# KINGS RIVER FISHERIES MANAGEMENT PROGRAM
# ANNUAL TECHNICAL REPORT
# 2012-2013

Kings River
FISHERIES MANAGEMENT PROGRAM

Prepared by Technical Steering Committee


Brian Beal (member)
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE

Louie Long (member)
Heidi Isner (alternate)
KINGS RIVER CONSERVATION DISTRICT

Steve Haugen (member)
Clifton Lollar (alternate)
Dr. Chuck Hanson (science advisor to the Association)
KINGS RIVER WATER ASSOCIATION


**Draft**
Issued: October 2013


*Executive Policy Committee*

Steve Haugen, KRWA

David Orth, KRCD

Jeff Single, CDFW

Steve Haugen
*Executive Officer*
559.266.0767

Diane Ruble
*Secretary*
559.237.5567

4888 E. Jensen Ave.
Fresno, CA 93725

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# EXECUTIVE SUMMARY

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 thirteen years in response to the Kings River Fisheries Management Program (FMP) Framework Agreement, which was approved on May 28, 1999, and the financial commitment extended for another ten year period on June 26, 2009. The Framework Agreement includes a number of 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 (ExCom). The scope of activities undertaken as part of the FMP between May 2012 and May 2013 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 FMP.

Hydrologic conditions and Pine Flat Reservoir operations and flows within the lower river during 2012-2013 are characterized by high seasonal variability characteristic of the Kings River watershed and water supply operations. Findings and recommendations regarding hydrology and operations 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;

- Results of daily flow measurements below Fresno Weir from June 2012 through May 2013 demonstrated **100% compliance** with the instream flow requirements as outlined in the Framework Agreement, with the majority of days greatly exceeding these minimum flow requirements;

- A real-time telemetry system provided information on flow at Fresno Weir that is available for monitoring and managing conditions within the lower river as part of the fishery program;

- Flows measured at Fresno Weir were subject to the levels representing an dry hydrologic year of the Exhibit C flow schedule (95 cfs at Fresno Weir, for a water year less than **1,555,000** acre feet);

- Results of daily flow measurements at Fresno Weir from June 2012 through May 2013 demonstrated **100% compliance** with the instream flow requirements as outlined in the Framework Agreement, with the majority of days greatly exceeding these minimum flow requirements;

- During the late summer and fall of 2012, the Turbine Bypass was utilized extensively for temperature and dissolved oxygen management purposes, due to the dry water year

resulting in necessary temperature management. The turbine bypass traditionally provides additional flexibility in managing the cold water pool within Pine Flat Reservoir and the temperature of water released into the lower river to support suitable habitat conditions for trout as part of the FMP. Multiple Hydrologic Reports were issued during the summer and fall of 2012, and these are available in Appendix B. It is anticipated the Turbine Bypass will be utilized heavily during the late summer and fall of 2013;

- Exhibit C flows at a rate of 95 cfs (level representing a dry hydrologic year) at Fresno Weir are expected to be released during the fall and winter of 2013. These flows have been triggered by the estimated 40% WY for the 2012-2013 season. The KRWA Member Units are anticipated to voluntarily provide the Exhibit C flows in the coming water-year (2013-2014);and

- In December of 2006, the KRWA member units signed internal agreements that will govern Exhibit D contributions in the future. Prior to signing these agreements, the KRWA member units provided Exhibit D flows under draft agreements during the 2005-2006 water year. The 2006-2007 and 2011-2012 water years resulted in Exhibit D flows provided under the signed agreement. The TSC supports and applauds the activities of the KRWA in completing these essential agreements

Results of water quality monitoring within Pine Flat Reservoir and the lower Kings River during 2012-2013 have shown:

- Pine Flat Reservoir becomes 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). The reservoir destratifies in the late-fall and winter due to water temperature becoming uniform throughout the water column;

- The temperature of water released from the reservoir into the lower river can be regulated and managed, to some extent, through selective operation of different outlet works, including the turbine bypass, which initiated operations during 2003. However, the ability to manage water temperatures is limited and constrained by the availability of cold water and release points during various seasonal periods within the reservoir, hydroelectric generation, requirements for irrigation releases, and other factors;

- Aeration and mixing of water released from the reservoir have proven to be effective in maintaining suitable dissolved oxygen concentrations within the lower river during periods when the power plant was in operation. Mean monthly dissolved oxygen concentrations, as measured at the ACOE Bridge, during 2012-2013 exceeded 7.0 mg/L;

- Water temperatures within the lower river showed a seasonal pattern with the coldest temperatures occurring during the late winter and temperatures generally increasing during the summer and early fall;

- Water temperature showed a characteristic longitudinal gradient downstream of Pine Flat Dam. During summer months the coldest temperatures were located immediately downstream of the dam and temperatures generally increased with distance downstream from the dam. During the fall and winter, when atmospheric temperatures are cool, a reverse temperature gradient was observed with temperatures decreasing as a function of distance downstream from Pine Flat Dam;

- Results of temperature monitoring, and results from the fishery monitoring program, provided no evidence that either dissolved oxygen concentrations or water temperature conditions within the lower river resulted in mortality to trout or other fish species during 2012-2013; and

- Results of the 2012-2013 water temperature and dissolved oxygen monitoring are being used by the TSC to refine water quality monitoring as part of the FMP and as a basis for evaluating alternative operational strategies, including operations of the turbine bypass, to address water quality issues affecting habitat conditions for trout in the future;

The FMP continued habitat enhancement efforts on the lower Kings River during 2012-2013 by the following actions:

- A portion of the Riparian Planting Project within the Habitat Masterplan was completed during the 2012-2013 program year. The trees and shrubs will be continually watered and monitored by KRCD staff through the fall of 2014.

The stocking of fish in State waters is the responsibility of the California Department of Fish and Wildlife. During the 2012-2013 reporting period, catchable and sub-catchable size rainbow trout were stocked in the Kings River between Pine Flat Dam and Fresno Weir. Due to a lack of availability, no trout eggs were supplied to the program by the CDFW for incubation and hatching in the lower river during the 2012-2013 reporting period. Catchable size rainbow trout were also planted in Pine Flat Reservoir and Avocado Lake. A brief summary of 2012-2013 stocking includes:

- In May 2012, the KRFMP obtained an unused building under long term lease from the County of Fresno for use as a trout incubator facility as mentioned in Element C17 of the Ten-Tear Plan 2012-2013;

- During the 2012 – 2013 program year approximately 297,000 eggs, purchased from Cold Springs Trout Farm, were incubated within the new building with a 70% - 75% hatch rate;

    - A total of 2,000 pounds (25,000 trout) of sub-catchable rainbow trout (4-6 inches in length) were stocked in the lower Kings River as part of the put-and-grow program;

- A total of 68 pounds (22,664 trout) of fingerling rainbow trout were stocked in the lower Kings River as part of the put-and-grow program;

- A total of 23,350 pounds of catchable sized trout (27,612 fish) were stocked in the lower Kings River during this reporting period;

- According to the data provided by CDFW, 6,600 pounds of trophy trout (1,456 fish) were stocked during the 2012-2013 program year. These numbers were included in the overall catchable numbers;

- A total of 1,177 pounds of Kokanee Salmon fingerlings (68,601 fish) were stocked in Pine Flat Reservoir during 2012-2013;

- CDFW stocked 30,520 pounds (58,997 fish) of catchable-sized rainbow trout in Pine Flat Reservoir during 2012-2013;

- No sub-catchable trout were planted in Pine Flat Reservoir during the reporting period;

- No trophy size class rainbow trout were stocked in Pine Flat Reservoir during the 2012 -2013 program year;

- CDFW stocked 1,125 pounds of Chinook salmon fingerlings (100,000 fish) in Pine Flat Reservoir during the 2012-2013 program year; and

- In the 2012-2013 reporting period, the San Joaquin Hatchery planted 14,761 pounds (108,153 fish) of catchable size rainbow trout in Avocado Lake.

As part of the FMP, habitat and fishery monitoring was conducted within the lower river and Pine Flat Reservoir. Results of the 2012-2013 monitoring program have shown:

- The FMP continues to monitor trout and non-Wildlife fish populations downstream of Pine Flat Dam; and

- The tenth Annual Technical Report was released in August 2013.

Public education and outreach activities during 2012-2013 included:

- KRWA has developed 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 developed from monitoring being conducted 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 occurring within the lower river that would affect habitat quality for trout. Weekly reports are typically distributed electronically to inform managers and other interested parties regarding conditions currently occurring within the lower river. The water temperature and flow monitoring and reporting provided a valuable tool for disseminating real-time information. During the 2012-2013 program year, reports were issued weekly beginning in August of 2012 and running through November of 2012. Copies of the reports are included in the Appendices;

- There were no tours given during the 2012-2013 program year; and

- Local groups of fisherman worked established a contract with the California Department of Fish and Wildlife's Enforcement branch to commit additional funds for Directed Enforcement Actions targeting the Kings River Fisheries Management Zone during the 2012-2013 program year. It is the hope of the fisherman that these funds will help Fish and Wildlife personnel in curtailing illegal fishing activities in the Fisheries Management Zone. These activities were officially outside of the Kings River Fisheries Management Program, but the FMP does thank Fish and Wildlife for the additional efforts.

# 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 (Figure 1-1) and Pine Flat Reservoir. These habitat enhancement projects have been implemented over the past eleven years in response to the Kings River Fisheries Management Program (FMP) Framework Agreement, which was approved on May 28, 1999. The Framework Agreement includes a number of 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 (ExCom). The scope of activities undertaken as part of the FMP between May 2012 and May 2013 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;

- Water Quality monitoring testing multiple constituents, including pesticides, at Fresno Weir to supplement data available from the Irrigated Lands Program. This sampling protocol included monthly samples taken from October 2006-October 2007 at Fresno Weir as per the suggestions from the 2004-2005 Water Quality Report. The results of this testing, and the results from the Irrigated Lands Program, are included in this annual report;

- Habitat enhancement projects including boulder acquisition and placement in the river, spawning gravel stockpiling and placement, operation and maintenance of the Thorburn Spawning and Rearing Channel, and riparian habitat protection;

- Fish stocking has occurred as part of the program within the lower river and Pine Flat Reservoir including Whitlock-Vibert box egg incubation, streamside egg incubators, routine stocking of sub-adult and catchable size trout, all done by the CDFW at no cost to the program (except for a small maintenance cost associated with streamside incubators);

- Monitoring activities associated with the FMP have included electrofishing surveys within the lower river to develop annual fish population indices, monitoring of fish use within areas associated with habitat enhancement projects such as coves and jetties, monitoring within the Thorburn Spawning and Rearing Channel, water quality

monitoring within the lower river, and macroinvertebrate surveys. Monitoring within Pine Flat Reservoir included the compilation of bass tournament records;

- Public education and outreach included summer hydrology and water temperature monitoring reports, internet web page development, news releases, issuance of a news letter on the FMP, and angler access improvements; and

- Maintenance activities included watering riparian vegetation planted along the Thorburn Channel, routine maintenance of the channel headgate, and repairs and maintenance of the streamside egg incubators.

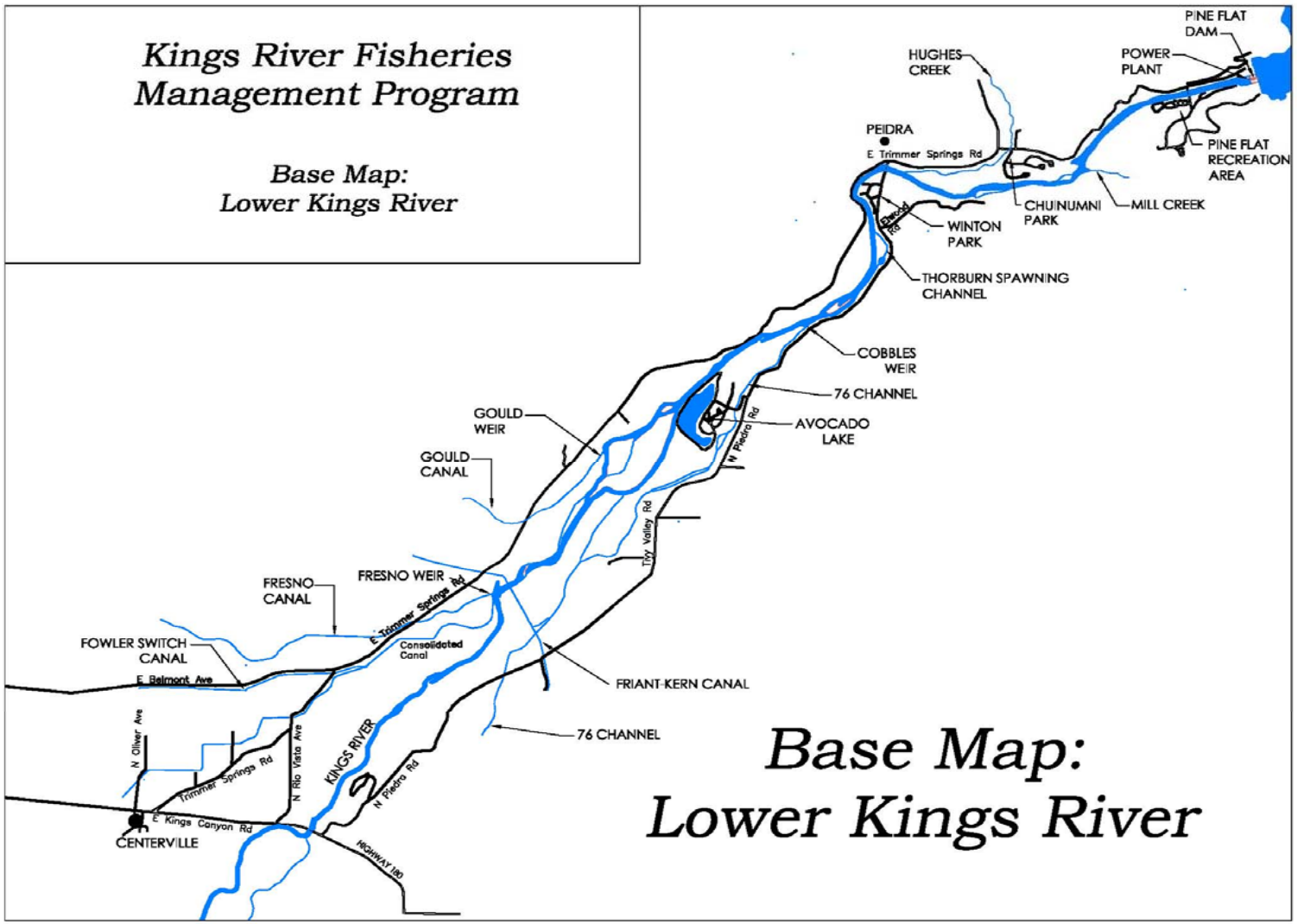



**Figure 1-1.** Map of the lower Kings River and key geographic locations.

The following report presents a compilation and synthesis of information regarding these habitat enhancements, trout population enhancements, and monitoring activities during 2012-2013. Since the Framework Agreement has been in place since 1999, the technical compilation and synthesis report also presents data from earlier projects and monitoring activities as part of the Framework Agreement. This technical report is designed to compile and summarize information available on the implementation and performance of the FMP and to convey information on the FMP to the ExCom, the Public Advisory Committee (PAG) and other interested parties. This annual technical report is intended to accompany the 10-Year Plan to describe and document results of the FMP to date, and to serve as the technical and scientific foundation for the identification of priority actions to be implemented as part of subsequent 10-Year Plans, to identify significant findings that would affect the fishery monitoring within Pine Flat Reservoir and the lower river, or the identification of specific management actions designed to enhance and improve habitat conditions for resident trout and other desirable fish species inhabiting the Kings River system.

One of the principle objectives of the annual report is to provide a project management structure for reviewing and prioritizing existing and proposed habitat enhancement 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 is to help ensure 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 FMP. The annual report also provides a framework to present monitoring results used by the TSC to evaluate a variety of alternative approaches each year for meeting the goals for the enhancement program, and for evaluating program performance.

## 1.1 ADMINISTRATIVE ACTIVITIES

On June 26, 2009, the parties to the Kings River Fisheries Management Program (KRFMP) agreed to and signed a 10-year financial extension of the Framework Agreement, ensuring that the enhancement efforts of the KRFMP will continue into the next ten year period. As a result of a change in the mechanism by which funds were being provided, the budgeting process had to be changed from the previous 5-Year Implementation Plan to a more grant based 10-Year Implementation Plan approach.

The Kings River Fisheries Management Program's fifth edition of the 10-Year Implementation Plan (for program year 2013-2014) was finalized and presented and approved by the Executive Committee at their meeting on September 4, 2013.

The ExCom did not meet during the 2012-2013 program year, but did meet on September 4, 2013 to hear reports from the TSC and the public, and to provide direction to the TSC going forward. The TSC met on an ongoing basis to continue their work on program development and administration. The PAG, with Hank Urbach as Chairman, met on a monthly basis to discuss and develop issues important to them. Members of the TSC and ExCom routinely attend the PAG meetings to report on their activities and to provide input as requested.

## 1.2 ANNUAL TECHNICAL REPORT

A number of interested parties and stakeholders, including the ExCom, PAG, resource and water agencies, local angling groups, and others have expressed interest in the information being collected as part of the FMP'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.

Fishery enhancement work under the guidance of the Framework Agreement has occurred on the lower Kings River and Pine Flat Reservoir since the signing of the Framework Agreement on May 28, 1999. The first annual report for the FMP covered the period of May 2002 through May 2003 and was released in September 2004. The second annual technical report covered the period of May 2003 through May 2004 and was released in February 2005. The third annual technical report, which summarizes results of the habitat enhancement activities, trout management, and fishery and habitat monitoring between May 2004 and May 2005, was released in February 2006, the fourth in August 2007, the fifth in February of 2008, the sixth in April of 2009, the seventh and eighth in July of 2010, the ninth in September of 2011, and the tenth and eleventh in September of 2013. This report represents the twelfth in the series, and covers the program year between May 2012 and May 2013.

The annual technical report summarizes key accomplishments and performance of the habitat enhancement actions and findings of the monitoring program. Compilation and analyses of available information used to assess performance of the FMP and habitat enhancement program is based upon results of both baseline monitoring within the Kings River and results of project-specific monitoring and performance evaluations. Information from a variety of program elements has been compiled each year representing results of each element of the Kings River monitoring program, as outlined in the 10-Year Plan. The annual technical report includes an executive summary followed by brief descriptions of individual monitoring program elements and results of key findings. The annual technical report summarizes information regarding the status and trends of the physical conditions affecting habitat quality and availability for rainbow trout within the river, and provides guidance and recommendations for future actions and modifications to the program. Documentation of data and other relevant information are included as appendices.

# 2.0 HYDROLOGY AND OPERATIONS

## 2.1 RESERVOIR INFLOW

Daily runoff into Pine Flat Reservoir from June 1, 2012 through May 31, 2013 is shown in Figure 2-1. Inflow into Pine Flat Reservoir is characterized by high seasonal and inter-annual variability reflecting variation in precipitation, snow pack, and runoff within the watershed. The total estimated annual inflow into Pine Flat Reservoir and the corresponding percent water year is summarized below (Table 2-1):

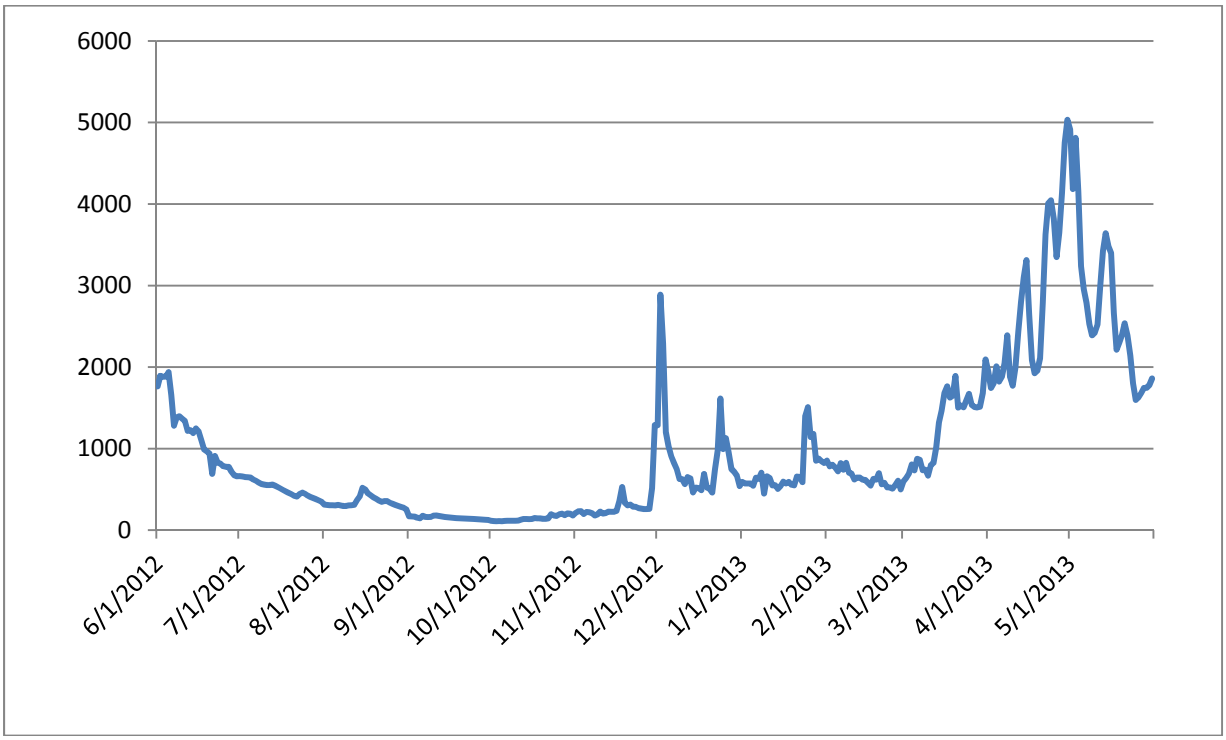



**Figure 2-1. Daily inflow into Pine Flat Reservoir in cfs between June 1, 2012 and May 31, 2013.**

## 2.2 RESERVOIR STORAGE

Daily reservoir water storage volume and water surface elevation in Pine Flat Reservoir from June 2012 through May 2013 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. Reservoir operations since implementation of the Framework Agreement have retained the temperature control pool at or above the 100,000 acre-foot pool.

| Period | Annual Runoff (TAF) | Percent Water Year |
|---|---|---|
| October 1999 -- September 2000 | 1,534 | 90% |
| October 2000 -- September 2001 | 1,010 | 59% |
| October 2001 -- September 2002 | 1,141 | 67% |
| October 2002 -- September 2003 | 1,426 | 84% |
| October 2003 -- September 2004 | 1,050 | 62% |
| October 2004 -- September 2005 | 2,531 | 149% |
| October 2005 – September 2006 | 2,952 | 173% |
| October 2006 – September 2007 | 679 | 39% |
| October 2007 – September 2008 | 1,216 | 74% |
| October 2008 - September 2009 | 1,348 | 79% |
| October 2009 – September 2010 | 2,062 | 121% |
| October 2010 - September 2011 | 3,318 | 193% |
| October 2011 – September 2012 | 826 | 48% |
| October 2012 – September 2013 | 691 | 40% |

**Table 2-1. Annual runoff in thousands of acre-feet (TAF) and Percent Water Year from October 1999 through September 2013.**

## 2.3 RESERVOIR RELEASES

Water releases from Pine Flat Reservoir to the lower Kings River show high variability within the year as shown in Figure 2-3. Releases from Pine Flat Reservoir during the late fall, winter, and spring months have been in accordance with the Exhibit C flow schedule established by the Framework Agreement. Average daily flow in the lower Kings River from June 2012 through May 2013 ranged from 100 to 6,610 cubic feet per second (cfs) (Figure 2-3).

The Framework Agreement established minimum instream Exhibit C flow releases from Pine Flat Reservoir, flow at Piedra, in Dennis Cut, at Fresno Weir and below Fresno Weir to support resident fish populations in the lower river. Results of daily flow measurements below Fresno Weir from June 2012 through May 2013 demonstrated **100% compliance** with the instream flow requirements as outlined in the Framework Agreement, with the majority of days greatly exceeding these minimum flow requirements. These results are shown in Figure 2-4.

Flows measured at Fresno Weir were subject to the levels representing a dry hydrologic year of the Exhibit C flow schedule (95 cfs at Fresno Weir, for a water year less than **1,555,000** acre

feet), and the corresponding results are shown in Figure 2-5. Results of daily flow measurements at Fresno Weir from June 2012 through May 2013 also demonstrated **100% compliance** with the 95 cfs target at Fresno Weir as outlined in the Framework Agreement. These results are shown in Figure 2-5. Information on daily water releases from Pine Flat Reservoir and daily flows at Fresno Weir are summarized in Appendix A.

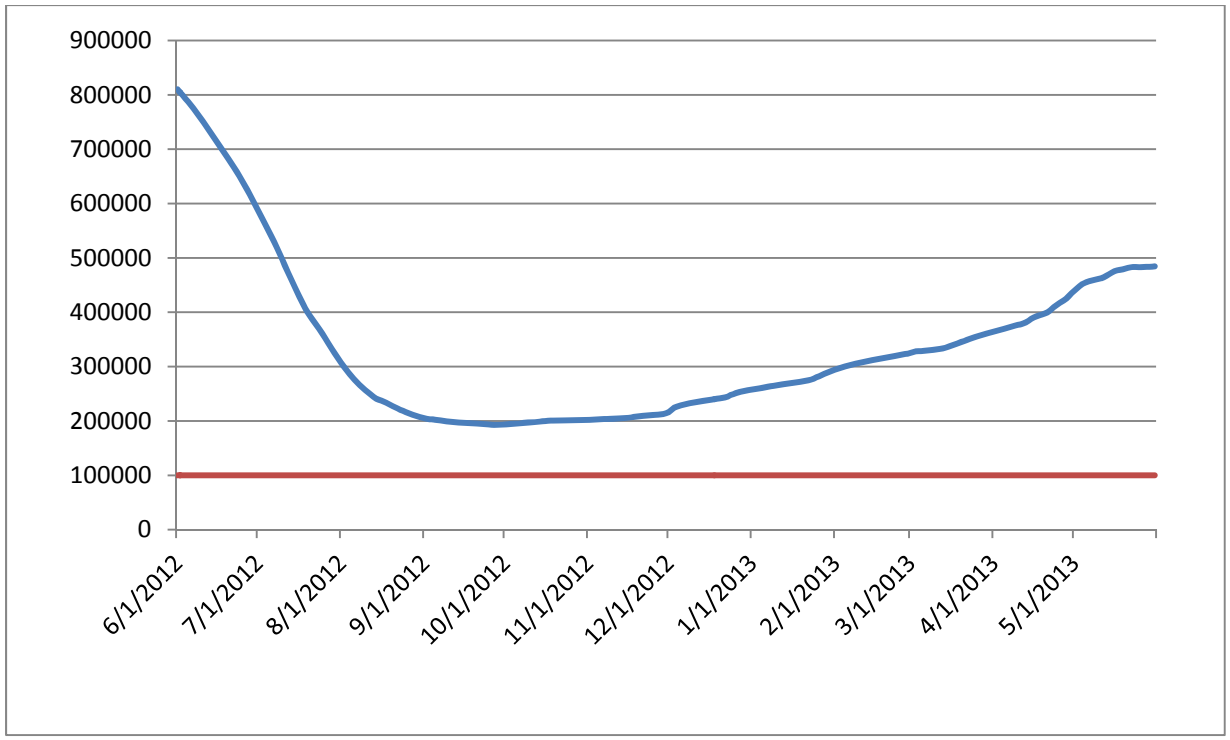



**Figure 2-2. Daily storage volume in Pine Flat Reservoir from June 2012 to May 2013.**
Note: ----- Storage values in acre-feet volumes. Red Line indicates Temperature Control Pool of 100,000 acre-feet.

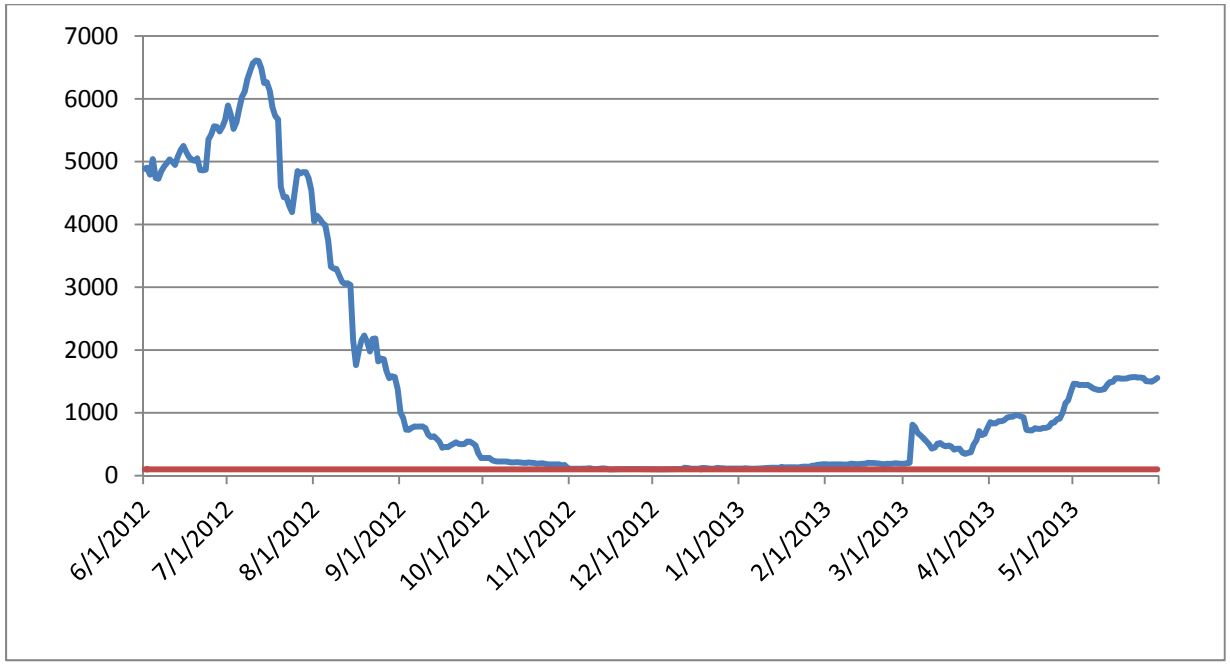



**Figure 2-3. Average daily water releases from Pine Flat Reservoir to the lower Kings River between June 2012 and May 2013.** Note: ----- Releases represented as flow rate in cfs. Red Line represents minimum flow rate as established by Exhibit C criterion (cfs).

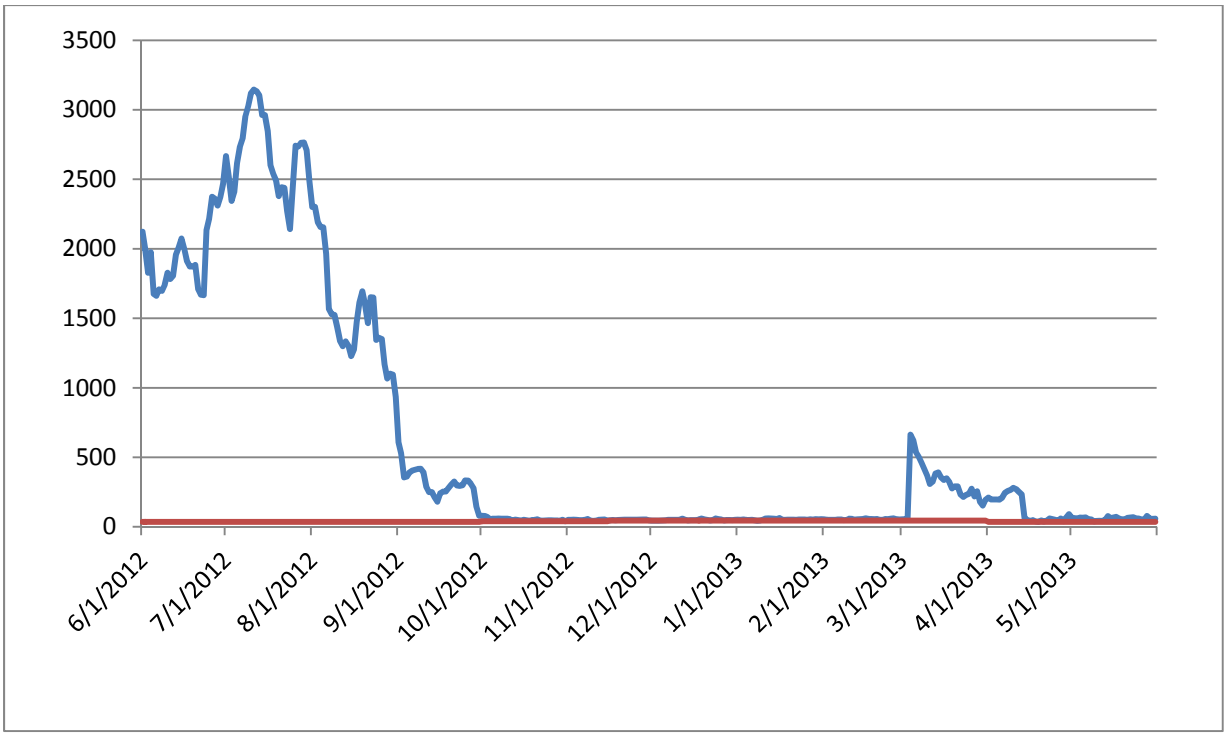



**Figure 2-4. Average daily flows in the Kings River below Fresno Weir from June 2012 through May 2013.** Note: ----- Flow rate represented in cfs. Red Line represents minimum flow rate as established by Exhibit C criteria (cfs).

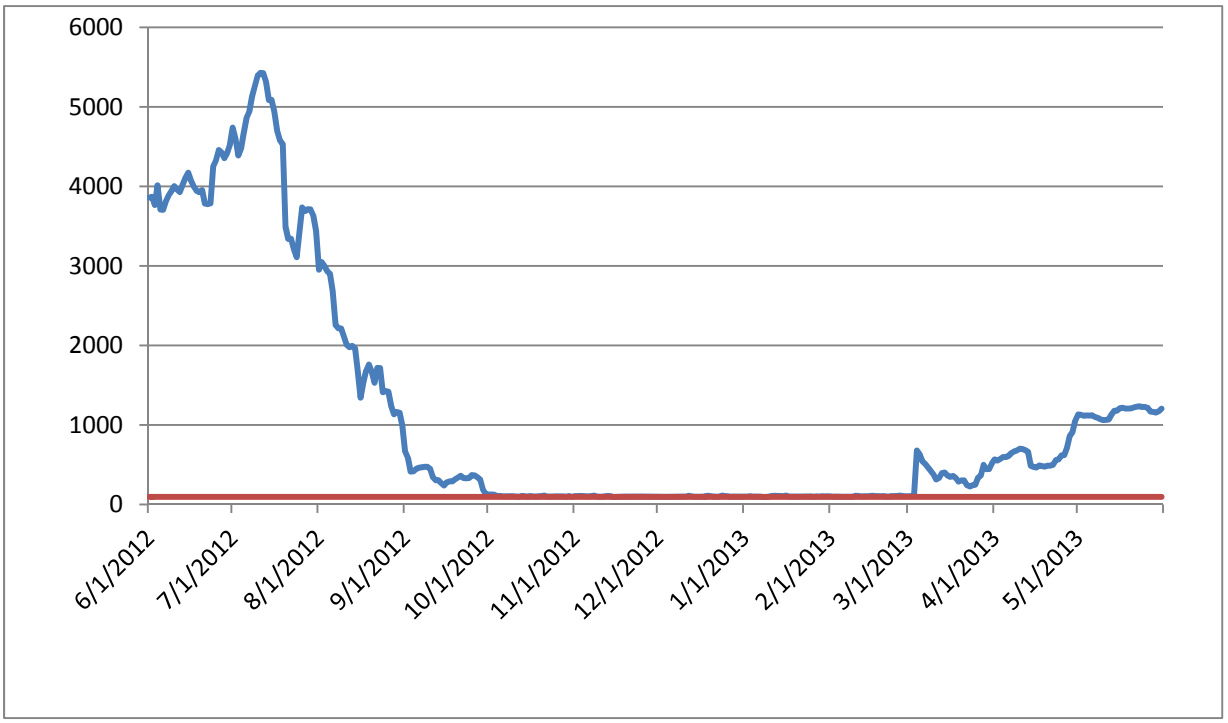



**Figure 2-5. Average daily flows in the Kings River at Fresno Weir from June 2012 through May 2013**. Note: ----- Flow rate represented in cfs. Red Line represents minimum flow rate as established by the Exhibit C criteria (cfs).

## 2.4 TELEMETRY SYSTEM

During 2012-2013, KRWA continued the use of a real-time (telemetry) flow monitoring stations at Fresno Weir and at Dennis Cut. 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 telemetry water temperature monitoring system complements the ongoing 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 trout within the river.

## 2.5 TURBINE BYPASS PROJECT

The turbine bypass project was completed in March 2003. The project was developed through the U. S. Army Corps of Engineers (ACOE) Pine Flat Dam Fish and Wildlife Habitat Restoration Investigation that began in 1993. KRCD served as the local sponsor with contributions from the CDFW, KRWA, and California Department of Water Resources (DWR). The turbine bypass provides increased flexibility in operating and managing flows and water temperatures released from Pine Flat Dam. The turbine bypass is operated by KRCD.

The approximately 6-million dollar project involved constructing a conduit system to the existing penstocks to allow for low flows to bypass the power plant turbines. This allows greater flexibility in making releases at various water elevations in Pine Flat Reservoir by allowing releases through the penstocks when flows are less than the 500 to 600 cfs necessary to run the power plant. In this way, there is more flexibility given to the limited releases of colder water made into the river from the reservoir to benefit the coldwater fishery during low-flow periods of the year. The turbine bypass is also used to increase the dissolved oxygen level in waters released from the power plant.

During the late summer and fall of 2012, the Turbine Bypass was utilized extensively for temperature and dissolved oxygen management purposes. The dry water year of 2011-2012 (48%) resulted in the drawdown of the reservoir, and the necessity to manage temperatures. It is anticipated, due to the second dry water year in a row of 2012-2013 (40%), that the Turbine Bypass will be utilized even more heavily during the late summer and fall of 2013.

## 2.6 EXHIBIT C AND D FLOWS

Section 1(e) of the Framework Agreement calls for the KRWA to diligently endeavor to increase the minimum water flows in the Kings River downstream of Pine Flat Dam as set forth in Exhibit C to those levels shown in Exhibit D by October 1, 2005. The Exhibit C flow schedule presented in the Framework Agreement is summarized in Table 2-2. Exhibit C flows have been implemented and monitored since 1999.

A KRWA Exhibit D committee was formed and has met regularly to develop programs that will enable the KRWA to reach the Exhibit D flow goals while avoiding or minimizing unacceptable water supply or operational impacts to its member units. Some ideas under discussion in the KRWA Exhibit D committee include rescheduling of irrigation demands and/or the temperature control pool, groundwater recharge and water banking projects, exchange arrangements with the State Water Project (SWP), downstream surface storage projects, and member contribution of entitlement/storage.

Exhibit D flows at a rate of 250 cfs (level representing a wet hydrologic year) at Fresno Weir were released for two consecutive years in the fall and winter of 2005 and 2006, and again in 2011. These flows were triggered by the larger than normal water-years in 2004-2005 (149% WY), 2005-2006 (173% WY), and 2010-2011 (193% WY) and the KRWA Member Units voluntarily provided the Exhibit D flows in the following water-years (2005-2006, 2006-2007 and 2011-2012).

Exhibit D flows at a rate of 135 cfs (level representing a hydrologic year greater than 1,555,000 AF and less than 2,100,000 AF) at Fresno Weir were released during the fall and winter of 2010, representing the first year in the history of the program that this level of Exhibit D flow was provided. These flows were triggered by the 121% WY for the preceeding 2009-2010 season. The dry 2011-2012 WY (48%) triggered an Exhibit C requirement for the 2012-2013 WY, which were provided by KRWA Member Units.

**Table 2-2. Exhibit C flows (cfs) from the Framework Agreement.**

| Season | Total Flow at Piedra | Minimum Flow in Dennis Cut | Minimum Flow to Fresno Weir | Water Divertable in China Slough | Required Flow Over Fresno Weir |
|---|---|---|---|---|---|
| **Oct. 1 – Nov. 15** | **100** | **5** | **95** | **10** | **40** |
| **Nov. 16 – March 31** | **100** | **5** | **95** | **5** | **45** |
| **April 1 – Sept. 30** | **100** | **5** | **95** | **15** | **35** |

In December of 2006, the KRWA member units signed internal agreements that will govern Exhibit D contributions in the future. Prior to signing these agreements, the KRWA member units provided Exhibit D flows under draft agreements during the 2005-2006 water year. In the 2006-2007, 2010-2011 and 2011-2012 water years, Exhibit D flows were provided under the signed agreements. The TSC supports and applauds the activities of the KRWA in completing these essential agreements.

## 2.7 DISSEMINATION OF TEMPERATURE DATA

Experience has taught the TSC that sharing water temperature information with our stakeholders during critical or near critical periods that are stressful to trout is important. To this end, KRWA began providing weekly hydrologic and climate reports (Appendix B) to the PAG members and other interested parties several years ago. These one-page reports provide information on flows in the lower river and tributary streams as well as a summary of flow and temperature trends. This has been beneficial to everyone who has an interest in the well being of the trout population in the lower river and has resulted in much improved communications regarding these possible temperature events. Multiple reports of this type were issued during the summer and fall of 2012, and copies of these reports are included in Appendix B.

## 2.8 SUMMARY AND DISCUSSION

Hydrologic conditions and Pine Flat Reservoir operations and flows within the lower river during 2012-2013 are characterized by high seasonal variability characteristic of the Kings River

watershed and water supply operations. Findings and recommendations regarding hydrology and operations 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;

- Results of daily flow measurements below Fresno Weir from June 2012 through May 2013 demonstrated **100% compliance** with the instream flow requirements as outlined in the Framework Agreement, with the majority of days greatly exceeding these minimum flow requirements;

- A real-time telemetry system provided information on flow at Fresno Weir that is available for monitoring and managing conditions within the lower river as part of the fishery program;

- Flows measured at Fresno Weir were subject to the levels representing an dry hydrologic year of the Exhibit C flow schedule (95 cfs at Fresno Weir, for a water year less than **1,555,000** acre feet);

- Results of daily flow measurements at Fresno Weir from June 2012 through May 2013 demonstrated **100% compliance** with the instream flow requirements as outlined in the Framework Agreement, with the majority of days greatly exceeding these minimum flow requirements;

- During the late summer and fall of 2012, the Turbine Bypass utilized extensively for temperature and dissolved oxygen management purposes, due to the dry water year resulting necessary temperature management. The turbine bypass traditionally provides additional flexibility in managing the cold water pool within Pine Flat Reservoir and the temperature of water released into the lower river to support suitable habitat conditions for trout as part of the FMP. Multiple Hydrologic Reports were issued during the summer and fall of 2012, and these are available in Appendix B. It is anticipated the Turbine Bypass will be utilized heavily during the late summer and fall of 2013;

- Exhibit C flows at a rate of 100 cfs (level representing a dry hydrologic year) at Fresno Weir are expected to be released during the fall and winter of 2013. These flows have been triggered by the estimated 40% WY for the 2012-2013 season. The KRWA Member Units are anticipated to voluntarily provide the Exhibit C flows in the coming water-year (2013-2014);and

- In December of 2006, the KRWA member units signed internal agreements that will govern Exhibit D contributions in the future. Prior to signing these agreements, the KRWA member units provided Exhibit D flows under draft agreements during the 2005-2006, 2006-2007 and 2011-2012 water years. The TSC supports and applauds the activities of the KRWA in completing these essential agreements.

# 3.0 WATER QUALITY

Water quality monitoring as part of the FMP has focused principally 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. The TSC developed a water quality monitoring program to characterize the chemical and physical parameters at Mill Creek near the confluence with the lower Kings River, and at Fresno Weir. Results of water temperature and dissolved oxygen monitoring within the reservoir and lower River are presented below.

## 3.1 WATER TEMPERATURE MONITORING

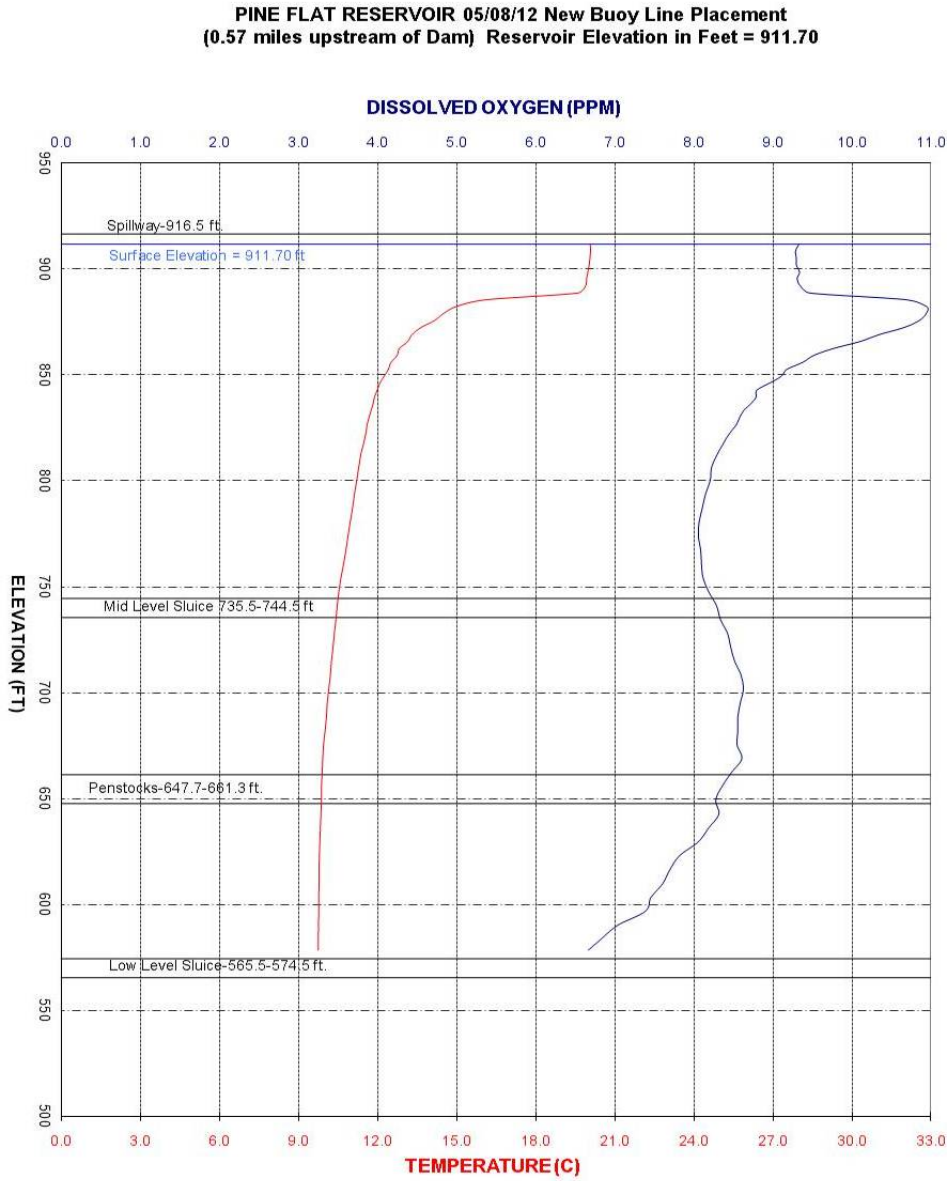
Habitat quality and availability to support resident trout within the lower Kings River is dependent, to a large extent, on the suitability of seasonal water temperatures. Water temperatures within the lower Kings River are affected by a variety of environmental factors including, but not limited to, the temperature of water released from Pine Flat Reservoir, air temperature, stream flow, and the distance downstream from Pine Flat Reservoir. Given the importance of water temperature as a factor affecting habitat conditions for trout within the lower river, the FMP includes an extensive water temperature monitoring component designed to provide information on water temperature within Pine Flat Reservoir and at various locations along the lower river.

### 3.1.1 Reservoir

Water temperature and dissolved oxygen profile measurements for Pine Flat Reservoir have been collected by KRCD biologists on approximately a monthly basis since 1986. Measurements are taken at a monitoring location approximately 0.5 mile upstream of the dam using a Hydrolab portable water quality meter. Vertical profile measurements of both water temperature and dissolved oxygen concentrations are recorded at 1 meter intervals from the surface for the first 30 meters and every 2 meters thereafter to the bottom of the water column. These measurements characterize the limnological profile within Pine Flat Reservoir in the vicinity of the dam outlet structures.

Results of water quality monitoring have shown a characteristic seasonal pattern of thermal stratification beginning in the spring forming a reservoir hypolimnion (cold water layer near the bottom) and epilimnion (warmer water layer near the surface) increasing through the summer months. Reservoir thermal stratification continues into the fall, at which time atmospheric cooling results in fairly uniform water temperatures throughout the reservoir (reservoir destratification). Later in the fall, cold air temperatures cool the upper layer of water so that the epilimnion is colder than the hypolimnion (reservoir turnover). Results of the May 2012 reservoir profile are presented in Figure 3-1 as an example of monitoring. Results of monthly vertical reservoir temperature and dissolved oxygen profile measurements during the period May 2012 through April 2013 are summarized in Appendix C. Additional vertical profile temperature measurements, collected during previous years, are on file at KRCD.

Results of the reservoir temperature and dissolved oxygen measurements are used as part of the FMP to determine both the dissolved oxygen concentration and temperature of water released from the reservoir into the lower river. The data are also used in temperature control pool management during the fall months after completion of the irrigation season to provide suitable habitat conditions to support trout and other fish species within Pine Flat Reservoir and the lower river. In addition to the vertical temperature profile measurements, water temperature is measured by KRCD at each of the individual outlet ports on Pine Flat Dam. Water temperature at each outlet is available on a real-time basis for use in evaluating water temperature released from the reservoir into the lower Kings River.



### 3.1.2 River

Water temperature within the lower Kings River is routinely monitored at a variety of locations from Pine Flat Dam downstream to Highway 180. Permanent monitoring locations within the lower river are shown in Figure 3-2. Water temperature is recorded throughout the year at each location using a computerized temperature sensor and data recording system (Onset temperature recorders), which is routinely calibrated to laboratory standards and is accurate within ± 0.5˚C.

Results of water temperature monitoring within the lower Kings River are shown, for example, at the Army Corp of Engineers Bridge (ACOE Bridge) for June 2012-May 2013 (Figure 3-3) and Fresno Weir for June 2012-December 2012 (Figure 3-4)**.** Results of water temperature monitoring at Gould Weir is included in Appendix D.

Results of temperature monitoring within the river have shown a general seasonal pattern with lowest temperatures occurring during the winter and early spring, 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. Results of temperature monitoring have also shown a general gradient of temperatures with the coldest temperatures occurring typically near Pine Flat Dam and increasing as a function of distance downstream within the lower river during summer months. In addition, results of temperature monitoring have shown that the diel temperature variation (e.g., 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.

A substantial body of information exists on the habitat suitability and response of trout to water temperatures. A variety of factors influence habitat suitability including, but not limited to, the average and daily maximum temperature, the duration of exposure to elevated temperature, diel temperature variation, prey availability, fish condition and stress, availability of microhabitat temperature refugia, and other factors. As a result of these interacting factors specific water temperature criteria have not been identified for use in evaluating habitat conditions but rather, general guidelines have been established to assess habitat conditions within the lower river. Information from the scientific literature was used by the TSC to assess conditions within the river during the 2012-2013 study period. As a general guideline, water temperatures within the range from approximately 15-18˚C have been identified as providing optimal habitat conditions for trout (Moyle 2002). Habitat conditions for trout were identified as stressful as average daily temperatures approach or exceed approximately 21˚C or maximum daily temperatures approach or exceed 25˚C. As water temperature becomes elevated above the optimal range, quality and availability of habitat within the river to support coldwater species such as rainbow trout may decrease. As part of the FMP, water temperature data collected through the ongoing monitoring program are continuing to be analyzed and evaluated, in addition to the evaluation of alternative management strategies, after completion of the irrigation season, and prior to seasonal declining atmospheric temperatures during the fall months (Section 3.4) to help maintain suitable conditions for trout.

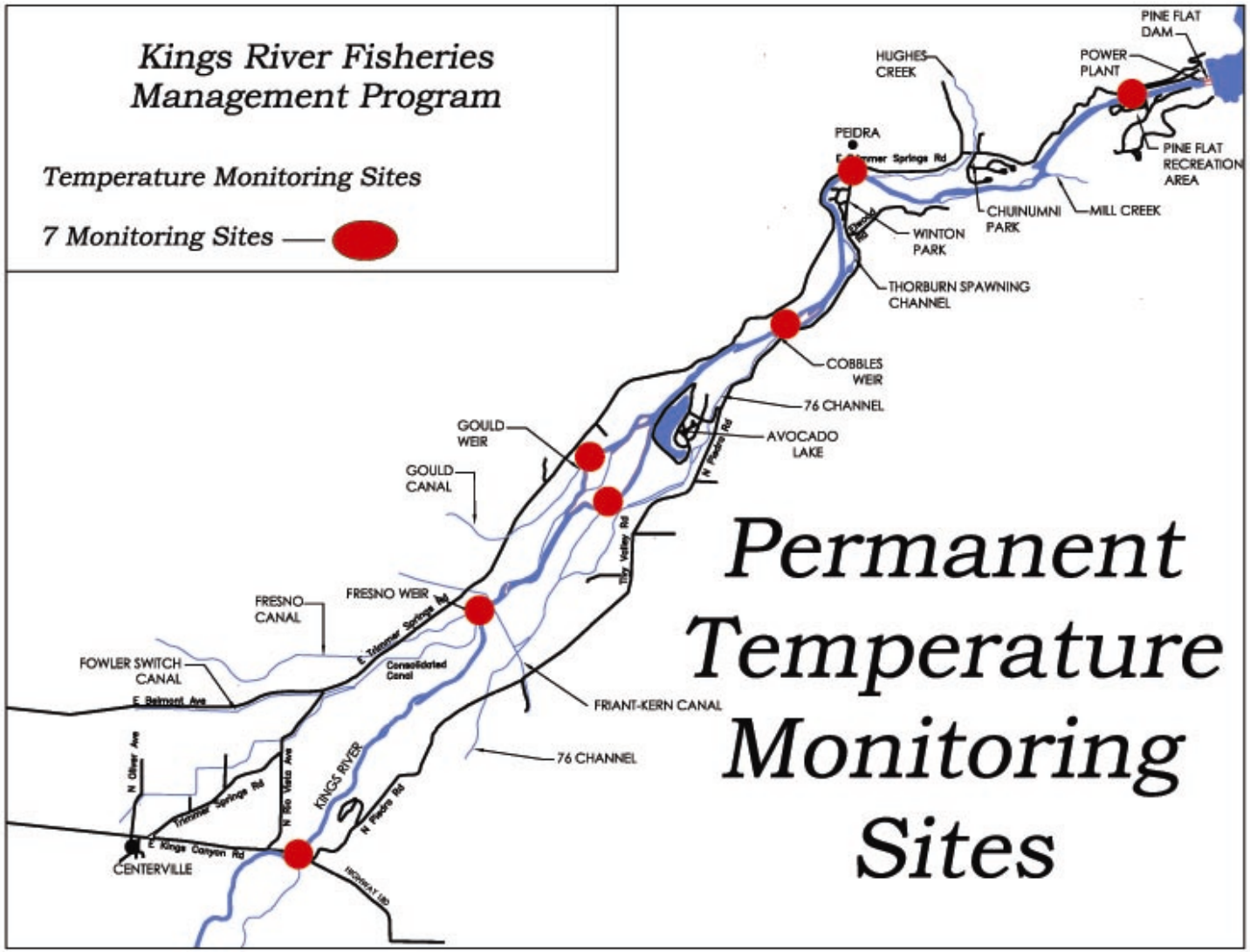



**Figure 3-2. Permanent water temperature monitoring locations on the lower Kings River**.

Results of water temperature monitoring at the Army Corps of Engineers Bridge (Figure 3-3) showed that seasonal temperatures were generally lower than temperatures observed downstream at Fresno Weir (Figure 3-4). Water temperature throughout the reach was within the range considered to provide suitable habitat conditions for resident trout during the entire year. Water temperatures at other locations within the lower river, were also monitored (Appendix D) as part of the evaluation of habitat conditions. The TSC is continuing to investigate and evaluate water temperature conditions affecting the quality and availability of habitat within the lower river for trout during the late-summer and early-fall and the effectiveness of various management actions, including operation of the turbine bypass (Section 3.4), to provide suitable habitat conditions downstream to Fresno Weir for resident trout throughout the year.

## 3.2 DISSOLVED OXYGEN MONITORING

Dissolved oxygen concentrations are measured both within Pine Flat Reservoir and within the lower Kings River at the Army Corp of Engineers Bridge. Results of dissolved oxygen monitoring, conducted by KRCD, are briefly summarized below.

### 3.2.1 Reservoir

As briefly described above, KRCD conducts monthly monitoring within Pine Flat Reservoir to evaluate vertical profiles in both water temperature and dissolved oxygen concentrations. Results of dissolved oxygen measurements have shown a seasonal pattern, which is strongly associated with reservoir stratification; in which dissolved oxygen concentrations throughout the water column within the reservoir are typically within a suitable range for fish (7 mg/L and above) during the winter and early spring months. As the reservoir becomes thermally stratified during late spring and early summer months, a vertical distribution of dissolved oxygen concentrations becomes apparent with greater dissolved oxygen levels in the upper part of the water column (warmer epilimnion waters) and decreased dissolved oxygen concentrations in the colder waters near the bottom (hypolimnion). The hypolimnion contains very low levels of oxygen. These seasonal patterns in the vertical distribution of dissolved oxygen concentrations within Pine Flat Reservoir are typical of other reservoirs located within the Central Valley, though the actual values may differ significantly. Results of dissolved oxygen monitoring within Pine Flat Reservoir during the period June 2012 through May 2013 are shown monthly in Appendix C in combination with results of vertical water temperature profile measurements. Additional information on results of dissolved oxygen monitoring conducted within Pine Flat Reservoir is on file at KRCD.

In addition to monitoring dissolved oxygen concentrations within the reservoir, KRCD also monitors dissolved oxygen concentrations in the water released from Pine Flat Reservoir into the lower Kings River. Monitoring is conducted at the reservoir outlet elevations to determine both the minimum dissolved oxygen concentrations and potential gas supersaturation resulting from releases through the hydroelectric generator outlet works.

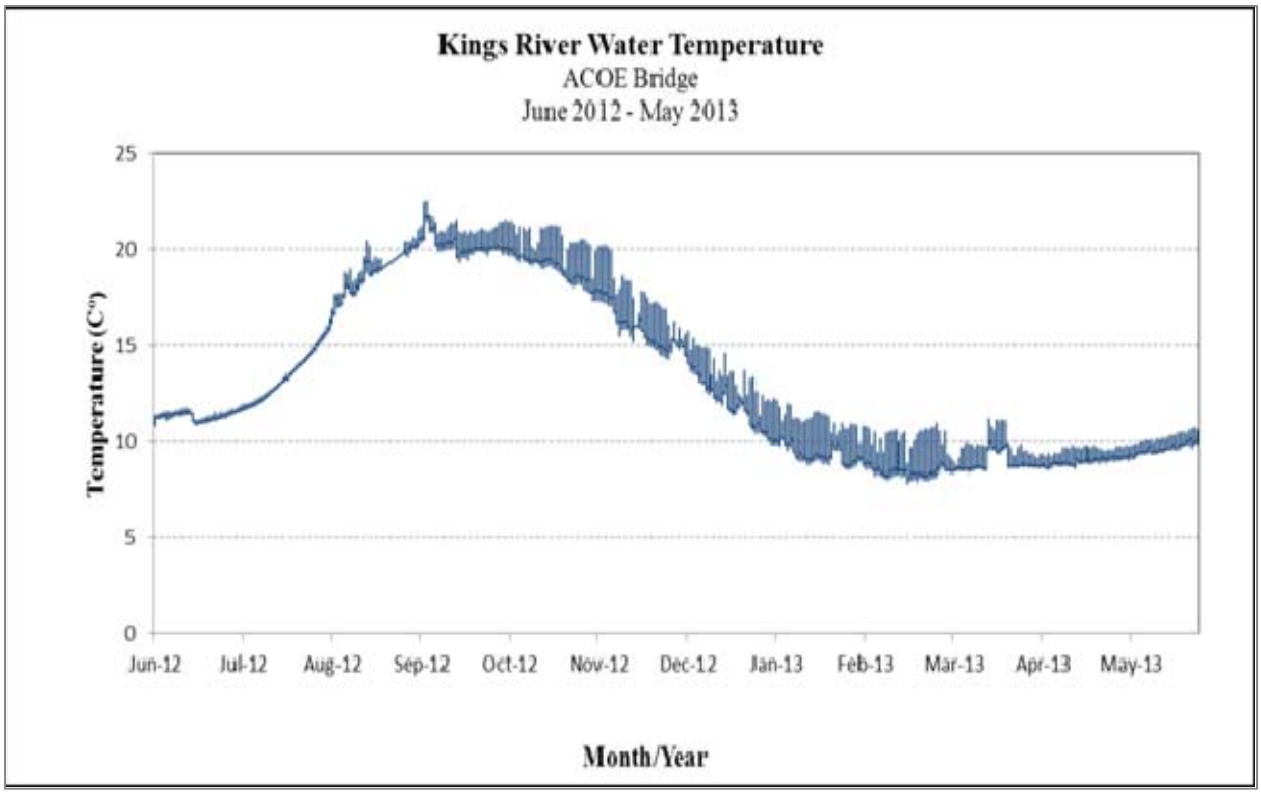



**Figure 3-3 Hourly water temperature monitoring results, Army Corps of Engineers Bridge**

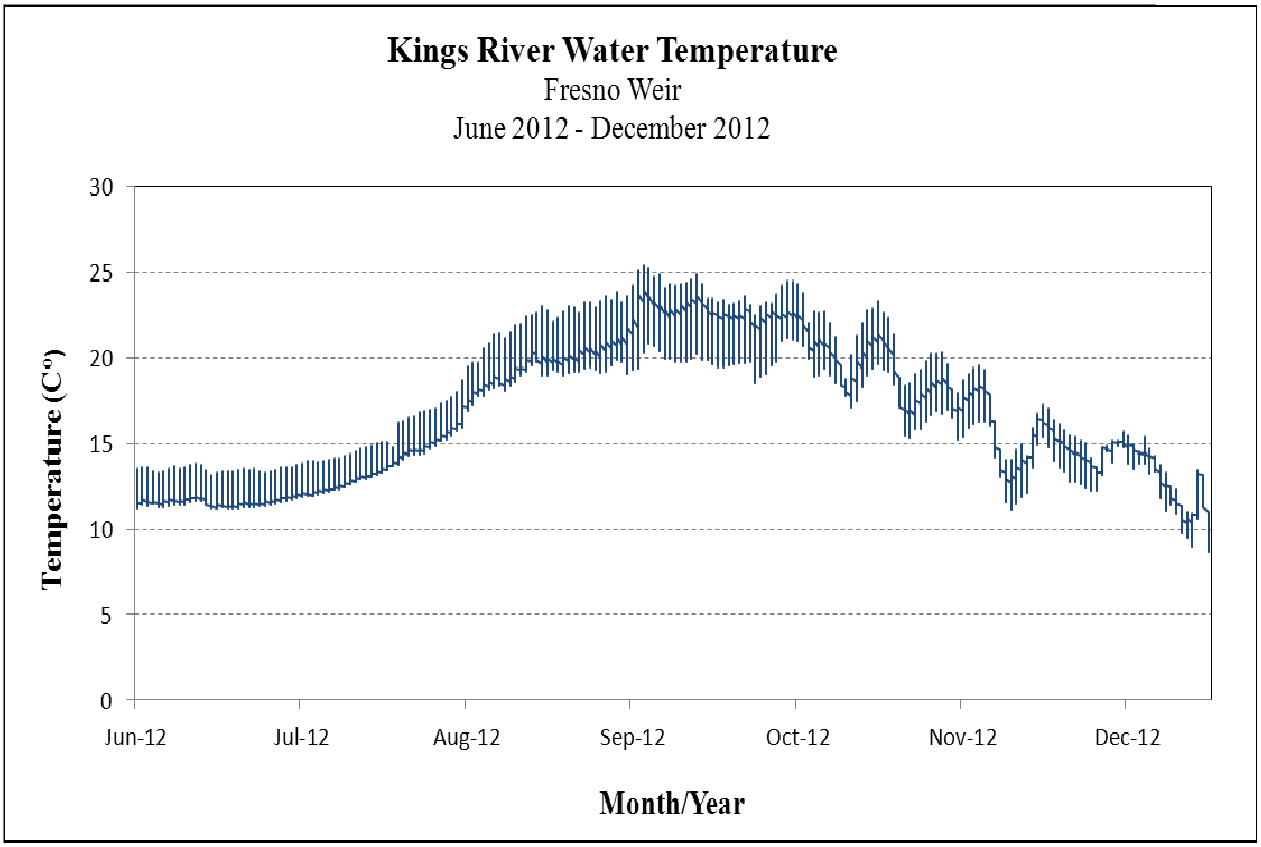



**Figure 3-4. Hourly water temperature monitoring results, Fresno Weir**

### 3.2.2 River

KRCD routinely monitors dissolved oxygen concentrations within the lower Kings River at the Army Corp of Engineers Bridge, which is located 0.6 miles downstream of Pine Flat Dam. Dissolved oxygen concentrations are measured on a continuous basis using a Hydrolab dissolved oxygen meter routinely (approximately monthly) calibrated to laboratory standards with an accuracy of ± 0.5 mg/L (Figure 3-5). As a condition of the Federal Energy Regulatory Commission (FERC) 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 operating. Results of dissolved oxygen measurements at the ACOE Bridge during the period from June 2012 through May 2013 are presented in Figure 3-6. Additional information on dissolved oxygen measurements within the lower Kings River is on file at KRCD. Results of these measurements have shown that dissolved oxygen concentrations within the lower Kings River are within the range considered to be suitable for various fish and macroinvertebrate species that occur in this section of the river.

**Figure 3-5. Dissolved oxygen monitoring station on the ACOE Bridge.**

## 3.3 COMPLIANCE WITH DISSOLVED OXYGEN REQUIREMENTS

Minimum dissolved oxygen concentrations specified by the FERC license are 7.0 mg/L when the power plant is operating. During 2012-2013, KRCD met its operating and monitoring requirements, and conditions were suitable for fish throughout the period when the power plant was in operation. Results of the monitoring are presented in KRCD's report "Dissolved Oxygen Monitoring, Final Report for Calendar Year 2013" (KRCD 2013) which is on file at KRCD.

## 3.4 PLANNING FOR WARM WATER TEMPERATURE EVENT

One of the fundamental goals and objectives, as outlined in the Framework Agreement, is the maintenance of suitable instream habitat conditions for trout throughout the year downstream to Fresno Weir. Water temperature in the lower Kings River during the early fall, after completion of irrigation demand releases, may become elevated to a level where habitat conditions are stressful and/or unsuitable for trout. Having real-time temperature data available allows for informed decisions by managers to perform operations, as needed, for temperature maintenance of water downstream of Pine Flat Dam in an effort to maintain suitable water temperatures for coldwater species such as rainbow and brown trout. Several management strategies have been identified for addressing temperature maintenance issues including: 1) operation of the turbine bypass to maintain downstream temperatures within an acceptable range; 2) selective releases from the dam's three levels of gates, 3) short-term (pulsed) water releases from Pine Flat

Reservoir, and 4) rescheduling of water deliveries to KRWA member units. These alternative operational strategies will continue to be developed by the TSC to maintain suitable water temperature conditions during the late-summer and fall months.

Temperatures at the ACOE Bridge and Fresno Weir were consistently within the range considered to provide suitable habitat for trout (average daily temperatures less than 21˚C). Water temperatures within the lower river were maintained within the range considered to be suitable for trout throughout the late-summer and fall of 2012. Temperature management during this period was achieved, in part, by modifying operations of Pine Flat Dam and the turbine bypass to allow release of cold water to the lower river through the low-level sluice gates when needed. Reservoir releases for the FMP during this period were coordinated between KRCD, KRWA and ACOE using results of real-time water temperature monitoring at Fresno Weir and other locations to manage reservoir releases to maintain suitable habitat conditions for trout. Operation of the turbine bypass, which became available for water temperature management in 2003, provided greater flexibility in managing water temperature releases from the dam to maintain suitable fish habitat in the lower river.

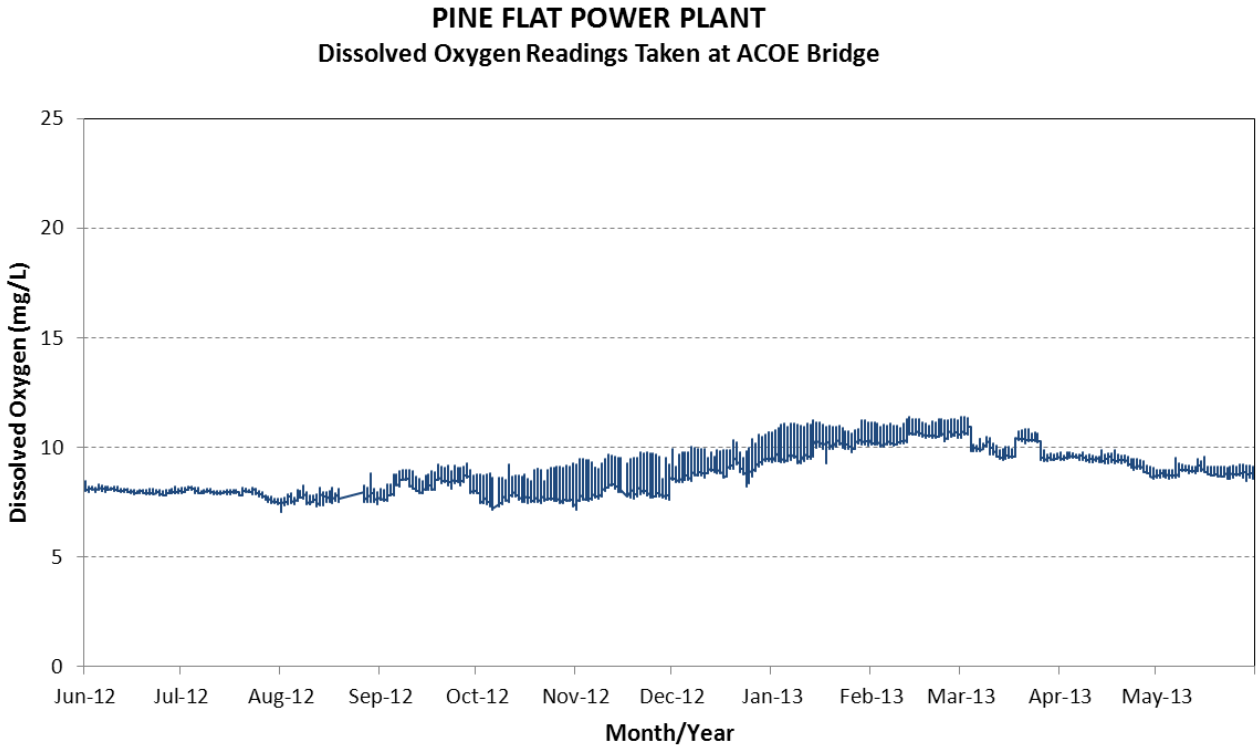



**Figure 3-6. Results of dissolved oxygen measurements at the Army Corps Bridge from June 2012 through May 2013.**

## 3.5 SUMMARY AND DISCUSSION

A great deal of progress has been made with real-time temperature monitoring and the ability to regulate and manage water temperature in the lower river during critical periods. Valuable tools for managing water temperature in the lower river to protect fish habitat 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.

Results of water quality monitoring within Pine Flat Reservoir and the lower Kings River during 2012-2013 have shown:

- Pine Flat Reservoir becomes 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). The reservoir destratifies in the late-fall and winter due to water temperature becoming uniform throughout the water column;

- The temperature of water released from the reservoir into the lower river can be regulated and managed, to some extent, through selective operation of different outlet works, including the turbine bypass, which initiated operations during 2003. However, the ability to manage water temperatures is limited and constrained by the availability of cold water and release points during various seasonal periods within the reservoir, hydroelectric generation, requirements for irrigation releases, and other factors;

- Aeration and mixing of water released from the reservoir have proven to be effective in maintaining suitable dissolved oxygen concentrations within the lower river during periods when the power plant was in operation. Mean monthly dissolved oxygen concentrations, as measured at the ACOE Bridge, during 2012-2013 exceeded 7.0 mg/L.

- Water temperatures within the lower river showed a seasonal pattern with the coldest temperatures occurring during the late winter and temperatures generally increasing during the summer and early fall;

- Water temperature showed a characteristic longitudinal gradient downstream of Pine Flat Dam. During summer months the coldest temperatures were located immediately downstream of the dam and temperatures generally increased with distance downstream from the dam. During the fall and winter, when atmospheric temperatures are cool, a reverse temperature gradient was observed with temperatures decreasing as a function of distance downstream from Pine Flat Dam;

- Results of temperature monitoring, and results from the fishery monitoring program, provided no evidence that either dissolved oxygen concentrations or water temperature conditions within the lower river resulted in mortality to trout or other fish species during 2012-2013; and

- Results of the 2012-2013 water temperature and dissolved oxygen monitoring are being used by the TSC to refine water quality monitoring as part of the FMP and as a basis for evaluating alternative operational strategies, including operations of the turbine bypass, to address water quality issues affecting habitat conditions for trout in the future;

# 4.0 HABITAT ENHANCEMENT

A fundamental goal and objective of the FMP 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. As part of the 2012-2013 FMP a variety of habitat enhancement projects were planned and/or implemented to benefit various life stages of trout, other fish species, and macroinvertebrates in the lower Kings River. A brief description of the habitat enhancement projects planned and/or implemented as part of the FMP during 2012-2013 is summarized below.

## 4.1 RIVER

Section 1(f) of the Framework Agreement – Funding / Projects discusses fish habitat improvements to enhance fish and wildlife resources in the lower Kings River. Habitat enhancement included the purchase of native trees and shrubs along with plumbing supplies for the Riparian Revegetation Project during the 2012-2013 program year.

### 4.1.1 Project Permitting

Permits from various state and federal agencies are required to perform work in a stream or river channel. These permits are meant to fully disclose the details of the work, identify any negative environmental impacts that might occur, and identify how these impacts will be avoided or mitigated. The FMP obtained river-wide and multi-year permits for future fish habitat enhancement projects as part of the Fishery Habitat Master Plan. Permits were obtained from the U. S. Army Corps of Engineers, Regional Water Quality Control Board, California Department of Fish and Wildlife, and State Reclamation Board. A Letter of Permission (LOP) to complete habitat enhancement work under the FMP's Clean Water Act Section 404 permit was received from the U.S. Army Corps of Engineers on May 13, 2010. In planning for the incubator building, pursuant to the California Government Code section 53091 subdivision (d), the Kings River Conservation District was not subject to county building ordinances for the construction of the Incubator Building. As such, no permitting work was required during the 2012-2013 program year.

### 4.1.2 Gravel Placement

No activities were conducted under Element C-2012-1: Fishery Habitat Master Plan of the 10-Year Implementation Plan.

### 4.1.3 Boulder Placement

No activities were conducted under Element C-2012-1: Fishery Habitat Master Plan of the 10-Year Implementation Plan.

### 4.1.4 Placement of Half Logs in the Thorburn Channel

No habitat work was completed on the Thorburn Channel.

### 4.1.5 Implementation of Exhibit D Flows

Due to the low water year of 2011-2012, there were no Exhibit D flows provided during the 2012-2013 program year. Exhibit D flows will also likely not be provided in the 2013-2014 program year. This activity was conducted under Element N-2004-1: Development of Exhibit D Flows of the 5-Year Implementation Plan.

**Figure 4-1. Placing boulders near Avocado Lake County Park**

### 4.1.7 Riparian Planting Project

During the 2012-2013 program year a Riparian Planting portion of the Fishery Habitat Master Plan was completed. Just downstream of Pine Flat Dam, fencing was installed to protect 80 native trees and multiple native shrubs and grasses that were planted in an effort to provide additional shading in this area of the river. An irrigation system was installed and tested, and is currently operational (C1, 2012-2013 Ten-Year Implementation Plan). The trees and shrubs will be continually watered and monitored by KRCD staff through fall 2014.

## 4.2 PINE FLAT RESERVOIR

There were no Reservoir projects completed during the 2012-2013 program year.

## 4.3 SUMMARY AND DISCUSSION

The FMP continued habitat enhancement efforts on the lower Kings River by the following actions:

- A portion of the Riparian Planting Project within the Habitat Masterplan was completed during the 2012-2013 program year. The trees and shrubs will be continually watered and monitored by KRCD staff through the fall of 2014.

# 5.0 FISH STOCKING

The stocking of fish in State waters is the responsibility of the California Department of Fish and Wildlife. During the 2012 through 2013 reporting period, the allotted catchable, sub-catchable, fingerling and trophy rainbow trout size classes were stocked in the Kings River between Pine Flat Dam and Fresno Weir. In addition, trout eggs were purchased by the program from Cold Springs Trout Farm for incubation and hatching in the lower river. Catchable and fingerling rainbow trout size classes and fingerling kokanee and chinook salmon were also planted in Pine Flat Reservoir. Avocado Lake received allotments of catachable and super catchable rainbow trout A brief description of the fish stocking activities is presented below.

## 5.1 RIVER

### 5.1.1 Whitlock-Vibert Boxes

Section G(1)(j) of the Framework Agreement "Stocking Program" discusses trout stocking in the lower Kings River. Trout egg planting is conducted to increase trout numbers by augmenting the naturally spawned population of rainbow trout. Planting of trout eggs is a fast, efficient, and inexpensive way to increase recruitment of juvenile fish in the river.

Whitlock Vibert Boxes (WVB) were not used during this reporting period to hatch eyed rainbow trout eggs, inside the streamside incubators. Due to the Incubator Expansion discussed below, it is likely the Whitlock-Vibert Boxes will no longer be utilized by the program.

### 5.1.2 Streamside Incubators

The streamside incubators consisted initially of refrigerators that had been modified to hatch trout eggs. Beginning in 2003, permanent streamside incubators were constructed to replace the refrigerators. The incubators consist of a concrete vault that contains a tank constructed of plywood and fiberglass. A 0.75 horse power pump supplies water from the river that flows through the tank, over the charged WVBs, and back into the river (Figure 5-1).

The upper streamside incubator was located downstream of Pine Flat Recreation Area. The lower incubator was located at the lower end of the Thorburn Spawning and Rearing Channel adjacent to the river. These incubators were stocked in previous years with eyed rainbow trout eggs purchased from Troutlodge Inc. Due to the Incubator Expansion discussed below, it is likely these Streamside Incubators will no longer be utilized by the program.

### 5.1.2.1 Incubator Expansion

In May 2012, the KRFMP obtained an unused building under long term lease from the County of Fresno for use as a trout incubator facility as mentioned in Element C17 of the Ten-Tear Plan 2012-2013. The building was fitted with two 15ft. long hatchery style troughs able to accommodate approximately 75,000 rainbow trout fry a piece. A pump and backup system were installed to continually deliver water directly from the Kings River into the raceways. Plumbing was designed to direct water back out to the high water channel adjacent to the building after passing through the system. Pacific Gas and Electric installed power to the building in September 2012. Automatic feeders, hatch jars, flowmeters and educational posters were also added. Building and accessory costs were reimbursed through the Ted Martin Grant with the cooperation of the Fresno Regional Foundation and the Kings River Conservancy. Pursuant to the California Government Code section 53091 subdivision (d), the Kings River Conservation District was not subject to county building ordinances for the construction of the Incubator Building.

During the 2012 – 2013 program year approximately 297,000 eggs, purchased from Cold Springs Trout Farm, were incubated within the new building with a 70% - 75% hatch rate. Once rainbow trout fry reached the button up stage (aprox. 1" long) they were released at various locations within the fishery management area. Release dates were December 12th 2012, January 5th 2013 and March 23rd 2013. These activities were conducted under Element C16 of the Ten-Year Plan 2012-2013.

The building has been up and running since November 2012. Necessary maintenance has been facilitated by KRCD staff as well as volunteer members of the PAG. The PAG has taken a very large role in this project, and is to be commended for all of their efforts.

**Figure 5-1. Raceways in the new Incubator expansion project.**

### 5.1.3 Rainbow Trout Stocking

Trout stocking is the responsibility of the CDFW and occurs at no cost to the FMP.

#### 5.1.3.1 Sub-Catchable Size Rainbow Trout

A total of 2,000 pounds (25,000 trout) of sub-catchable rainbow trout (4-6 inches in length) were stocked in the lower Kings River as part of the put-and-grow program.

#### 5.1.3.2 Fingerling Rainbow Trout

A total of 68 pounds (22,664 trout) of fingerling rainbow trout were stocked in the lower Kings River as part of the put-and-grow program.

#### 5.1.3.3 Catchable-Sized Rainbow Trout

The current annual allotment for the Kings River below Pine Flat is 18,000 pounds of catchable trout. A total of 23,350 pounds of catchable sized trout (27,612 fish) were stocked in the lower Kings River during this reporting period. Normally, 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.

#### 5.1.3.4 Super Catchable-Sized Rainbow Trout

The CDFW San Joaquin Hatchery did not stock super catchable trout in the lower Kings River during the 2012-2013 program year. Super catchable trout are defined as trout greater than one pound.

#### 5.1.3.5 Trophy Rainbow 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. The trophy trout program was implemented to increase licenses sales and get anglers to return to the Kings River. This created a huge response from anglers, throughout the Valley and State. The program also generated positive press releases and magazine articles as a result. Trophy trout are designated as trout greater than 2.99 pounds each. Trophy trout planted in the lower Kings river average approximately 4 pounds (Figure 5-2). According to the data provided by CDFW, 6,600 pounds of trophy trout (1,456 fish) were stocked during the 2012-2013 program year. These numbers were included in the overall catchable numbers.

**Figure 5-2. Trout averaging 4 pounds each were stocked by CDFW from December through March.**

### 5.1.4 Trout Relocation to the Lower Kings River

In 2004-2005, an element to relocate wild rainbow trout from the upper Kings River watershed to the lower Kings River was developed. Some preliminary planning and discussions were conducted for this element. This element may be implemented in the future. The activities were conducted under Element N-2004-8: Trout Relocation to the Lower Kings River of the 5-Year Implementation Plan. However, no work occurred during 2011-2012 reporting period.

## 5.2 RESERVOIR

### 5.2.1 Kokanee Salmon

A total of 1,177 pounds of Kokanee Salmon fingerlings (68,601 fish) were stocked in Pine Flat Reservoir during 2012-2013.

### 5.2.2 Fingerling Rainbow Trout

The CDFW San Joaquin hatchery personnel did not stock fingerling rainbow trout in Pine Flat Reservoir during the 2012-2013 program year.

### 5.2.3 Sub-Catchable Sized Rainbow Trout

No sub-catchable rainbow trout were stocked in Pine Flat Reservoir during the 2012 -2013 program year.

### 5.2.4 Catchable-Sized Rainbow Trout

The current annual allotment for Pine Flat Reservoir is 22,000 pounds for the calendar year. CDFW stocked 30,520 pounds (58,997 fish) of catchable-sized rainbow trout in Pine Flat Reservoir during 2012-2013.

#### 5.2.4.1 Super Catchable-Sized Rainbow Trout

The CDFW San Joaquin Hatchery did not report numbers during the 2012-2013 period.

#### 5.2.4.2 Trophy Rainbow Trout in Pine Flat Reservoir

No trophy size class rainbow trout were stocked in Pine Flat Reservoir during the 2012 -2013 program year.

### 5.2.5 Chinook Salmon

CDFW stocked 1,125 pounds of Chinook salmon fingerlings (100,000 fish) in Pine Flat Reservoir during the 2012-2013 program year.

### 5.2.6. Avocado Lake

Avocado Lake is a Fresno County Park located adjacent to the lower Kings River. The lake site served as a source of rock and gravel for the construction of Pine Flat Dam. The lake is a popular recreational site and supports thousands of angler hours each year. The annual allotment delivered during the winter months is 6,000 pounds. In the 2012-2013 reporting period, the San Joaquin Hatchery planted 14,761 pounds (108,153 fish) of catchable size rainbow trout in Avocado Lake.

## 5.3 SUMMARY AND DISCUSSION

- In May 2012, the KRFMP obtained an unused building under long term lease from the County of Fresno for use as a trout incubator facility as mentioned in Element C17 of the Ten-Tear Plan 2012-2013;

- During the 2012 – 2013 program year approximately 297,000 eggs, purchased from Cold Springs Trout Farm, were incubated within the new building with a 70% - 75% hatch rate;

    - A total of 2,000 pounds (25,000 trout) of sub-catchable rainbow trout (4-6 inches in length) were stocked in the lower Kings River as part of the put-and-grow program;

    - A total of 68 pounds (22,664 trout) of fingerling rainbow trout were stocked in the lower Kings River as part of the put-and-grow program;

    - A total of 23,350 pounds of catchable sized trout (27,612 fish) were stocked in the lower Kings River during this reporting period;

    - According to the data provided by CDFW, 6,600 pounds of trophy trout (1,456 fish) were stocked during the 2012-2013 program year. These numbers were included in the overall catchable numbers;

- A total of 1,177 pounds of Kokanee Salmon fingerlings (68,601 fish) were stocked in Pine Flat Reservoir during 2012-2013;

- CDFW stocked 30,520 pounds (58,997 fish) of catchable-sized rainbow trout in Pine Flat Reservoir during 2012-2013;

- No sub-catchable trout were planted in Pine Flat Reservoir during the reporting period;

- No trophy size class rainbow trout were stocked in Pine Flat Reservoir during the 2012 -2013 program year;

- CDFW stocked 1,125 pounds of Chinook salmon fingerlings (100,000 fish) in Pine Flat Reservoir during the 2012-2013 program year.; and

- In the 2012-2013 reporting period, the San Joaquin Hatchery planted 14,761 pounds (108,153 fish) of catchable size rainbow trout in Avocado Lake.

# 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 FMP and the overall status of the fishery. One objective of the FMP is to establish a comprehensive monitoring program that is to provide the agencies and the public with a gauge with which to evaluate the status of the fishery and the relative merits of any particular project.

## 6.1 RIVER

### 6.1.1 Annual Fish Population Surveys

Long-term annual baseline trout fisheries monitoring within the lower Kings River is being conducted as part of the FMP to determine (1) juvenile trout abundance and distribution; (2) adult trout abundance and distribution; (3) reproductive success, growth, and survival; (4) over-wintering survival, size and age structure of the population; and (5) assess the abundance and condition of the fish community inhabiting the lower Kings River.

The 5-Year Plan proposed that electrofishing surveys would be conducted two times per year during (1) spring (prior to initiation of the major irrigation releases) and (2) fall (at the completion of the irrigation season) at two sites in addition to the six sites that are sampled annually. During the 2012 - 2013 study period, electrofishing surveys were conducted in November, 2012 only. Electrofishing is performed at sampling sites within each of the three management reaches of the lower Kings River (Figure 6-1). 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 29 years (since 1983) in the Kings River by KRCD and CDFW biologists. The number of sites sampled has been expanded over the years. To the extent possible, sampling methods and the sampling locations utilized in previous surveys by KRCD have been incorporated as part of the electrofishing monitoring program to allow comparison of current results with previous monitoring. In 2007, the FMP began to use a multi-pass depletion technique. This allowed for a 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 and number of fish as well as length and weights. This data can then be used to determine trends in the populations and condition of the trout as well as other non-Wildlife species. Sampling sites are 300 feet in length and were sampled using backpack electrofishers. A final report is available in the KRCD library and on the KRCD website.

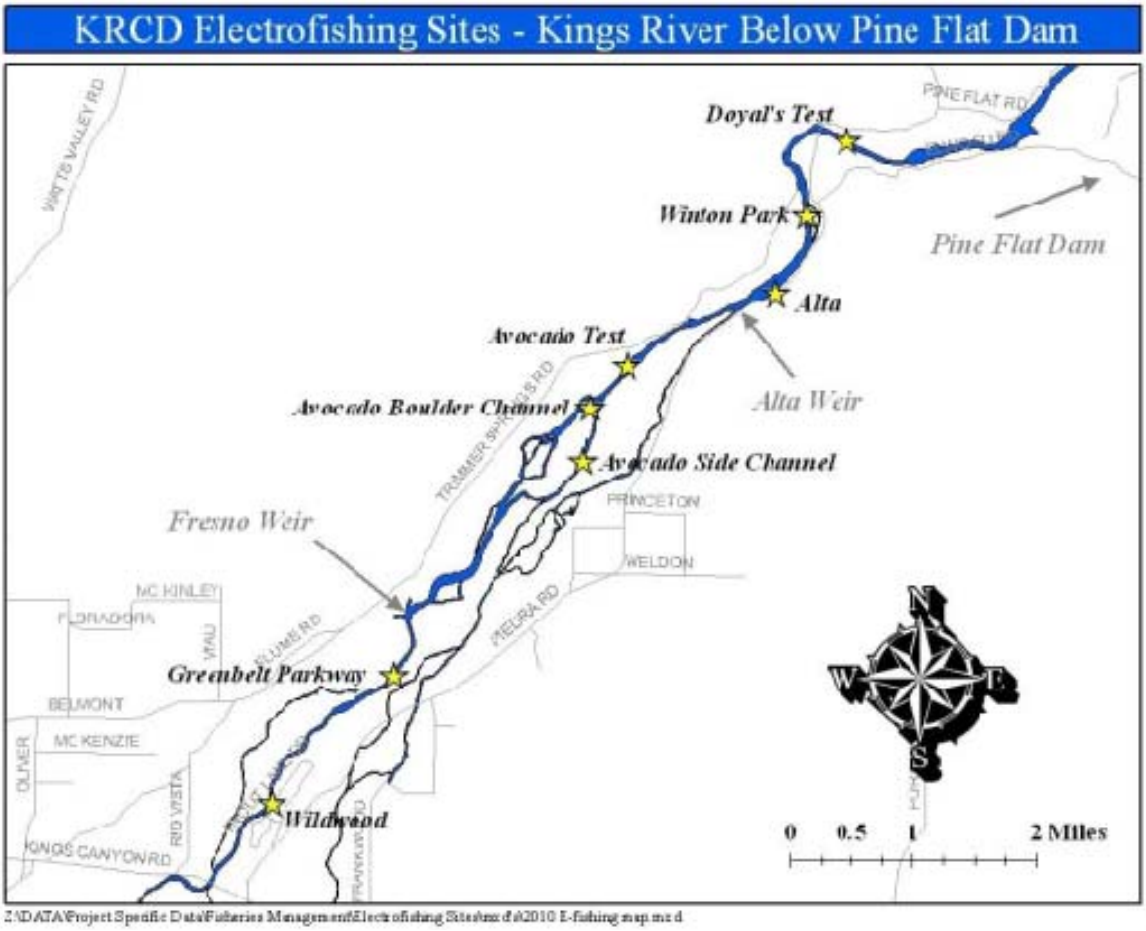



**Figure 6-1: Kings River Conservation District annual population monitoring survey sites. Eight sites were surveyed in 2010.**

Crews consisting of 15 to 24 people and four to eight electrofishers were used to conduct the sampling. Few resident rainbow trout (*Onchorhyncus mykiss*) were collected at any of the six sites sampled. The most abundant fish were the Sacramento sucker (Catostomus occidentalis), sculpin (Cottus spp.), Sacramento pikeminnow (*Ptycheilus grandis*) and California roach (Hesperoleucus symmetricus).

### 6.1.2 Pine Flat Reservoir and Lower Kings River Fish Population Study

While funds were budgeted for this element, no activity occurred and funds will be carried over to the next program year. Funds were budgeted under Element C-2012-5: Monitoring of the 10-Year Implementation Plan.

### 6.1.3 Bio Mass Estimate

While funds were budgeted for this element, no activity occurred and funds will be carried over to the next program year. Funds were budgeted under Element C-2012-5: Monitoring of the 10-Year Implementation Plan.

### 6.1.4 Calibrated Angler Study

While funds were budgeted for this element, no activity occurred and funds will be carried over to the next program year. Funds were budgeted under Element C-2012-5: Monitoring of the 10-Year Implementation Plan.

### 6.1.5 Incubator Effectiveness Study

297,000 diploid rainbow trout eggs were purchased from Cold Springs Hatchery in fall/winter of 2012-2013, in an effort to supplement the viable trout population within the Kings River below Pine Flat Dam. An estimated 70% - 75% hatch rate was observed and the resulting fry were released into the Kings River at various locations. Electrofishing surveys were performed intermittently in the Thorburn Channel in order to monitor the growth rate, dispersal and health of the trout released at that location. A more comprehensive trout marking and monitoring plan is planned for the 2013 – 2014 program year. While funds were budgeted for this element, the Kings River Conservancy has ensured reimbursement of up to $15,000.00 per year for purchased eggs over a 3year period. Funds were budgeted under Element C-2012-5: Monitoring of the 10-Year Implementation Plan.

### 6.1.6 Annual Technical Report

The tenth Annual Technical Report was published and distributed by the FMP in August 2013 The report covered activities for program year 2011-2012 and its 5-Year Implementation Plan. The report was reviewed and approved by the PAG and ExCom. The activities were conducted under Element C-2011-5: Monitoring of the 10-Year Implementation Plan.

## 6.2 RESERVOIR

### 6.2.1 Bass Tournament Results

The results of organized angling events are a cost effective means of monitoring the overall condition of the warmwater fishery (see 2002-2003 Annual Technical Report for details and references). The CDFW summarizes results of tournament records on an annual basis. The available information is summarized in Table 6-3.

For the 2012-2013 program year, CDFW chose not to release data regarding these angling tournaments.

**Table 6-1. Summary of results of organized bass angling tournaments held at Pine Flat Reservoir.**

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. Tournaments | 31 | 16 | 25 | 29 | 33 | 32 | 23 | 32 | 40 | 36 | 24 |
| No. Anglers | 862 | 367 | 702 | 820 | 890 | 841 | 658 | 1,000 | 1,413 | 994 | 698 |
| Total Hrs. Fished | 7,012 | 3,454 | 6,428 | 7,067 | 7,807 | 7,304 | 5,279 | 7,940 | 11,133 | 8,229 | 5,260 |
| Total No. Bass | 1,495 | 811 | 1,680 | 2096 | 2136 | 1,634 | 1,505 | 2,315 | 3,091 | 1,654 | 1,405 |
| Total Weight (lbs.) | 1,750 | 1,245 | 3,108 | 3,593.5 | 3,289.1 | 2,385 | 2,570 | 3,199 | 4,153 | 1,971 | 2,262 |
| Hrs fished/angler | 8.13 | 9.41 | 9.16 | 8.62 | 8.77 | 8.68 | 8.02 | 7.93 | 7.89 | 8.28 | 7.53 |
| Avg. per bass (lbs) | 1.17 | 1.54 | 1.85 | 1.71 | 1.54 | 1.46 | 1.71 | 1.38 | 1.34 | 1.19 | 1.54 |

In previous Annual Technical Reports, a value for Catch per Hour was given in the table above. This data was erroneously included, as the values representing Catch per Hour misrepresented the true experience of the anglers in these tournaments. In any given tournament, an angler may only report a maximum catch of 5 bass, and in fact the angler is attempting to keep the largest 5 bass possible to win the tournament. Additional bass that may have been caught and subsequently released by anglers are not reported. Therefore, the figures presented in previous Annual Technical Reports were likely to have under-represented the true Catch per Hour value each angler experienced.

### 6.2.2 Pine Flat Reservoir Fish Population

It is unknown whether electrofishing, gill netting, or sub-sampling of bass tournaments occurred during this reporting period.

## 6.3 SUMMARY AND DISCUSSION

As part of the FMP habitat and fishery monitoring has been conducted within the lower river and Pine Flat Reservoir. Results of the 2012-2013 monitoring program have shown:

- The FMP continues to monitor trout and non-Wildlife fish populations downstream of Pine Flat Dam; and

- The tenth Annual Technical Report was released in August 2013.

# 7.0 PUBLIC EDUCATION AND OUTREACH

## 7.1 News Releases and Newsletters

There were no newsletters produced during the 2012-2013 program year.

## 7.2 Summer Hydrology and Temperature Report

KRWA has developed 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 developed from monitoring being conducted 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 occurring within the lower river that would affect habitat quality for trout. Weekly reports are typically distributed electronically to inform managers and other interested parties regarding conditions currently occurring within the lower river. The water temperature and flow monitoring and reporting provided a valuable tool for disseminating real-time information. During the 2012-2013 program year, reports were issued weekly beginning in August of 2012 and running through November of 2012. Copies of the reports are included in the Appendices.

The TSC has recommended that the real-time monitoring and dissemination of weekly reports, when appropriate, be continued as part of the FMP. In addition, the TSC recommends that information on current conditions occurring within the lower Kings River be developed in a format compatible with posting on an Internet based web page that would be accessible to the public. The activities were conducted under Element C5: Monitoring of the 10-Year Implementation Plan.

## 7.3 Educational Tours & Clean-up: Thorburn Spawning and Rearing Channel

There were no tours given during the 2012-2013 program year.

## 7.5 Directed Enforcement

Local groups of fisherman worked established a contract with the California Department of Fish and Wildlife's Enforcement branch to commit additional funds for Directed Enforcement Actions targeting the Kings River Fisheries Management Zone during the 2012-2013 program year. It is the hope of the fisherman that these funds will help Fish and Wildlife personnel in curtailing illegal fishing activities in the Fisheries Management Zone. These activities were officially outside of the Kings River Fisheries Management Program, but the FMP does thank Fish and Wildlife for the additional efforts.

# 8.0 OUTSTANDING ELEMENTS

With limited exception, efforts on elements from previous years and the 2012-2013 10-Year Implementation Plan were not conducted during the program year or are ongoing. Some elements may be carried over to the next program year. Below is a brief summary of those elements.

Study of Pool Habitat and Constructed Deep Water Habitat Pilot Project (C15). -Implementation of this element did not occur during the program year. Funds will be carried over to the next program year.

# 9.0 MAINTENANCE ACTIVITIES

## 9.1 Thorburn Channel Maintenance

Spraying of weeds, brushing, and tree trimming took place along the roadway and nature trail. The headgate was checked every one to two weeks and accumulated debris was removed. Water was gradually shut off to the channel in late July 2012 in order to dry the channel and eliminate invasive aquatic vegetation. Water was allowed to reenter the channel in October 2012. The activities were conducted under Element M-2012-1: Thorburn Channel Maintenance of the 10-Year Implementation Plan.

## 9.2 Streamside Incubator Operation and Maintenance

Increased flows and sedimentation took the streamside incubator located at the Thorburn Channel out of commission in winter 2011. The upper streamside incubator located at the ACOE Recreation area was voluntarily taken out of commission by the FMP upon completion of the new incubator building across the river. Section G (1) of the Framework Agreement includes an element addressing adaptive management (Section 1b) and the stocking program (Section 1j). As provided for in Section G (1) (n) of the Framework Agreement, the Program will continue to engage in public awareness and education activities relative to the Program. This element proposed an expansion of the incubator program to include a new site that would be larger in scope, available for educational tours to the public as well, and enhance the monitoring efforts of the program, serving multiple purposes. The building has been up and running since November 2012. Necessary maintenance will be facilitated by KRCD staff as well as volunteer members of the PAG.

# 10.0 DEVELOPMENT OF 10-YEAR 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 5-Year 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.

With the extension of the Framework Agreement in June of 2009, due to the financial structure agreed to by all parties, it was determined that the new budgetary documents must reflect a longer term approach to financing projects. As such, the TSC was directed to develop a 10-Year Plan to replace what were previously 5-Year Plans.

A 10-Year Plan was developed during this reporting period (May 2012 to May 2013). This was the fourth edition of a 10-Year plan, which followed eight annual modifications to the previous 5-Year Plans since the signing of the Framework Agreement on May 28, 1999. Development of the 10-year work plan is based on a consideration of (1) specific requirements identified within the Framework Agreement; (2) results of previous fisheries and water quality monitoring; and (3) prioritization of habitat restoration activities based upon limiting factors analyses. The 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 10-Year Plan is a “living plan” that is reviewed by the TSC, PAG and ExCom on an annual basis throughout the 10-year period of the agreement and revised as projects and elements of the program are implemented and as new scientific information becomes available.

# 11.0 REFERENCES

McHenry, M. L., D. C. Morrill and E. Currence. 1994. Spawning Gravel Quality, Watershed Characteristics and Early Life History Survival of Coho Salmon and Steelhead in Five North Olympic Peninsula Watersheds. Lower Elwha S'Klallam Tribe, Port Angeles, WA. And Makah Tribe, Neah Bay, WA. Funded by Washington State Department of Ecology (205J grant).

Moyle, P. B. 2002. Inland Fishes of California: Revised and Expanded. University of California Press. Berkeley, California. 502 pp.

Lisle, T. E. 1989. Sediment transport and resulting deposition in spawning gravels, north coastal California. Water Resources Research 25(6): 1303-1319. [487k] http://www.rsl.psw.fs.fed.us/projects/water/Lisle89.pdf

Kondolf, G. M. 2000. Assessing Salmonid Spawning Gravel Quality. Transactions of the American Fisheries Society. 129:262-281.

Turner, Larry PhD 2003. Analysis of Risks to Endangered and Threatened Salmon and Steelhead. Environmental Research Branch – Office of Pesticide Programs – Environmental Protection Agency. http://www.epa.gov/espp/litstatus/effects/diuron_analysis_final2.pdf

# APPENDIX A

Summary of Daily Hydrologic Data for Pine Flat and the Kings River
(on following pages)

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 6/1/2012 | 810248 | 4888 | 1763 | 2123 |
| 6/2/2012 | 804423 | 4901 | 1892 | 1997 |
| 6/3/2012 | 798778 | 4793 | 1882 | 1828 |
| 6/4/2012 | 793000 | 5040 | 1884 | 1975 |
| 6/5/2012 | 787349 | 4740 | 1939 | 1676 |
| 6/6/2012 | 781618 | 4727 | 1657 | 1662 |
| 6/7/2012 | 774679 | 4838 | 1282 | 1708 |
| 6/8/2012 | 768030 | 4918 | 1384 | 1698 |
| 6/9/2012 | 761261 | 4975 | 1396 | 1740 |
| 6/10/2012 | 754323 | 5035 | 1367 | 1828 |
| 6/11/2012 | 747520 | 4997 | 1339 | 1783 |
| 6/12/2012 | 740602 | 4949 | 1218 | 1806 |
| 6/13/2012 | 733272 | 5087 | 1226 | 1958 |
| 6/14/2012 | 725834 | 5185 | 1190 | 2008 |
| 6/15/2012 | 718240 | 5250 | 1248 | 2074 |
| 6/16/2012 | 710934 | 5154 | 1211 | 2001 |
| 6/17/2012 | 703912 | 5077 | 1102 | 1912 |
| 6/18/2012 | 696735 | 5030 | 991 | 1873 |
| 6/19/2012 | 689309 | 5016 | 967 | 1873 |
| 6/20/2012 | 681925 | 5052 | 940 | 1884 |
| 6/21/2012 | 674252 | 4866 | 691 | 1710 |
| 6/22/2012 | 667334 | 4861 | 910 | 1670 |
| 6/23/2012 | 659984 | 4872 | 828 | 1666 |
| 6/24/2012 | 651417 | 5354 | 815 | 2132 |
| 6/25/2012 | 642771 | 5433 | 784 | 2215 |
| 6/26/2012 | 633863 | 5563 | 777 | 2374 |
| 6/27/2012 | 625022 | 5554 | 777 | 2361 |
| 6/28/2012 | 616019 | 5482 | 717 | 2311 |
| 6/29/2012 | 606995 | 5556 | 674 | 2373 |
| 6/30/2012 | 597683 | 5665 | 661 | 2469 |
| 7/1/2012 | 587475 | 5893 | 662 | 2667 |
| 7/2/2012 | 577839 | 5757 | 659 | 2521 |
| 7/3/2012 | 568678 | 5523 | 652 | 2344 |
| 7/4/2012 | 559118 | 5619 | 650 | 2410 |
| 7/5/2012 | 549300 | 5829 | 645 | 2616 |
| 7/6/2012 | 539700 | 6031 | 622 | 2735 |
| 7/7/2012 | 529725 | 6114 | 606 | 2795 |
| 7/8/2012 | 519225 | 6311 | 584 | 2952 |
| 7/9/2012 | 508341 | 6448 | 567 | 3027 |
| 7/10/2012 | 497291 | 6570 | 558 | 3119 |

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 7/11/2012 | 486206 | 6610 | 553 | 3145 |
| 7/12/2012 | 475051 | 6603 | 553 | 3134 |
| 7/13/2012 | 464382 | 6488 | 559 | 3104 |
| 7/14/2012 | 453954 | 6254 | 545 | 2962 |
| 7/15/2012 | 443303 | 6263 | 529 | 2962 |
| 7/16/2012 | 432971 | 6127 | 510 | 2846 |
| 7/17/2012 | 422802 | 5863 | 490 | 2601 |
| 7/18/2012 | 413052 | 5727 | 474 | 2540 |
| 7/19/2012 | 403347 | 5673 | 457 | 2491 |
| 7/20/2012 | 395849 | 4598 | 441 | 2379 |
| 7/21/2012 | 388674 | 4435 | 422 | 2442 |
| 7/22/2012 | 381320 | 4436 | 411 | 2438 |
| 7/23/2012 | 374563 | 4298 | 446 | 2272 |
| 7/24/2012 | 368008 | 4198 | 461 | 2142 |
| 7/25/2012 | 360483 | 4518 | 446 | 2437 |
| 7/26/2012 | 352597 | 4850 | 424 | 2741 |
| 7/27/2012 | 344433 | 4810 | 405 | 2736 |
| 7/28/2012 | 336369 | 4835 | 392 | 2762 |
| 7/29/2012 | 328372 | 4831 | 381 | 2765 |
| 7/30/2012 | 320734 | 4737 | 364 | 2709 |
| 7/31/2012 | 313605 | 4548 | 348 | 2491 |
| 8/1/2012 | 307381 | 4044 | 314 | 2301 |
| 8/2/2012 | 300317 | 4139 | 309 | 2302 |
| 8/3/2012 | 293771 | 4087 | 306 | 2191 |
| 8/4/2012 | 287239 | 4024 | 305 | 2157 |
| 8/5/2012 | 280786 | 3987 | 304 | 2154 |
| 8/6/2012 | 275004 | 3747 | 310 | 1964 |
| 8/7/2012 | 270319 | 3329 | 302 | 1567 |
| 8/8/2012 | 265617 | 3298 | 295 | 1528 |
| 8/9/2012 | 261104 | 3291 | 295 | 1524 |
| 8/10/2012 | 256718 | 3191 | 303 | 1437 |
| 8/11/2012 | 252628 | 3086 | 306 | 1336 |
| 8/12/2012 | 248572 | 3052 | 312 | 1299 |
| 8/13/2012 | 244663 | 3064 | 369 | 1334 |
| 8/14/2012 | 240926 | 3039 | 414 | 1303 |
| 8/15/2012 | 238903 | 2159 | 519 | 1228 |
| 8/16/2012 | 237274 | 1762 | 500 | 1277 |
| 8/17/2012 | 235404 | 1985 | 450 | 1474 |
| 8/18/2012 | 233160 | 2152 | 425 | 1615 |
| 8/19/2012 | 230113 | 2230 | 401 | 1694 |

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 8/20/2012 | 227707 | 2136 | 385 | 1600 |
| 8/21/2012 | 225556 | 1977 | 363 | 1465 |
| 8/22/2012 | 223015 | 2177 | 347 | 1651 |
| 8/23/2012 | 220436 | 2185 | 356 | 1649 |
| 8/24/2012 | 218691 | 1820 | 357 | 1344 |
| 8/25/2012 | 216428 | 1863 | 338 | 1360 |
| 8/26/2012 | 214151 | 1854 | 323 | 1351 |
| 8/27/2012 | 212380 | 1663 | 310 | 1168 |
| 8/28/2012 | 210876 | 1553 | 298 | 1067 |
| 8/29/2012 | 209145 | 1584 | 287 | 1101 |
| 8/30/2012 | 207730 | 1571 | 277 | 1094 |
| 8/31/2012 | 205860 | 1378 | 254 | 934 |
| 9/1/2012 | 204788 | 1008 | 171 | 611 |
| 9/2/2012 | 203668 | 917 | 169 | 528 |
| 9/3/2012 | 203186 | 732 | 166 | 356 |
| 9/4/2012 | 202907 | 729 | 152 | 361 |
| 9/5/2012 | 202299 | 760 | 145 | 391 |
| 9/6/2012 | 201514 | 782 | 177 | 405 |
| 9/7/2012 | 201035 | 781 | 163 | 411 |
| 9/8/2012 | 200404 | 782 | 161 | 417 |
| 9/9/2012 | 199624 | 782 | 163 | 418 |
| 9/10/2012 | 198996 | 758 | 178 | 392 |
| 9/11/2012 | 198143 | 650 | 180 | 288 |
| 9/12/2012 | 197843 | 616 | 175 | 250 |
| 9/13/2012 | 197543 | 628 | 171 | 250 |
| 9/14/2012 | 197293 | 587 | 163 | 212 |
| 9/15/2012 | 196993 | 542 | 157 | 181 |
| 9/16/2012 | 196519 | 443 | 154 | 241 |
| 9/17/2012 | 196245 | 456 | 150 | 253 |
| 9/18/2012 | 195772 | 455 | 148 | 254 |
| 9/19/2012 | 195398 | 482 | 145 | 280 |
| 9/20/2012 | 195249 | 506 | 144 | 304 |
| 9/21/2012 | 195001 | 532 | 143 | 326 |
| 9/22/2012 | 194852 | 506 | 141 | 298 |
| 9/23/2012 | 194579 | 501 | 138 | 294 |
| 9/24/2012 | 194133 | 506 | 138 | 299 |
| 9/25/2012 | 193489 | 543 | 136 | 334 |
| 9/26/2012 | 192994 | 540 | 135 | 332 |
| 9/27/2012 | 192822 | 516 | 132 | 309 |
| 9/28/2012 | 192748 | 482 | 130 | 278 |

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 9/29/2012 | 192748 | 351 | 128 | 145 |
| 9/30/2012 | 193044 | 281 | 126 | 80 |
| 10/1/2012 | 193538 | 281 | 115 | 79 |
| 10/2/2012 | 194108 | 281 | 112 | 78 |
| 10/3/2012 | 194653 | 280 | 110 | 70 |
| 10/4/2012 | 194752 | 246 | 111 | 54 |
| 10/5/2012 | 194976 | 230 | 110 | 58 |
| 10/6/2012 | 195224 | 226 | 113 | 59 |
| 10/7/2012 | 195722 | 226 | 115 | 60 |
| 10/8/2012 | 196444 | 226 | 115 | 59 |
| 10/9/2012 | 197143 | 226 | 115 | 59 |
| 10/10/2012 | 197318 | 218 | 116 | 58 |
| 10/11/2012 | 197393 | 211 | 118 | 55 |
| 10/12/2012 | 197693 | 212 | 129 | 43 |
| 10/13/2012 | 198168 | 216 | 137 | 52 |
| 10/14/2012 | 198770 | 209 | 137 | 48 |
| 10/15/2012 | 199448 | 204 | 135 | 45 |
| 10/16/2012 | 199951 | 203 | 137 | 50 |
| 10/17/2012 | 200253 | 211 | 149 | 47 |
| 10/18/2012 | 200631 | 205 | 145 | 44 |
| 10/19/2012 | 200782 | 203 | 144 | 49 |
| 10/20/2012 | 200858 | 190 | 138 | 49 |
| 10/21/2012 | 200858 | 194 | 139 | 54 |
| 10/22/2012 | 200934 | 197 | 145 | 45 |
| 10/23/2012 | 201009 | 187 | 195 | 45 |
| 10/24/2012 | 201085 | 180 | 180 | 46 |
| 10/25/2012 | 201136 | 180 | 175 | 47 |
| 10/26/2012 | 201211 | 180 | 194 | 47 |
| 10/27/2012 | 201312 | 180 | 202 | 46 |
| 10/28/2012 | 201439 | 180 | 185 | 46 |
| 10/29/2012 | 201590 | 165 | 206 | 42 |
| 10/30/2012 | 201641 | 168 | 202 | 51 |
| 10/31/2012 | 201868 | 129 | 180 | 40 |
| 11/1/2012 | 202046 | 109 | 211 | 50 |
| 11/2/2012 | 202299 | 111 | 232 | 51 |
| 11/3/2012 | 202603 | 111 | 233 | 52 |
| 11/4/2012 | 202881 | 111 | 198 | 51 |
| 11/5/2012 | 203161 | 111 | 224 | 48 |
| 11/6/2012 | 203414 | 111 | 219 | 48 |
| 11/7/2012 | 203668 | 114 | 208 | 51 |

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 11/8/2012 | 203745 | 119 | 181 | 56 |
| 11/9/2012 | 203948 | 108 | 194 | 45 |
| 11/10/2012 | 204203 | 105 | 228 | 42 |
| 11/11/2012 | 204432 | 105 | 203 | 45 |
| 11/12/2012 | 204610 | 112 | 210 | 51 |
| 11/13/2012 | 204865 | 115 | 227 | 52 |
| 11/14/2012 | 205145 | 111 | 226 | 53 |
| 11/15/2012 | 205503 | 100 | 225 | 47 |
| 11/16/2012 | 205809 | 100 | 237 | 47 |
| 11/17/2012 | 206423 | 100 | 355 | 49 |
| 11/18/2012 | 207602 | 100 | 529 | 47 |
| 11/19/2012 | 208219 | 105 | 336 | 49 |
| 11/20/2012 | 208682 | 105 | 304 | 49 |
| 11/21/2012 | 209171 | 105 | 314 | 52 |
| 11/22/2012 | 209687 | 105 | 288 | 52 |
| 11/23/2012 | 210100 | 105 | 287 | 52 |
| 11/24/2012 | 210514 | 105 | 271 | 52 |
| 11/25/2012 | 210928 | 105 | 265 | 52 |
| 11/26/2012 | 211290 | 105 | 259 | 52 |
| 11/27/2012 | 211679 | 105 | 259 | 52 |
| 11/28/2012 | 212198 | 106 | 260 | 53 |
| 11/29/2012 | 212770 | 106 | 516 | 53 |
| 11/30/2012 | 214281 | 103 | 1288 | 47 |
| 12/1/2012 | 216323 | 101 | 1287 | 45 |
| 12/2/2012 | 220516 | 101 | 2888 | 45 |
| 12/3/2012 | 224430 | 101 | 2285 | 45 |
| 12/4/2012 | 226388 | 101 | 1202 | 45 |
| 12/5/2012 | 228031 | 101 | 1027 | 46 |
| 12/6/2012 | 229382 | 102 | 907 | 47 |
| 12/7/2012 | 230683 | 105 | 823 | 50 |
| 12/8/2012 | 231797 | 105 | 750 | 50 |
| 12/9/2012 | 232805 | 105 | 627 | 50 |
| 12/10/2012 | 233761 | 105 | 625 | 50 |
| 12/11/2012 | 234609 | 105 | 564 | 50 |
| 12/12/2012 | 235487 | 126 | 651 | 59 |
| 12/13/2012 | 236311 | 123 | 636 | 50 |
| 12/14/2012 | 237136 | 113 | 462 | 46 |
| 12/15/2012 | 237908 | 111 | 522 | 48 |
| 12/16/2012 | 238626 | 111 | 515 | 48 |
| 12/17/2012 | 239317 | 111 | 490 | 48 |

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 12/18/2012 | 240232 | 115 | 687 | 52 |
| 12/19/2012 | 240981 | 123 | 524 | 60 |
| 12/20/2012 | 241704 | 118 | 510 | 54 |
| 12/21/2012 | 242373 | 113 | 460 | 49 |
| 12/22/2012 | 243321 | 111 | 743 | 46 |
| 12/23/2012 | 244803 | 113 | 975 | 49 |
| 12/24/2012 | 247669 | 124 | 1614 | 60 |
| 12/25/2012 | 249335 | 118 | 995 | 55 |
| 12/26/2012 | 251234 | 117 | 1128 | 53 |
| 12/27/2012 | 252884 | 111 | 957 | 46 |
| 12/28/2012 | 254054 | 114 | 750 | 49 |
| 12/29/2012 | 255141 | 114 | 715 | 49 |
| 12/30/2012 | 256144 | 112 | 669 | 48 |
| 12/31/2012 | 256977 | 114 | 542 | 50 |
| 1/1/2013 | 257869 | 114 | 593 | 52 |
| 1/2/2013 | 258647 | 114 | 572 | 50 |
| 1/3/2013 | 259484 | 117 | 573 | 53 |
| 1/4/2013 | 260265 | 113 | 572 | 49 |
| 1/5/2013 | 261046 | 113 | 545 | 49 |
| 1/6/2013 | 262033 | 114 | 643 | 50 |
| 1/7/2013 | 263021 | 114 | 630 | 47 |
| 1/8/2013 | 263982 | 113 | 705 | 50 |
| 1/9/2013 | 264536 | 113 | 449 | 48 |
| 1/10/2013 | 265471 | 119 | 661 | 52 |
| 1/11/2013 | 266378 | 127 | 639 | 60 |
| 1/12/2013 | 267141 | 128 | 549 | 61 |
| 1/13/2013 | 267875 | 127 | 551 | 60 |
| 1/14/2013 | 268521 | 126 | 506 | 59 |
| 1/15/2013 | 269169 | 123 | 542 | 56 |
| 1/16/2013 | 269906 | 138 | 595 | 63 |
| 1/17/2013 | 270673 | 132 | 573 | 51 |
| 1/18/2013 | 271412 | 133 | 592 | 51 |
| 1/19/2013 | 272152 | 133 | 556 | 52 |
| 1/20/2013 | 272923 | 133 | 550 | 52 |
| 1/21/2013 | 273903 | 133 | 657 | 52 |
| 1/22/2013 | 274975 | 132 | 654 | 51 |
| 1/23/2013 | 275929 | 138 | 589 | 53 |
| 1/24/2013 | 277752 | 144 | 1399 | 53 |
| 1/25/2013 | 280334 | 144 | 1508 | 53 |
| 1/26/2013 | 282263 | 141 | 1142 | 50 |

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 1/27/2013 | 284685 | 159 | 1181 | 54 |
| 1/28/2013 | 286782 | 162 | 852 | 52 |
| 1/29/2013 | 288704 | 171 | 877 | 55 |
| 1/30/2013 | 290787 | 176 | 845 | 54 |
| 1/31/2013 | 292692 | 183 | 823 | 55 |
| 2/1/2013 | 294542 | 182 | 854 | 54 |
| 2/2/2013 | 296399 | 178 | 783 | 50 |
| 2/3/2013 | 298199 | 179 | 802 | 51 |
| 2/4/2013 | 299724 | 179 | 771 | 50 |
| 2/5/2013 | 300879 | 179 | 721 | 50 |
| 2/6/2013 | 302098 | 179 | 821 | 53 |
| 2/7/2013 | 303352 | 179 | 742 | 53 |
| 2/8/2013 | 304639 | 177 | 825 | 48 |
| 2/9/2013 | 305804 | 179 | 706 | 49 |
| 2/10/2013 | 306939 | 190 | 693 | 59 |
| 2/11/2013 | 307950 | 188 | 621 | 57 |
| 2/12/2013 | 308963 | 182 | 646 | 52 |
| 2/13/2013 | 309977 | 184 | 645 | 54 |
| 2/14/2013 | 310993 | 189 | 619 | 55 |
| 2/15/2013 | 311916 | 190 | 615 | 56 |
| 2/16/2013 | 312903 | 204 | 582 | 61 |
| 2/17/2013 | 313765 | 203 | 547 | 56 |
| 2/18/2013 | 314627 | 203 | 630 | 56 |
| 2/19/2013 | 315716 | 197 | 620 | 55 |
| 2/20/2013 | 316742 | 193 | 699 | 56 |
| 2/21/2013 | 317705 | 185 | 562 | 50 |
| 2/22/2013 | 318638 | 183 | 581 | 50 |
| 2/23/2013 | 319540 | 189 | 526 | 56 |
| 2/24/2013 | 320379 | 188 | 524 | 55 |
| 2/25/2013 | 321219 | 193 | 509 | 58 |
| 2/26/2013 | 322060 | 197 | 553 | 61 |
| 2/27/2013 | 322999 | 191 | 606 | 55 |
| 2/28/2013 | 323843 | 189 | 500 | 53 |
| 3/1/2013 | 325273 | 189 | 598 | 54 |
| 3/2/2013 | 326804 | 198 | 640 | 55 |
| 3/3/2013 | 328274 | 204 | 692 | 60 |
| 3/4/2013 | 328470 | 812 | 806 | 663 |
| 3/5/2013 | 328568 | 768 | 734 | 624 |
| 3/6/2013 | 328993 | 677 | 875 | 537 |
| 3/7/2013 | 329648 | 639 | 862 | 503 |

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 3/8/2013 | 330140 | 595 | 735 | 461 |
| 3/9/2013 | 330534 | 545 | 741 | 414 |
| 3/10/2013 | 330994 | 496 | 669 | 369 |
| 3/11/2013 | 331881 | 432 | 797 | 308 |
| 3/12/2013 | 332638 | 447 | 826 | 326 |
| 3/13/2013 | 333461 | 508 | 1017 | 383 |
| 3/14/2013 | 334715 | 517 | 1321 | 391 |
| 3/15/2013 | 336269 | 485 | 1466 | 355 |
| 3/16/2013 | 338126 | 468 | 1680 | 337 |
| 3/17/2013 | 339922 | 481 | 1764 | 348 |
| 3/18/2013 | 341689 | 461 | 1626 | 322 |
| 3/19/2013 | 343461 | 414 | 1649 | 276 |
| 3/20/2013 | 345506 | 430 | 1891 | 291 |
| 3/21/2013 | 347121 | 429 | 1502 | 291 |
| 3/22/2013 | 349042 | 366 | 1529 | 232 |
| 3/23/2013 | 350834 | 347 | 1506 | 215 |
| 3/24/2013 | 352563 | 363 | 1591 | 229 |
| 3/25/2013 | 354670 | 372 | 1671 | 237 |
| 3/26/2013 | 356204 | 493 | 1536 | 274 |
| 3/27/2013 | 357707 | 564 | 1511 | 219 |
| 3/28/2013 | 358802 | 709 | 1505 | 255 |
| 3/29/2013 | 360071 | 645 | 1513 | 181 |
| 3/30/2013 | 361101 | 665 | 1681 | 153 |
| 3/31/2013 | 362787 | 764 | 2094 | 194 |
| 4/1/2013 | 364270 | 853 | 1946 | 210 |
| 4/2/2013 | 365687 | 831 | 1745 | 197 |
| 4/3/2013 | 367003 | 833 | 1804 | 197 |
| 4/4/2013 | 368494 | 868 | 2010 | 197 |
| 4/5/2013 | 369885 | 868 | 1822 | 195 |
| 4/6/2013 | 371034 | 882 | 1879 | 209 |
| 4/7/2013 | 372290 | 922 | 2047 | 245 |
| 4/8/2013 | 374038 | 933 | 2390 | 258 |
| 4/9/2013 | 375475 | 939 | 1880 | 266 |
| 4/10/2013 | 376598 | 963 | 1772 | 281 |
| 4/11/2013 | 377617 | 959 | 1995 | 271 |
| 4/12/2013 | 379413 | 943 | 2437 | 251 |
| 4/13/2013 | 381461 | 926 | 2802 | 234 |
| 4/14/2013 | 384331 | 729 | 3100 | 62 |
| 4/15/2013 | 387818 | 721 | 3312 | 49 |
| 4/16/2013 | 390533 | 720 | 2645 | 42 |

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 4/17/2013 | 392504 | 754 | 2088 | 48 |
| 4/18/2013 | 394337 | 744 | 1924 | 39 |
| 4/19/2013 | 395921 | 745 | 1957 | 35 |
| 4/20/2013 | 397618 | 759 | 2110 | 46 |
| 4/21/2013 | 399752 | 760 | 2791 | 38 |
| 4/22/2013 | 403274 | 776 | 3627 | 45 |
| 4/23/2013 | 407581 | 836 | 4008 | 60 |
| 4/24/2013 | 411727 | 846 | 4046 | 55 |
| 4/25/2013 | 415303 | 897 | 3815 | 51 |
| 4/26/2013 | 418339 | 908 | 3349 | 42 |
| 4/27/2013 | 421386 | 1005 | 3650 | 60 |
| 4/28/2013 | 424930 | 1156 | 4135 | 40 |
| 4/29/2013 | 429768 | 1201 | 4753 | 67 |
| 4/30/2013 | 434936 | 1346 | 5034 | 91 |
| 5/1/2013 | 439413 | 1463 | 4915 | 65 |
| 5/2/2013 | 443876 | 1460 | 4184 | 62 |
| 5/3/2013 | 447939 | 1444 | 4812 | 61 |
| 5/4/2013 | 451790 | 1445 | 4159 | 66 |
| 5/5/2013 | 454224 | 1444 | 3238 | 65 |
| 5/6/2013 | 456161 | 1446 | 2956 | 68 |
| 5/7/2013 | 457636 | 1419 | 2790 | 55 |
| 5/8/2013 | 459036 | 1390 | 2527 | 53 |
| 5/9/2013 | 460165 | 1374 | 2390 | 39 |
| 5/10/2013 | 461295 | 1364 | 2423 | 42 |
| 5/11/2013 | 462466 | 1366 | 2521 | 44 |
| 5/12/2013 | 464382 | 1376 | 2992 | 42 |
| 5/13/2013 | 467087 | 1445 | 3423 | 51 |
| 5/14/2013 | 469997 | 1490 | 3641 | 77 |
| 5/15/2013 | 472836 | 1494 | 3483 | 62 |
| 5/16/2013 | 475606 | 1550 | 3398 | 66 |
| 5/17/2013 | 476954 | 1553 | 2664 | 71 |
| 5/18/2013 | 477907 | 1544 | 2214 | 60 |
| 5/19/2013 | 478901 | 1544 | 2300 | 53 |
| 5/20/2013 | 480214 | 1548 | 2396 | 55 |
| 5/21/2013 | 481369 | 1563 | 2536 | 64 |
| 5/22/2013 | 482606 | 1567 | 2385 | 67 |
| 5/23/2013 | 483205 | 1571 | 2140 | 69 |
| 5/24/2013 | 483205 | 1563 | 1802 | 61 |
| 5/25/2013 | 482965 | 1563 | 1597 | 60 |
| 5/26/2013 | 482846 | 1554 | 1628 | 54 |

Provisional data, storage in acre-feet, other data in cubic feet per second.

| Date | Pine Flat Storage Acre-feet | Flow at Piedra cfs | Pre Project Piedra cfs | Measured Flows Below Fresno Weir cfs |
|---|---|---|---|---|
| 5/27/2013 | 483205 | 1505 | 1682 | 50 |
| 5/28/2013 | 483445 | 1502 | 1744 | 78 |
| 5/29/2013 | 483565 | 1497 | 1746 | 58 |
| 5/30/2013 | 483925 | 1521 | 1779 | 57 |
| 5/31/2013 | 484444 | 1554 | 1860 | 58 |

# APPENDIX B

Hydrologic and Climate Summary Reports for 2012-2013 Program Year

# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

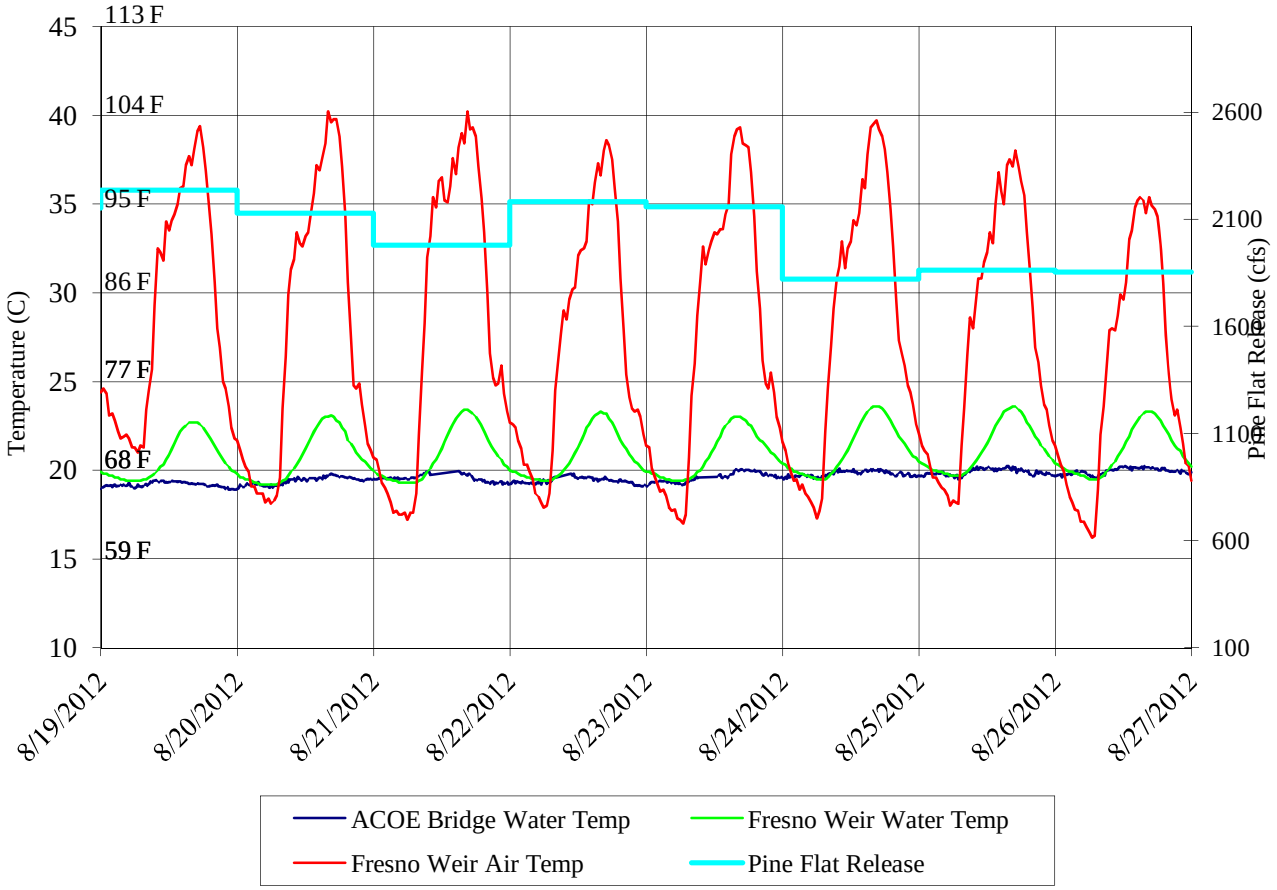
**Provisional Data - Subject to Revision**

**8/28/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 269 cfs | NA cfs | 8/28/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 8/28/2012 | | KRWA |
| Piedra | 1,554 cfs | 100 cfs | 8/28/2012 | | KRWA |
| Dennis Cut | 121 cfs | 5 cfs | 8/28/2012 | | KRWA |
| At Fresno Weir | 1,138 cfs | 95 cfs | 8/28/2012 | | KRWA |
| Over Fresno Weir | 1,088 cfs | 40 cfs | 8/28/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 211,783 af | | 8/28/2012 | 0700 | ACOE |
| Elevation | 764.14 ft | | 8/28/2012 | 0700 | ACOE |
| Release | 1,544 cfs | | 8/28/2012 | 0700 | KRCD |
| Release Temperature | 67.6 F | 19.8 C | 8/28/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 70.0 F | 21.1 C | 8/28/2012 | | |

## Flow and Temperature Trends



# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

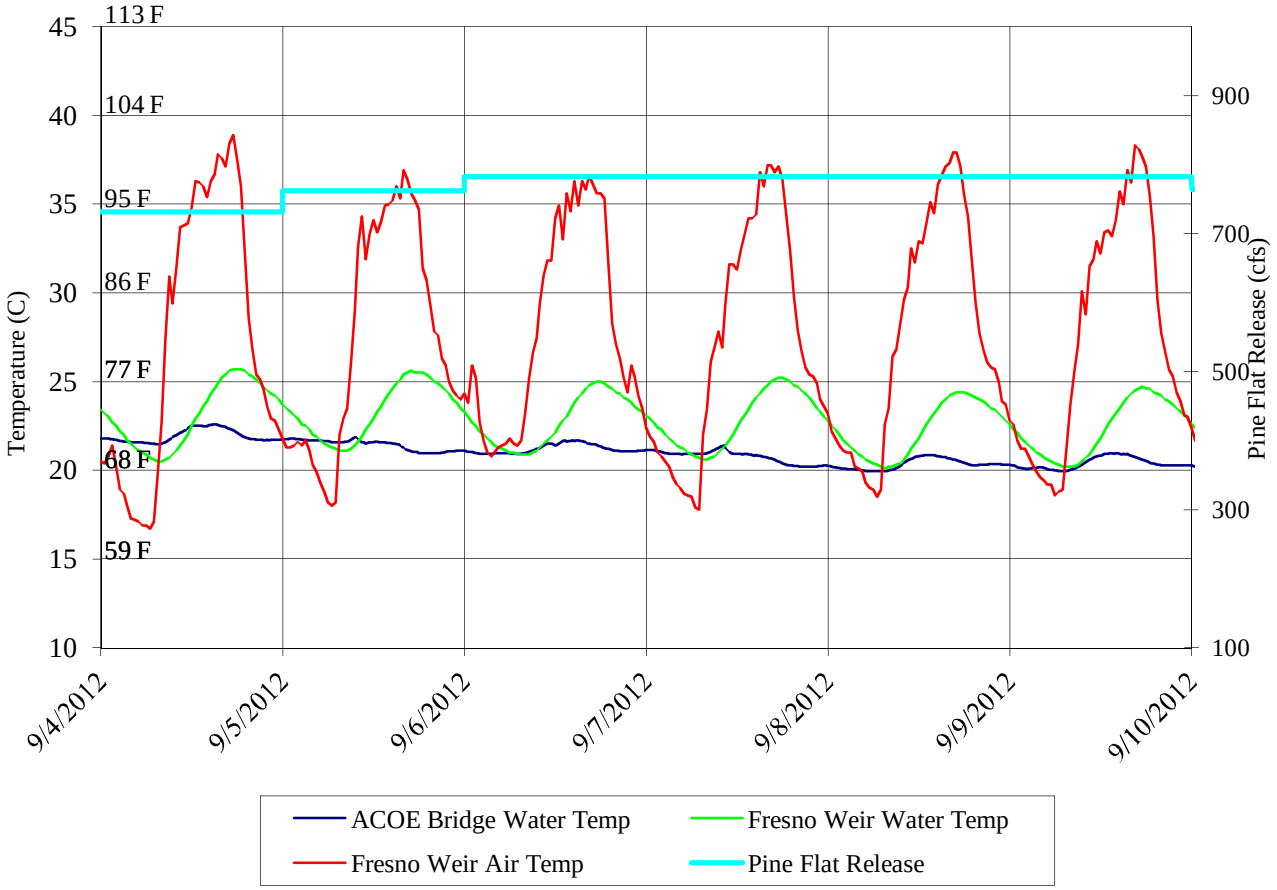
**Provisional Data - Subject to Revision**

**9/11/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 231 cfs | NA cfs | 9/11/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 9/11/2012 | | KRWA |
| Piedra | 702 cfs | 100 cfs | 9/11/2012 | | KRWA |
| Dennis Cut | 74 cfs | 5 cfs | 9/11/2012 | | KRWA |
| At Fresno Weir | 388 cfs | 95 cfs | 9/11/2012 | | KRWA |
| Over Fresno Weir | 348 cfs | 40 cfs | 9/11/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 198,569 af | | 9/11/2012 | 0700 | ACOE |
| Elevation | 758.96 ft | | 9/11/2012 | 0700 | ACOE |
| Release | 702 cfs | | 9/11/2012 | 0700 | KRCD |
| Release Temperature | 68.1 F | 20.1 C | 9/11/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 72.0 F | 22.2 C | 9/11/2012 | | |

## Flow and Temperature Trends



# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

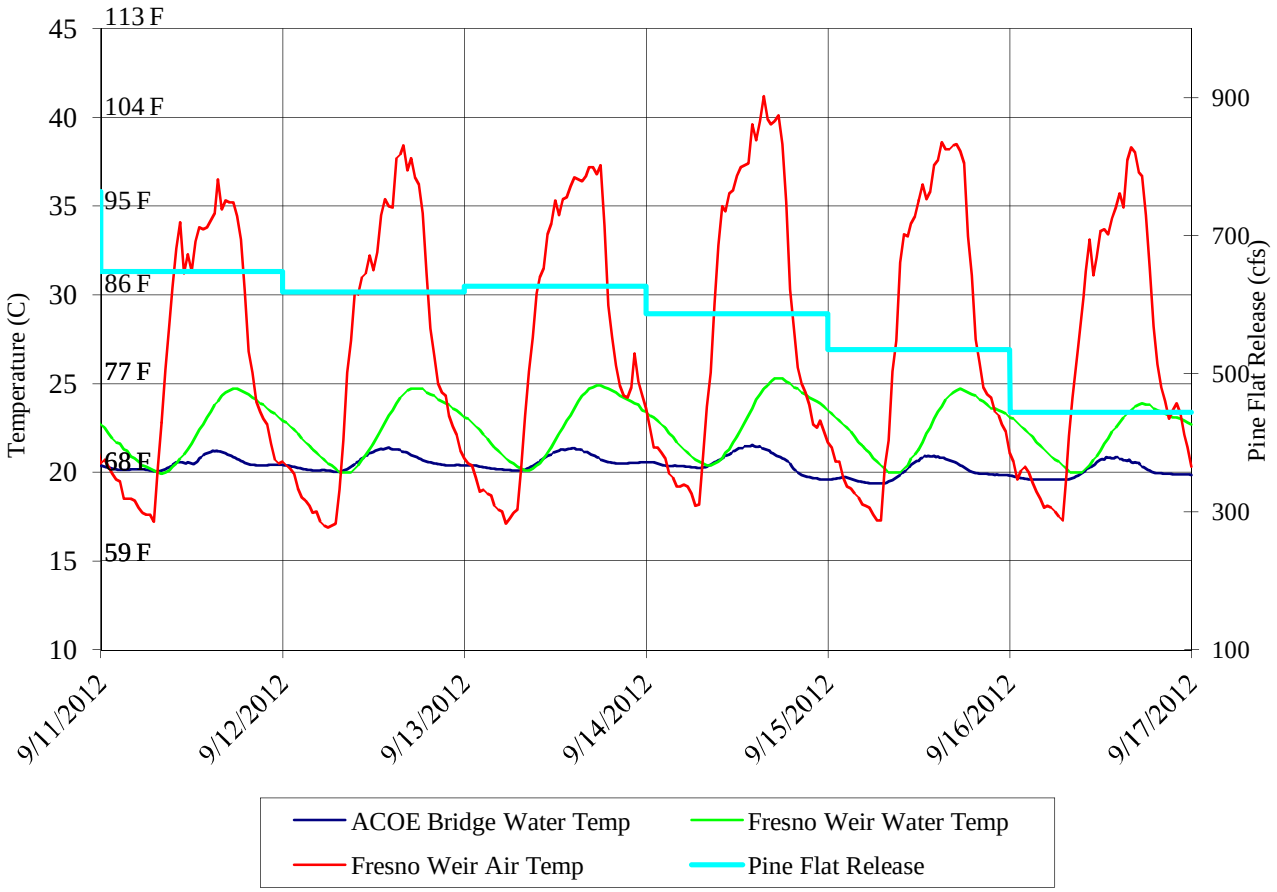
**Provisional Data - Subject to Revision**

**9/17/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 199 cfs | NA cfs | 9/17/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 9/17/2012 | | KRWA |
| Piedra | 465 cfs | 100 cfs | 9/17/2012 | | KRWA |
| Dennis Cut | 65 cfs | 5 cfs | 9/17/2012 | | KRWA |
| At Fresno Weir | 290 cfs | 95 cfs | 9/17/2012 | | KRWA |
| Over Fresno Weir | 275 cfs | 40 cfs | 9/17/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 196,394 af | | 9/17/2012 | 0700 | ACOE |
| Elevation | 758.09 ft | | 9/17/2012 | 0700 | ACOE |
| Release | 465 cfs | | 9/17/2012 | 0700 | KRCD |
| Release Temperature | 67.3 F | 19.6 C | 9/17/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 71.8 F | 22.1 C | 9/17/2012 | | |

## Flow and Temperature Trends



# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

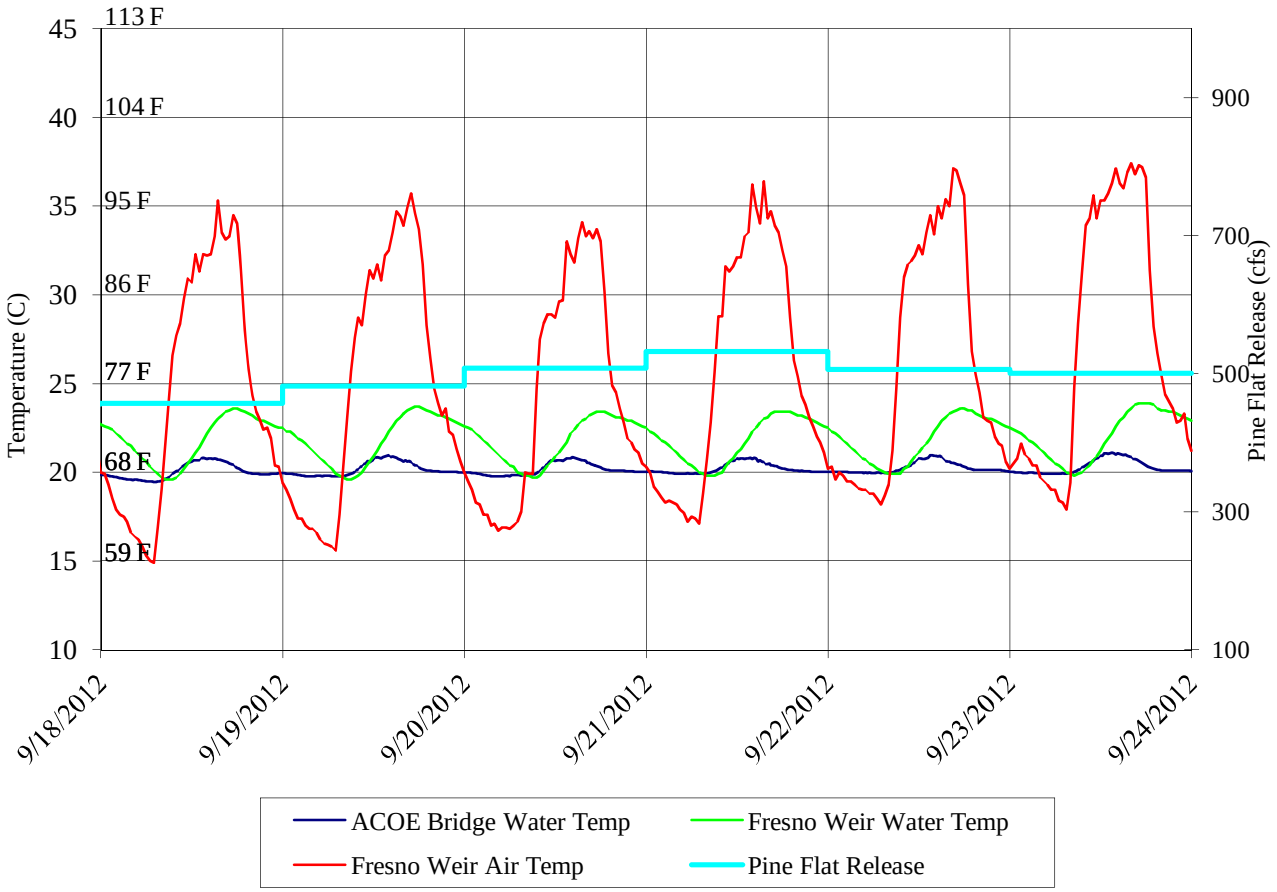
**Provisional Data - Subject to Revision**

**9/24/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 176 cfs | NA cfs | 9/24/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 9/24/2012 | | KRWA |
| Piedra | 498 cfs | 100 cfs | 9/24/2012 | | KRWA |
| Dennis Cut | 72 cfs | 5 cfs | 9/24/2012 | | KRWA |
| At Fresno Weir | 316 cfs | 95 cfs | 9/24/2012 | | KRWA |
| Over Fresno Weir | 301 cfs | 40 cfs | 9/24/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 194,454 af | | 9/24/2012 | 0700 | ACOE |
| Elevation | 757.31 ft | | 9/24/2012 | 0700 | ACOE |
| Release | 498 cfs | | 9/24/2012 | 0700 | KRCD |
| Release Temperature | 67.8 F | 19.9 C | 9/24/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 71.8 F | 22.1 C | 9/24/2012 | | |

## Flow and Temperature Trends



# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

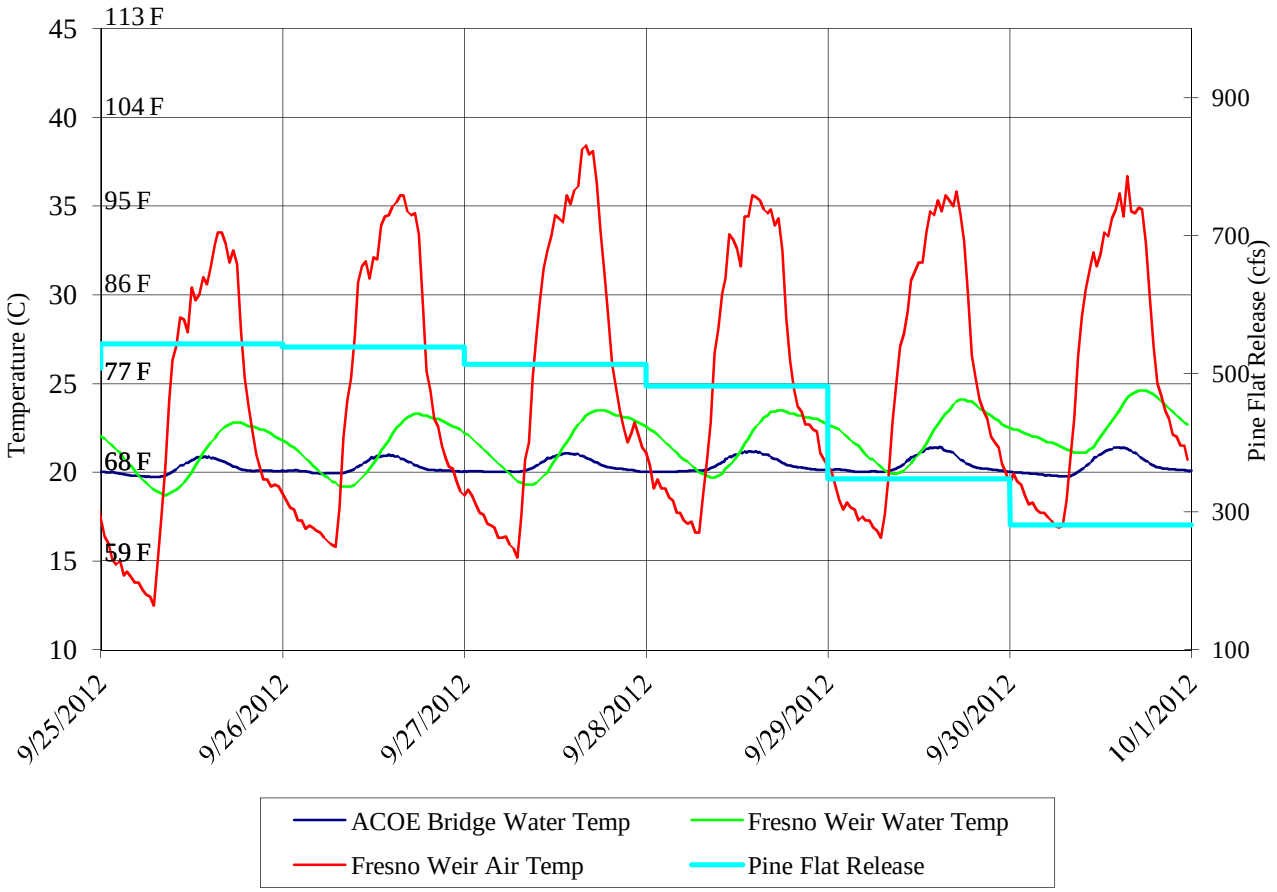
**Provisional Data - Subject to Revision**

**10/1/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 162 cfs | NA cfs | 10/1/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 10/1/2012 | | KRWA |
| Piedra | 281 cfs | 100 cfs | 10/1/2012 | | KRWA |
| Dennis Cut | 50 cfs | 5 cfs | 10/1/2012 | | KRWA |
| At Fresno Weir | 121 cfs | 95 cfs | 10/1/2012 | | KRWA |
| Over Fresno Weir | 71 cfs | 40 cfs | 10/1/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 193,093 af | | 10/1/2012 | 0700 | ACOE |
| Elevation | 756.76 ft | | 10/1/2012 | 0700 | ACOE |
| Release | 281 cfs | | 10/1/2012 | 0700 | KRCD |
| Release Temperature | 68.5 F | 20.3 C | 10/1/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 72.7 F | 22.6 C | 10/1/2012 | | |

## Flow and Temperature Trends



# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

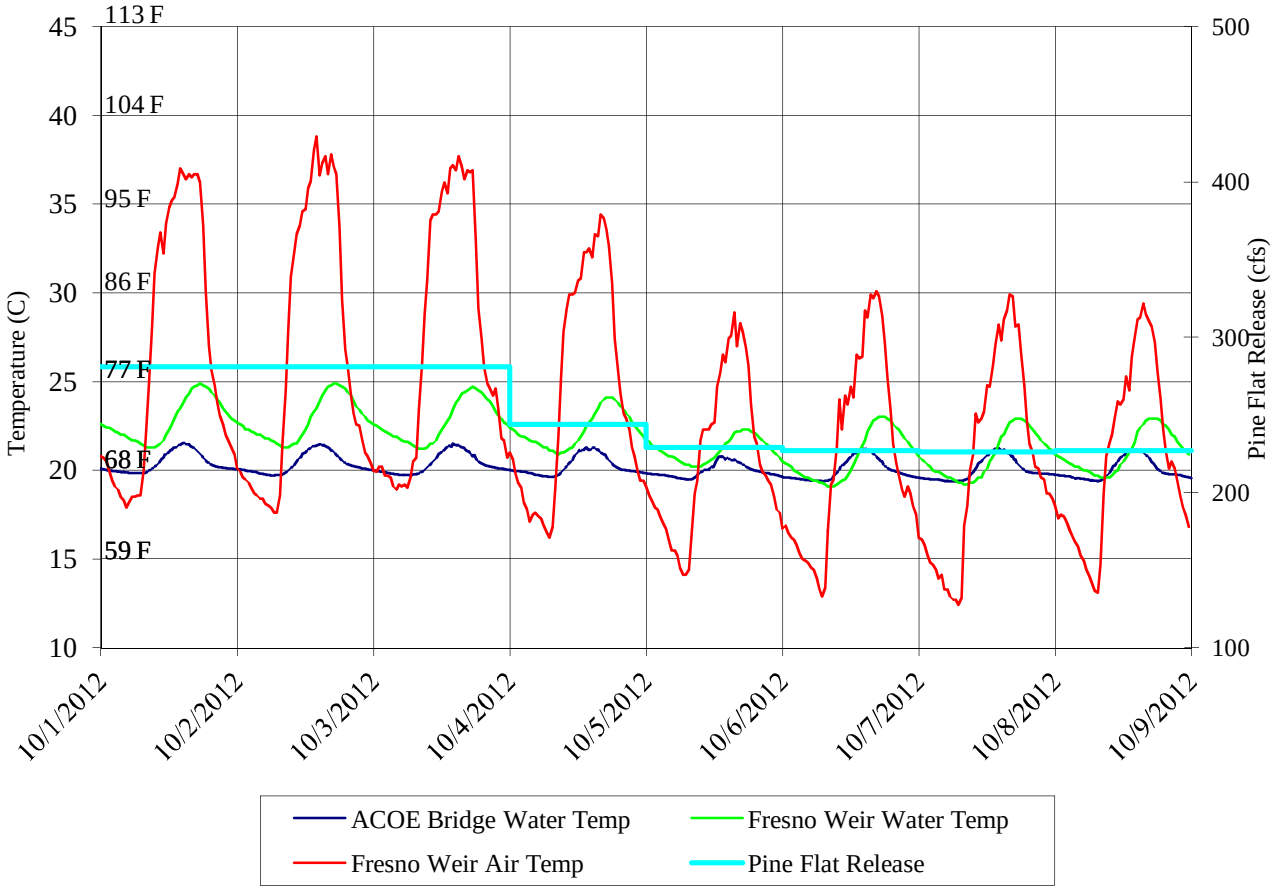
**Provisional Data - Subject to Revision**

**10/9/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 164 cfs | NA cfs | 10/9/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 10/9/2012 | | KRWA |
| Piedra | 225 cfs | 100 cfs | 10/9/2012 | | KRWA |
| Dennis Cut | 52 cfs | 5 cfs | 10/9/2012 | | KRWA |
| At Fresno Weir | 98 cfs | 95 cfs | 10/9/2012 | | KRWA |
| Over Fresno Weir | 53 cfs | 40 cfs | 10/9/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 196,444 af | | 10/9/2012 | 0700 | ACOE |
| Elevation | 758.11 ft | | 10/9/2012 | 0700 | ACOE |
| Release | 225 cfs | | 10/9/2012 | 0700 | KRCD |
| Release Temperature | 66.9 F | 19.4 C | 10/9/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 69.8 F | 21.0 C | 10/9/2012 | | |

## Flow and Temperature Trends



# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

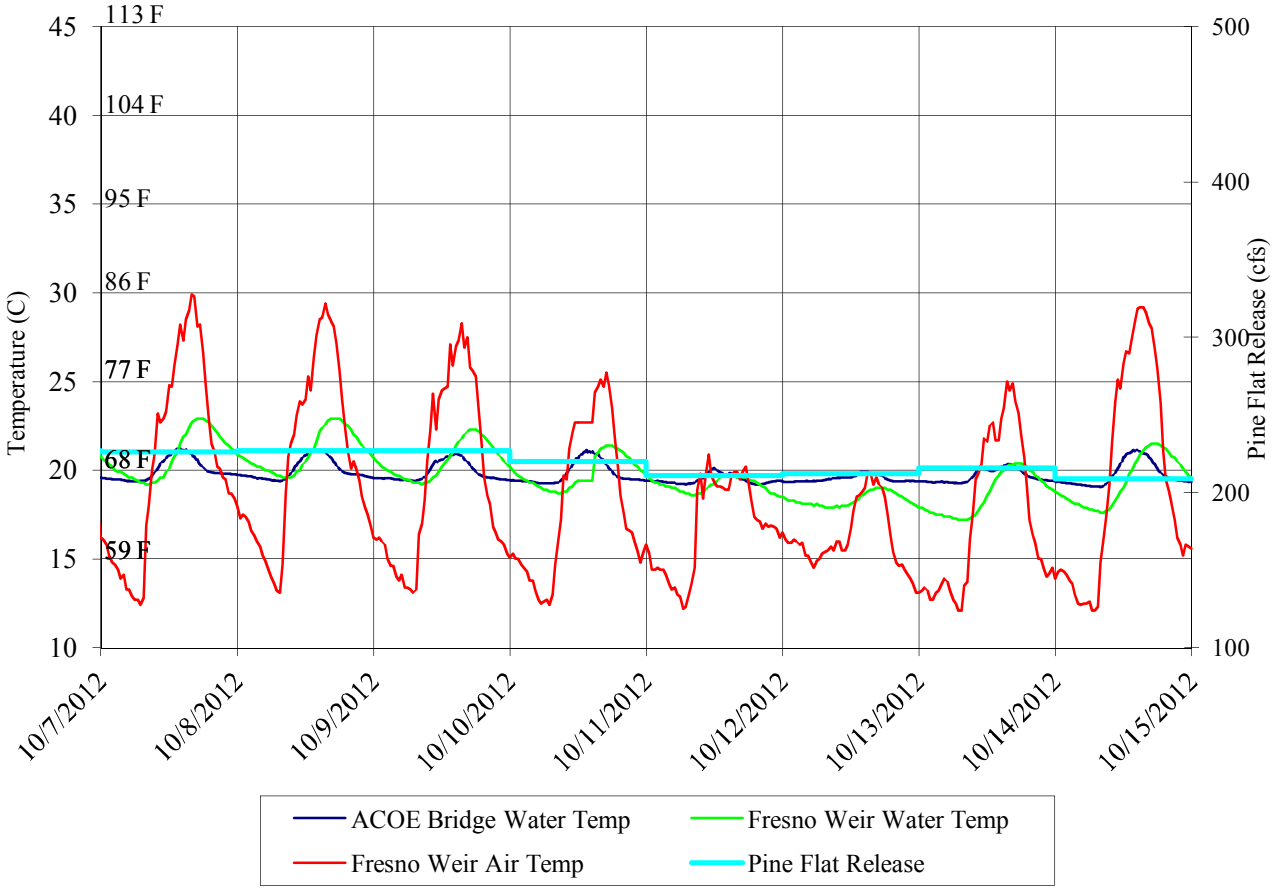
**Provisional Data - Subject to Revision**

**10/15/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 179 cfs | NA cfs | 10/15/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 10/15/2012 | | KRWA |
| Piedra | 205 cfs | 100 cfs | 10/15/2012 | | KRWA |
| Dennis Cut | 40 cfs | 5 cfs | 10/15/2012 | | KRWA |
| At Fresno Weir | 95 cfs | 95 cfs | 10/15/2012 | | KRWA |
| Over Fresno Weir | 40 cfs | 40 cfs | 10/15/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 198,820 af | | 10/15/2012 | 0700 | ACOE |
| Elevation | 759.06 ft | | 10/15/2012 | 0700 | ACOE |
| Release | 205 cfs | | 10/15/2012 | 0700 | KRCD |
| Release Temperature | 66.2 F | 19.0 C | 10/15/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 66.9 F | 19.4 C | 10/15/2012 | | |

## Flow and Temperature Trends



# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

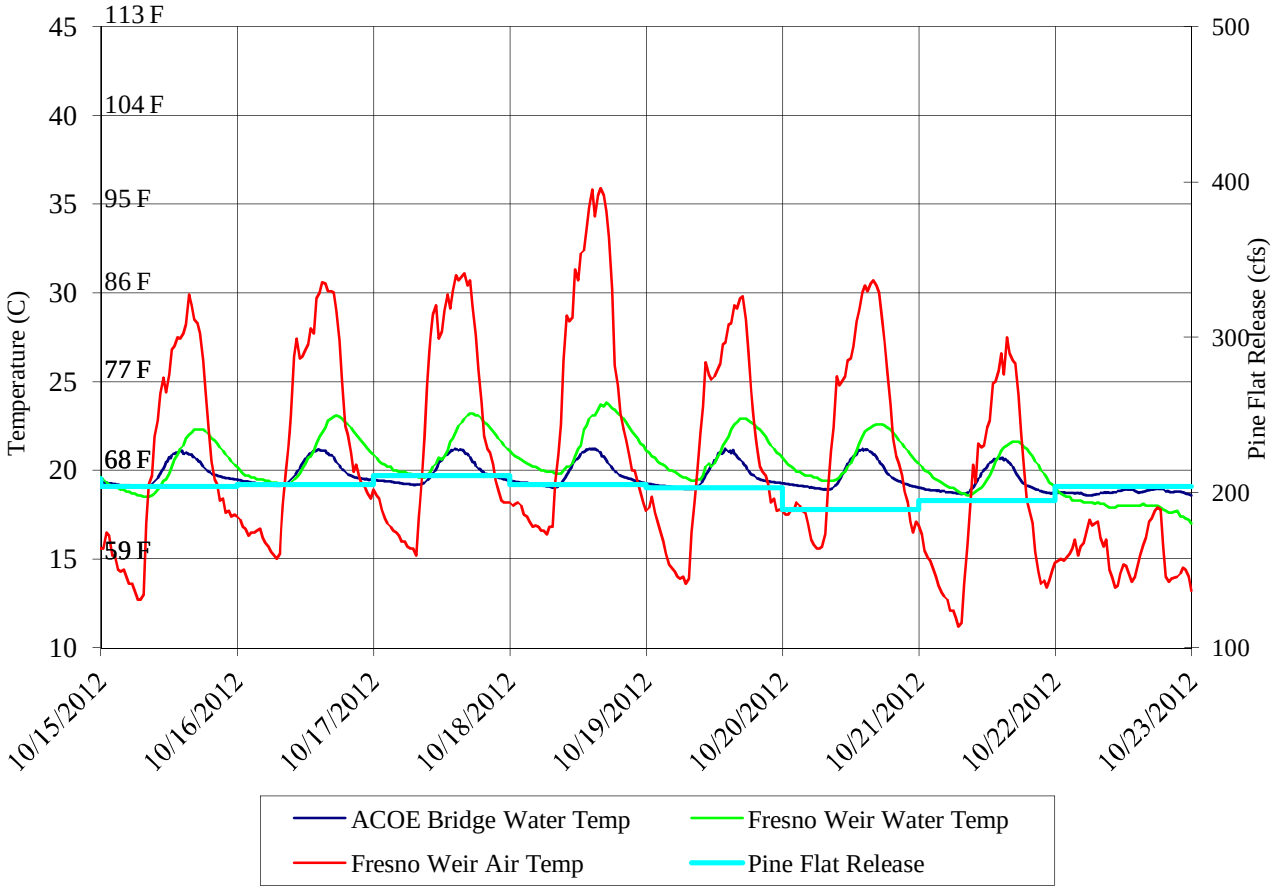
**Provisional Data - Subject to Revision**

**10/23/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 290 cfs | NA cfs | 10/23/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 10/23/2012 | | KRWA |
| Piedra | 191 cfs | 100 cfs | 10/23/2012 | | KRWA |
| Dennis Cut | 30 cfs | 5 cfs | 10/23/2012 | | KRWA |
| At Fresno Weir | 101 cfs | 95 cfs | 10/23/2012 | | KRWA |
| Over Fresno Weir | 46 cfs | 40 cfs | 10/23/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 200,883 af | | 10/23/2012 | 0700 | ACOE |
| Elevation | 759.88 ft | | 10/23/2012 | 0700 | ACOE |
| Release | 191 cfs | | 10/23/2012 | 0700 | KRCD |
| Release Temperature | 64.9 F | 18.3 C | 10/23/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 64.4 F | 18.0 C | 10/23/2012 | | |

## Flow and Temperature Trends



# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

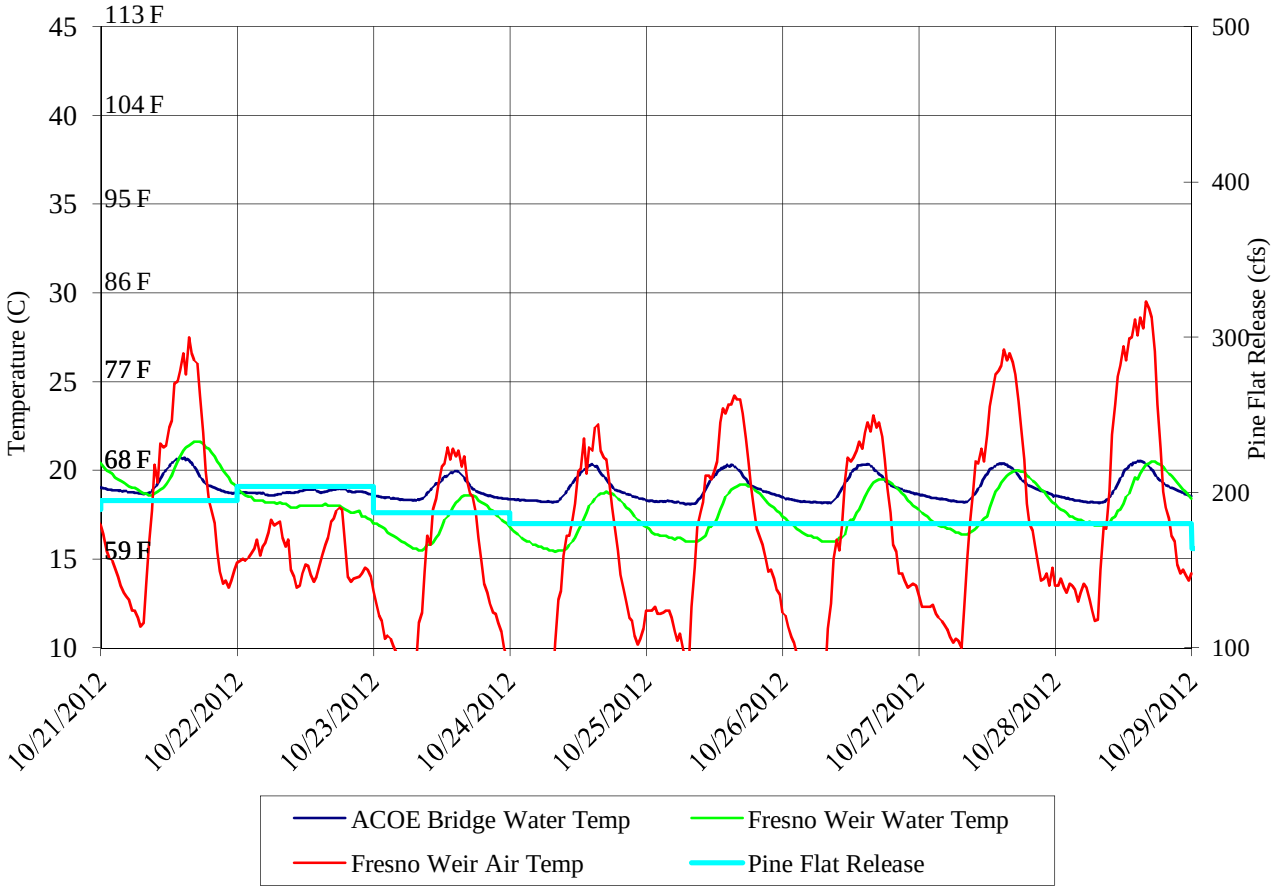
**Provisional Data - Subject to Revision**

**10/29/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 290 cfs | NA cfs | 10/29/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 10/29/2012 | | KRWA |
| Piedra | 160 cfs | 100 cfs | 10/29/2012 | | KRWA |
| Dennis Cut | 5 cfs | 5 cfs | 10/29/2012 | | KRWA |
| At Fresno Weir | 95 cfs | 95 cfs | 10/29/2012 | | KRWA |
| Over Fresno Weir | 40 cfs | 40 cfs | 10/29/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 201,438 af | | 10/29/2012 | 0700 | ACOE |
| Elevation | 760.10 ft | | 10/29/2012 | 0700 | ACOE |
| Release | 160 cfs | | 10/29/2012 | 0700 | KRCD |
| Release Temperature | 64.6 F | 18.1 C | 10/29/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 65.1 F | 18.4 C | 10/29/2012 | | |

## Flow and Temperature Trends



# Kings River Fisheries Management Program
# Hydrologic and Climatic Summary Report

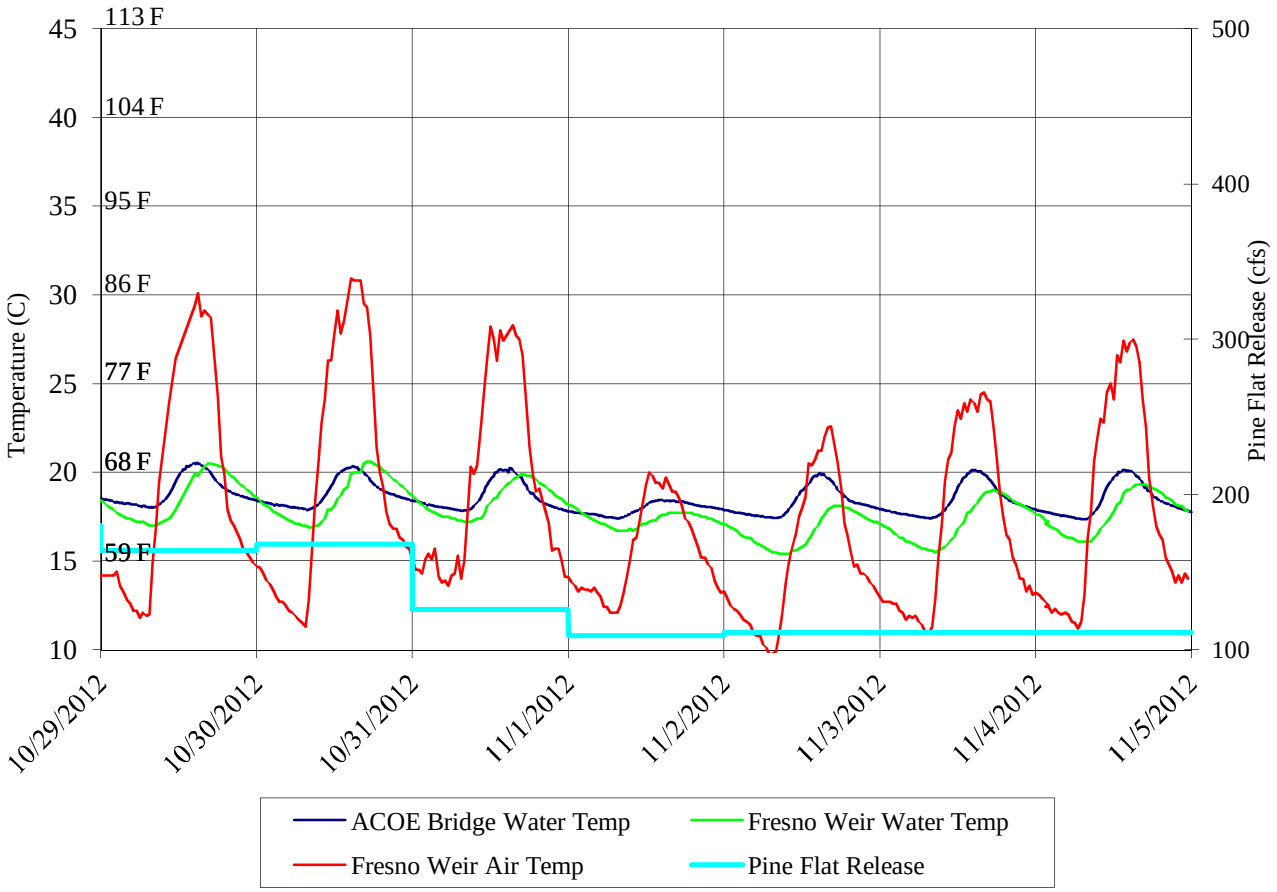
**Provisional Data - Subject to Revision**

**11/5/2012**

| Flow Rates | Actual | Exhibit "C" Criteria | Date | | |
|---|---|---|---|---|---|
| Kings River Below North Fork | 238 cfs | NA cfs | 11/5/2012 | | ACOE |
| Mill & Hughes Creeks | 0 cfs | NA cfs | 11/5/2012 | | KRWA |
| Piedra | 111 cfs | 100 cfs | 11/5/2012 | | KRWA |
| Dennis Cut | 5 cfs | 5 cfs | 11/5/2012 | | KRWA |
| At Fresno Weir | 100 cfs | 95 cfs | 11/5/2012 | | KRWA |
| Over Fresno Weir | 45 cfs | 40 cfs | 11/5/2012 | . | KRWA |

| Pine Flat | | | Date | | |
|---|---|---|---|---|---|
| Storage | 202,983 af | | 11/5/2012 | 0700 | ACOE |
| Elevation | 760.71 ft | | 11/5/2012 | 0700 | ACOE |
| Release | 111 cfs | | 11/5/2012 | 0700 | KRCD |
| Release Temperature | 63.1 F | 17.3 C | 11/5/2012 | 0700 | KRCD |
| Avg. Fresno Weir Water Temp | 63.7 F | 17.6 C | 11/5/2012 | | |

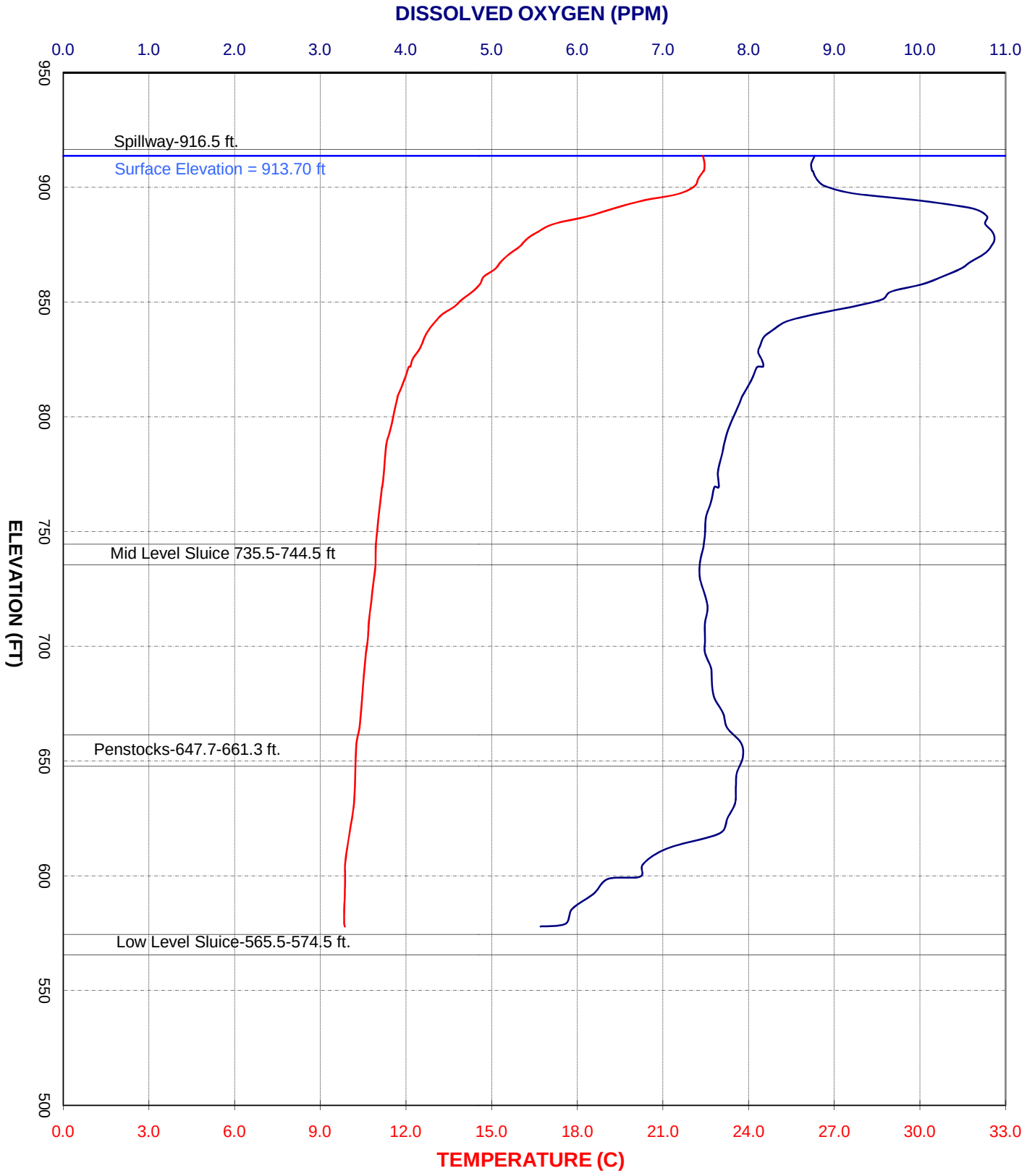
## Flow and Temperature Trends



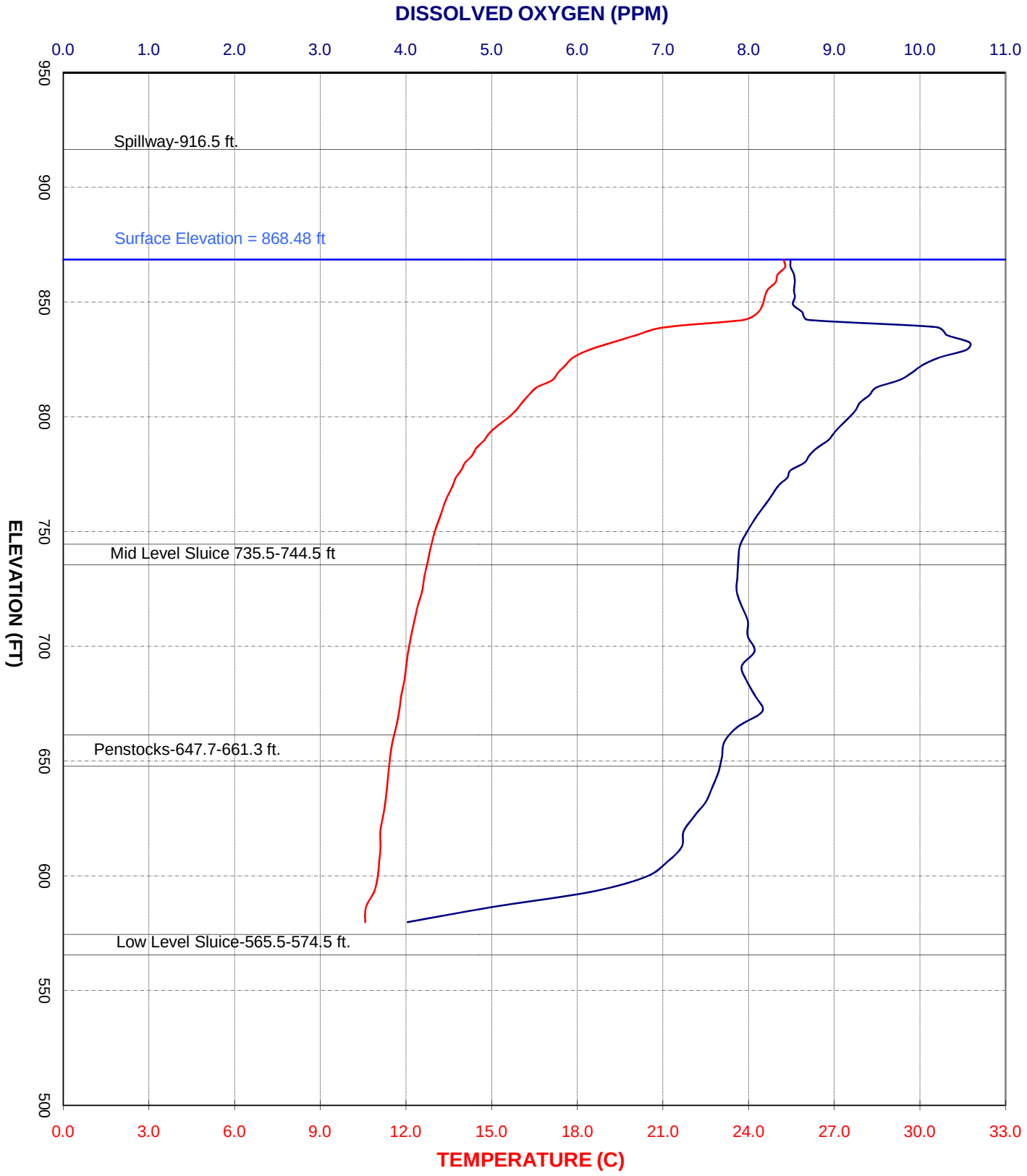
# APPENDIX C

Pine Flat Reservoir Temperature and Dissolved Oxygen Profiles from May 2012 through May 2013 (on following pages)

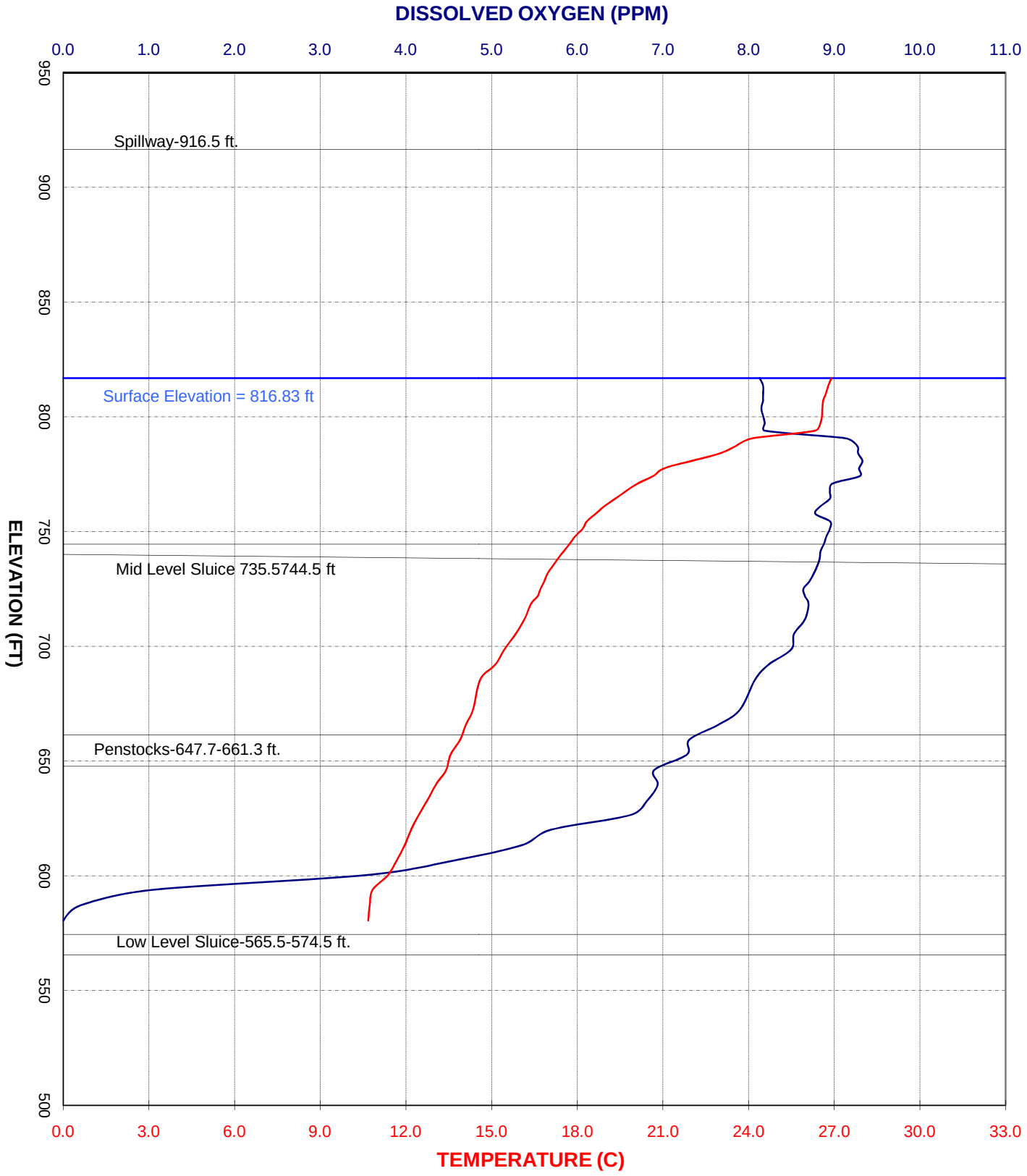
**PINE FLAT RESERVOIR 06/05/12 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 913.70**



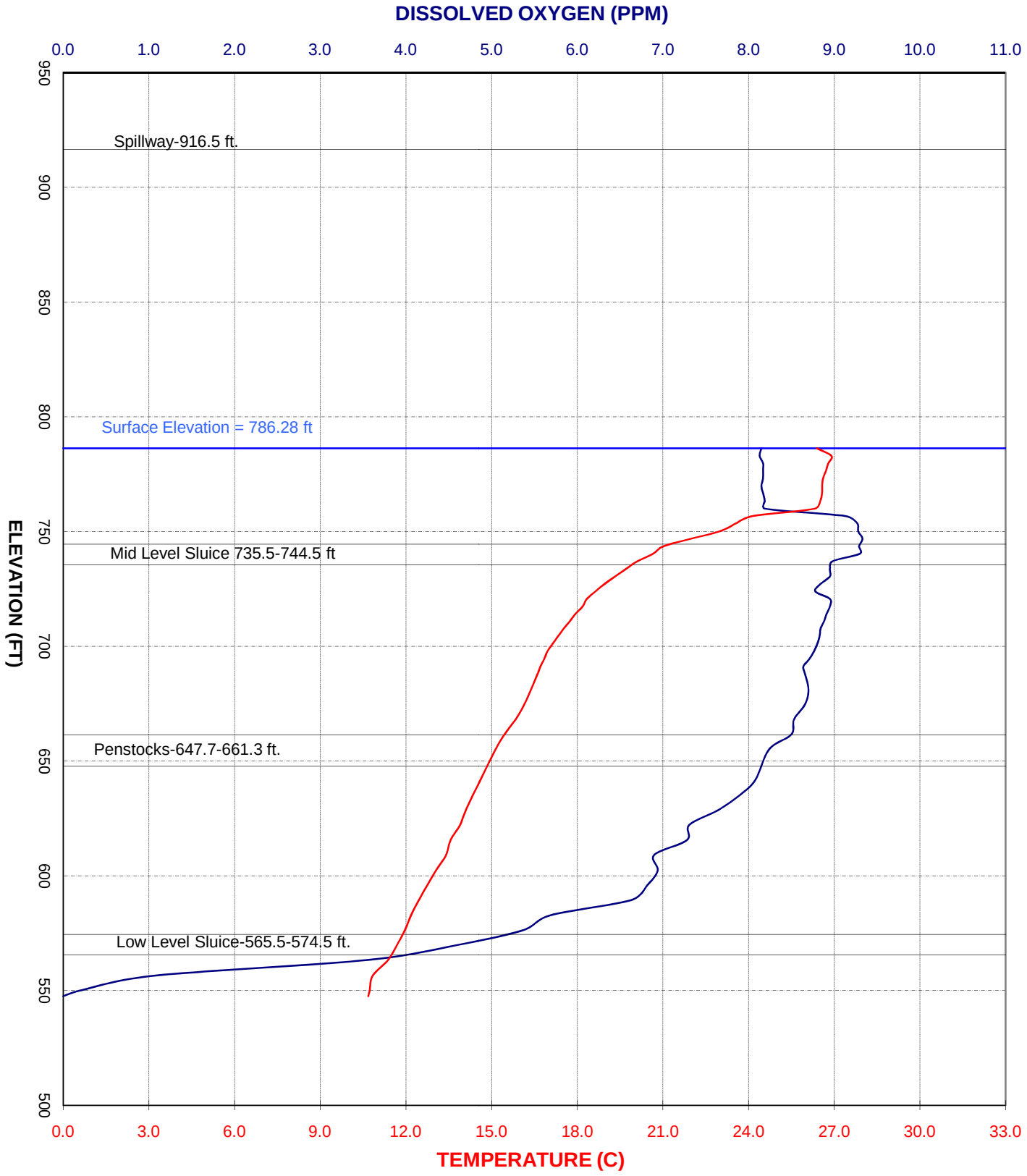
**PINE FLAT RESERVOIR 07/03/12 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 868.48**



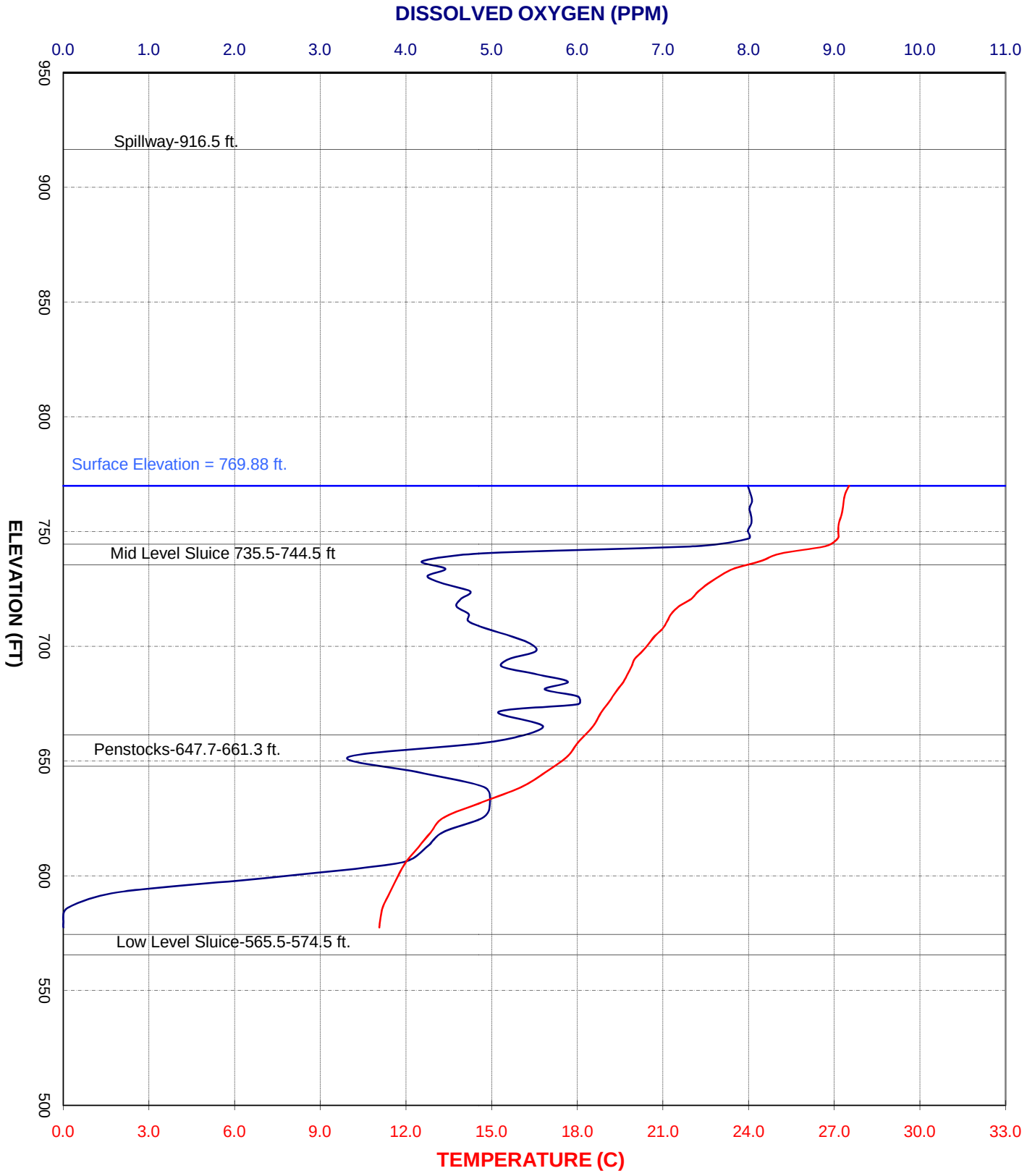
**PINE FLAT RESERVOIR 07/24/12 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 816.83**



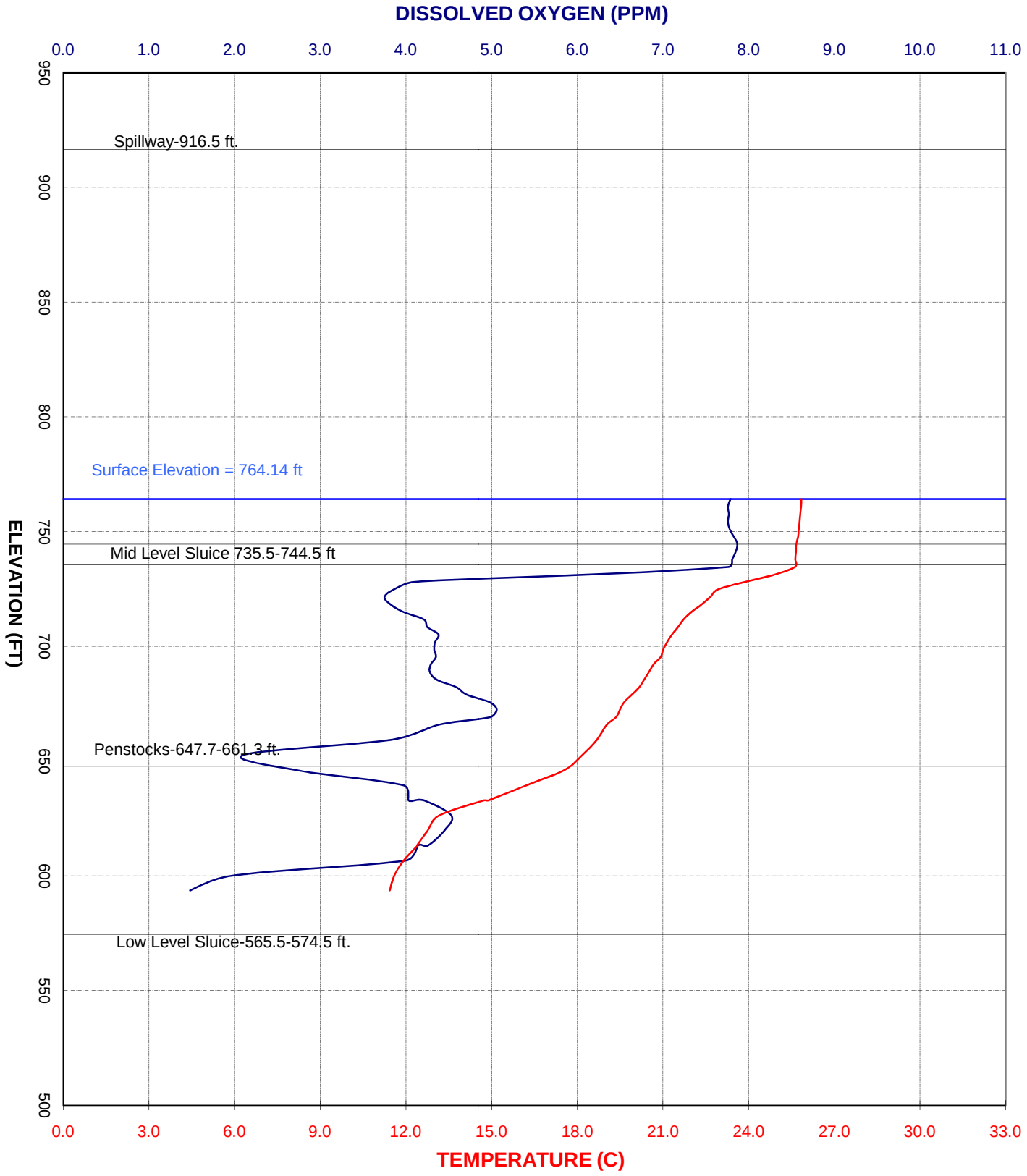
**PINE FLAT RESERVOIR 08/07/12 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 786.28**



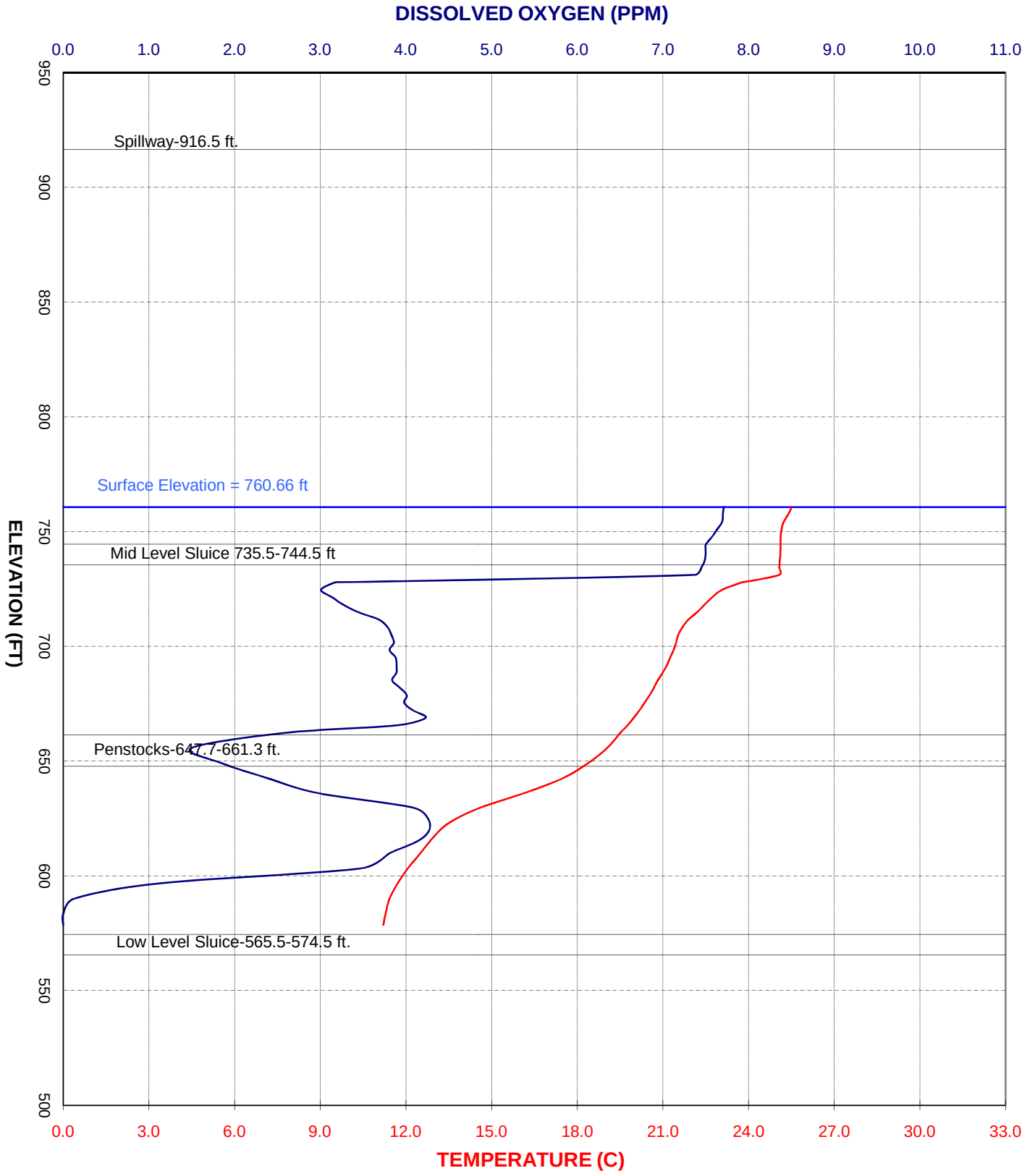
**PINE FLAT RESERVOIR 08/21/12 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 769.88**



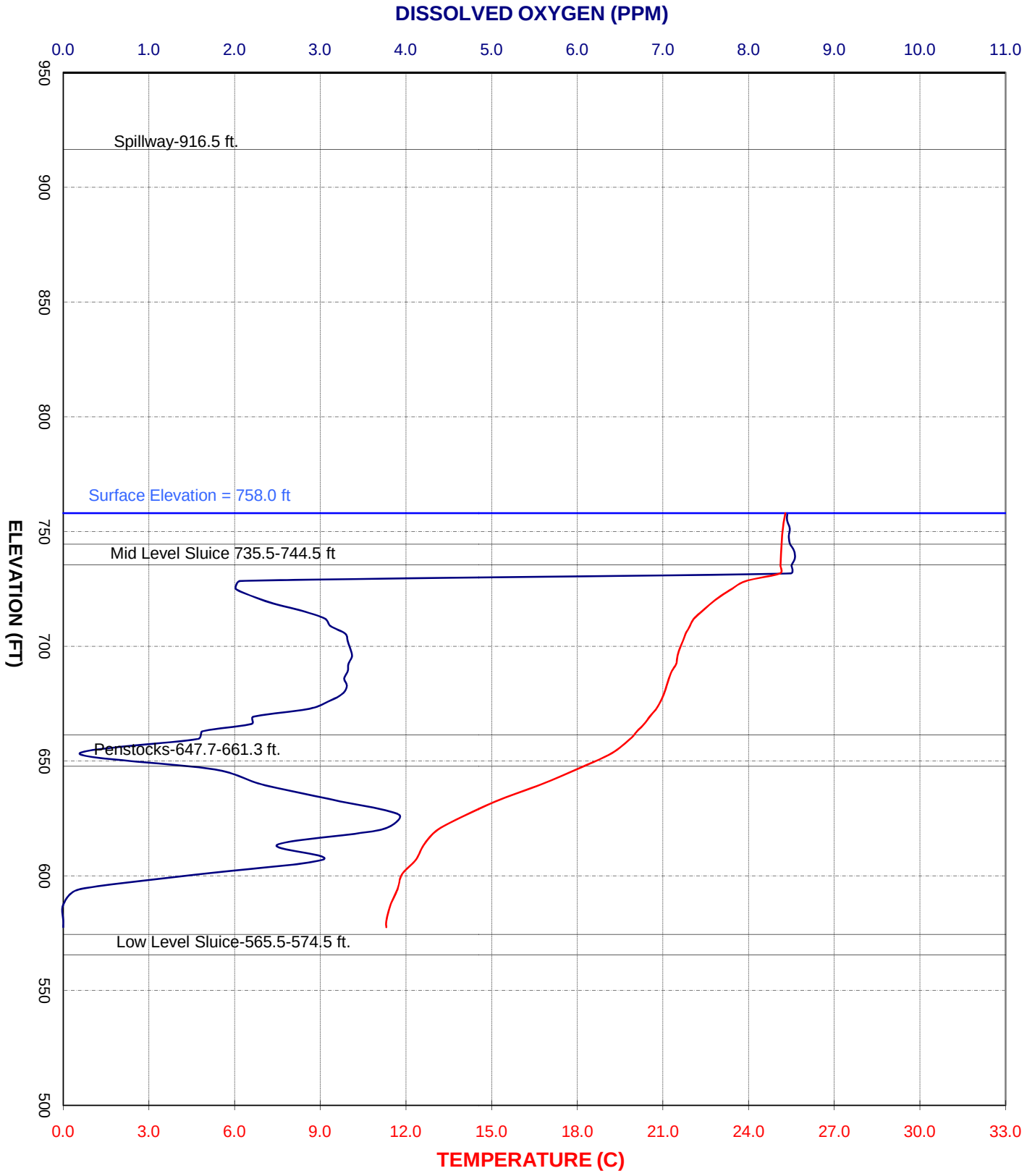
**PINE FLAT RESERVOIR 08/28/12 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 764.14**



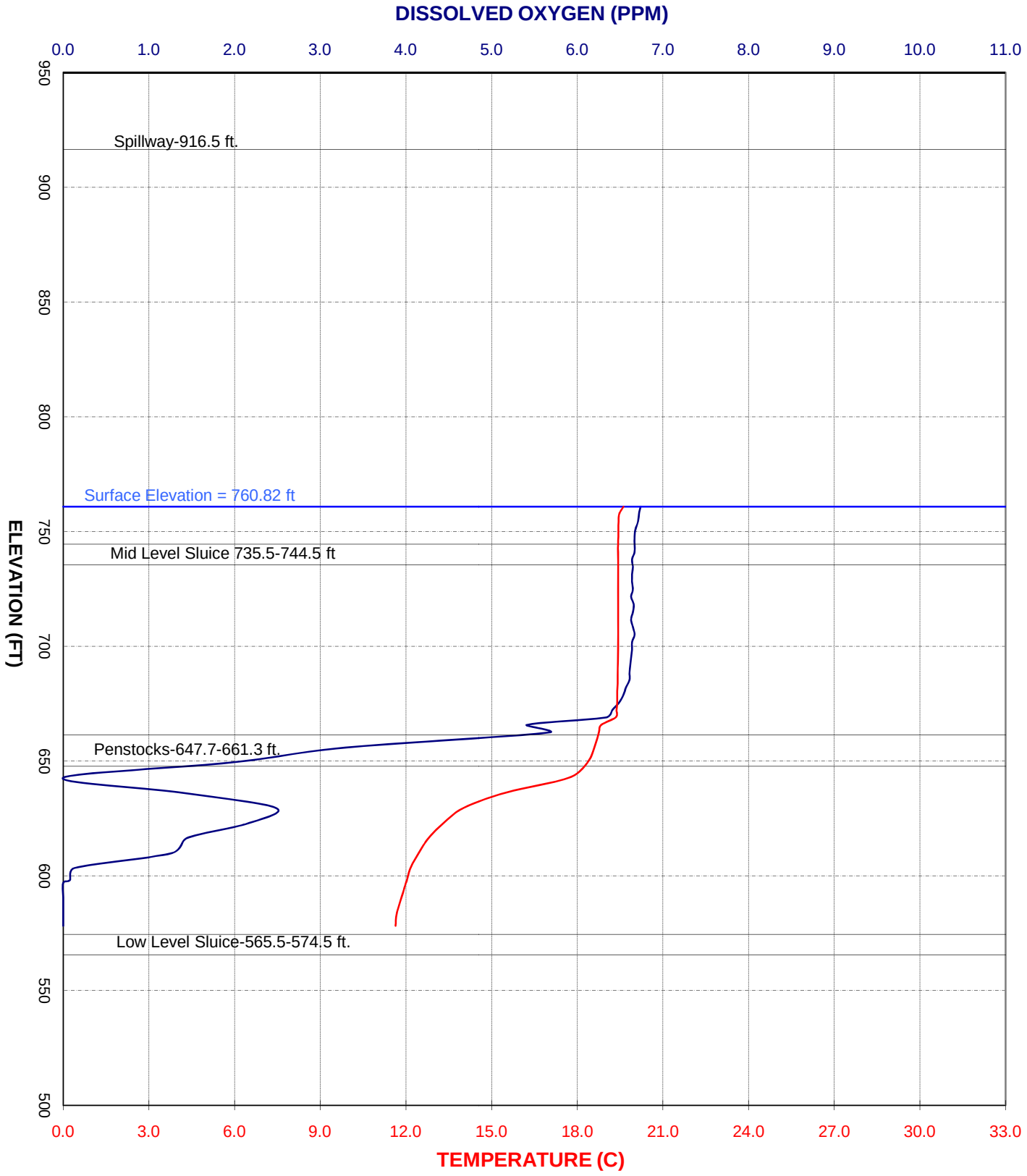
**PINE FLAT RESERVOIR 09/04/12 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 760.66**



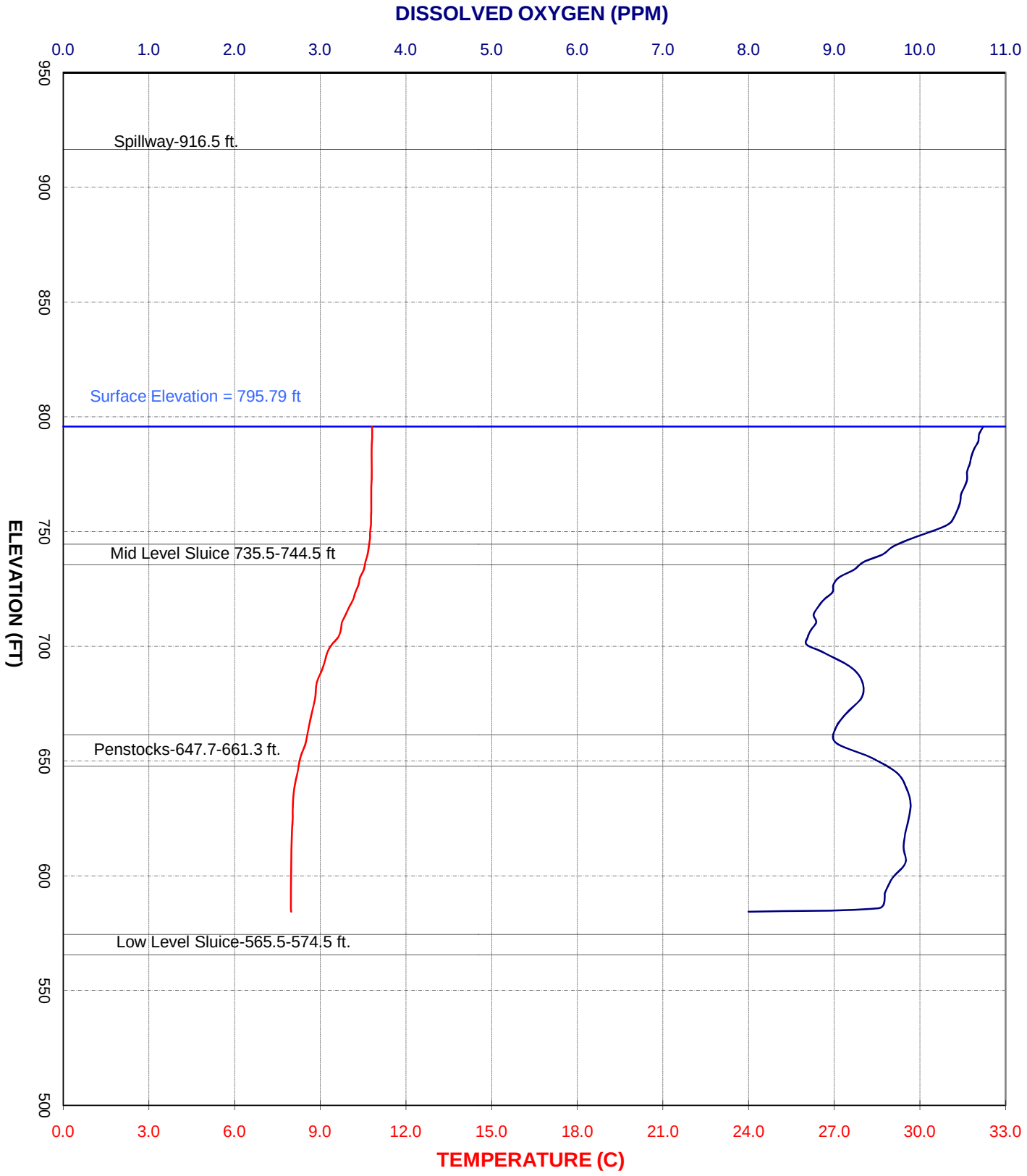
**PINE FLAT RESERVOIR 09/18/12 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 758.0**



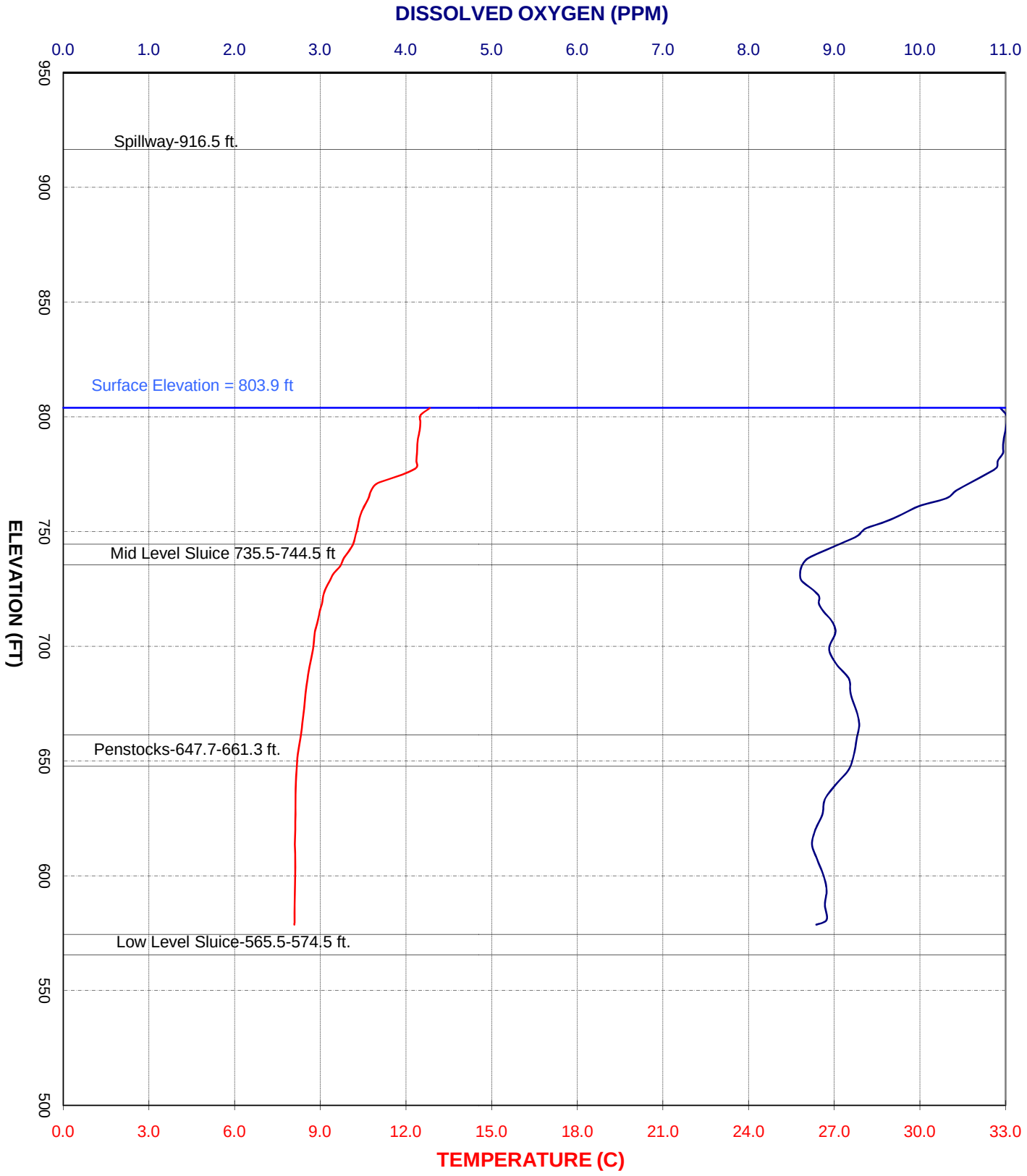
**PINE FLAT RESERVOIR 11/06/12 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 760.82**



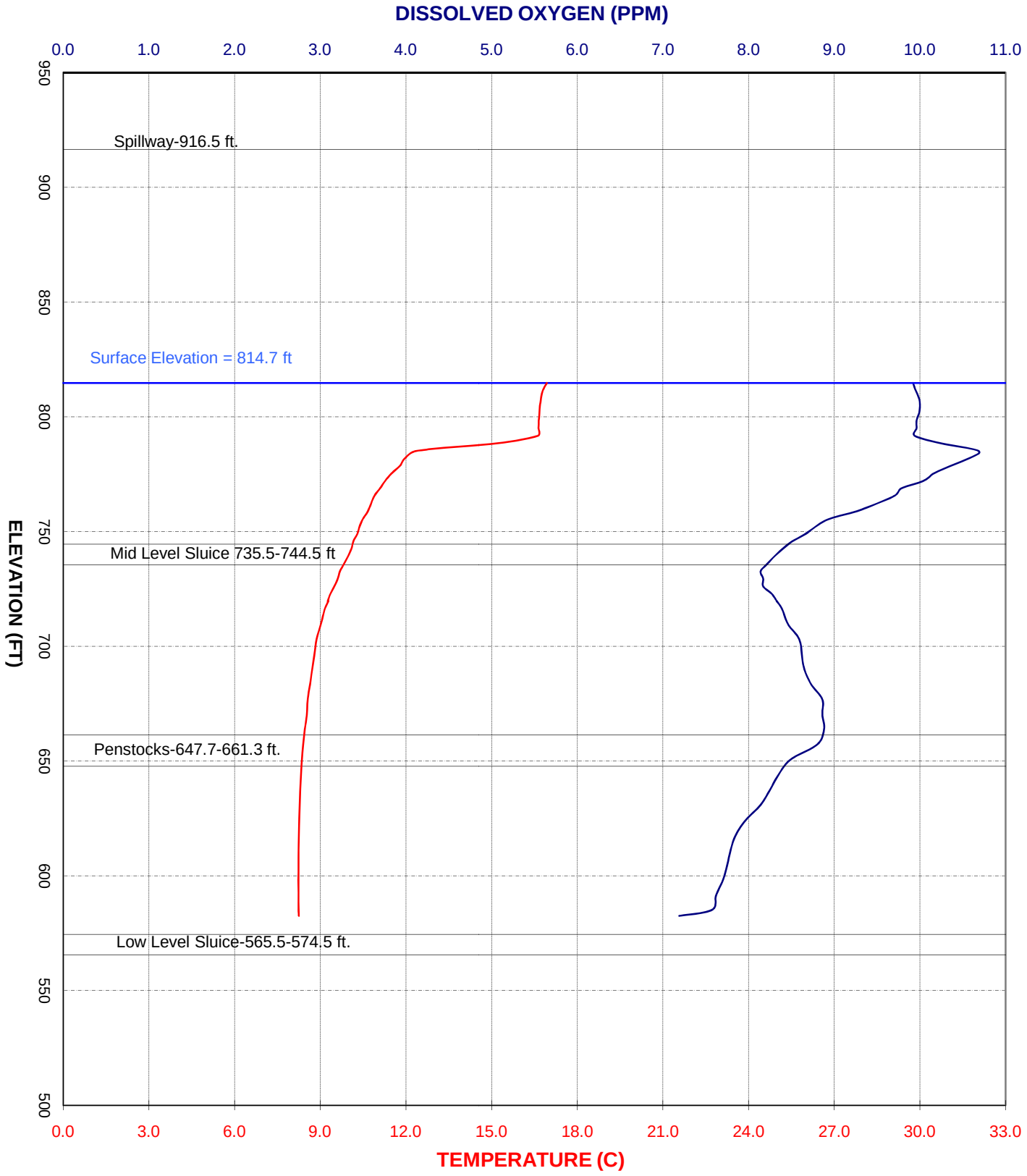
**PINE FLAT RESERVOIR 02/07/13 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 795.79**



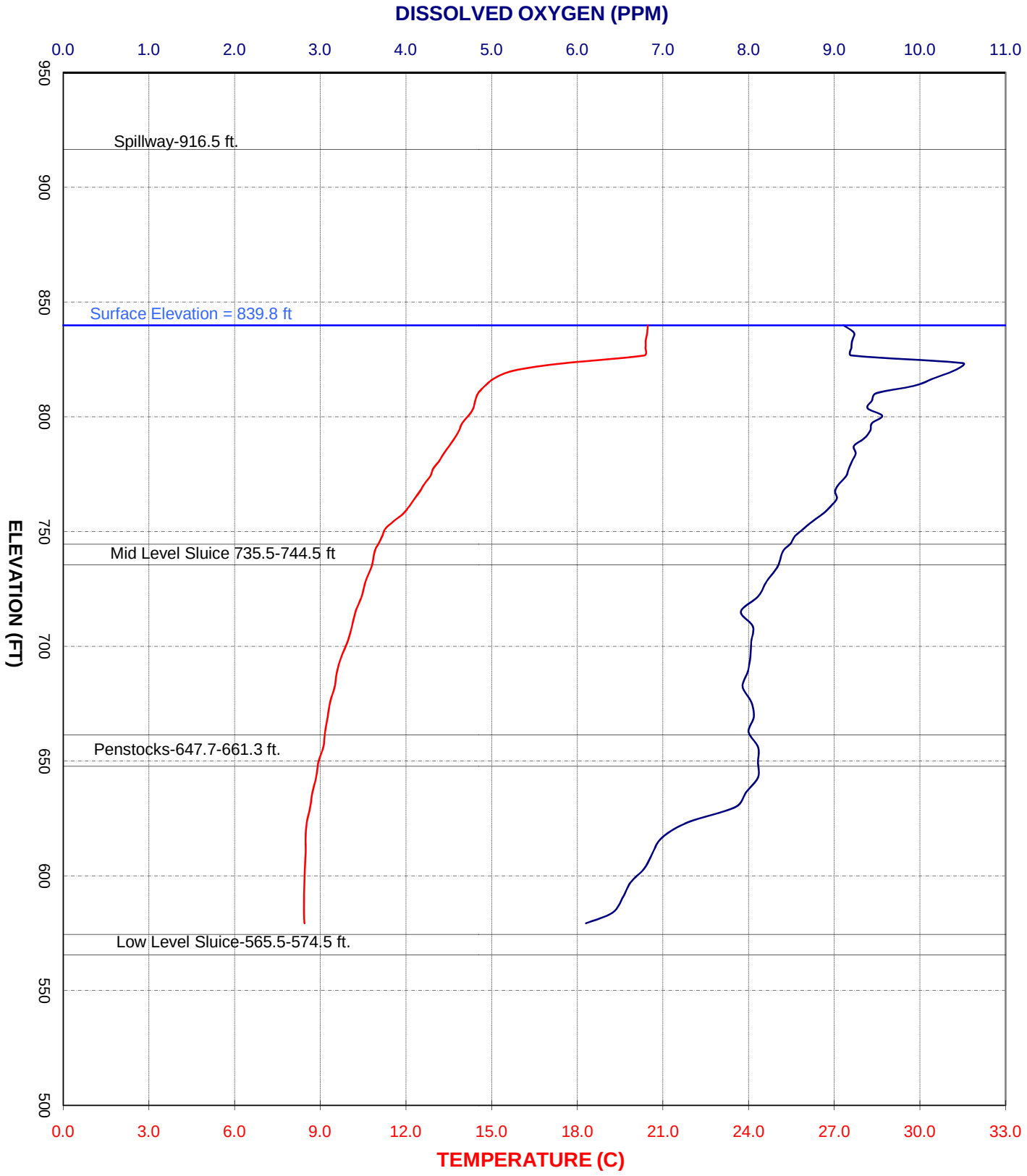
**PINE FLAT RESERVOIR 03/05/13 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 803.9**



**PINE FLAT RESERVOIR 04/02/13 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 814.7**



**PINE FLAT RESERVOIR 05/07/13 New Buoy Line Placement**
**(0.57 miles upstream of Dam) Reservoir Elevation in Feet = 839.8**



# APPENDIX D

Results of Water Temperature Monitoring at Gould Weir
(on following page)

**Kings River Water Temperature**
Gould Weir
June 2012 - May 2013