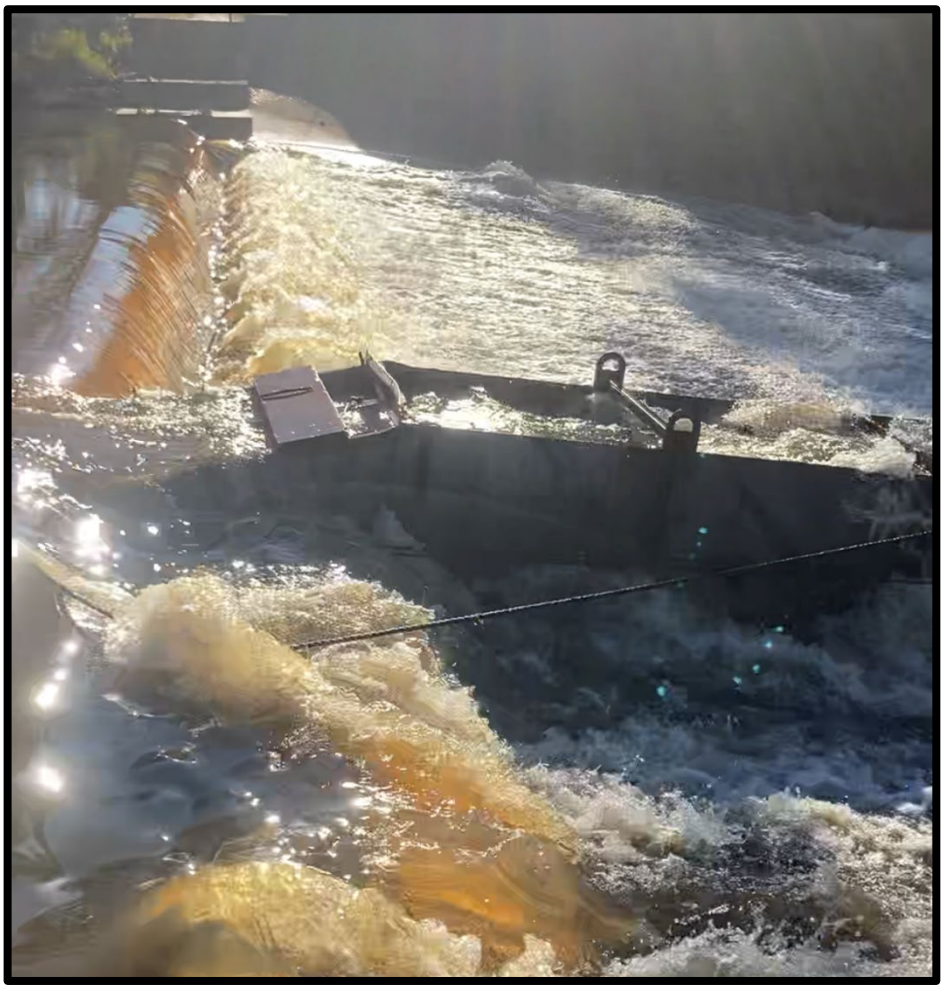
2021 Calaveras River Habitat Conservation Plan

Annual Report



Prepared by:

Stockton East Water District
6767 E. Main Street
Stockton, CA 95215

FISHBIO
1617 S. Yosemite Avenue
Oakdale, CA 953691

Table of Contents

Executive Summary

The Stockton East Water District (District) and FISHBIO have prepared the first annual report for the Calaveras River Habitat Conservation Plan (CHCP), approved by the National Marine Fisheries Service (NMFS) in August 2020. As required by the Compliance and Effectiveness Monitoring Plan for the Calaveras River Habitat Conservation Plan, the District has prepared and submitted this report to NMFS.

Over the past 16 months the District and FISHBIO have monitored the 11 compliance activities and 12 effectiveness activities outlined within the CHCP. Since approval of the CHCP, the District has commenced documenting the daily District operations to create a thorough database of flow and location information. In July 2020, the District worked with NMFS to modify seven of the flow monitoring locations to provide more useful data for the CHCP. The seven sites throughout Potter Creek, the Old Calaveras River, and Mosher Creek were replaced with seven additional sites along Mormon Slough, the primary waterway for fish passage.

Substantial progress was also made on the Bellota Fish Screen and Fish Passage Improvement Project, which includes design of fish passage improvements across the Bellota Weir, fish screen improvements for the Bellota Intake, and fish exclusion improvements for the Old Calaveras River Headworks. Additionally, design and permitting are nearly complete for the Hosie Low Water Crossing Fish Passage Improvement Project and the design and permitting has commenced for the George Watkins Low Water Crossing Fish Passage Improvement Project. The District also completed the installation of flow sensors to measure and record flow rates in the Calaveras River at the Shelton Road Bridge and diversions at the Old Calaveras River Headworks. Lastly, the District investigated the feasibility of installing a flow monitoring station at the confluence of the Old Calaveras River and the Stockton Diverting Canal in March of 2021.

Throughout 2021 FISHBIO continued performing fishery monitoring in the Calaveras River, as performed for over 20 years. The effectiveness monitoring performed by FISHBIO includes water quality, temperature, and various salmonid life history monitoring activities. During 2021 FISHBIO captured 1,982 individual Central Valley steelhead/rainbow trout (Oncorhynchus mykiss) in the Shelton Road Rotary Screw Trap. FISHBIO also participated in the District's dam removal activities to identify and relocate stranded fish. Through the dam removal monitoring efforts FISHBIO rescued and relocated 32 O. mykiss in the fall of 2021. Further, FISHBIO utilized a fish ladder and camera monitoring system at Bellota as a component of the adult salmonid monitoring program. Over 72 days of monitoring, three adult O. mykiss were observed ascending the ladder and no adult Chinook salmon. Additional summaries of FISHBIO's monitoring activities are included in their 2021 Calaveras River Fisheries Monitoring Report submitted with this report.

Introduction

The Calaveras River Habitat Conservation Plan (CHCP) describes operational criteria to support the biological goals of maintaining a viable population of rainbow trout and Central Valley steelhead (*Oncorhynchus mykiss*) within the CHCP boundaries, as well as maintaining adequate habitat condition upstream of Bellota for fall-, late fall-, spring- or winter-run Chinook salmon (*Oncorhynchus tshawytscha*) that may opportunistically migrate into the conservation area. This annual CHCP implementation report includes documentation of all Compliance Monitoring Activities (CM) and Effectiveness Monitoring Activities (EM) conducted between HCP adoption in August 2020 through the end of the 2021 calendar year. This report was prepared and submitted to the National Marine Fisheries Service (NMFS) within 120 days of December 31, 2021.

In general, CHCP monitoring programs must provide information to: "(1) evaluate compliance; (2) determine if biological goals and objectives are being met; and (3) provide feedback information for an adaptive management strategy" (65 FR 35242). Under the HCP, two categories of monitoring activities were undertaken to fulfill these requirements: Compliance Monitoring and Effectiveness Monitoring. CM will be conducted to verify that conservation strategies pursuant to the HCP are implemented according to the plan. EM will be implemented to evaluate whether the conservation strategies are achieving the HCP biological goals and objectives and provide information for the AMP process.

The overall goal of these studies has been to document baseline conditions and to collect information that will aid in the design and management of long-term conservation strategies and the Adaptive Management Plan's decision-making process (AMP process). Despite several years of monitoring, a few data gaps regarding salmonid populations within the Calaveras River still remain including:

(1) Steelhead/rainbow trout (*O. mykiss*) and Chinook salmon (*O. tshawytscha*) carrying capacity;

(2) Proportion of the *O. mykiss* population expressing different life-history patterns (i.e., resident, adfluvial, anadromous) and the factors influencing life-history expression (e.g., water temperature and migration delays);

(3) Susceptibility of individual salmonids to entrainment into individual private water diversions under varying conditions.

Compliance Monitoring Activities

Compliance Monitoring Activities (CM) will be conducted to verify that conservation strategies pursuant to the Calaveras River Habitat Conservation Plan (CHCP) are implemented according to the plan. A summary of CMs relative to biological objectives, targets, and conservation strategies are discussed below for the Stockton East Water District's (District) and FISHBIO's activities in 2021.

CM-1. Maintain Daily Flow and Operation Records in an Operations Database

Beginning in October 2020 the District began maintaining an operations database, which includes flow rate information at 17 locations, New Hogan Dam rainfall, Calaveras River flowrate at the Shelton Road Bridge, connectivity between the old Calaveras River and the Stockton Diverting Canal, and status of the Bellota fish ladder. The District's flow and operation records are included as Appendix A. The maximum release from New Hogan Dam was 253 cubic feet per second (CFS). The minimum release from New Hogan Dam was 15 CFS to ensure at least 10 CFS was available at the Shelton Road Bridge crossing. The 10 CFS instream flow requirement is permitted by CHCP Section 7.1 Conservation Strategies for New Hogan Reservoir Water Impoundment and Non-flood Control Operations. As outlined in the CHCP, the instream flow requirement may be reduced from 20 CFS to 10 CFS when the New Hogan Reservoir storage falls below the critical water storage volume of 99,100 acre-feet. The critical storage threshold was surpassed on September 1, 2021. District consultation with the National Marine Fisheries Service (NMFS) is included as Attachment 1.

The approved HCP identified 10 locations to be monitored and included within the operations database that were located in waterways other than the Mormon Slough. The 10 locations were monitored and recorded through June 30, 2021. The 10 locations not located within the Mormon Slough were replaced by 10 additional Mormon Slough locations, for a total of 12 Mormon Slough monitoring locations. The change was approved by NMFS on June 28, 2021, and operations database reporting of the 12 Mormon Slough locations began on July 1. Correspondence related to the minor modification of the HCP is included as Attachment 2.

CM-2. Document Implementation of Agriculture and Municipal Conservation Programs

The District's agricultural and municipal conservation programs are outlined within the District Agricultural and Urban Water Management Plans. The conservation programs, identified as best management practices (BMPs) in the plans, outline the District's efforts to improve water use efficiency. Copies of the District water management plans are available upon request.

BMP A-1. Water Measurement

The District has 170 active irrigation turnouts of the 224 total irrigation turnouts. All active irrigation turnouts are equipment with flow meters capable of volumetric totalizing and accurate within ±6%. Of the 170 active irrigation turnouts, 87 are integrated into the District's automated metering infrastructure (AMI) system. The 87 integrated meters are all electromagnetic style and provide a flow measurement accuracy ranging between ±0.5% and ±2%.

BMP A-2. Water Conservation Coordinator

The District created a position for a full time Water Conservation Coordinator in 2004 and continues to fund the position. The District's Water Conservation Coordinator develops and implements a comprehensive public outreach and water conservation education program. During the 2020-2021 school year, the Water Conservation Coordinator performed 195 presentations and connected with 10,756

school aged children. A full report for the 2020-2021 school year is available on the District's website at https://sewd.net/wp-content/uploads/2021/08/SAWS-Water-Education-Program-Report-2021-Final.pdf.

BMP A-3. Water Management Service

The District collaborates with other local agencies to provide technical assistance to growers with the goal of increasing on-farm water use efficiency throughout the Stockton area. Water management services offered by the District include (1) on-farm irrigation evaluations and water delivery information provided to water users, (2) real-time and normal irrigation scheduling and crop ET information via California Irrigation Management System (CIMIS) website, (3) surface, ground, and drainage water quality and quality data provided to water users, and (4) agricultural water management educational programs and materials provided to farmers, staff, and the public.

On-farm Evaluations and Water Delivery Information

Since 1999 the District has provided free on-farm irrigation evaluations to customers. The irrigation evaluations are voluntary and performed at the customers' request. In 2020 and 2021 the District completed three irrigation evaluations each year, for a total of six.

During 2019 the District began replacing irrigation turnout meters and integrating the new meters into a new AMI system. By the end of 2020, 64 meters were replaced and integrated. As of the end of 2021, the District has replaced and integrated an additional 23 meters, for a total of 87 new meters reporting to the AMI system. Although District customers do not currently have access to the AMI system, real-time flow rate and volumetric usage data is available to District customers upon request.

Real-time and Normal Irrigation Scheduling and Crop Evapotranspiration Information

In 2013 the District partnered with the Irrigation Training and Research Center (ITRC) at California Polytechnic State University, San Luis Obispo, to create an Irrigation Allowance Index. A list of crops and crop evapotranspiration values was compiled for the specific crops found within the District's service area. The index is still available upon request to District growers to assist with irrigation scheduling.

Surface, Ground, and Drainage Water Quantity and Quality Data

Annually the District tests multiple raw water quality parameters at eight sampling locations throughout the water supply system. The locations are strategically located to provide a fully encompassing snapshot, with samples being collected upstream of diversions and downstream of inflow locations. The water quality results for 2021 are included as Attachment 3.

Twice a year the District provides customers with a newsletter discussing District activities. The Spring-Summer newsletter includes new information like the flashboard dams installation schedule and the Fall-Winter newsletter includes information like the flashboard dams removal schedule. Also included in the Fall-Winter newsletter is the District's estimation of water availability for the next irrigation season. Both semi-annual newsletters include information about groundwater quantity and the Sustainable Groundwater Management Act (SGMA). A copy of the 2021-2022 Fall/Winter Newsletter is included as Attachment 4.

Agricultural Water Management Educational Programs

The District provides educational materials to approximately 6,500 customers via the semi-annual newsletter, included as Attachment 4. The District also published multiple updates annually to its website, including materials related to the HCP. The District's website can be accessed at www.sewd.net.

BMP A-4. Price Structure

The District has an established volumetric price structure for agricultural, municipal and industrial (M&I), and domestic water. In 2021, the adopted rates are:

- Agricultural surface water – $23.00 per acre-foot (AF)
- Agricultural groundwater – $5.53 per AF
- M&I groundwater – $344.95 per AF
- Domestic groundwater – $46.50 per dwelling unit

The 2021 volumetric rates were adopted on April 6, 2021, as Ordinance No. 47. A copy of the approved ordinance is included as Attachment 5.

BMP A-5. Policy Review

No progress was made to negotiate the District's three water contracts towards a standard contract year.

BMP A-6. Contractor Pump Efficiencies

The District maintains two agricultural pumps and 31 pumps at its water treatment facility. The District performed pump efficiency testing on both agricultural pumps in 2019 and the test results determined the pump efficiencies were acceptable. In April 2021, the District found one of the agricultural pumps had failed and the pump was subsequently rebuilt. After the pump rebuild, the pump efficiency was equivalent to new.

Of the 31 pumps at the District's water treatment facility, complete pump efficiency tests were performed on seven pumps and vibration analysis was performed on eight pumps. The testing only identified one pump out of specification and the pump was repaired. The District also rebuilt nine pumps and replaced two pumps, bringing 11 pumps to new pump efficiency.

BMP A-7. Facilitate/Promote On-Farm Irrigation System Capital Improvements

In 2021, the District received six applications for surface water and successfully enrolled one applicant into the Surface Water Incentive Program (SWIP); a program developed to increase the use of surface water instead of groundwater by offering a reduced surface water rate. In addition to continued advertisement of the District's SWIP, the District provided grant information during a HCP stakeholder workshop to fund irrigation turnout fish screens, posted information related to the California Department of Food and Agriculture's State Water Efficiency and Enhancement Program (SWEEP) to the District website, sent direct mailers with SWIP and SWEEP information to 58 relevant customers, and held a special workshop with three customers to discuss the conversion of 2,400 acres from groundwater to surface water.

BMP A-8. Line or Pipe Ditches and Canals/Regulating Reservoirs

Earthen ditches, canals, and regulating reservoirs positively contribute to groundwater recharge. Since the District is located within a critically overdrafted groundwater basin, the District has no plans to line facilities, thereby decreasing groundwater recharge. In 2021, the District performed maintenance on the

South Percolation Pond to remove vegetative growth and years of sediment buildup. The maintenance included deep ripping of the pond bottom, which restored the daily percolation rate to the new construction percolation rate.

BMP A-9. Flexible Water Ordering and Delivery

The District continues to require agricultural irrigation customers provide a 48 hour notice of planned irrigation activities.

BMP A-10. Construct and Operate Spill and Tail Water Recovery Systems

The amount of water historically estimated for end-of-system spill and the 20 miles of new facilities required for reuse of the recovered water make water recovery systems infeasible. The District did complete the design of five spill sites during 2021 and the spill sites are planned for construction and integration into the Supervisory Control and Data Acquisition System (SCADA) during the first quarter of 2022.

BMP A-11. Optimize Conjunctive Use

The District continues to implement programs and policies to optimize the conjunctive use of surface water and groundwater. The District optimizes conjunctive use through the water rates and through the SWIP. From 2020 to 2021, the agricultural groundwater rate increased by 1.3%, the maximum allowed by the District's founding legislation, whereas the surface water rate was not increased. Further, through the SWIP, the District offers customers to pay the current groundwater rate for surface water should the customers convert from groundwater to surface water use. The reduced surface water rate applies until the customer recovers the cost of investments in surface water or seven years, whichever occurs first.

BMP A-12. Automate Canal Structures

In 2020 and 2021, the District invested in several automation projects within the water supply system. The projects include two headworks automations, four diversion automations, and one flashboard dam automation. Locations of the automated facilities are identified in Figure 1.

BMP A-13. Facilitate/Promote Pump Testing Evaluation

The District does offer no-cost pump efficiency testing to its customers. The pump efficiency testing is included as part of the irrigation efficiency program discussed in subsection BMP A-3. Water Management Service.

Municipal Conservation

Since the District wholesales water for municipal uses, the District is unable to directly implement the BMPs within its Urban Water Management Plan. Instead, the District relies upon its three urban contractors, City of Stockton, California Water Service Company, and San Joaquin County, to implement the urban BMPs.

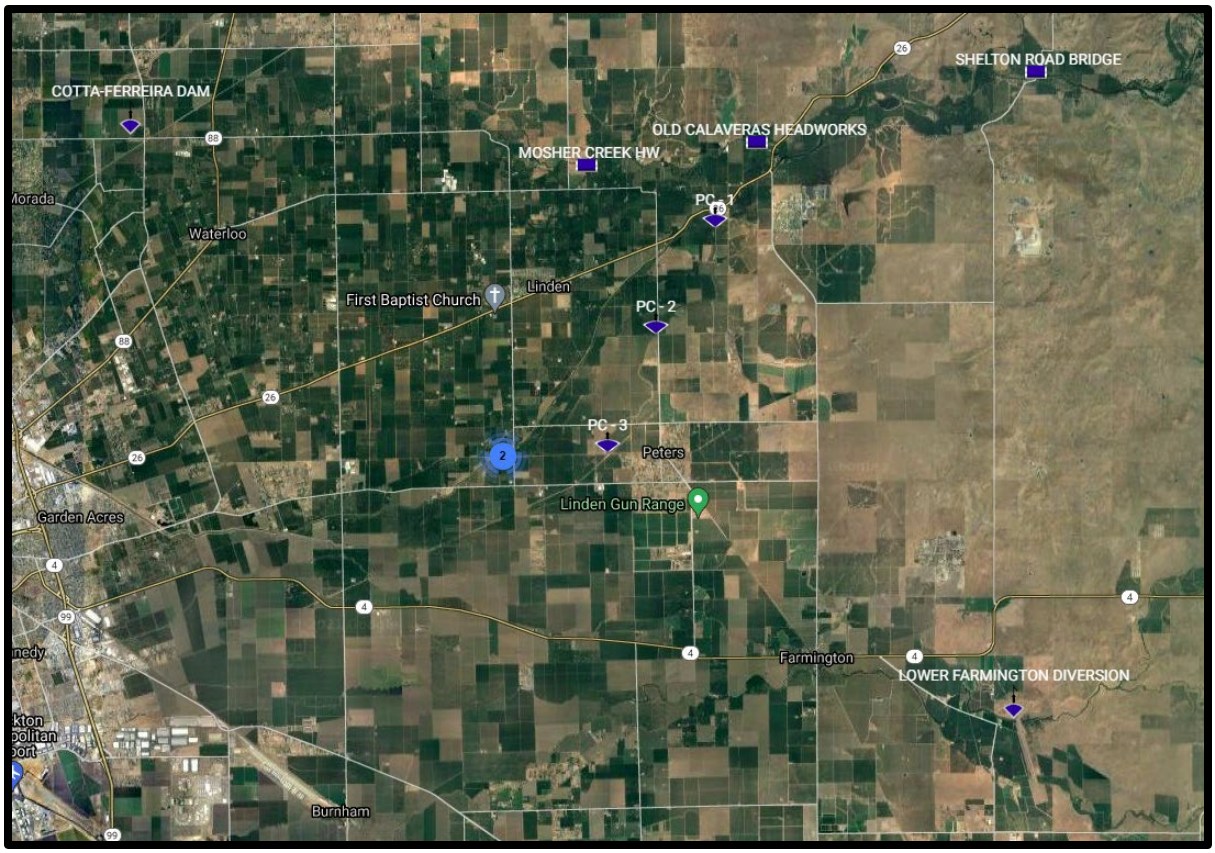


Figure 1. Automated Facilities Map

CM3. Document Completion of the Old Calaveras Headworks Facility Improvement Project

The Old Calaveras Headworks Facility Improvement Project was integrated into the overall Bellota Fish Screen and Passage Improvement Project (Project). As of November 2021, the District has received the 65% plans, specifications, and Engineering Design Report for the Project. The 65% design site plan is included as Attachment 6. In addition to the design progression, District staff and consultants have commenced archeological and biological site surveys, records searches, and draft environmental documents.

CM4. Document Completion of the Bellota Diversion Facility Improvement Project

The Bellota Diversion Facility Improvement Project was integrated into the overall Bellota Fish Screen and Passage Improvement Project (Project). As of November 2021, the District has received the 65% plans, specifications, and Engineering Design Report for the Project. The 65% design site plan is included as Attachment 6. In addition to the design progression, District staff and consultants have commenced archeological and biological site surveys, records searches, and draft environmental documents.

CM5. Document Schedules and Implementation Status for Artificial Instream Structure Improvement Projects and Flow Sensors

The Hosie Low Water Crossing Fish Passage Improvement Project (Hosie Project) was scheduled for construction during the summer of 2021. Due to permitting delays from the Central Valley Flood Protection Board and the U.S. Army Corps of Engineers, the Hosie Project was delayed until the summer

of 2022. The District is currently working with the California Department of Water Resources on the design of the next fish passage improvement project, the George Watkins Low Water Crossing Fish Passage Improvement Project (Watkins Project). The Watkins Project is tentatively scheduled for construction during the summer of 2023. A tentative schedule of fish passage improvement projects is shown in Table 1.

Line	Project Name	Construction Year
1	Hosie Low Water Crossing Fish Passage Improvement Project	2022
2	George Watkins Low Water Crossing Fish Passage Improvement Project	2023
3	Hogan Low Water Crossing Fish Passage Improvement Project	2024
4	Fujinaka Low Water Crossing Fish Passage Improvement Project	2024
5	Peters Pipeline Trestle Fish Passage Improvement Project	2025

Table 1. Fish Passage Improvement Projects Implementation Schedule

In November 2021 the District constructed the Shelton Road Bridge Meter Project. The new facility measures Calaveras River stage at the Shelton Road Bridge crossing. Through multiple flow rate measurements, the District developed a rating curve for determining flow rate based on water depth. The level measurement instrument and rating curve were both integrated into the District's SCADA system for real-time monitoring and data archiving. Shelton Road Bridge flows are included in Appendix A. The new site is still being commissioned and is expected to be fully functional by March 2022.

District's Engineering Department staff did investigate the feasibility of constructing a flow measurement structure in the Calaveras River downstream of the Stockton Diverting Canal confluence. Based on available information and flow measurement options identified during a site visit, District staff determined a new flow measure structure is not feasible. The District memo concluding the infeasibility is included as Appendix B. No other flow sensors were installed during 2021. The District is currently working on the design for the installation of flow sensors at three flashboard dam facilities in Mormon Slough. Installation of the three new flow sensors is tentatively planned for 2022.

CM6. Document Annual Fall Flashboard Dam Removal Operations and Any Associated Salmonid Relocation

For the 2020 irrigation season the District performed flashboard dam removals between October 8 and October 26. FISHBIO performed site surveys prior to the District beginning work in the waterways and performed spot checking for stranded fish. The 2020 flashboard dam removal schedule is included in Appendix C.

For the 2021 irrigation season the District performed flashboard dam removals between October 5 and October 26. FISHBIO performed site surveys prior to the District beginning work in the waterways and performed spot checking for stranded fish. A summary of FISHBIO's activities related to the stranding surveys are included in the 2021 Calaveras Fisheries Monitoring Report. The 2021 flashboard dam removal schedule is included in Appendix C. Notification to NMFS is included as Attachment 7.

CM7. Document Annual Installation of Flashboard Dam Notches

Fish notches are installed annually in the District's ten flashboard dams along Mormon Slough. A typical fish passage notch is shown in Figure 2. The flashboard dams were installed in downstream order, with entire reaches of the waterway being completed before installation proceeded to the next reach. Table 2 shows the 2021 flashboard dam installation schedule.

Figure 2. Fish Notch Installation

System	Installation Dates		
	Begin Dam Install	Complete Dam Install/ Begin Charging	Complete System Charging
Mormon Slough	4/6/21	4/15/21	4/19/21
Potter Creek	4/14/21	4/16/21	4/19/21
Old Calaveras	4/16/21	4/23/21	4/28/21
Mosher Creek	4/17/21	4/24/21	4/28/21

Table 2. 2021 Flashboard Dam Installation Schedule

The flashboard dam notches remained in service until May 14, 2021. Rotary screw trap measurements by FISHBIO at the Shelton Road Bridge indicated the last group of Age 1+ out-migrating salmonids most likely passed in April. The District and FISHBIO recommended and NMFS approved closure of the notches by May 14. Correspondence between the District and NMFS approving dam installations and the fish notch closures is included as Attachment 8.

CM8. Document Prioritization of Fish Screens for Privately Owned Diversions

To date the District has developed an inclusive list of all diversions along the Calaveras River to Bellota and continuing down Mormon Slough. The District lacks jurisdiction over many of the diversions, but has performed some customer outreach for fish screen installations. Over the next year the District will work towards prioritizing the screening of the diversions.

CM9. Document Stakeholder Education Program Activities

Beginning in 2020, the District has collaborated with the California Department of Water Resources – Riverine Stewardship Program to hold a quarterly Calaveras Fish Group meeting. The Calaveras Fish Group meetings engage various Calaveras River stakeholders, such as NMFS, the California Department of Fish and Wildlife, the U.S. Fish and Wildlife Service, San Joaquin County, U.S. Army Corps of Engineers, the Central Valley Flood Protection Board, California Department of Transportation, non-government organizations, and District customers. Calaveras Fish Group meetings were held in Q4 of 2020 and, Q1 and Q2 of 2021. Copies of the Calaveras Fish Group meeting agendas are included as Attachment 9.

The District was required to hold a stakeholder engagement workshop within the first six months of CHCP approval to discuss the need and availability of funding for fish screens on private diversions. The District hosted a stakeholder engagement workshop on February 10, 2021, to discuss the HCP and fish screen grant opportunities with customers along the Calaveras River and Mormon Slough. The workshop was advertised on the District's website, publicly announced at two Board of Directors meetings, and 44 mailers were sent directly to existing customers. Despite the outreach, only five surface water diverters attended the workshop. The direct mailer and website posting are included as Appendix D.

Lastly, the District has added a CHCP update notification feature to the District website. Parties interested in receiving HCP updates are able to submit their information to be provided stakeholder updates, as updates become available. To date, the District has registered five stakeholders and the stakeholders receive HCP related updates such as monthly reports and workshop notifications. A link to register for HCP updates is available here: https://sewd.net/habitat-conservation-plan/.

CM10. Document SEWD Instream Structures Maintenance

During 2021 the District did not perform any instream maintenance of structures.

CM11. Document Take Associated with Fisheries Monitoring

The District has no known take associated with the District operations and maintenance activities, other than the 32 individual O. mykiss rescued and relocated by FISHBIO during stranding surveys required by the seasonal removal of the flashboard dams. A summary of FISHBIO's activities conducted as part of the Calaveras River Fisheries Monitoring Program is included in their 2021 Calaveras River Fisheries Monitoring Report. Further, a detailed breakdown of take of ESA-listed species covered by Section 10(a)1(B) permit #23264 will be submitted directly to NMFS electronically as an Excel file (*.xlsx format).

Effectiveness Monitoring Activities

Effectiveness Monitoring Activities (EM) will be implemented to evaluate whether the conservation strategies are achieving the CHCP biological goals and objectives and provide information for the Adaptive Management Plan process. In water year 2021, FISHBIO collected data to inform the following EM activities, which include EM activities: 1 (Environmental Conditions), 2 (Adult Salmonid Monitoring), 3 (Juvenile Salmonid Monitoring), 4 (Stranding and Salmonid Rescue), 11 (Fisheries Take Reporting), and 12 (Alternative Fisheries Monitoring). Summaries of these activities are provided in the FISHBIO's 2021 Calaveras River Fish Monitoring Report, included as Appendix E. Therein, FISHBIO summarized EM activities conducted in water year (WY) 2021, encompassing a variety of fisheries and environmental monitoring activities. The water year is defined from October 1 to September 30 of the subsequent year. In this case, WY 2021 runs from October 1, 2020 to September 30, 2021. The report is meant to summarize and highlight EM activities on a water year basis which better matches the biology of O. mykiss, and in turn, the monitoring schedules of each EM activity.

Effectiveness monitoring activities 5 (Downstream Bellota Pool Monitoring), 7 (Structural Improvement Monitoring), and 8 (Stakeholder Education Efforts) are those most likely to occur during the District's maintenance operations or as a component of an associated Compliance Monitoring (CM) activity and are detailed herein.

EM1. Environmental Conditions

Results of EM 1 activities are accounted for as part of the environmental data collected during Juvenile Salmonid Monitoring at the Shelton Rd. Rotary Screw Trap (RST) and Water Temperature and Discharge Monitoring summaries in FISHBIO's 2021 Calaveras River Fish Monitoring Report. Further, while no BMI sampling was conducted during the 2020/2021 monitoring period, new procedures and rationale are detailed in Benthic Macroinvertebrate (BMI) Monitoring and Habitat Assessment summary.

EM2. Adult Salmonid Monitoring

Results of EM 2 activities are accounted for in the Fish Ladder Monitoring, Calaveras River Redds Survey, and Calaveras River O. mykiss Over-summer Abundance Surveys summaries in FISHBIO's 2021 Calaveras River Fish Monitoring Report.

EM3. Juvenile Salmonid Monitoring

Results of EM 3 activities are accounted for as part of the environmental data collected during Juvenile Salmonid Monitoring at the Shelton Rd. Rotary Screw Trap (RST) and Calaveras River O. mykiss Over-summer Abundance Surveys summaries in FISHBIO's 2021 Calaveras River Fish Monitoring Report.

EM4. Fish Evaluation and Salmonid Relocation during Fall Flashboard Dam Removal Operations

Results of EM 4 activities are presented in the Calaveras River O. mykiss Stranding Survey and Rescue summary in FISHBIO's 2021 Calaveras River Fish Monitoring Report.

EM5. Monitor Pool Downstream of Bellota for Salmonids during Interim Fish Ladder Operations

Results of EM 5 activities are logged after maintenance activities are conducted at Bellota. District staff monitored and visually checked for Salmonids before closing the ladder on October 30, 2020 and Jan 6, 2021. The District will be creating an observation log to better document our activities.

EM6. Fish Screen Effectiveness Monitoring

As there have been no improvements yet made to fish screening at District facilities during 2021, there are no activities to report related to effectiveness monitoring.

EM7. Structural Improvement Monitoring

No fish passage improvement structures have been constructed since approval of the CHCP. The District previously performed fish passage modifications to three structures in Mormon Slough and the Stockton Diverting Canal, but flow and level information is not available for those facilities.

EM8. Stakeholder Education Efforts

The District coordinated several stakeholder education and outreach events during 2020. Additional details about the events is discussed in Section CM9.

EM9. Fyke Net Evaluation of Flashboard Dam Notches

Prior to the implementation of the CHCP, a limited fyke trapping effort occurred at one of the flashboard dams in 2010. A more formalized study is currently being developed for a future monitoring season. However, the fact that fish were recovered during the 2020/2021 Flashboard Dam Removal Stranding Surveys implies that fish were able to utilize the notches.

EM10. SEWD Instream Structure Maintenance Operations Water Quality Monitoring and/or Visual Assessment

No such instream work, other than the removal/installation of the flashboard dams, occurred during the 2020/2021 monitoring period and therefore no summary relating to EM 10 is provided herein. As previously mentioned, results of stranding survey activities are presented in the Calaveras River O. mykiss Stranding Survey and Rescue summary in FISHBIO's 2021 Calaveras River Fish Monitoring Report.

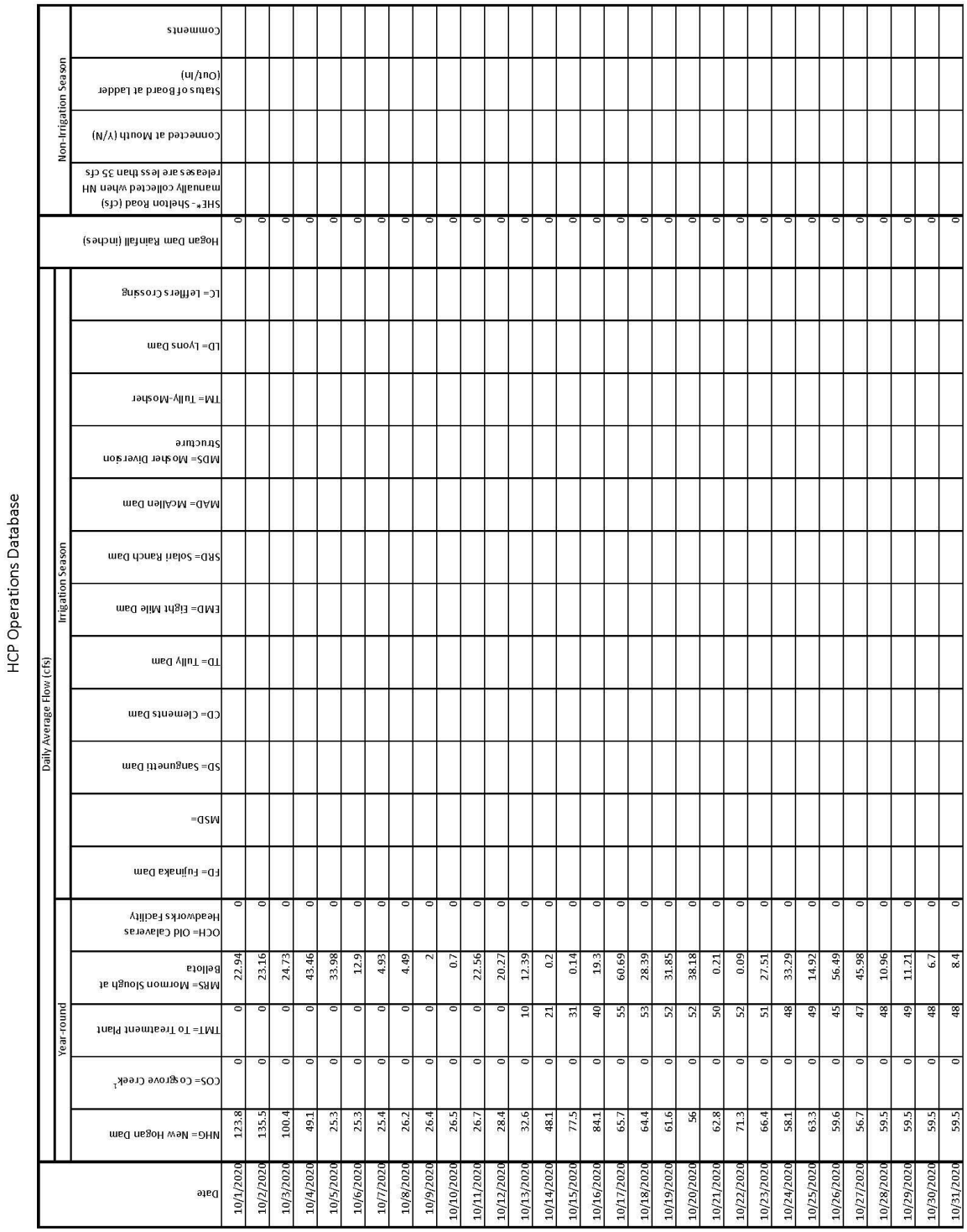
EM11. Fisheries Monitoring Take Assessment

There are many facets of FISHBIO's monitoring program covered by Section 10(a)1(B) #23264, however, several are required by the CHCP as annual monitoring activities and are detailed in Appendix D of the CHCP. Summaries for said activities can be found in FISHBIO's *2021 Calaveras River Fish Monitoring Report*. Components of the report pertinent to EM11 include: *Calaveras River Bellota Fish Ladder Camera Monitoring, Calaveras River O. mykiss Stranding Survey and Rescue, Calaveras River Benthic Macroinvertebrate Monitoring, Calaveras River Temperature and Flow, Calaveras River Juvenile O. mykiss Outmigration Monitoring, and the Calaveras River Redd and Carcass Monitoring* summaries. Further, an Excel spreadsheet detailing the take of salmonids across all activities will be provided to the National Marine Fisheries Service representative(s) identified for the coordination of the CHCP (currently Meiling Colombano and Monica Gutierrez).

EM12. Alternative Fisheries Monitoring

Some methods described in FISHBIO's monitoring program covered by Section 10(a)1(B) #23264 are not required annually, but may be performed to provide additional information to either inform the AMP or help to alleviate gaps in knowledge that may not be fully informed by routine monitoring. During 2021, the District funded several activities that help to inform summertime O. mykiss population abundance and expand our potential understanding of the life history strategies of Calaveras River *O. mykiss*. Summaries for said activities can be found in FISHBIO's *2021 Calaveras River Fish Monitoring Report*. Components of the report pertinent to EM12 include: *Calaveras River Oncorhynchus mykiss Life-History Study* and the *Calaveras River Oncorhynchus mykiss Over Summer Abundance Surveys* summaries. Further, an Excel spreadsheet detailing the take of salmonids across all activities will be provided to the National Marine Fisheries Service representative(s) identified for the coordination of the CHCP (currently Meiling Colombano and Monica Gutierrez).

Appendix A – Daily Flow and Operation Records Reports



Date	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	FD= Fujinaka Dam	MSD=	SD= Sanguinetti Dam	CD= Clements Dam	TD= Tully Dam	EMD= Eight Mile Dam	SRD= Solari Ranch Dam	MAD= McAllen Dam	MDS= Mosher Diversion Structure	TM= Tully-Mosher	LD= Lyons Dam	LC= Jeffers Crossing	Hogan Dam Rainfall (inches)	SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
10/1/2020	123.8	0	0	22.94	0													0				
10/2/2020	135.5	0	0	23.16	0													0				
10/3/2020	100.4	0	0	24.73	0													0				
10/4/2020	49.1	0	0	43.46	0													0				
10/5/2020	25.3	0	0	33.98	0													0				
10/6/2020	25.3	0	0	12.9	0													0				
10/7/2020	25.4	0	0	4.93	0													0				
10/8/2020	26.2	0	0	4.49	0													0				
10/9/2020	26.4	0	0	2	0													0				
10/10/2020	26.5	0	0	0.7	0													0				
10/11/2020	26.7	0	0	22.56	0													0				
10/12/2020	28.4	0	0	20.27	0													0				
10/13/2020	32.6	0	10	12.39	0													0				
10/14/2020	48.1	0	21	0.2	0													0				
10/15/2020	77.5	0	31	0.14	0													0				
10/16/2020	84.1	0	40	19.3	0													0				
10/17/2020	65.7	0	55	60.69	0													0				
10/18/2020	64.4	0	53	28.39	0													0				
10/19/2020	61.6	0	52	31.85	0													0				
10/20/2020	56	0	52	38.18	0													0				
10/21/2020	62.8	0	50	0.21	0													0				
10/22/2020	71.3	0	52	0.09	0													0				
10/23/2020	66.4	0	51	27.51	0													0				
10/24/2020	58.1	0	48	33.29	0													0				
10/25/2020	63.3	0	49	14.92	0													0				
10/26/2020	59.6	0	45	56.49	0													0				
10/27/2020	56.7	0	47	45.98	0													0				
10/28/2020	59.5	0	48	10.96	0													0				
10/29/2020	59.5	0	49	11.21	0													0				
10/30/2020	59.5	0	48	6.7	0													0				
10/31/2020	59.5	0	48	8.4	0													0				

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	FD= Fujinaka Dam	MSD=	SD= Sanguinetti Dam	CD= Clements Dam	TD= Tully Dam	EMD= Eight Mile Dam	SRD= Solari Ranch Dam	MAD= McAllen Dam	MDS= Mosher Diversion Structure	TM= Tully-Mosher	LD= Lyons Dam	LC= Lefflers Crossing		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
11/1/2020	59.7	0	70	8.62	0													0				
11/2/2020	56.9	0	67	48.61	0													0				
11/3/2020	54.3	0	67	19.43	0													0				
11/4/2020	59.8	0	63	2.37	0													0				
11/5/2020	59.8	0	56	23.82	0													0				
11/6/2020	60	0	54	23.12	0													0				
11/7/2020	58.8	0	56	32.6	0													0				
11/8/2020	55.2	0	59	31.35	0													0				
11/9/2020	55.5	0	60	2.43	0													0				
11/10/2020	56.8	0	61	3.96	0													0				
11/11/2020	63.8	0	60	11.68	0													0				
11/12/2020	60.3	0	60	38.08	0													0				
11/13/2020	55.2	0	58	40.5	0													0				
11/14/2020	57.3	0	56	0	0													0				
11/15/2020	61.9	0	54	0	0													0				
11/16/2020	60.3	0	52	18.38	0													0				
11/17/2020	56.7	0	52	31.5	0													0.34				
11/18/2020	59.6	0	50	3.23	0													0.69				
11/19/2020	59.5	0	50	2.47	0													0.03				
11/20/2020	59.5	0	52	0.41	0													0.01				
11/21/2020	59.5	0	52	0.53	0													0				
11/22/2020	59.5	0	52	4.62	0													0				
11/23/2020	57	0	53	5.16	0													0.01				
11/24/2020	53.4	0	51	2.04	0													0				
11/25/2020	50.9	0	53	0.01	0													0				
11/26/2020	39.3	0	55	16.98	0													0				
11/27/2020	26.1	0	43	40.67	0													0				
11/28/2020	26.5	0	34	46.97	0													0				
11/29/2020	26.5	0	19	99.13	0													0				
11/30/2020	26.5	0	9	93.25	0													0				

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	FD= Fujinaka Dam	MSD=	SD= Sanguinetti Dam	CD= Clements Dam	TD= Tully Dam	EMD= Eight Mile Dam	SRD= Solari Ranch Dam	MAD= McAllen Dam	MDS= Mosher Diversion Structure	TM= Tully-Mosher	LD= Lyons Dam	LC= Lefflers Crossing		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
12/1/2020	26.5	1	19	90.55	0													0				
12/2/2020	26.5	18	21	45.01	15													0				
12/3/2020	27.1	4	22	10.76	5													0.01				
12/4/2020	26.5	7	16	45.37	5													0				
12/5/2020	26.7	6	16	86.15	5													0				
12/6/2020	26.5	2	9	90.12	5													0				
12/7/2020	26.5	24	9	93.03	15													0				
12/8/2020	25.4	137	5	85.63	15													0.01				
12/9/2020	22.8	17	5	65.6	15													0				
12/10/2020	22.1	7	0	72.7	10													0.01				
12/11/2020	22.7	4	0	78.97	5													0.52				
12/12/2020	22.8	2	0	96.8	0													0.34				
12/13/2020	22.2	2	0	99.46	0													0.6				
12/14/2020	21.9	5	0	90.95	0													0.01				
12/15/2020	23.7	4	0	79.99	0													0.01				
12/16/2020	24.4	2	0	76.99	0													0.02				
12/17/2020	24.9	2	0	83.42	0													0.34				
12/18/2020	24.8	1	0	83.73	0													0.01				
12/19/2020	24.4	1	0	83.88	0													0.01				
12/20/2020	24.4	1	0	85.64	0													0.02				
12/21/2020	24.4	1	0	85.95	0													0				
12/22/2020	25.3	2	0	84	0													0.01				
12/23/2020	23	4	0	84.85	0													0				
12/24/2020	23	3	0	84.75	0													0.01				
12/25/2020	28.2	2	0	83.19	0													0.03				
12/26/2020	31.6	2	0	89.43	0													0.3				
12/27/2020	29.5	1	0	103.62	0													0				
12/28/2020	27.7	1	0	93.69	0													0.01				
12/29/2020	27.6	2	0	75.22	0													0.02				
12/30/2020	27.7	1	0	83.69	0													0.01				
12/31/2020	27.7	1	0	91.52	0													0.15				

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	FD= Fujinaka Dam	MSD=	SD= Sanguinetti Dam	CD= Clements Dam	TD= Tully Dam	EMD= Eight Mile Dam	SRD= Solari Ranch Dam	MAD= McAllen Dam	MDS= Mosher Diversion Structure	TM= Tully-Mosher	LD= Lyons Dam	LC= Lefflers Crossing		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
1/1/2021	27.7	1	25	91.65	0													0				
1/2/2021	27.83	1	21	92	0													0				
1/3/2021	27.33	1	22	91.52	0													0				
1/4/2021	26.69	1	25	91.53	0													0.17				
1/5/2021	26.91	1	27	91.08	0													0.01				
1/6/2021	26.5	1	29	84.81	0													0.01				
1/7/2021	27.32	1	29	81.01	0													0				
1/8/2021	27.5	1	28	92.53	0													0				
1/9/2021	27.64	3	25	96.19	0													0.01				
1/10/2021	27.68	3	24	95.91	0													0.01				
1/11/2021	27.63	2	27	55.44	0													0.01				
1/12/2021	26.69	1	26	40.93	0													0				
1/13/2021	26.63	2	20	23.4	0													0.01				
1/14/2021	26.51	2	24	23.44	0													0.01				
1/15/2021	26.8	1	25	22.2	0													0.02				
1/16/2021	26.84	4	27	21.91	0													0				
1/17/2021	27.39	10	27	22.32	0													0.01				
1/18/2021	27.55	5	28	21.82	0													0				
1/19/2021	27.48	4	29	21.48	0													0				
1/20/2021	27.36	3	28	21.24	0													0				
1/21/2021	27.55	3	28	23.82	0													0				
1/22/2021	27.41	2	27	25.59	0													0.5				
1/23/2021	27.46	2	25	26.64	0													0.01				
1/24/2021	27.7	2	24	26.04	0													0.39				
1/25/2021	28.63	2	24	28.97	0													0.41				
1/26/2021	26.69	6	22	36.34	0													0.23				
1/27/2021	29.09	7	22	37.91	0													2.23				
1/28/2021	35.22	4	24	151.23	0													2.09				
1/29/2021	35.39	3	29	446.86	0													0.51				
1/30/2021	29.71	2	21	127.87	0													0.01				
1/31/2021	29.37	2	20	16.3	0													0				

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	FD= Fujinaka Dam	MSD=	SD= Sanguinetti Dam	CD= Clements Dam	TD= Tully Dam	EMD= Eight Mile Dam	SRD= Solari Ranch Dam	MAD= McAllen Dam	MDS= Mosher Diversion Structure	TM= Tully-Mosher	LD= Lyons Dam	LC= Lefflers Crossing		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
2/1/2021	30.08	2	15	9.05	0													0.01				
2/2/2021	28.96	2	15	70.04	0													0.83				
2/3/2021	27.48	2	15	28.96	0													0.01				
2/4/2021	27.48	1	15	12.47	0													0				
2/5/2021	26.5	1	15	5.13	0													0				
2/6/2021	26.5	1	16	14.58	0													0				
2/7/2021	26.56	1	15	17.8	0													0				
2/8/2021	26.5	1	16	14.75	0													0				
2/9/2021	26.74	1	16	15.37	0													0.01				
2/10/2021	26.5	1	15	16.62	0													0				
2/11/2021	26.84	1	14	16.9	0													0.86				
2/12/2021	27.82	1	14	44.24	0													0.01				
2/13/2021	27.7	1	14	55.7	0													0.05				
2/14/2021	28.85	1	13	39.26	0													0				
2/15/2021	27.7	1	14	28.15	0													0.24				
2/16/2021	27.7	1	16	24.64	0													0				
2/17/2021	27.9	1	16	25.76	0													0.01				
2/18/2021	27.7	1	15	21.89	0													0				
2/19/2021	27.6	1	15	18.48	0													0.12				
2/20/2021	27.7	1	13	16.7	0													0.03				
2/21/2021	28.33	1	14	15.69	0													0				
2/22/2021	33.07	1	16	14.84	0													0.02				
2/23/2021	40.18	1	13	10.09	0													0.01				
2/24/2021	36.23	1	12	9.43	0													0				
2/25/2021	29	1	4	24.17	0													0				
2/26/2021	29	1	0	15.07	0													0				
2/27/2021	25.51	1	0	12.19	0													0				
2/28/2021	22.29	1	0	14.53	0													0				

HCP Operations Database

Date	Daily Average Flow (cfs)																		Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																	
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	FD= Fujimaka Dam	MSD=	SD= Sanguinetti Dam	CD= Clements Dam	TD= Tully Dam	EMD= Eight Mile Dam	SRD= Solari Ranch Dam	MAD= McAllen Dam	MDS= Mosher Diversion Structure	TM= Tully-Mosher	LD= Lyons Dam	LC= Lefflers Crossing		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
3/1/2021	22.73	1	1	11.83	0													0				
3/2/2021	22.59	1	0	10.06	0													0				
3/3/2021	22.66	1	0	10.38	0													0				
3/4/2021	23.01	1	0	10	0													0				
3/5/2021	22.86	1	0	8.75	0													0				
3/6/2021	23.01	1	0	8.75	0													0				
3/7/2021	22.86	1	0	3.65	0													0.23				
3/8/2021	30.51	0	14	6.02	0													0				
3/9/2021	32.79	0	23	12.99	0													0				
3/10/2021	28.8	1	27	5.51	0													0.21				
3/11/2021	32.47	1	41	0	0													0.31				
3/12/2021	41.39	1	56	2.14	0													0				
3/13/2021	42.65	1	55	2.53	0													0.01				
3/14/2021	43.9	1	52	0.62	0													0				
3/15/2021	43.9	1	47	0.42	0													0.07				
3/16/2021	43.9	1	42	0	0													0.26				
3/17/2021	43.9	1	44	0.03	0													0.01				
3/18/2021	42.57	1	47	3.63	0													0				
3/19/2021	40.02	1	46	5.43	0													0.56				
3/20/2021	38.33	1	47	9.65	0													0.38				
3/21/2021	34.23	1	49	16.27	0													0				
3/22/2021	29.37	1	51	8.18	0													0.01				
3/23/2021	29.12	1	51	0	0													0				
3/24/2021	34.49	1	51	0	0													0				
3/25/2021	42.5	1	52	0	0													0				
3/26/2021	59.54	1	55	8.49	0													0				
3/27/2021	62.83	1	55	25.39	0													0				
3/28/2021	55.86	1	55	14.7	0													0				
3/29/2021	51.03	1	55	5.92	0													0.01				
3/30/2021	50.88	1	56	4.32	0													0				
3/31/2021	43.9	0	58	2.43	0													0				

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	FD= Fujimaka Dam	MSD=	SD= Sanguinetti Dam	CD= Clements Dam	TD= Tully Dam	EMD= Eight Mile Dam	SRD= Solari Ranch Dam	MAD= McAllen Dam	MDS= Mosher Diversion Structure	TM= Tully-Mosher	LD= Lyons Dam	LC= Lefflers Crossing		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
4/1/2021	43.9	1	0	0.49	0													0				
4/2/2021	57.19	0	0	0.22	0													0.01				
4/3/2021	65.2	0	0	0.23	0													0				
4/4/2021	66.46	0	0	15.23	0													0				
4/5/2021	42.06	0	0	13.07	0													0				
4/6/2021	20.59	0	0	36.91	0													0				
4/7/2021	22.74	0	0	33.15	0													0				
4/8/2021	24.1	0	0	24.69	0													0				
4/9/2021	24.23	0	0	11.34	0													0				
4/10/2021	24.15	0	0	2.27	0													0				
4/11/2021	24.46	0	0	2.28	0													0				
4/12/2021	24.4	0	0	2.29	0													0				
4/13/2021	40.66	0	0	20.2	0	0						na		na				0				
4/14/2021	82.62	0	0	42.53	0	0	0	0				na		na				0				
4/15/2021	128.53	0	0	55.23	0	0	0	0				na		na				0				
4/16/2021	173.3	0	0	86.18	0	0	0	0				na		na				0				
4/17/2021	160.46	0	0	76.3	0	0	0	0				na		na				0				
4/18/2021	121.79	0	0	62.03	0	0	0	15				na		na				0				
4/19/2021	127.6	0	0	59.17	0	0	0	15				na		na				0				
4/20/2021	136.6	0	0	50.94	60	0	0	15	0			na		na				0				
4/21/2021	149.64	0	0	54.7	65	0	0	15	30	0	0	na	0	31	25	15	0	0				
4/22/2021	181.23	0	0	36.95	70	0	0	15	42	0	0	na	0	25	20	14	0	0				
4/23/2021	194.94	0	0	36.93	80	0	0	15	55	0	0	na	0	20	16	11	0	0				
4/24/2021	182.94	0	0	41.44	90	0	0	15	65	0	0	na	0	20	16	13	0	0				
4/25/2021	164.73	0	0	43.82	90	15	0	15	68	58		na	0	16	12	8	0	0				
4/26/2021	147.82	0	0	44.53	85	15	0	15	60	50		na	0	16	12	8	0	0.15				
4/27/2021	145.23	0	0	44.26	70	15	0	15	60	50		na	0	10	6	4	0	0.02				
4/28/2021	153.11	0	0	37.8	70	15	0	15	60	55		na	5	10	6	4	0	0.01				
4/29/2021	175.55	0	0	33.36	74	25	0	15	55	45		na	6	13	9	6	0	0.01				
4/30/2021	193.77	0	0	35.47	80	25	0	15	50	45		na	8	15	11	8	0	0.03				

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	FD= Fujimaka Dam	MSD=	SD= Sanguinetti Dam	CD= Clements Dam	TD= Tully Dam	EMD= Eight Mile Dam	SRD= Solari Ranch Dam	MAD= McAllen Dam	MDS= Mosher Diversion Structure	TM= Tully-Mosher	LD= Lyons Dam	LC= Lefflers Crossing		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
5/1/2021	205.44	0	0	37.53	80	15		20	58	50	40	na	8	17.5	13	9	3	0				
5/2/2021	200.17	0	0	41.46	80	15		20	55	42	36	na	5	20	16	12	9	0				
5/3/2021	194.9	0	0	39.85	70	15		15	50	42	36	na	5	18.5	15	8	4	0				
5/4/2021	190.64	0	0	38.54	70	15		15	45	35	30	na	0	18.5	15	8	4	0				
5/5/2021	182.39	0	0	39	80	15		15	50	40	32	na	0	18.5	15	8	4	0				
5/6/2021	195.5	0	0	37.54	90	15		15	55	42	35	na	6	18.5	15	8	4	0				
5/7/2021	230.6	0	0	38.88	100	15		20	75	60	48	na	7	18.5	15	8	4	0				
5/8/2021	249.26	0	0	41.5	110	15		20	85	70	50	na	9	12	10	7	3	0				
5/9/2021	242.2	0	0	43.73	95	15		20	60	50	40	na	10	22.5	17	11	7	0				
5/10/2021	209.92	0	0	43.1	90	15		20	55	45	43	na	15	25	18	13	7	0				
5/11/2021	193.9	0	0	32.94	85	12		15	60	80	60	na	15	18	15	12	5	0				
5/12/2021	194	0	0	35.65	80	12		20	60	45	60	na	7	16	13	12	4	0				
5/13/2021	187.66	0	0	35.59	80	12		20	60	50	50	na	7	18	15	12	4	0				
5/14/2021	197.61	0	0	33.26	100	12		20	80	60	50	na	7	22	18	15	7	0				
5/15/2021	217.7	0	0	33.95	120	12		20	90	70	56	na	8	17	14	10	4	0				
5/16/2021	222.57	0	0	34.37	120	15		20	90	70	58	na	8	17	14	10	3	0				
5/17/2021	192.13	0	0	34.65	100	15		17	80	65	57	na	8	17	14	10	3	0				
5/18/2021	181.37	0	0	33.56	100	5		17	80	65	54	na	8	17	14	10	3	0				
5/19/2021	184.13	0	0	33.22	100	5		17	80	65	55	na	6	17	14	10	3	0				
5/20/2021	196.94	0	0	39.59	105	5		15	82	65	55	na	6	18	15	12	3	0				
5/21/2021	226.82	0	0	39.98	120	5		15	90	75	59	na	6	25	20	9	3	0				
5/22/2021	220.22	0	0	47.77	120	5		15	85	65	56	na	6	30	25	15	3	0				
5/23/2021	184.53	0	0	35	100	5		15	80	65	54	na	6	12	18	14	3	0				
5/24/2021	155.47	0	0	34.37	100	5		15	80	65	54	na	6	20	16	15	3	0				
5/25/2021	165.29	0	0	35.97	105	5		14	70	55	45	na	3	30	25	18	6	0				
5/26/2021	182.12	0	0	32.63	110	4		14	90	75	55	na	4	18	15	15	5	0				
5/27/2021	191.77	0	0	45.97	110	4		14	90	75	60	na	5	18	15	12	4	0				
5/28/2021	197.01	0	0	40.01	115	4		14	85	70	62	na	5	20	16	10	3	0				
5/29/2021	193.94	0	0	34.69	115	4		14	90	70	60	na	5	16	13	8	0	0				
5/30/2021	194.77	0	0	38.2	115	4		14	90	75	65	na	4	16	13	8	0	0				
5/31/2021	184.02	0	0	36.79	110	4		12	90	75	64	na	4	18	15	8	0	0				

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	FD= Fulmeke Dam	MSD=	SD= Sanguinetti Dam	CD= Clements Dam	TD= Tully Dam	EMD= Eight Mile Dam	SRD= Solari Ranch Dam	MAD= McAllen Dam	MDS= Mosher Diversion Structure	TM= Tully-Mosher	LD= Lyons Dam	LC= Lefflers Crossing		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
6/1/2021	170.33		0	30.23	105	4		12	80	65	65	na	3	16	13	8	0	0				
6/2/2021	168.08	0	0	30.23	105	6		12	80	65	55	na	3	16	13	7	0	0				
6/3/2021	187.18	0	0	35.52	105	6		12	80	65	55	na	3	16	13	7	0	0				
6/4/2021	203.38	0	0	34.29	115	6		12	80	65	55	na	3	16	13	7	0	0				
6/5/2021	196.54	0	0	31.65	115	6		12	90	75	65	na	5	16	13	7	0	0				
6/6/2021	169.84	0	0	31.16	110	7		15	95	80	70	na	5	18	15	9	0	0				
6/7/2021	162.37	0	0	26.06	100	8		15	90	75	65	na	5	18	15	9	0	0				
6/8/2021	164.64	0	0	24.74	90	5		15	80	65	55	na	5	18	15	9	0	0				
6/9/2021	168.47	0	0	35.3	90	5		15	80	65	55	na	5	13	10	7	0	0				
6/10/2021	167.63	0	0	32.45	90	5		15	80	65	55	na	5	13	10	7	0	0				
6/11/2021	165.52	0	0	28.63	85	3		15	80	65	55	na	5	13	10	7	0	0				
6/12/2021	170.52	0	0	28.67	90	3		15	80	65	55	na	5	13	10	7	0	0				
6/13/2021	182.87	0	0	30.24	90	3		15	80	65	55	na	9	13	10	7	0	0				
6/14/2021	200.67	0	0	36.06	100	0		15	90	75	65	na	8	13	10	7	0	0				
6/15/2021	211	0	0	38.87	120	0		15	100	85	70	na	8	13	10	7	0	0				
6/16/2021	186.77	0	0	43.96	110	4		15	100	85	70	na	8	13	10	7	0	0				
6/17/2021	178.11	0	0	34.16	110	7		15	95	80	70	na	8	15	12	9	0	0				
6/18/2021	235.64	0	0	36.75	125	8		15	105	90	75	na	8	15	12	9	0	0				
6/19/2021	253.44	0	0	42.47	140	12		18	120	105	85	na	8	15	12	9	0	0				
6/20/2021	224.75	0	0	55.11	140	12		18	120	105	85	na	8	15	12	9	0	0				
6/21/2021	193.66	0	0	42.23	120	12		18	100	85	70	na	8	15	12	9	0	0				
6/22/2021	180.78	0	0	31.54	115	7		18	100	85	70	na	8	15	12	9	0	0				
6/23/2021	180.79	0	0	32	110	4		18	95	80	70	na	8	15	12	9	0	0				
6/24/2021	194.31	0	0	31.67	110	4		18	95	80	70	na	8	20	16	12	3	0				
6/25/2021	204.13	0	0	33.86	115	4		18	95	80	70	na	8	20	16	12	3	0				
6/26/2021	189.82	0	0	38.22	110	4		15	90	75	65	na	4	20	16	12	3	0				
6/27/2021	180.89	0	0	41.09	100	2		15	85	60	50	na	4	20	16	12	3	0				
6/28/2021	190.2	0	0	38.27	100	2		15	85	60	50	na	4	20	16	12	3	0				
6/29/2021	203.01	0	0	36.2	115	5		15	85	60	50	na	4	20	16	12	3	0				
6/30/2021	210.13	0	0	38.05	120	6		15	100	80	70	na	4	13	10	7	0	0				

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	Motoike Dam M1	Fine Road Dam	Avansino Dam	Hosie Dam	Bonomo Dam	Piazza Dam	Prato Dam	FD= Fujinaka Dam	Lavaggi Dam	Panella Dam	Main St. Dam	Budiselich Dam		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
7/1/2021	198.68	0	0	39.04	103	35	32	26	20	14	8.5	10	6	0	5	0	0					
7/2/2021	198.63	0	0	37.98	100	37	32	26	20	14	8.5	6	5	0	5	0	0					
7/3/2021	203.67	0	0	37.67	105	35	31	26	20	14	7	6	5	0	5	0	0					
7/4/2021	199.04	0	0	34.68	100	30	25	21	15	11	5	3	0	0	5	0	0					
7/5/2021	192.47	0	0	32.66	95	30	25	21	15	11	5	3	0	0	5	0	0					
7/6/2021	192.83	0	0	32.6	95	28	25	21	15	11	5	3	0	0	5	0	0					
7/7/2021	185.07	0	0	33.18	90	31	26	21	15	11	5	3	0	0	5	0	0					
7/8/2021	177.36	0	0	32.9	85	30	25	21	15	11	5	3	0	0	5	0	0					
7/9/2021	188.66	0	0	35.81	90	32	26	21	15	11	5	3	0	0	5	0	0					
7/10/2021	204.9	0	0	39.77	105	36	28	22	15	11	5	3	0	0	5	0	0					
7/11/2021	214.96	0	0	40.78	105	36	28	22	15	11	5	3	0	0	5	0	0					
7/12/2021	204.6	0	0	39.7	100	36	28	22	15	11	5	3	0	0	5	0	0					
7/13/2021	197.16	0	0	38.9	95	35	28	22	15	11	5	3	0	0	5	0	0					
7/14/2021	186.92	0	0	43.47	85	40	30	24	15	11	5	3	0	0	5	0	0					
7/15/2021	181.06	0	0	35.93	95	34	34	28	20	15	5	3	0	0	5	0	0					
7/16/2021	190.85	0	0	32.96	100	30	30	25	18	14	7	3	0	0	5	0	0					
7/17/2021	213.52	0	0	37	115	35	30	25	18	14	9	3	0	0	5	0	0					
7/18/2021	228.16	0	0	42.39	120	40	32	26	18	14	8	3	0	0	5	0	0					
7/19/2021	212.2	0	0	46.02	110	42	33	27	19	14	8	8	0	0	5	0	0					
7/20/2021	188.19	0	0	42.88	90	40	30	25	18	14	8	3	0	0	5	0	0					
7/21/2021	181.7	0	0	34.8	90	34	29	25	18	14	8	3	0	0	5	0	0					
7/22/2021	188.7	0	0	38.72	95	36	30	25	18	14	8	3	0	0	5	0	0					
7/23/2021	205.33	0	0	39.09	100	36	31	25	18	14	8	3	0	0	5	0	0					
7/24/2021	203.4	0	0	35.61	95	34	30	25	18	14	8	3	0	0	5	0	0					
7/25/2021	193.53	0	0	36.62	85	33	29	25	18	14	8	3	0	0	5	0	0					
7/26/2021	195.83	0	0	41.43	80	37	33	27	18	14	8	3	0	0	5	0	0					
7/27/2021	208.46	0	0	40.16	95	37	30	25	18	14	8	3	0	0	5	0	0					
7/28/2021	200.1	0	0	35.81	95	33	28	23	16	14	8	3	0	0	5	0	0					
7/29/2021	188.81	0	0	35.48	90	32	28	23	17	13	6	3	0	0	5	0	0					
7/30/2021	188.48	0	0	32	90	30	25	23	16	13	6	10	0	0	5	0	0					
7/31/2021	201.83	0	0	32.21	95	30	25	23	16	13	6	10	0	0	5	0	0					

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	Motoike Dam M1	Fine Road Dam	Avansino Dam	Hosie Dam	Bonomo Dam	Piazza Dam	Prato Dam	FD= Fujinaka Dam	Lavaggi Dam	Panella Dam	Main St. Dam	Budiselich Dam		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
8/1/2021	213.31	0	0	34.28	105	31	27	23	16	13	7	10	4	2	7	0	0					
8/2/2021	213.94	0	0	37.87	105	33	28	24	18	14	7	10	4	2	7	0	0					
8/3/2021	200.82	0	0	42.41	85	38	30	24	18	14	7	13	6	4	9	0	0					
8/4/2021	191.58	0	0	38.55	90	35	31	24	18	14	7	14	6	4	9	0	0					
8/5/2021	192.13	0	0	35.57	108	32	28	24	18	14	7	10	4	3	8	0	0					
8/6/2021	187.7	0	0	37.09	100	34	28	24	18	14	7	10	4	3	8	0	0					
8/7/2021	183.88	0	0	33.3	100	30	26	24	18	14	7	10	4	3	8	0	0					
8/8/2021	187.82	0	0	35.96	106	31	25	24	18	14	7	10	4	3	8	0	0					
8/9/2021	195.08	0	0	34.31	111	33	30	24	18	14	8.5	10	5	3	10	0	0					
8/10/2021	188.72	0	0	29.58	95	28	26	23	17	13	6	6	5	5	7	6	0					
8/11/2021	174.13	0	0	29.37	90	28	26	23	16	13	3	6	5	4	6	2	0					
8/12/2021	170.08	0	0	27.58	80	26	25	20	13	8	0	6	5	3	3	0	0					
8/13/2021	183.01	0	0	32.31	85	30	25	20	13	8	4	6	5	3	4	0	0					
8/14/2021	198.52	0	0	33.4	90	30	25	20	13	8	4	6	5	3	6	0	0					
8/15/2021	207	0	0	31.86	100	30	25	20	13	8	4	6	5	3	3	0	0					
8/16/2021	207	0	0	32.59	100	30	25	20	13	8	4	6	5	3	5	0	0					
8/17/2021	193	0	0	30.88	100	30	25	20	13	7	4	6	5	3	5	0	0					
8/18/2021	177.01	0	0	30.32	80	26	24	20	13	7	3	6	5	3	5	0	0					
8/19/2021	170.76	0	0	28.82	80	26	24	20	13	7	3	4	3	3	5	0	0					
8/20/2021	178.29	0	0	28.79	80	26	24	20	13	7	3	4	3	2	5	0	0					
8/21/2021	170.25	0	0	35.1	80	31	27	23	14	7	3	4	3	2	5	0	0					
8/22/2021	165.77	0	0	34.95	80	33	29	25	14	7	3	3	3	2	6	0	0					
8/23/2021	160.22	0	0	34.06	80	33	29	25	20	14	8	8	6	2	6	0	0					
8/24/2021	151.43	0	0	28.88	75	27	26	25	18	11	2	3	0	0	6	0	0					
8/25/2021	144.38	0	0	31.87	72	26	20	18	14	10	0	1	0	0	7	3	0					
8/26/2021	155.89	0	0	30.3	70	26	22	17	13	10	7	10	0	0	6	3	0					
8/27/2021	159.93	0	0	30.46	70	26	22	16	13	10	6	12	0	0	5	0	0					
8/28/2021	151.55	0	0	28.3	70	26	22	17	13	10	5	8	0	0	3.5	0	0					
8/29/2021	152.9	0	0	26.6	70	26	22	17	13	10	3.5	6	0	0	6	0	0					
8/30/2021	170.56	0	0	27.79	80	26	22	18	13	10	3	8	0	0	5	0	0					
8/31/2021	176.93	0	0	28.73	80	26	22	16	17	10	8	7.5	0	0	4	0	0					

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	Motoike Dam M1	Fine Road Dam	Avansino Dam	Hosie Dam	Bonomo Dam	Piazza Dam	Prato Dam	FD= Fujinaka Dam	Lavaggi Dam	Panella Dam	Main St. Dam	Budiselich Dam		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
9/1/2021	158.07	0	0	31.45	70	28	26	19	18	14	8.5	10	0	0	5	0	0					
9/2/2021	153	0	0	31.2	70	28	23	24	15	11	3	3	0	0	4	0	0					
9/3/2021	155.97	0	0	30.21	70	27	24	21	17	10	4.5	2.5	0	0	5	0	0					
9/4/2021	165.61	0	0	27.65	80	25	21	17	14	9	3	3	0	0	3	0	0					
9/5/2021	173.96	0	0	29.3	70	27	22	18	14	8	3	3	0	0	1	0	0					
9/6/2021	174	0	0	35.42	70	31	25	20	14	9	3	3	0	0	4	0	0					
9/7/2021	160.07	0	0	29.03	70	26	21	17	14	8	1.5	0	0	0	7	1	0					
9/8/2021	150 .67	0	0	30.47	75	27	22	19	15	8	1	0	0	0	5	0	0					
9/9/2021	168.79	0	0	29.56	90	25	20	16	13	8	5	3	6	1	5	0	0					
9/10/2021	191.91	0	0	24.64	95	21	19	17	14	8	2	9	10	1	0	0	0					
9/11/2021	195.04	0	0	28.15	100	26	24	19	15	13	12	12	13	4	0	0	0					
9/12/2021	181.19	0	0	28.25	90	24	20	16	13	10	9	9	8	5	2	5	0					
9/13/2021	169.71	0	0	25.22	90	22	19	16	13	12	11.5	9	7	6	13	10	0					
9/14/2021	149.38	0	0	23.01	70	22	19	16	12	8	4	9	5	0	5	3	0					
9/15/2021	143	0	0	22.57	70	22	19	16	12	8	4	5	5	0	4	3	0					
9/16/2021	151.97	0	0	20.25	70	20	19	16	12	8	4	4	5	0	3.5	0	0					
9/17/2021	160.41	0	0	19.81	75	19	19	16	12	7	4	4	2.5	0	3.5	0	0					
9/18/2021	160.97	0	0	21.87	75	20	19	16	12	7	3	5	2.5	0	4	0	0					
9/19/2021	157.27	0	0	20.31	65	20	19	16	12	6	3	9	4.5	0	6	0	0					
9/20/2021	152.94	0	0	21.53	60	20	19	16	12	7	4	4	3	0	6	0	0					
9/21/2021	153	0	0	23.09	60	21	19	16	12	6	3	8	7	0	8	6	0					
9/22/2021	141.26	0	0	20.8	60	20	19	16	12	6	3	12	7	6	9	7	0					
9/23/2021	134.58	0	0	18.66	60	18	16	13	10	6	3	10	6	5	8	5	0					
9/24/2021	141.88	0	0	17.92	65	17	16	13	10	6	2	7	5	5	9	6	0					
9/25/2021	155.67	0	0	18.2	65	17	16	13	10	7	3	6	4	3	10	6	0					
9/26/2021	163.71	0	0	18.9	70	17	16	13	10	6	3	5	2	0	7	5	0					
9/27/2021	159.08	0	0	19.51	70	18	16	13	10	6	3	4	4.5	0	7	5	0					
9/28/2021	139.84	0	0	17.21	60	16	14	13	8	5	2	10	6	5.5	7	5	0					
9/29/2021	125.85	0	0	16.24	65	15	14	13	8	5	0	8	5	3.5	5	5	0					
9/30/2021	117.99	0	0	15.49	55	15	14	13	8	5	3	6	4	2	5	4	0					

HCP Operations Database

Date	Daily Average Flow (cfs)																Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season															
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	Motoike Dam M1	Fine Road Dam	Avansino Dam	Hosie Dam	Bonomo Dam	Piazza Dam	Prato Dam	FD= Fujinaka Dam	Lavaggi Dam	Panella Dam	Main St. Dam	Budiselich Dam		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
10/1/2021	110.72	0	0	17.4	50	17	14	13	8	5	0	6	4	2	5	3	0	0.00		n	in	
10/2/2021	106.93	0	0	17.5	50	17	14	13	8	5	0	6	4	0	5	3	0	0.00		n	in	
10/3/2021	92	0	0	17.14	50	17	14	13	8	5	0	6	4	0	5	3	0	0.00		n	in	
10/4/2021	37.7	0	0	21.91	20													0.00		n	in	
10/5/2021	19.5	0	0	24.39	20													0.00	34	n	in	
10/6/2021	14.75	0	0	13.09	20													0.00	28	n	in	
10/7/2021	15.25	0	0	12.18	20													0.00	30	n	in	
10/8/2021	15.86	0	0	8.6	10													0.00	26	n	in	
10/9/2021	16.05	0	0	0.95	10													0.06	25	n	in	
10/10/2021	16.51	0	0	1.49	10													0.00	25	n	in	
10/11/2021	16.37	0	0	2.08	10													0.01	22	n	in	
10/12/2021	16.55	0	0	2.28	10													0.00	21	n	in	
10/13/2021	16.38	0	0	2.66	10													0.00	18	n	in	
10/14/2021	16.76	0	0	3.25	10													0.00	19	n	in	
10/15/2021	17.01	0	11	19.77	0													0.01	17	n	in	
10/16/2021	20.32	0	11	28.66	0													0.01	18	n	in	
10/17/2021	41.16	0	43	6.74	0													0.01	35	n	in	
10/18/2021	60.05	0	43	10.62	0													0.00	35	n	in	
10/19/2021	67.91	0	40	8.58	0													0.00	35	n	in	
10/20/2021	59.42	0	40	27.6	0													0.00	35	n	in	
10/21/2021	46.32	0	37	38.62	0													0.01	35	n	in	
10/22/2021	41.31	0	33	2.57	0													0.06	35	n	in	
10/23/2021	45.86	0	31	1.68	0													0.75	35	n	in	
10/24/2021	49.8	42	33	1.11	15													0.10	35	n	in	
10/25/2021	48.08	862	22	54.59	15													4.38	35	n	in	
10/26/2021	41.54	282	28	1125.93	15													1.94	35	y	out	
10/27/2021	26.57	7	28	266.6	15													0.00	35	y	out	
10/28/2021	31.47	3	29	34.99	0													0.00	35	y	out	
10/29/2021	44.49	1	36	1.87	0													0.00	35	y	out	
10/30/2021	49.8	1	40	0.79	0													0.00	35	n	in	
10/31/2021	40.8	1	40	0.03	0													0.00	35	n	in	

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	Motoike Dam M1	Fine Road Dam	Avansino Dam	Hosie Dam	Bonomo Dam	Piazza Dam	Prato Dam	FD= Fujinaka Dam	Lavaggi Dam	Panella Dam	Main St. Dam	Budiselich Dam		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
11/1/2021	42.65	0	40	0	0													0.00	35	n	in	
11/2/2021	43.23	0	36	0	0													0.00	35	n	in	
11/3/2021	29.16	0	27	0.03	0													0.00	34	n	in	
11/4/2021	29.82	0	30	0	0													0	30	n	in	
11/5/2021	43.68	0	40	0	0													0.01	35	n	in	
11/6/2021	57.72	0	40	0	0													0	35	n	in	
11/7/2021	65.31	0	40	0.35	0													0.06	35	n	in	
11/8/2021	57.02	0	42	1.39	0													0.02	35	n	in	
11/9/2021	53.8	0	42	0.6	0													0	35	n	in	
11/10/2021	65.31	0	42	0.34	0													0	35	n	in	
11/11/2021	57.02	0	42	0.76	0													0.12	35	n	in	
11/12/2021	53.8	0	40	0.8	0													0.3	35	n	in	
11/13/2021	53.81	0	38	0.2	0													0.02	35	n	in	
11/14/2021	49.14	0	38	0	0													0.01	35	n	in	
11/15/2021	43.59	0	38	0	0													0.01	35	n	in	
11/16/2021	49.8	0	36	1.21	0													0	35	n	in	
11/17/2021	42.08	0	36	0.96	0													0	35	n	in	
11/18/2021	45.34	0	36	0.35	0													0.01	35	n	in	
11/19/2021	54.25	0	40	0.86	0													0.02	35	n	in	
11/20/2021	44.74	0	40	7.74	0													0	35	n	in	
11/21/2021	39.8	0	35	8.61	0													0	35	n	in	
11/22/2021	38.27	0	28	7.13	0													0.01	35	n	in	
11/23/2021	40.38	0	31	5.18	0													0.01	35	n	in	
11/24/2021	44.35	0	31	6.02	0													0	35	n	in	
11/25/2021	34.72	0	31	12.49	0													0	35	n	in	
11/26/2021	33.09	0	31	7.1	0													0	35	n	in	
11/27/2021	39.78	0	31	4.58	0													0	35	n	in	
11/28/2021	39.8	0	30	8.21	0													0	35	n	in	
11/29/2021	34.96	0	30	7.82	0													0	35	n	in	
11/30/2021	44.16	0	34	3.6	0													0.01	35	n	in	

HCP Operations Database

Date	Daily Average Flow (cfs)																	Hogan Dam Rainfall (inches)	Non-Irrigation Season			
	Year-round					Irrigation Season																
	NHG= New Hogan Dam	COS= Cosgrove Creek[1]	TMT= To Treatment Plant	MRS= Mormon Slough at Bellota	OCH= Old Calaveras Headworks Facility	Motoike Dam M1	Fine Road Dam	Avansino Dam	Hosie Dam	Bonomo Dam	Piazza Dam	Prato Dam	FD= Fujinaka Dam	Lavaggi Dam	Panella Dam	Main St. Dam	Budiselich Dam		SHE*- Shelton Road (cfs) manually collected when NH releases are less than 35 cfs	Connected at Mouth (Y/N)	Status of Board at Ladder (Out/In)	Comments
12/1/2021	53.98	0	49	3.03	0													0	58.3	n	in	
12/2/2021	53.8	0	50	5.06	0													0	58.3	n	in	
12/3/2021	53.8	0	50	4.74	0													0	58.3	n	in	
12/4/2021	53.8	0	50	4.94	0													0	58.3	n	in	
12/5/2021	53.8	0	50	5.01	0													0	58.3	n	in	
12/6/2021	53.8	0	50	5	0													0	58.3	n	in	
12/7/2021	53.8	0	50	5.1	0													0.12	58.3	n	in	
12/8/2021	53.8	0	50	5.29	0													0.07	58.3	n	in	
12/9/2021	55.32	0	50	3.94	0													0.01	58.3	n	in	
12/10/2021	56.6	0	50	6.47	0													0.43	58.3	n	in	
12/11/2021	56.6	0	50	7.33	0													0.02	58.3	n	in	
12/12/2021	56.6	1	50	6.29	0													0.01	58.7	n	in	
12/13/2021	56.6	10	50	7.48	0													0.58	58.7	n	in	
12/14/2021	57.13	713	50	17.19	15													1.59	58.7	y	out	
12/15/2021	58.1	40	30	792.36	15													0.8	58.7	y	out	
12/16/2021	58.1	23	50	272.86	15													0.09	58.7	y	out	
12/17/2021	58.3	21	50	139.16	15													0.37	58.3	y	out	
12/18/2021	58.1	9	50	131.51	0													0.01	58.1	y	out	
12/19/2021	58.1	7	50	62.87	0													0.02	58.1	y	out	
12/20/2021	58.1	4	50	38.82	0													0	58.1	y	out	
12/21/2021	58.08	3	50	27.49	0													0	58.08	y	out	
12/22/2021	57.9	3	50	21.75	0													0.01	57.9	y	out	
12/23/2021	58	222	28	31.27	15													0.39	58	y	out	
12/24/2021	58	81	28	649.17	0													1.29	58	y	out	
12/25/2021	58	45	28	587.38	0													0.33	58	y	out	
12/26/2021	58	122	28	279.78	0													0.68	58	y	out	
12/27/2021	58	107	40	535.59	0													0.22	58	y	out	
12/28/2021	58	96	40	776.06	0													0.7	58	y	out	
12/29/2021	60.05	35	40	519.09	0													0	58	y	out	
12/30/2021	49	27	52	208.27	0													0.23	45	y	out	
12/31/2021	42	15	52	170.15	0													0.01	45	y	out	

Appendix B – Flow Measurement Structure Feasibility Memo

Memorandum

To: Justin Hopkins – Assistant General Manager
From: Darrel Evensen – District Engineer
Manuel Verduzco – Senior Engineer
Date: 03/30/2021
Re: Investigation of Flow Monitoring at Confluence of the Calaveras River and the Diverting Canal in Stockton, California

---

BACKGROUND

The Stockton East Water District's (District) Calaveras River Habitat Conservation Plan (HCP) requires an investigation of installation and monitoring of the flow at the confluence of the Calaveras River and the Diverting Canal in Stockton, California.

SUMMARY

Staff visited the confluence of the Calaveras River and the Diverting Canal (Confluence) and noted two potential locations for flow measurement. The first crossing downstream (Figure 1) of the confluent is a train bridge (Union Pacific) and the second crossing is a city of Stockton pedestrian bridge (Figure 2). The train bridge has power poles parallel to the tracks and could provide a closer hook up to the power, but working with Union Pacific is cumbersome and this location is not preferred.

The second site is the pedestrian bridge and is more favorable for a pressure transducer or radar level sensor. Both areas have vagrant issues and any installation will require site hardening. Once a level sensor is established, Staff will survey the bottom contours to prepare an equation for flow based on the water level in the waterway.

An estimated cost for this flow monitoring station would be around $50,000 to $100,000 depending on the difficulty of bringing power to the site and site hardening measures. The cost is consistent with other, similar District flow measurement facilities and is therefore reasonable.

The District will be installing flow measurements sites in the Old Calaveras River near McAllen Road and in the Mormon Slough at Main Street during 2021. The currently planned flow measurement sites will measure the same flows that pass through the Confluence, less any additional runoff flow input downstream of the sites. Because the Confluence flow measurement facility is redundant to upstream flow measurement facilities, staff thinks the cost to construct another facility is not feasible.

Figure 1. Railroad Bridge

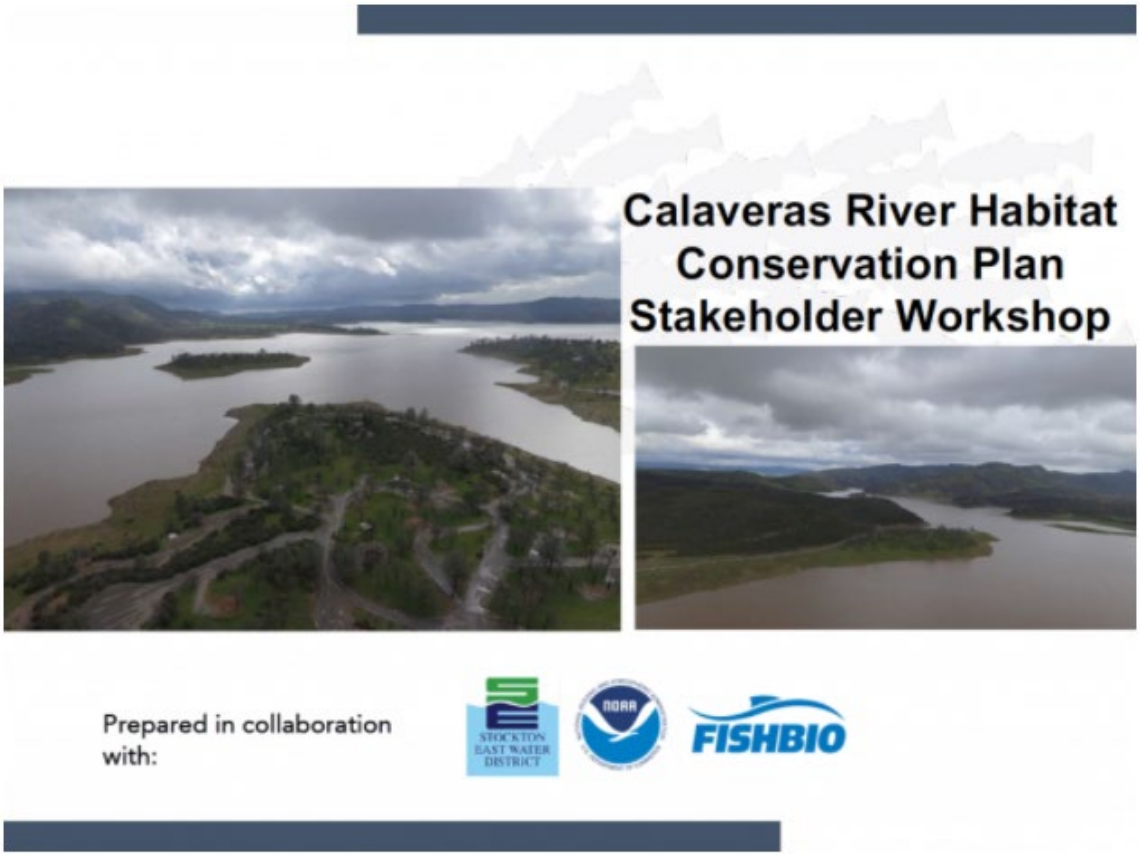
Figure 2. Pedestrian Bridge

Appendix C – Flashboard Dam Removal Schedules

2020			
System	Site	Begin Date	End Date
Duck Creek	Sanguinetti Dam		
Calaveras River	Bellota Weir	10/8/2020	10/9/2020
Mormon Slough	Budiselich Dam	10/9/2020	10/9/2020
Mormon Slough	Motoike Dam	10/13/2020	10/13/2020
Mormon Slough	Fine Road Dam		
Mormon Slough	Avansino Dam	10/14/2020	10/14/2020
Mormon Slough	Hosie Dam		
Mormon Slough	Bonomo Dam		
Mormon Slough	Piaza Dam	10/15/2020	10/15/2020
Mormon Slough	Prato Dam		
Mormon Slough	Fujinaka Dam		
Mormon Slough	Lavaggi Dam	10/16/2020	10/16/2020
Mormon Slough	Panella Dam		
Mormon Slough	Main Street Dam		
Old Calaveras River	Clements Dam	10/19/2020	10/19/2020
Old Calaveras River	Tully Dam		
Mosher Creek	Tully-Mosher Dam		
Mosher Creek	Lyons Dam	10/20/2020	10/20/2020
North Fork Potter Creek	Gondolfos Dam		
North Fork Potter Creek	Moitoke Dam #2		
Potter Creek	Drais Road Dam		
Mormon Slough	8000 Pump	10/21/2020	10/22/2020
Old Calaveras River	8 Mile Dam		
Old Calaveras River	Murphy Dam	10/23/2020	10/23/2020
Old Calaveras River	Pezzi Dam		
Old Calaveras River	Solari Dam		
Old Calaveras River	Cherryland Dam		
Old Calaveras River	McAllen Dam	10/26/2020	10/26/2020
Mosher Creek	Bear Creek Diversion		
Mosher Creek	Cotta-Ferreira Dam		
Mosher Creek	Lefler Dam		

2021			
System	Site	Begin Date	End Date
Mormon Slough	8000 Pump		
Duck Creek	Sanguinetti Dam	10/5/2021	10/5/2021
Calaveras River	Bellota Weir	10/6/2021	10/8/2021
Mormon Slough	Budiselich Dam	10/8/2021	10/8/2021
Mormon Slough	Motoike Dam	10/12/2021	10/13/2021
Mormon Slough	Fine Road Dam		
Mormon Slough	Avansino Dam		
Mormon Slough	Hosie Dam	10/13/2021	10/14/2021
Mormon Slough	Bonomo Dam		
Mormon Slough	Piaza Dam		
Mormon Slough	Prato Dam		
Mormon Slough	Fujinaka Dam	10/14/2021	10/15/2021
Mormon Slough	Lavaggi Dam		
Mormon Slough	Panella Dam		
Mormon Slough	Main Street Dam	10/15/2021	10/15/2021
Old Calaveras River	Clements Dam	10/18/2021	10/19/2021
Old Calaveras River	Tully Dam	10/19/2021	10/20/2021
Old Calaveras River	8 Mile Dam	10/20/2021	10/21/2021
Old Calaveras River	Murphy Dam	10/21/2021	10/22/2021
Old Calaveras River	Pezzi Dam		
Old Calaveras River	Solari Dam		
Old Calaveras River	Cherryland Dam	10/22/2021	10/22/2021
Old Calaveras River	McAllen Dam		
Mosher Creek	Tully-Mosher Dam	10/25/2021	10/26/2021
Mosher Creek	Lyons Dam		
Mosher Creek	Bear Creek Diversion		
Mosher Creek	Cotta-Ferreira Dam		
Mosher Creek	Lefler Dam		
North Fork Potter Creek	Gondolfos Dam	10/18/2021	10/18/2021
North Fork Potter Creek	Moitoke Dam #2		
Potter Creek	Drais Road Dam	10/15/2021	10/15/2021

Appendix D – HCP Workshop Stakeholder Outreach



Should you have any questions regarding the HCP, please contact Justin Hopkins, Assistant General Manager – Stockton East Water District, at (209) 948-0537 or jhopkins@sewd.net.


Calaveras River Habitat
Conservation Plan
VIRTUAL WORKSHOP
WEDNESDAY, FEBRUARY 10, 2021
1:00 p.m. - 2:00 p.m.
Virtual Meeting Info On Reverse


What Will Be Discussed?
• Overview of Calaveras River Fishery Issues
• Understand How Land Owners Can Provide Good Fishery Conditions
• Learn About Fish Screen Funding Opportunities
Zoom Virtual Meeting with FISHBIO & SEWD
Join on zoom.com or with the Zoom App
Meeting ID: 836 2739 2387
Passcode: 913996
Call In Option Dial:
+1 669 900 9128 US (San Jose)

Appendix E – 2021 Calaveras River Fish Monitoring Report

2021 Calaveras River Fisheries Monitoring Report

October 2020 – September 2021

Submitted To:
Stockton East Water District

Prepared By:
Patrick Cuthbert
Matt Peterson
Jim Inman

FISHBIO
1617 S. Yosemite Ave.
Oakdale, CA 95361
209.847.6300
www.fishbio.com

December 2021

Table of Contents

List of Acronyms

7DADM	Seven-day Average Daily Maximum
AIC	Akaike Information Criterion
AMP	Adaptive Management Plan
ANOVA	Analysis of variance
BMI	Benthic macroinvertebrate
cfs	cubic feet per second
CDEC	California Data Exchange Center
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CEDEN	California Environmental Data Exchange Network
CHCP	Calaveras Habitat Conservation Plan
CSBP	California Stream Bioassessment Procedure
CV	Central Valley
CWT	Coded wire tag
DO	Dissolved oxygen
DPS	Distinct Population Segment
EM	Effectiveness Monitoring
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FL	Fork length
ft	feet
GAM	Generalized additive model
GLM	Generalized linear model
GPS	Geographic positioning system
IP	Internet protocol
LED	Light emitting diode
MBC	Method of Bounded Counts
mm	millimeter
MRS	Mormon Slough gauging station
MSE	Mean square error
NMFS	National Marine Fisheries Service
NTU	Nephelometric turbidity unit
PIT	Passive Integrated Transponder
POE	Power Over Ethernet
RBT	Rainbow trout
rkm	River kilometer
RM	River mile
RST	Rotary screw trap
RWB	Reachwide Benthos
SAFIT	Southwest Association of Invertebrate Taxonomists
SCADA	Supervisory Control and Flow Data Acquisition System
SEWD	Stockton East Water District
SDC	Stockton Diverting Canal
SE	Standard error

STE	Standard taxonomic effort
SWAMP	Surface Water Ambient Monitoring Program
TRC	Target Riffle Composite
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
WY	Water year
YOY	Young-of-the-year
NZMS	New Zealand mud snail

Executive Summary

After more than a decade in development, the Calaveras River Habitat Conservation Plan (CHCP) was approved by the National Marine Fisheries Service on September 14, 2020. Since 2001 and throughout the development of the CHCP, Stockton East Water District (SEWD) has funded fisheries research and monitoring on the Calaveras River to better understand how water operations may affect at-risk salmonid populations and influence their life history pathways, particularly Central Valley steelhead and rainbow trout (*Oncorhynchus mykiss*). The CHCP lays the groundwork for a management plan that would support future studies of the fish community below New Hogan Dam. Beyond research and monitoring, the CHCP includes several management activities related to flow, fish passage, and water quality to further support fish conservation over the term of a 50-year permit for water operations.

The CHCP established 12 Effectiveness Monitoring (EM) activities to be implemented to collect data sufficient to evaluate whether conservation strategies are achieving biological goals and objectives set forth in the CHCP. Additionally, the EM activities provide information for improved decision making in the Adaptive Management Plan process (AMP). Here, we summarize EM activities conducted in water year (WY) 2021, encompassing a variety of fisheries and environmental monitoring activities. The water year is defined from October 1 to September 30 of the subsequent year. In this case, WY 2021 runs from October 1, 2020 to September 30, 2021. This report is meant to summarize and highlight EM activities on a water year basis which better matches the biology of *O. mykiss*, and in turn, the monitoring schedules of each EM activity.

In water year 2021, FISHBIO collected data to inform the following EM activities, which included EM activities 1 (*Environmental Conditions*), 2 (*Adult Salmonids*), 3 (*Juvenile Salmonids*), 4 (*Stranding and Salmonid Rescue*), 11 (*Fisheries Take Reporting*), and 12 (*Alternative Fisheries Monitoring*). SEWD is responsible for EM activities 5, 7, and 8, which will not be reported herein. Several EM activities (i.e., benthic macroinvertebrate [BMI] surveys under EM 1) were not completed in WY 2021, details of which will be discussed below. For the EM activities completed, a description of the methods, results, and key findings are provided in detail in each summary report. With the exception of the BMI surveys and flashboard dam notch monitoring, all other fisheries monitoring activities were implemented as planned. Briefly, we highlight some of the key findings from the suite of fisheries monitoring activities that were conducted.

The Shelton Road Rotary Screw Trap (EM 3) was operated for the 20th field season and was operated for 152 days during WY 2021. A total of 1,982 *O. mykiss* were captured during the trapping period. This figure was the second most number of *O. mykiss* captured on record.

The fish ladder and camera monitoring system at Bellota were operated for a total of 72 days from December 14, 2020 to February 23, 2021. This was the only monitoring method that observed steelhead during monitoring activities with a total of three adult steelhead observed to have ascended the fish ladder during January and February 2021. Two of these fish were determined to be naturally produced as they had an intact adipose fin. No adult Chinook salmon were observed during any fisheries monitoring activities during WY 2021 with no observations during either redd surveys or fish ladder monitoring (EM 2 - *Adult Salmonids*).

Snorkel surveys (EM 12 - *Alternative Fisheries Monitoring*), which began in 2011 were conducted for the 9th season and estimated abundance was 16,260 (95% confidence interval 8,980 – 23,542) *O. mykiss* of all sizes and ages combined. This figure is the 2nd highest on record and slightly higher than the 13,551 fish estimated in WY 2020. Of the 100 sampling units that were snorkeled, *O. mykiss* were observed in 87 of them indicating that *O. mykiss* were widely distributed throughout the surveyed reach.

Finally, the *O. mykiss* life history investigation (EM 12 - *Alternative Fisheries Monitoring*), first implemented in WY 2020 attempts to integrate PIT tagging and recapture efforts across RST trapping, active fish collections for PIT tagging and collections of biological samples, and the operation of the PIT tag antenna at the Bellota Fish Ladder. Data from this study should provide data suitable to characterize survival and movement patterns of *O. mykiss*, the fraction of the population that has the anadromous haplotype on the *Omy5* gene (i.e., whether they have the genetic background to become anadromous or not), and factors (i.e., growth, water temperature) that most affect the decision to become anadromous or not.

Introduction

Background

Since 2001 and throughout the development of the Calaveras River Habitat Conservation Plan (CHCP), Stockton East Water District (SEWD) has funded a variety of fisheries research and monitoring on the lower Calaveras River to better understand how water operations may affect at-risk salmonid populations and influence their life history pathways, particularly Central Valley steelhead and rainbow trout (*Oncorhynchus mykiss*). The suite of past and current fisheries monitoring studies (i.e., rotary screw trapping at Shelton Road) has both improved the knowledge of *O. mykiss* in the Calaveras River and informed the development of the CHCP. Briefly, the purpose of a Habitat Conservation Plan is to develop conservation strategies intended to monitor the status of species of interest that may be impacted by project operations and adaptively manage the system for the betterment of those species. Beginning in the early 2000s, SEWD engaged the National Marine Fisheries Service (NMFS) to develop an HCP for Central Valley steelhead in the Calaveras River. An additional benefit of the CHCP is that the regulatory burden and uncertainty on SEWD is reduced and that project operations, restoration activities, and other management programs can be better planned and implemented. After over a decade in development, the Calaveras River Habitat Conservation Plan (CHCP) was approved by the NMFS on September 14, 2020.

The CHCP lays the groundwork for a management plan that would support future studies of the fish community below New Hogan Dam. Beyond research and monitoring, the CHCP includes several management activities related to flow, fish passage, and water quality to further support fish conservation over the term of a 50-year permit for water operations. The CHCP also establishes the SEWD as the watershed coordinator, which acts to inform stakeholders about the current state of the river and provides a forum for stakeholder and citizen input in Calaveras River management.

The overall goal of the suite of studies has been to document baseline environmental and fisheries-related conditions and to collect information that will aid in the design and management of long-term conservation strategies and the Adaptive Management Plan's decision-making process (AMP process). The monitoring programs under the Habitat Conservation Plan must provide information to: *"**(1)** evaluate compliance; **(2)** determine if biological goals and objectives are being met; and **(3)** provide feedback information for an adaptive management strategy"* (65 FR 35242). Under the CHCP, two categories of monitoring activities were implemented after the approval of the CHCP in September 2020 to fulfill these requirements: compliance monitoring and effectiveness monitoring. Compliance monitoring activities were conducted to verify that conservation strategies pursuant to the CHCP are implemented according to the plan. Effectiveness monitoring activities were implemented to evaluate whether the conservation strategies are achieving the CHCP biological goals and objectives and provide information for the AMP process.

Effectiveness Monitoring Activities

Many of the activities conducted as part of the Calaveras River Fisheries Monitoring Program are designed to determine if biological objectives, targets, and data gaps are being addressed during

any given year. The typical field and reporting schedules are shown in **Table 1**. Additional information on the Calaveras River watershed can be found in Appendix D of the CHCP (SEWD and FISHBIO, 2020).

Table 1. General fisheries monitoring and reporting calendar based on the water year.

Water Year (Oct 1 - Sept 30)		= Implementation						= Internal Reporting						= Annual Reporting						
	Monitoring Activity and Effectiveness Monitoring	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
Required	Rotary Screw Trapping (EM 3)																			
	Fish Ladder Monitoring (EM 2)																			
	Redd/Carcass Surveys (EM 2)																			
	Stranding Surveys and Fish Rescue(s) (EM 4)	*												*						
	Water Temperature Monitoring (EM 1)																			
	Fisheries Take Reporting (EM 11)																			
	BMI (EM 1)																			
Related	Life History Study (EM 12)																			
	PIT Tag Operation (EM 12)																			
	Snorkel Surveys (EM 12)																			
Reporting	Annual Fisheries Monitoring Report (Draft to SEWD)																			
	Annual Fisheries Monitoring Report (Final to Agencies)																			
	Adaptive Management Plan																			

** Note that stranding surveys and fish rescues reported on a slightly different schedule than other field activities to ensure changes in procedures can be implemented prior to the next field season.*

Effectiveness monitoring (EM) activities are not arranged in any priority order and are described below:

EM 1. Environmental Conditions Monitoring

Data recorded will include flow, water temperature, turbidity, dissolved oxygen, and benthic macroinvertebrates (BMI). Water temperatures will be recorded year-round at up to 11 potential thermograph locations that automatically record temperatures at hourly intervals. Results of EM 1 activities are accounted for as part of the environmental data collected during *Juvenile Salmonid Monitoring at the Shelton Rd. Rotary Screw Trap (RST)* and *Water Temperature and Discharge Monitoring* summaries. Further, while no BMI sampling was conducted during the 2020/2021 monitoring period, new procedures and rationale are detailed in *Benthic Macroinvertebrate (BMI) Monitoring and Habitat Assessment* report.

EM 2. Adult Salmonid Monitoring

Adult salmonid counts in the spawning reach upstream of Bellota are important for establishing how many adults were able to access the spawning reach and to identify any relationships between spawner abundance and environmental or operational factors. Results of EM 2 activities are accounted for in the *Fish Ladder Monitoring*, *Calaveras River Redds Survey,* and *Calaveras River O. mykiss Over-summer Abundance Surveys* summaries.

EM 3. Juvenile Salmonid Monitoring

Juvenile downstream migration monitoring data collected at the Shelton Rd RST will be used in conjunction with EM 1 data to address whether measures designed to meet the biological objective and associated targets identified above are functioning as expected, as well as to provide information for addressing relevant data gaps to assist the Adaptive Management Plan process. Juvenile salmonid counts at the lowermost boundary of quality spawning habitat are important for identifying population level attributes (e.g., abundance, timing of emergence and early emigration), individual level attributes (e.g., condition factors, life history expression), and associated influencing habitat attributes (water temperature, flow, etc.). It also allows the possibility to infer trends in habitat availability relative to environmental factors in the reach upstream of the trap, as well as to identify how many migrants may be susceptible to diversions downstream of Shelton Road. Results of EM 3 activities are accounted for as part of the environmental data collected during *Juvenile Salmonid Monitoring at the Shelton Rd. Rotary Screw Trap (RST)* and *Calaveras River O. mykiss Over-summer Abundance Surveys* summaries.

EM 4. Fish Evaluation and Salmonid Relocation During Fall Flashboard Dam Removal Operations

Monitoring for presence/absence of fish in the Old Calaveras River channel during dewatering each year provides an indication of whether the interim or permanent barriers have been effective for preventing entrainment. If salmonids do enter the channel and become stranded, relocation operations during dewatering will prevent or minimize mortality and will secondarily provide information (i.e., fish size, length, condition factor) regarding characteristics of entrained fish. Results of EM 4 activities are presented in the *Calaveras River Stranding Survey* summary.

EM 5. Monitor Pool Downstream of Bellota for Salmonids during Interim Fish Ladder Operations

SEWD will record observations of salmonids in the pool downstream of Bellota during interim ladder operations. Prior to permanent improvements at the Bellota Diversion Facility, adult salmonids may enter the pool downstream of Bellota and become temporarily stranded under a declining hydrograph where the lower river becomes disconnected from the confluence. Under these circumstances, monitoring will identify whether salmonids are present in the pool and whether there are sufficient inflows to operate the upper ladder (i.e., ≥10 cfs). A summary of visual surveys of the pool during Bellota maintenance visits is included in *Stockton East Water District's (SEWD) Annual Operations Repor*t and is not accounted for herein.

EM 6. Fish Screen Effectiveness Monitoring

Monitoring will determine whether diversion screening design criteria were implemented and whether the screen provides salmonid protection from entrainment and impingement as expected. Once the permanent fish passage and screening improvements are implemented at the Bellota Diversion Facility, fish screen effectiveness monitoring will be conducted according to the study plan provided in Calaveras HCP Appendix D. As these improvements have not yet been implemented, no such monitoring occurred during the 2020/2021 monitoring period.

EM 7. Structural Improvement Monitoring

Effectiveness of instream structure modifications in meeting passage design criteria will be evaluated using as-built surveys and streamflow records. This information will also be used to

identify duration and frequency of passage opportunities. Supervisory Control and Flow Data Acquisition System (SCADA) data will also be used to provide an indication of flow levels associated with juvenile migration, which will allow documentation and evaluation of fish passage opportunities. No such activities occurred during the 2020/2021 monitoring period, however, in the future, summaries relating to EM 7 would be included in the *SEWD's Annual Operations Report* and would not be accounted for herein.

EM 8. Stakeholder Education Efforts

SEWD will record stakeholder education efforts and maintain an updated list of screened/unscreened diversion to address whether measures designed to meet the biological objectives and associated targets identified above are functioning as expected. SEWD will document completion of stakeholder educational program activities (periodic workshops, annual newsletters, and a regularly updated website) including any stakeholder comments. A summary of stakeholder outreach efforts and development of a comprehensive list of private water diversions is included in *SEWD's Annual Operations Report* and is not accounted for herein.

EM 9. Fyke Net Evaluation of Flashboard Dam Notches

Very little is known about the ability of salmonids to pass flashboard dams and any harm or injury that may be incurred during passage. Similarly, there are few examples of existing passage improvements at comparable structures to guide future improvements. Evaluating passage and potential injury of juvenile salmonids in the Old Calaveras River channel and Mormon Slough/Stockton Diverting Canal (SDC) will provide information on the success of passage improvement measures and guide future passage improvement efforts. Prior to the implementation of the CHCP, a limited fyke trapping effort occurred at a flashboard dam in 2010. A more formalized study will occur in a yet to be determined future monitoring season. It should be noted that fish were recovered during the 2020/2021 Flashboard Dam Removal Stranding Surveys, thereby implying that fish were able to utilize the notches.

EM 10. SEWD Instream Structures Maintenance Operations Water Quality Monitoring and/or Visual Assessment

If instream maintenance work will occur in flowing water, SEWD personnel will visually assess work areas for fish prior to and during activities and will disperse any fish observed. Any salmonids observed will be documented. Water quality measurements (water temperature, dissolved oxygen, electrical conductivity, and turbidity) will also be recorded. No such instream work, other than the removal/installation of the flashboard dams, occurred during the 2020/2021 monitoring period and therefore no summary relating to EM 10 is provided herein.

EM 11. Fisheries Monitoring Take Assessment

SEWD's fisheries biologists (FISHBIO) will maintain daily records of salmonid take (number and condition such as healthy, injured, or dead) to address whether measures designed to meet the biological objective and associated target identified above are functioning as expected. These data will be used to determine whether sampling protocols offer sufficient salmonid protection or need to be modified. Results of EM 11 activities are presented as the *Required Compliance Monitoring Activities* identified below. Further, an Excel spreadsheet detailing the take of salmonids across all activities will be provided to the National Marine Fisheries Service representative(s) identified for the coordination of the CHCP (currently Meiling Colombano and Monica Gutierrez).

EM 12. Alternative Fisheries Monitoring

Alternative monitoring activities such as seining, electrofishing, and telemetry will be conducted within funding constraints, if deemed necessary through the AMP process (i.e., an annual monitoring budget will be established, and varying monitoring activities can be selected each year dependent on recommendations of Governmental Resource Agencies and Science Advisors). One or more of these sampling methods can be used to evaluate fish assemblages between New Hogan Dam and the mouth of the river to determine: 1) what species are present and in what abundance, 2) how species assemblages change throughout the year in relation to environmental conditions, 3) residency rates and distribution of juvenile salmonids, 4) juvenile salmonid habitat use, and 5) if losses to juvenile salmonids are related to predation, water quality factors, entrainment, or a combination of these factors. Further, an Excel spreadsheet detailing the take of salmonids across all activities will be provided to the National Marine Fisheries Service representative(s) identified for the coordination of the CHCP (currently Meiling Colombano and Monica Gutierrez).

Study Area

The Calaveras River is a small, regulated tributary to the San Joaquin River and serves as an important source of surface water for agricultural and municipal uses in Calaveras and San Joaquin counties. SEWD's management of this precious resource on behalf of its constituents over the past forty years has created conditions which support a healthy *O. mykiss* fishery characterized by relatively high abundance and fish condition factors recorded during the various monitoring efforts conducted by SEWD's biologists (FISHBIO) and by anecdotal accounts from local fishermen. Additional information on the Calaveras River watershed can be found in Appendix B of the CHCP (SEWD and FISHBIO, 2020).

The plan area boundary is limited to the lower Calaveras River and its adjacent riparian zone between New Hogan Dam and the confluence with the San Joaquin River, as well as the New Hogan Reservoir (**Figure 1**). While the plan area boundary includes the lower Calaveras River, this report specifically analyzes and refers to the 18-mile stretch of premium spawning and rearing habitat available above Bellota as the Conservation Area. More broadly, the CHCP boundaries encompass those waterways that are potentially accessible to the Covered Species within the District's service area, including:

- Lower Calaveras River from New Hogan Dam river mile 42 (RM; as measured from the confluence with the San Joaquin River) to the confluence where it enters the San Joaquin Delta (RM 0) via both the Old Calaveras River channel and Mormon Slough/Stockton Diverting Canal (SDC) routes (**Figure 1**).
- Potter Creek from the headwaters to its two branches (North and South) and its two confluences with Mormon Slough – North branch enters Mormon Slough at the old Southern Pacific Railroad Bridge and the South branch enters Mormon Slough just upstream of Panella Dam. Note that no fisheries monitoring activities were conducted in these locations during WY 2021.

- Mosher Slough/Creek from the headwaters at Mosher Creek Dam to its confluence with Pixley Slough/Bear Creek. Note that no fisheries monitoring activities were conducted in these locations during WY 2021.

Fisheries monitoring and environmental conditions monitoring are conducted routinely at a variety of locations within the Calaveras River watershed. A list of key monitoring locations and other points of interest along with location information (river kilometer [rkm; as measured from the confluence with the San Joaquin River], river mile [RM], and coordinates) are provided in **Table 2**.

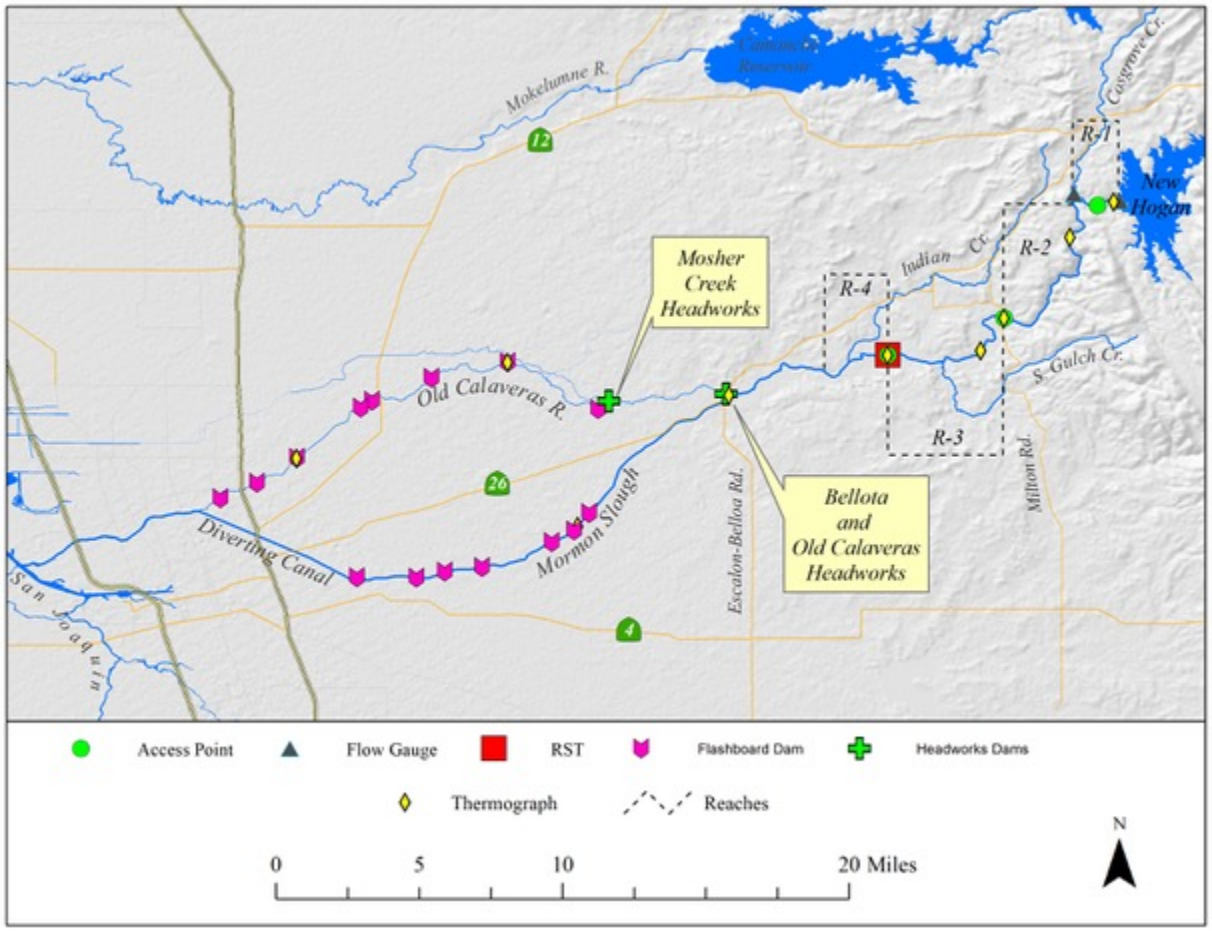


Figure 1. Map of Calaveras River watershed and key monitoring locations including the Old Calaveras River, the Stockton Diverting Canal, and the lower Calaveras River above Bellota. Note that Mosher Slough and Potter Creek are not shown on the map as no fisheries related monitoring was conducted in water year 2021 in these locations.

Table 2. List of key monitoring locations and other points of interest in the Calaveras River watershed (ordered from upstream to downstream).

Reach	Sub-Reach	Location	rkm	RM	Latitude	Longitude	Type
Conservation Area	Dam	New Hogan Dam	67.9	42.4	38.15032	-120.81420	Dam
		New Hogan Dam Gauge	67.9	42.4	38.15032	-120.81420	Flow Gauge
		Hogan Dam	67.8	42.4	38.15007	-120.81728	Thermograph
		Hogan Dam Rd.	66.9	41.8	38.14807	-120.82558	Public Access
		Cosgrove Creek Confluence	66.6	41.4	38.15015	-120.83240	Tributary Confluence
		Cosgrove Creek Gauge	0.6	0.4	38.15288	-120.83625	Flow Gauge
	Canyon	4763 Dunn Rd.	65.6	41.0	38.14950	-120.83841	Private Access
		Clements Pl.	62.9	39.3	38.13211	-120.83948	Thermograph
		Seigel Rd.	57.2	35.7	38.09136	-120.85589	Private Access
		Milton Rd./Jenny Lind Bridge	55.4	34.6	38.09148	-120.87266	Public Access
	Jenny Lind	Jenny Lind	55.0	34.4	38.09147	-120.87272	Thermograph
		Gotelli Ranch	51.9	32.4	38.07507	-120.88456	Private Access
		Gotelli Ranch	51.8	32.4	38.07480	-120.88581	Thermograph
		South Gulch Confluence	49.9	31.0	38.06952	-120.90512	Tributary Confluence
		Williams Crossing	47.9	30.0	38.07257	-120.92299	Alternative RST Location
		Williams Crossing	47.9	30.0	38.07257	-120.92299	Private Access
	Shelton Road	Shelton Rd.	47.2	29.5	38.07273	-120.93141	Primary RST Location
		Shelton Rd.	47.2	29.5	38.07278	-120.93152	Thermograph
		Shelton Rd.	47.1	29.5	38.07271	-120.93165	Private Access
		Indian Creek Confluence	45.3	28.1	38.06916	-120.95143	Tributary Confluence
		Dog Ranch	43.6	27.2	38.06383	-120.96260	Private Access
		Bellota	38.4	23.9	38.05249	-121.01165	Dam
		Upper Bellota	38.4	23.9	38.05249	-121.01165	Thermograph
Mormon Slough		Lower Bellota	38.3	23.8	38.05223	-121.01186	Thermograph
		Bonomo Flashboard Dam	28.7	18.0	37.99310	-121.08235	Flashboard Dam
		Milton Rd.	28.0	17.4	37.98645	-121.08803	Thermograph
		Piazza Flashboard Dam	27.6	17.3	37.98434	-121.08986	Flashboard Dam
		Prato Flashboard Dam	26.5	16.5	37.97844	-121.10120	Flashboard Dam
		McClean Flashboard Dam	22.9	14.3	37.96593	-121.13632	Flashboard Dam
		Lavaggi Flashboard Dam	21.2	13.2	37.96371	-121.15525	Flashboard Dam
		Panella Flashboard Dam	19.8	12.4	37.96059	-121.16941	Flashboard Dam
		Mainstreet Flashboard Dam	17.1	10.7	37.96075	-121.19957	Flashboard Dam
Old Calaveras		Headworks	32.8	20.5	38.05314	-121.01324	Thermograph
		Mosher Creek Headworks Dam	26.6	16.5	38.04950	-121.07214	Headworks Dam
		Clements Dam	25.7	16	38.04550	-121.07768	Flashboard Dam
		Tully Dam	19.6	12.2	38.06918	-121.12342	Flashboard Dam
		Tully Rd.	19.5	12.2	38.06916	-121.12350	Thermograph
		Eight Mile Dam	14.8	9.2	38.06125	-121.16192	Flashboard Dam
		Murphy Dam	10.9	6.8	38.04978	-121.19197	Flashboard Dam
		Pezzi Dam	10.1	6.3	38.04622	-121.19769	Flashboard Dam
		Solari Ranch Rd.	6.1	3.8	38.02071	-121.23002	Thermograph

Table 2, cont. List of key monitoring locations and other points of interest in the Calaveras River watershed (ordered from upstream to downstream).

Reach	Location	rkm	RM	Latitude	Longitude	Type
Old Calaveras	Solari Dam	6.0	3.7	38.02091	-121.22977	Flashboard Dam
	Cherryland Dam	3.5	2.2	38.00845	-121.25005	Flashboard Dam
	McAllen Dam	1.4	0.9	38.00053	-121.26841	Flashboard Dam

Calaveras River Juvenile *Oncorhynchus mykiss* Outmigration Monitoring

Water Year 2021 Annual Report

Prepared By:
Tyler Pilger
Patrick Cuthbert
Matt Peterson

Report Summary

During water year 2021, the Shelton Road rotary screw trap was operated for a total of 152 days between November 1, 2020 and July 23, 2021. A total of 1,982 juvenile and adult *Oncorhynchus mykiss* were captured in the trap. Based on the numbers of each size captured, 2021 was an age 1+ dominated year, as opposed to other years that were YOY dominant years. Daily catch of *O. mykiss* was consistent across the entire monitoring season, but there was a spike in catch that coincided with a spike in flow from Cosgrove Creek. Fulton condition factor was calculated for every individual that was both measured (standard length in mm) and weighed (grams). Overall, *O. mykiss* captured in the Shelton Road RST were in good or excellent condition. Few juvenile Chinook salmon (*O. tshawytscha*) were captured with a seasonal total of two individuals. Environmental variables of temperature, dissolved oxygen, and turbidity did not vary much throughout the season. The exception was turbidity that spiked at the same time as the Cosgrove Creek flow spike.

Introduction

O. mykiss Outmigration Monitoring

Monitoring of juvenile salmonids constitutes Effectiveness Monitoring (EM) under the Calaveras River Habitat Conservation Plan. On behalf of Stockton East Water District, FISHBIO performs the required EM 3 (Juvenile Salmonid Monitoring) to assess the conservation strategies related to New Hogan Reservoir Water Impoundment and Non-flood Control Operations. This monitoring is also expected to contribute data to address three major data gaps regarding Central Valley steelhead, those being 1) salmonid population carrying capacities, 2) percent of *O. mykiss* population expressing different life-history patterns and the factors influencing life-history expression, and 3) entrainment susceptibility of individual salmonids. Data collected for EM 3 is used in conjunction with EM 1 data (Environmental Conditions Monitoring) to address whether measures designed to meet the biological objective and associated targets are functioning as expected. Counts of juvenile salmonids occurs at the lowermost boundary of spawning habitat (i.e., Shelton Road) are used for identifying population level attributes (e.g., abundance, timing of emergence, and early migration), individual level attributes (e.g., condition factors and life history expression), and associated influencing habitat attributes (e.g., water temperature and flow). This monitoring is also important for detecting trends in habitat availability relative to environmental factors in the reach upstream of EM 3 activities, as well as to identify how many migrants may be susceptible to diversions downstream of EM 3 activities.

The stated goal of the Juvenile Salmonid Monitoring Program on the Calaveras River is to estimate annual abundance levels and migration characteristics in order to assess the effectiveness of conservation strategies and to provide information for adaptive management. Specific project objectives are to:

1. Monitor passage of *O. mykiss* with a rotary screw trap (RST) in the lower Calaveras River,
2. Monitor environmental variables in the lower Calaveras River, and
3. Determine the influence of environmental and biological variables on *O. mykiss* migration characteristics

History of Sampling

Rotary screw traps (RST) have been operated on the Calaveras River since January of 2002 (**Table 3**) to monitor salmonids that are presumably emigrating from the river. With few exceptions, the RST has been operated from November through July of the following year. During regular flow conditions, FISHBIO operates a 5-ft RST at the Shelton Road bridge (38.072719, 120.931417). However, during periods of high flows (typically > 300 cfs for an extended period), an alternate 8-ft diameter RST is permitted and can be operated at Williams Crossing (38.07174, -120.92194; FISHBIO 2017; Appendix A: Background on 8-foot diameter RST).

Table 3. Summary of rotary screw trap operation and catch by water year at the Shelton Road trapping location.

		O. mykiss			Chinook salmon		
Water Year	**Dates[1]**	**Total Catch**	**Abundance Index[1]**	**Length Range (mm)**	**Total Catch**	**Abundance Index[2]**	**Length Range (mm)[2]**
2002	01/17 – 05/09	1,132	2,702	20-450	7	-	66-87
2003	01/04 – 05/13	1,539	6,918	22-390	0	-	-
2004	12/02 – 05/13	1,411	4,397	24-286	0	-	-
2005	12/10 – 04/22	323	1,127	21-375	0	-	-
2006	01/19 – 06/30	706	5,029	21-423	5,945	39,123	30-115
2007	12/14 – 06/29	1,200	7,294	22-360	2,121	20,805	35-140
2008	11/13 – 06/29	1,877	11,116	20-315	1	-	110
2009	11/04 – 07/11	1,309	7,794	19-310	0	-	-
2010	11/10 – 07/10	2,818	13,670	19-355	0	-	-
2011	11/02 – 07/15	742	3,706	24-290	0	-	
2012	10/27 – 07/07	824	3,019	20-370	2,311	12,132	30-115
2013	11/06 – 07/12	336	2,091	22-284	449	4,082	35-140
2014	11/06 – 07/11	1,170	3,136	18-510	11	-	98-200
2015	11/18 – 07/01	539	884	17-450	21	-	78-103
2016	11/03 – 07/10	63	199	52-330	0	-	-
2017	11/03 – 07/14	60	248	25-350	33	-	34-110
2018	11/07 – 07/13	565	2,973	22-355	6,517	47,594[a]	26-147
2019	11/06 – 06/28	705	2,294	24-435	4,719	15,763[a]	29-125
2020	11/05 – 07/17	1,716	12,523	23-377	221	-	32-177
2021	11/03 – 07/23	1,982	5,737	23-555	2	-	112-120

[1] Abundance index excludes any adult *O. mykiss* (fork length > 300 mm).
[2] Dash indicates no data available for that year.
[a] Actual abundance estimated according to methods described in Pilger et al. 2019, 95% confidence intervals for 2018 are 32,546-74,924 and 2019 are 11,449-21,724, see FISHBIO 2019; Appendix B.

Methods

Sampling Gear

An RST is a commonly used trapping equipment to capture downstream migrating juvenile salmonids. The traps, manufactured by E.G. Solutions in Eugene, Oregon consist of a funnel-shaped core suspended between two pontoons. The traps are positioned in the current so that water enters the mouth of the funnel and strikes the internal screw core, causing the funnel to rotate. As the funnel rotates, fish are trapped in pockets of water and drawn downstream into a live box, where they remain until they are removed, identified, measured, and released in the river downstream of the trap (i.e., processed) by technicians.

As a safety precaution, signs are strategically placed at the trap, upstream of the trap, and downstream of the trap to warn people of drowning danger and potential damage to private property, as well as to direct boater traffic to pass safely. Flashing lights and flagging are placed on the traps and along the cabling to increase visibility.

A single 5-ft diameter RST was operated at approximately river mile (RM) 28, just upstream of the Shelton Road bridge (**Figure 1**; **Figure 2**). As described in Palmer and Sonke (2010), flow deflection structures were constructed and strategically placed in the river during lower flow periods in order to divert more water toward the trap, increasing velocity into the funnel for optimal functioning of the trap.

Figure 2. Five-foot diameter rotary screw trap operating during low flows on the Calaveras River at Shelton Road (picture taken on March 17, 2010).

RST Monitoring

The Shelton Road trap began fishing (i.e., the cone was lowered into the water and allowed to rotate) on November 2 with the first trap check on November 3. The trap was operated on a 5 day on and 2 day off schedule until it was removed on July 23, 2021. The trap was checked at least once per day when operating, typically in the morning hours. Additional trap checks were conducted as necessary; for example, during periods when heavy debris loads might obstruct the trap. Operations were consistent with the United States Fish and Wildlife Service (USFWS) RST protocols and safe fish handling procedures (USFWS 2008). The 8-foot diameter RST was not operated during WY 2021 as discharge levels did not reach high enough levels.

During each trap check, the contents of the livebox were removed and all fish were identified and counted. All salmonids, and up to 20 of each non-salmonid species, were anesthetized for safe handling using AlkaSeltzer® (1,916 mg Sodium Bicarbonate/4 liters of water; Bayer HealthCare, Whippany, NJ), measured for length, and salmonids were given a smoltification rating (**Table 4**). Juvenile *O. mykiss* were considered young-of-the-year (YOY) if they were under 100 mm FL and were considered one year-old or older (Age 1+) if there were between 100 and 299 mm FL. Weights (to nearest tenth of a gram) were taken from all *O. mykiss* and up to 20 non-salmonids each week using a scale (Navigator model, Ohaus, Pine Brook, NJ). After handling, fish were placed in a container with freshwater and allowed to recover prior to release downstream of the trapping location.

Catches were batched by daily (~24-hour) sampling periods in which all the catch subsequent to a morning check one day is added to the catch from the morning check on the following day. For example, the daily catch for *O. mykiss* on April 10 is the sum of all of the *O. mykiss* captured during the morning check on April 10 and the *O. mykiss* captured during any checks that occurred after the morning check on April 9. Based on years of conducting salmonid trapping during normal flow and turbidity conditions, the overwhelming majority of trap catches occur during darkness or the low light immediately prior to or following darkness (FISHBIO, unpublished data).

Table 4. Life stage classification criteria assigned to salmonid species captured in the Shelton Road RST.

Smolt Index	Life Stage	Criteria
1	Yolk-sac Fry	Newly emerged with visible yolk sac
2	Fry	Recently emerged with sac absorbed (button up fry) Pigmentation undeveloped
3	Parr	Darkly pigmented with distinct parr marks No silvery coloration Scales firmly set
4	Silvery Parr	Parr marks visible but faded Intermediate degree of silvering
5	Smolt	Parr marks highly faded or absent Bright silver or nearly white coloration Scales easily shed (deciduous) Black trailing edge on caudal fin More slender body
6	Adult	> 300 mm FL If < 300 mm FL, must be extruding eggs or milt

Mark-recapture Methods

PIT Tagging and Detection

Beginning in 2014, many *O. mykiss* captured in the RST were implanted with a Passive Integrated Transponder (PIT) tag. While individuals were anesthetized for processing, a 12-mm half-duplex PIT tag (BioMark, Boise, ID) was injected into the body cavity just below and to the center of the left pelvic fin. A bio-adhesive is used to cover the needle insertion point to reduce infection risk. To facilitate and increase recapture rates of fish from the Life History Study (see p. 87 for more details), all *O. mykiss* of taggable size (>80 mm) captured in the RST were checked for the presence of a PIT tag using a hand-held PIT tag reader prior to injecting with a PIT tag.

Trap Efficiency Estimates

A photonic dye system may be used to perform mark-recapture trials to estimate the RST capture efficiency when daily catch of juvenile salmonids is sufficient to perform trials (minimum of 50 individuals per batch date). After anesthetized fish were processed as described above, individuals are sorted according to size class (≤ 100 mm or > 100 mm) and placed in separate five-gallon buckets. Photonic marks are administered using a MadaJet compressed air injector (MADA Equipment Co., Inc, Carlstadt, NJ) and a brightly colored dye solution (Day-Glo Color

Corporation, Cleveland, OH). To apply the mark, fish are placed on marking board to with the predetermined fin splayed. Marking locations include caudal (top or bottom lobe), dorsal, or anal fin. The injector tip is placed against fin tissue, and then dye is injected into the fin rays. Unique marking locations or colors are used on individuals from different size classes for rapid group determination. Following marking, fish are placed into aerated coolers and transported to the release location upstream of the RST. At the release site, marked fish are held in live cars constructed of 15-inch diameter PVC pipe cut to 34 inches in length. The ends of the live car are fitted with fine mesh, with one end being removable to allow access. Live cars are submerged in a location with low water velocity (to minimize swimming stress) and tethered to the bank.

Prior to release, a subsample of the marked fish in each release group are measured to estimate mean length and to check for mark retention. Fish are transferred from the live cars to five-gallon buckets and carried to location in the river where they will be released. During the release, fish are netted from the bucket using small aquarium nets. Each net scoop (approximately 10 individuals) is lowered into the water so fish can volitionally disperse. After about 30 seconds, another net scoop is released. All marked fish are released approximately one hour after sunset.

Following the release, the RST live box is then checked at one-hour intervals for presence of marked fish. All recapture marked fish from each release group are noted in the data sheets then released downstream of the trap. The release procedure is dependent on capturing enough fish but given sufficient catch, will be performed at different flows to assess the relationship between discharge and capture efficiency.

Abundance Estimates

For statistical analyses, fish were separated into two different life stage categories based on fork lengths: young-of-year (YOY; ≤ 100 mm) and age 1+ fish (> 100 mm). Linear regression was used to evaluate relationships between daily expanded catch (N) of each life stage and daily environmental variables (flow, water temperature, and turbidity).

Interpolation of Daily Catch

Because the RST is not operated continuously throughout the season, catch for days when the trap is not in operation must be interpolated using statistical measures. Prior to 2018, and described in Appendix D of the Calaveras HCP, a linear model using catch from three days prior to and following the missing days was used to estimate the number of fish when the trap was not operated. Beginning in 2018, generalized additive regression modeling (GAM) was used to interpolate daily catch. Additive modeling is used when the relationship between a response variable and explanatory variables is non-linear (Zuur et al. 2007). Here, daily catch is the response variable and day is the explanatory variable. We assume that daily catch on any given day conforms to a Poisson distribution with some degree of autocorrelation (i.e., counts from two or more consecutive days correlated). The additive model applied to daily catch (Y_i) and day (X_i) is:

$$Y_i = \alpha + s(X_i) + \varepsilon_i$$

where α is the intercept, s is a smoothing function for X, and ε_i is some expected, normally distributed error. The smoothing function is used to describe the daily changes in catch and will

approximate daily catch across the season when the number of inflection points (i.e., basis dimension, '*k*') is specified. To determine the most appropriate *k* value, a series of GAMs are fit with sequentially increasing k. The AIC value for each model is calculated and the *k* value from the model with the lowest AIC is used. After the best smoother is determined, this model is then used to predict catch on days the trap was not operated.

Trap Efficiency Available

The most accurate abundance estimates require mark-recapture capture efficiency tests. Because fish size (i.e., length) can affect capture efficiency, separate capture efficiency releases are used for fish ≤ 100 mm fork length or > 100 mm fork length. Capture efficiency, which is the number of marked fish recaptured following a release, is used to expand the number of unmarked fish captured in the trap. Daily abundance estimates (N) for each size class are calculated using the Peterson estimator according to the equation:

$$N = \frac{M(C+1)}{R+1}$$

where M is the number of marked fish released above the trap, C is the total of unmarked fish captured, and R is the number of marked fish recaptured in the trap.

Trap Efficiency Not Available

From 2002 to 2015, trap capture efficiency mark-recapture releases could not be performed, thus the above method could not be used. Nonetheless, an index of *O. mykiss* abundance for the sampling season was calculated by first expanding the daily number of fish captured by the percentage of daily flow sampled through the trap. The percentage of flow sampled by the trap on day i (Φ_i) is a function of the trap velocity (V_i), trap radius (r), and daily discharge (F_i) according to the equation:

$$\Phi_i = \frac{V_i\left(3.14 * \frac{r^2}{2}\right)}{F_i}$$

Daily flow is measured at New Hogan Dam and Cosgrove Creek combined. Daily catch (C_i) is then expanded to abundance (N) according to:

$$N_i = \frac{C_i}{\Phi_i}$$

Then, a predictive regression equation and 80% confidence intervals was used to estimate the number of fish that would have been captured on those days that were not sampled (i.e., missing data). The daily missing value ($\hat{y}$) is estimated as:

$$\hat{y} = \alpha + \beta X_h$$

where X_h is the missing day number and α and β are derived using the daily estimated numbers for the three days prior to and immediately following the period of no sampling days.

Condition Factor

The overall condition of *O. mykiss* captured was calculated using Fulton's Condition factor (*K*) according to the equation:

$$K = \frac{W}{SL^3} * 100{,}000$$

where *W* is the weight (g) and *SL* is the standard length (mm).

Monitoring Environmental Factors

Flow Measurements, RST Speed, and Condition

After all fish were measured and released, trap function was recorded, and the trap was cleaned. Trap function was determined based on three measurements: 1) the instantaneous water velocity in front of the trap funnel measured with a Flow Probe (Global Water, Model FP101, Gold River, CA); 2) the number of rotations the funnel made in a 24-hour period; and 3) the average time it took the funnel to make one revolution (calculated from three timed revolutions). These measurements can provide information regarding correct positioning of the trap and in the event that it prematurely stopped (e.g., log jam), how long the trap sampled prior to stopping.

Mean daily discharge from New Hogan Reservoir outflow data were downloaded from via the California Data Exchange Center (CDEC; https://cdec.water.ca.gov). Daily stage data for Cosgrove Creek were downloaded via CDEC and converted to discharge (in cfs) according to a rating curve provided by the US Army Corps of Engineers (USACE).

Water Temperature, Turbidity, and Dissolved Oxygen

Environmental variables were measured daily. Instantaneous turbidity was measured in Nephelometric Turbidity Units (NTU) using a turbidity meter (LaMotte, Model 2020e, Chestertown, Maryland). Instantaneous water temperature and dissolved oxygen (DO) were recorded using a DO meter (Exstick II model DO600, Extech Instruments Corporation, Waltham, MA), and instantaneous conductivity was recorded using a conductivity meter (ExStik II model EC500, Extech Instruments Corporation, Waltham, MA). Daily average water temperature was calculated from data that was logged hourly using a submersible temperature logger (Hobo Water Temp Pro V2, Onset Computer Corporation, Pocasset, MA).

Results

RST Performance

Debris buildup on the RST was greatest during November and December requiring frequent cleanings. During this period, there were two days when the trap could not be operated because of clogging by leaves. Throughout the entire sampling season, there were nine instances when the trap was not rotating when technicians arrived for daily trap check. There were two instances when water in the live box was overflowing due to clogging by filamentous algae. Lastly, there were three days that trap rested on the bottom of the channel when completely lowered, requiring minor adjustments to the trap (e.g., placed trap on blocks).

Salmonid Catch

Steelhead/Rainbow Trout

Oncorhynchus mykiss were captured throughout the entire sampling period (**Figure 3**) and every life stage was present (**Figure 4**). From November to mid-March, catch consisted of age 1+ parr, silvery parr, smolts, and adults. Fry did not appear in the catch until the end of March and April and were absent again in late June and July (**Figure 4**). The season total catch was 1,982 *O. mykiss* and we were able to implant PIT tags in 1,016 individuals. The coarse index of abundance suggests approximately 5,700 YOY and age 1+ fish migrated past the trap (**Table 3**).

Young-of-year (YOY) fish made up 36% of catch and age 1+ made up 63% of total catch. Of the 673 YOY fish that migrated past the trap, 15% (n = 102) were classified as fry and 75% (n = 507) were classified as parr, and 9% (n = 59) were classified as silvery parr. A total of 1,184 age 1+ migrated past the trap, of which 24% (n = 285) were parr, 46% (n = 545) were silvery parr, and 26% (n = 307) were smolts. Twelve adults were captured in the trap.

Chinook Salmon

Two yearling Chinook salmon (fork length > 100 mm) were captured during trapping efforts in early November 2020 (**Table 3**). These fish measured 112 mm and 120 mm FL, respectively, and were captured on November 4 and 5, 2020.

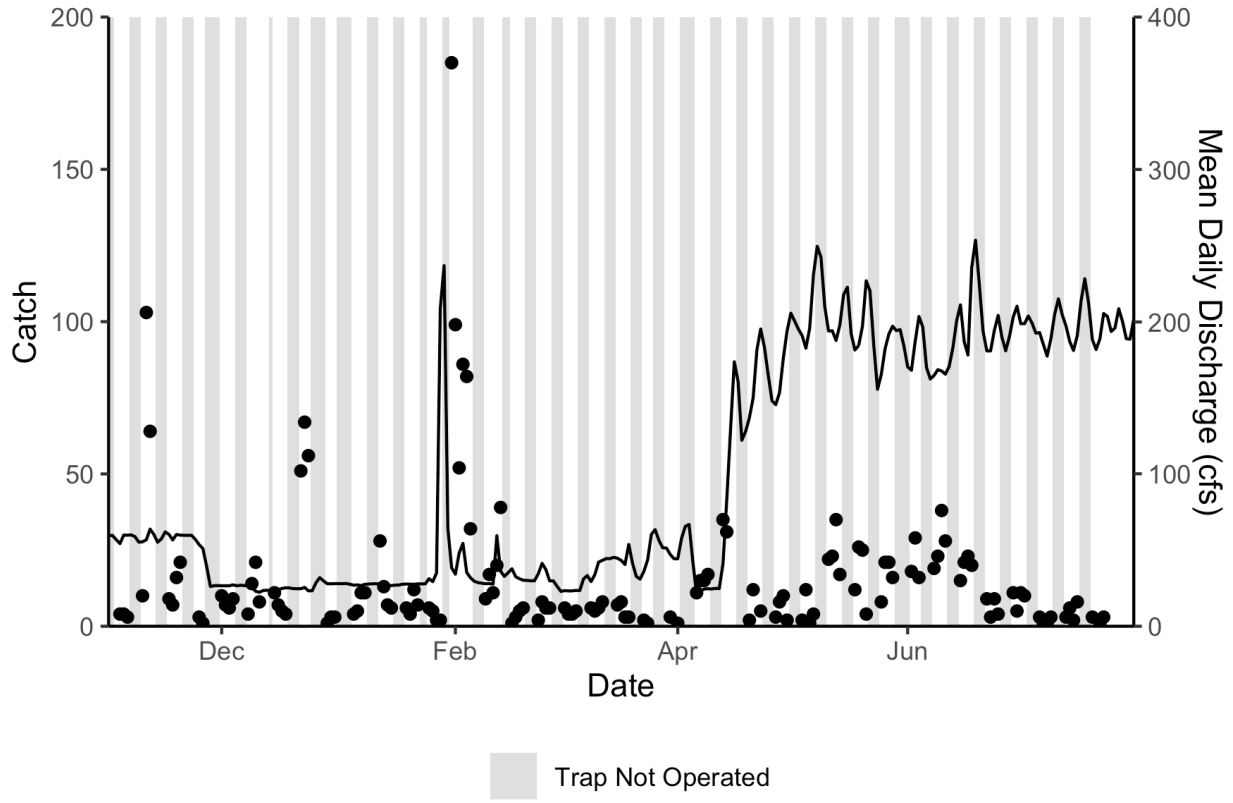


Figure 3. Daily catch totals for *O. mykiss* with combined discharge from New Hogan outflow and Cosgrove Creek. Shaded area are days when the trap was not operated, and no samples were collected.

Mark-recapture

In 2021, a total 1,016 *O. mykiss* captured at the RST were implanted with a PIT tag. All fish were released upstream of the RST and, in total, 181 fish were recaptured at the RST. In addition to recaptures at the RST, 10 tags deployed at the RST were detected at the PIT tag antenna located at Bellota. A single individual was detected upstream of the RST by crews sampling for the life history assessment project.

Not enough juvenile Chinook salmon were captured to perform capture efficiency mark-recapture trials in 2021.

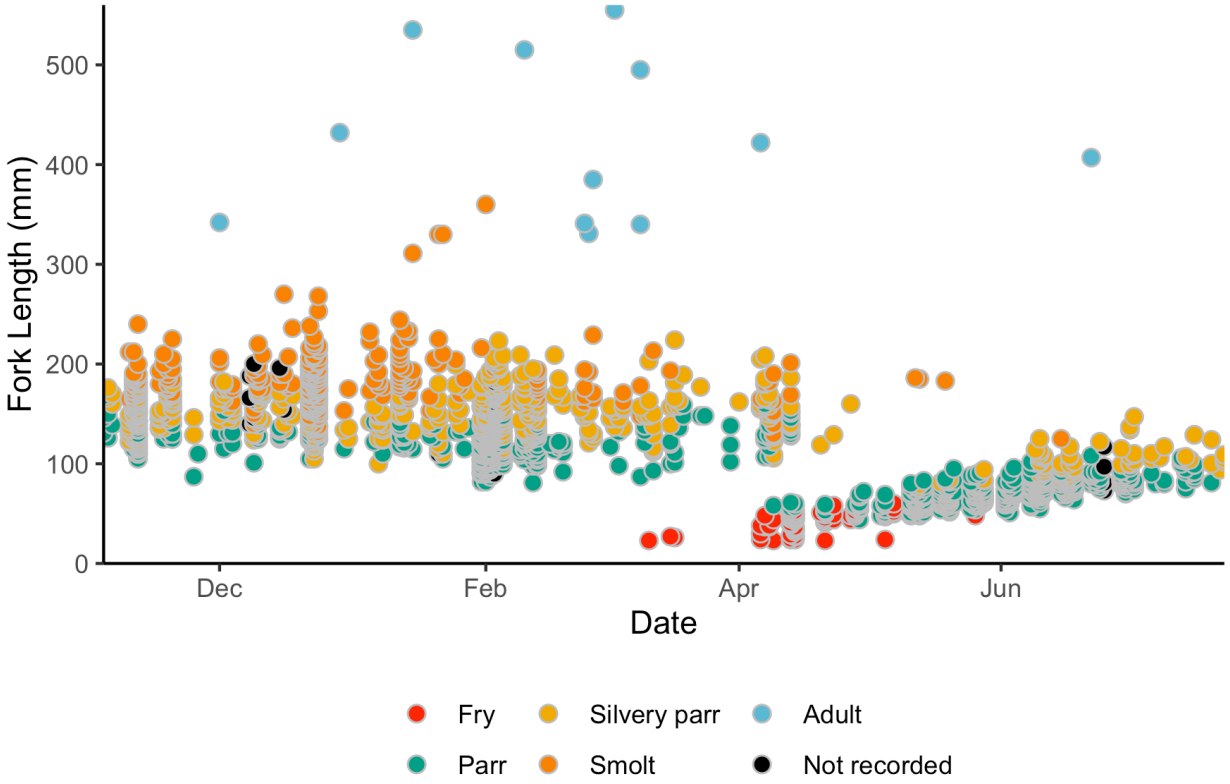


Figure 4. Fork lengths (mm) of all measured *O. mykiss* by date of capture. Color shading indicates life stage.

Condition Factor

Of the 1,982 *O. mykiss* captured, weights were collected on 1,657 (84%) individuals. The relationship between natural log of weight and natural log of standard length was linear with a slope of 2.91 (r^2 = 0.99). This observed slope validates the use of the exponent equaling 3 in the condition factor equation. Average condition factor (K) in 2021 was 1.37 and ranged from 0.42 to 3.50. Mean K for each size group and month category ranged from 1.24 to 1.49 (**Table 5**; **Figure 5**) Annual average K factors measured in the Calaveras during 2002-2015 ranged from 1.19 to 1.64 (n = 2,641).

Table 5. Summary of Fulton's condition factor (K) for *O. mykiss* captured at the Shelton Road RST.

Month	Standard Length (mm)	n	Mean	Range
Nov-Dec	<100	6	1.49	1.37-1.57
	100-199	313	1.26	0.90-1.68
	200-299	11	1.23	0.76-1.46
Jan-Feb	<100	51	1.35	1.09-1.82
	100-199	474	1.24	0.81-1.85
	200-299	12	1.25	1.09-1.53
Mar-Apr	<100	104	1.33	0.63-3.5
	100-199	111	1.27	1.02-1.83
	200-299	2	1.23	1.15-1.31
May-Jul	<100	525	1.42	0.42-1.89
	100-199	29	1.4	1.07-1.70

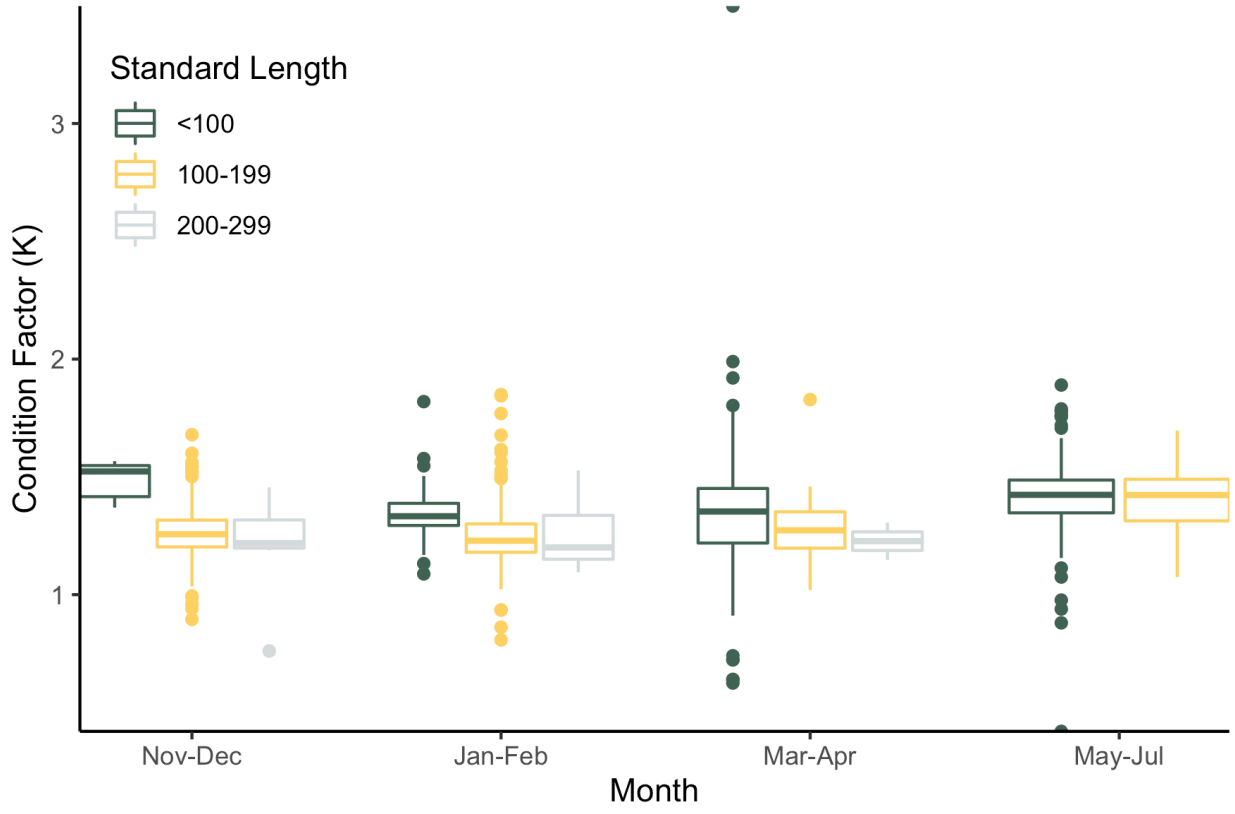


Figure 5. Fulton's condition factor (K) for *O. mykiss* captured in the Shelton Road RST in 2021

Non-salmonid Catch

A total of 1,726 non-salmonids were captured in the Shelton Road trap. Native fish Sacramento sucker (n = 1,394), Sacramento pikeminnow (n = 198), sculpin (n = 18), and hardhead (n = 2) made up the most frequently captured non-salmonids (**Table 6**). Nonnative species captured in the trap included black bass species (largemouth, smallmouth, or spotted bass), three species of sunfish, black crappie, channel catfish.

Table 6. Additional fish species captured in the Shelton Road RST from November 2020 through July 2021.

Common Name (Scientific Name)	Native (Y/N)	Total Catch	Length Range (mm)[1]
Chinook salmon (*Oncorhynchus tshawytscha*)	Y	2	112 – 120
Hardhead (*Mylopharodon conocephalus*)	Y	2	40 – 88
Sacramento pikeminnow (*Ptychocheilus grandis*)	Y	198	25 – 225
Sacramento sucker (*Catostomus occidentalis*)	Y	1,394	23 – 529
Channel catfish (*Ictalurus punctatus*)	N	1	72
Black bass (*Micropterus* spp.)	N	1	62
Black Crappie (*Pomoxis nigromaculatus*)	N	8	81 – 96
Bluegill sunfish (*Lepomis macrochirus*)	N	72	40 – 147
Pumpkinseed (*Lepomis gibbosus*)	N	1	131
Redear sunfish (*Lepomis microlophus*)	N	31	62 – 150
Sculpin (*Cottus* spp.)	Y	18	79 – 153*

[1]Reported lengths are measured according to fork length except when indicated by an asterisk when total length was used.

Environmental Factors

Daily mean discharge during the trapping period ranged from 21 cfs to 253 cfs. Instantaneous temperatures measured during morning trap checks ranged from 45°F to 59°F (**Figure 6**). Instantaneous measurements of dissolved oxygen ranged from 8.9 mg/L to 13.1 mg/L (**Figure 7**). Lastly, turbidity measured in during morning trap checks ranged from 0.1 NTU to 11.3 NTU (**Figure 8**). A freshet event on January 28, 2021, caused flows from Cosgrove Creek to spike which also caused a spike in turbidity. Additional instantaneous turbidity measurements collected during evening trap checks during the event were as high as 39.7 NTU.

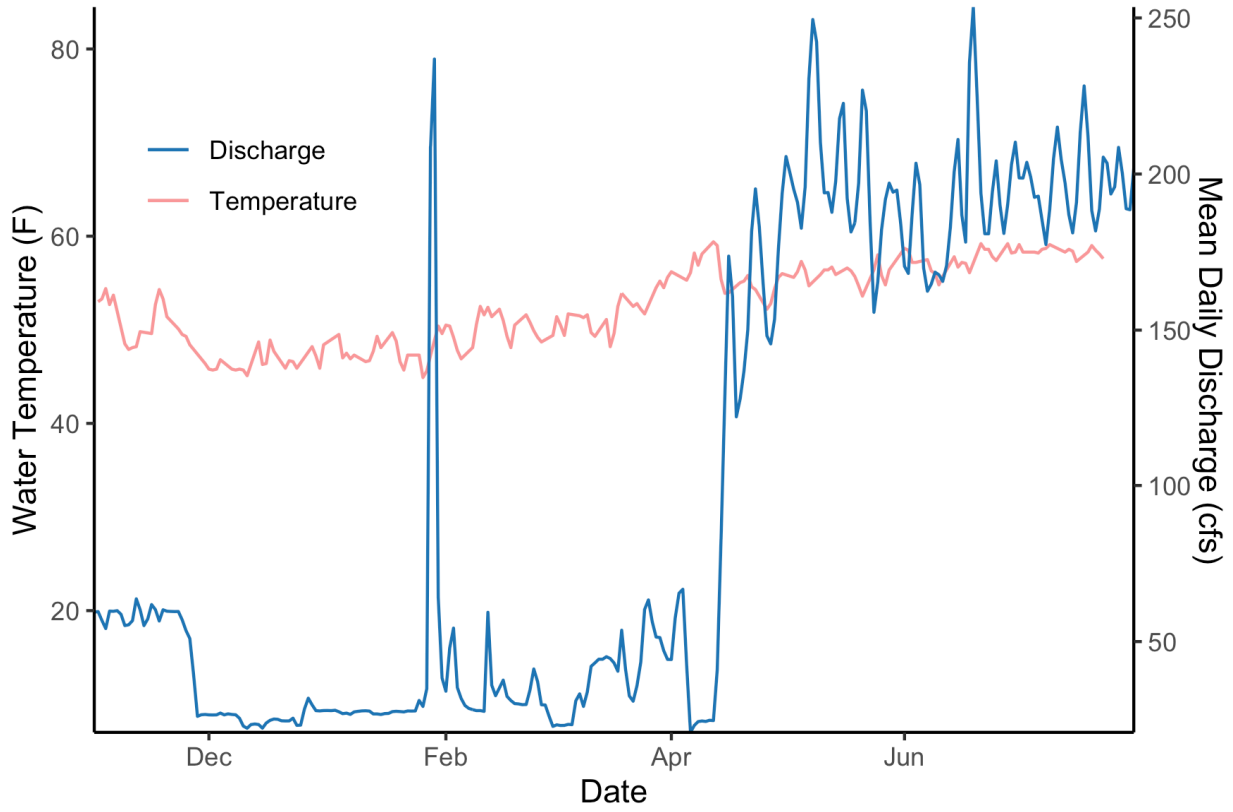


Figure 6. Instantaneous water temperature (°F) measured during daily checks of the Shelton Road RST along with mean daily discharge (cfs).

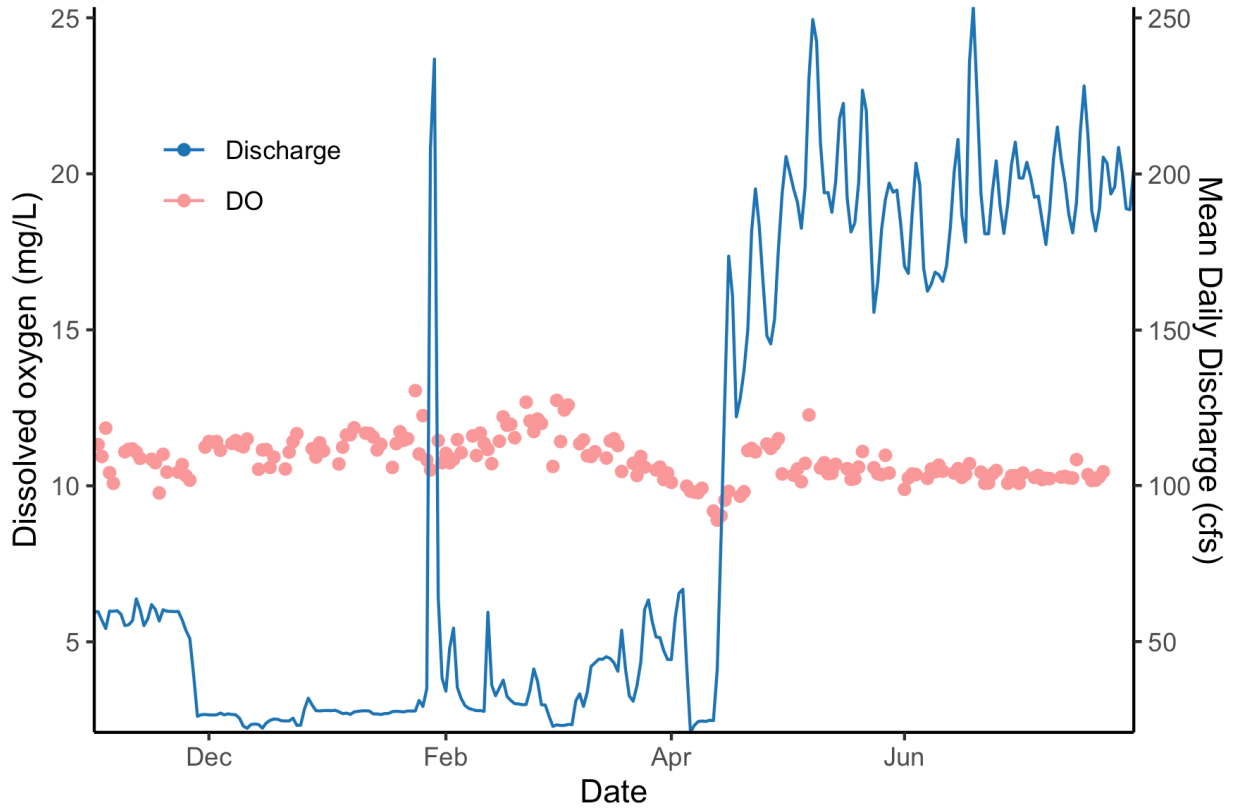


Figure 7. Instantaneous dissolved oxygen (mg/L) measured during daily checks of the Shelton Road RST along with mean daily discharge (cfs).

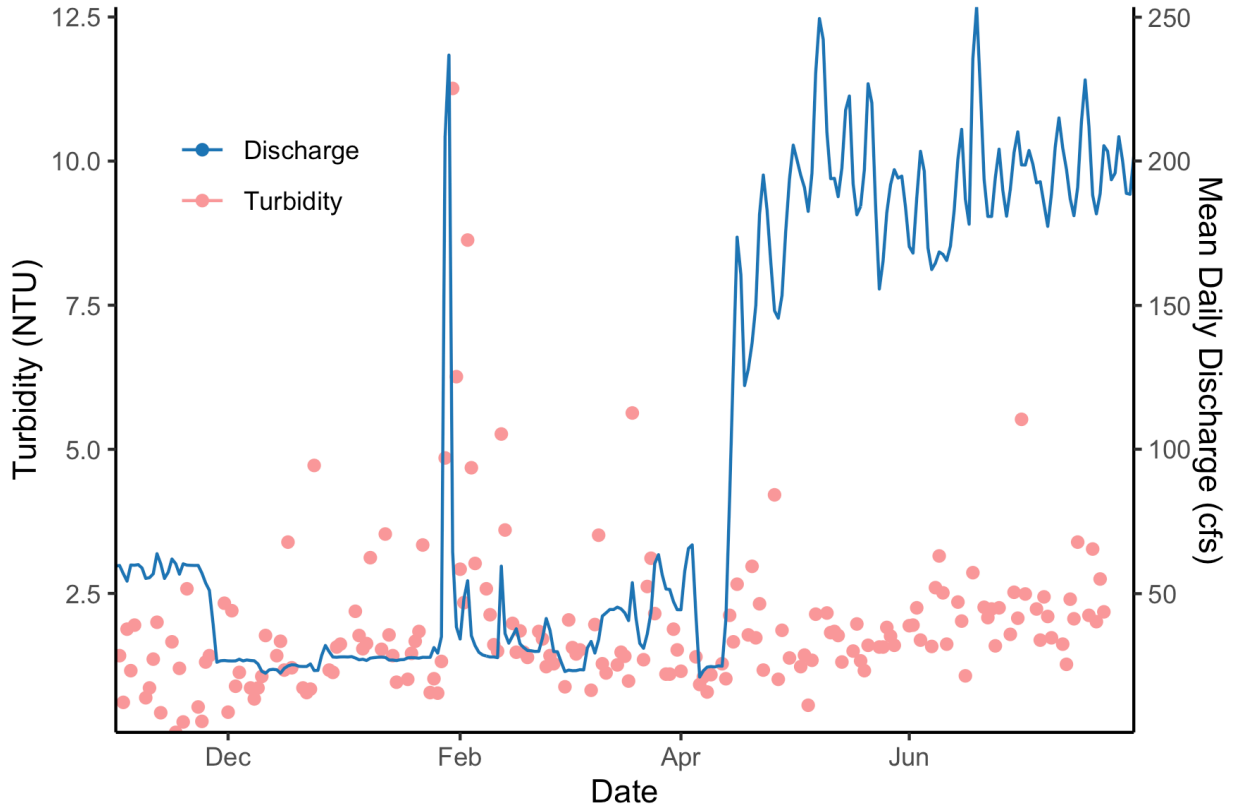


Figure 8. Instantaneous turbidity (NTU) measured during daily checks of the Shelton Road RST along with mean daily discharge (cfs).

Discussion

Total catch of both salmonid species in the 2020/2021 monitoring season was consistent with catch in previous sampling years. For *O. mykiss*, total catch of 1,982 individuals is in the upper range of what has been has been captured in the past. The *O. mykiss* index of abundance was in the middle of the range of previous years; however, any trends in this metric should be interpreted cautiously because the calculations do not incorporate capture efficiency of the trap. Further, we have yet to calculate uncertainty of these estimates (i.e., no confidence intervals), which means the degree of precision of these estimates cannot be assessed.

Consistent with prior years, nearly all YOY juveniles migrated past the trap from March to June, whereas age 1+ fish were present for the duration of the sampling season. Age 1+ were the most numerous juveniles captured in 2020/2021 but did not make up as large of a percentage as was observed in 2004 (88%), 2005 (72%), 2011 (77%), and 2015 (92%). In other years, (2002, 2003, 2006, 2007, 2008, 2009, 20010, 2012, and 2013), YOY juveniles were the dominant catch. Unlike prior age 1+ dominant years when silvery parr were made a large contribution to catch, this year, parr was the most numerous of age 1+ juveniles.

During the 2020/2021 sampling season, the highest daily catch of *O. mykiss* (n = 185) in February coincided with a large spike in discharge that came from Cosgrove Creek. There were other days of high catch (approximately 50 to 100 individuals/day), but these were not associated with

increases in discharge. During the YOY migration period (March-June), New Hogan outflows increased and during that time, there were days of relatively high catch (approximately 35-50 individuals/day). There appeared to be no impact of other environmental variables on the catch or migration characteristics of *O. mykiss*.

Like many previous years, the catch of juvenile Chinook salmon in the Shelton RST was low and no estimate of abundance could be made. Both juvenile Chinook salmon were classified as yearlings, suggesting that no production of Chinook salmon occurred in WY 2021. This is consistent with the observations that no adult Chinook salmon were observed passing through the Bellota Fish Ladder (see pages 41-47 for more details) and no live (or dead) adult Chinook salmon or redds were observed during redd surveys (see pages 48-62 for more details). The two yearlings were most likely born in WY 2020, then held over summer and captured in WY 2021. Over time, catch of juvenile Chinook salmon has been highly variable, alternating between consecutive years of high catch and years with low catch, a pattern that appears to be cyclical. Future analyses should strive to associate years of high catch with number of adult spawners and discharge variables to better understand factors influencing juvenile Chinook production.

Overall, condition factor of YOY and age 1+ *O. mykiss* remained steady over the course of sampling and did not differ among size groups. There was high variability among individual K values that may be from measurement error. For example, several outliers were observed when weight was plotted against standard length. These could be due to scale measurement error or transcription errors in field records. Nevertheless, the majority of individuals had K values of in between 1.2 and 1.3. Part of Effectiveness Monitoring EM 3 Juvenile Salmonid Monitoring is to assess correlations between trout condition factor and environmental variables of flow, temperature, and turbidity. Because there was no noticeable trend in K for any size group over the course of the season, there was no need to assess correlations. However, in the future, we can compare these environmental factors and K values across years to assess if these correlations occur over a longer time scale. The range of K values observed are the same or higher than those for rainbow trout reported elsewhere (e.g., Appalachian streams Cada et al. [1987] and Ensign et al. [1990]; Kings River, CA Murphy [1988]) indicating good to excellent condition.

Calaveras River Benthic Macroinvertebrate Monitoring

October 2020 – September 2021

Prepared By:
Michael Hellmair
Tyler Pilger
Patrick Cuthbert

Report Summary

The Calaveras River Habitat Conservation Plan (CHCP) outlines the requirement to conduct annual bioassessment of benthic macroinvertebrates (BMI) using standardized protocols. The project is designed to establish baseline aquatic biological community structure in the primary salmonid rearing reach of the lower Calaveras River. A secondary objective of this study is to document the presence and distribution of New Zealand Mud Snails (NZMS) and BMI community response to this invasive species.

Benthic macroinvertebrate sampling is listed as one of the activities for effectiveness monitoring under the CHCP, therein identified as EM1 - Environmental Conditions Monitoring. Various environmental factors are known to influence salmonid growth and survival (e.g., flow, water temperature, turbidity, and invasive species); therefore, it is important to monitor these factors to determine whether one or more are affecting salmonid populations within the Calaveras River and whether one or more of the District's activities influences these effects. Previous BMI surveys have indicated that the spawning and rearing reach between New Hogan Dam and Shelton Road is subject to human and invasive species disturbances.

Due to changes in standardized protocols since early drafts of the CHCP and the requirement to conduct BMI sampling during the seasonal baseflow period (prior to the first significant rainfall event of the season, which occurred early in 2021), the first (baseline) BMI sampling for CHCP implementation was postponed until fall of 2022, in agreement with the regulatory agencies and SEWD.

Background

Attachment D-2 of the CHCP outlines the requirement to conduct annual bioassessment of benthic macroinvertebrates using standardized protocols, specifically the California Stream Bioassessment Procedure (CSBP; CDFG 2003). The CSBP has since evolved to become more refined, inclusive and standardized, and all relevant parameters of the initial CSBP are now included in the Surface Water Ambient Monitoring Program (SWAMP) of the State Water Resources Control Board (Ode et al. 2016).

The main advantages for conducting future bioassessment on the lower Calaveras River according to the Standard Operating Procedures for the Collection of Field Data for Bioassessment of California Wadeable Streams include:

- use of current and widely used standardized protocol.
- comparability with a large number of monitored locations statewide (i.e., the Statewide Bioassessment Program), as well as a large number of compliance monitoring efforts.
- opportunity to include and archive collected data in the California Environmental Data Exchange Network (CEDEN).

While the SWAMP protocol also includes provisions for water chemistry and algal sampling, only the Reachwide Benthos (RWB) or Target Riffle Composite (TRC) sampling methodologies will be used on the Calaveras River, as these most closely align with the parameters initially included

and referenced in the CSBP. The change in methodology has been approved by NMFS and SEWD (M. Colombano [NMFS], pers. comm., November 12, 2021).

Samples intended for ambient bioassessments are generally collected when streams are at or near base flow (i.e., not influenced by storm runoff), as sudden flow increases can displace benthic organisms from the stream bottom and dramatically alter local community composition. In California streams, this generally corresponds to the fall months, which is historically the period of seasonal low flow in most California streams. This is also the time period to most accurately document abundance and reproduction of NZMS, which most often occurs in summer and fall.

An early-season storm in October 2021 resulted in significantly increased runoff in Cosgrove Creek, which enters the Calaveras River upstream of the Jenny Lind and Shelton sampling locations. As BMI sampling had not been conducted prior to this flow event, the first (baseline) BMI sampling for CHCP implementation was postponed until fall of 2022, in agreement with the regulatory agencies and SEWD (M. Colombano [NMFS], pers. comm., November 12, 2021).

Methods

Sampling Sites

Benthic macroinvertebrate sampling will occur at three sampling sites distributed throughout the primary salmonid rearing reach of the Calaveras River, the rock quarry (river mile [RM] 41.3), Jenny Lind (RM 34.6), and Shelton Road (RM 29.3; **Table 7**). Sites were selected so that the biological communities within the primary spawning and rearing reach below New Hogan Dam could be evaluated. According to Harrington (1999), sampling BMIs once a year can adequately characterize biological condition as long as sampling occurs at the same time each year (either spring or fall).

Table 7. Locations of BMI monitoring sites on the Calaveras River.

Station ID	RM	Latitude	Longitude	Elevation (ft)
Rock Quarry	41.3	N 38° 08.893’	W 120° 49.521’	529
Jenny Lind	34.6	N 38° 05.342’	W 120° 51.920’	229
Shelton Road	29.3	N 38° 04.367’	W 120° 55.887’	165

Collection of Benthic Macroinvertebrates

Sampling and laboratory protocols for the collection, processing and identification of benthic macroinvertebrate samples will follow standardized SWAMP protocols for the BMI sample collection outlined in Ode et al. (2016).

In summary, the sampling protocol entails collecting multiple kicknet (500 µm mesh) samples, each from one square-foot area, that are spaced along transects of the monitoring site. Kicknet samples are then cleaned of macroscopic debris and combined into a compound sample for each site. Invertebrate samples will be preserved in laboratory-grade ethanol and delivered to the Aquatic Bioassessment Laboratory (operated by CDFW) at Chico State University for identification.

Collected specimens will be identified to Level II standard taxonomic effort (STE) as defined by the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT), which generally corresponds to the genus-species level for most insects, and slightly less rigorous effort (e.g., class, family, or tribe/subfamily) for certain other taxa groups (Level II STE for California taxa is defined in Rogers & Richards [2006]).

Physical/Habitat Quality Assessment and Chemical Measurements

Physical Habitat and Chemical Data collection will follow the protocols outlined in Ode et al. (2016) using standardized SWAMP datasheets to permit inclusion of collected data in the SWAMP database.

Physical Habitat Data include evenly spaced transect measurements of width, depths, substrate classification, embeddedness, algal and macrophyte coverage of substrate, presence of coarse particulate organic matter, at 25%, 50% and 75% of wetted channel width. In addition, standardized measurements of canopy, riparian vegetation coverage, and human influence on the riparian area within 50 m of the wetted channel are recorded.

Water quality and chemical parameters measured at each site include water temperature, dissolved oxygen concentration, turbidity, pH, specific conductivity, salinity, and alkalinity.

Analysis of Benthic Macroinvertebrate Samples

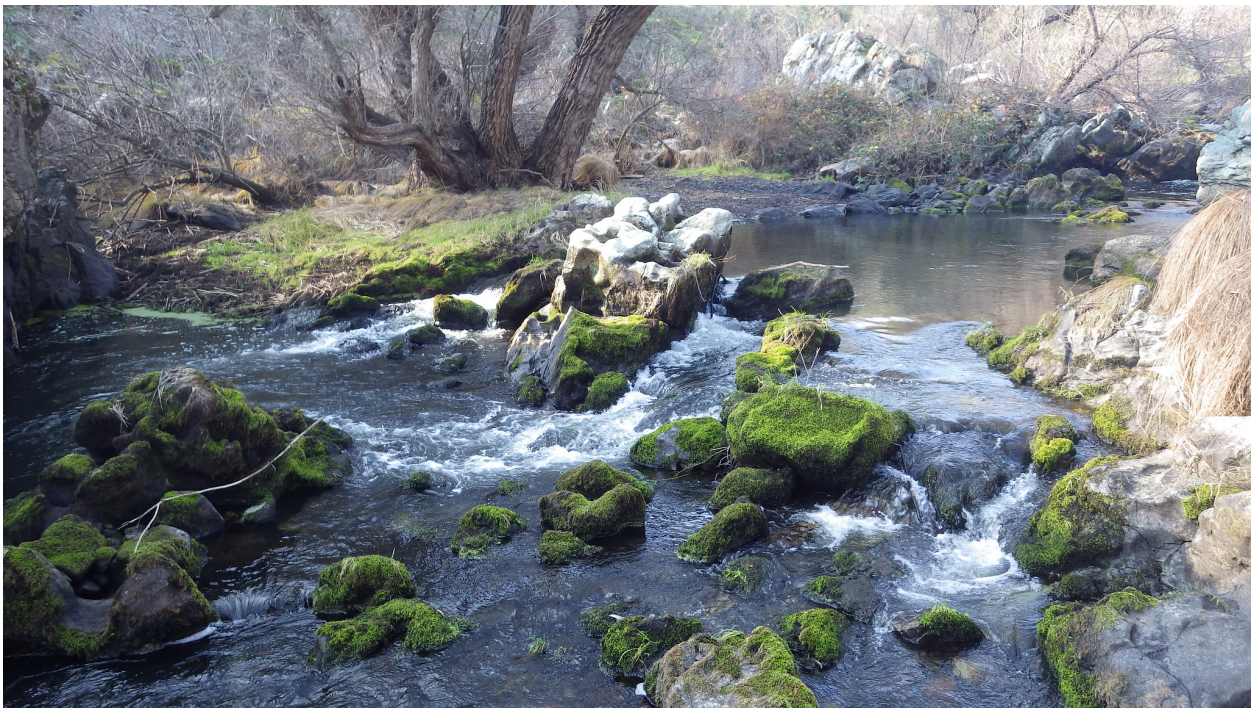
Evaluating the abundance and variety of benthic macroinvertebrates can provide an indication of the biological condition of that waterbody. Generally, streams in good biological condition support a wide variety and high number of macroinvertebrate taxa, including those that are intolerant of pollution, while samples yielding only pollution–tolerant species, low diversity or abundance are indicative of impaired conditions. Standard analysis of BMI data includes richness measures, composition measures, tolerance/intolerance measures, functional feeding groups and abundance, as required by the HCP (SEWD and FISHBIO 2020).

Results

BMI Monitoring was not conducted during 2021. BMI monitoring will occur in late September of 2022 utilizing the newly approved SWAMP protocol referenced above.

Water Temperature and Discharge Summary

October 1, 2020 – September 30, 2021



Prepared By:
Jack Eschenroeder
Matt Peterson
Patrick Cuthbert

Background

The Calaveras Habitat Conservation Plan (CHCP; Appendix D) states that Effectiveness Monitoring (EM) activities shall be conducted by SEWD and/or their fisheries biologist (FISHBIO). These are intended to ensure data is collected to address whether Biological Objectives, Targets and Data Gaps are addressed. Many environmental factors are known to affect the survival and growth of salmonids (i.e., discharge, water temperature, turbidity, and invasive species). Perhaps two of the most important factors are water temperature and discharge. Here, we provide a simple data summary of water temperature data collected at eleven monitoring locations and a discharge summary at three locations. Observed water temperatures during the summer and fall were compared to temperature criteria for salmonid rearing that are derived from the U.S. Environmental Protection Agency (USEPA 2003). These include a critical threshold of 16ºC for core rearing habitat and 18ºC for non-core rearing habitat.

Methods and Results

Water Temperature Monitoring

Water temperature data collected from multiple locations throughout the Calaveras River were used to characterize the thermal regime. A total of eleven HOBO Water Temperature Pro v2 Data Loggers (Part #U22-001; accuracy ±0.2°C; Onset Computers Corporation, Bourne, MA) were deployed in WY 2021. Six of the sites (Clements Place, Gotelli Ranch, Jenny Lind, New Hogan Dam, Shelton Road, and Upper Bellota) were located within the Conservation Area, two (Bellota and Milton) were located within Mormon Slough, and three (Headworks, Solari Ranch, Tully Road) were located within the Old Calaveras River (**Figure 1**). Each recorder was placed in a PVC housing, secured to the bank with ¼-inch coated stainless steel cable, and deployed at approximately 1 meter depth. Temperature loggers were set to record at hourly intervals and were typically downloaded once a month to minimize data loss from vandalism or theft, and to reduce the extent of missing data in case of battery failure.

Logger coverage for water year (WY) 2021 (October 1, 2020 – September 30, 2021) was incomplete for all locations except Jenny Lind and Headworks. Occasional corruption of data, loss of battery power, or loss of the logger itself led to several interruptions in recording of water temperatures. However, the bulk of missing data represents periods of dewatering, when the loggers were exposed to air. This was especially the case in the Old Calaveras River Canal. A summary of logger coverage for WY 2021 is provided in **Table 8**.

Discharge

Discharge data from WY 2021 for New Hogan Dam and Mormon Slough were downloaded via the California Data Exchange Center (CDEC; https://cdec.water.ca.gov). Because discharge monitoring data are not available for Cosgrove Creek, WY 2021 stage data from that system were downloaded via CDEC and converted into discharge using a rating curve provided by the U.S. Army Corps of Engineers (USACE).

Data Summary

Water Temperature

Table 8. A summary of missing data by logger location for WY 2021.

Location	rkm	Percentage of Days Missing	Region	Reason for Missing Data
New Hogan	67.8	5.8	Conservation Area	Dewatering
Clements Place	62.9	18.9	Conservation Area	Dewatering
Jenny Lind	55.0	0.0	Conservation Area	-
Gotelli Ranch	52.0	49.6	Conservation Area	Logger lost
Shelton Road	47.2	3.6	Conservation Area	Corrupted data
Upper Bellota	38.4	2.5	Conservation Area	Dewatering
Bellota	38.3	14.0	Mormon Slough	Dead battery
Milton Road	28.0	21.6	Mormon Slough	Dewatering
Headworks	32.8	0.0	Old Calaveras	-
Tully Road	19.5	44.7	Old Calaveras	Dewatering
Solari Ranch	6.1	48.8	Old Calaveras	Dewatering

Table 9. Monthly average temperatures (in ºC) at each logger location for WY 2021. A '-' denotes missing data (see **Table 8** for summary of data gaps).

		2020			2021								
Reach or Area	**Location**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Conservation Area	New Hogan	12.3	12.3	11.4	10.1	-	-	-	11.1	11.4	11.8	12.3	12.8
	Clements Place	10.1	-	-	9.6	10.0	10.9	12.0	12.0	12.5	12.9	13.2	13.5
	Jenny Lind	14.0	10.9	8.6	9.0	10.2	11.5	13.5	13.3	14.1	14.4	14.4	14.5
	Gotelli Ranch	-	-	-	-	-	-	14.1	13.9	14.8	15.2	15.1	15.1
	Shelton Road	14.9	11.0	-	9.1	-	12.2	14.7	14.5	15.6	15.9	15.7	15.6
	Upper Bellota	-	10.8	8.0	9.1	11.6	14.0	-	17.9	19.8	20.0	19.0	18.5
Mormon Slough	Lower Bellota	16.9	10.9	8.1	9.1	11.6	13.8	17.6	18.0	19.8	20.1	-	-
	Milton Road	9.0	11.9	-	-	22.6	25.7	26.9	25.5	23.7	-	-	7.9
Old Calaveras	Headworks	8.4	11.4	12.3	16.3	18.0	19.8	20.1	19.1	18.5	16.3	9.7	7.4
	Tully Road	-	-	-	-	18.7	21.0	21.5	20.2	19.0	-	-	-
	Solari Ranch	-	-	-	-	-	-	-	18.7	21.0	21.5	20.2	19.0

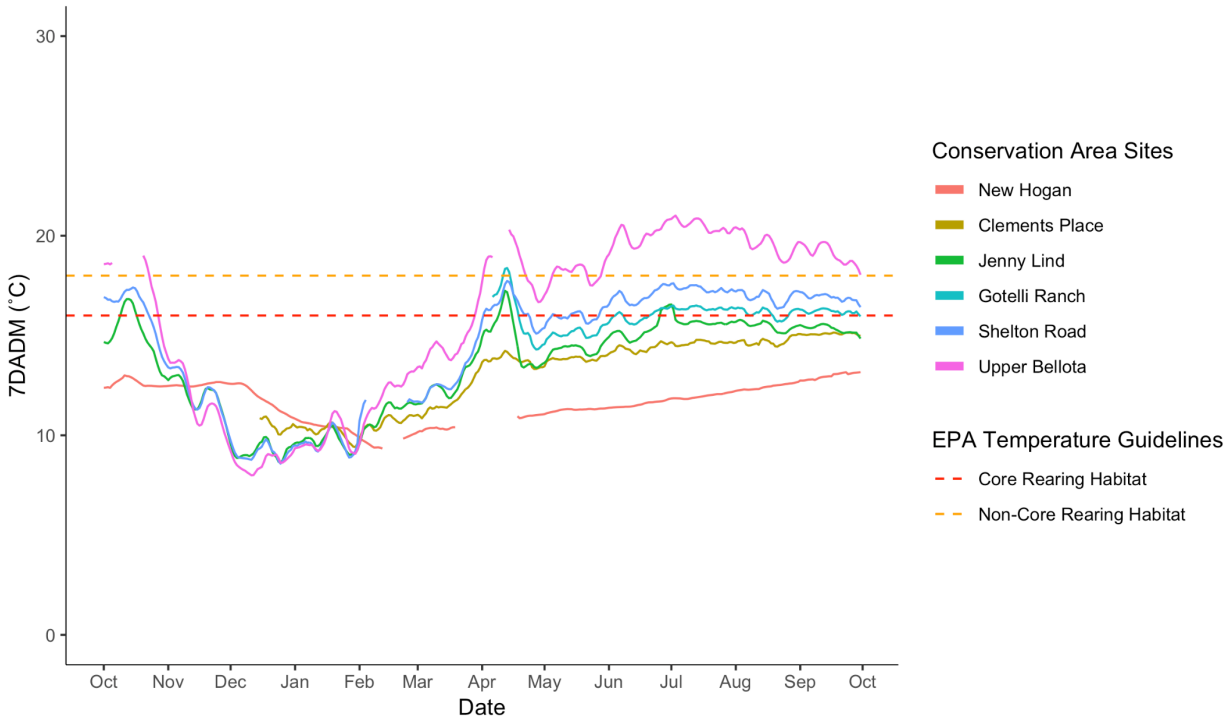


Figure 9. 7-day average daily maximum (7DADM) temperatures as recorded at the six logger sites in the Conservation Area. Gaps in the lines represent periods of missing data that primarily occurred at Gotelli Ranch due to a lost temperature logger (see **Table 8**).

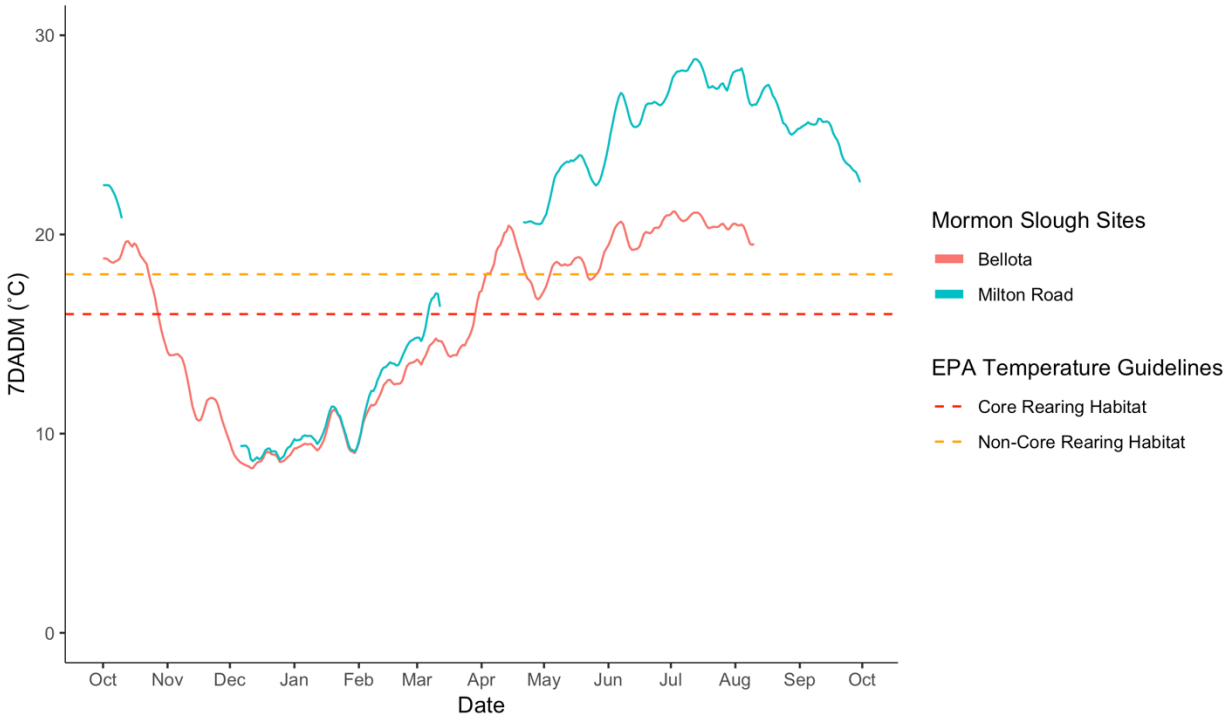


Figure 10. 7-day average daily maximum (7DADM) temperatures as recorded at the two logger sites in Mormon Slough. Gaps in the lines represent periods of missing data (see **Table 8**).

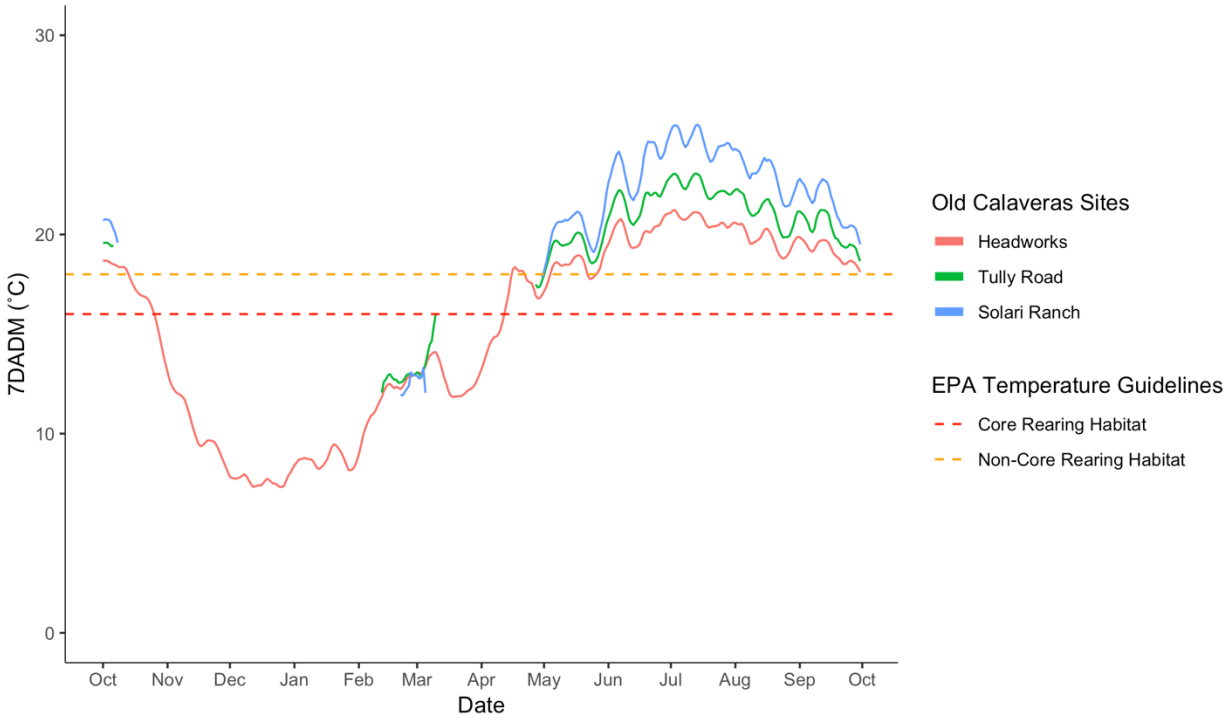


Figure 11. 7-day average daily maximum (7DADM) temperatures as recorded at the three logger sites in the Old Calaveras. Gaps in the lines represent periods of missing data, primarily from dewatering of loggers during the winter and early spring (see **Table 8**).

Discharge

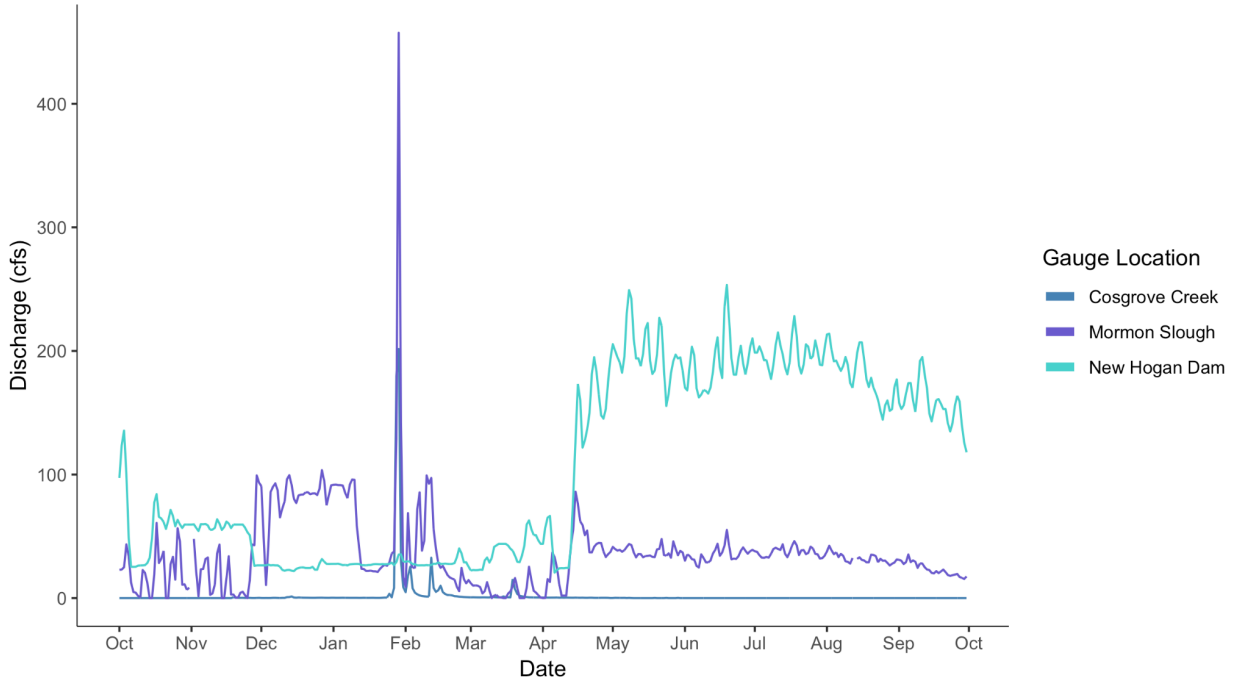


Figure 12. Calaveras River flow for WY 2021, as measured at New Hogan Dam and Cosgrove Creek. Flow from both of these locations contributes to total discharge downstream of the Cosgrove Creek confluence.

Conclusions

Water temperature monitoring was conducted at 11 locations throughout the monitoring season between October 1, 2020 and September 30, 2021. Some interruptions in monitoring occurred with most short in duration and for typical causes (i.e., dewatering). In the Conservation Area, four of the five temperature loggers provided adequate redundancy and characterized the water temperature regime for the majority of WY 2021. The one exception was at Gotelli Ranch, where the temperature logger was lost resulting in a large data gap. Only minor data gaps were noted in Mormon Slough. In the Old Calaveras River Canal, the water temperature loggers functioned as expected, but for the non-irrigation season (October – March), they were dewatered and exposed to air. For sites that are expected to be permanently wetted (i.e., above Bellota), several improvements could be made to field procedures to reduce data loss in the future. First, redundant temperature loggers should be placed at sites where the potential theft/vandalism is high or loss due to high discharge. Loggers could be placed at two slightly different locations to ensure that data could be retrieved from at least one of them. Second, several spare temperature loggers should be purchased and available if loggers are either dead or lost. This would minimize the amount of time of water temperature data was not collected. Finally, the frequency of visits may need to be adjusted to ensure that large data gaps are minimized.

From New Hogan Dam to Bellota, 7DADM temperatures were generally less than 18ºC for the majority of the reach from April to late September. At Bellota, the 7DADM hovered around 20º or 21ºC for that same time period. Water temperatures followed an expected pattern of cooler water temperatures upstream with warming temperatures downstream. The upper three monitoring locations were typically right around or less than 16ºC in the late spring, summer, and early fall. These upper three monitoring locations would have met the criteria for 'core rearing' for *O. mykiss* of 16ºC throughout WY 2021 (USEPA 2003). Shelton Road would have met the criteria for 'non-core rearing' for *O. mykiss* of 18ºC throughout WY 2021 (USEPA 2003). It is important to note that these criteria were developed based on studies of salmonids in the Pacific Northwest and may be overly conservative targets for *O. mykiss* inhabiting Central Valley streams. Studies of *O. mykiss* in the nearby Tuolumne River indicated that individuals could maintain 95% of their peak aerobic scope (i.e., the ability to provide oxygen for activity) even at temperatures as high as 24.6ºC (Verhille et al. 2016).

Water temperatures during the spawning and incubation periods of *O. mykiss* were typically less than 12ºC 7DADM between December 2020 and March 2021 (**Table 9**). This was consistent for all monitored locations. However, it should be noted that during this period, water temperatures at New Hogan Dam are slightly warmer than at downstream locations. A similar pattern is observed on the Stanislaus River during the fall and winter (Peterson et al. 2020). This suggests that the upstream reservoir has an insulating effect on the water prior to its release. After release and transport downstream, air temperatures affect the water temperature with increasing effect with increased distance downstream.

Water year 2021 was characterized as a dry water year type in the San Joaquin River basin (DWR 2021). As such, discharge patterns in the Calaveras River watershed were characterized by a relatively low base flow and minimal freshet events. Cosgrove Creek had peak flows of only around 200 cfs, which only occurred once in late January 2021. Peak seasonal flows have ranged from about 70 cfs to over 1,200 cfs based on a longer time series of hydrologic data (CHCP, Appendix D). The other intermittent streams (South Gulch and Indian Creek) had similarly timed seasonal peaks. In late January, discharge at Mormon Slough was recorded at about 450 cfs, suggesting that relatively similar contributions are made by those two ungauged streams.

Calaveras River Bellota Fish Ladder Camera Monitoring

Water Year 2021 Annual Report

Prepared By:
Mike Thomas
Jim Inman
Matt Peterson

Report Summary

The Bellota Fish Ladder video monitoring provides additional information on both behavior and counts of fishes moving between the lower and upper reaches of the accessible portions of the Calaveras River. Given the limitations to habitat above New Hogan reservoir, it is important to maintain connectivity between those habitats still readily available. During the 2021 field season, FISHBIO monitored the Bellota Fish Ladder using video cameras. We documented the use of this fish ladder by 12 individual *Oncorhynchus mykiss* (rainbow trout/steelhead) during the five-month period in which cameras were operated. Of the 12 individuals observed, we documented three adults moving upstream through the ladder indicating the potential for the anadromous form (steelhead) of the species moving into the system during a spawning migration.

Background

The Bellota Fish Ladder is in the middle reaches of the Calaveras River near the town of Bellota, California. The ladder serves as the primary fish passage structure allowing for access to the upper reaches of the Calaveras River below New Hogan Reservoir. Approximately 150 meters downstream of the confluence of Duck Creek, two flashboard dam structures serve to provide elevation and head pressure for upstream water diversions (**Figure 13**). Under optimal flow conditions, the two flashboard dams are easily passable by migratory fishes such as salmon and steelhead. However, under low flow conditions, habitat above Bellota becomes disconnected as fish are unable to pass without the assistance of the two fish ladders (**Figure 14**). To better understand passage of salmonids through this system FISHBIO has manufactured and installed a camera monitoring system to monitor and enumerate salmonids as they pass through the Bellota Fish Ladder. This report summarizes the results from the video monitoring system and observations of salmonids within the fish ladder during the 2020/2021 field season (e.g., Oct. 22 – Mar. 28).

Figure 13. A view of the Bellota Dam structure and the existing two fish ladders looking upstream.

Figure 14. An overhead view of the Bellota Dam and fish ladders under low flow conditions. Note how the lower pool is disconnected from the upper pool preventing fish passage without the assistance of ladders.

Methods

Video Monitoring System

Located at the top of the upper ladder (**Figure 15**), a passage chute extends three feet into the upstream pool of the two feet flashboard dam. The video camera structure is custom fabricated from 1/8-inch aluminum plate and is 3' wide, 2' high, and 3' long. There are two opposing cameras facing each other to eliminate any blind spots for fish passing through the camera structure. An LED light bar is mounted at the top of the structure illuminating the area between each of the two opposing cameras. The cameras are each configured with Internet Protocol (IP) and Power Over Ethernet (POE) for networking capabilities. Each of the cameras are fitted with a 180-degree wide angle viewing lens. Cameras are contained in the flume in custom-built PVC waterproof housings. Combination power/communication cables run from the cameras and lights through PVC conduit along the upstream side of the concrete abutment to a metal storage container at the top of the levee on the north side of the fish ladder. In the storage container, there is a POE switch and a laptop computer with a security system software that records motion activated and continuous video streams to an external hard drive. The external hard drives are swapped on a near-weekly basis during the monitoring season to minimize data loss.

Video monitoring is intended to occur 24 hours per day, however, occasional interruptions in monitoring do occur. Typical causes for monitoring outages include power outages, software or hardware issues, physical damage, and water leakage into lights or underwater camera housings.

Motion-activated video segments were controlled by adjusting motion sensitivity on a scale of 1 to 100 with 100 being the most sensitive. This setting basically determines how large of an object, or in our case a fish, will trigger motion activated recording. Through testing with different size objects, we have found that a motion sensitivity setting of 70 will detect even the smallest young-of-year *O. mykiss* (around 40 mm TL). A second setting for trigger time determines how easily motion files are activated. During the monitoring period, this setting is set to be the most sensitive with a trigger time of one frame. Using these motion-activation settings, there are a high number of false motion-activated video clips from debris and light reflections, however we are confident we will record any fish moving upstream through the ladder. The biggest limitation of using video to record fish passages is reduced visibility due to periods of high turbidity.

In fall 2020, the video system was installed and began monitoring prior to the operation of the fish ladder. This was to ensure that the system was fully functioning, and any technical issues were addressed prior to the operation of the ladder.

Video Review and Data Summary

Video footage from external hard drives were transferred to, stored at, and reviewed at the FISHBIO office in Oakdale, California. The video review process is performed manually and is conducted on a weekly basis. Review is often completed quickly as the videos only include periods with motion. Data recorded include the date and time of any salmonid passage, direction of passage (up or down), the species, sex, and presence of adipose fin, if they can be confidently assessed. The life stage of *O. mykiss* was also determined and fish were classified as either juvenile or adult

based on size and other physical characteristics (e.g., presence of a kype or adipose fin clip). The video quality for each fish observation was also recorded. While the primary species of interest are *O. mykiss* and fall-run Chinook salmon, all observations of other fish are also recorded. Performance of the system was assessed by calculating the percentage of the monitoring period with no technical issues of the total number of monitoring days available across the season.

Observations of other fish and/or mammals are frequently made during video review but are not recorded. Sacramento pikeminnow and black bass are frequently observed. Commonly observed mammals include beaver, otter, and mink. A detailed review of non-salmonid passages would add a tremendous amount of time to the video review process.

Discharge data from New Hogan Dam and Mormon Slough was downloaded from the California Data Exchange Center (CDEC).

Figure 15. Above photo shows the custom passage chute extending into the upper pool. The chute serves to both extend the ladder to the upper pool while crowding passing fish near the internal cameras to ensure complete coverage.

Results

System Performance

Camera monitoring at the Bellota Fish Ladder occurred from October 22, 2020 to March 28, 2021. The camera system was operational 146 of 158 days (92%). Technical issues prevented video monitoring for four days between November 6 and November 10, 2020 and again for seven days between March 5 and March 12, 2021. Neither video outage was during a period when the ladder was open resulting in little to no loss of fish data. The Bellota Fish Ladder was operational

beginning on December 14, 2020 and remained operational until February 23, 2021 or 72 days. The video monitoring system was operated during the entire period that the fish ladder was operated (**Figure 16**). During the period of operation only one rain event occurred on January 1, 2021. We observed one major pulse flow of 446 cfs at Mormon Slough (MRS) on January 30, 2021 (**Figure 16**) where fish could possibly pass upstream over the weir without going through the ladder.

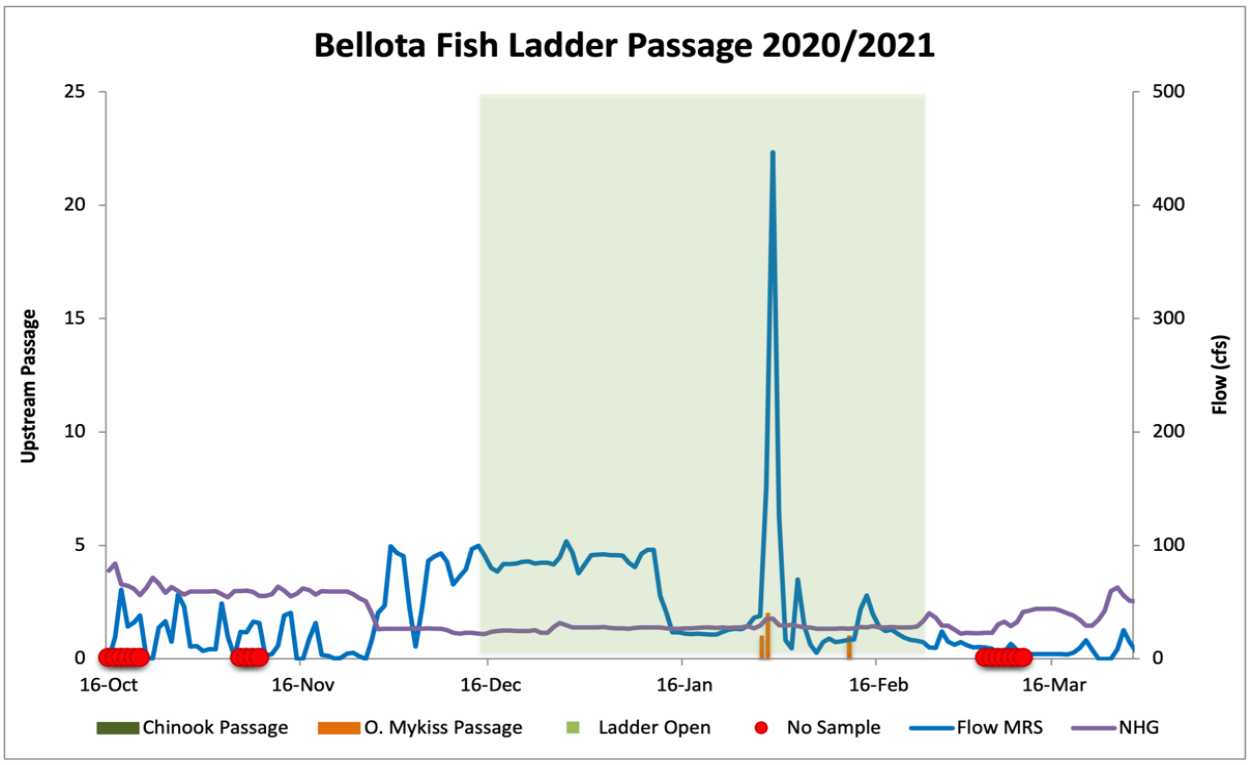


Figure 16. Shows a combined summary of monitoring effort across time on the x-axis. The left y-axis represents the daily fish passage total, indicated by orange bars. The red circles depict periods of when cameras were non-operational. The right y-axis shows the scale of flow measures at two gauging stations: blue is the discharge at the MRS gauging station and purple the NHG gauge included for reference.

Salmonid Observations

Over the course of the WY 2021 monitoring season, only *O. mykiss* were observed on the video monitoring system. No adult fall-run Chinook salmon were observed during the monitoring period. In total, we observed 12 individual *O. mykiss* using the upper fish ladder (**Table 10**). Of the 12 *O. mykiss* observed, three were classified as adults and the remaining nine were classified as juveniles. Two of the three adult *O. mykiss* were determined to have an intact adipose fin, indicating that the fish are naturally produced. We were unable to discern whether a third adult *O. mykiss* retained an adipose fin due to low visibility from high in-stream turbidity. All of the adult *O. mykiss* observed were determined to be moving upstream. We observed nine juvenile *O. mykiss* (rainbow trout) during monitoring, and of those 55.6% (n = 5) were moving upstream while the remaining 44.4% (n = 4) alternatively were moving downstream.

All of the observations of juvenile *O. mykiss* occurred between December 20 and January 16. The observations of adult *O. mykiss* occurred between late January and mid-February 2021. Two of the adult observations coincided with the largest flow event observed during the monitoring period when discharge reached 446 cfs at MRS (**Figure 16**).

Table 10. Passage information for each *O. mykiss* observed at the Bellota fish ladder during the 2020/2021 field season.

Date	Count	Life Stage	Sex	Adipose Fin Clip	Direction of Passage	Observation Certainty
12/20/2020	1	Juvenile	UNK	No	Up	High
1/9/2021	1	Juvenile	UNK	No	Down	High
1/9/2021	2	Juvenile	UNK	No	Down	High
1/11/2021	1	Juvenile	UNK	No	Up	High
1/12/2021	1	Juvenile	UNK	No	Up	High
1/15/2021	1	Juvenile	UNK	No	Down	High
1/16/2021	1	Juvenile	UNK	No	Up	High
1/16/2021	1	Juvenile	UNK	No	Up	High
1/28/2021	1	Adult	UNK	UNK	Up	Low
1/29/2021	1	Adult	UNK	No	Up	Low
2/11/2021	1	Adult	Female	No	Up	High

Conclusions

During the 2020/2021 field season, we observed very few individual salmonids within the fish ladder despite operating 72 days in total. Only *O. mykiss* were observed using the fish ladder. Two of the three adult *O. mykiss* (likely adult steelhead) were determined to have intact adipose fins, indicating natural production. We note that all hatchery steelhead are adipose fin clipped allowing for easy (and certain) visual identification of origin when conditions allow. No Chinook salmon were observed using the fish ladder during the monitoring period nor were any Chinook salmon redds observed during redd surveys (see pages 48-62 for more details).

With respect to the FISHBIO camera system installed at the Bellota Fish Ladder, we found the current version of the system to function particularly well for a remote monitoring system. However, we do acknowledge some limitations with turbidity affecting visibility at higher river discharges and during larger tributary contributions. Additional challenges include both sunlight and debris affecting the automated trigger of cameras, however we believe this to be of a lesser concern as design modifications into the future may likely resolve this inconvenience.

Calaveras River Redd and Carcass Monitoring Report

Water Year 2021 Annual Report

Prepared By:
John Montgomery
Matt Peterson
Patrick Cuthbert

Report Summary

Similar to past redd surveys conducted since water year (WY) 2015, *O. mykiss* redds, likely constructed by resident *O. mykiss* given their small size, were widely distributed throughout the lower Calaveras River. *O. mykiss* redds were detected between Shelton Road and New Hogan Dam during bi-weekly surveys that began in late November and ended in late March. A total of 27 new redds were observed during the surveys with most observed during the month of February, though redds were observed as early as December and as late as March. They were most frequently observed in the lower portion of the Canyon Reach and in the Jenny Lind Reach. No Chinook salmon redds or carcasses of either species were observed during the surveys. While redd surveys have routinely documented a wide distribution and long duration of spawning activity by *O. mykiss* since 2015, the data is currently limited in its use. The detection of redds (i.e., how were missed relative to how many were counted) of either species is not explicitly assessed during surveys, which limits the use of redd count data to infer trends of adult abundance of steelhead, resident *O. mykiss*, and/or Chinook salmon. Future studies should investigate the use of modified survey designs with the same approximate level of effort to address this issue.

Introduction

The Calaveras River is considered critical habitat for Central Valley steelhead (NMFS 2009). The entire lower reach of the Calaveras River, from the confluence with the San Joaquin River to New Hogan Dam is designated as critical habitat. Spawning habitat for steelhead (the anadromous life history form of *Oncorhynchus mykiss*) is limited to the reach above Bellota (Figure 1). Fall-run Chinook salmon (*O. tshawytscha*) have also been observed to pass Bellota and spawn in the upper sections of the Calaveras River as far upstream as the New Hogan Dam reach. Additionally, rainbow trout (the resident life history form of *O. mykiss*) reside in the Calaveras River year-round and also spawn in the Calaveras River.

The distribution of available spawning habitat throughout the lower Calaveras River and which habitats are actually used by spawning salmonids is valuable information for water managers to understand how water operations and environmental conditions influence spawning activity. This data can be collected annually and compared year-to-year to understand how river and environmental conditions may influence spawn timing and distribution. FISHBIO began conducting redd surveys during the winter of 2014/2015 (water year 2015) to gather information on the timing and distribution of Chinook salmon and *O. mykiss* spawning. The previous surveys conducted since water year 2015 have yielded four important insights into how salmonids are using the Calaveras River as spawning habitat and important limitations of the surveys.

First, redd surveys have focused on areas with the most suitable habitat for salmonid spawning which are located above and below the canyon reach. Our definition of 'suitable' habitat has been developed over the course of the study and field observations (i.e., observing redds in certain locations or reaches). Suitable habitats were generally defined as having the following characteristics: (1) being in a riffle or pool tailout and (2) having appropriately sized substrate (typically made up of gravels and cobble with little sand or silt. Due to poor accessibility and lack of spawning habitats found within the Canyon reach, it has not been surveyed as frequently as

other reaches. In January 2015, FISHBIO conducted an inventory of riffle habitat to quantify available spawning areas below New Hogan Dam. The canyon section (Reach 2) is comprised of narrow and confined canyon walls, high water velocities at most discharge levels, with mostly large cobble and bedrock substrates resulting in relatively few spawning riffles. Furthermore, due to the logistical challenges accessing and conducting surveys in the upper canyon, along with the sparse habitat it was determined the lower portion of the canyon reach would only be sampled where good river access and suitable substrate predominated. Additionally, the lower portion of the surveyed area, from Shelton Road to Dog Ranch Road (Reach 4) was only sampled on a limited basis, in years with greater spawning, as riffle habitats with suitable substrates are nearly non-existent with sand and silts becoming more prevalent in the lower portions of the river.

Second, the number of *O. mykiss* redds typically outnumber Chinook salmon redds on an annual basis with the exception of water years 2019 and 2020. The origin of the redds is mainly classified by the size of redds between the species, especially when fish are not present on redds. In past surveys, the median area of redds were much larger for Chinook salmon redds (50.6 ft2) than *O. mykiss* redds (3.6 ft2) but there has been large variation of sizes of Chinook salmon redd areas that resulted in a large overlap in the distribution of redd sizes between the two species (FISHBIO, unpublished report).

Third, no observations of live *O. mykiss* guarding or digging redds have been made. If *O. mykiss* are observed during redd surveys, which is a rare occurrence, they are most often observed fleeing from the area near the redd. Due to the lack of observations of live fish, it has been difficult to directly assess any differences between redd sizes of resident and anadromous life history forms of *O. mykiss*. However, based on measurements of redd sizes putatively from *O. mykiss*, most are likely resident *O. mykiss*. In two separate years, the sizes of spawning *O. mykiss* estimated from redd sizes have been 22 cm (range = 17 – 34 cm; FISHBIO, unpublished report).

Lastly, the Calaveras River below New Hogan Dam (RM 42.4) is a rain driven system subject to rainfall events (freshets) from Cosgrove Creek, Indian Creek and South Gulch and other smaller drainages. These freshets can often mobilize substrates enough to obscure evidence of *O. mykiss* redds created prior to the event. Therefore, given the limited scope of surveys and environmental challenges present, redd counts should be considered an index of relative abundance rather than a comprehensive inventory of annual spawning.

This memo describes the results of the sixth year of redd surveys conducted during the winter 2020/2021 (water year 2021). The objectives of the redd surveys were to: (1) enumerate the number of redds in each reach, (2) describe the spatial and temporal distribution of salmon and *O. mykiss* spawning, and (3) describe the relative importance of reaches or sites for salmon and *O. mykiss* spawning.

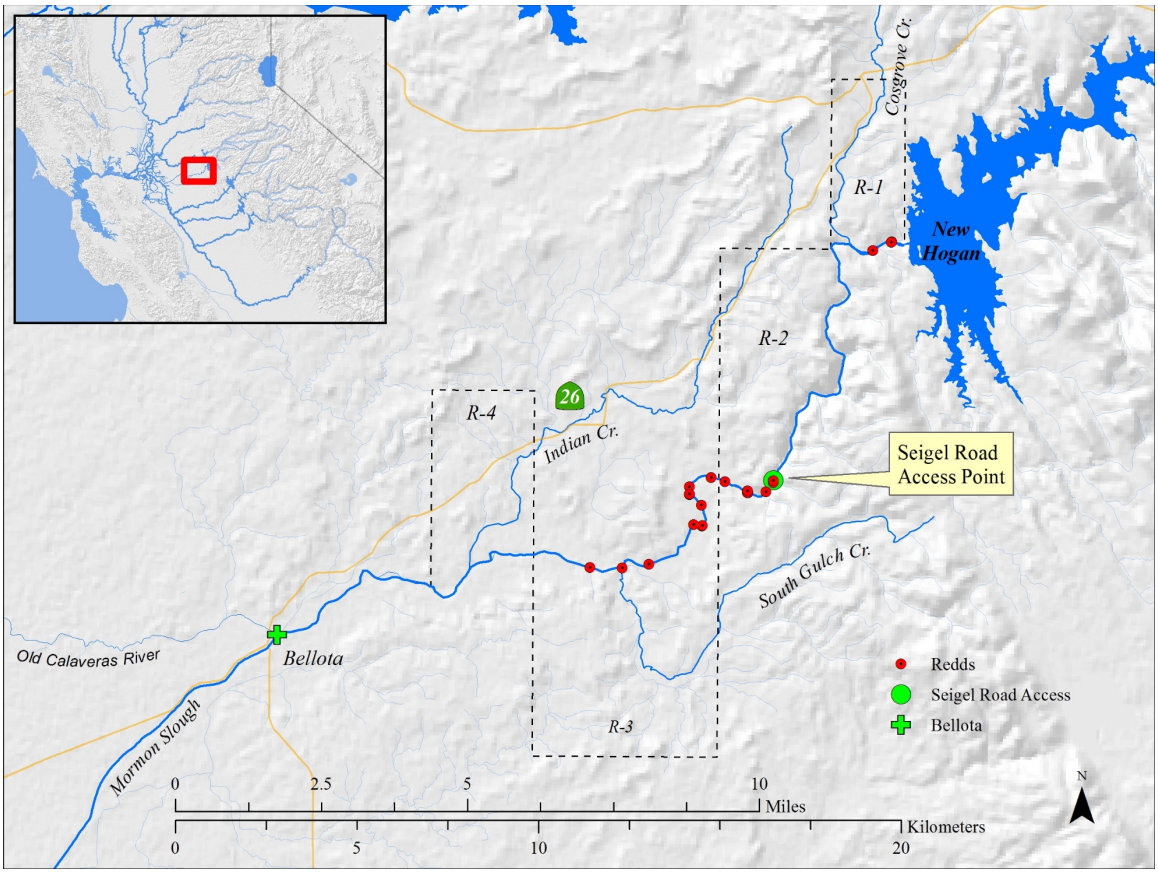


Figure 17. Map of surveyed reaches for *O. mykiss* and Chinook salmon redds and carcasses. Locations of *O. mykiss* redds observed in 2020/21 are shown as red circles.

Methods

Field Methods

Reach Designations

FISHBIO conducted surveys in the 15-mile reach from New Hogan Dam (RM 42.4) downstream to Dog Ranch Road (RM 27.2), which was divided into four reaches (**Table 11**; **Figure 17**). Reach 1 encapsulates the upstream limit of anadromy in the 1.3 miles span below New Hogan Dam to the start of the Canyon Reach and is characterized by low gradient (~0.3%) riffle and run habitat. Reach 2 (Canyon Reach) is 6.4 miles long and dominated by high gradient cascade and low gradient pool habitats (Avg. gradient ~0.9%) confined by steep bedrock and boulders on each bank. The characteristic Canyon Reach terminates just above the Siegel Road access (RM 35.7), however for logistical purposes the reach was extended to Jenny Lind bridge as access at Siegel Road was not available until the 2019 season. Reach 3 (Jenny Lind Reach) is 5.1 miles long and starts at Jenny Lind Bridge (RM 34.6) and extends downstream to Shelton Road Bridge (RM 29.5). This reach is characterized by low gradient (Avg. ~0.16%) riffle and run habitat, with the majority of optimal spawning conditions occurring in this section. Reach 4 (Shelton Road Reach) is a 2.3-mile section similar in gradient to Reach 3 (Avg. ~0.14%) but dominated by run and pool habitat with some small riffles. Substrates in this section are dominated by sand and silt mixed in pebble

matrix. Reach 4 was not sampled in the 2020 due to few redds being marked in the lower portion of Reach 3 providing little justification for continuing surveys lower down in the river.

Based on reconnaissance surveys in 2015, it was determined that the majority of suitable spawning habitat is located within Reach 1 ("Dam" reach) and 3 ("Jenny Lind" reach) ("core"). Habitat surveys in 2015 identified minimal spawning habitat in the upper Canyon reach, with most located in the lower 1.2 miles of the Canyon Reach, between the Siegel Road access (RM 35.7) and Jenny Lind Bridge (RM 34.6). During the 2017/18 (water year 2018) monitoring season, this lower canyon section was incorporated into the core sampling reaches. These core reaches were surveyed approximately bi-weekly in 2020/21.

Table 11. 2020/21 survey reach designations.

Reach	Name	Start Point	End Point	Sample Effort
1	Dam	New Hogan Dam (RM 42.4)	Top of Canyon (RM 41.0)	Core
2a	Canyon	Top of Canyon	Seigel Road (RM 35.7)	Opportunistic
2b	Canyon	Seigel Road	Jenny Lind Bridge (RM 34.6)	Core
3	Jenny Lind	Jenny Lind Bridge	Shelton Road (RM 29.5)	Core
4	Shelton	Shelton Road	Dog Ranch Road (RM 27.2)	Opportunistic

Timing of Surveys

Redd Surveys on the Calaveras River were initiated in late November 2020 and continued approximately bi-weekly through the end of March 2021 (**Figure 18**). Results of an analysis conducted in 2014 of the relationship between emergence timing (inferred from rotary screw trap data, 2002-2013) and water temperature indicated the majority of *O. mykiss* redd construction likely occurs from December to early March (FISHBIO, unpublished report).

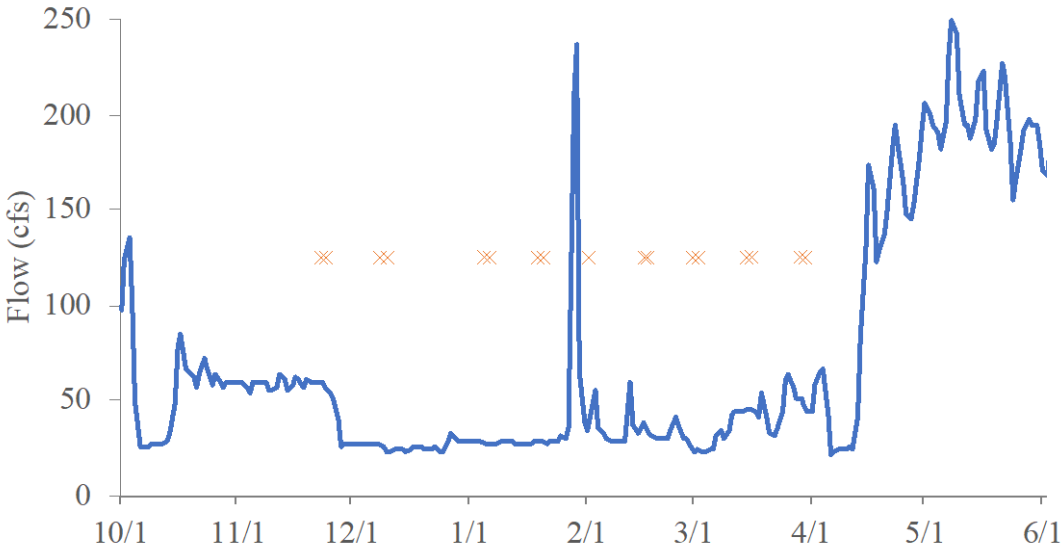


Figure 18. Sample days (orange 'x') with Mean daily flow (New Hogan release + Cosgrove Creek) during the 2020/21 redd survey period.

Redd Identification and Measurements

Water clarity, water speed, water roughness, ambient lighting conditions, cloud cover, and wind can affect the ability of observers to detect redds. Prior to and after each redd survey, observers recorded weather conditions into one of four categorical conditions. These categories included clear, cloudy, wind, and rain. Visibility was rated categorically, with ratings of 'good', 'fair', and 'poor'. A good visibility rating means that observers could clearly see more than three feet underwater, which is greater than the depth of nearly all redds observed. A poor visibility rating was indicative of minimum visibility necessary to detect some redds. Often conditions vary throughout the day/event and crews were instructed to create an additional 'Survey Info' entry to indicate a condition change that may affect sampling ability. Although redd surveys may be conducted under all weather conditions and visibility ratings, surveys planned on exceptionally windy or rainy days were rescheduled. Along the same lines, after a freshet event, surveys were delayed until water clarity permitted reasonable visibility.

Crews moved down the river to spawning areas either on foot or using inflatable kayaks and visually searched for signs of spawning activity. Care was taken to avoid impacting identified redds. Redds were visually identified by the presence of displaced gravel in the form of an excavated depression (pot) and downstream aggregation (tail or tail spill). When redds were located, crews used a Trimble (Geo-XH 6000, Sunnyvale, CA) Global Positioning System (GPS) to record the upstream end of the approximate egg pocket location. For each location marked (point) the GPS software (Trimble Terrasync, Sunnyvale, CA) records a minimum of ten positions (latitude/longitude) which were averaged to produce a single point.

For each redd, surveyors also documented redd age status (new, old, or incomplete), presence of fish, and redd characteristics **Table 12**). At each new redd location, physical dimensions were recorded to the nearest tenth of a foot with a stadia rod, as described in Gallagher et al. (2009). Redd measurements included pot length (PL), pot width (PW), tail spill length (TSL), and two

measurements of tail spill width (TSW1 and TSW2; **Figure 19**). The 'pot' is considered the area that is excavated by the female during construction of the redd, while the loose material dislodged and swept downstream and used to cover eggs and is called the tail spill and contains the egg pocket.

To ensure consistency in data collection the GPS was loaded with preset forms (Data dictionaries) with fields for each measurement with key metrics requiring valid values for points to be recorded. The data dictionaries were constructed using GPS Pathfinder Office software (Trimble; Sunnyvale, CA) and transferred to the GPS unit prior to surveys. This same software was also used to offload data files from the GPS and post-process the data at the end of the field season. Post-processing consisted of differentially correcting recorded points to account for positional error using the nearest reliable base data provider (UNAVCO, Linden, CA). Interference in GPS signals can vary day to day from various sources (e.g., atmospheric conditions, satellite distributions, GPS clock errors). After differential correction the GPS files were aggregated and exported to a shapefile format before being imported and stored as a single feature class within a file geodatabase. After the field season ended the feature class files were opened within ArcGIS software (ESRI; Redlands, CA) and examined. Because a single redd may be marked over multiple sampling events, records were overlaid and compared to produce a final count of unique redds.

Carcass Collections

In addition to enumerating redds, the surveys are used to collect carcasses of spent *O. mykiss* and Chinook salmon. The collection of carcasses to the surveys was added as a procedure to collection permits in 2019. The purposes of the collections are to determine the fraction of adult Chinook salmon that have been tagged with coded wire tags (CWT), the origin and age of adult Chinook salmon that have been tagged with a CWT, and to collect biological samples (i.e., otoliths and scales) to determine age structure and life history. For *O. mykiss*, the carcasses are collected in order to retrieve otoliths and scales for similar purposes described above. Field crews were prepared to collect salmon and trout carcasses if they were encountered. A field kit with the necessary materials to measure carcasses, remove and store the heads, and document relevant information was carried on each redd survey. The kit consisted of rubber gloves, a tape measure, serrated knife, scale envelopes, identification tags, plastic storage bags, and a printed copy of protocols/procedures. Additionally, the GPS data dictionary included a point feature for marking the carcass location and fields for relevant data. No carcasses were observed or collected during the 2020/2021 field season.

Table 12. Data collected to describe each identified redd.

Parameter	Attribute	Description
Redd Status	New	Signs of fresh digging activity, well developed pot and tail spill.
	Old	Redd fading, algae and/or redd flattening out but still visible.
	Incomplete	Not well developed, no defined pot or tail spill.
Fish Presence	Species	Chinook or *O. mykiss.*
	Count	Number of fish observed actively guarding or constructing the identified redd.
Redd Characteristics	Depth	Water depth immediately upstream of the pot.
	Substrate	Estimated median grain size immediately upstream of the pot.
	Pot Length (P_L)	Total length of the pot parallel to streamflow, measured from the top edge to bottom edge.
	Pot Width (P_W)	Maximum width of the pot perpendicular to the stream flow or pot length. When the pot is irregularly shaped, estimate the total width as accurately as possible.
	Tail Spill Length (TS_L)	Total length of the tail spill parallel to the stream flow. Measured from the top edge of the middle of the pot to the bottom edge of the tail spill.
	Tail Spill Width 1 (TS_{W1})	Maximum width of the tail spill perpendicular to the stream flow or pot length. easured about one-third of the distance down from the top edge of the tail spill.
	Tail Spill Width 2 (TS_{W2})	Maximum width of the tail spill perpendicular to the stream flow or pot length; measured about two-thirds of the distance down from the top edge of the tail spill.

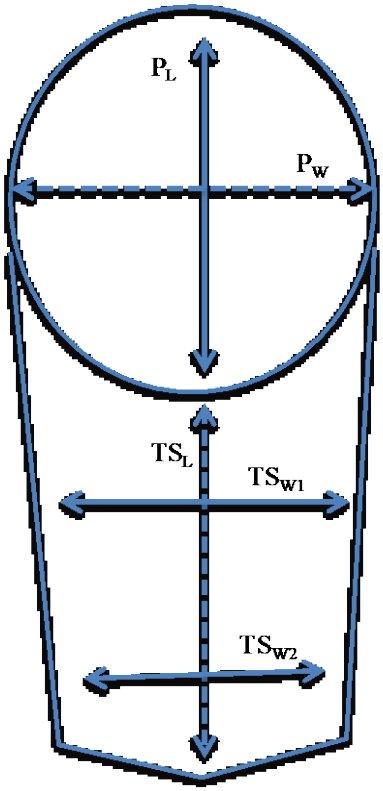


Figure 19. Schematic of the redd measurement locations. Definitions: P_L = pot length; P_W = pot width; TS_L = tail spill length; and TS_{W1} and TS_{W2} = two measurements of tail spill width.

Results

Redd surveys were initiated in the core reaches (Dam, and Siegel Road to Shelton Road) on November 23, 2020 and continued on an approximate biweekly schedule (depending on environmental conditions) through March 30, 2021. Surveys were conducted over nine different survey weeks or on 17 days. The largest gap in surveys during the 2021 water year occurred between December 10 and January 5 and was skipped due to the holidays. Similar to previous years, no surveys were conducted in the Upper Canyon reach during the 2020/2021 monitoring period based on previous assessments of limited spawning habitat in this reach.

Redd surveys were primarily conducted in optimal conditions during WY 2021. Weather conditions were often sunny, however five surveys (26%) were conducted in cloudy or windy conditions. On two occasions, ratings were degraded or changed (i.e., from clear to cloudy and from good to fair) from the start of the day to the end of the day. Water visibility was rated as 'good' during the majority surveys with 12 of 19 survey events conducted when observers could clearly see into the water three or more feet. One survey was conducted several days after a freshet event and visibility was rated as 'poor' on February 1, 2021. The remaining surveys were conducted when visibility was rated as 'fair'.

A total of 34 redds were marked over the season. All of these were classified as *O. mykiss* redds. Twenty-seven of those redds were classified as 'new' redds and were observed from early December 2020 through the first week of March 2021 (**Table 13**; **Table 14**). Seven redds were

marked as 'old' indicating that they were observed on previous surveys. No salmon redds were identified during the 2020/2021 season. Peak *O. mykiss* spawning occurred from the end of January through the first week of March (**Table 13**; **Table 14**). About 26% of the total number of new *O. mykiss* redds were observed during survey week 24 in mid-February. Discharge in the Calaveras River ranged from about 30 to 50 cfs during the preceding two weeks, however, there was a large freshet at the end of January (**Figure 18**).

About 85% of the *O. mykiss* redds were observed in the Reach 2b of the Canyon Reach and in the Jenny Lind Reach (**Table 13**). No surveys were conducted in Reach 2a of the Canyon Reach or in the Shelton Reach. About 15% of the new redds were observed in the Dam Reach (**Table 13**). New *O. mykiss* redds were observed in every surveyed reach and in nearly all river miles (**Table 14**). No live fish were observed on the redds during the surveys.

Table 13. New *O. mykiss* redds identified by reach and date during the 2020/21 survey period.

Week[1]	Survey Dates	Reach				Grand Total	Percent
		Dam	Canyon	Jenny Lind	Shelton		
12	11/23 – 11/24	0	0	0	--	0	0%
14	12/8 – 12/10	0	1	0	--	1	3.7%
18	1/5 – 1/6	0	1	2	--	3	11.1%
20	1/19 – 1/20	0	1	3	--	4	14.8
22	2/1	0	2	3	--	5	18.5%
24	2/16 – 2/17	1	3	3	--	7	25.9%
26	3/1 – 3/2	1	3	1	--	5	18.5%
28	3/15 – 3/16	2	0	0	--	2	7.4%
30	3/29 – 3/30	0	0	0	--	0	0%
Grand Total		**4**	**11**	**12**	**0**	**27**	--
Percent		**14.8%**	**40.7%**	**44.4%**	**0.0%**	--	--

[1] Survey week refers to the number of weeks starting the first full week of September (Week of September 6, 2020).

Table 14. Total number of new *O. mykiss* redds by river mile and survey week.

Reach	River Mile	Survey Week								Grand Total
		14	18	20	22	24	26	28	30	
Dam	42	0	0	0	0	1	1	2	0	**4**
	41	0	0	0	0	0	0	0	0	**0**
Canyon	40	--	--	--	--	--	--	--	--	n/a
	39	--	--	--	--	--	--	--	--	n/a
	38	--	--	--	--	--	--	--	--	n/a
	37	--	--	--	--	--	--	--	--	n/a
	36	0	0	0	1	1	1	0	0	**3**
	35	1	1	1	1	2	2	0	0	**7**
Jenny Lind	34	0	1	1	2	1	0	0	0	**5**
	33	0	0	0	1	2	1	0	0	**4**
	32	0	1	0	0	0	0	0	0	**1**
	31	0	0	2	0	0	0	0	0	**2**
	30	0	0	0	0	0	0	0	0	**0**
Shelton	29	--	--	--	--	--	--	--	--	n/a
	28	--	--	--	--	--	--	--	--	n/a
	27	--	--	--	--	--	--	--	--	n/a
Grand Total		**1**	**3**	**4**	**5**	**7**	**5**	**2**	**0**	**27**

Environmental Conditions

Mean daily streamflow during the survey period (November 1, 2020 - April 1, 2021) ranged from 22 cfs to 63 cfs (average 31 cfs) from New Hogan Dam and ranged from 22 cfs to 237 cfs (average 36 cfs) below Cosgrove Creek. During this period, the fish ladder at Bellota was open a total of 72 days (see pages 41-47 for more details). The seven-day average of daily maximum (7DADM) water temperatures generally decreased from November to December at Clements Place, Jenny Lind, Gotelli Ranch, and Shelton Road. Water temperatures reached their minimums in December 2020 and January 2021 (**Figure 9**). After January 2021, water temperatures at these locations increased slightly until the end of March 2021. At the Jenny Lind temperature logger, monthly mean water temperatures during the spawning season were 8.6ºC (47.5ºF), 9.0ºC (48.2ºF), 10.2ºC (50.4ºF), and 11.5ºC (52.7ºF) during the months of December through March.

Water temperatures from the New Hogan Dam temperature logger, located immediately downstream of the dam, showed a more muted, steady temperature pattern than more downstream temperatures. Temperatures at this location were lowest (around 10ºC [50ºF]) during the month of February 2021.

Comparison with Previous Redd Surveys

The total number of new *O. mykiss* redds in water year 2021 was the second lowest on record since surveys began (**Table 15**). The annual average redd count has been 70 from water years 2015 to 2020, excluding water year 2017. The count in water year 2021 was about 38% of the average observed in the previous five full survey years.

Data from past redd surveys have indicated that *O. mykiss* can spawn throughout the surveyed reach with observations of redds as far downstream as Dog Ranch Road (RM 27.2; **Figure 20**) and as far upstream as New Hogan Dam. No surveys were conducted in the Shelton Road Reach (Reach 4) in WY 2021, however, *O. mykiss* redds were observed in every other reach upstream. This is consistent with other years that have been surveyed.

The distribution of Chinook salmon redds is similar to that of *O. mykiss* with redds observed in every survey reach (**Figure 21**). Most spawning activity has been observed in the Jenny Lind Reach (Reach 3; **Figure 21**). No Chinook salmon redds were observed in WY 2021.

Table 15. Annual counts of new redds of during redd surveys from water years 2015 to 2021. Note that no surveys were conducted in water year 2017 due to high flows.

	Species		
Water Year	**Chinook Salmon**	***O. mykiss***	**Grand Total**
2015	5	33	38
2016	0	28	28
2017	n/a	n/a	--
2018	85	64	149
2019	95	19	114
2020	17	207	224
2021	0	27	27
Grand Total	**202**	**378**	**580**

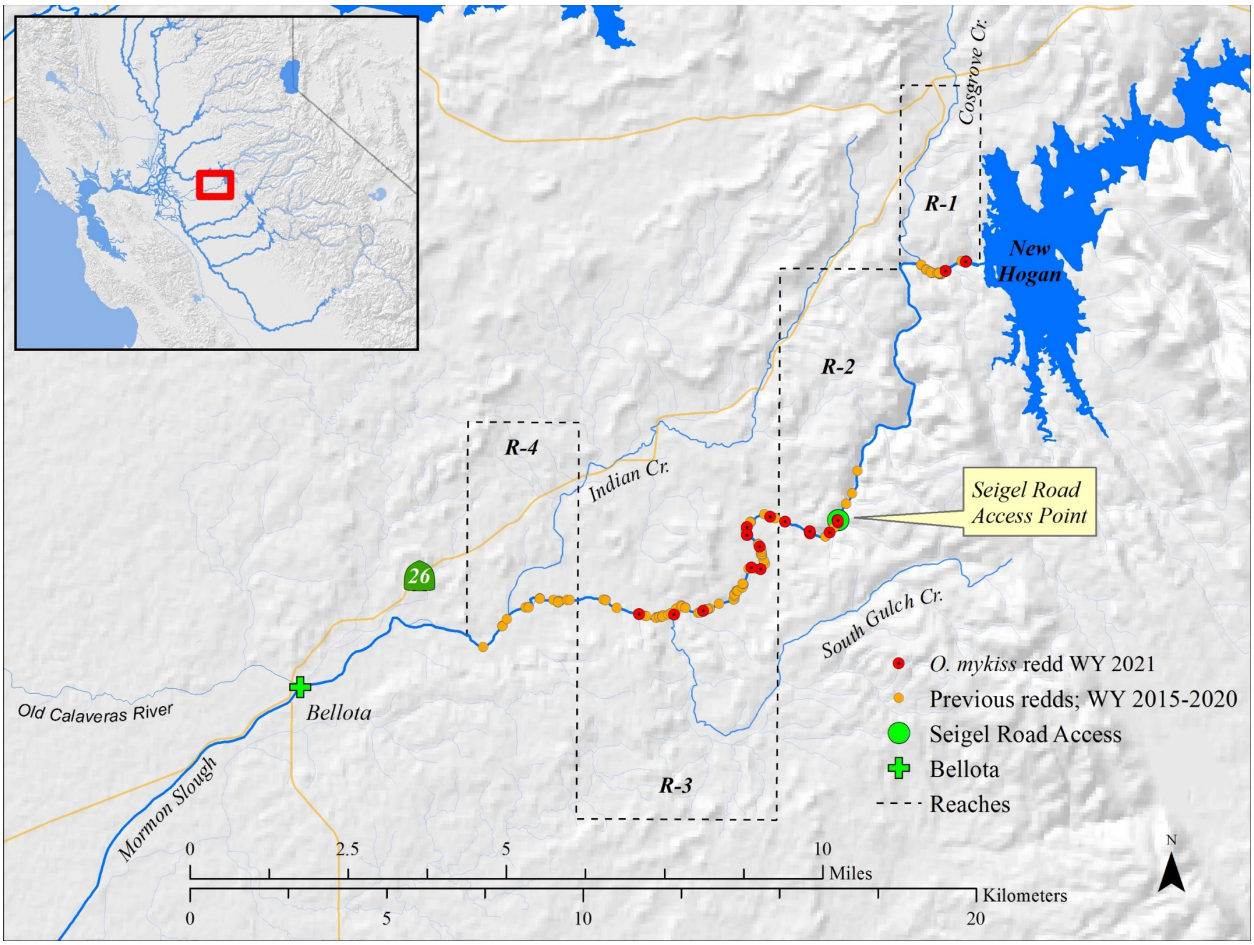


Figure 20. Spatial distribution of *O. mykiss* redds from previous redd surveys (WYs 2015-2020; orange points) and from WY 2021 (red points; n = 27).

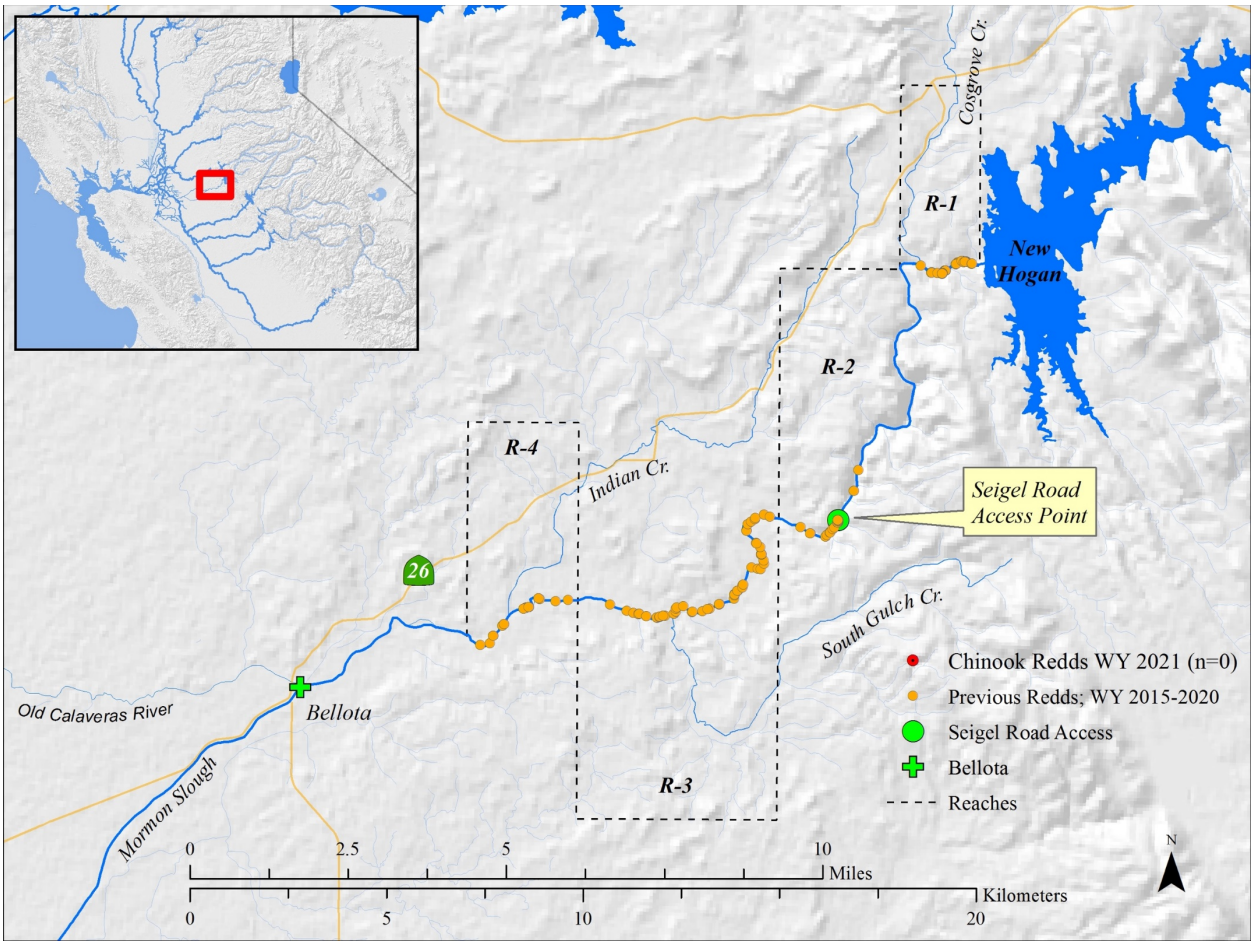


Figure 21. Spatial distribution of Chinook salmon redds from previous redd surveys (WYs 2015-2020; orange points). No Chinook salmon redds were observed in WY 2021.

Discussion

Redd surveys conducted in water year 2021 indicated that the spawning activity of *O. mykiss* occurs over a wide spatial area and for an extended period of time (i.e., December to March). This observation is consistent with observations in previous years. While no redd surveys were conducted below the Shelton Road rotary screw trap in WY 2021, previous surveys have indicated that spawning activity of both *O. mykiss* and Chinook salmon occurs below this location. This indicates that spawning conditions are generally suitable during a large portion of the spawning season and across a large area (i.e., from Shelton Road to New Hogan Dam). The remainder of the discussion focuses on *O. mykiss* as no Chinook salmon redds were observed during surveys conducted in WY 2021. Additionally, no carcasses of either species were encountered and collected during field surveys.

The total number of new *O. mykiss* redds observed in WY 2021 was less than both the long-term average (about 70 redds annual between WYs 2015 – 2020) and the previous year (WY 2020; 207 new redds). However, it is unclear if the differences are due to a true change in the abundance of the spawning population of *O. mykiss* or a change in the ability to detect redds. Compared to previous years, redd surveys were conducted in good conditions for the most part in WY 2021.

There was a relatively stable hydrograph over the course of the season. Typically, freshets will occur at multiple points throughout a redd season that can obscure redds occurring prior to the event. There was only one freshet during the 2020/2021 season that increased flow temporarily at the end of January, between the fourth and fifth redd surveys and was a relatively low magnitude increase (35 cfs to 237 cfs). Other conditions such as water turbidity and poor light conditions can make detection of redds difficult. However, visibility ratings made at the start and end of each survey event only indicate poor visibility on one occasion (2/1/21) immediately following the freshet event three days prior. Regardless of that five new redds were located on that event, followed by seven new redds two weeks later. Visibility was rated as good (n = 12) or Fair (n = 6) on all other surveys.

We caution against using these redds counts to infer the trends in population abundance as detection of redds has not been explicitly assessed. Currently, redd counts provided above should be considered only an index of spawning activity. Other surveys, such as snorkel surveys explicitly account for detection (via bounded counts) and have a more rigorous sampling design, should be considered a stronger data set to assess annual changes in population abundance of *O. mykiss* (see pages 74-86 for further details). For future redd surveys, we suggest that field methods be slightly modified to allow for a pilot-level assessment of detection of redds. However, it should be noted that detection of *O. mykiss* (and Chinook salmon) redds can be affected by factors outside to the control of surveyors. The most obvious is discharge as mentioned above but could also include the mobility of certain sizes of substrate. The ability for substrate to move and potentially reduce the amount of time redds can be detected is another important consideration related to detection rates.

Calaveras River *Oncorhynchus mykiss* Stranding Survey and Rescue

Summary from October 2020 and 2021

Prepared By:
Jim Inman
Matt Peterson

Report Summary

Annually in October, Stockton East Water District (SEWD) removes flashboard dams within and drains the Old Calaveras River channel. Upon completion and approval of the Calaveras Habitat Conservation Plan (CHCP), fall of 2020 was the first year of implementing Calaveras *O. mykiss* stranding surveys. In October of 2020, SEWD notified their fisheries biologist (FISHBIO) prior to flashboard dam removal but the channel had already been drained and there was no ponding of water behind the flashboard dams to seine for stranded *O. mykiss*. Improvements to the notification procedures were made by SEWD in 2021 and surveys were conducted as intended in 2021.

In October 2021, SEWD coordinated with FISHBIO to monitor water levels at the flashboard dams and conduct seining surveys of isolated pools for potentially stranded *O. mykiss* prior to removing flashboard dams. Seining surveys resulted in 32 *O. mykiss* captured and relocated, all from Tully Dam. There were no *O. mykiss* mortalities incurred or observed during the stranding survey, rescue, and relocation operations. Other native fish including Sacramento pikeminnow, Sacramento sucker, and prickly sculpin were also captured and relocated. Five non-native species were observed during sampling and included black bass, bluegill, common carp, mosquitofish, and red shiner.

Background

The Old Calaveras River is managed as a secondary channel that is only used for irrigation and groundwater recharge. The Old Calaveras River Channel is approximately 18.4 miles long from the Headworks at Bellota to the confluence with the Stockton Diverting Canal (**Figure 22**) and has a maximum channel capacity of 150 cfs. The Old Calaveras is characterized by a narrow channel with ample vegetative cover and large instream woody debris. Much of the vegetative cover consists of agricultural and non-native invasive plant species, such as Himalayan Blackberry. The Old Calaveras River becomes more channelized with less cover as it reaches the valley floor.

Stockton East Water District operates a temporary barrier (e.g., net) on the upstream side of the Old Calaveras Headworks Facility. The barrier is intended to prevent juvenile salmonids from migrating into the channel whenever water is diverted down the Old Calaveras River channel for irrigation or groundwater recharge. Implementation of this conservation strategy began in 2005 and will continue annually until a permanent non-entraining barrier is constructed at the Headworks Facility.

The temporary barrier (**Figure 23**) currently consists of a net that extends perpendicularly across the entire width and depth of the channel, which is held in place by a pulley system. The pulley system allows the net to be pulled to the streambank for cleaning, debris removal, or repair. Prior to pulling the net aside for maintenance, a back-up net is extended in front of the barrier net using a separate pulley system, which ensures that a barrier is always in place. Maintenance activities occur as needed, which is typically once a week. The net barrier reduces the possibility that juvenile salmonids and steelhead kelts migrating downstream are entrained into the Old Calaveras River channel downstream of the Headworks Facility (**Figure 24**).

Each year after the irrigation season is over in October; SEWD drains the Old Calaveras and removes flashboard dams (Appendix C; page 112) in a downstream order with the intention to eliminate or reduce the incidence of salmonid stranding and alleviate the need to relocate fish.

The first *O. mykiss* stranding surveys were conducted during October 2020 (Water Year 2021). However, the channel was dewatered prior to the removal of the flashboard dams and no ponding occurred. All the sites were surveyed for signs of *O. mykiss* but there were none recovered living or dead. This issue with operations and coordination was corrected and FISHBIO was notified prior to dewatering in October 2021 (WY 2022).

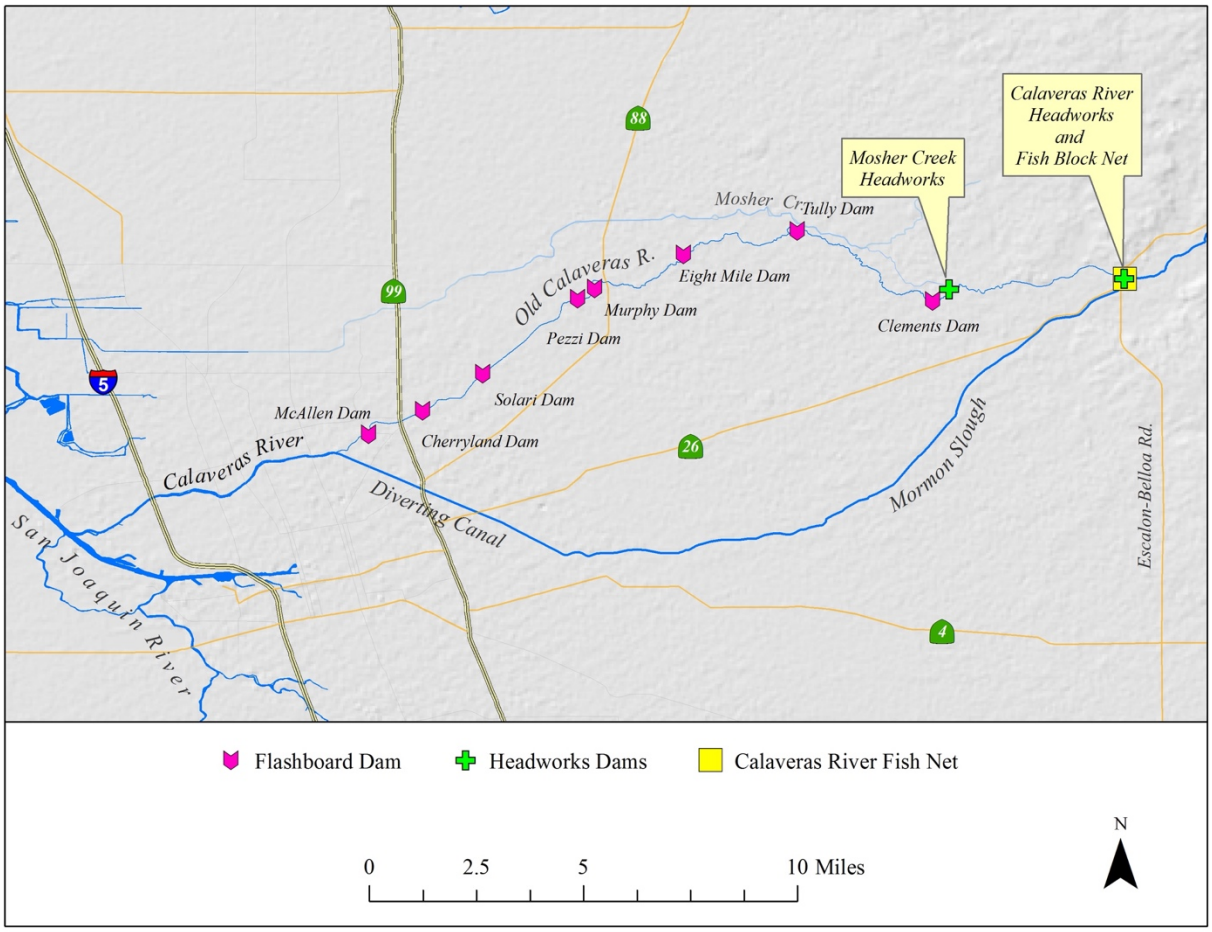


Figure 22. Map of flashboard dam locations in the Old Calaveras River.

Figure 23. Temporary fish barrier upstream of the Old Calaveras Headworks.

Figure 24. Old Calaveras Headworks structure.

Methods

Stockton East Water District coordinates with their fisheries biologists (FISHBIO) to conduct fish stranding surveys during the dewatering and removal of flashboard dams. SEWD begins flashboard dam removal by first removing the 8 ft Bellota Weir and installing the 2 ft weir then proceeding downstream in Mormon Slough. As flow is significantly reduced and eventually ceased in the Old Calaveras, FISHBIO monitored the conditions at the flashboard dam sites. The flashboard dam sites are checked for environmental conditions (water depth, water temperature, dissolved oxygen), connections in either direction, and/or for signs of fish in distress. Water depths must be reduced to about 2.5 ft in order to effectively capture fish with seine nets. The water does not necessarily drain from the upper dams to the lower dams, rather, the rate at which they drain is more dependent on the porosity of each dam and the percolation rate into the ground. The water upstream of each dam must be reduced to very minimal levels for SEWD personnel to safely remove the flashboard dam structure.

SEWD biologists (FISHBIO) follow Flashboard Dam Removal Fish Relocation Protocol as written in Attachment D-4 in Appendix D of the final Calaveras River HCP (SEWD and FISHBIO, 2020):

> *Immediately following the de-watering at each structure, SEWD's fisheries biologists will seine any ponded areas upstream or downstream to document fish presence. Block nets will be deployed at the upstream and downstream ends of each "unit" prior to seining to ensure that fish do not move out of the sample area. Seining will continue until a pass results in no catch. Any fish collected will be identified to species, lengths and weights will be measured, and smolt index will be obtained from a subsample of up to 25 O. mykiss or Chinook salmon. If mortalities are collected by SEWD personnel, or by SEWD's fisheries biologists, biological data will be collected from each fish, and NMFS and CDFW will be notified.*
>
> *Any dead Central Valley steelhead trout (O. mykiss) encountered will be placed in plastic bags (one fish per bag), which will be placed on ice in the field and transferred to a freezer at the end of the day. Labels containing species, date, capture location (GPS), length (mm), weight (0.1 grams), and body of water shall be placed in the bag along with the sample. The specimens shall be sent to CDFW for research purposes. The current Department contact is:*
>
> *Mrs. Lea Koerber*
> *California Department of Fish and Wildlife*
> *Central Valley Tissue Archive*
> *980 Riverside Parkway, Suite 110*
> *West Sacramento, CA 95605*
> *(916) 375-6092*

If mortality of salmonids is believed to be imminent, rescue operations will occur according to the following protocol. Non-salmonids will not be transported. Rescued salmonids will be placed into a 250-gallon aerated transport tank containing relatively clean water (as compared to the stranding location) obtained from the Calaveras River downstream from the stranding location, to provide similar water quality parameters such as temperature. Young-of-the-year *O. mykiss* (<100 mm) and adult *O. mykiss* (>300 mm) will be released upstream at Shelton Road, taking precaution to acclimate the fish to the cooler water. Age 1+ *O. mykiss* (100-300 mm) and all juvenile Chinook

salmon will be released in the San Joaquin Delta near Stockton, again taking precaution to acclimate the fish to the temperature at the release site, as it is expected to differ from the temperature at the collection site.

Introducing fish to drastic changes in water temperature with no acclimation period can create stress or thermal shock. To safeguard against any potential behavioral changes or physiological shock, the following acclimation protocol was developed. First, temperature will be measured at both the collection and release sites. If the release site water temperature is within 5ºF of the collection site temperature, fish will be released immediately. However, differences in temperatures above the 5ºF range will warrant an acclimation period of ten minutes per 1°F. Acclimation will be accomplished by slowly introducing release site water into the transport tank until the water temperature in the tank is equal to the release site temperature. If at any time during the acclimation period individual fish appear lethargic or are not able to maintain their equilibrium, the acclimation period will be extended as needed. During acclimation, fish will be held no longer than one hour to limit accumulated stress resulting from long holding periods with wild fish.

Any *O. mykiss* in good condition may be PIT tagged before release as part of the Calaveras *O. mykiss* Life History Study (see pages 87-94 for more details). Any *O. mykiss* that appeared stressed are scanned for an existing PIT tag and released with minimal handling.

Monitoring conditions included measuring water temperature and dissolved oxygen (DO) with a YSI (model: Pro ODO) meter, estimating max water depth, and looking for signs of fish in distress.

Results

FISHBIO began monitoring conditions (**Table 16**) at seven Old Calaveras River flashboard dams on October 9, 2021. Seven flashboard dams were removed in October 2021: Clements Dam, Tully Dam, Eight Mile Dam, Murphy Dam, Pezzi Dam, Cherryland Dam, and McAllen Dam. Mosher Creek Headworks Dam remains in place year-round, and Solari Dam was not installed in 2021.

Pezzi Dam was monitored from October 9 through October 13. Instantaneous temperature ranged from 48.8°F to 58.2°F and DO was between 1.41 mg/L and 6.96 mg/L (**Table 16**). Once the pool above the dam became isolated the size of the pool reduced quickly, the depth dropped to less than 2 ft and the DO dropped to 1.41 mg/L. On October 13, it was not feasible to use a seine net due to a large rootwad in the middle of the pool, so the scoop nets were used to search for fish. There were approximately 300 carp, 12 mosquitofish, one bluegill, and one red shiner recovered but no salmonids were captured or observed. All fish captured were left on site.

Eight Mile Dam was monitored from October 9 through October 13. Instantaneous temperature ranged from 51.0°F to 59.2°F and DO ranged from 2.77 mg/L to 5.39 mg/L (**Table 16**). Once the water level dropped to two feet on October 13, the pooled water above the dam was seined. Approximately 500 carp and 17 Sacramento pikeminnow (mean fork length [FL] 155 mm) were captured. The 17 Sacramento pikeminnow were transported to above the Bellota Weir and released, the carp were not rescued and left on site. There were no salmonids captured or observed at Eight Mile Dam.

The two most downstream dams McAllen Dam and Cherryland Dam were monitored from October 9 to October 14. At McAllen Dam the instantaneous temperature ranged from 55.7°F to 62.4°F and DO was between 4.11 mg/L and 10.25 mg/L (**Table 16**). Cherryland Dam instantaneous temperature ranged from 53.2°F to 58.6°F and DO was measured at 7.84 mg/L to 9.82 mg/L. These two dams are not as tall, approximately 5 feet, as the rest of the dams the channels have little slope upstream of each dam and do not form a defined pool behind each dam like the others upstream. McAllen Dam was seined on October 14 once the water level was reduced to approximately one foot. The site is not well suited for seining due to the steep sides of the channel and coarse rip-rap. No fish were captured at McAllen Dam. Cherryland Dam was also seined on October 14 when water depth had reached approximately two feet of max depth. Cherryland Dam also has steep banks, not much rip-rap, soft muddy substrate, and some overhanging vegetation. No fish were captured at McAllen Dam or Cherryland Dam.

Tully Dam was monitored from October 9 through October 16. Instantaneous temperature ranged from 52.7°F to 60.2°F and DO ranged from 3.50 mg/L to 7.87 mg/L (**Table 16**). Stockton East Water District staff pried open a couple of flashboards on October 14 to bring the pool down to about 3 feet deep. On October 15, FISHBIO setup a block net downstream of the flashboard dam and pried open a couple more flashboards to lower the water level in the pool upstream of the dam down to approximately 2 feet deep. The pool was seined and 31 *O. mykiss* were captured (**Table 17**) along with 81 Sacramento pikeminnow, 1 Sacramento sucker, and 1 prickly sculpin. All these fish were transported and released just upstream of the Bellota Weir. There were also approximately 200 carp, 12 bluegill, and 4 red shiners captured but were left on site. Tully Dam was rechecked on October 16 with one additional *O. mykiss*, 26 Sacramento pikeminnow, one Sacramento sucker, and one prickly sculpin captured and relocated to Bellota.

Clements Dam was monitored from October 9 through October 16. Instantaneous temperature ranged from 54.0°F to 59.4°F and DO was between 4.43 mg/L and 7.87 mg/L (**Table 16**). On October 16, FISHBIO setup a block net downstream of the flashboard dam and pried open a couple flashboards to lower the water level in the pool upstream of the dam down to approximately 2 feet deep. The pool was seined with multiple passes with approximately 30 carp and 10 Sacramento pikeminnow captured. The Sacramento pikeminnow were transported to Bellota and released upstream of the weir. There were no salmonids captured or observed at Clements Dam

Murphy Dam was monitored from October 9 through October 19. Instantaneous temperature ranged from 52.6°F to 60.9°F and DO ranged from 1.82 mg/L to 8.85 mg/L (**Table 16**). Murphy Dam was very watertight and the water level dropped very slowly over the 10 days of monitoring. The pool above the dam was seined on October 19. Approximately 400 carp, 100 black bass and 26 Sacramento pikeminnow (mean fork length = 150 mm) were captured. The 26 Sacramento pikeminnow were transported to above the Bellota Weir and released, the carp and black bass were not rescued and left on site. There were no salmonids captured or observed at Murphy Dam.

Table 16. Environmental conditions (water temperature [ºF] and dissolved oxygen [DO; mg/L]) and habitat characteristics (depth in ft) recorded during site visits conducted in the Old Calaveras River during October 2021. 'ns' denotes that no survey was conducted. Numbers bolded indicate the date(s) that the fish rescues were conducted.

Location	10/9/21	10/10/21	10/11/21	10/12/21	10/13/21	10/14/21	10/15/21	10/16/21	10/19/21
Clements Dam									
Temperature	59.4	58.8	59.3	55.5	55.2	55.4	54.1	**54.0**	ns
DO (mg/L)	5.30	4.48	4.43	7.87	5.90	5.84	5.38	**4.55**	ns
Max Depth ft.	8.0	8.0	7.5	7.0	6.5	6.0	4.0	**2.0**	ns
Tully Dam									
Temperature	60.2	59.1	59.3	55.5	56.0	55.0	**53.9**	**52.7**	ns
DO (mg/L)	6.69	6.77	5.93	7.87	6.70	6.44	**3.72**	**3.50**	ns
Max Depth ft.	7.0	6.5	6.0	5.0	4.0	3.0	**2.0**	**1.5**	ns
Eight Mile									
Temperature	59.2	57.7	58.1	53.0	**51.0**	ns	ns	ns	ns
DO (mg/L)	5.00	5.12	5.38	4.92	**2.77**	ns	ns	ns	ns
Max Depth ft.	6.0	6.0	5.0	2.0	**2.0**	ns	ns	ns	ns
Murphy Dam									
Temperature	60.0	59.3	60.9	59.7	55.8	57.1	ns	ns	**52.6**
DO (mg/L)	7.15	7.42	6.94	8.53	8.33	8.85	ns	ns	**1.82**
Max Depth ft.	6.0	6.0	5.5	5.0	4.8	4.5	ns	ns	**4.0**
Pezzi Dam									
Temperature	58.2	57.3	56.2	51.7	**48.8**	ns	ns	ns	ns
DO (mg/L)	6.70	6.96	6.40	3.00	**1.41**	ns	ns	ns	ns
Max Depth ft.	3.0	3.0	2.5	2.0	**1.5**	ns	ns	ns	ns
Cherryland									
Temperature	58.2	58.3	58.6	53.2	ns	**53.9**	ns	ns	ns
DO (mg/L)	8.81	8.74	7.84	9.82	ns	**8.81**	ns	ns	ns
Max Depth ft.	3.0	3.0	3.0	2.0	ns	**2.0**	ns	ns	ns
McAllen									
Temperature	59.2	60.1	62.4	55.7	ns	**56.3**	ns	ns	ns
DO (mg/L)	9.01	9.26	10.25	9.66	ns	**4.11**	ns	ns	ns
Max Depth ft.	3.0	2.0	2.0	1.5	ns	**1.0**	ns	ns	ns

Table 17. Sizes and PIT tag numbers of *O. mykiss* captured and relocated during October 2021.

Date	Capture Location	Release Location	Species	Fork Length (mm)	Total Length (mm)	Weight (g)	PIT Tag Number
10/15/21	Tully Dam	Bellota	*O. mykiss*	180	193	58.3	B982091062593500
10/15/21	Tully Dam	Bellota	*O. mykiss*	188	201	71.9	B982091062593459
10/15/21	Tully Dam	Bellota	*O. mykiss*	190	205	77.2	B982091062593433
10/15/21	Tully Dam	Bellota	*O. mykiss*	179	192	63.5	B982091062593437
10/15/21	Tully Dam	Bellota	*O. mykiss*	180	192	63.1	B982091062593457
10/15/21	Tully Dam	Bellota	*O. mykiss*	168	182	53.5	B982091062593453
10/15/21	Tully Dam	Bellota	*O. mykiss*	175	188	58.4	B982091062593430
10/15/21	Tully Dam	Bellota	*O. mykiss*	168	180	48.8	B982091062593452
10/15/21	Tully Dam	Bellota	*O. mykiss*	188	196	72.9	B982091062593445
10/15/21	Tully Dam	Bellota	*O. mykiss*	199	205	83.2	B982091062593467
10/15/21	Tully Dam	Bellota	*O. mykiss*	200	207	80.5	B982091062593423
10/15/21	Tully Dam	Bellota	*O. mykiss*	173	180	56	B982091062593419
10/15/21	Tully Dam	Bellota	*O. mykiss*	210	215	96	B982091062593431
10/15/21	Tully Dam	Bellota	*O. mykiss*	179	185	61.6	B982091062593490
10/15/21	Tully Dam	Bellota	*O. mykiss*	180	188	63.4	B982091062593454
10/15/21	Tully Dam	Bellota	*O. mykiss*	174	180	56.8	B982091062593600
10/15/21	Tully Dam	Bellota	*O. mykiss*	170	176	54.3	B982091062593581
10/15/21	Tully Dam	Bellota	*O. mykiss*	172	182	55.9	B982091062593567
10/15/21	Tully Dam	Bellota	*O. mykiss*	210	220	96.2	B982091062593555
10/15/21	Tully Dam	Bellota	*O. mykiss*	215	227	97.2	B982091062593609
10/15/21	Tully Dam	Bellota	*O. mykiss*	168	179	47.3	B982091062593563
10/15/21	Tully Dam	Bellota	*O. mykiss*	157	165	43.2	B982091062593594
10/15/21	Tully Dam	Bellota	*O. mykiss*	198	205	85	B982091062593611
10/15/21	Tully Dam	Bellota	*O. mykiss*	198	210	76	B982091062593561
10/15/21	Tully Dam	Bellota	*O. mykiss*	205	211	97.6	B982091062593533
10/15/21	Tully Dam	Bellota	*O. mykiss*	176	182	57.5	B982091062593595
10/15/21	Tully Dam	Bellota	*O. mykiss*	156	162	40.6	B982091062593535
10/15/21	Tully Dam	Bellota	*O. mykiss*	160	170	43.7	B982091062593583
10/15/21	Tully Dam	Bellota	*O. mykiss*	–	–	–	Not Tagged[1]
10/15/21	Tully Dam	Bellota	*O. mykiss*	388	409	–	B982091062593500[2]
10/15/21	Tully Dam	Bellota	*O. mykiss*	220	235	119	B982091062593073[3]
10/16/21	Tully Dam	Bellota	*O. mykiss*	183	192	65.8	B982091062593690[4]

[1] Fish appeared stressed, scanned for PIT tag, and released
[2] No weight collected, exceeded weight capacity of scale
[3] This was a recaptured fish, previously tagged on 6/10/21 at Shelton Road
[4] A tissue sample was collected on this fish, sample No. CAL-22021-469

Figure 25. Adult *O. mykiss* measuring 388 mm FL captured at Tully Dam on October 15, 2021.

Conclusions

Flashboard dams were monitored for environmental conditions and for signs of salmonids in distress at seven flashboard dam sites over a period of eleven days. No salmonid mortalities occurred during rescue operations. Seining surveys resulted in 32 *O. mykiss* captured at one location, Tully Dam. Although not required, other native fish including Sacramento pikeminnow, Sacramento sucker, and prickly sculpin were also captured and relocated. Of the 32 *O. mykiss* captured, 31 were age 1+ ranging in fork length 156 mm to 215 mm (mean 182.7 mm) and 1 adult fork length 388 mm was captured (**Figure 25**). Most of the *O. mykiss* captured appeared healthy and in good condition, only one of the age 1+ *O. mykiss* was not measured and tagged because it appeared stressed. It was only scanned for an existing PIT tag and released. Additionally, one of the age 1+ *O. mykiss* was a previously tagged fish, tagged at Shelton Road on June 6, 2021. This suggests that this fish entered the Old Calaveras Channel at some point after early June.

There were some inadvertent errors in the relocation of the rescued *O. mykiss*. The FISHBIO crew was referencing an old draft of the fish rescue protocol that called for Age 1+ *O. mykiss* to be released at Bellota when the current protocol calls for their release at the confluence of the

Calaveras River with the San Joaquin River. Under the old protocol adult *O. mykiss* were to be released at the confluence of the Calaveras with the San Joaquin River, however under the current protocol adult *O. mykiss* should be released above Shelton Road. FISHBIO notified NMFS October 15 of the rescued *O. mykiss* and requested and received permission to release the adult *O. mykiss* at Bellota. Measures will be taken to inform field crews of the updated fish rescue procedures prior to the implementation of this work in fall of 2022.

Calaveras River *Oncorhynchus mykiss* Over Summer Abundance Surveys

Water Year 2021 Annual Report

Prepared By:
Michael Hellmair
Matt Peterson
Jason Guignard
Patrick Cuthbert

Report Summary

Summertime snorkel surveys have been conducted on the Calaveras River since 2011 to estimate the abundance of *Oncorhynchus mykiss* downstream of New Hogan Dam. Since then, abundance estimates of *O. mykiss* have fluctuated greatly from a low of 650 in 2016 to a high of 23,089 in 2018. During the 2021 snorkel survey, 100 distinct habitat units were surveyed and 87 of these were occupied by at least one *O. mykiss*. First pass counts ranged from zero (in 13 units) to 77, with a mean first-pass count of 18.5 (compared to mean count of 0.6 per unit sampled in 2017, 35.4 in 2018, 9.5 in 2019, and 18.3 in 2020).

The estimated overall abundance of *O. mykiss* (all life stages combined) in the Calaveras River based on snorkel surveys in 2021 was 16,260 fish (95% confidence interval: 8,980–23,542), which represents a slight increase over the 13,551 fish estimated in 2020, and is the second highest estimated abundance since periodic snorkel surveys were implemented. Fish density (individuals per mile) was comparable among the Dam (1,270), canyon (1,174) and Jenny Lind (1,012) reaches, and lowest in the Shelton reach (459). Similar to past years, the majority of individuals (59%) fell within the smallest size class (<150 mm), which are most likely juveniles that hatched the previous winter/spring.

Background

Steelhead, the anadromous life-history form of rainbow trout (*Oncorhynchus mykiss*), were once abundant throughout California's Central Valley (CV). A combination of anthropogenic factors has resulted in severely reduced abundance of these ocean-going trout, including dam construction, mining, and logging. In addition, modification of creeks and rivers for navigation and flood protection has reduced and degraded available spawning- and rearing habitat (McEwan 2001). As a consequence, steelhead have become relatively rare in the Central Valley, prompting their listing as Threatened under the Endangered Species Act (ESA) in 1998, a status that was reaffirmed in 2006, 2011, and 2016.

Though this listing has afforded the species special protection and made resources available to facilitate its recovery, management of steelhead is complicated by the complex life history of the species (Satterthwaite et al. 2010; Kendall et al. 2015). Most populations of *O. mykiss* in anadromous watersheds are partially migratory: some individuals emigrate to the ocean where they grow to adulthood before returning to freshwater habitats to reproduce, while others remain in their natal riverine habitat and reach maturity without undergoing long-distance migrations. For anadromous individuals (steelhead), the food-rich marine environment offers the potential for faster growth, larger size, and higher fecundity. However, migration to the ocean and the typically later age at maturity of these individuals reduce their probability of surviving until reproduction (Fleming and Reynolds 2004). Resident rainbow trout typically mature at a younger age and smaller size, and have a higher chance of surviving until reproduction, as well as a higher rate of iteroparity (repeat spawning; Fleming and Reynolds 2004, Schill et al. 2010).

Further challenges to fisheries conservation and management stem from considerable plasticity within life-history types. For example, individuals that migrate to sea can do so at various ages, and some may migrate out to the Sacramento-San Joaquin Delta or San Francisco Bay and return

to spawn without spending any time in the open ocean (Teo et al. 2011, Null et al. 2012). Additionally, in rivers where steelhead and rainbow trout are sympatric, migratory and resident forms interbreed and may produce offspring with a life history different from their own (Zimmerman and Reeves 2000, Heath et al. 2008, Zimmerman et al. 2009, Christie et al. 2011, Courter et al. 2013). These various aspects of the species' complex and variable life history illustrate the difficulty in assessing steelhead population viability in the Central Valley.

Management of steelhead depends on the relative prevalence of the migratory and resident polymorphisms in a population. Within the CV Distinct Population Segment (DPS), it may not be possible to manage one life-history morph without reference to the other (Williams et al. 2007). Without information regarding the abundance of *O. mykiss* or the prevalence of various life-history morphs, it is difficult to examine how changes in the environment may affect the population abundance as a whole. Consistent and robust population monitoring is necessary to document trends and natural variation in *O. mykiss* abundance and to understand whether certain actions may negatively or positively affect population size (Eilers et al. 2010). While the life-history plasticity of *O. mykiss* raises substantial challenges for management and recovery of the anadromous population segment, it unequivocally underlines the importance of including resident rainbow trout in status assessment and recovery planning of anadromous steelhead.

While comprehensive monitoring plans are in place to track and assess most larger remaining populations of other anadromous salmonids (typically Chinook salmon, *Oncorhynchus tshawytscha*), nearly all of the 81 historical populations of steelhead in the CV are considered data deficient (Lindley et al. 2006, Lindley et al. 2007, National Marine Fisheries Service [NMFS] 2009). To address the increasingly recognized need to incorporate the resident rainbow trout populations in status assessment and management of the steelhead CV ESU, FISHBIO has conducted quantitative assessments of Calaveras River *O. mykiss* populations in 2011–2013, and 2016–2021 (**Table 18**).

Abundance estimates are based on direct observation dive counts (i.e., snorkel surveys), which are a cost-effective, non-invasive method of estimating abundance. This method does not require fish handling and can provide counts similar to depletion electrofishing under conditions such as those found on the Calaveras River during the summer months (Mullner et al. 1998, Allen and Gast 2007). An overview of the methodology, past findings, and detailed results from the 2021 surveys are presented herein.

Table 18. Summary of Calaveras River summertime snorkel surveys since 2011, including size- (in mm) and reach-specific abundance estimates.

	Dam			Canyon			Jenny Lind			Shelton			Total [c]	Standard
Year	**<100**	**>100**		**<100**	**>100**		**<100**	**>100**		**<100**	**>100**			**Deviation**
2011[a]	133	355		1,208	1,582		694	1,178		2	460		**5,612**	417
2012	NA [b]	NA [b]		313	1,699		254	1,328		12	63		**3,669**	2,475
	<150	**150-300**	**>300**	**<150**	**150-300**	**>300**	**<150**	**150-300**	**>300**	**<150**	**150-300**	**>300**		
2013	12	42	39	1,150	538	202	3,037	3,132	1,397	443	316	28	**10,336**	2,869
2014	-------- No Survey --------													
2015	-------- No Survey --------													
2016	100	0	0	110	234	42	0	124	28	0 [d]	0 [d]	0 [d]	**638**	765
2017	126	157	64	220	429	181	0	0	0	0	0	0	**1,177**	551
2018	4,893	1,737	687	5,503	760	99	7,467	1,320	160	463	0	0	**23,089**	12,783
2019	835	426	477	3,636	327	347	335	236	55	533	184	0	**7,391**	1,464
2020	19	65	24	1,780	825	753	4,552	4,310	218	463	491	51	**13,551**	4,500
2021	1,568	383	94	4,855	2,967	349	2,808	2,071	195	378	592	0	**16,260**	3,641

[a] In 2011, single-pass snorkel surveys were conducted, and abundance was estimated based on the mean number of fish observed in a given habitat type and reach, extrapolated by the total number of habitat units of that type in a reach, then summed over all habitat types and reaches.

[b] The Dam reach was not surveyed in 2012 due to high turbidity.

[c] Snorkel data from all previous surveys were reanalyzed during the preparation of this report. Deviations from previously reported population estimates are possible. The estimates reported herein should be considered the finalized estimates to be used in all future reporting.

[d] The Shelton reach was not surveyed in 2016 due to exceedingly low abundance the Jenny Lind Reach, and no observations of *O. mykiss* in the lower portion of the Jenny Lind. Consequently, Shelton abundance is assumed "zero" for 2016.

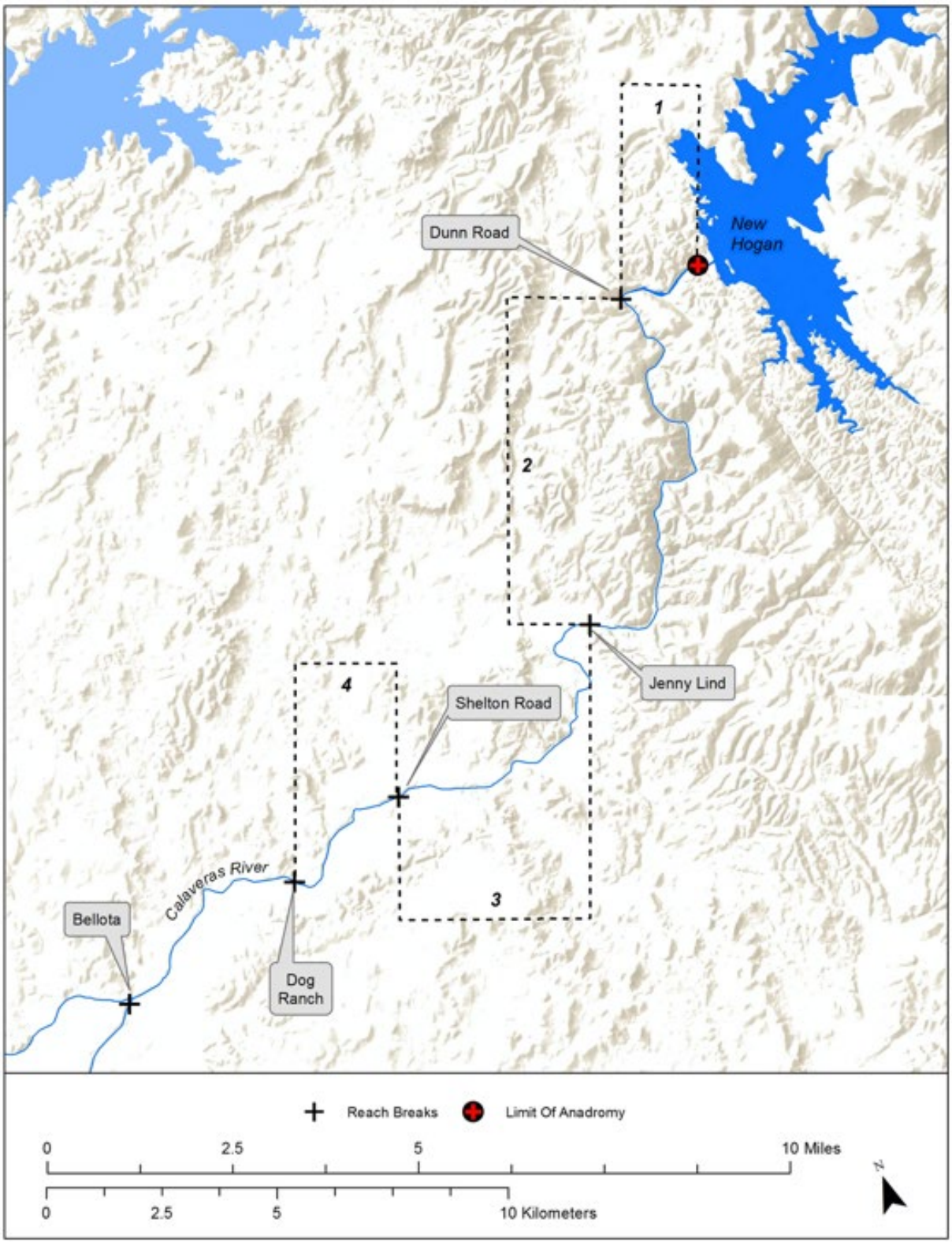


Figure 26. Map indicating survey reaches for population estimates of *Oncorhynchus mykiss* on the Calaveras River.

Methods

Habitat Mapping and Unit Selection

In order to obtain an accurate estimate of fish abundance, the entire reach of the Calaveras River from New Hogan Dam to Dog Ranch was surveyed and categorized into habitat units based on a four-category classification (i.e., riffle, run, pool, and cascade). Global Positioning Satellite (GPS) waypoints were taken at the boundaries of each habitat unit to accurately locate each unit during subsequent surveys. In addition, the length and width of each unit was measured. Other measurements recorded during habitat mapping included dominant substrate, dominant vegetative cover, and presence of large woody debris. Stream sections classified as "cascades" are often hazardous or do not permit sufficient visual coverage due to turbulence and were excluded from this survey. Classification and size of distinct habitat units is verified periodically. Within each reach (**Figure 26**) and habitat category (i.e., "stratum") conducive to visual surveys (run, riffle, pool), units were sampled randomly by determining a target sampling fraction (e.g., 40% of pools within the New Hogan Dam Reach). A sub-sample of the surveyed units was randomly selected for calibration of dive counts using the Method of Bounded Counts (MBC), as described in more detail below.

According to our classification, the reach of the Calaveras River between New Hogan Dam and Dog Ranch consists of 475 distinct habitat units (91 pools, 54 riffles, 249 runs, and 81 cascades or similar habitat that could not be sampled safely or effectively).

Dive Counts

There are numerous methods for estimating the total abundance of fish in freshwater systems, the majority of which depend on handling the fish during enumeration (e.g., electrofishing, seining etc.). Direct observation dive counts (i.e., snorkel surveys) are a cost-effective, non-invasive means of estimating abundance based on visual counts, which do not require fish handling (Allen and Gast 2007). Therefore, this method is preferred for species of special conservation concern. In some situations, when water visibility is excellent and conditions are good, snorkeling can provide counts similar to depletion electrofishing (Mullner et al. 1998). However, visual estimates are typically negatively biased due to imperfect detection (e.g., visibility, temperature, time of day, species-specific behaviors and fish size), resulting in an underestimation of true population size (Northcote and Wilkie 1963 as cited by Hagen and Baxter 2005, Mullner et al. 1998, Bradford and Higgins 2001, Hagen and Baxter 2005, O'Neal 2007, Hagen et al. 2010). Therefore, without estimates of observer bias (which generally require depletion estimates of abundance for a subsample of the reaches under study), single-pass snorkel surveys cannot provide an estimate of absolute abundance. Rather, they provide an unbiased index of abundance with associated confidence intervals. A viable alternative to obtaining accurate population size estimates by traditional methods (such as depletion electrofishing or mark-resighting experiments) is the Method of Bounded Counts. This approach relies on repeated counts of fish from the same unit (generally four passes) and produces nearly unbiased estimates of abundance if fish abundance in respective survey units is relatively low (Mohr and Hankin 2005). As such, this method provides a non-invasive (no fish handling required) alternative to traditional methods that is highly applicable to stream surveys involving species of special concern.

A standardized protocol was followed to ensure comparability of survey results with previous and future results and to minimize variation due to sampling error. The number of divers needed for a snorkel survey was adjusted based on the width of the stream and was chosen to ensure complete visual coverage of the stream. In most cases, four divers were required for complete visual coverage of the stream width, and parallel dive lanes were established prior to snorkeling. Dive lanes were assigned randomly to divers at each survey unit to minimize the effects of diver familiarity with the physical habitat and fish population during dive counts. Care was taken to minimize disturbance of fish prior to sampling each unit.

Divers entered the stream at the border of the survey unit and counted fish within their respective dive lanes as they proceeded downstream in unison with the other divers. At the bottom of the unit, two divers proceeded upstream along opposite banks to sample the stream margin. Riffles were generally surveyed in an upstream direction, when depth and velocity allowed. Divers recorded fish counts on a wrist-mounted dive slate and assigned a size category to each observation (less than 150 mm, 150-300 mm, and greater than 300 mm). Divers were equipped with two reference dowels (150 mm and 300 mm in length) to facilitate the correct estimation of fish size and account for underwater size distortion. When approaching the boundary of the survey unit, divers carefully monitored fish holding close to the unit boundary and included fish that crossed the unit boundary. Any fish that was observed moving between lanes was noted immediately after the dive to avoid multiple counts of the same fish. To minimize potential observer bias during all snorkel passes, the units selected for additional passes were not revealed to the divers until the first dive pass was completed. In sampling units that were selected for calibration of single-pass dive counts, a minimum of five minutes was allowed to elapse between each of the three subsequent dives.

Obtaining accurate counts of *O. mykiss* was the priority of this survey. Other observed species (and their lengths) were recorded, so long as this did not compromise counts of the focal species.

Fish Abundance

To estimate total abundance of focal fish species, a two-phase estimator was used in each stratum surveyed (runs, riffles, and pools) to "calibrate" single-pass counts. Error in abundance estimation can occur in the first and second phase of estimation, termed sampling error and measurement error, respectively. Error that occurs in the first phase is called sampling variance, which results from selecting any sample from a sampling universe. Sampling variance can be minimized by selecting an adequately large number of samples from all units that are available in a given stratum. In the second phase (in units selected for bounded counts), there is error associated with the measurement of any particular unit abundance (measurement error or precision) due to variation of dive counts within units surveyed multiple times.

For each unit selected for a bounded count (multiple passes), individual pass counts were ordered from highest to lowest, and unit abundance was estimated as

$$\tilde{y}_{Bk} = d_m + (d_m - d_{m-1})$$

where $\tilde{y}_{Bk}$ = the bounded count estimate of "true" abundance in unit *k*, d_m is the largest of the four counts for the unit, and d_{m-1} is the second largest of the four counts.

For example, if a unit was snorkeled four times with pass counts of 6, 7, 9, and 6 fish, the ordered counts would be 9, 7, 6, and 6. The difference between the highest count (9) and the next highest count (7) is 2, which is added to the highest pass count of 9, for an abundance estimate of 11 fish in the unit.

The estimate of error, or mean square error (MSE), around the unit abundance estimate was calculated as

$$\widehat{MSE}_{\tilde{y}_{Bk}} = (d_m - d_{m-1})^2$$

In the preceding example, the MSE would equal the squared difference between the highest count (9) and the next highest count (7), which would equal 4. The 95% confidence intervals would be twice the square root of MSE, which would also equal 4, for a final unit abundance estimate of 11 ± 4 (7–15).

For each stratum in which surveys were conducted, the total stratum abundance ($\hat{Y}_D$) is estimated as

$$\hat{Y}_D = N\underline{\tilde{y}}_{BD}\frac{\underline{x}_1}{\underline{x}_2}$$

where N is the total number of habitat units within stratum *D*, and $\underline{\tilde{y}}_{BD}$ is the mean estimated total abundance for all units in stratum *D* for which bounded counts were performed. The last term in the equation is the mean of the first pass counts in habitat units that were surveyed only once ($\underline{x}_1$) divided by the mean of the first pass counts in habitat units that were surveyed four times ($\underline{x}_2$). This is an adjustment factor that accounts for the observation probability during the snorkel surveys (i.e., the difference between a unit abundance derived from a single-pass survey versus a four-pass survey).

Estimates of error around the total stratum abundance were calculated as

$$\hat{V}(\hat{Y}_D) = N^2(1-f_1)\frac{s^2_{\tilde{y}}}{n_1} + N^2(1-f_2)\left(\frac{\underline{x}_1}{\underline{x}_2}\right)^2\frac{s^2_{\tilde{y}|x}}{n_2}$$

where f_1 and f_2 are the sampling fractions for the first and second phases, respectively; n_1 and n_2 are the numbers of units that are sampled in the first and second phases, respectively. The variation in the unit counts in the first phase, $s^2_{\tilde{y}}$, was calculated as

$$s^2_{\tilde{y}} = \frac{1}{n_2 - 1}\sum_{k=1}^{n_2}(\tilde{y}_{Bk} - \underline{\tilde{y}}_{BD})^2$$

where $\tilde{y}_{Bk}$ is the estimated abundance in the k^{th} second phase sample and $\underline{\tilde{y}}_{BD}$ is the mean abundance over all second phase samples in stratum *D*. The conditional variation (i.e., variation that arises from selecting particular second phase samples), $s^2_{\tilde{y}|x}$, was calculated as

$$s^2_{\tilde{y}|x} = \frac{1}{n_2-1}\sum_{k=1}^{n_2}\left[MSE_{\tilde{y}_{Bk}} + (\tilde{y}_{Bk} - \underline{\tilde{y}}_{BD}\frac{x_{Bk}}{\underline{x}_2})^2\right]$$

where $x_{Bk}$is the first pass dive count in unit *k*.

Sampling under a stratified design such as the one employed in this study is considered independent across the different habitat strata (run, riffle, pool; *D* = 1, 2, 3), so that estimates of total abundance for each of the habitat types, $\hat{Y}_D$, and their corresponding sampling variances, $\hat{V}(\hat{Y}_D)$, can be combined across strata (Thompson 2002):

$$\hat{Y} = \sum_{D=1}^{3} Y_D$$

and

$$\hat{V}(\hat{Y}) = \sum_{D=1}^{3} \hat{V}(\hat{Y}_D)$$

Results

Abundance and density

A total of 100 distinct habitat units were surveyed in 2021, of which 87 were occupied by at least one *O. mykiss*. First pass counts ranged from zero (in 13 units) to 77 (in habitat unit 356, a run in the Jenny Lind reach), with a mean first-pass count of 18.5 (compare to mean count of 0.6 per unit sampled in 2017, 35.4 in 2018, 9.5 in 2019, and 18.3 in 2020).

The estimated overall abundance of *O. mykiss* (all life stages combined) in the Calaveras River based on snorkel surveys in 2021 was 16,260 fish (95% confidence interval: 8,980–23,542; Figure 2), a slight increase over the 13,551 fish estimated in 2020, and the second highest abundance on record (**Figure 27**).

Fish density was comparable among the Dam (1,270 mile^{-1}), Canyon (1,174 mile^{-1}) and Jenny Lind (1,012 mile^{-1}) reaches, and lowest in the Shelton reach (459; **Figure 28**). The low estimated density in the Shelton reach is largely attributable to the low abundance of juveniles. Notably, the reaches with highest densities are inconsistent from year to year, in contrast to nearby river systems such as the Stanislaus River, where a downstream gradient in density is generally observed.

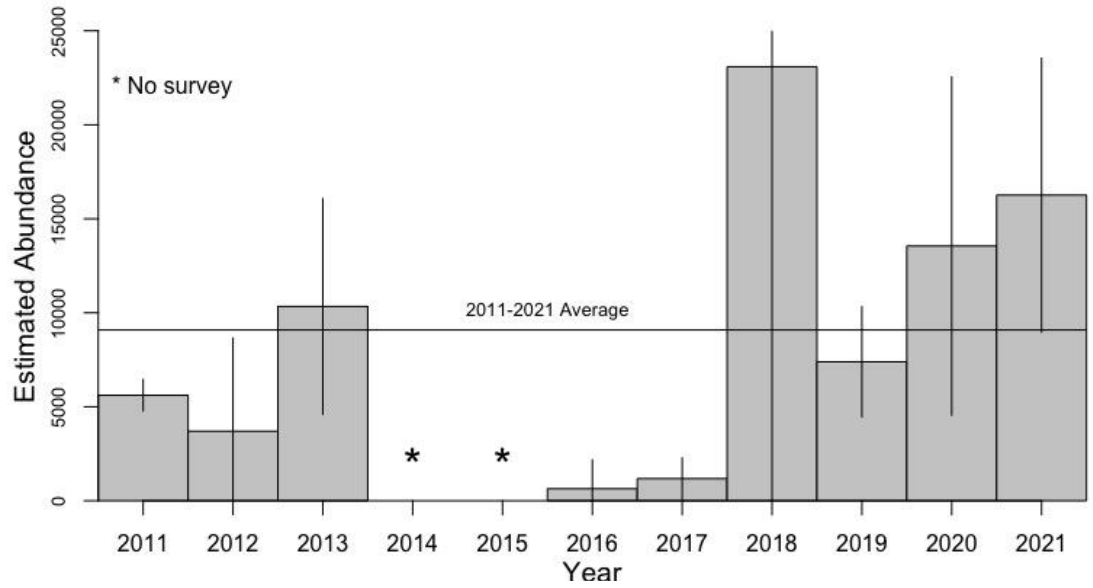


Figure 27. Annual *O. mykiss* abundance in the Calaveras River, 2011–2021. Vertical black lines indicate confidence intervals (±2 SD). The upper bounds for the 2018 confidence interval was 48,655 (not shown to scale). Standard deviations for overall abundance estimates are provided in **Table 18**. Note: the Dam reach was not surveyed in 2012 due to low visibility, so overall abundance is underestimated.

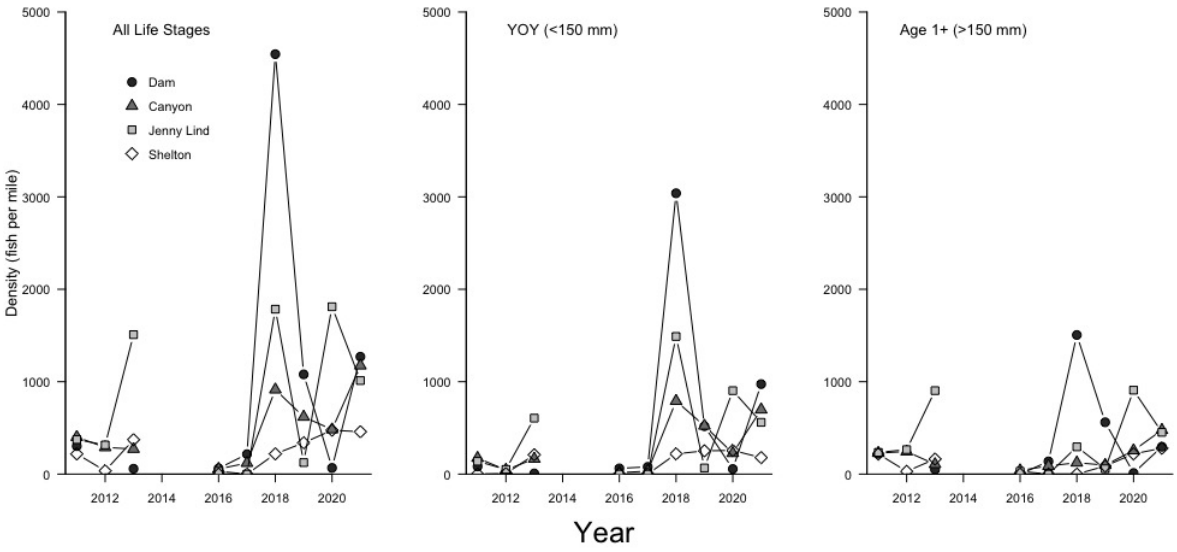


Figure 28. Estimated abundance of *O. mykiss* per mile in each reach during each year of 2011–2021.

Age Composition

Age composition of a population is difficult to determine without directly obtaining age information from scales or otoliths. In past visual population surveys on the Calaveras River, we have distinguished ages based on size class, defined as YOY (young of the year; juveniles most likely hatched the calendar year of the survey; <150 mm), and 1+ (150-300 mm and >300 mm), wherein all fish larger than 150 mm are at least one year old (or older). Individuals smaller than

150 mm include true young-of-the year fish, but probably not exclusively (a very minor fraction may consist of one-year-old fish). However, based on a detailed evaluation of age and growth relying on scale-pattern analysis of 772 *O. mykiss* captured in the Calaveras River rotary screw trap between 2002 and 2018, the mean estimated length by the end of the first growing season (annulus deposition, presumably in January) was 105 mm. As a consequence, we expect that a great majority of fish in the smallest (<150 mm) size class, as observed in the Calaveras River by late summer/early fall, are indeed YOY.

Both age classes of *O. mykiss* (YOY and Age 1+) have been observed in the Calaveras River each year since 2011, but with substantial differences in relative abundance. Generally, smaller fish, considered to be in their first year of life, are distributed throughout the study reach. In 2018, an unusually large fraction of observed fish was within the smallest size category, suggestive of exceptionally favorable reproductive conditions (**Figure 28**). High reproductive success is likely a combination of various factors that include favorable environmental conditions and reduced competition with other *O. mykiss* (a consequence of previously depressed abundance during the drought). Therefore, the large number and proportion of juvenile fish (<150 mm; 79% of the overall abundance) contributed greatly to the overall population estimate in 2018.

Similar to past years, the majority of individuals observed (59%) fell within the smallest size class (<150 mm), and are most likely juveniles that hatched the previous winter/spring (**Table 19**; **Figure 29**).

Table 19. Estimated abundance of *O. mykiss* in the Calaveras River, by reach and size class, in September 2021.

Reach	<150 mm	150 – 300 mm	>300 mm	Total
Dam (1)	1,568	383	94	**2,045**
Canyon (2)	4,855	2,967	349	**8,171**
Jenny Link (3)	2,808	2,071	195	**5,074**
Shelton (4)	378	592	0	**970**
Total	**9,609**	**6,013**	**638**	**16,260**

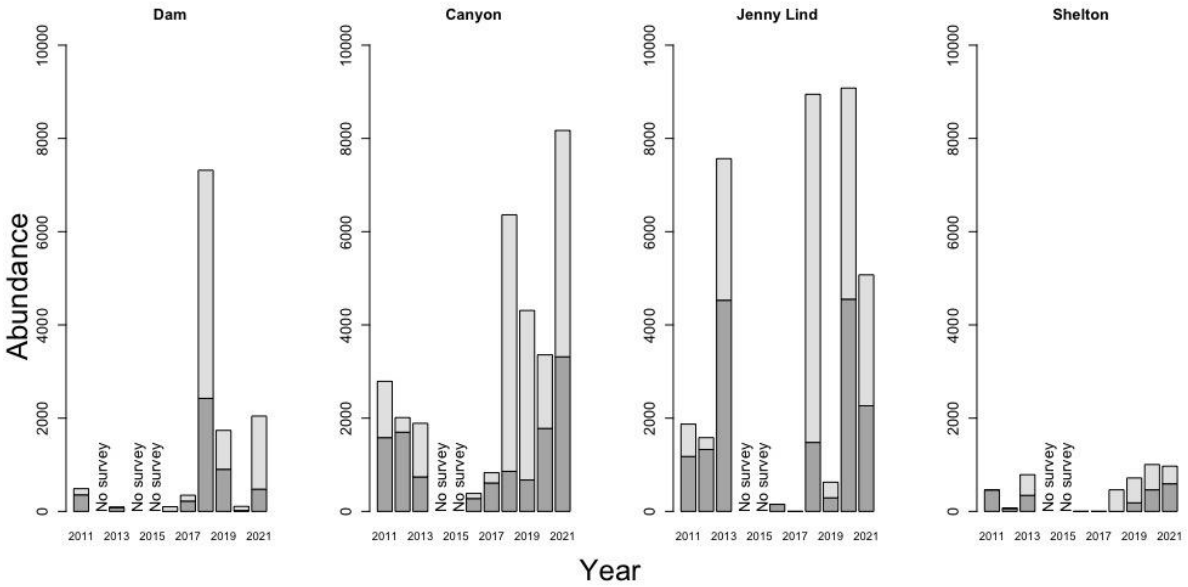


Figure 29. Estimated abundance of *O. mykiss* size classes (light gray: <150 mm; dark gray: >150 mm) in the Calaveras River by survey reach.

Discussion

Considered within the context of observational summertime abundance surveys conducted on the Calaveras River 2011, the 2021 population estimate ranks second only to 2018. Similar to the preceding years, overall abundance was dominated by juvenile (small) individuals in 2021, indicating favorable reproductive conditions.

Overall, abundance estimates of *O. mykiss* have fluctuated greatly from a low of 650 in 2016 to a high of 23,089 in 2018. Severely depressed abundance was observed during the recent record-breaking drought years of 2014–2016 that resulted in depleted storage in reservoirs and elevated water temperatures in many rivers in California's Central Valley and beyond. Similarly low abundance was expected following several years of suboptimal, stressful, or unsuitable environmental conditions. However, the high abundances estimated in 2018, and to a lesser extent in 2020 and 2021, raised multiple questions regarding the origin of this large number of (predominantly small) *O. mykiss*, which is likely attributable to an interaction of multiple factors. In those years, it is likely that anadromous *O. mykiss* (steelhead) contributed greatly to the large numbers of juveniles estimated to occupy the Calaveras River.

For 2018, the unusually high discharge in late November and early December 2017 could have attracted a number of steelhead bound for other Central Valley streams (or hatcheries), including the Mokelumne River, where escapement was the highest on record during the 2017/2018 winter. Redd surveys during winter 2017/2018 detected 64 *O. mykiss* redds in the Calaveras River. While this count is likely incomplete, it was twice as high as during earlier years (2014 and 2015) and more than three times as high as during the following winter (19 redds). During the winter 2019/2020, 207 *O. mykiss* redds were documented in the Calaveras River. The majority of redds during this winter (63.8%) were documented in the Jenny Lind reach, followed by the Canyon

Reach, the Dam Reach, and the Shelton Reach. Snorkel survey estimates for each reach rank in the same order.

The above explanation of the unexpectedly high abundance estimate in summer of 2018 is corroborated by Rotary Screw Trap (RST) monitoring during the 2018/2019 winter (FISHBIO 2021). The field protocol at the Shelton Road RST includes tagging juvenile *O. mykiss* with a PIT tag prior to releasing them upstream of the trap. The numbers of recaptured tagged individuals and untagged individuals can then be used to estimate trap efficiency and, subsequently, outmigration abundance (Bjorkstedt 2005). Using only those individuals that were classified as "silvery parr" (smolt index 4) or "smolts" (smolt index 5), the outmigration abundance for the winter 2018/2019 was estimated at 16,986 (SE = 6,560). This large outmigration estimate explains the apparent decrease in estimated summertime abundance between 2018 and 2019 from just over 23,000 individuals to 7,391.

Future juvenile outmigration and summertime abundance monitoring on the Calaveras will provide additional information on the status and trend of the Calaveras River population of *O. mykiss*.

Calaveras River *Oncorhynchus mykiss* Life-History Study

June 2020 – September 2021

Prepared By:
Michael Hellmair
Tyler Pilger
Patrick Cuthbert

Report Summary

The Calaveras River *Oncorhynchus mykiss* Life-History Investigation was implemented in late June 2020. This study, while not required by the Calaveras River Habitat Conservation Plan (HCP), is complimentary to specific monitoring activities outlined therein, and is a comprehensive, sustained study throughout the Calaveras River to estimate the abundance of rainbow trout/steelhead and evaluate factors that drive the expression of anadromous (ocean-going) or resident life-history expression.

The investigation relies on sampling *O. mykiss* by either backpack electrofishing or hook and line. Captured fish are then measured and weighed, a scale sample is collected for age determination, and a small tissue sample (fin clip) is retained for genetic analysis (sex and variation of the Omy5 gene, an indicator of migratory predisposition). By the end of the 2021 water year, September 30, 2021, a total of 1,332 *O. mykiss* have been captured (including 352 individuals during WY 2020). Of these 1,206 were tagged with PIT tags.

When a sufficient number of samples with a determined life-history trajectory (i.e., maturation in freshwater or migration to the marine environment) are collected, we expect to submit these samples for genetic analysis to determine their genetic makeup and the sex of the fish. Scale sample analysis of fish selected for genetic analysis will also be used to determine ages, back-calculated lengths at earlier age, and growth rates. The resulting data, in combination with additional mark-recapture information, will then be used to generate a statistical model to evaluate the factors that contribute to the expression of the different life-history pathways of *O. mykiss* in the Calaveras River and interpretation of this information in the context of the *O. mykiss* population and pertinent environmental factors. This analysis is expected to become more refined and statistically rigorous as sample numbers increase throughout the life of the study.

Preliminary results of these analyses are expected by the end of the next HCP reporting period and will be included in the 2022 Annual Report.

Background

FISHBIO has developed an overall strategic sampling framework to better understand the population dynamics and life-history expression of the *Oncorhynchus mykiss* population in the Calaveras River. Given the difficulty in studying the different life-history forms of *O. mykiss* (anadromous vs. resident life histories) and the inherent variability within each form, a concerted, long-term research effort is required to elucidate factors that influence life-history expression and other population parameters of *O. mykiss*, one of the most diverse salmonid species.

This study relies heavily on capturing and tagging individuals upstream of the Rotary Screw Trap (RST), followed by recapture upstream and/or at the RST. Captured fish are marked with PIT tags that allow for individual identification of previously captured fish in the event of a recapture. Collection of tissue samples (at first capture), as well as length and weight measurements will allow us to evaluate an individual's probability to express a resident or migratory life history based on genetic makeup, sex, and growth history. Of these factors, growth history could be influenced by management actions (such as magnitude of discharge during certain times of year) and overall

population abundance (higher density is typically indicative of more competition and reduced growth). Subsequent recaptures of tagged fish allow us to accurately evaluate growth since last capture, and data can be analyzed using multi-state mark-recapture models to estimate abundance. The collected data will also be used to evaluate patterns in seasonal survival and movement. Finally, Generalized Linear Models (GLMs) will be used to test the effects of length at date, age, genetic background, sex, and an individual's environmental exposure history (temperature and flow) on the probability of becoming anadromous (or resident).

Sampling effort for this investigation is complementary to ongoing activities (e.g., rotary screw trap [RST] monitoring, redd surveys, and fish ladder video monitoring), wherein supplementary periodic sampling will allow for synergies between these efforts to gather new and more refined data. For example, ongoing RST monitoring will provide an opportunity to collect and tag previously untagged *O. mykiss*, but more importantly, also serve as a recapture location for *O. mykiss* that were PIT tagged upstream during the previous year(s).

The study approach and data collected will provide valuable information to assist with the NMFS Recovery Action CEV-1.6, which is: 'Evaluate the relationship between resident and anadromous forms of *O. mykiss* to better understand the role that resident fish play in species maintenance and persistence (NMFS Recovery Plan, 2014, page 112).

Methods

Field Sampling

Field sampling for the life-history investigation began in June 2020, and the first full year of sampling occurred in 2021. Sampling occurs on a monthly basis, generally during the last week of each calendar month, at three reaches: Dam (New Hogan Dam [RM 42.4] to Cosgrove Creek [RM 41.4]), Jenny Lind to Gotelli Crossing (RM 34.4 to RM 32.4), and Gotelli Crossing to Shelton Road/Williams Crossing (RM 32.4 to 30.0).

Depending on seasonal flow conditions, fish are sampled either by backpack electrofishing (during fall and winter low-flow conditions) or hook and line sampling (during spring and summer). At the beginning of each sampling event, a water sample is collected to measure turbidity (NTU) and dissolved oxygen (mg/L) and conductivity (µS) are measured with a YSI meter. Water temperature is monitored throughout sampling to ensure water temperatures thresholds are not exceeded (21°C for hook and line sampling, 18°C for electrofishing).

Backpack Electrofishing

Sampling using electrofishing typically involves two personnel, one carrying the backpack electrofishing unit and another to net stunned fish. This method of sampling is most effective in shallow water (< 1 meter). FISHBIO uses a Smith-Root model LR-24 backpack unit with an auto-calibration function to set the voltage and amperage settings. Both personnel monitor the effects of electrofishing on stunned fish and readjust settings as needed to ensure fish are mildly stunned but recover (regain equilibrium) within a minute of being removed from the electric field.

Hook and Line

For hook and line sampling, two to three personnel equipped with spinning and/or fly rods, fish a section of water for up to 10 minutes at a time to capture fish. Artificial lures are used and include treble hook spinners, dry flies, and nymphs. All lures are barbless, meaning that the hooks for the lures do not contain a barb or the barb is pinched down. This ensures easy hook removal from any captured fish, limiting injury and stress to fish. No baited or scented lures are used. Captured fish are reeled in and allowed to recover in a bucket prior to being processed.

Fish Processing

Any fish that shows signs of stress or injury are immediately measured and returned to the river in a slow water velocity area. These individuals are monitored to ensure they volitionally swim away. Healthy fish are anesthetized using a solution of freshwater and AlkaSeltzer® (1,916 mg Sodium Bicarbonate/4 liters of water; Bayer HealthCare, Whippany, NJ). Individuals are placed in the solution a couple at a time and left until they lose equilibrium (i.e., turn over on their side), typically within 3 minutes. Fish are then weighed to the nearest tenth of a gram and measured (fork length and total length to the nearest mm). A small pocket knife is used to scrape 5-10 scales from the dorsum above the lateral line. Scales are then wiped on blotting paper and placed in a scale envelope labeled with a unique identification number for that individual. A small fin clip (< 5 mm2) is collected for genetic analysis and placed in an Eppendorf tube containing 95% ethanol. Tissue samples are labeled with the same identification number used to label the scale envelope. For any individual greater than 80 mm in fork length, a Passive Integrated Transponder (PIT) tag (12-mm half-duplex, BioMark) is injected using a PIT Tag injector and needle. PIT tags are injected just below and to the center of the left pelvic fin. Following injection, a bio-adhesive is used to close the injection site. All equipment is sterilized in a diluted solution of Nolvasan®, between individuals. Injection needles are replaced as needed when old needles become dull. Data recorded for each individual fish (e.g., length, weight, PIT tag number) is linked to biological samples using the unique identification number. Identification numbers include the river abbreviation, 2-digit year, followed by a unique number (e.g., Cal21-001). Unique PIT tag numbers make it possible to track individuals throughout their lifetime, assuming they are recaptured or resighted in subsequent monitoring activities. All processed fish are allowed to recover in freshwater before being released at or in the vicinity of their capture location.

Age Determination

Currently, scale samples collected as part of the life history investigation have not been processed. Scale samples from individuals will be processed and read according to the methods detailed in Hellmair and Peterson (2019). Briefly, samples will be prepared and mounted for reading. Digital images of all samples will be taken and archived. Scale samples will be aged independently by two expert readers. Data from scales and lengths will then be used to back-calculate fork lengths at previous ages to estimate growth rates and determine cohort year class.

Genetic Analysis

Currently, tissue samples for genetic analysis are being stored until a sufficient number is collected for batch processing and analysis.

Mark-recapture Data Analysis

Currently, the number of individuals recaptured is not sufficient for robust estimates of abundance or survival. In coming years, recapture data will be used to generate an estimate of population abundance and survival. Abundance may be estimated using the POPAN parameterization of the Jolly-Seber model (Schwarz and Arnason 1996). In short, this model uses numbers of marked and unmarked individuals captured over time to estimate the abundance of a population that is open to migration as well as births and deaths. Capture histories, which are strings of 0s and 1s indicating an individual was not detected (0) or detected (1) for each sampling event, will be constructed and used to model abundance. Capture histories form the input data for program MARK (White and Burnham 1999) that performs model fitting to estimate model parameters.

Using tag resight data from PIT tag antennas and recaptures at the Shelton Road RST, capture histories can also be constructed to implement Cormack-Jolly-Seber models. This class of models does not estimate abundance but can be used to estimate survival, movement, and other transition probabilities. These models will also be implemented using program MARK.

Sampling Summary

Sampling for the *O. mykiss* life history study during Water Year 2020 began on June 23, 2020 and went through September 30, 2020 for a total of nine sample days. The dominant method of sampling in 2020 was hook and line. Sampling during Water Year 2021 began on October 1, 2020 and continued until September 20, 2021 for a total of 25 sample days. Electrofishing was the dominant sample method from November to April, whereas hook and line was used from May to September.

During the 2020 Water Year (prior to October 1, 2020), a total of 352 *O. mykiss* were sampled, of which 344 were tagged with PIT tags. Lengths of captured trout ranged from 58 to 425 mm (**Figure 30**). Fish that were not tagged were either too small (<80 mm FL) or in poor physical condition. Equal probability of survival and capture for tagged and untagged fish is among the assumptions for subsequent data analysis; as injured fish may have a lower survival probability, tagging of these individuals is avoided to prevent bias during data analysis.

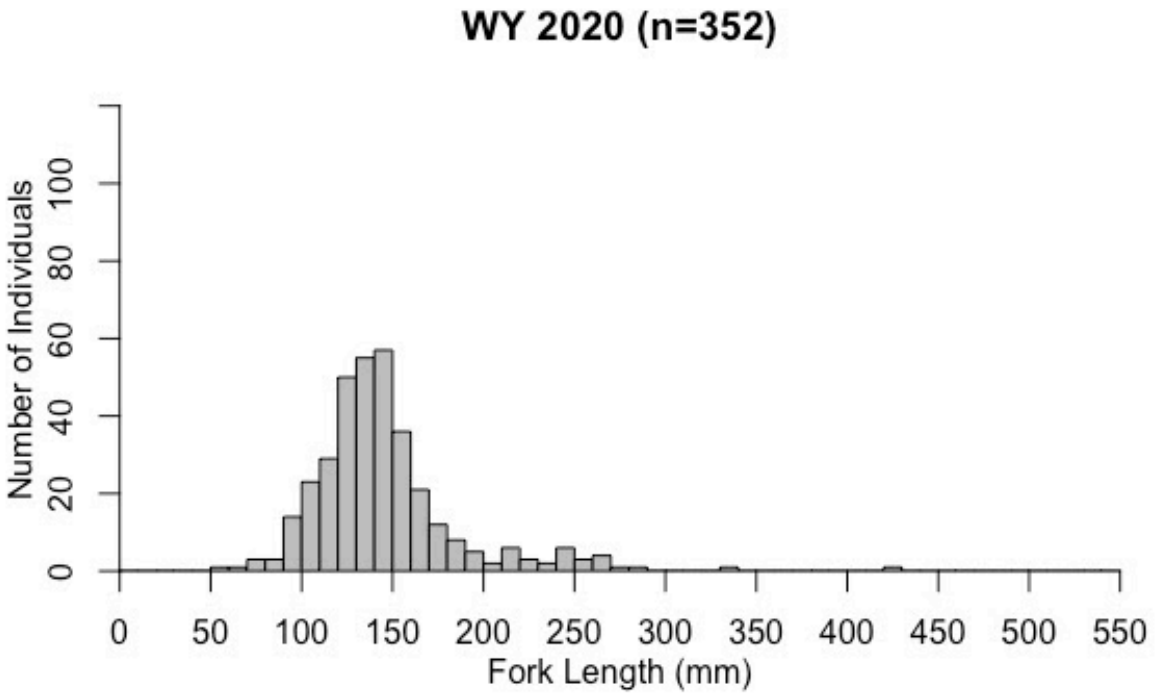


Figure 30. Length frequency histogram of *O. mykiss* captured during the first (incomplete) water year of the life history study (June 23, 2020 - September 30, 2020).

During the 2021 Water Year, the first complete year of sampling for this study, a total of 980 *O. mykiss* were sampled, and 863 individuals were tagged. Length of captured individuals ranged from 30 mm FL to 505 mm FL (**Figure 31**). The group of individuals that were not tagged was composed of recaptured fish (n=55), those that did not meet the size threshold for tagging (n = 29), those that were captured in excess of daily PIT tagging quotas (n = 32), or those judged to be in poor physical condition (n = 1).

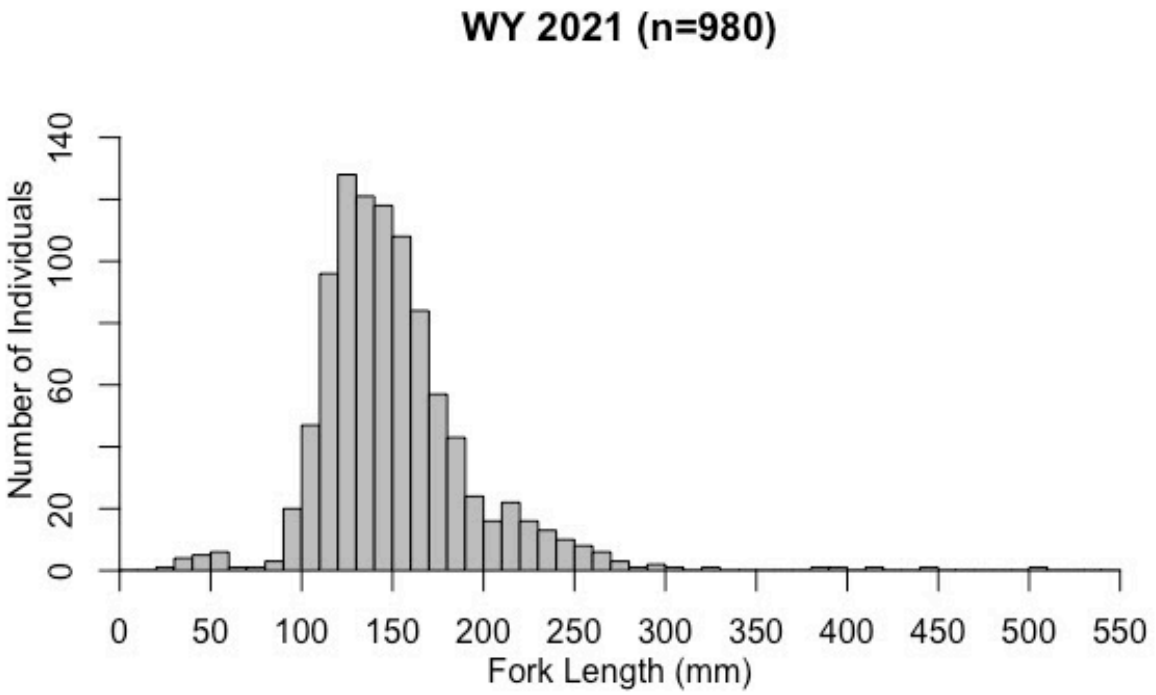


Figure 31. Length frequency histogram of *O. mykiss* captured during the 2021 water year (October 1, 2020 - September 30, 2021).

Recapture Summary

Multiple individuals tagged for this study have been recaptured or detected as part of this or complimentary monitoring efforts. During field sampling for this study, 56 individuals, ranging in size from 97 mm FL to 255 mm FL have been recaptured through September 30, 2021 (**Table 20**).

A total of 9 unique tags from this study were detected at the Bellota PIT tag antenna between November 19, 2020 and March 13, 2021 (see pages 41-47 for more details).

A number of tagged individuals were also detected during outmigration monitoring at the Calaveras River Rotary Screw Trap (n = 15), qualifying those individuals with a rating of either "Silvery Parr" or "Smolt" as having a determined life history trajectory and warranting their inclusion in subsequent analysis.

Table 20. Summary of PIT tagged *O. mykiss* recaptures from multiple Calaveras River monitoring programs.

		Recaptured or Resighted			
Deployed From	**Number Deployed**	**Shelton RST**	**LH Study**	**Fish Rescue**	**Bellota Antenna**
Shelton RST	1,068	153	2	1	24
LH Study	1,201	15	42	0	9
Fish Rescue	31	0	0	0	0

Outlook

Sampling for the life history investigation is scheduled to continue on a monthly basis in water year 2022.

As a sufficient number of samples (>100) with a determined life-history trajectory (i.e., mature in freshwater, as indicated by size [>300 mm] or sexual maturation [milting], or smolting [determined from visual appearance if recaptured during outmigration at the RST]) is accumulated, we expect to submit these samples for genetic analysis to determine their genetic makeup (presence of the AA, AR, or RR genotype of the Omy5 gene; Pearse et al. 2014) and the sex of the fish (female *O. mykiss* are more likely to adopt the anadromous life history than males). A randomly selected subsample from fish with an undetermined life history, representative of the overall population of juvenile *O. mykiss* in the Calaveras River, will also be analyzed. Scale sample analysis of fish selected for genetic analysis will be used to determine ages, back-calculated lengths at earlier age, and growth rates.

The resulting data, in combination with additional mark-recapture information, will then be used to generate a statistical model to evaluate the factors that contribute to the expression of the different life-history pathways of *O. mykiss* in the Calaveras River, and interpretation of this information in the context of the *O. mykiss* population and pertinent environmental factors. This analysis is expected to become more refined and statistically rigorous as sample numbers increase throughout the duration of the study.

Literature Cited

Allen, M. and T. Gast. 2007. Use of dive counts to estimate fish population abundance in the Rock Creek-Cresta reaches of the North Fork Feather River, California: 2006 Final Report. Prepared for Pacific Gas & Electric Company by Thomas R. Payne & Associates, Arcata, CA. May 31, 2007.

Bradford, M. J. and P. S. Higgins. 2001. Habitat-, season-, and size-specific variation in diel activity patterns of juvenile chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*). Canadian Journal of Fisheries and Aquatic Sciences 58: 365-374.

Bjorkstedt, E. P. 2005. DARR 2.0: updated software for estimating abundance from stratified mark-recapture data. NOAA Technical Memorandum NMFS-SWFSC-368. 13 p.

Cada, G. F., Loar, J. M. and Sale, M. J. 1987. Evidence of food limitation of rainbow and brown trout in southern Appalachian soft-water streams. Transactions of the American Fisheries Society, 116: 692-702.

[CDFG] California Department of Fish and Game. 2003. California Stream Bioassessment Procedure (Protocol Brief for Biological and Physical/Habitat Assessment in Wadeable Streams). Prepared by Aquatic Bioassessment Laboratory, CDFG, Sacramento, CA. 11 pp.

CDWR [California Department of Water Resources]. 2021. Water year 2021: An extreme year. Available online: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Water-Basics/Drought/Files/Publications-And-Reports/091521-Water-Year-2021-broch_v2.pdf

Christie M. R., M. L. Marine and M. S. Blouin. 2011. Who are the missing parents? Grandparentage analysis identifies multiple sources of gene flow into a wild population. Molecular Ecology 20: 1263–1276.

Courter, I. I., D. B. Child, J. A. Hobbs, T. M. Garrison, J. J.G. Glessner and S. Duery. 2013. Resident rainbow trout produce anadromous offspring in a large interior watershed. Canadian Journal of Fisheries and Aquatic Sciences 70: 701-710.

Eilers, C. D., J. Bergman, and R. Nielson. 2010. A comprehensive monitoring plan for steelhead (*Oncorhynchus mykiss*) in the California Central Valley. Fisheries Branch Administrative Report Number: 2010-2. Department of Fish and Game, Sacramento, CA. October 2010.

Ensign, W. E., Strange, R. J. and Moore, S. E. 1990. Summer food limitation reduces brook and rainbow trout biomass in a southern Appalachian stream. Transactions of the American Fisheries Society, 119: 894-901.

FISHBIO. 2017. Expanded rotary screw trap monitoring operations at the Shelton Road sampling site. Technical memorandum prepared by FISHBIO for Karna Harrigfeld and Stockton East Water District, January 18, 2017. [*see Appendix A for full memorandum*]

FISHBIO. 2019. Investigation of Calaveras River rotary screw trap Chinook salmon catch during the 2018 and 2019 monitoring years. Technical memorandum prepared by FISHBIO for Karna Harrigfeld and Stockton East Water District, April 22, 2019. [*see Appendix B for full memorandum*]

FISHBIO. 2021. Calaveras River juvenile *O. mykiss* Outmigration Monitoring. Annual Report submitted to Stockton East Water District.

Fleming, I. A. and J. D. Reynolds. 2004. Salmonid breeding systems. In Evolution illuminated: salmon and their relatives. Edited by A.P. Hendry and S.C. Stearns. Oxford University Press, New York. pp. 264 - 294.

Gallagher, S.K., P.K.J. Hahn, and D.H. Johnson. Redd Counts. Pages 197 – 234 *in* D.H. Johnson, B.M. Shrier. J.S. O'Neal, J.A. Knutzen, X. Augerot, T.A. O'Neill, and T.N. Pearsons. Salmonid field protocols handbook: techniques for assessing status and trends in salmon and trout populations. American Fisheries Society, Bethesda, Maryland.

Hagen, J. and J. Baxter. 2005. Accuracy of diver counts of fluvial rainbow trout relative to horizontal underwater visibility. North American Journal of Fisheries Management 25: 1367-1377.

Hagen, J., S. Decker, J. Korman, and R. G. Bison. 2010. Effectiveness of night snorkeling for estimating steelhead parr abundance in a large river basin. North American Journal of Fisheries Management 30: 1303-1314.

Harrington, J. and M. Born. 2000. Measuring the Health of California Streams and Rivers: A methods manual for resource professionals, citizen monitors and natural resources students, second edition. Sustainable Land Stewardship International Institute, Sacramento, CA.

Heath D. D., C. M. Bettles, S. Jamieson, I. Stasiak and M. F. Docker. 2008. Genetic differentiation among sympatric migratory and resident life history forms of rainbow trout in British Columbia. Transaction of the American Fisheries Society 137: 1268–1277.

Hellmair M, and M. Peterson. 2019. Age composition, growth- and life history characteristics of juvenile *Oncorhynchus mykiss* in the Calaveras River. Report prepared for Stockton East Water District. April. 22 pp.

Kendall, N.W., J.R. McMillan, M.R. Sloat, T.W. Buerhrens, T.P. Quinn, G.R. Pess, K.V. Kuzishin, M.M. McClure, and R.W. Zabel. 2015. Anadromy and residency in steelhead and rainbow trout (*Oncorhynchus mykiss*): a review of the processes and patterns. Canadian Journal of Fisheries and Aquatic Sciences 72: 319-342.

Lindley, S. T., R. S. Schick, A. Agrawal, M. Goslin, T. E. Pearson, E. Mora, J. J. Anderson, B. May, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2006. Historical population structure of Central Valley steelhead and its alteration by dams. San Francisco Estuary and Watershed Science 4 (1).

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science 5(1).

McEwan, D. R. 2001. Central Valley steelhead. Pages 1–43 In R. L. Brown, editor. Contributions to the biology of Central Valley salmonids. Vol. 1. California Department of Fish and Game, Sacramento, CA.

Mohr, M. S. and D. G. Hankin. 2005. Two-phase survey designs for estimation of fish abundance in small streams. Unpublished Manuscript. Preprint from D.G. Hankin, Department of Fisheries Biology, Humboldt State University, Arcata, CA.

Mullner, S., W. Hubert, and T. Wesche. 1998. Snorkeling as an alternative to depletion electrofishing for estimating abundance and length-class frequencies of trout in small streams. North American Journal of Fisheries Management 18: 947-953.

Murphy, K. D. 1988. Age and growth of wild rainbow trout, *Salmo gairdneri*, in the Kings River, Fresno County, California. Humboldt State University senior thesis.

[NMFS] National Marine Fisheries Service. 2009. Biological Opinion and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project. Prepared by Southwest Region, National Marine Fisheries Service.

Null, R. E., K. S. Niemela and S. F. Hamelberg, 2012. Post-spawn migrations of hatchery-origin *Oncorhynchus mykiss* kelts in the Central Valley of California. Environmental Biology of Fishes 96: 341-353.

Ode, P.R., Fetscher, A.E., Busse, L.B., 2016a. Standard Operating Procedures (SOP) for the Collection of Field Data for Bioassessments of California Wadeable Streams: Benthic Macroinvertebrates, Algae, and Physical Habitat (No. Technical Report 835). State Water Resources Control Board Surface Water Ambient Monitoring Program. Sacramento, CA

O'Neal, J.S. 2007. Snorkel Surveys. Pages 325-340 In D. H. Johnson, B. M. Shrier, J. S. O'Neal, J.A., Knutzen, X., Augerot, T.A. O'Neil, and T. N. Pearsons, editors. Salmonid Field Protocols Handbook. Techniques for Assessing Status and Trends in Salmon and Trout Populations. American Fisheries Society, Bethesda, MD.

Palmer, M.L. and C.L. Sonke. 2010. Outmigrant trapping of juvenile salmonids in the Lower Tuolumne River, 2009. Annual report prepared by FISHBIO Environmental for Turlock Irrigation District and Modesto Irrigation District, Turlock, CA.

Pearse, D.E., M.R. Miller, A. Abadía-Cardoso, and J.C. Garza. 2014. Rapid parallel evolution of standing variation in a single, complex, genomic region is associated with life history in steelhead/rainbow trout. Proc Biol Sci 281(1783):20140012

Peterson, M.L., Lee, D.J., Montgomery, J.D., Hellmair, M., Fuller, A.N., and Demko, D.B. 2020. Stability in reproductive timing and habitat usage of Chinook salmon across six years of

varying environmental conditions and abundance. Fisheries Management and Ecology 4:399-416. https://doi.org/10.1111/fme.12421

Pilger, T. J, M. L. Peterson, D. Lee, A. Fuller, and D. Demko. 2019. Evaluation of Long-Term Mark-Recapture Data for Estimating Abundance of Juvenile Fall-Run Chinook Salmon on the Stanislaus River from 1996 to 2017. San Francisco Estuary and Watershed Science, 17.

Rogers, D.C., and A.B. Richards. 2006. Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) Rules for the Development and Maintenance of the Standard Level of Taxonomic Effort. Available at: https://www.safit.org/Docs/ste_rules.pdf

Satterthwaite, W. H., M. P. Beakes, E. M. Collins, D. R. Swank, J. E. Merz, R. G. Titus, S. M. Sogard, and M. Mangel. 2010. State-dependent life history models in a changing (and regulated) environment: steelhead in the California Central Valley. Evolutionary Applications 3: 221-243.

Schill, D. J., G. W. LaBar, E. R. J. M. Mamer, and K. A. Meyer. 2010. Sex-ratio, fecundity, and models predicting length at sexual maturity of redband trout in Idaho desert streams. North American Journal of Fisheries Management 30: 1352 - 1363.

Schwarz. C.J. and A.N. Arnason. 1996. A general methodology for the analysis of capture-recapture experiments in open populations. Biometrics 52:860-873.

Stockton East Water District [SEWD] and FISHBIO. 2020. Calaveras River Habitat Conservation Plan. Available online at: https://www.fisheries.noaa.gov/action/calaveras-river-habitat-conservation-plan-and-environmental-assessment

Teo S. L. H., P. T. Sandstom, E. D. Chapman, R. E. Null, K. Brown, A. P. Klimley and B. A. Block. 2011. Archival and acoustic tags reveal the post-spawning migrations, diving behavior, and thermal habitat of hatchery-origin Sacramento River steelhead kelts (*Oncorhynchus mykiss*). Environmental Biology of Fishes 96: 175-187.

Thompson, S. K. 2002. Sampling, 2nd Edition. John Wiley & Sons, Inc., New York, New York.

[USEPA] United States Environmental Protection Agency. 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality (Report No. 910-B-03-002). United States Department of the Interior. https://purl.fdlp.gov/GPO/gpo128098

[USFWS] U.S. Fish and Wildlife Service. 2008. Draft rotary screw trap protocol for estimating production of juvenile Chinook salmon. Comprehensive Assessment and Monitoring Program. Sacramento (CA). p. 44. Available from: https://www.fws.gov/cno/fisheries/CAMP/Documents-Reports/Documents/2008_draft_CAMP_Rotary_Screw_Trap_Protocol.pdf

Verhille CE, English KK, Cocherell DE, Farrell AP, and Fangue, NA. 2016. High thermal tolerance of a rainbow trout population near its southern range limit suggests local thermal adjustment. Conserv Physiol. 4(1): cow057. https://doi.org/10.1093/conphys/cow057

Williams, J. G., J. J. Anderson, S. Greene, C. Hanson, S. T. Lindley, A. Low, B. P. May, D. McEwan, M. S. Mohr, B. MacFarlane, and C. Swanson. 2007. Monitoring and research needed to manage the recovery of threatened and endangered Chinook and steelhead in the Sacramento-San Joaquin basin. NOAA Technical Memorandum NMFS-SWFSC-399.

White, G. C., and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study 46: (Supplement 120–138).

Zimmerman, C. E., and G. H. Reeves. 2000. Population structure of sympatric anadromous and nonanadromous *Oncorhynchus mykiss*: evidence from spawning surveys and otolith microchemistry. Canadian Journal of Fisheries and Aquatic Sciences 57:2152–2162.

Zimmerman, C., G. Edwards, and K. Perry. 2009. Maternal origin and migratory history of steelhead and rainbow trout captured in rivers of the Central Valley, California. Transactions of the American Fisheries Society 138: 280-291.

Zuur, A. F., E. N. Ieno, N. J. Walker, A. A. Saveliev, and G. M. Smith. 2009. Mixed effect models and extensions in ecology with R. Springer, New York, New York, USA.

Appendix A: Background on 8-foot diameter RST

Please cite as: FISHBIO. 2017. Expanded rotary screw trap monitoring operations at the Shelton Road sampling site. Technical memorandum prepared by FISHBIO for Karna Harrigfeld and Stockton East Water District, January 18, 2017.

TO: Karna Harrigfeld
FROM: FISHBIO
DATE: January 18, 2017
SUBJECT: Expanded Rotary Screw Trap Monitoring Operations at the Shelton Road Sampling Site

Executive Summary

Stockton East Water District (SEWD) has been monitoring the populations of rainbow trout/steelhead (*Oncorhynchus mykiss*) and fall-run Chinook salmon (*O. tshawytscha*) that utilize the Calaveras River for over a decade. During this time, the Calaveras River Anadromous Fish Monitoring Program has yielded an exceptional long-term data set.

In 2012, FISHBIO presented several ideas for ways to strengthen this monitoring program by filling in some data gaps regarding the life history of salmonids in the Calaveras River. These activities would further inform fisheries management and help to advance the biological monitoring goals established by the upcoming implementation of the Calaveras River Habitat Conservation Plan (HCP). Three of the four activities previously recommended have been implemented in recent years, including 1) video monitoring of adult salmonids as the migrate upstream using the temporary fish ladder at Bellota, 2) winter redd surveys to observe the spawning activity of salmonids in the reaches upstream of Bellota, and 3) using PIT tagged *O. mykiss* to determine rotary screw trap (RST) efficiency. The fourth recommended activity was expanding the rotary screw trap (RST) monitoring program to allow for sampling during higher flows. As the HCP is closing in on implementation, FISHBIO feels it would be prudent to revisit this last recommendation.

Current Monitoring

The existing RST has been operated on behalf of the Stockton East Water District (SEWD) and Calaveras County Water District (CCWD) since 2002 at Shelton Road Bridge. This sampling method is intended to provide data regarding the presence, relative abundance, and migration timing of juvenile salmonids within the lower reaches of the Calaveras River. This trap typically operates on a 5-day per week schedule; the cone it is lowered on Monday and raised on Friday. However, the trap cannot fish in flows greater than 300 cfs, which has created substantial gaps during the monitoring season. As such, the schedule may differ from the standard 5-days per week, operating on average 4 days per week over the last decade (2007-2017) (range = 2 to 7 days). These data gaps can influence the resulting data set, leading to underestimates in the abundance of juvenile salmonids, increased uncertainty in abundance estimates, and inaccurate estimates of migration timing. To remedy this issue and further inform the biological goals of the forthcoming HCP, FISHBIO suggests two potential modifications to the RST monitoring program.

Table 1. Rotary screw trap sampling effort 2002-2017. *Note: The San Joaquin Valley experienced "Below Normal" or worse water-year types in eleven of the past sixteen monitoring seasons. "Wet" water year types were recorded in 2005, 2006, 2011, and 2017.

Year	RST Season	# of Days in Sampling Season	# of Days Sampled	# of No Sample days	% of season sampled	No Sample Days	
						Flows >300 cfs	Flows >19 and <300 cfs
2002	Jan 17 –May 9	113	44	69	39%	0 (0%)	55 (80%)
2003	Jan 4 – Jul 17	195	86	109	44%	0 (0%)	103 (95%)
2004	Dec 2 –May 13	164	90	74	55%	1 (1%)	69 (94%)
2005	Dec 10 –Apr 22	134	74	60	55%	15 (25%)	45 (75%)
2006	Jan 19 –Jun 30	163	72	91	44%	50 (55%)	41 (45%)
2007	Dec 14 –Jun 29	198	116	82	59%	0 (0%)	82 (100%)
2008	Nov 13 –Jul 11	242	131	111	54%	0 (0%)	111 (100%)
2009	Nov 4 – Jul 10	249	131	118	53%	0 (0%)	118 (100%)
2010	Nov 10 –Jul 15	248	139	109	56%	1 (1%)	108 (99%)
2011	Nov 2 – Jul 15	256	130	126	51%	41 (33%)	85 (67%)
2012	Oct 26 – Jul 7	256	207	49	80%	7 (14%)	42 (85%)
2013	Nov 5 – Jul 15	252	149	103	59%	2 (2%)	101 (98%)
2014	Nov 6 – Jul 12	249	159	90	64%	0 (0%)	81 (90%)
2015	Nov 18 – Jul 1	227	136	90	60%	0 (0%)	62 (69%)
2016	Nov 1 – Jun 13	226	132	94	58%	1 (1%)	84 (89%)
2017	Nov 1 – Jul 14	256	148	108	58%	64 (59%)	44 (41%)

Modification 1. Continuous Rotary Screw Trap Monitoring

In recent years of sampling, the monitoring season has been extended to sample earlier and later in the season (Table 1). This resulted in improving our understanding of the migration timing of older juvenile *O. mykiss* (i.e., Age 1+), which tend to migrate in November and December. This has also lead to an increase in the sample size of *O. mykiss* that can be PIT tagged, as individuals captured in the RST of appropriate size are rare during the original monitoring period. This has provided more information on the difference in timing between the young-of-the-year (YOY) and Age 1+ life stages, and increased our ability to provide more accurate estimates of downstream migration.

The current on/off sampling schedule causes regular gaps in data collection regardless of flow level, which results in increased uncertainty in estimates of juvenile downstream passage. Sampling at Shelton Road can range between two to seven days per week, depending on flow events or weekly schedule (i.e., weekends or holidays). This on/off schedule allows for relatively consistent sampling coverage, but the trap only operates on average 56% of the sampling season (Table 1).

To account for the fish that would have been captured during the non-sample period a predictive regression equation is used. Missing abundance estimates are only calculated for non-sample periods of seven days or less. The equation uses the daily catch expanded by estimated trap efficiency for the three days prior to and immediately following the period of no-sample days. Additionally, we estimate 80% confidence intervals around the missing values, to inform us about the uncertainty in our estimates. For example, during the 2010 sampling season (i.e., November 2009 to July 2010), an estimated 6,059 YOY *O. mykiss* passed Shelton Road, but the range of passage based on the 80% confidence intervals was 5,586 to 11,124 fish, indicating substantial uncertainty regarding these estimates. Moving to a seven days-per-week schedule for the entire sampling season would provide more accurate and precise passage counts.

Modification 2. High Flow Rotary Screw Trap Monitoring

Currently, juvenile salmonid migration is monitored in the lower Calaveras River using a 5-foot diameter rotary screw trap at Shelton Road. The site is a narrow bedrock channel, which limits RST operations, but may increase trap efficiency. It is not possible to operate a larger trap throughout the whole season at Shelton Rd. due to extended low flow periods with reduced water volume and velocity that prevent the trap from functioning properly (i.e., unable to spin or dragging on the substrate). When flows exceed 300 cfs or are less than 20 cfs the 5-foot trap cannot operate properly and the cone is lifted. High flow conditions have been relatively rare in recent years, but in wet years such as 2006, 2011 and 2017, over 40% of the days that were not sampled had flows greater than 300 cfs (Table 1). These seasonal freshet events and/or large reservoir discharges, with peak flows above 300 cfs, are likely to coincide with increased fish passage. FISHBIO has recorded peaks in passage associated with smaller flow pulses, and these high flow events often coincide with *O. mykiss* outmigration. By not fishing the higher flow events, we may be underestimating the abundance of juvenile salmonids. Therefore, it would be valuable to fish an alternative ‘high flow’ trap to capture fish during these peaks in flow.

Under typical flow conditions on the Calaveras, the 5-foot diameter RST is ideal, and trapping can be conducted up to 300 cfs. However, in years when frequent winter storms cause freshets of high flows (> 300 cfs) or during substantial releases from New Hogan Reservoir, one or two 8-ft. diameter RSTs could be used at an alternate location. This modification can be facilitated by obtaining 8-ft. diameter RST(s) on loan through various agency connections.

Methods

RST sampling effort at the present location at Shelton Rd. would be extended from five days to up to seven days-per-week from approximately November 1 to June 1. This task would not require additional equipment, infrastructure, or personnel training. Due to the channel morphology and flashy flow conditions in the Calaveras River, the trap at Shelton Road (i.e., the 5-ft diameter trap) cannot be operated under all conditions, thus trapping still may not occur every day between November and June.

A potential high flow trapping location has been identified 0.5 miles upstream of the Shelton Road site, just upstream of the Williams Low-Flow instream road crossing (Figures 1 and 2). The site is accessible by private road past a locked gate easily accessible from the current location. Frank Debenedetti, who owns the property, has been very cooperative in the past and has always allowed us access; therefore, we don't foresee any problems with site access. At low flow the wetted channel is 40 ft. wide with a uniform depth of 4.5 ft. and no measurable velocity. At bank-full flows, the channel widens to 61 ft. before spilling onto the floodplain. This site is deep enough to float one or two 8-ft. diameter RSTs during low flow conditions and has many large trees to secure the trap. At low flow, there is no measurable velocity to turn the trap (so the cone would be raised), but at flows above 300 cfs the trap would become operable. In some years, winter flows do not exceed 300 cfs (Table 1) and the high flow trap would not be operated.

Figure 1. Calaveras River looking upstream from Williams Low Flow Crossing (River Mile 28.5) at the proposed high flow 8-ft. RST site. February 9, 2012; 34 cfs (NHG+COS).

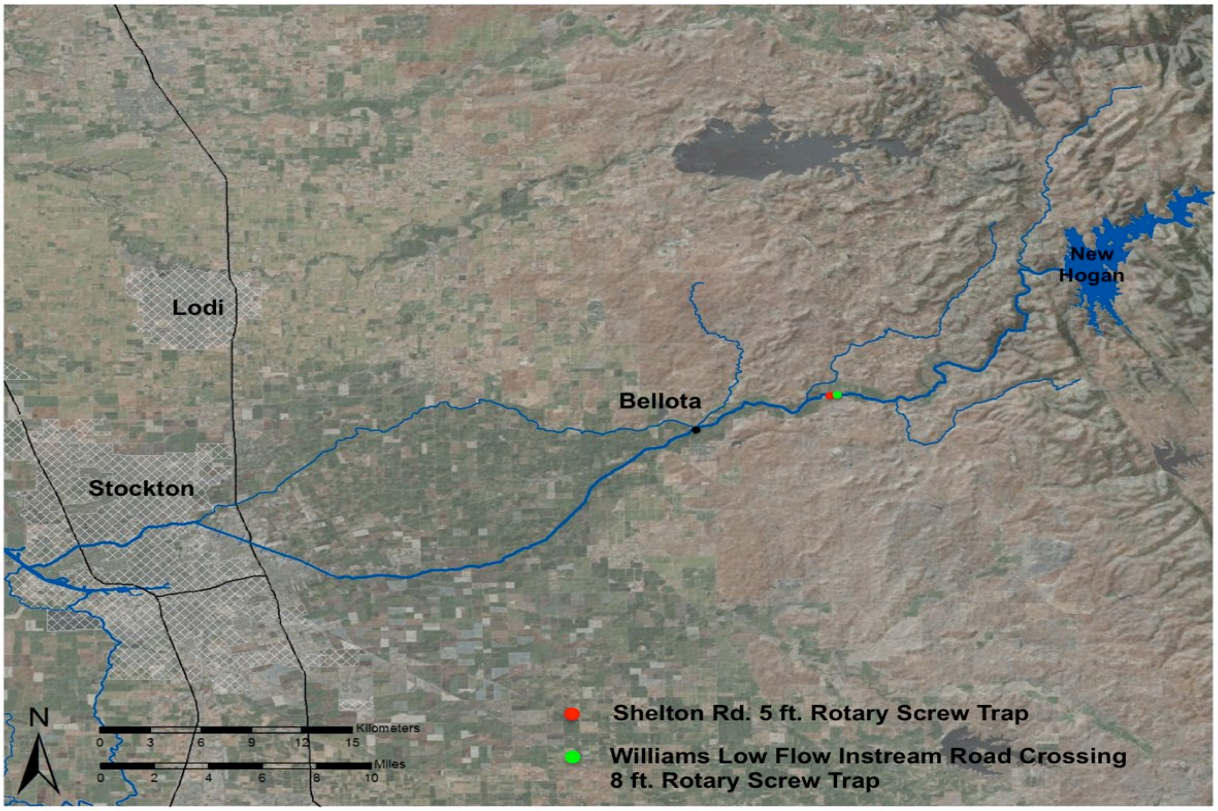


Figure 2. Aerial map of the Lower Calaveras River and Mormon Slough with locations of the existing 5 ft. RST at Shelton Rd. and the proposed 8 ft. RST site at Williams Low Flow Crossing.

Appendix B: Chinook salmon abundance estimates in 2018 and 2019

Please cite as: FISHBIO. 2019. Investigation of Calaveras River rotary screw trap Chinook salmon catch during the 2018 and 2019 monitoring years. Technical memorandum prepared by FISHBIO for Karna Harrigfeld and Stockton East Water District, April 22, 2019.

TO: Karna Harrigfeld
FROM: FISHBIO
DATE: April 22, 2019
SUBJECT: Investigation of Calaveras River Rotary Screw Trap Chinook Salmon Catch During the 2018 and 2019 Monitoring Years

After recently observing the large number of Chinook captured at the Calaveras rotary screw trap (RST) to date, we looked further into the potential sources of this increase and the potential implications for management and the forthcoming habitat conservation plan (HCP). As of April 6, the date when catch was identified to be evaluated, the number of individuals considered young-of-the-year (YOY) captured in 2019 (n = 1,513) exceeded that of YOY individuals observed in 2018 (n = 690). The season total of all Chinook salmon captured (i.e., YOY and Age 1+) captured in the Calaveras River in 2018 was 6,517 individual fish. Further, a significant number of adult Chinook have been observed passing over the fish ladder at Bellota during the 2018-2019 monitoring season (n = 298), which may have contributed to the larger than normal number of juveniles now be captured in the RST. In order to determine the potential size of this population and its significance to Calaveras River management, we compared and contrasted efficiency data from the RSTs from both the Calaveras and Stanislaus rivers from the 2017/18 and 2018/19 monitoring seasons in an effort to better understand the potential estimate of Chinook abundance in the Calaveras.

Comparison of Chinook Size

When reviewing the size of Chinook captured in the Calaveras and comparing them to those captured in the Stanislaus in the same year, several key findings became apparent:

- 2017/2018 Calaveras River Chinook appear to have divided between two cohorts (e.g., two distinct juvenile groups), indicating early season spawning and later arriving adults based on early season fry capture (n = 3 on Dec. 5, 2017) and a reappearance of fry size fish later on in the season (n = 8 on Mar. 4, 2018) while overlapping with larger sized juveniles (Figure 1).
- Juvenile Calaveras River Chinook tend to be larger at date of capture than Stanislaus River Chinook across both monitoring seasons.
    - In 2019, between Mar. 14 and Apr. 7, both the Calaveras and Stanislaus RSTs operated on a daily basis.
    - During this period, the differential of the average fork lengths of fish captured in the Calaveras RST ranged between 6.7 and 29.6 mm larger than their Stanislaus counterparts (average difference over period = 16.91 mm; Figure 1).

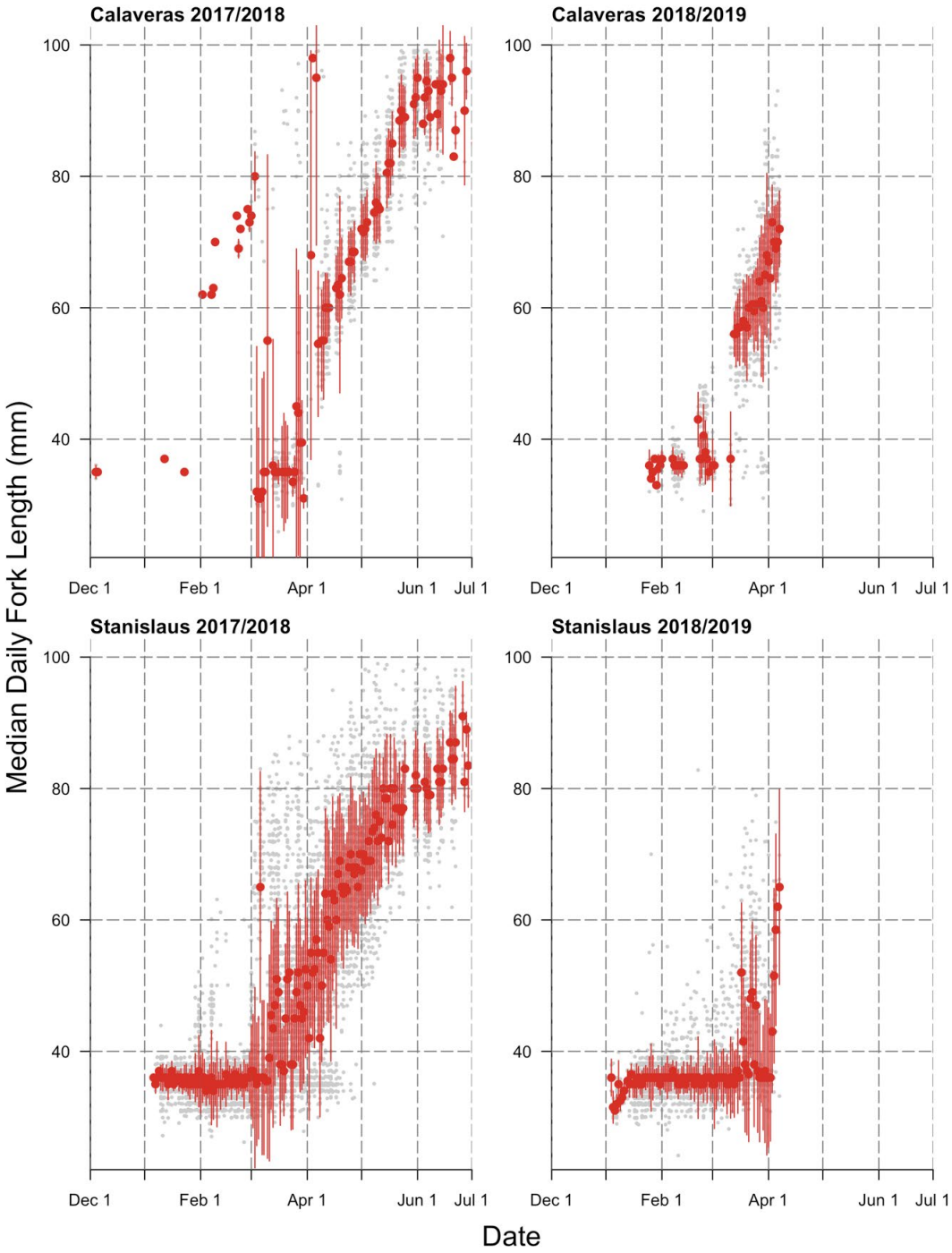


Figure 1. The mean daily fork length of Chinook captured in the Calaveras and Stanislaus rivers.

Comparison of Estimates of Chinook Abundance

While recent catch rates of Chinook in the Calaveras are impressive and the largest seen since the previous season total of 2,311 captured during the 2011/2012 monitoring season, they pale in

comparison to annual catches observed in the Stanislaus River. The recent higher than normal levels of Chinook catch on the Calaveras has allowed us to form RST efficiency test groups. These tests allow us to develop estimates of juvenile abundance.

- The 2018 juvenile Chinook estimate of abundance in the Calaveras was approximately 47,594 fish (range: 32,546 – 74,924).
- For the same season, the total estimate of juvenile Chinook abundance on the Stanislaus was 794,528 fish (range: 551,333 – 1,068,807).
- To date, the 2019 cumulative estimate of abundance of Calaveras juvenile Chinook is approximately 10,847 fish (range: 8,332 – 14,419).
- Currently, the 2019 juvenile Chinook cumulative estimate of abundance tracks closely with that documented in 2018 (Figure 2).

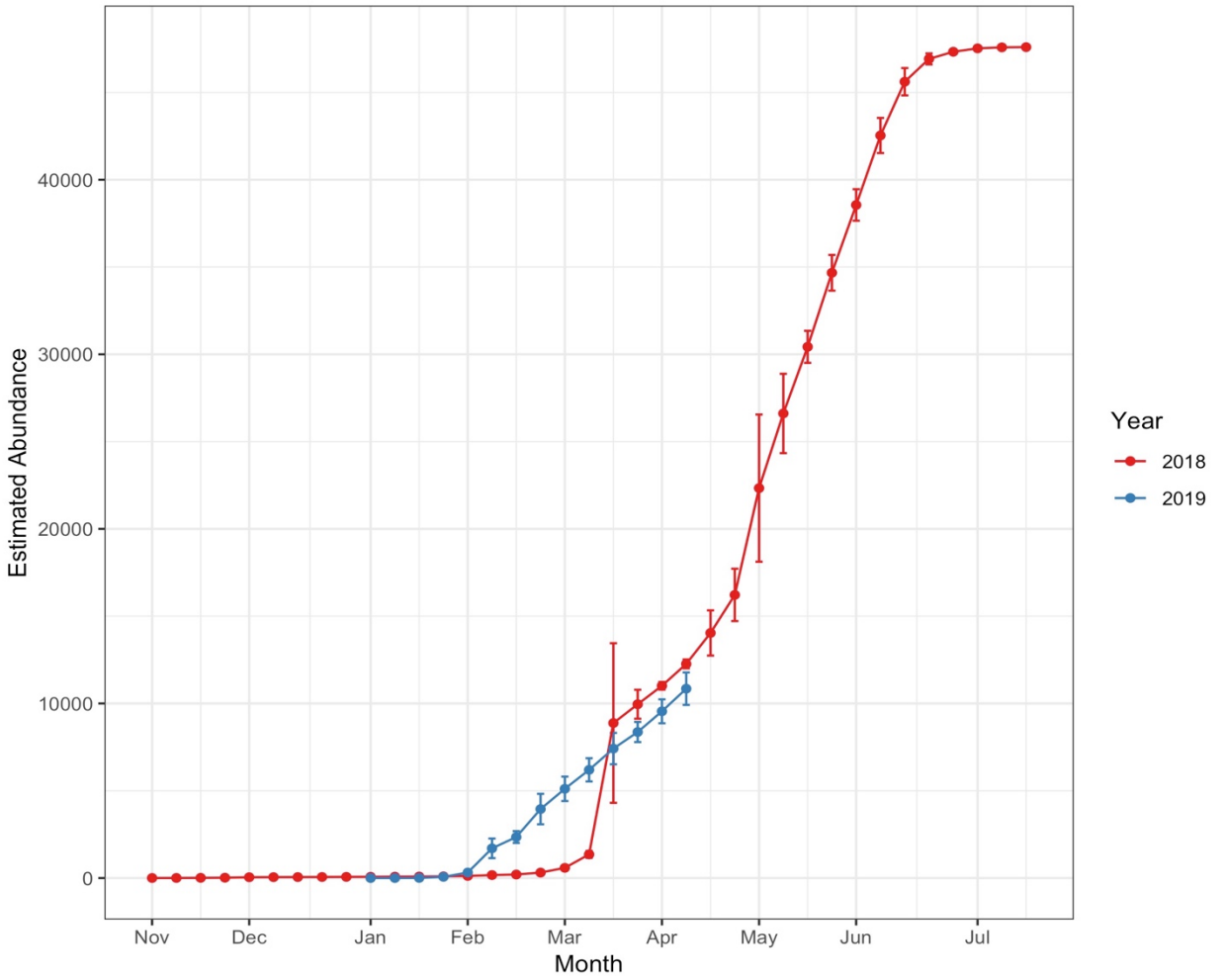


Figure 2. Weekly estimated abundance of Chinook in the Calaveras based on fish captured in the RST.

Effect of RST Diameter on Chinook Capture Size

As 2019 is the first year in which we have used an 8-ft diameter RST to sample high flow events (>300 cfs), there was some concern that the larger diameter cone may show bias in terms of size selectivity. While there are some gaps in the data due to the five-day-per-week trapping schedule, the size to date of capture appears to be consistent regardless of using the 5-ft or 8-ft diameter. This would appear to indicate that there is little influence of size selectivity based on RST cone diameter.

- While there are data gaps before and after switching from the 5-ft and 8-ft RSTs, average fish size at capture followed the expected trend when switching trap size.
- For example, while using the 5-ft trap for the week of Jan. 6 to Feb. 1, the average fork length of fry size fish captured ranged between 34 and 36 mm.
    - When switching to the 8-ft RST beginning Feb. 7 and fishing through March 11, the daily average fork length of fish captured ranged between 36 and 40 mm (Figure 3).

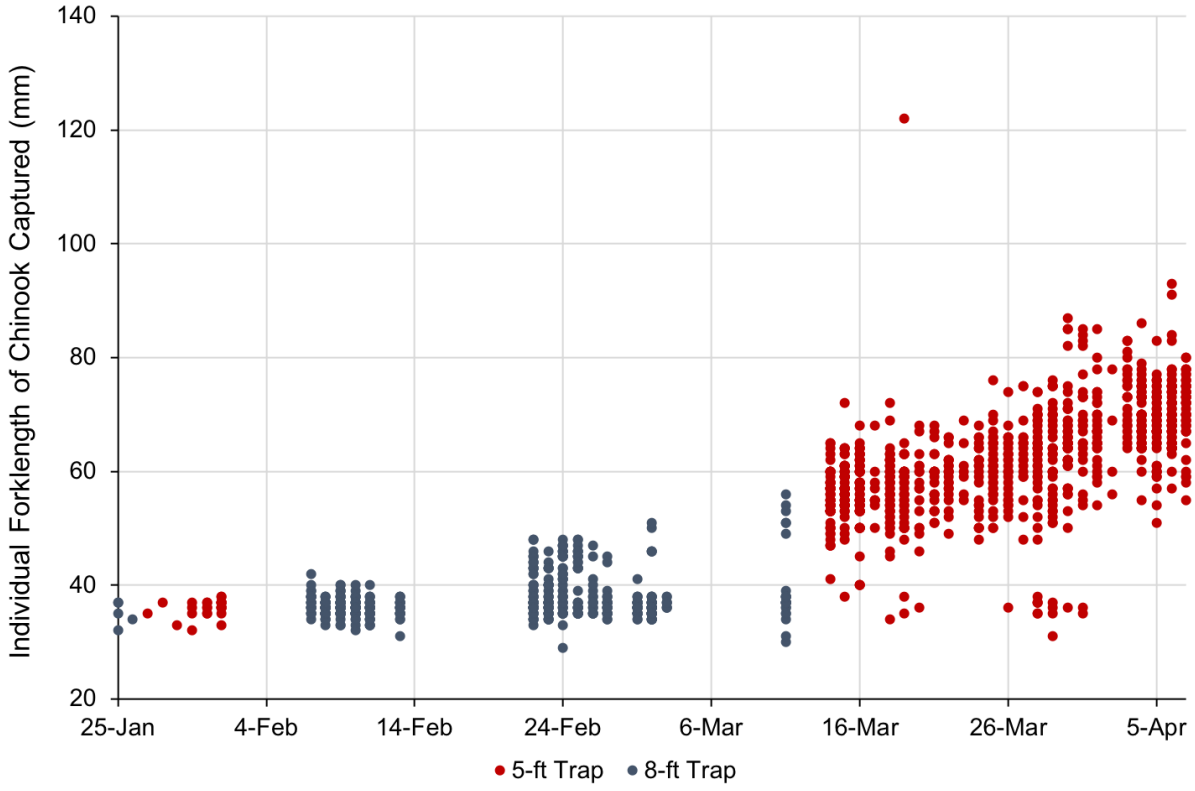


Figure 3. The individual fork length of juvenile Chinook captured over time between the 5 ft. and 8 ft. diameter Calaveras RSTs during 2019.

Water Temperature Comparison between Calaveras and Stanislaus

One factor leading to the difference in growth rate between Calaveras and Stanislaus River Chinook could be the differences observed in daily average water temperatures experienced by juvenile Chinook in their respective rivers. Water temperature can affect multiple Chinook salmon life history factors including the timing of emergence (i.e., from egg stage to alevin) and individual feeding/growth rate.

- During the early portions of the 2018 WY as adult Chinook were entering the system and spawning would begin (i.e., Oct. 1 to mid-Dec.), daily average water temperatures were higher and more variable than those on the Stanislaus (Figure 4).
- Additionally, daily average temperatures during key rearing periods and smolt outmigration (i.e., early March to late May), were similar on both rivers to start, but diverged around April and remained consistently higher in the Calaveras (Figure 5).
- The combination of higher average water temperatures in during spawning and rearing could, in part, explain the earlier emergence timing and the larger fish captured in the Calaveras River during 2018.

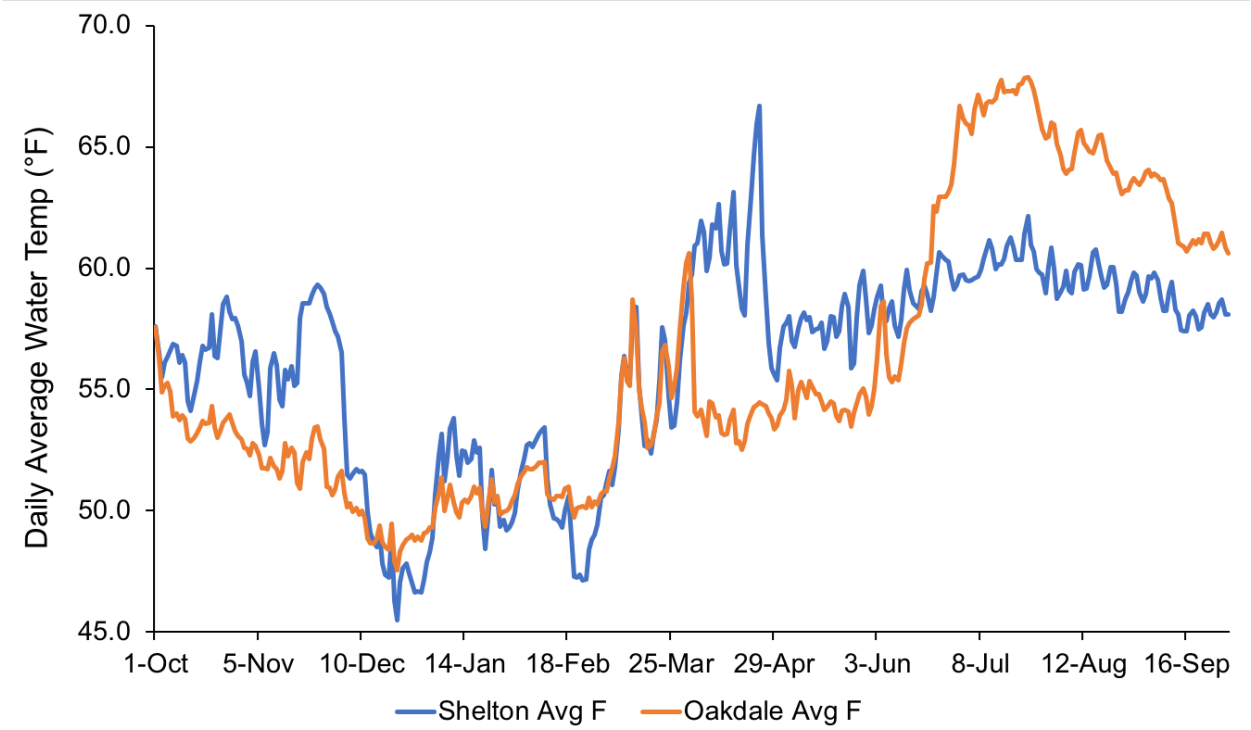


Figure 4. Daily average water temperatures in the Stanislaus and Calaveras during the 2018 water year.

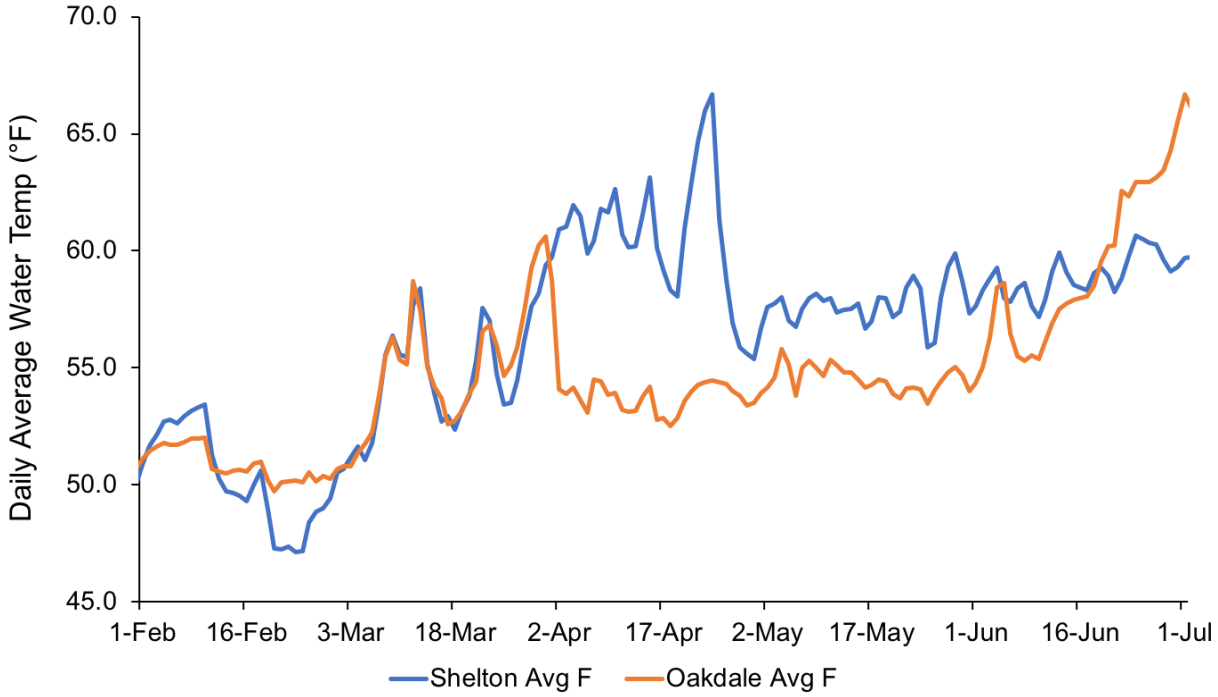


Figure 5. Closer look at daily average water temperatures during the Chinook salmon rearing and outmigration period.

Summary

While the recent catch totals of juvenile Chinook in the Calaveras River RST seem large, they are orders of magnitude lower than those observed in the Stanislaus River RST at Oakdale. However, the lower totals of Chinook encountered in the Calaveras appear to be of benefit to the species as Calaveras fish appear to larger than their Stanislaus River counterparts. The significantly lower estimate of juvenile Chinook abundance on the Calaveras than the Stanislaus could lead to less feeding competition among juvenile Chinook salmon in the Calaveras, perhaps due to density dependence. When combined with the Calaveras River's higher daily average water temperatures during key Chinook life history periods, this could explain the elevated growth rates observed versus those in those in the Stanislaus.

Further, these higher catch rates at the Calaveras RST have allowed us to perform RST efficiency test that help to refine our estimates of abundance. Typically, daily salmonid catch does not yield enough individuals to form a sufficiently sized release group for a mark and recapture study. Our standard protocol requires a group of at least 50 individuals for a smaller sized river to yield statistically significant data. As catch rates of juvenile Chinook have been higher than average during both the 2018 and 2019 monitoring season, we have been able to conduct at least one efficiency test per week. This strategy (e.g., one efficiency test per week) will continue as longer a daily catch at the Calaveras RST continues to yield the minimum number of fish to form a release group. This will allow us to further refine our RST efficiency value and create more robust estimates of abundance.

Appendix C: Flashboard Dam site photographs


Clements Dam, October 16, 2021


Tully Dam, October 16, 2021


Eight Mile Dam, October 13, 2021


Murphy Dam, October 19, 2021


Pezzi Dam, October 13, 2021


Cherryland Dam, October 14, 2021

McAllen Dam, October 14, 2021

Attachment 1 – NMFS Consultation for Instream Flow Reduction

From: Monica Gutierrez - NOAA Federal
To: Justin Hopkins
Cc: Scot A. Moody; Meiling Colombano - NOAA Federal
Subject: Re: New Hogan Critical Water Storage Release
Date: Tuesday, August 24, 2021 10:11:01 AM

Thanks for the heads up on this Justin. I too was wondering if SEWD was going to go down to 10 cfs as it's been previously done during other critically dry water years. Since this is under the CHCP, there is no need for further action with us, only keep us in the loop as things progress. Thanks!

On Tue, Aug 24, 2021 at 8:49 AM Justin Hopkins <JHopkins@sewd.net> wrote:

> Good morning Monica,
>
> The District is closely monitoring and modeling the water storage in New Hogan Reservoir during this critically dry year. The District's current projections estimate by September 1st the New Hogan reservoir storage will fall below the 99,100 acre-feet identified within the Calaveras River Habitat Conservation Plan (HCP) as the threshold for critical water storage. Once the reservoir reaches the critical water storage levels, the District is allowed to decrease the minimum instream flow commitment from 20 cubic feet per second (CFS) at the Shelton Road Bridge to 10 CFS.
>
> The District expects to maintain New Hogan releases above 10 CFS until mid-December due to customer demands and District projects. The projected New Hogan storage level in mid-December is 73,800 acre-feet, at which time the District plans to provide a minimum instream flow of 10 CFS. The HCP requires District consultation with NMFS prior to making the change. I know mid-December is a long time from now, but national weather service models are not looking favorable for filling New Hogan reservoir. Since a critical water storage level in New Hogan seems imminent, I thought we could begin consultation now so we can be on the same page well ahead of implementing any changes. Please let me know if you have any questions or if the District needs to provide additional information.
>
> Have a nice day,
>
> Justin M. Hopkins, P.E.
>
> Assistant General Manager
>
> **Stockton East Water District**
>
> O: 209-444-3150

Attachment 2 – Minor HCP Modification of Operations Database Monitoring Locations

From: Monica Gutierrez - NOAA Federal
To: Justin Hopkins
Cc: Meiling Colombano - NOAA Federal
Subject: Re: Minor Modification to the CHCP
Date: Monday, June 28, 2021 8:24:07 AM

Hi Justin,

I think that is a great idea to transfer the monitoring stations to Mormon Slough as that is the primary migration route. Can you send over a letter documenting this so I can add it to my administrative record?

Also, Erin Strange is no longer with NMFS, as she has accepted a position with USFWS. You don't need to include her in future correspondence. Thank you!

On Fri, Jun 25, 2021 at 4:45 PM Justin Hopkins <JHopkins@sewd.net> wrote:

> Good afternoon Monica and Erin,
>
> I tried sending this email about half an hour ago but the email got kicked back as undeliverable. I think the attachment site (21mb) may have exceeded your email server limit. I do have a map to include with the below email, but am not sure what the best way is to get the map over to you. I will try uploading the map to the District's DropBox account and email both of you links.
>
> I would like to propose a minor modification to the Calaveras River Habitat Conservation Plan (CHCP), specifically changes to Section 7.1 Conservation Strategies for New Hogan Reservoir Water Impoundment and Non-Flood Control Operations – Compliance Monitoring (P.96). Currently the CHCP requires Stockton East Water District (District) to collect daily flow records during irrigation season at all the facilities listed in the below table:

System	Facility
Mormon Slough	Fujinaka Dam
Mormon Slough	Main Street Dam
Potter Creek	Sanguinetti Dam
Old Calaveras River	Clements Dam
Old Calaveras River	Tully Dam
Old Calaveras River	Eight Mile Dam
Old Calaveras River	Solari Ranch Dam
Old Calaveras River	McAllen Dam
Old Calaveras River	Mosher Diversion Structure
Mosher Creek	Tully-Mosher Dam
Mosher Creek	Lyons Dam
Mosher Creek	Lefflers Crossing

I think the above facilities were originally included within the Compliance Monitoring portion of Section 7.1 of the CHCP because the facilities were part of a District SCADA project in 2005. The SCADA project was ultimately unsuccessful and no longer in use, so all flow measurements are made and recorded manually. Additionally, Potter Creek is not naturally supplied irrigation water by the Calaveras River, so all water diverted into Potter Creek is either through the Bellota Pipeline after the Bellota Intake Facility fish screens or by lift pumps in Mormon Slough; fish are not able to swim from the Calaveras River to Potter Creek. Lastly, Mosher Creek is supplied by the Old Calaveras River and fish migration into the Old Calaveras River is prevented by a temporary fish barrier upstream of the headworks facility. With no capability of fish migration into Potter Creek, Mosher Creek, or the Old Calaveras River, I do not think daily flow recordings provide any benefit to the CHCP reporting.

In lieu of the Potter Creek, Mosher Creek, and Old Calaveras River monitoring locations, I would like to propose additional monitoring locations along Mormon Slough, the primary waterway providing fish access to and from the Delta and the Calaveras River fishery. The Mormon Slough contains 12 flashboard dams downstream of the Bellota Weir, two of which are already included as flow monitoring locations. In addition to continued monitoring of the Bellota Weir, Bellota Intake, and Old Calaveras headworks flows, I recommend the District also begin monitoring flows at all 12 flashboard dam sites. I have attached a map of all the proposed flow monitoring sites (in purple) and all the sites currently included in the CHCP that will no longer be monitored (in white).

If NMFS is amendable to the proposed change, I would like to cease District monitoring efforts in Potter Creek, Mosher Creek, and Old Calaveras River on June 30, 2021, and commence District monitoring efforts for the 10 additional flashboard dam facilities in Mormon Slough on July 1, 2021. I look forward to receiving your feedback and thank you for considering this minor modification.

Have a great weekend,

Justin M. Hopkins, P.E.

Assistant General Manager

Stockton East Water District

O: 209-444-3150

F: 209-948-4219

STOCKTON
EAST WATER
DISTRICT
PROVIDING SERVICE SINCE 1948
www.sewd.net

Phone 209-948-0333
Fax 209-948-0423

E-mail sewd@sewd.net

6767 East Main Street
Stockton, CA 95215

Post Office Box 5157
Stockton, CA 95205

July 8, 2021

Monica Gutierrez, Acting San Joaquin River Branch Chief
NOAA Fisheries
U.S. Department of Commerce
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814

Subject: Calaveras HCP Monitoring Locations – Modification

Dear Monica,

The Calaveras Habitat Conservation Plan (CHCP) requires the Stockton East Water District (District) to collect daily flow records during the irrigation season at 14 compliance monitoring locations listed in Section 7.1 Conservation Strategies for New Hogan Reservoir Water Impoundment and Non-Flood Control Operations – Compliance Monitoring (P.96). Of the 15 monitoring locations, only five locations are located within Mormon Slough or the Calaveras River, while the remaining 10 locations are within Potter Creek, old Calaveras River (OCR), and Mosher Creek. Potter Creek is not naturally supplied irrigation water by the Calaveras River, so all water diverted into Potter Creek is either through the Bellota Pipeline after the Bellota Intake Facility fish screens or by lift pumps in Mormon Slough; fish are not able to swim from the Calaveras River to Potter Creek. Mosher Creek is supplied by the OCR and fish migration into the OCR is prevented by a temporary fish barrier upstream of the headworks facility. With no capability of fish migration into Potter Creek, Mosher Creek, or the OCR, the District does not think daily flow recordings provide any benefit to the CHCP reporting.

In lieu of the Potter Creek, Mosher Creek, and OCR monitoring locations, the District proposes additional monitoring locations along Mormon Slough, the primary waterway providing fish access to and from the Delta and the Calaveras River fishery. The Mormon Slough contains 12 flashboard dams downstream of the Bellota Weir, two of which are already included as flow monitoring locations. The District recommends monitoring flows at all 12 flashboard dam sites in addition to continued monitoring of the Bellota Weir, Bellota Intake, and OCR headworks flows. Table 1 lists the proposed compliance monitoring sites and current compliance monitoring sites identified in the CHCP. The attached map geographically locates the proposed compliance monitoring sites (in purple) and current compliance monitoring sites included in the CHCP that will no longer be monitored (in white).

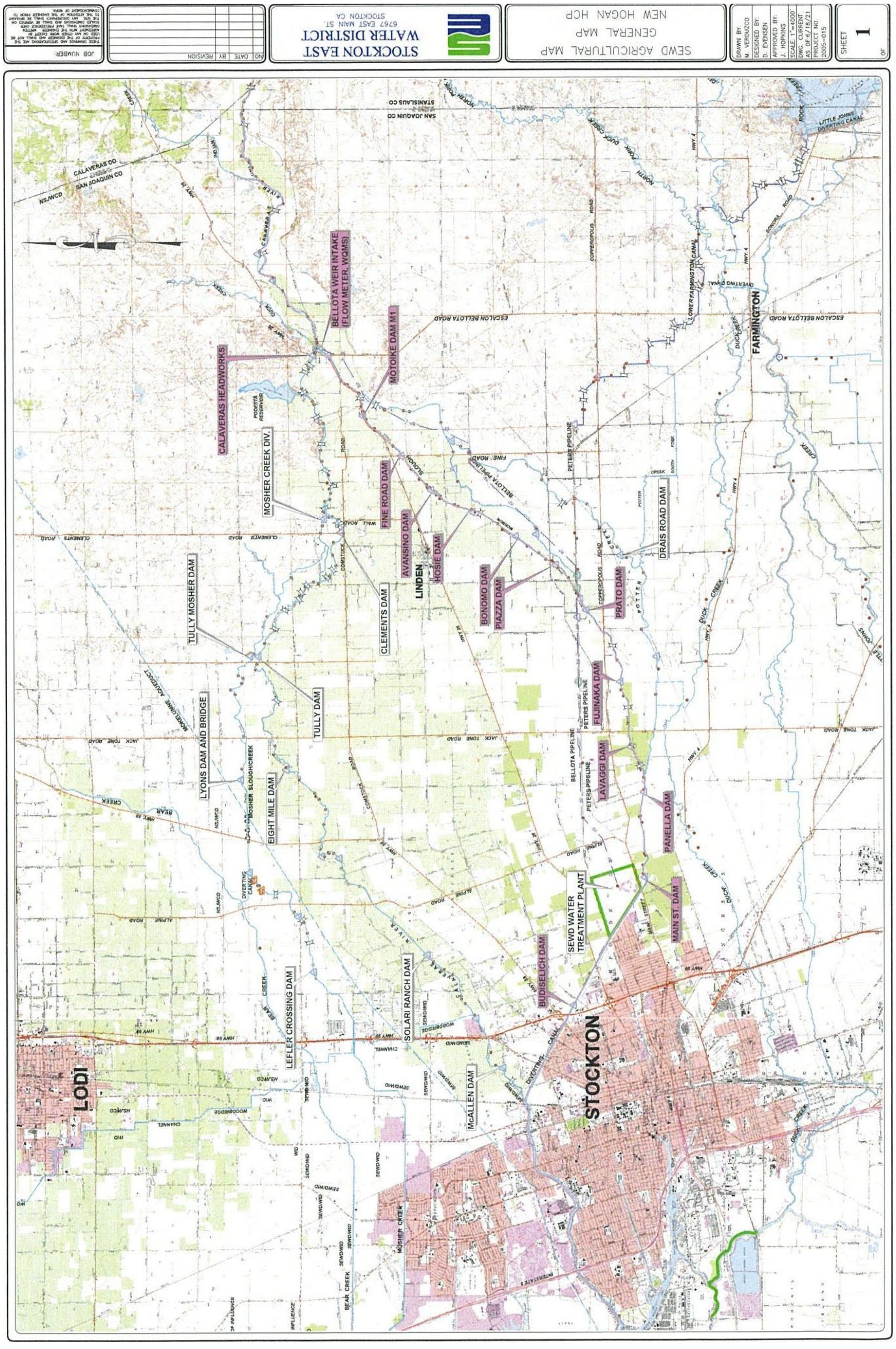
Current Locations		Proposed Locations	
System	Facility	System	Facility
Calaveras River	OCR Headworks	Calaveras River	OCR Headworks
Calaveras River	Bellota Intake	Calaveras River	Bellota Intake
Calaveras River	Bellota Weir	Calaveras River	Bellota Weir
Mormon Slough	Fujinaka Dam	Mormon Slough	Motoike Dam
Mormon Slough	Main Street Dam	Mormon Slough	Fine Road Dam
Potter Creek	Drais Road Dam (Sanguinetti Dam)	Mormon Slough	Avansino Dam
OCR	Clements Dam	Mormon Slough	Hosie Dam
OCR	Tully Dam	Mormon Slough	Bonomo Dam
OCR	Eight Mile Dam	Mormon Slough	Piazza Dam
OCR	Solari Ranch Dam	Mormon Slough	Prato Dam
OCR	McAllen Dam	Mormon Slough	Fujinaka Dam
OCR	Mosher Headworks	Mormon Slough	Lavaggi Dam
Mosher Creek	Tully-Mosher Dam	Mormon Slough	Panella Dam
Mosher Creek	Lyons Dam	Mormon Slough	Main Street Dam
Mosher Creek	Lefflers Crossing	Mormon Slough	Budiselich Dam

Table 1. Current and Proposed CHCP Compliance Monitoring Locations

If you are amendable to the proposed change, the District would like to cease monitoring efforts in Potter Creek, Mosher Creek, and OCR on June 30, 2021, and commence District monitoring efforts for the 10 additional flashboard dam facilities in Mormon Slough on July 1, 2021. I look forward to receiving your feedback and thank you for considering this minor modification.

Respectfully,

Scot A. Moody, CSDM
General Manager


STOCKTON EAST WATER DISTRICT
6767 EAST MAIN ST.
STOCKTON CA
SEWD AGRICULTURAL
GENERAL MAP
NEW HOGAN HCP
DRAWN BY: M. VERDUZCO
DESIGNED BY: D. EVENSEN
APPROVED BY: J. HOPKINS
SCALE: 1"=4000'
PROJECT NO 2005-015
SHEET 1
CALAVERAS HEADWORKS
BELLOTA WEIR INTAKE (FLOW METER, WQMS)
MOTOIKE DAM M1
MOSHER CREEK DIV.
FINE ROAD DAM
AVANSINO DAM
HOSIE DAM
LINDEN
CLEMENTS DAM
BONOMO DAM
PIAZZA DAM
PRATO DAM
DRAIS ROAD DAM
TULLY MOSHER DAM
TULLY DAM
FUJINAKA DAM
LYONS DAM AND BRIDGE
LAVAGGI DAM
EIGHT MILE DAM
PANELLA DAM
SEWD WATER TREATMENT PLANT
MAIN ST. DAM
BUDISELICH DAM
SOLARI RANCH DAM
LEFLER CROSSING DAM
McALLEN DAM
STOCKTON
LODI
FARMINGTON
ESCALON BELLOTA ROAD
JACK TONE ROAD
STANISLAUS CO
SAN JOAQUIN CO
CALAVERAS CO

Attachment 3 – 2021 Raw Water Quality Data

FGL ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

August 3, 2021

Stockton East Water Dist.
P.O. Box 5157
Stockton, CA 95205

Description : PC-1
Project : Surface Water Monitoring

Lab ID : STK2139695-001
Customer : 3008528

Sampled On : July 13, 2021
Sampled By : KB/SM
Received On : July 13, 2021
Matrix : Surface Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
Calcium	22	1.1	50	60	**				
Magnesium	9	0.74	34	24	**				
Potassium	2	0.051	2	5	**				
Sodium	7	0.3	14	19					
Anions									
Carbonate	<10	0	0	0					
Bicarbonate	100	1.6	80	270	**				
Sulfate	12.6	0.26	13	34	**				
Chloride	5	0.14	7	14					
Nitrate	<0.4	0	0	0					
Fluoride	<0.1	0	0	0					
Minor Elements									
Boron	<0.1			0					
Copper	<0.01			0					
Iron	0.080			0.22					
Manganese	<0.01			0					
Zinc	<0.02			0					
TDS by Summation	158			430					
Other									
pH	7 units								
E. C.	0.21 dS/m								
SAR	0.300								
Crop Suitability									
No Amendments	Good								
With Amendments	Good								
Amendments									
Gypsum Requirement	0.02 Tons/AF								
Sulfuric Acid (98%)	5.60 oz/1000Gal				Or 14 oz/1000Gal of urea Sulfuric Acid(15/49)				
Leaching Requirement	1.5 %								

Good — Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

ALP

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

August 3, 2021

Stockton East Water Dist.

Description : PC-1
Project : Surface Water Monitoring

Lab ID : STK2139695-001
Customer : 3008528

Sampled By : KB/SM
Matrix : Surface Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
			Slight	Moderate	Severe
Chemical					
Manganese	<0.01	mg/L			
Iron	0.08	mg/L			
TDS by Summation	158	mg/L			
No Amendments					
pH	7	units			
Alkalinity (As CaCO3)	80	mg/L			
Total Hardness	91.9	mg/L			
With Amendments					
Alkalinity (As CaCO3)	16	mg/L			
Total Hardness	16	mg/L			
pH	5.4 - 6.7	units			

Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as asoil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercisecaution when using this material as excesses may be harmful to the system and/or the plants being irrigated.The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH shouldrange from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is beingachieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea SulfuricAcid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has aspecific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell** Digitally signed by Ben Waddell Title: Director of Ag. Services Date: 2021-08-03

August 3, 2021

Stockton East Water Dist.
P.O. Box 5157
Stockton, CA 95205

Description : CR-1
Project : Surface Water Monitoring

Lab ID : STK2139695-002
Customer : 3008528

Sampled On : July 13, 2021
Sampled By : KB/SM
Received On : July 13, 2021
Matrix : Surface Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
Calcium	21	1	51	57	**				
Magnesium	8	0.66	32	22	**				
Potassium	2	0.051	2	5	**				
Sodium	7	0.3	15	19					
Anions									
Carbonate	<10	0	0	0					
Bicarbonate	90	1.5	77	240	**				
Sulfate	13.7	0.29	15	37	**				
Chloride	5	0.14	7	14					
Nitrate	0.8	0.013	1	2					
Fluoride	<0.1	0	0	0					
Minor Elements									
Boron	<0.1			0					
Copper	<0.01			0					
Iron	<0.03			0					
Manganese	<0.01			0					
Zinc	<0.02			0					
TDS by Summation	148			400					
Other									
pH	7 units								
E. C.	0.201 dS/m								
SAR	0.300								
Crop Suitability									
No Amendments	Good								
With Amendments	Good								
Amendments									
Gypsum Requirement	0.01 Tons/AF								
Sulfuric Acid (98%)	5.60 oz/1000Gal				Or 14 oz/1000Gal of urea Sulfuric Acid(15/49)				
Leaching Requirement	1.5 %								

Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

August 3, 2021

Stockton East Water Dist.

Description : CR-1
Project : Surface Water Monitoring

Lab ID : **STK2139695-002**
Customer : **3008528**

Sampled By : KB/SM
Matrix : Surface Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
			Slight	Moderate	Severe
Chemical					
Manganese	<0.01	mg/L			
Iron	<0.03	mg/L			
TDS by Summation	148	mg/L			
No Amendments					
pH	7	units			
Alkalinity (As CaCO3)	80	mg/L			
Total Hardness	85.3	mg/L			
With Amendments					
Alkalinity (As CaCO3)	16	mg/L			
Total Hardness	16	mg/L			
pH	5.4 - 6.7	units			

Good  Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as asoil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercisecaution when using this material as excesses may be harmful to the system and/or the plants being irrigated.The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH shouldrange from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is beingachieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea SulfuricAcid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has aspecific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell** Digitally signed by Ben Waddell Title: Director of Ag. Services Date: 2021-08-03

August 3, 2021

Stockton East Water Dist.
P.O. Box 5157
Stockton, CA 95205

Description : CR-5
Project : Surface Water Monitoring

Lab ID : STK2139695-003
Customer : 3008528

Sampled On : July 13, 2021
Sampled By : KB/SM
Received On : July 13, 2021
Matrix : Surface Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
Calcium	21	1	49	57	**				
Magnesium	9	0.74	35	24	**				
Potassium	2	0.051	2	5	**				
Sodium	7	0.3	14	19					
Anions									
Carbonate	<10	0	0	0					
Bicarbonate	90	1.5	78	240	**				
Sulfate	13.2	0.27	15	36	**				
Chloride	5	0.14	7	14					
Nitrate	<0.4	0	0	0					
Fluoride	<0.1	0	0	0					
Minor Elements									
Boron	<0.1			0					
Copper	<0.01			0					
Iron	<0.03			0					
Manganese	<0.01			0					
Zinc	<0.02			0					
TDS by Summation	147			400					
Other									
pH	7 units								
E. C.	0.199 dS/m								
SAR	0.300								
Crop Suitability									
No Amendments	Good								
With Amendments	Good								
Amendments									
Gypsum Requirement	0.005 Tons/AF								
Sulfuric Acid (98%)	5.60 oz/1000Gal				Or 14 oz/1000Gal of urea Sulfuric Acid(15/49)				
Leaching Requirement	1.4 %								

Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

August 3, 2021

Stockton East Water Dist.

Description : CR-5
Project : Surface Water Monitoring

Lab ID : **STK2139695-003**
Customer : **3008528**

Sampled By : KB/SM
Matrix : Surface Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
			Slight	Moderate	Severe
Chemical					
Manganese	<0.01	mg/L			
Iron	<0.03	mg/L			
TDS by Summation	147	mg/L			
No Amendments					
pH	7	units			
Alkalinity (As CaCO3)	80	mg/L			
Total Hardness	89.4	mg/L			
With Amendments					
Alkalinity (As CaCO3)	16	mg/L			
Total Hardness	16	mg/L			
pH	5.4 - 6.7	units			

Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as asoil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercisecaution when using this material as excesses may be harmful to the system and/or the plants being irrigated.The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH shouldrange from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is beingachieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea SulfuricAcid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has aspecific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell** Digitally signed by Ben Waddell Title: Director of Ag. Services Date: 2021-08-03

August 3, 2021

Stockton East Water Dist.
P.O. Box 5157
Stockton, CA 95205

Description : MS-1
Project : Surface Water Monitoring

Lab ID : STK2139695-004
Customer : 3008528

Sampled On : July 13, 2021
Sampled By : KB/SM
Received On : July 13, 2021
Matrix : Surface Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
Calcium	21	1	50	57	**				
Magnesium	9	0.74	35	24	**				
Potassium	2	0.051	2	5	**				
Sodium	6	0.26	12	16					
Anions									
Carbonate	<10	0	0	0					
Bicarbonate	90	1.5	78	240	**				
Sulfate	13.4	0.28	15	36	**				
Chloride	5	0.14	7	14					
Nitrate	<0.4	0	0	0					
Fluoride	<0.1	0	0	0					
Minor Elements									
Boron	<0.1			0					
Copper	<0.01			0					
Iron	<0.03			0					
Manganese	<0.01			0					
Zinc	<0.02			0					
TDS by Summation	146			400					
Other									
pH	7 units								
E. C.	0.201 dS/m								
SAR	0.300								
Crop Suitability									
No Amendments	Good								
With Amendments	Good								
Amendments									
Gypsum Requirement	0.0 Tons/AF								
Sulfuric Acid (98%)	5.60 oz/1000Gal				Or 14 oz/1000Gal of urea Sulfuric Acid(15/49)				
Leaching Requirement	1.5 %								

Good  Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

August 3, 2021

Stockton East Water Dist.

Description : MS-1
Project : Surface Water Monitoring

Lab ID : **STK2139695-004**
Customer : **3008528**

Sampled By : KB/SM
Matrix : Surface Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
Chemical			Slight	Moderate	Severe
Manganese	<0.01	mg/L			
Iron	<0.03	mg/L			
TDS by Summation	146	mg/L			
No Amendments					
pH	7	units			
Alkalinity (As CaCO3)	80	mg/L			
Total Hardness	89.4	mg/L			
With Amendments					
Alkalinity (As CaCO3)	16	mg/L			
Total Hardness	16	mg/L			
pH	5.4 - 6.7	units			

Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as asoil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercisecaution when using this material as excesses may be harmful to the system and/or the plants being irrigated.The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH shouldrange from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is beingachieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea SulfuricAcid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has aspecific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell** Digitally signed by Ben Waddell Title: Director of Ag. Services Date: 2021-08-03

August 3, 2021

Stockton East Water Dist.
P.O. Box 5157
Stockton, CA 95205

Description : MS-2
Project : Surface Water Monitoring

Lab ID : STK2139695-005
Customer : 3008528

Sampled On : July 13, 2021
Sampled By : KB/SM
Received On : July 13, 2021
Matrix : Surface Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
Calcium	21	1	49	57	**				
Magnesium	9	0.74	35	24	**				
Potassium	2	0.051	2	5	**				
Sodium	7	0.3	14	19					
Anions									
Carbonate	<10	0	0	0					
Bicarbonate	100	1.6	81	270	**				
Sulfate	11.9	0.25	12	32	**				
Chloride	5	0.14	7	14					
Nitrate	<0.4	0	0	0					
Fluoride	<0.1	0	0	0					
Minor Elements									
Boron	<0.1			0					
Copper	<0.01			0					
Iron	0.21			0.57					
Manganese	<0.01			0					
Zinc	<0.02			0					
TDS by Summation	156			420					
Other									
pH	7 units								
E. C.	0.208 dS/m								
SAR	0.300								
Crop Suitability									
No Amendments	Good								
With Amendments	Good								
Amendments									
Gypsum Requirement	0.02 Tons/AF								
Sulfuric Acid (98%)	5.60 oz/1000Gal				Or 14 oz/1000Gal of urea Sulfuric Acid(15/49)				
Leaching Requirement	1.5 %								

Good  Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

August 3, 2021

Stockton East Water Dist.

Description : MS-2
Project : Surface Water Monitoring

Lab ID : **STK2139695-005**
Customer : **3008528**

Sampled By : KB/SM
Matrix : Surface Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
			Slight	Moderate	Severe
Chemical					
Manganese	<0.01	mg/L			
Iron	0.21	mg/L			
TDS by Summation	156	mg/L			
No Amendments					
pH	7	units			
Alkalinity (As CaCO3)	80	mg/L			
Total Hardness	89.4	mg/L			
With Amendments					
Alkalinity (As CaCO3)	16	mg/L			
Total Hardness	16	mg/L			
pH	5.4 - 6.7	units			

Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as asoil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercisecaution when using this material as excesses may be harmful to the system and/or the plants being irrigated.The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH shouldrange from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is beingachieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea SulfuricAcid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has aspecific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell** Digitally signed by Ben Waddell Title: Director of Ag. Services Date: 2021-08-03

August 3, 2021

Stockton East Water Dist.
P.O. Box 5157
Stockton, CA 95205

Description : CR-6
Project : Surface Water Monitoring

Lab ID : STK2139695-006
Customer : 3008528

Sampled On : July 13, 2021
Sampled By : KB/SM
Received On : July 13, 2021
Matrix : Surface Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
Calcium	21	1	49	57	**				
Magnesium	9	0.74	35	24	**				
Potassium	2	0.051	2	5	**				
Sodium	7	0.3	14	19					
Anions									
Carbonate	<10	0	0	0					
Bicarbonate	90	1.5	78	240	**				
Sulfate	13.1	0.27	14	36	**				
Chloride	5	0.14	7	14					
Nitrate	<0.4	0	0	0					
Fluoride	<0.1	0	0	0					
Minor Elements									
Boron	<0.1			0					
Copper	<0.01			0					
Iron	0.040			0.11					
Manganese	<0.01			0					
Zinc	<0.02			0					
TDS by Summation	147			400					
Other									
pH	8.3 units								
E. C.	0.2 dS/m								
SAR	0.300								
Crop Suitability									
No Amendments	Fairly Poor								
With Amendments	Good								
Amendments									
Gypsum Requirement	0.005 Tons/AF								
Sulfuric Acid (98%)	5.60 oz/1000Gal				Or 14 oz/1000Gal of urea Sulfuric Acid(15/49)				
Leaching Requirement	1.4 %								

Good  Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

August 3, 2021

Stockton East Water Dist.

Description : CR-6
Project : Surface Water Monitoring

Lab ID : **STK2139695-006**
Customer : **3008528**

Sampled By : KB/SM
Matrix : Surface Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
Chemical			Slight	Moderate	Severe
Manganese	<0.01	mg/L			
Iron	0.04	mg/L			
TDS by Summation	147	mg/L			
No Amendments					
pH	8.3	units			
Alkalinity (As CaCO3)	80	mg/L			
Total Hardness	89.4	mg/L			
With Amendments					
Alkalinity (As CaCO3)	16	mg/L			
Total Hardness	16	mg/L			
pH	5.4 - 6.7	units			

Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as asoil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercisecaution when using this material as excesses may be harmful to the system and/or the plants being irrigated.The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH shouldrange from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is beingachieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea SulfuricAcid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has aspecific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell** Digitally signed by Ben Waddell Title: Director of Ag. Services Date: 2021-08-03

August 3, 2021

Stockton East Water Dist.
P.O. Box 5157
Stockton, CA 95205

Description : M-1
Project : Surface Water Monitoring

Lab ID : STK2139695-007
Customer : 3008528

Sampled On : July 13, 2021
Sampled By : KB/SM
Received On : July 13, 2021
Matrix : Surface Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
Calcium	20	1	48	54	**				
Magnesium	9	0.74	35	24	**				
Potassium	2	0.051	2	5	**				
Sodium	7	0.3	15	19					
Anions									
Carbonate	<10	0	0	0					
Bicarbonate	90	1.5	79	240	**				
Sulfate	12.6	0.26	14	34	**				
Chloride	5	0.14	8	14					
Nitrate	<0.4	0	0	0					
Fluoride	<0.1	0	0	0					
Minor Elements									
Boron	<0.1			0					
Copper	<0.01			0					
Iron	0.030			0.082					
Manganese	<0.01			0					
Zinc	<0.02			0					
TDS by Summation	146			400					
Other									
pH	7 units								
E. C.	0.201 dS/m								
SAR	0.300								
Crop Suitability									
No Amendments	Good								
With Amendments	Good								
Amendments									
Gypsum Requirement	0.01 Tons/AF								
Sulfuric Acid (98%)	5.60 oz/1000Gal				Or 14 oz/1000Gal of urea Sulfuric Acid(15/49)				
Leaching Requirement	1.5 %								

Good  Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

August 3, 2021

Stockton East Water Dist.

Description : M-1
Project : Surface Water Monitoring

Lab ID : **STK2139695-007**
Customer : **3008528**

Sampled By : KB/SM
Matrix : Surface Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
			Slight	Moderate	Severe
Chemical					
Manganese	<0.01	mg/L			
Iron	0.03	mg/L			
TDS by Summation	146	mg/L			
No Amendments					
pH	7	units			
Alkalinity (As CaCO3)	80	mg/L			
Total Hardness	86.9	mg/L			
With Amendments					
Alkalinity (As CaCO3)	16	mg/L			
Total Hardness	16	mg/L			
pH	5.4 - 6.7	units			

Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as asoil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercisecaution when using this material as excesses may be harmful to the system and/or the plants being irrigated.The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH shouldrange from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is beingachieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea SulfuricAcid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has aspecific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell** Digitally signed by Ben Waddell Title: Director of Ag. Services Date: 2021-08-03

August 3, 2021

Stockton East Water Dist.
P.O. Box 5157
Stockton, CA 95205

Description : PP-1
Project : Surface Water Monitoring

Lab ID : STK2139695-008
Customer : 3008528

Sampled On : July 13, 2021
Sampled By : KB/SM
Received On : July 13, 2021
Matrix : Surface Water

General Irrigation Suitability Analysis

Test Description	Result				Graphical Results Presentation				
Cations	mg/L	Meq/L	% Meq	Lbs/AF	Good	Possible Problem	Moderate Problem	Increasing Problem	Severe Problem
Calcium	7	0.35	58	19	**				
Magnesium	2	0.16	27	5	**				
Potassium	<1	0	0	0	**				
Sodium	2	0.087	14	5.4					
Anions									
Carbonate	<10	0	0	0					
Bicarbonate	30	0.49	93	82	**				
Sulfate	1.8	0.037	7	5	**				
Chloride	<1	0	0	0					
Nitrate	<0.4	0	0	0					
Fluoride	<0.1	0	0	0					
Minor Elements									
Boron	<0.1			0					
Copper	<0.01			0					
Iron	0.050			0.14					
Manganese	<0.01			0					
Zinc	<0.02			0					
TDS by Summation	43			120					
Other									
pH	7.9 units								
E. C.	0.0583 dS/m								
SAR	0.200								
Crop Suitability									
No Amendments	Fair								
With Amendments	Good								
Amendments									
Gypsum Requirement	0.008 Tons/AF								
Sulfuric Acid (98%)	1.40 oz/1000Gal				Or 3.4 oz/1000Gal of urea Sulfuric Acid(15/49)				
Leaching Requirement	0.42 %								

Good — Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.
** Used in various calculations; mg/L = Milligrams Per Liter (ppm) meq/L = Milliequivalents Per Liter.

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
TEL: (805)392-2000
Env FAX: (805)525-4172 / Ag FAX: (805)392-2063
CA ELAP Certification No. 1573

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209)942-0182
FAX: (209)942-0423
CA ELAP Certification No. 1563

Office & Laboratory
563 E. Lindo Avenue
Chico, CA 95926
TEL: (530)343-5818
FAX: (530)343-3807
CA ELAP Certification No. 2670

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
TEL: (805)783-2940
FAX: (805)783-2912
CA ELAP Certification No. 2775

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
TEL: (559)734-9473
FAX: (559)734-8435
CA ELAP Certification No. 2810

August 3, 2021

Stockton East Water Dist.

Description : PP-1
Project : Surface Water Monitoring

Lab ID : STK2139695-008
Customer : 3008528

Sampled By : KB/SM
Matrix : Surface Water

Micro Irrigation System Plugging Hazard

Test Description	Result		Graphical Results Presentation		
Chemical			Slight	Moderate	Severe
Manganese	<0.01	mg/L			
Iron	0.05	mg/L			
TDS by Summation	43	mg/L			
No Amendments					
pH	7.9	units			
Alkalinity (As CaCO3)	20	mg/L			
Total Hardness	25.7	mg/L			
With Amendments					
Alkalinity (As CaCO3)	10	mg/L			
Total Hardness	4	mg/L			
pH	5.4 - 6.7	units			

Good Problem

Note: Color coded bar graphs have been used to provide you with 'AT-A-GLANCE' interpretations.

Water Amendments Application Notes:
The Amendments recommended on the previous pages include:

Gypsum:
This should be applied at least once a year to the irrigated soil surface area. Gypsum can also be applied in smaller quantities in the irrigation water.Apply the smaller (bracketed) amount of gypsum when also applying the recommended amount of Sulfuric Acid and the larger amount when applying only Gypsum.

Sulfuric Acid:
These products should be applied as needed to prevent emitter plugging in micro irrigation systems and/or as asoil amendment to adjust soil pH to improve nutrient availability and to facilitate leaching of salts. Please exercisecaution when using this material as excesses may be harmful to the system and/or the plants being irrigated.The reported Acid requirement is intended to remove approximately 80 % of the alkalinity. The final pH shouldrange from 5.4 to 6.7. We recommend a field pH determination to confirm that the pH you designate is beingachieved. This application is based upon the use of a 98% Sulfuric Acid product. The application of Urea SulfuricAcid is based upon the use of a product that contains 15% Urea (1.89 lbs Nitrogen), 49% Sulfuric Acid and has aspecific gravity of 1.52 at 68 °F.
Please contact us if you have any questions.

BRW:KEH

Reviewed and Approved By **Ben Waddell** Digitally signed by Ben Waddell Title: Director of Ag. Services Date: 2021-08-03

ENVIRONMENTAL AGRICULTURAL
Analytical Chemists

CHAIN OF CUSTODY

www.fglinc.com

Annual

Laboratory Copy (1 of 3)

32724:07/05/2021

Client: Stockton East Water Dist.
Address: P.O. Box 5157
Stockton, CA 95205

Phone: (209)948-0537 Fax: (209)948-4219
Contact Person: Ed Morley
Project Name: **Surface Water Monitoring**
Purchase Order Number:
Quote Number:

Sampler(s)
KB/SM

Sampling Fee:_____ Pickup Fee: _____
Compositor Setup Date: ___/___/___ Time: ___/___

Lab Number: **STK 2396 95** 3-8528

Samp Num	Location Description	Date Sampled	Time Sampled	Method of Sampling: Composite(C) Grab(G)	Type of Sample **SEE REVERSE SIDE**	Potable(P) Non-Potable(NP) Ag Water(AgW)	Bacti Type: Other(O) System(SYS) Source(SR) Waste(W)	Bacti Reason: Routine(ROUT) Repeat(RPT) Replace(RPL) Other(O) Special(SPL)	Irrigation Suit 32oz(P)	Field Test-Field pH !!pH = 15 MINUTE HOLD TIME!!	Field - pH Date	Field - pH Time
1	PC-1	7/13/21	1010	G	SW				1	7.0	7/13/21	1010
2	CR-1	"	1125	G	SW				1	7.0	"	1125
3	CR-5	"	1050	G	SW				1	7.0	"	1052
4	MS-1	"	1200	G	SW				1	7.0	"	1202
5	MS-2	"	1225	G	SW				1	7.0	"	1225
6	CR-6	"	1240	G	SW				1	7.0	"	1240
7	M-1	"	0950	G	SW				1	~~7.00~~	"	0952
8	PP-1	"	1035	G	SW				1	7.0	"	1035

Remarks:

Relinquished	Date:	Time:	Relinquished	Date:	Time:	Relinquished	Date:	Time:
	7/13/21	055		7/13/21	1335		7/13/2021	1700
Received By:	**Date:**	**Time:**	**Received By:**	**Date:**	**Time:**	**Received By:**	**Date:**	**Time:**
				7/13/2021	1335		7/13/2021	1700

Corporate Offices & Laboratory
853 Corporation Street
Santa Paula, CA 93060
Phone: (805) 392-2000
Env Fax: (805) 525-4172 / Ag Fax: (805) 392-2063

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
Phone: (209) 942-0182
Fax: (209) 942-0423

Office & Laboratory
563 E. Lindo
Chico, CA 95926
Phone: (530) 343-5818
Fax: (530) 343-3807

Office & Laboratory
3442 Empresa Drive, Suite D
San Luis Obispo, CA 93401
Phone: (805) 783-2940
Fax: (805) 783-2912

Office & Laboratory
9415 W. Goshen Avenue
Visalia, CA 93291
Phone: (559) 734-9473
Fax: (559) 734-8435

7/15/21 9:30

Inter-Laboratory Condition Upon Receipt (Attach to COC) 21 39695

Sample Receipt at: (STK) CC CH VI

1. Number of ice chests/packages received: 1 Shipping tracking # _____
2. Were samples received in a chilled condition? Temps: 6.° / ____ / ____ / ____ / ____
   Surface water SWTR bact samples: A sample that has a temperature upon receipt of >10° C, whether iced or not, should be flagged unless the time since sample collection has been less than two hours.

3.	Do the number of bottles received agree with the COC?	(Yes)	No	N/A
4.	Were samples received intact? (i.e. no broken bottles, leaks etc.)	(Yes)	No	
5.	VOAs checked for Headspace?	Yes	No	(N/A)
6.	Were sample custody seals intact?	Yes	No	(N/A)
7.	If required, was sample split for pH analysis?	Yes	No	(N/A)
8.	Were all analyses within holding times at time of receipt?	(Yes)	No	
9.	Verify sample date, time and sampler name	(Yes)	No	

Sign and date the COC, place in a ziplock and put in the same ice chest as the samples.
Sample Receipt Review completed by (initials): DM

Sample Receipt at SP:

1. Were samples received in a chilled condition? Temps: 4 / 4 / ____ / ____ / ____
   Acceptable is above freezing to 6Û C. If many packages are received at one time check for tests/H.T.'s/rushes/
2. Shipping tracking numbers:
   5539108734 / 9548

3.	Do the number of bottles received agree with the COC?	(Yes)	No	N/A
4.	Were samples received intact? (i.e. no broken bottles, leaks etc.)	(Yes)	No	
5.	Were sample custody seals intact?	Yes	No	(N/A)

Sign and date the COC, obtain LIMS sample numbers, select methods/tests and print labels.

Sample Verification, Labeling and Distribution:

1.	Were all requested analyses understood and acceptable?	(Yes)	No		
2.	Did bottle labels correspond with the client's ID's?	(Yes)	No		
3.	Were all bottles requiring sample preservation properly preserved? [Exception: Oil & Grease, VOA and CrVI verified in lab]	Yes	No	(N/A)	FGL
4.	VOAs checked for Headspace?	Yes	No	(N/A)	
5.	Have rush or project due dates been checked and accepted?	Yes	No	(N/A)	
6.	Were all analyses within holding times at time of receipt?	(Yes)	No		

Attach labels to the containers and include a copy of the COC for lab delivery.
Sample Receipt, Login and Verification completed by (initials): DAB

Discrepancy Documentation:

Any items above which are "No" or do not meet specifications (i.e. temps) must be resolved.

1. Person Contacted:_____ Phone Number:_____
   Initiated By:_____ Date:_____
   Problem:
   Resolution:

2. Person Contacted:_____ Phone Number:_____
   Initiated By:_____
   Problem:
   Resolution:

(Please use the back of this sheet for additional con
contacts)

(3008528)
Stockton East Water Dist.
STK2139695
apb 07/13/2021 16:42:56
STK2139695

Attachment 4 – 2021-2022 Fall/Winter Newsletter

STOCKTON EAST WATER DISTRICT

Newsletter & AG Water Report

2021/2022 Fall ♦ Winter

SUSTAINABLE GROUNDWATER MANAGEMENT ACT (SGMA)

As you may recall, the District is part of an organization called the Eastern San Joaquin Groundwater Joint Powers Authority (JPA). This group includes all Groundwater Sustainability Agency (GSA) participants within the Eastern San Joaquin groundwater basin and together we have written the Groundwater Sustainability Plan (GSP). This GSP identifies that our groundwater basin is over drafted by 70,000 acre-feet, on average, each year. The State considers this unsustainable and therefore all groundwater agencies must correct this issue by 2040. There are only two means by which this can be accomplished:

1. **Get substantially more landowners to switch from groundwater to surface water use or**
2. **Require all growers within the basin to fallow a percentage of their lands that would be equal to reducing the amount of groundwater use by 70,000 acre-feet.**

Option 2 is obviously not something any of us want to consider and the JPA is committed to preventing this option from happening. The District needs your help in getting owners of all lands that could potentially use surface water to contact the District so that staff can assist landowners in the process of transitioning from groundwater to surface water use when surface water is available.

2021 Tentative Dam Removal Schedule

System	Site	Begin Date	End Date
Mormon Slough	8000		
Duck Creek	Sanguinetti Dam	10/5/2021	10/5/2021
Calaveras River	Bellota Weir	10/6/2021	10/8/2021
Mormon Slough	Budiselich Dam	10/8/2021	10/8/2021
Mormon Slough	Motoike Dam	10/12/2021	10/13/2021
Mormon Slough	Fine Road Dam		
Mormon Slough	Avansino Dam		
Mormon Slough	Hosie Dam	10/13/2021	10/14/2021
Mormon Slough	Bonomo Dam		
Mormon Slough	Piaza Dam		
Mormon Slough	Prato Dam		
Mormon Slough	Fujinaka Dam	10/14/2021	10/15/2021
Mormon Slough	Lavaggi Dam		
Mormon Slough	Panella Dam		
Mormon Slough	Main Street Dam	10/15/2021	10/15/2021
Old Calaveras River	Clements Dam	10/18/2021	10/19/2021
Old Calaveras River	Tully Dam	10/19/2021	10/20/2021
Old Calaveras River	8 Mile Dam	10/20/2021	10/21/2021
Old Calaveras River	Murphy Dam	10/21/2021	10/22/2021
Old Calaveras River	Pezzi Dam		
Old Calaveras River	Solari Dam		
Old Calaveras River	Cherryland Dam	10/22/2021	10/22/2021
Old Calaveras River	McAllen Dam		
Mosher Creek	Tully-Mosher Dam	10/25/2021	10/26/2021
Mosher Creek	Lyons Dam		
Mosher Creek	Bear Creek Diversion		
Mosher Creek	Cotta-Ferreira Dam		
Mosher Creek	Lefler Dam		
North Fork Potter Creek	Gondolfos Dam	10/18/2021	10/18/2021
North Fork Potter Creek	Moitoke Dam #2		
Potter Creek	Drais Road Dam	10/15/2021	10/15/2021

The District's tentative dam removal schedule shown above is unlike past years. In accordance with the District's Habitat Conservation Plan (HCP) all dams will be removed in downstream order.

Updates to this tentative schedule will be posted online at, *www.sewd.net*

2022 WATER SUPPLY OUTLOOK

We are expecting to end the current irrigation season at approximately 80,000-acre feet in New Hogan Reservoir. This is not a lot of water when considering AG, municipal and environmental demands. Let's all pray for a wet winter and spring!

New Melones Reservoir is currently at 889,216-acre feet as of September 6, 2021. Again, given the demands placed upon New Melones, this is not a lot of water and a good snowfall season is needed. The District is concerned that we may not have New Melones water next year.

BOARD OF DIRECTORS

The District's Board of Directors meet regularly every Tuesday at 12:30 p.m. located at 6767 East Main Street Stockton, CA 95215

DIVISION 1—Richard Atkins, Vice President

DIVISION 2—Andrew Watkins, President

DIVISION 3—Alvin Cortopassi

DIVISION 4—Melvin Panizza

DIVISION 5—Paul Sanguinetti

DIVISION 6—Loralee McGaughey

DIVISION 7—Thomas McGurk

Due to COVID-19, Board Meetings are available by teleconference

SAWS Water Education Program Returns to Stockton Area Classrooms

The Stockton Area Water Suppliers (SAWS) Water Education Program is once again offering in-class water education presentations in Stockton area schools.

These stimulating, in-class presentations are offered to K-6 educators in all schools served by the SAWS contractors, which include the City of Stockton, California Water Service Company and San Joaquin County. Each grade-specific presentation is designed to support classroom curriculum and provide content standards based learning that will inform and educate students about the practical and scientific concepts behind society's need to conserve water.

As an alternative to in-class presentations, the SAWS Water Education Program also offers a virtual learning experience that includes delivery of supplies to support the lesson.

Above SAWS Water Educator Kathy Kirchhof leads a class of second graders in a reenactment of a rainstorm as they learn about the water cycle.

Progress Bills. In accordance with the District Act, the 2021 Progress Bill payment is due on or before October 31, 2021. Penalties will apply if not paid by this date. Please note, the only acceptable forms of payment are **check or cash** ***(exact change)***.

Please contact Akaash Sharma, Accounts Receivable at (209) 444-3112 if you have questions or need further assistance.

COVID-19 Update

The District requires face masks be worn by all public visiting the District.

As Progress Billing is upon us, District staff kindly requests that if paying your bill with cash that exact change is provided. If you do not have exact change, the excess amount will be applied to your account.

Do not hesitate contacting District staff prior to your visit if you have any questions regarding your bill or otherwise. All billing questions can be directed to Akaash Sharma, Accounts Receivable. His contact information is provided above.

2021 WATER RATES

For quick reference, the Water Rates are listed below and are also available online at www.sewd.net.

- AG Groundwater Assessment is $5.53/per acre-foot of water;
- AG Surface Water Rate is $23.00/per acre-foot of water;
- Domestic Groundwater Assessment is $46.50/ per Domestic Use Unit (occupied or not);
- Out-of-District Water Rate shall be the cost of water designated under the purchase contract PLUS a charge up to the New Melones Conveyance System Wheeling Rate of $27.81/per acre-foot of water;
- Total Municipal Groundwater Assessment Rate is $344.95/per acre-foot of water ($3.60 base Groundwater Production Assessment + $341.35 Rate Equalization).

District Ordinance No. 47, Adopted by the Board, 04/06/21

CALAVERAS HCP

As part of this long-term agreement, NOAA fisheries has issued a 50-year Incidental Take Permit (ITP) for the operations and maintenance of SEWD facilities on the river. In turn, SEWD has committed to an array of conservation actions to benefit fish populations on the Calaveras River over that time period. The Calaveras HCP allows for an adaptive management plan that would support future studies of the fish community below the dam. Conservation actions include a guaranteed minimum flow in key fish habitat, screening water diversions, improving fish passage over structures, water conservation measures, and continued fisheries research and monitoring on the Calaveras River. The Calaveras HCP also establishes SEWD as a watershed coordinator that acts to inform stakeholders about the current state of the river and provides a forum for stakeholder and citizen input regarding Calaveras River management. Essentially, the Calaveras HCP establishes a roadmap of best management practices for SEWD to conserve the river and its fish populations from an operational standpoint, while also providing opportunities for community members and other water users to help advance conservation goals.

More information about the plan, including monthly reports and videos are available on the District's website "HCP" page

HEALTH & WELLNESS INITIATIVE GRANT

"The Struggle is Real"

Stockton East Water District was awarded the ACWA/JPIA 2021 Wellness Grant in the amount of $1,292 and this is the 7th year the District has been awarded this Grant. In partnership with Anthem Blue Cross, ACWA/JPIA extended the opportunity to obtain a Wellness Grant to all of its members. The program funding will assist the District in providing education & incentives to our employees to create a work culture that is supportive of District employees lifestyle goals. No matter what the issue, we know that *The Struggle is Real!*

District Staff

ADMINISTRATION DEPARTMENT
Scot A. Moody, General Manager
Kristin Carido, Administrative Services Manager

FINANCE DEPARTMENT
Juan Vega, Finance Director
Priya Ram, Accountant

OPERATIONS DEPARTMENT
Justin Hopkins, Assistant General Manager
Jim Wunderlich, Water Operations Manager

ENGINEERING DEPARTMENT
Darrel Evensen, District Engineer

MAINTENANCE DEPARTMENT
David Higares, Maintenance Supervisor

WATER SUPPLY DEPARTMENT
Aaron Riojas, Construction/Water Supply Supervisor
Lou Mendez, Grounds/Water Supply Supervisor
Chris Donis, Operations/Water Supply Supervisor

WATER CONSERVATION
Kristin Coon, Water Conservation Coordinator

CONTACT US

(209) 948-0333	Administration
(209) 948-0537	Treatment Plant
(209) 469-3335	Ag Water Order
(209) 444-3126	Water Conservation
(209) 948-0423	Fax
www.sewd.net	District Website
sewd@sewd.net	District Email

6767 East Main Street
Stockton, CA 95215

Post Office Box 5157
Stockton, CA 95205

"Our Mission is to ensure proper management of our groundwater basin and provide supplemental surface water supplies"

Attachment 5 – Ordinance No. 47

ORDINANCE NO.47
Adopted 04/06/2021

AN ORDINANCE ESTABLISHING MUNICIPAL GROUNDWATER ASSESSMENTS, AGRICULTURAL GROUNDWATER ASSESSMENTS, DOMESTIC GROUNDWATER ASSESSMENTS, CHARGES FOR STREAM-DELIVERED WATER AND CHARGES FOR OUT-OF-DISTRICT WATER FOR CALENDAR YEAR 2021

The Board of Directors of Stockton East Water District does hereby ordain as follows:

Section 1: The Municipal Groundwater Assessment for calendar year 2021 shall be Three Hundred Forty-One Dollars and Thirty-Five Cents ($341.35) for Rate Equalization and Three Dollars and Sixty Cents ($3.60) for base Groundwater Production Assessment for a Total Municipal Groundwater Assessment of Three Hundred Forty-Four Dollars and Ninety-Five Cents ($341.35 + $3.60= $344.95) per acre-foot of water.

Section 2: The Agricultural Groundwater Assessment for calendar year 2021 shall be Five Dollars and Fifty-Three Cents ($5.53) per acre-foot of water.

Section 3: The Domestic Groundwater Assessment for calendar year 2021 shall be Forty-Six Dollars and Fifty Cents ($46.50) per Domestic Use Unit.

Section 4: The rate for sales of Stream-Delivered Water for calendar year 2021 shall be Twenty-Three Dollars ($23.00) per acre-foot of water.

Section 5: The rate for sales of Out-Of-District Water shall be the cost of water designated under the purchase contract PLUS a charge up to the New Melones Conveyance System wheeling rate of Twenty-Seven Dollars and Eighty-One Cents ($27.81) per acre-foot of water.

Section 6: This ordinance shall take effect thirty (30) days after its final passage, and shall be published at least once in a newspaper of general circulation within fifteen (15) days after its final passage, with the names of the members of the Board of Directors voting for and against the same.

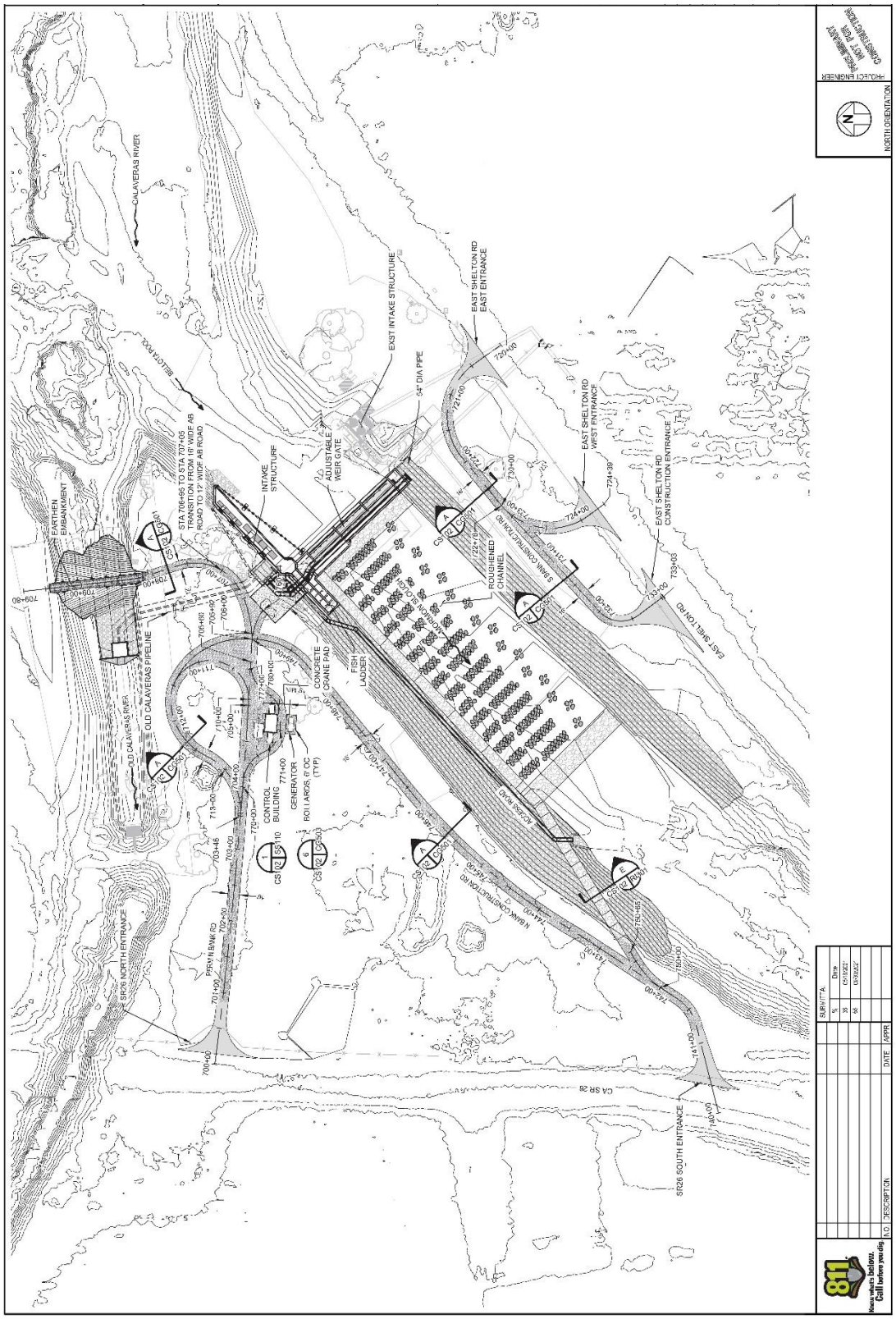
AYES: Atkins, Cortopassi, McGaughey, McGurk, Panizza, Sanguinetti, Watkins
NAYES: None
ABSTAIN: None
ABSENT: None

Andrew Watkins, President
Board of Directors

ATTEST:

Scot A. Moody, Secretary
Board of Directors

Attachment 6 – Bellota Fish Screen and Passage Improvement Project Site Plan



Attachment 7 – 2021 Flashboard Dam Removal Correspondence

From: Justin Hopkins
To: Monica Gutierrez - NOAA Federal; McKibbin, Chris@Wildlife; "Patrick Cuthbert"
Cc: Scot A. Moody (smoody@sewd.net)
Subject: SEWD Fall Dam Removal
Date: Monday, September 20, 2021 7:56:00 AM
Attachments: 2021 Dam Removal Schedule.pdf

Good morning all,

The Stockton East Water District's (District) Board of Directors approved staff's proposed flashboard dam removal schedule (attached) for the District's facilities located in Potter Creek, Mormon Slough, Calaveras River, and Mosher Creek. District staff have already begun coordination efforts with FISHBIO to facilitate implementation of the HCP requirements. Please feel free to reach out to me with any questions or if you need additional information.

Have a nice day,

Justin M. Hopkins, P.E.
Assistant General Manager
Stockton East Water District
O: 209-444-3150
F: 209-948-4219

Attachment 8 – 2021 Fish Notch Closure Correspondence

From: Monica Gutierrez - NOAA Federal
To: Justin Hopkins
Cc: McKibbin, Chris@Wildlife; Jim Inman
Subject: Re: Bellota and Mormon Slough Dam Installation
Date: Thursday, April 1, 2021 12:49:11 PM

Thank you for the update.

On Thu, Apr 1, 2021 at 12:17 PM Justin Hopkins <JHopkins@sewd.net> wrote:

> Good afternoon Monica and Chris,
>
> The District received approval of our time variance request from the Central Valley Flood Protection Board (Board). With the Board's approval, the District is authorized to begin dam installation today, however I do not expect the District to be reasonably ready to begin the Bellota dam work any earlier than Monday, April 5. The Bellota dam and other flashboard dam installations are contingent upon completion of the precursory work by FISHBIO and approval of the District's Verification Request Forms.
>
> Have a nice day,
>
> - Justin M. Hopkins
>
> ---
>
> **From:** Jim Inman <jiminman@fishbio.com>
> **Sent:** Wednesday, March 31, 2021 12:34 PM
> **To:** Monica Gutierrez <Monica.Gutierrez@noaa.gov>; McKibbin, Chris@Wildlife <chris.mckibbin@wildlife.ca.gov>
> **Cc:** Justin Hopkins <JHopkins@sewd.net>
> **Subject:** Bellota and Mormon Slough Dam Installation
>
> Hello,
>
> Just letting you know on behalf of Stockton East Water District, that the 8ft Bellota dam and the downstream flashboard dams will be going in beginning April 13 and completed by April 30. The District will follow protocol establish within the CHCP and provide fish passage openings in the flashboard dams in Mormon Slough. Please let me know if you have any questions.

Regards,

Jim Inman

Wildlife Biologist

FISHBIO
jiminman@fishbio.com
O: (209) 847-6300
C: (209) 988-2314
www.fishbio.com

--
Monica Gutierrez | Fisheries Biologist
San Joaquin River Branch
California Central Valley
NOAA Fisheries | West Coast Region
U.S. Department of Commerce
650 Capitol Mall, Suite 5-100, Sacramento, CA 95814
916-930-3657 (Office) | 916-201-3259 (Cell)
Monica.Gutierrez@noaa.gov

During the COVID-19 pandemic, I am on mandatory telework. I may be working flexible hours to balance family and personal needs. I appreciate your patience if my response time is delayed. If you have a request, please specify important time frames or deadlines. I will do my best to respond accordingly. Because I have limited ability to retrieve mail, please send any formal correspondence that would normally be sent through the physical mail to ccvo.consultationrequests@noaa.gov. Thank you.

From: Monica Gutierrez - NOAA Federal
To: Justin Hopkins
Subject: Re: Fish Notches
Date: Tuesday, May 11, 2021 11:42:56 AM

Hi Justin,

Considering the increase in temperatures, I think that should be fine to close the notches by May 14th.

On Tue, May 11, 2021 at 11:34 AM Justin Hopkins <JHopkins@sewd.net> wrote:

> Good morning Monica,
>
> The District ended up receiving our full New Hogan allocation, so I did not proceed with a formal District request to close the Mormon Slough flashboard dams' fish notches very early. We are approaching the goal date of May 15th, identified in the HCP as being about the appropriate time to close the fish notches. Since May 15th is a Saturday and my operations team will not be fully staffed, I would like to begin closing the fish notches as early as tomorrow and complete fish notch closures, in a downstream order, by Friday, May 14th. The attached rotary screw trap (RST) data from FISHBIO includes catches at the Shelton Road bridge from January 1 through May 10. As evident from the data, the last group of age 1+ out migrating fish were captured in early April. FISHBIO's and the District's opinion is that the fish captured in early April should have had enough time to out migrate by now and closure of the fish notches will not impact any further out migration.
>
> Please let me know if NMFS is amendable to the proposed fish notch closure dates so I can coordinate the corresponding operational changes with my staff.
>
> Thanks and have a nice day,
>
> - Justin M. Hopkins

Attachment 9 – Calaveras Fish Group Agendas

MEETING
Wednesday November 4, 2020
10:00 AM – 12:00 PM

Join Microsoft Teams Meeting

+1 916-573-2034 United States, Sacramento (Toll)

Conference ID: 719 014 476#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

DRAFT AGENDA

ITEM	LEAD	TIME
1. Introductions, agenda review, and meeting goal	Randy	10:00 – 10:10
2. DWR/SEWD Agreement	Randy/Austin/Justin	10:10 – 10:15
3. Updates/Priorities	All	10:15 – 10:30
4. Hosie Low-water Crossing Replacement Update	Randy/Austin/Justin	10:30 – 10:40
5. Bellota Weir Update	Justin	10:40 – 11:00
6. HCP Overview and Discussion	Justin/FishBio	11:00 – 11:25
7. Above Bellota Opportunities	Matt/Jacob	11:25 – 11:50
8. Action Items/Wrap up/Next Meeting Date	All	11:50 – 12:00

MEETING

Thursday February 4, 2020
10:00 AM – 12:00 PM

Join Microsoft Teams Meeting

+1 916-573-2034 United States, Sacramento (Toll)

Conference ID: 481 998 00#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

DRAFT AGENDA

ITEM	LEAD	TIME
1. Meeting Goal, Agenda Review, and Introductions	Jacob/Randy	10:00 – 10:15
2. Announcements and Project Updates	By Agency/ Organization	10:15 – 10:45
3. Above Bellota Proposed Project	Austin	10:45 – 10:55
4. Low Flow Discussion	Jim/Randy	10:55 – 11:15
5. Paired Managed Watershed Data Exploration (Mokelumne/Calaveras)	Jacob	11:15 – 11:35
6. Open Discussion	All	11:35 – 11:50
7. Action Items/Wrap up/Next Meeting Date	All	11:50 – 12:00

QUARTER 2 MEETING

Thursday May 6th, 2021
10:00 AM – 12:00 PM

Join Microsoft Teams Meeting

+1 916-573-2034 United States, Sacramento (Toll)

Conference ID: 168 642 669#

Local numbers | Reset PIN | Learn more about Teams | Meeting options

DRAFT AGENDA

ITEM	LEAD	TIME
1. Introductions	Randy	10:00 – 10:05
2. Agenda Review, Meeting Goals, and SharePoint Site Overview	Jacob	10:05 – 10:10
3. Project Updates	By Agency/ Organization	10:10 – 10:50
4. Calaveras River Anadromous Fish Monitoring Program	Patrick	10:50 – 11:20
5. Opportunities for Expanding the Fishery and Production	Matt	11:20 – 11:30
6. Open Discussion	All	11:30 – 11:50
7. Action Items/Wrap up/Next Meeting Date	All	11:50 – 12:00