# 2017 Robles Fish Passage Facility
# Progress Report

Debris jam on lower San Antonio Creek created during the 18 February 2017 storm. A 102 cm *Oncorhynchus mykiss* redd was observed downstream of the jam prior to the storm event on 14 Feb 2017.

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## 1.0 EXECUTIVE SUMMARY

Casitas Municipal Water District (CMWD) is implementing the Robles Fish Passage Facility Project (Robles Fish Facility) described in the Proposed Action of the Bureau of Reclamation's Biological Assessment (BA); (USBOR 2003). The effects of the Robles Fish Facility were analyzed in the Biological Opinion (BO) prepared by the National Marine Fisheries Service (NMFS 2003a). This 2017 Robles Fish Passage Facility Progress Report, as described by the BO, is the culmination of monitoring, evaluation, and operational data collected during the reporting period of 01 July 2016 to 30 June 2017.

The monitoring and evaluation studies related to the Robles Fish Facility conducted during the 2016-2017 reporting period are included in two main sections of this progress report. The Fisheries Monitoring and Evaluation section includes: upstream fish migration, impediment evaluation, sandbar monitoring at the mouth of the Ventura River, fish attraction evaluation, fish passage monitoring, downstream fish passage evaluations, and downstream fish migration through the Robles Reach. The Facility Operation section includes: information and data on the facility status, flow observations and control, costs associated with operation and monitoring, assessment of the effectiveness to provide fish passage, recommendations of priorities for future activities, and revisions deemed necessary to the operations.

Significant precipitation occurred in the Ventura River Basin during the 2017 fish passage season. Four BO-defined storm events occurred that allowed data collection for the monitoring and evaluations of the Robles Fish Facility. The sandbar at the mouth of the Ventura River was open for the entire fish migration season and provided opportunity for steelhead passage through the lower mainstem Ventura River. Only 2 *Oncorhynchus mykiss* were detected passing through the Robles Fish Facility during the fish migration period of 2017.

## 2.0 GENERAL INTRODUCTION

The National Marine Fisheries Service (NMFS) listed the southern California steelhead, *Oncorhynchus mykiss*, as endangered in 1997 (NMFS 1997) under the Endangered Species Act (ESA, 16 U.S.C. § 1531 et. seq.) of 1973, as amended. Steelhead were organized into stocks (i.e., groups) of evolutionary significant units (ESU) that were considered to be substantially reproductively isolated from other steelhead stocks and were an important part of the evolutionary legacy of the species. The southern California steelhead ESU included, at that time, steelhead populations from the Santa Maria River in San Luis Obispo County south to Malibu Creek in Los Angeles County. The ESU was later extended to the US/Mexican border in San Diego County during 2002 (NMFS 2003b). In a later delineating approach, NMFS categorized the anadromous life history form of *O. mykiss* as a distinct population segment (DPS) as described under the ESA (NMFS 2005). The DPS policy differs from the ESU by delineating a group of organisms by "marked separation" rather than "substantial reproductive isolation" as originally listed. In the case of *O. mykiss* of the southern California steelhead ESU, this marked separation between the two life history forms was considered valid because of physical, physiological, ecological, and behavioral factors related to its anadromous life history characteristics. Both resident and anadromous *O. mykiss*, where the two forms co-occur and are not reproductively isolated, are still part of the ESU; however, the anadromous *O. mykiss* (i.e., steelhead) are now part of a smaller subset identified as the southern California steelhead DPS. Anadromous *O. mykiss* in the southern California DPS exhibit a winter-run life-history pattern during their spawning migrations; see life history discussion below.

Rainbow trout (*O. mykiss*) can be generally organized into four large groupings (Behnke 1992; Scott and Crossman 1973): 1) coastal rainbow trout that extend from northern Baja California to northern Alaska near the Kuskokwim River and also the Kamchatkan Peninsula of northeastern Asia, 2) redband trout of the inland Columbia and Frazer River basins, 3) redband trout of the central valley of California, and 4) trout of the Gulf of California drainages. The taxonomic group of coastal rainbow trout, *O. m. irideus*,

exhibit two life history forms; anadromous and resident. The common name for the anadromous life history form is “steelhead trout” and the resident form are “rainbow trout”. Throughout the range of coastal rainbow trout, the anadromous life history form is widespread (Behnke 1992). There are two general life-history patterns exhibited by adult anadromous steelhead when they return from the ocean to spawn in fresh water. The patterns are grouped by either summer or winter spawning runs. There are many exceptions to this pattern, but this general characterization has been used to group steelhead runs by the season in which the peak spawning occurs as they return from the ocean (Busby et al. 1996). Summer steelhead are generally found in river systems that drain from farther inland, such as the Columbia River basin. Winter-run steelhead are typically found in the coastal systems where river systems are smaller. The winter-run pattern is the more common of the two anadromous life histories within the natural range of the species (Busby et al. 1996).

*Monitoring and Research of the Robles Diversion and Fish Passage Facility*

As stated in the BO (NMFS 2003a), the “Modifications to the Robles Diversion Facility and associated operation criteria have been targeted at improving fish passage conditions within the Robles Reach of the Ventura River while maintaining suitable conditions through the Fish Passage Facility.” The monitoring and evaluation studies and activities related to the modification of the Robles Facility, as outlined in the BO (NMFS 2003a), were intended to achieve three main objectives:

I. Monitor Fish Passage Facility operations and performance.

II. Determine if the Fish Passage Facility functions and operates in such a fashion that migrating steelhead:
    a. Successfully navigate into and through the facility, and
    b. Move through the facility in good physical condition.

III. Determine if the operations at the Robles Diversion are enhancing the opportunity for:
    a. Adult steelhead to migrate upstream to the Robles Facility, and
    b. Smolts and kelts to migrate downstream through the Robles Reach.

*5-year Reevaluation of Initial Evaluation and Monitoring Activities*

As described in the BO, a 5-year reevaluation of the initial fish flow operations would be conducted to determine if monitoring and evaluations have been completed (NMFS 2003a). The initiation of the 5-year period began in 2006, which was the first year the Robles Fish Facility was fully operational. An annual and ongoing reevaluation began after the 2010 fish passage season. Through the Cooperative Decision Making Process, the Robles Biological Committee will review annually each of the specific evaluations and determine if the original objectives have been addressed and could be discontinued or if additional study would be needed. Due to the variable water conditions and insufficient numbers of adult and juvenile steelhead, all objectives of the monitoring and evaluation program have not yet been accomplished. This has been exacerbated by the historic 5-year exceptional drought affecting much of California, and particularly the southern coast of California including the Ventura River Basin. After the 2017 season, the drought in Ventura River basin has diminished to a moderate level. Each aspect of the monitoring and evaluation program will be assessed annually to determine if sufficient information has been collected to complete each objective. While significant progress has been made, it is recommended that all aspects of the monitoring and evaluation for the Robles Fish Facility be continued during 2018.

## 3.0 UPSTREAM FISH MIGRATION IMPEDIMENT EVALUATION

*Introduction*

The ability of adult steelhead to swim upstream can be impeded during migration at times of low-river flow (NMFS 2003a). Evaluations at shallow water habitat units (i.e., critical riffles) have been commonly used as a method to determine if impediments exist for adult and juvenile steelhead in California rivers (Dettman and Kelley 1986; Bratovich and Kelley 1988; Hagar 1996). The Robles Reach, which extends downstream from the Robles Fish Facility approximately 6.5 km (NMFS 2003a) to just upstream of the Santa Ana Boulevard bridge (Appendix 1), is a wide alluvial section of the Ventura River that is

composed of active wash deposits of unconsolidated silt, sand, gravel, and boulders (Tan and Jones 2006). Due to this type of channel morphology and geology, alluvial channels like the Robles Reach have high infiltration rates that cause channel surface flow to rapidly recede and cease shortly after storm events (Cooke et al. 1992).

An initial assessment of potential passage impediments in relation to river discharge was completed by ENTRIX (1999). The physical characteristics of seven potential impediments were evaluated using the Thompson (1972) passage criteria. The Thompson (1972) passage criteria for adult steelhead at critical riffles is a water depth of 0.6 ft for 25% of the total transect width and a continuous portion equal to 10% of the total transect width. ENTRIX (1999) also evaluated the potential impediments using criteria of 0.5 ft and 0.6 ft depth for 25% of the total width and a total width of 8 ft for both depths. The resulting discharge required to meet critical criteria was estimated to be between 40 and 65 cfs. There have been several modifications to the Thompson passage criteria by other researchers; Dettman and Kelly (1986) on the Carmel River used a depth of 0.6 ft over a 5 ft continuous section, a criteria of 0.6 ft depth over an 8-ft section was used on the Santa Ynez River (SYRTAC 2000), and Harrison et al. (2006) used a criteria of 0.6 ft depth over a 10-ft section on the Santa Clara River. Thompson's (1972) depth criterion of 0.6 ft was not based on actual migration observations and was never validated as a minimum condition for passage. It has been observed that adult salmonids can successfully move through riffles shallower than the 0.6 ft criterion (Mosley 1982).

The objective of the impediment evaluation is to assess factors that may impede steelhead's ability to migrate to the Robles Fish Facility (NMFS 2003a). Because low-river flows have the potential to impede upstream fish migration in the Robles Reach, characterizing the effect of flows on critical riffles in this reach will be the primary focus of the impediment evaluations (NMFS 2003a).

*Methods*

Selected channel features that may pose an impediment to upstream passage were surveyed multiple times during the fish migration season (January through June) to measure water depth, velocity, and channel width along a transect at each site. The selected sites were planned to be surveyed over a range of discharges from approximately 30-171 cfs (the upper limit is dependent on the ability to safely conduct the surveys), which was correlated with discharge at the Robles Fish Facility. The number of repeated surveys has depended on the number and duration of significant rain events, rate of hydrograph recession, and time constraints due to other aspects of the monitoring and evaluation program. Impediment surveys will likely be conducted over a number of years given the natural variation of water conditions. The selected impediment sites will be resurveyed as many times as needed to develop a statistically rigorous data set to evaluate fish passage in relation to Robles Fish Facility discharge.

*Site Selection Process*

During the initial phase, the Ventura River was surveyed from the mouth to the Robles Fish Facility (23 km) using standard stream survey techniques and was completed in 2008 (CMWD 2008). This provided physical measurements of all habitat units for the selection process. The survey methodology followed Moore et al. (2002) and was equivalent to a level IV survey as described in the California Salmonid Stream Habitat Restoration Manual (Flosi et al. 2002).

Over the course of three meetings and one conference call between 24 January and 18 June of 2009, the Biological Committee (BC) for the Robles Fish Facility completed an impediment site selection process that culminated in the original selection of eight sites that would be monitored for the impediment evaluation. The BC reviewed physical parameters of the 379 habitat units surveyed and general river characteristics that included: unit type, length, width, water depth, slope, longitudinal location (river km), step height on step units, discharge at Foster Park and the Robles Fish Facility at the time of the surveys, and a river profile for the 23 km of the Ventura River below the

Robles Fish Facility. Upon completing an initial assessment of this data, a list of potential sites was developed that the BC visited in the field on 27 May 2009 to determine if monitoring was warranted. This data and field assessment included regular BC members (at the time of the assessment) Mike Kinsey (BOR), Stan Glowacki (NMFS), Mary Larson (CDFW), and Scott Lewis (CMWD). Mike Gibson (CMWD), hydrologists Bob Hughes (CDFW), and David Crowder (NMFS) also participated in this assessment and selection process.

The flow event that peaked on 20 March 2011 at approximately 20,000 cfs at the USGS Foster Park gage station, a recurrence interval of about 6 years, significantly altered some impediments sites that necessitated modifications to the monitoring. See CMWD (2011) for a detailed description of the high-flow caused site alterations. A Biological Committee (BC) field assessment on 11 January 2012 was conducted to review alterations that occurred and select replacement sites for ones that no longer appeared to be impediments. Regular BC members (at the time of the assessment) Ned Gruenhagen (BOR), Rick Bush (NMFS), Mary Larson (CDFW), and Scott Lewis (CMWD) participated in this review and site-selection process; Mike Gibson (CMWD) and hydrologist Bob Hughes (CDFW) were also involved in this assessment and selection process. Based on this field review, Site 2 was no longer considered a potential impediment. Site 10 was identified as a replacement site during the January field trip. Site 8, which was originally selected during dry conditions, was not considered as restrictive as other potential sites after evaluating data collected during 2010 and 2011. Consequently, Site 8 was replaced with Site 9 during the January 2010 field trip. The complete list of current impediment sites that the BC visited and determined to be satisfactory for monitoring during the 2012 season can be found in Appendix 2. However, at the time the new site selections were made (i.e., 11 January 2012), insufficient flows were available to make final site selection or transect placements. Until March of 2014, the lack of precipitation and subsequent insufficient surface flow, did not allow for confirmation of these new sites. This confirmation was completed after the March 2014 storm provided the first notable surface flows in 3 years and allowed available members of the BC to visit sites 9 and 10 on 03 March 2014. The

confirmation was conducted by Scott Lewis (CMWD), Dana McCanne (CDFW), and Mike Gibson (CMWD).

*ENTRIX Study Site Assessments*

An effort was made to locate and determine the status of the ENTRIX (1999) study sites during 2009. Because there were numerous bed-mobilizing runoff events after the study was completed, the current status of the sites was unknown. Based on the site descriptions in the ENTRIX (1999) study report, field surveys were conducted to locate and describe the existing channel conditions at the original site locations. Of the seven sites originally identified by ENTRIX (1999), only four sites were located with any degree of certainty. Of those four sites, all were no longer in the primary low-flow channel. A more detailed description of the ENTRIX sites can be found in a previous progress report (CMWD 2011).

*Results*

During the reporting period for 2017, four BO-defined storm events occurred. During the intervening periods between the storms, a total of 40 water depth transects were completed. Precipitation in the Ventura River basin ranged from approximately 83-136% of normal for the 2017 water year. A total of 35.3 inches of precipitation was measured in Matilija Canyon (Ventura County site 207c). Daily mean discharge into the Robles Fish Facility ranged from 0 to approximately 2,800 cfs (see section 6.1.2 for detailed flow observations). Similar to previous years with larger storm events, the farther downstream a site was in the Ventura River, the more the channel was altered. The channel alterations caused significant changes at sites 6-2 and 10 that required establishing new transects at those locations. Data were analyzed by modeling discharge from the Robles Fish Facility and water depth at each site for several passage criteria. This yielded numerous adult steelhead passage criteria discharges and were included in this progress report to provide the current status of data collection for each impediment site (Appendix 3).

Site 3-2 was surveyed three times during 2017. The channel at the site was not altered enough to consider it substantially different than that existed prior to the storm events. The invasive species *Arundo donax* had established dense stands in mid-channel prior to the 18 February 2017, but most of it was scoured out from the 18 February storm event. Discharges at Robles ranging from 49 to 84 cfs during the surveys. The Site 3-2 regression did not produced plausible results (Appendix 4) using the Thompson passage criteria (p-values ≥ 0.97), which were 283 and 292 cfs. The resulting minimum discharges required to meet the three other criteria also were not plausible because they ranged from 1,300 to 1,700 cfs.

Site 4 was not surveyed during 2017 because the site was considered a lower priority for data collection due to more complete data set collected during 2010-11. However, the 18 February storm event substantially modified the channel as Site 4. A visual inspection of the site following the 18 February storm indicated the site had substantial deposition, scour, and other channel modifications that would necessitate the establishment of a new transect if further measurements are needed.

Site 5 did not incur substantial channel changes from the 18 February storm event. Two transects were conducted at Site 5 when Robles discharged ranged from 92 to 141 cfs (these were made at the largest discharges to supplement previous data collection). The resulting minimum discharges required to meet the Thompson criteria were 159 and 147 cfs (Appendix 5). However, the regressions were negative and therefore not plausible using only the 2017 data.

Site 6-3, was substantially modified by the 18 February storm event. Two transects were conducted prior to the 18 February storm event, which could be pooled with previous years transect data. A new transect was established approximately 20 m downstream from Site 6-3 following the storm event. This new transect, Site 6-4, was surveyed six times at Robles discharges ranging from 32 to 71 cfs. The resulting minimum discharges required to meet the Thompson criteria were 40 and 34 cfs

(Appendix 6). The resulting minimum discharges required to meet the three other criteria ranged from 36 to 41 cfs.

Site 7 was not substantially modified by the 18 February storm event. Only three transects were conducted at Robles discharges ranging from 56 to 88 cfs (Appendix 7). The resulting minimum discharges required to meet the Thompson criteria were -413 and 216 cfs. The resulting minimum discharges required to meet the three other criteria ranged from 222 to 245 cfs. Because two of the regressions were negative and all three were not significant (p-values ≥ 0.22), these results are not plausible using only the 2017 data.

Site 9 was not substantially modified by the 18 February storm event. Some erosion occurred on the right bank looking upstream, but it was less than 10 feet and only lengthened the transect. Ten transects were conducted at Robles discharges ranging from 24 to 148 cfs (Appendix 8). The resulting minimum discharges required to meet the Thompson criteria were 17 and -9 cfs. The resulting minimum discharges required to meet the three other criteria ranged from 36 to 51 cfs.

Site 10, was substantially modified by the 18 February storm event and a new transect was established (Site 10-2). Seven transects were conducted at Site 10 prior to the storm event at Robles discharges ranging from 31 to 166 cfs and were analyzed separately from the new transect. Site 10-2 was established at approximately the same location following the storm event and was surveyed five times at Robles discharges ranging from 32 to 68 cfs. The resulting minimum discharges required to meet the Thompson criteria for Site 10 were 68 and 42 cfs (Appendix 9). The minimum discharges required to meet the three other criteria ranged from 36 to 51 cfs. Site 10-2 minimum discharges required to meet the Thompson were 25 and 21 cfs (Appendix 10). The minimum discharges required to meet the three other criteria for Site 10-2 ranged from 22 to 25 cfs.

Photos of the potential impediment sites at a Robles discharge of about 50 cfs are in Appendix 13a-g for reference. Regression equations and statistics for the five passage criteria correlating Robles discharge are in Appendix 11. The calculated minimum discharges to meet the five passage criteria correlating Robles discharge are in Appendix 12.

*Discussion*

During January and February of 2017, four storm peaks provided sufficient surface flow to collect transect data for fish passage evaluations. The four BO-defined peak flows provided the first satisfactory opportunity for upstream fish migration impediment evaluations in the Ventura River over the last 5 years. Given that the last satisfactory data collections occurred during 2011 and several impediments monitoring changes have since been made by the Biological Committee (BC), only the data from 2017 were analyzed for this report. In addition, an effort was made to collect data at newer transect sites and ones with limited data sets. The results for discharge requirements often were implausible (e.g., inverse relation between discharge and upstream fish passage conditions) and/or statistically insignificant results) for some sites. These results are not unexpected given the limited number of transects that were collected. Further analysis will be needed once a decision is made on pooling data from impediment sites.

3.1 *Sandbar Monitoring*

*Introduction*

The Ventura River, like many other California rivers, frequently develops a seasonal sandbar at the mouth during the late spring or summer that is breached by higher river flows in the late fall or winter. If a sandbar develops, which occurs more often during dry years, the resulting lagoon can provide important rearing habitat for steelhead juveniles because of the abundant food resources available. Additionally, this can

facilitate the physiological and behavioral changes associated with smoltification (Cannata 1998) and also enhance marine survival (Bond et al. 2008).

The primary objective of the sandbar monitoring is to determine if the criteria for initiation of the fish passage augmentation season have been met (NMFS 2003a). As stipulated in the BO, the fish passage augmentation season will extend from 01 January through 30 June of each year and will commence after the sandbar has been breached at least once during the current year's fish flow operations season. During the fish passage augmentation season, several Robles Fish Facility operation criteria must also be implemented (see NMFS 2003a for a complete list of operational criteria).

*Methods*

During each sandbar inspection, observations and recordings were made that included: date, time, status of the sandbar, general location of the mouth, tidal stage, water temperature, and discharge at the Robles Fish Facility and the USGS Foster Park gage station. The sandbar was open on 03 January 2017 and its status was monitored once every two weeks through June. Outside of the fish passage augmentation season the sandbar was monitored at least monthly.

*Results*

During the reporting period, July 2016 through June 2017, the mouth of the Ventura River was inspected 20 times to determine if the sandbar was open or closed. There were 12 observations that occurred during the fish passage augmentation season (January through June 2016) and 8 observations outside of the season. The sandbar was open throughout the fish passage augmentation season (Appendix 14). The sandbar was closed on 13 December 2016 and was open, and remained open for the fish passage season, after 30 December 2016 for volitional passage. On the days the sandbar was inspected during the reporting period, the mean daily discharge at the USGS Foster Park gage station ranged from approximately 0 to 64 cfs and 0 to 54 cfs

at the Robles Fish Facility. When the sandbar was open, the river was observed primarily exiting from the west side of the estuary during the reporting period.

*Discussion*

The sandbar at the mouth of the Ventura River tends to remain open during average and above average precipitation years and closes only during years with few significant rain events (Lewis et al. 2010). This typical pattern of the sandbar remaining open during the fish passage season is illustrated from 2008 to 2017 (Appendix 15). The pattern commonly includes a period during the summer and into the fall months when the sandbar is closed. A single low precipitation year can produce a longer period of closure, as occurred in 2007 and 2012. Consecutive dry years may cause a closure to persist into the fish passage season, only opening during short periods following rain events, such as in 2013 through 2015.

The tendency of the sandbar to remain open in all but very dry years is likely due to a few likely factors. Although the middle reach of the Ventura River goes dry every year, during most years subsurface water continues to flow and eventually begins to resurface just upstream of the confluence with San Antonio Creek and continues to increase slightly proceeding downstream. Additionally, treated effluent water from the Ojai Valley Sanitary District at rkm 7.5 increases the river discharge by approximately 3 cfs. Finally, tributary flow from San Antonio Creek also adds to the Ventura River through a surface or subsurface connection throughout the year. These factors likely contributed water to the Ventura River keeping the sandbar from fully forming and therefore remaining open during most years.

The status of the sandbar indicates changes in the estuary/lagoon that may help determine potential entry and exit conditions for adult steelhead and juvenile *O. mykiss* migrating to the ocean. It appears that passage conditions remain suitable during most seasons when steelhead are likely migrating. However, lagoon conditions optimal for juvenile rearing (i.e., when a sandbar closes and results in an estuary forming a deeper

freshwater lagoon; Bond et al. 2008), appear to have been limited during years with potential smolt recruitment for the study period beginning in 2006.

## 4.0 EVALUATE FISH MOVEMENT THROUGH THE PASSAGE FACILITY

### 4.1 *Water Velocity and Depth Validation Evaluation*

Sufficient flows occurred during the 2016-2017 season so that data was collected for the performance testing evaluation. Velocity measurements were taken at each of the fish ladder slots during the 2016-2017. Velocity measurements were also taken at the rock weirs. Casitas was unable to take velocity measurements during the February peak storm as all of the consultant's equipment was in use at other locations. To prevent lost measurement opportunities in the future, Casitas has budgeted funds to purchase a Sontek RiverSurveyor, a Teledyne RiverPro or equivalent system.

### 4.2 *Fish Attraction Evaluation*

#### *Introduction*

River discharge has been shown to be one of several key environmental factors initiating and facilitating steelhead, and other salmonids, adult and juvenile migrations in natural fluvial environments (Shapovalov and Taft 1954; Banks 1969; Spina et al. 2005). As adults and juveniles approach fish passage facilities, suitable discharge and water velocities become even more important to ensure successful passage through any facility (Clay 1995; Beeman and Maule 2001).

The entrance of the fish ladder at the Robles Fish Facility is located approximately 20 m downstream of the spillway gates and is where fish migrating upstream enter and where fish migrating downstream exit the facility (i.e., two-way passage facility). The downstream end of the ladder is adjacent to a large pool (entrance pool). The ladder was designed for a maximum discharge at the exit of 171 cfs (50 cfs through the entire

ladder and an additional 121 cfs that can be supplemented at the lower end of the ladder). The distance downstream from the entrance pool to the lower most rock weir is approximately 200 m. This reach includes all four rock weirs and the facility's discharge measurement weir, which also functions as a low-flow road crossing. The habitat unit types that can be used by migrants in this reach include the four pools created by the weirs, a glide created by the discharge measurement weir, a riffle, and the entrance pool.

The objective of the fish attraction evaluation is to determine if adult or juvenile steelhead are holding immediately downstream of the Robles Fish Facility during the fish passage augmentation season (NMFS 2003a).

*Methods*

Three separate methods were employed to determine the presence of *O. mykiss* for the Fish Attraction Evaluation to encompass a range of spatial and temporal scales. The methods used included: 1) Weekly bank/snorkel survey during the fish passage season, 2) post-storm bank/snorkel surveys in the entrance pool during the BO-defined ramp-down period, and 3) post-storm underwater video monitoring at the fish ladder entrance during the ramp-down period.

1) Weekly bank/snorkel fish attraction surveys, a methodology used since 2007, were conducted during the fish passage season from January through June of 2017 when water was present. During 2017, the four storms created surface flows and allowed surveys to be completed for approximately 6 months. The particular survey methodology used (i.e., bank or snorkel) was determined based on water visibility, river discharge, expected steelhead life history stage present at the time of the survey, and safety of surveyors. A combination of bank and snorkel surveys were conducted during the 6-month period. Bank surveys were conducted by one or two surveyors in an upstream direction. The surveyors wore polarized sunglasses to reduce water-surface reflection. Snorkel surveys were conducted by one or two surveyors in an upstream

direction. If present, fish species were identified and enumerated to the greatest extent possible permitted by the ambient river conditions and fish densities at the time of each survey. If *O. mykiss* were present, lengths of each fish was estimated to the nearest cm if only a few individuals (generally <10) were present. In order to collect additional information that may help determine *O. mykiss* upstream and downstream movements through the Robles Fish Facility, an upstream study reach was added in 2009. The upstream study reach included observations in the screenbay of the facility and the area immediately upstream of the low-flow fish exit in the forebay. The total distance of this upstream reach was approximately 140 m.

2) Post-storm bank/snorkel surveys were conducted in the entrance pool during the ramp-down period for all BO-defined storm. This consisted of daily surveys during the 10-12 day augmentation period after a storm event. Beginning the day after a BO-defined peak event, a Secchi depth was measured in the entrance pool to determine when surveys could begin. Bank surveys were conducted when visibility was poor and snorkel surveys were conducted after visibility increased (> 1.0 m Secchi), assuming this would allow *O. mykiss* to be observed.

3) The post-storm underwater video monitoring was conducted after a BO-defined storm and during the ramp-down period. After the storm event occurred, video cameras were installed at the entrance of the fish ladder. The video cameras were mounted on a bracket adjacent to the fish ladder entrance and lowered into place to provide monitoring following the storm event. The cameras recorded the entire 10-12 day ramp-down period to a digital video recorder (DVR) and reviewed at a later date.

*Results*

1) A total of 42 surveys (16 bank and 26 snorkel) were completed during the weekly surveys and two *O. mykiss* were observed (Appendix 16). The two *O. mykiss* were observed on 23 March 2017 in the upstream study reach. During the 6-month period, a total of 6,300 m were surveyed by either bank or snorkel methods. Water temperatures

during the study period ranged from 9 °C to 26 °C and turbidity ranged from <1 to 20 NTUs when the surveys were conducted. The mean daily discharge at the Robles Fish Facility ranged from 0.2 to 50 cfs at the time of the surveys.

2) There were four BO-defined storm events that post-storm fish attraction surveys were conducted during 2017. A total of 35 surveys were conducted and no *O. mykiss* were observed (Appendix 17). Water temperatures during the study period ranged from 9 °C to 13 °C and turbidity ranged from 2 to 1,750 NTUs when the surveys were conducted. The mean daily discharge at the Robles Fish Facility ranged from 24 to 2,795 cfs at the time of the surveys.

3) There were four BO-defined storm events that post-storm underwater video monitoring was conducted during 2017. At total of 26 days of recordings were made. No *O. mykiss* were observed on the video. Because no adult steelhead were detected in the Riverwatcher, the video was subsampled between the hours 0600-0900 h and 1600-1900h each day and 5 min of every 15 min period watch.

### 4.3 *Downstream Fish Passage Evaluation*

#### *Introduction*

Passage evaluations of salmonids migrating through fish passage facilities have been conducted throughout the western United States for many years (Odeh 2000). Methods to determine if a facility is operating as designed and not causing harm to the intended fish species vary. Early work typically entailed trapping and tagging fish before entering a facility and recapturing them after exiting. Trapping and visual inspections for injuries, PIT tagging, radio telemetry, and acoustical telemetry have been conducted extensively as well.

There are two objectives for the downstream fish passage evaluation. The first objective is to determine if downstream migrants are successfully passing through the

Robles Fish Facility. The second objective is to capture and examine steelhead smolts and kelts and determine if injuries are occurring as they pass downstream through the Robles Fish Facility (NMFS 2003a).

*Methods*

For a full description of evaluation methods, see section 5.0.

*Results*

No *O. mykiss* were captured during trapping operations and evaluations for the Downstream Passage Evaluation could not be conducted.

## 5.0 DOWNSTREAM FISH MIGRATION THROUGH THE ROBLES REACH

*Introduction*

When the number of fish physically handled in a study is of concern, such as with an endangered species, radio telemetry can be a useful method over others like extensive trapping (Hockersmith et al. 2000). Telemetry migration information of steelhead smolts in the Ventura River would allow for the determination of survival, travel time and rates through select reaches, migration relative to river discharge, habitat use, and passage success through critical riffles. By tracking the tagged fish until the batteries die, it is anticipated that downstream migration can be monitored all the way to the Ventura River estuary/lagoon and could provide important data on estuary rearing and emigration behavior.

The purpose of the downstream migration evaluation is to determine how successful smolts are at migrating through the Robles Reach (NMFS 2003a). Because of the limited number of steelhead smolts likely passing downstream through the facility, a NMFS approved pilot study using radio telemetry was used for evaluations.

*Methods*

A weir trap was placed and operated approximately 100 m downstream of the Robles Fish Facility. The weir trap consisted of a live-box (120 cm for all three dimensions) with an internal fyke. The trap was situated in the center of the river channel and thalweg. The live-box internal frame was constructed of PVC pipe and covered with plastic fencing with 1.9-cm diagonal openings. A plastic fence (3-cm openings) supported by T-bar fence posts was extended upstream on both sides of the live-box at 30° angles into the river channel. There was a 1-m gap on the right bank so any adult steelhead could bypass the trap location and move upstream. Two-meter deflector wings positioned on both banks approximately 14 m upstream of the trap to guide shore-orientated smolts toward the thalweg and trap. Because the vast majority of downstream steelhead migrants were expected to be captured from mid-March through mid-June (Shapovalov and Taft 1954; Dettman and Kelley 1986), the trap was intended to be operated from mid-March through June 2017 or until water temperatures exceeded a daily mean of 22°C, which could negatively impact captured fish (SYRTAC 2000), or the surface water connection was lost in the mainstem of the Ventura River. For a full description of evaluation methods, see the 2017 CMWD monitoring and evaluation study plan (Lewis et al. 2017).

*Results*

No *O. mykiss* were captured during the 2017 trapping operations. The trap was operated continuously for 38 days from 07 March to 13 April 2017. The surface flow connection was lost on 13 April and trapping was discontinued. Water velocity measurements were collected at 1-m intervals upstream of the trap and guidance wings on 27 March at a discharge of 40 cfs. Mean velocity for the left wing was 0.16 f/sec and 0.18 f/sec for the right wing. Mean water velocity across the upstream face of the trap/fyke was 0.31 f/sec (0.5 m-intervals) and velocity at the fyke opening was 0.48 f/sec.

# 6.0 LONG-TERM MONITORING COMPONENTS

## 6.1 *Monitoring Robles Facility Operations*

### 6.1.1 Facility Status

The Robles Fish Passage Facility started the 2016-2017 season in a fully functional mode. The 2016-2017 season was characterized by an above average rainfall year as measured at Casitas Dam. 31.4 inches of rain were measured at Casitas Dam during the October 2016-July 2017 period. The average annual rainfall at the dam is 23.54 inches. This was the first year with above average rainfall since 2010/11 water year. No water was downloaded from Lake Matilija to Robles and no valves were operated at Matilija Dam.

*The 2016 Report identified several projects to be completed during the summer and fall. The principal projects were:*

- Install repaired Sontek IQ Pipe flowmeter in the auxiliary water supply pipe.
- Install level sensors at the fish ladder entrance to read water levels in the entrance pool.
- Install new diffuser perforated plate for the fish screens and the auxiliary water supply.

A brief description of each project and the project's status is listed below:

1) Install repaired Sontek IQ Pipe flowmeter in the auxiliary water supply pipe- The repaired flow meter was installed in the fall of 2016. The auxiliary pipe was used to augment downstream releases following the January 20, 2017 and February 17, 2017 storm events. Maximum discharge measured through the auxiliary pipe was 93 cfs. This is close to the original design capacity of 100 cfs. The flow meter was registering 1-4 cfs through the auxiliary pipe after the gate was completely closed. It is believed the gate seals may be leaking. Inspection and/or replacement of these seals will be placed on the 2017 Summer/Fall work list.

2) Install a level sensor at the fish ladder entrance to read water levels in the entrance pool-Casitas did not get this item completed this year. This is not a BO requirement.

3) Install new diffuser perforated plate for the fish screens and the auxiliary water supply-this item was mostly completed on January 4 and fully completed by January 27.

6.1.2 Flow Observations and Control

Flow and level measurement devices are located at various locations within the Robles Fish Passage Facility. The primary points of measuring and recording stream flows entering, flowing through, and leaving the Robles Fish Passage Facility are:

- Matilija Creek at Matilija Hot Springs – located approximately 2,100 feet downstream of Matilija Dam – good rating for low to moderate flows – operated by Casitas Municipal Water District, formerly a USGS station;
  A second gaging station at this location is operated by the County.
- Matilija Dam Stage Bubbler-Located at the dam, this gage provides the lake elevation. Under high flows, the dam acts as a weir. This is the primary flow measurement location under high flows and to determine if a peak has occurred.
- North Fork Matilija Creek – located approximately 3,000 feet upstream of its confluence with Matilija Creek – good rating for low to moderate flows – operated by the Ventura County Watershed District;
- Robles-Casitas Diversion Canal – located on the diversion canal approximately 1,300 feet downstream of the Robles headworks – trapezoidal channel with a good rating for flows up to 600 cfs;
- Ventura River near Meiners Oaks (VRNMO or Measurement Weir) – located approximately 540 feet downstream of the Robles Fish Passage spillway – concrete weir section – good rating to 100 cfs, use of equations above 100 cfs with no verifications at higher flows above 1000 cfs. This is the most reliable flow

measurement for the fish passage and downstream releases with a 50-year plus history. This site was formerly a USGS site.

- Fish Ladder- A Sontek IQ Plus has been added to this location to measure flow in the fish passage operation and was nominal with ongoing assessment.
- Auxiliary Water Supply- A Sontek IQ Pipe has been installed to obtain flow measurements in the auxiliary water supply and was nominal with ongoing assessment.

All of the instruments can suffer from inaccuracies from time to time. The inaccuracies can be caused by clogging of bubbler lines, electronic creep, debris accumulating on sensors, changes to the measured cross sections, human interactions and equipment problems. For this reason, the data is verified against field measurements and observations. The information gathered from each of these locations has been reduced to the mean daily flows in cfs (Appendix 7). The mean daily Robles Fish Facility discharge and corresponding turbidity and temperature measurements for the entire Fish Passage Season are presented in Appendix 8.

The measurement weir bubbler data collector and the back-up data collector failed during the season. The failure occurred sometime in March. A new data collector has since been installed. The weir bubbler data collector was operational during all BO defined peaks.

Surface flow over the measurement weir was first observed on January 8, 2017. Four BO-defined peak flow events occurred during the 2016-17 fish passage season. One of the four peaks met the criteria as an overlapping storm with modified release requirements, this peak occurred on February 17, 2017. This peak was the largest for the season at about 10,000 cfs. There were 52 days this year with some diversions. Flow over the measurement weir ended on June 21, 2017.

6.1.3 Costs Associated with Operation and Monitoring

The BA/BO specified that the District provide the costs that are associated with the activity. The following is a summary of the direct costs incurred by the District during the 2016-17 fiscal year:

- **Fisheries Monitoring**:

| | |
|---|---|
| Salaries & Benefits | $412,220 |
| Equipment/Material | $ 17,981 |
| | $430,201 |

- **Facility Operations**:

| | |
|---|---|
| Salaries & Benefits | $ 46,836 |
| Equipment/Materials | $ 8,490 |
| Outside Contracts | $ 53,555 |
| Utilities | $ 1,853 |
| Permit | $ 1,166 |
| | $111,900 |

- **Capital Improvements**:

The fish screen diffuser panels and the auxiliary water diffuser panels were replaced this year. The cost of the installation is included above.

6.1.4 Water Velocity and Depth Validation Evaluation

Casitas entered into an agreement with HydroScientific West to complete the first phase of the performance (hydraulic) testing. Performance testing of the fish screen was completed March 25, 2011.

Velocity tests were taken in the fish passage and at the weirs during the 2016-17 season. Tests in the entrance pool and at the auxiliary water-entrance box were not completed as the Consultant did not have the equipment available when the flows reached the appropriate levels for testing. To avoid this situation in the future, Casitas has budgeted the purchase of a Sontek RiverSurveyor, Teledyne River/Stream Pro or equivalent instrument.

All performance testing will be completed in general accordance with the NMFS approved Performance Evaluation Program and Biological Committee recommendations.

### 6.1.5 Recommendations Regarding the Prioritization of Future Activities

The District has completed its eleventh season with the Robles Fish Facility operational. No new major projects were identified this year.

### 6.1.6 Recommendations Deemed Necessary to the Operations

Casitas continues to recommend that the construction of the 15-weir portion of the project be put on hold at least until the Matilija Dam Removal Project is completed. Preliminary plans for the High Flow Sediment Bypass and High Flow Fish Passage portion of the Matilija Dam Removal Project require this area to be graded to new elevations. The existing temporary weir system has proven to be passable by adult *O. mykiss*.

## 6.2 *Fish Passage Monitoring*

*Introduction*

Monitoring of migratory fish moving through fish passage facilities has been conducted using many different methods that include: visual counting, trapping and hand counting, continuous video recording, PIT tagging, radio telemetry, and acoustical telemetry. In each fish passage application, the particular physical and biological conditions (e.g., variable discharge, turbidity, debris, size of facility, and number of fish) usually dictate which method would be most effective. New technologies have been employed to improve fish passage monitoring in turbid conditions specifically. One such monitoring device is the Vaki Riverwatcher® (Riverwatcher). The Riverwatcher has the capability to operate in greater turbidity than more traditional monitoring equipment. Because of this

advertised capability, the Riverwatcher was selected to be used in the Robles Fish Facility by the Technical Advisory Group during original facility design.

The primary objective of fish passage monitoring is to provide a long-term index of upstream adults and downstream kelts migrating through the Robles Fish Facility (NMFS 2003a). Although the Riverwatcher has the ability to detect smolt-sized steelhead, the manufacturer recommends it for monitoring fish with body depths ≥ 40 mm (Vaki 2003). Consequently, it was not known how well it would work at detecting smolt-sized fish given the debris load of the Ventura River (NMFS 2003a).

*Methods*

Fish migrating upstream and downstream through the Robles Fish Facility were monitored using the Riverwatcher. The Riverwatcher is located in the fish bypass channel, which is the channel between the fish ladder and fish screens. The Riverwatcher consists of two scanner plates with light diodes that transmit beams of infrared light through the water to a corresponding receiver plate. When a fish swims (or debris drifts) through the infrared light beams, it breaks the light signal and a digital silhouette of the fish is recorded on a computer. Other data recorded when the Riverwatcher scanner is triggered are: date and time, total length (TL) of the fish (from a length/height ratio), swimming speed (m/sec), and direction of the fish movement (upstream or downstream). In addition, the scanner triggers an underwater camera to record a 10-second video clip (25 frames/sec).

The Riverwatcher was experiencing technical issues of malfunctioning video during the 2015 monitoring season. In the fall of 2015 the Riverwatcher was sent to Vaki for servicing. Through diagnostic testing, Vaki concluded no repairs were necessary and did not experience any issues with malfunctioning video. Vaki stated recent improvements to the Riverwatcher system could be integrated into older systems, and recommended upgrading the Robles Riverwatcher. This recommendation was discussed and approved by BC members at the 2015 committee meeting. The primary

upgrade was changing from an analog camera to a digital camera. In conjunction with updated software, the camera now records video for both upstream and downstream detections. Additional upgrades to the Riverwatcher included: white and infrared lights, cabling, multiplexor, and power supply. To improve video detection of fish, an additional camera was installed and is located upstream of the Riverwatcher scanners in an aluminum tunnel below the Riverwatcher camera. A second DVR camera is located above the Riverwatcher and pointed at the scanner plates. These two DVR cameras are independent of the Riverwatcher system and have to be reviewed separately for detections. The digital cameras recorded continuously at 12 frames/sec and capture about 5 weeks of data until the DVR data storage drive is full. Once the DVR memory is full, it can be exchanged with a second DVR and data can be reviewed.

The Riverwatcher scanner and cameras are positioned at the bottom of an aluminum frame (crowder) covered with 1/2 inch aluminum bars, spaced 1 1/2 inches on center resulting in 1-inch spacing between the bars, which directs the fish to swim between the scanner plates. The crowder can be raised and lowered in guide slots of the fish bypass channel with the aid of an A-frame hoist for cleaning or repair. The Riverwatcher is usually operated during the entire flow augmentation season as long as sufficient water elevations in the fish bypass are present and debris and turbidity are low enough so that the crowder will not be damaged and the Riverwatcher will function.

The Riverwatcher was operated from 22 January 2017 to 23 June 2017 of the reporting period. During this fish passage season, the crowder was removed from the fish bypass channel and cleaned or inspected 61 times. Typically, during times of higher debris, the cleaning and inspections occur multiple times per day, and at times of lower debris, cleaning and inspections occur only once every 2-3 days. At times of very low flow (< 1-2 cfs), the crowder may only be cleaned once per week. The crowder was removed for cleaning for a combined total of approximately 15 h during the operation period. The Riverwatcher was operated a total of 147 days, 98% of the time the Riverwatcher could be operated during the fish augmentation period, this includes times of low flow (approximately < 3-5 cfs) when fish passage is not possible.

Prior to 2010, each upstream and downstream Riverwatcher detection was reviewed and classified as either: an adult steelhead, *O. mykiss* non-adult steelhead, other species if identifiable, unknown fish, fish probable, or false detection (see Appendix 9 for detection classification flow chart). At the request of NMFS, this classification system was modified during the review process of the 2010 progress report. It is NMFS' belief that supporting data do not exist to distinguish between the resident and anadromous forms of steelhead. All confirmed *O. mykiss* were classified solely as *O. mykiss*. The classifications were determined by using a combination of the silhouette images, estimated lengths, and video clips. In addition, if larger adult sized *O. mykiss* were detected and a useful video clip was recorded, measurements of eye diameter and standard length (SL) were estimated from the video clip to calculate morphometric ratios that were compared to known steelhead and rainbow trout.

A commonly used morphological method to discriminate differences is to develop ratios of body measurements for comparison to remove the effects of body size (Strauss and Bond 1990). This is done by comparing SL to the ratio of eye diameter in linear regression. Standard length is the length from the snout to the end of the hypural plate near the end of the fleshy caudal peduncle, which is unaffected by caudal fin deformities (Anderson and Neumann 1996).

Before 2010, the adult steelhead classification was used if the fish observed was an *O. mykiss* and displayed the typical characteristics of an anadromous adult steelhead, such as black spotting on dorsal, adipose, and caudal fins, black spotting on dorsal side of body, silvery body, vertical edge to caudal fin, ≥ 38 cm TL (Shapovalov and Taft 1954), and had an eye diameter/SL ratio ≤ 0.045 (CMWD 2008). The new classification method may include juvenile resident, smolts, adult resident, and adult anadromous *O. mykiss* migrating throughout the basin. Conceivably, after more data are collected from the downstream trapping component, or from other Ventura River basin research projects, a more thorough classification system of Riverwatcher detections could be used again.

The “fish unknown” classification was used if a detection was identified to be a fish based on video evidence, but further classification could not be determined due to high turbidity or an inadequate amount of the fish captured within the camera’s field of view. The “fish probable” classification was used if no fish was observed in the video, but the silhouette was similar to that of a typical fish silhouette confirmed by video evidence. Even with reasonably good video coverage, smaller fish are still able to pass through the Riverwatcher undetected by the video cameras. This occurs if fish swim very close, high, or low relative to the cameras. In addition, this can happen if a fish swims upstream through the scanners but stops before entering the video field of view. High turbidity can also obscure the video detection and identification of fish. The “false detection” classification was used when no fish was observed in the video and the silhouette was not similar to that of a typical fish silhouette. Because false detections tended to occur frequently during higher discharges, when turbidity and debris also were high, it was likely that most false detections during these periods are caused by debris, high turbidity, and water turbulence. A second video camera is directed at the Riverwatcher scanner plates to help determine the cause of many of the false detections. After reviewing selected times where many assumed false detections occurred, it was concluded that debris, air bubbles, and turbulence were indeed the source of the detections. During low-flow periods (<10 cfs), 99.9% of the time the Riverwatcher was operating, surface water turbulence was likely the cause of most false detections. When turbidity exceeds about 100 NTUs, hundreds of false detections can occur per hour due to high concentration of suspended solids breaking the infrared beams of the scanner plates. When turbidity is less than about 100 NTUs, false detections from suspended solids are not as frequent, but poor camera visibility does not always allow for video confirmation, depending on how close to the camera that a fish swims during passage. Once the turbidity falls below about 25-30 NTUs, turbidity does not limit the Riverwatcher’s capability for detecting and confirming fish (Table 1). In spring 2016, the Riverwatcher was tested in an above-ground pool with wooden fish silhouettes at varying water turbidities. This was intended to simulate natural stream conditions to provide further resolution of the operational capabilities of the Riverwatcher (Lewis et al. 2016).

Table 1. Riverwatcher general operational status for ranges of water turbidity (NTUs).

| Approximate Turbidity (NTUs) | Riverwatcher status |
|---|---|
| > 200 | Not functional |
| 100-200 | Many false scanner detections, not fully functional |
| 30-100 | Scanner functional, but unable to confirm with video |
| < 30 | Scanner functional, grid detectable for video confirmation |

A standardization test for the Riverwatcher was developed using wooden silhouettes of a typical smolt and adult steelhead. To confirm the Riverwatcher is functioning correctly, this test was conducted before the Riverwatcher was operated during the 2016 fish passage season. A more detailed description of this test can be found in Lewis et al. (2016).

*Results and Discussion*

During the 2017 fish migration season, the Riverwatcher detected 11 upstream *O. mykiss* and 9 downstream *O. mykiss* (Appendix 21). False detections were recorded by the Riverwatcher, of which 616 were upstream and 1,127 were downstream.

The first steelhead smolt passed downstream through the Riverwatcher on 18 March 2017 at 01:13 h and was estimated to be 19 cm TL. The second *O. mykiss* was first detected passing downstream on 05 April 2017 and was estimated to be 27 cm TL. It was concluded that the 27 cm *O. mykiss* was the source of 19 of the total 20 *O. mykiss* detections during 2017. This was determined by several lines of evidence: 1) The 19 *O. mykiss* detections occurred within a period of 6 days, 17 were on just two days. For example, 12 detections occurred within 1.5 h on 05 April alone, and 5 detections in 1 h on a subsequent day. 2) All estimated total lengths were within 6 mm, most within 3 mm, for same swimming direction. 3) Reviewing the video clips indicated that based on general shape and color that this was the same fish. 4) Finally, 17 of the 20 detections were in alternating downstream and upstream order, within minutes or seconds, indicating that the fish went downstream and then came back upstream.

The 1,782 false detections recorded by the Riverwatcher were assumed to be caused from turbidity, debris, turbulence, air bubbles, and settings of the Riverwatcher to detect smaller fish. The review of the second DVR camera directed at the Riverwatcher scanner plates provides confidence that these are the likely cause of false detections. None of the detections produced silhouettes that appeared to be fish based on previous experience operating the Riverwatcher. In the event that one of these silhouettes could have been caused by a fish, all detection video clips created by the Riverwatcher were reviewed and no fish were observed. For the 2017 season, the minimum threshold height remained at 28 mm so that a large number of false detections could be eliminated while still attempting to detect steelhead smolts. Based on available data from the Ventura Basin, a height of 28 mm was determined to be similar to some of the smallest steelhead smolts expected to emigrate downstream through the Robles Fish Facility. This height corresponds to 146 mm TL and 139 mm FL. The estimated fish detection rate from a Riverwatcher verification study indicated that up to 93% of smolt sized *O. mykiss* will not be detected by the Riverwatcher (Lewis et al. 2016). Additionally, it was concluded that larger-sized fish (i.e., height > 80 mm) appeared to be detected nearly 100% of the time. This height is equal to about 475 mm TL. Shapovalov and Taft's (1954) 9-year study documented only 4% of the total number of adult steelhead were smaller than 475 mm. Therefore, the number of small adult steelhead that may not be detected would likely be low. However, the vast majority of adult steelhead would be detected.

# 7.0 ADDITIONAL BIOLOGICAL AND ENVIRONMENTAL MONITORING STUDIES

## 7.1 *O. mykiss Presence/Absence Surveys*

### *Methods*

In addition to the fish attraction monitoring, *O. mykiss* relative abundance index surveys were conducted in the Ventura River mainstem between the Robles Fish Facility and the Ventura River mouth and San Antonio Creek. Surveys were conducted upstream of

the Robles Fish Facility in Matilija and North Fork Matilija creeks. These additional sites were surveyed using both bank and snorkeling methods (depending on water conditions and expected life history stage) but were conducted primarily after storm events for adults and during the rest of the year for smolts, parr, and fry. Methods to estimate fish size and numbers were the same as those used in the fish attraction evaluation. A total of 14 sites were monitored and both pool and riffle habitat at each site were included (Appendix 22). These additional areas were surveyed to determine if adult steelhead were entering the Ventura River, migrating upstream, holding and spawning, and if they were successfully passing through the Robles Fish Facility. Also, juvenile *O. mykiss* (smolts and residents) were surveyed to learn spatial and temporal patterns.

The sites were initially selected based on ease of access, coverage of basin, and presumed chance of detecting *O. mykiss*. However, after all habitat surveys were completed, site selection was also based on quantitative measurements identifying high-quality habitats used for *O. mykiss* juvenile rearing and adult holding.

*Results*

Peak snorkel counts within each year have generally been between 350 and 400 *O. mykiss* until 2013. Due to the exceptional 5-year drought, the peak numbers of *O. mykiss* have dropped substantially (Appendix 23). The peak count of *O. mykiss* was 9 during 2017, 2 of which were fry estimated to be ≤ 3 cm.

### 7.2 *O. mykiss Index Spawning Surveys*

*Methods*

Spawning surveys were conducted throughout the Ventura Basin that is accessible to adult steelhead and only resident rainbow upstream of Matilija Dam. A total of 21 index sites or reaches were subjectively selected (Appendix 24) with small to medium size gravel that are suitable for steelhead spawning (Shapovalov and Taft 1954; Orcutt et al.

1968). During 2008, the spawning index sites selected were initially distributed broadly within the basin to capture general spawning locations and timing. Since 2008, longer reaches have been added to incorporate and replace previously surveyed discrete sites to accommodate for spawning gravel redistribution after storm events. Additional sites have been added to capture quality spawning habitat and to be more representative of each surveyed sub-basin. This initial information will used to establish long-term index sites to capture population trends. The spawning surveys were conducted biweekly from January through June, or until no further spawning was observed, and observations were made at sites to identify and count *O. mykiss* redds; redds were identified by typical characteristics (Orcutt et al. 1968; Chapman 1988). Once a redd was identified, physical measurements similar to those recorded by Zimmerman and Reeves (2000) were collected to characterize the redd. The physical measurements were only recorded during the first three years because it was felt sufficient data was collected to characterize redds. Currently, larger redds (likely anadromous) have all measurements collected. Pit and tailspill lengths were measured from the upstream end to the downstream end of each, respectively. Redd width was measured at the widest point of the tailspill (Appendix 25). Water depth was measured at four locations: in the pit, adjacent to the pit, upstream of the pit, and at the tailspill. The surface median ($D_{50}$) and maximum substrate size of each redd tailspill was estimated. All adjacent measurements were taken on the thalweg side of each redd. Photos and GPS locations were also recorded for all redds identified. This information will help determine steelhead spawning habitat selection characteristics.

*Results*

Spawning surveys started in 2008, numbers initially increased from only 3 redds to a high of 165 redds in 2012. Over the last 4 years, as the current drought intensified, the available habitat diminished, and there have been corresponding dramatic losses to the adult and juvenile *O. mykiss* populations with significantly lower redd counts. In 2017, only 1 redd was counted (Appendix 26).

## 7.3 *Ambient Water Quality Monitoring*

In order to fully evaluate several aspects of the monitoring and evaluation program, water quality data is collected throughout the Ventura River basin (Appendix 27). Water temperatures are recorded at 12 locations throughout the Ventura River basin. The locations include the Ventura River estuary and mainstem, Coyote Creek, San Antonio Creek, North Fork Matilija Creek, and Matilija Creek upstream and downstream of Matilija Dam. The loggers record at 30-min intervals. Monthly grab samples are also collected at the same locations with a multiprobe that measures: dissolved oxygen, pH, conductivity, salinity, TDS, and temperature. A monthly water quality profile is also collected in the estuary/lagoon. The profiles are collected at approximately the mid-point of the estuary/lagoon and at least four depths are recorded. A continuous turbidity probe is also installed in the Robles Fish Facility near the Riverwatcher. It records water turbidity at 1-hr intervals when the bypass is operational. Turbidity measurements are also collected at several sites upstream, downstream, and within the Robles Fish Facility to ensure the continuous probe is located in a position that will be representative of the turbidity in the Ventura River. All locations were monitored if sufficient water was present. A weather station has been installed at the Robles Fish Facility to collect various atmospheric data including rainfall, temperature, pressure, wind, humidity, and dew point (Appendix 28).

## 7.4 *Estuary/Lagoon Monitoring*

The sandbar is monitored during the fish passage season to determine if it is open. If open, Robles Fish Facility operating criteria must be met per the BO. Outside of the passage season, monitoring has been conducted and expanded to better understand the nature of the Ventura River sandbar and how it may affect fish passage year round, and also potential rearing capacity. The estuary/lagoon has been monitored monthly for water depth as part of the water quality monitoring. In addition, the surface area has been measured every 6 months. Together, these physical measurements can provide some general index of rearing capacity of the Ventura River estuary/lagoon over time.

From 2008 through 2011, which were wetter years, the sandbar status and estuary/lagoon depth and size varied with conditions. However, since the beginning of the current drought in 2012, conditions have remained somewhat uniform (Appendix 29).

### 7.5 *Surface Flow Monitoring*

The Ventura River, like most rivers in southern California, have significant reaches that lose surface flow during most years after storm flows recede. To quantify this natural pattern, surface flows have been observed and documented beginning at the end of 2007. Like the sandbar monitoring, clear patterns have become apparent. During normal precipitation years, there are typically surface flows throughout the length of the Ventura River mainstem during the fish passage season. Even during years of normal precipitation, the Robles Reach goes dry shortly after storms occur. However, beginning with the drought, the Robles Reach has been dry for extensive periods of time, even extending downstream of the San Antonio Creek confluence. This dry pattern was reduced significantly due to the precipitation and runoff during 2017 monitoring period (Appendix 30).

### 7.6 *Photographic Index Sites*

Photographic index sites were established throughout the Ventura River basin in 2007 to monitor general changes of the stream channel morphology, water conditions, and riparian zones. There are a total of 14 sites where an upstream and downstream photo are taken (Appendix 31). The sites were re-visited twice during the reporting period, in September 2016 and March 2017. As a representation of the general patterns within the mainstem of the Ventura River, Appendix 32 shows the general trend that has been observed of increasing riparian and within channel vegetation over time since 2009.

## 7.7 *Underwater Video Monitoring*

As time allowed, a pilot study of an underwater video monitoring system was continued to determine if remote monitoring for adults or smolts is feasible within the Ventura River or tributaries. The monitoring system was placed at selected locations when water conditions were suitable to record fish rearing, holding, or migrating. The system consisted of an underwater video camera attached to a DVR that can record for 6-8 hours at a time. The system was powered by a 12 volt DC battery so the system could be placed anywhere within the basin. The video was reviewed to determine presence or absence and relative numbers of steelhead. If this pilot study is successful, it may be expanded and developed into a more quantitative monitoring tool. This the system also was used at the fish ladder entrance during post-storm observations. Underwater video monitoring was not conducted during the 2017 fish passage season.

## 7.8 *Stranding Surveys*

Stranding surveys were conducted during the reporting period as part of other monitoring and evaluations (i.e., impediment, snorkel, and spawning surveys) and no stranded *O. mykiss* were observed.

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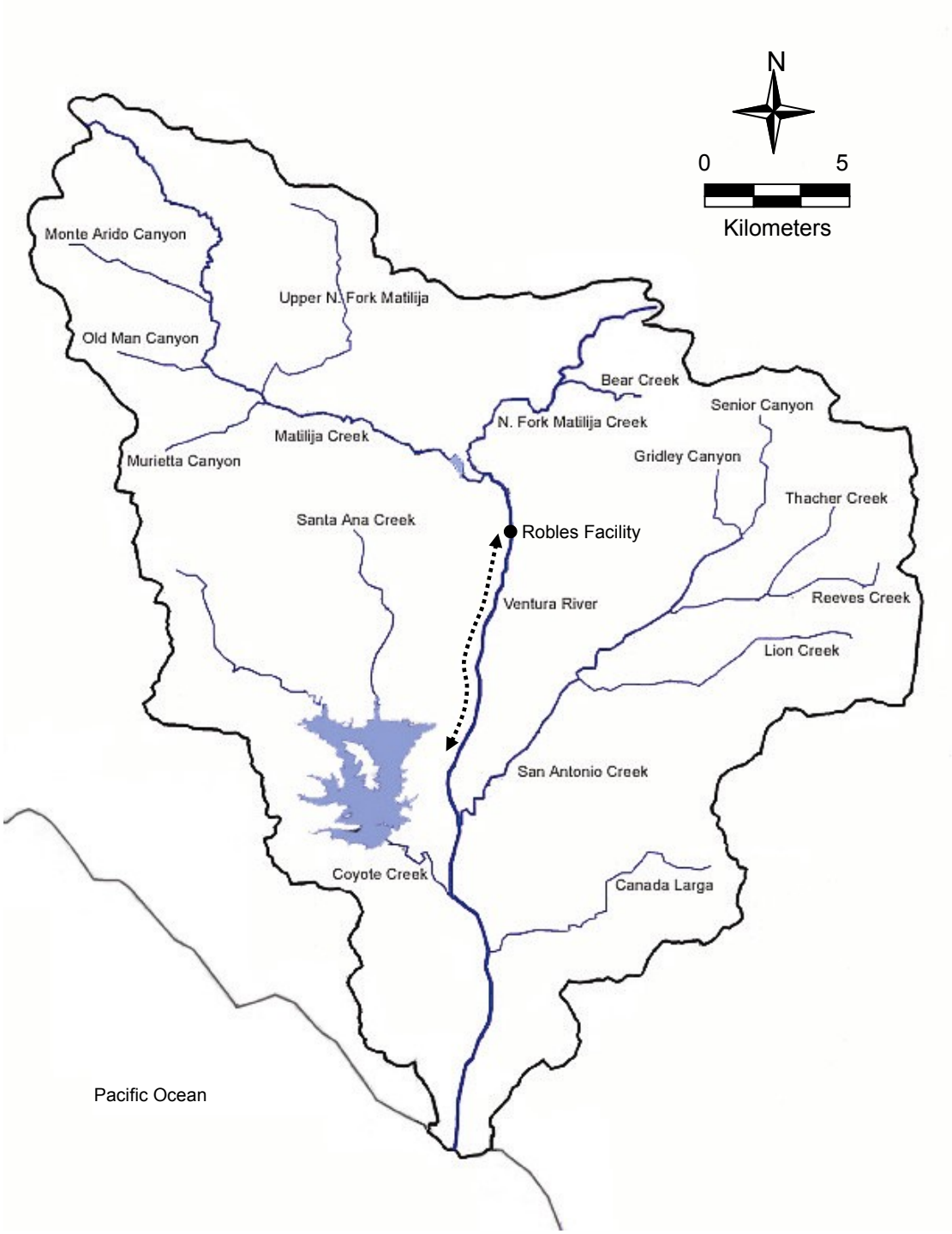
# 9.0 APPENDICES




Appendix 1. Basin map of the Ventura River. The Robles Fish Passage Facility is identified by the black dot and the Robles Reach is identified by the dashed line downstream of the Robles Facility.

Appendix 2. Summary data of impediment sites selected for upstream fish migration impediment evaluations.

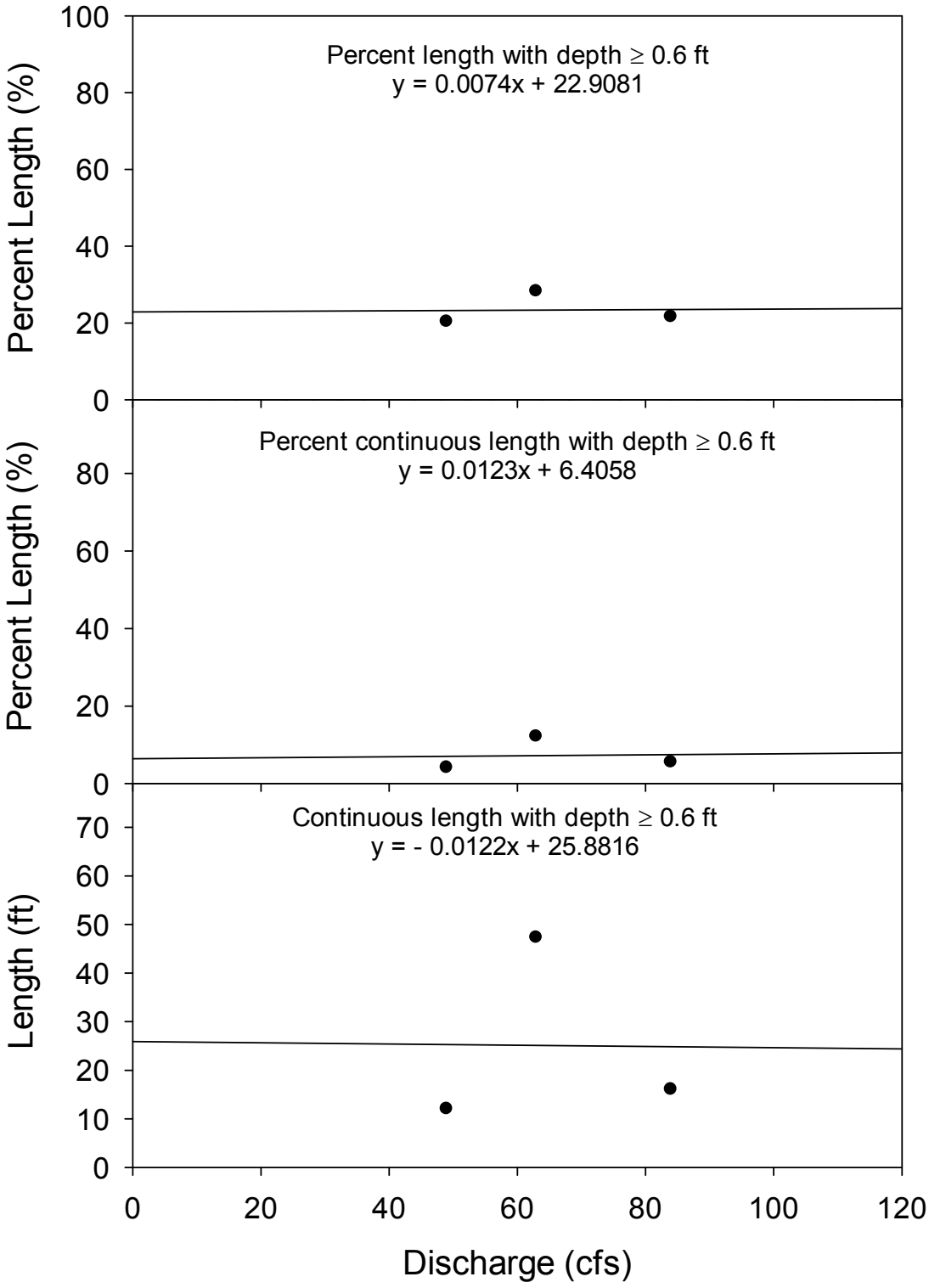
| Site No. | Latitude (N) | Longitude (W) | km | Habitat Type[a] | Site Description | Length (m) | Slope (%) | Percent Substrate[b] | | | | | | Active Channel Width (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | SO | SD | GR | CB | BD | BR | |
| 10 | 34.365265° | 119.311082° | 11 | RI | Near Casitas Springs at bottom of levy | 38.2 | 1.0 | 0 | 0 | 10 | 70 | 20 | 0 | 44.5 |
| 3-2 | 34.373789° | 119.308417° | 12 | RB | Near Casitas Springs at top of levy | 22.0 | 3.7 | 10 | 5 | 10 | 65 | 10 | 0 | 27.0 |
| 4 | 34.384743° | 119.310030° | 14 | RI | 0.5 km upstream of San Antonio Cr. confluence | 23.8 | 5.0 | 0 | 0 | 0 | 15 | 85 | 0 | 27.9 |
| 5-2 | 34.396095° | 119.309537° | 15 | RI | 0.4 km downstream of Santa Ana Blvd. bridge | 8.4 | 7.0 | 0 | 5 | 5 | 45 | 45 | 0 | 50.6 |
| 6-4 | 34.411318° | 119.301491° | 17 | CB | 1.4 km upstream of Santa Ana Blvd. bridge | 26.1 | 5.0 | 0 | 0 | 0 | 65 | 35 | 0 | 33.8 |
| 9 | 34.426708° | 119.301831° | 19 | RI | 0.2 km upstream of Hwy 150 bridge | 67.9 | 1.5 | 0 | 0 | 0 | 30 | 70 | 0 | 32.4 |
| 7 | 34.438184° | 119.299528° | 20 | RB | 1.1 km upstream of Hwy 150 bridge | 31.6 | 2.0 | 5 | 0 | 10 | 40 | 45 | 0 | 65.9 |

[a]The habitat types are: RB = rapid with protruding boulders, RI = riffle, and CB = cascade over boulders.
[b]The substrate types are: SO = silt and organics, SD = sand, GR = gravel, CB = cobble, BD = boulders, and BR = bedrock.

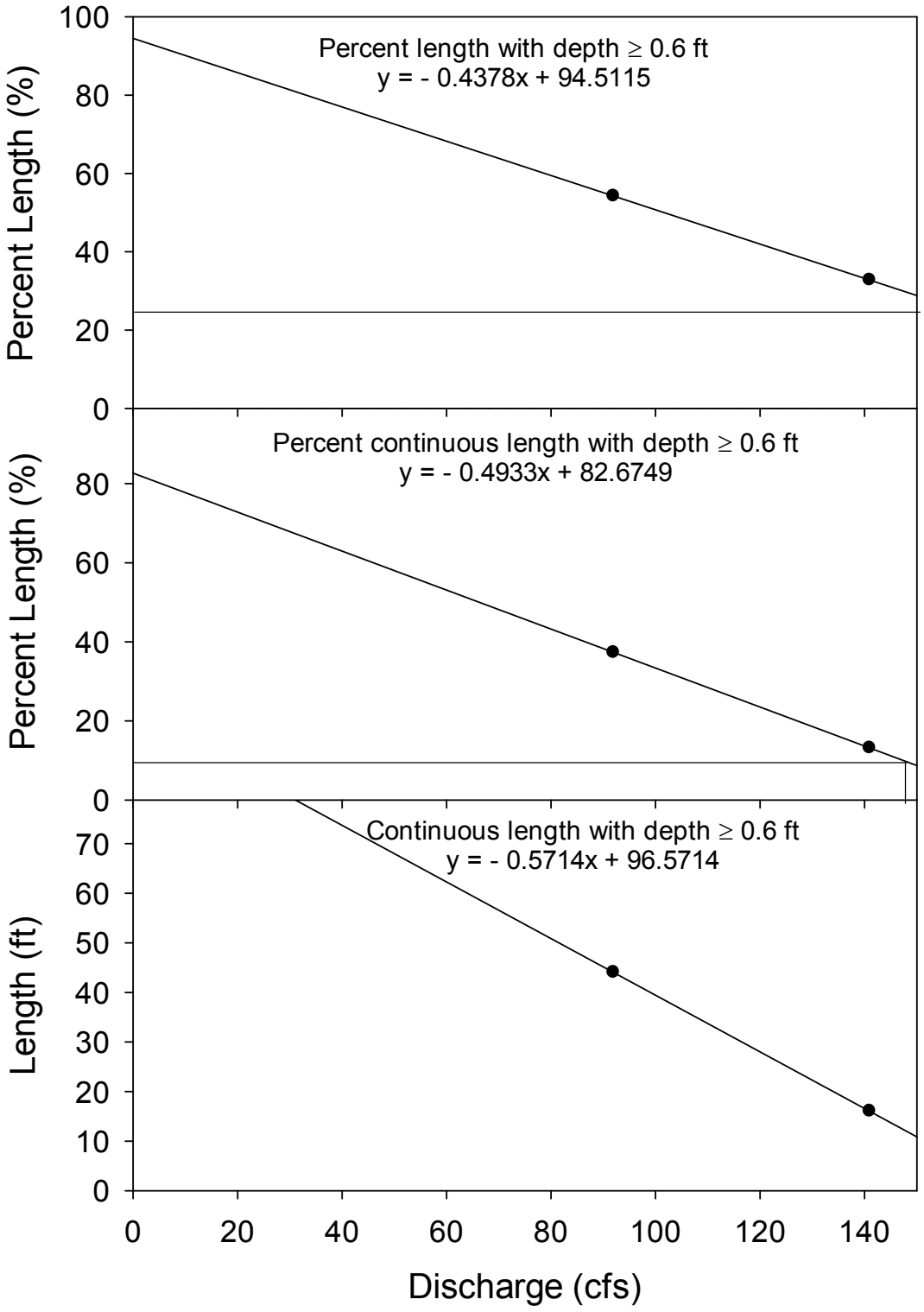
Appendix 3. Completed transects at impediment sites for ramp down target discharges from the Robles Fish Facility through 2017.

| Robles Discharge (cfs) | Impediment Sites | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 3-2 | 4 | 5-2 | 6-2<br>6-3 | 6-4 | 7 | 9 | 10 | 10-2 |
| 171 | x | | x | x, x | | | x | x | |
| 100 | | x | x | | | x | | x | |
| 82 | x, x | x | | | | x, x | x, x | x | |
| 74 | | x | x, x | x, x | x | x | x | | |
| 68 | x | | | | x | x | x | | x |
| 62 | x | x, x, x, x | x | x | | x | x | x | x |
| 56 | x | | x | x | x | x | x | dry | |
| 50 | x | x | x | x, x | x | x, x | x | x, x | x |
| 40 | x | x, x, x | x, x | x | x | x, x, x | x, x, x | x | x |
| 30 | x | x, x | x | x | x | x, x, x | x, x | x | x |
| 20 | | x | | | | | x | | |

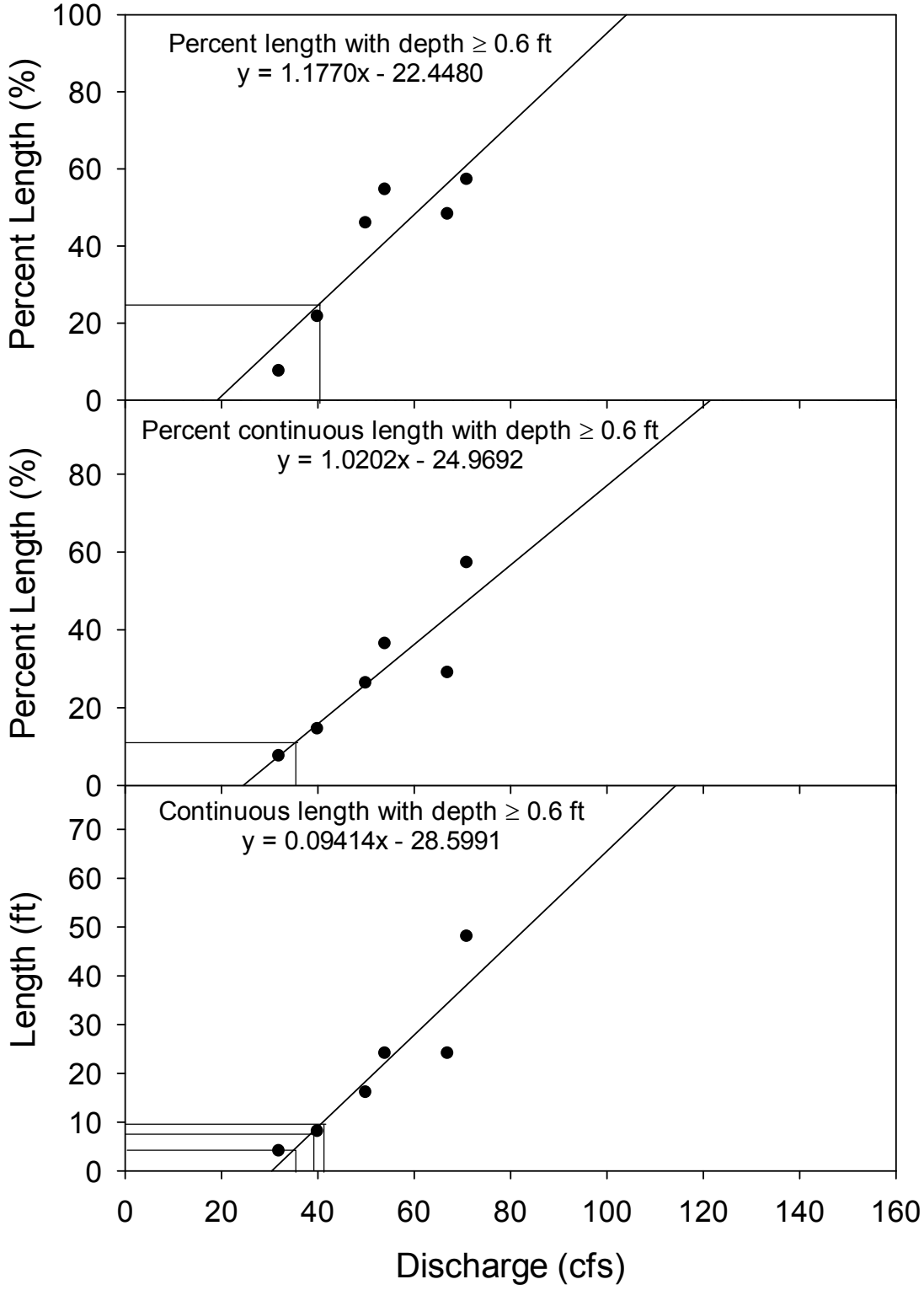
Completed transects rounded to nearest Robles discharge (e.g., the four transects measured at Site 4 ranged from 61-63 cfs) based on mean 2.6 rkm/h lag time and averaging hourly discharge of released water from Robles. Colors correspond to year of survey: x = 2010, x = 2011, x = 2014, x = 2017.



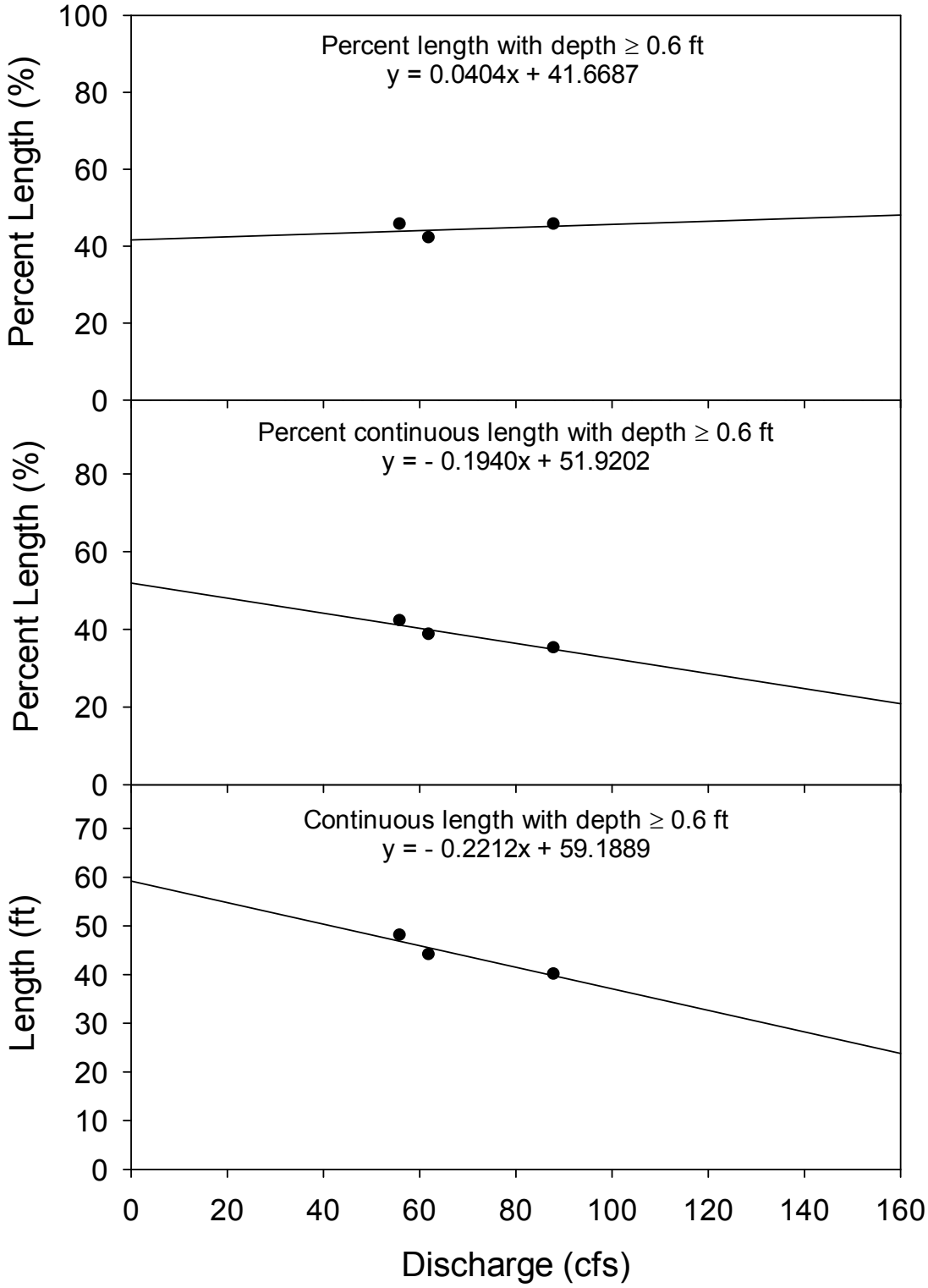

Appendix 4. Relation between Robles discharge and water depth at Site 3-2 near Casitas Springs and resulting discharge for various passage criteria.



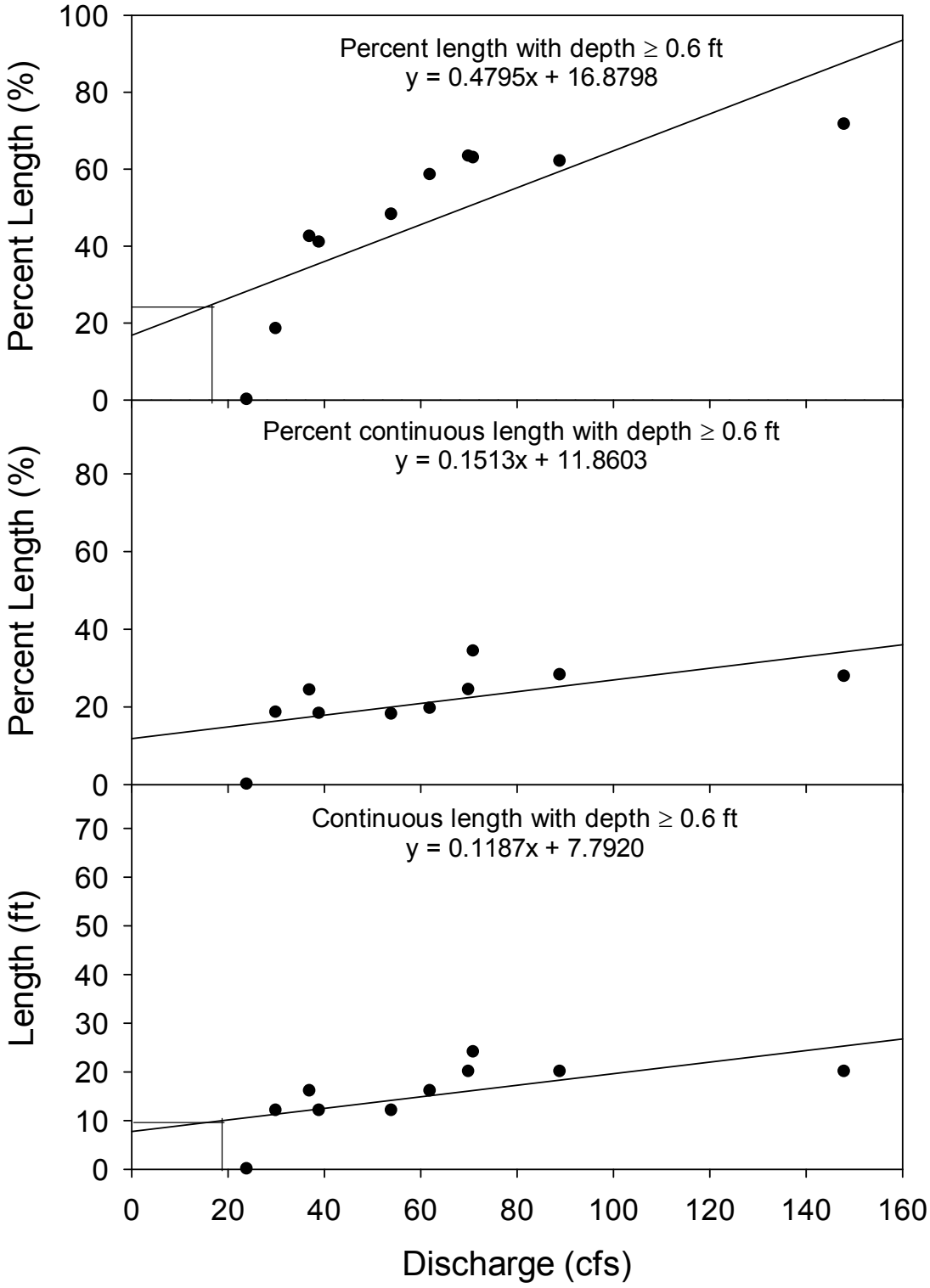

Appendix 5. Relation between Robles discharge and water depth at Site 5-2 downstream of Santa Ana Bridge and resulting discharge for various passage criteria.



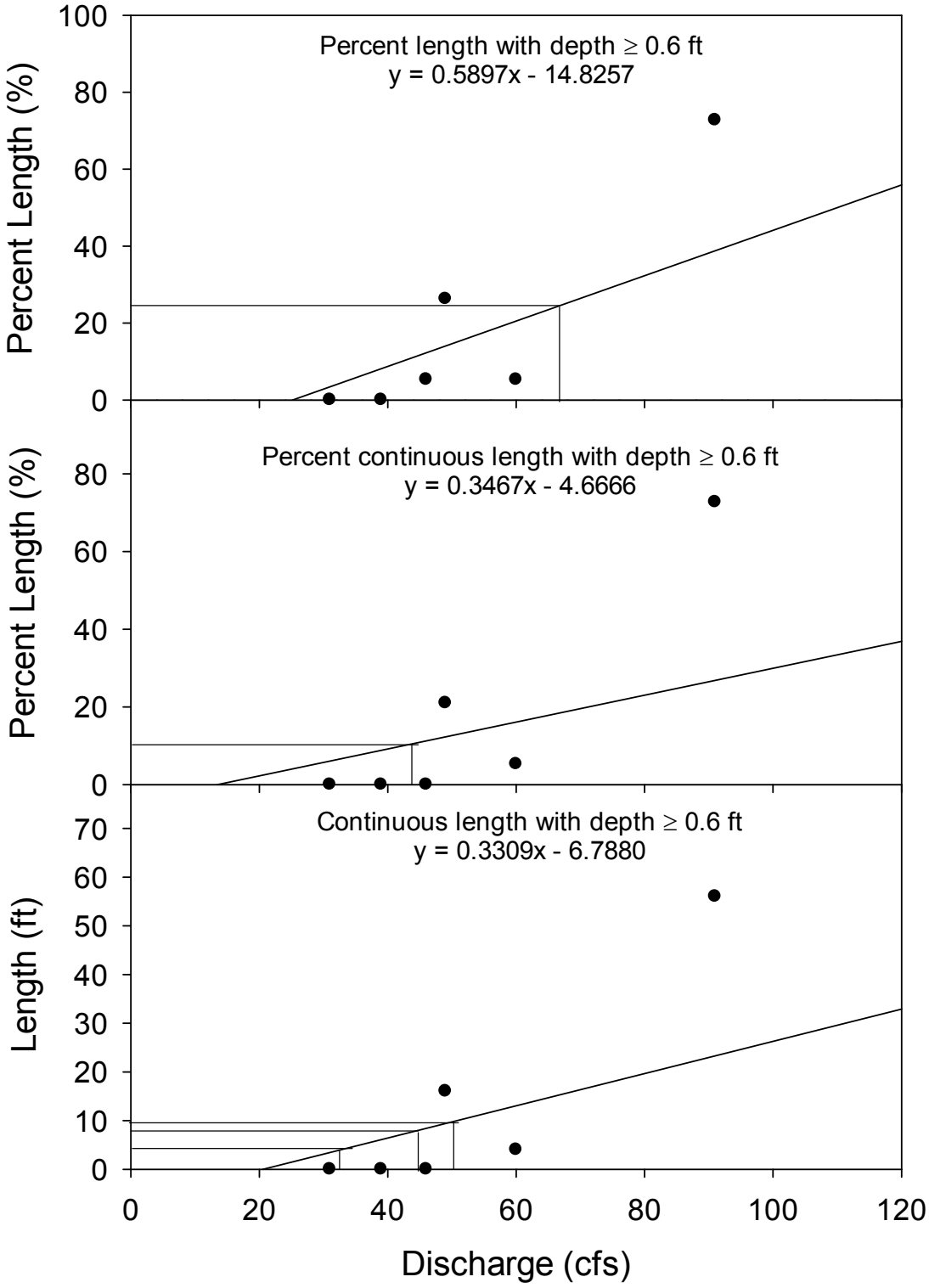

Appendix 6. Relation between Robles discharge and water depth at Site 6-4 upstream of Santa Ana Bridge and resulting discharge for various passage criteria.



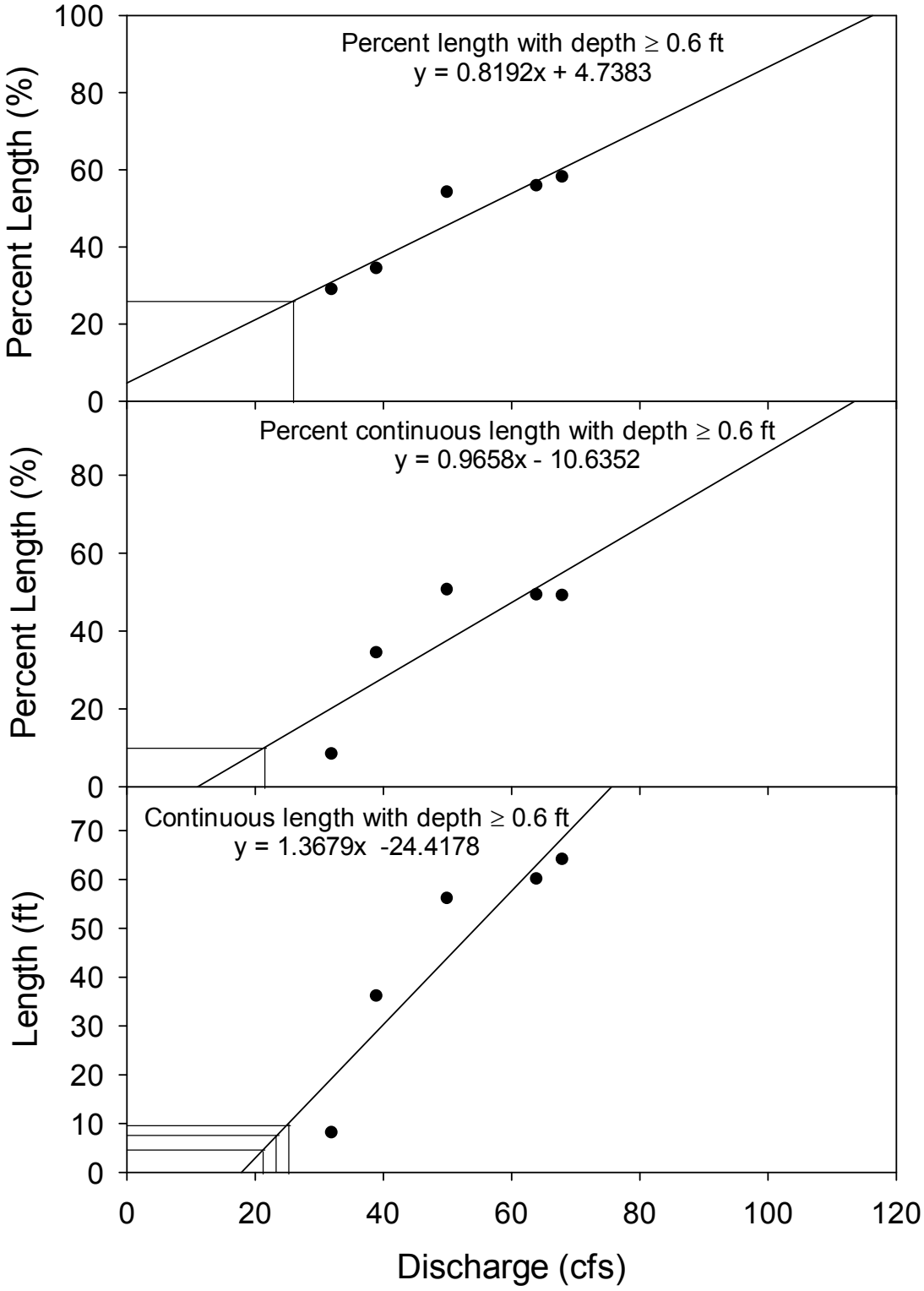

Appendix 7. Relation between Robles discharge and water depth at Site 7 upstream of Hwy 150 bridge and resulting discharge for various passage criteria.




Appendix 8. Relation between Robles discharge and water depth at Site 9 upstream of Hwy 150 bridge and resulting discharge for various passage criteria.




Appendix 9. Relation between Robles discharge and water depth at Site 10 downstream of Casitas Springs and resulting discharge for various passage criteria.




Appendix 10. Relation between Robles discharge and water depth at Site 10-2 downstream of Casitas Springs and resulting discharge for various passage criteria.

Appendix 11. Regression equations and statistics of five passage criteria correlating Robles discharge and water depth at potential impediment sites.

| | % Total Length with Depth ≥ 0.6 ft | | | % Continuous Length with Depth ≥ 0.6 ft | | | Continuous Length (ft) with Depth ≥ 0.6 ft | | |
|---|---|---|---|---|---|---|---|---|---|
| Site | Equation | $R^2$ | p-value | Equation | $R^2$ | p-value | Equation | $R^2$ | p-value |
| 3-2 | y=0.0074x+22.9081 | 0.00 | 0.98 | y=0.0123x+6.4058 | 0.00 | 0.97 | y= -0.01222x+25.8816 | 0.00 | 0.99 |
| 5-2 | y=-0.4378x+94.5115 | 1.00 | N/A | y=-0.4933+82.6749 | 1.00 | N/A | y=-0.5714x+96.5714 | 1.00 | N/A |
| 6-4 | y=1.1770x-22.4480 | 0.79 | 0.02 | y=1.0202x-24.9692 | 0.77 | 0.02 | y=0.9414X-28.5991 | 0.82 | 0.01 |
| 7 | y=0.0404x+41.6687 | 0.12 | 0.78 | y=-0.1940x+51.9202 | 0.88 | 0.22 | y=-0.2212X+59.1889 | 0.88 | 0.22 |
| 9 | y=0.4795x+16.8798 | 0.60 | 0.01 | y=0.1513x+11.8603 | 0.36 | 0.07 | y=0.1187x+7.7920 | 0.41 | 0.05 |
| 10 | y=0.5897x-14.8257 | 0.72 | 0.02 | y=0.3467x-4.6666 | 0.36 | 0.16 | y=0.3309x-6.7880 | 0.50 | 0.08 |
| 10-2 | y=0.8192x+4.7383 | 0.88 | 0.02 | y=0.9658x-10.6352 | 0.69 | 0.08 | y=1.3679x-24.4178 | 0.84 | 0.03 |

Appendix 12. Calculated discharge (cfs) required from the Robles Fish Facility to meet five adult passage criteria.

| Site | 25% Total length with depth ≥ 0.6 ft[a] | 10% Continuous length with depth ≥ 0.6 ft[a] | Minimum discharge to meet Thompson criteria[a] | 10-ft Continuous length with depth ≥ 0.6 ft[b] | 8-ft Continuous length with depth ≥ 0.6 ft[c] | 5-ft Continuous length with depth ≥ 0.6 ft[d] |
|---|---|---|---|---|---|---|
| 3-2 | 283 | 292 | 292 | 1,300 | 1,463 | 1,709 |
| 5-2 | 159 | 147 | 159 | 152 | 155 | 160 |
| 6-4 | 40 | 34 | 40 | 41 | 39 | 36 |
| 7 | -413 | 216 | 216 | 222 | 231 | 245 |
| 9 | 17 | -7 | 17 | 19 | 2 | -24 |
| 10 | 68 | 42 | 68 | 51 | 45 | 36 |
| 10-2 | 25 | 21 | 25 | 25 | 24 | 22 |

[a]Thompson (1972).
[b]Harrison et al. (2006).
[c]Santa Ynez River Technical Advisory Committee (2000).
[d]Dettman and Kelly (1986).

A.

B.

C.

D.

Appendix 13a. Photos of impediment Site 3-2 on February 8, 2017 during 50 cfs discharge release from Robles Fish Facility, looking from: (A) upstream, (B) downstream, (C) left to right bank, and (D) right to left bank.

A.

B.

C.

D.

Appendix 13b. Photos of impediment site number 5-2 on February 20, 2017 during 74 cfs discharge release from Robles Fish Facility, looking from: (A) upstream, (B) downstream, (C) left to right bank, and (D) right to left bank.

A.

B.

C.

D.

Appendix 13c. Photos of impediment site number 6-4 on February 24, 2017during a 50 cfs discharge release from Robles Fish Facility, looking from: (A) upstream, (B) downstream, (C) left to right bank, and (D) right to left bank.

A.

B.

C.

D.

Appendix 13d. Photos of impediment site number 7 on February 22, 2017 during a 54 cfs discharge release from Robles Fish Facility, looking from: (A) upstream, (B) downstream, (C) left to right bank, and (D) right to left bank.

A.

B.

C.

D.

Appendix 13e. Photos of impediment site number 9 on February 7, 2017 during 50 cfs discharge release from Robles Fish Facility, looking from: (A) upstream, (B) downstream, (C) left to right bank, and (D) right to left bank.

A.

B.

C.

D.

Appendix 13f. Photos of impediment site number 10 on February 8, 2017 during 50 cfs discharge releases from Robles Fish Facility, looking from: (A) upstream, (B) downstream, (C) left to right bank, and (D) right to left bank.

A.

B.

C.

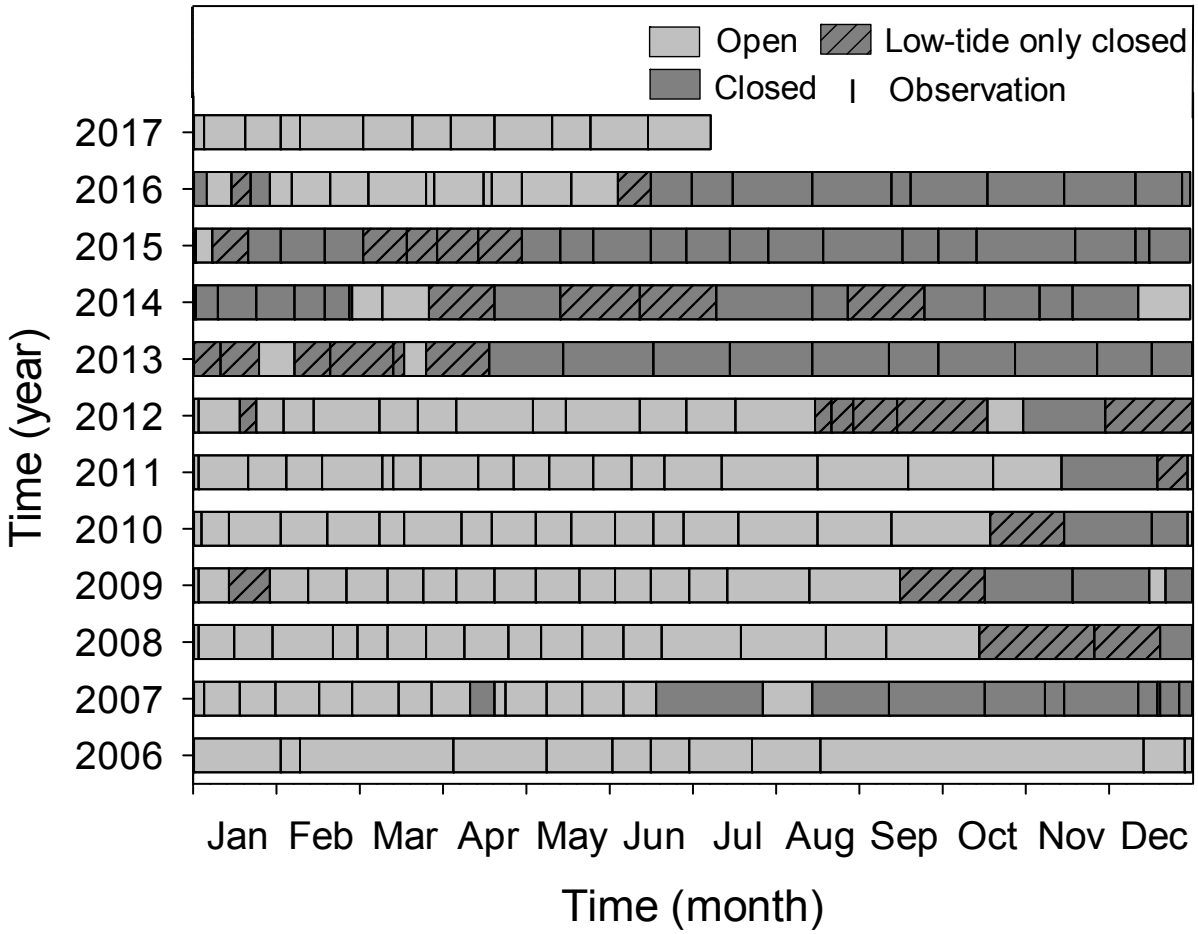
D.

Appendix 13g. Photos of impediment site number 10-2 on February 24, 2017 during 50 cfs discharge releases from Robles Fish Facility, looking from: (A) upstream, (B) downstream, (C) left to right bank, and (D) right to left bank.

Appendix 14. Ventura River sandbar monitoring data from July 2016 through June 2017.

| | | | | | High Tide | | Low Tide | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Sandbar Breached (Y/N) | Time (24h) | Tide Height (ft) | Tidal State | Time (24h) | Height (ft) | Time (24h) | Height (ft) | Mean Daily Discharge at Foster[a] (cfs) | Mean Daily Discharge at Robles (cfs) | Notes |
| 07/15/2016 | N | 9:05 | 3.16 | ebb | 8:15 | 3.25 | 12:53 | 2.29 | 0.02 | 0.0 | Sandbar closed |
| 08/17/2016 | N | 9:27 | 4.37 | slack | 9:59 | 4.46 | 3:49 | -0.50 | 0.01 | 0.0 | Sandbar closed |
| 09/15/2016 | N | 8:55 | 5.03 | ebb | 9:19 | 5.09 | 3:12 | -0.22 | 0.00 | 0.0 | If breached, east bank |
| 09/22/2016 | N | 10:10 | 3.17 | flood | 14:27 | 5.29 | 8:05 | 2.44 | 0.00 | 0.0 | If breached, east bank |
| 10/20/2016 | N | 8:15 | 2.83 | flood | 12:48 | 5.72 | 6:39 | 2.35 | 0.00 | 0.0 | Sandbar closed |
| 11/17/2016 | N | 9:00 | 5.65 | flood | 10:32 | 6.35 | 4:27 | 2.06 | 0.00 | 0.0 | Sandbar closed |
| 12/13/2016 | N | 8:00 | 7.04 | slack | 8:02 | 7.04 | 1:52 | 1.38 | 0.00 | 0.0 | Sandbar closed |
| 12/30/2016 | Y | 15:30 | -0.31 | slack | 9:12 | 5.82 | 16:31 | -0.62 | 0.00 | 0.0 | Open, west bank |
| 01/03/2017 | Y | 13:45 | 3.89 | flood | 11:54 | 4.49 | 19:12 | 0.31 | 0.00 | 0.0 | Open, west bank |
| 01/18/2017 | Y | 9:00 | 2.18 | slack | 13:27 | 3.40 | 8:17 | 2.12 | 0.02 | 0.0 | Open, west bank |
| 01/31/2017 | Y | 9:30 | 4.42 | flood | 10:58 | 4.94 | 5:08 | 1.60 | 12.00 | 27.0 | Open, west bank |
| 02/07/2017 | Y | 12:55 | -0.83 | ebb | 6:09 | 5.91 | 13:30 | -0.94 | 64.00 | 54.0 | Open, west bank |
| 03/02/2017 | Y | 15:00 | 2.31 | ebb | 11:50 | 4.02 | 17:55 | 0.81 | 51.00 | 31.0 | Open, east bank |
| 03/20/2017 | Y | 9:00 | 1.64 | ebb | 3:10 | 3.85 | 11:37 | 0.98 | 39.00 | 31.0 | Open, east bank |
| 04/03/2017 | Y | 8:45 | 0.71 | ebb | 2:53 | 4.76 | 10:43 | 0.01 | 27.30 | 27.0 | Open, west bank |
| 04/19/2017 | Y | 9:03 | 1.40 | ebb | 3:28 | 3.77 | 11:32 | 0.63 | 22.20 | 17.0 | Open, west bank |
| 05/10/2017 | Y | 9:10 | 3.54 | flood | 10:20 | 3.89 | 4:17 | -0.25 | 17.60 | 11.0 | Estuary open west bank |
| 05/24/2017 | Y | 13:00 | 1.80 | ebb | 9:22 | 4.28 | 14:51 | 0.93 | 12.60 | 6.0 | Estuary open west bank |
| 06/14/2017 | Y | 8:50 | 0.32 | flood | 14:40 | 3.57 | 7:43 | 0.07 | 5.89 | 0.0 | Estuary open west bank |
| 06/22/2017 | Y | 11:09 | 4.22 | slack | 11:02 | 4.22 | 15:15 | 1.54 | 13.00 | 0.0 | Open, west bank |

[a]USGS gauging station number 11118500, downstream of Foster Park.




Appendix 15. Sandbar status at the mouth of the Ventura River from 2006 through July of 2017. Each observation is indicated by vertical lines and the sandbar status was assumed to remain unchanged until the next observation.

Appendix 16. Weekly fish attraction counts at the Robles Fish Facility during 2017.

| Date | Method | Direction | Length (m) | Temp (°C) | Turbidity (NTU) | Robles Discharge (CFS) | Species[a] | Count |
|---|---|---|---|---|---|---|---|---|
| 01/10/2017 | Bank | Downstream | 200 | 9 | 2 | 1.1 | NFO | 0 |
| 01/10/2017 | Bank | Upstream | 140 | 9 | 2 | 1.1 | NFO | 0 |
| 01/22/2017 | Bank | Downstream | 200 | 9 | 20 | 41 | NFO | 0 |
| 01/22/2017 | Bank | Upstream | 140 | 9 | 20 | 41 | NFO | 0 |
| 02/10/2017 | Bank | Downstream | 200 | 15 | 5 | 50 | NFO | 0 |
| 02/10/2017 | Bank | Upstream | 140 | 15 | 5 | 50 | NFO | 0 |
| 02/27/2017 | Bank | Downstream | 200 | 10 | 7 | 30 | NFO | 0 |
| 02/27/2017 | Bank | Upstream | 140 | 10 | 7 | 30 | NFO | 0 |
| 03/03/2017 | Bank | Downstream | 200 | 12 | 4 | 31 | NFO | 0 |
| 03/03/2017 | Bank | Upstream | 140 | 12 | 4 | 31 | NFO | 0 |
| 03/07/2017 | Snorkel | Downstream | 200 | 17 | 3 | 31 | NFO | 0 |
| 03/07/2017 | Snorkel | Upstream | 140 | 17 | 3 | 31 | NFO | 0 |
| 03/17/2017 | Bank | Downstream | 200 | 15 | 2 | 32 | NFO | 0 |
| 03/17/2017 | Bank | Upstream | 140 | 15 | 2 | 32 | NFO | 0 |
| 03/23/2017 | Bank | Downstream | 200 | 15 | 2 | 32 | NFO | 0 |
| 03/23/2017 | Bank | Upstream | 140 | 15 | 2 | 32 | OMY | 2 |
| 03/31/2017 | Snorkel | Downstream | 200 | 17 | 2 | 29 | NFO | 0 |
| 03/31/2017 | Snorkel | Upstream | 140 | 17 | 2 | 29 | NFO | 0 |
| 04/14/2017 | Snorkel | Downstream | 200 | 14 | 2 | 23 | NFO | 0 |
| 04/14/2017 | Snorkel | Upstream | 140 | 14 | 2 | 23 | NFO | 0 |
| 04/21/2017 | Bank | Downstream | 200 | 19 | 2 | 19 | NFO | 0 |
| 04/21/2017 | Bank | Upstream | 140 | 19 | 2 | 19 | NFO | 0 |
| 04/27/2017 | Snorkel | Downstream | 200 | 19 | 2 | 15 | NFO | 0 |
| 04/27/2017 | Snorkel | Upstream | 140 | 19 | 2 | 15 | NFO | 0 |
| 05/05/2017 | Snorkel | Downstream | 200 | 22 | 2 | 9 | NFO | 0 |
| 05/05/2017 | Snorkel | Upstream | 140 | 22 | 2 | 9 | NFO | 0 |
| 5/11/2017 | Snorkel | Downstream | 200 | 18 | 1 | 10 | NFO | 0 |
| 05/11/2017 | Snorkel | Upstream | 140 | 18 | 1 | 10 | NFO | 0 |
| 05/19/2017 | Snorkel | Downstream | 200 | 18 | <1 | 7.4 | NFO | 0 |
| 05/19/2017 | Snorkel | Upstream | 140 | 18 | <1 | 7.4 | NFO | 0 |
| 05/24/2017 | Snorkel | Downstream | 200 | 20 | <1 | 5.5 | NFO | 0 |
| 05/24/2017 | Snorkel | Upstream | 140 | 20 | <1 | 5.5 | NFO | 0 |
| 06/02/2017 | Snorkel | Downstream | 200 | 21 | 2 | 3.8 | NFO | 0 |
| 06/02/2017 | Snorkel | Upstream | 140 | 21 | 2 | 3.8 | NFO | 0 |
| 06/08/2017[b] | Snorkel | Downstream | 40 | 20 | <1 | 3.6 | NFO | 0 |
| 06/08/2017 | Snorkel | Upstream | 140 | 20 | <1 | 3.6 | NFO | 0 |
| 06/13/2017[b] | Snorkel | Downstream | 40 | 19 | 1 | 3.0 | NFO | 0 |
| 06/13/2017 | Snorkel | Upstream | 140 | 19 | 1 | 3.0 | NFO | 0 |
| 06/23/2017[b] | Snorkel | Downstream | 140 | 25 | 2 | 0.6 | NFO | 0 |
| 06/23/2017 | Snorkel | Upstream | 140 | 25 | 2 | 0.6 | NFO | 0 |
| 06/29/2017[b] | Snorkel | Downstream | 40 | 26 | 3 | 0.2 | NFO | 0 |
| 06/29/2017 | Snorkel | Upstream | 140 | 26 | 3 | 0.2 | NFO | 0 |
| | | Upstream | 2,940 m | | | | Upstream | 2 |
| | | Downstream | 3,360 m | | | | Downstream | 0 |
| | | Total | 6,300 m | | | | Total | 2 |

[a]OMY = *O. mykiss* and NFO = no fish observed.
[b]Partial survey due to dry habitat unit.

Appendix 17. Post-storm fish attraction counts of *O. mykiss* at the Robles Fish Facility for 2017 Storm Events.

| Date | Time | Method | Location | Temp (°C)[a] | Turbidity (NTU)[a] | Robles Discharge (CFS)[a] | Species[b] | Count |
|---|---|---|---|---|---|---|---|---|
| 01/21/2017 | 13:45 | Bank | Entrance Pool | 9 | 46 | 67 | NFO | 0 |
| 01/22/2017 | 11:00 | Bank | Entrance Pool | 9 | 20 | 41 | NFO | 0 |
| 01/23/2017 | 13:45 | Bank | Entrance Pool | 9 | 334 | 147 | NFO | 0 |
| 01/24/2017 | 12:00 | Bank | Entrance Pool | 9 | 75 | 95 | NFO | 0 |
| 01/25/2017 | 15:20 | Bank | Entrance Pool | 10 | 36 | 72 | NFO | 0 |
| 01/26/2017 | 16:15 | Bank | Entrance Pool | 10 | 30 | 53 | NFO | 0 |
| 01/27/2017 | 15:15 | Bank | Entrance Pool | 10 | 18 | 39 | NFO | 0 |
| 01/28/2017 | 14:30 | Bank | Entrance Pool | 9 | 14 | 34 | NFO | 0 |
| 01/29/2017 | 15:15 | Bank | Entrance Pool | 11 | 7 | 28 | NFO | 0 |
| 01/30/2017 | 14:00 | Bank | Entrance Pool | 11 | 7 | 27 | NFO | 0 |
| 01/31/2017 | 13:45 | Bank | Entrance Pool | 10 | 6 | 30 | NFO | 0 |
| 02/01/2017 | 14:00 | Bank | Entrance Pool | 11 | 7 | 25 | NFO | 0 |
| 02/02/2017 | 14:40 | Bank | Entrance Pool | 11 | 4 | 24 | NFO | 0 |
| 02/03/2017 | 14:00 | Bank | Entrance Pool | 11 | 4 | 29 | NFO | 0 |
| 02/07/2017 | 16:30 | Bank | Entrance Pool | 11 | 67 | 55 | NFO | 0 |
| 02/08/2017 | 10:00 | Bank | Entrance Pool | 13 | 60 | 49 | NFO | 0 |
| 02/09/2017 | 11:00 | Bank | Entrance Pool | 14 | 7 | 50 | NFO | 0 |
| 02/10/2017 | 11:45 | Bank | Entrance Pool | 13 | 6 | 51 | NFO | 0 |
| 02/11/2017 | 12:15 | Bank | Entrance Pool | 13 | 5 | 45 | NFO | 0 |
| 02/12/2017 | 10:00 | Bank | Entrance Pool | 12 | 5 | 50 | NFO | 0 |
| 02/13/2017 | 14:30 | Bank | Entrance Pool | 12 | 3 | 50 | NFO | 0 |
| 02/14/2017 | 15:45 | Bank | Entrance Pool | 13 | 2 | 48 | NFO | 0 |
| 02/15/2017 | 14:00 | Bank | Entrance Pool | 12 | 2 | 44 | NFO | 0 |
| 02/16/2017 | 14:00 | Bank | Entrance Pool | 12 | 2 | 43 | NFO | 0 |
| 02/17/2017 | 10:00 | Bank | Entrance Pool | 12 | 1,750 | 48 | NFO | 0 |
| 02/18/2017 | 10:30 | Bank | Entrance Pool | 12 | 1,200 | 2,795 | NFO | 0 |
| 02/19/2017 | 10:30 | Bank | Entrance Pool | 12 | 195 | 55 | NFO | 0 |
| 02/20/2017 | 9:30 | Bank | Entrance Pool | 12 | 87 | 97 | NFO | 0 |
| 02/21/2017 | 10:00 | Bank | Entrance Pool | 12 | 48 | 65 | NFO | 0 |
| 02/22/2017 | 9:30 | Bank | Entrance Pool | 12 | 38 | 61 | NFO | 0 |
| 02/23/2017 | 9:15 | Bank | Entrance Pool | 10 | 23 | 54 | NFO | 0 |
| 02/24/2017 | 11:15 | Bank | Entrance Pool | 10 | 23 | 49 | NFO | 0 |
| 02/25/2017 | 12:00 | Bank | Entrance Pool | 10 | 19 | 50 | NFO | 0 |
| 02/26/2017 | 9:15 | Bank | Entrance Pool | 10 | 11 | 51 | NFO | 0 |
| 02/27/2017 | 9:15 | Bank | Entrance Pool | 10 | 7 | 30 | NFO | 0 |

[a]Environmental conditions at time of survey.
[b]OMY = *O. mykiss* and NFO = no fish observed.

Appendix 18. Monthly flow summary for Robles Fish Facility, reporting year 2016-2017.

**Ventura River Flow Assessment**
**Water Year 2016 -2017**

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| | Matilija Ck | North Fork | Sum of Creek | Required | Fishway | VRNMO | Diversion | Total Inflow |
| **Jul-16** | D/S Dam | Matilija Ck.* | Flows | Flow Release | Ladder | Weir | Canal | |
| | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) |
| 1 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 2 | 0.6 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 3 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 4 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 5 | 0.6 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 6 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 7 | 0.5 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 8 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 9 | 0.4 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 10 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 11 | 0.3 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 12 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 13 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 14 | 0.3 | 0.2 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 15 | 0.2 | 0.2 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 16 | 0.2 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 17 | 0.2 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 18 | 0.2 | 0.2 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 19 | 0.2 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 20 | 0.2 | 0.2 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 21 | 0.2 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 22 | 0.1 | 0.2 | 0.3 | 20 | 0 | 0 | 0 | 0 |
| 23 | 0.1 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 24 | 0.1 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 25 | 0.2 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 26 | 0.2 | 0.2 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 27 | 0.2 | 0.2 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 28 | 0.2 | 0.2 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 29 | 0.1 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 30 | 0.2 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 31 | 0.3 | 0.2 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| Totals | 10 | 8 | 17 | 620 | 0 | 0 | 0 | 0 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| Aug-16 | Matilija Ck D/S Dam (cfs) | North Fork Matilija Ck.* (cfs) | Sum of Creek Flows (cfs) | Required Flow Release (cfs) | Fishway Ladder (cfs) | VRNMO Weir (cfs) | Diversion Canal (cfs) | Total Inflow (cfs) |
| 1 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 2 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 3 | 0.4 | 0.2 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 4 | 0.6 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 5 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 6 | 0.5 | 0.3 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 7 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 8 | 0.3 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 9 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 10 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 11 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 12 | 0.2 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 13 | 0.2 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 14 | 0.3 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 15 | 0.3 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 16 | 0.2 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 17 | 0.2 | 0.2 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 18 | 0.2 | 0.2 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 19 | 0.1 | 0.2 | 0.3 | 20 | 0 | 0 | 0 | 0 |
| 20 | 0.1 | 0.3 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 21 | 0.2 | 0.3 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 22 | 0.2 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 23 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 24 | 0.4 | 0.3 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 25 | 0.3 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 26 | 0.1 | 0.3 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 27 | 0.2 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 28 | 0.2 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 29 | 0.3 | 0.3 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 30 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 31 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| Totals | 9 | 8 | 17 | 620 | 0 | 0 | 0 | 0 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| Sep-16 | Matilija Ck D/S Dam (cfs) | North Fork Matilija Ck.* (cfs) | Sum of Creek Flows (cfs) | Required Flow Release (cfs) | Fishway Ladder (cfs) | VRNMO Weir (cfs) | Diversion Canal (cfs) | Total Inflow (cfs) |
| 1 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 2 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 3 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 4 | 0.3 | 0.3 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 5 | 0.3 | 0.3 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 6 | 0.3 | 0.3 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 7 | 0.3 | 0.3 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 8 | 0.4 | 0.3 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 9 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 10 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 11 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 12 | 0.4 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 13 | 0.4 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 14 | 0.4 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 15 | 0.4 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 16 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 17 | 0.3 | 0.4 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 18 | 0.2 | 0.4 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 19 | 0.3 | 0.4 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 20 | 0.3 | 0.4 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 21 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 22 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 23 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 24 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 25 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 26 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 27 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 28 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 29 | 0.3 | 0.4 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 30 | 0.4 | 0.4 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| Totals | 10 | 11 | 20 | 600 | 0 | 0 | 0 | 0 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| Oct-16 | Matilija Ck D/S Dam (cfs) | North Fork Matilija Ck.* (cfs) | Sum of Creek Flows (cfs) | Required Flow Release (cfs) | Fishway Ladder (cfs) | VRNMO Weir (cfs) | Diversion Canal (cfs) | Total Inflow (cfs) |
| 1 | 0.5 | 0.1 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 2 | 0.4 | 0.1 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 3 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 4 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 5 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 6 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 7 | 0.4 | 0.1 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 8 | 0.4 | 0.1 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 9 | 0.3 | 0.1 | 0.4 | 20 | 0 | 0 | 0 | 0 |
| 10 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 11 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 12 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 13 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 14 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 15 | 0.4 | 0.1 | 0.5 | 20 | 0 | 0 | 0 | 0 |
| 16 | 0.4 | 0.1 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 17 | 0.5 | 0.1 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 18 | 0.4 | 0.1 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 19 | 0.4 | 0.1 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 20 | 0.4 | 0.1 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 21 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 22 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 23 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 24 | 0.4 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 25 | 0.5 | 0.2 | 0.6 | 20 | 0 | 0 | 0 | 0 |
| 26 | 0.5 | 0.2 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 27 | 0.5 | 0.2 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 28 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 29 | 0.5 | 0.2 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 30 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 31 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| Totals | 13 | 4 | 17 | 620 | 0 | 0 | 0 | 0 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| Nov-16 | Matilija Ck D/S Dam (cfs) | North Fork Matilija Ck.* (cfs) | Sum of Creek Flows (cfs) | Required Flow Release (cfs) | Fishway Ladder (cfs) | VRNMO Weir (cfs) | Diversion Canal (cfs) | Total Inflow (cfs) |
| 1 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 2 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 3 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 4 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 5 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 6 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 7 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 8 | 0.6 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 9 | 0.5 | 0.2 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 10 | 0.5 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 11 | 0.6 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 12 | 0.6 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 13 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 14 | 0.6 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 15 | 0.5 | 0.3 | 0.7 | 20 | 0 | 0 | 0 | 0 |
| 16 | 0.5 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 17 | 0.5 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 18 | 0.5 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 19 | 0.5 | 0.3 | 0.8 | 20 | 0 | 0 | 0 | 0 |
| 20 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 21 | 0.7 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 22 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 23 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 24 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 25 | 0.6 | 0.3 | 0.9 | 20 | 0 | 0 | 0 | 0 |
| 26 | 0.7 | 0.3 | 1.0 | 20 | 0 | 0 | 0 | 0 |
| 27 | 0.7 | 0.3 | 1.0 | 20 | 0 | 0 | 0 | 0 |
| 28 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 29 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 30 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| Totals | 18 | 8 | 26 | 600 | 0 | 0 | 0 | 0 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| Dec-16 | Matilija Ck D/S Dam (cfs) | North Fork Matilija Ck.* (cfs) | Sum of Creek Flows (cfs) | Required Flow Release (cfs) | Fishway Ladder (cfs) | VRNMO Weir (cfs) | Diversion Canal (cfs) | Total Inflow (cfs) |
| 1 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 2 | 0.8 | 0.3 | 1.0 | 20 | 0 | 0 | 0 | 0 |
| 3 | 0.8 | 0.3 | 1.0 | 20 | 0 | 0 | 0 | 0 |
| 4 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 5 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 6 | 0.9 | 0.3 | 1.2 | 20 | 0 | 0 | 0 | 0 |
| 7 | 0.9 | 0.3 | 1.2 | 20 | 0 | 0 | 0 | 0 |
| 8 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 9 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 10 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 11 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 12 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 13 | 0.8 | 0.3 | 1.1 | 20 | 0 | 0 | 0 | 0 |
| 14 | 0.8 | 0.3 | 1.0 | 20 | 0 | 0 | 0 | 0 |
| 15 | 0.9 | 0.3 | 1.2 | 20 | 0 | 0 | 0 | 0 |
| 16 | 1.2 | 2.4 | 3.6 | 20 | 0 | 0 | 0 | 0 |
| 17 | 0.5 | 1.5 | 2.0 | 20 | 0 | 0 | 0 | 0 |
| 18 | 0.5 | 1.4 | 1.9 | 20 | 0 | 0 | 0 | 0 |
| 19 | 0.5 | 1.4 | 1.9 | 20 | 0 | 0 | 0 | 0 |
| 20 | 0.6 | 1.4 | 2.0 | 20 | 0 | 0 | 0 | 0 |
| 21 | 0.6 | 1.4 | 2.0 | 20 | 0 | 0 | 0 | 0 |
| 22 | 0.9 | 1.4 | 2.3 | 20 | 0 | 0 | 0 | 0 |
| 23 | 2.7 | 2.7 | 5.4 | 20 | 0 | 0 | 0 | 0 |
| 24 | 4.6 | 3.1 | 7.7 | 20 | 0 | 1 | 0 | 1 |
| 25 | 2.1 | 1.8 | 3.9 | 20 | 0 | 0 | 0 | 0 |
| 26 | 1.6 | 1.6 | 3.2 | 20 | 0 | 0 | 0 | 0 |
| 27 | 1.6 | 1.6 | 3.2 | 20 | 0 | 0 | 0 | 0 |
| 28 | 1.6 | 1.6 | 3.2 | 20 | 0 | 0 | 0 | 0 |
| 29 | 1.7 | 1.5 | 3.2 | 20 | 0 | 0 | 0 | 0 |
| 30 | 1.6 | 1.5 | 3.1 | 20 | 0 | 0 | 0 | 0 |
| 31 | 1.6 | 1.6 | 3.2 | 20 | 0 | 0 | 0 | 0 |
| Totals | 36 | 32 | 68 | 620 | 0 | 1 | 0 | 1 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| | Matilija Ck | North Fork | Sum of Creek | Required | Fishway | VRNMO | Diversion | Total Inflow |
| Jan-17 | D/S Dam (cfs) | Matilija Ck.* (cfs) | Flows (cfs) | Flow Release (cfs) | Ladder (cfs) | Weir (cfs) | Canal (cfs) | (cfs) |
| 1 | 1.7 | 1.6 | 3.3 | 20 | 0 | 0 | 0 | 0 |
| 2 | 1.6 | 1.6 | 3.2 | 20 | 0 | 0 | 0 | 0 |
| 3 | 1.4 | 1.6 | 3.0 | 20 | 0 | 0 | 0 | 0 |
| 4 | 2.1 | 1.6 | 3.7 | 20 | 0 | 0 | 0 | 0 |
| 5 | 3.7 | 1.8 | 5.5 | 20 | 0 | 0 | 0 | 0 |
| 6 | 2.3 | 1.7 | 4.0 | 20 | 0 | 0 | 0 | 0 |
| 7 | 2.6 | 2.5 | 5.1 | 20 | 0 | 0 | 0 | 0 |
| 8 | 3.5 | 2.2 | 5.7 | 20 | 0 | 0.3 | 0 | 0.3 |
| 9 | 4.4 | 3.6 | 8.0 | 20 | 3 | 4 | 0 | 4 |
| 10 | 3.2 | 2.6 | 5.8 | 20 | 2 | 1 | 0 | 1 |
| 11 | 3.9 | 2.7 | 6.6 | 20 | 3 | 2 | 0 | 2 |
| 12 | 4.6 | 3.3 | 7.9 | 20 | 4 | 4 | 0 | 4 |
| 13 | 3.8 | 3.2 | 7.0 | 20 | 4 | 3 | 0 | 3 |
| 14 | 3.1 | 2.7 | 5.8 | 20 | 2 | 1 | 0 | 1 |
| 15 | 3.1 | 2.5 | 5.6 | 20 | 2 | 0.9 | 0 | 0.9 |
| 16 | 3.1 | 2.4 | 5.5 | 20 | 2 | 0.6 | 0 | 0.6 |
| 17 | 3.2 | 2.3 | 5.5 | 20 | 1 | 0.2 | 0 | 0.2 |
| 18 | 3.4 | 2.3 | 5.7 | 20 | 1 | 0.4 | 0 | 0.4 |
| 19 | 6.7 | 3.8 | 10 | 20 | 6 | 7 | 0 | 7 |
| 20 | 46 | 40 | 86 | 20 | 29 | 93 | 0 | 109 |
| 21 | 45 | 11 | 56 | 50 | 34 | 64 | 0 | 64 |
| 22 | 256 | 170 | 426 | 50 | 32 | 592 | 77 | 669 |
| 23 | 258 | 70 | 328 | 171 | 38 | 150 | 199 | 353 |
| 24 | 109 | 25 | 134 | 100 | 41 | 117 | 14 | 126 |
| 25 | 69 | 13 | 82 | 82 | 40 | 80 | 0.7 | 80 |
| 26 | 52 | 9.9 | 62 | 74 | 30 | 55 | 0 | 55 |
| 27 | 42 | 8.9 | 51 | 68 | 33 | 43 | 0 | 43 |
| 28 | 36 | 8.4 | 44 | 62 | 31 | 37 | 0 | 37 |
| 29 | 32 | 8.4 | 40 | 56 | 27 | 32 | 0 | 32 |
| 30 | 29 | 8.4 | 37 | 56 | 26 | 31 | 0 | 31 |
| 31 | 26 | 8.3 | 34 | 50 | 24 | 27 | 0 | 27 |
| Totals | 1060 | 427 | 1487 | 1219 | 415 | 1345 | 291 | 1650 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

Represents change on date dictated by storm flow augmentation ramp-down schedule.

Peak flow met BO definition of potential migration event.

Periods of spill exceeded reliable accuracy of rating table.

## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| Feb-17 | Matilija Ck D/S Dam (cfs) | North Fork Matilija Ck.* (cfs) | Sum of Creek Flows (cfs) | Required Flow Release (cfs) | Fishway Ladder (cfs) | VRNMO Weir (cfs) | Diversion Canal (cfs) | Total Inflow (cfs) |
| 1 | 24 | 8.2 | 32 | 50 | 22 | 26 | 0 | 26 |
| 2 | 22 | 8.2 | 31 | 40 | 20 | 24 | 0 | 24 |
| 3 | 30 | 10 | 40 | 30 | 25 | 28 | 0 | 28 |
| 4 | 26 | 10 | 36 | 30 | 23 | 27 | 0 | 27 |
| 5 | 23 | 10 | 33 | 30 | 20 | 24 | 0 | 24 |
| 6 | 117 | 39 | 156 | 30 | 30 | 34 | 98 | 132 |
| 7 | 104 | 18 | 122 | 50 | 39 | 42 | 62 | 107 |
| 8 | 77 | 13 | 90 | 50 | 46 | 50 | 23 | 72 |
| 9 | 64 | 11 | 75 | 50 | 46 | 50 | 8 | 58 |
| 10 | 60 | 11 | 71 | 50 | 46 | 50 | 2 | 52 |
| 11 | 66 | 12 | 78 | 50 | 44 | 49 | 16 | 65 |
| 12 | 59 | 12 | 71 | 50 | 47 | 51 | 7 | 58 |
| 13 | 54 | 11 | 65 | 50 | 48 | 51 | 3 | 54 |
| 14 | 50 | 10 | 60 | 50 | 44 | 49 | 0.4 | 49 |
| 15 | 46 | 9.4 | 56 | 50 | 40 | 46 | 0 | 46 |
| 16 | 44 | 9.0 | 53 | 50 | 37 | 44 | 0 | 44 |
| 17 | 1337 | 435 | 1772 | 50 | 33 | 2300 | 61 | 2700 |
| 18 | 1264 | 372 | 1636 | 50 | 41 | 2800 | 316 | 3100 |
| 19 | 456 | 116 | 572 | 100 | 49 | 136 | 441 | 577 |
| 20 | 321 | 82 | 403 | 74 | 44 | 83 | 287 | 369 |
| 21 | 257 | 63 | 320 | 61 | 44 | 66 | 218 | 283 |
| 22 | 213 | 49 | 262 | 54 | 47 | 59 | 166 | 225 |
| 23 | 181 | 41 | 222 | 50 | 46 | 53 | 129 | 184 |
| 24 | 157 | 34 | 191 | 50 | 50 | 49 | 105 | 153 |
| 25 | 141 | 29 | 170 | 50 | 49 | 49 | 86 | 135 |
| 26 | 132 | 25 | 157 | 40 | 41 | 42 | 85 | 127 |
| 27 | 119 | 22 | 141 | 30 | 32 | 34 | 78 | 113 |
| 28 | 109 | 19 | 128 | 30 | 30 | 32 | 67 | 99 |
| Totals | 5553 | 1489 | 7042 | 1349 | 1083 | 6348 | 2258 | 8931 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

Represents change on date dictated by storm flow augmentation ramp-down schedule.

Peak flow met BO definition of potential migration event.

Period of flow over cut-off wall. Inflow estimated. Spill exceeded reliable accuracy of rating table.

Periods of spill exceeded reliable accuracy of rating table.

## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| Mar-17 | Matilija Ck D/S Dam (cfs) | North Fork Matilija Ck.* (cfs) | Sum of Creek Flows (cfs) | Required Flow Release (cfs) | Fishway Ladder (cfs) | VRNMO Weir (cfs) | Diversion Canal (cfs) | Total Inflow (cfs) |
| 1 | 99 | 17 | 116 | 30 | 30 | 32 | 56 | 89 |
| 2 | 93 | 16 | 109 | 30 | 29 | 31 | 51 | 82 |
| 3 | 87 | 15 | 102 | 30 | 28 | 31 | 45 | 76 |
| 4 | 82 | 15 | 97 | 30 | 27 | 31 | 42 | 73 |
| 5 | 80 | 15 | 95 | 30 | 27 | 30 | 42 | 72 |
| 6 | 74 | 15 | 89 | 30 | 28 | 31 | 35 | 66 |
| 7 | 70 | 14 | 84 | 30 | 28 | 31 | 30 | 61 |
| 8 | 66 | 13 | 79 | 30 | 28 | 31 | 27 | 58 |
| 9 | 63 | 12 | 75 | 30 | 29 | 32 | 23 | 55 |
| 10 | 61 | 11 | 72 | 30 | 28 | 32 | 21 | 53 |
| 11 | 58 | 11 | 69 | 30 | 28 | 32 | 19 | 51 |
| 12 | 55 | 11 | 66 | 30 | 29 | 31 | 16 | 47 |
| 13 | 53 | 11 | 64 | 30 | 29 | 31 | 14 | 46 |
| 14 | 51 | 10 | 61 | 30 | 30 | 32 | 12 | 44 |
| 15 | 49 | 10 | 59 | 30 | 30 | 32 | 11 | 42 |
| 16 | 48 | 9.7 | 57 | 30 | 30 | 32 | 10 | 41 |
| 17 | 46 | 9.4 | 56 | 30 | 30 | 32 | 9 | 40 |
| 18 | 44 | 9.3 | 54 | 30 | 29 | 31 | 7 | 38 |
| 19 | 43 | 9.0 | 52 | 30 | 26 | 32 | 6 | 38 |
| 20 | 42 | 9.0 | 51 | 30 | 25 | 32 | 5 | 37 |
| 21 | 53 | 8.7 | 62 | 30 | 27 | 33 | 13 | 46 |
| 22 | 49 | 7.9 | 57 | 30 | 26 | 32 | 12 | 44 |
| 23 | 43 | 7.4 | 50 | 30 | 26 | 32 | 6 | 38 |
| 24 | 40 | 7.1 | 47 | 30 | 25 | 32 | 4 | 36 |
| 25 | 39 | 6.8 | 46 | 30 | 25 | 32 | 3 | 35 |
| 26 | 37 | 6.4 | 43 | 30 | 25 | 32 | 1 | 34 |
| 27 | 36 | 6.0 | 42 | 30 | 26 | 32 | 0.6 | 32 |
| 28 | 34 | 5.7 | 40 | 30 | 26 | 32 | 0 | 32 |
| 29 | 33 | 5.5 | 38 | 30 | 26 | 31 | 0 | 31 |
| 30 | 32 | 5.4 | 38 | 30 | 25 | 30 | 0 | 30 |
| 31 | 30 | 5.2 | 35 | 30 | 24 | 29 | 0 | 29 |
| Totals | 1691 | 315 | 2006 | 930 | 849 | 976 | 521 | 1496 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| | Matilija Ck | North Fork | Sum of Creek | Required | Fishway | VRNMO | Diversion | Total Inflow |
| Apr-17 | D/S Dam | Matilija Ck.* | Flows | Flow Release | Ladder | Weir | Canal | |
| | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) | (cfs) |
| 1 | 29 | 5.1 | 34 | 30 | 23 | 28 | 0 | 28 |
| 2 | 28 | 4.9 | 33 | 30 | 22 | 27 | 0 | 27 |
| 3 | 28 | 5.0 | 33 | 30 | 21 | 27 | 0 | 27 |
| 4 | 27 | 4.8 | 32 | 30 | 21 | 26 | 0 | 26 |
| 5 | 26 | 4.5 | 31 | 30 | 20 | 25 | 0 | 25 |
| 6 | 26 | 4.5 | 30 | 30 | 20 | 24 | 0 | 24 |
| 7 | 26 | 4.5 | 31 | 30 | 20 | 25 | 0 | 25 |
| 8 | 27 | 4.6 | 32 | 30 | 21 | 26 | 0 | 26 |
| 9 | 25 | 4.4 | 29 | 30 | 20 | 24 | 0 | 24 |
| 10 | 24 | 4.2 | 28 | 30 | 20 | 24 | 0 | 24 |
| 11 | 23 | 4.2 | 28 | 30 | 19 | 23 | 0 | 23 |
| 12 | 23 | 4.1 | 27 | 30 | 19 | 23 | 0 | 23 |
| 13 | 23 | 4.1 | 27 | 30 | 19 | 23 | 0 | 23 |
| 14 | 22 | 4.0 | 26 | 30 | 19 | 23 | 0 | 23 |
| 15 | 22 | 3.9 | 25 | 30 | 18 | 22 | 0 | 22 |
| 16 | 21 | 3.9 | 25 | 30 | 18 | 22 | 0 | 22 |
| 17 | 21 | 3.9 | 25 | 30 | 17 | 21 | 0 | 21 |
| 18 | 22 | 3.9 | 26 | 30 | 18 | 22 | 0 | 22 |
| 19 | 21 | 3.7 | 25 | 30 | 18 | 22 | 0 | 22 |
| 20 | 20 | 3.4 | 23 | 30 | 16 | 20 | 0 | 20 |
| 21 | 19 | 3.4 | 22 | 30 | 15 | 19 | 0 | 19 |
| 22 | 19 | 3.4 | 22 | 30 | 15 | 18 | 0 | 18 |
| 23 | 18 | 3.4 | 22 | 30 | 15 | 18 | 0 | 18 |
| 24 | 18 | 3.3 | 21 | 30 | 13 | 16 | 0 | 16 |
| 25 | 18 | 3.2 | 21 | 30 | 13 | 16 | 0 | 16 |
| 26 | 18 | 3.3 | 21 | 30 | 12 | 15 | 0 | 15 |
| 27 | 17 | 3.2 | 21 | 30 | 12 | 15 | 0 | 15 |
| 28 | 17 | 3.2 | 20 | 30 | 11 | 14 | 0 | 14 |
| 29 | 16 | 3.0 | 19 | 30 | 11 | 14 | 0 | 14 |
| 30 | 16 | 3.0 | 19 | 30 | 10 | 13 | 0 | 13 |
| Totals | 661 | 118 | 779 | 900 | 516 | 635 | 0 | 635 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

Weir data logger malfunction. Discharge estimated.

Fishway flow meter malfunction. Discharge estimated.

## Ventura River Flow Assessment
## Water Year 2016 -2017

| May-17 | (1) Source Stream Mean Daily Flows: Matilija Ck D/S Dam (cfs) | (2) Source Stream Mean Daily Flows: North Fork Matilija Ck.* (cfs) | (1) + (2) Source Stream Mean Daily Flows: Sum of Creek Flows (cfs) | B.O. Required Flow Release (cfs) | (3) Robles Facility Mean Daily Flows: Fishway Ladder (cfs) | (4) Robles Facility Mean Daily Flows: VRNMO Weir (cfs) | (5) Robles Facility Mean Daily Flows: Diversion Canal (cfs) | (4) + (5) Robles Facility Mean Daily Flows: Total Inflow (cfs) |
|---|---|---|---|---|---|---|---|---|
| 1 | 15 | 3.0 | 18 | 30 | 10 | 13 | 0 | 13 |
| 2 | 15 | 3.0 | 18 | 30 | 10 | 12 | 0 | 12 |
| 3 | 15 | 3.0 | 18 | 30 | 9 | 12 | 0 | 12 |
| 4 | 15 | 3.0 | 18 | 30 | 9 | 11 | 0 | 11 |
| 5 | 15 | 3.0 | 18 | 30 | 9 | 11 | 0 | 11 |
| 6 | 16 | 3.1 | 19 | 30 | 10 | 11 | 0 | 11 |
| 7 | 17 | 3.3 | 20 | 30 | 11 | 11 | 0 | 11 |
| 8 | 17 | 3.1 | 20 | 30 | 11 | 10 | 0 | 10 |
| 9 | 16 | 3.0 | 19 | 30 | 10 | 10 | 0 | 10 |
| 10 | 16 | 3.0 | 19 | 30 | 9 | 11 | 0 | 11 |
| 11 | 16 | 3.0 | 19 | 30 | 10 | 11 | 0 | 11 |
| 12 | 15 | 2.8 | 18 | 30 | 9 | 11 | 0 | 11 |
| 13 | 14 | 2.7 | 17 | 30 | 9 | 10 | 0 | 10 |
| 14 | 14 | 2.6 | 17 | 30 | 8 | 9 | 0 | 9 |
| 15 | 15 | 2.7 | 17 | 30 | 9 | 8 | 0 | 8 |
| 16 | 15 | 2.6 | 17 | 30 | 10 | 7 | 0 | 7 |
| 17 | 14 | 2.6 | 17 | 30 | 9 | 6 | 0 | 6 |
| 18 | 14 | 2.5 | 16 | 30 | 8 | 7 | 0 | 7 |
| 19 | 13 | 2.3 | 15 | 30 | 7 | 6 | 0 | 6 |
| 20 | 13 | 2.3 | 15 | 30 | 7 | 7 | 0 | 7 |
| 21 | 12 | 2.2 | 14 | 30 | 6 | 8 | 0 | 8 |
| 22 | 12 | 2.2 | 14 | 30 | 6 | 7 | 0 | 7 |
| 23 | 12 | 2.2 | 14 | 30 | 6 | 5 | 0 | 5 |
| 24 | 12 | 2.2 | 14 | 30 | 6 | 4 | 0 | 4 |
| 25 | 12 | 2.2 | 14 | 30 | 6 | 6 | 0 | 6 |
| 26 | 12 | 2.2 | 14 | 30 | 7 | 5 | 0 | 5 |
| 27 | 12 | 2.2 | 14 | 30 | 5 | 4 | 0 | 4 |
| 28 | 12 | 2.1 | 14 | 30 | 5 | 4 | 0 | 4 |
| 29 | 11 | 2.1 | 13 | 30 | 4 | 4 | 0 | 4 |
| 30 | 11 | 2.0 | 13 | 30 | 5 | 5 | 0 | 5 |
| 31 | 11 | 2.0 | 13 | 30 | 5 | 4 | 0 | 4 |
| Totals | 425 | 80 | 505 | 930 | 245 | 250 | 0 | 250 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).

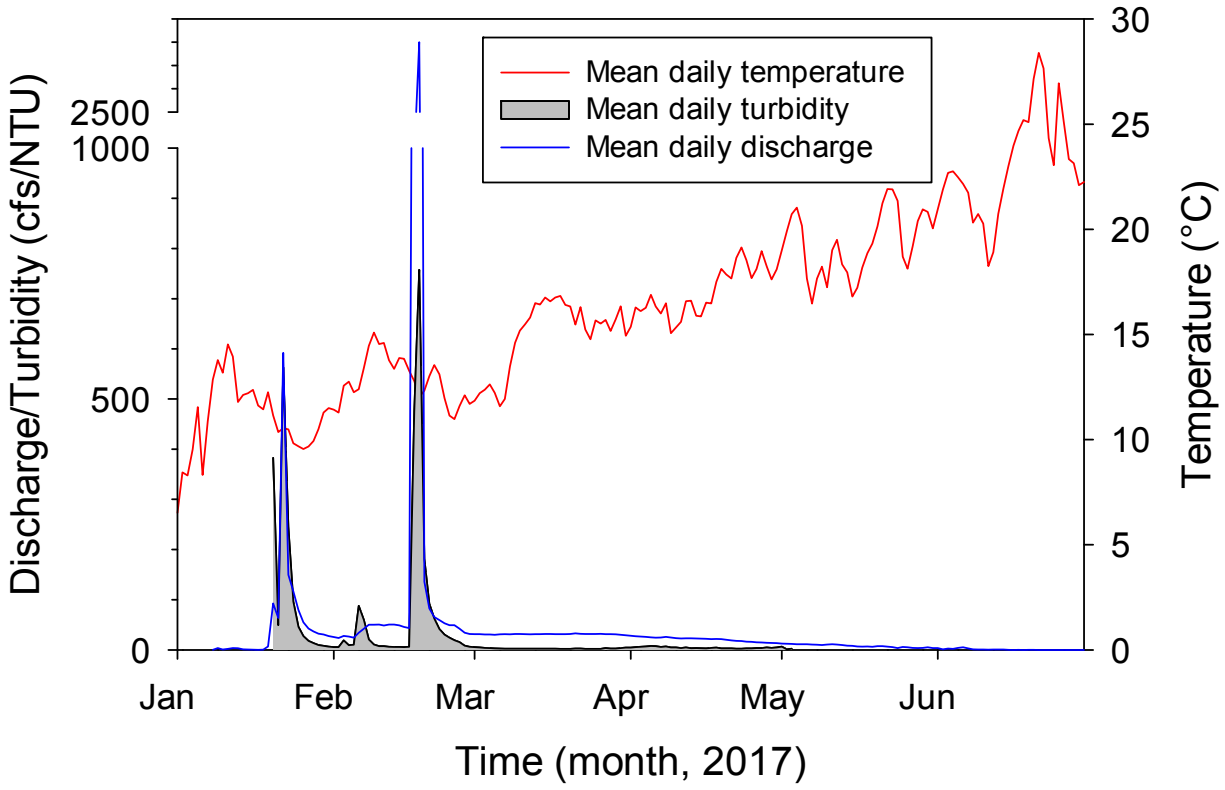
Weir data logger malfunction. Discharge estimated.

Fishway flow meter malfunction. Discharge estimated.

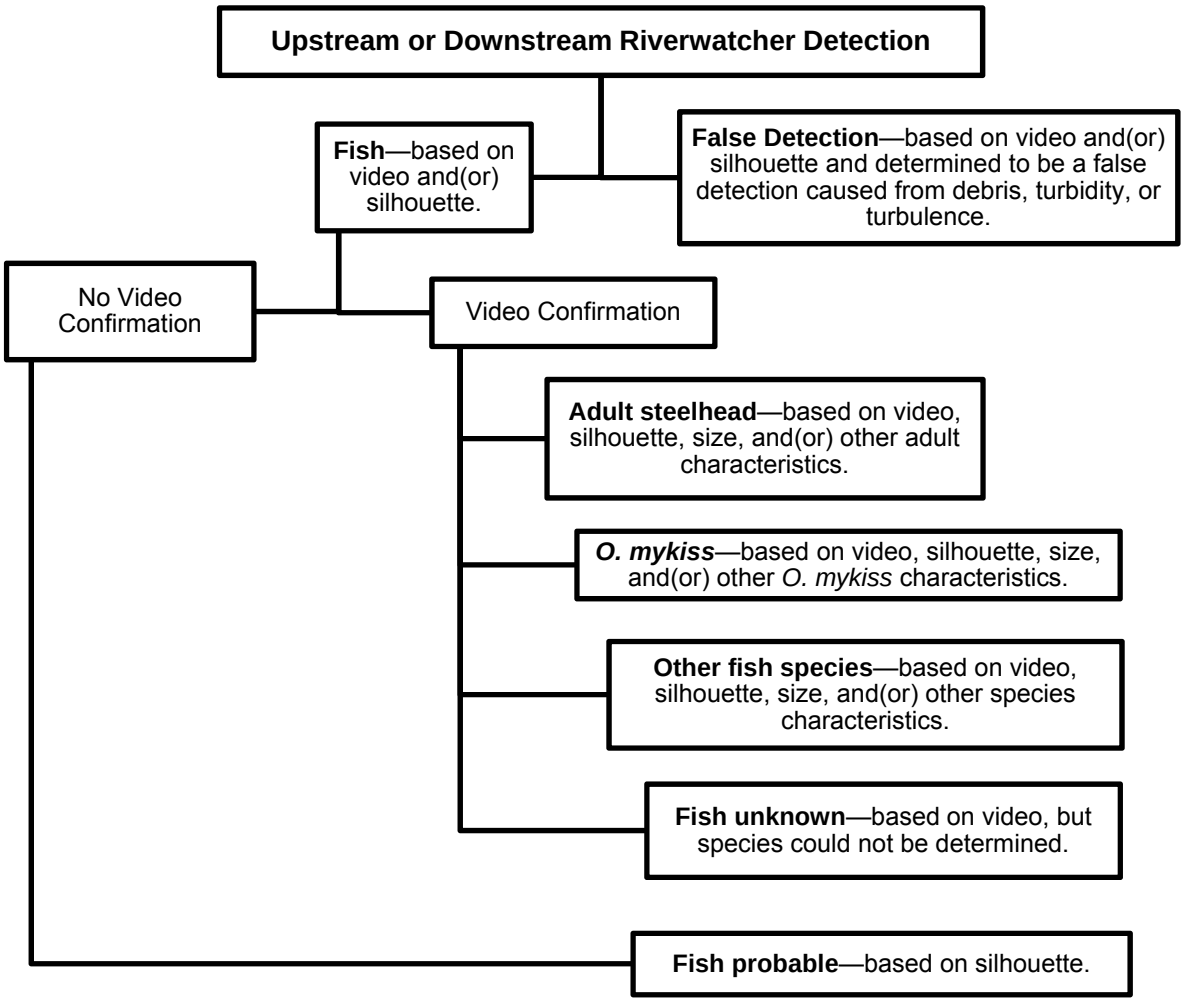
## Ventura River Flow Assessment
## Water Year 2016 -2017

| | (1) | (2) | (1) + (2) | | (3) | (4) | (5) | (4) + (5) |
|---|---|---|---|---|---|---|---|---|
| | Source Stream Mean Daily Flows | | | B.O. | Robles Facility Mean Daily Flows | | | |
| Jun-17 | Matilija Ck D/S Dam (cfs) | North Fork Matilija Ck.* (cfs) | Sum of Creek Flows (cfs) | Required Flow Release (cfs) | Fishway Ladder (cfs) | VRNMO Weir (cfs) | Diversion Canal (cfs) | Total Inflow (cfs) |
| 1 | 11 | 2.0 | 13 | 30 | 4 | 4 | 0 | 4 |
| 2 | 10 | 1.9 | 12 | 30 | 4 | 1 | 0 | 1 |
| 3 | 10 | 1.8 | 11 | 30 | 4 | 3 | 0 | 3 |
| 4 | 10 | 1.8 | 11 | 30 | 4 | 2 | 0 | 2 |
| 5 | 9 | 1.8 | 11 | 30 | 4 | 4 | 0 | 4 |
| 6 | 11 | 1.8 | 12 | 30 | 4 | 5 | 0 | 5 |
| 7 | 9 | 1.8 | 11 | 30 | 3 | 3 | 0 | 3 |
| 8 | 10 | 1.8 | 12 | 30 | 4 | 1 | 0 | 1 |
| 9 | 10 | 1.7 | 12 | 30 | 3 | 1 | 0 | 1 |
| 10 | 10 | 1.7 | 12 | 30 | 4 | 1 | 0 | 1 |
| 11 | 11 | 1.7 | 12 | 30 | 4 | 0.7 | 0 | 0.7 |
| 12 | 10 | 1.7 | 12 | 30 | 4 | 0.8 | 0 | 0.8 |
| 13 | 9 | 1.6 | 11 | 30 | 3 | 1 | 0 | 1 |
| 14 | 9 | 1.6 | 11 | 30 | 3 | 0.7 | 0 | 0.7 |
| 15 | 9 | 1.6 | 10 | 30 | 3 | 0.1 | 0 | 0.1 |
| 16 | 8 | 1.5 | 10 | 30 | 2 | 0 | 0 | 0 |
| 17 | 9 | 1.5 | 10 | 30 | 2 | 0.1 | 0 | 0.1 |
| 18 | 9 | 1.5 | 11 | 30 | 3 | 0 | 0 | 0 |
| 19 | 10 | 1.2 | 11 | 30 | 2 | 0.1 | 0 | 0.1 |
| 20 | 9 | 1.2 | 10 | 30 | 1 | 0.1 | 0 | 0.1 |
| 21 | 9 | 1.2 | 10 | 30 | 1 | 0 | 0 | 0 |
| 22 | 8 | 1.1 | 9 | 30 | 1 | 0 | 0 | 0 |
| 23 | 7 | 1.1 | 8 | 30 | 0.6 | 0 | 0 | 0 |
| 24 | 7 | 1.1 | 8 | 30 | 1 | 0 | 0 | 0 |
| 25 | 7 | 1.1 | 8 | 30 | 0.9 | 0 | 0 | 0 |
| 26 | 7 | 1.1 | 8 | 30 | 0.6 | 0 | 0 | 0 |
| 27 | 7 | 1.1 | 8 | 30 | 0.7 | 0 | 0 | 0 |
| 28 | 6 | 1.0 | 7 | 30 | 0.5 | 0 | 0 | 0 |
| 29 | 6 | 1.0 | 7 | 30 | 0.2 | 0 | 0 | 0 |
| 30 | 6 | 1.0 | 7 | 30 | 0.7 | 0 | 0 | 0 |
| Totals | 261 | 44 | 305 | 900 | 72 | 29 | 0 | 29 |

*Flow data from North Fork Malija Creek are preliminary and subject to change (VCWPD).




Appendix 19. Mean daily discharge, water temperature, and turbidity at the Robles Fish Facility during the 2017 fish passage season.



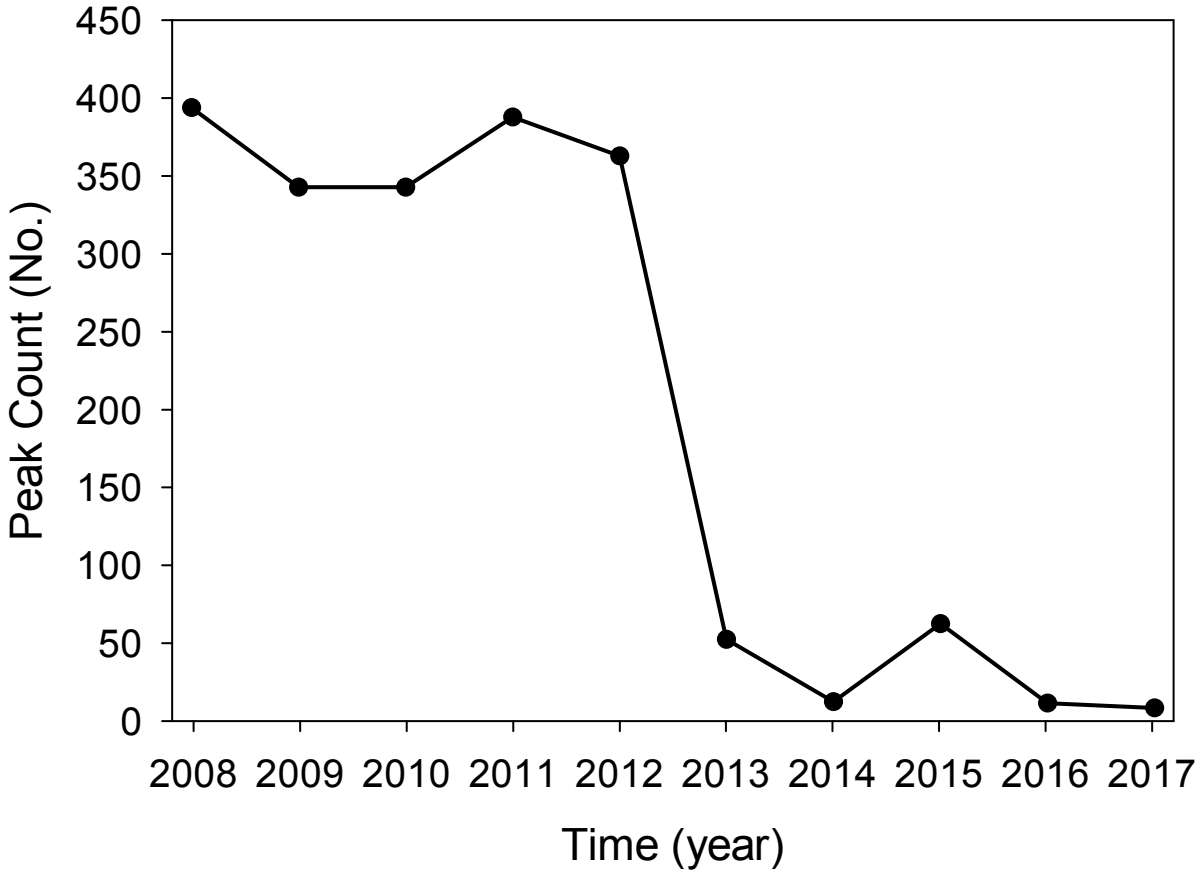

Appendix 20. Riverwatcher detection classification flow chart that outlines the pathways for upstream and downstream detections.

Appendix 21. Summary of Riverwatcher detections classified as fish probable and *O. mykiss* from February through April of 2017.

| | Upstream | Downstream |
|---|---|---|
| *O. mykiss* | 11 | 9 |
| Fish, non *O. mykiss* | 15 | 4 |
| Fish, unknown | 0 | 0 |
| Fish, probable | 0 | 0 |
| False detections | 616 | 1127 |
| Total | 642 | 1140 |
| | | |
| Mean date - *O. mykiss* | 04/07/2017 | 04/04/2017 |
| Mean date - fish, non *O. mykiss* | 04/29/2017 | 04/24/2017 |
| Mean date - fish, unknown | n/a | n/a |
| Mean date - fish, probable | n/a | n/a |
| | | |
| Mean time - *O. mykiss* (24h) | 19:20 | 17:15 |
| Mean time - fish, non *O. mykiss* (24h) | 04:11 | 07:04 |
| Mean time - fish, unknown (24h) | n/a | n/a |
| Mean time - fish, probable (24h) | n/a | n/a |
| | | |
| Mean length - *O. mykiss* (cm) | 32 | 27 |
| Mean length - fish, non *O. mykiss* (cm) | 51 | 43 |
| Mean length - fish, unknown (cm) | n/a | n/a |
| Mean length - fish, probable (cm) | n/a | n/a |
| | | |
| Mean daily temperature - *O. mykiss* (°C) | 16 | 17 |
| Mean daily temperature - fish, non *O. mykiss* (°C) | 18 | 18 |
| Mean daily temperature - fish, unknown (°C) | n/a | n/a |
| Mean daily temperature - fish, probable (°C) | n/a | n/a |
| | | |
| Mean daily turbidity - *O. mykiss* (NTU) | 6 | 6 |
| Mean daily turbidity - fish, non *O. mykiss* (NTU) | 3 | 4 |
| Mean daily turbidity - fish, unknown (NTU) | n/a | n/a |
| Mean daily turbidity - fish, probable (NTU) | n/a | n/a |
| Mean daily turbidity - false detections (NTU) | 92 | 96 |
| | | |
| Mean daily discharge - *O. mykiss* (cfs) | 24 | 25 |
| Mean daily discharge - fish, non O. *mykiss* (cfs) | 15 | 17 |
| Mean daily discharge - fish, unknown (cfs) | n/a | n/a |
| Mean daily discharge - fish, probable (cfs) | n/a | n/a |
| Mean daily discharge - false detections (cfs) | 68 | 71 |

Appendix 22. *O. mykiss* relative abundance survey index sites in the Ventura Basin.

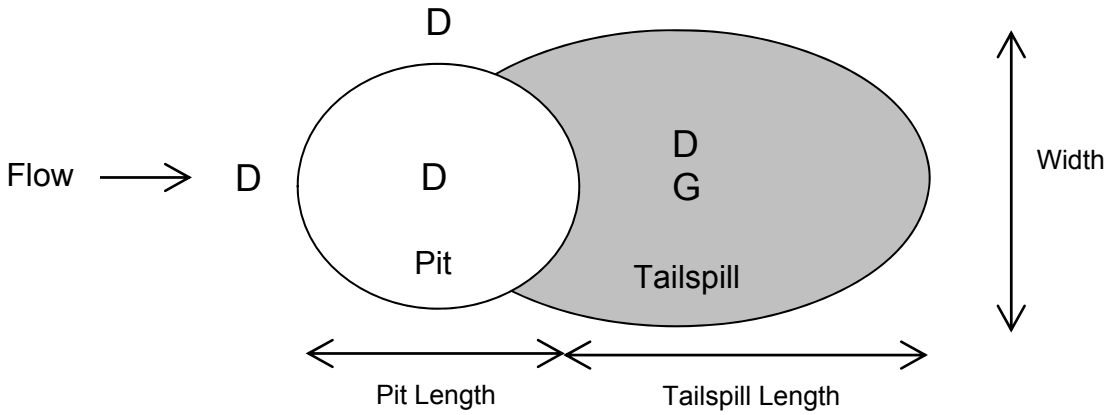
| Site No. | Location | River km | Site | Lat. | Long. | Length (m) | Width (m) |
|---|---|---|---|---|---|---|---|
| 1 | Ventura River | 0.9 | Main Street pool | 34.28126 | -119.30887 | 25.1 | 10.0 |
| | | 0.9 | Main Street riffle | 34.28164 | -119.30893 | 34.0 | 8.0 |
| 2 | Ventura River | 9.4 | Foster Park pool 1 | 34.35236 | -119.30790 | 25.0 | 15.4 |
| | | 10.0 | Foster Park pool 2 | 34.35508 | -119.30988 | 46.0 | 16.0 |
| | | 9.7 | Foster Park riffle | 34.35308 | -119.30877 | 45.0 | 11.0 |
| 3 | Ventura River | 13.0 | San Antonio conf. pool 1 | 34.38042 | -119.30752 | 33.0 | 22.0 |
| | | 13.0 | San Antonio conf. riffle | 34.38011 | -119.30755 | 42.0 | 14.0 |
| | | 12.9 | San Antonio conf. pool 2 | 34.37969 | -119.30781 | 50.0 | 10.0 |
| 4 | Ventura River | 18.8 | Hwy 150 pool 1 | 34.42643 | -119.30220 | 43.3 | 14.0 |
| | | 18.8 | 150 pool 2 | 34.42689 | -119.30123 | 49.5 | 9.0 |
| | | 18.7 | Hwy 150 riffle | 34.42576 | -119.30258 | 43.6 | 11.0 |
| 5 | Ventura River | 22.1 | Land Cons. pool 1 | 34.45342 | -119.29314 | 50.1 | 19.1 |
| | | 22.2 | Land Cons. pool 2 | 34.45448 | -119.29293 | 48.6 | 15.1 |
| | | 22.1 | Land Cons. Riffle | 34.45411 | -119.29315 | 44.6 | 18.8 |
| 6 | Ventura River | 23.2 | Robles weir pools | 34.46306 | -119.29058 | 58.7 | 19.0 |
| | | 23.3 | Robles glide | 34.46368 | -119.29065 | 78.3 | 17.3 |
| | | 23.4 | Robles entrance pool | 34.46446 | -119.29058 | 39.8 | 21.8 |
| | | 23.4 | Fish ladder entrance box | 34.46460 | -119.29062 | 15.0 | 3.0 |
| | | 23.5 | Robles screenbay | 34.46451 | -119.29133 | 42.2 | 13.5 |
| | | 23.5 | Robles forebay | 34.46503 | -119.29053 | 33.0 | 17.2 |
| 7 | San Antonio Cr. | 0.2 | Lower San Antonio pool 1 | 34.38088 | -119.30542 | 16.0 | 6.0 |
| | | 0.2 | Lower San Antonio riffle | 34.38098 | -119.30711 | 20.2 | 3.5 |
| | | 0.4 | Lower San Antonio pool 2 | 34.38103 | -119.30657 | 40.0 | 6.0 |
| 8 | San Antonio Cr. | 9.4 | Upper San Antonio riffle | 34.43268 | -119.25090 | 25.0 | 5.0 |
| | | 9.5 | Upper San Antonio pool | 34.43241 | -119.25095 | 19.8 | 5.5 |
| 9 | NF Matilija Cr. | 0.1 | Lower NF pool 1 | 34.48508 | -119.30105 | 7.3 | 13.3 |
| | | 0.1 | Lower NF pool 2 | 34.48533 | -119.30138 | 7.9 | 10.9 |
| | | 0.2 | Lower NF riffle | 34.48523 | -119.30198 | 17.8 | 8.0 |
| 10 | NF Matilija Cr. | 6.6 | Upper NF pool | 34.50956 | -119.27520 | 29.0 | 9.0 |
| | | 6.6 | Upper NF riffle | 34.50933 | -119.27528 | 33.1 | 7.5 |
| 11 | Matilija Cr. | 0.3 | Lower Matilija pool | 34.48282 | -119.30170 | 21.1 | 24.7 |
| | | 0.3 | Lower Matilija riffle | 34.48302 | -119.30154 | 15.9 | 8.0 |
| 12 | Matilija Cr. | 2.1 | Upper Matilija pool | 34.49190 | -119.31599 | 89.4 | 13.7 |
| | | 2.1 | Upper Matilija riffle | 34.49233 | -119.31704 | 51.0 | 9.0 |
| 14 | San Antonio Cr. | 4.3 | Fraser St. pool | 34.40276 | -119.28169 | 12.8 | 13.8 |
| | | 4.4 | Fraser St. riffle | 34.40291 | -119.28157 | 30.8 | 5.9 |
| 15 | Ventura River | 8.5 | Bedrock pool | 34.34539 | -119.29931 | 50.0 | 17.0 |
| | | 8.5 | Bedrock pool riffle | 34.34569 | -119.29958 | 37.0 | 6.0 |



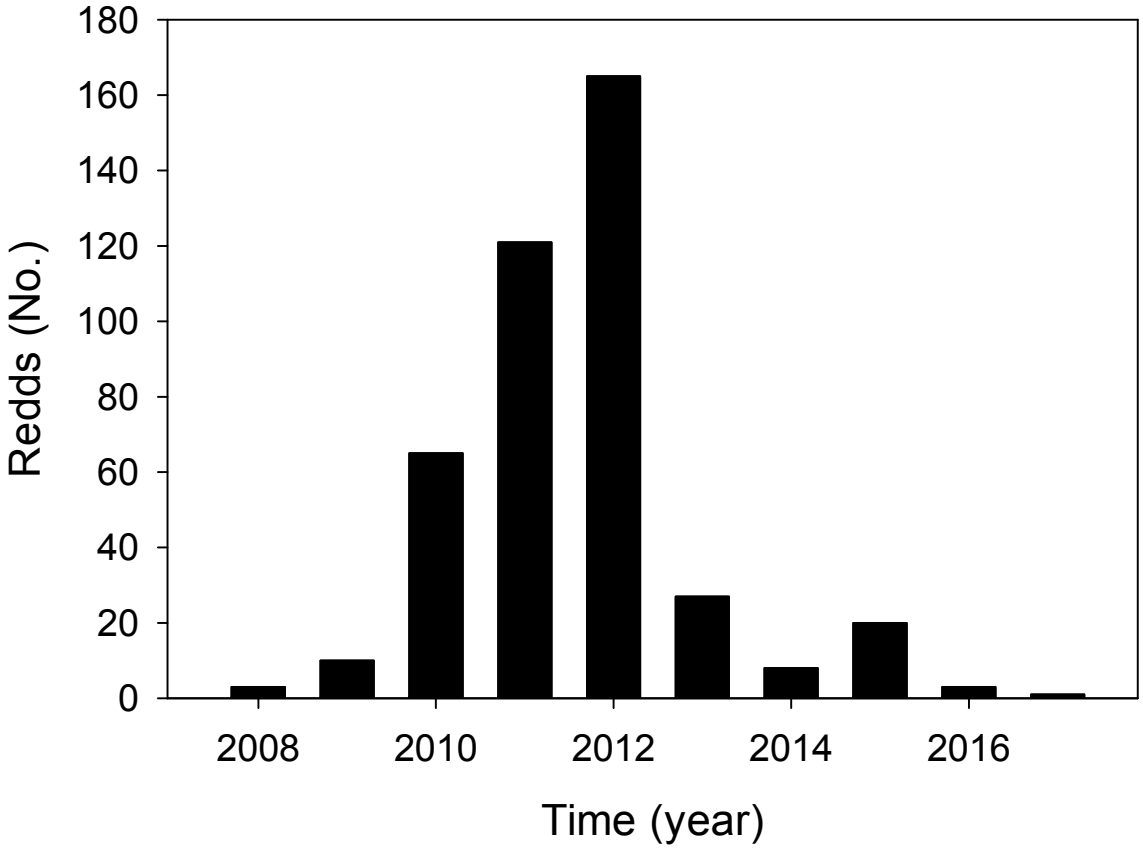

Appendix 23. Peak snorkel counts of *O. mykiss* during the period 2008-2017 at survey index sites in the Ventura Basin.

Appendix 24. *O. mykiss* spawning index sites in the Ventura Basin.

| Site No. | Unit | Location | River km | Description | Lat. | Long. | Length (m) | Width (m) | Spawning Area ($m^2$) |
|---|---|---|---|---|---|---|---|---|---|
| 24 | 1 | Ventura River | 0.8 | Main St. Bridge | 34.28085 | -119.30862 | 220.0 | 10.0 | 2,200 |
| 2 | 1 | Ventura River | 7.9 | Near Treatment Plant | 34.34030 | -119.29782 | 90.0 | 18.0 | 1,620 |
| | 2 | | 8.1 | Near Treatment Plant | 34.34208 | -119.29849 | 39.0 | 20.0 | 780 |
| 4 | 1 | Ventura River | 15.5 | Near Santa Ana Blvd bridge | 34.39950 | -119.30853 | 26.7 | 8.0 | 214 |
| 5 | 1 | Ventura River | 18.7 | Upstream of Hwy 150 | 34.42641 | -119.30227 | 18.0 | 10.0 | 180 |
| 6 | 1 | Ventura River | 22.1 | Land Conservancy pool tailout | 34.45334 | -119.29309 | 18.1 | 19.5 | 353 |
| | 2 | | 22.2 | Land Conservancy pool tailout | 34.45445 | -119.29298 | 16.3 | 14.7 | 240 |
| 7 | 1 | Ventura River | 23.3 | Robles-1st weir pool | 34.46334 | -119.29061 | 15.4 | 23.9 | 368 |
| | 2 | | 23.4 | Robles tailout of entrance pool | 34.46436 | -119.29045 | 18.2 | 21.9 | 399 |
| 8 | 2 | Ventura River | 24.3 | Upstream of Robles | 34.46504 | -119.29032 | 6.2 | 15.4 | 95 |
| | 3 | | 23.4 | Upstream of Robles forebay | 34.46504 | -119.29032 | 80.0 | 6.0 | 480 |
| 12 | 1 | NF Matilija Cr. | 0.7 | Lower NF Matilija Cr. | 34.48825 | -119.30525 | 41.0 | 9.0 | 369 |
| 13 | 1 | NF Matilija Cr. | 6.6 | Downstream of Wheeler Gorge | 34.50911 | -119.27501 | 23.0 | 8.0 | 184 |
| | 2 | | 6.6 | Downstream of Wheeler Gorge | 34.50960 | -119.27528 | 22.3 | 8.0 | 178 |
| 14 | 1 | Matilija Cr. | 1.9 | Lake Matilija delta | 34.49000 | -119.31446 | 26.2 | 14.6 | 383 |
| | 2 | | 2.1 | Upstream of Lake Matilija | 34.49198 | -119.31645 | 15.0 | 10.0 | 150 |
| | 3 | | 2.2 | Upstream of Lake Matilija | 34.49209 | -119.31661 | 315 | 9.0 | 2,835 |
| 15 | 1 | Matilija Cr. | 8.4 | End of Matilija Road | 34.50456 | -119.37449 | 20.0 | 19.0 | 380 |
| 17 | 1 | Ventura River | 9.3 | DS of Foster to US reach | 34.35069 | -119.30463 | 1750 | 11.0 | 19,250 |
| 18 | 1 | Ventura River | 12.3 | Casitas Springs | 34.37354 | -119.30877 | 60 | 12.0 | 960 |
| | 2 | | 12.7 | Casitas Springs | 34.37712 | -119.30721 | 230 | 9.0 | 2070 |
| 19 | 1 | San Antonio Cr. | 0.0 | Mouth to end of Old Cr. Rd. reach | 34.38030 | -119.30738 | 2160 | 8.0 | 17,280 |
| 20 | 1 | San Antonio Cr. | 4.2 | DS to US of Frasier St. | 34.40197 | -119.28237 | 180 | 8.0 | 1,440 |
| 21 | 1 | San Antonio Cr. | 7.8 | Camp Comfort reach | 34.42493 | -119.26110 | 690 | 5.0 | 3,450 |
| 22 | 1 | San Antonio Cr. | 9.5 | Upper San Antonio Cr. reach | 34.43269 | -119.25087 | 640 | 5.0 | 3,200 |
| 23 | 1 | NF Matilija Cr. | 0.1 | Lower NF Matilija Cr. | 34.48520 | -119.30118 | 120 | 6.0 | 720 |
| 25 | 1 | NF Matilija Cr. | 4.1 | Near Wheeler's Springs Reach | 34.50826 | -119.28955 | 300 | 4.5 | 1,350 |
| 26 | 1 | NF Matilija Cr. | 1.0 | Downstream of NF gage bridge | 34.49049 | -119.30586 | 302 | 4.3 | 1,299 |
| 27 | 1 | Matilija Cr. | 5.7 | Upstream Matilja hot springs | 34.50030 | -119.34993 | 105 | 8.0 | 840 |
| | | | | | | | | Total = | 63,266 |




Appendix 25. Diagram of *O. mykiss* redds measurements. (D) = locations of depth measurements and (G) = location of gravel substrate sampling.



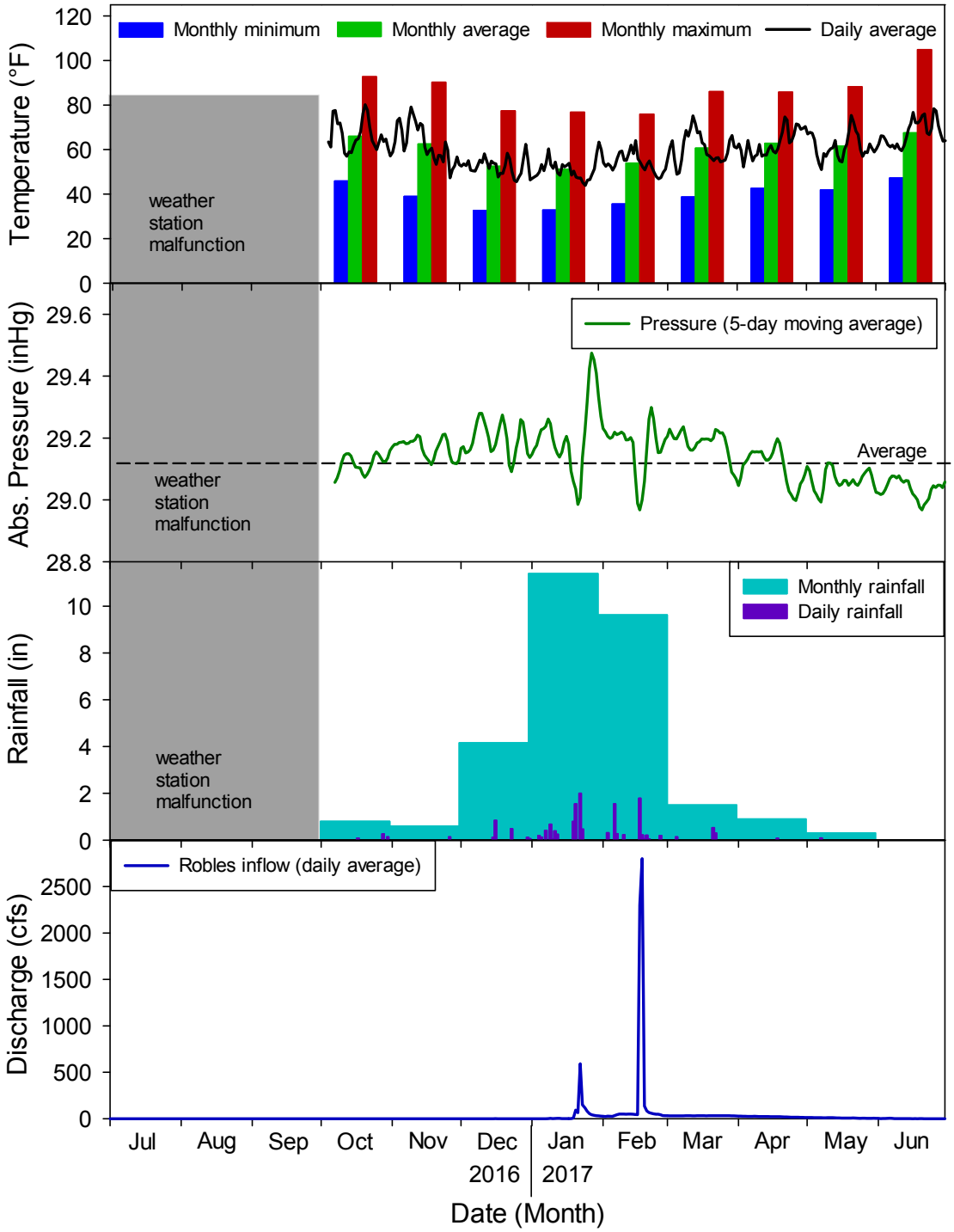

Appendix 26. Total number of *O. mykiss* redds counted at index spawning sites from 2008 through 2017 spawning years.

Appendix 27. Water quality monitoring sites and sampling summary.

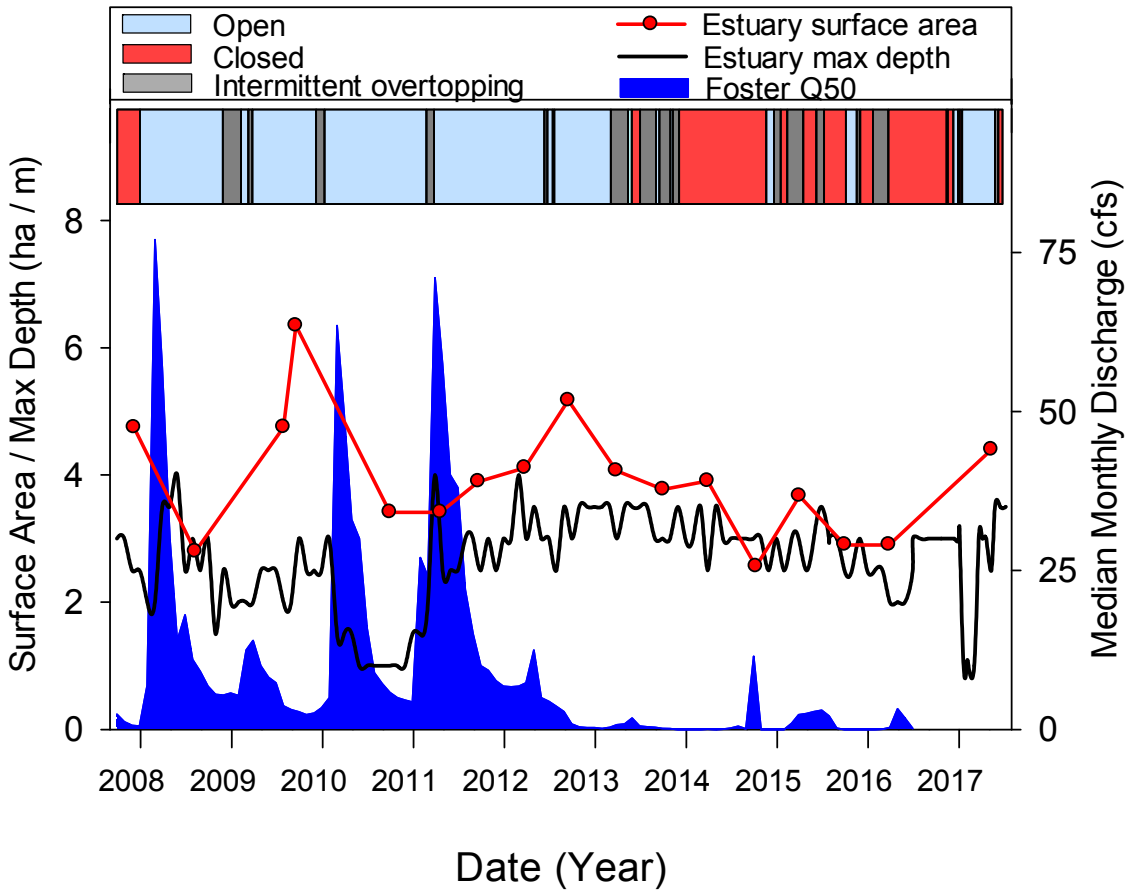
| Site Number | Site Description | Site Location[a] | Sampling Method[b] | Sampling Type[c] | Frequency |
|---|---|---|---|---|---|
| 1 | Estuary | V 0.3 km | Multiparameter | Grab profile | Monthly |
| 2 | Main St. Bridge | V 1.0 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 3 | Foster Park | V 9.7 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 4 | Santa Ana Blvd Bridge | V 15.5 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 5 | Hwy 150 Bridge | V 18.7 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 6 | Robles Dam | V 23.5 km | Temperature<br>Multiparameter<br>Turbidity<br>Weather | Continuous<br>Grab<br>Continuous<br>Continuous | 30 min<br>Monthly<br>Hourly<br>30 min |
| 7 | North Fork Matilija | N 1.3 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 8 | Below Matilija Dam | M 1.0 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 9 | Above Matilija Dam | M 2.1 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 10 | Middle Matilija | M 8.5 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 11 | Lower San Antonio | S 0.3 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 12 | Middle San Antonio | S 9.5 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 13 | Lower Coyote | C 0.4 km | Temperature<br>Multiparameter | Continuous<br>Grab | 30 min<br>Monthly |
| 14 | Fraser St. | S 4.4 km | Temperature | Continuous | 30 min |

[a]Site location is identified by the river system and kilometers from its confluence. C = Coyote Creek, M = Matilija Creek, N = North Fork Matilija Creek, S = San Antonio Creek, V = Ventura River.

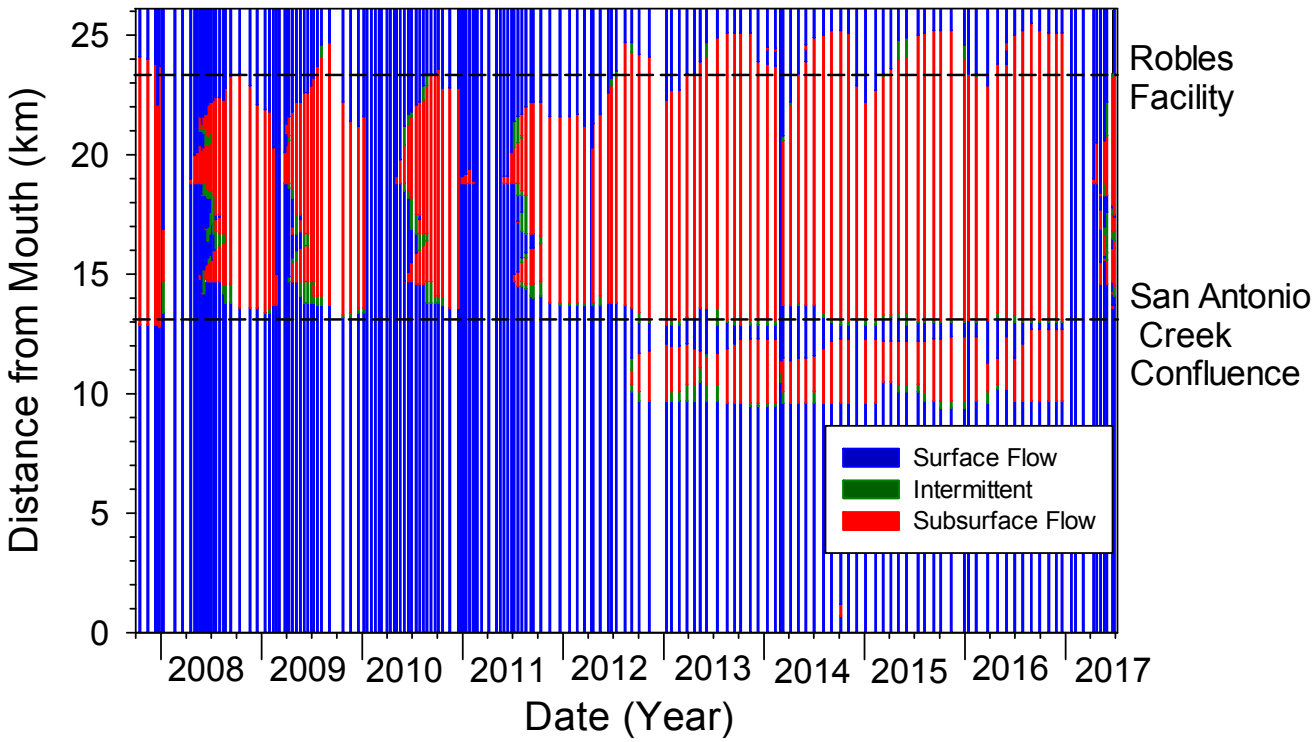
[b]Temperature data were collected using programmable loggers. Multiparameter water quality probe was use to collected water quality data including: temperature, dissolved oxygen, conductivity, salinity, pH, turbidity (separate meter). Turbidity data was collected using a programmable logger.




Appendix 28. Summary of weather and discharge data from the Robles Fish Facility for the reporting period.




Appendix 29. Ventura River estuary/lagoon water depth, surface area, sandbar status, and discharge at Foster Park since 2008.




Appendix 30. Ventura River channel surface flow monitoring from 2008 to 2017.

Appendix 31. Photographic monitoring sites within the Ventura River basin.

| Site Number | Site Description | Site Location[a] | Photo Direction | Frequency |
|---|---|---|---|---|
| 1 | Train bridge in estuary, east bank | V 0.3 km | Downstream | Biannual |
| 2 | Train bridge in estuary, west bank | V 0.3 km | Upstream Downstream | Biannual |
| 3 | Main Street Bridge | V 1.0 km | Upstream Downstream | Biannual |
| 4 | Shell Road Bridge | V 5.2 km | Upstream Downstream | Biannual |
| 5 | Casitas Vista Road Bridge (Foster Park) | V 9.7 km | Upstream Downstream | Biannual |
| 6 | Santa Ana Boulevard Bridge | V 15.5 km | Upstream Downstream | Biannual |
| 7 | Highway 150 Bridge | V 18.7 km | Upstream Downstream | Biannual |
| 8 | Robles Fish Passage Facility | V 23.5 km | Downstream | Biannual |
| 9 | Camino Cielo Road Bridge | V 25.7 km | Upstream Downstream | Biannual |
| 10 | Highway 33 Bridge at NF Matilija USGS Gauging Station | N 1.3 km | Upstream Downstream | Biannual |
| 11 | End of North Matilija Road | M 8.5 km | Upstream Downstream | Biannual |
| 12 | Highway 33 Bridge near Old Creek Road | S 0.3 km | Upstream Downstream | Biannual |
| 13 | Creek Road near Creek Lane | S 9.5 km | Upstream Downstream | Biannual |
| 14 | Santa Ana Road Bridge | C 0.4 km | Upstream Downstream | Biannual |

[a]Site location is identified by the river or tributary system and kilometers from its confluence.
C = Coyote Creek, M = Matilija Creek, N = North Fork Matilija Creek, S = San Antonio Creek, V = Ventura River.


Appendix 32. Multiple year photo comparison of ephemeral and perennial reaches of the Ventura River. Photo series row A and row C are looking upstream from Hwy 150 bridge. Photo series row B and row D are looking upstream from the bridge near the Shell Rd exit off Hwy 33.