



**KINGS RIVER FISHERIES MANAGEMENT PROGRAM
ANNUAL TECHNICAL REPORT
Water Year 2018-2019**



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EXECUTIVE SUMMARY

The Kings River Water Association, Kings River Conservation District, and California Department of Fish and Wildlife have jointly implemented habitat and trout population enhancement projects and conducted a series of monitoring programs in the lower Kings River and Pine Flat Reservoir. These habitat enhancement projects have been implemented over the past eighteen years in response to the Kings River Fisheries Management Program (KRFMP) Framework Agreement, which was approved on May 28, 1999, with the financial commitment extended for another ten-year period on June 26, 2009. The Framework Agreement includes actions designed to protect and enhance fishery habitat within the lower Kings River and in Pine Flat Reservoir. The Technical Steering Committee is responsible for implementing the actions authorized under the agreement and approved by the Executive Policy Committee. The scope of activities undertaken as part of the KRFMP between October 2018 and September 2019 described in this annual technical report includes: a compilation and synthesis of information regarding habitat enhancements, trout population enhancements, and monitoring activities conducted as part of the KRFMP. Report timeline for activities includes Water Year 2019 (October 2018- September 30, 2019) and CDFW stocking activity for Calendar year 2019.

Key Elements of the program in recent years includes:

- Most instream flow targets met as outlined in the Framework Agreement, with most days greatly exceeding these targets;
- Kings River Fisheries Management Program website improved and maintained;
- Incubated 232,000 rainbow trout eggs in the incubator building;
- Implementation of a supplemental Rainbow Trout stocking plan in addition to CDFW annual budgeted stocking program;
- Received final report integrating green- LiDAR with 2-D hydrologic and Habitat modelling. *Lower Kings River Habitat Characterization and Identification for habitat Enhancement Opportunities* – Cramer Fish Sciences;

1.0 INTRODUCTION

The Kings River Water Association (KRWA), Kings River Conservation District (KRCD), and California Department of Fish and Wildlife (CDFW) have jointly implemented habitat and trout population enhancement projects and conducted a series of monitoring programs in the lower Kings River and Pine Flat Reservoir. These habitat enhancement projects have been implemented over the past eighteen years in response to the Kings River Fisheries Management Program (KRFMP) Framework Agreement, which was approved on May 28, 1999. The Framework Agreement includes actions designed to protect and enhance fishery habitat within the lower Kings River and in Pine Flat Reservoir. The Technical Steering Committee (TSC) is responsible for implementing the actions authorized under the agreement and approved by the Executive Policy Committee. The scope of activities undertaken as part of the KRFMP between October 2018 and September 2019 and CDFW stocking in 2019 described in this annual technical report includes:

- Monitoring hydrology and operations including inflow to Pine Flat Reservoir, reservoir storage, reservoir releases, operation of remote sensing telemetry systems, turbine bypass operation, and activities to implement enhanced winter flows for fishery habitat as outlined in Exhibits C and D of the Framework Agreement;
- Monitoring water quality including water temperature and dissolved oxygen within Pine Flat Reservoir and the lower Kings River, compliance with dissolved oxygen requirements within the lower river, and planning and monitoring water temperature conditions at the completion of the irrigation season;
- Routine fish stocking by the CDFW, KRFMP supplemental stocking, and continued contributions of rainbow trout fry produced from the incubator building.

The annual report provides a project management structure for reviewing and prioritizing existing and proposed activities, fish stocking, and implementation of other elements contained in the Framework Agreement. Results of the fishery and habitat monitoring program are intended to provide a technical and scientific framework for identifying design criteria and priorities for determining the appropriate scale and location of habitat enhancement projects, linkages among potential projects to maximize biological benefits and reduce cost, identify priorities for habitat enhancement project locations, and identify potential opportunities for expanding enhancement projects through funding augmentation from collaborative grant applications from state, federal, and private funding sources. In addition, one of the key objectives of the annual report improves coordination and communication among the parties involved in implementing various elements of the Framework Agreement, and to facilitate a process for reviewing and evaluating the performance of management actions in achieving the overall goals of the KRFMP.

1.1 ADMINISTRATIVE ACTIVITIES

During the year the parties to the KRFMP agreed and signed a 10-year financial extension of the Framework Agreement, ensuring that the enhancement efforts will continue into the next ten-year period expiring May 28, 2029.

Along with the financial commitment, in-kind support from KRFMP agencies are estimated below. In-kind support may include staff time for data collection, weir management, analysis, reporting, water operations, meetings, and other administrative activities which vary by agency. The following tables show estimates of agency in-kind support for October 1, 2018 through September 30, 2019; KRWA (Table 1-1), KRCD (Table 1-2), CDFW (Table 1-3). Estimated in-kind support from agencies for the KRFMP was 5,153 hours or about 2.5 Full-Time Equivalent (FTE). Additionally, volunteers involved with assisting the KRFMP are vital for the program success, providing approximately 593 hours of service (Table 1-4).

The in-kind support does not account for CDFW fish stocking or the loss of water supply and storage loss for temperature control pool management. Section 5 outlines stocking activities related to the KRFMP. In 2019, the CDFW allotment for the Kings River included approximately \$102,263 or 20,870 pounds of catchable size rainbow trout to the Lower Kings River, Avocado Lake, and Pine Flat Reservoir. Fish stocking by CDFW also included approximately \$73,180 or 14,934.5 pounds of fish in sub-catchable, fingerling, super-catchable, and trophy trout. Section 2 outlines hydrologic conditions for Water Year 2019. The temperature control pool has been maintained above 100,000 acre-feet, a storage volume unavailable to water users. For Water Year 2019, water made available for KRFMP requirements as releases from Pine Flat and target minimum flows at locations below Pine Flat Dam were approximately 22,520 acre-feet.

Table 1-1: Estimate of KRWA In-Kind Support for the KRFMP, October 1, 2018 - September 30, 2019

KRFMP Support Activity	Hours/Year	Days/Year	FTE
Weir Management (Dennis Cut)	117	14.6	0.06
Weir Management (Fresno Weir)	130	16.3	0.06
Fall Electrofishing Survey	144	18.0	0.07
River Operations	364	45.5	0.18
Reservoir Operations	78	9.8	0.04
Internal Water Accounting	104	13.0	0.05
Administrative Activities	594	74.3	0.29
Total In-Kind Support	1531	191.4	0.74

Table 1-2: Estimate of KRCD In-Kind Support for the KRFMP, October 1, 2018 -September 30, 2019

KRFMP Support Activity	Hours/Year	Days/Year	FTE
Administrative Activities	1915	239.4	0.92
Education Outreach	9	1.1	0.00
Fall Electrofishing Survey	379	47.4	0.18
Incubator Fry Release	14	1.8	0.01
Incubator Maintenance	130	16.3	0.06
Incubator Operation	460	57.5	0.22
Pine Flat Reservoir Profile	84	10.5	0.04
Public Relations/Outreach	44	5.5	0.02
Total In-Kind Support	3035	379.4	1.46

Table 1-3: Estimate of CDFW In-Kind Support for the KRFMP, October 1, 2018 - September 30, 2019

KRFMP Support Activity	Hours/Year	Days/Year	FTE
Fall Electrofishing Survey	240	30	0.12
Administrative Activities	337	42.125	0.16
Sub-Catchable Stocking	10	1.25	0.00
Total In-Kind Support	587	73.375	0.28

Table 1-4: Estimate of Volunteer Hours for the KRFMP, October 1, 2018 -September 30, 2019

KRFMP Support Activity	Hours/Year	Days/Year	FTE
Fall Electrofishing Survey	354	44.3	0.17
Incubator Fry Release	42	5.3	0.02
Incubator Operation	74	9.3	0.04
Public Advisory Group	108	13.5	0.05
Sub-Catchable Stocking	15	1.9	0.01
Total Volunteer Support	593	74.1	0.29

1.2 ANNUAL TECHNICAL REPORT

Interested parties and stakeholders, including the KRFMP Executive Policy Committee (ExCom), KRFMP Public Advisory Group (PAG), resource and water agencies, local angling groups, and others have expressed interest in the information being collected as part of the KRFMP's monitoring program. Preparation and distribution of an Annual Technical Report has been identified as a useful method of conveying information regarding the program status and monitoring results to interested parties.

2.0 HYDROLOGY AND OPERATIONS

2.1 RESERVOIR INFLOW

Daily average inflow into Pine Flat Reservoir from hydrologic year 2019, October 1, 2018 through September 30, 2019, are shown in Figure 2-1. Inflow into Pine Flat Reservoir is characterized by high seasonal and inter-annual variability reflecting variation in precipitation, snowpack, and runoff within the watershed. Kings River basin discharge averaged 3,993 cfs, ranging from 178 to 19,298 cfs. Table 2-1 shows the Kings River calculated annual runoff and the corresponding percent water year for the past 20 years; years included in this report are in bold text.

Table 2-1: Kings River basin calculated annual runoff by Water Year, October-September

Water Year (Oct-Sept)	Annual Runnof (TAF)	Percent Water Year
2000	1,534	90%
2001	1,010	59%
2002	1,141	67%
2003	1,426	84%
2004	1,050	62%
2005	2,531	149%
2006	2,952	173%
2007	679	39%
2008	1,216	74%
2009	1,348	79%
2010	2,062	121%
2011	3,318	193%
2012	826	48%
2013	691	40%
2014	537	33%
2015	361	17%
2016	1,253	72%
2017	4,096	220%
2018	1,275	75%
2019	2,177	177%

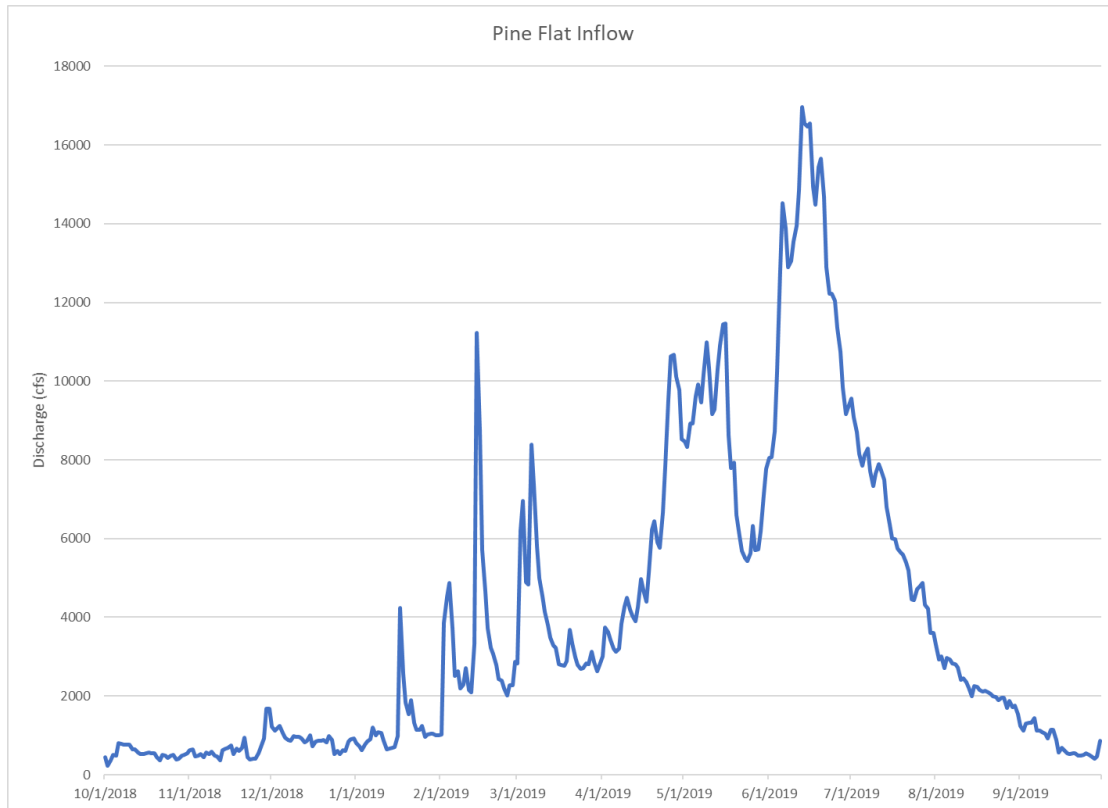


Figure 2-1: The annual inflow into Pine Flat Reservoir from October 1, 2018 through September 30, 2019

2.2 RESERVOIR STORAGE

Daily reservoir water storage volume in Pine Flat Reservoir from October 1, 2018 through September 30, 2019 is shown in Figure 2-2. Reservoir storage reflects the combined effects of reservoir inflow, releases from Pine Flat Reservoir to the lower Kings River, and evaporation. As part of the Framework Agreement, a voluntary 100,000 acre-feet temperature control pool was established. Pine Flat reservoir storage was maintained above the temperature control pool during this report period.

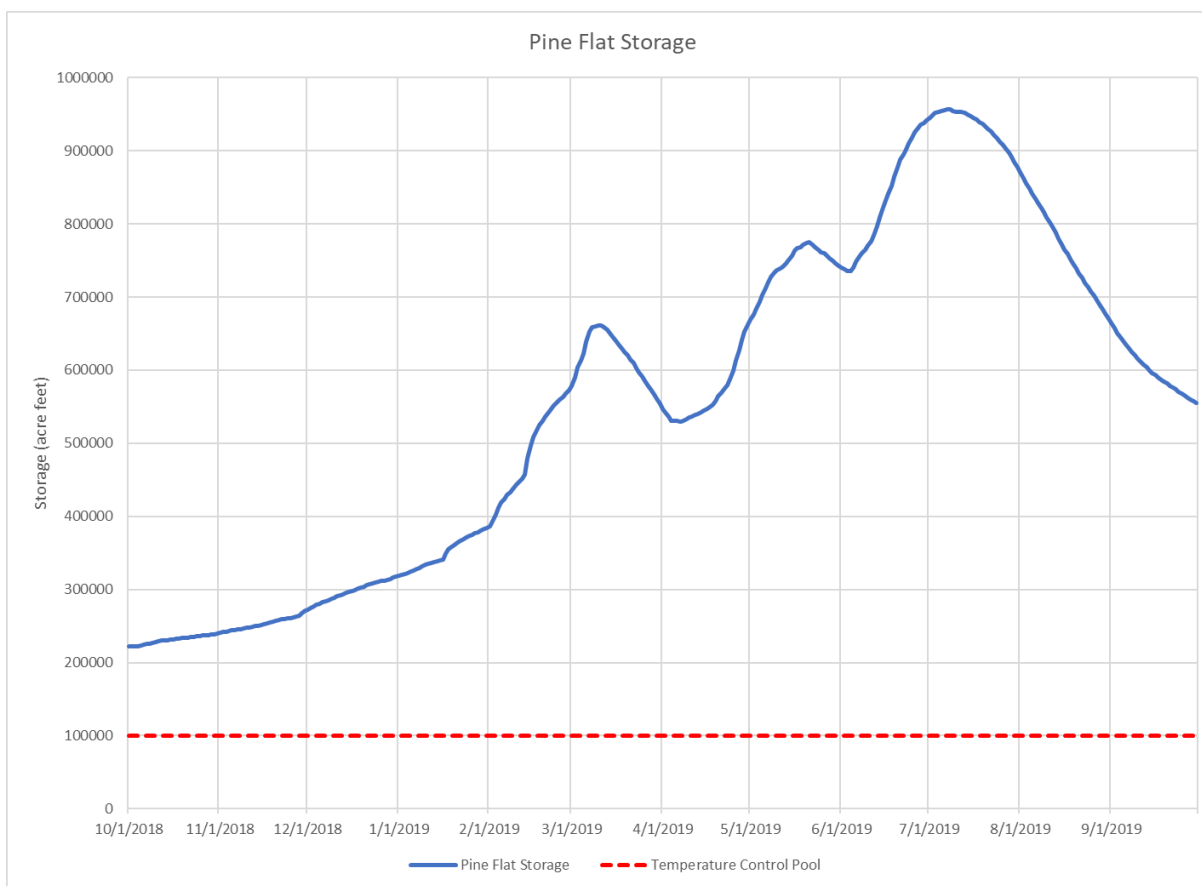


Figure 2-2: Average daily storage in Pine Flat from October 1, 2018 through September 30, 2019

2.3 RESERVOIR RELEASES

Framework Agreement established minimum instream Exhibit C and Exhibit D flow releases from Pine Flat Reservoir (Figure 2-3), flow at Piedra (Figure 2-4), in Dennis Cut (Figure 2-5), at Fresno Weir (Figure 2-6) and below Fresno Weir (Figure 2-7) to support resident fish populations in the lower river (Table 2-2).

Water discharge from Pine Flat Reservoir to the lower Kings River show high variability within the year as shown in Figure 2-3. Average daily discharge from Pine Flat in the lower Kings River from October 1, 2018 through September 30, 2019 ranged from 50 to 10,834 cfs, all above target flows. Average discharge from Pine Flat was 3,417 cfs during the report period.

Daily average Kings River flow at Piedra from October 1, 2018 through September 30, 2019 ranged from 102 to 10,852 cfs, all above target flows. Flow at Piedra averaged 3,472 cfs during the report period.

Daily average flow at Dennis Cut from October 1, 2018 through September 30, 2019 demonstrated two slight departures from the 5 cfs target as outlined in the Framework Agreement, 2-days occurred with daily average flow of 4 cfs (Figure 2-5). These occurred on November 5, 2018 and February 1, 2019. Both instances occurred coming into or coming out of Exhibit “C” flow, either due to drops in irrigation demand or unregulated stormwater entering the river, which may require weir maintenance and resetting or adjustments for releases to account for variable river flow. Flow

at Dennis Cut averaged 60 cfs during the report period, ranging from 4 to 178 cfs.

Exhibit C flow schedule occurred in WY 2019, due to preceding year conditions in WY 2018 (95 cfs, for a water year less than 1,555,000 acre feet) (Figure 2-6). Daily average Kings River flow at Fresno Weir from October 1, 2018 through September 30, 2019 was 3,474 cfs, ranging from 95 to 10,707 cfs.

Daily flows below Fresno Weir from October 1, 2018 through September 30, 2019 demonstrated one slight departure from the targets outlined in the Framework Agreement, 1-day occurred with daily average flow of 44 cfs instead of the target 45 cfs on December 13, 2018 (Figure 2-7). Average Flow below Fresno Weir during the month of this departure was 48 cfs, ranging from 44 cfs to 53 cfs. For Water Year 2019, flow below Fresno Weir averaged 2,864 cfs, ranging from 42 to 9,412 cfs.

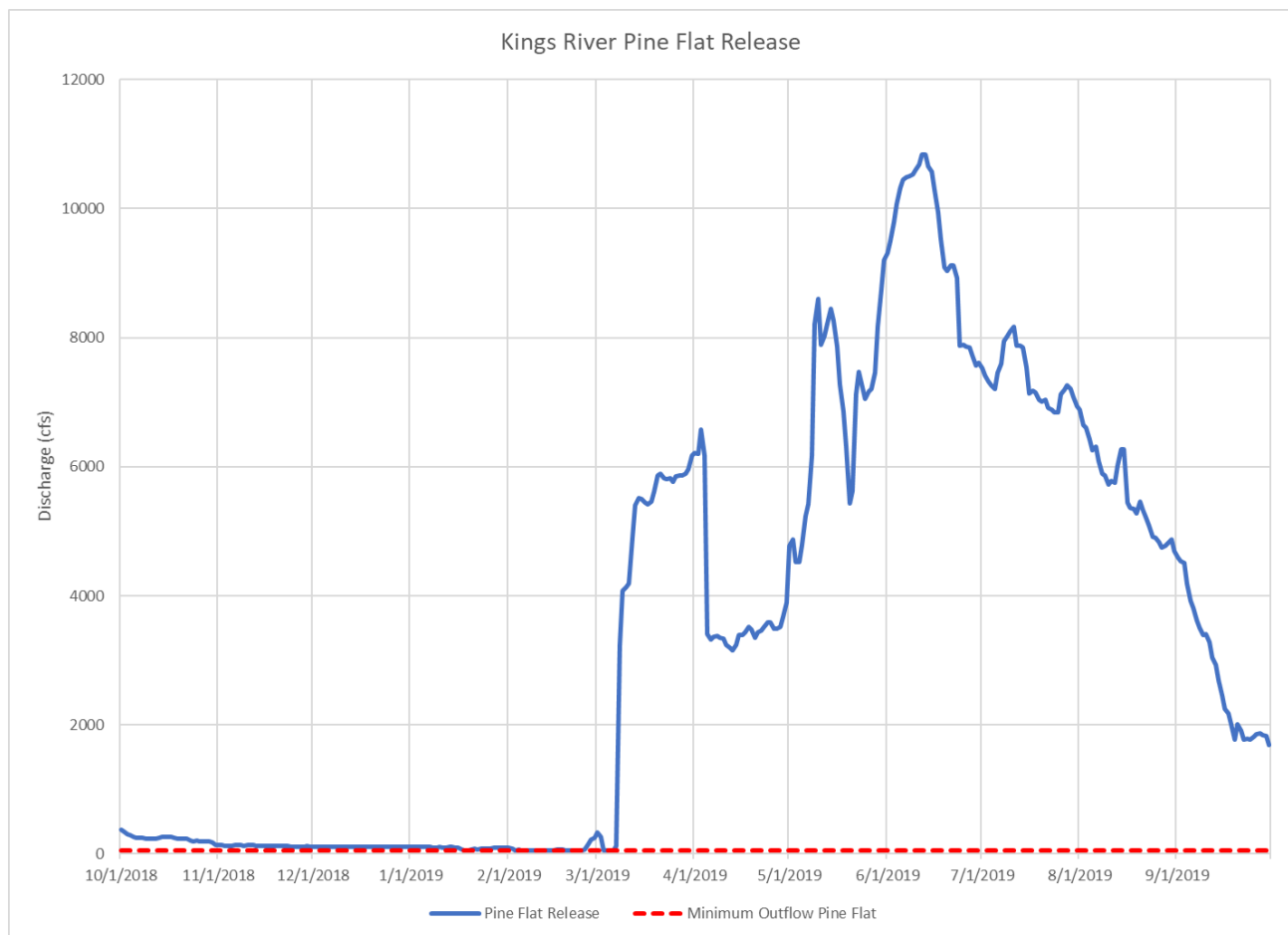


Figure 2-3: Average daily discharge from Pine Flat into the Kings River from October 1, 2018 through September 30, 2019

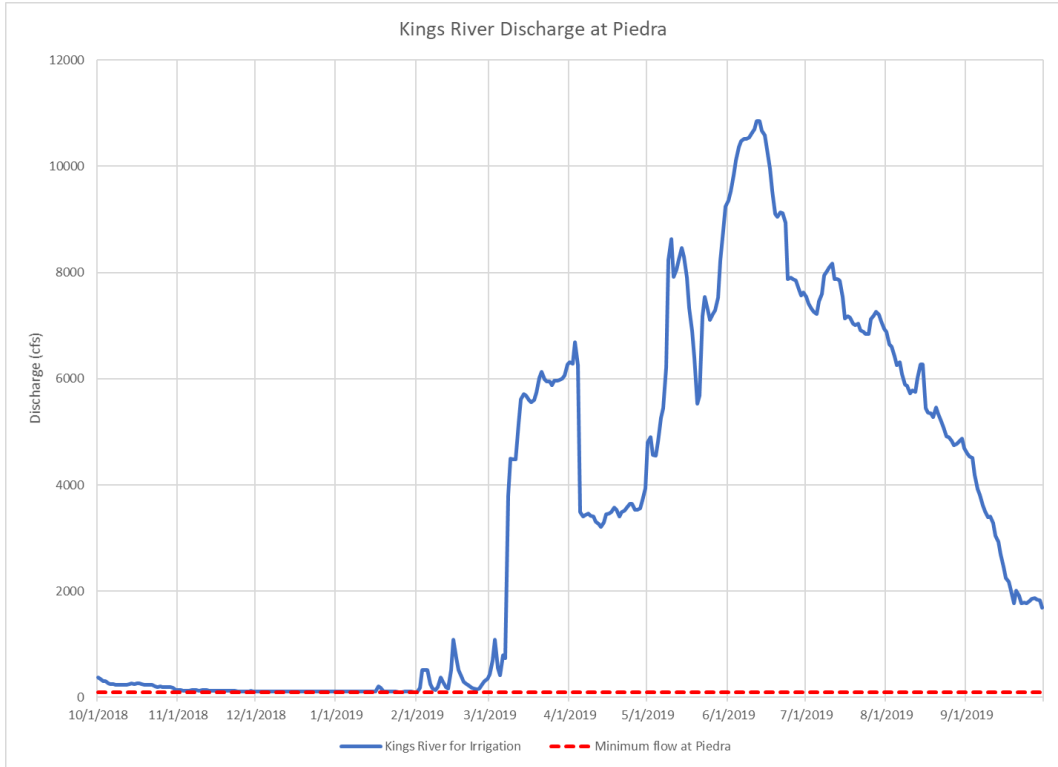


Figure 2-4: Average daily flow of Kings River at Piedra from October 1, 2018 through September 30, 2019

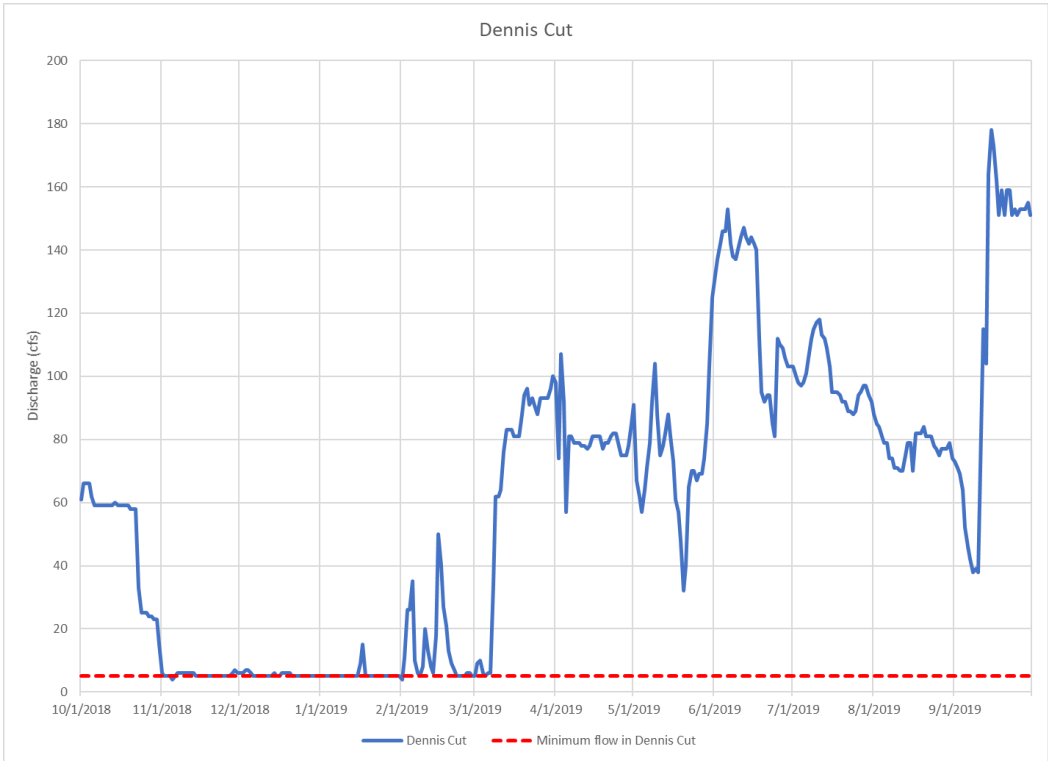


Figure 2-5: Average daily flow in Dennis Cut from October 1, 2018 through September 30, 2019

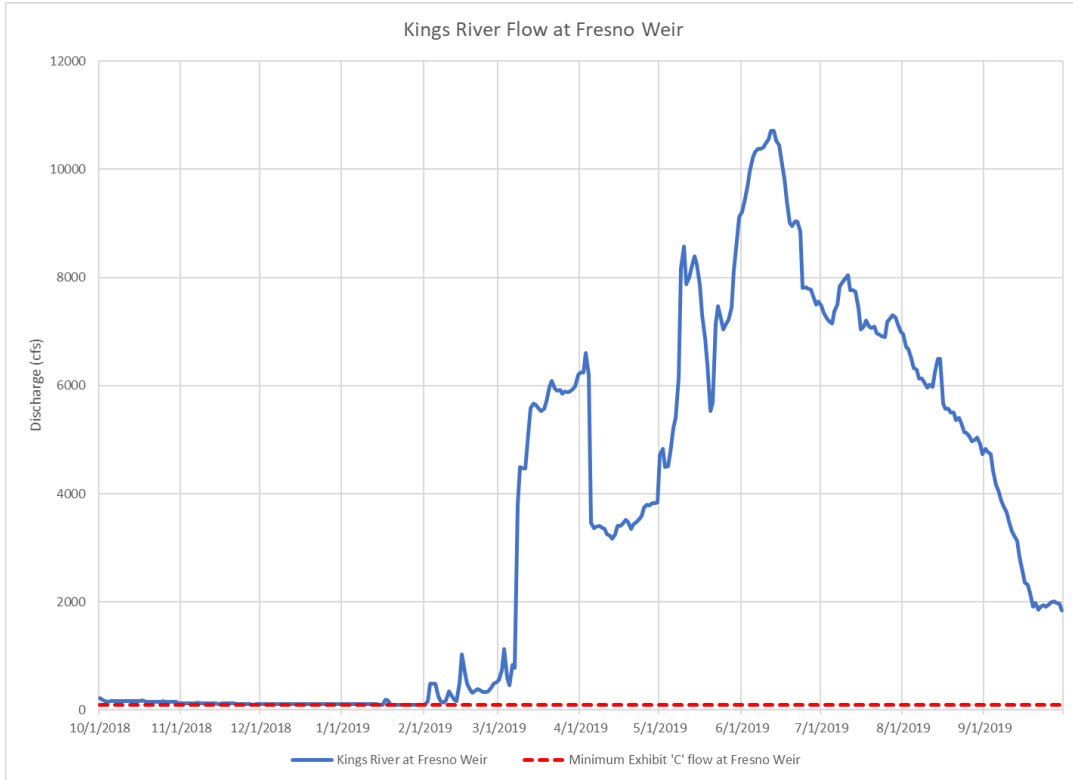


Figure 2-6: Average daily flow of Kings River at Fresno Weir from October 1, 2018 through September 30, 2019

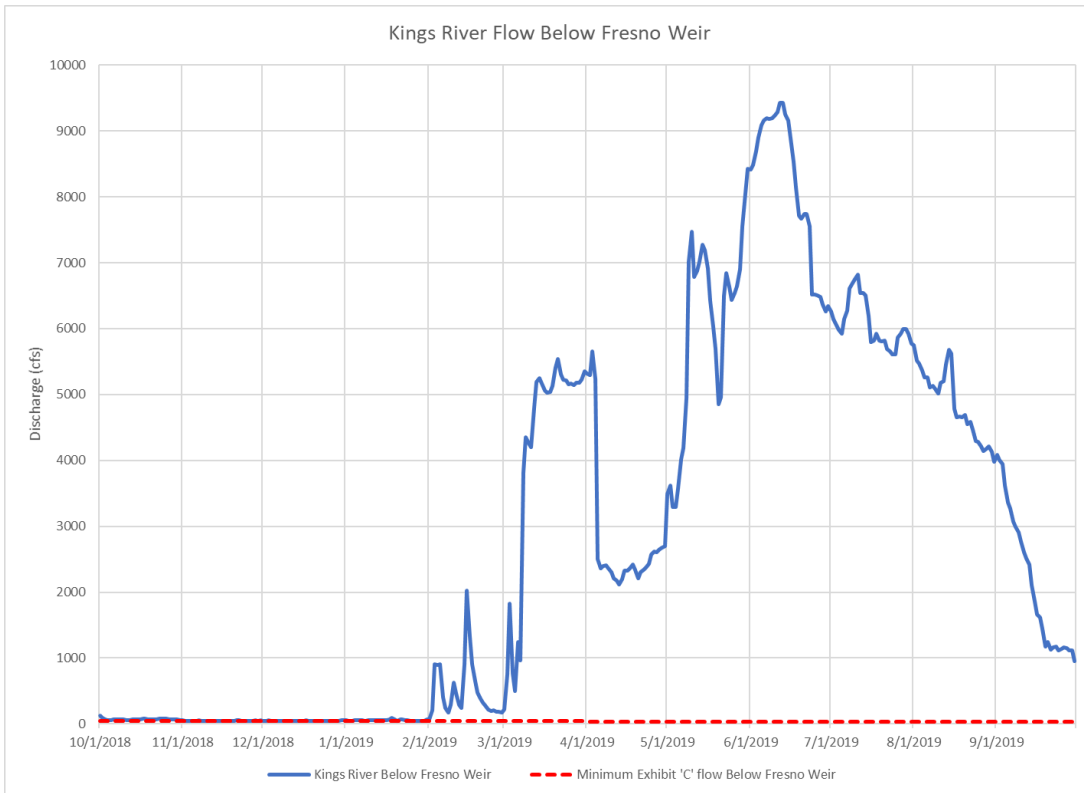


Figure 2-7: Average daily flow of Kings River below Fresno Weir from October 1, 2018 through September 30, 2019

2.4 TELEMETRY SYSTEM

Use of real-time flow monitoring stations below Fresno Weir and at Dennis Cut continued. These systems provide data that supports informed decisions on water temperature and flow management after completing the irrigation and delivery season when elevated water temperatures may affect habitat quality for trout within the lower river. The real-time water temperature monitoring system complements temperature monitoring at fixed locations within the river (Section 3.1.2) for use in evaluating factors affecting habitat conditions and the potential health and condition of biota within the river.

2.5 EXHIBIT C AND D FLOWS

Minimum flow targets are dependent on prior water year volumes. The dry Water Year 2018 (1,274,000 acre feet) triggered an ‘Exhibit C’ requirement (Table 2-2) during Water Year 2019. ‘Exhibit C’ flows occur for a preceding water year less than 1,555,000 acre feet.

‘Exhibit D’ flows were not required during Water Year 2019, October 1, 2018 – September 30, 2019. For ‘Exhibit D’ flows to occur a preceding water year must exceed 1,555,000 acre feet. Additionally, minimum flow targets increase when preceding water year runoff exceeds 2,100,000 acre feet.

Table 2-2. ‘Exhibit C’ target flows (cfs) from the Framework Agreement.

Exhibit C flows	Oct 1 - Nov 15	Nov 16 - Mar 31	Apr 1 - Sept 30
Required from Pine Flat	50	50	50
Total flow at Piedra	100	100	100
Minimum in Dennis Cut	5	5	5
Minimum to Fresno Weir	95	95	95
Water divertible to China Slough	10	5	15
Required over Fresno Weir	40	45	35

2.6 SUMMARY

Hydrologic conditions, Pine Flat Reservoir operations and flows within the lower river during Water Year 2019 are characterized by high seasonal variability characteristic of the Kings River watershed and water supply operations. Findings and recommendations regarding hydrology and operations for this reporting period include:

- Pine Flat Reservoir operations were successful in maintaining the temperature control pool in the reservoir above the minimum level specified in the Framework Agreement;
- Daily average discharge from Pine Flat, Kings River flow at Piedra, and Kings River flow at Fresno Weir demonstrated 100% compliance with the instream flow targets as outlined in the Framework Agreement, with most days greatly exceeding these targets;
- A real-time telemetry system provided information on flow at Fresno Weir and Dennis Cut that is available for monitoring and managing conditions within the lower river as part of the fishery program;
- Flows levels representing ‘Exhibit C’ flow schedule during WY 2019.
- Dennis Cut and King River Below Fresno Weir flow showed slight departures from target instream flow as outlined in the Framework Agreement, with most days greatly exceeding these flow targets.

3.0 WATER QUALITY

Water quality monitoring as part of the KRFMP has focused on measurements of water temperature and dissolved oxygen concentrations that directly affect habitat quality for fish and macroinvertebrates within Pine Flat Reservoir and the lower Kings River.

3.1 RESERVOIR WATER QUALITY

Reservoir temperature and dissolved oxygen measurements are monitored monthly throughout the year. Reservoir profile data are used in temperature control pool management during the fall months after completion of the irrigation season to provide suitable temperature conditions for trout and other fish species within Pine Flat Reservoir and the lower river. Water temperature at each outlet (dam and power plant) are used on a real-time basis for use in evaluating water temperature released from the reservoir into the lower Kings River. On October 3, 2018 water releases began from the low-level sluices as well as the turbine bypass. By taking advantage of blending colder water from the lower levels of the reservoir with well oxygenated water from the turbine bypass, conditions within the tailrace could be maintained lower than would have occurred otherwise. Water continued to be blended through these gates until November 17, 2018 and cooling conditions in the river and reservoir had become sufficient to resume all releases through the turbine bypass.

Vertical profiles in Pine Flat Reservoir of temperature and dissolved oxygen are collected on a regular basis. An example reservoir profile is presented in Figure 3-1. Appendix A includes monthly vertical reservoir temperature and dissolved oxygen profile measurements during the reporting period October 2018 – September 2019. A characteristic seasonal pattern of thermal stratification beginning in the spring includes formation of a reservoir hypolimnion (cold water layer near the bottom) and epilimnion (warmer water layer near the surface), which increases through the summer months. Reservoir profiles indicate thermal stratification occurred March through November (Appendix A). Reservoir thermal stratification continues into the fall, at which time atmospheric cooling results in uniform water temperatures throughout the reservoir (reservoir destratification). Reservoir destratification occurred December through February (Appendix A). Later in the fall-winter, cold air temperatures cool the upper layer of water so that the epilimnion is colder than the hypolimnion (reservoir turnover). Pine Flat Reservoir did not experience lake turnover in this reporting period. Reservoir profiles also indicate dissolved oxygen was well distributed throughout the reservoir December through March and June through August.

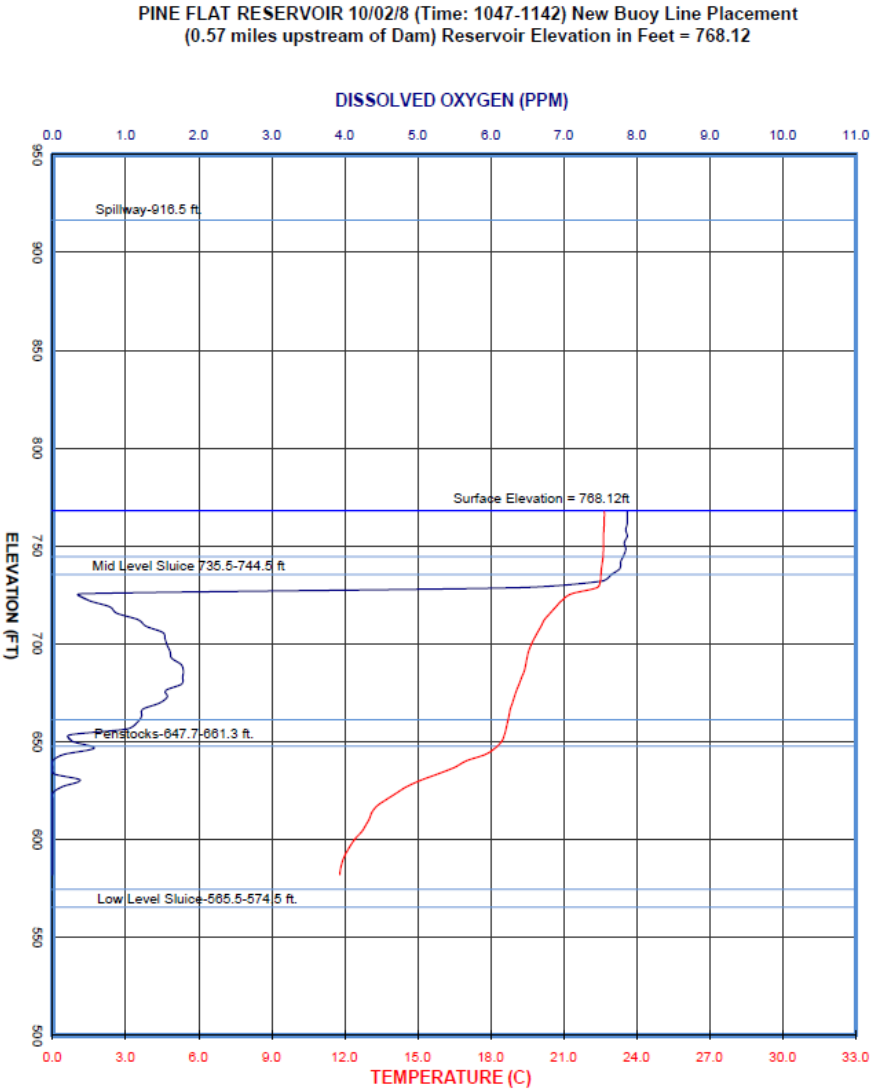


Figure 3-1: Pine Flat Reservoir profile taken 10/02/2018

3.2 RIVER WATER QUALITY

Water temperature and dissolved oxygen concentrations within the lower Kings River are monitored at the ACOE Bridge, which is located 0.6 miles downstream of Pine Flat Dam. A Hydrolab DataSonde, mounted to the weir, records water temperature and dissolved oxygen levels every 10 minutes. Water temperature is also measured at Fresno Weir at the stilling well in the weir pool. Although not ideal for measurement of main current temperature, these locations allow for real-time data collections throughout the season. Average daily water temperature in the lower Kings River are shown for ACOE Bridge (Figure 3-2) and Fresno Weir (Figure 3-3). The daily minimum, maximum, and average temperatures recorded at the ACOE Bridge were 7.3°C, 18.7°C, and 11.8°C respectively. The daily minimum, maximum, and average temperatures recorded at Fresno Weir were 8.4°C, 21.4°C, and 13.3°C. Throughout the season, daily average water temperature at Fresno Weir were approximately 1.5 °C higher than at ACOE Bridge. However, Fresno Weir daily average water temperature at Fresno Weir were recorded as much as 6 °C higher and 1.4 °C lower than at ACOE Bridge. Water releases which blended cold water from the low-level sluices and from the turbine bypass was initiated on October 3, 2018 and continued through November 16, 2018 in a targeted effort to keep temperatures below Pine Flat Dam lower than they otherwise would be given releases strictly from the warmer levels in the reservoir. The result of the blended release was observed at the ACOE Bridge and Fresno Weir.

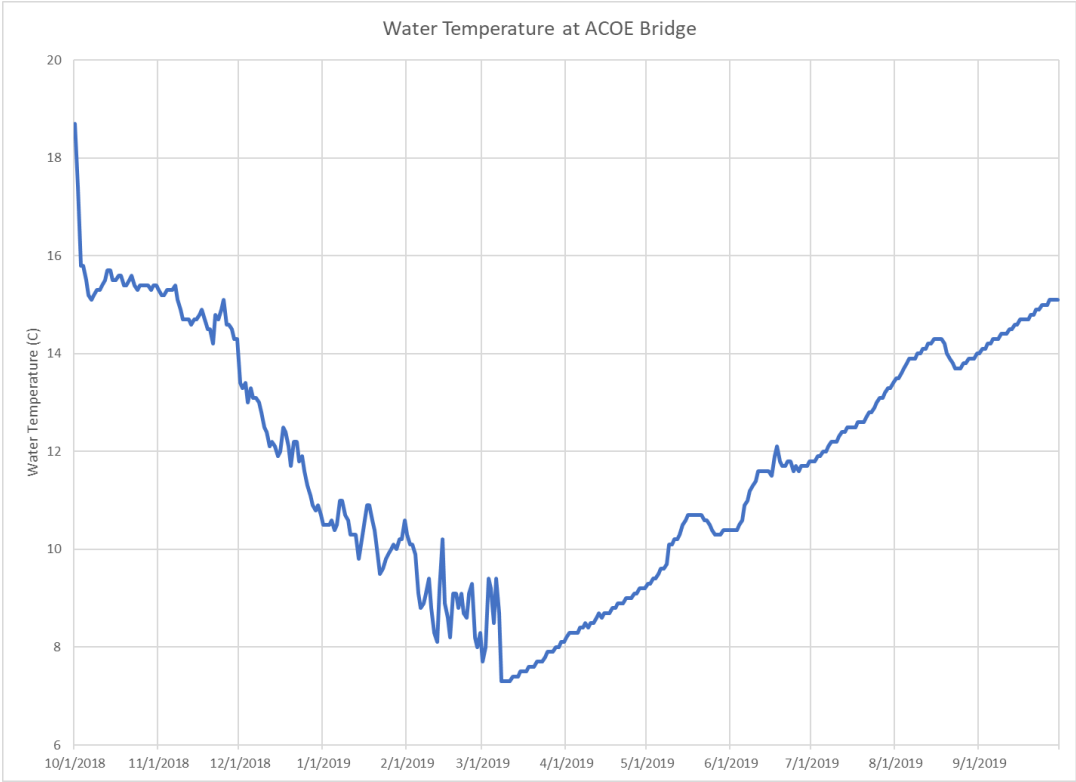


Figure 3-2: Daily average water temperature at ACOE Bridge October 1, 2018 through September 30, 2019

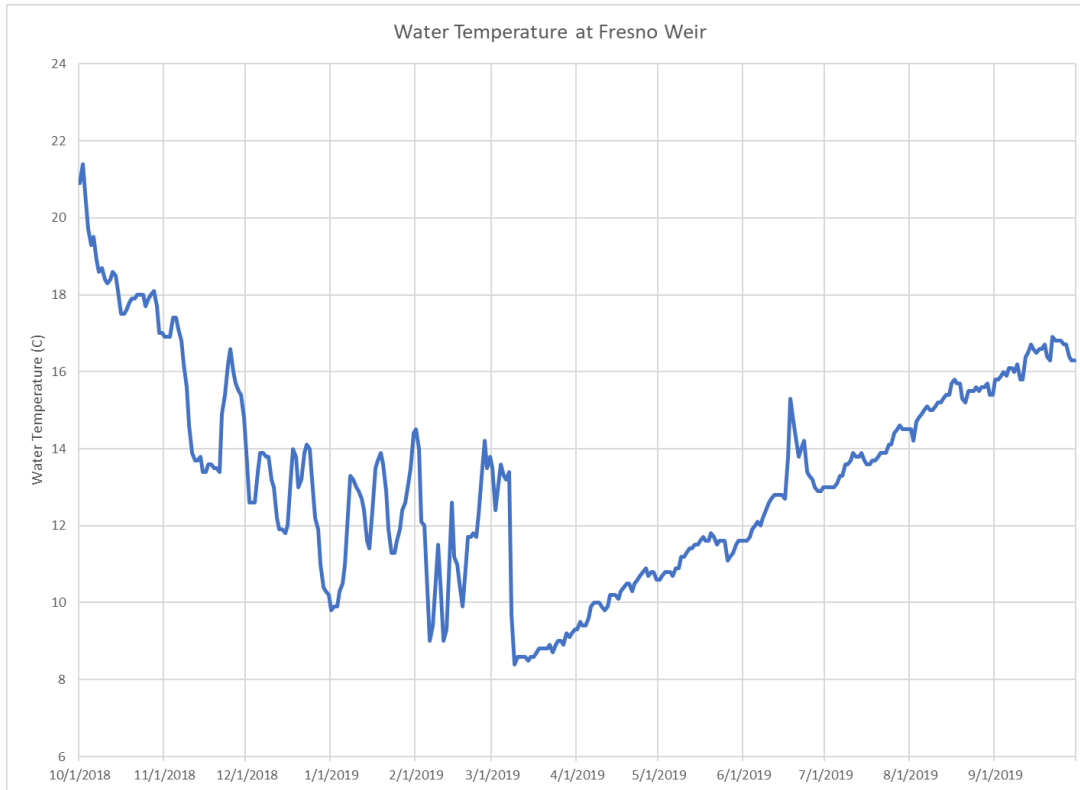


Figure 3-3: Daily average water temperature at Fresno Weir October 1, 2018 through September 30, 2019

Temperatures within the river have a seasonal pattern, with lowest temperatures occurring during the winter and early spring and increasing during the spring and summer months, with the greatest increase in seasonal temperatures occurring during the late summer and early fall after completion of the irrigation season. For much of the year, spatial temperature gradients occur in the lower river with the coldest temperatures near Pine Flat Dam and typically increase as a function of distance downstream within the lower river. However, during the 2018-2019 water year cooler temperatures were recorded in November through January at Fresno Weir than at the ACOE Bridge. This reverse temperature gradient is observed during the fall and winter when atmospheric conditions cool. The diel temperature variation (difference between the maximum and minimum daily temperature) is typically lowest immediately downstream of Pine Flat Dam with diel temperature variation increasing as a function of distance downstream within the lower river.

As a condition of the Federal Energy Regulatory Commission (FERC) Project License P-2741 license, KRCD is required to maintain a minimum dissolved oxygen concentration at the ACOE Bridge of 7.0 mg/L for the protection of fish and other aquatic organisms inhabiting the lower Kings River when the power plant is in operation. KRCD met its license operating and monitoring requirements for the duration of this reporting period. The Hydrolab dissolved oxygen meter used for monitoring is calibrated to laboratory standards with an accuracy of ± 0.5 mg/L. Dissolved oxygen concentrations at the ACOE Bridge during the period from October 2018 through September 2019 are presented in Figure 3-4. Dissolved oxygen concentrations within the lower Kings River are within the range considered suitable for various fish and macroinvertebrate species that occur in this section of the river. During the 2018-2019 reporting period, the daily minimum,

maximum, and average was 6.9 mg/L, 12.7 mg/L, and 9.2 mg/L respectively.

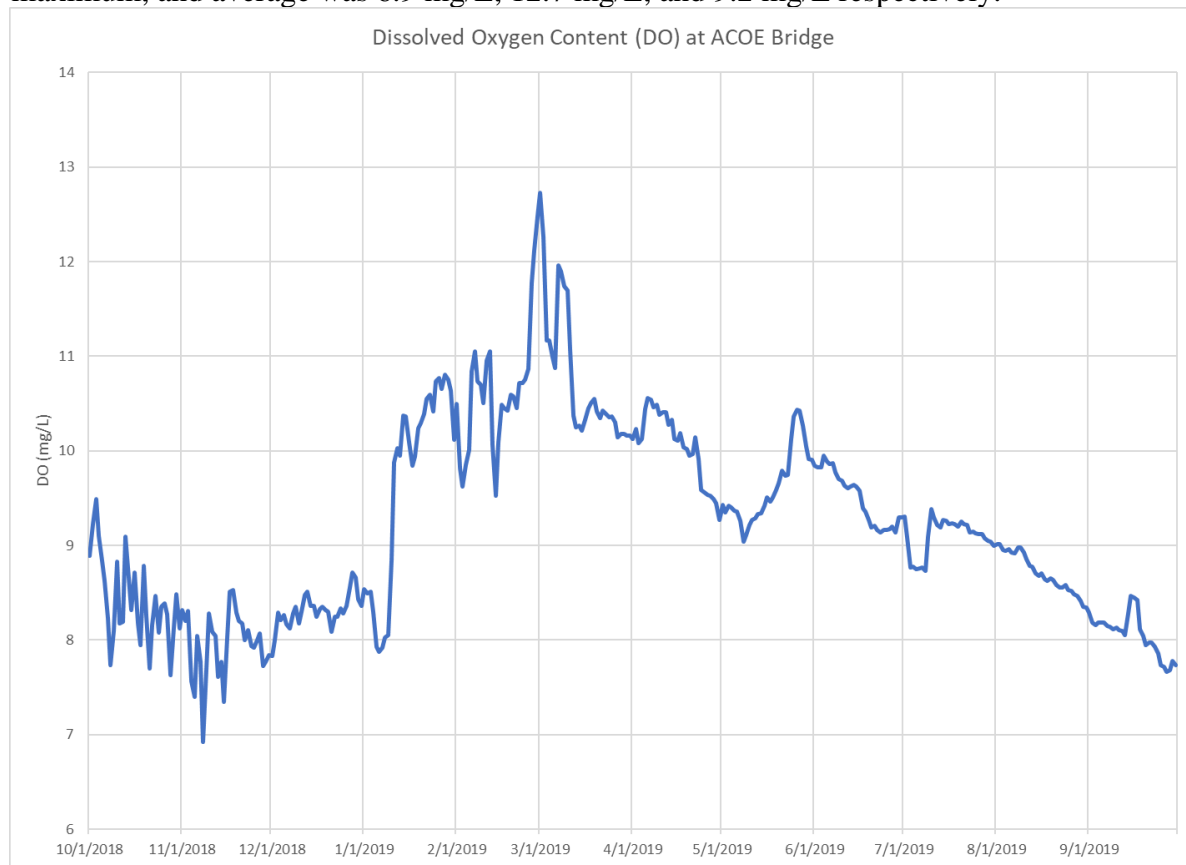


Figure 3-4: Daily average dissolved oxygen (DO) at ACOE Bridge October 1, 2018 through September 30, 2019.

3.0 SUMMARY

Several tools for managing water temperature in the lower river include cooperation from the ACOE in allowing the use of the lower sluice gates to release cold water during critical periods, and improved flexibility in managing water temperatures by using the turbine bypass. Water quality monitoring within Pine Flat Reservoir and the lower Kings River during Water Year 2019 have shown:

- Pine Flat Reservoir can become stratified during late spring, summer, and fall showing a characteristic pattern of warmer water near the surface (epilimnion) and colder water with reduced dissolved oxygen concentrations near the bottom of the reservoir (hypolimnion). Reservoir profile water temperature becomes almost uniform in the late-fall and winter. During the 2018-2019 water year reservoir profiles indicate thermal stratification occurred March through November, with destratification occurring December through February. During the 2018-2019 reporting period Pine Flat Reservoir did not experience lake turnover. Reservoir profiles also indicate dissolved oxygen was well distributed throughout the reservoir December through March and June through August.
- The temperature of water released from the reservoir into the lower river can be managed through selective operation of different outlet works, including the turbine bypass. The

ability to manage water temperatures is limited by the availability of cold water in Pine Flat Reservoir at release points during critical times. From October 3, 2018 through November 16, 2018 the program utilized releases from the low-level sluices blended with turbine bypass releases.

- Aeration and mixing of water released from the reservoir are effective in maintaining suitable temperature and dissolved oxygen concentrations within the lower river. KRCD power plant operators monitor conditions throughout the year, to ensure that dissolved oxygen levels do not fall below 7.0 mg/l. Dissolved oxygen concentrations reached an instantaneous minimum of 6.33 mg/L on November 5, 2018. A maximum of 13.39 mg/L was recorded on March 7, 2019.
- Water temperatures are variable along a longitudinal gradient downstream of Pine Flat Dam. During summer months the coldest temperatures are immediately downstream of the dam and temperatures generally increase with distance downstream from the dam until reaching thermal equilibrium with downstream from Pine Flat Dam, atmospheric conditions. During the fall and winter, when atmospheric temperatures are cool, a reverse temperature gradient may be observed with temperatures decreasing as a function of distance.

4.0 HABITAT ENHANCEMENT

One goal of the KRFMP is to enhance the quality and availability of habitat for a variety of fish and macroinvertebrates within Pine Flat Reservoir and the lower Kings River. A brief description of the habitat enhancement projects planned and/or implemented as part of the KRFMP during 2019 is summarized below.

4.1 RIVER

Cramer Fish Sciences was contracted in 2018 to create a 2D hydrologic model, quantify the seasonal availability of spawning and rearing habitat by flow rate, locate and identify locations for future habitat enhancement projects and create weighted habitat suitability models. The final report was submitted to the KRFMP in September 2019 and will be presented to the Executive committee for approval in March 2020. Findings indicated a substantial lack of spawning sized gravel in areas of seasonal inundation, channelization, fewer than optimal pool to riffle habitat transitions and a deficit in available habitat for young of the year. Possible project recommendations were also provided for programmatic review. The report is anticipated to serve as a tool to help direct future habitat enhancement projects within the tailwater fishery for rainbow trout.

4.2 PINE FLAT RESERVOIR

The KRFMP budgets for projects to enhance and/or benefit the fishery created within Pine Flat Reservoir. The Pine Flat Army Corps of Engineers (ACOE) staff has been instrumental in helping the program discern the size, type, and locations of such projects. In addition, the ACOE has provided the necessary personnel and logistic resources needed to ensure project completion. In 2019 Pine Flat Reservoir retained enough water throughout the year to limit access to potential

project areas. ACOE also focused efforts on necessary maintenance throughout 2019, taking precedence over habitat enhancement projects. The KRFMP plans to continue working with the ACOE through the foreseeable future.

5.0 FISH STOCKING

CDFW transitioned from stocking triploid rainbow trout into the lower Kings River in favor of diploid rainbow trout at the start of 2018. In 2019, Catchable rainbow trout, Sub-catchable brown trout and fingerling Chinook salmon were planted in Pine Flat Reservoir. Avocado Lake received a catchable allotment of rainbow trout. In addition, rainbow trout eggs were incubated by KRCD and released in the lower river. A supplemental rainbow trout stocking program was initiated by the KRFMP in the fall of 2018 and continued into 2019.

5.1 SUPPLEMENTAL STOCKING

In 2017 the KRFMP developed a supplemental rainbow trout stocking plan for the tailwater fishery below Pine Flat Dam. The plan focuses on stocking only diploid trout with increased stocking in the fall and winter months when river flows and temperature are best for angler success. The intent is to provide a population of hatchery-produced catchable sized trout capable of sustaining the current level of angler pressure in both the put-and-take and catch-and-release zones. Additionally, the reinstatement of stocking diploid trout provides the potential for holdover trout to spawn and contribute to the resident population when and where conditions are suitable. The plan was fully approved in May 2018 and Calaveras Trout Farm, a private aquaculture facility in Snelling, CA was awarded a 3-year renewable contract to provide the KRFMP 30,000 (10,000 lbs) to 50,000 (16,600 lbs) of diploid rainbow trout between October and March each year. Trout measured approximately 9-10” in fork length with an average weight of about 3 fish per pound. Supplemental stocking by Calaveras Trout Farm began in October 2018, providing weekly plantings distributed 75/25 % into both the Put & Take Zone (Reach 1) and the Catch & Release Zone (Reach 2) (Table 5-1).

Table 5-1: Summary of 2018-2019 supplemental stocking by Calaveras Trout Farm in the lower Kings River. All fish are catchable size with an average fork length of 9.4” and average 3 fish per pound.

Month	Reach 1		Reach 2		Total	
	# lbs	# fish	# lbs	# fish	# lbs	# fish
October	1,200	3,600	400	1,200	1,600	4,800
November	2,400	7,200	800	2,400	3,200	9,600
December	3,000	9,000	1,000	3,000	4,000	12,000
January	2,400	7,200	800	2,400	3,200	9,600
February	1,950	5,850	650	1,950	2,600	7,800
March	1,500	4,500	500	1,500	2,000	6,000
Total	12,450	37,350	4,150	12,450	16,600	49,800

5.2 INCUBATOR BUILDING

The incubator building has run seasonally since November 2012. Maintenance has been facilitated by KRCD staff as well as volunteers interested in the fishery and the Kings River. During the 2018 – 2019 program year diploid rainbow trout eggs were purchased from Cold Springs Trout Farm, with two incubation periods completed. The first incubation period was canceled prior to the initiation of incubation due to poor water quality conditions stemming from releases from the low-level sluices of the dam in October. Table 5-2 summarizes the incubation periods, number of eggs incubated, estimated hatch rate, estimated number of fry released, and the percentage of fry released into both the Put & Take and Catch & Release Zones. When trout fry reached the button up stage (about 1” long) they were released at multiple locations within the fishery management area. These activities were conducted under SE4 and P1 of the 2018 Annual Implementation Plan.

Table 5-2: Incubator building activity 2018 – 2019. Number of eggs incubated per rearing period, estimated hatch rate, estimated number of fry released, and percentage released in both the Put & Take and Catch & Release Zones. First incubation period was canceled prior to initiation of incubation.

Incubation Period	Eggs Incubated (#)	Hatch Rate (Est)	Fry Released (Est #)	Put & Take Zone	Catch & Release Zone
10/31/2018-12/20/2018	0	NA	NA	NA	NA
12/31/2018-02/21/2019	132,000	94%	96,000	36%	64%
02/25/2019-04/18/2019	100,000	65%	53,000	51%	49%

5.3 CDFW STOCKING

The CDFW annual stocking between January-December 2019 are summarized here. CDFW provided hatchery grown salmonids in several different size categories to the Kings River below Pine Flat Reservoir (71,443 fish, 25,191 pounds), Pine Flat Reservoir (118,513 fish, 10,213.5 pounds), and Avocado Lake (840 fish, 400 pounds). These numbers do not include the supplemental fish provided for the KRFMP, which occurred after October 2019, which will be summarized in the next years report. Details for each size class are summarized below.

5.3.1 Fingerlings

Pine Flat Reservoir received approximately 487 pounds of fingerling salmon (75,013 fish) in 2019. Table 5-3 details stocking of fingerling size fish.

Table 5-3: CDFW salmonid fingerlings planted in Pine Flat Reservoir or the Kings River below Pine Flat 2019

Water	Species	Fingerlings	
		Year	
		2019	
		# Trout	Pounds
Kings River below Pine Flat Reservoir	Brook Trout	0	0.0
	Rainbow Trout	0	0.0
Pine Flat Reservoir	Brook Trout	0	0.0
	Rainbow Trout	0	0.0
	Chinook Salmon	75,013	487.1
	Kokanee	0	0.0
Total		75,013	487.1

5.3.2 Sub-Catchable Trout

Sub-catchable rainbow trout stocked by CDFW are generally 4-6 inches long. Table 5-3 details stocking of sub-catchable trout. A total of 4821 pounds (43,485 fish) of sub-catchable rainbow trout were stocked in the lower Kings River as part of the put-and-grow program during 2019. Pine Flat reservoir received a total of 2726.4 pounds (30,000 fish) of sub-catchable brown trout during this same period.

Table 5-4: CDFW sub-catchable trout stocked 2019

Water	Species	Sub-Catchables	
		Year	
		2019	
		# Trout	Pounds
Kings River below Pine Flat Reservoir	Brook Trout	0	0.0
	Rainbow Trout	43,485	4,821.0
Pine Flat Reservoir	Brown Trout	30,000	2,726.4
	Rainbow Trout	0	0.0
Total		73,485	7,547.4

5.3.3 Catchables

Catchable trout (2 fish per pound) are stocked either once or twice per week during the non-irrigation period (roughly October through March) and once each week during the irrigation season when flows are high. Table 5-5 details stocking of catchable size trout. A total of 13,470 pounds (25,213 fish) of catchable size rainbow trout were stocked in the lower Kings River during 2019. Pine Flat received a total of 7,000 pounds (13,500 catchable rainbow trout) and Avocado Lake received a total of 400 pounds (840 catchable rainbow trout) during this same period.

Table 5-5: CDFW catchable sized trout stocked 2019

Water	Species	Catchables	
		Year	
		2019	
		# Trout	Pounds
Kings River below Pine Flat Reservoir	Rainbow Trout	25,213	13,470.0
Pine Flat Reservoir	Rainbow Trout	13,500	7,000.0
Avocado Lake	Rainbow Trout	840	400.0
Total		39,553	20,870.0

5.3.4 Super Catchables

Super-catchable size trout are defined as trout greater than one pound. Table 5-6 details stocking of super-catchable size trout. Kings River below Pine Flat Reservoir received a total of 4,600 pounds of super-catchable trout (2,183 rainbow and brook trout) in 2019.

Table 5-6: CDFW super-catchable sized trout stocked 2019

Water	Species	Super-Catchables	
		Year	
		2019	
		# Trout	Pounds
Kings River below Pine Flat Reservoir	Brook Trout	605	1,000.0
	Rainbow Trout	1,578	3,600.0
Pine Flat Reservoir	Rainbow Trout	0	0.0
Avocado Lake	Rainbow Trout	0	0.0
Total		2,183	4,600.0

5.3.5 Trophy Trout

Beginning December 2005, CDFW implemented a trophy trout stocking program in the put-and take section as well as the catch-and-release section. Trophy trout are designated as trout greater than 2.99 pounds each. Trophy trout planted in the lower Kings River average approximately 4 pounds (Table 5-7). A total of 2,300 pounds of trophy trout (562 rainbow trout) were planted in the Kings River below Pine Flat Reservoir in 2019.

Table 5 - 7: CDFW trophy sized rainbow trout stocked 2019

Water	Species	Trophy	
		Year	
		2019	
		# Trout	Pounds
Kings River below Pine Flat Reservoir	Rainbow Trout	562	2,300.0
Total		562	2,300.0

6.0 MONITORING

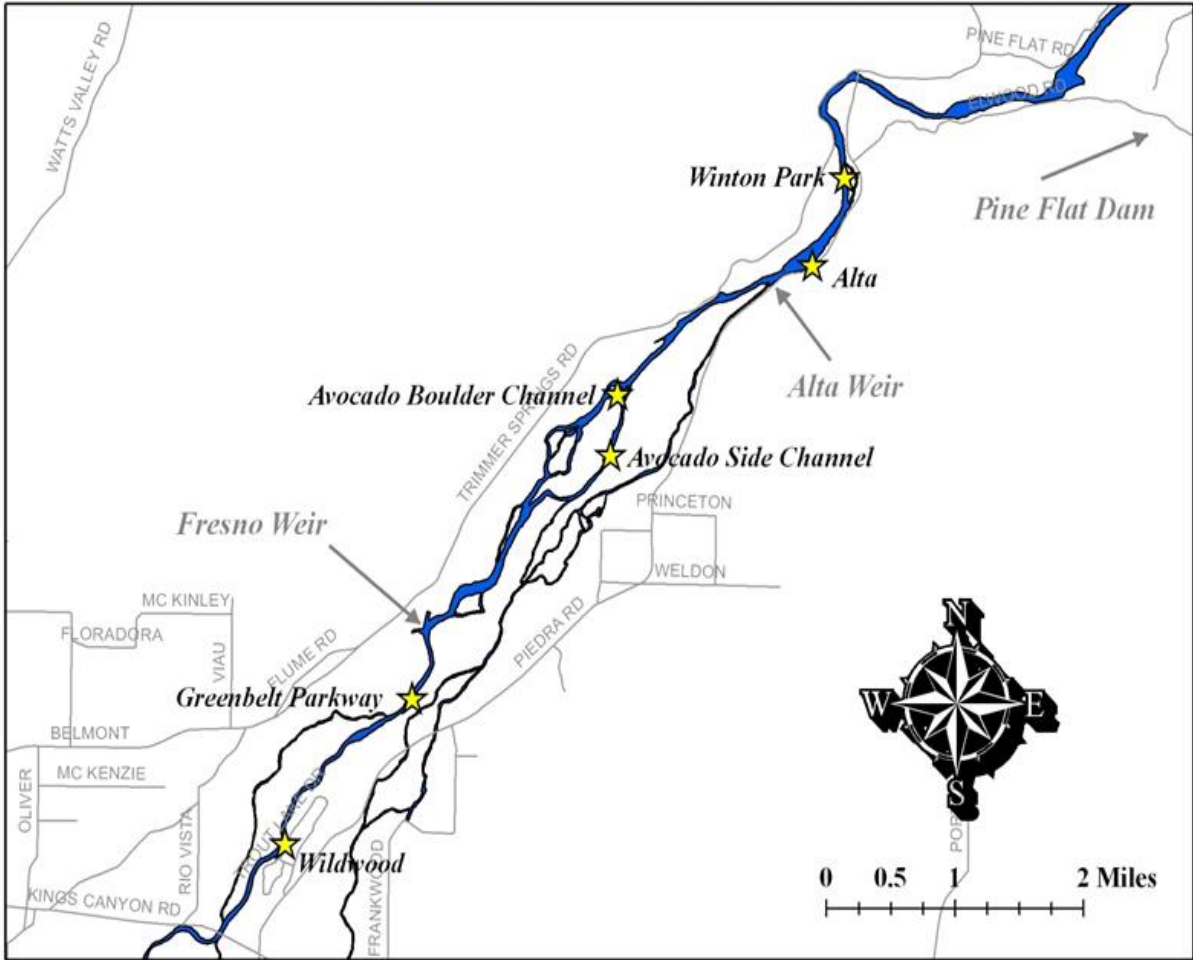
Section G (1)(k) of the Framework Agreement “Development of Criteria/Monitoring” calls for the agencies to carry out a monitoring program to determine the effects of various elements of the KRFMP and the overall status of the fishery. Water temperature and dissolved oxygen monitoring remain a priority. The KRFMP is also dedicated to continuing its annual fish population surveys in the fall.

6.1 ANNUAL FISH POPULATION SURVEYS IN THE LOWER KINGS RIVER

Long-term annual baseline trout fisheries monitoring within the lower Kings River is being conducted as part of the KRFMP to determine (1) the assemblage, abundance and condition of the fish community inhabiting the lower Kings River; (2) overall biomass; (3) wild and hatchery rainbow trout abundance and distribution; (4) overwintering survival, size and age structure of rainbow trout populations. Surveys are completed with KRFMP agency staff and the assistance of local volunteers and students from Reedley College.

During this reporting period electrofishing surveys were successfully conducted at all six designated study sites in 2018. Electrofishing is performed at sampling sites within each of the three management reaches of the lower Kings River (Figure 6-1). Management reaches are defined as “Put and Take” from the Army Corps of Engineers Bridge to Alta Weir, “Catch and Release” from Alta Weir to Fresno Weir and “Opportunistic” from Fresno Weir to the highway 180 bridge. Surveys are conducted at the same sampling sites each year for use in establishing an abundance index, and for determining trends in abundance of trout and other fish species. Sampling is conducted using a block net on the upper end and lower end of the sample reach and backpack electrofishers. Electrofishing surveys have been conducted over a period of 35 years (since 1983) in the Kings River by KRCD and CDFW biologists. In 2007, the KRFMP began to use a multi-pass depletion technique. This allowed for more rigorous sampling and provided a more complete assessment of the species composition and abundance found in the sample site. Data collected during the survey include species to the lowest practical taxon, (Table 6-1), total length measured to the nearest mm, fork length is measured for trout, and weight measured to the nearest tenth of a gram. In 2018 rainbow trout and hatchery rainbow trout were treated as separate species for the purpose of analysis and data collection. Rainbow trout which were clearly distinguishable in the field as having hatchery origins due to the presence of worn down or missing fins and were either of moderate or deep olive coloration with heavy spotting were classified as hatchery rainbow trout. Rainbow trout of any size which had fins in excellent condition, exhibited silver to moderate coloring, and light to moderate spotting or parr marks was classified as a rainbow trout. This group of rainbow trout is assumed to have originated via natural in-river reproduction, from the KRFMP incubator facility, or via recruitment through Pine Flat Dam. This data can then be used to determine trends in the populations and condition of sampled fish species. Sampling sites are 300 feet in length and were sampled using backpack electrofishers (Kings River Conservation District 2019). The final reports are available on the KRFMP website <http://krfmp.org/resources/reports-documents/>.

KRCD Electrofishing Sites - Kings River Below Pine Flat Dam



Z:\DATA\Project Specific Data\Fisheries Management\Electrofishing Sites\mxd\2009 E-fishing map.mxd

Figure 6-1: Kings River Conservation District annual population monitoring survey sites.

Table 6-1: Fish species, number collected, and percentage of total catch during the annual fish population survey in 2018. Note that in 2018 the Rainbow Trout species classification includes only those rainbow trout which could not be definitively identified in the field of being of hatchery origin.

November 2018								
	Winton	Alta	Avo Boulder	Avo Side	Greenbelt	Wildwood	Total	% of Total
Bass sp.	0	0	0	1	1	0	2	0.0%
California Roach	0	5	44	10	64	324	447	8.9%
Catfish sp.	0	0	0	0	1	0	1	0.0%
Hardhead	0	0	0	0	1	0	1	0.0%
Hatchery Trout	4	4	4	3	0	0	15	0.3%
Lamprey sp.	2	71	10	153	6	6	248	4.9%
Rainbow Trout	1	2	7	8	0	0	18	0.4%
Sacramento Pikeminnow	6	11	12	5	142	47	223	4.4%
Sacramento Sucker	324	390	387	375	174	360	2,010	40.0%
Sculpin sp.	622	651	142	172	239	143	1,969	39.2%
Three-spined Stickleback	11	10	16	32	15	10	94	1.9%
Total Fish Captured	970	1,144	622	759	643	890	5,028	
% of Total	19%	23%	12%	15%	13%	18%		100%

Table 6-2: 2018 Estimate of fish species per-mile in the lower Kings River tailwater fishery. Note that in 2018 the Rainbow Trout species classification includes only those rainbow trout which could not be definitively identified in the field of being of hatchery origin.

2018 Species Per-mile Estimate	
Bass sp.	6
California Roach	1,311
Catfish sp.	3
Hardhead	3
Hatchery Trout	44
Lamprey sp.	727
Rainbow Trout	53
Sacramento Pikeminnow	654
Sacramento Sucker	5,896
Sculpin sp.	5,776
Three-spined Stickleback	276

7.0 PUBLIC EDUCATION AND OUTREACH

7.1 WEBSITE

KRCD staff has maintained and updated the website throughout 2019. The site contains a photo album, contact page, volunteer site, access to program reports and documents, projects and links to resources; <http://krfmp.org/>

7.2 HYDROLOGY AND TEMPERATURE REPORT

For operations, KRWA uses a real-time telemetry system for monitoring water temperature and streamflow at Fresno Weir. Typically, during the summer and fall of dry hydrologic years, information collected on the lower Kings River is compiled in weekly reports and distributed by

KRWA to members of the PAG and other interested parties to provide current information on environmental conditions that would affect habitat quality. These one-page reports have provided information on flows in the lower river and tributary streams as well as a summary of flow and temperature trends. Copies of these reports remain on file at KRWA. Weekly Hydrologic and Climate Summary Reports were circulated October 4, 2018 – October 29, 2018 a timeframe when reservoir outflow was being reduced from high irrigation levels and temperature blending of reservoir releases was used to keep lower Kings River temperatures cooler during the late summer. By November 16, 2018 no blending was occurring.

7.3 EDUCATIONAL TOURS

7.3.1 Incubator Building

Multiple tours were hosted at the incubator building during the 2018-2019 rearing period as part of educational outreach (Table 7-1). Topics covered during tours include a general overview of the purpose of the history of the trout rearing program, the purpose of the incubator, the trout lifecycle, and any information regarding the developmental stage currently present in the incubator. Also covered is the role trout play in the local ecosystem.

Table 7 - 1: Organizations and school groups provided with tours of the KRFMP Trout Incubator during the 2018-2019 season.

Date	Organization
1/21/2019	Kings River Conservancy
1/25/2019	Ag Leaders
2/26/2019	Sanger High School – Green Team
3/12/2019	Sanger High School – AP Biology (10th-12th Grade)
3/29/2019	Quail Lake Charter School – Science (7th Grade)
4/1/2019	Sanger Academy Charter School – Science (7th Grade)
4/2/2019	Washington Academic Middle School – Science (7th Grade)
4/4/2019	Fairmont Elementary School – Science (7th Grade)
4/4/2019	Boys and Girls Club – Sanger/Orange Cove (Unit Directors)

8.0 MAINTENANCE ACTIVITIES

8.1 THORBURN CHANNEL

Spraying of weeds, brushing, and tree trimming took place along the roadway and nature trail. All activities were conducted under Element M-2012-1: Thorburn Channel Maintenance of the Annual Implementation Plan and supported through KRCD Flood Maintenance staff.

8.2 INCUBATOR BUILDING

While in service, daily operation of the incubator facility is performed by KRCD Environmental staff Monday thru Friday. Volunteers care for the trout fry in the facility most weekends and holidays during incubator operation. Volunteers are also utilized to assist with planting of trout fry into the river. The total number of individuals who volunteered time to assist with either daily operation of the incubator building or with fry release are summarized in table 8-1. Staff from the KRCD Pine Flat Power Plant provide building and equipment maintenance as needed. During this

reporting period, October 1 – September 30, the pumps were removed for maintenance and the building re-plumbed with both stainless steel and schedule 80 PVC. The provided maintenance and re-plumb greatly increased the efficiency of the building by accommodating greater control over the quantity and quality of flows entering the raceways.

Table 8 - 1: Number of volunteers and amount of time dedicated to the KRFMP Trout Incubator during the 2018-2019 season. NA indicates no volunteer participation due to the cancellation of the first scheduled run of the incubator during the 2018-2019 rearing period.

Incubation Period	Volunteers (#)	~ Volunteer Hours
10/31/2018-12/20/2018	NA	NA
12/31/2018-02/21/2019	18	59
02/25/2019-04/18/2019	17	57

During the 2018-2019 rearing season only two of the three scheduled rearing periods were conducted. Out of an abundance of caution the first rearing period (Oct 31 to Dec 20) was cancelled due to concerns about water quality conditions. In the days immediately prior to egg arrival high levels of very fine sediment was observed to have passed through the filter system and been deposited into the raceways. The source of this sedimentation was presumed to be from the bottom of Pine Flat Reservoir as all water releases at the time were occurring through the low-level sluices. It was believed an attempt at egg incubation under these conditions would result in high mortality, either due to suffocation from sediment settling in the egg jars, or reduced flow and oxygen to the raceways due to clogged filters.

For the second scheduled rearing period (Dec 31 to Feb 21), of the 132,000 eggs incubated an estimated 94% were successfully hatched. It is estimated that approximately 96,000 trout fry were released, with 36% released into the Put & Take Zone, and 64% released into the Catch & Release Zone. River flows, at the time of fry release measured 51 cfs from Pine Flat Dam to the confluence with Mill Creek, and 226 cfs below the confluence. Eighteen volunteers contributed approximately 59 hours during this period. The instantaneous minimum, maximum, and average temperature within the incubator was 7.47°C, 13.35°C, and 10.89°C respectively.

For the third scheduled rearing period (Feb 25 to April 18), of the 100,000 eggs incubated an estimated 65% were successfully hatched. It is estimated that 53,000 trout fry were released, with 51% released into the Put & Take Zone, and 49% released into the Catch & Release Zone. River flows, at the time of fry release measured 3,523 cfs from Pine Flat Dam to the confluence with Mill Creek, and 3,583 cfs below the confluence. Seventeen volunteers contributed approximately 57 hours during this period. The instantaneous minimum, maximum, and average temperature within the incubator was 7.39°C, 14.31°C, and 9.4°C respectively.

9.0 DEVELOPMENT OF A LONG-TERM IMPLEMENTATION PLAN

Section G(1) of the Framework Agreement includes elements addressing adaptive management (Section 1b); stream temperature monitoring (Section 1d); funding for habitat enhancement projects (Section 1f); enforcement, education, and awareness program (Section 1i); stocking program (Section 1j); development of criteria/monitoring (Section 1k); and access (Section 1p). The Annual Implementation Plan helps to provide guidance, prioritize activities and the allocation of expenditures, and coordinate among the parties to facilitate efficient implementation of these

elements of the Framework Agreement. The Long Term Implementation Plans (formerly 10 Year Plans): (1) provide a project management structure for reviewing and prioritizing proposed habitat enhancement activities, fish stocking, and other elements of the Framework Agreement; (2) identify the objectives and methods to be used to assess the overall response of trout and other species for use in evaluating achievement of the Kings River aquatic resource goals as identified in Section 1a of the Framework Agreement; and (3) provide a framework for the experimental design and evaluation of specific enhancement activities (e.g., enhancement projects funded under the Framework Agreement, fish stocking and supplementation, pulse flows for temperature management, etc.) within the context of the overall goals and activities being implemented through the Framework Agreement. Results of monitoring and evaluation activities serve, in part, as the basis for the adaptive management element of the Framework Agreement (Section 1b) and for identifying changes in program priorities, or the allocation of resources from one program element to another. The Long-Term Implementation Plan is a “living plan” that is reviewed by the TSC, Public and ExCom on an annual basis and revised as projects and elements of the program are implemented and as new scientific information becomes available.

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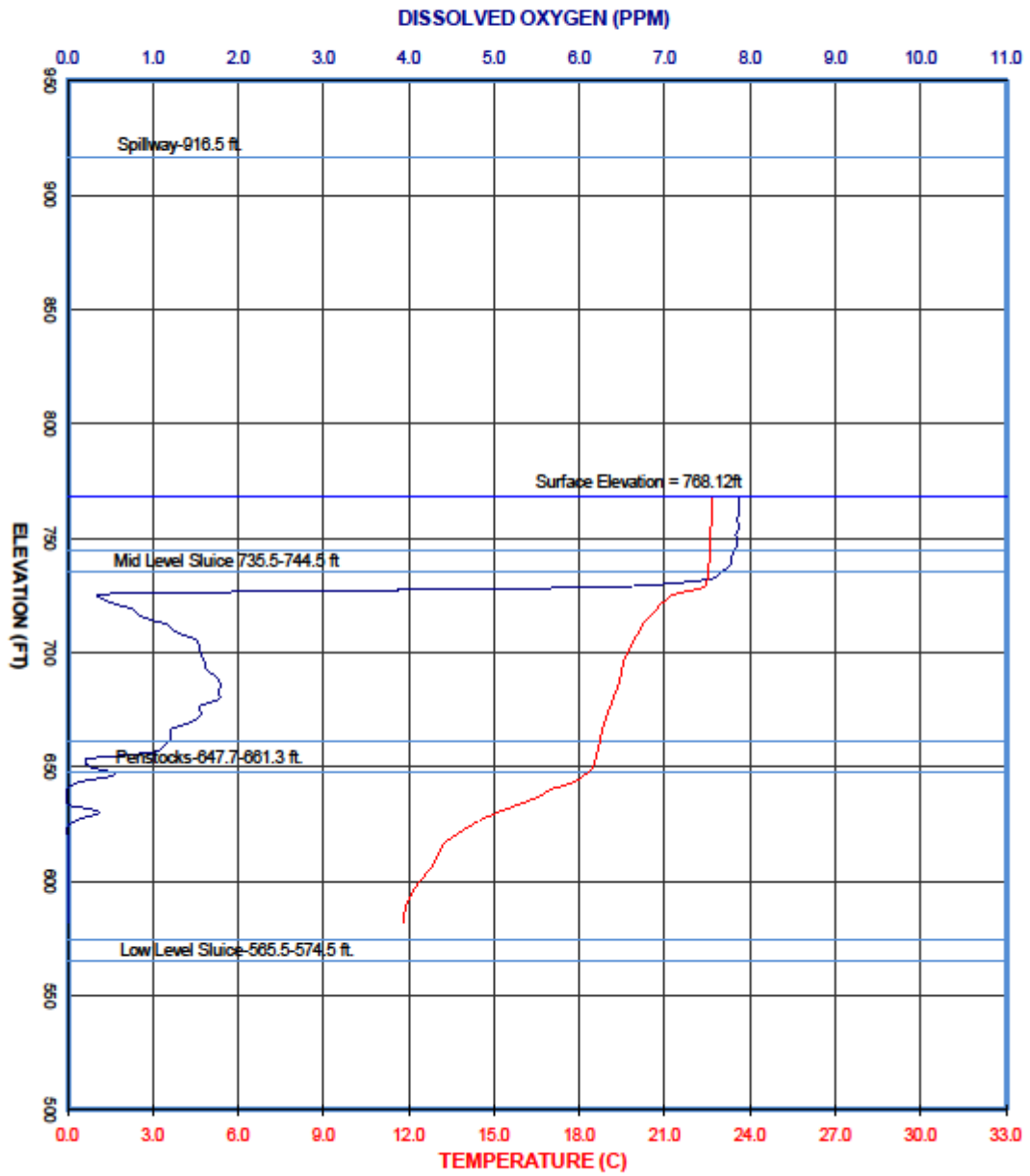
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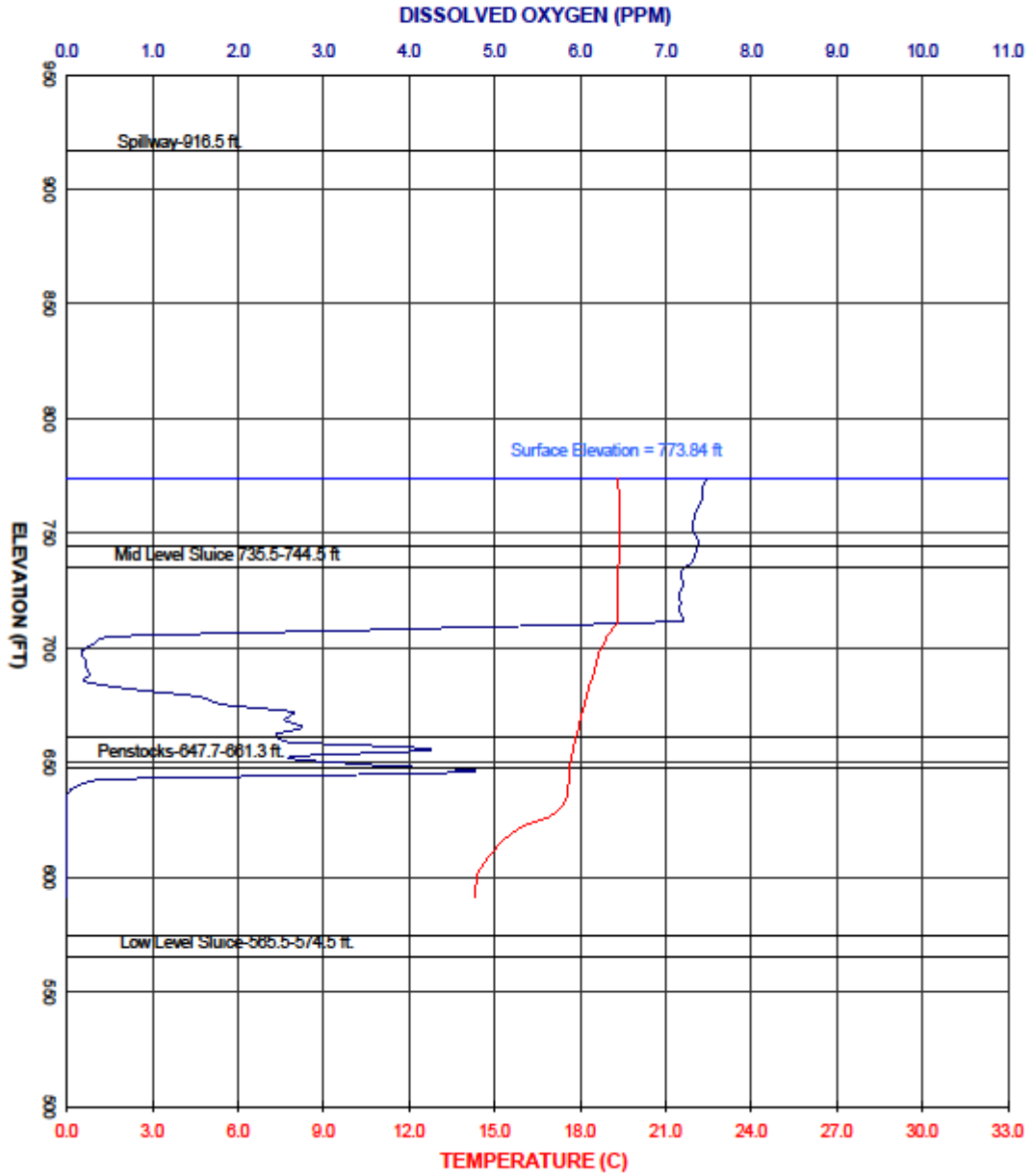
Appendix A

Pine Flat Reservoir Temperature and Dissolved Oxygen Profiles
October 2018 – September 2019

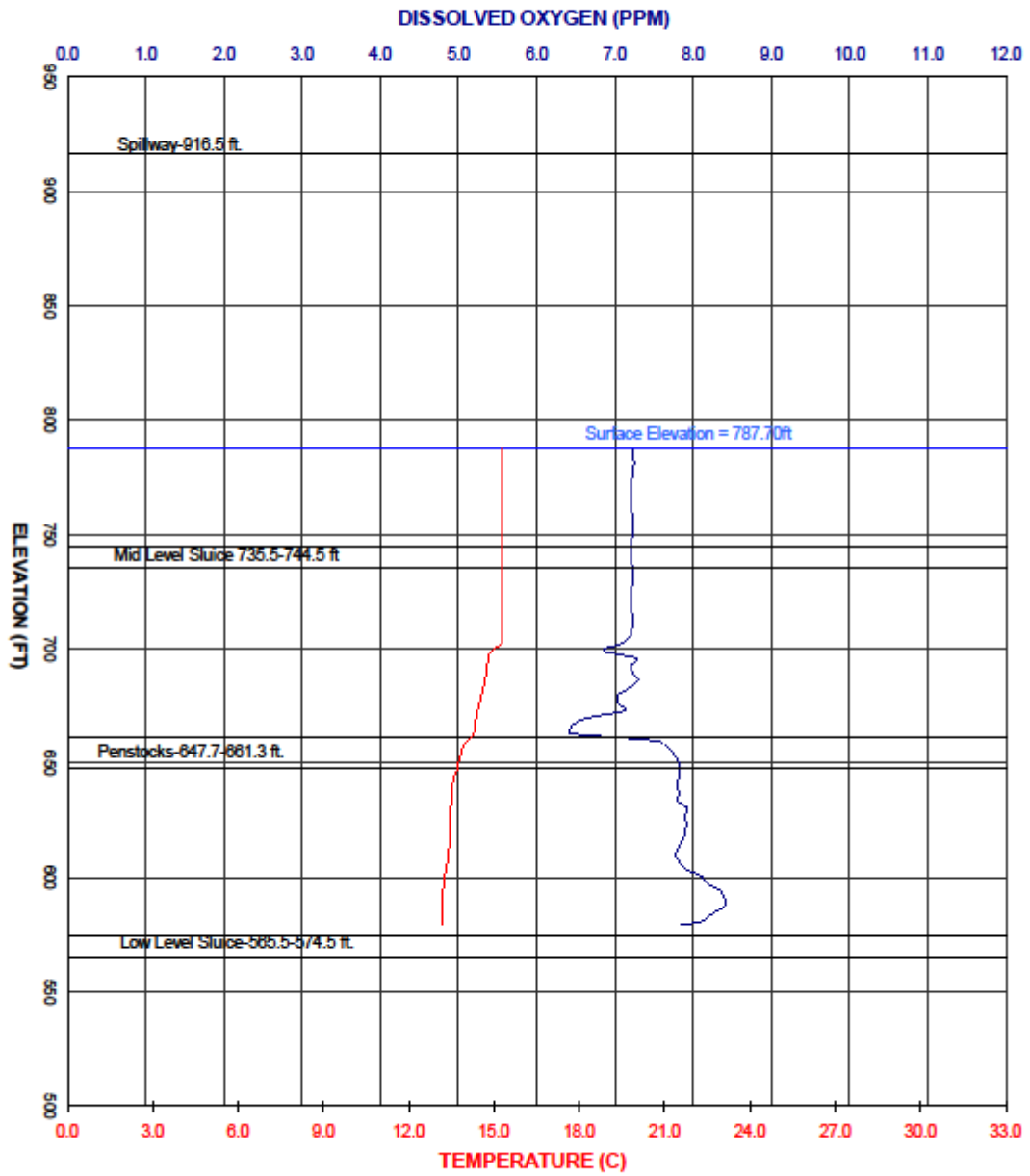
PINE FLAT RESERVOIR 10/02/18 (Time: 1047-1142) New Buoy Line
Placement (0.57 miles upstream of Dam) Reservoir Elevation in Feet = 768.12



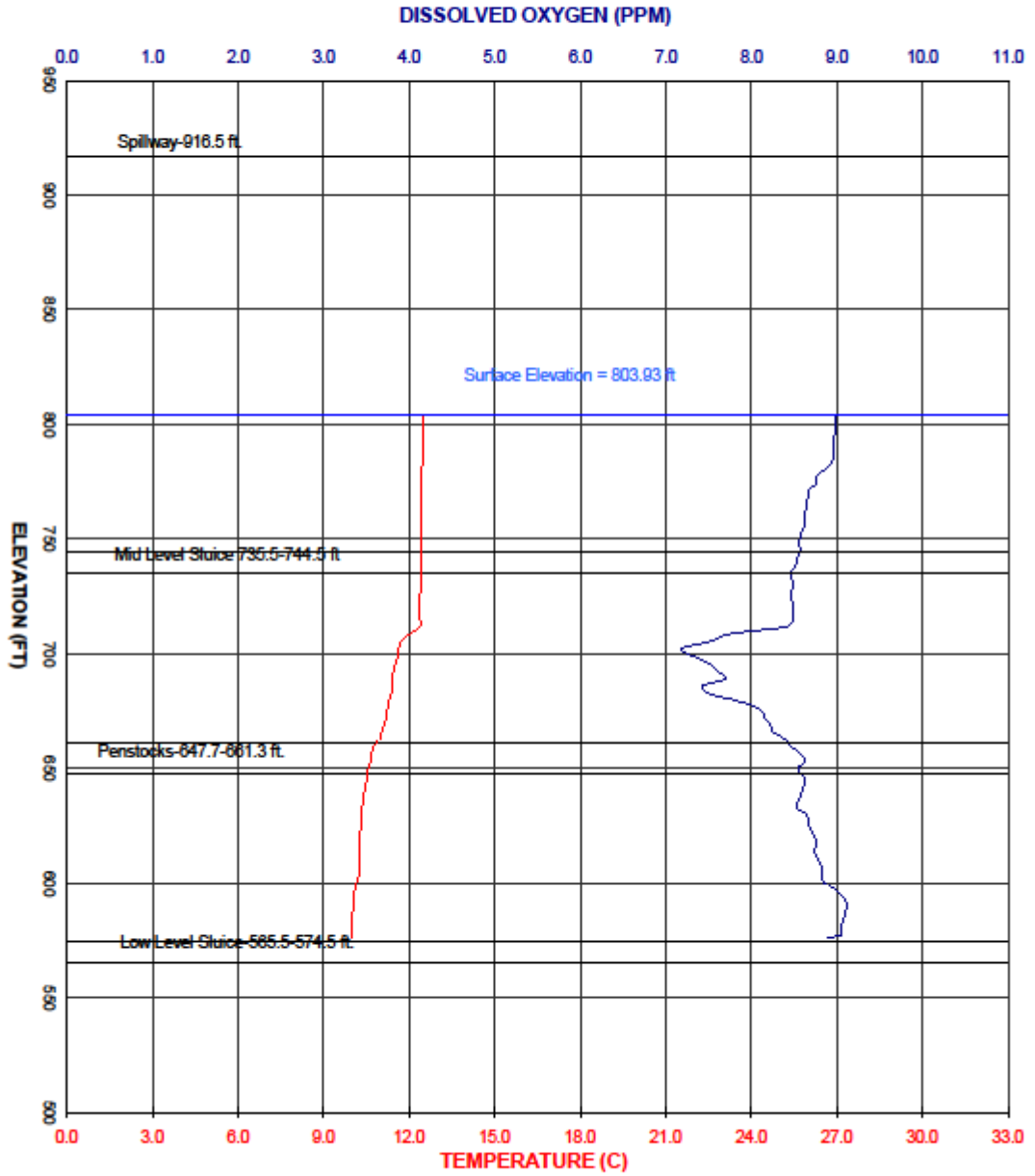
PINE FLAT RESERVOIR 10/29/2018 (Time: 1058-1144) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 773.84



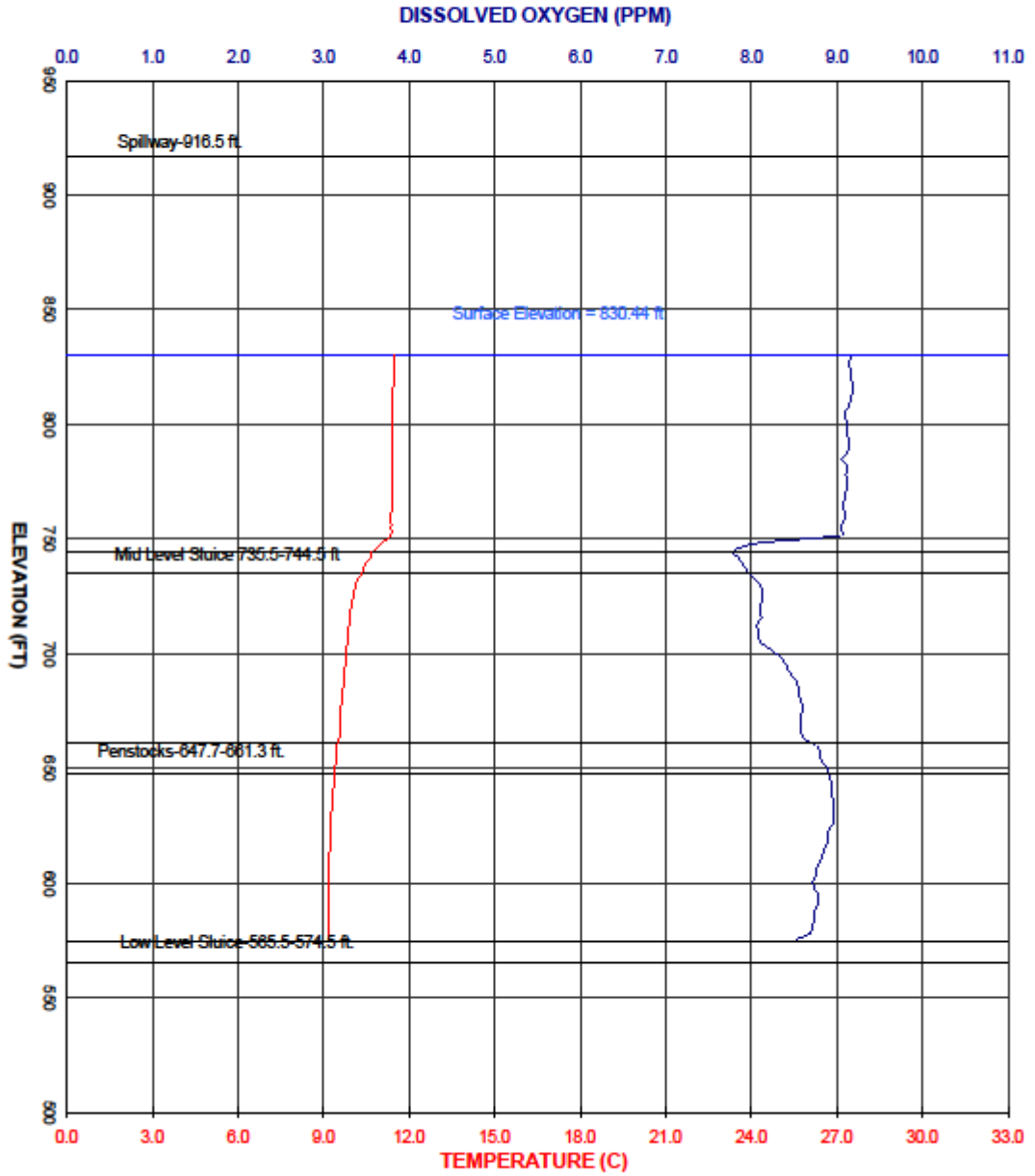
PINE FLAT RESERVOIR 12/04/2018 (Time: 1008-1103) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 787.70



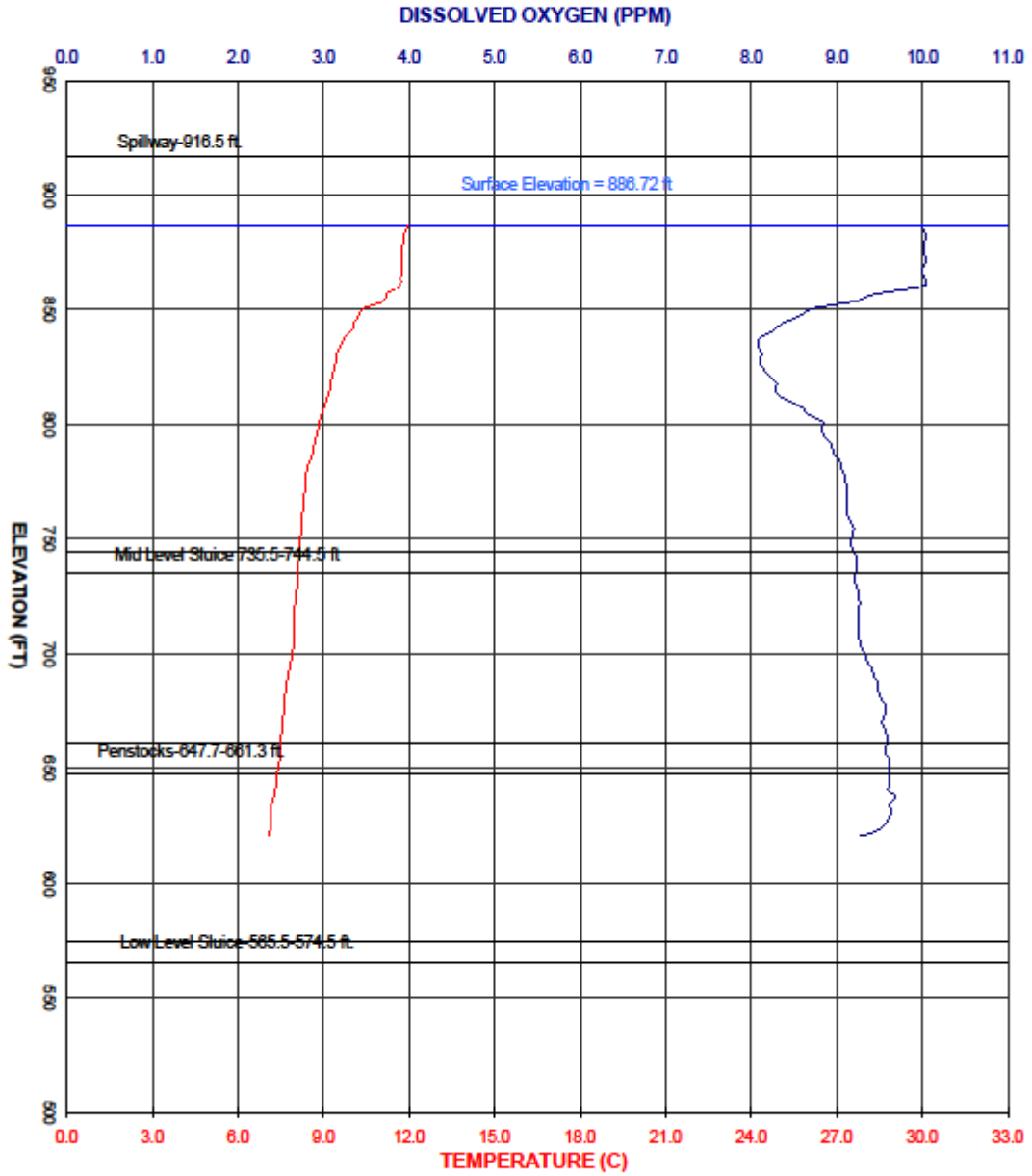
**PINE FLAT RESERVOIR 1/8/2019 (Time: 1013-1115) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 803.93**



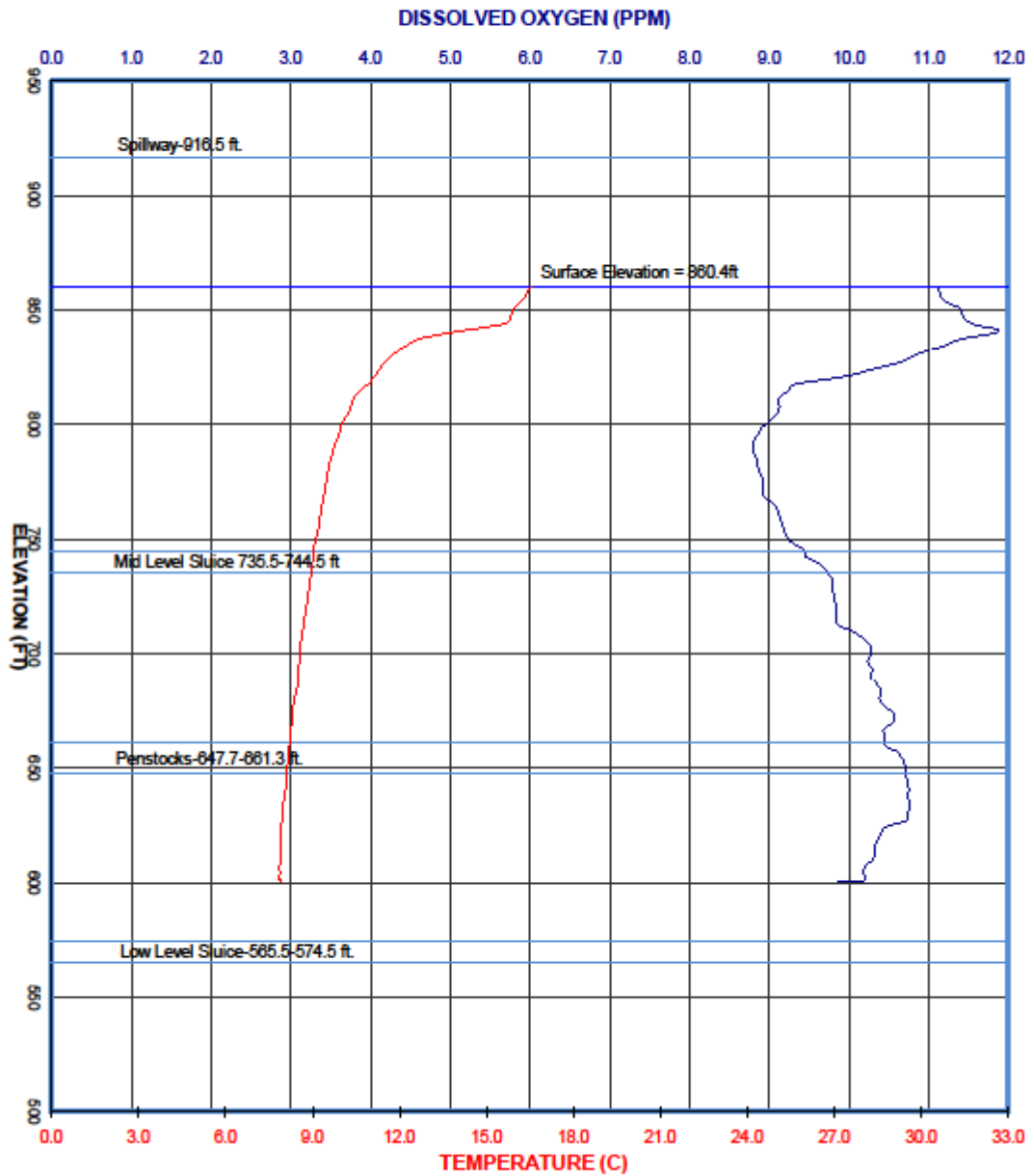
PINE FLAT RESERVOIR 2/6/2019 (Time: 1038-1204) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 830.44



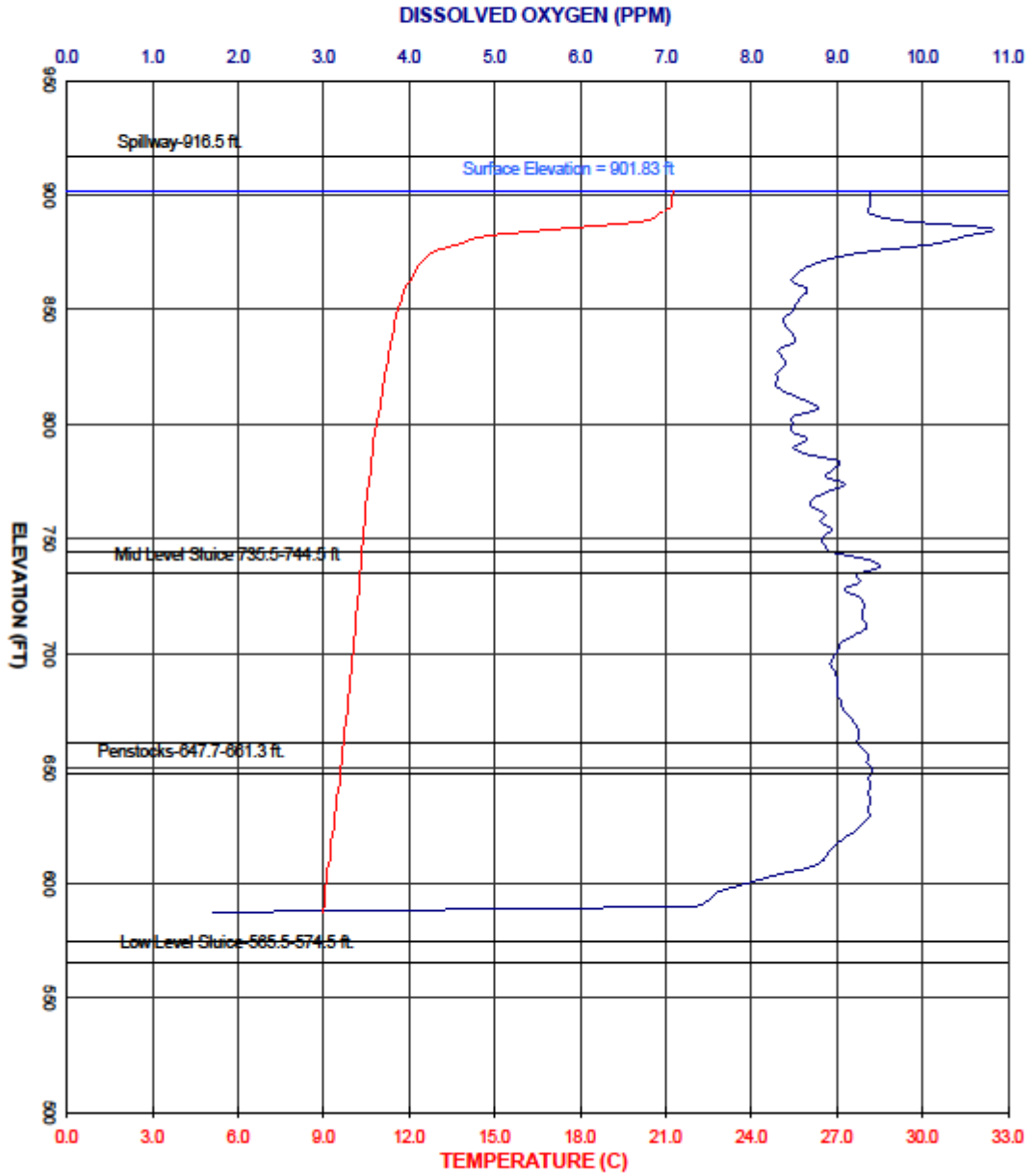
PINE FLAT RESERVOIR 3/13/2019 (Time: 1048-1221) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 886.72



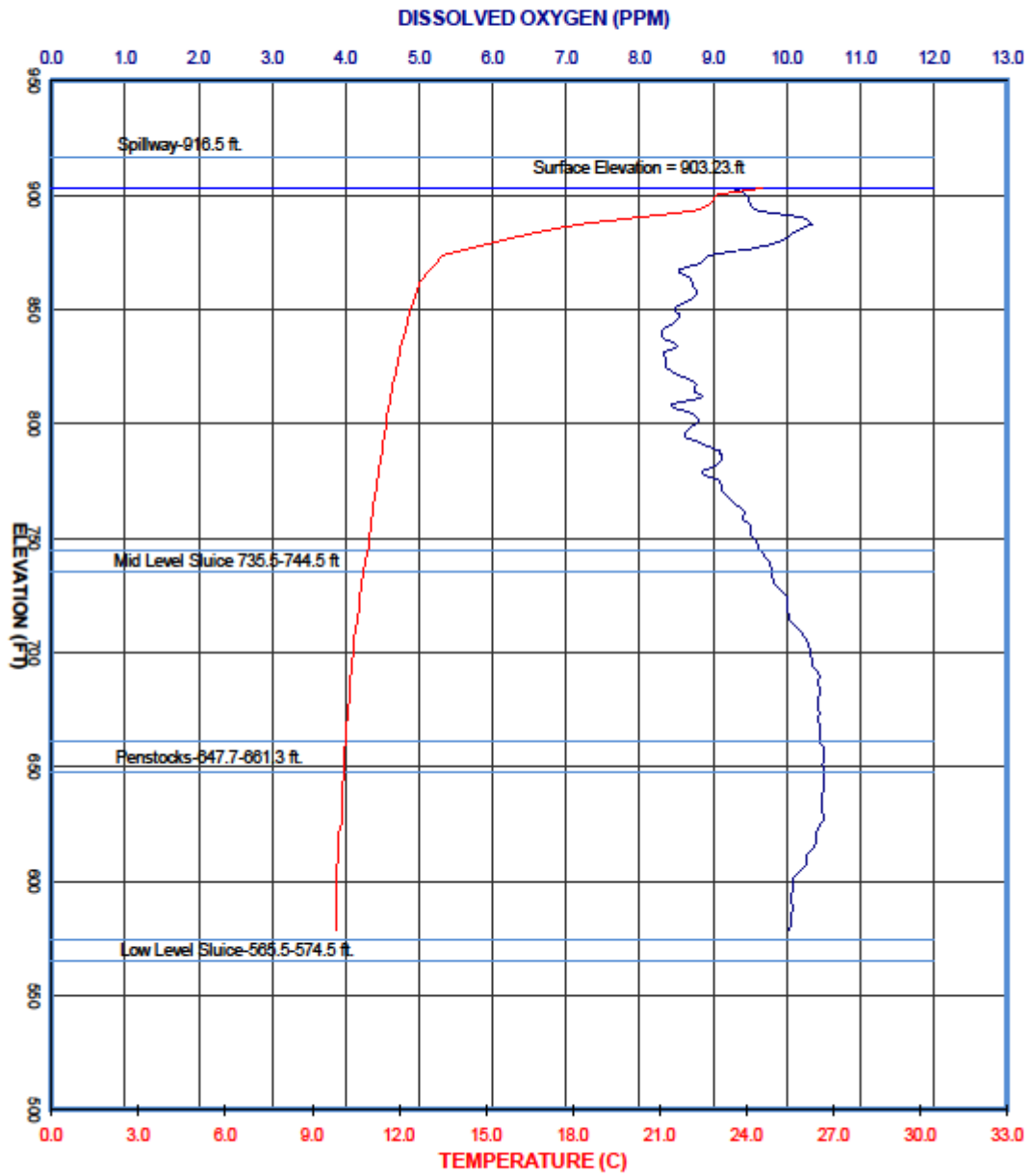
**PINE FLAT RESERVOIR 04/03/2019 (Time: 0924-1016) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 860.4**



**PINE FLAT RESERVOIR 5/9/2019 (Time: 1024-1144) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 901.83**

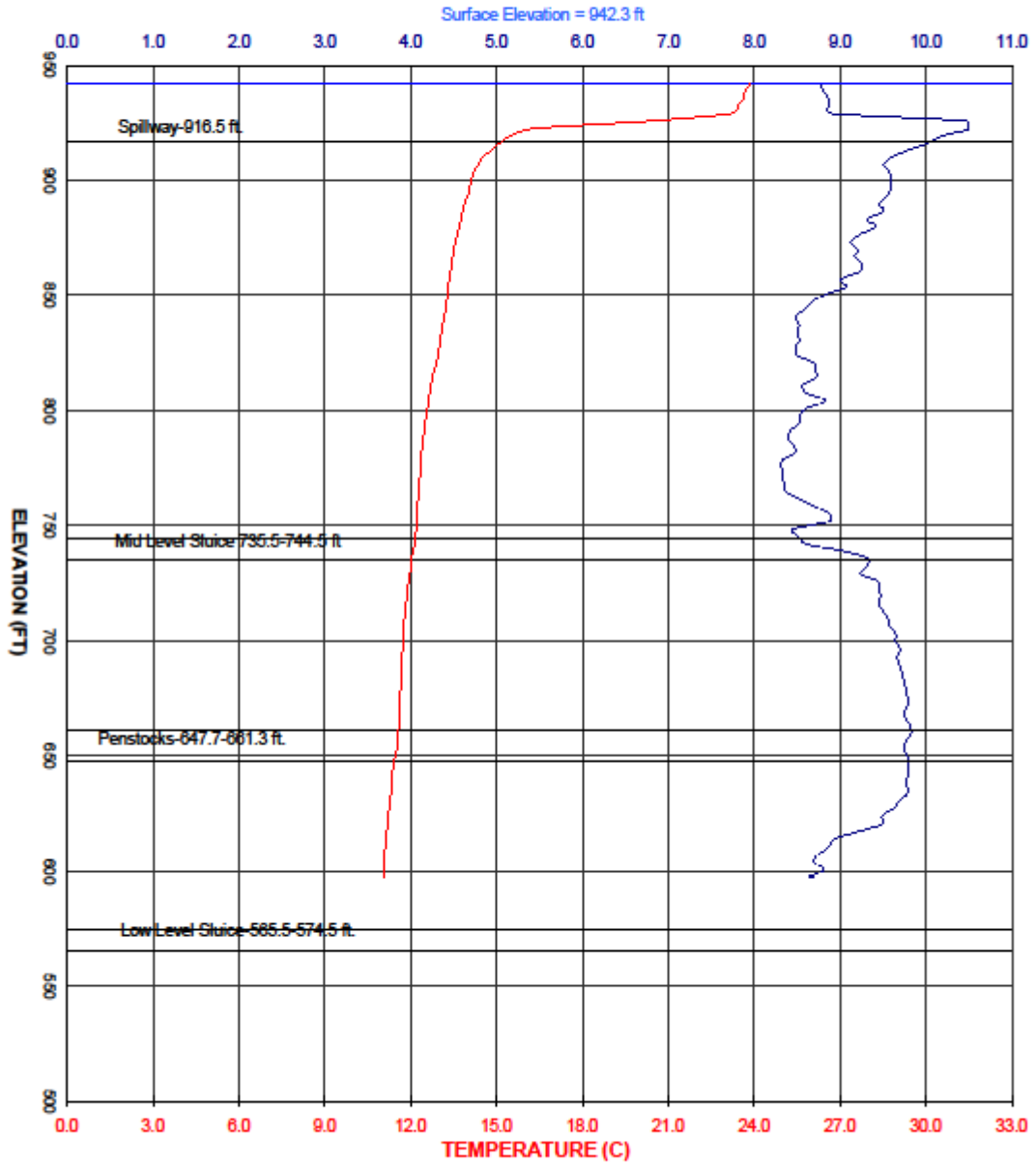


PINE FLAT RESERVOIR 06/05/2019 (Time: 1002-1114) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 903.23

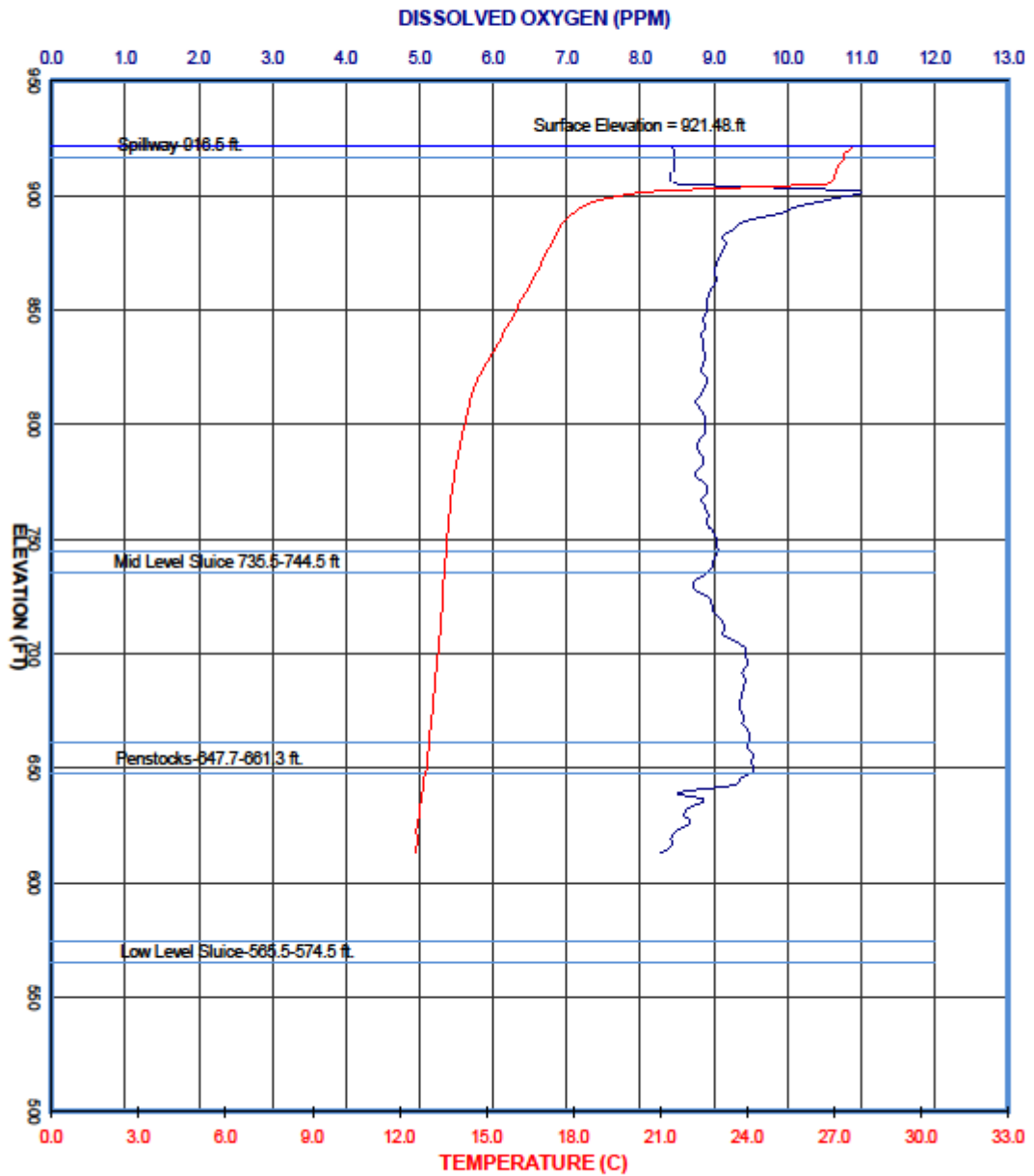


**PINE FLAT RESERVOIR 7/2/2019 (Time: 0912-1106) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 942.3**

DISSOLVED OXYGEN (PPM)



PINE FLAT RESERVOIR 08/07/2019 (Time: 0939-1055) New Buoy Line Placement
 (0.57 miles upstream of Dam) Reservoir Elevation in Feet = 921.48



**PINE FLAT RESERVOIR 9/11/2019 (Time: 0930-1130) New Buoy Line Placement
(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 877.26**

