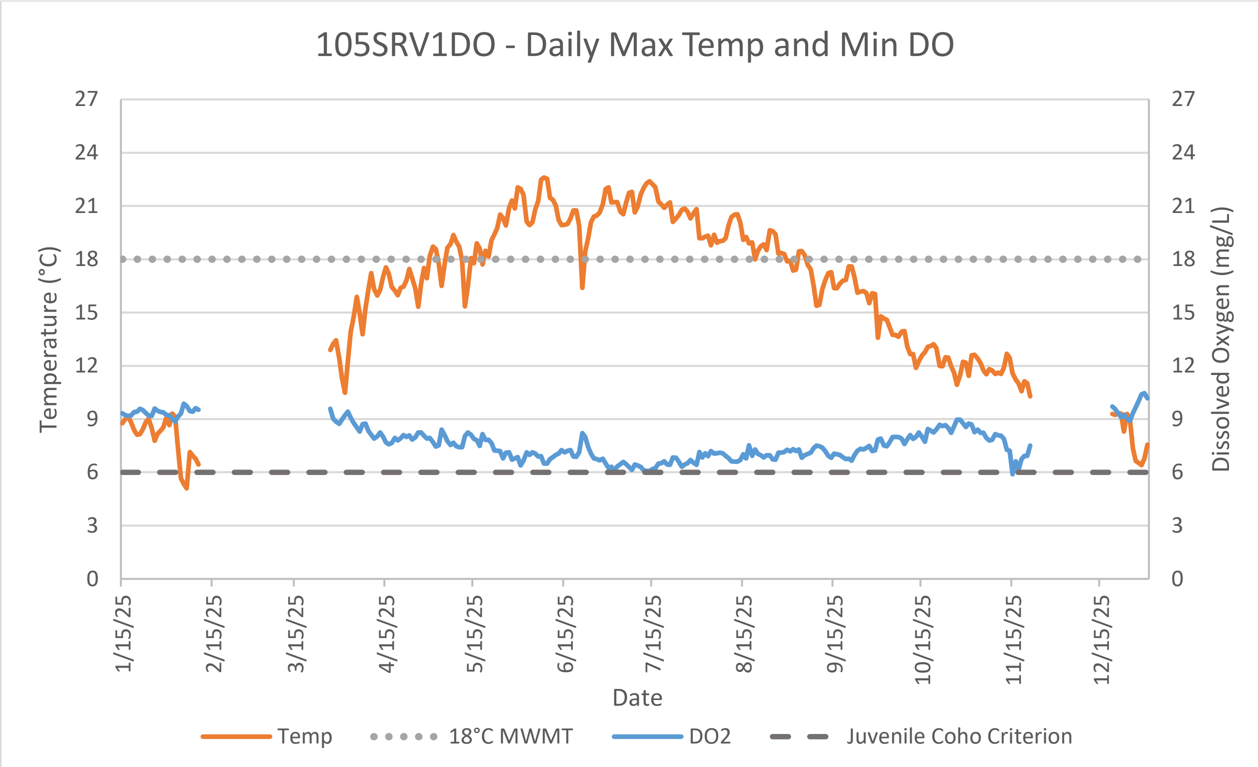


FIGURE 32. 2025 DAILY MAXIMUM TEMPERATURE AND DAILY MINIMUM DO AT 105SRV1DO, SHASTA RIVER.

Daily maximum temperature, daily minimum DO, and juvenile coho DO criterion for site 105SRN1DO are shown in Figure 33Figure 34. DO equipment was deployed between January 1 and December 31, 2025. DO levels fell below the juvenile criterion DO criterion of 6 mg/L in 67 of the 183 days for which quality data was recorded during the 2025 irrigation season.

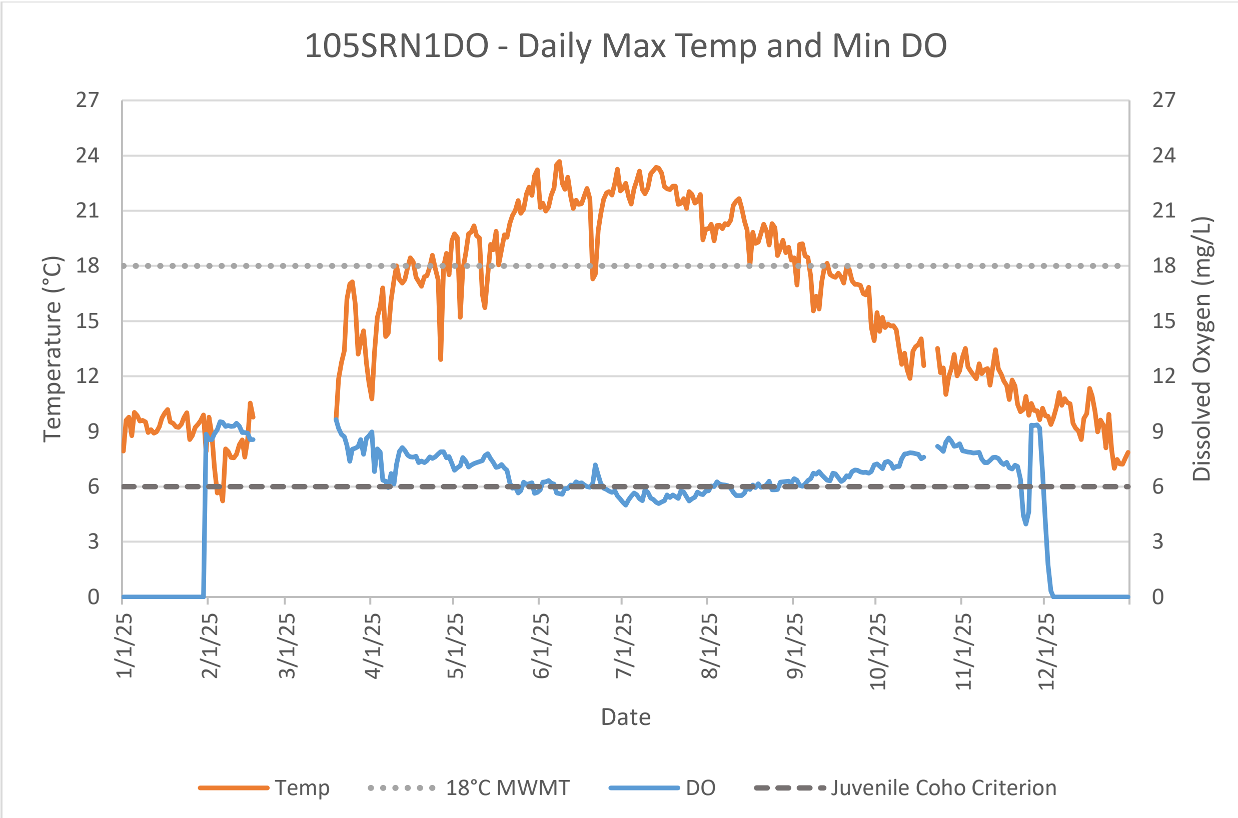


FIGURE 34. 2025 DAILY MAXIMUM TEMPERATURE AND DAILY MINIMUM DO AT 105SRN1DO, SHASTA RIVER.

REACH 5

Daily maximum temperature, daily minimum dissolved oxygen (DO), and the juvenile coho DO criterion for site 105SRP1DO are shown in Figure 26. DO and temperature data were collected over 184 days from July 25 through October 27, 2025. Data prior to this period are absent due to sensor failures earlier in the year: following deployment on January 1, 2025, the sensor experienced two major failures from which data could not be retrieved, and replacement equipment was unavailable during the repair period. DO did not fall below the juvenile coho criterion of 6 mg/L on any of the 68 days for which quality-controlled DO data were recorded during the 2025 irrigation season.

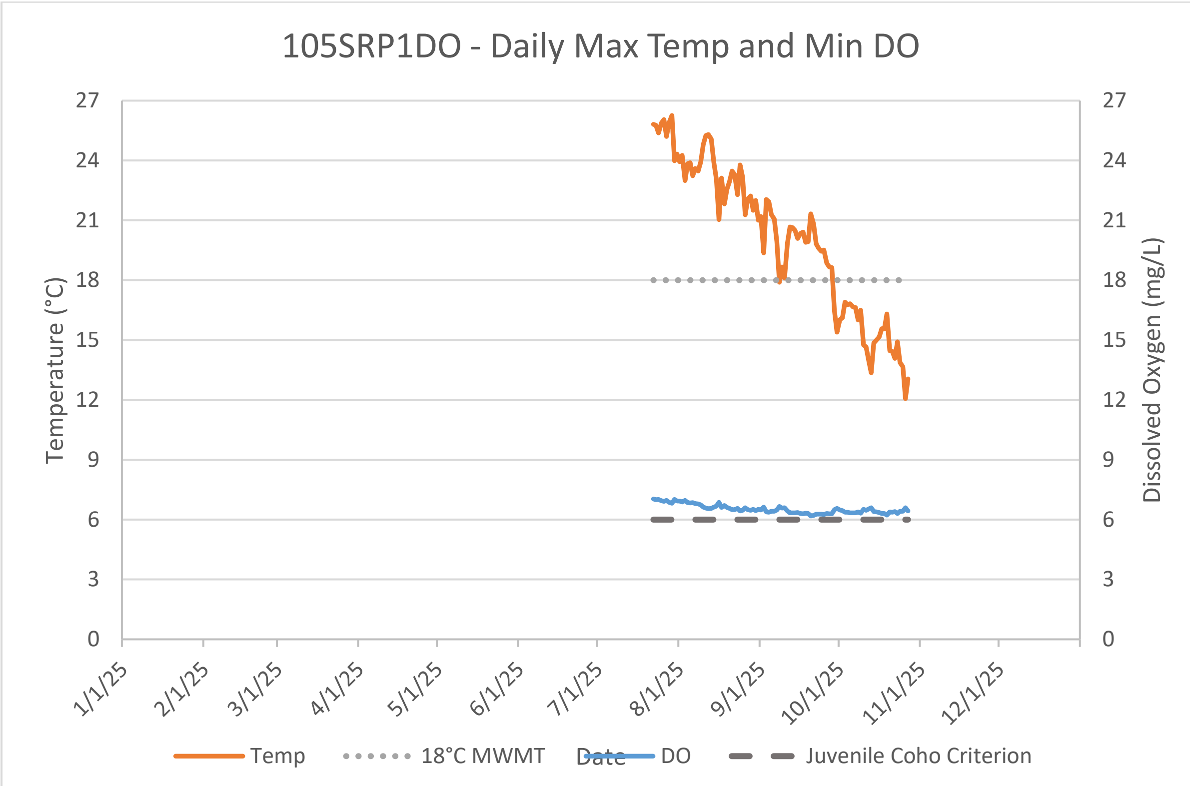


FIGURE 35. 2025 DAILY MAXIMUM TEMPERATURE AND DAILY MINIMUM DO AT 105SRP1DO, PARKS CREEK.

REACH 6

Daily maximum temperature, daily minimum DO, and the juvenile coho DO criterion for site 105SRU2DO are shown in Figure 36. DO and temperature equipment were deployed for 213 days from March 21 to December 9, 2025. Long term DO data at 105SRU2DO should be closely reviewed as the sensor regularly captures data from two separate flow regimes, one is dominated by subsurface inflows from an adjacent cold spring, and the second is Shasta River water released from Dwinnell Reservoir. Additionally, WY 2025 was cool and wet and provided enough precipitation over the winter that a spring water pipeline connection project could be operated. The presence of nearby beaver dams has reduced flow velocities and increased fine sediment deposition which can increase sediment oxygen demand (SOD). DO levels fell below the juvenile coho DO criterion of 6 mg/L in 62 of the 171 days for which quality DO data was recorded during the 2025 irrigation season. The extended DO crash between April 17th and June 3rd is because of sediment burial withing the canister which houses the sensor.

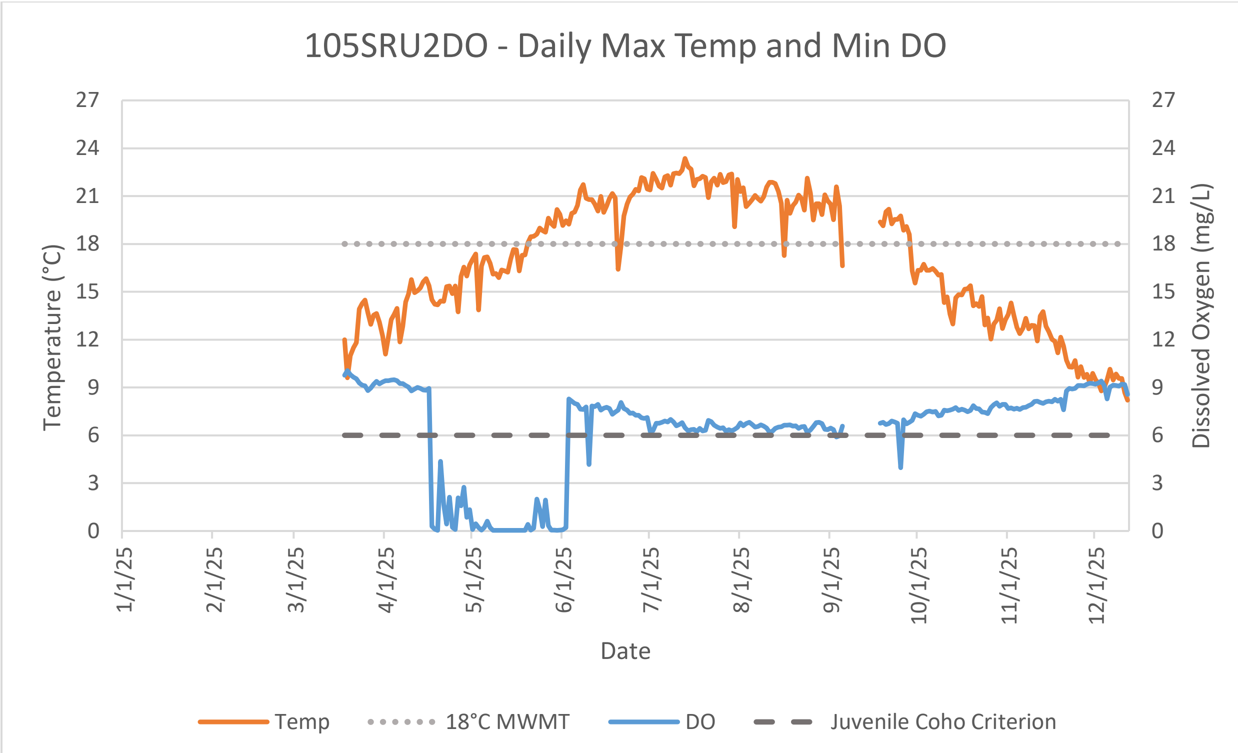


FIGURE 36. 2025 DAILY MAXIMUM TEMPERATURE AND DAILY MINIMUM DO AT 105SRU1DO, SHASTA RIVER.

SUMMARY OF MANAGEMENT ACTIONS

The Governor's emergency drought declaration for Siskiyou County brought minimum instream flow requirements for the Shasta River. Marking the fourth full year of emergency instream required flows, 2025 saw nearly twice the volume of water move through the mainstem of the Shasta River during the irrigation season compared to non-curtailed years, particularly between Big Springs Creek and the confluence with the Klamath River. Using the water rights established in the Shasta River Decree as a guide when local collaboration did not achieve the required flows, curtailment of diversions from the Shasta River were enforced until the minimum required flow target was met, as measured at the Shasta River gauge near Yreka (see Table 6).

The intermittent drought, emergency minimum instream flow requirements, and dam removal present major changes to the Shasta River watershed management. These large-scale management changes make evaluation of progress of individual projects and changes to ranch management particularly challenging, but the multi-year longitudinal analysis of MWMT, MWAT, and Absolute Max temperatures clarifies year to year trends. A multi-year analysis between any two consecutive water quality monitoring sites in the proximity of known habitat restoration, water conservation, or changes to on-farm management projects is needed to fully assess efficacy of related actions. Looking at relative changes between two consecutive points on the river eliminates differences resulting from air temperatures, which are known to be the predominant driver of instream temperatures. Additionally, increased spatial resolution of water temperature and dissolved oxygen data, as well as spatial, temporal, and quantity of cold groundwater and spring water inputs would be helpful to better understand specific actions or changes in management within a given reach.

IMPACT ON WATER QUALITY

Water temperatures coinciding with increased flow volumes during the 2025 irrigation season generally corroborate the RMS model assumptions in the 2006 *Staff Report for the Action Plan for the Shasta River Watershed Temperature and Dissolved Oxygen Total Maximum Daily Loads*. Specifically, the 50% flow increase model scenario and the water quality compliance model scenario were broadly reproduced through the enforced diversion curtailment of BSID and diverters downstream of Big Springs Creek. Increased flow in an open channel increases stage which can have an insulating effect on water temperatures and increase habitat connectivity. The magnitude of this impact is variable and is highly dependent on channel morphology. Greater flow volume has a more pronounced effect on flow velocity. Since ambient air temperature is the primary factor influencing surface water temperatures in the Shasta River, increased water velocity helps reduce heat by moving water through the system more quickly, thereby lowering maximum temperatures. Despite this, water temperatures in the Shasta River still exceeded TMDL and MWMT objectives during the 2025 irrigation season at all monitoring sites that were not directly measuring spring inflows.

Increased water flow stabilizes dissolved oxygen levels by diluting the effects of oxygen consumption and production. With more water moving through the system, oxygen use has a weaker impact, and photosynthetic oxygen production is less concentrated, reducing daily fluctuations.

CONCLUSIONS

The compounding effects of a warming climate, ongoing drought, significant reaches lacking continuous riparian shade, and warm tailwater inputs continue to impact water temperatures in the Shasta River. Water temperatures and DO levels exceeded TMDL and MWMT objectives during the 2025 irrigation season at all monitoring sites that were not directly measuring spring inflows.

While comparisons and multi-year analysis of data have been made and presented, additional data and analysis are needed to make direct comparisons to the modeled water quality compliance scenario, including:

- Improved meteorological understanding of air temperature and annual precipitation within the upper watershed and valley floor.
- Improved understanding of site potential shade and channel width on expected temperature allocation
- Analysis of all temperature data using 5-DAD maximum temperatures.
- And improved data resolution around TMDL temperature and DO compliance point at RM 5.6.

Many recorded DO crashes in previous years were likely attributable to sensor burial rather than actual low-oxygen plumes moving through the river system. To address this, most DO monitor stations were updated in 2025 with new equipment designed to keep sensors elevated at least 6 inches above the riverbed in a fixed position. This improvement proved largely successful: data collected with the upgraded sensors show a clearer representation of true DO dynamics throughout the river system, with fewer anomalous depression events consistent with burial. While sediment burial was not eliminated as a source of data interference, the 2025 monitoring season demonstrated a meaningful improvement in data quality and confidence in the DO record.

Additional coordination with other entities involved in preparing integrated hydrologic models for the Shasta River Watershed would also be beneficial. These include the Siskiyou County Flood Control and Water Conservation District and their agents, as well as the State Water Resources Control Board and the California Department of Fish and Wildlife.

Continued efforts to identify high quality water within the watershed while also improving infrastructure and on farm practices to leverage and increase the impact of improved water quality remain the SVRCDs top priority.

SVRCD looks forward to working with agencies and stakeholders to support them in adapting to broader changes to resource management within our district.

REFERENCES

United States Geological Survey. 2023. Shasta River Flow datasets. Datasets accessed 2023-01-31 at https://waterdata.usgs.gov/ca/nwis/.

Carter, K. 2005. The Effects of Temperature on Steelhead Trout, Coho Salmon, and Chinook Salmon Biology and Function by Life Stage: Implications for Klamath Basin TMDLs. California Regional Water Quality Control Board North Coast Region. 26pp.

Chesney, W. R., Adams, C. C., Crombie, W. B., Langendorf, H. D., Stenhouse, S. A., & Kirkby, K. M. (2009). Shasta River juvenile coho habitat and migration study. *Prepared for US Bureau of Reclamation, Klamath Area Office by California Department of Fish and Game*.

Fry, F. E. J. 1971. The effect of environmental factors on the physiology of fish. W. . Hoar and D. J. Randall, editors. Fish physiology. Volume 6. Academic Press, New York.

Jeffres, C. A., R.A. Dahlgren, M.L. Deas, J.D. Kiernan, A.M. King, R.A. Lusardi, J.M. Mount, P.B. Moyle, A.L. Nichols, S.E. Null, S.K. Tanaka, A.D. Willis. 2009. Baseline Assessment of Physical and Biological Conditions Within Waterways on Big Springs Ranch, Siskiyou County, California. Report prepared for: California State Water Resources Control Board.

Nichols, A.L., C.A Jeffres, A.D. Willis, N.J. Corline, A.M. King, R.A. Lusardi, M.L. Deas, J.F. Mount, and P.B. Moyle. 2010. Longitudinal Baseline Assessment of Salmonid Habitat Characteristics of the Shasta River, March to September 2008. Report prepared for: United States Bureau of Reclamation, Klamath Basin Area Office.

North Coast Regional Water Quality Control Board. 2007. Action Plan for the Shasta River Watershed Temperature and Dissolved Oxygen Total Maximum Daily Loads. Water Quality Control Plan for the North Coast Region. http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/shasta_river/060707/finalshastatmdlactionplan.pdf

North Coast Regional Water Quality Control Board. 2010. Staff Report for the Klamath River TMDLs, the Klamath River Site Specific Dissolved Oxygen Objective, and the Klamath and Lost River Implementation Plans. http://www.waterboards.ca.gov/water_issues/programs/tmdl/records/region_1/2012/ref3985.pdf

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APPENDIX

Public Data Access

California Irrigation Management Information System (CIMIS)

- Station 260 – Montague
- Station 261 – Gazelle

https://cimis.water.ca.gov/

California Data Exchange Center (CDEC)

- Hydrologic Data Acquisition System (HyDAS)
    - Station SVG – Goosenest
        - https://cdec.water.ca.gov/dynamicapp/staMeta?station_id=SVG
    - Station SVB – Bolam
        - https://cdec.water.ca.gov/dynamicapp/staMeta?station_id=SVB

California Data Exchange Center (CDEC)

- Shasta River Discharge and Stage
    - Station SRM – Near Montague
        - https://cdec.water.ca.gov/dynamicapp/staMeta?station_id=SRM
    - Station SRY – Near Yreka
        - https://cdec.water.ca.gov/dynamicapp/staMeta?station_id=SRY