Stockton East Water District
Calaveras River Habitat Conservation Plan

Appendix C

Stockton East Water District
Project Operations

Project Operations conducted by Stockton East Water District (SEWD) which are covered in the Calaveras River Habitat Conservation Plan (CHCP) are discussed in greater detail below and include:

1. New Hogan Reservoir Non-Flood Control Operations
2. SEWD Old Calaveras River Headworks Facility Operations
3. SEWD Bellota Diversion Facility Operations
4. Artificial Instream Structures and SEWD Small Instream Dam Operations
5. Privately Owned Diversion Facilities Operated within the District's Service Areas
6. SEWD Channel Maintenance for Instream Structures
7. Fisheries Monitoring Program

In the following sections, Project Operations are frequently discussed in relation to their occurrence during either the irrigation or non-irrigation season; therefore, these seasons are defined as follows:

- The irrigation season is contingent on the water conditions both of the prior year and projections of the upcoming year. A decision as to the water year classification (i.e. Dry or Normal/Wet) for operation will be made solely by the District based on available information.
  - Dry Season Determination - Irrigation season begins on or proximally after March 15 and ends on or before October 15 dependent on weather.
  - Normal/Wet Season Determination - Irrigation season begins on or proximally after April 15 and ends on or before October 15 dependent on weather.
- Non-irrigation season begins on or about October 16 and ends on or about April 14, dependent on weather.

In addition, there are two non-Project Operations (i.e., USACE New Hogan Reservoir Flood Control Operations and Podesta Reservoir Operations) that are not covered as part of this HCP, but are discussed below due to their influence on Project Operations.

1. New Hogan Reservoir Non-Flood Control Operations

During non-flood control periods, operational releases from New Hogan Reservoir are called for by the Watermaster, SEWD, as authorized by the contract between the Bureau of Reclamation (Reclamation), Calaveras County Water District (CCWD), and SEWD. The contract gives SEWD the exclusive right to determine the rate of release of water from the water supply pool in accordance with the water rights described below. The USACE determines releases when the water level rises above the top of the water supply pool and into the flood control pool (see Section 1.3 for USACE reservoir operations). The contract for water supply (Contract No. 14-06-200-5057A) specifies the priority of water uses in the following section of the contract:

> ***Reservoir Operation-Use of Water by Districts***
> 4.(a) Acting through the USACE District Engineer, at the request of the Watermaster, the United States shall store, regulate and/or release all flows of the Calaveras River at New Hogan for the purpose of making available agricultural, municipal, and industrial, and domestic water for use by the Districts. Such storage, regulation, and release of water shall be subordinate only to the storage and release of water for flood control, as conclusively determined by the USACE District Engineer; maintenance of a storage basin of fifteen thousand (15,000) acre-foot capacity for silting and storage of water for recreational and incidental uses, including recreational use on United States lands adjacent to the Reservoir; and to release of the portion of the unregulated runoff in the Calaveras River which is passed through New Hogan as it occurs in recognition of prior downstream water rights entitlements.

Releases for irrigation and municipal water are in accordance with daily requirements determined by the joint management of SEWD and CCWD. The volume of the release at New Hogan Lake varies during different times of the year and from year to year depending on the amount of rainfall. Releases during the irrigation season generally range from 75-250 cfs. During the non-irrigation season, releases requested by SEWD may range from 20-85, and additional instream flows may occur as a result of inflows from tributaries below New Hogan Dam or from flood control releases made by the USACE.

During the irrigation season, SEWD diverts releases through the Old Calaveras River Headworks Facility, Mosher Creek Headworks Control Structure, the Bellota Weir slide gates, and the Bellota Diversion Facility to accommodate agricultural users in the Old Calaveras River channel, Mosher Slough/Creek, Mormon Slough, and Potter Creek, respectively. Although diversions into Potter Creek are typically made through the Bellota Diversion Facility, water may also be delivered to Potter Creek through a pump located on Mormon Slough approximately one mile downstream of the Bellota Weir or through the Peters Pipeline from the New Melones System. Water is also diverted through the Bellota Diversion Facility to the Dr. Joe Waidhofer Water Treatment Plant (WTP) for municipal and industrial (M&I) users and groundwater recharge.

During the non-irrigation season, SEWD diverts releases through the Bellota Diversion Facility and into the WTP for M&I users and groundwater recharge. SEWD may also divert a small portion (i.e., about 15-35 cfs) of natural tributary inflows into the Old Calaveras River channel for groundwater recharge. Otherwise, natural inflows and/or flood control releases flow past Bellota into Mormon Slough.

1.1 SEWD Water Supply Allocation

Each year, SEWD considers the amount of stored water in the New Hogan Reservoir, availability of water from New Melones Reservoir, and the anticipated demand for water and makes a decision around April 1 as to the schedule for deliveries of water from New Hogan Reservoir. As water supply is reduced below 84,100 acre-feet (AF) or less in New Hogan Reservoir, SEWD restricts diversions to meet CCWD requirements, minimum contract requirements, and riparian users. There are no riparian allocations on the Old Calaveras River channel, only on the Calaveras River and Mormon Slough.

<u>Availability of water from New Melones Reservoir</u>
In 1983, in furtherance of the legislative direction to acquire additional surface water supplies to replenish the critically overdrafted groundwater basin, SEWD contracted with Reclamation for 75,000 AF of water from New Melones Reservoir on the Stanislaus River to be used for agricultural and M&I purposes in SEWD's service area. Conveyance facilities were constructed between New Melones Reservoir and the WTP. Since completion of SEWD's conveyance facilities in 1993, Reclamation has not always fulfilled its obligations under the contract for delivery of water requested by SEWD. The most water delivered to SEWD pursuant to its contract is 34,400 AF (46%) in 1998[1]. Over the past 13 years, SEWD has received an average of 11.5 % of its contractual entitlement. Unfortunately, the water supply from the Stanislaus River is very unreliable, which has made the Calaveras River SEWD's sole reliable source of surface water for its M&I and agricultural customers.

<u>Diversion schedules and rates</u>
The following tables indicate typical diversion schedules and rates under different water year type conditions. Water year types are based on the accumulated inflow after October 1 of the previous calendar year, where above normal/wet is >84,000 AF, and below normal/dry/critical year is <84,000 AF. Table C-1 depicts past average delivery schedules and diversions rates for both normal/wet year and dry year operations.

Table C-2 illustrates SEWD's water management operations including New Hogan Reservoir releases under a typical above normal year condition. During a representative above-normal water year (i.e., water year 2000-2001), SEWD maintained an average release below New Hogan Dam of 161 cfs during April through October and 39 cfs during November through March.

[1] Reclamation allocated SEWD its full contractual supply in water years 2006, 2010-2013 and 2016.

Table C-1. SEWD water treatment plant and agricultural diversion rates for above normal/wet year and below normal/dry/critical year operation scenarios. Source: SEWD.

Time Period	Average Diversion Amounts
Above Normal/Wet Years Operations	
November 1 through March 31	20-50 cfs daily for M&I* use
April 1 through October 31	20-70 cfs daily for M&I use
April 1 through October 31	75-250 cfs daily for agricultural use
Below Normal/Dry/Critical Years Operations	
November 1 through March 31	0-50 cfs daily for M&I* use
April 1 through March 31	0-70 cfs daily for M&I use
April 1 through March 31	75-250 cfs daily for agricultural use

* M&I = Municipal and Industrial

Table C-2. SEWD water management under above normal year conditions, water year 2000-2001. Codes are WTP = SEWD water treatment plant; NHG = New Hogan; AG = Agriculture use AF = acre-feet; cfs = cubic feet per second.

Month/Year	NHG Reservior Storage (AF)	Average NHG Release (cfs)	NHG Release Range (cfs)	WTP Average Production (cfs)	WTP/NHG Average (cfs)	WTP/NEW Melones Average (cfs)	AG Average Usage (cfs)
Oct 2000	155,420	87	47-163	61	47	14	40
Nov 2000	151,851	37	34-54	58	14	44	23
Dec 2000	150,812	36	33-42	54	6	48	30
Jan 2001	150,307	44	36-65	44	23	21	21
Feb 2001	153,716	41	36-51	40	24	18	17
Mar 2001	169,793	38	27-60	47	26	21	12
Apr 2001	184,014	133	51-188	53	53	0	80
May 2001	183,670	181	140-205	64	16	48	165
Jun 2001	173,070	206	161-235	66	8	57	198
Jul 2001	159,844	196	155-219	67	7	61	189
Aug 2001	146,445	197	163-215	66	6	60	191
Sep 2001	133,057	160	98-218	65	8	57	152
Oct 2001	122,991	54	21-110	64	15	49	39
Ave. Apr-Oct		161		64	16	47	145
Ave. Nov-Mar		39		49	19	30	21

Table C-3 illustrates SEWD's New Hogan Reservoir operations under drought conditions. During a representative drought water year (i.e., water year 1990-1991), SEWD maintained an average of 77 cfs during April through October and an average of 7 cfs during November through March.

Table C-3. New Hogan Reservoir operations under drought conditions, water year 1990- 1991. Codes are WTP = SEWD water treatment plant; NHG = New Hogan; AG = Agriculture; AF = acre-feet; cfs = cubic feet per second.

Month/Year	NHG Reservior Storage (AF)	Average NHG Release (cfs)	NHG Release Range (cfs)	WTP Average Production (cfs)	AG Average Usage (cfs)
Oct 1990	20,138	48	5.3-51	29	15
Nov 1990	17,027	25	3.0-50	19	0
Dec 1990	15,590	4	3.4-6.6	0	0
Jan 1991	15,259	3	1.3-3.6	0	0
Feb 1991	15,074	1	1.1-1.5	0	0
Mar 1991	15,648	4	1.0-25	20	0
Apr 1991	55,108	2	0.8-2.3	7	0
May 1991	59,115	82	1.2-259	31	51
Jun 1991	54,402	99	36-294	45	54
Jul 1991	47,722	103	31-245	46	57
Aug 1991	40,348	101	37-279	49	52
Sep 1991	33,266	92	27-280	48	44
Oct 1991	27,352	60	32-71	43	17
Ave. Apr-Oct		77	0	38	39
Ave. Nov-Mar		7	0	8	0

1.2 USACE New Hogan Reservoir Management for Flood Control

During the flood control season, the USACE operates the reservoir based on the USACE Water Control Plan, which includes a Flood Control Diagram and portions of a Water Control Manual. In 2002, the USACE consulted with NOAA Fisheries under Section 7 of the ESA. NOAA Fisheries issued a Biological Opinion for flood control operations; therefore, the USACE's operations are not included as part of the District's covered activities and incidental take permit request. However, information pertaining to the USACE's flood control operations is provided in the CHCP because it influences the parameters under which SEWD operates New Hogan Dam during non-flood control periods.

Flood control operations by the USACE occur when the storage in New Hogan exceeds the flood control space required at any particular time as determined under the authorized Flood Control Diagram. The maximum water conservation storage capacity of the reservoir is 317,100 AF, with a maximum flood control reservation of 165,000 AF. The Water Control Manual designates both required reserved flood control volume and allowable water conservation storage volume. Space reserved in the reservoir for flood control increases linearly from zero on October 1 to a maximum of 165,000 AF by November 30. From November 30 to December 31, a minimum flood reservation pool of 165,000 AF is required. From January 1 through March 20, as much as 165,000 AF of flood control space may be required, depending on a precipitation index of basin wetness. After March 20, flood control space decreases linearly to zero as early as May 8 or as late as June 9, depending on the precipitation index of basin loss rate (USACE 2001). Table C-4 is a brief summary of allowed water conservation.

As noted, between January 1 and June 8 of each year, the allowable storage varies depending on the amount of seasonal rainfall received to date that year. If conservation storage is not drawn down to the allowable 152,000 AF by December 1 in each year, flood control releases are undertaken to reach that level. Similarly, large seasonal rainfall amounts (greater than 12 inches) require that the 152,000 AF allowable storage amount remain in effect until March 20 before greater storage volumes would be allowed in such a wet year, and flood control releases are made throughout the rainy season to achieve this storage amount. The rate of change of release is restricted to a maximum of 2,000 cfs in any two-hour period (USACE 1981).

Table C-4. New Hogan Reservoir allowable water conservation. AF indicates acre-feet.

Time Period	Allowable Storage
June 8 through September 30	Up to 317,100 AF
October 1 through December 1	Linearly reduced from 317,100 to 152,000 AF
December 1 through January 1	152,000 AF
January 1 through March 20	Depending on rainfall quantities, linearly increased from 152,000 to 217,100 AF
March 20 through June 8	Depending on rainfall quantities, linearly increased from 152,000 to 317,100 AF

The USACE uses a Microsoft Excel spreadsheet model on an hourly basis when flood control operations are likely. During these periods, allowable water conservation storage figures are calculated to determine if and when flood control releases should be made.
The USACE operates the New Hogan Dam whenever flood control is required, and SEWD's General Manager is 'watermaster' during all other times of the year.

Deviations from the standard operating criteria have been made in the past during periods of drought and for environmental purposes. During the 1976-1977 drought, SEWD received permission from the USACE to use water from new Hogan's 15,000 AF minimum pool, and the pool was subsequently reduced to 11,178 AF (USACE 2001). The USACE also approved two other petitions, once in water year 1995-1996 and again in 1998-1999. Both petitions granted SEWD to carry-over additional storage, if available, for release during fall and winter.

The USACE has stated that future requests for water supply deviations will not likely be approved. The South Pacific Division stated that a permanent change to the Water Control Plan should be made if additional water supply can be made available without a decrease in project flood control benefits (USACE 2001). Depending on the magnitude of the reallocation of flood control space, changes to the Water Control Plan occur either at USACE Headquarters, or through Congressional reauthorization (USACE 2001).

In 2005, the USACE Sacramento District informed SEWD that its operating procedures allow a deviation over conservation storage from 7.5 to 15% based on current year hydrology. This is in keeping with the USACE Water Control Manual, which states that one of the specific objectives of the operation of New Hogan is to provide the maximum practical amount of conservation storage without impairment of other New Hogan functions.

2. SEWD Old Calaveras River Headworks Facility Operations

The Old Calaveras River Headworks Facility (Headworks Facility) is located at about RM 24 via the Old Calaveras route and began operating around 1949 to provide water during the irrigation season for agricultural diverters in the Old Calaveras River channel.

The Headworks Facility consists of four concrete culverts with 4-foot square openings and slide gates on the upstream end of the Old Calaveras River channel (Figure C-1). SEWD operates two of the four slide gates during the irrigation season to control flows down this channel which has a severely restricted capacity (i.e., approximately 100 to 150 cfs) due to the channel's small cross section and dense bank overgrowth. The slide gates are closed during New Hogan flood control operations to prevent high flows from entering the channel, which may lead to increased potential for flooding. Likewise, the slide gates are closed whenever Podesta Reservoir spills into the Old Calaveras River channel to prevent flooding[2].

In addition to providing water for irrigation, SEWD operates the slide gates to provide groundwater recharge, which generally occurs whenever natural inflows are available between November and June, unless Podesta Reservoir is spilling. Flows diverted for groundwater recharge are limited to approximately 15 cfs in order to prevent flows in the Old Calaveras River channel from reaching the confluence with the mainstem.

[2] Podesta Reservoir is a small privately-owned reservoir that lies in a small drainage basin just north of the Old Calaveras River channel approximately one mile downstream of Bellota. Podesta Reservoir operations are not included as part of the District's covered activities since it is not within the District's service areas. However, information pertaining to Podesta Reservoir operations is provided in the CHCP because it influences the parameters under which SEWD operates the Headworks Facility. Podesta Reservoir stores local run-off for irrigation purposes, but during the winter may contribute flows in excess of its approximate 3,000 AF capacity to the Old Calaveras River channel which increases the potential for flooding within the channel. There are no flow controls on the Podesta Reservoir so spills occur whenever run-off exceeds its storage capacity. There are also no structures to transport water from the Old Calaveras River channel back into the reservoir.

3. SEWD Bellota Diversion Facility Operations

The Bellota Diversion Facility, which consists of the Bellota Diversion and Bellota Weir, is located at RM 24 via the Mormon Slough route. The Bellota Diversion and associated Bellota Weir began operating in 1978 and 1967, respectively, to provide year-round water supplies for SEWD's M&I treatment plant and to augment irrigation supplies during the irrigation season. Since 1978, when SEWD began diverting water at the Bellota Diversion, low but sustained flows have been provided year-round above Bellota in most years.

The Bellota Diversion (Figure C-2) is located just upstream of the Bellota Weir and downstream from the Calaveras Headworks. The diversion is an unscreened, gravity-fed intake that delivers water to SEWD's M&I water supply system year-round as needed, as well as to agricultural diverters in Potter Creek during the irrigation season. The diversion has a maximum intake conveyance of approximately 75 cubic feet per second (cfs) whenever the 8-foot Bellota Weir is installed and about 60 cfs whenever the temporary, 2-foot weir is installed (A. Lozano, SEWD personnel, pers. comm., 2004). However, with the addition of the new Peters Pipeline to SEWD's infrastructure, and fish screens installed on the Bellota intake, diversion rates may fluctuate more often than in the past, but are not likely to exceed these maximums.

The Bellota Weir, located at the top of Mormon Slough immediately downstream of the split between the slough and the Old Calaveras River channel/Calaveras River Headworks, is a removable check dam (i.e., flashboards and stanchions). During the irrigation season (generally October 15-April 15), the height of the weir is increased to 8-ft (Figure C-3) in order to provide the hydraulic head needed for SEWD to divert Calaveras River water into the Bellota intake for use in Potter Creek and the WTP, or into the Headworks Facility for use in the Old Calaveras River channel. In addition, flow control slide gates are installed on the face of Bellota Weir to divert flow into Mormon Slough. An order of the Reclamation Board allows SEWD to install the 8-foot high flashboards at the Bellota Weir March 20 and requires their removal before October 10. In practice, the Bellota Diversion is typically installed on or about April 15 and removed on or about October 15. In years when irrigation demand is earlier than normal due to dry, warm conditions, SEWD obtains variances from the Reclamation Board to install the dam a few days earlier than allowed by the order.

Upon removal of the 8-ft flashboard dam from the upstream edge of the Bellota Weir, SEWD typically replaces it directly with a 2-ft temporary dam and fish ladder (see Figure C-1.1 in Attachment C-1). However, whenever reservoir storage exceeds 152,000 AF on October 15 and results in high, fall flow releases, then installation of the temporary dam and fish ladder may be delayed until December. The temporary dam is installed to provide the hydraulic head needed for SEWD to divert Calaveras River water either into the Bellota intake for SEWD's WTP, or into the Headworks Facility for groundwater recharge in the Old Calaveras River channel[3]. The fish ladder is installed to maximize upstream fish

[3] The 2-foot dam is sufficient to create enough head for water diversion needs during the non-irrigation season, but is not sufficient to meet water demands during the irrigation season.

passage opportunities from the pool on the apron of Bellota Weir to areas above Bellota. Criteria for operating the fish ladder have been established and details are provided in Attachment C-1.

For the Bellota Weir, installation or removal of the flashboard dam can take anywhere from 1½ to 2½ days and flows must be less than 3 inches at the weir site for safety of SEWD personnel. In order to achieve this flow level, releases from New Hogan are reduced to between 20-25 cfs about 48 hours prior to installation/removal. These reduced flows are then maintained throughout the installation/removal process. Also, during years when sediment maintenance is required in front of the Bellota intake, reduced flows are maintained for an additional 24 hours.

4. Artificial Instream Structures and SEWD Small Instream Dam Operations

There are 28 flashboard dams (25 owned and operated by SEWD, and three owned by the County but operated by SEWD), two earthen dams (one owned and operated by SEWD, and one privately owned but operated by SEWD), and one headgate dam (owned and operated by SEWD) located within the areas covered under the CHCP (Table C-5). Twelve removable flashboard dams are located along Mormon Slough/Stockton Diverting Canal (SDC); eight removable flashboard dams in the Old Calaveras River channel; five removable flashboard dams in Mosher Creek including one combination flashboard/diversion dam; three removable flashboard dams and one earthen dam in Potter Creek; one earthen dam in the Calaveras River above Bellota; and one headgate dam located at the junction of the Old Calaveras with Mosher Creek (see map in Attachment C-2).

Table C-5. Instream Structures operated and/or maintained by SEWD; ownership varies between SEWD, San Joaquin County (County), or private landowners. Instream structure types include culvert crossing (CC), low flow crossing (LFC), earth dam, slide gate, headgate, and flashboard dam (FD), and diversion dam (DD). Channel locations include Calaveras River mainstem between Bellota and New Hogan Dam (CR), Old Calaveras River (OCR), Mosher Creek (MCR), Mormon Slough (MRS), Stockton Diverting Canal (SDC), and Potter Creek (PC).

Structure Name	Channel	River Mile	Structure Type	Ownership
Gotelli Crossing	CR	35.3	CC	Private
William Crossing	CR	33	LFC	Private
Robie Crossing	CR	32.9	CC	Private
McGurk Earth Dam	CR	27.1	Earth Dam	Private
Sitkin Crossing	CR	27.1	CC	Private
Wilson Crossing	CR	28	LFC	Private
Wilson Diverting Channel	CR	28	LFC	Private
Calaveras River Headworks	OCR	25.9	Slide Gate	SEWD
Mosher Creek Dam	OCR/MCR Junction	21.6 (OCR)	Headgate	SEWD
Clements Dam	OCR	21.5	FD	SEWD
Tully Dam	OCR	17.9	FD	SEWD
Eight Mile Dam	OCR	15	FD	SEWD
Murphy Dam	OCR	12.5	FD	SEWD
Pezzi Dam	OCR	12.1	FD	SEWD
Solari Dam	OCR	10.1	FD	SEWD
Cherryland Dam	OCR	7.9	FD	SEWD
McAllen Dam	OCR	6.9	FD	-
Bellota Water Intake Structure	MRS	25.1	FD/Slide Gate	SEWD
Watkin Crossing	MRS	16.9	LFC	SEWD
Motoike Dam (aka, Hwy 26 Flashboard Dam or Flashboard Dam #3)	MRS	16.6	FD	SEWD
Fine Road Dam	MRS	15.6	FD	SEWD
Avansino Dam	MRS	14.4	FD	SEWD
Hosie Dam	MRS	13.4	FD	SEWD
Hosie Crossing	MRS	13.2	LFC	SEWD
Bonomo Dam	MRS	12.2	FD	SEWD
Piazza Dam	MRS	12	FD	SEWD
Prato Dam	MRS	10.4	FD	SEWD
McClean Dam	MRS	8.5	FD	SEWD
Lavaggi Dam	MRS	7.5	FD	SEWD
Panella Dam	MRS	6.6	FD	SEWD
Main Street Dam	MRS	4.9	FD	SEWD
Budiselich Dam	SDC	2.1	FD	SEWD
Cotta-Ferreira Concrete Crossing	MCR	11.74	FD	SEWD
Lyons Dam	MCR	14.7	FD	County
Leffler Dam	MCR	10.2	FD	County
Bear Creek Diversion	MCR	12.9	FD/DD	County
Cotta-Ferreira Dam	MCR	11.8	FD	SEWD
Billingmeier Dam	PC	3.6	FD	SEWD
Motoike Dam #2	PC	1.4	FD	SEWD
Sanguinetti Dam	PC	-	FD	SEWD
Kennedy Earth Dam	PC	4.7	Earth Dam	SEWD
Machado Crossing	PC	1.0	LFC	SEWD
Motoike Low Water Crossing	PC	6.5	LFC	Private

4.1 Flashboard Dams

Flashboard dams generally have a permanent concrete foundation and a set of removable wooden flashboard planks (Figure C-4). SEWD generally operates flashboard dams during the irrigation season to assist privately owned diversions, but some flashboard dams are also occasionally operated through late fall for groundwater recharge.

Due to flood control considerations, the Reclamation Board has established installation and removal dates for flashboard dams within Mormon Slough, but there are no such timing requirements for flashboard dams in the remaining non-flood control channels (i.e., Old Calaveras and Potter, Mosher, Bear creeks). In Mormon Slough, the Reclamation Board allows SEWD to install flashboard dams beginning April 15, with the exception of Bellota Weir and Budiselich Dam, which may be installed earlier than April 15 and requires their removal by November 1. In some years, when irrigation demand is earlier than normal, SEWD obtains variances from the Reclamation Board to install the other flashboard dams earlier than allowed by the order.

Flashboard dams in the Old Calaveras and Potter, Mosher, Bear creeks are generally installed and removed at the same time as those in Mormon Slough. However, in some years, flashboards are left in place in these latter waterways through November for percolation benefits.

Installation or removal of individual flashboard dams within these channels takes approximately three to four hours each, with the exception of Eight Mile Dam which can take up to 2½ days to complete. Installation typically occurs when the channels are already dry and no flow changes are necessary.

4.2 Flashboard Diversion Dam

Approximately a quarter mile east of Alpine Road on Mosher Creek, San Joaquin County constructed a diverting canal from Mosher Creek to Bear Creek with gates to prevent flow into Mosher Creek for flood control. During the irrigation season, SEWD installs a 4-foot flashboard diversion dam, Bear Creek Diversion Dam, and opens the gates to allow flows from the Old Calaveras River into Mosher Creek for irrigation and recharge. The dam prevents water entering the Bear Creek diverting canal and Bear Creek during the irrigation season. After the irrigation season, the gates at Mosher Creek are closed, the dam is removed, and Old Calaveras River diversions into Mosher Creek are stopped.

During wet years, SEWD can divert water into Bear Creek for the North San Joaquin Water Conservation District irrigation and increased recharge. Water is allowed to flow over the diversion dam and siphons can be installed to increase the amount of water diverted to Bear Creek.

4.3 Earthen Dams

The McGurk Earthen Dam (Figure C-5), also called levees by the SEWD, consists of two dams at the bottom of a large pool below Old Dog Ranch. The McGurk levees are operated annually to divert water from the Calaveras River. At times, these levees have required repairs in order to mitigate for damages caused by elevated flows in excess of 3,000 cfs resulting from freshet events or flood control releases. The levees (dams) have been washed away/eroded by large flows in 2011 and 2015.

Figure C-5. McGurk Earthen Dam, approached from a large pool below Old Dog Ranch.

4.4 Headgate Dam

During the irrigation season, SEWD operates Mosher Creek Dam (Figure C-6)- a small headworks control structure with a slidegate- to divert water from the Old Calaveras River channel into Mosher Creek for irrigators along the creek. During the winter, the control structure is closed for flood control. There is no mechanism to actively divert water from Mosher Creek into the Old Calaveras River channel. Mosher Creek and the channel immediately north, Bear Creek, flow into Fourteen Mile Slough which then flows into the Sacramento-San Joaquin Delta. Woodbridge Irrigation District diverts water from Bear Creek to Mosher Creek at HWY 99 to provide irrigation water for their customers, which keeps that stretch of the creek connected to Fourteen Mile Slough during the irrigation season. Like the Old Calaveras River channel, Mosher Creek is dry when there is no flow from surface run-off events. Except during major flood events, neither creek typically provides upstream access from the San Joaquin River.

Figure C-6. View from upstream of Mosher Creek Dam during water delivery season.

In October 2003, several adult salmon were observed in Mosher Creek near its intersection with the Southern Pacific Railroad. It is believed that these fish were able to gain access to this location due to a combination of (1) SEWD's operation of a recharge test in an existing storm retention basin adjacent to State Highway 99 and Mosher Creek using flows diverted from the Old Calaveras River channel, and (2) the City of Stockton's operation of a recharge test in an existing retention basin just upstream of the Southern Pacific Railroad using flows diverted from the Mokelumne River into Mosher Creek via the Woodbridge Irrigation District distribution system. SEWD may use the retention basin in the future, but only with available water supply.

5. Privately Owned Diversion Facilities Operated within the District's Service Areas

There are a total of 194 small, privately owned diversions identified throughout the District's CHCP Service Areas and an additional 53 diversions may exist according to CDFW (CDFG 2006). Between New Hogan and Bellota Weir, SEWD serves 35 privately owned irrigation diversions above Bellota; one screened and 34 unscreened (Table C-6). Additionally, 52 have been identified in the Mormon Slough; 61 in the Old Calaveras River; 22 in Mosher Creek; 24 in Potter Creek, as well as additional sites in Bear Creek. Specifics on known privately owned irrigation diversions in these areas are provided below (Table C-6).

Table C-6. Privately owned diversion facilities operated within the District's Service Areas in the Calaveras River. Source: SEWD files, CH2M Hill 2005, and CDFG 2006. Codes: [a] indicates estimated value; [b] indicates screened diversion; and "-" indicates unknown. Grey shaded cells were calculated estimates.

CDFG Diversion No.	SEWD Diversion No.	District Service Area	Channel	River Mile	Diversion Type	hp Rating	Intake Size (inches)	1999 Pump Flow Value (cfs)
U092919A	C-3	SEWD	CR	31.5	Centrifugal	40	9	3[a]
U092918D	C-4	SEWD	CR	31.4	Slant	40	12	3.34
U092919B	C-2	SEWD	CR	31.3	Centrifugal	40	8	1.78
U092918C	C-5	SEWD	CR	30.9	Centrifugal	60	14	6.68
U092918B	C-6	SEWD	CR	30.5	Vertical	25	12	2.23
U092918A	C-9	SEWD	CR	30.1	Slant	50	8	6.68
U092919G	C-8A	SEWD	CR	30	Vertical	50	10	2.01
U092919H	C-10	SEWD	CR	30	Centrifugal	75	8	2.9
U092920A	C-13	SEWD	CR	29	Centrifugal	30	8	1.23
U092917A	C-13A	SEWD	CR	27.8	Vertical	-	16	3.79
U092916G,H	C-14	SEWD	CR	27	Vertical	10	48	5.79
U092920C	C-15	SEWD	CR	27	Vertical	15-25 est.	14	3.34
U092920D	C-16	SEWD	CR	26.4	Vertical	60	14	3.34
U092916F	C-17	SEWD	CR	26.3	Vertical	75	14	3.34
U092921A	C-18A,B,C,D	SEWD	CR	25.9	Vertical	30	16	8.91
U092921C	C-19A	SEWD	CR	25.4	Centrifugal	-	14	3.34
U092921B	C-19	SEWD	CR	25.4	Centrifugal	40	8	2.31
U092916E	C-20	SEWD	CR	25.1	Slant	20	14	1.44
U092820G	CR-1B	SEWD	OCR	24.8	Vertical	-	10	3
U092820H	CR-1A	SEWD	OCR	24.8	Vertical	75	13	3.5
U092820F	CR-1A	SEWD	OCR	24.8	Vertical	40	12	3
U092820E	CR-1	SEWD	OCR	24.4	Vertical	25	12	4.5
U092820C	CR-2	SEWD	OCR	24	Vertical	30	16	4.5

CDFG Diversion No.	SEWD Diversion No.	District Service Area	Channel	River Mile	Diversion Type	hp Rating	Intake Size (inches)	1999 Pump Flow Value (cfs)
U092820D	CR-3	SEWD	OCR	24	-	-	8	1.7
U092820B	CR-5	SEWD	OCR	23.6	Vertical	10	8	1.5
U092819G	CR-6	SEWD	OCR	23	Centrifugal	15	8	1.74
U092819H	CR-5	SEWD	OCR	22.8	Vertical	30	9	2.2
U092819C	CR-8	SEWD	OCR	22.4	Vertical	40	12	3
U092819B	CR-7	SEWD	OCR	22.4	Vertical	5	8	1
U092818B	CR-11	SEWD	OCR	22.3	Vertical	5	9	1.5
U092818C	CR-10	SEWD	OCR	22.2	Centrifugal	25	6	0.5
U092819F	CR-9	SEWD	OCR	22.2	Vertical	15	14	4.5
U092819D	CR-11A	SEWD	OCR	22.1	Vertical	15	13	3.5
U092817D	CR-13	SEWD	OCR	21.8	Screwgate	-	-	-
U092817E	CR-15	SEWD	OCR	21.6	Vertical	15	13	3.5
U092817C	CR-17	SEWD	OCR	21.4	Slant	7.5	10	1.9
U092817B	CR-18	SEWD	OCR	21.3	Centrifugal	10	4	0.2
U092818A	CR-14	SEWD	OCR	21.2	Vertical	50	14	4.5
U092816D	CR-19	SEWD	OCR	21.2	Vertical	10	10	2.7
U092817A	CR-21B,C,D	SEWD	OCR	21	Slidegate	-	28	21.3
U092816B	CR-22	SEWD	OCR	20.9	Centrifugal	-	10	1.9
U092816C	CR-23	SEWD	OCR	20.8	Vertical	15	12	3
U092816A	CR-24	SEWD	OCR	20.5	Vertical	-	8	1
U092815B	CR-27	SEWD	OCR	20.3	Vertical	-	10	1.9
U092815A	CR-28	SEWD	OCR	20.1	Vertical	-	10	1.9
U092521B	CR-30	SEWD	OCR	19.8	Vertical	20	12	3.9
U092521C	CR-30	SEWD	OCR	19.8	Centrifugal	25	8	1.7
U092521D	CR-30	SEWD	OCR	19.8	Centrifugal	-	-	-
U092521E	CR-31	SEWD	OCR	19.7	Centrifugal	15	12	3
U092521A	CR-32	SEWD	OCR	19.5	Centrifugal	30	6	0.5
U092520E	CR-32A	SEWD	OCR	19.3	Centrifugal	20	6	0.5
U092520D	CR-31A	SEWD	OCR	18.8	Centrifugal	7.5	8	1
U092520B	CR-32C	SEWD	OCR	18.4	Vertical	25	8	1
U092520C	CR-32B	SEWD	OCR	18.4	Vertical	10	10	1.9
U092520A	CR-33	SEWD	OCR	18.2	Vertical	15	13	3.5
U092519C	CR-34	SEWD	OCR	18.1	Centrifugal	7.5	8	1
U092519B	CR-35	SEWD	OCR	17.6	Centrifugal	20	6	0.5
U092519A	CR-36	SEWD	OCR	17.4	Vertical	-	10	1.9
U092518E	CR-38	SEWD	OCR	17.1	Vertical	20	12	3
U092518D	CR-39A	SEWD	OCR	16.8	Vertical	5	12	3
U092518C	CR-40	SEWD	OCR	16.7	Centrifugal	10	6	0.5

CDFG Diversion No.	SEWD Diversion No.	District Service Area	Channel	River Mile	Diversion Type	hp Rating	Intake Size (inches)	1999 Pump Flow Value (cfs)
U092518B	CR-42	SEWD	OCR	16.6	Centrifugal	10	8	1
U092518A	CR-44	SEWD	OCR	16.1	Centrifugal	10	8	1
U092517C	CR-44A	SEWD	OCR	15.9	Centrifugal	25	8	1
U092517D	CR-45	SEWD	OCR	15.7	-	-	8	1
U092517B	CR-46	SEWD	OCR	15.4	Centrifugal	15	16	6.5
U092517E	CR-47	SEWD	OCR	15.3	Vertical	15	12	3
U092517A	CR-48	SEWD	OCR	15.1	Centrifugal	10	7	0.7
U092516B	CR-49	SEWD	OCR	15	Centrifugal	-	6	0.5
U092516A	CR-52	SEWD	OCR	14.5	Centrifugal	15	8	1
U092321E	CR-51	SEWD	OCR	14.4	Vertical	25	18	8.5
U092321D	CR-63A	SEWD	OCR	14.3	-	-	-	-
U092515D	CR-52A	SEWD	OCR	14.3	Vertical	15	12	3.9
U092515C	CR-55	SEWD	OCR	14	Centrifugal	30	8	1
U092321C	CR-54	SEWD	OCR	13.9	Vertical	5	10	2.7
U092515A	CR-57	SEWD	OCR	13.8	Vertical	20	14	4.5
U092321B	CR-58	SEWD	OCR	13.5	Centrifugal	40	8	1
U092321A	CR-59	SEWD	OCR	13.3	Vertical	10	13	3.5
U092320H	CR-60	SEWD	OCR	13.2	Slant	7.5	9	1.5
U092320I	CR-61	SEWD	OCR	13	Centrifugal	-	8	1
U092320D	CR-63A	SEWD	OCR	12.5	Slant	5	12	3
U092320E	CR-63	SEWD	OCR	12.4	Centrifugal	-	8	1
U092320C	CR-62	SEWD	OCR	12.3	Vertical	5	8	1
U092320F	CR-66	SEWD	OCR	12.3	Slant	10	14	4.5
U092320B	CR-64	SEWD	OCR	12.2	Vertical	5	10	1.9
U092320A	CR-65	SEWD	OCR	12	Slant	7.5	10	2.7
U092319A	CR-69	SEWD	OCR	11.3	Vertical	25	13	3.5
U092319C	CR-71	SEWD	OCR	11.1	Vertical	30	10	1.9
U092821A	CR-28	SEWD	OCR	8.5	Centrifugal	-	6	1
U121516A	M-57	SEWD	MRS	-	Vertical	-	8	1
U121516B	M-56	SEWD	MRS	-	Centrifugal	-	10	2.7
U121516C	M-54A	SEWD	MRS	-	Slant	25	12	3.9
U121516D	M-51	SEWD	MRS	-	Centrifugal	-	10	1.9
U121516E	M-47	SEWD	MRS	-	Slant	20	12	3
U121516F	M-46	SEWD	MRS	-	Slant	25	9	1.5
U121517A	M-45	SEWD	MRS	-	Vertical	-	-	
U121517B	M-44	SEWD	MRS	-	Slant	30	14	4.5
U121517C	M-43	SEWD	MRS	-	Vertical	25	12	3
U121517D	M-40	SEWD	MRS	-	Centrifugal	10	10	1

CDFG Diversion No.	SEWD Diversion No.	District Service Area	Channel	River Mile	Diversion Type	hp Rating	Intake Size (inches)	1999 Pump Flow Value (cfs)
U121517E	M-43	SEWD	MRS	-	Centrifugal	30	12	3.9
U121517F	M-39	SEWD	MRS	-	Vertical	-	-	1
U121517G	M-38	SEWD	MRS	-	Centrifugal	-	8	0.5
U121518B	M-37D	SEWD	MRS	-	Vertical	-	8	3
U121518C	M-36	SEWD	MRS	-	Vertical	15	4	1
U121518D	M-37E	SEWD	MRS	-	Centrifugal	-	8	1
U121518E	M-37A	SEWD	MRS	-	Vertical	15	12	3
U121518F	M-37B	SEWD	MRS	-	Centrifugal	60	10	1.9
U121518G	M-37C	SEWD	MRS	-	Slant	30	12	3
U121518H	M-35	SEWD	MRS	-	Vertical	10	10	1.9
U121519A	M-31	SEWD	MRS	-	Centrifugal	7.5	8	1
U121519B	M-30	SEWD	MRS	-	Centrifugal	10	6	0.5
U121519C	M-33	SEWD	MRS	-	Centrifugal	50	8	1
U121519E	M-29A	SEWD	MRS	-	Centrifugal	-	7	0.7
U121519F	M-28	SEWD	MRS	-	Centrifugal	40	14	4.5
U121519G	M-27	SEWD	MRS	-	Centrifugal	7.5	8	1
U121519H	M-29	SEWD	MRS	-	-	-	-	-
U121520A	M-26	SEWD	MRS	-	Centrifugal	-	10	1.9
U121520B	M-25B	SEWD	MRS	-	Slant	15	10	1.9
U121520C	M-26B	SEWD	MRS	-	Centrifugal	20	6	1
U121520D	M-25A	SEWD	MRS	-	Centrifugal	30	13	3.5
U121520E	M-23	SEWD	MRS	-	Centrifugal	-	10	1.9
U121520F	M-22	SEWD	MRS	-	Centrifugal	20	12	3
U121520G	M-24	SEWD	MRS	-	Vertical	60	14	4.5
U121521A	M-21	SEWD	MRS	-	Centrifugal	-	12	3
U121521B	M-20	SEWD	MRS	-	Centrifugal	15	10	1.9
U121521C	M-19	SEWD	MRS	-	Vertical	-	12	3
U121521D	M-16	SEWD	MRS	-	Centrifugal	40	7	0.7
U121521E	M-13	SEWD	MRS	-	Centrifugal	50	-	-
U121521F	M-18B	SEWD	MRS	-	Centrifugal	15	6	0.5
U121521G	M-18	SEWD	MRS	-	Vertical	15	10	1.9
U121521H	M-17	SEWD	MRS	-	Vertical	15	12	3
U121521I	M-15	SEWD	MRS	-	Vertical	40	12	3
U121521J	M-14	SEWD	MRS	-	Centrifugal	20	7	0.7
U121521K	M-15	SEWD	MRS	-	Centrifugal	20	6	3
U121522A	M-11A	SEWD	MRS	-	Vertical	60	12	3
U121522B	M-48	SEWD	MRS	-	Vertical	-	8	1
U121522C	M-49	SEWD	MRS	-	Centrifugal	-	8	1

CDFG Diversion No.	SEWD Diversion No.	District Service Area	Channel	River Mile	Diversion Type	hp Rating	Intake Size (inches)	1999 Pump Flow Value (cfs)
U121523A	M-50	SEWD	MRS	-	Vertical	15	10	1.9
U121523B	M-52	SEWD	MRS	-	Centrifugal	-	7	0.7
U121523C	M-54	SEWD	MRS	-	Slant	15	8	1
U121523D	M-55	SEWD	MRS	-	Vertical	-	12	3
U121716A	M-11	SEWD	MRS	-	Vertical	-	12	3
U121716B	M-9	SEWD	MRS	-	Vertical	-	10	1.9
U121716C	M-8	SEWD	MRS	-	Centrifugal	30	9	1.5
U121716D	M-7	SEWD	MRS	-	Centrifugal	40	8	2
U121716E	M-5	SEWD	MRS	-	Centrifugal	20	10	1.7
U121716F	M-5B	SEWD	MRS	-	-	-	6	0.5
U121717C	M-4	SEWD	MRS	-	Slant	75	10	1.9
U121717D	M-1	SEWD	MRS	-	Vertical	10	8	1
U121717E	M-2	SEWD	MRS	-	Centrifugal	30	10	1.9
U121717F	M-6	SEWD	MRS	-	Centrifugal	-	8	1
U121717G	M-10	SEWD	MRS	-	Vertical	30	6	0.5
W092915D	MS-3	SEWD	MCR	-	Centrifugal	PTO	7	1
W092915E	MS-3A	SEWD	MCR	-	Centrifugal	-	6	1
W092915F	MS-2	SEWD	MCR	-	-	-	8	-
W092915G	MS-3B	SEWD	MCR	-	Slant	-	14	-
W092916A	MS-5	SEWD	MCR	-	Vertical	20	12	3.9
W092916B	MS-4	SEWD	MCR	-	Centrifugal	15	6	1
W092916D	MS-6	SEWD	MCR	-	Vertical	10	12	3.9
W092916E	MS-7	SEWD	MCR	-	Vertical	15	10	2.7
W092916F	MS-7A	SEWD	MCR	-	Vertical	10	10	2.7
W092917B	MS-8	SEWD	MCR	-	Vertical	-	10	2.7
W092917C	MS-9A	SEWD	MCR	-	Vertical	7.5	12	3.9
W092917E	MS-11A	SEWD	MCR	-	Centrifugal	15	12	3
W092918A	MS-8A	SEWD	MCR	-	Centrifugal	30	10	2.7
W092918C	MS-9B	SEWD	MCR	-	Vertical	10	6	1
W092918D	MS-12	SEWD	MCR	-	Centrifugal	15	16	0.5
W092918E	MS-13	SEWD	MCR	-	Vertical	-	8	1.7
W092918F	MS-14	SEWD	MCR	-	Centrifugal	20	12	0.7
W092919B	MS-14B	SEWD	MCR	-	Vertical	25	8	1.7
W092919C	MS-15	SEWD	MCR	-	Vertical	10	12	3
W092920A	MS-18	SEWD	MCR	-	Vertical	14	14	5.3
W092920C	MS-22B	SEWD	MCR	-	Vertical	20	12	3.9
W092920D	MS-22A	SEWD	MCR	-	Vertical	10	10	2.7
W092920E	MS-21	SEWD	MCR	-	Centrifugal	25	6	1

CDFG Diversion No.	SEWD Diversion No.	District Service Area	Channel	River Mile	Diversion Type	hp Rating	Intake Size (inches)	1999 Pump Flow Value (cfs)
W092920H	MS-22	SEWD	MCR	-	Vertical	7.5	10	2.7
W092921A	MS-23	SEWD	MCR	-	Centrifugal	25	8	1.7
-	PC-9A	SEWD	PC	-	Vertical	-	-	3.3
-	PC-8B	SEWD	PC	-	Vertical	-	-	2.5
-	PC-6	SEWD	PC	-	Trash Pump	-	-	0.2
-	PC-5	SEWD	PC	-	Vertical	-	10	2.7
-	PC-4	SEWD	PC	-	Vertical	-	-	3.1
-	PC-3	SEWD	PC	-	Centrifugal	-	6	2.7
-	PC-3B	SEWD	PC	-	Centrifugal	-	10	3.3
-	PC-3C	SEWD	PC	-	Vertical	-	6	4.2
-	PC-3A	SEWD	PC	-	Vertical	-	10	3.1
-	PC-2	SEWD	PC	-	Centrifugal	-	-	1.6
-	PC-10	SEWD	PC	-	Vertical	-	10	3.8
-	PC-11	SEWD	PC	-	Centrifugal	-	12	3.9
-	PC-1A	SEWD	PC	-	Centrifugal	-	-	-
-	PC-1	SEWD	PC	-	Centrifugal	-	6	1
-	PC-4a	-	-	-	Vertical	-	8	3.1
-	PC-13	-	-	-	Vertical	-	10	3.1
U092819A	-	SEWD	OCR	22.4	Centrifugal	15	6	1
U092818D	-	SEWD	OCR	22	Centrifugal	20	6	1
U092320G	-	SEWD	OCR	12.3	Centrifugal	-	10	2.7
U092319D	-	SEWD	OCR	11.7	Slant	7.5	10	2.7
U092318E	-	SEWD	OCR	9.9	Centrifugal	-	10	2.7
U092318A	-	SEWD	OCR	9.2	Centrifugal	-	8	1.7
U092318B	-	SEWD	OCR	9.2	-	-	6	1
U092318D	-	SEWD	OCR	9.1	Centrifugal	-	4	0.43
U092318C	-	SEWD	OCR	9.1	Centrifugal	-	8	1.7
U092317D	-	SEWD	OCR	8.8	-	-	8	1.7
U092821B	-	SEWD	OCR	8.5	Centrifugal	-	8	1.7
U092317G	-	SEWD	OCR	8.4	Slant	-	9	2.2
U092317E	-	SEWD	OCR	8.3	Centrifugal	10	6	1
U092317F	-	SEWD	OCR	8.3	Centrifugal	-	-	-
U092317H	-	SEWD	OCR	7.8	Centrifugal	7.5	8	1.7
U092317C	-	SEWD	OCR	7.8	Centrifugal	10	9	2.2
U092317I	-	SEWD	OCR	7.7	Centrifugal	10	9	2.2
U092317B	-	SEWD	OCR	7.7	-	-	12	3.9
U092317A	-	SEWD	OCR	7.5	Vertical	-	12	3.9
U092316G	-	SEWD	OCR	7.3	Vertical	7.5	12	3.9

CDFG Diversion No.	SEWD Diversion No.	District Service Area	Channel	River Mile	Diversion Type	hp Rating	Intake Size (inches)	1999 Pump Flow Value (cfs)
U092316F	-	SEWD	OCR	6.8	-	-	-	-
U092316E	-	SEWD	OCR	6.6	Vertical	9.5	12	3.9
U092316D	-	SEWD	OCR	6.5	Vertical	10	12	3.9
U092316C	-	SEWD	OCR	6.2	-	-	12	3.9
U121519D	-	SEWD	MRS	-	Centrifugal	-	10	2.7
U121717A	-	SEWD	MRS	-	Vertical	30	14	5.3
U121717B	-	SEWD	MRS	-	Slant	50	20	-
U121718A	-	SEWD	MRS	-	-	-	8	1.7
R041815D	-	SEWD	CR	2.4	Vertical	-	14	5.2
R041815C	-	SEWD	CR	2	-	-	12	3.9
R041817A	-	SEWD	CR	2	-	-	10	2.7
R041815B	-	SEWD	CR	1.2	Vertical	40	12	3.9
R041815A	-	SEWD	CR	1.2	Centrifugal	1	3	0.24
R041814E	-	SEWD	CR	0.6	Vertical	10	12	3.9
R041817B	-	SEWD	CR	0.6	Centrifugal	-	6	1.15
R041817C	-	SEWD	CR	0.6	Centrifugal	-	6	1
R041814D	-	SEWD	CR	0.2	Vertical	5	8	1.7
W092915H	-	SEWD	MCR	-	Vertical	-	8	1.7
W092916C	-	SEWD	MCR	-	Centrifugal	7.5	10	2.7
W092917A	-	SEWD	MCR	-	Vertical	7.5	10	2.7
W092917D	-	SEWD	MCR	-	Vertical	15	10	2.7
W092918B	-	SEWD	MCR	-	Centrifugal	-	6	1
W092919A	-	SEWD	MCR	-	Submersible	-	8	1.7
W092920F	-	SEWD	MCR	-	Centrifugal	-	4	0.43
W092920G	-	SEWD	MCR	-	Centrifugal	-	2	0.1
W092921B	-	SEWD	MCR	-	Vertical	7.5	12	3.9
W092922A	-	SEWD	MCR	-	Centrifugal	7.5	8	1.7
R050218A	-	SEWD	MCR	-	Siphon	-	16	5.2
R050218B	-	SEWD	MCR	-	Centrifugal	-	13	3.9
R050218C	-	SEWD	MCR	-	Siphon	-	14	3.9
R050218D	-	SEWD	MCR	-	Vertical	10	14	3.9
R050218E	-	SEWD	MCR	-	Vertical	15	16	5.2
R050219A	-	SEWD	MCR	-	Siphon	-	14	3.9

Diversions are one of six different types:

1. Centrifugal pumps (a.k.a., suction pumps; Figure C-7) typically have a pump motor and impeller on the bank with a pipe or hose that extends into the water. If the pump impeller is above the water surface, it needs to be "primed" before water will flow. Pipes typically have a "foot valve" at the bottom of the pipe to keep the pipe/pump "primed."
2. Vertical pumps (Figure C-7) have a motor on a platform that is attached to a shaft inside a straight section of pipe. The shaft turns an impeller (propeller) at the bottom end of the pipe section (underwater). These pipes usually have a flared pipe section below the impeller. Usually, vertical pumps are seen on pump platforms over the water surface.
3. Slant pumps (Figure C-7) are virtually the same as vertical pumps, but the straight section of pipe below the pump motor is slanted along the bank slope. Slanting the pipe along the bank is usually done to avoid having to build a pump platform. Since the pipe enters the water at a slant, there must be a deep hole to pump water at the base of the slope.
4. Siphon diversions consist of a pump that initially primes the water into a pipe but once started, a siphon requires no additional energy to keep the liquid flowing up and out of the river.
5. Submersible pumps may either be submerged underwater or underground at the level of the water table and pump water to a diversion pipe.
6. Slide gates are gravity-fed diversions where a valve is opened to release water built up behind the structure (Figure C-1).

Figure C-7. Representative pump facilities: centrifugal pump (left), slant pump (center), and vertical pump (right). Source: CDFG 2006.

Diversion facilities range in intake size from 2-48 inches diameter (average= 10 inches) and known capacities range from 1-10 cfs. Diversions occur only as needed generally from mid-April through mid-October, which is typically twice a month for 5-10 days. During these diversion periods, pumps may operate in a variety of different patterns (e.g., continuously, during daylight hours only, a few hours each day, or during non-peak power periods) depending on various factors such as weather, size of diversion and irrigated acreage, and type of crop.

SEWD serves approximately 168 private landowners with irrigation water from the Old Calaveras River channel, Mosher Creek, Potter Creek, and Mormon Slough/Stockton Diverting Canal channels. Individual diversions below Bellota have not been inventoried so specific information is unavailable; however; diversions are expected to be within the same flow capacity range (i.e., 1-10 cfs) as those identified above Bellota by CH2M Hill (2005). Water is delivered to the Old Calaveras River channel via the Headworks Facility (see number 4 above); Mosher Creek via a small headworks control structure; Potter Creek via Potter Creek intake pumps or outlets from the Bellota or Peters Pipeline; and Mormon Slough via Bellota Weir slide gates. When water supplies are exceptionally low, these channels are mostly dry and diverters resort to pumping groundwater to meet their irrigation demands.

6. SEWD Channel Maintenance

SEWD performs channel maintenance as needed on numerous structures including diversion dikes (flashboard or earthen dams), road and low water crossings; and intake structures with slide gates and trash racks (Attachment C-2). Routine channel maintenance becomes necessary whenever debris is deposited in these areas due to high flow events and may include: (1) debris removal, (2) sediment removal, (3) vegetation control, (4) repair of previous erosion control work, (5) minor erosion control work, and (6) riprap placement using heavy equipment and/or manpower, and (7) bridge washing and painting within the stream zone.

Maintenance is conducted during authorized timeframes specific to each structure and generally occurs when flows recede enough to access and remove debris (Attachment C-2). Debris is removed using a backhoe or boom truck that is stationed either on the streambank or on the crossing itself when debris is too far to reach from the streambank. Details regarding routine channel maintenance activities for individual structures are provided in a Routine Maintenance Agreement (RMA) between SEWD and CDFW (Attachment C-2).

Non-routine channel maintenance activities include removing sediment at the entrance of Bellota and reconstruction of McGurk Earth Dam. Whenever flow events occur that are greater than 4,000-5,000 cfs, sediments can build up at the entrance to the Bellota intake structure which need to be removed. In addition, McGurk Earthen Dam can wash out during high flows and need to be re-built. Sediment removal and re-construction of the McGurk Earthen Dam is conducted in conjunction with the installation of the flashboards at the Bellota Weir during April and usually takes one to two days to complete. If these maintenance activities need to take place, it usually takes about 4-5 days of reduced flows (i.e., 20-25 cfs released from New Hogan Dam) to complete these activities combined with flashboard installation at Bellota.

7. Fisheries Monitoring Program

Currently, limited data exists on the number and life-history variations of salmonids in the Calaveras River. The Fisheries Monitoring Program (Monitoring Program) consists of two study components (juvenile salmonid migration and adult salmonid migration monitoring) that will establish baseline data and provide current data throughout the term of the ITP regarding salmonid presence, relative abundance, and migrational behavior, as well as, environmental and/or anthropomorphic conditions that affect salmonid production in the Calaveras River.

The baseline data collected during this Monitoring Program will be used to help assess the benefits of any recommended fish screens or passage improvements that are constructed on the Calaveras River as a result of ongoing screening and passage evaluations. In addition, this Monitoring Program will provide resource managers on the Calaveras River with sufficient data to make informed adaptive management decisions for sustained native fishery management.

Juvenile Salmonid Migration

An evaluation of juvenile salmonid downstream migration will be conducted each year at Shelton Road using a rotary screw trap (RST). The primary purpose of the RST monitoring is to characterize juvenile salmonid downstream migration within the lower Calaveras River, including (1) temporal patterns during migration; (2) annual estimated number of migrants by lifestage; (3) condition factor; (3) effects of environmental factors on migration timing, migration rate, and survival; and (4) effects of water management operations on migration timing, migration rate, and survival. See attached *Calaveras River Juvenile Salmonid Migration Monitoring Program* (Attachment C-3) for details of the sampling plan.

Adult Salmonid Migration

Monitoring of adult salmonid migrants will be conducted at the Bellota Weir ladder using either a Vaki Riverwatcher system or a video recording system, and/or by portable resistance board weir at an undetermined site between November and March each year. In addition to direct adult migrant monitoring, seasonal snorkel surveys may be conducted to characterize fish assemblages in the river between Bellota and New Hogan as described under Section 7.2(a) of the CHCP. Snorkel surveys may provide supplementary information regarding adult salmonid migrants. The need for snorkel surveys would be determined through the AMP process identified in Chapter 9 of the CHCP.

These adult monitoring efforts will provide information regarding relative abundance, migration timing, percentage of hatchery strays (i.e., ad-clipped fish), size, sex, and influence of environmental conditions on migration timing of adult migrants. In addition, if authorized to collect scale and otolith samples, these samples would provide information regarding age and maternal origin for determining stock structure.

REFERENCES

CDFG [California Department of Fish and Game]. 2006. Calaveras River water diversions/barriers inventory including Mormon Slough and Mosher Creek/Slough. Diversion/barrier data files created for CDFG Fish Screen and Fish Passage Project. CD-Rom provided to Michele Simpson (CFS) by Katie Witts (CDFG).

CH2M Hill. 2005. Calaveras River Fish Screen Facilities Feasibility Study. Prepared for Stockton East Water District and Calaveras County Water District. Prepared by CH2M Hill, Sacramento, CA.

USACE [U.S. Army Corps of Engineers]. 1981. New Hogan Fishery Investigation, California. Reconnaissance Report, March 1981.

USACE. 2001. Information Paper Section 7 Consultation: New Hogan Dam and Lake Project.

Attachment C-1
Interim Bellota Fish Ladder Operating Criteria

Due to flood control concerns and the current configuration of the Bellota Weir, no permanent fish passage structures have previously been installed at the Bellota Weir location. In recent years, temporary fish ladders have been used to increase upstream migrating salmonid passage opportunities during low flow conditions. These temporary fish ladders will continue to be used during the majority of the non-irrigation season (i.e., typically October 15 through April 15) until a permanent fish passage solution at Bellota is implemented.

At the end of the irrigation season, SEWD removes the 8-foot flashboard dam from the upstream edge of the Bellota Weir and replaces it with a 2-foot temporary dam and fish ladder (Figure C-1.1). The temporary dam is installed to provide the hydraulic head needed for SEWD to divert Calaveras River water either into the Bellota intake for the Dr. Joe Waidhofer Water Treatment Plant (WTP), or into the Old Calaveras River channel for groundwater recharge purposes, while the fish ladder is installed to maximize upstream fish passage opportunities from the pool on the apron of Bellota Weir to areas above Bellota.

Most of the temporary dam consists of flashboards supported by temporary braces placed within stationary anchors. However, a row of sandbags extends approximately 10-15 feet from the flashboards to the left bank (looking upstream; Figure 1). This sandbag area acts as a pressure regulator during moderately increasing flows (i.e., whenever increasing flows begin to exert too much pressure on the temporary dam, the sandbags are dislodged first, which relieves stress on the remaining structure and prevents the loss of flashboards at moderately high flows). Under high flow conditions, sandbags and flashboards are dislodged. It is estimated that sandbags may be dislodged at 500± 250 cfs and flashboards may be dislodged at 800± 250 cfs (J. Yoshimura, SEWD personnel, pers. comm., 2004).

A second 2-foot temporary dam and fish ladder is also installed at the downstream side of the Bellota Weir apron (Figure C-1.1). This lower ladder was funded through the USFWS's AFRP and is installed to increase opportunities for upstream migrating fish to access the upper ladder. The lower ladder allows fish to pass over the initial portion of the weir structure and onto the apron of the weir at low flows. Migrating fish can then rest on the weir apron and orient themselves in the pool created behind the lower 2-foot dam before entering the upper ladder.

Even with both ladders installed at the weir, fish passage is not always available and is dependent on sufficient flows at the weir. Flows greater than 10 cfs are needed prior to opening the upper ladder due to diversion constraints (i.e., at least 10 cfs is required to maintain enough head for diversion to occur at Bel1ota). Also, continuous flows in the river between Bellota and the confluence with the San Joaquin River via the Mormon Slough route are needed to allow fish to reach the ladders at Bellota. Whenever fish passage over the weir is not possible (i.e., flows are less than 10 cfs and/or there are no continuous flows between Bellota and the San Joaquin River confluence[1]), a board is placed at the upstream edge of the upper fish ladder to essentially complete the 2-foot temporary dam and provide the hydraulic head needed for the diversion facility.

Figure C-1.1. Aerial view of Bellota Weir during the non-irrigation season when the ladders are installed including an upper temporary 2-foot dam consisting of flashboards and an associated denil fish ladder; and a lower temporary 2-foot dam consisting of flashboards and an associated denil fish ladder.

Whenever there is enough flow available (i.e., greater than 10 cfs and there are continuous flows between Bellota and the confluence), the board is removed from the upper ladder to provide fish passage. Also, at flows above 10 cfs, the removal of the board from the ladder does not interfere with maintaining enough hydraulic head to operate the diversion facility. In order to maximize the amount of low flows directed into the fish ladders, plastic sheeting will be placed on the upstream side of the flash boards to reduce leakage that occurs due to gaps in the flashboards.

[1] In the event that adult salmonids are observed in the pool below Bellota weir, the upper ladder may remain open regardless of current flow connectivity to the confluence (see specific operating criteria #4 for details).

Specific Operating Criteria. Once the temporary dams and ladders have been installed, the General Manager and the WTP Operator must determine when to remove the board from the upper ladder to allow for fish passage through the ladder and when to replace the board to allow for uninterrupted water diversion. This determination is based on several critical factors including:

1. **Is Mormon Slough flow continuous downstream from Bellota to the confluence with the San Joaquin River?**

   During the business week (Monday through Friday), SEWD personnel will perform daily visual observations at several road crossings between Main Street and Bellota to determine whether flows are continuous to the confluence.

2. **Is runoff from the Calaveras River across Bellota Weir and into Mormon Slough ≥10 cfs?**

   Each morning, SEWD personnel will review the instantaneous hourly readings at the Escalon-Bellota gauging station to determine whether flows into Mormon Slough are ≥ 10 cfs.

3. **Is runoff expected to be continuously ≥10 cfs for at least the next 24-hours?**

   The General Manager and WTP Operator on duty use their extensive knowledge of the Calaveras River system and personal judgment to determine runoff expectations over the next 24 hours. SEWD personnel determine the expected water balance at Bellota based on a variety of factors including, but not limited to, New Hogan releases, Cosgrove Creek flows, precipitation forecasts, recharge needs in the Old Calaveras, and diversion needs at Bellota.

4. **Are there indications of adult salmonids present in the pool below the Bellota Weir?**

   The Bellota pool extends approximately 50 yards downstream of the cement structure at the Bellota Weir. If flows are no longer continuous, but were continuous within the previous 24 hours, SEWD personnel will perform a visual inspection of the pool to determine whether adult salmonids are present.

If the answer to the above critical factor questions #1 through #3 are affirmative, then the board in the upper fish ladder will be removed. Whenever anyone of these three critical factor questions is answered in the negative, the board in the upper fish ladder will be either kept in place or re-installed unless the answer to question #4 is affirmative. Since negative responses to any of questions #1-3, in conjunction with a negative response to question #4, indicate inadequate upstream passage opportunities for fish in Mormon Slough, the replacement of the board at the ladder will not have a detrimental impact on upstream passage of salmonids at Bellota Weir.

If the answer to question #4 is affirmative at any time, SEWD (1) will notify NOAA Fisheries and CDFW; and (2) will remove the board in the upper ladder, as long as inflows greater than 10 cfs are available to operate the ladder, and regardless of whether flows are continuous between Bellota and the confluence. On the following day, the board will be re-installed in the upper ladder, unless there is evidence that adult salmonids arc still present below the weir. If adult salmonids are still present below the weir, NOAA Fisheries and CDFW will be notified. At this point, SEWD and NOAA Fisheries will cooperatively determine whether any additional actions are necessary with assistance from CDFW.

Maintenance Criteria. During high flow events, the flashboards, sandbags, and/or plastic sheeting may become dislodged and need to be replaced. Every effort wi1l be made to replace these items as soon as possible; however, replacement will be dependent on flows receding to a level that assures the safety of maintenance personnel. Once flows decrease to approximately 10 cfs any dislodged flashboards, sandbags, and/or plastic sheeting will be replaced. Replacement will only occur during daylight hours and will also be dependent on sufficient personnel being on-duty at the time (i.e., delays can be expected if conditions occur during holidays or weekends when insufficient personnel are on-duty).

Attachment C-2
Streambed Alteration Agreement
Notification No. 1600-2018-0106-R2
SEWD Routine Maintenance Agreement

Attachment C-3
Calaveras River Juvenile Salmonid Migration Monitoring Program

Currently, limited data exist on the abundance and life-history characteristics of salmonids in the Calaveras River, which makes it difficult to ascertain potential impacts on salmon and rainbow/steelhead trout resulting from various human activities and from the recently discovered introduction of New Zealand mud snails (NZMS) into the area. The information collected during the Calaveras River anadromous fish migration monitoring program will document baseline data regarding juvenile salmonid presence, abundance, and migration behavior, as well as identify the environmental and/or water management conditions that affect juvenile salmonids ability to migrate successfully out of the river and susceptibility to entrainment into unscreened diversions. Baseline fishery information is vital for resource managers to be able to develop appropriate conservation measures in order to successfully maintain and restore salmonid populations within the Calaveras River. In the future, the baseline data collected during this monitoring program will be used to assess the effectiveness of applied conservation measures, particularly the effectiveness of long-term solutions implemented at Bellota and the Old Calaveras River Headworks. In addition, the monitoring program will provide resource managers on the Calaveras River with data regarding fish populations to assist in making informed adaptive management decisions for sustained native fishery management.

We hypothesize that annual abundance of juvenile salmonids will increase relative to pre-conservation measure levels. The ability to detect a statistically significant difference between pre- and post-project abundance is based on the assumption that we can obtain a representative sample of biological information. Production levels of fish populations are naturally subject to annual variations regardless of the quality of the habitat. Production level variations can be caused by changes in environmental (climate, fire, etc.) and/or biological (primary production, disease, etc.) conditions. Therefore, we expect that future fish populations will fluctuate widely in annual abundance levels, but we also expect to observe higher mean levels of abundance than those prior to conservation measures being implemented.

The goal of the Project is to be able to estimate annual abundance levels and migration characteristics of juvenile salmonids in order to assess the effectiveness of future conservation measures and to provide information for adaptive management.

Our objectives are to: (1) monitor passage of *O. mykiss* with a rotary screw trap 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 and life-history preferences.

Our Null Hypotheses include:

1. Null hypothesis: There is no significant difference between average abundance prior to structural improvements and post-structural improvements.

2. Null hypothesis: There is no significant relationship between migration patterns and environmental variables (e.g., flow, temperature, and turbidity).

3. Null hypothesis: There is no significant correlation between level of smoltification and fish age (estimated by fork length).

4. Null hypothesis: There is no significant correlation between condition factor and environmental variables (e.g., flow, temperature, and turbidity).

GENERAL PLAN OF WORK

Objective 1: Monitor juvenile salmonid downstream migration with a rotary screw trap in the lower Calaveras River.

In order to evaluate salmonid relative abundance, migration timing, and life-history preferences, SEWD's biologists will sample migrating juvenile salmonids with a rotary screw trap in the Calaveras River at Shelton Road (RM 28). This site was chosen primarily due to the channel morphology in the area which allows the trap to operate more effectively.

Task 1.1 Monitor juvenile salmonid downstream migration with a rotary screw trap near Bellota during intermittent periods between November 1 and July 15 each year.

SEWD's biologists will monitor the migration characteristics (e.g., timing, age composition, etc.) and abundance of juvenile Chinook and *O. mykiss* as they migrate downstream in the Calaveras River during intermittent periods between November 1 and July 15 using a rotary screw trap. The trap will sample 24 hours per day for an average of 5 days per week dependent on flow conditions and personnel availability. During sampling, the trap will be monitored a minimum of once per day (may be increased dependent on flow changes or anticipated in-trap debris load) which includes processing all fish captured and clearing the live box of debris to ensure that (1) fish do not experience mortality or stress as a result of debris accumulation, and (2) the trap is not hampered by debris and is fishing properly. All fish captured will be identified to species, enumerated, and a sub-sample of salmon and *O. mykiss* will be measured (see Task 1.2).

All data will be collected on data sheets in the format used by the U.S. Fish and Wildlife Service (USFWS) throughout the Central Valley and will be collected in compliance with standards established in the CVPIA Comprehensive Assessment and Monitoring Program protocol. Copies of data sheets, summaries, and electronic computer files will be supplied to the National Marine Fisheries Service, USFWS, California Department of Fish and

Game, and other relevant resource agencies on a monthly basis or as requested by individual agencies during sampling and at the end of each sampling season.

Abundance Estimates

Estimates of *O. mykiss* relative abundance for the sampling season are calculated by first expanding the daily number of fish captured by the percentage of daily flow sampled through the trap:

$$N_e = \frac{V_d \left(3.14 * \frac{r^2}{2} \right)}{F_d}$$

where, N_e is the expanded daily number of fish, V_d is the daily velocity, r is the radius of the trap, and F_d is the daily flow measured at New Hogan Dam.

Then, with these expanded numbers, SEWD's biologists used a predictive regression equation and 80% confidence intervals to estimate the number of fish that would have been captured on those days that were not sampled (i.e., missing data) as follows:

Daily Missing Value = $\hat{y}$

where, $\hat{y} = \alpha + \beta X_h$ and X_h =missing day number

and, $CI_{(80\%)} = t_{\alpha/2;df} \sqrt{MSE\left(1 + \frac{1}{n} + \frac{(X_h - \overline{X})^2}{\sum (X_i - \overline{X})^2}\right)}$

where, X_i =sampled day number

The values for α and β for each block of missing values will be derived by using the daily estimated numbers for the three days prior to and immediately following the period of no sampling days. Missing data estimates will not be calculated for non-sampling periods extending greater than seven days. The total estimated number of fish migrating for a sampling season will then be calculated by adding all of the daily expanded numbers and daily missing value estimates.

In order to calculate more accurate abundance estimates, mark-recapture trap efficiency tests need to be performed and will be conducted throughout the study period (see Task 1.3). Because fish lengths may affect the efficiency of collection, the number of *O. mykiss* captured will be separated into two size classes (based on forklength; mm) prior to analyses: size class 1 (≤100 mm) and size class 2 (>100 mm). Daily abundance estimates for each size class will be calculated using Peterson's unbiased estimator equation:

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

where N=estimated number of migrants migrating downstream in the river.
M = number of migrants marked and released above the rotary-screw trap.
C = total number of migrants captured at the rotary-screw trap, and
R = number of marked migrants recaptured at the rotary-screw trap.

For days not sampled, we will use a predictive regression equation and 80% confidence intervals to estimate the number of fish that would have been captured on those days that were not sampled (i.e., missing data) as follows:

Daily Missing Value = $\hat{y}$
where, $\hat{y} = \alpha + \beta X_h$

and X_h =missing day number; and $CI_{(80\%)} = t_{\alpha/2;df} \sqrt{MSE\left(1 + \frac{1}{n} + \frac{(X_h - \overline{X})^2}{\sum (X_i - \overline{X})^2}\right)}$

where, X_i =sampled day number

The values for α and β for each block of missing values were derived by using the daily expanded numbers (N_e) for the three days prior to and immediately following the period of no sampling days. Missing data estimates were not calculated for non-sampling periods extending greater than 7 days. The total estimated number of fish migrating for a sampling season was then calculated by adding all of the daily expanded numbers and daily missing value estimates ($\sum Ne_i + \hat{y}_i$).

For statistical analyses, fish were separated into two different lifestage 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 the daily expanded numbers (N_e) of each lifestage and daily environmental parameters (flow, water temperature, and turbidity).

Condition Factor

The overall condition of *O. mykiss* captured will be calculated using Fulton's Condition Factor:

$$K = \left(\frac{W}{SL^3}\right) * 10^5$$

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

Task 1.2. Biosampling of salmonids and non-salmonids.

All fish captured will be identified to species and enumerated. All salmonids will be inspected for marks (e.g., adipose clips, fin clips, dye) and any adipose clipped salmonid(s) will be sacrificed for coded-wire tag retrieval. In addition, sub-samples of salmonids and non-salmonids will be measured and evaluated as follows:

Biosampling Salmonids. Forklengths (mm) will be measured for up to 50 randomly selected fish from each species within each size class and any additional Chinook or *O. mykiss* will be counted in respective size classes. Measured salmonids will also be evaluated for degree of smolting based on a scale ranging from 1 to 3 for Chinook (1 having no physical signs of smolting and 3 having obvious signs) and from 1 to 5 for *O. mykiss* (as described in the *O. mykiss* life-stage assessment protocol developed by the IEP Steelhead Project Work Team in 1998), inspected for overall physical condition, and weighed. Salmonids to be measured will be anesthetized with a solution of fresh river water and aspirin-free Alka-Seltzer tablets (carbon dioxide method for sedation). After processing, fish will be placed into buckets of fresh water to recover fully (at least 5 minutes) before being returned to the Calaveras River.

Biosampling Non-salmonids. After all salmonids have been processed, forklengths (mm) will be measured for up to 25 randomly selected individuals per non-salmonid fish species and any additional individuals will be counted. Measured non-salmonids will also be inspected for overall physical condition. Smaller non-salmonids (under 150 mm) to be measured will be anesthetized with a solution of fresh river water and aspirin-free Alka-Seltzer tablets (carbon dioxide method for sedation), and, after processing, will be placed into buckets of fresh water to recover fully before being returned to the Calaveras River. Larger non-salmonids will be kept in separate containers, measured, and then released back into the river.

Task 1.3. Conduct mark-recapture trap efficiency tests for use in calculating abundance estimates.

A photonic dye injection system will be used for marking trap efficiency release groups because of the high quality of marks and the ability to use the marking equipment in rapid succession. Juvenile *O. mykiss* (>30mm) will be tagged photonically using either a MadaJet (MADA Equipment Co., Inc., Carlstadt, NJ) or a Pow'r-ject injector (NewWest Technologies, Santa Rosa, CA) and Day-Glo Color Corporation (Cleveland, OH) tag solution. This solution was recommended by CDFW staff at the Merced River Hatchery and has been used to tag juvenile Chinook salmon for their studies since 1999.

For photonic dye efficiency marking on the screwtrap, we will conduct the following procedure: Upon removal from the livebox, *O. mykiss* will be roughly sorted by size and temporarily placed in 5-gallon buckets equipped with battery-operated aerators. All *O. mykiss* will be anesthetized; checked for marks and overall health; and up to 50 young-of-year (≤100 mm) and up to 50 Age 1+ (>100 mm) will be measured (forklengths and weights) and scale samples collected. Any previously marked fish will be placed in a 5-gallon bucket(s) containing fresh river water. A portion of unmarked *O. mykiss* (>30 mm) will receive a photonic mark. With the photonic marking method, a marker tip is placed against the caudal (top or bottom lobe), dorsal or anal fin and dye is injected into the fin rays. One mark will be applied to each fish and all fish in a group will receive the same mark, but the mark location will vary between groups so each group can be uniquely identified. Several different photonic dye colors can be used to differentiate the groups including blue, orange, yellow, pink, and green. The color used for efficiency releases will be coordinated with the regional CDFW biologist. According to the manufacturer, the photonic mark is visible for up to six months. Upon marking, marked fish will be placed immediately in an aerated cooler(s) containing fresh river water.

Immediately after all fish are processed and have recovered from anesthesia, the unmarked fish in the bucket(s) will be released downstream of the trap, and newly marked fish in the aerated cooler(s) will be transported to the trap efficiency release site a small distance upstream (approximately a half-mile above the trap). Upon arrival at the trap efficiency release site, marked fish will be released immediately.

Releases will be made by using a dip net to scoop up to10 fish at a time and place them in the river so they can swim away. After releasing a “net-full” of fish, we will wait 30 seconds to 3 minutes before releasing another “net-full” of up to 10 fish. This is the same release procedure used on the Stanislaus and Tuolumne rivers since 1995. Due to the confined channel morphology at the release site, marked fish are essentially evenly distributed across the width of the stream during release.

Objective 2. Monitor environmental variables that may influence timing, size, and number of migrants.

Both environmental and biological factors may influence the timing, size, and number of juvenile Chinook and steelhead trout migrating downstream in the Calaveras River. We will monitor environmental variables (e.g., flow, temperature, and turbidity) and use regression analysis to determine their potential influence on juvenile Chinook and *O. mykiss* migration.

SEWD’s biologists will record hourly water temperatures using thermographs placed in the lower Calaveras River approximately every five miles between New Hogan Dam and Mormon Slough. Thermograph data will be downloaded approximately monthly. SEWD’s biologists will also record instantaneous water temperature (°F), turbidity (nephelometric turbidity units; NTUs), conductivity (µS), dissolved oxygen (mg/L) and weather conditions each day at the trapping site. In addition, SEWD’s biologists will assemble relevant data on daily river flow and water quality collected by the USGS at stations below New Hogan Dam and by the USACE at New Hogan Dam and Mormon Slough.

Objective 3. Determine the influence of environmental and biological factors on migration characteristics of juvenile Chinook salmon and *O. mykiss* in the Calaveras River.

Data pertaining to number and size/age (at release) of salmonids along with environmental parameters will be summarized in charts, graphs, and tables. Depending on the hypothesis and distributional properties of the data, an appropriate statistical test will be applied to determine potential relationships or correlations between environmental (e.g., flow, temperature, turbidity), structural (e.g., flashboards installed or not installed, particularly at Bellota; combined crest gate/fishway/fish screen installed at Bellota), and biological (e.g., size/age at release, estimated size at detection based on growth curves) parameters and migration activity. The suite of likely candidate tests includes least squares regression, Student's *t*-test, Kolmogorov-Smirnov test, ANOVA, and the chi-squared test.

Deliverables:

1. Distribute weekly progress reports to various entities including resource agencies listed under Task 1.1 via e-mail newsletter. Weekly summaries will include a written description of project activities, as well as relevant tables, graphs, and photographs.

2. Distribute an annual summary to various entities including resource agencies listed under Task 1.1. The annual summary will include the study findings including estimates of juvenile migrant abundance for salmon and *O. mykiss* in the lower river; determination of migration duration and magnitude; indices of smoltification and length frequency distribution through time; differences in migration parameters between smolts and young-of-year; and relationship/non-relationship between migration patterns and environmental variables.