Detailed Fish Passage Assessment Evaluations for Tier 1 Caltrans Stream Crossing Structures in Santa Barbara, Ventura, and Los Angeles Counties

Prepared by:
Casey Horgan and Michael Morales
Pacific States Marine Fisheries Commission
and
California Department of Fisheries and Wildlife
1933 Cliff Drive, Suite 9 Santa Barbara, CA 93109

May 31, 2020

Abstract

The primary goal of this project was to assess California Department of Transportation (Caltrans) roadway stream crossing structures for their impact on the migration of steelhead trout (*Oncorhynchus mykiss*). Structures assessed were specified by Caltrans within fish passage assessment priority lists dated September 6, 2019. In total, 30 structures were assessed in Santa Barbara county, 53 structures were assessed in Ventura county, and two structures were assessed in Los Angeles county. Data collection was conducted following the Caltrans Reconnaissance and Detailed Fish Passage Assessment Data Collection Instructions and Procedures protocols (HDR Engineering Inc. 2007). Fish passage analysis for the assessed crossing structures was primarily performed with the use of FishXing software (version 3.0.20), with additional support from fish passage considerations listed in the California Salmonid Stream Habitat Restoration Manual (CSSHRM) and professional judgement. Structures determined to constrict *O. mykiss* upstream movement were provided a barrier passage status following California Department of Fish and Wildlife (CDFW) definitions. Additionally, information regarding stream channel conditions, passage improvement considerations, and barrier remediation prioritization are provided.

Table of Contents

Abstract **2**
1.0 Introduction and Project Information **5**
2.0 Study Area/Watershed Overview **6**
2.1 Caltrans District 5 (Santa Barbara County) Assessed Crossing Structures 7
2.2 Caltrans District 7 (Ventura County) Assessed Crossing Structures 8
2.3 Caltrans District 7 (Los Angeles County) Assessed Crossing Structures 10
3.0 Methods **11**
3.1 Accessing Caltrans Crossing Structures 11
3.2 Data Collection: First Pass Reconnaissance Fish Passage Barrier Assessments 11
3.3 Data Collection: Second Pass Detailed Fish Passage Barrier Assessments 11
3.4 Data Processing: Fish Passage Analysis 12
3.4.1 Fish Passage Analysis: *O. mykiss* Swimming Capabilities 13
3.4.2 Fish Passage Analysis: Crossing Structure Information 14
3.4.3 Fish Passage Analysis: Stream Channel Information 14
3.4.4 Fish Passage Analysis: Streamflow Reduction Factors 15
3.4.5 Fish Passage Analysis: Streamflow Analysis Levels 16
3.4.6 Fish Passage Analysis: Barrier Statuses 17
4.0 Results **18**
4.1 Passage Analysis Results: Summary 18
6.0 Discussion **20**
6.1 Stream Habitat and Passage Condition Fluctuations 21
6.2 Stream Channel and Habitat Conditions Present at Assessed Caltrans Crossing Structures 22
6.3 Anthropogenic Influences on Fish Passage 22
6.4 Caltrans Crossing Structure Barrier Assessment Limitations 22
6.5 Caltrans Crossing Structure Fish Passage Analysis Limitations 23
6.5.1 Caltrans Crossing Structure Fish Passage Analysis: Data Limitations 24
6.5.3 Caltrans Crossing Structure Fish Passage Analysis: Upstream Conditions 25
6.5.4 Caltrans Crossing Structure Fish Passage Analysis: Fish Physiology and Behavior 25
6.6 Barrier Remediation Prioritization 26
6.6.1 Barrier Remediation Prioritization: Barrier Severity 26
6.6.2 Barrier Remediation Prioritization: Habitat Suitability Index Scoring 27
6.6.3 Barrier Remediation Prioritization: Quantity and Location of Suitable Habitat 28
6.6.4 Barrier Remediation Prioritization: Habitat Value Scores 28
6.6.5 Barrier Remediation Prioritization: Barrier Watershed Position 28
6.6.6 Barrier Remediation Prioritization: Presence of Upstream Salmonid Populations 29
6.6.5 Barrier Remediation Prioritization: Social and Economic Considerations 30
6.7 Effective Barrier Remediation 30

Table of Contents Continued

7.0 Conclusion **31**
Acknowledgements **32**
References **33**
Appendix A **37**
Appendix B **166**
Appendix C **368**
Appendix D **377**

List of Maps

Figure 1. Assessed Caltrans crossing structure locations within Santa Barbara County **8**
Figure 2. Assessed Caltrans crossing structure locations within Ventura County **9**
Figure 3. Assessed Caltrans crossing structure locations within Los Angeles County **10**

1.0 Introduction and Project Information

Oncorhynchus mykiss is a species of salmonid native to many freshwater streams within the North American and Asian portions of the Pacific basin. Their current range extends from the Kamchatka Peninsula in southeast Russia through the western coast of Canada and the United States to the northern extent of the Mexican Baja Peninsula (Fuller, 2020). Steelhead along the west coast of North America have been divided into Distinct Population Segments (DPS) based on discrete factors separating populations (NMFS, 2011). The most southern extent of the species range was declared a federally endangered evolutionary significant unit (ESU) in 1997 by the National Marine Fisheries Service (NMFS). This ESU initially extended along the California coast from Point Conception to Malibu Creek, but was expanded to include all coastal streams from the Santa Maria River to the Mexican border in 2002. In 2006 NMFS distinguished the anadromous steelhead form of the species within southern California as a DPS. It is estimated that annual steelhead runs within this DPS have declined from historical averages of 32,000 – 46,000 annual returns to less than 500 annual returns (Good et al., 2005). Many scientists believe the southern California DPS to be the most endangered steelhead DPS in North America (Stoecker, 2004).

O. mykiss exhibit unique life history strategies depending on environmental conditions and available habitat. Resident *O. mykiss*, commonly referred to as rainbow trout, may remain in their native freshwater watershed for the duration of their lives. The anadromous form of *O. mykiss*, known as steelhead trout, migrate to the ocean as smolts where they spend their adult lives before returning to freshwater streams to spawn. One of the numerous factors contributing to the decline of anadromous *O. mykiss* in southern California is the presence of man-made structures within stream channels. Such structures interfere with the life cycle of anadromous fish by limiting or in some cases completely inhibiting their ability to migrate between freshwater spawning habitat and the ocean. Additionally, these structures often limit the passage of sediment and debris necessary for maintaining suitable downstream spawning habitat (Brenkman et al., 2012). Structures limiting or preventing migratory fish movement are often significant impediments to the recovery of vulnerable fish species, including those listed under the Endangered Species Act (Headwaters Economics, 2016). The types of man-made barriers limiting *O. mykiss* migration include dams, bridges, culverts, water diversions, grade controls, and artificially constructed flood control channels. When these structures are removed, a cascade of ecological improvements has been documented by researchers. Apart from reopening historical habitat, plant and animal health in the upper portions of watersheds becomes more robust due to ocean-derived nutrients being transported into the system by migrating anadromous fish (Tonra et al., 2015). Also, increased sediment movement improves plant and animal health in estuaries and river mouths (Baurick, 2015) and overall stream water quality improves with the removal of these structures (Bednarek, 2001).

Within California, documented man-made structures and naturally occurring formations assessed to potentially limit upstream migration of salmonids have been compiled within the California Fish and Wildlife (CDFW) fish Passage Assessment Database (PAD). This database lists a variety of parameters pertaining to each documented barrier, and is publicly accessible on the CDFW website (https://nrm.dfg.ca.gov/PAD/Default.aspx). Previous efforts to assess migration barriers within the southern California steelhead DPS have been documented in PAD. While wide ranging efforts have been made to document and remove anadromous fish migration barriers throughout California, a considerable number of barriers remain in place.

In 2005 California passed and approved senate bill 857 (Streets and Highways Code, Section 156.1), which requires Caltrans to locate, assesses, remediate, and report on state owned transportation

structures that pose as potential barriers to fish passage. Caltrans has partnered with the Pacific States Marine Fisheries Commission (PSMFC), California Conservation Corps (CCC), and CDFW to conduct fish passage assessments on state highway system stream crossing structures and collect relevant watershed habitat and species presence data utilized to establish barrier remediation priorities. Using this data, Caltrans has distinguished state highway system stream crossing structures into three tiers prioritizing fish passage assessment and potential remediation efforts. For Caltrans districts located within the historical range of anadromous fish, tier 1, 2, and 3 priority lists have been developed for stream crossing structures. While many high priority crossing structures have been assessed and, in some cases, remediated to improve fish passage conditions, the barrier statuses of many state highway crossing structures remain unknown. The information contained in this report outlines the results of barrier assessments conducted on tier 1 Caltrans stream crossing structures located within Santa Barbara (Caltrans District 5), Ventura, and a portion of Los Angeles (Caltrans District 7) counties conducted by Pacific States Marine Fisheries Commission (PSMFC) staff between September 2019 and January 2020.

2.0 Study Area/Watershed Overview

Fifty-five tier 1 crossing structures within Caltrans District 7 and 30 tier 1 crossings structures within Caltrans District 5 were assessed and analyzed for this project. Many of the streams crossed by these structures are small to moderately sized tributaries within larger expansive watersheds, such as the Santa Clara River, Ventura River, and Santa Ynez River watersheds. Some of the assessed crossing structures intersected small single-stream coastal canyon watersheds. All assessed crossing structures are located within watersheds that are within the northern portion of the NMFS distinguished southern California steelhead DPS. Many of these watersheds contain headwater streams that flow from east-west orientated transverse mountain ranges characterized by steep topographic relief. Much of the mountainous portions of these watersheds are within the Los Padres National Forest. Chaparral savanna oak woodlands is the dominant vegetation type across these watersheds. Coast live oak (*Quercus agrifolia*) and valley oak (*Quercus lobate*) are common at lower elevations. At higher elevations, big cone spruce (*Pseudotsuga macrocarpa*), grey pine (*Pinus sabiniana*), and coulter pine (*Pinus coulteri*) are present. Native plants common at all elevations include ceanothus (*Ceanothus tomentosus*), manzanita (*Arctostaphylos*), Chamise (*Adenostoma fasciculatum*), California Buckwheat (*Eriogonum gasciculatum)*, various sages (*Salvias*), and mountain-mahogany (*Cerocarpus betuloides*). Riparian areas within the assessed watersheds typically include sycamores (*Plantus racemose*), arroyo willow (*Salix lasiolepis*), white alder (*Alnus rhombifolia)*, and fremont cottonwood (*Populus fremontii*). *Arundo donax*, an invasive reed, has become widespread within many of these watersheds.

All assessed watersheds are located within a semi-arid Mediterranean climate characterized by wet winters and warm, dry summers. Roughly 90% of annual precipitation occurs between November and April. Stream flows within the assessed watersheds tend to be flashy as they rise and fall quickly in response to precipitation events. Frequency, intensity, and duration of winter and spring precipitation events can vary greatly from year to year. Extreme and persistent drought conditions occurred in southern California between 2011 and 2016. During this time period, annual precipitation ranged from 40-69% of normal in Santa Barbara County and 38-67% of normal in Ventura County (Santa Barbara Public Works Department, 2019, Ventura County Watershed Protection District, 2019) (Table 1). However, above-average precipitation occurred between 2017 and 2019. Additionally, the amount of precipitation that occurs across the assessed watersheds can vary significantly with additional orographic precipitation occurring in the mountainous portions of these watersheds (Table 1).

		Ventura River Watershed		Carpinteria Creek Watershed	
	Rainfall Gage Location and (elevation)	Ventura Govt Center (280 ft)	Wheeler Gorge (1900 ft)	Carpinteria Fire Station (30ft)	Edison Trail (1650 ft)
Water Year Measured Rainfall (inches) (% of average)	2011-2012	9.49 (59%)	14.48 (52%)	9.83 (57%)	15.39 (61.7%)
	2012-2013	5.80 (36.1%)	10.51 (37%)	8.33 (48%)	13.7 (55%)
	2013-2014	6.14 (38%)	14.74 (53%)	5.83 (34%)	9.21 (37%)
	2014-2015	9.15 (57%)	17.37 (62%)	8.48 (48%)	12.52 (50%)
	2015-2016	8.49 (53%)	14.16 (51%)	10.11 (58%)	15.35 (62%)
	2016-2017	19.11 (119%)	32.24 (116%)	21.75 (125%)	32.48 (130%)
	2017-2018	7.16 (45%)	14.7 (53%)	9.04 (52%)	15.52 (62%)
	2018-2019	19.19 (119%)	37.79 (133%)	18.19 (105%)	34.57 (137%)

Table 1. *Measured rainfall and percent of average at varying elevations over the last 8 water years in the Ventura River and Carpinteria Creek Watersheds (Ventura County Watershed Protection District and Santa Barbara County Water Resources 2020).*

In contrast to winter and spring precipitation events, weather during summer and autumn months across these watersheds is typically hot and dry. This leads to steady decreases in residual stream flow, eventually leading to significant portions of stream channels experiencing sub-surface flow or going dry. The inconsistent dynamics of precipitation events and streamflow regimes associated with the southern California steelhead DPS watersheds provides limited and specific timeframes in which anadromous steelhead trout attempt their upstream migrations from the ocean. This exacerbates the impact migration barriers have within the Southern California Steelhead DPS.

2.1 Caltrans District 5 (Santa Barbara County) Assessed Crossing Structures

The 30 tier 1 crossing structures assessed within Santa Barbara County were located on California state highways 1 (n=1), 101 (n=20), 154 (n=1), 192 (n=4), and 246 (n=4). Twenty of these crossing structures are located within small watersheds on the coastal south facing side of the Santa Ynez mountains. The other ten crossing structures are located within the Santa Ynez Valley over streams which are part of the Santa Ynez River Watershed. Several of the assessed crossings structures are located within developed urban and residential areas, including the cities of Buellton (n=1), Santa Ynez (n=1) Goleta (n=3), Santa Barbara (n=3), and Carpinteria (n=1).

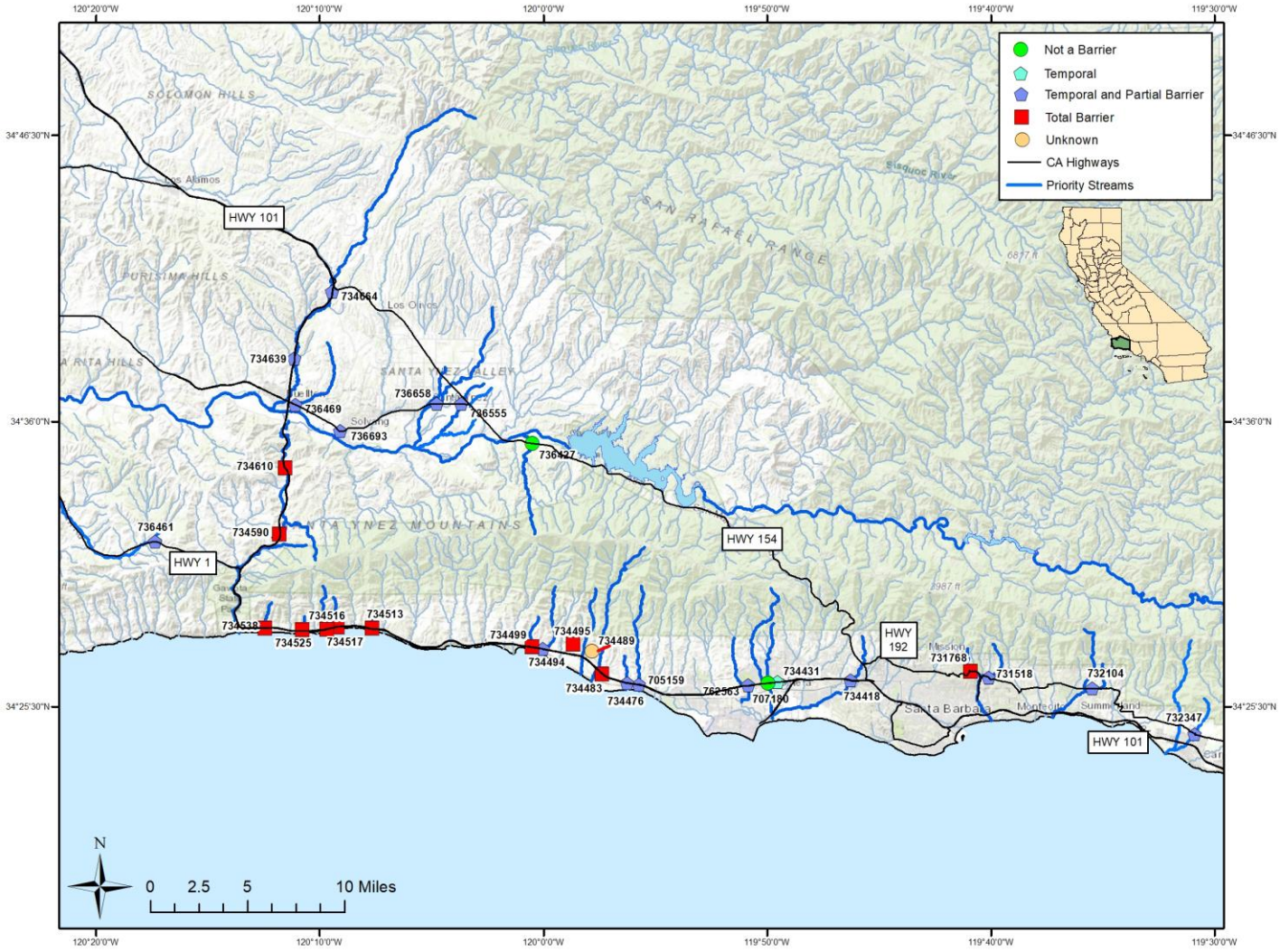


Figure 1. *Assessed Caltrans crossing structure locations within Santa Barbara county.*

2.2 Caltrans District 7 (Ventura County) Assessed Crossing Structures

The 53 tier 1 crossing structures assessed within Ventura County were located on California state highways 33 (n=27), 34 (n=3), 101 (n=3), and 150 (n=20). 33 of these structures cross tributaries within the Ventura River watershed and 11 cross tributaries within the Santa Clara River Watershed. The other nine structures cross small coastal watershed streams. Of the 53 assessed crossing structures, 16 are located within agricultural areas, including the Oxnard Plain (n=5), the Ojai Valley (n=9), and Santa Paula Canyon (n=2). Twelve of the 53 assessed crossing structures are located within developed urban and residential areas including the cities of Ventura (n=1), Ojai (n=4), unincorporated communities of Miners Oaks (n=2), Mira Monte (n=3), and Casitas Springs (n=2). Eighteen of the 53 crossing structures are located within minimally developed areas. This includes portions of the Casitas Valley (n=3) and Los Padres National Forest (n=15). Seven of these crossings are located within the industrial area of the lower portion of the Ventura River.

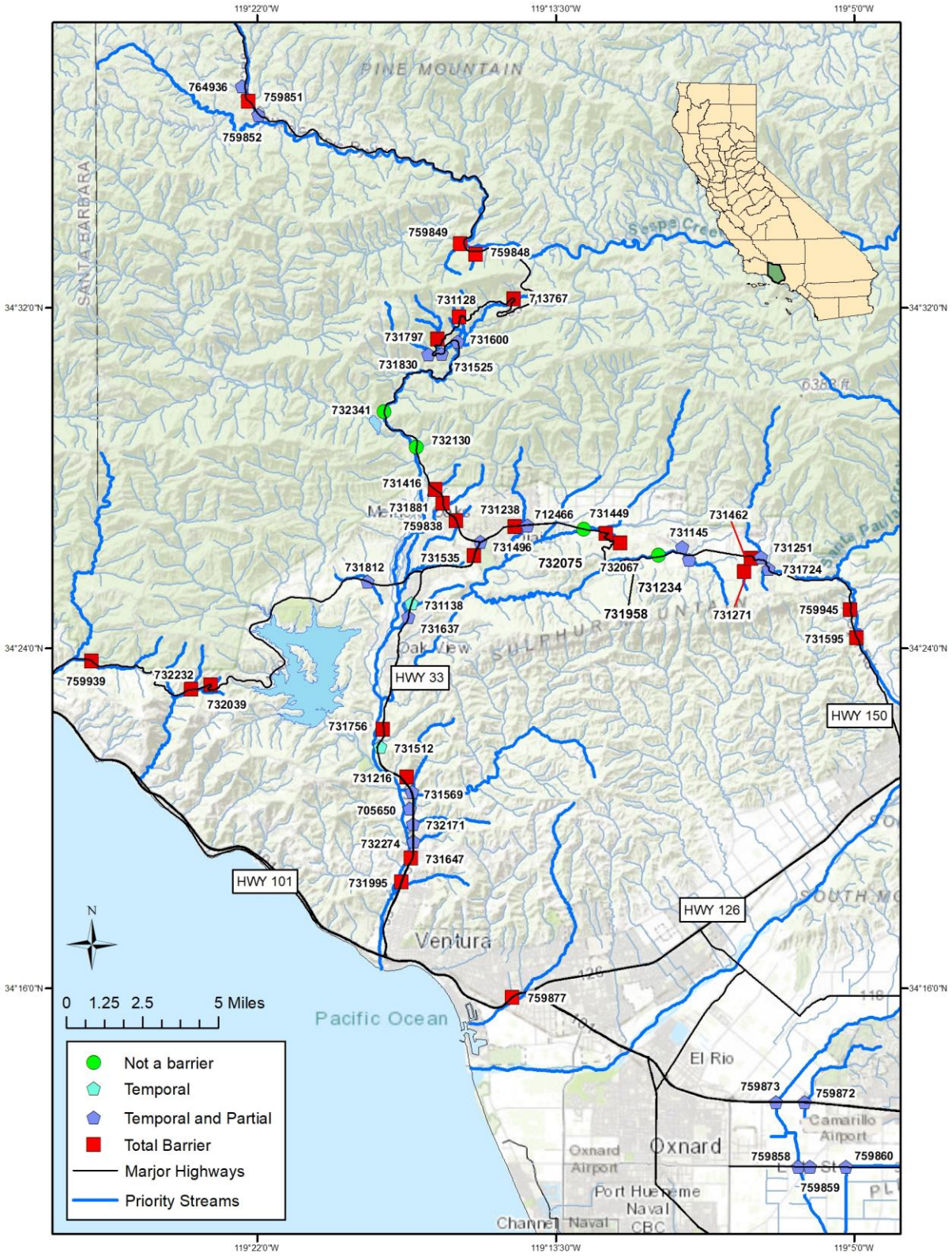


Figure 2. *Assessed Caltrans crossing structure locations within Ventura county.*

2.3 Caltrans District 7 (Los Angeles County) Assessed Crossing Structures

Two crossings structures were assessed within Los Angeles County. Both crossings are Highway 27 structures and are located within the Topanga Creek Watershed. This watershed is located within the Santa Monica Mountains. Despite being the third largest watershed draining into the Santa Monica Bay with an area of 18 mi², the watershed is relatively small when compared to many other watersheds in southern California (Resource Conservation District of the Santa Monica Mountains, 2020). The watershed contains some residential housing, but is relatively undeveloped, especially when compared to the surrounding Los Angeles metropolitan area. Both structures assessed within the watershed cross small unnamed tributaries to Topanga Creek.

Figure 3. *Assessed Caltrans crossing structure locations within the Topanga Creek watershed in Los Angeles county.*

3.0 Methods

Caltrans stream crossing structures assessed for fish passage were specified on the Southern Steelhead and Central Coast 2nd Pass Tier 1 Priorities list dated September 6th, 2019. Barrier assessment data was collected according to methods outlined within the Caltrans reconnaissance first pass fish passage assessment and detailed fish passage assessment protocols (HDR Engineering Inc., 2007). Data was recorded on hard copy Caltrans reconnaissance assessment survey datasheets (version 03/31/2007) and road-stream crossing survey detailed fish passage assessment datasheets (version 03/31/2007). Survey crews consisted of two to four trained personnel from PSMFC, California Conservation Corps (CCC), and California Department of Fish and Wildlife (CDFW).

3.1 Accessing Caltrans Crossing Structures

Vehicles were utilized to travel to and park in the general vicinity of each assessed crossing structure. Vehicles were parked in safe locations, commonly on the shoulder or side of frontage roads, exit ramps, or residential streets. In some instances, vehicles were parked on the shoulder or in pull-outs along state roadways when no other parking options were available. Surveyors gained access to crossing structures by hiking to the inlet or outlet of each structure. Navigating to each crossing structure was aided by entering their coordinates into a handheld Garmin GPS device.

3.2 Data Collection: First Pass Reconnaissance Fish Passage Barrier Assessments

Caltrans reconnaissance fish passage assessments were conducted for each assessed Caltrans crossing structure. Reconnaissance fish passage assessments were completed to ensure the crossing structure and the conditions within the stream channel met the criteria for the completion of a detailed fish passage assessment. Reconnaissance fish passage assessments also ensured the exact locational coordinates of each crossing structure were recorded. Using a handheld Garmin GPS device locational coordinates were recorded at the inlet of each crossing structure. If the inlet of a crossing structure was inaccessible coordinates were recorded at another specified portion of the crossing structure. Reconnaissance fish passage assessments also ensured information regarding land ownership, structure accessibility, potential hazards, and assessment limitations were identified and recorded.

3.3 Data Collection: Second Pass Detailed Fish Passage Barrier Assessments

Caltrans detailed fish passage assessments were conducted if Caltrans road crossing structures were found to contain fish passage constraints and were located within definable stream channels. Under these assessments, the physical characteristics of crossing structures and surrounding stream channel features were measured by completing longitudinal and cross section profiles. Longitudinal profiles and cross section elevation measurements were collected using a tripod-mounted automatic level. The automatic level provided foresight readings from a 25 ft fiberglass stadia rod placed vertically at designated longitudinal profile and cross section points. A transect tape, with measurements listed in decimal feet, was used to obtain the station location points (horizontal datum) along profiles and cross sections. Longitudinal profile measurements were taken along the stream's thalweg at various points upstream, within, and downstream of the assessed road crossing structures. Longitudinal profiles began at the tailwater control point of the first resting habitat upstream of each crossing structure and extended to points along the channel slope downstream of each crossing structure. Points measured in each longitudinal profile included the upstream and downstream extents of crossing structure aprons, crossing structure inlets and outlets, crossing structure segment change points, the downstream habitat unit max depth point, and the downstream habitat unit tailwater control point. Channel cross section profiles were

obtained between the channel bankfull margins at the determined downstream tailwater control point. At least nine points representative of channel slope breaks were measured between the bankfull margins. The active channel margins and thalweg point of the downstream unit tailwater control were always included in these measurements. Crossing structure cross-section measurements were obtained only when the base of the crossing structure was not flat. For example, cross-sections measurements were obtained at pipe arch culverts containing a concave base.

Other crossing structure information obtained during detailed barrier assessments included the shape, height, width/span, and length of road crossing structure components or segments. If a stain or rust line was visible, its mean height from the base of the structure was recorded. Any presence of damage or deterioration to the crossing structure was recorded and photographed. Alignment of the structure in relation to the upstream and downstream stream channel was recorded in addition to any changes in alignment between structure segments. The presence of trash racks, weirs, or fish ladder components were also recorded. If accessible, pictures were taken of the inlet and outlet of each crossing structure as well as the upstream and downstream channels. If the crossing structure contained embedded substrate, the dominant substrate type was recorded and, if possible, the depth of the substrate was measured with a stadia rod.

Some portions of the detailed fish passage assessment were not conducted. This included road fill prism volume measurements and site sketches. Road fill prism volume measurements were not taken as they do not contribute to the assessment of fish passage. Additionally, Caltrans personnel indicated that detailed road fill measurements would be completed prior to any barrier remediation efforts occurring at these crossing structures. Site sketches were not made as pictures are likely to better convey crossing structure and stream channel features and conditions.

3.4 Data Processing: Fish Passage Analysis

Analysis of *O. mykiss* abilities to gain passage through and under assessed Caltrans road crossing structures was primarily made with the use of FishXing software (V3.0.20). FishXing “Fish Crossing” software is designed to assist in the evaluation and design of culverts for fish passage by comparing fish swimming abilities to crossing structure characteristics, channel geometry, and local streamflow hydrology. Fish passage through open bottom structures with natural streambed substrates such as bridges can also be modeled with FishXing (HDR Engineering, 2007). The following sections explain how data for the various selectable parameters within FishXing were utilized in fish passage analysis. An example, selected FishXing parameters for a reinforced box culvert crossing structure are shown in figure 4 below.

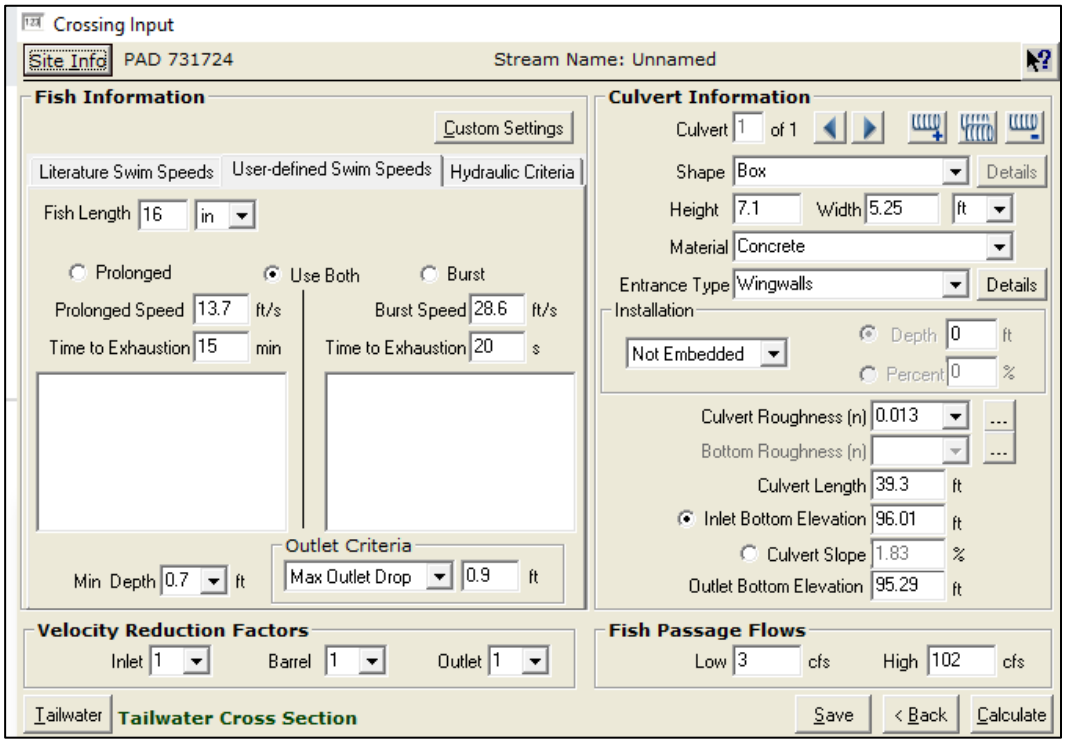


Figure 4: *Example of FishXing inputs for reinforced concrete box culvert under Hwy 150 in Ventura County (PAD ID 731724).*

3.4.1 Fish Passage Analysis: *O. mykiss* Swimming Capabilities

FishXing allows for the selection and analysis of specific fish swimming capability parameters. These parameters are specific to various species and life stages. *O. mykiss* swimming capability parameters used in FishXing analysis were drawn from various sources of reviewed literature. The strongest reviewed swimming capabilities of both resident and anadromous *O. mykiss* life stages were used in fish passage analysis. Selecting the strongest swimming capabilities allowed the upper thresholds of *O. mykiss* passage abilities to be assessed. This also ensured barrier statuses generated from results of FishXing analysis were stringent and applicable to all *O. mykiss* swimming abilities. Tables 2 and 3 below list the *O. mykiss* swimming abilities used in FishXing analysis and their associated sources.

FishXing Evaluated Anadromous Steelhead Swimming Capabilities		
FishXing Parameter	**Value Assessed**	**Reference**
Fish length	> 16 inches	Stoecker, 2002
Prolonged Speed	13.7 feet per second	Powers and Osborn, 1985
Time to Exhaustion	15 minutes	Hawkins and Quinn, 1996
Burst Speed	28.6 feet per second	Powers and Osborn, 1985
Time to Exhaustion	20 seconds	Hunter and Mayor, 1986
Minimum Required Water Depth	0.7 feet	Thompson, 1972, as cited in Stoecker, 2002
Max Leap speed	26.5 feet per second	Powers and Osborn, 1985

Table 2: *Anadromous Steelhead swimming capabilities used in FishXing analysis.*

FishXing Evaluated Adult Resident *O. mykiss* Swimming Capabilities		
FishXing Parameter	**Value Assessed**	**Reference**
Fish length	4.06 – 14.7 inches	FishXing (Jones et al., 1974)
Prolonged Speed	2.2 feet per second	FishXing (Jones et al., 1974)
Time to Exhaustion	10 minutes	FishXing (Jones et al., 1974)
Burst Speed	4.1 feet per second	FishXing (Hunter and Mayor, 1986, Bainbridge, 1960)
Time to Exhaustion	10 seconds	FishXing (Hunter and Mayor, 1986, Bainbridge, 1960)
Minimum Required Water Depth	0.5 feet	California Department of Fish and Wildlife
Max Leap speed	11.7 feet per second	FishXing (Hunter and Mayor, 1986, Bainbridge, 1960)

Table 3. *Adult resident O. mykiss swimming capabilities used in FishXing analysis.*

3.4.2 Fish Passage Analysis: Crossing Structure Information

Crossing structure information utilized in FishXing analysis was derived from longitudinal profiles, cross section profiles, dimensional measurements, and specific structure observations. Longitudinal profiles provided the measurements used to determine the length and slope of crossing structure segments analyzed with FishXing. Cross section profiles were used to determine the base radius dimensions entered within FishXing for crossing structures which contained concave bases but did not have a uniform diameter. Other crossing structure dimensional inputs such as the height, width, and span of structures were also used in FishXing analysis. If any of these crossing structure dimensions varied, the mean value was used for analysis. In addition to dimensions, the shape of the crossing structure stream passageway was selected from a list in FishXing. Crossing structure passageway shapes available for selection included circular, box, arch (single radius), pipe-arch (multiple radius), low-profile arch, high-profile arch, and horizontal ellipse.

3.4.3 Fish Passage Analysis: Stream Channel Information

FishXing software does not incorporate upstream channel conditions or dimensions into the fish passage analysis it performs. Stream channel information was primarily derived from tailwater cross section profiles. Measurements from tailwater cross section profiles were entered into FishXing to predict the depth of water that would occur at the tailwater over varying rates of streamflow. This relation of tailwater depth to the rate of streamflow is known as a hydrologic rating curve. An example of tailwater information entered within FishXing and the resulting rating curve is shown in Figures 5 and 6.

Linear fluctuations present within the downstream channel recorded in longitudinal profiles were also utilized for FishXing analysis inputs. Specific locational measurements used included the maximum depth within the initial downstream habitat unit, the tailwater control point, and channel slope change points downstream of the tailwater control point. Upstream channel measurements, conditions, and potential impacts to *O. mykiss* passage were considered on a professional judgement basis for fish passage analysis. Parameters considered in this judgment included; additional potential upstream obstacles, upstream channel substrate configurations, upstream channel vegetation, and the distance and height of the initial rest unit available to *O. mykiss* if crossing structure passage was achieved.

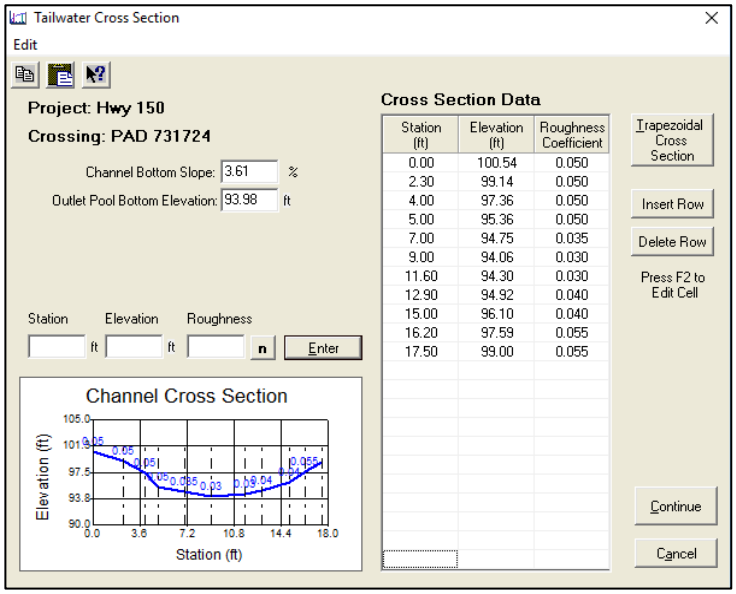


Figure 5: *Tailwater cross section FishXing inputs for PAD ID 731724.*

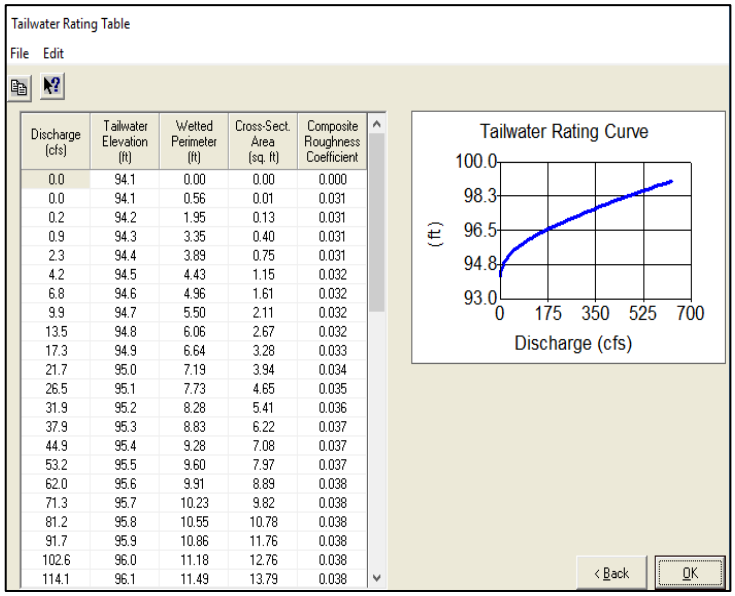


Figure 6: *Tailwater rating curve generated from tailwater cross section for PAD ID 731724.*

3.4.4 Fish Passage Analysis: Streamflow Reduction Factors

Additional parameters considered in FishXing passage analysis are structural and stream channel influences on streamflow. FishXing allows for the selection of two different streamflow reduction factors expressed with Manning's roughness coefficients and velocity reduction factors. Manning's roughness coefficients are a variable of Manning's equation, which is an empirical formula that estimates the average velocity of a liquid through a conduit such as a stream channel or culvert as a function of flow area (channel or culvert dimensions), slope, and surface roughness. Roughness coefficient values represent the friction applied to the flow of a liquid by the surface in which the liquid is flowing over and between. Roughness coefficient values utilized for FishXing analysis were selected from reference tables established by Ven Te Chow (Open Channel Hydraulics, 1959), listed within the FishXing user manual. Roughness coefficient reference tables are listed in Appendix D. FishXing passage analysis incorporates roughness coefficient values for the surface over which streamflow travels through a crossing structure as well as the conditions within the downstream channel. Roughness coefficients were selected to represent the coarseness of crossing structure stream passageway bases and walls. Downstream roughness coefficients were selected for each point measured along tailwater cross sections based on the substrate and vegetation conditions present in those locations at the time of assessment.

FishXing also allows streamflow velocity reduction factors to be applied to the inlet, barrel, and outlet zones of analyzed crossing structures. Streamflow velocity reduction factors are a ratio of the occupied streamflow velocity (the portion of the crossing structure were a fish would swim) to the structure's cross-sectional average streamflow velocity. Streamflow velocity reduction factors are used to account for features which reduce streamflow water velocity and may be utilized by fish to conserve energy. According to the FishXing user manual, streamflow velocity reduction factors "vary substantially and are influenced by many factors, such as the shape and roughness of the culvert, the culvert alignment with the upstream channel, outlet conditions, and the size of the fish," and "velocity reduction factors are usually only applicable for small fish (FishXing Manual, 2012)." For this project, there was not sufficient data collected for consistent specification of factors capable of influencing streamflow velocity in relation to passage attempts made by large migrating anadromous *O. mykiss*. Therefore, Manning's roughness

coefficients were the only streamflow reduction factors incorporated into FishXing modeling and passage analysis.

3.4.5 Fish Passage Analysis: Streamflow Analysis Levels

Rate of streamflow are also a selectable variable within FishXing for passage analysis. FishXing allows for passage analysis to be made between user-set high and low rates of streamflow. California Department of Fish & Wildlife guidelines suggest utilizing exceedance values produced from streamflow duration analysis as a means of considering fish passage into the designs of crossing structures. Streamflow exceedance values are based on the percentage of time streamflow is likely to equal or exceed a specified rate. Due to the flashy nature of streamflow within southern California streams, exceedance values do not provide an accurate representation of the short-lived streamflow spikes commonly conducive to *O. mykiss* migration. For example, the 1% annual exceedance streamflow rate for Carpinteria Creek located in Santa Barbara County is 45 ft^3/s (USGS, 2019). To ensure all streamflow levels conducive to migration and possible barrier passage were considered in FishXing passage analysis, the estimated mean annual peak rate of streamflow occurring at each assessed Caltrans crossing structure was set as the high evaluation streamflow level for FishXing passage analysis. For Carpinteria Creek the mean annual peak rate of streamflow is currently 1,064.5 ft^3/s (USGS, 2019).

Estimated mean annual peak streamflow rates were calculated based off available streamflow gauge data within Santa Barbara and Ventura counties. This included streamflow gauge data from the United States Geological Survey (USGS) and the Ventura County Public Works Agency. Some of the assessed Caltrans crossing structures were located within streams with records of streamflow gauge data, but many were not. For crossing structures located within streams absent of streamflow gauge data records, the mean annual peak rate of streamflow was estimated with the use of a regional regression flow equation developed for the south coast region of California by the USGS, shown in figure 7 (Waananen and Crippen, 1977). This equation provides mean annual peak streamflow estimations by comparing the drainage area and yearly peak streamflow of streams with streamflow data records to nearby non-gauged streams with a similar drainage area. To make estimations more robust, the equation was used to make estimated peak streamflow calculations based on comparisons to multiple individual gauged streams located nearby. The mean of these multiple comparison values was then used as the high streamflow rate in FishXing passage analysis of crossing structures located within streams absent of streamflow gauge data records. ArcMap GIS Desktop (version 10.6.0.8321) was used to determine the drainage area of streams used in the Waananen and Crippin regional regression streamflow equation. Using the topographic base map within Arc GIS the drainage area upstream of each assessed Caltrans crossing structure was traced and made into a polygon layer. The area of these polygons was than determined from the area of these polygon layers.

$$\boldsymbol{Qu} = \boldsymbol{Qg}\left(\frac{\boldsymbol{Au}}{\boldsymbol{Ag}}\right)^{\boldsymbol{h}}$$

$\boldsymbol{Qu}$ = Discharge at stream site without gauge streamflow record
$\boldsymbol{Qa}$ = Measured discharge at nearby stream site with gauge streamflow record
$\boldsymbol{Au}$ = Drainage area of stream site without gauge streamflow record
$\boldsymbol{Au}$ = Drainage area of stream site with gauge streamflow record
$\boldsymbol{h}$ = Regionally based suggested exponent (0.14 for southern California coastal streams)

Figure 7. *Waananen and Crippen regional regression streamflow prediction equation.*

3.4.6 Fish Passage Analysis: Barrier Statuses

The barrier passage statuses assigned to assessed Caltrans crossing structures were based on barrier definitions listed in the CDFW PAD and shown below in Table 4. Passage statuses were primarily assigned based off the results of FishXing passage analysis. If FishXing analysis indicated a crossing structure was not passable to strong swimming anadromous *O. mykiss*, the crossing was assigned a total barrier status. If FishXing analysis indicated a crossing structure was potentially passable to anadromous *O. mykiss*, then FishXing analysis was conducted for resident *O. mykiss* swimming capabilities. Resident *O. mykiss* complete their life cycle in the freshwater and are typically smaller in size (NFMS, 2012). The results of this additional analysis for resident *O. mykiss* passage abilities directed the selection of temporal, partial, or temporal and partial barrier status for the crossing structure. Crossing structures assessed to be free of passage constraints, such as free spanning bridges over natural streambed substrate, were considered to not be barriers to *O. mykiss* upstream migration.

Professional judgment was relied upon to assign barrier passage statuses to crossing structures that were unable to be analyzed with FishXing due to limitations preventing the completion of a detailed fish passage assessment. Stream channel conditions and the perceived or calculated length, slope, height, and roughness of crossing structure segments were considerations factored into professional judgement-based barrier status determinations. Comparisons to the results of FishXing passage analysis on crossing structures with similar dimensions were often considered when making professional judgements of *O. mykiss* passage abilities. Additionally, when plunge points were present at crossing structures, the passage considerations outlined within the California Salmonid Stream Habitat Restoration Manual (CSSHRM) (Flosi et al., 1998) were also factored into professional judgement barrier status selection. These CSSHRM passage analysis considerations are listed below.

1. Is the gradient of the structure less than 1?
    - Gradient = height of plunge point / breadth of streamflow over plunge point
    - Low gradients increase the jump distance required to clear the plunge and thus decrease likelihood of successful fish passage.
2. Is the maximum jumping height of anadromous steelhead *O. mykiss* (11 feet reported in Reiser and Peacock 1985) greater than the height of the plunge point (measured from the surface of the water downstream of structure)?
3. Is the depth of the plunge unit downstream (directly below) of the potential barrier greater than 1.25 times the height of the structure?

Barrier Passage Status	Definition
Total	Structure/site is impassable to all fish species at all life stages under all streamflow conditions.
Temporal	Structure/site is impassable to all life stages of fish under some streamflow conditions.
Partial	Structure/site is impassable to particular fish species or life stages under all streamflow conditions.
Temporal & Partial	Structure/site is impassable to all species and life stages of fish under some flow conditions and also impassable to particular fish species or life stages under all streamflow conditions.
Not a Barrier	Structure/site has been determined not to present as a barrier to any fish species or life stages.
Unknown	Structure/site passage status unable to be determined without additional assessment(s).
Unassessed	Structure/site has not been assessed for fish passage.

Table 4. *CDFW barrier passage statuses and definitions adapted from definitions listed in the California Salmonid Habitat Restoration Manual (Flosi et al., 1998).*

4.0 Results

The data collected for this project and results of our Caltrans crossing structure barrier analysis is representative of the environmental and physical conditions present at the time of assessment. Structures were assessed during low streamflow conditions and in many cases, when streamflow was absent. Periods of elevated streamflow following rain events may change the conditions present upstream, downstream, and within crossing structures. Further discussion regarding the potential for environmental and physical changes to occur at assessed Caltrans crossing structures and the areas surrounding them are provided in section 6.1 of this report. Details regarding the specific data collected from barrier assessments conducted on Caltrans road crossing structures and the results of *O. mykiss* passage analysis is outlined in appendixes A, B, and C.

4.1 Passage Analysis Results: Summary

Caltrans detailed fish passage assessments and FishXing passage analysis were completed on 67 of the 85 (79%) tier 1 crossing structures assessed for this report. The primary reason a detailed fish passage assessment was not performed were confined space restrictions, present within 12 (14%) of the assessed crossing structures. Six (7%) of the assessed crossing structures did not contain any fish passage constraints and therefore did not meet the criteria for a detailed barrier assessment. Seventy-seven (91%) of the assessed crossing were found to contain some level of passage constraint to *O. mykiss*. Table 5 lists the number and percentage of crossing structures found to be total barriers, temporal & partial barriers, temporal barriers, as well as not a barrier. Reference tables listing the locational coordinates, assigned barrier status, structure type, and Caltrans fish passage assessments conducted at each crossing structure are listed at the beginning appendixes A, B, and C.

County	Caltrans Crossing Structures Assessed	Assessed Barrier Status			
		Total Barrier	Temporal & Partial Barrier	Temporal Barrier	Not a Barrier
Santa Barbara County*	30	11 (36.6%)	15 (50%)	1 (3.3%)	2 (6.6%)
Ventura County	53	25 (47.2%)	22 (41.5%)	2 (3.7%)	4 (7.5%)
Los Angeles County	2	1 (50%)	1 (50%)	0	0
All Assessed Crossing Structures	85	38 (44.7%)	38 (44.7%)	3 (3.5%)	6 (7.1%)

Table 5. *Barrier statuses of Tier 1 Caltrans crossing structures assessed in Santa Barbara, Ventura, and Los Angeles counties. *A barrier status for one of the assessed crossing structures in Santa Barbara county was unable to be determined.*

Assessed crossing structures ranged in length from 27.1 ft to 2,190.4 ft, with a mean length of 202 ft ± 32.7 ft [mean ± SE]. The range in distance (stream miles) of the assessed crossing structures from the ocean was 73.36 miles to 0 miles, with a mean of 16.51 miles ± 1.93 miles [mean ± SE]. A well-defined upstream resting area with the potential for *O. mykiss* to utilize after any successful passage was not located within the vicinity of 16 (18.8%) assessed crossings. For the 70 crossing structures with an upstream resting area within their vicinity at the time of their assessment the resting areas ranged from 68.8 ft to 0 ft from the structures, with a mean distance of 19.83 ft ± 1.77 ft [mean ± SE]. The height of these resting areas above the upstream base extent of the crossing structures ranged from 6.95 ft to 0 ft, with a mean height of 1.04 ft ± 0.18 ft [mean ± SE]. The mean active channel width upstream of the assessed crossing structures was 11.9 ft ± 1.02 ft [mean ± SE], with a range from 50.1 ft to 1.5 ft. A well-defined downstream tailwater stream channel control point was not present at 28 (32.9%) of the assessed crossing structures. For the 57 crossing structures with a well-defined tailwater control point within the downstream stream channel they ranged from 106.6 ft to 3.0 ft from the crossing structures, with a mean distance of 24.2 ft ± 2.09 ft [mean ± SE]. None of the assessed Caltrans crossing structures contained fish passage structures such as weirs or fishways.

4.2 Passage Analysis Results: Passage Restrictions

FishXing passage analysis provides a list of the specific types of restrictions predicted to occur within each assessed crossing structure that limit or prevent the ability of a fish to gain successful passage. Passage restrictions provided from FishXing passage analysis are listed below in Table 6. Passage restrictions predicted to occur under the estimated annual mean peak streamflow for each assessed crossing structure are listed in appendixes A, B, and C. Professional judgement was relied upon to select potential passage restrictions for crossing structures that FishXing passage analysis was unable to be performed for. For anadromous *O. mykiss* insufficient streamflow depth was the most common passage restriction predicted to occur, limiting passage at 78 (92%) of the 85 assessed crossing structures. This is not surprising considering the frequency of low streamflow rates within southern California streams. Excessive streamflow velocity restrictions were predicted to occur at 32, (38%) of the assessed crossing structures. Impassable plunge or cascade points were predicted to occur at 22, (26%) of the assessed crossing structures. Excessive leap heights were predicted to occur at four, (5%) of the assessed crossing structures. An outlet unit restriction was predicted to occur at 21, (25%) of the assessed crossing structures. An absence of resting units was predicted to restrict passage at four, (5%) of the assessed crossing structures. Seven of the assessed crossing structures were incorporated into larger flood control channels which were predicted to restrict or prevent *O. mykiss* passage due to absence of resting units.

FishXing Predicted Passage Restrictions	Passage Restriction Description
Insufficient Streamflow Depth	If the water depth anywhere within the structure is predicted to be less than the minimum depth required to allow for successful fish passage. Generally, the minimum water depth is defined as the depth of water required to submerge a fish.
Excessive Streamflow Velocity (Exhaustion Restriction)	Predicted conditions for this passage restriction include. -If the streamflow velocity causes exhaustion in a fish when its prolonged swimming speed doesn't allow it to gain passage through the structure. - If the total time that the fish swims at burst speed exceeds the fish's burst time to exhaustion before the fish can gain passage through the structure. - If the reduced average water velocity, (average velocity * velocity reduction factor) is greater than or equal to fish's burst swimming speed. - If the difference between the fish's prolonged speed and the reduced average water velocity, (average velocity * velocity reduction factor) is less than 0.01 ft/sec then the fish will not make adequate headway through the structure.
Impassable Plunge/Cascade	If the plunge/cascade height (difference in elevation between the water surface and downstream control point) is greater than the max leaping height of the fish.
Excessive Leap Height	If the leaping height required to gain passage of a plunge/cascade point or obstruction is greater than the leaping ability of the fish as defined by its max leap speed.
Outlet Unit Restriction	If the outlet pool depth (tailwater control point elevation – outlet unit max depth) is less than the length, then it is considered too shallow to allow for leaping and is classified as an outlet unit barrier. This barrier criterion only applies to structures with an outlet configuration that requires leaping.
Absence of Resting Units	If the structure has an excessive length and lacks weirs or other infrastructure that creates streamflow conditions that allow an upstream moving fish the ability to rest and recover before reaching exhaustion.

Table 6. *FishXing passage restrictions and definitions (FishXing Manual, 2012).*

6.0 Discussion

There are a number of factors to be considered when interpreting the data listed in this report and using it as a reference for future Caltrans crossing structure barrier remediation and stream habitat restoration efforts. Foremost there are various challenges and limitations when it comes to performing crossing structure barrier assessments, performing barrier analysis, and determining barrier status. Rates of streamflow and stream channel conditions are extremely dynamic. Each crossing structure contains unique design features, dimensions, and orientations creating distinct and fluctuating hydraulic conditions. Additionally, the physiological abilities and migration behaviors among various fish species and individuals within each species vary immensely.

In addition to the various complications associated with assessing and analyzing the ability of fish to gain passage of each particular crossing structure, there are many factors to consider in determining

remediation priorities for the structures which are predicted to constrict the movement of fish. Finally, there are a number of specific factors to consider with regards to designing and implementing barrier remediation efforts on crossing structures. Many considerations are necessary to ensure remediation efforts are effective and remain effective over time. The many factors and considerations associated with the assessment, analysis, prioritization, and remediation of Caltrans crossing structures which restrict the movement of fish are discussed in the following sections.

6.1 Stream Habitat and Passage Condition Fluctuations

Fluctuations in habitat and passage conditions should be considered when interpreting the passage conditions and barrier analysis results listed in this report. As with any ecosystem, habitat conditions within riparian systems are ever-changing. These changes are most evident in seasonal and reactionary streamflow regimes. This is a common trend for any stream, but streamflow fluctuations in southern California streams are exceptionally pronounced. Under the Mediterranean climate of the often steep and rocky southern California coastline significant streamflow reductions occur during the dry summer and fall months, often leading to dry portions of stream channel. Winter storms bring brief elevated spikes of streamflow allowing *O. mykiss* the potential to move upstream and downstream. Occurrences of elevated streamflow also may cause erosion and scour. These fluctuations primarily influence *O. mykiss* habitat conditions, but also can influence *O. mykiss* abilities to move within a stream, including passage of Caltrans crossing structures. With this consideration, it should be stressed that the passage analyses and barrier statutes described within this report are representative of the stream channel and crossing structure conditions present at the time of assessment.

Additionally, natural disasters, such as wildfire, can amplify the rate of change that occurs within stream channels and at crossing structures. Wildfires reduce the abundance of vegetation within a watershed, increasing the rate of sedimentation and subsequently reducing the availability and quality of freshwater habitat. This can influence fish passage conditions throughout the watershed, including at man-made structures. Reductions in mean stream depth due to sedimentation tends to impact barrier conditions and the ability of salmonids to migrate. Streamflow velocity and turbulence tends to be higher in channel areas with shallow channels lacking areas of scour. This requires salmonids to expend more energy in their upstream movements and reduces potential resting areas. Due to the flashy streamflow regimes typical of southern California streams, there are limited windows of streamflow conducive to *O. mykiss* migration. Diminished stream depths due to sedimentation are likely to further limit these migration windows. Additionally, fine sediment loads with concentrations of 3,000 parts per million or greater suspended within the water column have been shown to cause damage to salmonid gill filaments (Herbert and Merkens, 1961). Fine sediments that settle out of the water column have been observed to cover substrate suitable to salmonid spawning, suffocate eggs, or prevent the emergence of recently hatched young (Cordone and Kelly, 1961).

Furthermore, soil can become hydrophobic following wildfires and therefore lead to increases in surface runoff rates during precipitation events. Following the Thomas Fire many streams within Santa Barbara and Ventura county experienced destructive debris flows brought on by torrential rains of up to 0.60 inches in just a five-minute period (National Weather Service, 2019). These debris flows caused rapid and significant alterations to the stream channel, riparian zone vegetation, and surrounding man-made structures, including five Hwy 192 crossing structures (Noozhawk, 2018). Additional potential wildfire associated impacts on stream habitat include reduced benthic macroinvertebrate populations, decreased channel bank stability, water quality fluctuations, decreased water depth, increased dissolved nutrients, increased pH levels, increased water temperature, and increased turbidity (Klose, 2018). Additionally, each of these impacts can create individual chain reactions that further alter stream habitat

conditions. For instance, increased water turbidity interferes with sunlight penetration and reduces aquatic vegetation photosynthesis resulting in lower dissolved oxygen concentration. Turbidity may also clog the gills of fish and result in decreased growth rates for juvenile salmonids (CDFW PAD, 2019). Overall stream ecosystem impacts associated with wildfire adversely impact fish populations as the quality and quantity of habitat available to them is reduced. Some of the Caltrans crossing structures assessed for this report are located within or downstream of recent wildfire burn scars, including the Thomas Fire (2018), Whittier Fire (2018), Sherpa File (2016), and Cave Fire (2019).

6.2 Stream Channel and Habitat Conditions Present at Assessed Caltrans Crossing Structures

This report includes inferences regarding the potential for the streams of assessed crossing structures to support *O. mykiss*. Many of the crossing structures were assessed during the autumn months of 2019, the peak of the dry season in southern California, and subsequently often lacked presence of active streamflow. This intermittent streamflow is typical of many southern California streams and is likely only one of many indicators of a stream's capacity to support *O. mykiss* populations. During the warm and dry months of summer and autumn, there may be several large sections of intermittent and perennial streamflow. Areas of perennial streamflow may provide habitat capable of supporting resident southern California *O. mykiss*. Therefore, to gain greater understanding of the likelihood each stream is to support *O. mykiss* the entire stream length should be surveyed up to all naturally occurring barrier limits of anadromy. Ideally these surveys would be conducted multiple times over the course of a year so seasonal effects on habitat conditions can be assessed and factored into HSI scoring. Additionally, data from these surveys would help distinguish temporal barriers allowing streamflow fluctuations and the hydraulic conditions associated with them to be assessed.

6.3 Anthropogenic Influences on Fish Passage

In addition to natural influences on riparian habitat and salmonid passage abilities, anthropogenic factors play a large role in altering streamflow and riparian habitat dynamics. Water diversions can have large impacts on freshwater habitat and salmonid migration abilities. Streamflow diversion is common within much of California and is one of many types of infrastructure used to support the State Water Project. Diversion structures such as the Vern Freeman, Harvey, Robles, and Foster Park dams in Ventura County are very influential to *O. mykiss* migration abilities in the Santa Clara and Ventura Rivers. Not only do these structures serve as physical impediments to *O. mykiss* migration, but the streamflow they divert have various impacts downstream. The maximum diversion rate for the Robles dam is 500 ft^3/s and the Vern Freeman dam diverts approximately 58,000-acre feet of water annually (Casitas Water and United Water Districts, 2019). The degree to which diversions like this impact *O. mykiss* migration due to diminished streamflow is not well understood. However, according to the California PAD Fish Passage Report "diminished instream flows as a result of water diversions may present as serious and as chronic a barrier to fish passage as large dams."

6.4 Caltrans Crossing Structure Barrier Assessment Limitations

For a number of the assessed Caltrans stream crossing structures, certain limitations prevented data collection associated with various portions of the detailed fish passage assessment. The most common limitation encountered were crossing structures with confined spaces. Confined spaces are defined by the Caltrans Reconnaissance First Pass Barrier Assessment protocol as spaces with heights or diameters of less than 60 inches. Crossings structures with confined spaces were not entered and measurements using a transect tape through the structure were unable to be completed. As a result, a

longitudinal profile could not be completed for 26 (30%) of the crossing structures assessed for this report.

Twelve (14%) of the assessed Caltrans crossing structures were located next to, over, or within other man-made stream channel modifications. The most common stream channel modification structures encountered were flood control channels and grade controls. When possible the extents of these larger structures were measured following Caltrans detailed barrier assessments protocols. However, at seven (8%) of the assessed crossing structures the full extent of the incorporated flood control channel was unable to be assessed. In these instances, the full length and slope of the flood control channel was estimated with the use of the ruler and elevation profile tools in Google Earth software. Other flood control channel dimensions including width, height, and shape were assumed based off the measurements obtained in the vicinity of the particular crossing structure being assessed.

Another common limitation to collecting detailed barrier assessment data, was the presence of dense, and at times, hazardous vegetation such as poison oak (*Toxicodendron diversilobum*). Vegetation restrictions limited the ability to perform portions of the longitudinal and tailwater cross section profiles at six (7 %) crossing structures. When possible, partial tailwater control cross section profiles were completed and the unmeasured portion of the profiles were assigned station and elevation values which mirrored to the measurements obtained from the opposing portion of the channel cross section. For example, if the river right bankfull channel margin measurements were unobtainable the river left bankfull channel margin measurements were mirrored to represent an approximation of the river right bankfull channel margin.

6.5 Caltrans Crossing Structure Fish Passage Analysis Limitations

There are also complexities associated with determining the degree to which Caltrans crossing structures act as barriers to fish migration. Each Caltrans crossing structure contains a distinct set of dimensions and thus has unique influences on hydraulic streamflow conditions that continuously fluctuate with changing rates of streamflow. For this project FishXing software was used to model hydraulic conditions occurring at man-made structures and compare *O. mykiss* swimming capabilities to those conditions. While a useful tool, FishXing is not without issues and limitations as it does not account for all of the variables associated with fish passage. As with most statistical models, the generated estimates should be interpreted with discretion. Many studies assessing the accuracy of FishXing modeling have concluded its estimates tend to be conservative (Blank et al. 2005; Poplar-Jeffers et al. 2008; Mangin et al. 2010). Shortcomings associated with FishXing can be attributed to imprecise or limited crossing dimensional input and incomplete knowledge of fish physiology and behavior.

FishXing assessments of fish passage are based on generalized dimensional inputs of the crossing structure and downstream channel. For instance, only a select set of elevation measurement points (crossing inlet, crossing outlet, outlet pool bottom, outlet pool tailout, and downstream channel) taken along the thawleg of streamflow are factored into FishXing calculations. This leaves the hydraulic conditions occurring along the margins of each stream channel and within each crossing structure to be assumed based on the tailwater cross section inputs and height, width, span, and rise dimensions of the crossing structure. The generalized modeling associated with FishXing may discount unique crossing structure features or dimensions and their potential impacts on hydraulic conditions and subsequently *O. mykiss* passage abilities. Features documented within crossing structures assessed for this project that likely were not well represented within FishXing modeling included inlet and outlet aprons, structure deteriorations, and presence of multiple crossing segments with differing orientations. Attempts were made to accurately represent these unique features within FishXing. For example, inlet and outlet apron measurements were often factored into the crossing length and slope of a structure.

6.5.1 Caltrans Crossing Structure Fish Passage Analysis: Data Limitations

As expected, the limited data collection experienced for some of the Caltrans crossing structures assessments resulted in limitations to the respective *O. mykiss* passage analysis. The most significant passage analysis limitation was the lack of longitudinal profiles for crossing structures with confined spaces. These structures were unable to be modeled in and analyzed with FishXing software. Alternate approaches to assessing fish passage abilities such as those suggested within the CSSHRM still require structure measurements which allow the slope of the structure to be calculated. Therefore, calculations to compare the physiological swimming abilities of *O. mykiss* to streamflow velocities predicted to occur within a crossing structure were unable to be completed outside of FishXing analysis. As a result, professional judgement and basic passage considerations, as listed in section 3.4.6 were relied upon to assign barrier statues for crossing structures that FishXing passage analysis was unable to be performed for. The use of special survey equipment would likely allow for the collection of more detailed structural dimension data at crossing structures with confined spaces and allow for more accurate fish passage analysis and barrier status determinations to be made.

Data collection limitations also led to limited fish passage analyses of Caltrans crossing structures incorporated into larger man-made structures. In some cases, complete measurements of larger incorporated structure extents could not be obtained. In these instances, estimates and assumptions were relied upon for modeling the structures in FishXing and performing passage analysis. This resulted in generalized passage analysis for these larger incorporated structures. Despite these generalizations, this approach allowed for passage analysis of conditions specifically associated with the Caltrans crossing structure as well as those occurring throughout larger incorporated structures. This approach helped generate a more encompassing picture of potential passage constraints present in these streams. However, passage analysis of large extended structures, such as flood control channelization, would be improved from complete detailed assessment measurements.

The approach of using multiple fish passage analysis models was used to assess Caltrans crossing structures with multiple segments of varying dimension, shape, and orientation. FishXing models assume each crossing structure contains consistent slope and streamflow hydraulics from inlet to outlet. As a result, FishXing passage analysis of multi-segmented crossing structures is generalized and does not account for variations in the dimension, shape, or slope occurring within a structure or the resulting effects on streamflow hydraulics. To account for the inconsistent streamflow conditions occurring within multi-segmented crossing structures, FishXing analysis was performed on each crossing structure segment, in addition to the generalized assessment performed on the full extent of the structure. This approach allowed comparisons of the passage conditions expected to occur within each crossing structure segment. This segment by segment passage analysis approach also highlighted which portion of crossing structures were most restrictive to *O. mykiss* passage.

6.5.2 Caltrans Crossing Structure Barrier Analysis Limitations: Roughness Coefficient Selections

The selection of Manning's stream channel roughness coefficients used in FishXing passage analysis modeling, particularly those applied to the tailwater cross section measurements were primarily based on matching visually assessed conditions present at the time of assessment to descriptions of representative coefficient values. Manning's roughness equation and the coefficients produced from it are most useful for estimating streamflow velocity occurring directly over structures with uniform geometry and roughness, such as a concrete reinforced box culverts. Manning's roughness coefficients may not be as accurate for determining streamflow velocity reductions in natural channel conditions which rarely display uniform slope, roughness, or shape. Factors providing resistance to streamflow through natural channels include substrate particle arrangement and size, sediment loads, vegetation, channel expansions

and contractions, sinuosity, turbulence, and water depth. Determining and selecting a single flow resistance variable to accurately represent these many dynamic factors governing streamflow across a tailwater control cross section is difficult and often contributes to poor streamflow velocity estimates (Marcus et al., 1992). Man-made structures such as culverts can add to the complexity of determining an accurate and representative streamflow resistance variable to include in Manning's equation. Man-made structures often do not share a uniform slope or alignment with the stream channel they are located in and can often alter upstream and downstream stream channel morphology through increased channelization, grade degradation, and localized scouring (Forman and Alexander, 1998).

The selection of roughness coefficient values to represent resistance to streamflow within crossing structures was more straightforward as most structures contained a single lining material such as concrete. For crossing structures that did not contain a single uniform lining material or were embedded with substrate a coefficient value representing the overall mean roughness throughout the structure was selected for use in FishXing passage analysis. As with roughness coefficients selected for tailwater control cross sections the selection of a single roughness coefficient to represent varying conditions within a crossing structure is a generalization and may not accurately account for all influences on streamflow velocity or hydraulics. Additionally, conditions resulting from embedded substrate within a crossing structure will fluctuate as the arrangement of the substrate particles are redistributed with each occurrence of elevated streamflow.

6.5.3 Caltrans Crossing Structure Fish Passage Analysis: Upstream Conditions

A ubiquitous facet of performing fish passage analysis with FishXing software is the exclusion of conditions occurring upstream of each assessed structure. Upstream conditions are important when assessing the full degree of passage constraints associated with crossing structures. The primary aspect of upstream conditions impacting the ability of fish to successfully gain passage of man-made structures is the location of an adequate resting area. The location within the stream channel which provides a fish the ability to rest after prolonged or burst swimming efforts can vary greatly. A resting area or habitat unit is rarely present immediately upstream of a crossing structure. Therefore, fish must often maintain swimming efforts even after successful passage through or under a man-made structure. If a fish reaches exhaustion during these additional upstream swimming efforts streamflow may potentially push it back downstream of the structure it has passed. Extended flat riffle units with minimal potential resting areas were present upstream of a majority of the assessed Caltrans crossing structures. An adequate resting area could not be located upstream at 17 (20%) of the assessed Caltrans crossing structures. The conditions present upstream of each assessed crossing structure and the location of a resting area, if present, were factored into *O. mykiss* passage abilities using professional judgment and are discussed in the appendixes. As with many factors associated with fish passage abilities the stream channel conditions present upstream of a crossing structure are subject to change, including the presence and location of a resting area.

6.5.4 Caltrans Crossing Structure Fish Passage Analysis: Fish Physiology and Behavior

The degree to which fish successfully gain passage through or under a Caltrans crossing structure is largely dependent on their swimming and leaping capabilities. These capabilities can vary greatly with "species, life-stage, body size, motivation, presence or predators, water temperature, streamflow, and many other factors" (Cahoon et al. 2007). The physiological swimming and leaping capabilities of *O. mykiss* utilized for barrier analysis in this report have predominantly been derived through experimental means including swim chamber testing (Hawkins and Quinn, 1996) and predictive equations (Powers and Osborn, 1985). These capability estimates can be misleading as they do not account for an

extensive migration through natural stream conditions and areas with turbulent streamflow (Hinch & Rand, 1998).

Fish behavior, including how, when, and where fish make barrier passage attempts is not considered in FishXing passage analysis. This is largely due to the limited understanding associated with the behaviors fish exhibit when they encounter man-made barrier structures. Specifics such as to what extent fish attempt to swim in areas of reduced streamflow associated with barrier structure boundaries or whether fish exhibit avoidance of barrier structures is not fully understood (Kemp et al., 2005, 2008). One biological limitation incorporated within FishXing passage analysis is the minimum water depth required to allow fish to swim effectively. This parameter is important for predicting the minimum streamflow required for potential successful passage attempts and is likely a considerable factor in determining barrier statuses within southern California streams considering their tendency to exhibit persistent low streamflow conditions. For this report, the lowest required minimum swimming depths and strongest swimming capabilities stated in reviewed literature were used in FishXing barrier analysis. These values were selected in attempt to represent the upper threshold of *O. mykiss* passage abilities. As expected, there was a clear distinction between the passage abilities of strong swimming anadromous *O. mykiss* and resident *O. mykiss*.

To better assess the shortcomings of FishXing and accuracy of its passage calculations, specific hydraulic measurements and fish passage attempt observations would be required at crossings structures under numerous rates of streamflow. Such efforts would be time consuming and instances of anadromous steelhead passage attempts would be rare. As is the case with all assessment and calculation methods FishXing is subject to error, however the advantages of FishXing lie in its ability to provide relative rapid passage estimations for numerous fish species and life stages at selected ranges of streamflow. Additionally, the conservative nature of FishXing passage estimations help to ensure the expensive costs associated with restoration and barrier remediation are focused where they are truly necessary (Mahlum et al., 2014).

6.6 Barrier Remediation Prioritization

There are several factors that should be considered apart from the results of assessments and analysis detailed in this report when prioritizing barrier remediation efforts of Caltrans crossing structures. Barrier remediation priority criteria listed in the CSSHRM may serve as a guide for developing Caltrans crossing structure barrier remediation ranking values. Through this process Caltrans crossing structures which receive higher overall remediation scores reflect greater assumed benefits from the completion barrier remediation efforts. Criteria that should be considered in barrier remediation prioritization include barrier severity, quality of upstream habitat, quantity of upstream habitat, barrier position within each watershed, presence of resident fish populations, social and economic factors. Examples of prioritization values for each of these criterion and the parameters for determining those are included in the following sections.

6.6.1 Barrier Remediation Prioritization: Barrier Severity

Barrier remediation prioritization should consider the degree to which man-made structures are determined to limit upstream passage of salmonids. These criteria ensure structures which pose greater restrictions on fish passage receive greater consideration for remediation efforts. Barrier passage statues may be used to assign barrier severity score ranges. Suggested barrier severity score ranges are shown in Table 7 below. Other barrier severity considerations such as the range of streamflow predicted to allow for passage or frequency of streamflow allowing potential passage may be relied upon to select a value

from the established barrier passage status score ranges. These additional parameters help to ensure the varying degree of barrier severity within each passage status category is considered. For structures in which the barrier passage status is unknown professional judgement, which "plays an important part in deciding the order of barrier remediation treatment" as stated by the CSSHRM may also be relied upon to select a barrier severity score.

Barrier Passage Status	Score Severity Range
Total	5
Temporal	1-3
Partial	2-4
Temporal & Partial	3-4
Unknown	1-5

Table 7. *Example of barrier severity scores based off barrier passage status.*

6.6.2 Barrier Remediation Prioritization: Habitat Suitability Index Scoring

Any future surveys attempting to identify barriers and the extent to which they limit available habitat to salmonid fish species should perform assessments to gather quantifiable data pertaining to the quality of habitat present within each stream and watershed. Barriers found to prevent salmonid species from accessing quality habitat should be given greater priority for remediation efforts. Various methodologies have been developed to assess and quantify stream habitat for fish (Wesche and Rechard, 1980, Fausch et al., 1988). Many of these methodologies have been used to assess *O. mykiss* habitat within southern California streams. However, habitat data collected by different organizations can be difficult to compare due to the subjectivity and a lack of standardization between these methodologies. In order to provide a standardized assessment of aquatic habitat across geographic locations the United States Fish and Wildlife Service (USFWS) developed Habitat Evaluation Procedures (HEP) (USFWS 1980).

One component of HEP is the Habitat Suitability Index (HSI) which rates overall habitat quality over individual variables on a scale of 0 to 1, with 1 being the most optimal habitat. HSI variables specific to assessing *O. mykiss* habitat suitability in freshwater streams have been specified by the United States Forest Service (USFS) (Raleigh et al., 1984). These *O. mykiss* specific HSI variables were developed for and have been applied to streams across much of North America. However, there has been minimal validation when using these variables to rate the unique habitat conditions typically present within southern California streams. When compared to broader North American *O. mykiss* habitat, stream habitat conditions within the Southern California can be harsh and highly variable. Consecutive years of extreme drought can be followed by periods of sudden elevated and swift streamflow. These unique conditions may diminish the relative importance of habitat parameters as modeled in the USFS HSI formula and their appropriateness to southern California steelhead (Allen and Riley, 2004). To account for this, Allen and Riley proposed adjustments to a portion of the *O. mykiss* specific HSI variable scoring curves. Their adjustments also included separate HSI scoring curves to account for the significant riparian and stream habitat seasonal fluctuations typical within southern California. These HSI adjustments should be considered when directing future *O. mykiss* habitat assessments in southern California streams. The results of these habitat assessments should be incorporated into *O. mykiss* barrier remediation priority decision making. The assessments of Caltrans crossing structures conducted for this report included general visual assessments of the stream and riparian zone habitat conditions present at the time of assessment directly upstream and downstream of each crossing structure. Assessment of *O. mykiss* specific HSI parameters were not included in these general visual assessments.

6.6.3 Barrier Remediation Prioritization: Quantity and Location of Suitable Habitat

In addition to habitat suitability within a stream, the quantity of suitable habitat and its location should also be considered in barrier remediation prioritization. The combination of these factors provides a more robust picture of the type of habitat that would become accessible to fish if the passage constrains of a particular barrier are remediated. Barrier remediation efforts should be focused on providing fish direct access to habitat capable of sustaining healthy populations. For example, the lower reaches of Santa Paula Creek in Ventura County have been significantly altered by concrete boulder riprap channelization. This channelization has significantly degraded habitat conditions in this portion of Santa Paula Creek. On the other hand, the upper reaches of Santa Paula Creek flow through undeveloped Los Padres National Forest land, contains high quality habitat, and a population of resident *O. mykiss* (Horgan, CDFW unpublished data, 2019). Variations in habitat quality throughout a stream such a Santa Paula Creek may not be well reflected in HSI scores, unless those scores are applied to specific and standardized survey reaches established within each stream and watershed. This approach will allow habitat quality and suitability comparisons to be made over the course of each stream and will be beneficial in barrier remediation prioritization.

Habitat Quantity Ranges (ft)	**Suggested Remediation Score**
0 – 500’	0.5
500’ – 1,000’	1
1,000’ – 1,500’	1.5
1,500’ – 2,000’	2
2,000’ – 2,500’	2.5
2,500’ – 3,000’	3
3,500’ – 4,000’	3.5
4,000’ – 4,500’	4
4,500’ – 5,000’	4.5
5,000’- 5,500’	5
5,500’ – 6,000’	5.5
6,000’ – 6,500’	6
6,500’ – 7,000’	6.5
7,000’ – 7,500’	7
7,500’ - 8,000’	7.5
8,000’ – 8,500’	8
8,500’ – 9,000’	8.5
9,000’ – 9,500’	9
9,500’ 10,000’	9.5
> 10,000’	10

Table 8. *Example of habitat quantity remediation prioritization scores.*

The CSSHRM suggests a remediation score be assigned to a barrier for every 500 feet of stream deemed potentially suitable that would become accessible if the passage constraints of the barrier were remediated. The location of additional known upstream barriers may or may not be included in this habitat quantity scoring method. An example of this habitat quantity scoring is shown in Table 8.

6.6.4 Barrier Remediation Prioritization: Habitat Value Scores

The quality and quantity of suitable habitat upstream of a particular barrier can be further evaluated for barrier prioritization determinations by applying habitat value scores to each barrier. These scores are a factor of habitat quantity scores and habitat quality as determined by HSI scores. The mean of these two scores serve as the habitat value score.

6.6.5 Barrier Remediation Prioritization: Barrier Watershed Position

It is common for streams and watersheds to contain multiple man-made and naturally occurring barriers. Although, the remediation of any one barrier will allow fish to gain access to additional habitat, but the presence of multiple barriers within a watershed will perpetuate the fragmentation of habitat accessible to fish. Therefore, the location of all barriers, both man-made and natural, within each stream and watershed is an important aspect of remediation prioritization. In general, when considering barriers to anadromous fish, the barriers located in the most downstream portions of each stream and watershed

should be given higher remediation priority, unless unique opportunities arise from the passage improvement of upstream barriers (Stoecker, 2002). Prioritizing the remediation of the most downstream passage constraints will help to ensure habitat to anadromous fish attempting to migrate upstream is truly reopened. An example of quantify barrier watershed position for incorporation into barrier remediation prioritization is shown in Table 9.

Number of Barriers Located Downstream	Suggested Remediation Score
0	10
1	9
2	8
3	7
4	6
5	5
6	4
7	3
8	2
9	1
> 10	0

Table 9. *Example of barrier watershed position remediation prioritization scores.*

6.6.6 Barrier Remediation Prioritization: Presence of Upstream Salmonid Populations

The historical documented and current presence of salmonids within a stream or watershed is a great indicator of the quality of habitat it contains and is another factor that should be included within barrier remediation prioritization. Historically *O. mykiss* were far more widespread within southern California than that of current DPS designated resident populations. It should be noted that the historical presence of salmonids may not be a reliable indication of the likelihood for a particular stream to currently contain quality habitat capable of supporting *O. mykiss*. This is primarily because a considerable portion of the streams located within the southern California DPS have been altered due to widespread urbanization and agricultural land uses. Such widespread development has included the addition of numerous barrier structures which have fragmented streams historically documented to have supported *O. mykiss*. In some cases, large swaths of stream channels have been significantly altered with concrete and various riprap materials to reinforce the channel for flood control purposes. Additionally, streams in urban areas tend to contain more contaminants (Coles et al., 2012). These alterations often greatly diminish the quality and quantity of habitat capable of supporting *O. mykiss*. Considering this, the streams within southern California with known and stable populations of surviving *O. mykiss* should be given considerable weight when determining barrier remediation priorities. Remediating barriers to allow anadromous *O. mykiss* the ability to gain access to resident populations greatly increases the likelihood of successful spawning and provides genetic diversity within a population (Fausch et al., 2006). To ensure these intrinsic benefits are reflected in barrier remediation scoring any structures determined to constrain salmonid passage to any degree can automatically be given an increased barrier severity score, as reflected in Table 10 below.

Barrier Passage Status	Score Severity Range
Total	10
Temporal	3-6
Partial	4-6
Temporal & Partial	5-6
Unknown	1-10

Table 10. *Example of barrier severity scores based off barrier passage status for structures located within watersheds with known salmonid populations.*

6.6.7 Barrier Remediation Prioritization: Social and Economic Considerations

As noted by Robison et al. (2000) numerous social and economic factors must also be considered when prioritizing barriers to remediate. Many in-stream structures are utilized and relied upon by numerous individuals and organizations. This is especially true for roadway crossing structures, which allow the transportation for people, goods, and services. As a result, barrier remediation designs, plans, and implementation generally involve coordination with multiple stakeholders. One aspect of coordinating barrier remediation efforts includes securing and allocating funding to complete the various steps involved in the process. Apart from the millions of dollars often involved in the implementation of barrier remediation efforts, funding is also required to conduct barrier assessments, gather associated data, analyze data, and design appropriate remediation plans. These numerous social and economic factors involved in barrier remediation play a significant role in how and where remediation efforts take place. Social and economic factors were not considered in our results listed in this report as they require an entirely different dataset than was utilized for this report.

6.7 Effective Barrier Remediation

Considerable focus should be given to ensuring all barrier remediation efforts are effective in providing sustained conditions conducive to salmonid passage. Deliberation should be given to considerations of retrofitting barrier structures with baffles, fishways, or other artificial passage facilities. Studies evaluating the effectiveness of such facilities and their ability to create conditions conducive to sustained fish passage have revealed various shortfalls (Stoecker, 2004). Generally, baffles and fishways only provide adequate passage conditions when operating under the specific streamflow levels they were designed for. This tends to make them most effective when used in streams with consistent streamflow. Southern California streams are characterized by inconsistent streamflow that generally only supports upstream migration for short periods following winter rain events. Even when streamflow is adequate to provide passage through baffles or fishways, the difficulty of passage may require salmonids to make multiple passage attempts. Delays and expended energy due to failed passage attempts may hinder passage of additional upstream temporal barrier features and prevent salmonids from reaching spawning habitat. In addition to these limitations, maintenance efforts are typically required to ensure retrofitting efforts remain effective in providing conditions suitable to fish passage. Artificial passage facilities are highly dependent on continual debris and sediment removal. They also may reduce stream flow capacity and are therefore prone to structural failure during intense high streamflow events. If baffles or fishways are constructed within culverts they may increase the likelihood of damage occurring to the culvert itself or structure the culvert passes through. Structural damage to artificial passage facilities may make them ineffective and prevent upstream salmonid passage until they can be repaired.

It is widely accepted that man-made structures which most closely mimic natural stream conditions are the most effective in allowing passage of all aquatic species (Katapodis, 2005). The importance of considering crossing designs that are conducive to allowing passage of all aquatic species should not be ignored. Aquatic ecosystems and the species inhibiting them are interdependent thus making survival of a target salmonid species largely dependent on an ecosystem-based design approach for all habitat restoration efforts (Forest Service Stream-Simulation Working Group, 2008). With these benefits in mind consideration should also be given to structural designs that allow for the passage of terrestrial wildlife species. Providing migration corridors for terrestrial species may be particularly beneficial for Caltrans roadway crossing structures. Roadway migration corridor structures have been shown to reduce animal-vehicle collisions by up to 95 % in some locations (Huijser et al., 2009). In most cases free spanning bridges over natural substrate generally are the most conducive structures to allowing for natural stream conditions to persist and allow for unimpeded passage of all species and life stages

under the widest range of streamflow conditions (Stoecker, 2004). Free spanning bridges also allow for unimpeded downstream migration of salmonids, an often overlooked consideration of passage design. In general, bridges provide greater high streamflow conveyance capacity thus often making them more cost effective as they tend to require less maintenance and last longer than culverts. Bridges passing over natural streambeds also provide aquatic habitat that serves to maintain riparian connectivity. Additionally, aesthetically designed bridges have potential to increase the value of surrounding properties.

7.0 Conclusion

Caltrans crossing structures are one of many types of man-made structures that have the potential to constrain the ability of salmonids to migrate, complete the entirety of their life cycle, and fulfill their ecological niche. Despite extreme declines, remaining populations of *O. mykiss* persist within the Southern California DPS. Despite this resiliency, the presence of numerous man-made barriers continues to limit and restrict *O. mykiss* migration abilities while also fragmenting and reducing habitat available to them. As a result, southern California *O. mykiss* populations are isolated from one another and their ability to transfer genetics through spawning is greatly limited. In turn, this lack of genetic diversity limits *O. mykiss* abilities to adapt to environmental fluctuations and recover from disease. This fragmentation and reduction of available habitat "correlates directly to the reduction in population size of the species that uses that habitat" (Netti, 1997). This increases the potential magnitude of benefits that come with remediating barriers to *O. mykiss* migration in these watersheds. Historical habitat that is reopened through the removal of man-made barriers will allow for an expanded range of southern California *O. mykiss* populations and a cascade of ecological benefits. Streams currently unoccupied by resident *O. mykiss* may be recolonized by returning anadromous steelhead migrations. The benefits of remediating migration barriers may come to fruition in a relatively short period of time as steelhead returns are still documented within southern California watersheds. An anadromous steelhead was observed in the pool unit directly downstream of the Robles Diversion Dam on the Ventura River on March 7th, 2019 by two Casitas Municipal Water District (CMWD) fisheries biologists (Lewis et al., 2019). Additionally, two steelhead were documented successfully passing through the Vern Freeman Diversion Dam fish ladder on March 21, 2020 and May 2, 2020 respectively (E. Lashly, personal communication, 2020). Remediating man-made barriers such as Caltrans crossing and mitigating the numerous negative impacts associated with them is critical to the perpetuation of the anadromous life cycle of steelhead and overall survival of *O. mykiss* in Southern California streams.

Acknowledgements

There are many individuals who provided invaluable assistance, insight, encouragement, and support with the many steps involved in creating this report. First off, I would like to recognize all those who enthusiastically helped to perform fish passage assessments on Caltrans crossing structures that were not always the most inviting areas to work under and within. This includes Elijah Mitrano for his eagerness to assess the dirtiest and darkest culverts, Lauren Marquez for filling in on short notice, and Michael Morales for helping to ensure we measured everything and stayed safe.

I also want to thank all who contributed to organizing and processing the massive amounts of data collected throughout the course of the project. In particular I want to thank Michael Morales for filling out, looking over, and organizing hundreds of datasheets. Additionally, your contribution of entering data into FishXing and on hundreds of pages of crossing structure drafts was extremely helpful in making this report come together. Thank you to Kyle Evans for your assistance in creating the maps included in this report. Thank you to Katie Carmody for your assistance in the analysis of data and feedback on the contents of this report.

Thank you to everyone who provided their attention, ideas, thoughts, feedback, encouragement, humor, and flexibility in the process of conducting this work and putting this report together. Thank you to Mary Larson and Stan Allen for providing me with the opportunity to conduct this project, explore the often unseen infrastructure of the California state highway system, and contribute to the ongoing efforts to allow aquatic species the ability to access their historical habitat. Finally, thank you to Caltrans for recognizing the importance in this work and providing the funding for this project.

References

HDR Engineering Inc. 2007. Detailed Fish Passage Assessment Data Collection Instructions and Procedures. Contract No. 43A0150 Task Order 3. Prepared for California Department of Transportation.

Allen M.A., Riley S. 2004. Assessment of Steelhead Habitat in the Ventura River/Matilija Creek Basin. Thomas R. Payne & Associates. Ventura County Watershed Protection District, Ventura, CA.

Chow V. T., 1959. Open-Channel Hydraulics. 30057th Edition. McGraw-Hill Book Company, Inc.

Baurick T. 2015. Threatened fish makes a comeback in restored Elwha. Kitsap Sun. [accessed 2015 February]. http://www.kitsapsun.com/news/local/threatened-fish-makes-a-comeback-in-restored-elwhaep-951933878-354896431.html.

Becker G.S. and Reining I.J. 2008. Steelhead/rainbow trout (*Oncorhynchus mykiss*) resources south of the Golden Gate, California. Cartography by D.A. Asbury. Center for Ecosystem Management and Restoration. Oakland, CA.

Bednarek AT. 2001. Undamming rivers: A review of the ecological impacts of dam removal. Environ Manag.

Brenkman S.J., Duda J.J., Torgersen C.E., Welty E, Pess GR, Peters R, McHenry ML. 2012. A riverscape perspective of Pacific salmonids and aquatic habitats prior to large-scale dam removal in the Elwha River, Washington, USA. Fisheries Manag Ecol.

Blank M, Cahoon J, Burford D, McMahon T, Stein O. 2005. Studies of fish passage through culverts in Montana. Conference proceedings of the 2005 international conference on ecology and transportation held in San Diego, CA, pp 647–661

Cahoon, Joel & Mcmahon, Thomas & Solcz, Andy & Blank, Matt & Stein, Otto. 2007. Fish Passage in Montana Culverts: Phase II - Passage Goals. Montana State University, Bozeman

Coles, James F.; McMahon, Gerard; Bell, Amanda H.; Brown, Larry R.; Fitzpatrick, Faith A.; Scudder Eikenberry, Barbara C.; Woodside, Michael D.; Cuffney, Thomas F.; Bryant, Wade L.; Cappiella, Karen; Fraley-McNeal, Lisa; Stack, William P. 2012. Effects of urban development on stream ecosystems in nine metropolitan study areas across the United States. United States Geological Survey.

Cordone A.J., Kelley D.W. 1961. The Influences of Inorganic Sediment on the Aquatic Life of Streams. California Department of Fish and Game. Inland Fisheries Branch. Volume 47.

Fausch K.D., Rieman B.E., Young M.K., Jason B.D. 2006. Strategies for Conserving Native Salmonid Populations at Risk from Nonnative Fish Invasions. United States Forest Service. Rocky Mountain Research Station. General Technical Report RMRS-GTR-174.

FishXing User Manual. 2012. http://www.fsl.orst.edu/geowater/FX3/help/FX3_Help.html. Accessed 2/6/2020.

Flosi G., Downie S., Hopelain J., Bird M., Coey R., and Collins B. 1998. California Salmonid Stream Habitat Restoration Manual. Fourth Edition. State of California. The Resources Agency. California Department of Fish and Game. Wildlife and Fisheries Division.

Forest Service Stream-Simulation Working Group. 2008. Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms are Road-Stream Crossings. U.S. Department of Agriculture. Forest Service. National Technology and Development Program. 7700-Transportation Management.

References Continued

Forman R.T. and Alexander L.E. 1998. Roads and Their Major Ecological Effects. Annual Review of Ecology and Systematics, Vol. 29, pp. 207-231+C2

Fuller, P., J. Larson, A. Fusaro, T.H. Makled, and M. Neilson, 2020, *Oncorhynchus mykiss* (Walbaum, 1792): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL, https://nas.er.usgs.gov/queries/FactSheet.aspx?species ID=910, Access Date: 2/27/2020

Good, T. P., Waples, R. S., and P. Adams (eds.). 2005. Updated status of federally listed ESUs of 24 west coast salmon and steelhead. U.S. Dept. of Commer., NOAA Tech. Memo. NMFS25 NWFSC-66. 598 pp.

Hawkins D.K. and Quinn T.P. Critical swimming velocity and associated morphology of juvenile coastal cutthroat trout (Oncorhynchus clarki clarki), steelhead trout (Oncorhynchus mykiss), and their hybrids. School of Fisheries, University of Washington. Seattle, Washington.

Headwaters Economics. 2016. Dam Removal: Case Studies on the Fiscal, Economic, Social, and Environmental Benefits of Dam Removal. Published Online: http://headwaterseconomics.org/economic-development/local-studies/dam-removal-case-studies

Herbert, D.W.M., and J.C. Merkens. 1961. *The effects of suspended mineral solids on the survival of trou*t. Int. J. Air Water Polout. 5(l).

Hinch, S. G., and P. S. Rand. 1998. Swim speeds and energy use of up-river migrating sockeye salmon: role of local environment and fish characteristics. Canadian Journal of Fisheries and Aquatic Sciences 55:1821-1831.

Holland, Brooke. “Highway 192 Bridge Repairs This Winter.” *Noozhawk*. 5 December 2018. https://www.noozhawk.com/article/caltrans_construction_montecito_bridge_repairs_192_update. Accessed 4 April 2020.

Huijser, M. P., J. W. Duffield, A. P. Clevenger, R. J. Ament, and P. T. McGowen. 2009. Cost–benefit analyses of mitigation measures aimed at reducing collisions with large ungulates in the United States and Canada; a decision support tool. *Ecology and Society* 14(2): URL: http://www.ecologyandsociety.org/vol14/iss2/art15/

Hunter L.A. and Mayor L. 1986. Analysis of Fish Swimming Performance Data, Volume I. North-South Consultants. Department of Fisheries and Oceans, Alberta Department of Transportation

Katapodis, C. 2005. Developing a toolkit for fish passage, ecological flow management, and fish habitat works. Journal of Hydraulic Research. 43(5): 451-467.

Kemp PS, Gessel MH, Williams JG (2005) Seaward migrating subyearling Chinook salmon avoid overhead cover. J Fish Biol 67:381–1391

Kemp PS, Gessel MH, Williams JG (2008) Response of downstream migrant juvenile Pacific salmonids to accelerating flow and overhead cover. Hydrobiologia 609:205–207

Klose K. 2018. Fisheries Resource Report Thomas Fire BAER Assessment. Santa Barbara and Ojai Ranger Districts. Lost Padres National Forest.

Lewis S et al. 2019. Technical Memorandum. Robles Biological Committee. Casitas Municipal Water District.

References Continued

Mahlum, S., D. Cote, Y.F. Wiersma, D. Kehler, K.D. Clarke. 2014. Evaluating the barrier assessment technique derived from FishXing software and the upstream movement of Brook trout through road culverts. Transactions of the American Fisheries Society 143: 39-48.

Mangin SF, Stipetich M, Tritico HM (2010) Reducing the error associated with Manning's roughness in culvert design for improved fish passage. World environment and water resources congress 2010: challenge of change—proceedings of the world environmental and water resources congress, pp 1540–1553

Marcus A.W, Harvey L, Roberts K, and Tackman G. 1992. An Evaluation of Methods for Estimating Manning's n in Small Mountain Streams. Mountain Research and Development, Vol. 12, No. 3, pp. 227-239

National Marine Fisheries Service. 2012. Southern California Steelhead Recovery Plan. Southwest Region, Protected Resources Division, Long Beach, California.

Netti S. 1997. *"Where have all the Steelhead Gone."* California Cast. Summer.

Poplar-Jeffers IO, Petty JT, Anderson JT, Kite SJ, Strager MP, Fortney RH. 2008. Culvert replacement and stream habitat restoration: Implications from brook trout management in an Appalachian watershed. USA Restoration Ecol 17:404–413

Powers, Patrick D., John F. Orsborn - Albrook Hydraulics Laboratory, WSU, Final Project Report Part 4 of 4, Analysis of Barriers to Upstream Fish Migration An Investigation of the Physical and Biological Conditions Affecting Fish Passage Success at Culverts and Waterfalls, Report to Bonneville Power Administration, Contract No. 1982BP36523, Project No. 198201400, 134 electronic pages (BPA Report DOE/BP-36523-1)

Raleigh, R.F., T. Hickman, R.C. Solomon, and P.C. Nelson. 1984. Habitat suitability information: Rainbow trout. United States Fish and Wildlife Service FWS/OBS-82/10.60. 64pp

Reiser, D.W. and White R.G. 1981. Incubation of Steelhead Trout and Spring Chinook Salmon Eggs in a Moist Environment. Prog. Fish-Cult. 43 (3): 131-134.

Resource Conservation District of the Santa Monica Mountains. https://www.rcdsmm.org/resources/watersheds/topanga-creek-watershed/. Accessed 3 August 2019

Stoecker M. 2002. Steelhead Assessment and Recovery Opportunities in Southern Santa Barbara Country, Stoecker Ecological. Santa Barbara, California. Conception Coast Project

Stoecker M. 2004. Steelhead Migration Barrier Inventory and Recovery Opportunities for the Santa Ynez River, CA. Stoecker Ecological, Santa Barbara, California for Community Environmental Council, Santa Barbara, California.

Stoecker, M, and E. Kelley. 2005. Santa Clara River steelhead trout: assessment and recovery opportunities. Santa Clara River Trustee Council and The Nature Conservancy, Ventura, California.

Tonra CM, Sager-Fradkin K, Morley SA, Duda JJ, Marra PP. 2015. The rapid return of marine-derived nutrients to a freshwater food web following dam removal. Biol Conserv.

United Water Conservation District. Santa Paula, CA https://www.unitedwater.org/about-us-6/facilities-a-strategies. Accessed 2 July 2019.

References Continued

USFS. 2006a. FishXing3.01b. Software and Learning System for Fish Passage through Culverts. United States Forest Service. http://www.stream.fs.fed.us/fishxing/

Ven Te Chow. 1959. Open Channel Hydraulics. University of Illinois. McGraw Hill Book Company.

United States Geological Survey. National Water Information System data (Water Data for the Nation). https://waterdata.usgs.gov/nwis/uv?site_no=11119500. Accessed 16 Dec 2019.

Waananen, A.O. and Crippen J.R. 1977. Magnitude and frequency of floods in California. USGS, Water Resources Investigation 77-21, Menlo Park, CA

Wesche, T. A., and P. A. Rechard. 1980. A Summary of Instream Flow Methods for Fisheries and Related Research Needs. Eisenhower Consortium Bulletin No. 9. Laramie: University of Wyoming, Eisenhower Consortium for Western Environmental Forestry Research.

Appendix A

Fish Passage Barrier Assessment Data and Analysis Results for Tier 1 Caltrans Stream Crossing Structures in Santa Barbra County (Caltrans District 5)

This appendix lists information from the completion of Caltrans reconnaissance and detailed fish passage barriers assessments conducted on Caltrans stream crossing structures listed on the Tier 1 priority list for Santa Barbara County dated September 6, 2019. Information included in this appendix include collected data points, descriptions of each assessed crossing structure, results of FishXing fish passage analysis conducted on those structures, and limitations experienced during assessment and analysis. Multi-segmented crossing structures have had their segments numbered starting from the inlet to outlet of the structure. Graphs are included in this appendix for crossing structures in which a longitudinal profile was able to be completed. These graphs are included to serve as visual aids to convey the general shape, orientation, and conditions of crossing structures. The dimensions and shapes depicted in these graphs may not be accurate to the true proportions of each crossing structure.

Table of Contents

(page listings for each assessed crossing structure are listed in the Assessment Reference Table)

Santa Barbara County Tier 1 Caltrans Stream Crossing Structure Assessment Reference Table...37

Highway 1 Assessed Crossing Structures.....38

Highway 101 Assessed Crossing Structures.....42

Highway 154 Assessed Crossing Structures.....126

Highway 192 Assessed Crossing Structures.....129

Highway 246 Assessed Crossing Structures.....146

Santa Barbara County Tier 1 Caltrans Stream Crossing Structure Assessment Reference Table							
PAD ID Number	**Route**	**Post Mile**	**Structure Location** (location coordinates recorded)	**Caltrans Fish Passage Assessments Conducted**	**Barrier Status Assigned**	**Crossing Structure Type**	**Listing Page**
736461	Hwy 1	3.85	34.52617, -120.28925 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	39
734418	Hwy 101	19.01	34.44164, -119.77090 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Arch and Pipe Culvert	43
734431	Hwy 101	22.14	34.43999, -119.82551 (at outlet)	Reconnaissance Only	Temporal Barrier	Concrete Reinforced Box Culvert	47
707180	Hwy 101	22.56	34.43962, -119.83299 (at inlet)	Reconnaissance & Detailed	Not a Barrier	Free Spanning Bridge	51
762563	Hwy 101	23.42	34.43841, -119.84779 (at inlet)	Reconnaissance Only	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	55
705159	Hwy 101	28.18	34.43906, -119.42877 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Arch Culvert	58
734476	Hwy 101	28.69	34.44011, -119.93747 (at inlet)	Reconnaissance & Partial Detailed	Temporal & Partial Barrier	Concrete Reinforced Pipe and Box Culvert	62
734483	Hwy 101	29.89	34.44565, -119.95584 (at inlet)	Reconnaissance Only	Total Barrier	Concrete Reinforced Pipe Culvert	66
734489	Hwy 101	30.85	34.45543, -119.96938 (at inlet)	Reconnaissance Only	Unknown	Reinforced Concrete Pipe Culvert	69
734494	Hwy 101	30.98	34.45618, -119.97146 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	72
734495	Hwy 101	32.67	34.46080, -120.00029 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Arch and Box Culvert	77
734499	Hwy 101	33.1	34.46188, -120.00838 (at inlet)	Reconnaissance & Partial Detailed	Total Barrier	Concrete Reinforced Box and Pipe Culvert	82
734513	Hwy 101	40.23	34.47305, -120.12730 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	86
734516	Hwy 101	41.65	34.47462, -120.15354 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box and Arch Culvert	90
734517	Hwy 101	42.11	34.47327, -119.16138 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box and Arch Culvert	94
734525	Hwy 101	43.21	34.47205, -120.17981 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box, Pipe, and Arch Culvert	99
734538	Hwy 101	44.85	34.47416, -120.20802 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Pipe and Box Culvert	104
734590	Hwy 101	50.3	34.53119, -120.19563 (at outlet)	Reconnaissance Only	Total Barrier	Plastic Pipe Culvert	109
734610	Hwy 101	54.28	34.57058, -120.19106 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	112
734639	Hwy 101	58.89	34.63857, -120.18604 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	117
734664	Hwy 101	62.5	34.67904, -120.15681 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	122
736427	Hwy 154	11.52	34.58649, -120.00851 (on structure)	Reconnaissance Only	Not a Barrier	Bridge (with concrete supports)	127
731768	Hwy 192	5.4	34.44730, -119.68308 (at inlet)	Reconnaissance & Detailed	Total Barrier	Multi-segmented Bridge	130
731518	Hwy 192	6.41	34.44295, -119.66830 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Brick Box Culvert	135
732104	Hwy 192	11.32	34.43618, -119.59157 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Brick Box Culvert	139
732347	Hwy 192	17.44	34.40794, -119.51482 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	143
736469	Hwy 246	26.61	34.61031, -120.18473 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	147
736693	Hwy 246	28.85	34.59367, -120.15179 (at outlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	152
736658	Hwy 246	33.23	34.61045, -120.07967 (at outlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	157
736555	Hwy 246	34.29	34.61079, -120.06119 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Corrugated Steel Pipe Arch Culvert	162

Highway 1 Assessed Crossing Structures

Crossing Site Information for PAD 736461					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 1	3.85	34.52617, -120.28925	± 9 ft	30.15

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed Creek 0.559 mi^2	El Jaro Creek	136.61 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Current presence of *O. mykiss* within this stream is unlikely considering its small drainage area and the intermittent streamflow conditions it appears to experience. This stream is part of the Santa Ynez River watershed. Records indicate historical *O. mykiss* presence to have been widespread in the watershed. Currently, *O. mykiss* are present in the watershed, but in far lower numbers than historically documented. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
9/26/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
9/26/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (inlet and outlet)	No

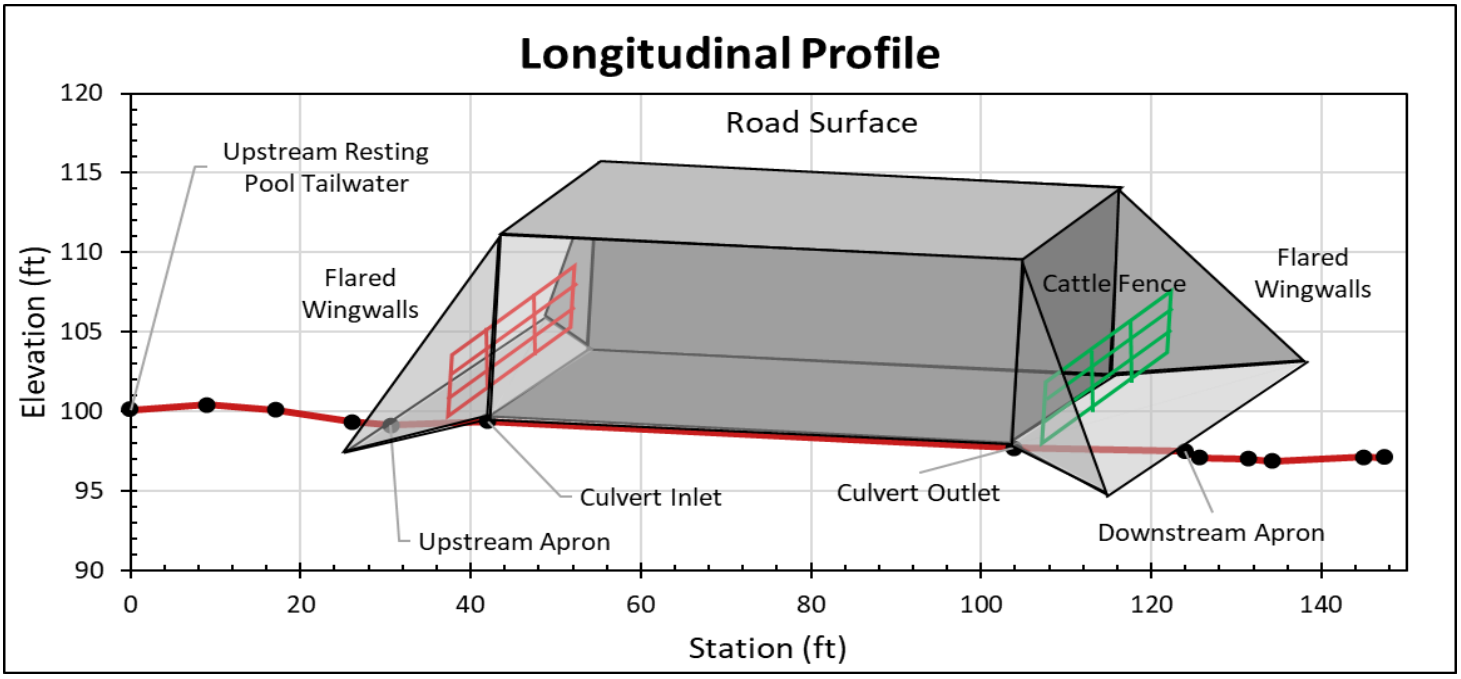
Crossing Structure Description and Condition
This structure is a large concrete reinforced box culvert with flared inlet and outlet wingwalls. Concrete inlet and outlet aprons are present between the wingwalls. The crossing structure was in good condition with no visible damage or erosion at the time of assessment. At the time of assessment steel cattle gates extended across the channel between both the inlet and outlet wingwalls.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	16	11.4	-2.28 % (apron slopes upstream)
Culvert	10	10	13	61.5	2.75 %
Outlet Apron	n/a (open channel)	n/a (open channel)	16	20.5	0.98 %
Full Structure	10	10	14	93.4	1.75 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained broad channel banks and vague active channel margins. A riffle unit with little variation cut through open pasture and short grass was growing throughout much of the channel.	30.6 ft	1.76 ft	14.56 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the immediate downstream active channel was wide and muddy with thick aquatic vegetation. The active channel narrowed considerably further downstream Both channel banks were covered with tall grass. Dominant streambed substrates were silt and sand at time of assessment. The downstream unit was a shallow pool that drained into a narrow riffle with heavy vegetation.	Silt	41.5 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	100.09	
Upstream Channel Point 1	9	100.42	
Upstream Channel Point 2	17.1	100.11	
Upstream Channel Point 3	26	99.35	
Inlet Apron (upstream extent)	30.6	99.14	Upstream substrate is level with the inlet apron.
Culvert Inlet	42	99.4	
Culvert Outlet	103.5	97.71	
Outlet Apron (downstream extent)	124	97.51	Downstream substrate is level with the outlet apron.
Downstream Max Depth (within 5 ft of outlet apron)	125.6	97.12	
Downstream Max Depth	134.2	96.89	
Tailwater Control Point	145	97.14	Control point is from a wide riffle unit.
Downstream Channel Point 1	131.4	97.04	
Downstream Channel Point 2	147.5	97.12	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing was modeled as a box culvert within FishXing. Both aprons were factored into the structure length value used in FishXing analysis. This increased the length from 61.8 ft to 93.4 ft. A roughness coefficient of 0.013 was assigned to model the smooth concrete lining within the culvert.	93.86 – 2,764	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was assessed to be passable to strong swimming anadromous life stages of *O. mykiss*, but not passable to resident *O. mykiss* life stages. Due to these results this crossing structure was determined to be a temporal and partial barrier. FishXing analysis estimates streamflow rates greater than 93.86 ft^3/s would provide adequate water depth for successful steelhead *O. mykiss* passage. A velocity barrier was not predicted by FishXing below streamflow rates of 2,764 ft^3/s, well above the estimated annual mean peak streamflow rate of 136.61 ft^3/s.

Assessment and Analysis Limitations

No limitations were encountered in assessing or performing fish passage analysis of this crossing structure.

Passage Improvement Recommendations

The most effective remediation option would be to remove the concrete lining the channel bottom under this crossing structure and replace it with natural streambed substrate. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss.*

Highway 101 Assessed Crossing Structures

Crossing Site Information for PAD 734418					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	19.01	34.44164, -119.77090	± 17 ft	4.26

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Segment 1 to 2 Transition Point

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Atascadero Creek 1.17 mi^2	Pacific Ocean	380.1 ft^3/s	Historical records indicate this stream has supported *O. mykiss* in the past. These records indicate *O. mykiss* were present in Atascadero Creek as recently at the last 1980s. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
01/13/2020	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
01/13/2020	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Arch and Pipe Culvert	1	3	No	No

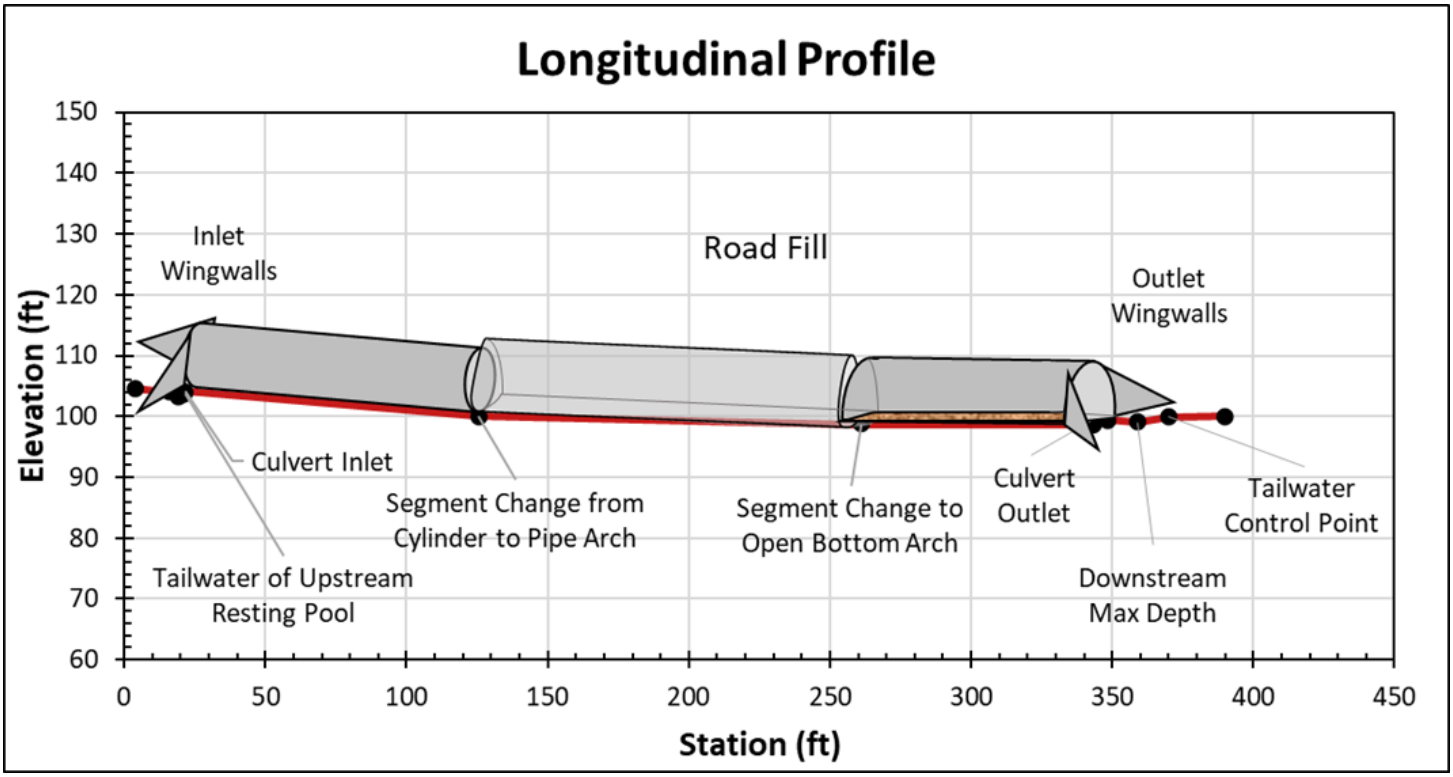
Crossing Structure Description and Condition
This structure is a culvert with three distinct segments, each of which has a different shape. A circular concrete pipe culvert is present at the inlet (segment 1). This cylindrical pipe culvert leads to a concrete pipe arch culvert (segment 2). The final segment is a brick and mortar top-arch culvert with a flat base. The inlet and outlet contained flared wingwalls. The structure has a relatively flat profile and sandy substrate was embedded from the outlet to roughly the midpoint of segment 2. Segment 2 also contained standing water at the time of assessment. No significant damage was visible to any portion of the structure. The structure runs under highway 101 and a railroad track (Coast Line) owned by Union Pacific.

Crossing Structure Dimensions					
Segment (shape)	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1 (pipe)	7.4	7.4	7.4	104	3.93 %
2 (arched pipe)	7.7	7.7	8	135.6	0.96 % (embedded substrate)
3 (brick top arch)	7	7	6	82.5	0.16 % (embedded substrate)
Full Structure	7.37	7.37	7.13	322.1	1.71 % (embedded substrate)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel makes a sharp turn towards river left as it enters the culvert. The channel has defined active channel margins and steep banks with sparse grass vegetation. Large eucalyptus trees line both sides of the channel and have dropped moderate woody debris into the channel. There are also a few drainage pipes from the upstream road that lead directly into the stream.	0.25 ft	0 ft	8.24 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel primarily consisted of sand and silt substrates forming an extended riffle unit with small areas of scour. This seems to have contributed to moderately defined active channel margins. The downstream channel banks are steep and contain moderate tree and brush vegetation.	Silt	26.4 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	4	104.52	
Upstream Channel Point 2	16	104.02	
Upstream Channel Point 3	19	103.25	
Upstream Resting Unit	21.1	103.76	
Culvert Inlet Lip	21.35	103.86	Outer ring of concrete pipe culvert.
Culvert Inlet	21.5	104.08	
Segment 1 to 2 Change Point	125.5	100	Structure changes from pipe culvert to pipe arch culvert.
Segment 2 to 3 Change Point	261.1	98.7	Structure changes from pipe arch culvert to top arch culvert with flat bottom.
Culvert Outlet	343.6	98.57	
Downstream Max Depth (within 5 ft of structure)	348.6	99.44	
Downstream Max Depth	359	99.04	
Tailwater Control Point	370	99.92	
Downstream Channel Point	390	99.98	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (four models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* A pipe arch shape was selected to model this structure in FishXing. This shape was chosen because the pipe-arch segment of the culvert was the longest of the three segments. The concave base of the pipe arch segment also closely matches the shape of the cylindrical pipe segment of the structure.	23.2 to 273.2	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 1 for Anadromous *O. mykiss* Concrete Pipe Culvert	12.1 to 780.8	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 2 for Anadromous *O. mykiss* Concrete Pipe Arch Culvert	16.5 to 749.5	Insufficient Streamflow Depth
Segment 3 for Anadromous *O. mykiss* Brick and Mortar Top Arch Culvert	8.1 to 1,144.2	Insufficient Streamflow Depth
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status
Temporal & Partial Barrier This crossing structure was assessed to be passable to strong swimming anadromous steelhead *O. mykiss*, but not passable to resident *O. mykiss*. Due to these results this crossing structure was determined to be a temporal and partial barrier to upstream migrating *O. mykiss.* FishXing analysis estimates streamflow rates greater than 23.19 ft^3/s would provide adequate water depth for successful steelhead *O. mykiss* passage. A velocity barrier was predicted to occur at streamflow rates greater than 273.22 ft^3/s. The main factors allowing this structure to be potentially passable to steelhead are its relatively flat profile and presence of embedded sandy substrate. These two characteristics provide for moderate streamflow velocities within the culvert. However, each occurrence of elevated streamflow is likely to change the arrangement and abundance of embedded substrate within this culvert and cause fluctuations to passage conditions.

Assessment and Analysis Limitations
There were limitations associated with both data collection and fish passage analysis performed for this crossing structure. The main data collection limitation was the presence of embedded substrate which prevented the true dimensions and slope of segment 3 from being measured. Fish passage analysis was limited by the variation of culvert shapes incorporated into the structure. FishXing is designed to model crossing structures with a uniform shape. Additionally, due to thick vegetation on the downstream channel banks, the elevations for the bankfull channel widths in the tailwater cross section had to be estimated.

Passage Improvement Recommendations
Fish passage conditions could be improved through this culvert if the concrete base lining the culvert were replaced with natural substrates or weirs were installed within the culvert.

Crossing Site Information for PAD 734431					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	22.14	34.43999, -119.82551	± 9 ft	2.07

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.94 mi^2	San Pedro Creek	148.55 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. It is highly unlikely that this stream currently supports *O. mykiss* considering it has a small drainage area, lacks a defined downstream channel, and is primarily located in an urban area. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
01/13/2020	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	No	No

Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert. At the time of assessment sandy substrate was present over the entire base of the culvert. It is possible the entire culvert was embedded, or the culvert does not contain a concrete base. At the time of assessment, a considerable amount of trash was located inside the culvert. The culvert appeared to be in good condition with no notable damage visible.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height**	**Mean Outlet Height**	**Mean Width**	**Length**	**Slope**
Culvert	Unable to measure	3.25 ft	6 ft	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
Gaining direct access to the upstream channel was not possible due extensive fencing. The channel remains in close vicinity of highway 101 as it runs parallel to the highway. It is likely the stream experiences various points of roadway runoff and may be a drainage ditch. The active channel margins appeared well defined. The channel banks were short and contained excessive brush.	Not Recorded	Not Recorded	Not Recorded

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel is poorly defined contained considerable amounts of trash. An additional culvert runs under railroad tracks roughly 100 ft from the crossing structure outlet. Downstream of the railroad culvert the channel becomes undefined as it reaches a wide drainage ditch that parallels the railroad tracks. Grass and small shrubs are present within the channel.	Silt	Not Recorded

Longitudinal Profile Measurements
Longitudinal profile data was not collected for this crossing structure because it didn't meet the criteria for a Caltrans detailed fish passage assessment due to the lack of a defined stream channel.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment	Unknown, structure is likely passable when streamflow conditions provide adequate water depth.	Unknown, potential for insufficient streamflow depth restriction.

Crossing Structure Barrier Status
Temporal Barrier Upstream *O. mykiss* passage attempts are highly unlikely to occur at this crossing structure, due to the lack of a defined downstream stream channel. However, if any life stage of *O. mykiss* were able to gain access to this crossing structure it likely would be able to gain passage under adequate rates of streamflow. This crossing structure was assigned a temporal barrier status to reflect this professional judgement assessment.

Assessment and Analysis Limitations
The stream channel upstream of this crossing was not accessed due to extensive fencing. Additionally, the temporal barrier status assigned to this crossing structure is based off professional judgement as only a Caltrans reconnaissance first pass barrier assessment was performed. A detailed fish passage assessment could be conducted but was not completed due to the lack of defined stream channel downstream of the crossing.

Passage Improvement Recommendations
Passage improvement efforts are not recommended for this crossing structure considering it has a natural substrate bottom and is likely passable to *O. mykiss* when adequate streamflow conditions are present. Additionally, the lack of defined channel downstream of this crossing make it highly unlikely a returning anadromous steelhead would ever reach this crossing structure.

Crossing Site Information for PAD 707180					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	22.56	34.43962, -119.83299	± 9 ft	1.72

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Bridge Inlet)

Downstream Looking Upstream (Bridge Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Las Vegas Creek 2.081 mi^2	San Pedro Creek	412.21 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* Records show resident and anadromous *O. mykiss* were periodically observed within Las Vegas Creek's tributary San Pedro creek in the 1980s, 1990s, and 2000s. The last documented observation of *O. mykiss* in the San Pedro Creek was in 2008 (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/11/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/11/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Free Spanning Bridge	n/a	1	No	No

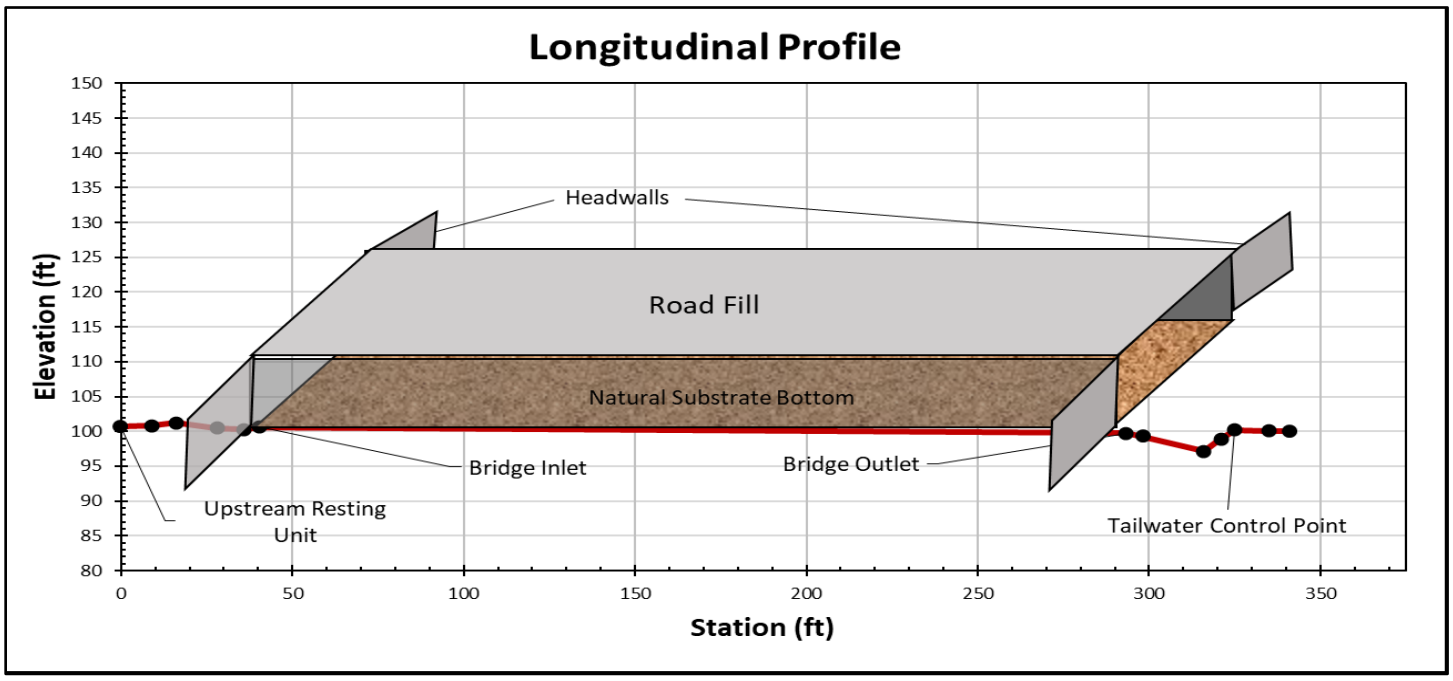
Crossing Structure Description and Condition
This crossing structure is a large free spanning bridge over natural streambed substrate, primarily sand. The bridge has vertical concrete walls lining each side of the channel. The crossing structure was in good condition with no visible damage or erosion at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope** (substrate below bridge)
Bridge	9.5	8.9	40	253	0.36 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel had wide and relatively undefined active channel margins. The channel consisted and sand and silt substrate with tall reed, grass, and brush vegetation present in both the active channel and channel banks. The Calle Real Road crossing is located roughly 100 ft upstream of this Hwy 101 bridge. The Calle Real Road crossing is not listed in PAD and structure consists of two side by side concrete reinforced box culverts. A plunge point is present from the outlet of these culverts and the structure clearly presents as a barrier to upstream *O. mykiss* movement.	40.33 ft	0.05 ft	25.58 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel was similar to the upstream channel as it contained a wide and minimally defined active channel margin. The downstream channel also contained dense brush and shrub vegetation. The active channel width veered towards river left to signs of a notable pool scour. A railroad crossing bridge is located roughly 40 ft downstream of the Hwy 101 bridge. This railroad bridge has instream supports, but passes over natural streambed substrate and likely doesn't present as barrier to *O. mykiss*. Downstream of the railroad bridge the active channel margin narrows significantly.	Sand	31.67 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	100.65	Resting unit is small and not well defined.
Upstream Channel Point 1	9	100.83	
Upstream Channel 2	16	101.19	
Upstream Channel 3	28	100.46	
Upstream Channel 4	36	100.26	
Bridge Inlet	40.33	100.6	
Bridge Outlet	293.33	99.7	
Downstream Max Depth (within 5 ft of structure)	298.33	99.25	
Downstream Max Depth	316	97.15	
Tailwater Control Point	325	100.23	
Downstream Channel 1	321	98.9	
Downstream Channel 2	335	100.08	
Downstream Channel 3	341	100	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was modeled as a box culvert within FishXing. The bridge's mean height above the channel was entered for culvert height. The bridge's upstream to downstream extent was entered as the length of the culvert. A roughness coefficient of 0.035 was selected to represent the predominantly sandy substrate present underneath the bridge.	> 55.11	None

Crossing Structure Barrier Status

Not a Barrier

This free spanning bridge crossing structure was determined to be free of passage constraints under the criteria of the Caltrans reconnaissance first pass fish passage assessment. Due to this a Caltrans detailed passage assessment was not necessary, but was still performed. FishXing analysis indicated that this structure is passable to both anadromous steelhead and resident *O. mykiss* life stages when adequate streamflow (> 55.11 ft^3/s) is present to provide adequate water depth. Therefore, this structure is not a barrier to *O. mykiss* upstream movement.

Assessment and Analysis Limitations

There were no limitations experienced in conducting a detailed fish passage assessment and FishXing passage analysis on this crossing structure.

Passage Improvement Recommendations

No passage improvement efforts are recommended for this structure as it does not pose as an immediate concern for fish passage.

Crossing Site Information for PAD 762563					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	23.42	34.43807, -119.8477	± 15 ft	3.56

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.825 mi^2	Carneros Creek	99.7 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. No records were found indicating the stream has supported *O. mykiss* in the past. It is very unlikely this stream currently supports *O. mykiss* considering its small watershed, low estimated peak streamflow, and lack of definable channel upstream of the crossing structure. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/11/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	2	1	No	No

Crossing Structure Description and Condition
This crossing structure consists of two side by side concrete reinforced box culverts, separated by a vertical concrete divider. The structure extends under Hwy 101 and Calle Real Road. The downstream half of the culverts have a slight continuous curve towards river right. The base of the structure at the inlet is elevated 1.5 ft above the level the upstream substrate. The downstream substrate is level with the base of the structure at the outlet. The crossing structure appeared to be in good condition with no visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	4	4	10 (each culvert is 5 ft wide)	241	Not measured

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment there was no discernable defined channel upstream of this crossing structure. The area upstream of the crossing structure was heavily vegetation with thick brush and small trees typical of riparian habitat in southern California.	No distinct resting unit present at time of assessment.	No distinct resting unit present at time of assessment.	Active channel margins were not distinguishable

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
A definable channel was present downstream, but the active channel margins were narrow, poorly defined, and continued minimal scour. The channel and surrounding area contained thick brush, which was growing over the narrow active channel margins.	Sand	A defined tailwater control point was not present at the time of assessment.

Longitudinal Profile Measurements
Due to the lack of a definable upstream channel this structure did not meet the criteria for a Caltrans detailed fish passage assessment. Therefore, a longitudinal profile was not completed for this crossing structure.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment	Unknown, structure is likely passable under a specific range of streamflow.	Unknown, potential for insufficient streamflow depth restriction.

Crossing Structure Barrier Status
Temporal & Partial Barrier A temporal and partial barrier status was assigned to this crossing structure. This status is based on professional judgement due to the absence of data required to complete FishXing analysis. To make this judgement the conditions present within this crossing structure were compared to other crossing structure culverts of similar size, length, and slopes that were assessed with FishXing. With these comparisons this crossing structure is likely only passable to strong swimming anadromous *O. mykiss* and only during a specific range of streamflow rates. Conditions conducive to potential passage would only occur when streamflow is high enough to provide adequate water depth, but also not create a velocity barrier. The low estimated annual mean peak streamflow rate of 99.7 ft^3/s indicates that the specific streamflow conditions likely required for potential successful passage rarely occur.

Assessment and Analysis Limitations
No limitations were experienced in conducting a Caltrans reconnaissance fish passage assessment for this crossing structure. If a detailed fish passage assessment had been performed a longitudinal profile would have been difficult to perform as the low height of this crossing structure created confined space.

Passage Improvement Recommendations
Further analysis of this stream/watershed should be conducted to determine if barrier remediation efforts are appropriate and necessary. Conditions upstream of this culvert should be assessed for the presence of a defined channel and viable *O. mykiss* habitat. If barrier remediation efforts are deemed necessary, the most effective option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 705159					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	28.18	34.43906, -119.92877	± 11 ft	0.07

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Eagle Canyon Creek 4.72 mi^2	Pacific Ocean	462.29 ft^3/s	Records indicate that this stream likely historically supported *O. mykiss*. The last reported documentation of *O. mykiss* being seen in this stream was in 1984. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/28/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/28/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Arch Culvert	1	3	No	No

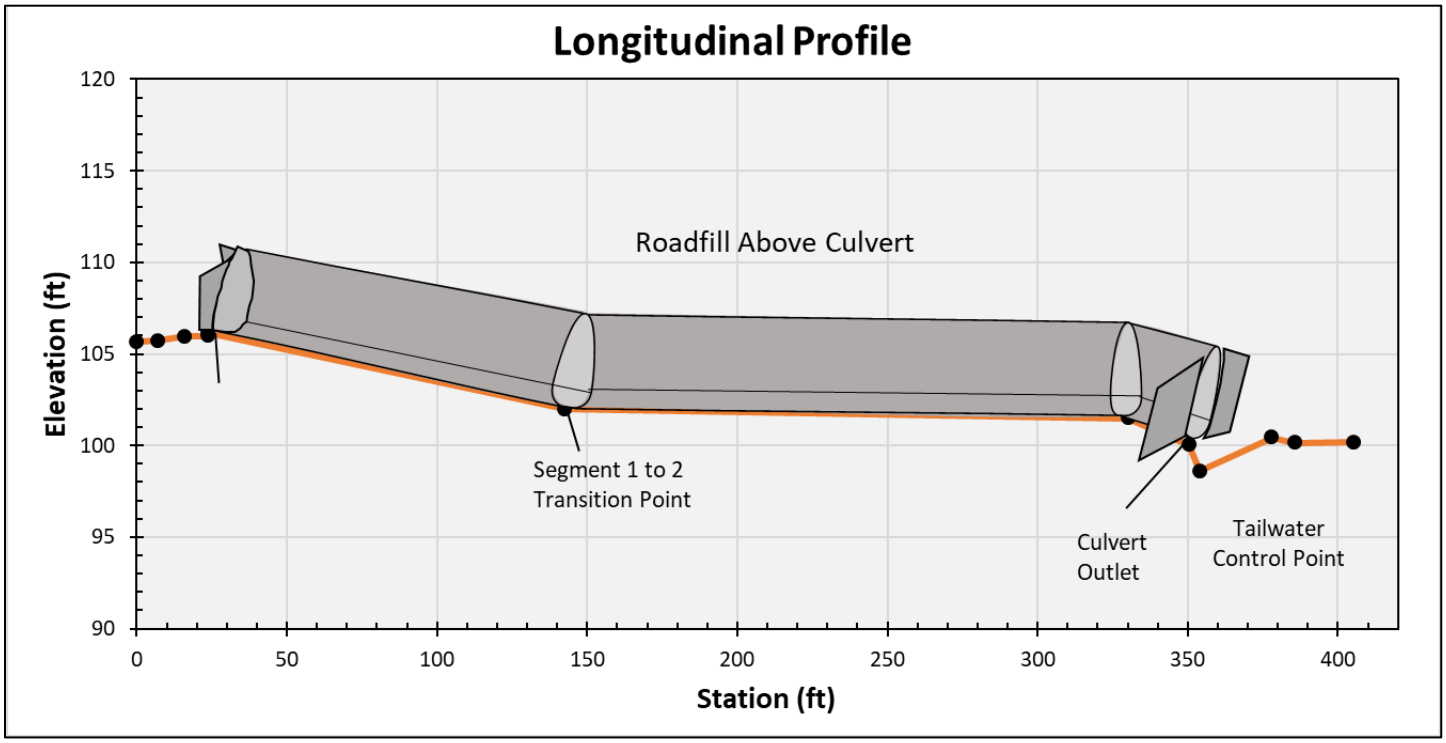
Crossing Structure Description and Condition
This crossing structure is a large concrete reinforced arch culvert with 3 distinct segments. Each segment is oriented in line with each other, but have different widths and degrees of slope. Flared wingwalls are present at the inlet and outlet. The structure is absent of any aprons. The upstream and downstream streambed substrate was level with the base of the culvert at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1	12.5	12	13	118.75	3.52 %
2	12	12	11	187.45	0.27 %
3	12	12	12	20.3	7.21 %
Full Structure	12.5	12	12	326.5	1.88 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream active channel margins were well defined with sand, silt, and small cobbles as the dominate substrate types. The channel banks were covered with dense riparian vegetation and had a moderate slope. A free spanning bridge (Calle Real Road) over natural streambed substrate is located roughly 300 ft upstream and does not contain any passage constraints.	24 ft	0 ft	10.08 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained wide and moderately defined active channel margins with an extended shallow riffle unit containing minimal scour. Dominant streambed substrates were cobble and gravel. The channel banks were small and moderately sloped. They contained some large woody debris and dense riparian vegetation.	Sand	27.5 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	105.66	
Upstream Channel 1	7	105.72	
Upstream Channel 2	16	105.96	
Upstream Channel 3	23.8	105.97	
Culvert Inlet	24	106.16	
End of Segment 1	142.75	101.98	
End of Segment 2	330.2	101.48	
Culvert Outlet	350.5	100.02	
Downstream Max Depth	354	98.61	Same point as max depth within 5 ft of structure.
Tailwater Control Point	378	100.43	
Downstream Channel 1	385.8	100.14	
Downstream Channel 2	405.2	100.16	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (four models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled in FishXing as a pipe-arch culvert using the dimensions of segment 1.	46.83 – 266.56	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 1 Analysis for Anadromous *O. mykiss*	64.07 – 1,209.3	Insufficient Streamflow Depth
Segment 2 Analysis for Anadromous *O. mykiss*	17.74 – 1,512.3	Insufficient Streamflow Depth
Segment 3 Analysis for Anadromous *O. mykiss*	57.49 – 1,431.5	Insufficient Streamflow Depth
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

FishXing analysis predicted strong swimming anadromous *O. mykiss* would potentially be able to gain passage through this culvert during the occurrence of a specific range of streamflow (46.83 – 266.56 ft^3/s). However, FishXing analysis predicted that resident life stages of *O. mykiss* would not be able to gain passage under any rate of streamflow. As a result of this analysis this crossing structure was assigned a temporal and partial barrier status.

Assessment and Analysis Limitations

There were no limitations associated with the collection of data to complete a detailed fish passage assessment for this crossing structure. The varying widths of each segment within the culvert did present as a limitation with FishXing passage analysis. The dimensions of segment 1, which is the widest segment within the structure were used for the full structure FishXing passage analysis. Despite the slight differences in width in each segment of this culvert the base of each segment maintained the same concave derivative, so passage analysis results are likely minimally impacted by using the dimensions of segment 1.

Passage Improvement Recommendations

Due to the concrete lining and steep slope of this culvert, velocity and depth barriers can be remediated by removing the concrete on the channel bottom, installing weirs for passage, or replacing the structure with free spanning bridge.

Crossing Site Information for PAD 734476					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	28.69	34.43995, -119.93750	± 20 ft	0.25

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Segment 2 to 3 Transition Point

Standing Water and Substrate in Segment 3

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.47 mi^2	Pacific Ocean	134.83 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is one of many small Gaviota Coast watersheds. Records indicate that many of the Gaviota Coast watersheds have historically supported anadromous fish. Some Gaviota Coast watersheds, such as Arroyo Hondo Creek are still currently supporting resident *O. mykiss* populations. However, due to the small drainage area and low estimated annual mean peak streamflow it is unlikely that this stream currently supports *O. mykiss*. (NMFS 2012 Southern California Steelhead Recovery Plan; Center for Ecosystem Management & Restoration 2008. CDFW unpublished data, 2013-2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/12/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
01/28/2020	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Pipe and Box Culvert	1	3	Yes (only at inlet)	No

Crossing Structure Description and Condition
This crossing structure is a concrete reinforced pipe and box culvert. The two most upstream segments are pipe culverts and the most downstream segment is a box culvert. The lower portion of the box culvert was heavily embedded with gravel substrate which created a confined space. This lower segment also contained standing water at the time of assessment. Short flared wingwalls were present at the inlet and outlet, with a short concrete apron located between the inlet wingwalls. The structure appeared to be in good condition with no visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	5	0.9	89.44 %
1 (pipe culvert)	5	5	5	120.9	3.44 %
2 (pipe culvert)	5	5	5	58	2.17 %
3 (box culvert)	5	1.5 (due to embedded substrate)	5	Unable to measure	Unable to measure
Full Structure	5	1.5 (due to embedded substrate)	5	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined, but narrow active channel margins. Minimal scour was present within the active channel and extended riffle units were dominant. The channel banks were small and contained grass and sparse brush.	0 ft	0 ft	10.6 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained very dense brush vegetation. Some of the vegetation was growing within the narrow active channel margins. The active channel margin lacked areas of scour creating extended shallow riffle units.	Silt	No distinct tailwater control point present at the time of assessment.

Longitudinal Profile Measurements (profile only able to be completed to inlet of segment 3)			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	102.6	
Upstream Resting Unit	2.5	102.29	
Upstream Channel Point 2	8.1	102.6	
Inlet Apron (upstream extent)	16.3	101.99	Upstream extent of apron.
Culvert Inlet	17.2	101.39	
Segment 1 to 2 Transition Point	138.1	97.23	Culvert orientation shifts 15° to river left.
Segment 2 to 3 Transition Point	196.1	95.97	Culvert orientation shifts 15° to river right.
Upstream Extent of Embedded Substrate	219	95.28	Downstream extent of profile.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing (four models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* The entirety of this structure was unable to be modeled within FishXing due to the inability to complete the longitudinal profile through segment 3 to the structure outlet.	Unknown, but assumed to be passable within a specific range of streamflow.	Unknown, potential for streamflow depth, and excessive streamflow velocity restrictions.
Segment 1 Analysis for Anadromous *O. mykiss*	20.41 – 394.85	Insufficient Streamflow Depth
Segment 2 Analysis for Anadromous *O. mykiss*	14.72 – 400.83	Insufficient Streamflow Depth
Segment 1 and 2 Combined Analysis for Anadromous *O. mykiss*	19.16 – 281.52	Insufficient Streamflow Depth
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status
Temporal & Partial Barrier FishXing analysis on the two most upstream segments of this structure predicted that strong swimming anadromous life stages of *O. mykiss* would be able to gain passage under specific rates of streamflow. FishXing predicted these segments to be impassable to resident life stages of *O. mykiss*. The most downstream segment was unable to be analyzed in FishXing, but due to its flat profile, presence of embedded substrate, and standing water it is assumed to also be passable to anadromous *O. mykiss*. The sustained effort required for passage attempts through the entirety of the structure likely narrow the range of passable rates of streamflow.

Assessment and Analysis Limitations
The only limitation experienced in assessing this crossing structure was the inability to access the downstream portion of the structure (segment 3) due to the confined space caused by embedded substrate. This limited our ability to complete a full longitudinal profile. As a result, FishXing analysis was only able to be completed for the two most upstream segments within the structure. The temporal and partial barrier status assigned to the crossing structure is partially based on professional judgement.

Passage Improvement Recommendations
The most effective remediation to improve fish passage conditions through this crossing structure would be to replace it with a free spanning bridge. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss.*

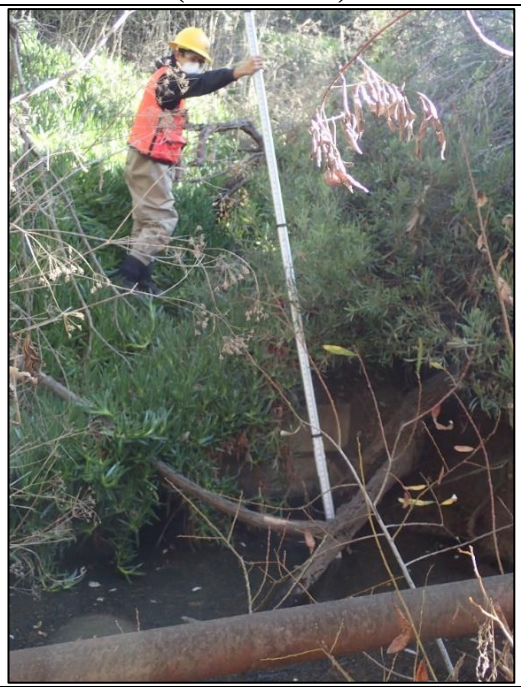
Crossing Site Information for PAD 734483					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	29.89	34.44565, -119.95584	± 24 ft	0.6

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)



Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
East Dos Pueblos Creek 1.0 mi^2	Dos Pueblos Creek	179.12 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is one of many small Gaviota Coast watersheds. Records indicate that many of the Gaviota Coast watersheds have historically supported anadromous fish. Some Gaviota Coast watersheds, such as Arroyo Hondo Creek are still currently supporting resident *O. mykiss* populations. (NMFS 2012 Southern California Steelhead Recovery Plan; Center for Ecosystem Management & Restoration 2008. CDFW unpublished data, 2013-2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/12/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Pipe Culvert	1	Unknown	No	No

Crossing Structure Description and Condition
This crossing structure is a concrete reinforced pipe culvert with wingwalls at its inlet. At the time of assessment, the culvert outlet was almost fully embedded, with the embeddedness starting just 63 ft downstream from the inlet. The culvert contains an orientation shift towards river right. No damage was visible at the time of assessment.

Crossing Structure Dimensions				
Segment	**Mean Inlet Diameter**	**Mean Outlet Diameter**	**Length**	**Slope**
Culvert	6 ft	Unknown, outlet is was nearly fully embedded at the time of assessment.	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined and narrow active channel margins. The channel banks were steep and contained thick blackberry and brush. A trickle of streamflow was present and the water appeared to be saturated with iron oxidizing bacteria giving it an orange color.	Not Recorded	Not Recorded	Not Recorded

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, there was a large pool unit located downstream of the culvert outlet. The active channel margins were wide and moderately defined. The channel banks were steep. Dense brush vegetation was present both within the active channel margins and on the channel banks. A concrete flood control channel is listed in PAD (ID 707396) downstream of the stream's confluence with Dos Pueblos Creek as is considered a total barrier.	Silt	Not Recorded

Longitudinal Profile Measurements
A longitudinal profile was not able to be completed due to the embedded substrate within the culvert and the confined space restriction it caused.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment	Unknown, structure is likely not passable under any rate of streamflow.	Unknown, potential for passage obstructions, streamflow velocity, and streamflow depth restrictions.

Crossing Structure Barrier Status
Total Barrier Under the conditions assessed this structure is not believed to be passable to any life stages of *O. mykiss* due to passage blockage from the heavy embedded substrate within the culvert.

Assessment and Analysis Limitations
Due to the embedded substrate within the culvert, a full detailed assessment could not be completed for this crossing. As a result, FishXing analysis was unable to be completed. The total barrier status assigned to this structure was determined from professional judgement.

Passage Improvement Recommendations
The most effective remediation to improve fish passage conditions through this crossing structure would be to replace it with a free spanning bridge. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss.*

Crossing Site Information for PAD 734489					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	30.85	34.45543, -119.96938	± 9 ft	0.7

Pictures	
Upstream Channel	**Upstream Looking Downstream** (Culvert Inlet)
Downstream Looking Upstream (Culvert Outlet)	**Downstream Looking Downstream**
Downstream channel not assessed due to private property access restriction.	Downstream channel not assessed due to private property access restriction.

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
East Las Varas Creek 0.38 mi^2	Las Varas Creek	89.45 ft^3/s	It is unknown if this stream has historically supported *O. mykiss*. This stream is one of the Gaviota coast watersheds, which have historically supported anadromous fish. However, due to the small drainage area and low estimated annual mean peak streamflow it is unlikely that this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/12/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Pipe Culvert	1	Unknown	No apron at inlet, unknown for outlet	No

Crossing Structure Description and Condition
This crossing structure is a concrete reinforced pipe culvert and is located under Hwy 101 and Calle Real Road. Only the inlet of the structure was able to assessed due to confined space and private property restrictions. The inlet contained a small headwall and appeared to be in good condition.

Crossing Structure Dimensions				
Segment	**Mean Inlet Diameter**	**Mean Outlet Diameter**	**Length**	**Slope**
Culvert	6 ft	Unable to access and measure outlet	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel is located within an avocado orchard. The active channel margins were poorly defined, and the channel banks were wide and moderately slopped. The channel was comprised of extended riffle units lacking areas of scour. The dominant streambed substrates were sand and cobble.	Not Recorded	Not recorded	Not Recorded

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
The downstream channel was not able to be assessed due private property access restrictions. From topographic analysis, the channel appears to contain heavy vegetation and its confluence with Las Varas Creek is about 0.13 miles from Hwy 101.	Unable to assess	Unable to assess

Longitudinal Profile Measurements
A longitudinal profile was not completed due to confined space restrictions preventing entry into the crossing structure.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment	Unknown	Unknown, potential for streamflow velocity and streamflow depth restrictions.

Crossing Structure Barrier Status
Unknown Without the ability to assess to the interior and outlet of this structure a definitive barrier status could not be determined. The small diameter of the culvert likely leads to streamflow velocity barriers. Additionally, the low estimated annual mean peak streamflow indicates the presence of adequate streamflow for potential *O. mykiss* passage attempts rarely occurs.

Assessment and Analysis Limitations
The crossing structure meets the criteria of a confined space outlined in the Caltrans Reconnaissance Fish Passage Assessment protocol, thus assessing the inner portion of the structure would require special equipment. The outlet and downstream channel conditions were not able to be assessed due to private property access restrictions. As a result, a longitudinal profile and FishXing passage analysis was unable to be completed.

Passage Improvement Recommendations
Further analysis of this stream/watershed should be conducted to determine if barrier remediation efforts are appropriate and necessary. Channel conditions upstream of this culvert should be assessed for the presence of viable *O. mykiss* habitat. From topographic analysis it appears the upstream channel is unlikely to contain quality *O. mykiss* habitat. If barrier remediation efforts are deemed necessary, the most effective option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 734494					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	30.98	34.45618, -119.97146	± 9 ft	0.77

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Las Varas Creek 3.12 mi²	Pacific Ocean	436.26 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is one of many small Gaviota Coast watersheds. Records indicate that many of the Gaviota Coast watersheds have historically supported anadromous fish. Some Gaviota Coast watersheds, such as Arroyo Hondo Creek are still currently supporting resident *O. mykiss* populations. (NMFS 2012 Southern California Steelhead Recovery Plan; Center for Ecosystem Management & Restoration 2008. CDFW unpublished data, 2013-2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/10/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/10/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	6	No	No

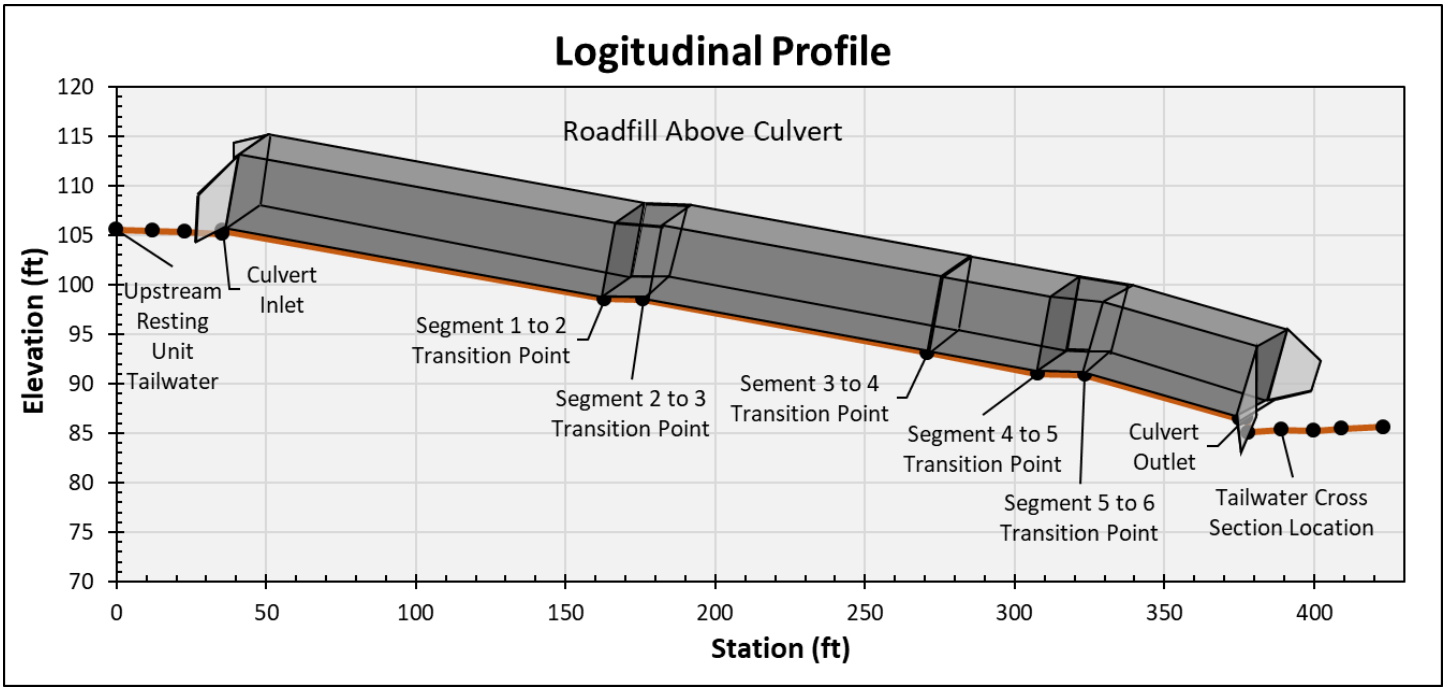
Crossing Structure Description and Condition
This structure is a concrete reinforced box culvert with flared inlet and outlet concrete wingwalls. The culvert has six similar segments with the same dimensions, but are distinguishable by changes in slope, length, and orientation. The crossing structure was in good condition with no visible damage or erosion at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1	10	10	10	127.42	5.41 %
2	10	10	10	13	0.77 %
3	10	10	10	95	5.65 %
4	10	10	10	36.6	5.77 %
5	10	10	10	15.9	0.75 %
6	10	10	10	51.67	8.61 %
Full Structure	10	10	10	339.59	5.60 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
An extended riffle unit with silt/sand dominant substrate was present within the upstream channel at the time of assessment. The river left bank had roughly twice the height of the river right bank. The upstream channel was lined with moderately dense vegetation and moderately sized and avocado orchard trees.	35.58 ft	0.13 ft	11.26 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, minimal scour was present below the outlet apron of the culvert. An extended and wide riffle unit was present downstream of the culvert without a defined tailwater control point. The active channel width at the tailwater profile location was 32 ft. Sparse and low vegetation was growing within the active channel margins and each bankside had moderate density of vegetation including some large trees.	Silt	No defined tailwater control point present at the time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	105.59	
Upstream Channel 1	12	105.44	
Upstream Channel 2	23	105.36	
Upstream Channel 3	35.42	105.14	
Culvert Inlet	35.58	105.46	
Segment 1 to 2 Transition Point	163	98.58	No change in culvert orientation.
Segment 2 to 3 Transition Point	176	98.48	Culvert orientation shifts 5° to river left.
Segment 3 to 4 Transition Point	271	93.12	Culvert orientation shifts 17° to river left.
Segment 4 to 5 Transition Point	307.6	91.01	No change in culvert orientation.
Segment 5 to 6 Transition Point	323.5	90.89	Culvert orientation shifts 17° to river left.
Outlet	375.17	86.46	
Outlet Apron (downstream extent)	377.33	86.57	Short 2.16 ft long apron between concrete wingwalls.
Downstream Max Depth (within 5 ft of structure)	378	85.09	Located directly below outlet apron. Same point as downstream max depth within 5ft of structure.
Downstream Channel 1	400	85.26	Within extended riffle unit.
Downstream Channel 2	409.17	85.47	
Downstream Channel 3	423	85.62	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (seven models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* The length of the structure's outlet apron was factored into the culvert length value used in FishXing analysis. This increased the culvert length from 339.59 ft to 342.49 ft. The FishXing analysis of each culvert segment is listed below. Segment numbers begin at the culvert inlet.	None	Insufficient Streamflow Depth
Segment 1 Analysis for Anadromous *O. mykiss*	None	Insufficient Streamflow Depth
Segment 2 Analysis for Anadromous *O. mykiss*	12.35 – 436	Insufficient Streamflow Depth
Segment 3 Analysis for Anadromous *O. mykiss*	None	Insufficient Streamflow Depth
Segment 4 Analysis for Anadromous *O. mykiss*	308.67 – 436	Insufficient Streamflow Depth
Segment 5 Analysis for Anadromous *O. mykiss*	13.32 – 436	Insufficient Streamflow Depth
Segment 6 Analysis for Anadromous *O. mykiss*	None	Insufficient Streamflow Depth
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status
Total Barrier This crossing structure was assessed to be a total barrier to all life stages of *O. mykiss* attempting to move upstream. FishXing analysis indicates the main passage constraint is a lack of streamflow depth occurring within the culvert due to its wide (10 ft) flat base. Additionally, the slope of the culvert (5.60 %) coupled with the relatively wide and flat tailwater control point prevents streamflow from backing up into the culvert. FishXing analysis indicates segment 1, 3 and 6 likely are the most restrictive to allowing *O. mykiss* passage as they are the longest and steepest segments within the culvert.

Assessment and Analysis Limitations
No limitations were experienced in the assessment of this crossing structure.

Passage Improvement Recommendations
The most effective remediation for fish passage purposes would be to remove and replace this structure with a free spanning bridge over natural streambed substrate. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss.*

Crossing Site Information for PAD 734495					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	32.67	34.46031, -120.0006	± 24 ft	0.14

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

River Right Outlet Wingwall

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Las Llagas Creek 2.43	Pacific Ocean	421.26 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is one of many small Gaviota Coast watersheds. Records indicate that many of the Gaviota Coast watersheds have historically supported anadromous fish. Some Gaviota Coast watersheds, such as Arroyo Hondo Creek are still currently supporting resident *O. mykiss* populations. (NMFS 2012 Southern California Steelhead Recovery Plan; Center for Ecosystem Management & Restoration 2008. CDFW unpublished data, 2013-2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/28/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/28/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Arch and Box Culvert	1	4	No	No

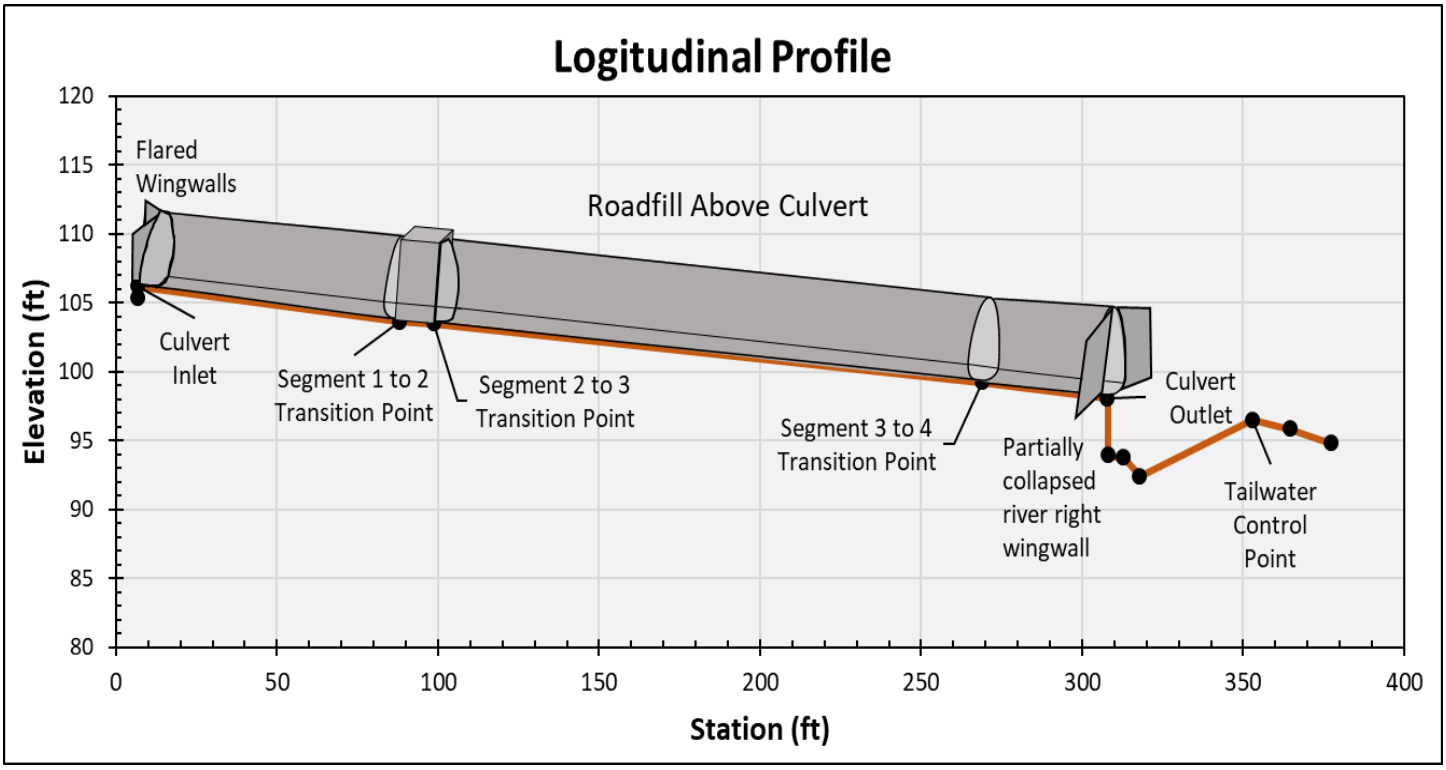
Crossing Structure Description and Condition
This crossing structure is a large concrete reinforced lined arch and box culvert consisting of four segments. The 2nd segment (from structure inlet) is a short transitional box culvert segment in which the orientation of the culvert shifts slightly to river left. The bottom lining of each structure segment has a continuous concave shape creating a distinct center thalweg for streamflow. The inlet and outlet of the structure contains concrete wingwalls. The outlet river right wingwall is intact, but has shifted inward towards the channel and is partially obstructing the structure outlet. It appears erosion and road fill sediment could continue to slide and push this wingwall further into the stream channel over time.

Crossing Structure Dimensions					
Segment (shape)	**Max Inlet Height** (ft)	**Max Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1 (arch culvert)	12.5	12.5	12.7	81	3.12 %
2 (box culvert)	14	15	14.3	10.7	1.22 %
3 (arch culvert)	12.5	12.5	11.2	170.3	2.51 %
4 (arch culvert)	12.8	12.8	12.7	39	2.9 %
Full Structure	12.95	13.2	12.725	301	2.7 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, a shallow and long pool unit was present immediately upstream of the crossing structure inlet. Streambed sediment was 0.84 ft below the inlet of the structure. Dense brush and tree vegetation is present on both channel banks.	0 ft	0 ft	10.6 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrates**	**Distance to Downstream Control Point**
At the time of assessment, a 2.4 ft plunge was present from the outlet to the water level of a large downstream pool unit. A small portion of calcium and magnesium carbonate deposit build up is present at the outlet creating a small cascade point. Dense brush and tree vegetation is present on both channel banks. There is another large arch culvert roughly downstream for the railroad, which drains through private property and into the Pacific Ocean.	Silt	45 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	6.9	105.33	Immediately above the inlet.
Culvert Inlet	7	106.17	Structure does not contain inlet apron.
Segment 1 to 2 transition	88	103.64	
Segment 2 to 3 transition	98.7	103.51	
Segment 3 to 4 transition	269	99.24	
Culvert Outlet	308	98.05	Downstream extent of segment 4.
Outlet Plunge Point	308.2	93.94	At time of assessment elevation of downstream pool unit water level was 95.35 ft.
Downstream Max Depth (within 5 ft of structure)	313	93.76	
Downstream Max Depth	318	92.41	
Tailwater Control Point	353	96.48	
Downstream Channel Point 1	308.2	93.94	
Downstream Channel Point 2	364.6	95.86	
Downstream Channel Point 3	377.5	94.78	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (five models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled in FishXing as a pipe-arch culvert using the dimensions of segment 1. The outlet plunge point height (2.7 ft) measured to the downstream pool unit water surface at the time of assessment on 10/28/19 was used in modeling. Additionally, due to FishXing limitations in regards to analysis of the full structure the box culvert (segment 2) portion of the structure was modeled as a pipe-arch culvert.	56.09 - 213.39	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 1 Analysis for Anadromous *O. mykiss*	55.99 - 421.26	Insufficient Streamflow Depth
Segment 2 Analysis for Anadromous *O. mykiss* For comparison this segment was modeled as both a box culvert and a pipe-arch culvert.	Box culvert model (67.37 - 421.26) Pipe-arch model (28.39 - 242.58)	Insufficient Streamflow Depth
Segment 3 Analysis for Anadromous *O. mykiss*	54.08 - 421.26	Insufficient Streamflow Depth
Segment 4 Analysis for Anadromous *O. mykiss*	47.41 - 421.26	Insufficient Streamflow Depth
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status
Temporal & Partial Barrier This crossing structure was predicted to be passable to strong swimming anadromous *O. mykiss* under a specific range of streamflow (56.09 - 213.39 ft^3/s), but not passable to resident life stages of *O. mykiss*.

Assessment and Analysis Limitations
There were no limitations associated with the collection of data to complete a detailed fish passage assessment for this crossing structure. However, there were limitations in performing FishXing passage analysis due to the inclusion of both pipe-arch segments and one box culvert segment in this crossing structure. FishXing is unable to perform passage analysis on culverts which include more than one culvert shape. Due to this restriction the 10 ft long box culvert segment included within this structure was modeled as a pipe-arch culvert in the full structure FishXing analysis. Due to this, the range of potentially passable streamflow rates predicted from FishXing analysis is likely an overestimate. Within the box culvert segment of this structure streamflow dynamics are likely more dispersed as compared to streamflow dynamics occurring within the pipe-arch segments of the structure. This dispersal of water over the flat bottom of the box culvert decreases the depth of flow while also increasing the velocity of flow. This in turn causes conditions which are less conducive to fish passage. Due to modeling the entire structure as a pipe-arch culvert the actual streamflow conditions occurring within the box culvert segment are not accurately accounted for in FishXing analysis. When modeling the true dimensions of the box culvert segment within FishXing passage for steelhead *O. mykiss* lifeforms was predicted possible at streamflow rates above 67.37 ft^3/s. When modeling the box culvert segment as a pipe-arch culvert the passage prediction began at streamflow rates above 28.39 ft^3/s.

Passage Improvement Recommendations
The most effective remediation for fish passage purposes would be to remove and replace this structure with a free spanning bridge over natural streambed substrate. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss.*

Crossing Site Information for PAD 734499					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	33.1	34.46188, -120.00838	± 10 ft	0 (outlet drains onto beach)

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream channel was unable to be accessed

Inside Culvert Looking Downstream
(Steep grade to outlet drop)

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Canada De La Destiladera Creek 0.85 mi²	Pacific Ocean	175.05 ft³/s	It is unknown if this stream has historically supported *O. mykiss*. This stream is located along the Gaviota Coast and many of the coastal watersheds in the area have historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/09/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box and Pipe Culvert	1	4	Yes (only at outlet)	No

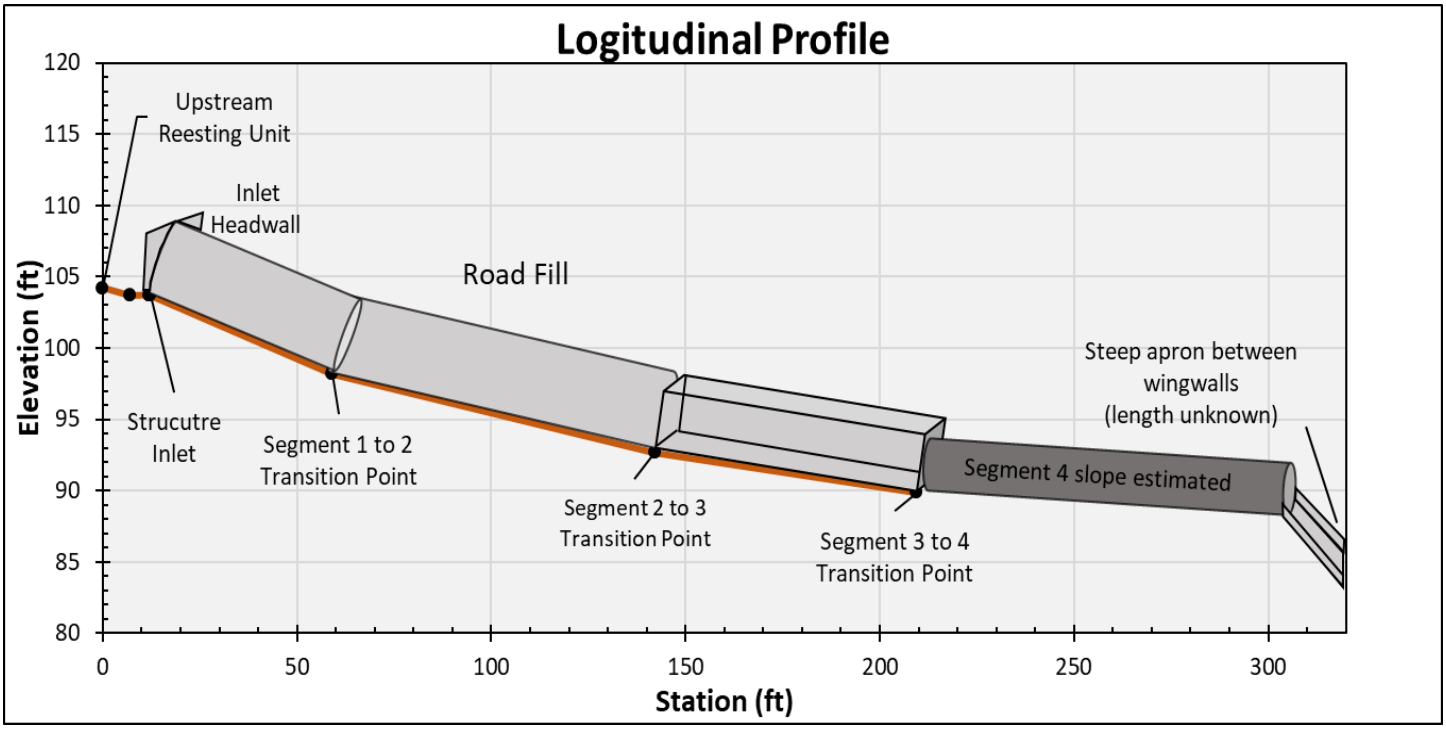
Crossing Structure Description and Condition
This crossing structure is a reinforced mulit-segment box and pipe culvert. The 3 most upstream segments are concrete and the downstream most segment is steel. A steep concrete outlet apron is located between parallel wingwalls. The inlet contains a small concrete headwall. The structure runs under highway 101 and a railroad track (Coast Line) owned by Union Pacific.

Crossing Structure Dimensions				
Segment	**Mean Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1 (pipe culvert)	6	6	46.8	11.79 %
2 (pipe culvert)	6	6	83	6.68 %
3 (box culvert)	5	5	67.5	4.12 %
4 (pipe culvert)	4	4	96.5	unable to measure
Full Structure	5.5	5.5	306 (to outlet, unable to measure length of outlet apron)	unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins with large cobble, boulder, and sand. The channel banks are low and wide and contain dense brush vegetation. A concrete low-water crossing with two small (1.5 ft diameter) pipe culverts running through it is located 37 ft upstream of the inlet.	0 ft	0 ft	10.38 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
The outlet and area downstream of the crossing structure was not able to be assessed due to the steep ocean side bluff in which the outlet apron was located on. A very tall plunge point to the beach was located from the end of the outlet apron.	Sand	No tailwater control point present at the time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	104.21	
Upstream Channel Point 2	7	103.67	
Upstream Resting Unit	12	103.71	
Culvert Inlet	12.2	103.67	
Segment 1 to 2 Transition Point	59	98.19	Culvert orientation shifts 40° to river left.
Segment 2 to 3 Transition Point	142	92.66	Culvert orientation shifts 10° to river right.
Segment 3 to 4 Transition Point	209.5	89.88	Culvert orientation shifts 26° to river right.
Outlet	306	Unable to measure	Downstream extent of longitudinal profile.
Outlet Apron	Unable to measure	Unable to measure	The outlet apron is steep and long and has a slope of approximately 70 %.



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages FishXing analysis was not performed on this crossing structure because the structure is clearly impassable to all life stages of *O. mykiss*. Additionally, performing FishXing analysis would be limited by the inability to complete a longitudinal profile for the entirety of the crossing structure.	This crossing structure is not believed to be passable at any rate of streamflow.	Impassable plunge and cascade, outlet unit restriction, and excessive leap height restrictions and likely present. Also potential for insufficient streamflow depth and excessive streamflow velocity restrictions.

Crossing Structure Barrier Status
Total Barrier This crossing structure contains steep segments and a very steep and narrow outlet apron with a significant plunge point below it. Due to this plunge point, all life stages of *O. mykiss* would not even be able to gain access to the structure. If *O. mykiss* were able to gain access to the structure its steep slope would likely create a velocity barrier over most rates of streamflow.

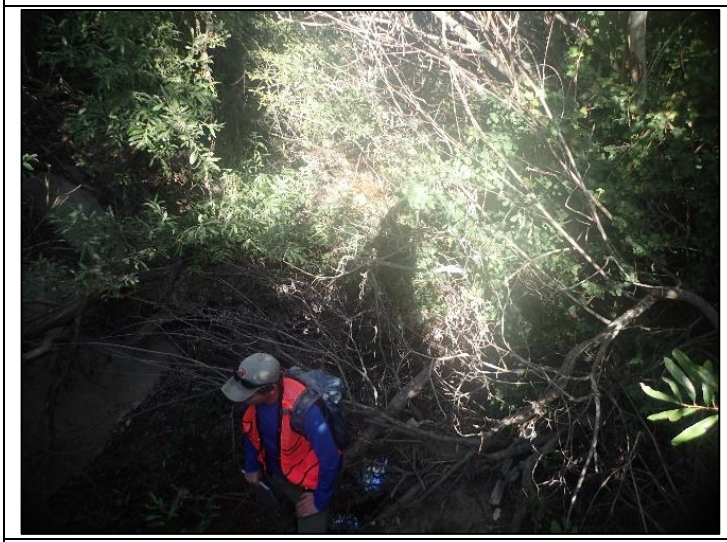
Assessment and Analysis Limitations
The steep slope of this structure's outlet apron and the plunge point from it prevented access to the downstream stream channel. This limited the extent of the longitudinal profile. Additionally, the downstream stream channel was unable to be accessed.

Passage Improvement Recommendations
Further analysis of this stream/watershed should be conducted to determine if barrier remediation efforts are appropriate and necessary. Channel conditions upstream of this culvert should be assessed for the presence of viable *O. mykiss* habitat. If barrier remediation efforts are deemed necessary, the most effective option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 734513					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	40.23	34.47305, -120.12730	± 37 ft	0.5

Pictures

Upstream Looking Upstream



Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Inside Culvert

Downstream Looking Downstream

No photo taken

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Pila Creek 0.824 mi²	Pacific Ocean	165.36 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is one of many small Gaviota Coast watersheds. Records indicate that many of the Gaviota Coast watersheds have historically supported anadromous fish. Some Gaviota Coast watersheds, such as Arroyo Hondo Creek are still currently supporting resident *O. mykiss* populations. (NMFS 2012 Southern California Steelhead Recovery Plan; Center for Ecosystem Management & Restoration 2008. CDFW unpublished data, 2013-2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/17/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
12/09/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (only at inlet)	No

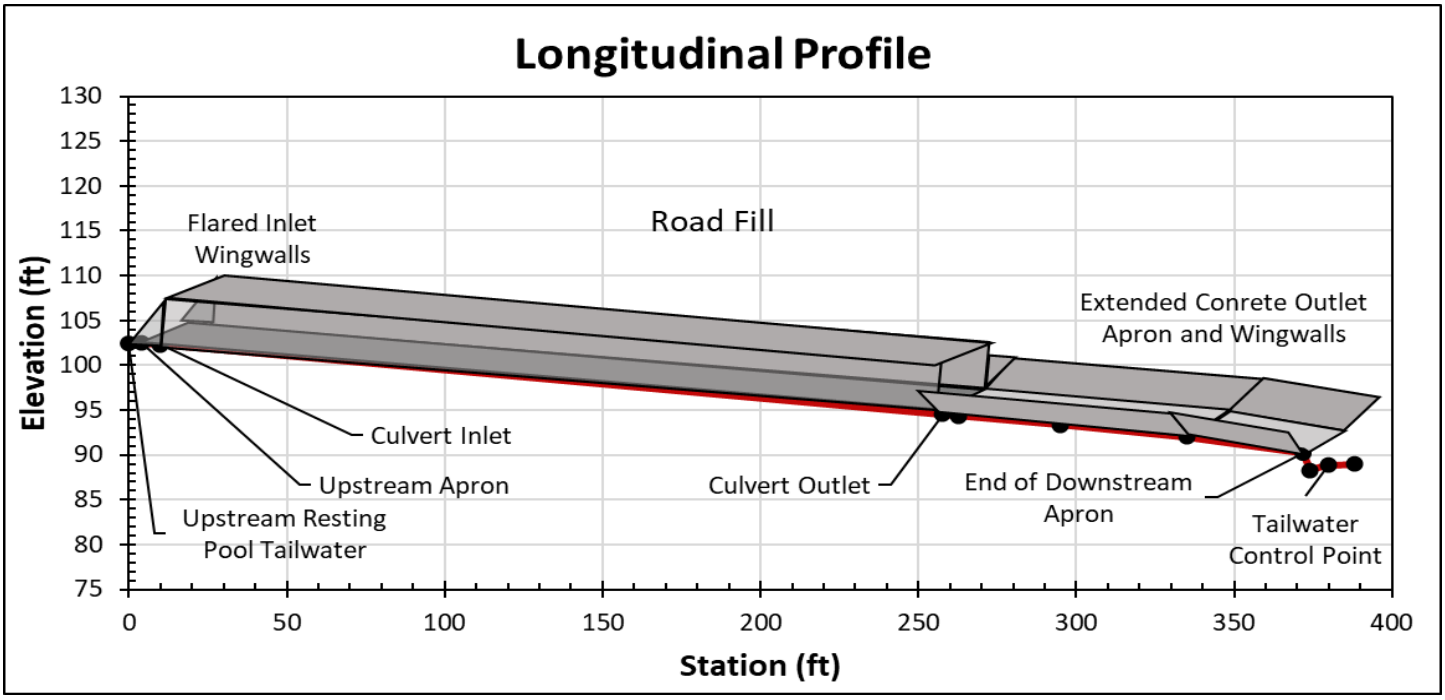
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with a concrete apron located between concrete wingwalls at both its inlet and outlet. The inlet wingwalls are flared, with a short apron located between them. The outlet wingwalls and apron extend 114.4 ft from the outlet of the structure and thus resemble a flood control channel. The outlet wingwalls are sloped and parallel to one another. A plunge point with a mean height of 2 ft was present at the downstream extent of the outlet apron. The culvert contains a slight curve towards river left and its base contains a slight concave shape to channel streamflow to its center. The structure contained no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	6.5	6	3.0 %
Box Culvert	5	5	6.5	247.6	3.12 %
Extended Outlet Apron	n/a (open channel)	n/a (open channel)	6.5	114.4	3.84 %
Full Structure	5	5	6.5	362	3.35 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained narrow and moderately defined active channel margins. The active channel contained sand, silt, and small cobble substrate. Dense brush and small trees were present on both channel banks and were encroaching into the active channel.	4 ft	0 ft	6.74 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, a small scour pool unit was located immediately downstream of the plunge point from the outlet apron. The downstream channel contained well defined active channel margins and steep channel banks covered with dense brush and trees.	Gravel	8 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	102.42	
Inlet Apron (upstream extent)	4	102.45	
Culvert Inlet	10	102.27	
Culvert Outlet	257.6	94.55	
Outlet Apron Point 1	262.6	94.36	
Outlet Apron Point 2	315	92.61	
Outlet Apron Point 3	360	90.97	
Downstream Extent of Outlet Apron	372	90.16	
Downstream Max Depth	374	88.27	Bottom of plunge point from outlet apron. Same as max depth within 5 ft of outlet.
Tailwater Control Point	380	88.93	
Downstream Channel Point 1	388	89	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages The structure was modeled in FishXing as a box culvert. The inlet and outlet aprons were factored into the culvert length modeled.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Total Barrier

This crossing structure was predicted to be impassable to all life stages of *O. mykiss*. For anadromous *O. mykiss* a velocity barrier causing exhaustion during passage attempts was predicted to occur above streamflow rates of 66.07 ft^3/s. Insufficient water depth was predicted to occur below streamflow rates of 78 ft^3/s.

Assessment and Analysis Limitations

There were no limitations experienced in collecting data associated with a full detailed fish passage assessment. However, modeling the structure as a box culvert in FishXing likely isn't completely compatible with the actual streamflow and passage conditions which occur through this crossing structure. For instance, the base of the culvert contains a slightly concave shape, but FishXing analysis assumed the culvert contained a flat base. Additionally, modeling the outlet apron as a box culvert assumed the wingwalls lining the apron were vertical. In reality, the outlet wingwalls are slopped, but FishXing isn't able to perform analysis on structures were slopped walls. These shortcomings of FishXing passage analysis are likely minimal when compared to the actual streamflow hydraulic conditions that occur through this crossing structure.

Passage Improvement Recommendations

Due to the excessive length of the concrete lining of this culvert, velocity and depth barriers can be remediated by removing the concrete on the channel bottom, installing weirs for passage, or replacing the structure with a free spanning bridge.

Crossing Site Information for PAD 734516					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	41.65	34.47462, -120.15354	± 22 ft	0.04

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Erosion Inside Culvert

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Canada de Guillermo 0.537 mi^2	Pacific Ocean	155.74 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is one of many small Gaviota Coast watersheds. Records indicate that many of the Gaviota Coast watersheds have historically supported anadromous fish. Some Gaviota Coast watersheds, such as Arroyo Hondo Creek are still currently supporting resident *O. mykiss* populations. However, due to the small drainage area and low estimated annual mean peak streamflow it is unlikely that this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2013-2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/17/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/17/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box and Arch Culvert	1	5	No	No

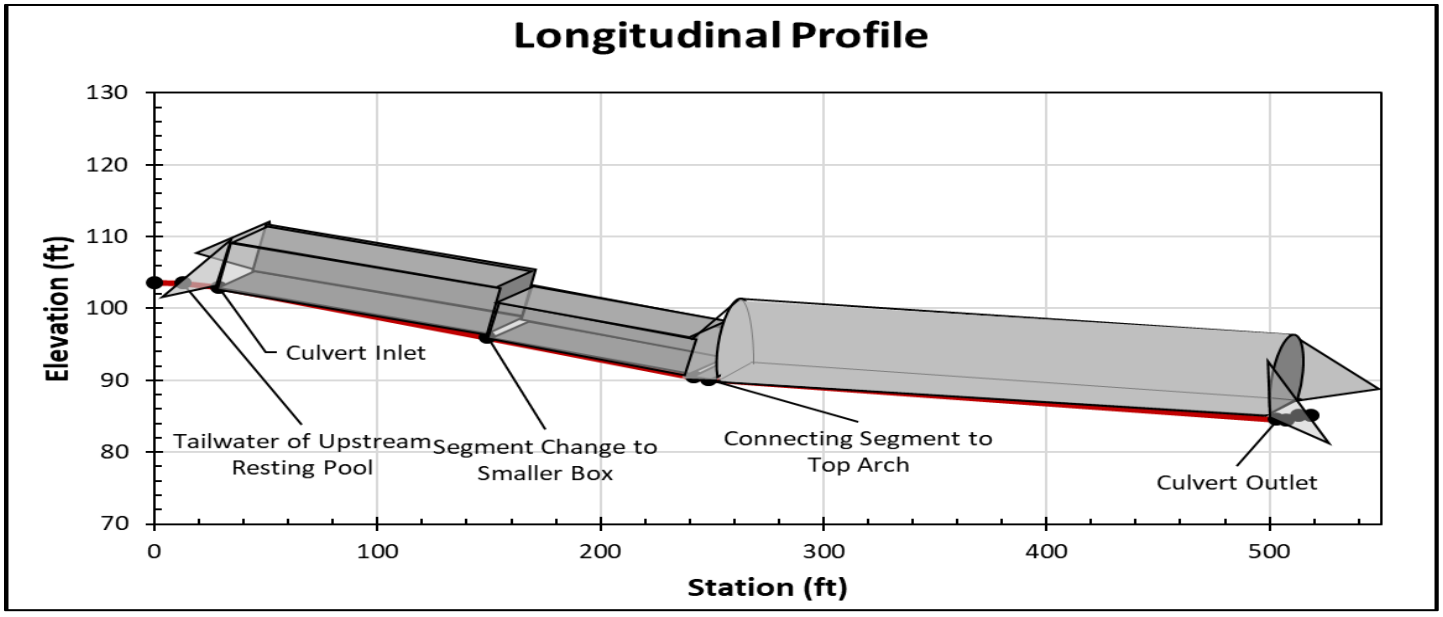
Crossing Structure Description and Condition
This crossing structure is a reinforced multi-segment culvert that contains four box culvert segments and one segment with a top arch shape. The box culvert segments are constructed of concrete and the top arch segment consists of brick and mortar walls and a cobble cemented base. The structure runs under highway 101 and a railroad track (Coast Line) owned by Union Pacific. The inlet and outlet have flared wingwalls, but no aprons. There were sections of heavy erosion inside portions of the box culvert segments with exposed rebar.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1 (box culvert)	6	5.3	6	16.2	3.58 %
2 (box culvert)	5.3	5.3	5.3	120.5	5.80 %
3 (box culvert)	5.7	5.7	6	92.5	5.95 %
4 (box culvert)	5.9	9	6.2	6.7	5.38 %
5 (arch top culvert)	7	7	5.8	254.8	2.17 %
Full Structure	6	7	5.86	490.7	3.86 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained poorly defined active channel margins with silt, sand, and cobble substrates. The channel banks were dense brush and tree vegetation, which had overgrown much of the channel.	12.8 ft	0.11 ft	6.14 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Downstream Control Point Distance from Structure**
At the time of assessment, the downstream channel contained heavy brush and tree vegetation. This vegetation was present in all portions of the channel making the active channel margins hard to identify. The channel banks were steep.	Silt	9.5 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	103.58	
Upstream Channel Point 1	6	103.43	
Upstream Channel Point 2	10	103.21	
Culvert Inlet	12.8	103.47	
Segment 1 to 2 Transition Point	29	102.89	
Segment 2 to 3 Transition Point	149.5	95.91	
Segment 3 to 4 Transition Point	242	90.42	
Segment 4 to 5 Transition Point	248.7	90.06	
Culvert Outlet	503.5	84.53	
Downstream Max Depth	507.7	84.47	Same as max depth within 5 ft of structure.
Tailwater Control Point	513	85.1	Point is not well defined.
Downstream Channel Point 1	519	85.04	Located in extended riffle unit.



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was assessed a box culvert within FishXing. The mean width and height of the structure were used for the culvert dimensions analyzed. The extended concrete outlet apron was factored into the length of the culvert. A culvert roughness coefficient of 0.016 was used in analysis instead of the 0.013 concrete roughness value to account of the cemented cobble base of the top arch segment. was not performed for each segment because the entirety of the crossing structure was assessed to be impassable.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Total Barrier

This crossing structure was predicted to be impassable to all life stages of *O. mykiss*. For strong swimming anadromous life stages of *O. mykiss* a velocity barrier causing exhaustion was predicted to occur at streamflow rates greater than 44.5 ft^3/s. Insufficient streamflow depth was predicted to limit passage under streamflow rates of 64.83 ft^3/s.

Assessment and Analysis Limitations

The main limitation experienced in assessing this structure was the inability to complete a tailwater control point cross section due to the dense vegetation located within the downstream channel. As a result, a constant tailwater control using the max depth elevation of the outlet unit was used in FishXing analysis. The modeling of the top arch segment of the structure as a box culvert is appropriate because this segment also contained vertical walls and a flat base.

Passage Improvement Recommendations

Due to the excessive length of the concrete lining of this culvert, velocity and depth barriers can be remediated by removing the concrete on the channel bottom, installing weirs for passage, or replacing the structure with a free spanning bridge.

Crossing Site Information for PAD 734517					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	42.11	34.47327, -120.16138	± 9	0.05

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Segment 3 Base Erosion and Scour

Downstream Potential Natural Barrier

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Posta Creek 1.065 mi²	Pacific Ocean	281.11 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is one of many small Gaviota Coast watersheds. Records indicate that many of the Gaviota Coast watersheds have historically supported anadromous fish. Some Gaviota Coast watersheds, such as Arroyo Hondo Creek are still currently supporting resident *O. mykiss* populations. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2013-2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/18/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/18/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box and Arch Culvert	1	5	Yes (only at outlet)	No

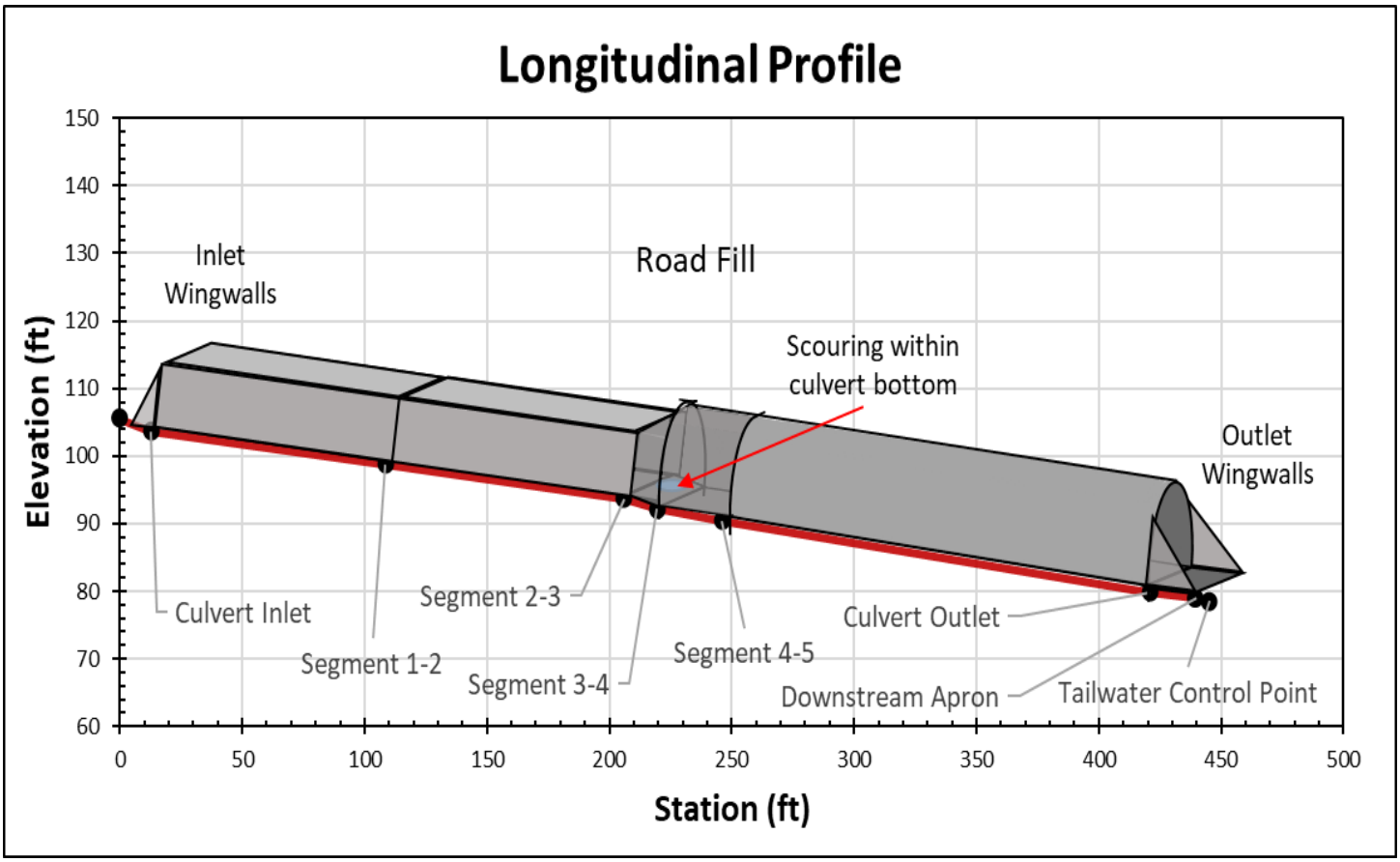
Crossing Structure Description and Condition
This structure is a long concrete reinforced culvert containing both box and top arch culvert shapes. The culvert contains five distinct segments. The first three segments are concrete lined box culvert shapes and the two most downstream segments are brick and mortar box culverts with arched tops and concrete cobble bottoms. These two downstream segments are located under the Union Pacific Railroad Coast Line and appear to have been constructed prior to the box culvert segments located under Hwy 101. The structure has flared wingwalls at the inlet and outlet, with a concrete cobble apron located between the outlet wingwalls. Moderate erosion is present along the base of segments 4 and 5. Significant erosion is present along through the concrete base lining of segment 3. Scouring has occurred in the substrate below segment 3 creating small pools.

Crossing Structure Dimensions					
Segment (shape)	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1 (box culvert)	8	8	8	95.6	5.09 %
2 (box culvert)	8	8	8	97.7	5.28 %
3 (box culvert)	8	11.7	8	13.5	11.7 %
4 (arch top culvert)	8.6	8.7	8	26.5	6.54 %
5 (arch top culvert)	8.7	9	8	174.8	6.03 %
Outlet Apron	n/a (open channel)	n/a (open channel)	10	18.9	5.1 %
Full Structure	8	9	8	427	5.8 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained dense brush vegetation on both banks, which was partially growing over and obstructing the active channel. The active channel margins were visible despite the presence of this vegetation. Dominant substrates types within the active channel were silt, sand, and large cobble.	12.8 ft	1.8 ft	9.66 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream active channel margins were not well defined as small trees and aquatic vegetation was present across the wetted portion of the channel. The river left channel bank contained trees and dense brush. The river right channel bank was scoured with near vertical bedrock face. Sparse cattails were present at the base of this scour. Additionally, a bedrock outcropping is located a short distance downstream of this crossing structure which is a potential temporal and partial barrier to *O. mykiss*. This bedrock outcropping contained a mean plunge height of 3.3 ft at the time of assessment.	Silt	5.25 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	105.47	
Upstream Channel Point 1	4.92	104.28	
Upstream Channel Point 2	7.87	103.74	
Culvert Inlet	12.80	103.67	
Segment 1 to 2 Transition Point	108.4	98.81	Culvert orientation shifts 10° to river left.
Segment 2 to 3 Transition Point	206.1	93.66	Culvert orientation shifts 5° to river left.
Segment 3 to 4 Transition Point	219.6	92.14	No change in culvert orientation. Arch top of culvert begins at this transition point.
Segment 4 to 5 Transition Point	246.1	90.41	Culvert orientation shifts 5° to river right.
Culvert Outlet	420.93	79.88	
Outlet Apron (downstream extent)	439.80	78.92	Apron is located between flared brick and mortar wingwalls and has length of 18.86 ft.
Outlet Apron Plunge Point	439.96	78.27	Mean plunge point height is 0.65 ft
Downstream Max Depth	442.91	77.5	Same as max depth within 5 feet of structure
Tailwater Control Point	445.05	78.5	This point was not well defined at the time of the assessment
Downstream Channel 1	449.48	77.51	Within extended riffle unit.
Downstream Channel 2	454.07	78	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (six models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for all *O. mykiss* Life Stages This full structure was modeled as a box culvert for FishXing passage analysis. Despite the presence of arch top shapes in the two downstream segments modeling the structure as a box culvert is appropriate considering all segments have flat bottoms and vertical walls. The length of the outlet apron was factored into the culvert length value used in FishXing analysis. This increased the culvert length from 408.13 ft to 427 ft. Additionally, to account for the cobble concrete bottom of the two downstream segments, outlet apron, and scour within segment 3 the overall culvert Manning's roughness coefficient was increased from 0.013 value used for concrete to 0.018.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 1 Analysis for Anadromous *O. mykiss*	90.89 – 1,025	Insufficient Streamflow Depth
Segment 2 Analysis for Anadromous *O. mykiss*	92.77 – 947.5	Insufficient Streamflow Depth
Segment 3 Analysis for Anadromous *O. mykiss*	71.31 – 1,375	Insufficient Streamflow Depth
Segment 4 Analysis for Anadromous *O. mykiss*	67.39 – 1,400	Insufficient Streamflow Depth
Segment 5 Analysis for Anadromous *O. mykiss*	80.59 – 321	Insufficient Streamflow Depth

Crossing Structure Barrier Status

Total Barrier

This crossing structure was assessed to be a total barrier to all life stages of *O. mykiss* attempting to move upstream. FishXing analysis indicates the main passage constraints to be insufficient streamflow depth and excessive streamflow velocity. Water depth is predicted to be insufficient for *O. mykiss* passage when streamflow rates are below 79.04 ft^3/s. When the rate of streamflow is above this level FishXing predicts the velocity of streamflow and length of culvert will cause *O. mykiss* to reach exhaustion during passage attempts.

Assessment and Analysis Limitations

No limitations were experienced in assessing this crossing structure. One limitation associated with *O. mykiss* passage analysis for this structure were the variation of characteristics present in the base of the culvert. The impact to streamflow hydraulics associated with the cobble and concrete base of the two most downstream segments differs from the impacts associated with the concrete base of the three upstream segments. Furthermore, streamflow hydraulics are also affected by the erosion and scour present within the base of segment 3. FishXing only allows a single culvert roughness coefficient value to be applied in its passage analysis. Therefore, a roughness coefficient value was selected to represent the assumed combined conditions occurring over the entire length of the culvert.

Passage Improvement Recommendations

Due to the excessive length of the concrete lining of this culvert, streamflow velocity and depth barriers can be remediated by removing the concrete on the channel bottom, installing weirs for passage, or replacing the structure with a free spanning bridge.

Crossing Site Information for PAD 734525					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	43.21	34.47205, -120.17981	± 15 ft	0 (culvert drains directly to beach)

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Segment 2 to 3 Change Point

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Zorillas Creek 0.528 mi²	Pacific Ocean	155.37 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is one of many small Gaviota Coast watersheds. Records indicate that many of the Gaviota Coast watersheds have historically supported anadromous fish. Some Gaviota Coast watersheds, such as Arroyo Hondo Creek are still currently supporting resident *O. mykiss* populations. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2013-2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/18/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/18/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box, Pipe, and Arch Culvert	1	4	Yes (only at outlet)	No

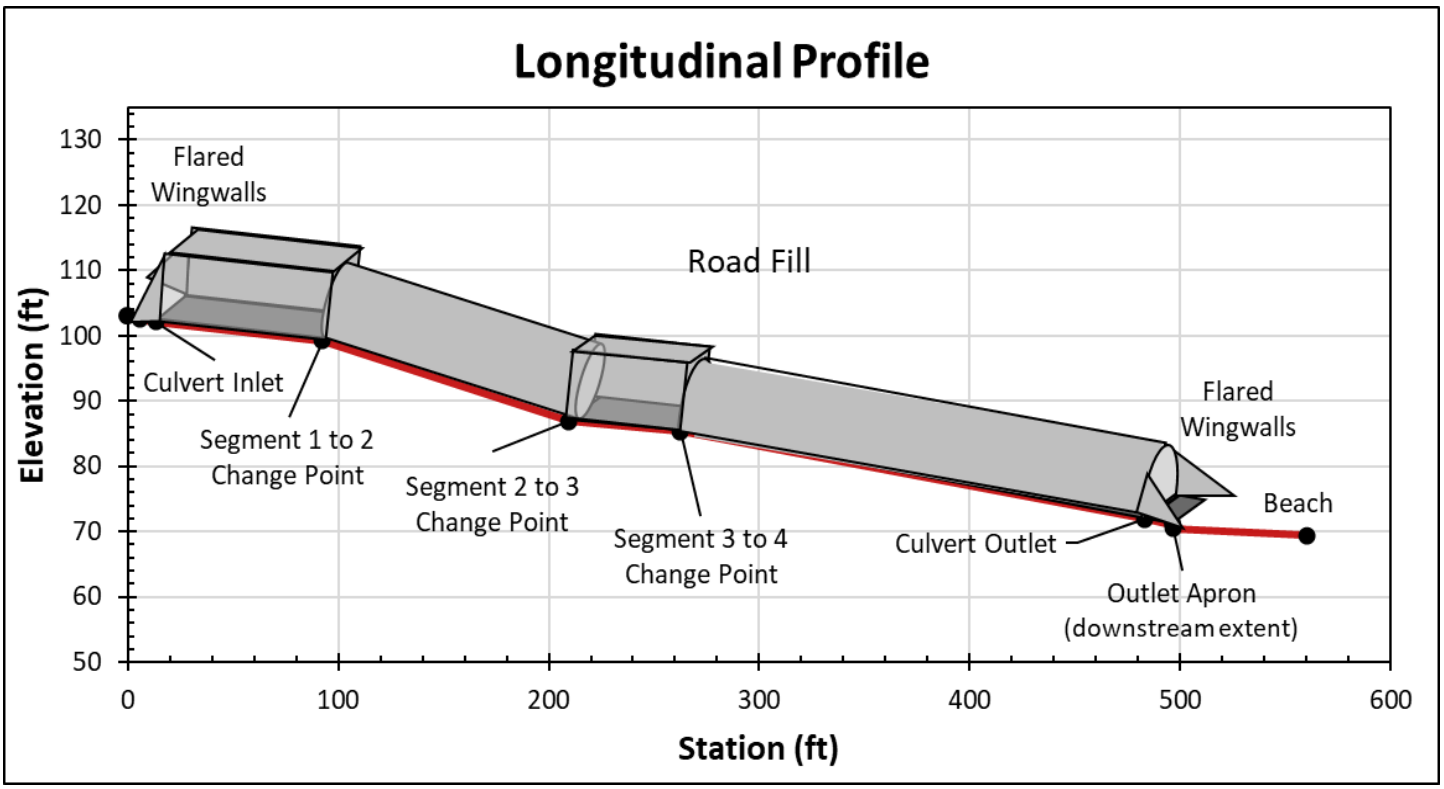
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced multi-segment culvert that contains two box culvert segments, one pipe culvert segment, and one and one arch top segment. The arch top segment contains a cobble and cement base. The inlet and outlet of the structure contains small flared wingwalls. A short cobble and cement apron is located between the outlet wingwalls. The structure runs under highway 101 and a railroad track (Coast Line) owned by Union Pacific.

Crossing Structure Dimensions					
Segment (shape)	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1 (box culvert)	5	5	5	79.4	3.78 %
2 (pipe culvert)	6	6	6	117.13	10.55 %
3 (box culvert)	6	6	6	52.82	3.03 %
4 (arch top culvert)	7	7	6	220.8	6.07 %
Outlet Apron	n/a (open channel)	n/a (open channel)	16.4	13.12	6.80 %
Full Structure	5	7	5.75	483.27	6.46 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained moderately defined active channel margins and many small boulders within silt substrate. Small piles of woody debris were also present within the channel. The channel banks contained dense brush and tree vegetation, which was partially encroaching into the active channel.	13.12 ft	0.80 ft	7.3 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
There was no definable stream channel downstream of this crossing structure as the outlet is located on the beach. It appeared the high tide line reached into the culvert. The beach contained sand and scattered cobble and boulder.	Sand	No tailwater control point present at the time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	102.98	
Upstream Channel Point 1	5.58	102.52	
Upstream Channel Point 2	9.19	102.29	
Culvert Inlet	13.12	102.18	
Segment 1 to 2 Transition Point	92.52	99.18	
Segment 2 to 3 Transition Point	209.65	86.89	
Segment 3 to 4 Transition Point	262.47	85.29	
Culvert Outlet	483.27	71.91	End of segment 4
Downstream Extent of Outlet Apron	496.39	71.02	
Plunge Point from Outlet Apron	496.72	70.48	
Downstream Channel Point 1	560.37	69.45	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was molded as both a box culvert and a pipe culvert. The structures mean width and height were used for the culvert dimensions analyzed in both models. A culvert roughness coefficient of 0.018 was used in analysis instead of the 0.013 roughness value used for concrete to account of the cemented cobble base of the top arch segment. FishXing passage analysis was not performed for each segment because the entirety of the crossing structure was assessed to be impassable.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Total Barrier

This crossing structure was predicted to be impassable to all life stages of *O. mykiss* in both the box culvert model and the pipe culvert model. The results predicted from box culvert model indicated a velocity barrier would occur during streamflow rates greater than 27.57 ft^3/s. It also predicted insufficient water depth would prevent passage at streamflow rates under 79.88 ft^3/s. Under the pipe culvert model, a velocity barrier was predicted under all rates of streamflow. The presence of a velocity barrier in this structure is due to its steep slope and lack of tailwater control point to allow for any pooling or restriction of streamflow within the structure.

Assessment and Analysis Limitations
The main limitation associated with performing FishXing passage analysis on this structure was the variety of culvert shapes present within structure. FishXing is only capable of performing passage analysis on crossing structures which contain a single uniform shape. Streamflow hydraulics occurring with the box and top arch segments are likely similar due to their vertical walls and flat bases. However, the streamflow hydraulics occurring through the pipe culvert segment of the structure are likely less conducive to *O. mykiss* passage abilities than in the other segments. This assumption is supported by the pipe culvert model which predicted a velocity barrier to occur over all rates of streamflow.

Passage Improvement Recommendations
Due to the excessive length of the concrete lining of this culvert, velocity and depth barriers can be remediated by removing the concrete on the channel bottom, installing weirs for passage, or replacing the structure with a free spanning bridge.

Crossing Site Information for PAD 734538					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	44.85	34.47416, -120.20802	± 25 ft	0.14

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Bridge Inlet)

Downstream Looking Upstream
(Bridge Outlet)

Downstream Looking Downstream

Segment 1 to 2 Change Point

Segment 2 to 3 Change Point

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Canada del Cementerio Creek 0.736 mi^2	Pacific Ocean	162.77 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is one of many small Gaviota Coast watersheds. Records indicate that many of the Gaviota Coast watersheds have historically supported anadromous fish. Some Gaviota Coast watersheds, such as Arroyo Hondo Creek are still currently supporting resident *O. mykiss* populations. However, due to the small drainage area and low estimated annual mean peak streamflow it is unlikely that this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2013-2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/17/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/17/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Pipe and Box Culvert	1	3	Yes (only at inlet)	No

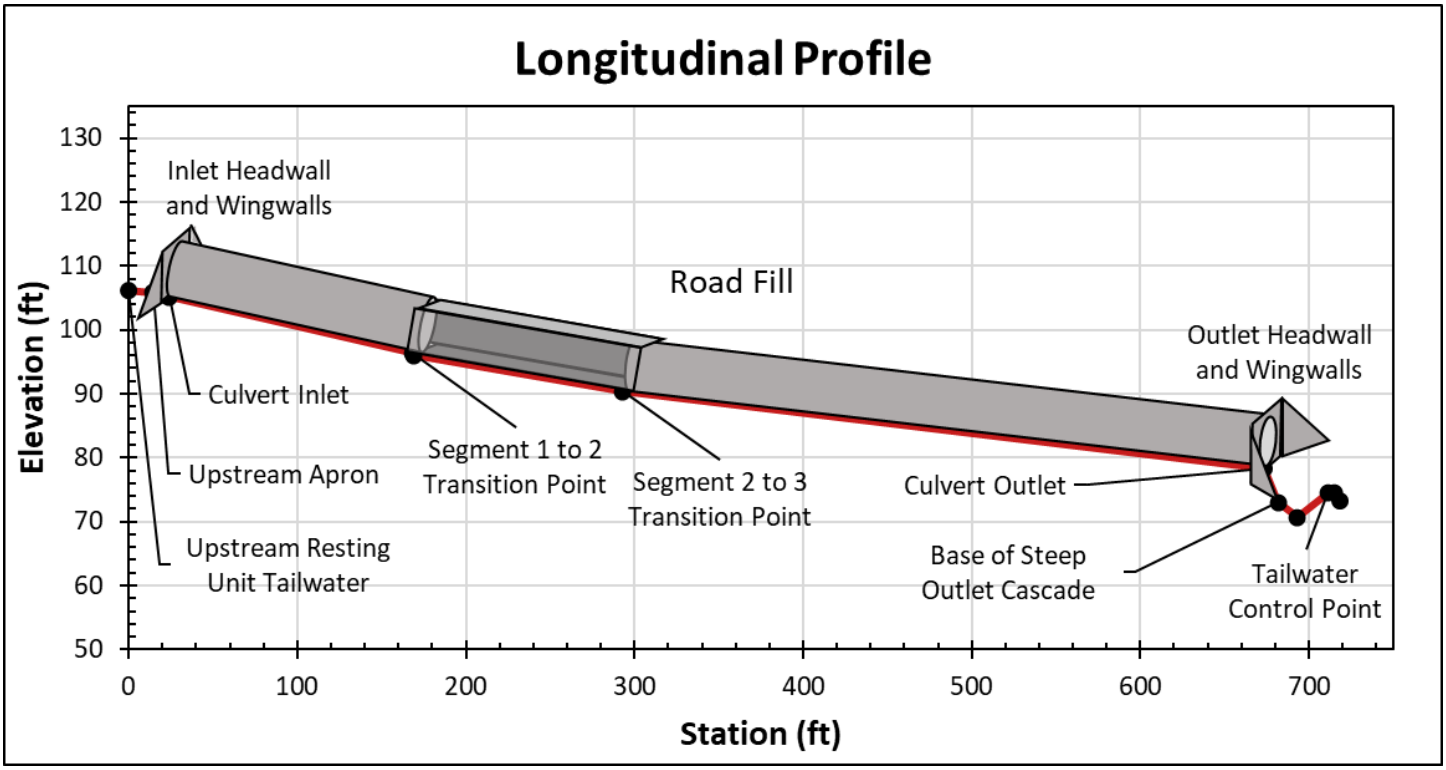
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced culvert with one box and two pipe shape segments. A change in the orientation of the culvert occurs at the transition point between segment 1 and 2. The most downstream segment (segment 3) contains two continuous curves, one to river right and one to river left. Concrete headwalls with flared wingwalls extending from them are located at the inlet and outlet. The structure is located under highway 101 as well as the on and off ramps for the Mariposa Reina Road exit. The inlet of the structure also contains a short-cemented cobble apron. At the time of assessment, the structure was in good condition with no damage visible.

Crossing Structure Dimensions					
Segment (shape)	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	7	9.6	6.89 %
1 (pipe culvert)	7	7	7	144.2	6.08 %
2 (box culvert)	8	8	8	125	4.83 %
3 (pipe culvert)	7	7	7	380.5	3.17 %
Full Structure	7	7	7.33	659.3	4.17 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins with gravel and large cobble as the dominant substrates. Riffle units were most common, but the channel contained areas with moderate scour creating small pool units. The channel banks were wide and contained grass, brush, and sporadic large eucalyptus trees.	14.3 ft	0.32 ft	7.34 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, significant scour immediately downstream of the outlet had created a deep pool unit. A steep cascade with a mean height of 5.33 ft is located from the outlet of the structure to the downstream pool unit. Downstream of the scour pool the channel contained well defined active channel margins, with boulders and cobble substrates. The channel banks were short and steep with many exposed tree roots. The channel runs through a dense eucalyptus grove.	Cobble	38.39 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Rest Unit	0	106.1	
Upstream Channel Point 1	7	105.98	
Inlet Apron (upstream extent)	14.3	105.78	Upstream extent of apron.
Culvert Inlet	23.9	105.12	
Segment 1 to 2 Transition Point	168.1	96.37	Culvert orientation turns 23° to river left.
Segment 2 to 3 Transition Point	293.1	90.34	
Culvert Outlet	673.6	78.28	
Outlet Cascade Point 1	675.73	77.6	
Downstream Max Depth (within 5 ft of structure)	678.85	75.2	Located within outlet cascade.
Outlet Cascade Point 2	681.80	72.95	Downstream extent of cascade.
Downstream Max Depth	693.29	70.61	Located within pool unit.
Tailwater Control Point	711.99	74.41	
Downstream Channel Point 1	715.27	74.43	Located within riffle unit.
Downstream Channel Point 2	718.88	73.15	Located within riffle unit.



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was molded as both a box culvert and a pipe culvert. The structures mean width and height were used for the culvert dimensions analyzed in both models. An outlet drop of 5.33 ft was used to represent the steep cascade from the outlet of the structure. FishXing passage analysis was not performed for each segment because the entirety of the crossing structure was assessed to be impassable.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Impassable Cascade

Crossing Structure Barrier Status

Total Barrier

This crossing structure was predicted to be impassable to all life stages of *O. mykiss* in both the box culvert model and the pipe culvert model. The results predicted from box culvert model indicated a velocity barrier would occur during streamflow rates greater than 46.04 ft^3/s. It also predicted insufficient water depth would prevent passage at streamflow rates under 79.68 ft^3/s. Under the pipe culvert model, a velocity barrier was predicted under all rates of streamflow. The presence of a velocity barrier in this structure is due to its steep slope and the low elevation of the tailwater control point, which prevents any pooling or restriction of streamflow within the structure. The outlet cascade was also predicted to prevent anadromous *O. mykiss* from even being able to gain access to the structure under streamflow rates less than 968.63 ft^3/s.

Assessment and Analysis Limitations

The only limitation experienced in collecting detailed fish passage assessment data at this crossing was the inability to complete a full tailwater control point cross-section profile. At the time of assessment, thick poison oak was present on the river right tailwater control point cannel bank. The cross-section profile dimensions from the left channel bank were applied to right channel bank and thus a uniform mirrored profile was used in FishXing analysis. The left and right channel banks were similar in shape and thus this tailwater cross section mirroring likely had minimal impact on FishXing passage analysis results. The main limitation associated with performing FishXing passage analysis on this structure was the presence of the both box and pipe culvert shapes. FishXing is only capable of performing passage analysis on crossing structures which contain a single uniform shape. The streamflow hydraulics occurring through the pipe culvert segment of the structure is likely less conducive to *O. mykiss* passage abilities than within the box culvert segments. This assumption is supported by the pipe culvert model which predicted a velocity barrier to occur over all rates of streamflow.

Passage Improvement Recommendations

Due to the concrete lining and steep slope of this culvert, velocity and depth barriers can be remediated by removing the concrete on the channel bottom, installing weirs for passage, or replacing the structure with free spanning bridges. Remediation efforts may be required to mitigate the passage restrictions associated with the outlet cascade and downstream scouring.

Crossing Site Information for PAD 734590					
County	**Route**	**Post Mile**	**Location** (at outlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	50.3	34.53119, -120.19563	± 9 ft	40.7

Pictures	
Upstream Looking Upstream	**Upstream Looking Downstream** (Culvert Inlet)
Upstream channel was not assessed.	Culvert inlet was not assessed.
Downstream Looking Upstream (Culvert Outlet)	**Downstream Looking Downstream**

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.3 mi²	Nojoqui Creek	86.5 ft³/s	It is unknown if this stream has historically supported *O. mykiss*. It is very unlikely this stream currently supports *O. mykiss* considering its small watershed, estimated low peak streamflow, and lack of definable channel downstream of the crossing structure. This stream is part of the Santa Ynez River watershed, which has historically supported anadromous fish. *O. mykiss* were last recorded to be present in Nojoqui Creek (tributary to this stream) in 1997. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/26/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Plastic Pipe Culvert	1	Unknown	No	No

Crossing Structure Description and Condition
This crossing structure is a small plastic pipe culvert and appears to be in place only for drainage purposes. Only the outlet end of the culvert structure was assessed, which projects from abundant road fill. This segment of the culvert extents for roughly 130 ft and drops roughly 58 ft down the side of the road fill embankment. The outlet of the culvert lies atop boulder riprap.

Crossing Structure Dimensions			
Segment	**Diameter** (ft)	**Length** (ft)	**Slope**
Outlet Segment	3.2	130	49.86 %
Other Segments	Unable to measure	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel was not assessed due to the total barrier passage constraints assessed at the downstream portion of the crossing structure.	Not assessed	Not assessed	Not assessed

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
A defined downstream channel is only present for a few hundred feet from the culvert outlet. This defined portion of stream channel had a mean active channel margin of less than 2 ft. Downstream of the boulder riprap located below the outlet of the culvert the stream channel runs through thick brush vegetation, which was growing over and within the stream channel at the time of assessment. This vegetation extends for roughly 70 ft to a private low-water road crossing through the stream channel substrate. Downstream of this low-water crossing the defined portion of the stream channel eventually ends as it drains into an agricultural field.	Gravel	No tailwater control point present at the time of assessment.

Longitudinal Profile Measurements
A longitudinal profile was not able to be completed due to confined space restrictions of the crossing structure.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
<u>Analysis for all *O. mykiss* Life Stages</u> FishXing passage analysis was not able to be performed for this crossing structure due to the inability to collect longitudinal profile data.	This crossing is likely not passable at any rate of streamflow	Unknown, streamflow depth, streamflow velocity, impassable plunge point, and outlet unit restrictions are possible at this crossing structure.

Crossing Structure Barrier Status
Total Barrier This structure was assessed to be impassable to all life stages of *O. mykiss*. The 3.2 ft diameter of the outlet segment of the culvert coupled with its steep slope (49.86%) creates high streamflow velocities through this portion of the structure and would prevent all life stages of *O. mykiss* from successfully gaining passage through this structure.

Assessment and Analysis Limitations
The crossing structure meets the criteria of a confined space outlined in the Caltrans Reconnaissance Fish Passage Assessment protocol, thus assessing the inner portion of the structure would require special equipment. The inlet and upstream channel conditions were not assessed due to the total barrier conditions present at the outlet.

Passage Improvement Recommendations
Due to the lack of a defined channel currently present downstream of this structure further analysis of this stream/watershed should be conducted to determine if barrier remediation efforts are appropriate and necessary. Channel conditions upstream of this culvert should be assessed for the presence of viable *O. mykiss* habitat. From topographic analysis it appears less than 0.5 stream miles would be opened from remediation efforts. If barrier remediation efforts are deemed necessary, the most effective option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 734610					
County	**Route**	**Post Mile**	**Location** (at Inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	54.28	34.57058, -120.19106	± 11 ft	37

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.895 mi²	Nojoqui Creek	130.17 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream part of the Santa Ynez River watershed, which has historically supported anadromous fish. This stream is tributary to Nojoqui Creek, which was last recorded to support *O. mykiss* in 1997. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/26/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/26/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	2	No	No

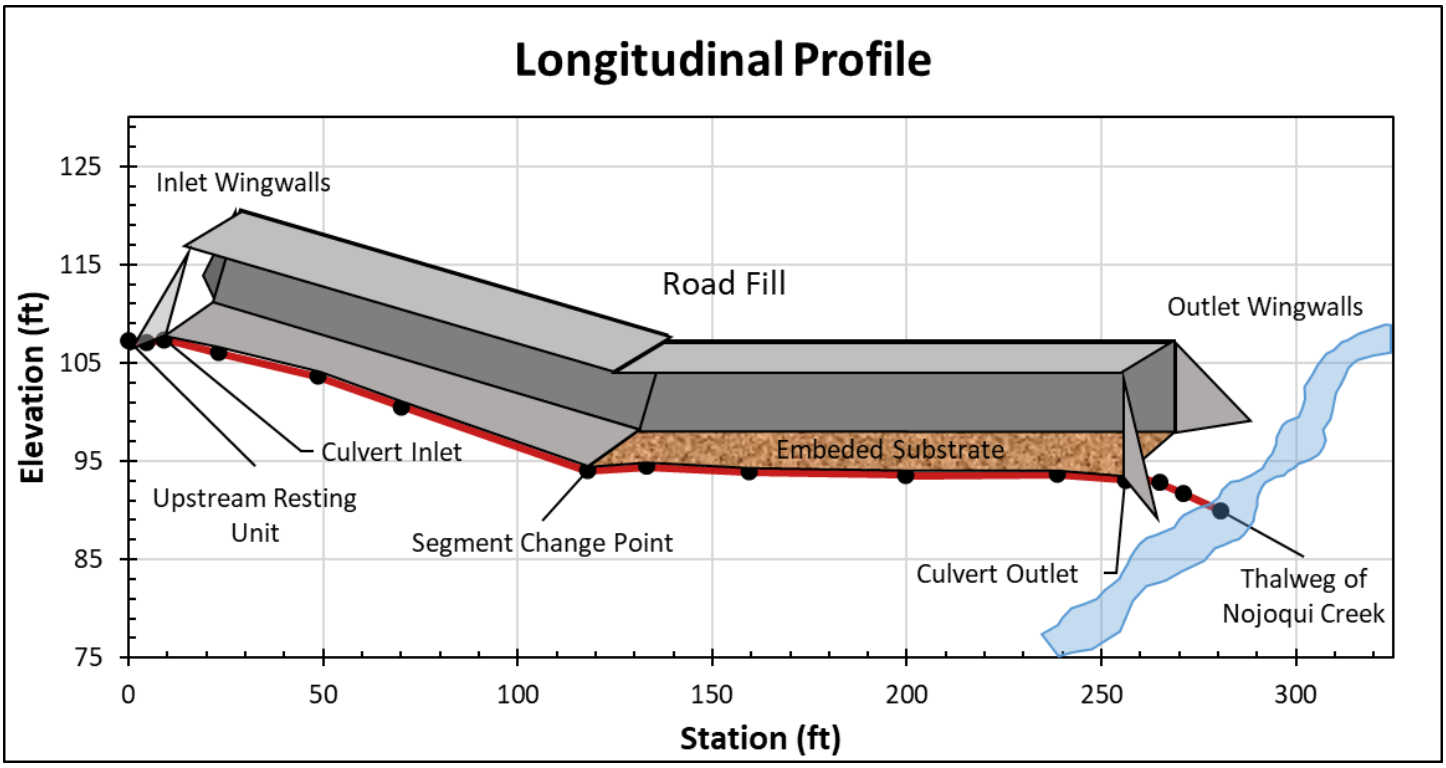
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with two segments. The downstream segment has a relatively flat profile compared to the steep profile of the upstream segment. It appeared that stream water likely collects within the culvert as the downstream segment contained significant embedded silt and sand substrate. Flared wingwalls were present at the inlet and parallel wingwalls were present at the outlet. The base of the structure contained minimal erosion, but otherwise appeared to be in good condition.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1	8.2	8.2	8.2	108.7	12.38 %
2	8.2	5.5 (due to embedded substrate)	8.2	138.3	0.66 % (embedded substrate)
Full Structure	8.2	5.5 (due to embedded substrate)	8.2	247	5.78 % (embedded substrate)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the active channel margins of the upstream channel were moderately defined. Minimal scour was present and the channel contained an extended riffle unit comprised of sand and sporadic boulders. The channel banks were steep and contained dense grass and brush vegetation. Some of the brush had grown across the active channel.	9.1 ft	0 ft	5.64 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
The outlet of this structure drains directly into the stream channel of Nojoqui Creek and no distinct tailwater control point was present. At the time of assessment, this stream channel contained well defined active channel margins with sand and silt substrate types. Some aquatic vegetation was also present. The channel banks were steep and contained grass and small trees. The river left channel bank also contained exposed bedrock. Three small bay trees were present between the outlet wingwalls indicated sporadic high rates of streamflow from the unnamed stream.	Silt	No distinct tailwater control present at the time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	107.22	
Upstream Channel Point 1	1.8	107.17	
Upstream Channel Point 2	4.6	107.03	
Upstream Channel Point 3	9	107.02	Located below lip of culvert inlet base.
Culvert Inlet	9.1	107.35	
Segment Change Point	117.8	94	Significant slope change and upstream extent of substrate embeddedness.
Culvert Outlet	256.1	93.09	
Downstream Max Depth (within 5 feet of outlet)	259.8	93.36	No downstream max depth point because culvert outlet drains directly into Nojoqui Creek.
Downstream Channel Point 1	265	92.74	No distinct tailwater control point present.
Downstream Channel Point 2	271.1	91.67	
Downstream Channel Point 3	280.7	89.88	Point located within Thalweg of Nojoqui Creek.



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (three models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled as a box culvert within FishXing. The mean dimensions of the structure were applied to the FishXing model. A culvert roughness coefficient of 0.016 was used in analysis instead of the 0.013 concrete roughness value to account for the embedded substrate in the downstream segment.	93.58 – 130.01	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 1 Analysis for Anadromous *O. mykiss* A culvert roughness coefficient of 0.013 was used in analysis of this segment as it did not contain embedded substrate.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 2 Analysis for Anadromous *O. mykiss* A culvert roughness coefficient of 0.018 was used in analysis of this segment as the entire segment contains embedded silt and sand substrate.	31.65 – 865.84	Insufficient Streamflow Depth
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status
Total Barrier This crossing structure was predicted to be impassable to all life stages of *O. mykiss*. The main factor preventing *O. mykiss* passage in this structure is the steep slope of the upstream segment. When FishXing analysis was performed on the full structure the mean slope, from inlet to outlet was used. Under this analysis a constant slope of 5.78 % was assumed. However, when the true slope of the upstream segment (12.38%) was analyzed a velocity barrier was predicted to occur at streamflow rates of 116.02 ft^3/s and water depth barrier was precited to occur at streamflow rates of less than 151.07 ft^3/s.

Assessment and Analysis Limitations
The only limitation experienced in performing fish passage analysis on this crossing structure was the presence of embedded substrate in the downstream segment. The actual dimensions of the downstream segment are likely the same as the upstream segment, but this could not be confirmed. As a result, the slope and outlet dimensions of the culvert resemble the conditions present at assessment and may not reflect the actual slope and outlet dimensions of the crossing structure.

Passage Improvement Recommendations
Due to the excessive length of the concrete lining of this culvert, velocity and depth barriers can be remediated by removing the concrete on the channel bottom, installing weirs for passage, or replacing the structure with a free spanning bridge.

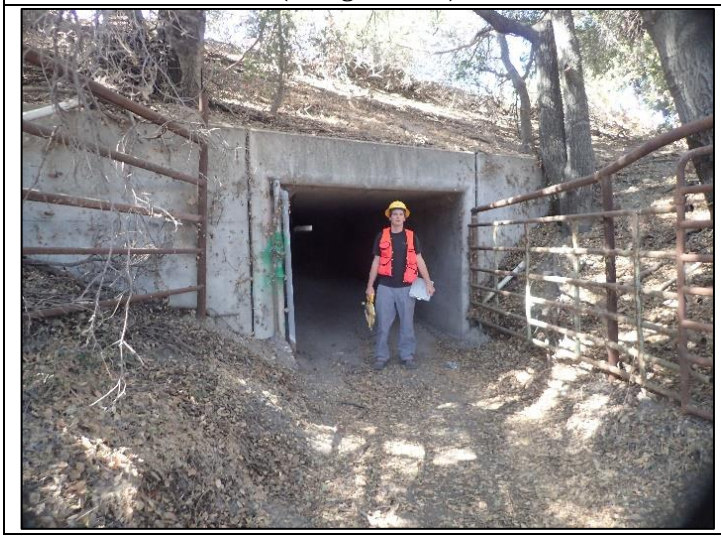
Crossing Site Information for PAD 734639					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	58.89	34.63857, -120.18604	± 19 ft	35.75

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Bridge Inlet)

Downstream Looking Upstream (Bridge Outlet)



Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Dry Creek 3.673 mi²	Zaca Creek	121.57 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Santa Ynez River watershed, which has historically supported anadromous fish. Dry Creek is a tributary to Zaca Creek, which was recorded to contain *O. mykiss* in the 1940s. Given the low estimated annual mean peak rate of streamflow, channel conditions present when surveyed, and inland location it is unlikely this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
01/10/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
01/10/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	3	No	No

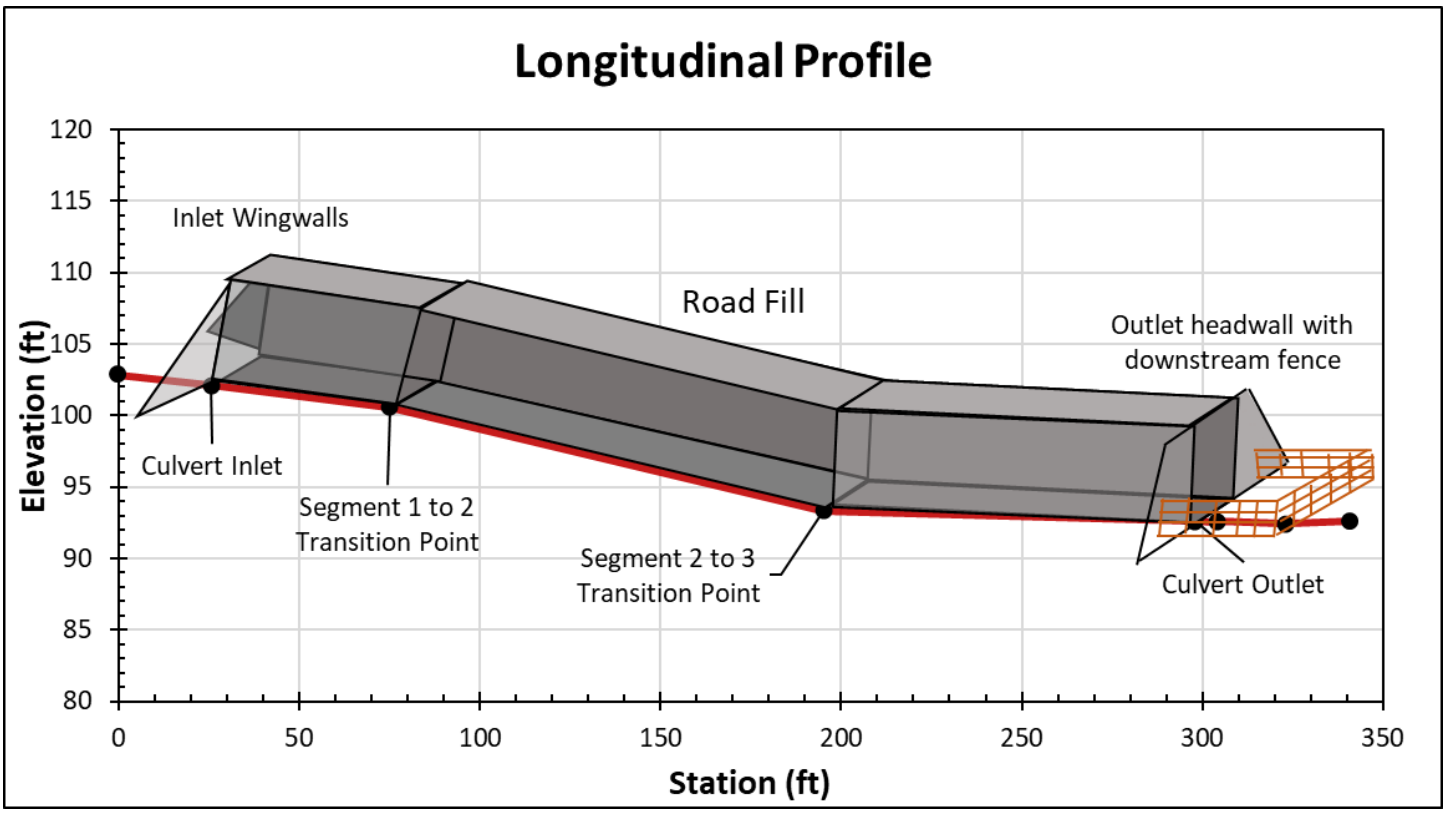
Crossing Structure Description and Condition
This crossing structure is a multi-segmented concrete reinforced box culvert. The crossing structure passes under highway 101 and Jonata Park Road. The orientation of the culvert sifts slightly to river left at the upstream segment transition point. At the time of assessment, the most downstream segment was partially embedded with sand and gravel substrate. Small flared wingwalls are present at the inlet and a small headwall is present at the outlet. It also appeared as the culvert has been used for small vehicles (ATV) crossings under the highway. The structure appeared to be in good condition with no visual evidence of erosion or damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1	8	8	8	49.3	3.17 %
2	8	8	8	120.2	6.01 %
3	8	8	8	102.8	0.72 %
Full Structure	8	8	8	272.3	3.49 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, a small dirt path/roadway led a short distance upstream from the culvert inlet and eventually proceeded up the river left channel bank. Upstream of this pathway the active channel margins were poorly defined. The active channel and channel banks contained grass and brush. Dominant streambed substrates were sand and gravel. Based on the conditions of the upstream channel, there is little evidence that the stream ever contains much flow.	25.7 ft	0.7 ft	3.36 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, a small dirt path/roadway was also located within the downstream channel. This channel alteration appeared to have limited any areas of scour within the channel. A large metal cattle gate also crossed the channel a short distance downstream. The channel banks were small and contained grass and oak trees.	Sand	25 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	102.82	Upstream of dirt road that leads into culvert
Culvert Inlet	25.7	102.12	
Segment 1 to 2 Transition Point	75	100.56	Culvert orientation shifts 12° to river left.
Segment 2 to 3 Transition Point	195.2	93.35	No shift in culvert orientation.
Culvert Outlet	298	92.61	
Downstream Max Depth (within 5 feet of outlet)	304	92.58	Within extended riffle unit. Channel appears impacted by vehicle use.
Downstream Max Depth	314	92.45	Within extended riffle unit. Channel appears impacted by vehicle use.
Tailwater Control Point	323	92.44	Tailwater control point is poorly defined. Channel appears impacted by vehicle use.
Downstream Channel 1	341	92.61	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (four models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled within FishXing as a box culvert. A culvert roughness coefficient of 0.016 was used in analysis instead of the 0.013 concrete roughness value to account for the embedded sand and silt substrate in the downstream segment of the structure.	84.89 – 145.27	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 1 Analysis for Anadromous *O. mykiss*	60.1 – 796.55	Insufficient Streamflow Depth
Segment 2 Analysis for Anadromous *O. mykiss*	102.13 – 460.52	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 3 Analysis for Anadromous *O. mykiss*	38.56 – 877.17	Insufficient Streamflow Depth
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status
Temporal & Partial Barrier
This crossing structure was predicted to be passable to strong swimming anadromous life stages of *O. mykiss* under a specific range of streamflow. The crossing structure was predicted to be impassable to resident *O. mykiss* life stages under all rates of streamflow. FishXing analysis estimates streamflow rates greater than 84.89 ft^3/s would provide adequate water depth for successful steelhead *O. mykiss* passage. A velocity barrier was predicted by FishXing above streamflow rates of 145.27 ft^3/s. Adequate rates streamflow to create conditions conducive to potential anadromous *O. mykiss* passage is unlikely to occur often as the estimated annual mean peak streamflow rate is only 121.57 ft^3/s.

Assessment and Analysis Limitations
There were no limitations experienced in conducting a full detailed fish passage assessment and fish passage analysis.

Passage Improvement Recommendations
Due to the concrete lining and steep slope of this culvert, velocity and depth barriers can be remediated by removing the concrete on the channel bottom, installing weirs for passage, or replacing the structure with free spanning bridges.

Crossing Site Information for PAD 734664					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 101	62.5	34.67904, -120.15681	± 10 ft	39.86

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Cattle Fence and Woody Debris Pile at Culvert Inlet

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed Creek 1.4 mi^2	Zaca Creek	106.22 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Santa Ynez River watershed, which has historically supported anadromous fish. Dry Creek is a tributary to Zaca Creek, which was recorded to contain *O. mykiss* in the 1940s. Given the low estimated annual mean peak rate of streamflow, channel conditions present when surveyed, and inland location it is unlikely this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
01/10/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
01/10/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	2	No	No

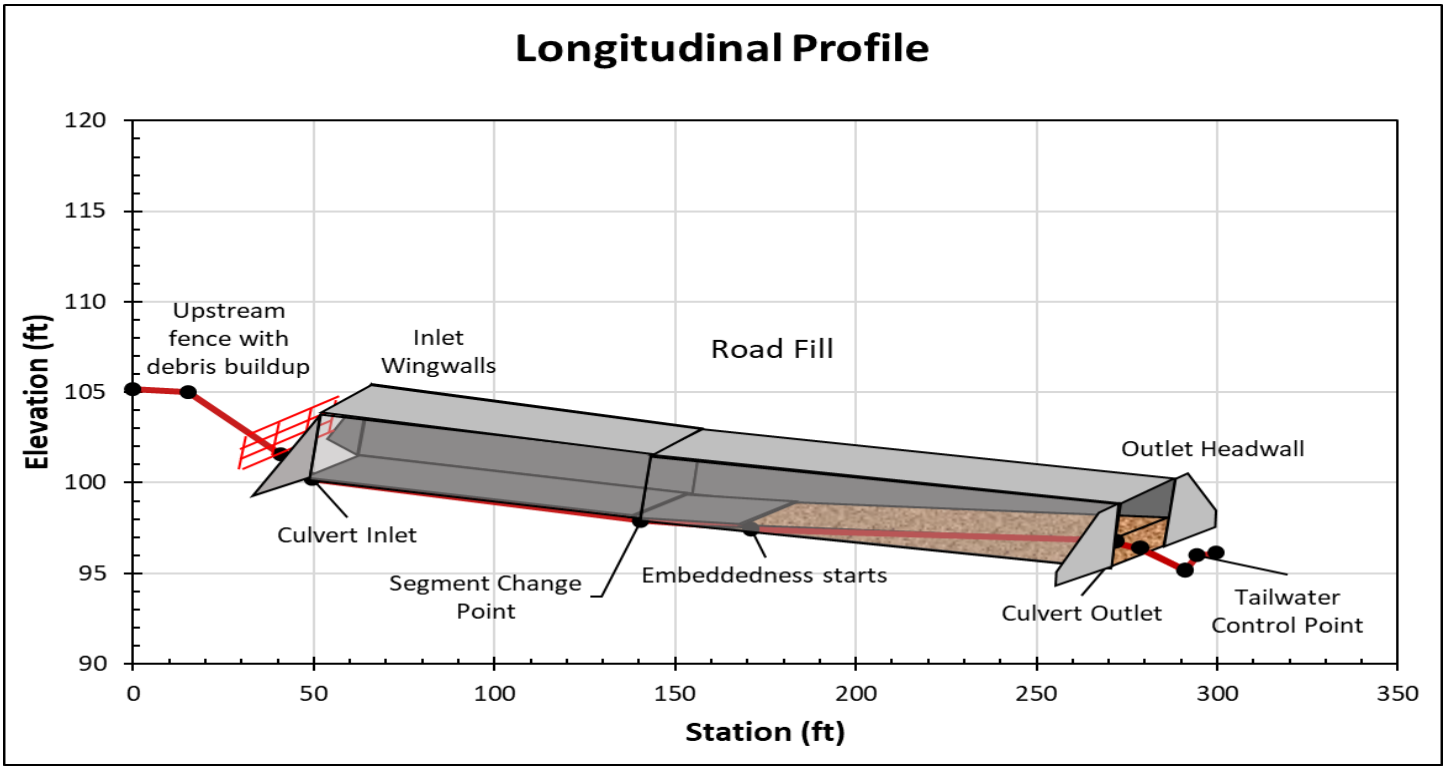
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with two distinct segments. The culvert contains a slight orientation change towards river right at the segment change point. The crossing structure passes under highway 101 and a San Marcos Pass Road. The downstream segment gradually becomes more embedded with gravel and sand substrate towards the outlet. The inlet of the structure short concrete wingwalls and the outlet contains a small concrete headwall. A metal cattle fence with moderate damage crosses the channel between the inlet wingwalls.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1	8	8	8	90.9	2.52 %
2	8	3.1 (due to embedded substrate)	8	134	1.09 % (embedded substrate)
Full Structure	8	3.1 (due to embedded substrate)	8	224.9	1.67 % (embedded substrate)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained a narrow and moderately defined active channel margins, indicating infrequent occurrences of high streamflow. The channel banks were small and contained grass and oak trees. Some of the oak trees had grown into the active channel, including near the inlet of the culvert. A significant amount of woody debris and substrate had built up behind the cattle fence that is located between the inlet wingwalls.	49.6 ft	4.96 ft	11.96 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained poorly defined active channel margins and significant woody debris. The channel banks were also poorly defined and contained brush and sparse small trees. It appeared downstream conditions were influenced by the Zaca Creek stream channel, which was located nearby. Dominant substrates types were sand, gravel, and cobble.	Sand	20 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Rest Unit	0	105.17	
Upstream Channel Point 1	15.3	105	
Upstream Channel Point 2	37	102.92	
Upstream Channel Point 3	41	101.55	Point is located on woody debris pile near in stream cattle fence.
Culvert Inlet	49.6	100.21	
Embedded Substrate (upstream extent)	126.2	97.47	
Segment Change Point	140.5	97.92	Culvert orientation shifts 8° to river right.
Culvert Outlet	274.5	96.54	
Downstream Max Depth (within 5 feet of outlet)	278.3	96.46	
Downstream Max Depth	291	95.17	Within extended riffle unit.
Tailwater Control Point	294.5	95.99	Poorly defined tailwater control point.
Downstream Channel Point 1	300	96.1	Within extended riffle unit.



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (three models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled as a box culvert in FishXing. The outlet embeddedness depth was set to 4.9 ft under the assumption that the actual height of the culvert outlet is 8ft, the same as the inlet. A culvert roughness coefficient of 0.016 was used in analysis instead of the 0.013 concrete roughness value to account for the gravel and sand substrate within the lower portion of the culvert.	60.22 – 332.7	Insufficient Streamflow Depth
Segment 1 Analysis for Anadromous *O. mykiss* A culvert roughness coefficient of 0.013 was used in this model as most of this segment was not embedded.	66.04 – 1,369.37	Insufficient Streamflow Depth
Segment 2 Analysis for Anadromous *O. mykiss*	39.6 – 545.36	Insufficient Streamflow Depth
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status
Temporal & Partial Barrier
This crossing structure was predicted to be passable to strong swimming anadromous life stages of *O. mykiss*, but not passable to resident *O. mykiss* life stages. FishXing analysis estimates streamflow rates greater than 60.22 ft^3/s would provide adequate water depth for successful steelhead *O. mykiss* passage. A velocity barrier was not predicted by FishXing below streamflow rates of 332.7 ft^3/s.

Assessment and Analysis Limitations
There were no limitations experienced in collecting data at this crossing sight. The only limitation experienced in conducting fish passage analysis was attempting to account for the upstream channel and inlet conditions. The presence of the cattle fence and woody debris piled up in its vicinity likely place further restrictions on *O. mykiss* passage abilities. The fence and woody debris likely create turbulent conditions and complex hydraulics near the culvert inlet, which FishXing is not capable of modeling. Any *O. mykiss* attempting to gain passage would be encountering turbulent conditions at the inlet when fatigued and potentially may not successfully complete their passage attempt.

Passage Improvement Recommendations
The easiest action to improve passage conditions at this crossing structure would be to remove the cattle fence and debris at the culvert inlet. Removing the concrete base lining, installing weirs, or replacing the structure with free spanning bridge would also improve passage conditions.

Highway 154 Assessed Crossing Structures

Crossing Site Information for PAD 736427					
County	**Route**	**Post Mile**	**Location** (on bridge surface)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 154	11.52	34.58649, -120.00851	± 9 ft	45.5

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Bridge Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
San Lucas Creek 4.96 mi^2	Santa Ynez River	193.69 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Santa Ynez River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/30/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information			
Structure Type	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Bridge (with concrete supports)	1	No	No

Crossing Structure Description and Condition
This crossing structure is a bridge over natural streambed substrate (Caltrans bridge # 51-121). The bridge contains multiple concrete pillar supports within the stream channel, these supports straddle each side of the active channel margins. The bridge appeared to be in good condition with no damage or deterioration visible.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height**	**Mean Outlet Height**	**Mean Width**	**Length**	**Slope**
1	21 ft	22 ft	Not measured	74 ft	Not measured

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel was graded into a dirt and gravel roadway, assumedly by the landowner. This alteration of the stream channel had eliminated any viable *O. mykiss* that may have existed near the crossing. The unaltered portion of the stream channel was visible several hundred feet upstream. The channel banks were steep and contained grass, sparse brush, and large oak trees.	Not measured	Not Measured	Not Measured

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel was also graded into a gravel roadway. The unaltered portion of the channel was visible several hundred feet downstream and contained defined active channel margins. The channel banks were steep and covered in grass and brush.	Gravel	No tailwater control point present due to road grading alterations within the channel.

Longitudinal Profile Measurements
A longitudinal profile was not completed because the bridge was assessed to be free of *O. mykiss* passage constraints.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was not modeled in FishXing because it was assessed to be free of passage constraints and not a barrier during the Caltrans Reconnaissance Fish Passage Assessment	All streamflow levels	None

Crossing Structure Barrier Status
Not a Barrier This structure was assessed to be free of passage constraints and doesn't restrict the movement of *O. mykiss*. The alterations to the stream channel and presence of a gravel roadway under the bridge has a greater impact to *O. mykiss* habitat than their ability to migrate. However, the elimination of scour within the channel due to this alteration has likely eliminated potential resting areas for *O. mykiss* to use in their movement.

Assessment and Analysis Limitations
There were no limitation experienced in completing a Caltrans reconnaissance first pass fish passage assessment on this bridge.

Passage Improvement Recommendations
No remediation efforts are suggested for this crossing structure. However, habitat restoration efforts should be considered for the stream channel within the vicinity of the structure and the landowner should be advised to case grading the channel and using it as a roadway.

Highway 192 Assessed Crossing Structures

Crossing Site Information for PAD 731768					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 192	5.4	34.44730, -119.68308	± 10 ft	2.86

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Bridge Inlet)

Downstream Looking Upstream (Bridge Outlet)

Downstream Looking Downstream

Bridge Segment Change

Cement Cobble Base and Plunge Point

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Sycamore Creek 0.69 mi^2	Pacific Ocean	169.97 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/31/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/31/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Multi-segmented Bridge	1	2	Yes (at inlet and outlet)	No

Crossing Structure Description and Condition

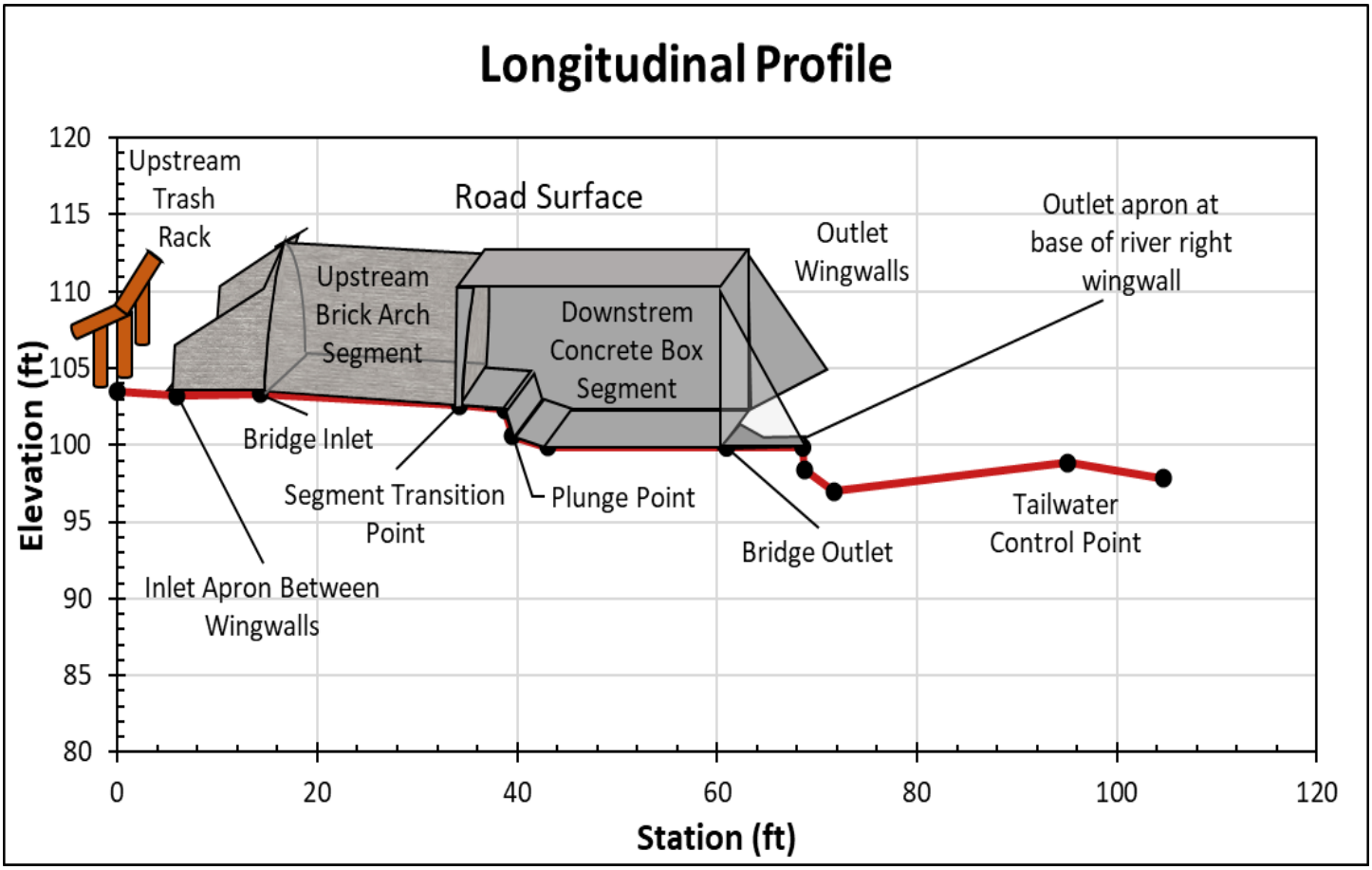
This crossing structure is a bridge with two distinct segments. The upstream segment is an old brick and mortar arch bridge with vertical walls and the downstream segment is concrete and has a box shape. The downstream segment appears to have been constructed to widen the bridge. The channel contains a cemented cobble base lining under both segments of the bridge. A plunge point with a mean height of 1.75 ft is located from the base lining under the upstream segment to the base lining of the downstream segment. The base lining within the downstream segment is damaged and includes portions of exposed natural sand and cobble substrates. A partial concrete outlet apron is located along the base of the river right outlet wingwall. A plunge point with a mean height of 1.8 ft occurs from this outlet apron. The inlet of the bridge contains brick and mortar wingwalls and a short apron.

Crossing Structure Dimensions					
Segment Listed from structure inlet to outlet	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	16	8.25	0 %
1	12.2	13	16	20	3.80 %
2	17	17	16	26.75	3.44 %
Outlet Apron	n/a (open channel)	n/a (open channel)	2.3	7.6	0 %
Full Structure	12.2	17	16	62.6	5.59 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, a moderately sized pool unit was present directly upstream of the inlet apron. Upstream of the pool unit the active channel margins became narrow and poorly defined. The channel banks were steep and contained dense brush vegetation that was partially obstructing the active channel. A steel trash rack is located 24 ft from the inlet of the bridge. A moderate amount of woody debris was located upstream of the trash rack.	0.7 ft	0 ft	Not recorded

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained a narrow, but well-defined active channel margin. The channel banks were steep and contained grass, small and large trees, and some brush. The river right channel bank was scoured with exposed boulders and tree roots. A small pool unit ran parallel to the outlet apron below the river right wingwall. Small trees were growing near the outlet of bridge just above the river left active channel margin.	Boulder	34.1 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	103.46	
Upstream Resting Unit	5.3	102.72	
Inlet Apron (upstream extent)	6	103.2	
Bridge Inlet	14.25	103.34	
Segment 1 to 2 Transition Point	34.25	102.58	
Segment 1 Outlet Apron	38.7	102.33	
Segment 1 Outlet Apron Plunge Point	39.5	100.58	
Bridge Outlet	61	99.84	
Outlet Apron (downstream extent)	68.6	99.84	Measurement taken at stream thalweg location.
Outlet Apron Plunge Point	68.7	98.4	
Max Depth Downstream	71.7	97	Same point as max depth within 5 ft of structure.
Tailwater Control Point	95.1	98.58	
Downstream Channel Point 1	104.7	97.81	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (three models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* This crossing was modeled in FishXing as a large box culvert. The mean width and height of the structure were used for the culvert dimensions analyzed. The length of the inlet and outlet aprons were factored in the length of the culvert. The height of the two plunge points were added together as FishXing is only capable of performing analysis on a single plunge point. A culvert roughness coefficient of 0.018 was used in analysis instead of the 0.013 concrete roughness value to account of the portion of natural streambed substrate present in the downstream segment.	176.6 – 3,037.46	Insufficient Streamflow Depth
Segment 1 Analysis for Anadromous *O. mykiss*	None	Impassable Plunge Point Insufficient Streamflow Depth
Segment 2 Analysis for Anadromous *O. mykiss*	106.38 – 1,736.18	Insufficient Streamflow Depth
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status
Total Barrier This crossing structure was predicted to be impassable to all life stages of *O. mykiss.* The main factor limiting *O. mykiss* passage abilities is the plunge point that occurs between the two segments of the bridge. The area below the plunge contains damaged cemented cobble. This unnatural base lining prevents scour and pooling of water *O. mykiss* would need to potentially jump this plunge point. The full structure analysis predicted that strong swimming anadromous *O. mykiss* would be able to gain passage under high rates of streamflow that provide adequate water depth. Under the full structure model, the plunge point is placed at the structure outlet where downstream scour allows *O. mykiss* to achieve more of their jump potential.

Assessment and Analysis Limitations
There were no limitations associated with the collection of data to complete a detailed fish passage assessment for this crossing structure. However, modeling this structure in FishXing was challenging due to the variety of conditions present under the bridge, including two plunge points, an outlet apron with an odd orientation, and both natural and cemented cobble base sections. This variety of conditions and the complexities it causes to streamflow hydraulics occurring under the bridge likely was not modeled correctly by FishXing. From a professional judgement standpoint, the conditions under the bridge appeared to be quite limiting to *O. mykiss* passage abilities. For instance, minimal scour was present below the plunge point from the upstream segment outlet apron. This would increase the difficultly for *O. mykiss* to successfully jump this plunge. Observation of streamflow dynamics at this crossing structure under high rates of streamflow would likely help clarify potential passage restrictions and their impacts to *O. mykiss* passage abilities.

Passage Improvement Recommendations
Removing the cemented cobble lining within the base of this structure and the upstream trash rack would greatly improve *O. mykiss* passage conditions.

Crossing Site Information for PAD 731518					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 192	6.41	34.44295, -119.66830	± 22 ft	2.59

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed Creek 0.651 mi^2	Sycamore Creek	94.08 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Considering the small drainage area, low estimated annual mean peak streamflow, and channel conditions present in this stream when assessed it is unlikely that it currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/07/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/07/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Brick Box Culvert	1	1	Yes (only at outlet)	No

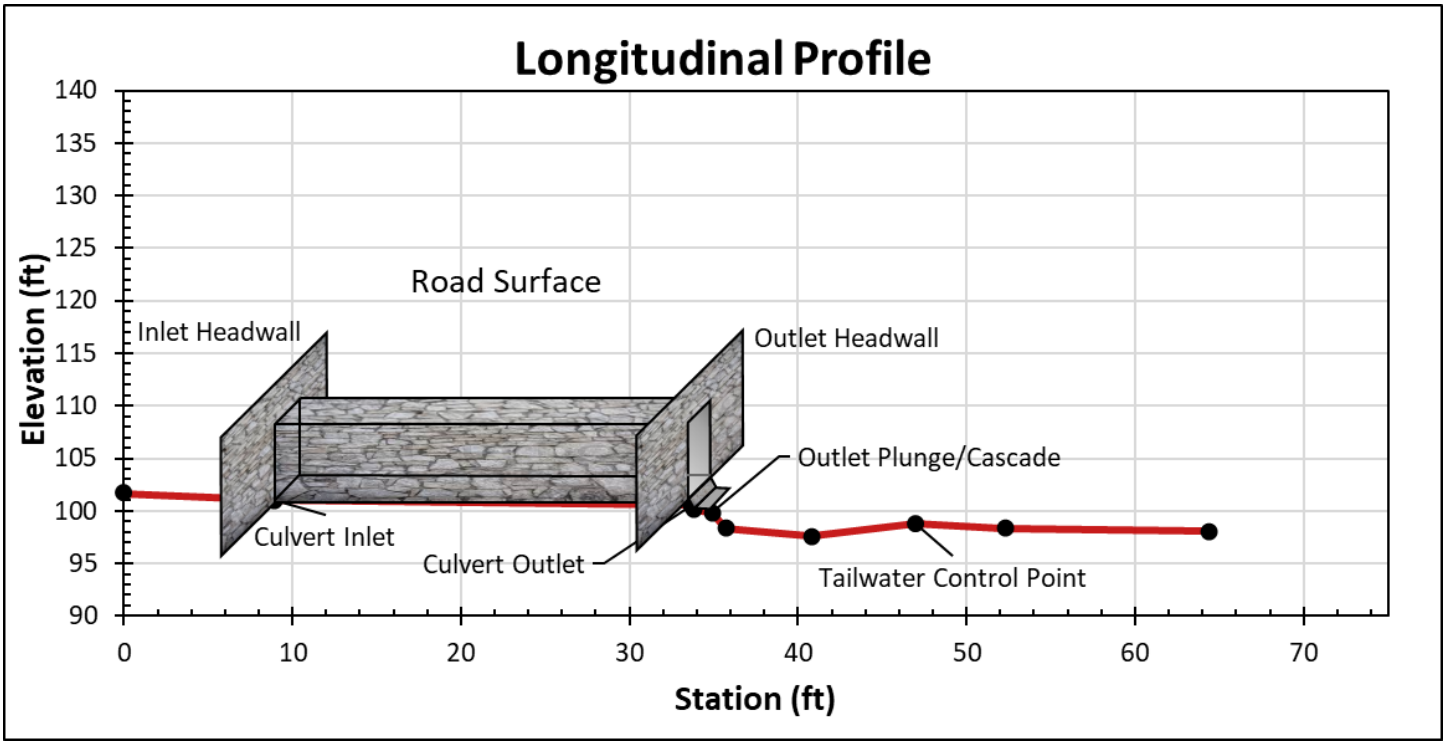
Crossing Structure Description and Condition
This crossing structure is a small cobble and cement box culvert with a fully cement lined base. The inlet and outlet both contain cobble cemented headwalls. A short cemented cobble apron is present at the outlet which creates a 0.38 ft plunge point and cascade is a mean height of 1.77 ft. The orientation of the culvert shifts slightly toward river right at its midpoint. The culvert appeared to be in good condition, but did show evidence of light erosion along its base and walls.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1	4.2	4.1	4	24.8	2.02%

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream active channel margins were narrow, but well defined. Minimal scour was present, and the channel contained extended riffle units. The channel banks were also narrow and lined with concrete boulder riprap. The extent of this channel lining was not determined. Dense, but low vines were present between the channel walls. Dense brush and tree cover were present above the channel walls.	8.9 ft	0.64 ft	5 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the active channel margins downstream of the structure were also well defined. A moderately sized pool unit was present below the culvert outlet. Both channel walls were lined with cemented cobble walls, but these walls only extended 14 ft downstream of the culvert outlet. Downstream of these channel walls the channel banks were steep and contained sporadically spaced trees.	Cobble	12.1 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	101.66	Within riffle unit.
Upstream Channel Point 1	3.2	101.29	
Culvert Inlet	8.9	101.02	
Culvert Outlet	33.7	100.52	
Outlet Apron Point 1	33.8	100.14	Outlet plunge point.
Outlet Apron Point 2	34.9	99.84	Located within outlet cascade.
Downstream Max Depth (within 5 ft of outlet)	35.7	98.37	Downstream extent of outlet cascade.
Downstream Max Depth	40.8	97.56	
Tailwater Control Point	47	98.76	Located within pool unit.
Downstream Channel Point 1	52.3	98.32	
Downstream Channel Point 2	64.4	98.04	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing structure was modeled within FishXing as a box culvert. The mean height of the outlet plunge point and cascade were added together for the outlet drop height used in the model.	23.56 – 60.62	Impassable Plunge/Cascade Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Impassable Plunge/Cascade Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was predicted to be passable to strong swimming anadromous life stages of *O. mykiss*, but not passable to resident *O. mykiss* life stages. The predicted range of potentially passable rates of streamflow was limited. Adequate water depth was predicted to occur when streamflow rates are greater than 23.56 ft^3/s, but when streamflow rates are above 60.62 ft^3/s the hydraulics of water flowing out of the culvert and down the outlet plunge/cascade was predicted to prevent *O. mykiss* from being able to gain entry into the culvert and subsequent passage. The force of streamflow is increased at lower rates of streamflow due to the small dimensions of this culvert.

Assessment and Analysis Limitations

There were no limitations for conducting a full detailed fish passage assessment and analysis for this crossing structure.

Passage Improvement Recommendations

The most effective remediation option would be to replace this culvert with a free spanning bridge.

Crossing Site Information for PAD 732104					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 192	11.32	34.43618, -119.59157	± 18 ft	2.47

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Picay Creek 0.651 mi^2	Romero Creek	141.26 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Picay Creek is a tributary to Romero Creek, which has been recorded as supporting *O. mykiss*. The most recent documentation of *O. mykiss* in Romero Creek was in 2006. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
11/19/18	Caltrans Reconnaissance Fish Passage Assessment	PSMFC, CCC, CDFW
02/05/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Brick Box Culvert	1	1	Yes (only at outlet)	No

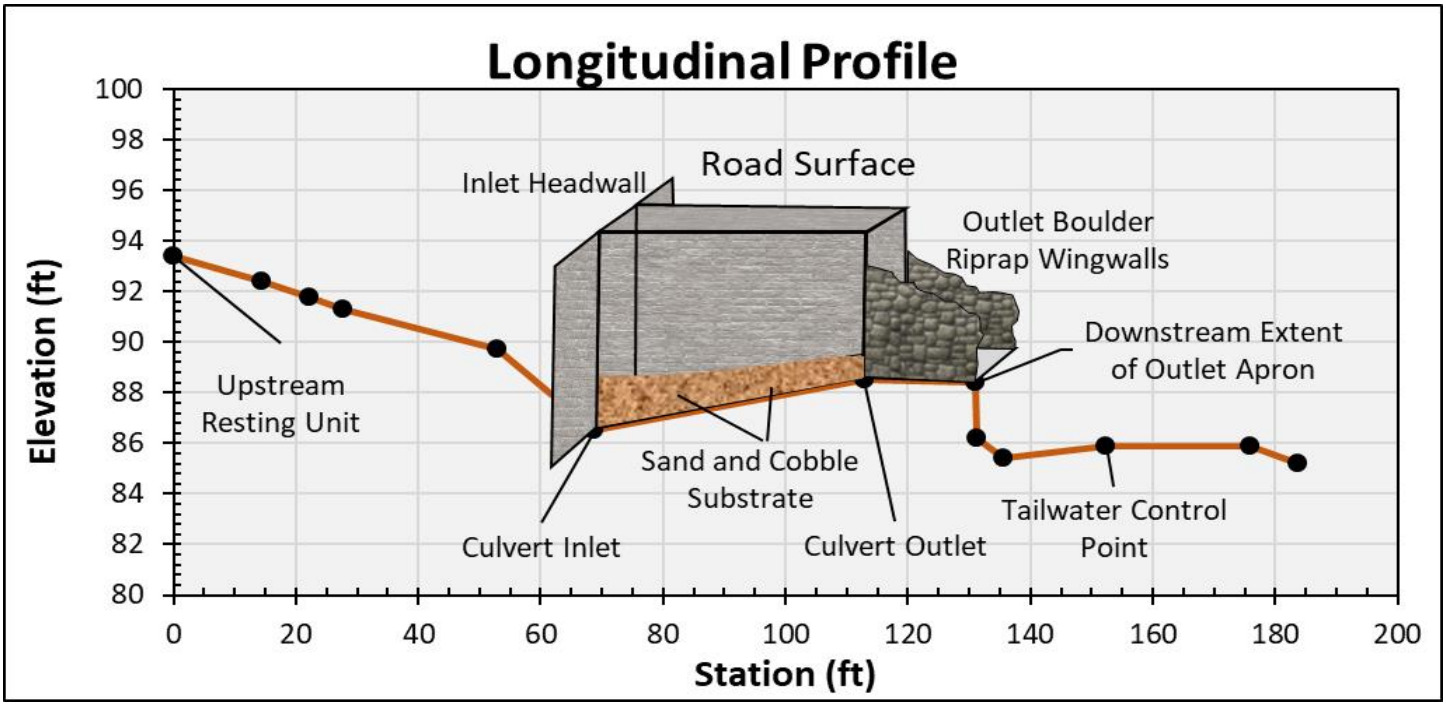
Crossing Structure Description and Condition
This crossing structure is a brick and concrete reinforced box culvert. A concrete headwall is located at the inlet of the structure. A concrete outlet apron is located between parallel boulder riprap wingwalls. A plunge point with a mean height of 2.2 ft is present at downstream end of the outlet apron. At the time of assessment, the base of the structure was embedded with sand and cobble substrate, but its depth could not be determined. It could be possible that the base of the structure does not contain any concrete lining. The culvert was in good condition, but contained some areas of minor erosion along its walls.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Outlet Apron	n/a (open channel)	n/a (open channel)	8.5	18.3	0.55 %
Full Structure	10	8.7	8.5	62.3	- 4.55% (Culvert base slopes upstream towards inlet)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream active channel margins were well defined. Minimal scour was present, and the channel contained extended riffle units with boulder, cobble, and sandy substrate. The channel banks were low and contained moderately dense brush vegetation and large oak trees.	68.8 ft	6.95 ft	16.7 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream active channel margins were also well defined. The channel banks were low and contained sparse brush vegetation and areas of dense small trees.	Sand	21.3 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	93.4	Above extended and steep riffle unit.
Upstream Channel Point 1	14.4	92.4	
Upstream Channel Point 2	22.3	91.8	
Upstream Channel Point 3	27.6	91.3	
Upstream Channel Point 4	53.0	89.7	
Culvert Inlet	68.8	86.5	
Culvert Outlet	112.8	88.5	
Outlet Apron (downstream extent)	131.1	88.4	
Outlet Apron Plunge Point	131.2	86.2	
Downstream Max Depth	135.5	85.4	Same point as max downstream depth within 5 ft of structure.
Tailwater Control Point	152.4	85.9	
Downstream Channel Point 1	175.9	85.9	Within extended riffle unit.
Downstream Channel Point 2	183.6	85.2	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing structure was modeled within FishXing as a box culvert including a 2.2 ft plunge point from the outlet. The length of the outlet apron was factored into the length of the culvert within the model. A culvert roughness coefficient of 0.02 was assigned to account for the sand and cobble substrate base within the culvert.	50 – 1,462.03	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Impassable Plunge Point

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was predicted to be passable to strong swimming anadromous life stages of *O. mykiss*, but not passable to resident *O. mykiss* life stages. FishXing analysis estimated that streamflow rates greater than 50 ft^3/s would provide adequate water depth for an anadromous *O. mykiss* to jump the outlet apron plunge point and pass through the culvert. A velocity barrier was not predicted to occur below streamflow rates of 1,462.03, well above the estimated annual mean peak streamflow rate of 141.26 ft^3/s. FishXing analysis predicted resident life stages of *O. mykiss* would not be able to successfully jump the outlet plunge point at any rate of streamflow.

Assessment and Analysis Limitations

There were no limitations for conducting a full detailed fish passage assessment and analysis for this crossing structure.

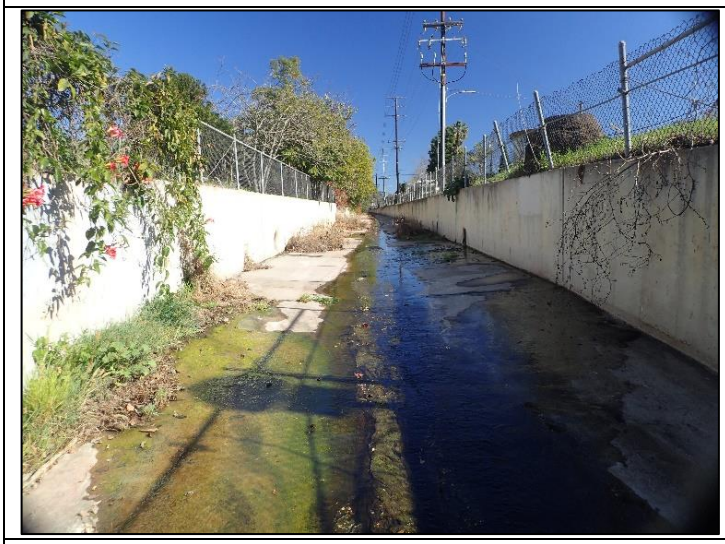
Passage Improvement Recommendations

The most effective remediation option would be to replace this culvert with a free spanning bridge. Removing the concrete outlet apron may improve passage conditions if the culvert doesn't contain a concrete base lining.

Crossing Site Information for PAD 732347					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 192	17.44	34.40794, -119.51482	± 9 ft	1.82

Pictures

Upstream Looking Upstream



Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.934 mi²	Franklin Creek	177.33 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Considering much of this stream channel appears to have been converted into a concrete flood control channel it is unlikely that it currently supports *O. mykiss.* (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
02/06/2020	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
02/06/2020	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	No	No

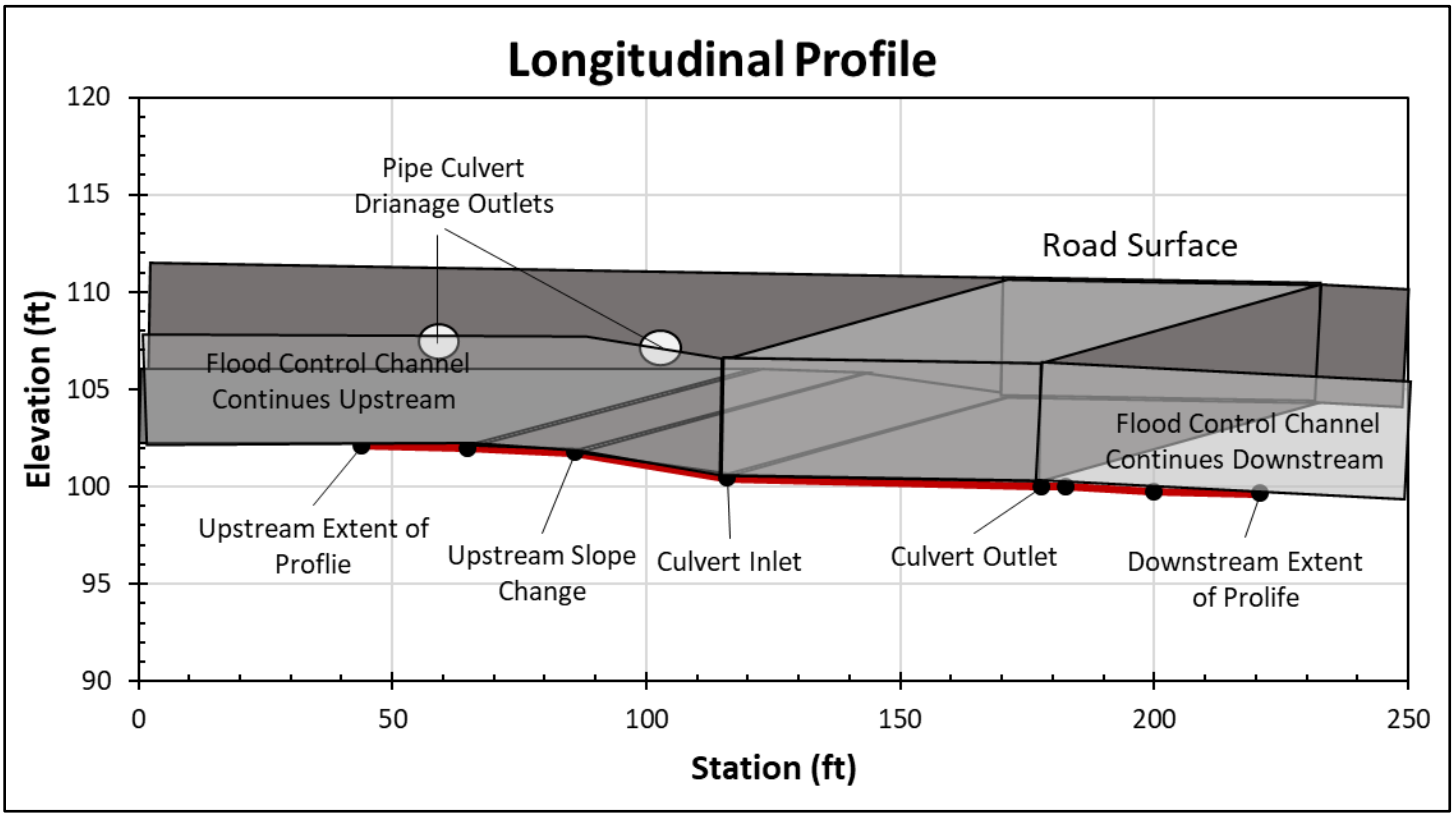
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert within and a large section of concrete lined flood control channel. The road surface is located directly above the culvert. The culvert appeared to be in good condition with no damage or erosion visible.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Road Crossing Structure	6	6	15.4	62	0.69 %
Entirety of Flood Control Channel	n/a (open channel)	n/a (open channel)	15.4 (estimated)	12,409 (estimated)	1.32 % (estimated)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel is a concrete lined flood control channel. Stormwater drains into the channel from various sources, including the nearby roads and farms. The channel makes a slight change in slope right before the inlet. From Google Earth analysis, the upstream concrete lining continues for roughly 1.3 miles running parallel to Hwy 192.	There are no upstream resting unit near this crossing structure due to upstream concrete lining in channel.		15.4 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Downstream Control Point Distance from Outlet**
The downstream channel is also a concrete lined flood control channel. Roughly 200 ft from the culvert is the confluence with Franklin Creek, which has also been converted into a flood control channel. From Google Earth analysis, the downstream concrete channel continues for another mile before ended at the Carpinteria Salt Marsh.	Concrete	No tailwater control point present due to the uniform concrete lining within the channel.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	44	102.08	No upstream resting unit present.
Upstream Channel Point 2	65	101.96	
Upstream Channel Point 3	86	101.71	
Culvert Inlet	116	100.4	
Culvert Outlet	178	99.97	
Downstream Channel Point 1	182.7	99.78	
Downstream Channel Point 2	188	99.82	
Downstream Channel Point 3	200	99.71	
Downstream Channel Point 4	221	99.62	No tailwater control point present.



FishXing Passage Analysis		
Description of Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis of Hwy 192 Crossing Structure for Anadromous *O. mykiss* This model is representative of the measurements collected from the longitudinal and cross section profiles completed for the box culvert structure under Hwy 150.	73.76 – 2,157.7	Insufficient Streamflow Depth
Analysis of Hwy 192 Crossing Structure for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity
Analysis of Flood Control Channel for all life stages of *O. mykiss* This model was made to assess the estimated extent and inlet/outlet elevations of the flood control channel extending upstream and downstream of the Hwy 192 crossing structure. Unfortunately, the maximum length structure FishXing can perform analysis on is 4,000 ft. As a result, the estimated inlet/outlet elevations and mean width of the flood control channel were applied to a structure with a length of 4,000 ft. This model is more representative of the conditions an upstream migrating *O. mykiss* would encounter as it accounts for the streamflow hydraulics occurring upstream and downstream of the Hwy 192 box culvert crossing structure.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units

Crossing Structure Barrier Status

Hwy 192 Crossing Structure: Temporal & Partial Barrier

FishXing predicts anadromous life stages of *O. mykiss* may be able to gain passage through the Hwy 192 box culvert portion of the structure under specific rates of streamflow (73.76 – 2,157.7 ft^3/s), but predicts the box culvert to be impassable to resident *O. mykiss* under all rates of streamflow.

Flood Control Channel: Total Barrier

The entirety of the flood control channel upstream and downstream of the Hwy 192 crossing structure was predicted to be impassable to all life stages of upstream migrating *O. mykiss*. FishXing predicts the entirety of the extended concrete flood control channel upstream and downstream of the Hwy 192 box culvert to be impassable to all life stages of *O. mykiss*. The main factors preventing *O. mykiss* passage are insufficient water depth, high streamflow velocities, and lack of resting areas within the flood control channel.

Assessment and Analysis Limitations

There were no limitations experienced in assessing and performing analysis on this Hwy 192 crossing structure. The assessment and passage analysis performed on the flood control channel was based off estimated dimensions from Google Earth analysis. Additionally, the estimated length of the flood control channel (12,409 ft) was beyond the maximum length structure FishXing can perform passage analysis on. The maximum FishXing structure analysis length of 4,000 ft was therefore used in the flood control structure model.

Passage Improvement Recommendations

The most effective passage improvement option would be to remove the concrete lining of the flood control channel and conduct habitat restoration efforts within the stream channel.

Highway 246 Assessed Crossing Structures

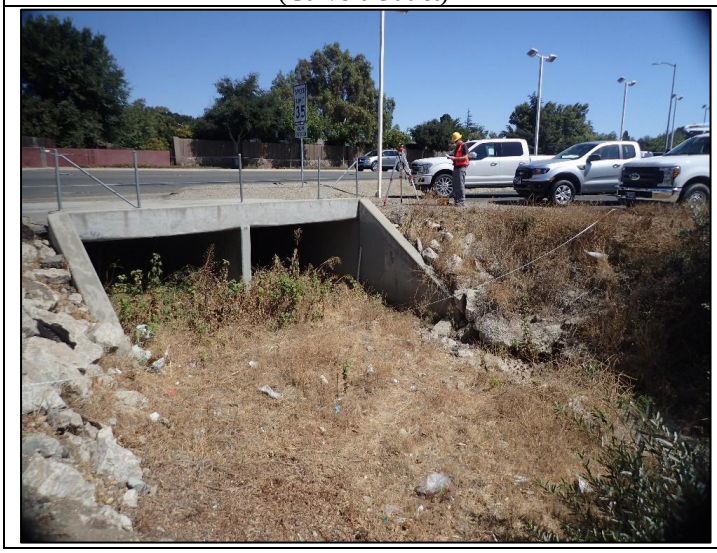
Crossing Site Information for PAD 736469					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 246	26.61	34.61031, -120.18473	± 9 ft	34.5

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)



Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed Creek 2.58 mi^2	Santa Ynez River	150.94 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is a part of the Santa Ynez River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/01/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/01/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	2 bays	1	Yes (only at inlet)	No

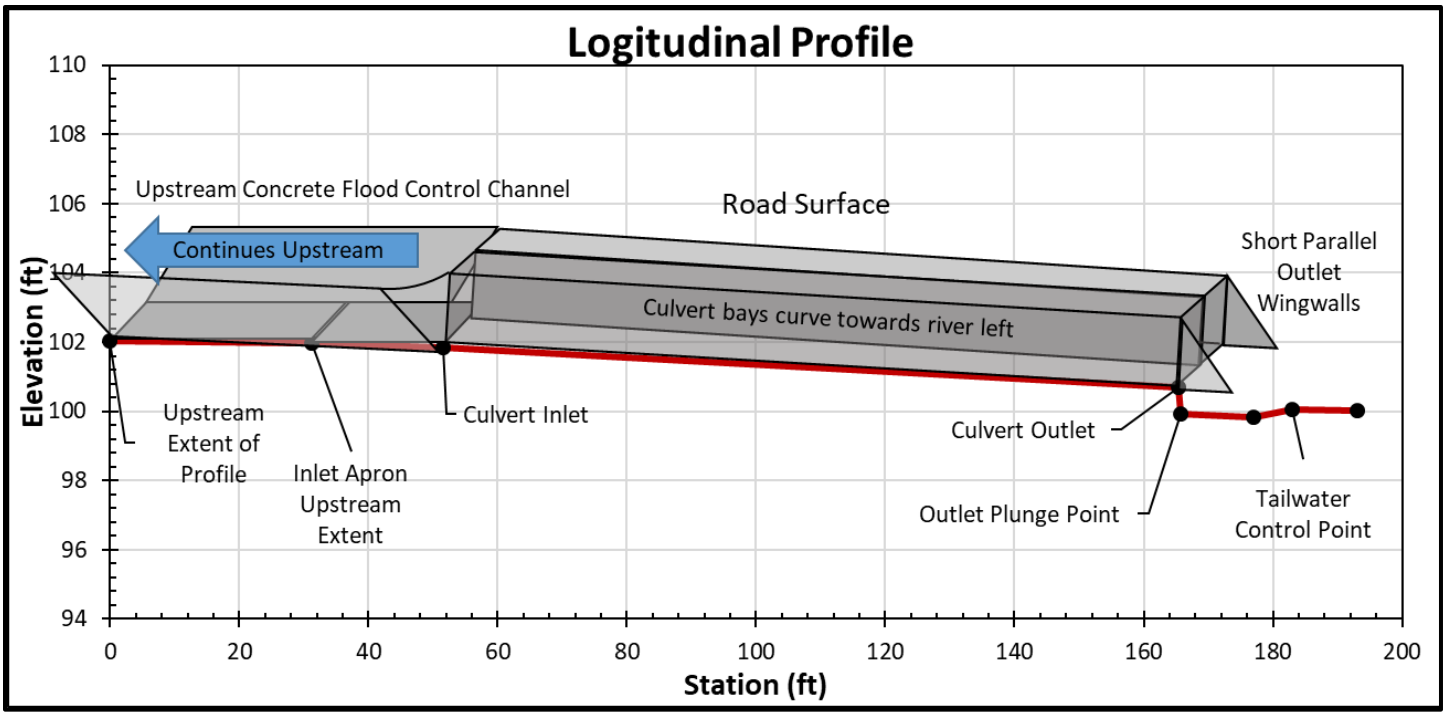
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with two side by side bays separated by a vertical concrete wall support. Both culvert bays contain a slight and continuous curve from river right to river left. The river right culvert was partially embedded with cobble and gravel substrate at the time of assessment. A short plunge point with a mean height of 0.76 ft is present at the outlet of the structure. Short parallel concrete wingwalls extend from the structure outlet. The structure appeared to be in good condition with no significant damage visible at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Upstream Flood Control Channel	n/a (open channel)	n/a (open channel)	12 (estimated)	1,584 (estimated)	1.52 % (estimated)
Inlet Apron	n/a (open channel)	n/a (open channel)	16	20.3	0.99 %
Culvert	6.1	6.1	20 (each bay is 10ft)	113.8	0.95 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel has been converted into a fully concrete lined flood control channel with sloped walls and a flat bottom surface. From Google Earth analysis it appears the flood control channel extends approximately 0.3 miles upstream of the crossing structure.	No upstream resting unit visible	No upstream resting unit visible	12 ft (width of flood control channel)

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained well defined active channel margins with extended riffle units with minimal scour. Portions of the active channel contained established grass vegetation indicating infrequent occurrences of high streamflow. The channel banks contain a short section of boulder riprap downstream of the outlet wingwalls. Downstream of the boulder riprap channel lining the channel banks are steep and small with grass and small tree vegetation present.	Gravel	17.5 ft

Longitudinal Profile Measurements (measured through river left bay)			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	102.04	No upstream rest pool visible. Points within concrete flood control channel.
Upstream Channel Point 2	12	102.05	
Upstream Channel Point 3	22	102	
Inlet Apron (upstream extent)	31.3	101.97	
Culvert Inlet	51.6	101.77	
Culvert Outlet	165.4	100.69	
Downstream Max Depth (within 5 feet of outlet)	165.8	99.93	Outlet plunge point.
Downstream Max Depth	177	99.82	
Tailwater Control Point	182.9	100.05	
Downstream Channel Point 1	193	100.01	Within extended riffle unit.
Downstream Channel Point 2	205	99.99	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (two models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis of Hwy 246 Crossing Structure for Anadromous *O. mykiss* Due to FishXing limitations this crossing structure was modeled within FishXing as a single bay box culvert with a width of 20 ft, which is the width of both culvert bays added together. An outlet plunge point of 0.76 ft was included in the model. Additionally, the length of the inlet apron was factored into the length of the culvert.	109.98 – 2,491.75	Insufficient Streamflow Depth
Analysis of Hwy 246 Crossing Structure for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity
Analysis of Upstream Flood Control Channel for Anadromous *O. mykiss* This model attempts to assess the conditions predicted to occur within of the flood control channel upstream of the Hwy 246 box culvert crossing. The flood control channel was modeled as an extended box culvert. In this model it is assumed the flood control channel maintains a width of 12 ft. The length and slope of the flood control channel was estimated with the use of the elevation profile and ruler tools in Google Earth. This model is more representative of the conditions an upstream migrating *O. mykiss* would encounter as it accounts for the streamflow hydraulics occurring upstream of the Hwy 246 crossing structure.	117.98 – 153.45	Insufficient Streamflow Depth Absence of Resting Units
Analysis of Upstream Flood Control Channel for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units

Crossing Structure Barrier Status

Temporal & Partial Barrier

FishXing predicts this Hwy 246 culvert and the upstream flood control to be impassable to resident life stages of *O. mykiss* under all rates of streamflow. FishXing does predict that strong swimming anadromous *O. mykiss* may be able to gain passage through the Hwy 246 crossing structure and the upstream flood control channel under a specific range of streamflow rates. Streamflow rates above 109.98 ft^3/s are predicted to provide adequate water depth for passage through the Hwy 246 culvert and streamflow rates above 117.98 ft^3/s predicted to provide adequate water depth for continual passage through the upstream flood control channel. A velocity barrier is predicted to occur above streamflow rates of 153.45 ft^3/s causing exhaustion in passage attempts through the upstream flood control channel. Considering the estimated annual mean peak streamflow is only 150.94 ft^3/s the occurrence of conditions conducive to passage through the Hwy 246 culvert and upstream flood control channel are likely very rare.

Assessment and Analysis Limitations

The were no limitations experienced in collecting longitudinal and cross section profile data for the crossing structure. FishXing is not able to conduct passage analysis on structures with multiple bays and therefore the structure had to be modeled as a single bay culvert for passage analysis. Additionally, the entirety of the upstream flood control channel was not assessed, and the dimensions used to assess passage through it were estimated from Google Earth analysis and therefore my not be accurate.

Passage Improvement Recommendations
On remediation option would be to remove the concrete base lining of this culvert structure. The most effect option would be to replace the structure with a free spanning bridge. Additionally, any remediation efforts should include removing the concrete lining of the upstream flood control channel and conducting habitat restoration efforts within the stream channel.

Crossing Site Information for PAD 736693					
County	**Route**	**Post Mile**	**Location** (at outlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 246	28.85	34.59367, -120.15179	± 15 ft	36.21

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Adobe Creek 2.761 mi^2	Santa Ynez River	152.41 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is a part of the Santa Ynez River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/30/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/30/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	2 bays	1	Yes (only at outlet)	No

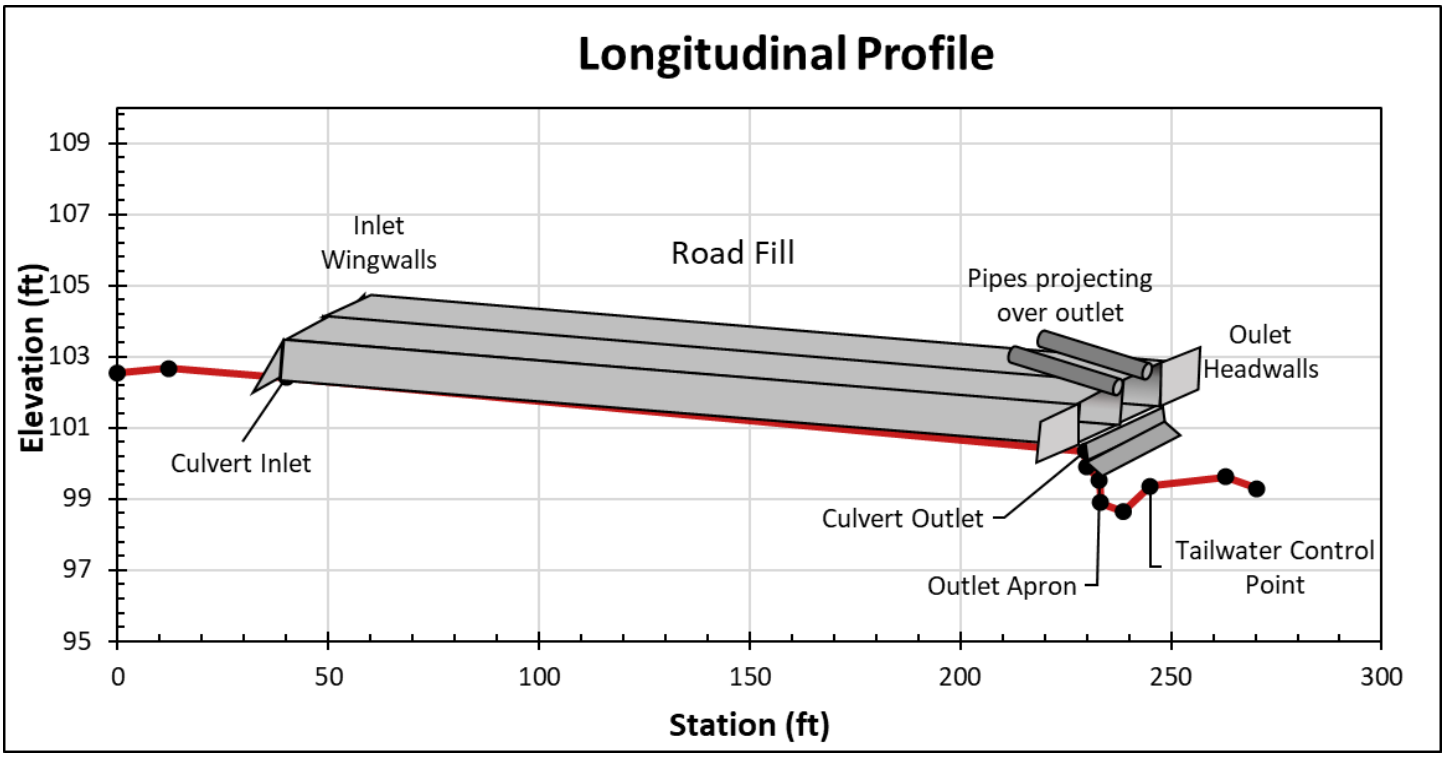
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with two side by side bays separated by a vertical concrete wall support. Short flared concrete wingwalls were present at the inlet and a small concrete headwall was present at the outlet. A small plunge point is present from the culvert outlet to a short concrete apron. At the time of assessment, the mean height of the plunge point was 0.43 ft. Some woody debris built up on central divider between the culvert bays at the inlet indicating recent occurrence of high streamflow. Two small pipes project above the culvert outlet and presumably drain roadway runoff. The structure appeared to be in good condition with no significant damage visible at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	5	5	10 (each bay is 5 ft)	189.6	1.10 %
Outlet Apron	n/a (open channel)	n/a (open channel)	10	3.3	25.32 %
Full Structure	5	5	10 (each bay is 5 ft)	192.9	1.50 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained wide, relatively uniform, and well-defined active channel margins. The channel contained extended riffle units with minimal presence of scour. The channel banks were small and steep and contained large oak trees.	40 ft	0.12 ft	15.54 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel also contained wide, relatively uniform, and well-defined active channel margins. Concrete and boulder riprap is located along the channel banks and extends roughly 50 ft downstream of the culvert outlet. Downstream of this riprap channel lining the channel banks are steep and contain sparse grass and brush vegetation with a few large willow and oak trees.	Gravel	12.1 ft

Longitudinal Profile Measurements (measured through river right bay)			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	102.54	
Upstream Channel Point 1	12	102.67	Within extended riffle unit.
Upstream Channel Point 2	23	102.65	
Upstream Channel Point 3	35	102.68	
Culvert Inlet	40	102.42	
Culvert Outlet	229.6	100.34	
Outlet Plunge Point	229.9	99.91	Short plunge from outlet to outlet apron.
Outlet Apron (downstream extent)	232.9	99.53	
Max Downstream Depth (within 5 ft of outlet)	233.1	98.9	
Max Downstream Depth	238.7	98.64	
Tailwater Control Point	245	99.36	
Downstream Channel Point 1	263	99.62	
Downstream Channel Point 2	270.3	99.3	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* Due to FishXing limitations this crossing structure was modeled within FishXing as a single bay box culvert with a width of 10 ft, which is the width of both culvert bays added together. An outlet plunge point of 0.43 ft was included in the model. The length of the outlet apron was not factored into the length of the culvert because its short length likely would not have a significant impact of *O. mykiss* passage ability.	60.79 – 881.28	Insufficient Streamflow Depth Outlet Unit Restriction
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Outlet Unit Restriction

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was predicted to be passable to strong swimming anadromous life stages of *O. mykiss*, but not passable to resident *O. mykiss* life stages. FishXing analysis estimated that streamflow rates greater than 60.79 ft^3/s would provide adequate water depth for an anadromous *O. mykiss* to jump the outlet plunge point and pass through the culvert. A velocity barrier was not predicted to occur below streamflow rates of 881.28, well above the estimated annual mean peak streamflow rate of 152.41 ft^3/s. FishXing analysis predicted resident life stages of *O. mykiss* would have difficultly jumping the outlet plunge point and would reach exhaustion if they were able to gain access to the culvert at all rates of streamflow.

Assessment and Analysis Limitations
The were no limitations experienced in collecting longitudinal and cross section profile data for the crossing structure. FishXing is not able to conduct passage analysis on structures with multiple bays and therefore the structure had to be modeled as a single bay culvert for passage analysis.

Passage Improvement Recommendations
The most effective remediation option would be to replace this culvert with a free spanning bridge. Removing the concrete base lining within the culvert or installing weirs may also improve passage conditions.

Crossing Site Information for PAD 736658					
County	**Route**	**Post Mile**	**Location** (at outlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 246	33.23	34.61045, -120.07967	± 14 ft	40

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Bridge Inlet)

Downstream Looking Upstream
(Bridge Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed Creek 4.533 mi^2	Zanja de Cota Creek	163.37 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is a part of the Santa Ynez River watershed, which has historically supported anadromous fish. Considering the upstream and downstream channel conditions present when this crossing was assessed it seems unlikely that this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/30/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/30/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforce Box Culvert	1	1	Yes (only at outlet)	No

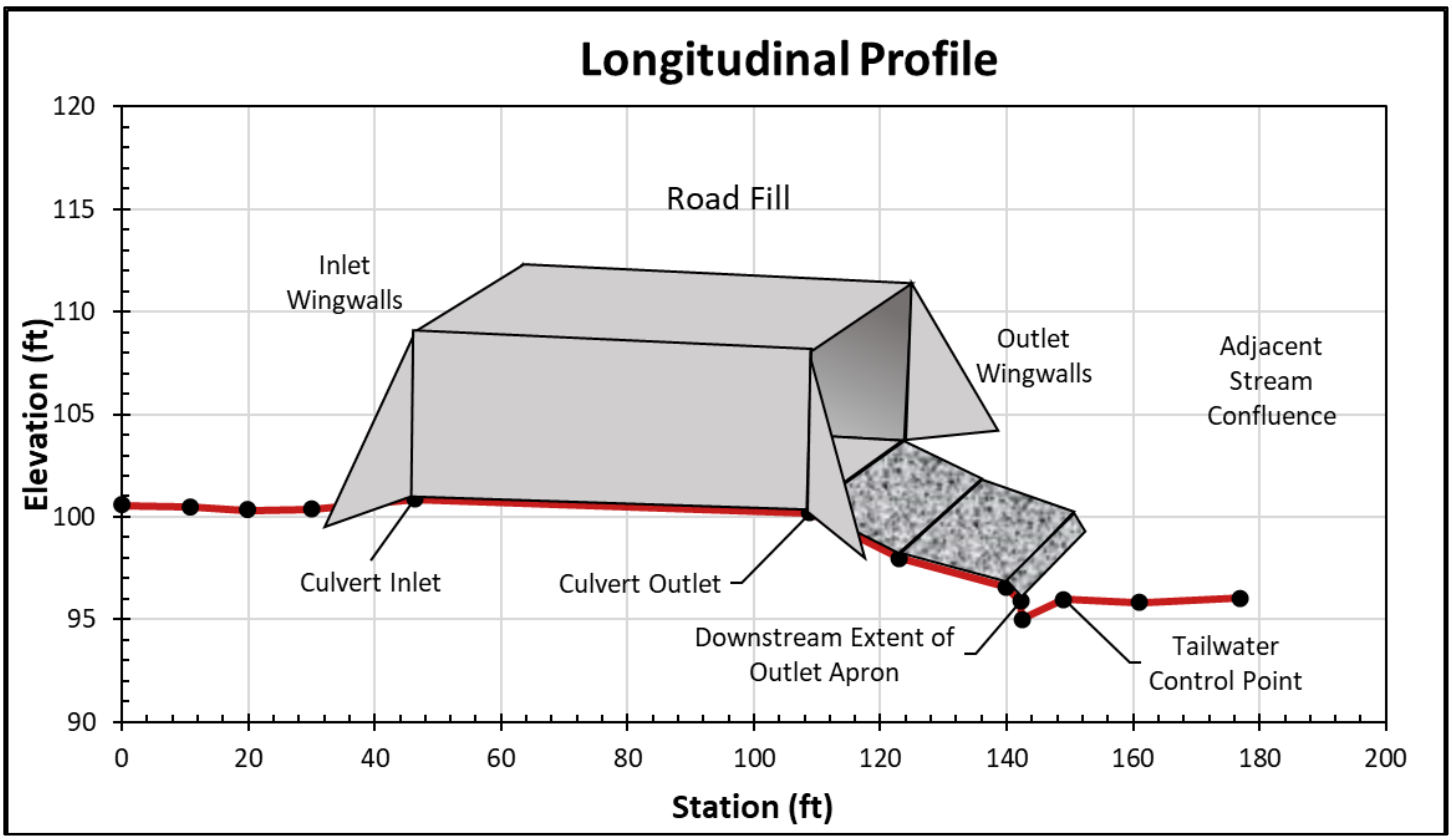
Crossing Structure Description and Condition
This crossing structure is a large concrete reinforced box culvert. The culvert has flared concrete wingwalls at its inlet and outlet. The outlet also contains a large cemented boulder riprap apron. This apron creates a cascade and a small plunge point to the downstream substrate. At the time of assessment, the plunge point had a mean height of 0.9 ft. The culvert contains some minor erosion on its walls, but overall appeared to be in good condition.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	10	12	10	62.5	1.06 %
Outlet Apron	n/a (open channel)	n/a (open channel)	17	33.4	12.98 %
Full Structure	10	12	10	95.9	5.18 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained narrow and moderately defined active channel margins. The channel contained extend riffle units without any areas of significant scour. The channel banks were low and contained sparse grasses, some of which have grown into the active channel indicated rare occurrences of high streamflow. There was little to no canopy cover over the channel. A barbed wire fence crossed the cannel approximately 37 ft upstream of the culvert inlet.	No upstream resting unit visible.	No upstream resting unit visible.	8.38 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
Another unnamed stream has its confluence with this stream at the base of the culvert outlet apron. This seems to have created a much wider active downstream channel margin than is present upstream of this culvert. The downstream channel also contains extended riffle units lacking areas of scour. The downstream channel banks are steep and much larger than the upstream channel banks. The channel banks contain grass and large oak trees on the river right bank.	Gravel	9.2 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	100.56	No visible upstream resting unit. Points located within extended riffle unit.
Upstream Channel Point 2	11	100.48	
Upstream Channel Point 3	20	100.32	
Upstream Channel Point 4	30	100.38	
Upstream Channel Point 5	46.1	100.68	Point located below culvert inlet lip.
Culvert Inlet	46.3	100.86	
Culvert Outlet	108.8	100.2	
Outlet Apron Point 1	123	97.98	
Outlet Apron Point 2	139.6	97.47	
Outlet Apron Point 3 (downstream extent)	142.2	95.9	
Max Depth Downstream (within 5 ft of structure)	142.4	95	Plunge point from outlet apron. Same as max downstream depth.
Tailwater Control Point	149	95.58	
Downstream Channel 1	161	95.84	Points located within extended riffle unit.
Downstream Channel 2	177	96.05	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (three models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled as a box culvert within FishXing. The length of outlet apron was factored into the length of the culvert for the model.	139.96 – 1,298.68	Insufficient Streamflow Depth Outlet Unit Restriction
Culvert Analysis for Anadromous *O. mykiss* This model assessed the inlet to outlet culvert portion of the crossing structure.	67.45 – 469.14	Insufficient Streamflow Depth
Outlet Apron Analysis for Anadromous *O. mykiss* This model assesses the outlet apron portion of the crossing structure. In this model the mean width of the outlet apron (17 ft) was used.	227.06 – 807.33	Not predicted to be passable at streamflow rates less than the estimated annual mean peak flow rate due to outlet unit restriction.
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Outlet Unit Restriction

Crossing Structure Barrier Status
Temporal & Partial Barrier
This crossing structure was predicted to be passable to strong swimming anadromous life stages of *O. mykiss*, but not passable to resident *O. mykiss* life stages. The estimated range of streamflow predicted to potentially allow for successful anadromous *O. mykiss* passage through this crossing structure is (227.06 – 469.14 ft^3/s). Adequate water depth was precited to occur under streamflow rates as high as 227.06 ft^3/s and an outlet plunge point barrier was predicted to occur under streamflow rates as low as 469.14 ft^3/s. Instances in which this stream experiences enough streamflow to allow for potential passage are likely very rare considering the estimated annual mean peak streamflow rates is only 163.37 ft^3/s. A velocity barrier was not predicted to occur below streamflow rates of 1,405.39 ft^3/s for anadromous *O. mykiss*. Velocity, streamflow depth, and outlet plunge points were all predicted to prevent resident *O. mykiss* passage abilities.

Assessment and Analysis Limitations
There were no limitations experienced in assessing this crossing structure.

Passage Improvement Recommendations
The most effective remediation action would be to replace this crossing structure with a free spanning bridge.

Crossing Site Information for PAD 736555					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Santa Barbara	Hwy 246	34.29	34.61079, -120.06119	± 9 ft	42.35

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
0.712 mi²	Santa Ynez River	96.62 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is a part of the Santa Ynez River watershed, which has historically supported anadromous fish. Considering the low estimated annual mean peak streamflow and the upstream and downstream channel conditions present when this crossing was assessed it is unlikely that this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/30/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/30/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Corrugated Steel Pipe Arch Culvert	1	1	Yes (inlet and outlet)	No

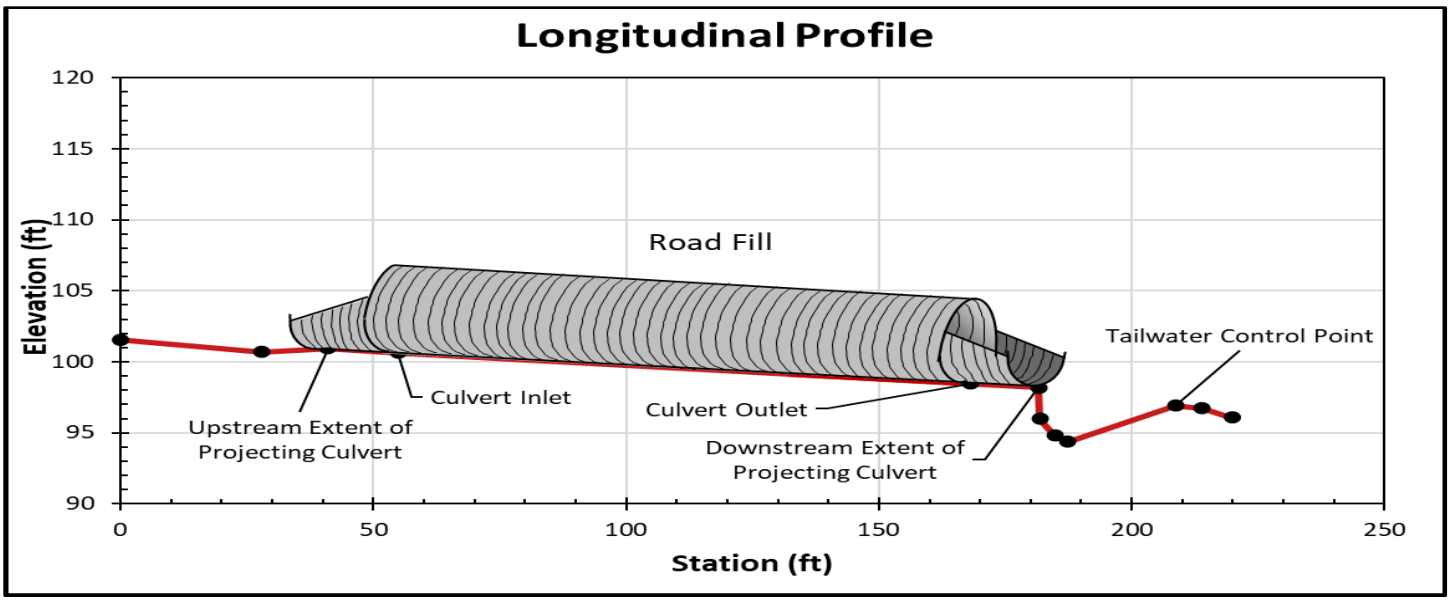
Crossing Structure Description and Condition
This crossing structure is a large steel corrugated pipe arch culvert with multiple large plates bolted together. The corrugations are annular, have a 2-inch rise, and are spaced at 6-inch intervals. The base of the culvert has been lined with asphalt. The inlet and outlet have cut (precast) projecting barrels, which serve as aprons. At the time of assessment, a plunge point with a mean height of 2.72 ft occurs from the cut portion of the outlet to the downstream substrate.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	14	13.9	2.23 %
Culvert	12	12	14	113.1	1.94 %
Outlet Apron	n/a (open channel)	n/a (open channel)	14	13.6	2.06 %
Full Structure	12	12	14	140.6	1.64 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time pf assessment, the upstream channel contained no active channel margins and broad poorly defined channel banks. The upstream channel appeared to just be a low point of a large field with grass vegetation where water collects and drains through the culvert. Additionally, a steel cattle fence is located at the inlet of culvert and extends entirely across its margins.	No upstream resting unit visible.	No upstream resting unit visible.	No defined active channel margins visible.

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, moderate scour was present in the area immediately downstream of the culvert outlet. Downstream of this area of scour the channel contains a narrow and moderately defined active channel. The channel banks were low. Grass vegetation was prominent on the channel banks and within the active channel margins. Additionally, a barbed wire fence spans across the channel roughly 46 ft downstream of the culvert.	Cobble	27 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	101.54	No visible resting unit or defined active channel margins.
Upstream Channel Point 2	20.8	101.03	
Upstream Channel Point 3	28	100.69	
Inlet Apron (upstream extent)	41	100.95	
Culvert Inlet	54.9	100.64	
Culvert Outlet	168	98.45	
Outlet Apron (downstream extent)	181.6	98.17	
Outlet Plunge Point	181.8	95.98	
Downstream Max Depth (within 5 ft of structure)	184.8	94.82	
Downstream Max Depth	187.4	94.36	
Tailwater Control Point	208.6	96.91	
Downstream Channel Point 1	213.9	96.74	Within flat riffle unit with grass vegetation.
Downstream Channel Point 2	220	96.04	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This structure was modeled within FishXing as a pipe arch culvert. The entire length of the structure was factored into the model. A culvert roughness coefficient of 0.018 was used in analysis to account of the asphalt lined base and corrugated side walls of the culvert. A 2.72 ft plunge point was applied to the outlet.	49.75 – 1,913.92	Insufficient Streamflow Depth Outlet Unit Restriction
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Outlet Unit Restriction

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was predicted to be passable to strong swimming anadromous life stages of *O. mykiss*, but not passable to resident *O. mykiss* life stages. FishXing analysis estimated that streamflow rates greater than 49.75 ft^3/s would provide adequate water depth for an anadromous *O. mykiss* to jump the outlet plunge point and pass through the culvert. A velocity barrier was not predicted to occur below streamflow rates of 1,913.92, well above the estimated annual mean peak streamflow rate of 96.62 ft^3/s. FishXing analysis predicted resident life stages of *O. mykiss* would have difficultly jumping the outlet plunge point during all rates of streamflow.

Assessment and Analysis Limitations

There were no limitations for conducting a full detailed fish passage assessment and analysis for this crossing structure.

Passage Improvement Recommendations

Fish passage could be greatly improved by removing the culvert and replacing the crossing with a free spanning bridge. However, based on the conditions of the stream channel at the time of assessment, it appears this stream rarely experiences sustained streamflow and is highly unlikely to support *O. mykiss* upstream of this crossing structure.

Appendix B

Fish Passage Barrier Assessment Data and Analysis Results for Tier 1 Caltrans Stream Crossing Structures in Ventura County (Caltrans District 7)

This appendix lists information from the completion of Caltrans reconnaissance and detailed fish passage barriers assessments conducted on Caltrans stream crossing structures listed on the Tier 1 priority list for Ventura County dated September 6, 2019. Information included in this appendix include, collected data points, descriptions of each assessed crossing structure, results of fish passage analysis conducted on those structures, and limitations experienced during assessment and analysis. Multi-segmented crossing structures have had their segments numbered starting from the inlet to outlet of the structure. Graphs are included in this appendix for crossing structures in which a longitudinal profile was able to be completed. These graphs are included to serve as visual aids to convey the general shape, orientation, and conditions of crossing structures. The dimensions and shapes depicted in these graphs may not be accurate to the true proportions of each crossing structure.

Table of Contents

(page listings for each assessed crossing structure are listed in the Assessment Reference Table)

Ventura County Tier 1 Caltrans Stream Crossing Structure Assessment Reference Table.....167

Highway 33 Assessed Crossing Structures.....169

Highway 34 Assessed Crossing Structures.....274

Highway 101 Assessed Crossing Structures.....284

Highway 150 Assessed Crossing Structures.....295

Ventura County Tier 1 Caltrans Stream Crossing Structure Assessment Reference Table							
PAD ID Number	**Route**	**Post Mile**	**Structure Location** (location coordinates recorded)	**Caltrans Fish Passage Assessments Conducted**	**Barrier Status Assigned**	**Crossing Structure Type**	**Listing Page**
731995	Hwy 33	2.1	34.30846, -119.29789 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	169
731647	Hwy 33	2.97	34.31983, -119.29287 (at outlet)	Reconnaissance Only	Total Barrier	Concrete Reinforced Box Culvert	173
732274	Hwy 33	3.26	34.32360, -119.29211 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	176
732171	Hwy 33	3.76	34.33116, -119.29221 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	180
705650	Hwy 33	4.28	34.33856, -119.29213 (at inlet) 34.33735, -119.29307 (at outlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	185
731569	Hwy 33	4.81	34.34455, -119.29442 (at outlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	189
731216	Hwy 33	4.83	34.34657, -119.29518 (at inlet)	Reconnaissance Only	Total Barrier	Concrete Reinforced Box Culvert	193
731512	Hwy 33	6.4	34.36379, -119.30774 (at inlet)	Reconnaissance & Detailed	Temporal Barrier	Concrete Reinforced Box Culvert	196
731756	Hwy 33	6.5	34.36529, -119.30667 (at inlet)	Reconnaissance Only	Total Barrier	Corrugated Steel Pipe Culvert	201
731637	Hwy 33	9.9	34.41229, -119.29472 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	204
731138	Hwy 33	10.3	34.41782, -119.29317 (at inlet)	Reconnaissance & Detailed	Temporal Barrier	Concrete Reinforced Box Culvert	208
759838	Hwy 33	12.18	34.44989, -119.27193 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Pipe Culvert	212
731881	Hwy 33	12.83	34.45666, -119.27377 (at furthest upstream inlet)	Reconnaissance Only	Total Barrier	System of Concrete Reinforced Box and Pipe Culverts	217
731416	Hwy 33	13.27	34.46225, -119.28180 (at inlet)	Reconnaissance Only	Total Barrier	Corrugated Steel Pipe Culvert	221
732130	Hwy 33	14.58	34.47897, -119.29077 (at inlet)	Reconnaissance & Detailed	Not a Barrier	Free Spanning Bridge	224
732341	Hwy 33	16.14	34.49274, -119.30638 (at inlet)	Reconnaissance Only	Not a Barrier	Free Spanning Bridge	227
731600	Hwy 33	19.82	34.52008, -119.27143 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	230
731525	Hwy 33	20.48	34.51533, -119.27916 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	234
731797	Hwy 33	20.8	34.51496, -119.28338 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	238
731830	Hwy 33	21.12	34.51889, -119.28178 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	241
731128	Hwy 33	22.27	34.52983, -119.27092 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	246
713767	Hwy 33	24.17	34.53671, -119.24493 (at outlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	250
759848	Hwy 33	29.19	34.55540, -119.26315 (at inlet)	Reconnaissance & Detailed	Total Barrier	Corrugated Steel Pipe Culvert	254
759849	Hwy 33	29.54	34.55779, -119.26838 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	258
759851	Hwy 33	38.81	34.60875, -119.36567 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Corrugated Steel Pipe Culvert	262
764936	Hwy 33	39.26	34.61382, -119.37030 (at inlet)	Reconnaissance & Detailed	Total Barrier	Corrugated Steel Pipe Culvert	266
759852	Hwy 33	39.49	34.61646, -119.37222 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	270
759858	Hwy 34	8.15	34.19669, -119.10970 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Bridge Over Concrete Channel	274

Table continues to next page

PAD ID Number	Route	Post Mile	Structure Location (location coordinates recorded)	Caltrans Fish Passage Assessments Conducted	Barrier Status Assigned	Crossing Structure Type	Listing Page
759859	Hwy 34	8.4	34.19675, -119.10412 (at inlet)	Reconnaissance Only	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	278
759860	Hwy 34	9.4	34.19644, -119.08714 (at outlet)	Reconnaissance Only	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	281
759872	Hwy 101	18	34.22242, -119.10607 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	284
759873	Hwy 101	18.8	34.2228, -119.11990 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Bridge Over Concrete Channel	288
759877	Hwy 101	26.9	34.26237, -119.24568 (at outlet)	Reconnaissance Only	Total Barrier	System of Concrete Reinforced Box and Pipe Culverts	292
759939	Hwy 150	0.5	34.39506, -119.44511 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	295
732232	Hwy 150	4	34.38403, -119.39774 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	299
732039	Hwy 150	4.53	34.38575, -119.38832 (at inlet)	Reconnaissance Only	Total Barrier	Corrugated Steel Pipe Culvert	303
731812	Hwy 150	12.86	34.42615, -119.31392 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	306
731535	Hwy 150	16.2	34.43634, -119.26358 (at inlet)	Reconnaissance Only	Total Barrier	Corrugated Steel Pipe Culvert	310
731496	Hwy 150	16.59	34.44191, -119.26052 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	313
731238	Hwy 150	17.64	34.44781, -119.24429 (at outlet)	Reconnaissance Only	Total Barrier	Steel Pipe Culvert & Reinforced Box Culvert	317
712466	Hwy 150	17.84	34.44822, -119.24102 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	320
731449	Hwy 150	19.56	34.44668, -119.21107 (at inlet)	Reconnaissance Only	Not a Barrier	Free Spanning Bridge	324
732075	Hwy 150	20.16	34.44489, -119.20100 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	327
732067	Hwy 150	20.24	34.44484, -119.19962 (at inlet)	Reconnaissance Only	Total Barrier	Corrugated Steel Pipe Culvert	331
731958	Hwy 150	23.18	34.43634, -119.17601 (at inlet)	Reconnaissance & Detailed	Not a Barrier	Free Spanning Bridge	334
731145	Hwy 150	23.93	34.43701, -119.16838 (at outlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Arch Bridge	337
731234	Hwy 150	24.01	34.43639, -119.16270 (at outlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	341
731271	Hwy 150	25.93	34.43480, -119.13084 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	345
731462	Hwy 150	26.02	34.43479, -119.12938 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	349
731251	Hwy 150	26.12	34.43469, -119.12798 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	353
731724	Hwy 150	26.5	34.43124, -119.12379 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	357
759945	Hwy 150	29.51	34.41498, -119.08507 (at inlet)	Reconnaissance Only	Total Barrier	Concrete Reinforced Pipe Culvert	361
731595	Hwy 150	30.3	34.40411, -119.08199 (at inlet)	Reconnaissance & Detailed	Total Barrier	Concrete Reinforced Box Culvert	364

Highway 33 Caltrans Crossing Structures

Crossing Site Information for PAD 731995					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	2.1	34.30846, -119.29789	± 9 ft	2.51

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Canada De San Joaquin Creek 1.65 mi^2	Ventura River	140.4 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
10/21/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/21/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	2	1	Yes	No

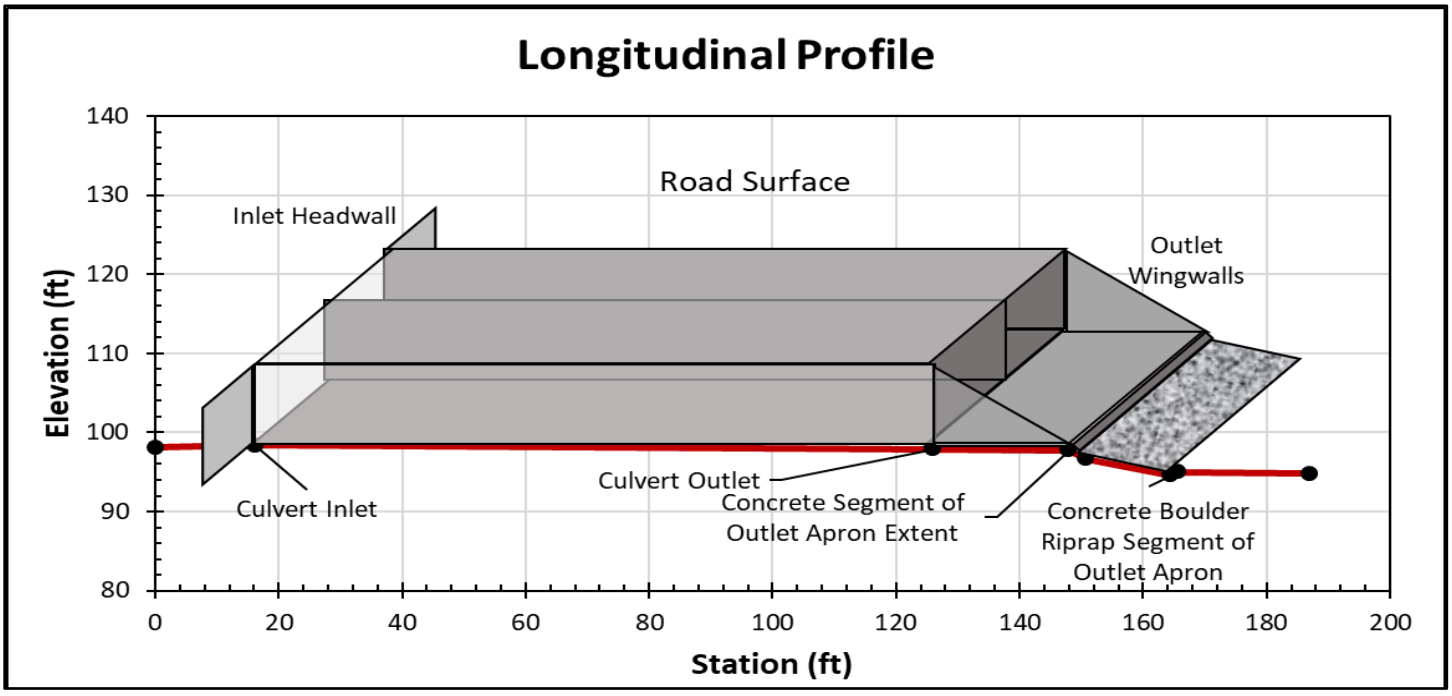
Crossing Structure Description and Condition
This crossing structure is double bay side by side concrete reinforced box culvert. At the time of assessment both bays were partially embedded with sand and silt. The inlet contains a headwall and outlet has short parallel wingwalls. An outlet apron is present consisting of concrete between the wingwalls and a segment of concrete boulder riprap which forms a small cascade to the downstream channel. The road surface is directly above the culvert.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	8	8	20 (each bay is 10 ft)	109.8	0.5 %
Outlet Apron	n/a (open channel)	n/a (open channel)	20	24.8	4.8 %
Full Structure	8	8	20	134.6	1.3 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel was wide with a defined active channel margin. However, the active channel was flat, comprised primarily of sand and silt, and lacked any distinct areas of scour to provide habitat variety. An additional double bay concrete reinforced box culvert is located roughly 50 ft upstream. It appears a concrete lined flood control channel may be also be present upstream from Google Earth analysis.	No upstream resting unit visible at time of assessment.	No upstream resting unit visible at time of assessment.	14 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
Downstream of the outlet apron the stream contains well defined active channel margins and short channel banks containing brush vegetation. The channel was very sandy with scattered cobble and lacked areas of scour.	Sand	39.7 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	98.12	No visible upstream resting unit.
Upstream Channel Point 2	6	98.14	
Upstream Channel Point 3	11	98.27	
Upstream Channel Point 4	16.1	98.07	Stream height just below culvert inlet base.
Culvert Inlet	16.2	98.37	
Culvert Outlet	126	97.86	
Downstream Apron Point 1	148	97.74	Downstream extent of concrete segment.
Downstream Apron Point 2	148.1	97.54	Upstream extent of concrete riprap boulder apron segment.
Downstream Apron Point 3	150.7	96.62	
Downstream Apron Point 4	150.8	96.68	End of concrete boulder riprap apron segment.
Downstream Channel Point 1	156.5	96.66	
Downstream Max Depth	164.5	94.61	Same point as max depth within 5 ft of structure.
Tailwater Control Point	165.7	95.01	
Downstream Channel Point 2	187	94.81	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was modeled in FishXing as a large box culvert. The width of each bay was added together to represent the entire width of the structure. The length of the concrete segment of the outlet apron was included in the length of the culvert. The height (0.86 ft) of the concrete boulder riprap segment of the outlet apron was entered modeled in FishXing as a plunge point because upstream migrating *O. mykiss* fish would likely need to jump this portion of the structure in their passage attempts.	None	Insufficient Water Depth Impassable Cascade

Crossing Structure Barrier Status

Total Barrier

This crossing structure was assessed to be impassable to all life stages of *O. mykiss.* The primary factor limiting passage is the steep concrete boulder riprap portion of the outlet apron. The lack of scour below this portion of the apron prevents the water depth and streamflow velocity conditions conducive to allowing *O. mykiss* to successfully jump this cascade. Additionally, due to the 20 ft width of the structure FishXing predicts that a streamflow rate of 135.74 ft^3/s or greater would be required to provide adequate water depth for *O. mykiss* passage. Considering the estimated annual mean peak streamflow rate is 140.44 ft^3/s adequate water depth is likely rarely present.

Assessment and Analysis Limitations

The only limitation experienced with assessing this crossing was modeling the structure in FishXing. FishXing is unable to model multiple bay culverts. Therefore, the structure was modeled as a single bay culvert with the width of each bay. This modeling neglects the impacts of the concrete divider between the two bays on streamflow hydraulics and velocity.

Passage Improvement Recommendations

The most effective remediation effort would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. A secondary remediation option would be to remove the concrete base lining of the structure, including the boulder riprap outlet apron cascade.

Crossing Site Information for PAD 731647					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	2.97	34.31983, -119.29287	± 10 ft	3.42

Pictures

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Catchment Basin Downstream of Culvert
(Looking Upstream)

Catchment Basin Downstream of Culvert
(Looking Downstream)

Upstream Channel
(Looking Downstream Towards Culvert Inlet)

Upstream Channel
(Looking Upstream Above Road Past Culvert)

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.41 mi²	Ventura River	115.5 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. It is highly unlikely that this stream currently supports *O. mykiss* considering it has a small drainage area, lacks a defined downstream channel, and is primarily located in an industrial area. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
12/02/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Pipe Culvert	1	Unknown	Yes	No

Crossing Structure Description and Condition
This crossing structure is a small concrete pipe culvert. The outlet of culvert drains into a narrow concrete lined channel which leads into a downstream concrete lined catch basin. The inlet of the culvert was unable to be directly accessed due to be located within fenced off private property. From a distance, the culvert inlet appeared to have similar diameter/proportions as the outlet.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height**	**Mean Outlet Height**	**Mean Width**	**Length**	**Slope**
Culvert	Unable to measure	4 ft	4 ft	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel contained portions of concrete and boulder riprap lining as well as portions of dense vegetation. An additional concrete reinforced box culvert is present under North Ventura Avenue, located roughly 600 ft upstream of this highway 33 crossing structure. Upstream of North Ventura Avenue the stream channel appears to be contained an extended underground concrete reinforced box culvert. The inlet of this extended box culvert was not located. Much of the upstream channel is lined with a chain-link fencing.	Not Recorded	Not Recorded	Not Recorded

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
The culvert outlet drains into a concrete channel, which contained portions of woody debris at the time of assessment. The downstream concrete channel leads to a short plunge into a large concrete catch basin. The catch basin had no visible outlet, but likely is located at the base of the catch basin. Downstream of the catch basin the channel remains concrete lined. The extent of this concrete lining was not determined.	Concrete Catch Basin	Concrete catch basin is roughly 120 ft downstream of crossing structure outlet.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment.	None	Unknown, potential for impassable plunge points, outlet unit restrictions, streamflow depth, and streamflow velocity restrictions.

Longitudinal Profile Measurements
A longitudinal profile was not completed for this crossing structure due to the confined space restrictions of the crossing structure and upstream accessibility issues.

Crossing Structure Barrier Status
Total Barrier Upstream *O. mykiss* passage is not currently possible at this location. The downstream catch basin is clearly a total barrier to all life stages of *O. mykiss*. The highway 33 crossing structure culvert with upstream and downstream concrete channel lining is also likely impassable to all life stages of *O. mykiss*. Finally, the upstream concrete channel lining and box culverts are likely also total barriers.

Assessment and Analysis Limitations
The stream channel upstream of this crossing was not able to be accessed due to extensive fencing and private property. The total barrier status assigned to this crossing structure is based off professional judgement as FishXing passage analysis was unable to be performed. The small diameter and confined space of the culvert prevents the completion of a longitudinal profile associated with a detailed assessment.

Passage Improvement Recommendations
Due to the channel alterations upstream and downstream of the culvert, considerable efforts would be required to remediate the passage constraints at this location, including the removal of the downstream catch basin and upstream concrete channel lining and additional box culverts. Presence of viable upstream *O. mykiss* habitat is likely minimal and should be investigated before any barrier remediation efforts are enacted.

Crossing Site Information for PAD 732274					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	3.26	34.32360, -119.29211	± 13 ft	3.73

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Culvert Erosion

Outlet Apron Plunge Point

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Canada De Las Encinas Creek 0.53 mi²	Ventura River	119.6 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
12/2/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
12/2/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (only at outlet)	No

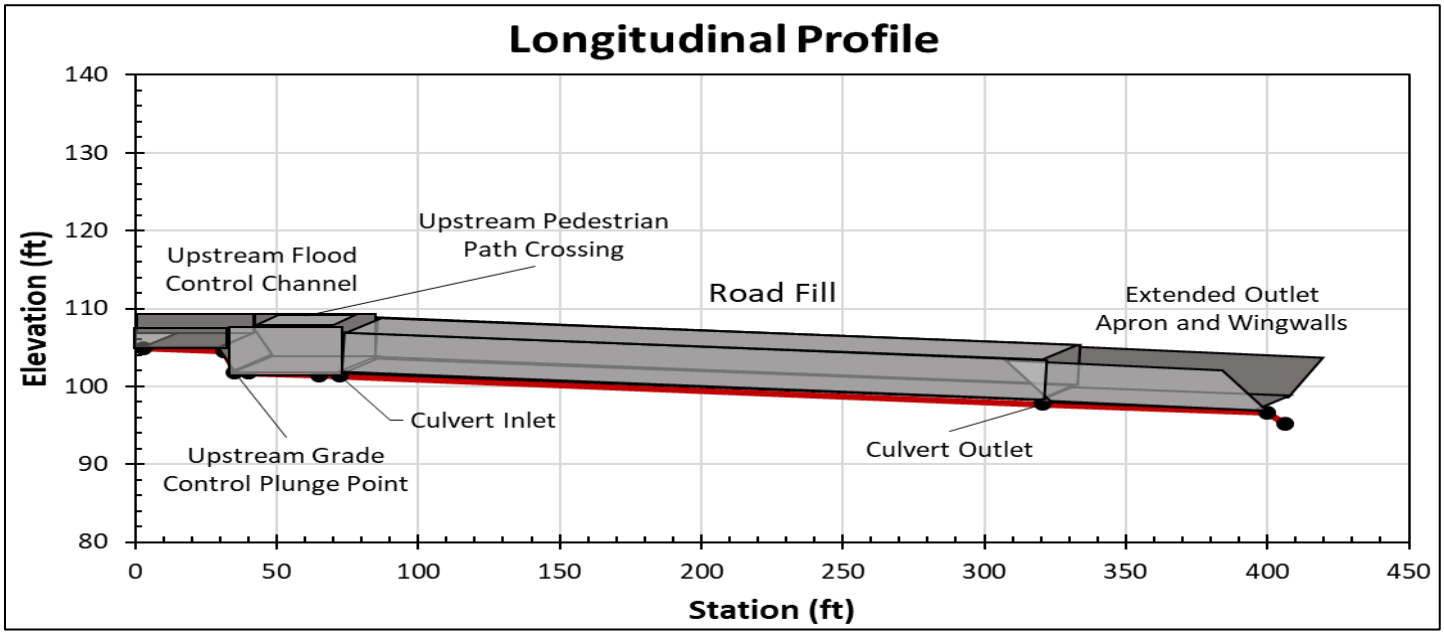
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with an extended outlet apron. The outlet apron has sloped walls and a short plunge point to the downstream substrate. The culvert has a curve to river right near its inlet and a curve to river left near its outlet. At the time of assessment, the culvert was partially embedded with sand. There were small areas of minor erosion damage on the culvert walls with portions of exposed rebar.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Upstream Flood Control Channel	n/a (open channel)	n/a (open channel)	6	1,414 (estimated)	5.1 % (estimated)
Culvert	6	6	6	248.4	1.5 %
Outlet Apron	n/a (open channel)	n/a (open channel)	8	79.4	1.3 %
Full Hwy 33 Crossing Structure	6	6	7	328	1.5 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel has been converted to a concrete lined flood control channel. Directly upstream of the culvert is an additional concrete reinforced box culvert under a pedestrian path. There is also a grade control plunge point roughly 36 ft upstream of the Hwy 33 culvert inlet. The mean height of this plunge point is 3 ft.	No upstream resting unit present.	No upstream resting unit present.	6 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained well defined active channel margins and short steep channel banks. The active channel was almost entirely composed of sand and lacked any areas of significant scour. The channel banks contained dense brush vegetation that was partially growing into the active channel.	Sand	3 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Extent of Transect Tape	3	104.89	Points located within a concrete flood control channel. No visible upstream rest pools.
Top of Upstream Grade Control	31.5	104.49	
Bottom of Upstream Grade Control	35.3	102.13	
Upstream Plunge Point	35.5	101.73	
Inlet of Upstream Box Culvert	40.3	101.67	
Outlet of Upstream Box Culvert	65.3	101.36	
Culvert Inlet	72.3	101.28	
Culvert Outlet	320.7	97.68	
Outlet Apron Point 1	356	97.14	
Outlet Apron Point 2	400.1	96.62	Downstream extent of concrete wingwalls.
Outlet Apron Point 3	400.3	96.28	
Outlet Apron Point 4 (downstream extent)	401	96.19	
Max Depth Downstream	401.2	95.24	Short vertical plunge from outlet apron. Same as
Tailwater Control Point	404	95.21	Control point not well defined.
Downstream Channel Point 1	406.5	95.11	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (two models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Hwy 33 Crossing Structure for Anadromous *O. mykiss* The first model is representative of the main Hwy 33 crossing structure box culvert and its extended downstream apron.	45.12 to 161.08	Insufficient Streamflow Depth
Inclusion of Upstream Flood Control Channel for Anadromous *O. mykiss* The second model incorporated the continuation of the upstream flood control channel and its 3.3 ft high grade control structure into fish passage analysis. This model is more representative of the entirety of conditions an *O. mykiss* would encounter in passage attempts as it accounts for the streamflow hydraulics occurring downstream, within, and upstream of the crossing structure. The length and slope of the upstream flood control channel was estimated with the use of the elevation profile and ruler tools in Google Earth.	None, entirety of Hwy 33 crossing structure and the upstream flood control channel is not passable to *O. mykiss*	Excessive Streamflow Velocity Insufficient Streamflow Depth Impassable Plunge Point
Resident *O. mykiss* Analysis for both Models	None	Excessive Streamflow Velocity Insufficient Streamflow Depth Impassable Plunge Point

Crossing Structure Barrier Status

Hwy 33 Crossing Structure – Temporal & Partial Barrier

The Hwy 33 culvert and its outlet apron was predicted to be passable to strong swimming anadromous *O. mykiss* under a specific range of streamflow, but not passable to resident life stages of *O. mykiss* under any rate of streamflow. For anadromous O. mykiss streamflow rates greater than 45.12 ft^3/s were predicted to provide adequate water depth for passage. Streamflow rates greater than 161.08 ft^3/s were predicted to prevent passage due to excessive hydraulic velocities.

Upstream Flood Control Channel - Total Barrier

When considering the continuation of the upstream concrete lined flood control channel and grade control structure this structure is a total barrier to all life stages of *O. mykiss*. The continuation of concrete channel lining upstream of the culvert eliminates any potential resting areas and increases streamflow velocity. Additionally, the 3.3 ft plunge from the upstream grade control is not passable as the concrete lining prevents sufficient water depth and conditions to allow *O. mykiss* to jump past the plunge point.

Assessment and Analysis Limitations

The only limitation experienced in assessing and performing fish passage analysis on this crossing structure was estimating the extend of the upstream flood control channel with the use of Google Earth.

Passage Improvement Recommendations

The most effective remediation option would be to remove the concrete flood control channel and grade control upstream of this crossing structure as well as the concrete base of the culvert.

Crossing Site Information for PAD 732171					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	3.76	34.33107, -119.29226	± 20 ft	4.2

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
1.17 mi²	Ventura River	133.7 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
2/25/20	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
2/25/20	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Reinforced Box Culvert	2 bays	1 (in each bay)	Yes (inlet and outlet)	No

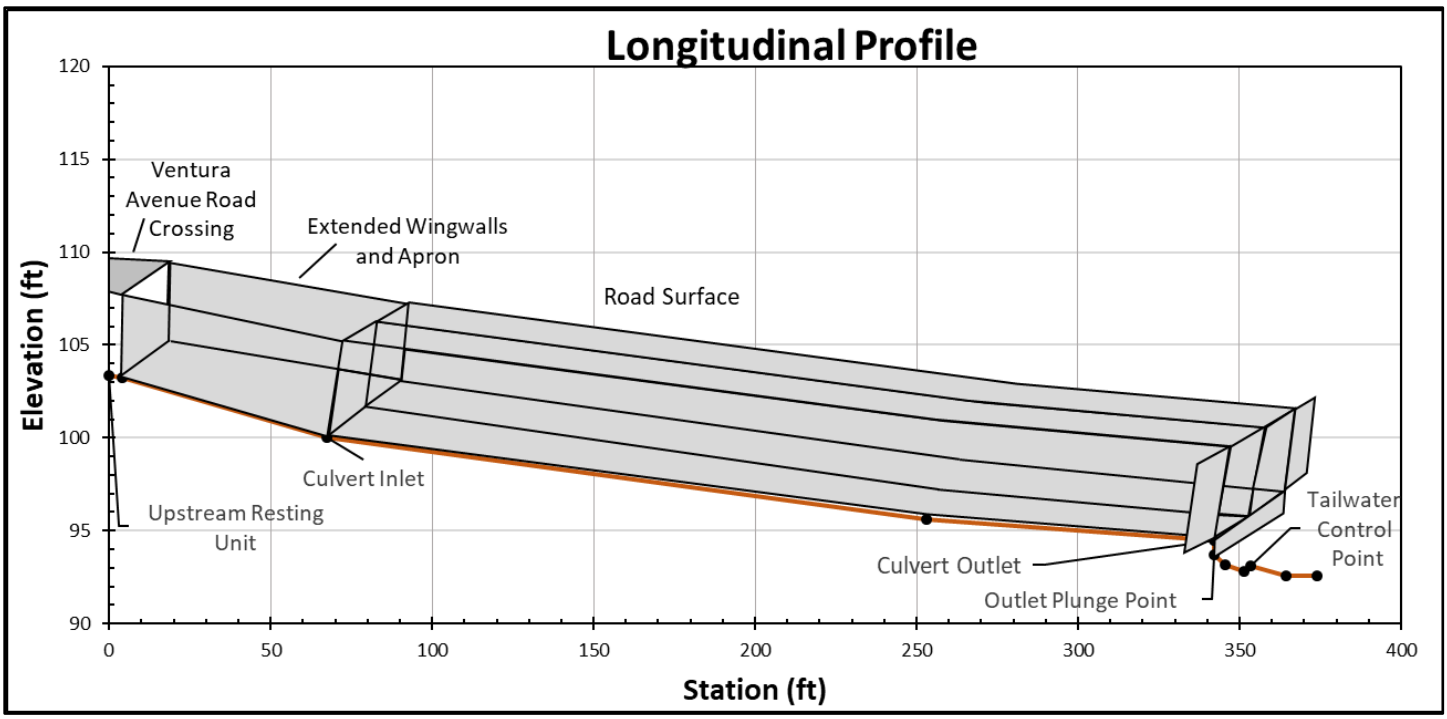
Crossing Structure Description and Condition
This crossing structure is a double bay concrete reinforced box culvert. The two bays are separated by a vertical concrete support wall. The culvert has an inconsistent curved slope which gradually decreases from the inlet to the outlet. The inlet has an extended concrete apron with vertical concrete wingwalls. The outlet contains a small headwall and a very short 0.8 ft plunge point from its outlet to the downstream substrate.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope** (mean)
Channelized Inlet Apron	n/a (open channel)	n/a (open channel)	10	63.4	5.1 %
Upstream Steep Portion of Culvert	5	5	10 (each bay is 5 ft wide)	185.6	2.4 %
Downstream Portion of Culvert	5	5	10 (each bay is 5 ft wide)	89	1.3 %
Full Culvert	5.2	5	10 (each bay is 5 ft wide)	274.6	2.0 %
Full Structure	5.2	5	10 (each bay is 5 ft wide)	338	2.6 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The inlet apron extends to the Ventura Avenue road crossing (not listed in PAD). The Ventura Avenue road crossing is a small box culvert with a natural streambed substrate base. Due to the natural substrate base the crossing is unlikely to place additional passage constrains on *O. mykiis*. Upstream of the Ventura Avenue road crossing the stream channel contained poorly defined active channel margins and steep incised channel banks. The channel consisted of sand and cobble and extended riffle units. The top of the channel banks contained sparse brush vegetation.	4 ft	0.1 ft	5.3 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained narrow and well defined active margins. The channel banks contained grass and were wide, low, and lined with cement brick channelization. The active channel contained extended narrow riffle units.	Sand	11.6 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	103.33	Located under Ventura Avenue Road crossing
Inlet Apron (upstream extent)	4	103.23	
Culvert Inlet	67.4	100	
Inside Culvert Point 1	253	95.63	
Culvert Outlet	342	94.46	
Outlet Plunge Point	342.1	93.69	
Downstream Max Depth (within 5 ft of structure)	345.6	93.16	
Downstream Max Depth	351.4	92.83	
Tailwater Control Point	353.6	93.13	
Downstream Channel 1	364.4	92.58	Within extended riffle unit.
Downstream Channel 2	374	92.58	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (two models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
<u>Full Structure Analysis for Anadromous *O. mykiss*</u> This crossing was modeled in FishXing as a single box culvert, with the width of 10ft, the added width of both culvert bays in the structure. The upstream channelization inlet apron was incorporated into the length and slope of the model. The length of the culvert in this model 338.1 and the slope is 2.59 %.	93.28 – 155.56	Insufficient Streamflow Depth Outlet Unit Restriction
<u>Partial Structure for Anadromous *O. mykiss*</u> Due to the inconsistent slope across the base of the structure this model was used to analyze the variation of passage conditions within the structure. This model analyzed the steeper upstream portion of the structure including the upstream channelization inlet apron. The length of the culvert in this model was 249 ft with a slope of 3.5 %.	108.74 - 213.41	Insufficient Streamflow Depth Outlet Unit Restriction
<u>Resident *O. mykiss* Analysis for both Models</u>	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Outlet Unit Restriction

Crossing Structure Barrier Status
Temporal & Partial Barrier This crossing structure was predicted to be passable to strong swimming anadromous *O. mykiss*, but not resident life stages of *O. mykiss*. Between the two models used for analysis in FishXing adequate water depth was predicted to occur when streamflow rates were greater than 108.74 ft^3/s. Streamflow velocity was predicted to prevent passage when above 155.56 ft^3/s. The estimated annual mean peak streamflow rate at this crossing is 133.72 ft^3/s so conditions conducive to passage likely rarely occur. Additionally, due to the flashy nature of streamflow in southern California streams any occurrence of conditions conducive to possible passage have a short duration.

Assessment and Analysis Limitations
There were no limitations in assessing this crossing structure. Passage analysis limitations included the inconsistent base slope of the structure because FishXing analysis assumes the structure maintains a consistent slope from its inlet to outlet. Additionally, FishXing is unable to assess culverts with multiple bays, so this crossing structure was modeled and analyzed as if it contained a single large culvert bay. This modeling neglects the influences on streamflow hydraulics from the center concrete support divider within the structure.

Passage Improvement Recommendations
The most effective option to remediate the passage constrictions at this crossing would be to replace it with a free spanning bridge over natural streambed substrate. Installing weirs or other fishway structures may be a secondary option to improve passage conditions.

Crossing Site Information for PAD 705650					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	4.28	34.33856, -119.29213	± 9 ft	4.76

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Downstream Flood Control Channel/Outlet Apron

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Canada Larga Creek 19.24 mi^2	Ventura River	1,870.7 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
02/14/20	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
02/14/20	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	2 bays	1 (in each bay)	Yes (only at inlet)	No

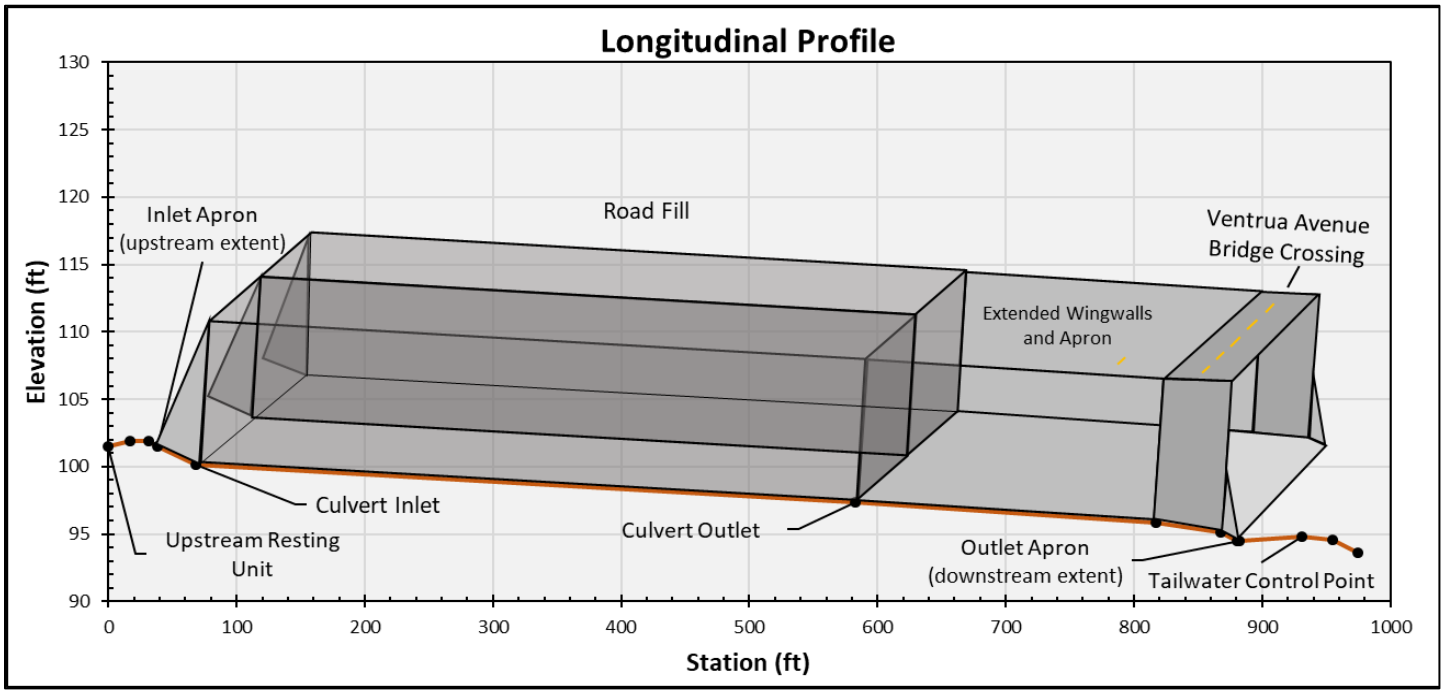
Crossing Structure Description and Condition
This crossing structure is double bay side by side concrete reinforced box culvert. At the time of assessment both bays were partially embedded with sand and silt. The inlet contains short parallel wingwalls with the concrete dividing wall located between them. A wide and long extension of parallel wingwalls with a concrete apron between them extends from the culvert outlet. These wingwalls and apron extend just downstream of the Ventura Avenue bridge crossing. The culvert contained some minor erosion damage along its base near the inlet, but otherwise appeared to be in good condition.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	24	19.4	7.1 %
Culvert	12	12	24	514.7	0.5 %
Outlet Apron	n/a (open channel)	n/a (open channel)	32	297.7	0.1 %
Full Structure	n/a (open channel)	n/a (open channel)	28	842.7	0.8 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins with steep channel banks. The active channel contained extended riffles with small pools between them. The channel banks contained grass and dispersed small tress. A residential area was located above the river left channel bank.	38 ft	0 ft	12.52 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained well defined active channel margins and wide low channel banks. The active channel contained cobble and gravel in long extended riffle units. The channel banks contained dense brush and dispersed small trees.	Sand	No downstream control point present at time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	101.51	
Upstream Channel Point 1	17	101.91	
Upstream Channel Point 2	31	101.87	
Inlet Apron (upstream extent)	38	101.51	
Culvert Inlet	68.3	100.14	
Culvert Outlet	583	97.35	
Inlet of Downstream Bridge	817	95.88	Bridge passes over Hwy 33 crossing structure outlet apron concrete channelization.
Outlet of Downstream Bridge	867.7	95.12	
Outlet Apron Channelization (downstream extent)	880.7	94.52	
Downstream Max Depth	882	94.48	Same point as downstream max depth within 5 ft of structure.
Tailwater Control Point	931	94.78	
Downstream Channel Point 1	955	94.6	Within extended riffle unit.
Downstream Channel Point 2	975	93.58	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing was modeled in FishXing as a single box culvert with the width of 24ft, the added width of both culvert bays in the structure. The inlet apron and downstream channelization/extended outlet apron were incorporated into the length and slope of the model. Despite the structure including portions of embedded substrate the culvert roughness coefficient was not increased because the concrete base was exposed along the thalweg of streamflow throughout the structure.	133.17 – 503.17	Insufficient Streamflow Depth Excessive Streamflow Velocity
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was predicted to be passable to strong swimming anadromous *O. mykiss*, but not resident life stages of *O. mykiss*. Adequate water depth was predicted to occur when streamflow rates were greater than 133.17 ft^3/s. Streamflow velocity was predicted to prevent passage when above 503.17 ft^3/s.

Assessment and Analysis Limitations

There were no limitations in assessing this crossing structure. For analysis FishXing is unable to assess culverts with multiple bays, so this crossing structure was modeled and analyzed as if it contained a single large culvert bay. This modeling neglects the influences on streamflow hydraulics from the center concrete support divider within the structure.

Passage Improvement Recommendations

The most effective option to remediate the passage constrictions at this crossing would be to replace it with a free spanning bridge over natural streambed substrate. Installing weirs or other fishway structures may be a secondary option to improve passage conditions.

Crossing Site Information for PAD 731569					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	4.81	34.41782, -119.29317	± 9 ft	5.34

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Weldon Canyon Creek 2.12 mi^2	Ventura River	145.4 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
09/23/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/23/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (only at outlet)	No

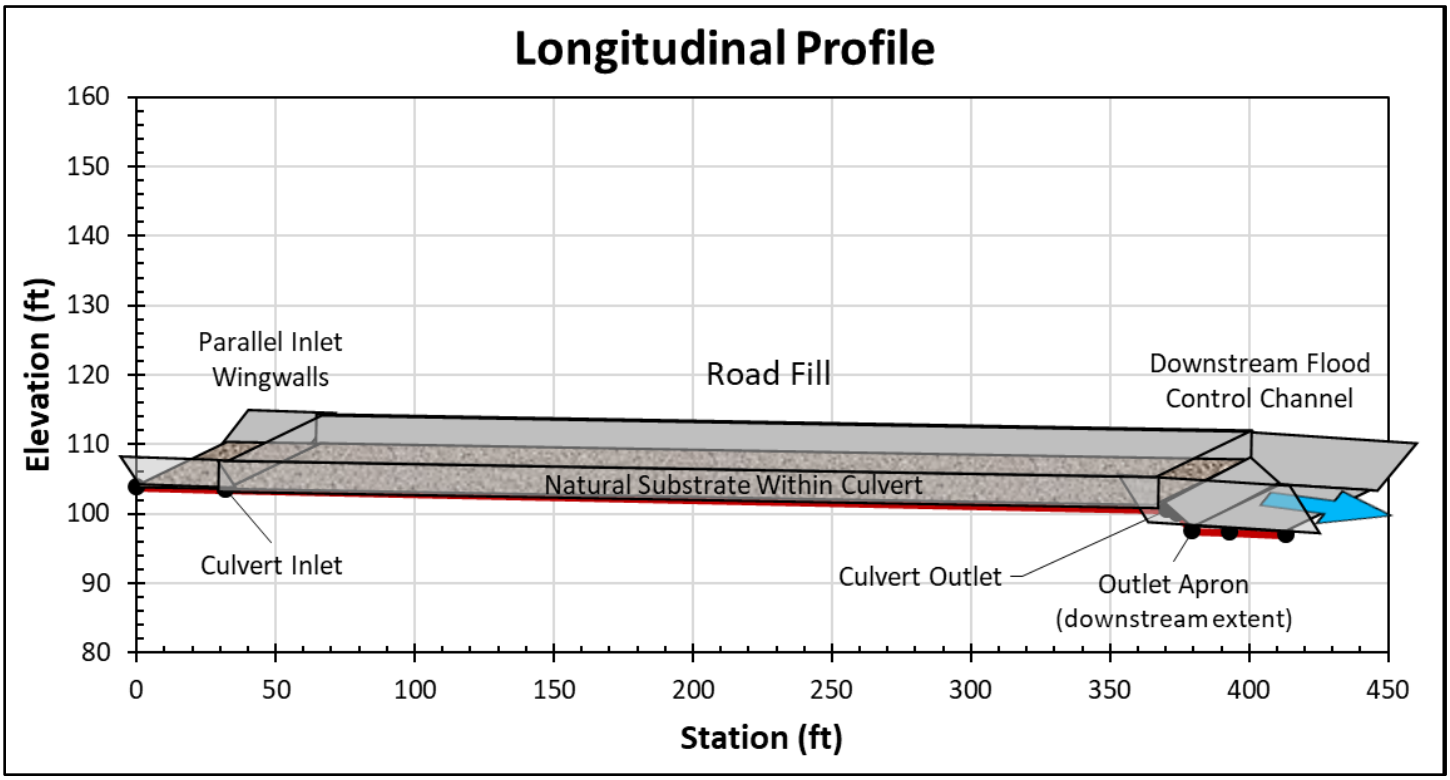
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with concrete channel walls wingwalls extending upstream of the inlet. The outlet contains wingwalls and a steep concrete apron. The outlet apron leads to a concrete lined flood control channel. The base of the culvert contains natural sand and silt streambed substrate. The structure appeared to be in good condition with no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	5.2	5	15.5	338.58	1.0 %
Outlet Apron	n/a (open channel)	n/a (open channel)	18	8.86	31.0 %
Full Structure	5.2	5	16	347.44	1.7 %
Downstream Flood Control Channel	n/a (open channel)	n/a (open channel)	20	1,667 (estimated)	2.1 % (estimated)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margin with a flat streambed lacking areas of scour and consisting of sand and silt substrate. The channel banks were lined with concrete walls. The extent of these concrete channel walls was not determined. Brush and chaparral vegetation were present above the channel walls.	No upstream resting unit present at time of assessment	No upstream resting unit present at time of assessment	10.3 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
The downstream channel has been converted to a concrete lined flood control channel. From Google Earth analysis this flood control channel appears to extend downstream roughly 0.25 miles.	Concrete	No downstream control point present at time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	103.8	No upstream resting unit present at time of assessment.
Upstream Channel Point 2	9.84	103.48	
Upstream Channel Point 3	26.25	103.44	
Culvert Inlet	32.15	103.38	
Culvert Outlet	370.73	100.05	
Outlet Apron Point 1	374.34	99.95	Substrate changes to concrete
Outlet Apron Point 2 (downstream extent)	379.59	97.43	
Downstream Channel Point 1	384.19	97.37	Within concrete lined flood control channel. No tailwater control point.
Downstream Channel Point 2	393.04	97.25	
Downstream Channel Point 3	403.54	97.08	
Downstream Channel Point 4	413.39	96.88	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (three models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Hwy 33 Crossing Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled within FishXing as box culvert. A culvert roughness coefficient of 0.18 was used to represent the natural substrate base within the culvert.	125.14 - 348.71	Insufficient Streamflow Depth
Hwy 33 Culvert Outlet Apron Analysis for Anadromous *O. mykiss* Due to its steep slope a model was used to assess the passage of the outlet apron. The outlet apron was modeled as a box culvert.	> 182	Insufficient Streamflow Depth Excessive Streamflow Velocity
Inclusion of Downstream Flood Control Channel Analysis for Anadromous *O. mykiss* This model included the estimated length and slope of the downstream concrete lined flood control channel. This model also used a box culvert shape. The length of the culvert within this model was 1,667 ft with a slope of 2.05%.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units
Resident *O. mykiss* Analysis for all Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Hwy 33 Crossing Structure: Temporal & Partial Barrier

The Hwy 33 crossing structure and its outlet apron was predicted to be passable to strong swimming anadromous *O. mykiss* under specific rates of streamflow, but not to resident life stages of *O. mykiss*. Water depth was predicted to allow for potential passage when streamflow rates were greater than 182 ft^3/s and streamflow velocity was predicted to prevent potential passage when streamflow rates are greater than 348.71 ft^3/s.

Inclusion of Downstream Flood Control Channel: Total Barrier

When the conditions in the downstream flood control channel were considered in FishXing passage analysis the entirety of the flood control and crossing structure was predicted to be impassible to all life stages of *O. mykiss*. FishXing predicted a streamflow velocity barrier would occur to strong swimming anadromous *O. mykiss* at rates of streamflow greater than 136.22 ft^3/s and a water depth barrier would occur under streamflow rates of 114 ft^3/s.

Assessment and Analysis Limitations

The main limitation experienced in assessing and analyzing this crossing structure was the flood control channel downstream of the crossing structure. The length and slope of this flood control channel were estimated through the use of the elevation profile and ruler tools within Google Earth. Another analysis limitation was the slope variance between the Hwy 33 culvert and its outlet apron. FishXing analysis assumes a uniform slope throughout each structure so this full structure analysis is based off the mean slope of the entirety of the structures base. To account for this FishXing analysis was also performed specifically for the outlet apron.

Passage Improvement Recommendations

Removing the concrete outlet apron and downstream flood control would greatly improve fish passage conditions. However, replacing this structure with a free spanning bridge and restoring the natural stream channel would likely produce the best results.

Crossing Site Information for PAD 731216					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	4.83	34.34657, -119.29518	± 9 ft	5.45

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Unnamed 0.098 mi^2	Ventura River	31.2 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Current presence of *O. mykiss* within this stream is highly unlikely considering its lack of definable stream channel, small drainage area, and the intermittent streamflow conditions it appears to experience. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
09/16/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (inlet and outlet)	No

Crossing Structure Description and Condition
This crossing structure is a low clearance concrete reinforced box culvert. Parallel wingwalls with a slope of 45 % are present at the inlet and outlet. Concrete inlet and outlet aprons are located between the wingwalls. The structure appeared to be in good condition with no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	8	35	Not measured
Culvert	3	3	8	Unable to measure	Unable to measure
Outlet Apron	n/a (open channel)	n/a (open channel)	8	64	Not measured

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from inlet)	**Height to Resting Unit** (from inlet)	**Mean Upstream Active Channel Width**
The upstream channel is flat and poorly defined. The upstream area appears to have been formed to serve as drainage for an agricultural field. Thick grass and brush were present across the channel. No areas of suitable *O. mykiss* habitat were visible.	Not Recorded	Not Recorded	Not Recorded

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
An additional low clearance double bay concrete reinforced box culvert (under North Ventura Avenue) is located immediately downstream of this highway 33 crossing structure. Downstream of the additional box culvert the stream channel drains into an agricultural field and becomes undefined.	Concrete	A defined tailwater control point was not present at the time of assessment.

Longitudinal Profile Measurements
Longitudinal profile data was not collected for this crossing structure because it didn't meet the criteria for a Caltrans detailed fish passage assessment due to the lack of a defined stream channel. Additionally, the crossing structure contains confined space.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment	None	Unknown, potential for insufficient streamflow depth restriction.

Crossing Structure Barrier Status
Total Barrier Upstream *O. mykiss* passage attempts are highly unlikely to occur at this crossing structure, due to the lack of a defined downstream stream channel. However, if an *O. mykiss* were able to gain access to this crossing structure it likely would not be able to gain passage. This professional judgement assessment is based on the likelihood of streamflow velocity barriers caused by the extended length of the concrete lining upstream and downstream of the culvert and its moderate slope.

Assessment and Analysis Limitations
No limitations were experienced with the completion of a Caltrans reconnaissance fish passage assessment. A detailed fish passage assessment was not conducted due to the lack of defined stream channel downstream and upstream of the crossing. Without FishXing modeling and fish passage analysis the barrier status of the crossing structure was determined through professional judgement.

Passage Improvement Recommendations
Due to the absence of a defined upstream and downstream channel barrier remediation efforts are not recommended for this crossing structure. If barrier remediation is conducted the most effective option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 731512					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	6.4	34.36379, -119.30774	± 25 ft	6.9

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 1.57 mi²	Ventura River	139.5 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
09/16/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/16/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	No	No

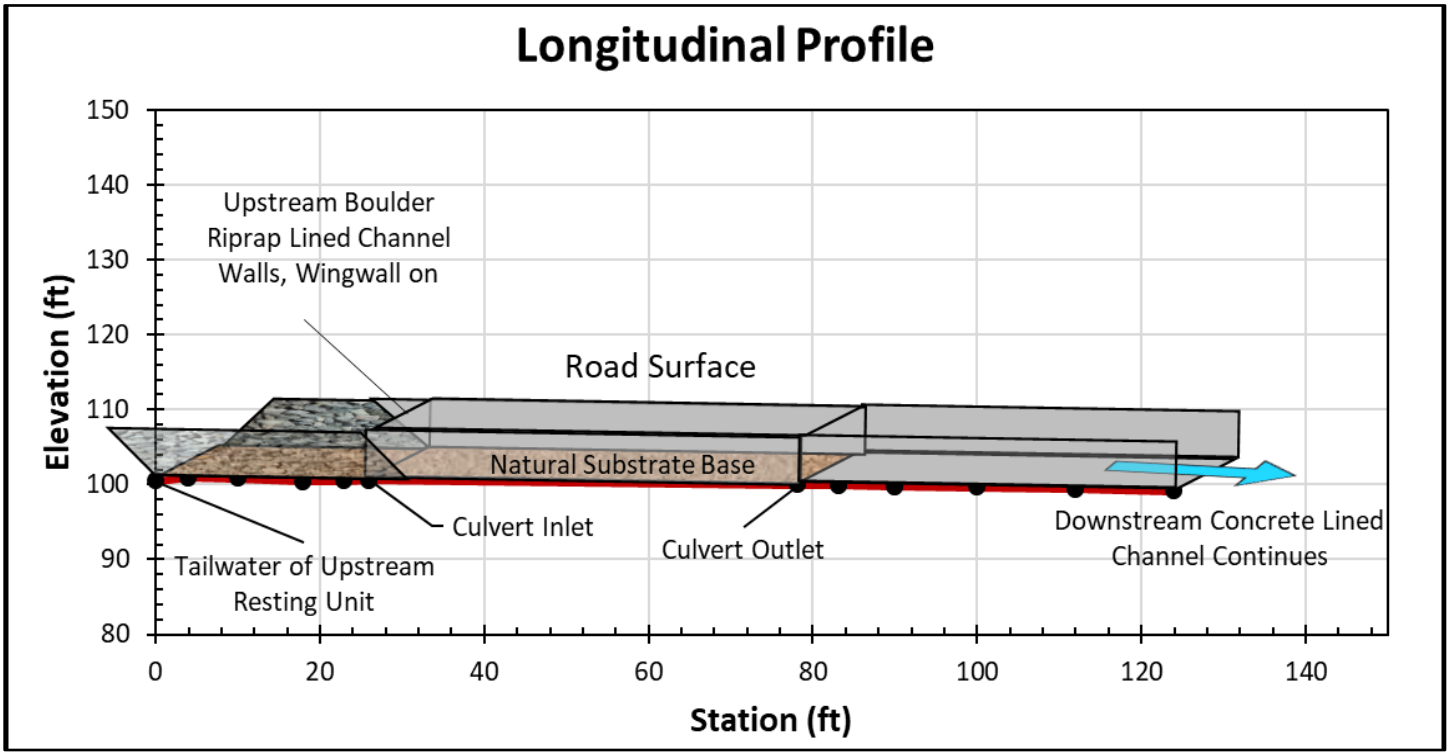
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with a natural streambed substrate which leads into a fully concrete lined flood control channel. This flood control channel acts as an extended outlet apron. The outlet of a small road drainage culvert (PAD ID 731756) is positioned within the side wall of the crossing structure. The crossing structure appeared to be in good condition at the time of assessment with no visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Hwy 33 Box Culvert	5.6	6 ft	12 ft	52.2 ft	1 %
Downstream Flood Control Channel	n/a (open channel)	n/a (open channel)	12 ft (estimated)	660 ft (estimated)	2.6 % (estimated)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from inlet)	**Height to Resting Unit** (from inlet)	**Mean Upstream Active Channel Width**
The upstream channel contains boulder riprap on both channel banks creating a defined active channel margin. There was very little vegetation on the channel banks dominant streambed substrates were boulders and large cobble. A private free spanning bridge is located a short distance upstream.	26 ft	0 ft	19.22 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel has been converted to concrete lined flood control channel.	Concrete	A defined tailwater control point was not present at the time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	100.45	
Upstream Channel Point 1	4	100.85	
Upstream Channel Point 2	10	100.82	
Upstream Channel Point 3	18	100.36	
Upstream Channel Point 4	23	100.43	
Culvert Inlet	26	100.5	
Culvert Outlet	78.2	99.98	
Downstream Channel Point 1	83.2	99.86	A distinct downstream max depth is not present due to the uniform shape of the concrete lined channel
Downstream Channel Point 2	90	99.71	Point chosen for tailwater cross section to represent the shape of the downstream channel
Downstream Channel Point 3	100	99.61	
Downstream Channel Point 4	112	99.33	
Downstream Channel Point 5	124	99.1	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (three models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Hwy 33 Crossing Structure Analysis for Anadromous *O. mykiss* This model is representative of the measurements collected from the detailed assessment of the box culvert structure under Hwy 33. A culvert roughness coefficient of 0.024 was utilized to account for the natural streambed substrate in the culvert.	67.21 – 1,413	Insufficient Streamflow Depth
Hwy 33 Crossing Structure Analysis for Resident *O. mykiss* This model uses the same structure inputs as the model used for anadromous *O. mykiss* but assesses the swimming abilities for adult resident *O. mykiss*.	17.44 – 55.12	Insufficient Streamflow Depth Excessive Streamflow Velocity
Analysis of Downstream Flood Control Channel for all *O. mykiss* Life Stages This model attempts to assess the conditions predicted to occur within of the flood control channel downstream of the Hwy 33 box culvert crossing. The flood control channel was modeled as an extended box culvert. In this model it is assumed the flood control channel maintains a width of 12 ft. Length and slope of the flood control channel was estimated with the use of the elevation profile and ruler tools in Google Earth. A constant tailwater was used for this model as a tailwater control profile was not completed downstream of the flood control channel. This model is more representative of the conditions an upstream migrating *O. mykiss* would encounter as it accounts for the streamflow hydraulics occurring downstream of the Hwy 33 box culvert crossing structure.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units

Crossing Structure Barrier Status

Hwy 33 Crossing Structure: Temporal Barrier

FishXing passage analysis predicted this Hwy 33 culvert to be passable to both resident and anadromous life stages of *O. mykiss* under specific ranges of streamflow. Streamflow rates above 17.44 ft^3/s were predicted to provide adequate water depth for resident *O. mykiss* passage, while streamflow rates above 67.12 ft^3/s were predicted to provide adequate water depth for anadromous *O. mykiss*. Streamflow rates above 55.12 ft^3/s were predicted to create hydraulic velocities preventing resident passage while streamflow rates above 1,413 ft^3/s were predicted to prevent anadromous passage.

Inclusion of Downstream Flood Control Channel: Total Barrier

FishXing predicts both resident and anadromous life stages of *O. mykiss* could gain passage through the highway 33 crossing box culvert when adequate streamflow is present (> 67.21 ft^3/s). However, when the dimensions of the downstream flood control channel are factored into FishXing passage analysis this structure is predicted to be impassable to all life stages of *O. mykiss*. The main factor limiting *O. mykiss* passage is the absence of resting areas within the concrete lined flood control channel. This likely causes any *O. mykiss* attempting to gain passage to reach exhaustion.

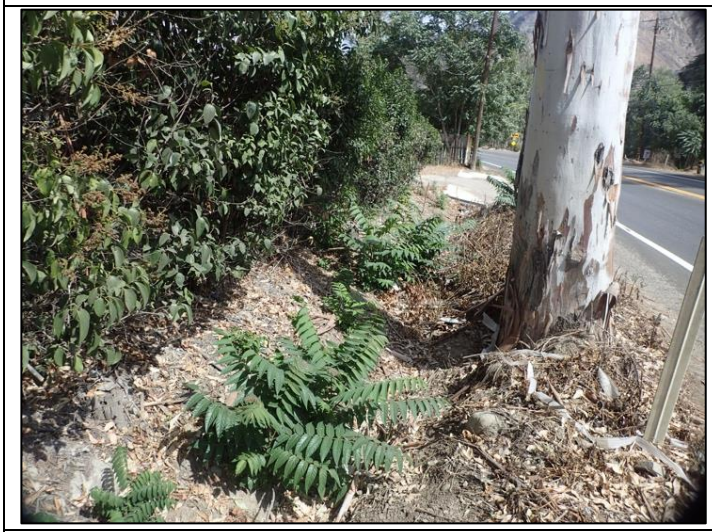
Assessment and Analysis Limitations
The extent of the downstream flood control channel was the primary limitation experienced in assessing this crossing structure. Due to its length the longitudinal profile completed for this structure did not cover the full extent of the downstream flood control channel. Therefore, the length and slope of the flood control channel was estimated with the use of the elevation profile and ruler tools in Google Earth.

Passage Improvement Recommendations
The most effective barrier remediation action would be to remove the concrete base lining the downstream flood control channel and replace it with natural streambed substrate. The full extent of the downstream flood control channel should also be surveyed prior to any remediation efforts taking place.

Crossing Site Information for PAD 731756					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	6.5	34.36529, -119.30667	± 10 ft	7.0

Pictures

Upstream Looking Upstream



Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.23 mi^2	Ventura River	35.1 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. It is highly unlikely that this stream currently supports *O. mykiss* considering it has a small drainage area and lacks a defined upstream channel. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
09/16/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Corrugated Metal Pipe Culvert	1	Unknown	Yes (only at inlet)	No

Crossing Structure Description and Condition
This crossing structure is a small corrugated metal pipe culvert. The inlet of the culvert has a small apron and wingwalls with trash rack crossbars located on top of the wingwalls. The culvert appears to run underground parallel to highway 33. The outlet of the culvert is encased within the wall of a separate highway 33 crossing structure (PAD ID 731512), which is a concrete reinforced box culvert. The primary function of the culvert appears to be for roadway water runoff. The inlet trash rack has minor damage, but the rest of the culvert appears to be in good condition.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	2.3	5.5 ft	Not measured
Culvert	2.1	3	Unknown	600 ft (estimated)	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel is narrow and appears to be a small ditch to channel water runoff from highway 33. There was minimal vegetation within the channel at the time of assessment.	Not Recorded	Not Recorded	1.5 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Downstream Control Point Distance from Structure**
The downstream channel has been converted to a concrete lined flood control channel with vertical walls and a flat bottom.	Concrete	No defined tailwater control point present at time of assessment.

Longitudinal Profile Measurements
A longitudinal profile was not able to be conducted for this crossing structure due to the confined space restrictions.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment.	None	Unknown, potential for streamflow depth and impassable cascade restrictions.

Crossing Structure Barrier Status
Total Barrier Upstream *O. mykiss* passage is not considered to be possible at this location. The trash rack located above in the inlet wingwalls would block any *O. mykiss* attempting to gain passage. Additionally, the small size of the culvert would likely create a streamflow velocity barrier.

Assessment and Analysis Limitations
No limitations were experienced with the completion of a Caltrans reconnaissance fish passage assessment. Due to the small size of the culvert, a longitudinal profile could not be completed and FishXing passage analysis could not be performed. The barrier status assigned to this crossing structure was determined through professional judgement.

Passage Improvement Recommendations
Due to the absence of a defined upstream channel and the structure serving primarily for roadway drainage barrier remediation efforts are not recommended.

Crossing Site Information for PAD 731637					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	9.9	34.41229, -119.29472	± 9 ft	10.8

Pictures

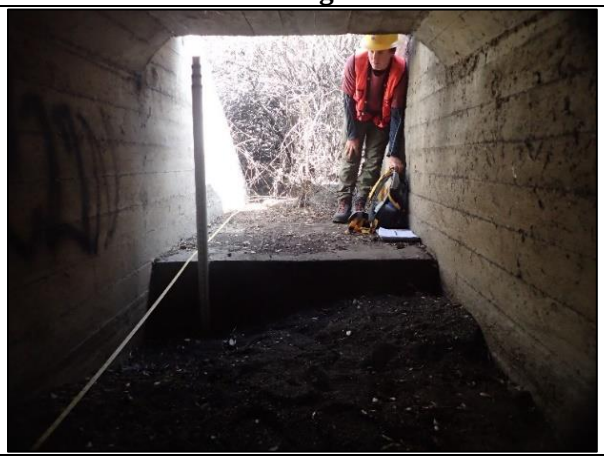
Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Grade Control Plunge within Culvert



Downstream Concrete Pipe Culvert

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.02 mi²	Ventura River	24.6 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. It is unlikely this stream currently supports *O. mykiss* when considering its small watershed, low estimated annual mean peak streamflow, and channel conditions present during the assessment. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
9/23/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
2/12/20	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (inlet and outlet)	No

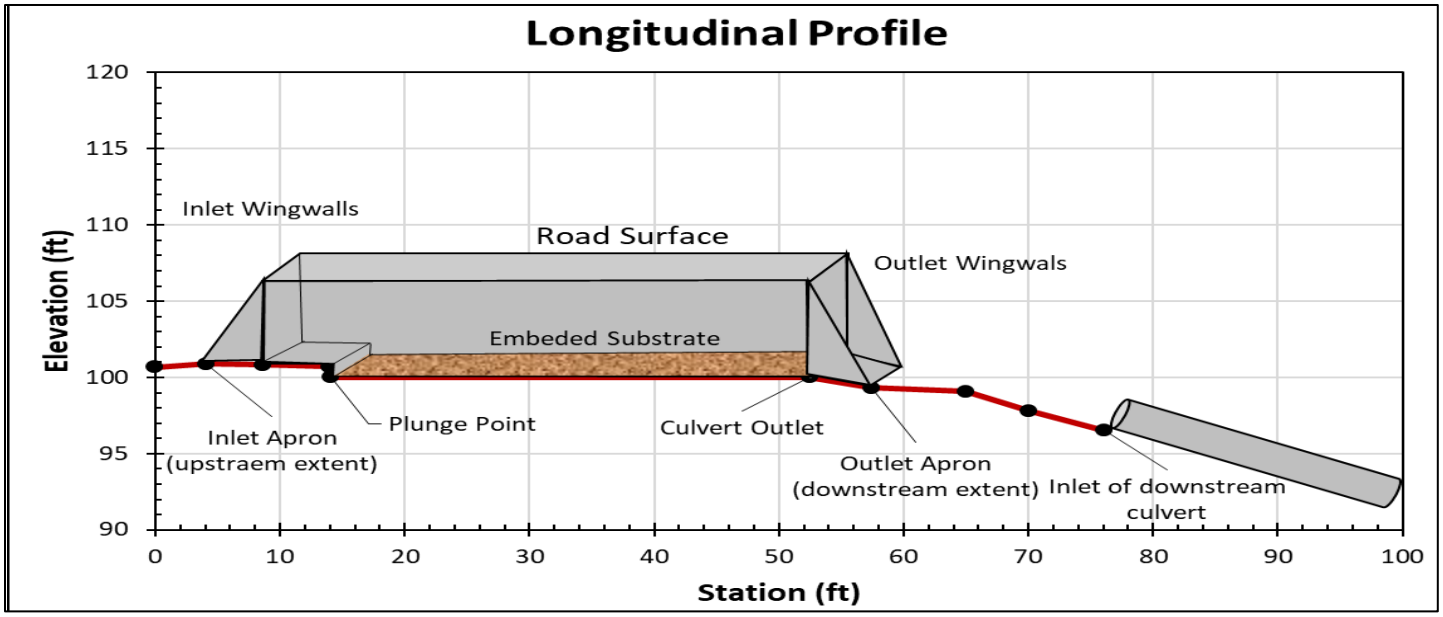
Crossing Structure Description and Condition
This crossing structure is a small concrete reinforced box culvert. Short parallel wingwalls are located at the inlet and outlet with concrete aprons located between them. There is a small plunge point with a height of 0.7 ft located 5.4 feet from the inlet. The culvert was partially embedded with gravel substrate downstream of this plunge point. The culvert appeared to be in good condition at the time of assessment, with no visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	5	4.5	0.9 %
Culvert	5	3.9	5	43.9	1.9 %
Outlet Apron	n/a (open channel)	n/a (open channel)	5	5	14.1 %
Full Structure	5	3.9	5	53.3	2.9 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained a very small and poorly defined active channel margins. The channel was primarily composed of silt and clay in extended riffle units. The channel banks were small and contained very dense brush. This brush has grown over and into the active channel.	No upstream resting unit present.	No upstream resting unit present.	3 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
A small concrete pipe culvert is located just 18.7 ft from the outlet of the Hwy 150 culvert. This pipe culvert is small (3ft diameter) and has a concrete inlet apron. The extent of the pipe culvert was not able to be determined, but due to its steep slope and small size likely is a total barrier to all life stages of *O. mykiss*.	No control point present at time of assessment.	No control point present at time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	100.68	Upstream channel is overgrown and obscured with brush vegetation.
Inlet Apron (upstream extent)	4.1	100.88	
Culvert Inlet	8.6	100.84	
Culvert Outlet	52.5	100	
Outlet Apron (downstream extent)	57.4	99.33	
Downstream Channel Point 1	65	99.07	
Downstream Channel Point 2	70	97.81	
Inlet of Downstream Pipe Culvert	76.1	96.52	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing was modeled in FishXing as a box culvert. The inlet and outlet aprons were incorporated into the length and slope of the model. Due to FishXing limitations the plunge point created from the small grade control structure located within the culvert was applied to the outlet within the model.	38.95 – 195.04	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was predicted to be passable to strong swimming anadromous *O. mykiss* under a specific range of streamflow, but not resident life stages of *O. mykiss*. Adequate water depth was predicted to occur when streamflow rates were greater than 38.95 ft^3/s. The plunge point within the structure was predicted to be impassable when streamflow rates were greater than 195.04 ft^3/s. Streamflow velocity was predicted to prevent passage when above 498.64 ft^3/s. This small stream was estimated to have an annual mean peak streamflow rate of 24.59 ft^3/s so conditions allowing for passage of this structure likely rarely occur.

Assessment and Analysis Limitations

There were no limitations in assessing this crossing structure. FishXing is only capable of modeling plunge points from the outlet of a structure, so the plunge point within this culvert was modeled as if it was located at the outlet for the structure for fish passage analysis.

Passage Improvement Recommendations

The most effective option to remediate the passage constrictions at this crossing would be to replace it with a free spanning bridge over natural streambed substrate. However, the downstream concrete pipe culvert is likely a total barrier and should be remediated prior to any remediation efforts being conducted on this structure.

Crossing Site Information for PAD 731138					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	10.3	34.41782, -119.29317	± 9 ft	11.10

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.916 mi^2	Ventura River	129.3 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
09/23/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/23/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	No	No

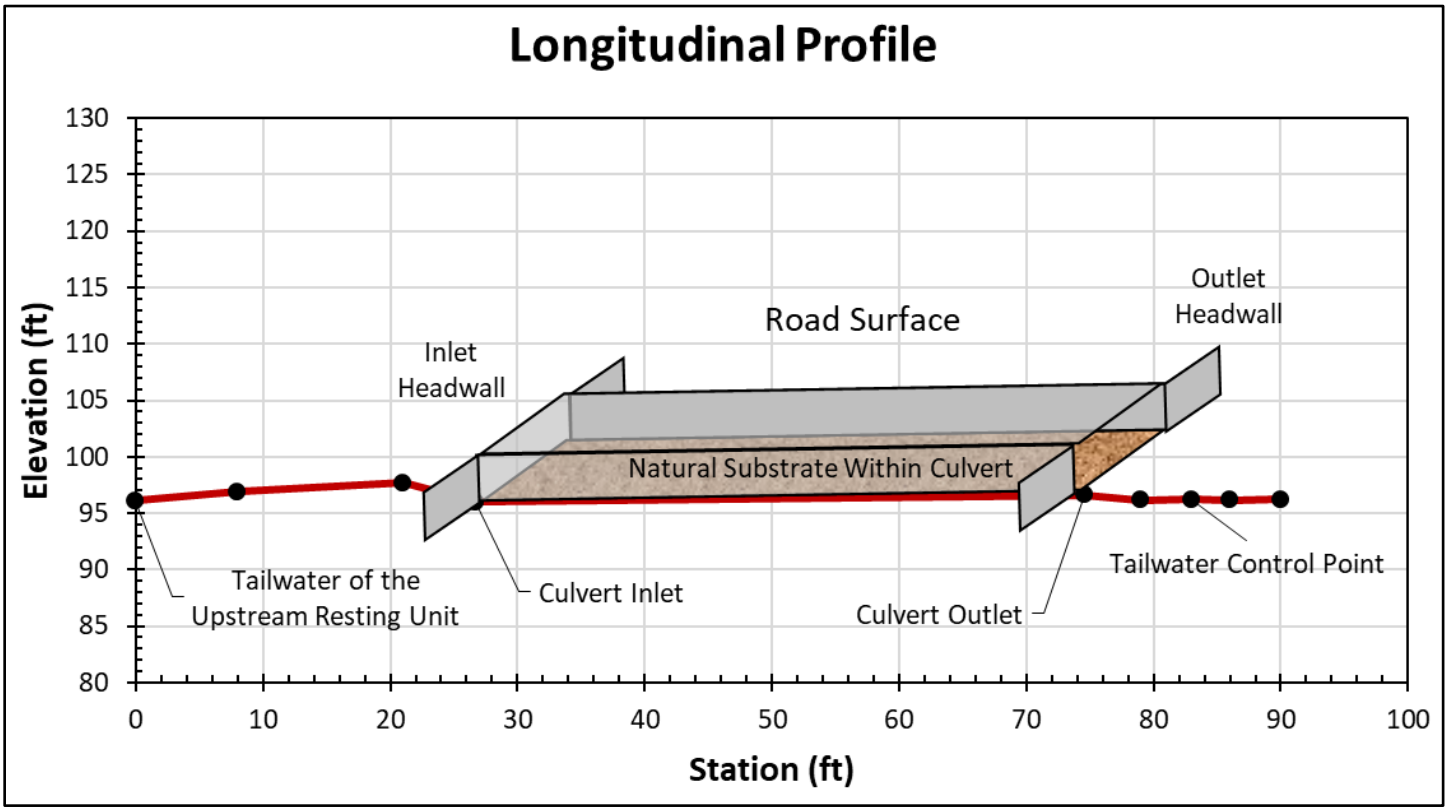
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with concrete headwalls at its inlet and outlet. The base of the contains natural streambed substrate, improving the conditions for fish passage through the structure. It could not be determined if the natural substrate is embedded and covering a concrete base. The structure appeared to be in good condition with no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	3.8	3.5	10	47.9	-1.3 % (outlet is higher than inlet)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained dense vegetation with vines and shrubs. This vegetation was obstructing the active channel margins which were poorly defined, indicating that this channel rarely experiences high rates of streamflow. Additionally, the active channel contained extended riffle units with minimal areas of scour. The channel banks were small and contained dense vegetation.	26.7 ft	0.14 ft	10.2 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Downstream Control Point Distance from Structure**
An additional concrete reinforced box culvert is located directly downstream of this Hwy 33 crossing structure. This additional box culvert runs under a paved bike path. Downstream of this additional culvert the channel runs through an urbanized residential area with little surrounding vegetation. The channel contains a defined banks and active margins, but little scour and extended riffle units. It appears unlikely the area would support *O. mykiss* and would be detrimental to any upstream migration attempts.	Sand	8.4 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	96.12	
Upstream Channel Point 1	8	96.9	
Upstream Channel Point 2	21	96.67	
Culvert Inlet	26.7	95.98	
Culvert Outlet	74.6	96.62	
Downstream Max Depth	79	96.16	Same as max depth point within 5 ft of the structure.
Tailwater Control Point	83	96.23	
Downstream Channel Point 1	86	96.14	
Downstream Channel Point 2	90	96.23	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rate < estimated annual mean peak flow rate)
<u>Analysis for Anadromous *O. mykiss*</u> This crossing structure was modeled as a box culvert. A culvert roughness coefficient of 0.02 was used to represent the natural substrate base present in the culvert at the time of assessment.	8.78 - 817.31	Insufficient Streamflow Depth
<u>Analysis for Resident *O. mykiss*</u> No changes were made to the modeled crossing structure parameters.	8.78 - 75.14	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status
Temporal Barrier
This crossing structure was predicted to be passable to both anadromous and adult resident life stages of *O. mykiss* when adequate rates of streamflow are present. A streamflow velocity barrier was predicted to occur for anadromous *O. mykiss* at streamflow rates greater than 817.31 ft^3/s and a streamflow rates greater than 75.14 ft^3/s for resident *O. mykiss*

Assessment and Analysis Limitations
The only limitation for conducting a full detailed assessment on this crossing structure was determining the embeddedness of the substrate underneath the culvert. It could not be determined if there is concrete under the embedded substrate.

Passage Improvement Recommendations
The structure does not pose as an immediate barrier to migrating fish. However, remediation efforts would be better suited towards the bike path crossing and the altered stream channel directly downstream of the culvert.

Crossing Site Information for PAD 759838					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	12.18	34.44898, -119.27193	± 18 ft	13.8

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Segment 1 to 2 Change Point

Downstream Looking Downstream
(Culvert Outlet)

No picture taken

Downstream Looking Downstream
(Downstream of Outlet Flood Control Channel)

Downstream Looking Upstream
(Downstream extent of Flood Control Channel)

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.29 mi²	McDonald Canyon Creek	36.2 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. Considering the low estimated annual mean peak streamflow and channel conditions upstream and downstream of this crossing structure it is unlikely that this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
10/03/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/03/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Pipe & Box Culvert	1	2	Yes	No

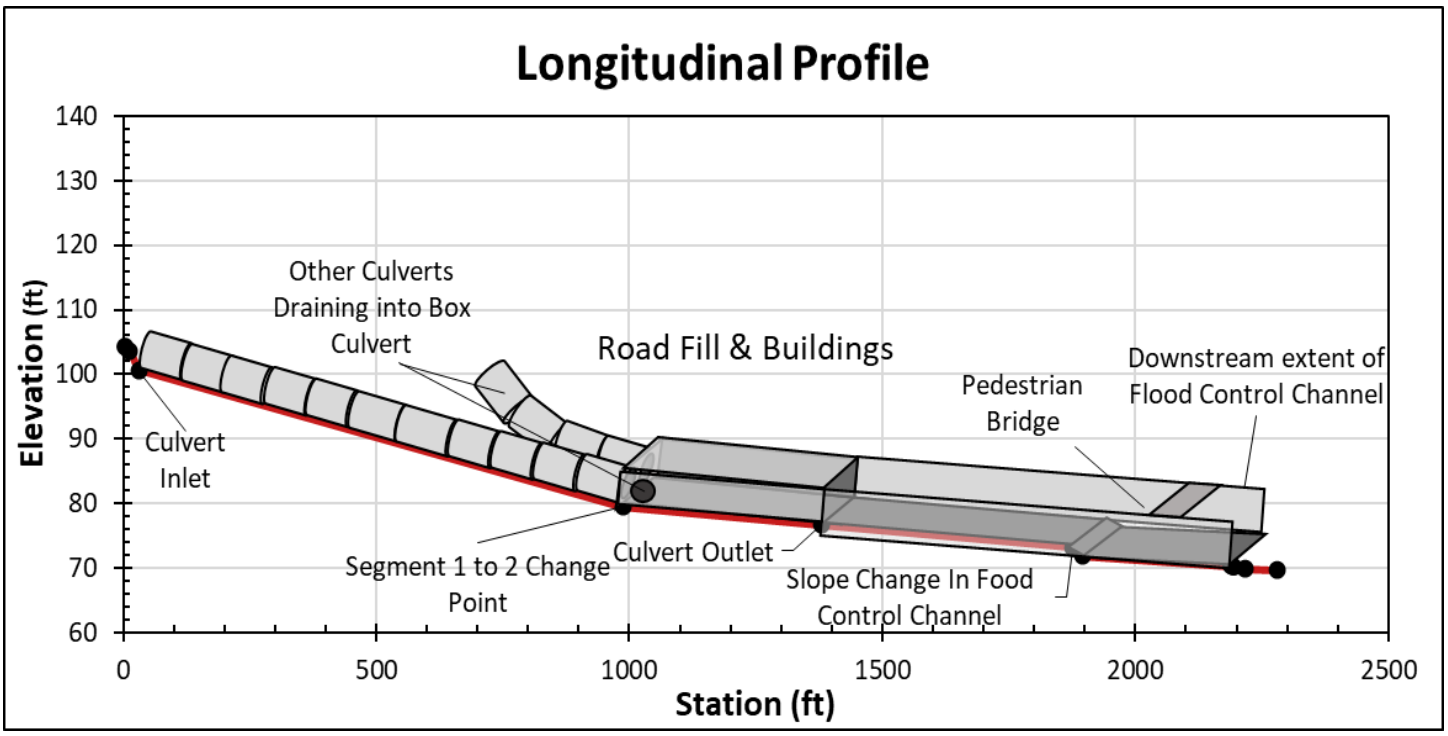
Crossing Structure Description and Condition
This crossing structure is a long concrete pipe culvert that drains into a concrete reinforced box culvert. The inlet contains a short apron between parallel slopped wingwalls. A concrete lined flood control channel is located at the outlet. An additional pipe culvert of a similar size also drains into the box culvert portion of the structure. Several smaller pipe culverts drain into the box culvert and downstream flood control channel. The system of culverts sits underneath several roads, buildings, and residencies. No areas of significant damage were visible within the system of culverts at the time of assessment.

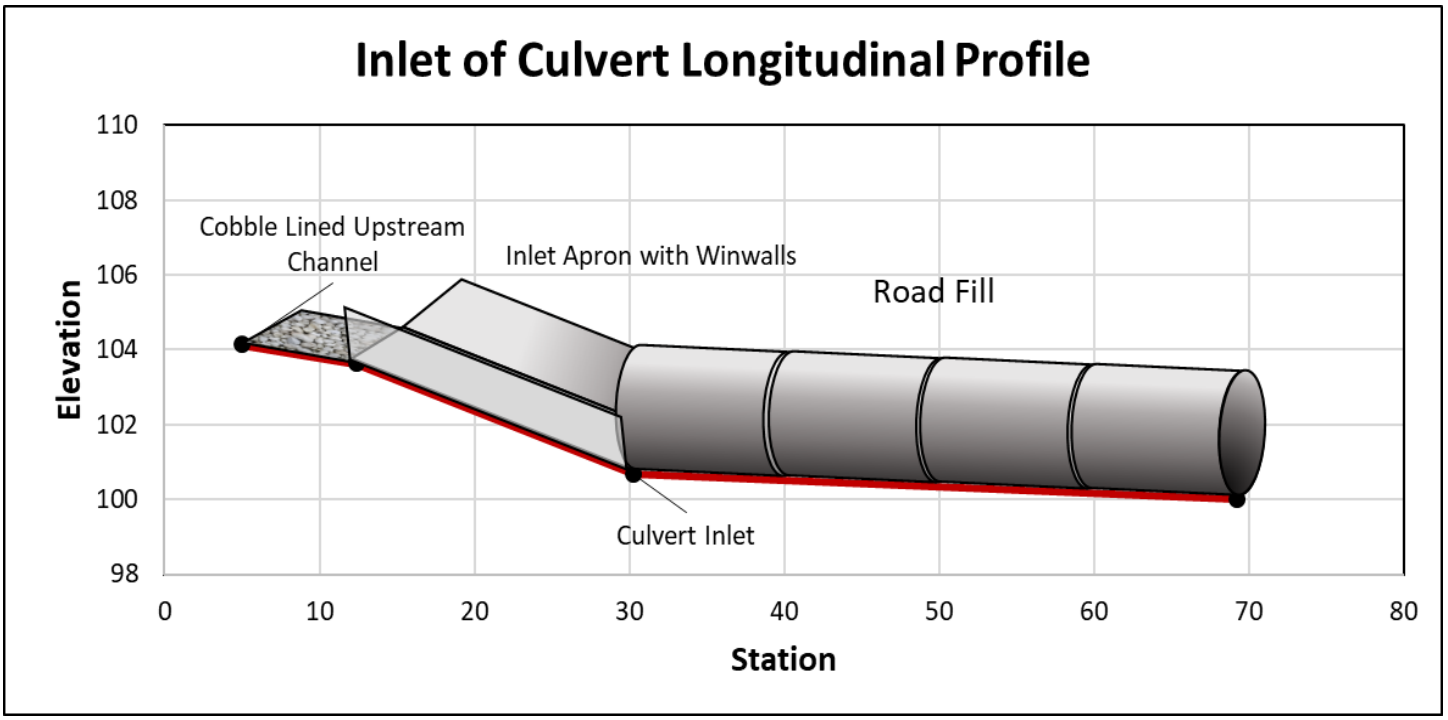
Crossing Structure Dimensions					
Segment (shape)	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	5 (at base)	17.9	2.6 %
1 (pipe culvert)	5.4	5.4	5	956.7	2.2 %
2 (box culvert)	5.1	5.1	15	393.4	0.7 %
Downstream Flood Control Channel	n/a (open channel)	n/a (open channel)	15	810	0.8 %
Full Structure	5.4	5.1	10	2,190.4	1.4 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel has been converted into a cemented cobble flood control channel with vertical walls. The extent of this cobble channel lining was not determined.	No resting unit visible	No resting unit visible	8 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel has been converted into a concrete lined flood control channel with vertical walls. This flood control channel extends downstream for roughly 810 ft. Downstream of the flood control channel the stream has been graded into a uniform shape with a flat bottom and sloped channel walls. It appeared this grading had been completed recently as there was no vegetation present within the channel.	Sand	A defined tailwater control point was not present at the time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	5	104.12	
Inlet Apron (upstream extent)	12.4	103.62	
Culvert Inlet	30.3	100.67	
Segment 1 to 2 Change Point	987	79.47	Additional concrete pipe culvert joins box culvert segment at same location.
Culvert Outlet	1380.4	76.63	
Downstream Flood Control Channel Point 1	1875.4	73.19	Slope change in concrete lined channel
Downstream Flood Control Channel Point 2	1895.4	71.87	Slope change in concrete lined channel
Downstream Flood Control Channel Point 3	2190.4	70.26	Downstream extent of flood control channel
Downstream Max Depth	2195.4	70.06	Same point as max depth within 5 ft of the structure.
Downstream Channel 1	2217.4	69.87	Channel has been graded into uniform shape. No tailwater control point present.
Downstream Channel 2	2280.4	69.69	


Longitudinal Profile
Elevation (ft)
140
130
120
110
100
90
80
70
60
0
500
1000
1500
2000
2500
Station (ft)
Other Culverts Draining into Box Culvert
Road Fill & Buildings
Pedestrian Bridge
Downstream extent of Flood Control Channel
Culvert Inlet
Segment 1 to 2 Change Point
Culvert Outlet
Slope Change In Food Control Channel


Inlet of Culvert Longitudinal Profile
Elevation
110
108
106
104
102
100
98
0
10
20
30
40
50
60
70
80
Station
Cobble Lined Upstream Channel
Inlet Apron with Winwalls
Road Fill
Culvert Inlet

FishXing Passage Analysis		
Description of Structure Modeling within FishXing (four models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for all *O. mykiss* Life Stages This crossing structure was modeled within FishXing as both a box culvert and pipe culvert. The mean width of the structure was used as the width within both models. Additionally, the length of the inlet apron and outlet flood control channel were factored into the model.	Pipe Culvert Model None Box Culvert Model None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units
Segment 1 Analysis for all *O. mykiss* Life Stages This segment was modeled as a pipe culvert.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity
Segment 2 & Downstream Flood Control Channel Analysis for all *O. mykiss* Life Stages This segment and flood control channel were modeled as a box culvert.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Total Barrier

This crossing structure was predicted to be impassable to all life stages of *O. mykiss*. The excessive length of the structure would cause any *O. mykiss* to reach exhaustion in any attempts to gain passage. Among all models the mean velocity barrier for strong swimming *O. mykiss* was streamflow rates greater than 42.42 ft^3/s while the mean depth barrier was streamflow rates less than 68.58 ft^3/s.

Assessment and Analysis Limitations

There were several limitations experienced in assessing and analyzing this culvert. The main limitation in assessing this structure were the multiple other culverts which entered the structure. These other culverts were not assessed. As a result the impact these additional culverts have on fish passage abilities was not able to be analyzed. Additionally, FishXing is unable to model culverts which contain more than one shape and thus this crossing structure was analyzed as both a box and pipe culvert.

Passage Improvement Recommendations

Remediating this crossing would require a significant amount of stream, road, and city modifications due to the large area of land it covers. Restoring the natural streambed and replacing the culvert with several free spanning bridges would be the most effective option for improving fish passage. However, due to the amount of properties and land that this culvert is located under, completely restoring the channel and removing all of the concrete lining does not seem feasible. Installing a fishway or weirs within the culvert may improve passage, but with the excessive length and multiple inlets, it is likely that upstream migrating fish could get lost or reach fatigue. Beyond the immediate downstream channel, the stream crosses through more urbanized areas which would also need to be remediated.

Crossing Site Information for PAD 731881						
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location** (at outlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	12.83	34.45666, -119.27377	34.45670, -119.28455	± 9 ft	14.01

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Main Inlet)

Upstream Channel Next to Hwy 33

Secondary Culvert Inlet Next to Hwy 33

Downstream Looking Downstream

Downstream Looking Upstream
(Culvert Outlet)

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
McDonald Canyon Creek 0.874 mi^2	Ventura River	128.4 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
10/03/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
System of Concrete Reinforced Box and Pipe Culverts	Unknown, appears structure contains multiple culverts	Unknown, structure has multiple segments	Yes (inlet and outlet)	No

Crossing Structure Description and Condition
This crossing structure is part of a large system of concrete reinforced box and pipe culverts. The system of culverts is located centered under Fairview Road and is estimated to be roughly 0.4 miles in length. The main culvert has several inlets, with one next to Hwy 33. Two other inlets are further up Fairview Rd, with large concrete boxes and plunges into the inlet. At the time of assessment, one of the inlets along Fairview Rd had an empty reservoir. A steep flat ramp is located near the culvert system outlet. Parallel concrete wingwalls extend from the outlet. A concrete apron containing small debris deflectors is located between the wingwalls. Downstream the wingwalls the apron contains boulder concrete riprap and channel walls. The total length of the outlet apron is 96 ft. No significant damage was visible within this culvert system at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Aprons	n/a (open channels)	n/a (open channels)	Inlet aprons widths vary	Inlet aprons lengths vary	Inlet aprons slopes vary
Culvert Structure	Culvert inlet sizes vary. The largest inlet has a height of 8 ft.	4	12 (main culvert)	2,000 (estimated)	Unable to measure
Outlet Apron	n/a (open channel)	n/a (open channel)	12	96	Not measured

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel also appeared to have been altered. It is uniformly shaped and relatively flat with minimal vegetation present. The channel banks are low and contain boulder riprap. At the time of assessment, the active channel margins were well defined and consist of extended riffle units with scattered small pool units.	Gravel	Not Recorded

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit**	**Height to Resting Unit**	**Mean Upstream Active Channel Width**
Several channels and drainages flow into this crossing structure and culvert drainage system. All channels appeared unlikely to contain viable *O. mykiss* habitat. The largest stream channel contained a small amount of streamflow and appeared heavily altered as it contained a uniform shape and lack of vegetation on its banks. There was some aquatic vegetation growing within the channel. The dominant substrates were cobble and sand in extended riffle units. The channel located closest to Hwy 33 is also uniformly shaped and sits between several houses. The dominant substrate was sand, and little vegetation was present on the channel banks.	Not measured in any of the upstream channels.	Not measured in any of the upstream channels.	Not measured in any of the upstream channels.

Longitudinal Profile Measurements
A longitudinal profile was not completed due to confined space restrictions, extensive length, and the presence of multiple inlets.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
<u>Analysis for all *O. mykiss* Life Stages</u> This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment.	Unknown, structure is likely not passable under any rate of streamflow.	Unknown, passage through this structure is likely restricted by lack of streamflow depth, excessive streamflow velocity, and lack of resting areas.

Crossing Structure Barrier Status
<u>Total Barrier</u> This system of culverts is clearly a total barrier to all life stages of *O. mykiss*. The extended outlet apron and steep flat ramp leading to it likely create streamflow velocity barriers. Additionally, the length of the structure eliminates resting areas for any *O. mykiss* attempting to gain passage.

Assessment and Analysis Limitations
A longitudinal profile could not be completed for this crossing due to the excessive length, areas of confined space, and presence of multiple inlets. The total barrier status assigned to this crossing structure is based off professional judgement as FishXing passage analysis was unable to be performed.

Passage Improvement Recommendations
Considerable actions would be required to remediate the passage constraints present within this culvert system structure. Remediation efforts would also be costly and complicated considering the infrastructure present above the culvert system. Presence of viable upstream *O. mykiss* habitat should be investigated before any barrier remediation efforts are enacted.

Crossing Site Information for PAD 731416					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	13.27	34.46225, -119.28180	± 10 ft	14.25

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Inside Erosion

Downstream Looking Upstream
(downstream of fence)

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.02 mi²	Cozy Dell Creek	76.3 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. However, considering the low estimated annual mean peak streamflow for this stream and the poor habitat conditions upstream and downstream of this crossing it is unlikely this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
10/03/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Corrugated Steel Pipe Culvert	1	1	No	No

Crossing Structure Description and Condition
This cross structure is a small corrugated steel pipe culvert. The culvert contains erosion and rust along its base with exposed road fill sediment visible at its inlet. The inlet is encased within a small concrete headwall. The culvert becomes gradually more embedded from inlet to outlet. The outlet is nearly fully embedded and projects slightly from the road fill.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	4	1.4 (due to embedded substrate)	4	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained narrow and poorly defined active channel margins with small channel banks with moderate brush and tree vegetation. Some of this vegetation was growing over and into the active channel margins.	Not Recorded	Not Recorded	5.3 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel also contained narrow and poorly defined active channel margins with small channel banks. The channel banks contain dense grass and sporadic trees. Grass vegetation was also present within the active channel margins. A chain link fence crosses the channel a short distance downstream of the culvert outlet.	Sand	Not Recorded

Longitudinal Profile Measurements
A longitudinal profile was not completed due to confined space restrictions at the crossing structure. The heavy erosion damage inside the culvert, with its small diameter, and embedded substrate made it dangerous and difficult to extend a transect tape through the culvert.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile.	This structure is likely not passable under any rate of streamflow.	Unknown, potential for impassable cascades, streamflow depth, streamflow velocity restrictions.

Crossing Structure Barrier Status
Total Barrier This culvert is likely impassable to all life stages of *O. mykiss* under its current condition. The embedded substrate and damage along the base of the culvert likely creates turbulent streamflow conditions.

Assessment and Analysis Limitations
Due to the small diameter, embedded substrate, and heavy erosion inside this culvert, a Caltrans detailed fish passage assessment could not be completed. As a result the barrier status assigned to this crossing is based upon professional judgement instead of FishXing passage analysis.

Passage Improvement Recommendations
The most effective remediation option would be to remove and replace this culvert with a free spanning bridge over natural substrate.

Crossing Site Information for PAD 732130					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	14.58	34.47897, -119.29077	± 19 ft	15.63

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Bridge Inlet)

Downstream Looking Upstream (Bridge Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Sheldon Canyon Creek 0.73 mi^2	Ventura River	125.3 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008.)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/3/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Free Spanning Bridge	n/a	1	No	No

Crossing Structure Description and Condition
This crossing structure is a free spanning bridge (Caltrans Bridge Number 52 0042) over natural streambed substrate. The channel banks under the bridge contain boulder riprap. The crossing structure was in good condition with no visible damage or erosion at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope** (substrate below bridge)
Bridge	9.7	11.3	75	27.1	5.7 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained a steep gradient (> 3%) with well-defined active channel margins and steep small channel banks. Dense chaparral vegetation covers the channel banks and the active channel contains some established vegetation. The dominate streambed substrates were large cobble and boulders within extended riffle units and small areas of scour.	21.5 ft	0.38 ft	17.7 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel splits a short distance from the crossing structure with two distinct active channel margins and maintains a steep gradient. Significant chaparral vegetation was present on moderate channel banks. This vegetation was also partially established within the active stream channel margins. Dominate streambed substrates were large cobble and boulders at the time of assessment.	Cobble	10.4 ft

Longitudinal Profile Measurements
A longitudinal profile was not completed because the bridge was assessed to be free of *O. mykiss* passage constraints.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This structure was not modeled in FishXing because it was assessed to be free of passage constraints and not a barrier during the Caltrans Reconnaissance Fish Passage Assessment.	All streamflow levels	None

Crossing Structure Barrier Status
Not a Barrier This structure was assessed to be free of passage constraints and is not believed to restrict the movement of *O. mykiss*.

Assessment and Analysis Limitations
There were no limitation experienced in completing a Caltrans reconnaissance first pass fish passage assessment on this bridge.

Passage Improvement Recommendations
The structure does not pose as an immediate concern for fish passage. Continual monitoring for the development of fish passage constraints is advised.

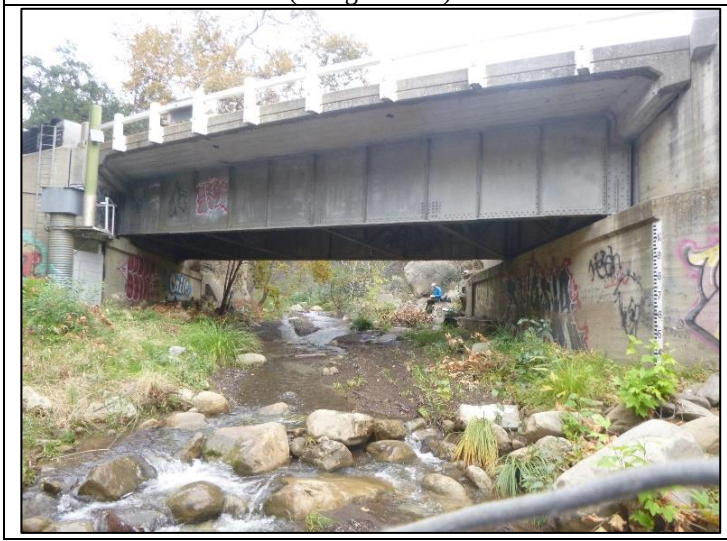
Crossing Site Information for PAD 732341					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	16.14	34.49274, -119.30638	± 9 ft	16.84

Pictures

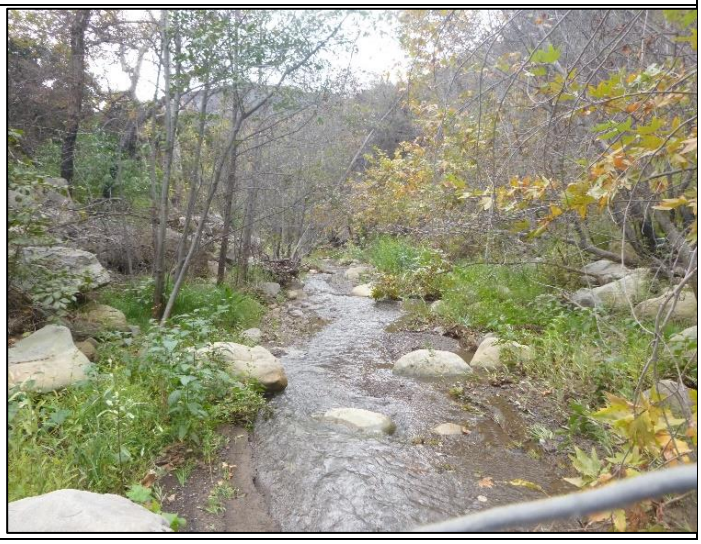
Upstream Looking Upstream

Upstream Looking Downstream
(Bridge Inlet)

Downstream Looking Upstream
(Bridge Outlet)



Downstream Looking Downstream



Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
North Fork Matilija Creek 15.89 mi^2	Ventura River	1,237.0 ft^3/s	There are extensive records of *O. mykiss* being supported within North Fork Matilija Creek. Records indicate heavy fishing and occurrences of hatchery stocking of *O. mykiss*. A recent study of the genetic structure of southern California *O. mykiss* found reports that North Fork Matilija Creek population is more closely related to populations upstream from the Matilija Dam than to other populations considered in the study (Girman and Garza, 2006; NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
12/10/18	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information			
Structure Type	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Free Spanning Bridge	1	No	No

Crossing Structure Description and Condition
This crossing structure is a free spanning bridge (Caltrans Bridge Number 52 0173) over natural streambed substrate. The bridge has vertical concrete walls on each side of the channel. The bridge appeared to be in good condition with no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Bridge	9.5	11.2	Not measured	Not measured	Not measured

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins and low wide channel banks. The channel consisted primarily of riffle units with a few small pool units. The channel banks contained grass and numerous trees. Cobble, gravel, and scattered boulders made up the channel substrate.	Not measured	Not measured	14 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained the same characteristics as the upstream channel.	Gravel	Not measured

Longitudinal Profile Measurements
A longitudinal profile was not completed for this structure because it did not meet the criteria for a Caltrans detailed fish passage assessment.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was not modeled in FishXing because it was assessed to be free of passage constraints and not a barrier during the Caltrans Reconnaissance Fish Passage Assessment	All streamflow levels	None

Crossing Structure Barrier Status
Not a Barrier This free spanning bridge was assessed to not contain fish passage constraints and is not believed to limit *O. mykiss* upstream movement.

Assessment and Analysis Limitations
There were no assessment or analysis limitations experienced for this crossing structure.

Passage Improvement Recommendations
This crossing structure does not require remediation actions in its current condition.

Crossing Site Information for PAD 731600					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	19.82	34.52008, -119.27143	± 15 ft	20.32

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.15 mi²	Cannon Creek	100.8 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
12/05/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
12/05/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (inlet and outlet)	No

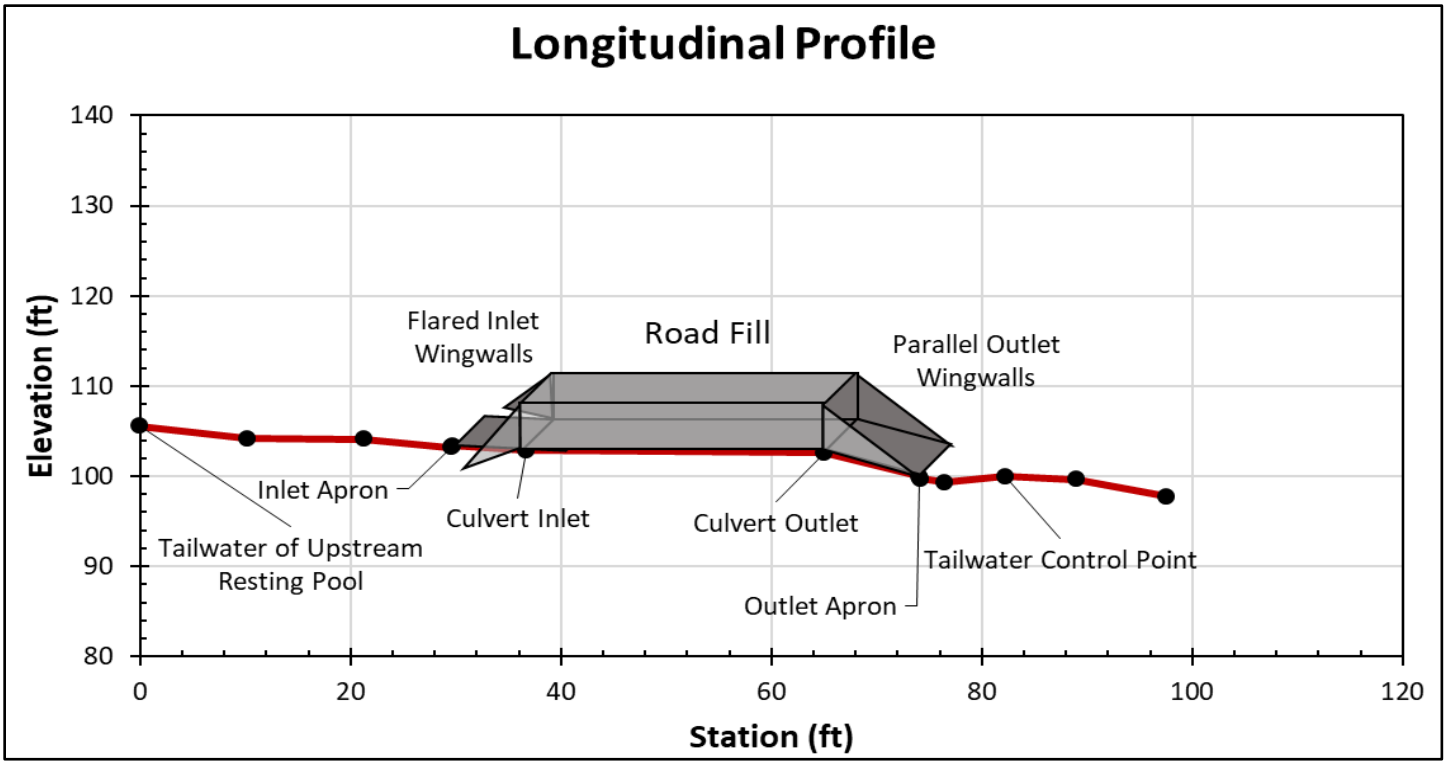
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with flared inlet wingwalls and parallel outlet wingwalls. Concrete aprons are located between the inlet and outlet wingwalls. At the time of assessment, the walls of the culvert contained some minimal erosion and small cracks. Additionally, a small PVC pipe runs through the culvert. It was not clear what the purpose of this pipe was. The crossing structure appeared to be in good condition with no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	5	7	7.3 %
Culvert	5	5	5	28.3	7.9 %
Outlet Apron	n/a (open channel)	n/a (open channel)	7.5	9.2	9.7 %
Full Structure	5	5	5.5	44.4	7.7 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins and small channel banks with dense chaparral vegetation. The channel was comprised of small boulders, cobble, and gravel with small scour pools located within extended riffle units. A small road run off scour channel entered the main stream channel a short distance upstream of the crossing structure inlet.	29.7 ft	2.19 ft	9.82 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained well defined active channel margins and small channel banks with dense chaparral and grass vegetation. The channel was primarily made up of silt, sand, and gravel in extended riffle units. A small scour pool was located immediately downstream of the crossing structure outlet apron.	Gravel	8.1 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Tailwater of Upstream Resting Unit	0	105.56	
Upstream Channel Point 1	10.2	104.14	
Upstream Channel Point 2	21.3	104.13	
Upstream Channel Point 3	29.6	103.2	
Inlet Apron	29.7	103.37	
Culvert Inlet	36.7	102.86	
Culvert Outlet	65	100.62	
Outlet Apron	74.1	99.94	
Downstream Channel Point 1	74.2	99.73	
Downstream Max Depth	76.5	99.29	Same point as max depth within 5 ft of structure.
Tailwater Control Point	82.2	99.94	
Downstream Channel Point 2	89	99.63	
Downstream Channel Point 3	97.6	97.71	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing structure was modeled as a box culvert within FishXing. The length of the inlet and outlet aprons were factored into the length and slope of the culvert within the model.	55.67 – 549.48	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was assessed to be passable to strong swimming anadromous life stages of *O. mykiss*, but not passable to resident *O. mykiss* life stages. Due to these results this crossing structure was determined to be a temporal and partial barrier. FishXing analysis estimates streamflow rates greater than 55.67 ft^3/s would provide adequate water depth for successful steelhead *O. mykiss* passage. A velocity barrier was not predicted by FishXing below streamflow rates of 549.48 ft^3/s, well above the estimated annual mean peak streamflow rate of 100.76 ft^3/s. FishXing predicted resident *O. mykiss* would reach exhaustion during passage attempts at all rates of streamflow.

Assessment and Analysis Limitations

There were no limitations in assessing or performing fish passage analysis of this crossing structure.

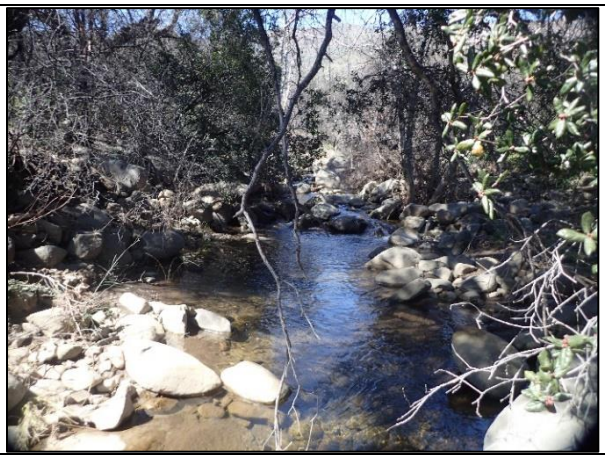
Passage Improvement Recommendations

The most effective remediation option to improve passage conditions at this location would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 731525					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	20.4	34.51522, -119.27916	± 15 ft	21.9

Pictures

Upstream Looking Upstream



Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Debris Buildup at Inlet Center Wall

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Cannon Creek 1.40 mi²	North Fork Matilija Creek	137.3 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss.* There are extensive records of *O. mykiss* presence within North Fork Matilija Creek. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
12/18/2018	Caltrans Reconnaissance Fish Passage Assessment	PSMFC/CCC
3/13/2019	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	2	1 each	Yes (only at inlet)	No

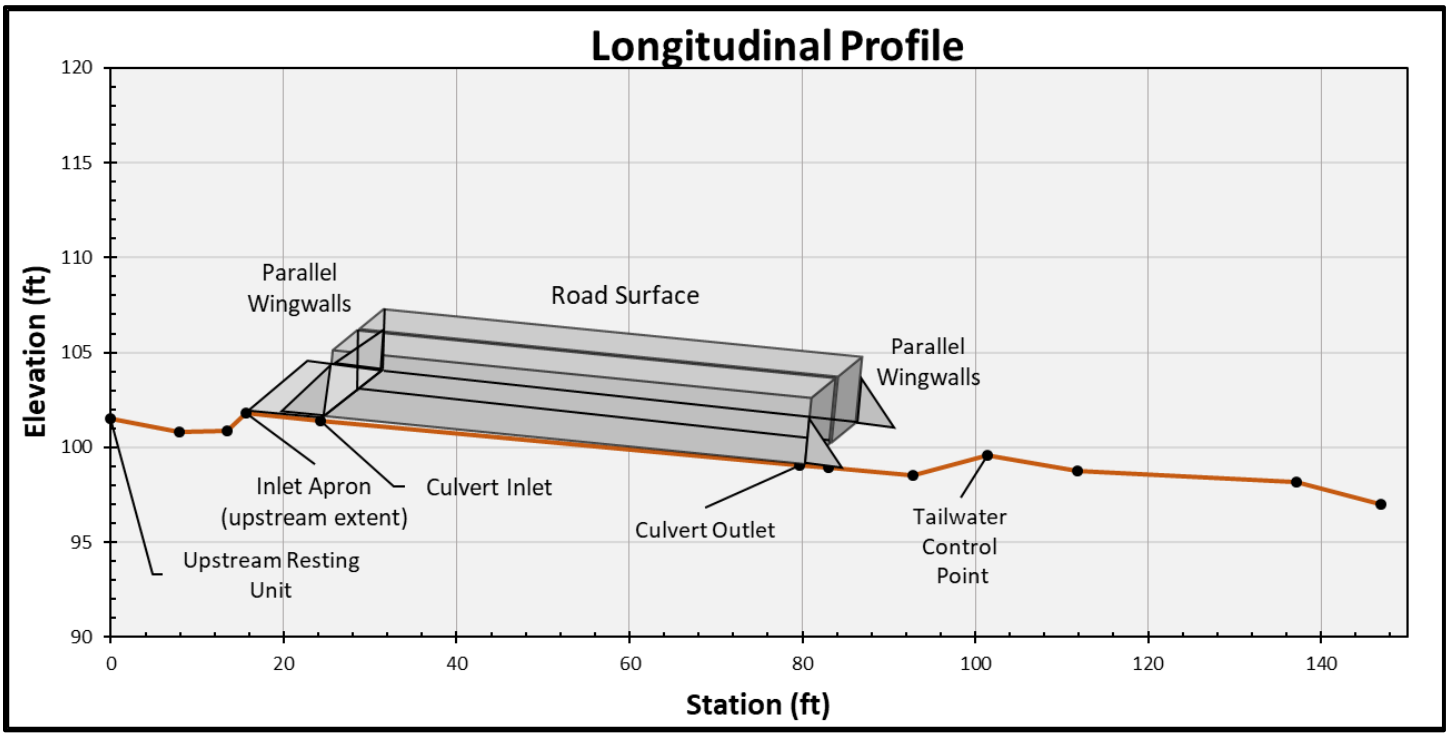
Crossing Structure Description and Condition
This crossing structure is a double bay concrete reinforced box culvert with short parallel wingwalls at its inlet and outlet. A concrete apron is located between the inlet wingwalls. The culvert bays a separated by a vertical concrete wall. At the time of assessment, a woody debris pile had built up at the inlet location of the center wall. The Hwy 33 road surface was located directly above the culvert. The culvert has some minor erosion damage along its base, but otherwise appear to be in good condition.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	20	8.7	4.5 %
Culvert	5	5	20 (each bay is 10 ft wide)	55.4	4.3 %
Full Structure	n/a (open channel)	n/a (open channel)	20	64.1	4.3 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins and low wide channel banks. The active channel consisted of sand, gravel, and boulders with pool, flatwater, and riffle units. The channel banks contained brush and small trees.	15.58 ft	0 ft	17.26 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel was similar to the upstream channel with well-defined active channel margins and wide low channel banks. The active channel contains pools and flatwater units with sand, gravel, and large cobbles. The channel banks contained brush and trees.	Cobble	21.66 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	101.54	
Upstream Channel Point 1	7.87	100.8	
Upstream Channel Point 2	13.45	100.86	
Inlet Apron (upstream extent)	15.58	101.81	
Culvert Inlet	24.28	101.42	
Culvert Outlet	79.72	99.04	
Downstream Max Depth (within 5 ft of structure)	83.01	98.93	
Downstream Max Depth	92.85	98.54	
Tailwater Control Point	101.38	99.61	
Downstream Channel Point 1	111.88	98.76	
Downstream Channel Point 2	137.14	98.16	
Downstream Channel Point 3	146.98	97.01	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing structure was modeled as a box culvert for FishXing passage analysis. Due to FishXing limitations the structure was modeled as a single bay culvert with the added width of both culvert bays of the actual crossing structure. The inlet apron and slope were factored in the modeled culvert.	160.24 - 942	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure is predicted to be passable to strong swimming anadromous *O. mykiss*, but not passable to resident life stages of *O. mykiss*. Streamflow depth was predicted to allow for anadromous *O. mykiss* passage when streamflow rates are greater than 160.24 ft^3/s. The estimated annual mean peak streamflow is 137.27 ft^3/s, so conditions conducive to successful passage likely rarely occur at this crossing structure. Streamflow greater than 942 ft^3/s were predicted to prevent anadromous *O. mykiss* passage due to excessive hydraulic velocities.

Assessment and Analysis Limitations

There were no limitations experienced in the assessment of this crossing structure. The only limitation associated with fish passage analysis for this structure was modeling the structure as a single bay culvert in FishXing instead of a double bay culvert.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 731797					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	20.8	34.51496, -119.28338	± 16 ft	22.2

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Cannon Creek 1.36 mi^2	North Fork Matilija Creek	136.6 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* There are extensive records of *O. mykiss* presence within North Fork Matilija Creek. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
12/18/18	Caltrans Reconnaissance Fish Passage Assessment	PSMFC & CCC
3/13/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	2 bays	1 (in each bay)	Yes (inlet and outlet)	No

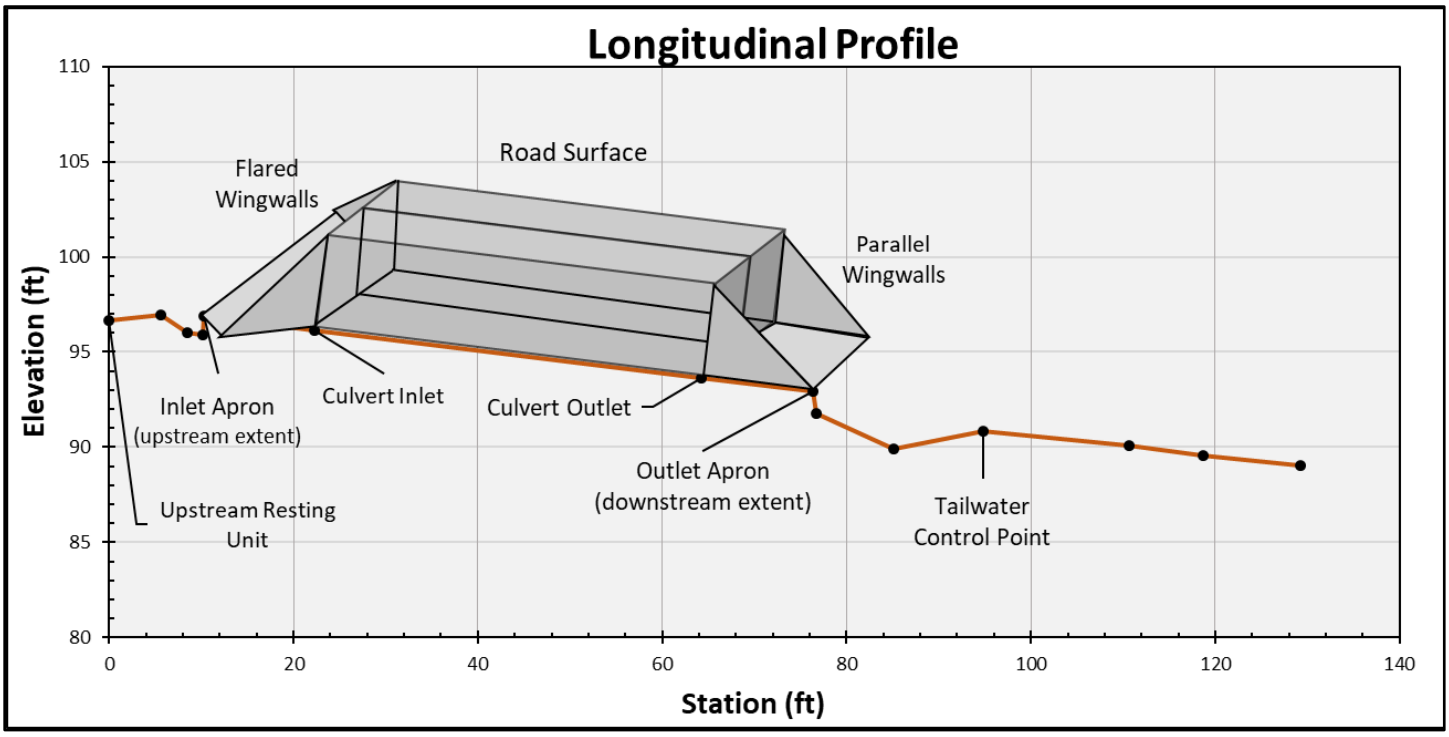
Crossing Structure Description and Condition
This crossing structure is a double bay concrete reinforced box culvert with inlet and outlet wingwalls. Concrete aprons are located between both sets of wingwalls. The inlet wingwalls are flared and the outlet wingwalls are parallel. The culvert bays are separated by a vertical concrete wall. The base of the culvert contained some minor erosion damage at the time of assessment, but otherwise appeared to be in good condition.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	26	12	6.3 %
Culvert	5.1	5.1	22 (each bay is 11 ft wide)	42	5.9 %
Outlet Apron	n/a (open channel)	n/a (open channel)	22	12.1	5.9 %
Full Structure	5.1	5.1	24	66.1	6.0 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained moderately defined active channel margins and low wide channel banks. The active channel contained small pool units and extended riffle units with boulder and gravel substrate. The channel banks contained sparse brush and small trees.	10.3 ft	0 ft	27.7 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained well defined active channel margins and small steep channel banks. The active channel contained pool, flatwater, and riffle units with boulder, gravel, and cobble substrate. The channel banks contained sparse brush and small trees.	Cobble	8.4 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	96.63	
Upstream Channel Point 1	5.6	96.93	
Upstream Channel Point 2	8.53	96.04	
Upstream Channel Point 3	10.2	95.88	
Inlet Apron (upstream extent)	10.3	96.88	
Culvert Inlet	22.3	96.13	
Culvert Outlet	64.3	93.64	
Outlet Apron (downstream extent)	76.4	92.93	
Downstream Max Depth (within 5 ft of structure)	76.7	91.78	
Downstream Max Depth	85.1	89.88	
Tailwater Control Point	94.8	90.86	
Downstream Channel Point 1	110.6	90.08	
Downstream Channel Point 2	118.7	89.58	
Downstream Channel Point 3	129.3	89.05	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing structure was modeled as a box culvert for FishXing passage analysis. Due to FishXing limitations the structure was modeled as a single bay culvert with the added width of both culvert bays of the actual crossing structure. The inlet apron and slope were factored in the modeled culvert.	130.07 - 942	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure is predicted to be passable to strong swimming anadromous *O. mykiss*, but not passable to resident life stages of *O. mykiss*. Streamflow depth was predicted to allow for anadromous *O. mykiss* passage when streamflow rates are greater than 130.07 ft^3/s. The estimated annual mean peak streamflow is 136 ft^3/s, so conditions conducive to successful passage are likely infrequent at this crossing structure. Streamflow greater than 942 ft^3/s were predicted to prevent anadromous *O. mykiss* passage due to excessive hydraulic velocities.

Assessment and Analysis Limitations

There were no limitations experienced in the assessment of this crossing structure. The only limitation associated with fish passage analysis for this structure was modeling the structure as a single bay culvert in FishXing instead of a double bay culvert.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

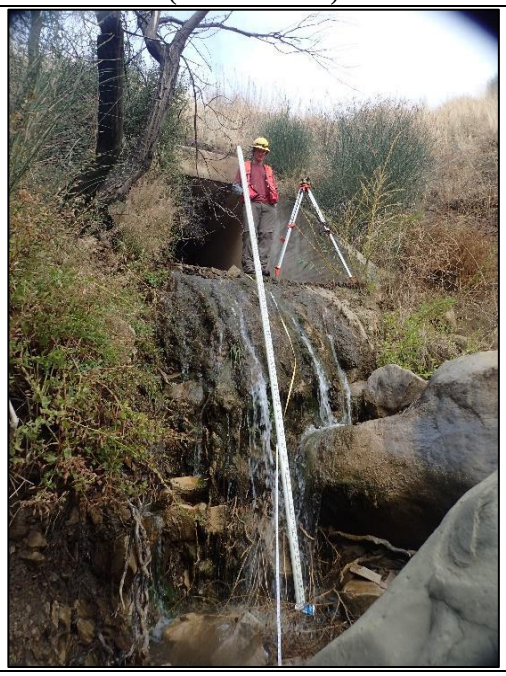
Crossing Site Information for PAD 731830					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	21.12	34.51889, -119.28178	± 13 ft	21.15

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)



Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.97 mi²	Cannon Creek	130.4 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
12/05/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
12/05/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (inlet and outlet)	No

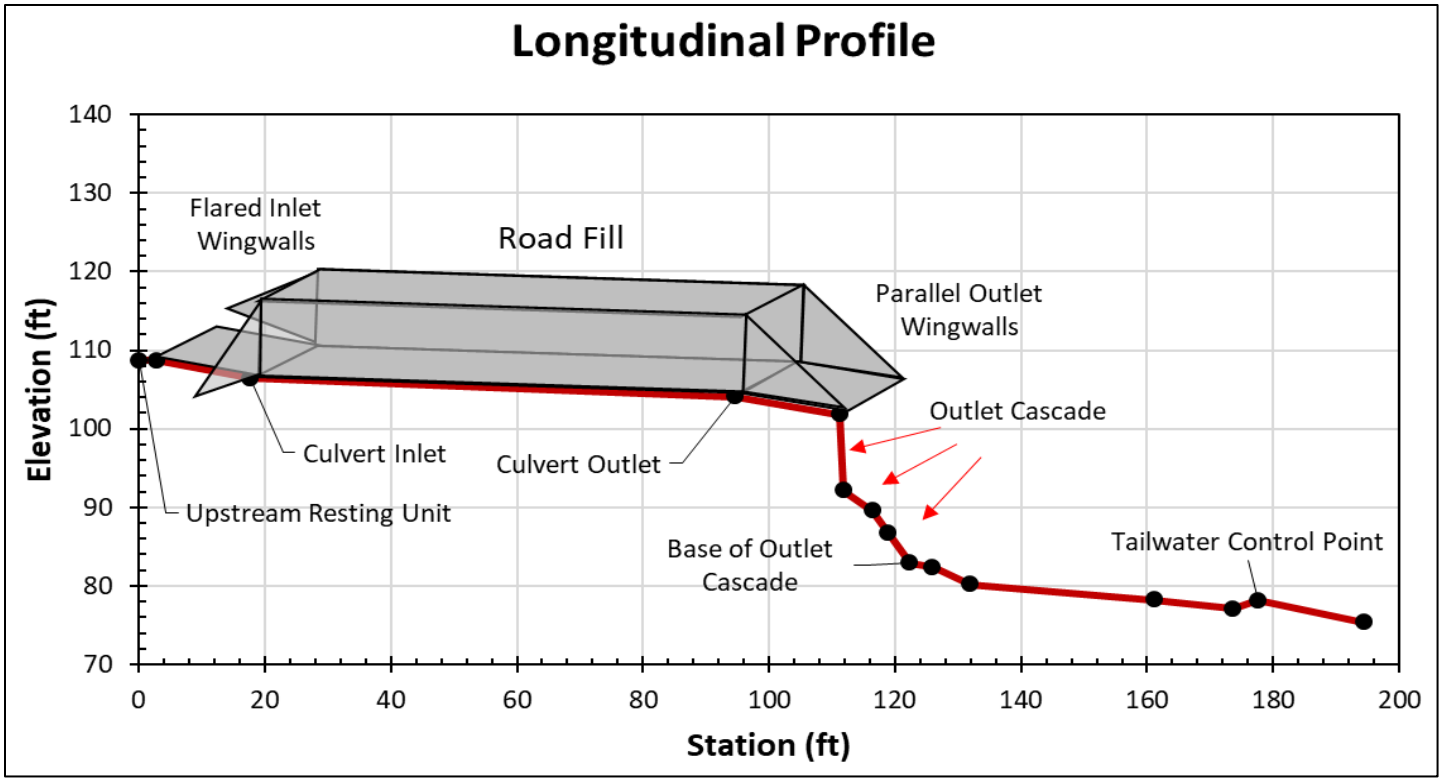
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with flared inlet wingwalls and parallel outlet wingwalls. Concrete inlet and outlet aprons are located between the wingwalls. The structure was in good condition at the time of assessment with no visible damage or erosion.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	12.5	15	15.3 %
Culvert	10	10	10	76.9	3.0 %
Outlet Apron	n/a (open channel)	n/a (open channel)	10	16.6	14.0 %
Full Structure	10	10	11	108.5	6.4 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins with wide and low channel banks. The channel contained slit, gravel, and boulders scattered within extensive riffle units with small scour pools. The channel banks contained dense grass, brush, and tree vegetation.	2.8 ft	0.01 ft	6.5 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, a significant and steep cascade was present from the outlet apron to the downstream channel. The cascade had a mean height of 10.9 ft and contained portions of exposed roots and large boulders. Downstream of the cascade the active channel margins were well defined and the channel banks were steep with areas of exposed bedrock and minimal vegetation. Bedrock was also present within the active channel margins which created a short section of split channel. Extended riffle units over gravel were present in both sides of this channel.	Gravel	66.3 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	108.68	
Upstream Channel Point 1	2.4	108.42	
Inlet Apron (upstream extent)	2.8	108.67	
Culvert Inlet	17.8	106.4	
Culvert Outlet	94.7	104.08	
Outlet Apron (downstream extent)	111.3	101.78	
Outlet Cascade Point 1	111.9	92.15	
Outlet Cascade Point 2	116.5	89.52	Max depth within 5 ft of structure.
Outlet Cascade Point 3	119	86.68	
Outlet Cascade Point 4	122.4	82.87	
Downstream Max Depth	173.7	77.04	Located downstream of bedrock outcropping.
Tailwater Control Point	177.6	78.14	
Downstream Channel Point 1	194.5	75.34	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was modeled as a box culvert within FishXing. The length of the inlet and outlet aprons were factored into the length and slope of the culvert within the model. An outlet plunge point with a height of 10.9 ft was applied to represent the outlet cascade.	None	Excessive Leap Height Impassable Plunge/Cascade Outlet Unit Restriction

Crossing Structure Barrier Status

Total Barrier

This crossing structure was assessed to be impassable to all life stages of *O. mykiss*. The main factor preventing passage is the significant cascade present from the structure's outlet apron. The lack of scour within downstream of the cascade and its height is predicted to prevent *O. mykiss* from being able to successfully jump the cascade and gain access to the culvert. Even if an strong swimming anadromous O. mykiss were able to gain access to the culvert it is predicted that water depth would not allow for successful passage unless streamflow rates were above 143.81 ft^3/s, which is greater than the estimated annual mean peak streamflow rate of 130.4 ft^3/s.

Assessment and Analysis Limitations

There were no limitations in assessing or performing fish passage analysis of this crossing structure.

Passage Improvement Recommendations

The most effective remediation option to improve passage conditions would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 731128					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	22.27	34.52983, -119.27092	± 19 ft	21.27

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Location of Tripod for Tailwater Cross Section

Downstream Looking Downstream From Outlet Apron

Damage at Inlet

Segment Offset Rotation

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.37 mi²	Ventura River	67. 6 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Ventura River watershed, which has historically supported anadromous fish. This stream is located (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
12/03/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
12/03/19	Caltrans Detailed Fish Passage Assessment	PSMFC

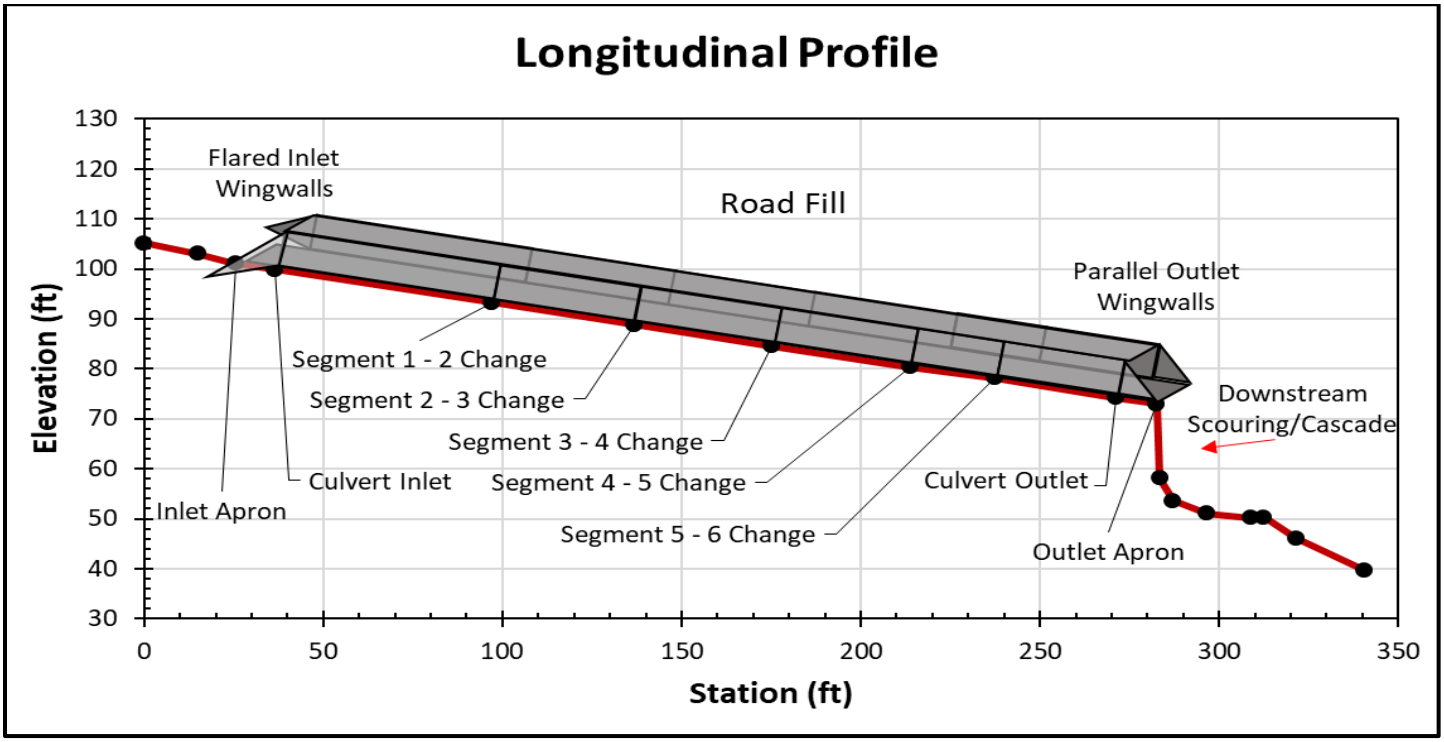
Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	6	Yes (inlet and outlet)	No

Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with 6 segments. Each segment has the same dimensions, but different orientations. Concrete inlet and outlet aprons are located between wingwalls. The inlet wingwalls are flared and the outlet wingwalls are parallel. At the time of assessment, the culvert contained a few areas of damage. Rebar was exposed at the top lining at the inlet. The 3rd and 4th segments appear to have shifted from their original position and are partially rotated towards river left. This segment rotation indicates a potential instability within the structure and surrounding road fill.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	7.5	11.2	11.1 %
1	7	7	6	60.5	10.9 %
2	7	7	6	39.5	11.3 %
3	7	7	6	38.5	11.1 %
4	7	7	6	38.6	11.0 %
5	7	7	6	23.7	9.24 %
6	7	7	6	33.9	11.7 %
Outlet Apron	n/a (open channel)	n/a (open channel)	6	11.2	11.7 %
Full Structure	7	7	6.5	257.1	11.0 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained a considerable amount of cobble, which appeared to have been recently deposited within the stream channel. The active channel margins were poorly defined, and the channel banks were steep. The channel banks contained chaparral vegetation with dispersed oak trees. The channel contained extended shallow riffle units with minimal areas of scour.	36.7 ft	5.36 ft	14.82 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Downstream Control Point Distance from Structure**
At the time of assessment, a significant plunge with a mean height of 21.8 ft was present from the culvert outlet apron. The downstream channel had poorly defined active channel margins and steep bedrock channel walls containing minimal vegetation. Portions of exposed bedrock were present across the channel surrounded by gravel. A large segment of disconnected and damaged concrete was located below the outlet plunge. Small pool units were located within the channel, but they were a considerable distance downstream of the crossing structure.	Gravel	29.9 ft



Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	105.15	
Upstream Channel Point 1	8	104.42	
Upstream Channel Point 2	15	103.08	
Upstream Channel Point 3	22	102.3	
Inlet Apron (upstream extent)	25.5	101.03	
Culvert Inlet	36.7	99.8	
Segment 1 to 2 Change Point	97.2	93.23	22° change in alignment towards river left
Segment 2 to 3 Change Point	136.7	88.78	
Segment 3 to 4 Change Point	175.2	84.54	Segment 3 and 4 are shifted and slightly rotated counterclockwise towards river left. Therefore. the segment bottoms lean towards river left.
Segment 4 to 5 Change Point	213.8	80.33	
Segment 5 to 6 Change Point	237.5	78.15	31° change in alignment towards river right
Culvert Outlet	271.4	74.22	
Outlet Apron (downstream extent)	282.6	72.92	
Outlet Plunge Point 1	283.5	58.15	
Outlet Cascade Point 1	287.1	53.53	Also, max depth within 5 ft of outlet apron.
Outlet Cascade Point 2	296.7	51.1	
Downstream Max Depth	309	50.16	
Tailwater Control Point	312.5	50.26	

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was modeled within FishXing as a box culvert. The length of the inlet and outlet aprons were factored in the length of slope of the modeled culvert. Segment by segment analysis was not performed due to the various passage constraints identified within the full structure.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Impassable Plunge Point Excessive Leap Height Outlet Unit Restriction

Crossing Structure Barrier Status

Total Barrier

This crossing structure was determined to be impassible to all life stages of *O. mykiss*. The main factor limiting *O. mykiss* passage is the excessive plunge point from the outlet of the culvert. Even if a strong swimming *O. mykiss* was able to gain access to the culvert it was predicted to still not be able to gain passage. A velocity barrier was predicted to occur when streamflow rates are greater than 35.12 ft^3/s and a water depth barrier was predicted to occur when streamflow rates were less than 109.1 ft^3/s.

Assessment and Analysis Limitations

No limitations were encountered in assessing and performing passage analysis for this crossing structure.

Passage Improvement Recommendations

The most effective remediation option would be to replace the culvert with a free spanning bridge.

Crossing Site Information for PAD 713767					
County	**Route**	**Post Mile**	**Location** (at outlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	24.17	34.53671, -119.24493	± 12 ft	23.4

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
North Fork Matilija Creek 0.40 mi^2	Ventura River	115.0 ft^3/s	There are extensive records of *O. mykiss* being supported within North Fork Matilija Creek. Records indicate heavy fishing and occurrences of hatchery stocking of *O. mykiss*. A recent study of the genetic structure of southern California *O. mykiss* found reports that North Fork Matilija Creek population is more closely related to populations upstream from the Matilija Dam than to other populations considered in the study (Girman and Garza, 2006; NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
12/13/18	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
02/21/2019	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (inlet and outlet)	No

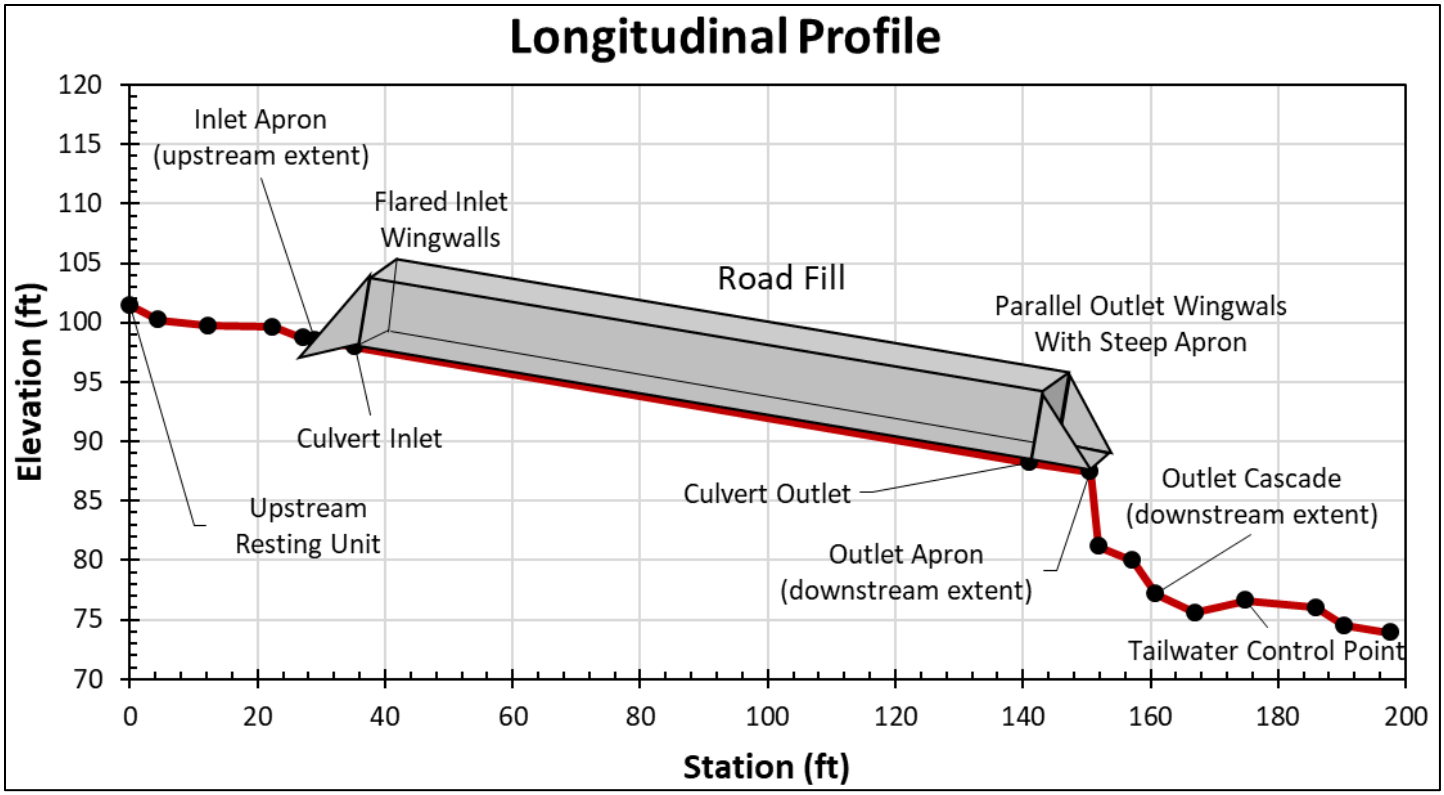
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert, with a steep slope. Concrete wingwalls and aprons are located at the inlet and outlet. The inlet wingwalls are flared and the outlet wingwalls are parallel. A significant plunge point/cascade with a mean height of 10.27 ft is present from the outlet apron to a scour pool unit. The structure was located far beneath the road surface through significant road fill and appeared to be in good condition when assessed.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	8.5	6.3	9.9 %
Culvert	5	5	6	105.8	9.3 %
Outlet Apron	n/a (open channel)	n/a (open channel)	6	9.5	13.4 %
Full Structure	5	5	6.5	121.6	9.2 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained wide and poorly defined active channel margins. The channel banks were steep with undefined bankfull margins with dense chaparral brush vegetation. The channel contained small pool units and extended riffle units amongst widespread jagged cobble and boulders, indicating recent landslides.	29 ft	2.92 ft	8.12 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Downstream Control Point Distance from Structure**
At the time of assessment, the downstream channel contained significant scour from the outlet plunge/cascade. Apart from the moderate sized pool unit in this area of scour the channel contained extended riffle and small pool units. The active channel margins were well defined, and the channel banks were steep and contained dense brush and dispersed small trees.	Gravel	24.4 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	101.46	Small shallow pool unit.
Upstream Channel Point 1	4.5	100.24	Extended riffle unit through cobble and boulders.
Upstream Channel Point 2	12.3	99.7	
Upstream Channel Point 3	22.4	99.62	
Upstream Channel Point 4	27.2	98.72	
Inlet Apron (upstream extent)	29	98.54	
Culvert Inlet	35.3	97.92	
Culvert Outlet	141.1	88.18	
Outlet Apron (downstream extent)	150.6	87.44	
Outlet Cascade Point 1	151.9	81.14	
Outlet Cascade Point 2	157.2	79.96	
Outlet Cascade Point 3	160.9	77.17	Base/downstream extent of cascade.
Downstream Max Depth	167	75.56	Within moderate sized pool unit.
Tailwater Control Point	175	76.58	
Downstream Channel Point 1	185.9	76	
Downstream Channel Point 2	190.4	74.5	
Downstream Channel Point 3	197.6	73.9	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This crossing structure was modeled in FishXing as a box culvert. The length of the inlet and outlet aprons were factored into the length of culvert within the model. A plunge point from the outlet apron was included in the model.	None	Impassable Plunge/Cascade Point Outlet Unit Restriction Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Total Barrier

This crossing structure was estimated to be impassable to all life stages of *O. mykiss* at all rates of streamflow. The main factor preventing *O. mykiss* passage abilities is the plunge/cascade point present from the outlet apron. Even if a strong swimming anadromous *O. mykiss* were able to jump this plunge point and gain access to the culvert the steep slope of the structure was predicted to create a hydraulic velocity barrier when streamflow rates are above 98.23 ft^3/s.

Assessment and Analysis Limitations

No limitations were experienced in the assessment or analysis of this crossing structure.

Passage Improvement Recommendations

Due to this crossing structure being located near the headwaters of North Fork Matilija Creek the upstream channel should be surveyed to determine if it contains viable *O. mykiss* habitat prior to any barrier remediation efforts taking place. If remediation efforts are performed the most effective option would be to replace this structure with a free spanning bridge.

Crossing Site Information for PAD 759848					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	29.19	34.55540, -119.26315	± 9 ft	61.42

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.334 mi²	Sespe Creek	120.3 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Santa Clara River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
12/03/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
12/03/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Corrugated Steel Pipe Culvert	1	1	No	No

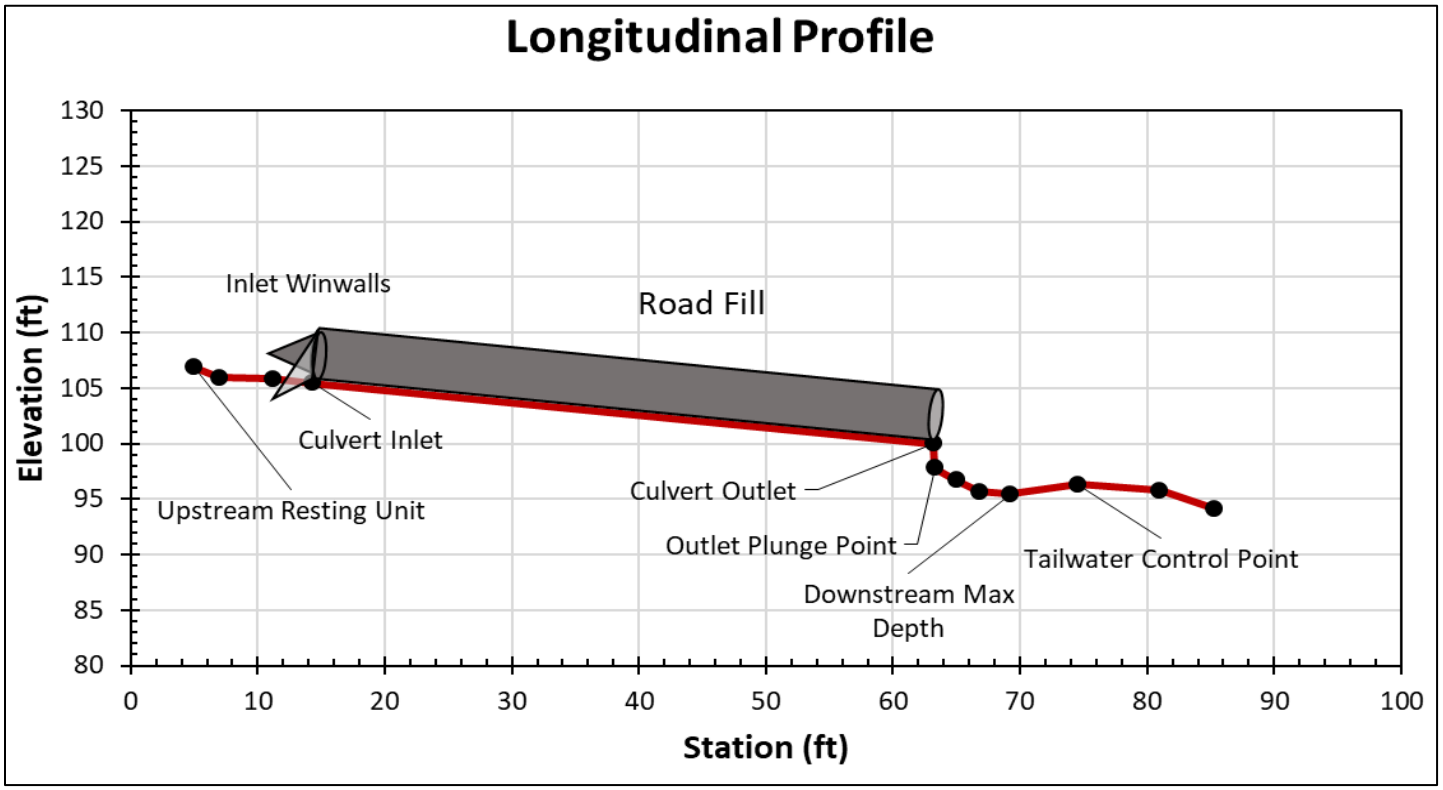
Crossing Structure Description and Condition
This crossing structure is a corrugated steel pipe culvert. The corrugations are annular and are spaced three inches apart with a one inch rise. The inlet is encased in cement boulder riprap headwalls with short wingwalls. This cement boulder riprap is minor erosion damage with several visible cracks. The outlet is projecting from road fill and is suspended over the downstream channel. The culvert contained some rush and the projecting outlet contained some minimal deformation damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	5	5	5	48.9	11.9 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained moderately defined active channel margins. The channel banks were steep and contained many exposed boulders and sparse chaparral vegetation. The dominant substrates within the channel were boulders and large cobble. The channel contains small pool units between extended riffle units.	9.3 ft	1.44 ft	5.54 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained well defined active channel margins and low channel banks with dense chaparral vegetation with dispersed small conifers. A plunge point with a mean height of 2.2 ft was present from the outlet of the culvert to the downstream channel. A small scour pool is located at the plunge point. Extended riffle units are present downstream of the scour pool.	Cobble	11.4 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	5	106.88	
Upstream Channel Point 1	7	105.94	
Upstream Channel Point 2	11.2	105.82	
Culvert Inlet	14.3	105.44	
Culvert Outlet	63.2	100	
Outlet Plunge	63.3	97.8	
Downstream Channel Point 1	65	96.67	
Downstream Max Depth (Within 5 ft of the Outlet)	66.8	95.68	
Downstream Max Depth	69.2	95.44	
Tailwater Control Point	74.6	96.32	
Downstream Channel Point 2	81	95.75	
Downstream Channel Point 3	85.3	94.13	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages The crossing structure was modeled in FishXing as a steel pipe culvert with 3" x 1" annular corrugations. An outlet plunge of 2.2 ft was applied to the model.	None	Insufficient Streamflow Depth Impassable Plunge Point Outlet Unit Restriction

Crossing Structure Barrier Status
Total Barrier This crossing structure was predicted to be impassable to all life stages of *O. mykiss*. The main factor preventing *O. mykiss* passage is the plunge point from the outlet of the culvert coupled with a shallow scour pool unit at the plunge point. This prevents *O. mykiss* from being able to obtain their full jump potential to gain access to the culvert. If a strong swimming anadromous *O. mykiss* was able to gain access the culvert streamflow greater than 17.67 ft^3/s would provide adequate water depth for passage. Streamflow greater than 436.88 ft^3/s were predicted to create streamflow velocities which would prevent passage.

Assessment and Analysis Limitations
The only limitation experienced in assessing this structure was thick vegetation on the downstream channel banks. Due to this the extent of the tailwater control cross section profile was slightly limited. It is likely that the downstream bankfull width extends slightly beyond the points measured and included within this survey.

Passage Improvement Recommendations
The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 759849					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	29.54	34.55779, -119.26838	± 9 ft	61.67

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Tripod Location for Tailwater Cross Section

Inside Culvert

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.992 mi²	Sespe Creek	140.1 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Santa Clara River watershed, which has historically supported anadromous fish. This stream is a tributary to Sespe Creek, which has many historical records of supporting all life stages of *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
11/07/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
11/07/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes	No

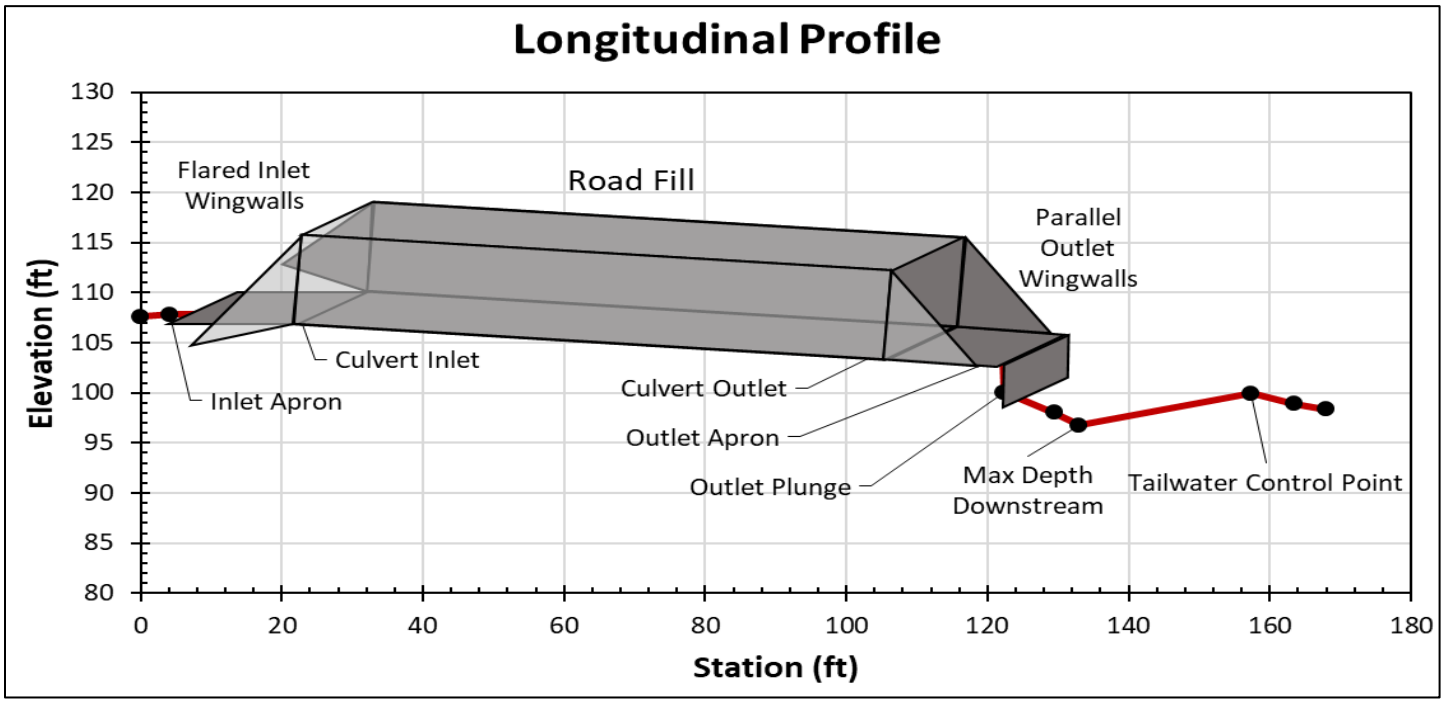
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert. Aprons are located between wingwalls at the inlet and outlet. The inlet wingwalls are flared and the outlet wingwalls are parallel. A plunge/cascade point was present at the outlet apron with a mean height of 5.6 ft. The structure appeared to be in good condition with no visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	12	18.2	0.6 %
Culvert	9.8	9.8	8	83.8	4.1 %
Outlet Apron	n/a (open channel)	n/a (open channel)	8	16	5.3 %
Full Structure	9.8	9.8	8	118	3.6 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins and steep channel walls. The dominant substrates are boulders and large cobble creating extended riffle units. The channel banks consist of bedrock and sparse chaparral vegetation.	0 ft	0 ft	12 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained well defined active channel margins and low channel banks, with dense chaparral vegetation. The channel was primarily comprised of riffle units.	Large Cobble	35.2 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	107.61	
Upstream Channel Point 1	4	107.64	
Inlet Apron (upstream extent)	4.2	107.84	
Culvert Inlet	22.4	107.94	
Culvert Outlet	106.2	104.48	
Outlet Apron (downstream extent)	122.2	103.64	
Outlet Plunge Point 1	122.3	100.04	Base of plunge point and start of outlet cascade.
Outlet Cascade Point 2	127.2	99.14	Max depth within 5 ft of structure.
Outlet Cascade	129.5	98.01	Base of outlet cascade.
Downstream Max Depth	133	96.76	Dominant substrates are sand/silt.
Tailwater Control Point	157.4	99.96	
Downstream Channel 1	163.5	98.89	Within extended riffle unit.
Downstream Channel 2	168	98.34	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was modeled within FishXing as a box culvert. The inlet and outlet aprons were factored into the length and slope of culvert modeled. A plunge point with a height of 5.6 ft was included at the outlet.	None	Insufficient Streamflow Depth Outlet Unit Restriction

Crossing Structure Barrier Status

Total Barrier

This crossing structure as predicted to be impassible to all life stages of *O. mykiss* over all rates of streamflow. The main aspect preventing the ability of O. mykiss to gain passage is the outlet plunge point and the lack of water depth currently able to occur downstream of it. A strong swimming anadromous *O. mykiss* has the physiological ability jump the plunge point, but the assessed downstream conditions prevent them from being able to reach their maximum jump height potential. If a strong swimming anadromous *O. mykiss* was able to gain access into the culvert FishXing analysis predicted streamflow rates greater than 79.96 ft^3/s would provide adequate water depth for passage. Streamflow velocities below 620.88 ft^3/s were predicted to be passable to anadromous *O. mykiss*.

Assessment and Analysis Limitations

There were no limitations experience in assessing and performing FishXing passage analysis on this crossing structure.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 759851					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	38.81	34.60875, -119.36567	± 9 ft	72.52

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.12 mi²	Adobe Creek	94.7 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Santa Clara River watershed, which has historically supported anadromous fish. However, considering the small drainage area of the stream, low estimated annual mean peak streamflow, channel conditions present at the time of assessment, and inland location it is unlikely this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
11/19/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
11/19/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Corrugated Steel Pipe Culvert	1	1	No	No

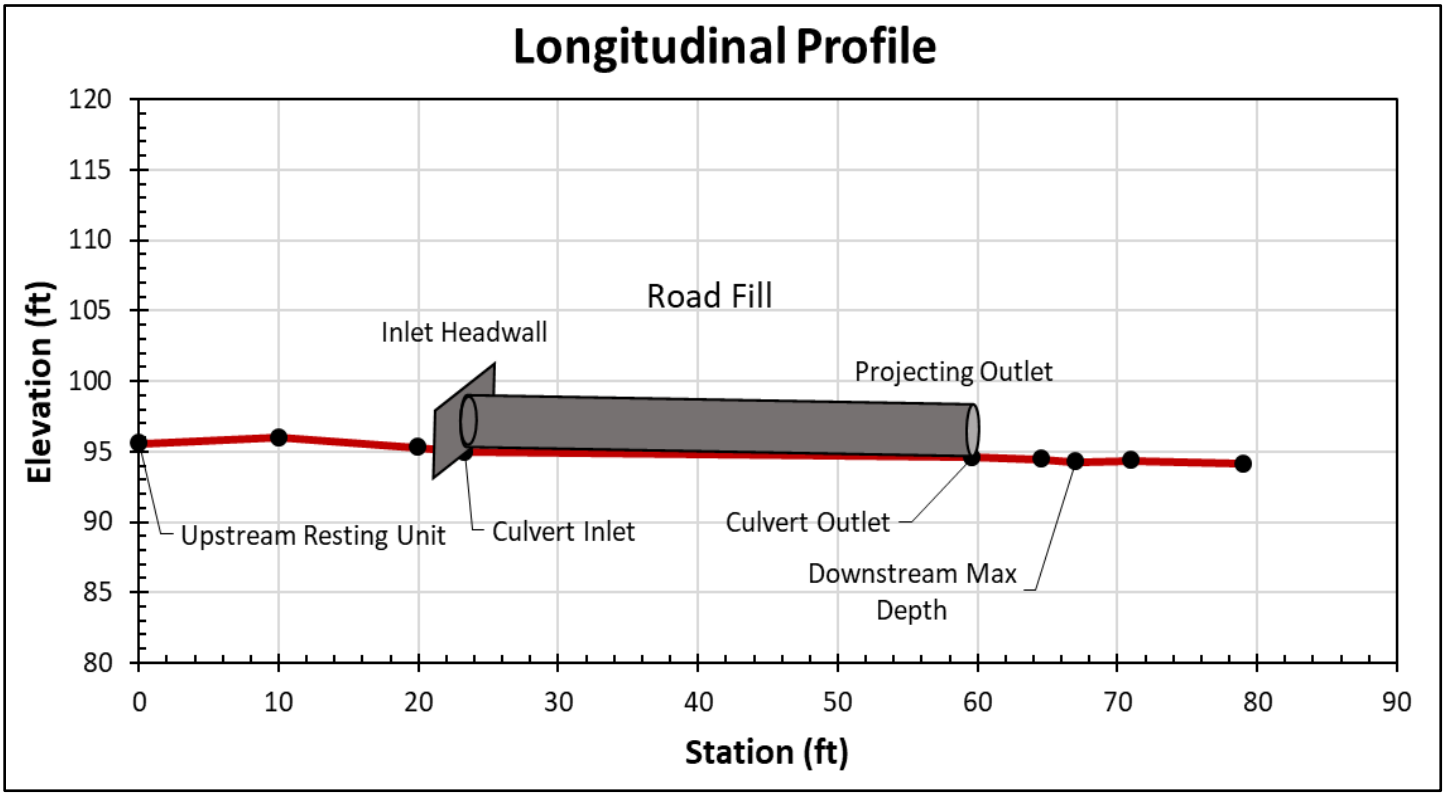
Crossing Structure Description and Condition
The crossing structure is a steel pipe culvert with 3” x 1” annual corrugations. The culvert inlet is encased in a concrete headwall and its outlet projects a short distance from the road fill. At the time of assessment, the culvert was partially embedded with sand and contained rust on its base and side walls.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	4	4	4	36.3	1.1 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
An additional plastic pipe culvert is located roughly 40 ft upstream of this crossing structure which poses as an additional barrier to *O. mykiss*. This additional pipe culvert runs under a chain linked fence. At the time of assessment, the stream channel contains defined active channel margins with very small channel banks. The channel primarily consists of sand and extended riffle units. The channel banks contained sparse grass and shrubs.	23.3 ft	0.57 ft	10.12 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained well defined active channel margins with steep small channel banks. The channel was sandy with extended riffle units and no areas of scour. The channel banks contained dense brush vegetation. A barbed wire fence crosses the channel a short distance downstream of the crossing structure.	Sand	No defined tailwater control point present at time of assessment

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	95.55	Pool unit created from scour downstream of upstream pipe culvert outlet.
Upstream Channel Point 1	10	95.96	
Upstream Channel Point 2	20	95.3	
Culvert Inlet	23.3	94.98	
Embedded Substrate (upstream extent)	35	Unable to measure	Elevation not recorded due to the small size of culvert.
Culvert Outlet	59.6	94.58	
Downstream Max Depth (within 5 ft of structure)	64.6	94.46	
Downstream Max Depth	67	94.26	
Downstream Channel Point 1	71	94.34	No tailwater control point present. Points located within extended flat riffle unit.
Downstream Channel Point 2	79	94.14	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous O. mykiss This crossing structure was modeled a circular pipe culvert with 3" x 1" annual corrugations. The culverts true diameter and length was used for the model.	9.33 – 255.17	Insufficient Streamflow Depth
Analysis for Resident O. mykiss	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was assessed to be passable to strong swimming anadromous *O. mykiss* under certain streamflow rates, but impassable to resident *O. mykiss* life stages over all rates of streamflow. For anadromous *O. mykiss* it was predicted water depth would be adequate for passage when streamflow rates were greater than 9.33 ft^3/s. Streamflow velocity was predicted to prevent passage when above 255.17 ft^3/s.

Assessment and Analysis Limitations

There were no limitations in assessing or performing fish passage analysis of this crossing structure.

Passage Improvement Recommendations

The extent of this stream should be surveyed to determine its likelihood to provide quality habitat capable of supporting *O. mykiss*. Additionally, given the inland location of this crossing structure many natural and man-made barriers to *O. mykiss* likely exist downstream and should be assessed and remediated prior to this crossing. If remediation efforts are performed the most effective option to improve passage conditions at this location would be to replace this culvert with a free spanning bridge over natural streambed substrate. Any remediation efforts on this crossing should also address the passage constraints associated with the additional pipe culvert located directly upstream.

Crossing Site Information for PAD 764936					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	39.26	34.61382, -119.37030	± 9 ft	73.16

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.08 mi²	Adobe Creek	89.2 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Santa Clara River watershed, which has historically supported anadromous fish. However, considering the small drainage area of the stream, low estimated annual mean peak streamflow, channel conditions present at the time of assessment, and inland location it is unlikely this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
11/19/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
11/19/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Corrugated Steel Pipe Culvert	1	1	No	No

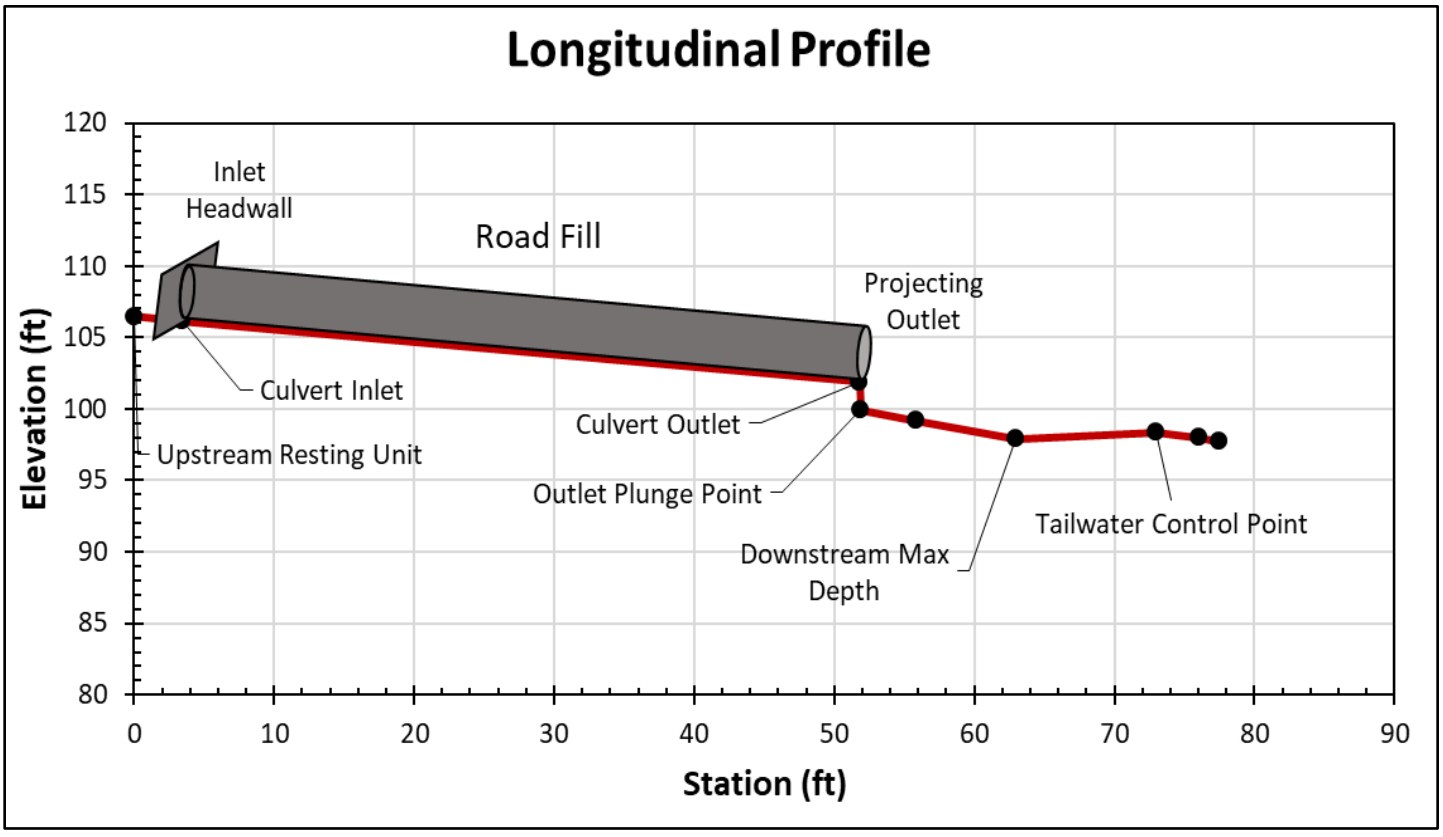
Crossing Structure Description and Condition
This crossing structure is a steel pipe culvert with 3" x 1" annual corrugations. The culvert inlet is encased in a concrete headwall and its outlet projects a short distance from the road fill. The projecting outlet is suspended above the downstream channel and at the time of assessment had a mean plunge height of 2.0 ft. The culvert was in good condition apart from minor damage at the projecting outlet.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	4	4	4	48.4	8.8 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins and small channel banks. The channel lacked areas of scour and consisted of extended riffle units in cobble and gravel substrates. The channel banks contained grasses and scattered low chaparral vegetation.	3.4 ft	0.35 ft	7.1 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained moderately defined active channel margins and small steep scoured channel banks. The channel had moderate scour immediately downstream of culvert projection creating a small pool unit. Downstream of this pool unit the channel consisted of extended riffle units. The channel banks contained dense brush, which partially extended into the active channel margins.	Small Cobble	No control point

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	106.49	Small scour created around boulder. Upstream channel primarily consists of riffle units lacking resting areas.
Culvert Inlet	3.4	106.14	
Culvert Outlet	51.8	101.9	
Outlet Plunge Point	51.9	99.92	
Downstream Max Depth (within 5 ft of structure)	55.8	99.2	
Downstream Max Depth	63	97.92	
Tailwater Control Point	73	98.36	Located within small pool unit.
Downstream Channel Point 1	76	98.02	
Downstream Channel Point 2	77.5	97.72	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was modeled a circular pipe culvert with 3" x 1" annual corrugations and a 2 ft plunge point from its outlet. The culverts true diameter and length was used for the model.	None	Insufficient Streamflow Depth Outlet Unit Restriction

Crossing Structure Barrier Status

Total Barrier

This crossing structure was assessed to be impassable to all life stages of *O. mykiss*. The main factor preventing passage is the plunge point from the outlet projection. Anadromous *O. mykiss* could potentially jump the plunge and gain entry into the culvert, but the outlet unit lacked scour and thus enough water depth for *O. mykiss* to reach their full jump height potential. If an anadromous *O. mykiss* could gain entry into the culvert the FishXing analysis predicted adequate water depth would occur at streamflow rates greater than 13.7 ft^3/s. A velocity barrier was not predicted to occur under streamflow rates less than 255.17 ft^3/s.

Assessment and Analysis Limitations

The only limitation experienced in assessing this crossing structure was dense vegetation along the downstream channel banks. This vegetation slightly limited the ability to measure the full extent of tailwater cross section between the channel bankfull extents. No limitations were experienced in the FishXing analysis of this crossing structure.

Passage Improvement Recommendations

The extent of this stream should be surveyed to determine its likelihood to provide quality habitat capable of supporting *O. mykiss*. Additionally, given the inland location of this crossing structure many natural and man-made barriers to *O. mykiss* likely exist downstream and should be assessed and remediated prior to this crossing. If remediation efforts are performed the most effective option to improve passage conditions at this location would be to replace this culvert with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 759852					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	39.49	34.61646, -119.37222	± 14 ft	73.36

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.167 mi²	Adobe Creek	109.2 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Santa Clara River watershed, which has historically supported anadromous fish. It is unlikely anadromous *O. mykiss* currently will have the ability to gain access to this crossing due to numerous downstream barriers in the watershed and the distance the structure is located from the ocean. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
11/19/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
11/19/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (inlet and outlet)	No

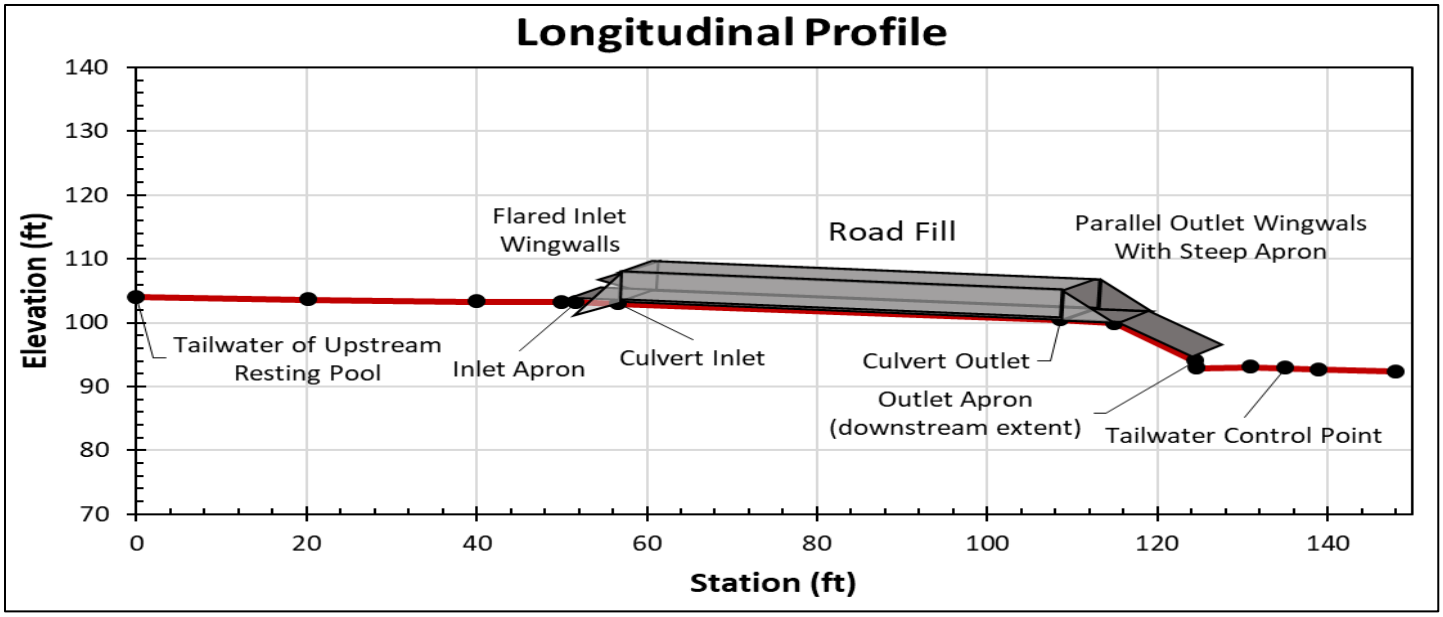
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced lined box culvert with short wingwalls and aprons at the inlet and outlet. The inlet wingwalls are flared and the downstream wingwalls are parallel. The outlet apron extends beyond wingwalls and has a steep slope. The culvert appeared to be in good condition at the time of assessment with no visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	5	5	4.8 %
Culvert	4	4	4	52	4.7 %
Outlet Apron	n/a (open channel)	n/a (open channel)	4.5	15.8	45.0 %
Full Structure	4	4	4.5	72.8	12.8 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins and small channel banks. The channel primarily contained gravel and cobble in extended riffle units with minimal areas of scour. The channel banks were covered in grasses and dense brush vegetation.	51.7 ft	0.77 ft	5.88 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
This culvert drains directly into Adobe Creek. At the time of assessment, Adobe Creek contained well defined active channel margins with short steep channel banks. The channel primary consisted of sand and gravel in riffle units with small areas of scour. There was minimal downstream scour near the outlet of the culvert and thus no streamflow control point. The channel banks contained dense chaparral vegetation.	Small Cobble	No distinct downstream control point was present at the time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	104.01	
Upstream Channel Point 1	20.3	103.56	Within extended riffle unit.
Upstream Channel Point 2	40	103.32	
Upstream Channel Point 3	50	103.24	
Inlet Apron (upstream extent)	51.7	103.24	
Culvert Inlet	56.7	103	
Culvert Outlet	108.7	100.46	
Outlet Apron Point 1	115	99.92	Downstream extent of outlet wingwalls.
Outlet Apron Point 2 (downstream extent)	124.5	93.98	
Downstream Max Depth	124.6	92.85	This point is located below a short 1.1 ft plunge point from the outlet apron. It is also the downstream max depth within 5 ft of the structure.
Downstream Channel Point 1	131	93	
Downstream Channel Point 2	135	92.91	
Downstream Channel Point 3	139	92.67	Within extended riffle unit.
Downstream Channel Point 4	148	92.31	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (two models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Full Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled in FishXing as a box culvert. The inlet and outlet aprons were considered for the length and slope of modeled culvert.	65.31 – 187	Insufficient Streamflow Depth
Outlet Apron Analysis for Anadromous *O. mykiss* Due to the steep slope of the outlet apron passage analysis was performed on it by modeling it as a steeply sloped box culvert with a mean width of 5 ft.	90.57 – 226.38	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was predicted to be passable to anadromous *O. mykiss* under specific ranges of streamflow, but impassable to resident life stages of *O. mykiss*. FishXing modeling predicted that adequate water depth would allow for potentially strong swimming steelhead passage when streamflow is greater than 90.57 ft^3/s. Streamflow velocity was predicted to prevent passage when streamflow rates are greater than 187 ft^3/s.

Assessment and Analysis Limitations

There were no limitations experienced in the assessment of this crossing structure. The main limitation experienced with FishXing passage analysis was the variance in the slope of the culvert and the outlet apron. FishXing analysis assumes a uniform slope throughout each structure so this full structure analysis is based off the mean slope of the entirety of the structures base. To account for this FishXing analysis was also performed specifically for the outlet apron.

Passage Improvement Recommendations

The most effective remediation option to improve passage conditions at this crossing site would be to replace this culvert with a free spanning bridge over natural streambed substrate.

Highway 34 Caltrans Crossings Structures

Crossing Site Information for PAD 759858					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 34	8.15	34.19669, -119.10970	± 9 ft	8

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

River Right Agricultural Drainage Channel

River Left Agricultural Drainage Channel

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Revolon Slough 41.41 mi²	Calleguas Creek	1,613.7 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Due to the extensive flood control channelization and extensive agricultural land use in the area this stream is unlikely to contain habitat suitable to the current sustainment of *O. mykiss* in its lower reaches. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
02/06/2020	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
02/06/2020	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Bridge over a concrete lined flood control channel	2 bays	1 (in each bay)	No	No

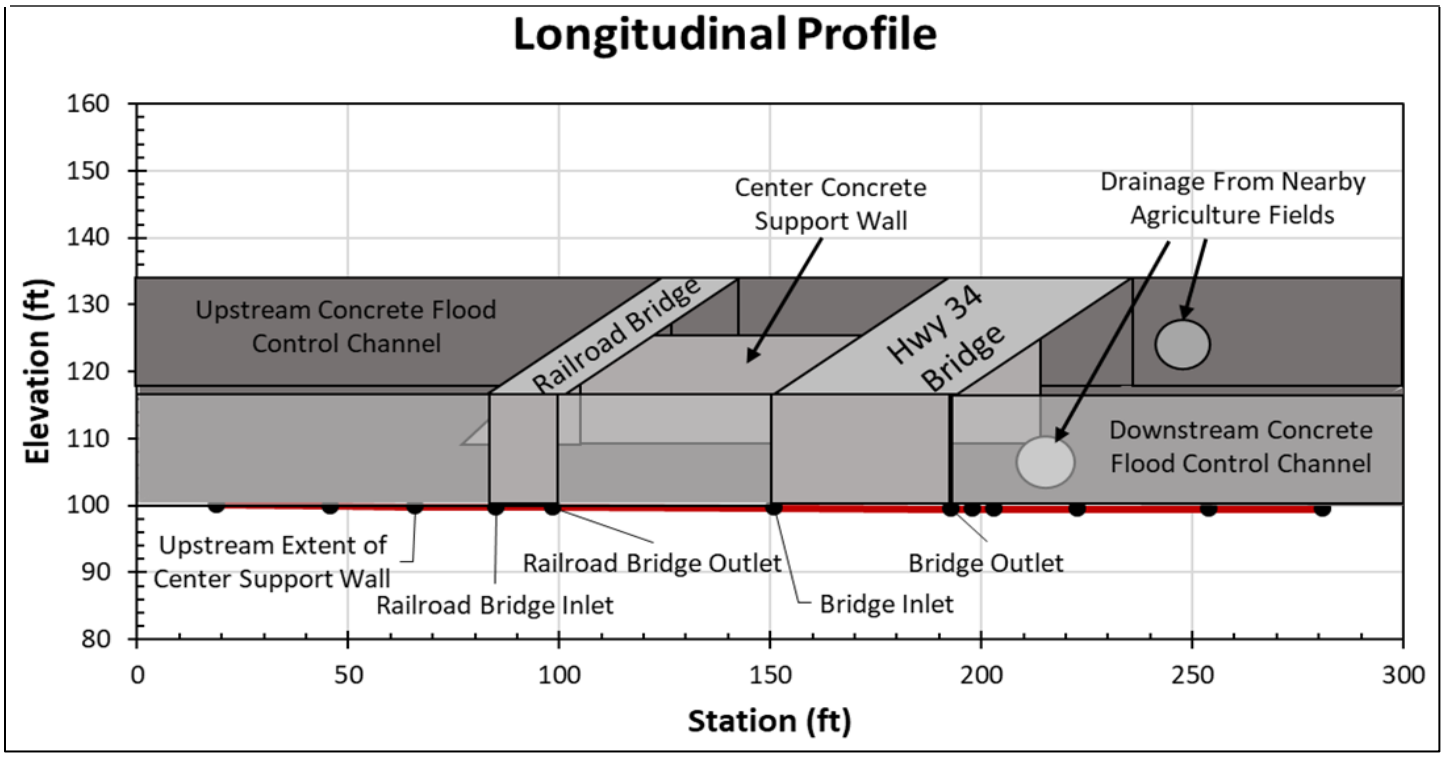
Crossing Structure Description and Condition
This crossing structure is a bridge over a concrete lined flood control channel. The bridge contains a central concrete support that divides the bridge into two bays.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Upstream Flood Control Channel	n/a (open channel)	n/a (open channel)	50 (estimated)	20,134 (estimated)	0.5 % (estimated)
Hwy 34 Bridge	15.9	15.8	50 (each bay is 24.8 ft)	42	0.4 %
Downstream Flood Control Channel	n/a (open channel)	n/a (open channel)	50 (estimated)	10,788 (estimated)	0.2 % (estimated)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel is concrete lined and continues for another 3.48 miles upstream. A railroad crossing bridge is located a short distance upstream.	No resting unit present	No resting unit present	50.1 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel is also concrete lined and continues for approximately 2 miles downstream. Directly downstream of the Hwy 34 crossing bridge, two 6-ft-diameter culverts drain into the channel from river right and river left. The water from these culverts comes from the agricultural fields that border the channel.	Concrete	A defined tailwater control point was not present at the time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Extent of Transect Tape	19	100.04	Within uniform concrete flood control channel. No upstream resting units present.
Upstream Channel Point 1	46	99.93	
Upstream Channel Point 2	66	99.8	Channel becomes divided by concrete support.
Upstream Channel Point 3	85	99.73	Upstream railroad bridge inlet.
Upstream Channel Point 4	98.7	99.74	Upstream railroad bridge outlet.
Bridge Inlet	151	99.59	West-bound Hwy 34 lane.
Bridge Outlet	193	99.44	East-bound Hwy 34 lane.
Downstream Channel Point 1	198	99.44	Within uniform concrete flood control channel. No tailwater control point.
Downstream Channel Point 2	203	99.43	
Downstream Channel Point 3	223	99.46	
Downstream Channel Point 4	254	99.44	
Downstream Channel Point 5	281	99.44	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (two models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Hwy 34 Bridge Analysis for Anadromous *O. mykiss* This crossing structure was modeled in FishXing as a box culvert. When the extent of the Hwy 34 bridge was analyzed FishXing estimated it to be passable to strong swimming anadromous *O. mykiss* when adequate water depth was present during streamflow rates greater than 186.29 ft^3/s.	> 186.29	Insufficient Streamflow Depth
Flood Control Channel Analysis for Anadromous *O. mykiss* The estimated extent and slope of the of the flood control channel was also attempted to be analyzed in FishXing as a box culvert. However, the length of the flood control channel was too long for FishXing to perform analysis on. Therefore, the results listed for the passage analysis of the Flood Control Channel is based on professional judgment.	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units
Resident *O. mykiss* Analysis for both Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units

Crossing Structure Barrier Status

Hwy 34 Crossing Structure: Temporal & Partial Barrier

FishXing analysis predicted a strong swimming anadromous *O. mykiss* could gain passage under the Hwy 34 bridge when adequate water depth is present, which was predicted to occur when streamflow rates exceeded 186.29 ft^3/s. For resident *O. mykiss* life stages FishXing analysis predicted a velocity barrier would occur when streamflow rates were greater than 22.71 ft^3/s. Water depth was predicted to be insufficient for resident *O. mykiss* passage unless streamflow rates were greater than 106.88 ft^3/s.

Full Extent of Flood Control Channel: Total Barrier

Although the full extent of flood control channel was unable to be analyzed in FishXing it is very unlikely that an *O. mykiss* could gain passage through the multiple miles of concrete channelization due to the absence of resting areas.

Assessment and Analysis Limitations

There were no limitations experienced in the assessment of this crossing structure. The extent of the flood control channel was unable to analyzed within FishXing. As a result, the total barrier status of the flood control channel is based of professional judgement.

Passage Improvement Recommendations

The most effective option would be to replace the concrete lining the channel bottom with natural substrate. However, due to the extensive modifications on this watershed, the drainages from agricultural fields and roads would need to be remediated as well. The majority of this stream appears to be poor fish habitat for both resident and migrating individuals.

Crossing Site Information for PAD 759859					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	8.4	34.19675, -119.10412	± 9 ft	7.9

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 1.26 mi²	Revolon Slough	44.5 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Considering the small drainage area of the stream, low estimated annual mean peak streamflow, channel conditions present at the time of assessment, it is unlikely this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
11/26/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC & CCC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	2 bays	1 (in each bay)	No	No

Crossing Structure Description and Condition
This crossing structure is double bay concrete reinforced box culvert with low clearance. Small flared wingwalls are located at the inlet and outlet. At the time of assessment, the there was a short plunge point from the concrete base of the culvert to the downstream channel substrate.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	2.1 ft	2.2 ft	18 (each bay is 8.2 ft wide)	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
An additional railroad crossing double bay concrete reinforced box culvert is located roughly 65 ft upstream of the Hwy 34 culvert. The upstream channel parallels Hwy 34 and appears to receive drainage from the road and surrounding agricultural fields. At the time of assessment, the upstream channel contained poorly defined active margins and low channel banks. The entirety of the upstream channel contains dense grass vegetation. The upstream channel appears to receive drainage	No upstream resting unit present at the time of assessment.	No upstream resting unit present at the time of assessment.	Not measured

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel also appears to receive drainage from surrounding agricultural fields. At the time of assessment, the channel contained poorly defined active margins and low channel banks. The downstream channel is also heavily vegetated with grass and weeds.	Sand	No downstream control point present.

Longitudinal Profile Measurements
A longitudinal profile was not completed for this crossing structure due to the confined space restrictions of the crossing structure.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment.	Unknown, structure is likely passable under specific streamflow conditions.	Unknown, potential for streamflow depth restriction.
Analysis for Resident *O. mykiss*	Unknown, structure is unlikely to be passable to resident *O. mykiss* life stages at any rate of streamflow.	Unknown, potential for streamflow depth and velocity restrictions.

Crossing Structure Barrier Status
Temporal & Partial Barrier It appears possible for a strong swimming anadromous *O. mykiss* to successfully gain passage of this crossing structure under specific rates of streamflow. However, the estimated annual mean peak streamflow 44.53 ft^3/s may not provide adequate water depth needed for anadromous *O. mykiss* passage. With this in mind, conditions conducive to allowing passage are unlikely to occur often. It is unlikely resident life stages of *O. mykiss* would be able to gain passage through this structure over all rates of streamflow.

Assessment and Analysis Limitations
The low clearance and confined space of this culvert prevented the completion of a longitudinal profile associated with a detailed fish passage assessment. As a result, fish passage analysis was unable to be completed with FishXing for this culvert. The temporal and partial barrier status assigned to this culvert is based off provisional judgement.

Passage Improvement Recommendations
Due to the extensive agricultural modifications of the upstream and downstream stream channel, it is unlikely that this stream provides suitable habitat to sustain *O. mykiss*. If it is determined that the passage constrains of this structure should be remediated the best option would to be replace it with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 759860					
County	**Route**	**Post Mile**	**Location** (at outlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 34	9.4	34.19644, -119.08714	± 9 ft	7.56

Pictures

Upstream Looking Upstream
(railroad bridge culvert crossing and dense vegetation)

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Upstream Looking Upstream
(Upstream of Railroad Crossing)

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 1.57 mi²	Revolon Slough	45.9 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss.* Current presence of *O. mykiss* within this stream is highly unlikely considering its small drainage area, low estimated annual mean peak streamflow, and the considerable impacts from surrounding agricultural land use. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
1/2/20	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (inlet and outlet)	No

Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with short flared wingwalls at its inlet and outlet. At the time of assessment woody debris, vegetation, and trash was built up inside the culvert. The culvert appeared to be in good condition with no visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	5	5	5	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
An additional railroad crossing concrete reinforced box culvert is located roughly 80 ft upstream of the Hwy 34 culvert. At the time of assessment, the upstream channel contained poorly defined active channel margins and uniform man-made channel banks. The channel is located between agricultural fields and contained dense grass and weed vegetation. The channel was actively receiving runoff from the surrounding agricultural fields.	No defined upstream resting unit present at the time of assessment.	No defined upstream resting unit present at the time of assessment.	13.58

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The conditions of the downstream channel also is located between agricultural fields and contains low man-made channel banks. At the time of assessment, the active channel margins were poorly defined and contained dense grass and weed vegetation. The downstream channel also likely receives agricultural runoff.	Silt	No defined tailwater control point present at time of assessment.

Longitudinal Profile Measurements
A longitudinal profile was not able to be conducted due to debris and trash obstruction within this culvert at the time of assessment.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment	Unknown, assumed to be passable under specific streamflow conditions.	Unknown, potential for streamflow depth and impassable cascade restrictions.
Analysis for Resident *O. mykiss*	Unknown, unlikely to passable at any rate of streamflow.	Unknown, potential for streamflow depth, excessive streamflow velocity, and impassable cascade restrictions.

Crossing Structure Barrier Status
Temporal & Partial Barrier If the debris within this culvert is removed it appears possible for a strong swimming anadromous *O. mykiss* to successfully gain passage of this crossing structure under specific rates of streamflow. However, the estimated annual mean peak streamflow 45.93 ft^3/s may not provide adequate water depth needed for anadromous *O. mykiss* passage. With this in mind, conditions conducive to allowing passage are unlikely to occur often. It is unlikely resident life stages of *O. mykiss* would be able to gain passage through this structure over all rates of streamflow.

Assessment and Analysis Limitations
A detailed fish passage assessment was unable to be completed for this structure due to excessive debris within the culvert. This prevented the ability to safely extend a transect tape through the culvert and complete longitudinal profile measurements. As a result, FishXing passage analysis was unable to be completed for this culvert and its temporal and partial barrier status is based on professional judgement.

Passage Improvement Recommendations
Due to the extensive agricultural modifications of the upstream and downstream stream channel, it is unlikely that this stream provides suitable habitat to sustain *O. mykiss*. If it is determined that the passage constrains of this structure should be remediated the best option would to be replace it with a free spanning bridge over natural streambed substrate.

Highway 101 Caltrans Crossing Structures

Crossing Site Information for PAD 759872					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 101	18	34.22242, -119.10607	± 10	10.06

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Wood Creek 1.755 mi^2	Calleguas Creek	193.7 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Calleguas Creek watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
01/02/2020	Caltrans Reconnaissance Fish Passage Assessment	PSMFC/ WSP
01/02/2020	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	2 bays	1 (in each bay)	No	No

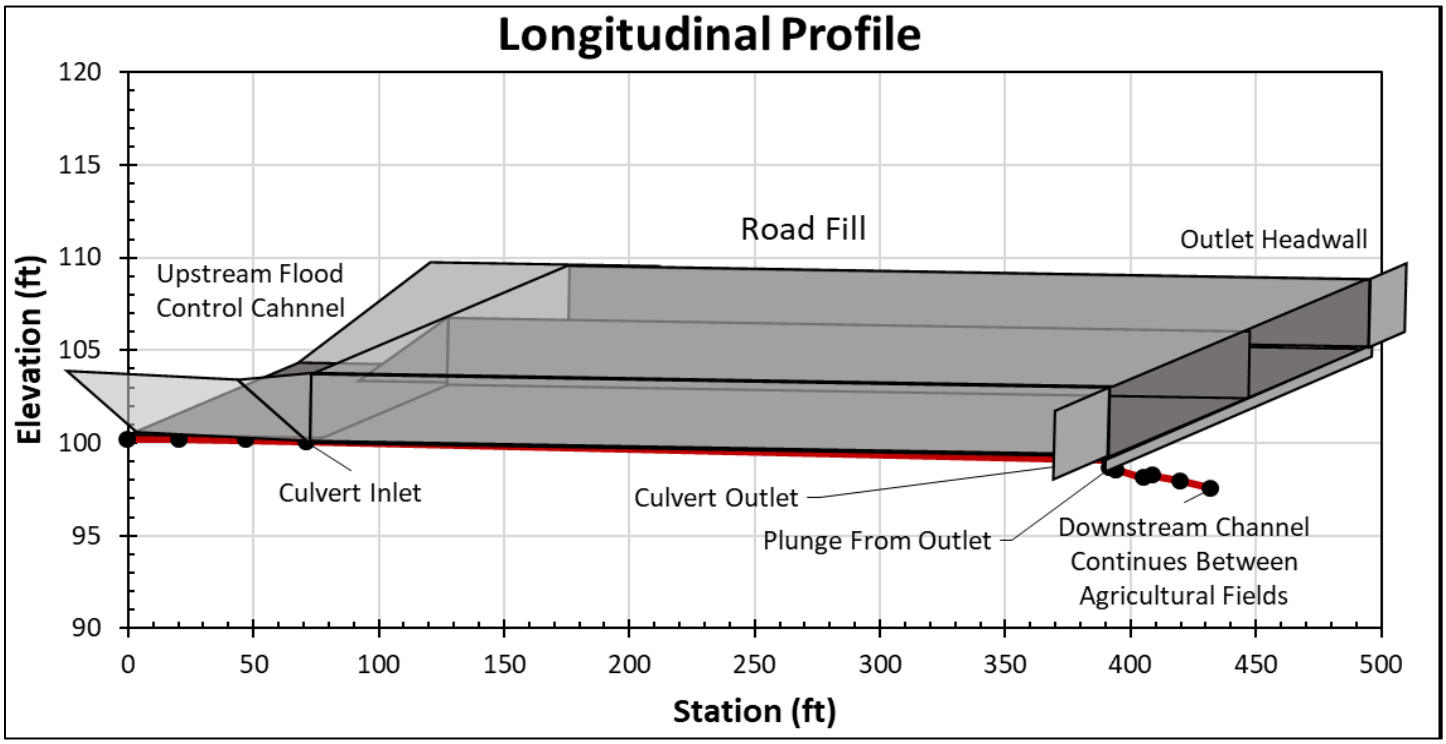
Crossing Structure Description and Condition
This crossing structure is a double bay concrete reinforced box culvert. The culverts are located directly under Hwy 101 and Del Norte Road. The culvert bays curve slightly towards river left from the inlet to their outlet. The structure appeared to be in good condition with no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Upstream Flood Control Channel	n/a (open channel)	n/a (open channel)	8.5 (estimated)	6,673 (estimated)	0.2 % (estimated)
Culvert	4	4	21 (each bay is 10 ft wide with 1 ft wide wall between them)	320.7	0.3 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from inlet)	**Height to Resting Unit** (from inlet)	**Mean Upstream Active Channel Width**
The upstream channel is a concrete lined flood control channel with inward sloping walls. From analysis through Google Earth it appears this channelization extends upstream for roughly 6,673 ft. It is unknown if channelization maintains the same dimensions as present near the Hwy 101 crossing structure.	No upstream resting unit present.	No upstream resting unit present.	8.5 ft (width of flood control channel)

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
The downstream channel has been uniformly shaped to sit between agricultural fields and did not contained well defined active channel margins at the time of assessment. The channel banks are low and uniform and contain grass vegetation. Dense brush vegetation was present within much of the active channel. From Goggle Earth analysis it appears the downstream channel reaches another area of concrete channelization roughly 0.4 miles from the Hwy 101 crossing structure.	Silt	17.1 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	100.2	Within concrete flood control channel. No resting units present.
Upstream Channel Point 2	20.6	100.18	
Upstream Channel Point 3	47	100.16	
Culvert Inlet	71.2	100.06	
Culvert Outlet	391.9	99.1	
Outlet Plunge Point	392	98.68	
Downstream Max Depth (within 5 ft of the structure)	394.4	98.52	
Downstream Max Depth	405.6	98.12	
Tailwater Control Point	409	98.24	
Downstream Channel Point 1	420	97.94	
Downstream Channel Point 2	432.1	97.54	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (two models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Hwy 101 Crossing Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled in FishXing as a large single bay box culvert. The width of the modeled culvert was 20 ft, the combined width of the two 10 ft wide bays present in the actual crossing structure.	71.21 – 1,148.4	Insufficient Streamflow Depth
Upstream Flood Control Channel Analysis for Anadromous *O. mykiss* This model included the estimated length and slope of the upstream concrete lined flood control channel. This model also used a box culvert shape. The length of the culvert within this model was only 3,900 ft as that is the structure length limit for FishXing passage analysis. A 10 ft width was applied for this model in attempt to account for the slopped channel walls.	None	Insufficient Streamflow Depth Absence of Resting Units
Resident *O. mykiss* Analysis for both Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units

Crossing Structure Barrier Status

Hwy 101 Crossing Structure: Temporal & Partial Barrier

The Hwy 101 crossing structure was predicted to be passable to strong swimming anadromous *O. mykiss* under specific rates of streamflow, but not to resident life stages of *O. mykiss*. Water depth was predicted to allow for potential passage of anadromous *O. mykiss* when streamflow rates were greater than 71.21 ft^3/s and streamflow velocity was predicted to prevent potential passage when streamflow rates are greater than 1,148.4 ft^3/s.

Downstream Flood Control Channel: Total Barrier

When the assumed conditions of the upstream and downstream flood control channel were considered in FishXing passage analysis the entirety of the flood control and crossing structure was predicted to be impassible to all life stages of *O. mykiss*. FishXing predicted any fish attempting to gain passage would reach exhaustion due to the extensive length of concrete channelization and absence of potential resting areas.

Assessment and Analysis Limitations

The only limitation experienced in assessing and analyzing this crossing structure was the flood control channel downstream of the crossing structure. The length and slope of this flood control channel were estimated through the use of the elevation profile and ruler tools within Google Earth.

Passage Improvement Recommendations

Due to the excessive amount of stream modifications upstream and downstream of this culvert, remediating the crossing would likely not affect fish passage within this channel. The most effective option would be to remove all concrete lining the crossing and upstream channel. It appears the downstream channel would also benefit from restoration efforts to return it to a more natural state.

Crossing Site Information for PAD 759873					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 101	18.8	34.2228, -119.11990	± 9 ft	9.78

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Present**
Beardsley Wash 28.411 mi²	Calleguas Creek	1530.7 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Calleguas Creek watershed, which has historically supported anadromous fish. However, due to the extensive stream modifications for agriculture and urban planning, the majority of the stream in its current state is poor fish habitat. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
01/02/2020	Caltrans Reconnaissance Fish Passage Assessment	PSMFC & Watershed Stewards Program Members
01/02/2020	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Bays**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Bridge (with in channel support)	2	1 (in each bay)	No	No

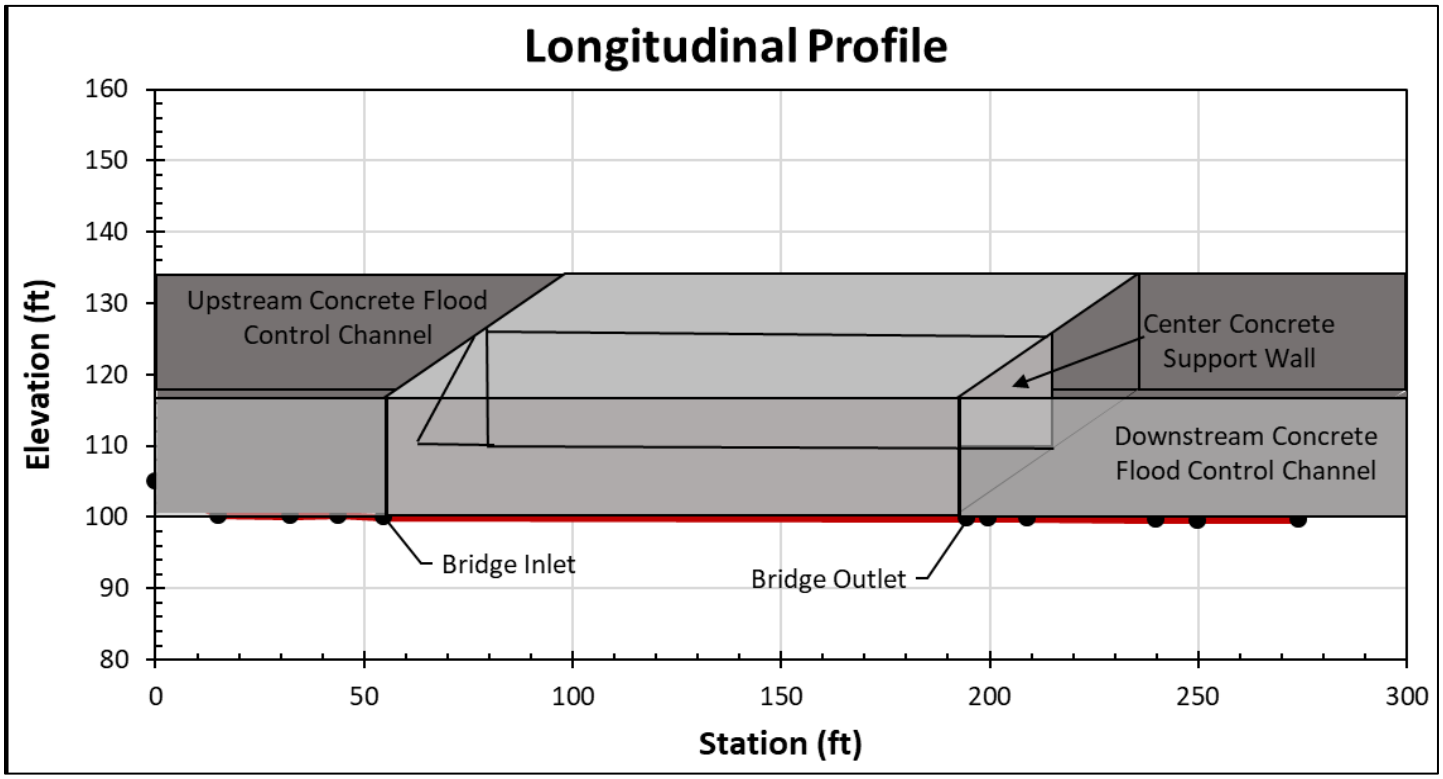
Crossing Structure Description and Condition
This crossing structure is a bridge with a single concrete support structure located throughout its midpoint. The bridge is located over a concrete lined flood control channel, so the structure resembles a large double bay box culvert. The structure appeared to be in good condition with no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Upstream Flood Control Channel	n/a (open channel)	n/a (open channel)	50 (estimated)	9,712 (estimated)	0.7 % (estimated)
Hwy 101 Bridge	17	17.3	50 (each bay is 22.6 ft wide)	139.7	0.1 %
Downstream Flood Control Channel	n/a (open channel)	n/a (open channel)	50 (estimated)	21,033 (estimated)	0.2 % (estimated)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from inlet)	**Height to Resting Unit** (from inlet)	**Mean Upstream Active Channel Width**
The upstream channel has been converted into a concrete lined flood control channel. From Google Earth analysis it appears this channelization extends roughly 1.83 miles upstream of the Hwy 101 crossing structure.	No upstream resting unit present	No upstream resting unit present	47 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Downstream Control Point Distance from Structure**
The downstream channel has also been converted to a concrete lined flood control channel. From Google Earth analysis it appears this channelization extends for roughly 4 miles downstream of the Hwy 101 crossing structure. Several pipe culvert outlets are located in the flood control channel walls near the Hwy 101 crossing structure. These pipe culverts appear to be in place to drain water from the surrounding agricultural fields.	Concrete	No downstream control point present.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Channel Point 1	0	104.96	Within concrete lined flood control channel. No upstream resting unit present.
Upstream Channel Point 2	15	100.23	
Upstream Channel Point 3	32.5	100.16	
Upstream Channel Point 4	44	100.17	
Bridge Inlet	54.9	99.98	
Bridge Outlet	194.6	99.8	
Downstream Channel Point 1	199.6	99.8	Within concrete lined flood control channel.
Downstream Channel Point 2	209	99.76	
Downstream Channel Point 3	240	99.59	
Downstream Channel Point 4	250	99.53	
Downstream Channel Point 5	274	99.59	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (two models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Hwy 101 Crossing Structure Analysis for Anadromous *O. mykiss* This crossing structure was modeled in FishXing as a large single bay box culvert. The width of the modeled culvert was 50 ft, the combined width of the two 10 ft wide bays present in the actual crossing structure.	157.5 – 6,550	Insufficient Streamflow Depth
Flood Control Channel Analysis for Anadromous *O. mykiss* This model included the estimated length and slope of the upstream and downstream concrete lined flood control channel. This model also used a box culvert shape. The length of the culvert within this model was only 3,900 ft as that is the structure length limit for FishXing passage analysis. A 50 ft width was also used for this model.	None	Insufficient Streamflow Depth Absence of Resting Units
Resident *O. mykiss* Analysis for both Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units

Crossing Structure Barrier Status

Hwy 101 Crossing Structure: Temporal & Partial Barrier

The Hwy 101 crossing structure was predicted to be passable to strong swimming anadromous *O. mykiss* under specific rates of streamflow, but not to resident life stages of *O. mykiss*. Water depth was predicted to allow for potential passage of anadromous *O. mykiss* when streamflow rates were greater than 157.5ft^3/s and streamflow velocity was predicted to prevent potential passage when streamflow rates are greater than 6,550 ft^3/s.

Downstream Flood Control Channel: Total Barrier

When the conditions of the upstream flood control channel were considered in FishXing passage analysis the entirety of the flood control and crossing structure was predicted to be impassible to all life stages of *O. mykiss*. FishXing predicted any fish attempting to gain passage would reach exhaustion due to the extensive length of concrete channelization and absence of potential resting areas.

Assessment and Analysis Limitations

The only limitation experienced in assessing and analyzing this crossing structure was the flood control channel downstream of the crossing structure. The length and slope of this flood control channel were estimated through the use of the elevation profile and ruler tools within Google Earth.

Passage Improvement Recommendations

Due to the excessive length of the downstream and upstream flood control channel, it is unlikely that remediating this crossing will assist in fish passage for this stream. If the passage constraints associated with the flood control channel are remediated the concrete lining under this Hwy 101 bridge should also be remediated.

Crossing Site Information for PAD 759877							
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Location** (at outlet)	**Location Error**	**Stream Miles Inland from Ocean** (measured to structure outlet)
Ventura	Hwy 101	26.9	34.27858, -119.24885	± 9	34.26237, -119.24568	± 13	1.5

Pictures

Upstream Looking Upstream

Downstream Looking Upstream
(Culvert Outlet)

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Unnamed 0.784 mi²	Arundell Barranca Creek	205.5 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Arundell Barranca Creek watershed which does not have records indicating historical *O. mykiss* presence. The small drainage area of this stream and lack of natural riparian habitat remaining within it greatly diminishes the likelihood of current *O. mykiss* presence. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
12/19/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
System of Concrete Reinforced Box and Pipe Culverts	Unknown, structure has multiple culverts	Unknown, structure has multiple segments	Yes (inlet and outlet)	No

Crossing Structure Description and Condition
This structure appears to have been incorporated into an extensive urban storm water drainage system. The entirety of the structure was not assessed due to its length and confined space limitations. The outlet is an arched steel plate corrugated culvert encased in concrete. The base of the culvert near the outlet contains rust and erosion damage. Streamflow was visible flowing under this damaged section indicating that this base damage extends further into the culvert. From the outlet, the culvert continues upstream beyond Hwy 101 and remains under Mills Road for approximately one mile. Although not confirmed it is likely the main portion of the culvert has multiple inlets for roadway storm water drainage. Only one inlet was located next to Loma Vista elementary school. This inlet was a small cylindrical steel corrugated culvert encased in concrete.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Full Structure	3 (surveyed inlet, other inlets likely)	12	Unable to measure	5,700 (estimated)	2.4 % (estimated)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel is a narrow concrete lined flood control channel with sloped channel walls. This concrete lined channel extends approximately 770 ft to small and short concrete cylindrical culvert under a private road crossing.	No resting unit identified	No resting unit identified	4.5 ft (concrete flood control channel)

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel is also a concrete lined flood control channel. The extent of the downstream flood control channel was not assessed, but appears to extend approximately 1.5 miles to the Ventura Harbor when viewed from Google Earth.	Concrete	No control point present at time of assessment.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment	Unknown, structure is likely not passable under any rate of streamflow.	Unknown, potential for insufficient streamflow depth, streamflow velocity, and absence of resting unit restrictions.

Crossing Structure Barrier Status

Total Barrier

Despite the inability to complete a detailed barrier assessment this crossing structure likely should be considered a total barrier to all life stages of *O. mykiss*. The extensiveness of the culvert coupled with the upstream and downstream concrete flood control channels likely eliminates resting areas for any *O. mykiss* attempting to make passage attempts. Additionally, multiple areas of stormwater runoff into the culvert likely create turbulent and potentially hazardous streamflow conditions. It is likely any *O. mykiss* attempting to make passage would reach exhaustion.

Assessment and Analysis Limitations

No limitations were experienced with the completion of a Caltrans first pass reconnaissance fish passage assessment. A detailed fish passage assessment was not conducted due to the extensive length of the culvert, confined space, and multiple inlets. Without FishXing modeling and fish passage analysis the barrier status of the crossing structure was determined through professional judgement.

Passage Improvement Recommendations

Any barrier remediation efforts would require extensive actions considering this structure appears to be part of a large urban storm water drainage system. Apart from reconstructing the storm water drainage system on potential remediation action would be installation of weirs within the culvert to create streamflow conditions more conducive to *O. mykiss* passage.

Highway 150 Caltrans Crossing Structures

Crossing Site Information for PAD 759939					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	0.5	34.39506, -119.44511	± 13 ft	3.08

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.65 mi²	Casitas Creek	353.4 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Rincon Creek watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
10/07/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/07/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (inlet and outlet)	No

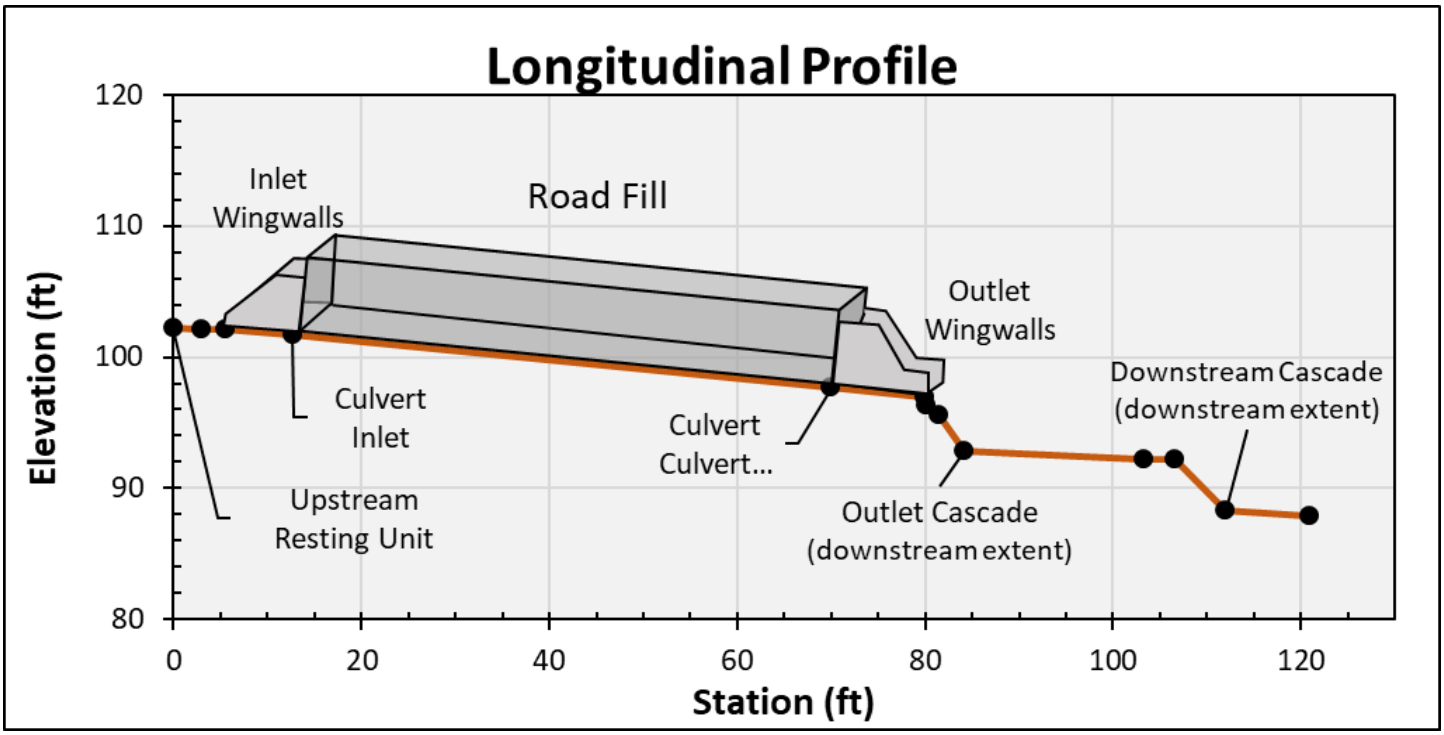
Crossing Structure Description and Condition
Fully concrete lined box culvert with short inlet and outlet wingwalls. The wingwalls are oriented parallel to the walls of the culvert. Concrete inlet and outlet aprons are present between the wingwalls. The crossing structure was in good condition with no visible damage or erosion at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	6	7.1	6.6 %
Culvert	6	6	6	57.3	9.7 %
Outlet Apron	n/a (open channel)	n/a (open channel)	6	10	10.5 %
Full Structure	6	6	6	74.4	12.3 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment this upstream channel contained narrow and moderately defined active channel margins with many short riffle units. The channel banks were steep and contained heavy brush vegetation and some moderate-sized woody debris. Some of the vegetation and woody debris was encroaching into the active stream channel margins at the time of assessment.	5.6 ft	0.09 ft	5.5 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
At the time of assessment, there was considerable scour below the structure outlet apron at the time of assessment. This scour has created a steep cascade/plunge from the structure outlet apron with a mean height of 4.06 ft. The downstream unit was a shallow and narrow riffle. The downstream channel is incised with steep banksides and a narrow bankfull width. The bankfull width was 11 ft at the downstream tailwater control point. Another steep cascade was present from the tailwater control point with a mean height of 3.93 ft.	Bedrock	106.6 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	102.2	
Upstream Channel Point 1	3	102.13	
Inlet Apron (upstream extent)	5.6	102.11	Inlet apron is between wingwalls
Culvert Inlet	12.7	101.64	
Culvert Outlet	70	97.66	
Outlet Apron (downstream extent)	80	96.92	Outlet apron is between wingwalls
Outlet Cascade Point 1	80.1	96.36	
Outlet Cascade Point 2	81.5	95.61	
Outlet Cascade Point 3	84.2	92.86	Base of outlet cascade. Also, max depth within 5 ft of structure.
Downstream Max Depth	103.3	92.19	Located within downstream riffle unit
Tailwater Control Point	106.6	92.24	
Downstream Channel Point 1	112	88.31	Located at downstream extent of cascade from tailwater control point
Downstream Channel Point 2	121	87.9	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was modeled in FishXing as a box culvert. The length of the structure inlet and outlet aprons was factored into the culvert length value used in FishXing analysis.	None	Outlet Plunge/Cascade Outlet Unit Restriction Insufficient Streamflow Depth

Crossing Structure Barrier Status

Total Barrier

FishXing passage analysis estimated this crossing to be impassable to all life stages of *O. mykiss* over all rates of streamflow. The main factor preventing *O. mykiss* passage is the cascade/plunge from the structure outlet apron, coupled with an insufficient water depth that currently can occur within in the downstream riffle unit. This limits the jump height an *O. mykiss* may achieve in order to gain access into the crossing structure. FishXing analysis also indicated streamflow hydraulics occurring within the crossing structure as factor limiting *O. mykiss* passage. According to FishXing even if a strong swimming Steelhead were able to gain access to the crossing structure it would not be able to successfully gain passage unless streamflow rates were above 70.25 ft^3/s, to provide adequate water depth.

Assessment and Analysis Limitations

Due to the steep grade of and thick vegetation on the downstream channel banks the extent of the tailwater control profile was slightly limited. It is likely that the downstream bankfull width extends slightly beyond the points measured and included within this survey. It is estimated the true downstream bankfull width at the tailwater control point is 2 to 4 feet wider than the 11 ft value used in FishXing analysis.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 732232					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	4	34.38403, -119.39774	± 27 ft	3.5

Pictures

Upstream Looking Upstream

Downstream Looking Upstream
(Culvert Outlet)

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Poverty Canyon Creek 0.825 mi^2	Los Sauces Creek	331.2 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Los Sauces Creek watershed which does not have records indicating historical *O. mykiss* presence. The small drainage area of this stream and abundance of vegetation growing within the channel indicates that sustained streamflow conditions are rare and the likelihood of *O. mykiss* presence is likely low. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/07/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/07/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (at outlet)	No

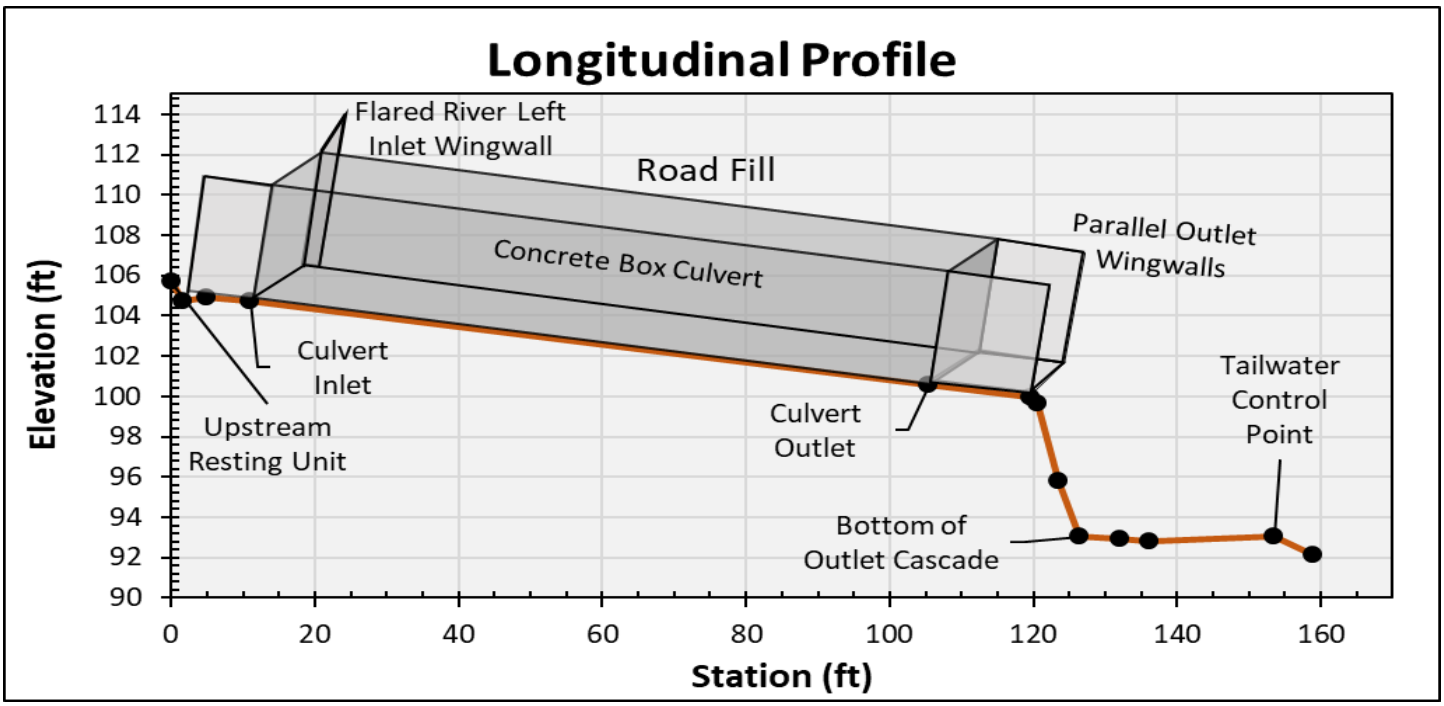
Crossing Structure Description and Condition
This crossing structure is a single segment concrete reinforced box culvert. Concrete wingwalls are present at both the inlet and outlet. Each wingwalls apart from the river left inlet wingwall are parallel to the orientation of the culvert. The river left inlet wingwall is flared at a 45-degree angle from the inlet of the culvert. A concrete apron is located between the outlet wingwalls.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	8	8	8	94.4	4.4 %
Outlet Apron	n/a (open channel)	n/a (open channel)	8	14.1	4.1 %
Full Structure	8	8	8	108.5	4.4 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At time of assessment, the active channel margins upstream of the structure were not well defined. Thick brush, aquatic vegetation, and small trees were present within the upstream active channel margins. The upstream channel walls contained boulder riprap, which extended upstream roughly 40 ft from the culvert inlet. At this upstream point some of the riprap boulders converged into the active channel margins to create a cascading grade control. The cascade of the grade control contained passage constraints to *O. mykiss* and is likely impassable except at high rates of streamflow. More analysis of the grade control would need to be completed before assigning a barrier status to it.	11 ft	0.98 ft	10 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the active channel margins downstream of the culvert were well defined. Downstream vegetation was less dense than upstream vegetation, however tree trunks, branches, and roots were present next to the outlet apron and were partially obstructing the active channel. Additionally, a considerable cascade with a mean height of 7 ft is present from the outlet apron. This cascade leads into a small and shallow pool unit. Moderate brush and tree cover was present along the channel banks.	Cobble	34 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	105.68	
Upstream Channel Point 1	1.6	104.72	
Upstream Channel Point 2	5.0	104.93	
Culvert Inlet	11	104.7	
Culvert Outlet	105.4	100.56	
Downstream Apron	119.5	99.98	
Outlet Cascade Point 1	120.5	99.67	
Outlet Cascade Point 2 (Max depth within 5 ft of structure)	123.5	95.81	
Outlet Cascade Point 3	126.4	93.03	Bottom of outlet cascade
Downstream Channel Point 1	132	92.94	
Downstream Max Depth	136.1	92.82	
Tailwater Control Point	153.5	93.06	
Downstream Channel Point 2	159	92.13	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
The length of the outlet apron was factored into the culvert length value used in FishXing analysis. This increased the culvert length from 94.4 ft to 108.5 ft. The mean height of the outlet cascade (7 ft) was modeled as an outlet drop within FishXing.	None	Insufficient Streamflow Depth Impassable Cascade Outlet Unit Restriction

Crossing Structure Barrier Status

This structure was assessed to be a total barrier to all life stages of *O. mykiss*. The main factor restricting passage through this structure is the cascade from the outlet apron. The small and shallow pool unit downstream of the cascade prevents *O. mykiss* from being able to achieve a jump height to clear the cascade and gain entry into the culvert. Even if an *O. mykiss* was able to gain access to the culvert FishXing predicts water depth to be insufficient for successful passage unless streamflow is greater 86.54 ft^3/s. A streamflow velocity barrier within the culvert is predicted at streamflow rates greater than 988.11 ft^3/s.

Assessment and Analysis Limitations

No limitations were encountered in assessing this crossing structure. The only limitation of FishXing passage analysis was the modeling of the outlet cascade as a plunge point. This likely had very little influence over the results of fish passage analysis as the cascade was steep and did not have any potential areas for an *O. mykiss* to rest or perform subsequent jumps attempts from.

Passage Improvement Recommendations

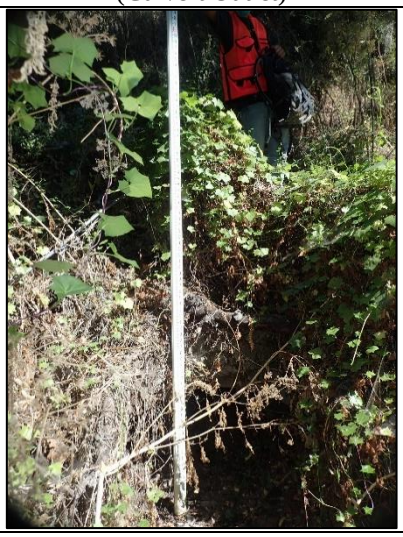
The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. The installation of weirs within the culvert likely would lead to blockage of streambed substrate and debris which would impact passage conditions and potentially lead to structural damage of the crossing structure.

Crossing Site Information for PAD 732039					
County	**Route**	**Post Mile**	**Location** (At inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	4.53	34.38557, -119.38859	± 9 ft	4.11

Pictures

Upstream Looking Upstream

Downstream Looking Upstream (Culvert Outlet)



Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Downstream

Culvert Inlet Looking Downstream

Culvert Inlet Looking Upstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Unnamed 0.147 mi²	Los Sauces Creek	107.2 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Los Sauces Creek watershed which does not have records indicating historical *O. mykiss* presence. The small drainage area of this stream and absence of a defined active channel when survived indicates that sustained streamflow conditions are rare and the likelihood of *O. mykiss* presence is likely very low. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
10/7/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Corrugated Metal Pipe Culvert	1	1	No	No

Crossing Structure Description and Condition
This structure is a corrugated metal pipe culvert. The inlet and outlet are encased in a concrete headwall. At the time of assessment, the culvert was heavily embedded with substrate and woody debris. The inlet of the culvert had a mean embeddedness of 2 ft. Embeddedness increased a short distance from the inlet and the culvert was nearly fully embedded down to its outlet. The outlet had a mean embeddedness of roughly 4.4 ft. The outlet was also partially obstructed by overgrown surrounding vegetation. Moderate rust was visible along the exposed base of the culvert near the inlet.

Crossing Structure Dimensions			
Segment	**Mean Diameter**	**Length**	**Slope**
Culvert	6 ft	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At time of assessment, the active channel margins upstream of the structure were not well defined. Thick grass and brush was present within the channel and along the channel banks. No distinct habitat units were present in the upstream channel.	Not measured	Not measured	Not measured

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the active channel margins downstream of the culvert were not well defined. Very dense brush vegetation was present within the channel and banksides. Similar to the upstream channel no distinct habitat units were present in the downstream channel.	Gravel	Not measured

Longitudinal Profile Measurements
A longitudinal profile was not able to be completed due to the confined space restrictions.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile.	Unknown, structure is likely not passable under any rate of streamflow.	Unknown, potential for streamflow depth, streamflow velocity, and impassable cascade restrictions.

Crossing Structure Barrier Status

Total Barrier

Despite the inability to complete a detailed barrier assessment this crossing structure likely should be considered a total barrier to all life stages of *O. mykiss*. The high degree to which the culvert is embedded with both substrate and woody debris likely creates turbulent conditions when streamflow is present. Although not measured the culvert also appeared to have considerable slope, which would increase the difficultly for upstream migrating *O. mykiss* to successfully gain passage.

Assessment and Analysis Limitations

A detailed barrier assessment, including a longitudinal profile was not able to be completed for this crossing structure due to the high degree of embeddedness and the confined space it created within the culvert. Due to this a passage assessment through FishXing modeling was unable to be completed for this crossing and the barrier status is based off professional judgement.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. The installation of weirs within the culvert likely would lead to blockage of streambed substrate and debris which would impact passage conditions and potentially lead to structural damage of the crossing structure.

Crossing Site Information for PAD 731812					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	12.86	34.42615, -119.31392	± 13 ft	11.30

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 1.487 mi^2	Ventura River	138.4 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/23/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/23/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (at outlet)	No

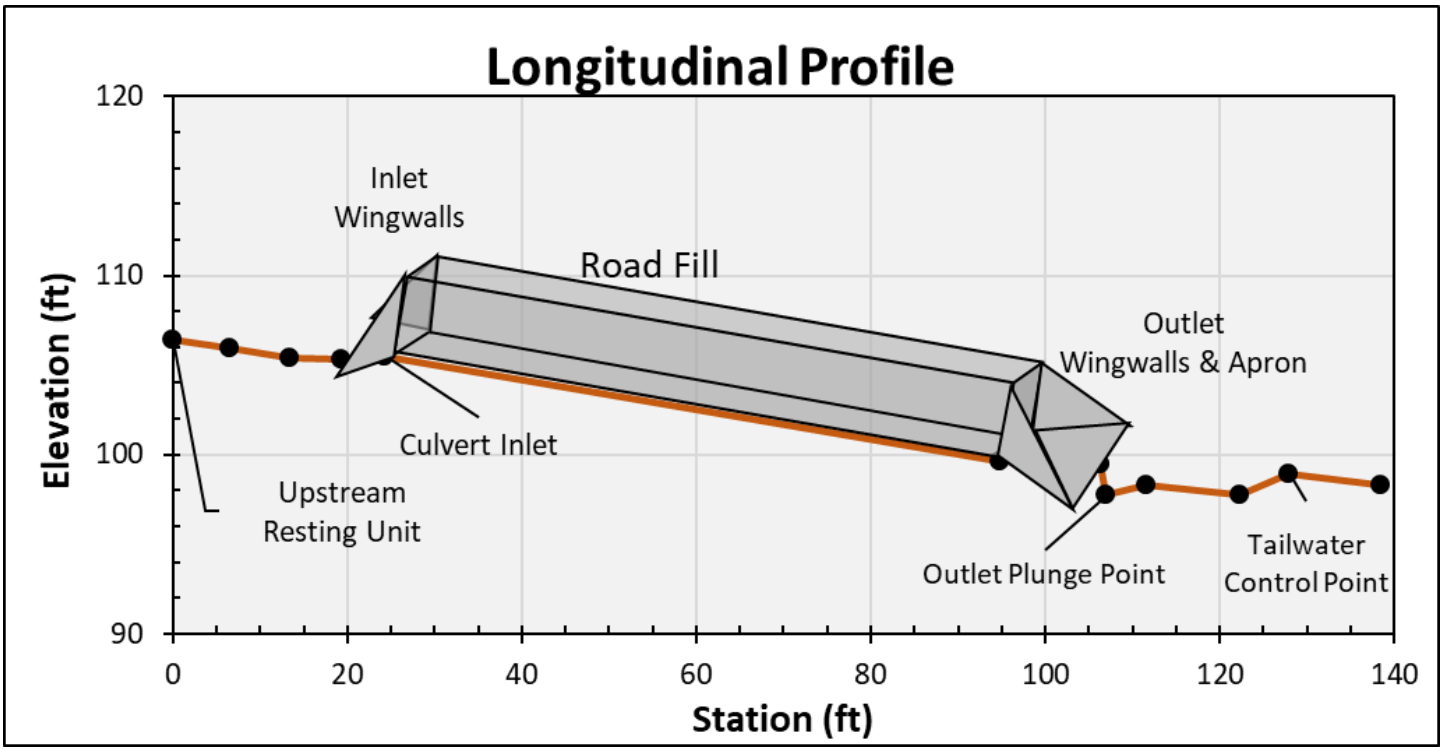
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with wingwalls and an outlet apron. The river right inlet wingwall is at the same orientation as the culvert and the river left inlet wingwall is flared. Both outlet wingwalls are flared. The culvert appeared to be in good condition with no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	10	10	8.8	70.54	8.3 %
Outlet Apron	n/a (open channel)	n/a (open channel)	14	11.46	1.7 %
Full Structure	10	10	10	82.02	7.4 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins and large channel banks. The channel was primary comprised of boulders and large cobble and consisted of riffle, flatwater, and small pool units. The channel banks contained oak trees and low brush vegetation.	24.28 ft	0.93 ft	14.56 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
The downstream channel veers towards river left directly downstream of the culvert outlet. A small plunge point with a mean height of 1.74 ft. A large pool unit is located directly downstream of the culvert. Downstream of the pool unit the channel contains well defined active channel margins with riffle, flatwater, and additional pool units. The channel banks are low and densely covered with brush and small trees.	Boulders	21.65 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	106.41	
Upstream Channel Point 1	6.56	105.95	
Upstream Channel Point 2	13.45	105.38	
Upstream Channel Point 3	19.36	105.36	
Culvert Inlet	24.28	105.48	
Culvert Outlet	94.82	99.65	
Outlet Apron (downstream extent)	106.3	99.46	
Downstream Max Depth	106.96	97.72	Plunge point below outlet apron, within pool unit.
Downstream Channel Point 1	111.55	98.33	
Downstream Channel Point 2	122.38	97.76	
Tailwater Control Point	127.95	98.93	
Downstream Channel Point 3	138.45	98.32	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing structure was modeled in FishXing as a box culvert. The outlet apron length and slope was factored into the modeled culvert.	130.94 – 1,015.29	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal and Partial

This crossing structure was assessed to be potentially passable to anadromous *O. mykiss* over a specific range of streamflow, but not passable to resident life stages of *O. mykiss*. For strong swimming steelhead sufficient water depth to allow for potential passage was predicted to occur during streamflow rates greater than 130.94 ft^3/s. Excessive streamflow velocity was not predicted to prevent passage below 1,015.29 ft^3/s. Considering the predicted annual mean peak streamflow is only 138.36 ft^3/s, conditions conducive to anadromous *O. mykiss* passage likely rarely occur.

Assessment and Analysis Limitations

There were no limitations experienced in assessing or performing FishXing passage analysis on this crossing structure.

Passage Improvement Recommendations

The most effective remediation option to improve passage conditions at this site would be to replace this culvert with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 731535					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	16.2	34.43634, -119.26358	± 13 ft	13.5

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.0696 mi^2	Ventura River	29.7 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Current presence of *O. mykiss* within this stream is unlikely considering its small drainage area and intermittent streamflow associated with it. This stream is part of the Ventura River watershed which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/24/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Pipe Culvert	1	1	No	No

Crossing Structure Description and Condition
This crossing structure is a concrete reinforced pipe culvert with small headwalls at its inlet and outlet. The outlet was partially embedded with gravel and silt substrate. The inner portions of the culvert could not be accessed due to confined space restrictions. The inlet and outlet of the culvert appeared to be in good condition with no visible damage.

Crossing Structure Dimensions				
Segment	**Mean Inlet Diameter** (ft)	**Mean Outlet Diameter** (ft)	**Length** (ft)	**Slope**
Culvert	4	4	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel is narrow with poorly defined active channel margins and small uniform channel banks. The channel runs between the highway and a pedestrian path. It appears to serve as drainage ditch from Hwy 150 and surrounding residential area. Brush and grass vegetation were present across the entirety of the channel.	Not recorded	Not recorded	Not recorded

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
The downstream channel also had poorly defined active channel margins at the time of assessment. The channel did not have defined banksides, so streamflow appears to disperse into a wide area. A chain-link-fence crosses the channel a short distance from the outlet of the culvert. There was a small plunge point created by tree roots downstream of the fence. A small scour pool is located below this plunge point. The poorly defined channel contained brush and grass vegetation and appears to receive drainage from the surrounding residential area.	Silt	No defined tailwater control point present at the time of assessment.

Longitudinal Profile Measurements
A longitudinal profile was unable to be completed for this crossing structure due to confined space restrictions present at this crossing structure.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment.	None	Unknown, potential for streamflow depth and streamflow velocity restrictions.

Crossing Structure Barrier Status
Total Barrier Upstream *O. mykiss* passage attempts appear highly unlikely to occur at this crossing structure, due to the lack of a defined downstream stream channel. However, if an *O. mykiss* were able to gain access to this crossing structure it likely would not be able to gain passage. This professional judgement assessment is based on the likelihood of streamflow velocity barriers likely to be created from the small diameter of embedded substrate further constricting the area within this culvert.

Assessment and Analysis Limitations
Due to the small diameter of this culvert, a transect tape could not be passed through this structure and a longitudinal profile associated with a Caltrans detailed fish passage assessment could not be completed. As a result, FishXing analysis was unable to be performed on this crossing structure and the total barrier status assigned to it is based on professional judgement.

Passage Improvement Recommendations
Due to the absence of a defined downstream channel barrier remediation efforts are not recommended for this crossing structure. If barrier remediation is conducted the most effective option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 731496					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	16.59	34.44191, -119.26052	± 14 ft	14.31

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.58 mi²	San Antonio Creek	39.9 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Current presence of *O. mykiss* within this stream is unlikely considering its small drainage area and intermittent streamflow associated with it. This stream is part of the Ventura River watershed which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/24/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/24/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (at inlet)	No

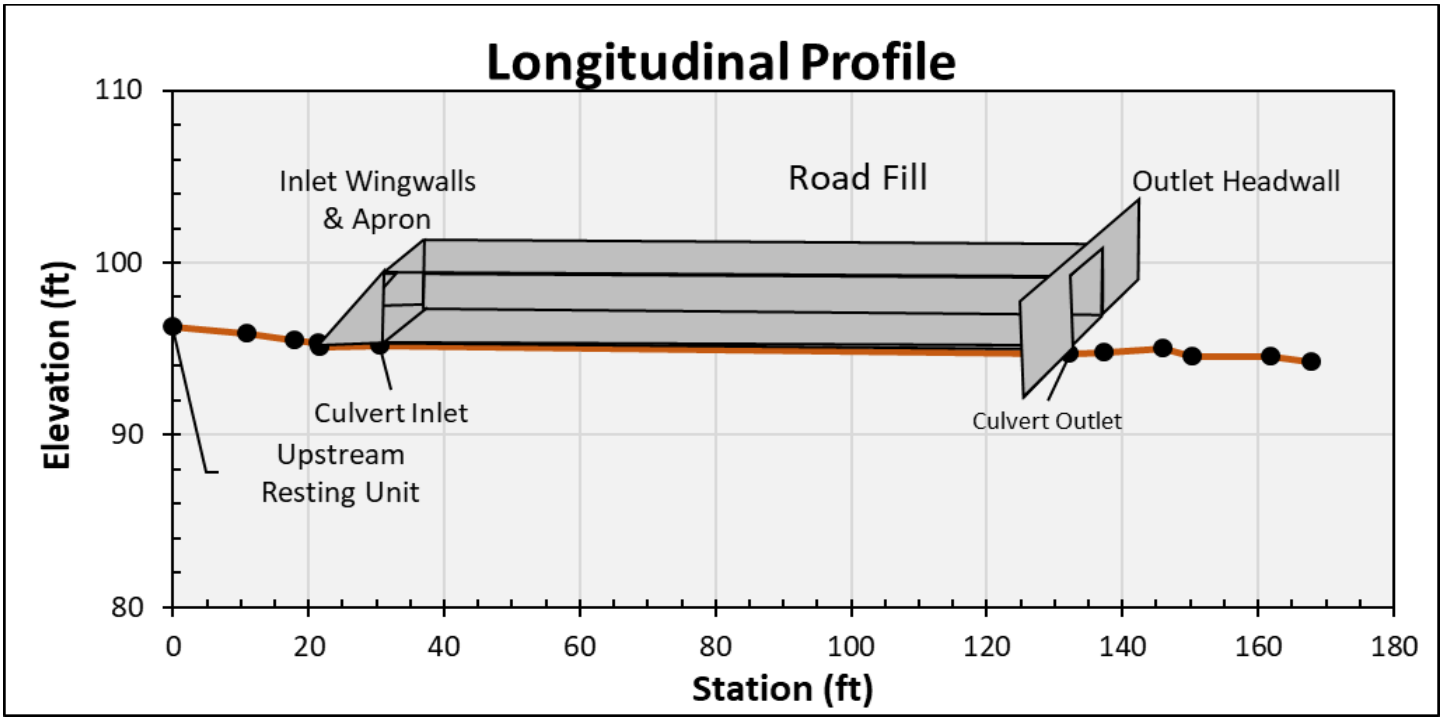
Crossing Structure Description and Condition
The crossing structure is a concrete reinforced box culvert, with wingwall at the inlet and a headwall at the outlet. A concrete apron is located between the inlet wingwalls. At the time of assessment, the downstream portion of the culvert was embedded with gravel and cobble substrate. The culvert is located under a portion of a busy three-way intersection that commonly experiences heavy traffic. The culvert appeared to be in good condition with no visible damage at the time of assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	6	8.9	-1 % (slopes upstream)
Culvert	4.1	3.85	4.1	101.7	0.4 %
Full Structure	4.1	3.85	4.5	110.6	0.3 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained poorly defined active margins and small channel banks. The channel banks contained grass and oak trees. The channel runs parallel to Del Norte Road and continues north through a neighborhood with extended riffle units. Telephone poles sit on the river left bank.	21.7 ft	1.19 ft	7.1 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained poorly defined active margins, extended riffle unit, and small channel banks. Minimal vegetation was located on the channel banks. The downstream channel runs through a small residential area park and free spanning pedestrian bridge crosses the channel near the Hwy 150 culvert outlet.	Sand	No definable tailwater control point present at time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	96.25	
Upstream Channel Point 1	11	95.84	
Upstream Channel Point 2	18	95.5	
Upstream Channel Point 3	21.6	95.36	
Inlet Apron (upstream extent)	21.7	95.06	
Culvert Inlet	30.6	95.15	
Culvert Outlet	132.3	94.72	
Downstream Max Depth (within 5 ft of outlet)	137.3	94.81	
Downstream Channel Point 1	146	95.02	
Downstream Max Depth	150.3	94.57	
Downstream Channel Point 2	162	94.57	
Downstream Channel Point 3	168	94.26	
Downstream Channel Point 4	173	93.58	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing structure was modeled in FishXing as a box culvert. The length and slope of the inlet apron were factored into the modeled culvert. A culvert base roughness coefficient of 0.18 was used to represent the embedded substrate at the downstream portion of the culvert.	14.48 – 333.02	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was predicted to be passable to strong swimming anadromous *O. mykiss* during specific rates of streamflow, but not to resident life stages of *O. mykiss* at any rate of streamflow. For anadromous *O. mykiss* it was predicted water depth would be adequate for passage when streamflow rates were greater than 14.5 ft^3/s. Streamflow velocity was predicted to prevent passage when above 333 ft^3/s.

Assessment and Analysis Limitations

No limitations were encountered in assessing this crossing structure or in performing FishXing analysis.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 731238					
County	**Route**	**Post Mile**	**Location** (at outlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	17.64	34.44781, -119.24429	± 22 ft	14.94

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

The culvert inlet was not accessible.

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Culvert Segment Transition Looking Upstream

Culvert Segment Transition Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 2.40 mi^2	Fox Canyon Barranca Creek	147.6 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed, which has historically supported anadromous fish (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
9/24/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Steel Pipe Culvert & Concrete Reinforced Box Culvert	1	2	No	No

Crossing Structure Description and Condition
This crossing structure is partially located under the foundations of the buildings located north of Hwy 150. It contains 2 distinct segments and transition area between them. The upstream inlet segment is a small low-profile corrugated steel arch pipe. This pipe arch runs under the foundation of buildings located north of Hwy 150 and leads to a large open concrete reinforced box culvert transition area with wood and concrete building supports located within it. Additional small pipe culverts drain into this transition area. The downstream box culvert portion is located under Hwy 150. The combined length of both culvert segments is estimated to be roughly 900 ft. No significant damage was visible within the assessed portion of this multiple segment culvert structure.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Arch Pipe Segment	Unable to access and measure, assumed to be 3 ft.	3	5 ft	Unable to measure	Unable to measure
Box Culvert Segment	4.85	4.85	8	Not measured	Not measured

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The portion of the stream channel where the inlet of this culvert structure is located is within private property blocked by fencing. Therefore, the stream channel area directly upstream of the culvert inlet was unable to be accessed. The portion of the upstream channel that was accessible contained poorly defined active margins and low channel banks.	Unable to measure	Unable to measure	Unable to measure

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel contains poorly defined active channel margins and has a flat profile with extended shallow riffle units. The river right portion of the channel is lined with a tall concrete retaining wall for a building structure. The river left portion of the channel has a low channel bank with dense brush vegetation.	Sand	No defined tailwater control point present at time of assessment.

Longitudinal Profile Measurements
A longitudinal profile was not able to be completed due to the confined space restrictions of the pipe arch segment of the structure.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment.	Unknown, structure is likely not passable under any rate of streamflow.	Unknown, potential for streamflow depth, streamflow velocity, and absence of resting unit restrictions.

Crossing Structure Barrier Status
Total Barrier This crossing structure likely should be considered a total barrier to all life stages of *O. mykiss*. The extended length of the culvert segments and variations in streamflow hydraulics throughout these segments could potentially confuse any *O. mykiss* attempting to gain passage. Additionally, the small pipe arch segment likely contains excessive streamflow velocities, which could cause exhaustion in *O. mykiss* attempting to gain passage.

Assessment and Analysis Limitations
A detailed barrier assessment, including a longitudinal profile was not able to be completed for this crossing structure due the confined space conditions of the pipe arch segment. As a result, passage assessment through FishXing modeling was unable to be completed for this crossing and the barrier status is based off professional judgement

Passage Improvement Recommendations
Remediating the passage constrains associated with this structure would be difficult due to its location under several buildings north of Hwy 150. Installation of weirs within the culvert may improve passage conditions. The most effective remediation option may be to reroute this stream with an attempt to replicate natural streambed conditions.

Crossing Site Information for PAD 712466					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	17.84	34.44822, -119.24102	± 9 ft	15.22

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Fox Canyon Barranca Creek 1.62 mi^2	San Antonio Creek	254.0 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Ventura River watershed, which has historically supported anadromous fish. Seasonal CDFW spawning surveys have been completed within Fox Canyon Barranca Creek's tributary San Antonio creek yearly beginning in 2013. Redd and individual *O. mykiss* observations have not been made since 2015. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2013-2015)

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
09/24/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
09/24/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	No	No

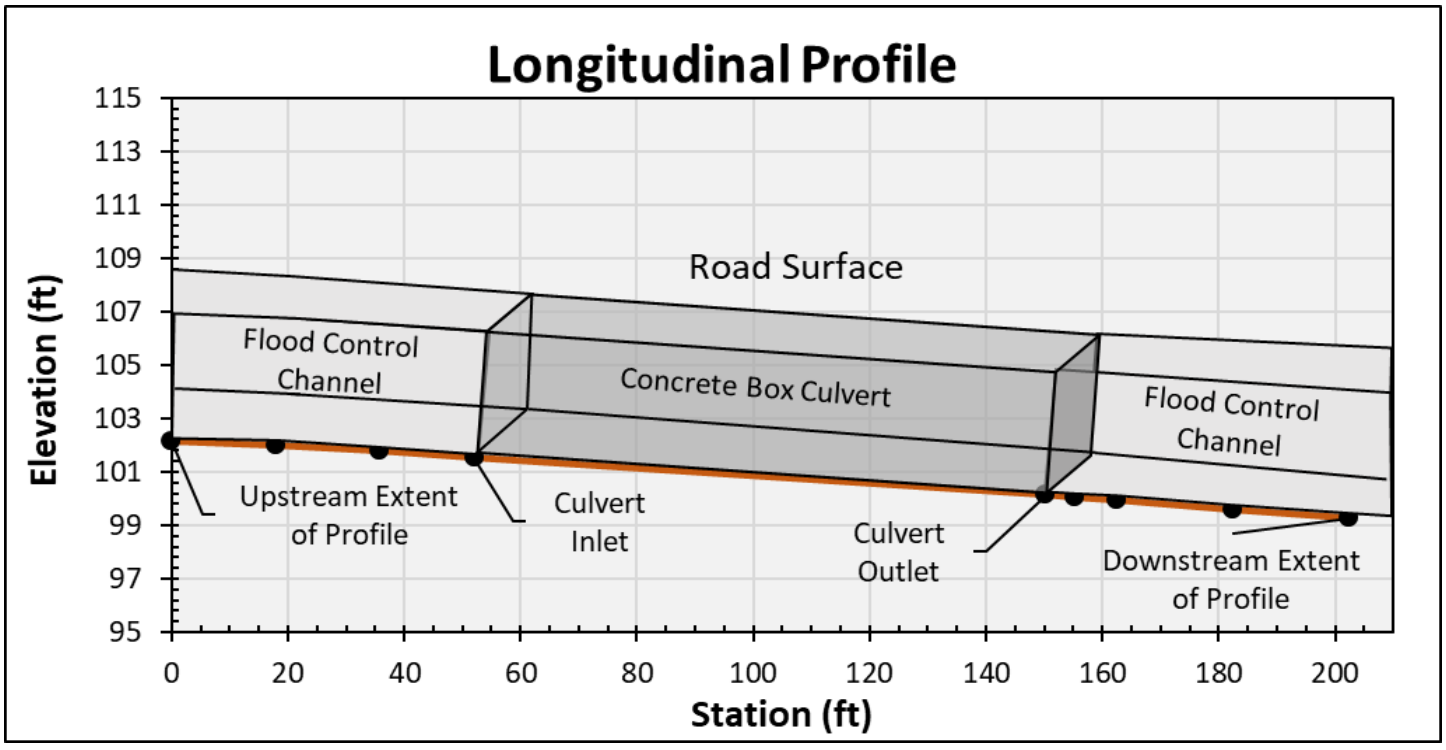
Crossing Structure Description and Condition
This structure is a concrete reinforced box culvert directly under the surface of the roadway. The culvert is part of a larger concrete lined flood control channel. This open concrete lined flood control channel extends upstream and downstream of the crossing structure. A detailed barrier assessment was not performed on the entirety of the flood control channel was not surveyed. No damage was visible within the culvert structure or surveyed portion of the flood control channel.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Hwy 150 Crossing Structure	5.8	6	12	98.3	2.5 %
Full Flood Control Channel	n/a (open channel)	n/a (open channel)	12 (estimated)	3,273 (estimated)	1.6 % (estimated)

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel is a 12 ft wide concrete lined flood control channel with 6 ft high walls. From Google Earth analysis it appears this flood control channel extends 0.40 miles upstream of the crossing structure.	Unknown	Unknown	12 ft (width of flood control channel)

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel is a 12 ft wide concrete lined flood control channel with 6 ft high walls. From Google Earth analysis it appears this flood control channel extends 0.22 miles downstream of the crossing structure. There are two additional downstream road crossings passing over the concrete lined extent of the channel.	Concrete	No control point present at time of assessment.

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Survey Extent	0	102.13	No upstream resting unit within vicinity of crossing structure.
Upstream Channel 1	18	102.02	
Upstream Channel 2	35.7	101.78	
Culvert Inlet	52	101.53	
Culvert Outlet	150.3	100.14	
Downstream Channel 1	155.3	100.6	
Downstream Channel 2	162.6	99.93	This point was chosen for the location of the tailwater cross section despite no control point being present.
Downstream Channel 3	182.4	99.58	
Downstream Channel 4	202.3	99.26	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing (two models used)	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Hwy 150 Crossing Structure Analysis for Anadromous *O. mykiss* This model is representative of the measurements collected from the longitudinal and cross section profiles completed for the box culvert structure under Hwy 150.	79.46 – 1,152	Insufficient Streamflow Depth
Flood Control Channel Analysis for Anadromous *O. mykiss* This model assesses the entirety of the flood control channel upstream and downstream of the Hwy 150 box culvert crossing. The flood control channel was modeled as an extended box culvert. In this model it is assumed the flood control channel maintains a width of 12 ft and 6 ft high walls. Length and slope of the flood control channel was estimated with the use of the elevation profile and ruler tools in Google Earth. A constant tailwater was used for this model as a tailwater control profile was not completed downstream of the flood control channel. This model is more representative of the conditions an upstream migrating *O. mykiss* would encounter as it accounts for the streamflow hydraulics occurring upstream and downstream of the Hwy 150 box culvert crossing structure.	None, entirety of the flood control channel is not passable.	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units
Resident *O. mykiss* Analysis for both Models	None	Insufficient Streamflow Depth Excessive Streamflow Velocity Absence of Resting Units

Crossing Structure Barrier Status

Hwy 150 Crossing Structure: Temporal and Partial Barrier

The Hwy 150 crossing structure was predicted to be passable to strong swimming anadromous *O. mykiss* under specific rates of streamflow, but not to resident life stages of *O. mykiss*. Water depth was predicted to allow for potential passage of anadromous *O. mykiss* when streamflow rates were greater than 79.46 ft^3/s and streamflow velocity was predicted to prevent potential passage when streamflow rates are greater than 1,152 ft^3/s.

Inclusion of Upstream and Downstream Flood Control Channel Total Barrier

The box culvert crossing structure coupled with the flood control channel it is located in is predicted to be impassable to all life stages of *O. mykiss* over all rates of streamflow. The main factors preventing *O. mykiss* passage are insufficient water depth, high streamflow velocities, and lack of resting areas within the flood control channel.

Assessment and Analysis Limitations

There were no limitations experienced in assessing and performing analysis on this Hwy 150 crossing structure. The assessment and passage analysis performed on the flood control channel was based off estimated dimensions from Google Earth analysis.

Passage Improvement Recommendations

The most effective option would be to remove the concrete lining from the bottom of the extended entire flood control channel. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss.*

Crossing Site Information for PAD 731449					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	19.56	34.44668, -119.21107	± 9 ft	16.5

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Bridge Inlet)

Downstream Looking Upstream (Bridge Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Thacher Creek 9.25 mi^2	San Antonio Creek	1,283.7 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is a tributary to San Antonio Creek which has many records of supporting *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
12/20/18	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information			
Structure Type	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Free Spanning Bridge	1	No	No

Crossing Structure Description and Condition
This crossing structure is free spanning bridge (Caltrans Bridge ID 52 0098) over natural streambed substrate. The bridge contains vertical concrete walls which extend to form flared inlet and outlet wingwalls. The bridge appeared to be in good condition at the time of assessment, with no visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	12.8	11.4	Not measured	Not measured	Not measured

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained well defined active channel margins and wide low channel banks. The active channel contained gravel, cobble, and boulders in extended riffle units. The channel banks contained grass, brush, and dispersed small trees. A large plastic pipe lined the river right channel bank.	n/a (structure is not a barrier)	n/a (structure is not a barrier)	27.7 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained well defined active channel margins and short steep channel banks. The active channel contained cobble and gravel in extended riffle units. The channel banks contained dense brush vegetation.	Cobble	Not measured

Longitudinal Profile Measurements
A longitudinal profile was not completed for this structure because it did not meet the criteria for a Caltrans detailed fish passage assessment.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was not modeled in FishXing because it was assessed to be free of passage constraints and not a barrier during the Caltrans Reconnaissance Fish Passage Assessment	All streamflow levels	None

Crossing Structure Barrier Status
Not a Barrier
This free spanning bridge was assessed to not contain fish passage constraints and is not believed to limit *O. mykiss* upstream movement.

Assessment and Analysis Limitations
There were no assessment or analysis limitations experienced for this crossing structure.

Passage Improvement Recommendations
No barrier remediation actions are recommended for this structure.

Crossing Site Information for PAD 732075					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	150	20.16	34.44489, -119.20100	± 10 ft	17.21

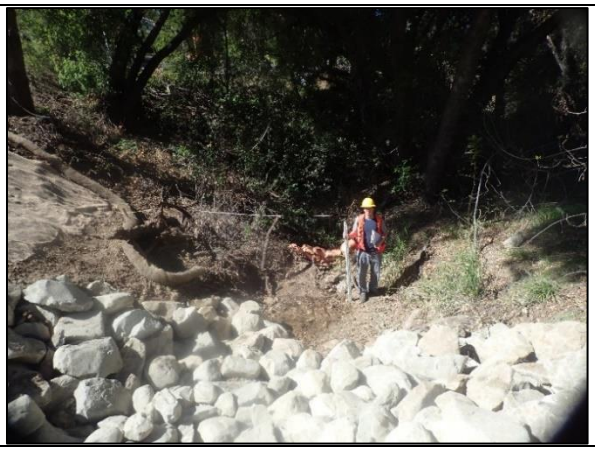
Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream



Additional Upstream Looking Upstream

Downstream Boulder Riprap

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.10 mi²	Thacher Creek	101.3 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss.* This stream is part of the Ventura River watershed, which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
12/19/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
2/25/20	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (only at outlet)	No

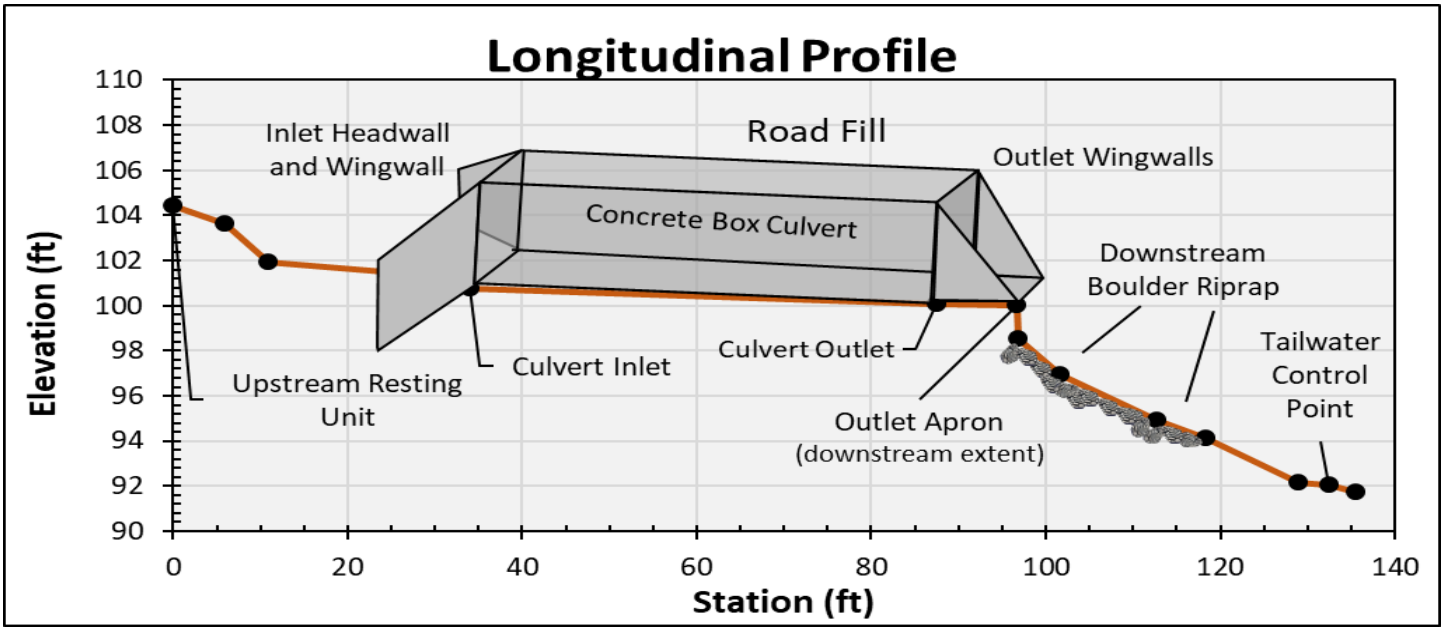
Crossing Structure Description and Condition
This crossing structure is a newly constructed concrete reinforced box culvert with an outlet apron between parallel wingwalls. The inlet of the culver contains a headwall on the river right and a short flared wingwall on river left. A short plunge point is located at the downstream extent of the outlet apron with a mean height of 1.46 ft at the time of the assessment.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	7	7	7	53.5	1.3 %
Outlet Apron	n/a (open channel)	n/a (open channel)	7	9.2	0.9 %
Full Structure	7	7	7	62.7	1.2 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the area immediately upstream of the culvert was an active construction area. The channel was undefined and consisted of soil within this construction area. An additional small drainage met the channel a short distance from the culvert inlet. Upstream of the construction area the channel contained narrow and moderately defined active margins. The channel consisted of grass vegetation and extended riffle units with minimal scour. The channel banks were steep and contained grass vegetation with small trees.	34 ft	3.66 ft	3.34 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
Boulder riprap has been placed across the entirety of the channel immediately downstream of the culvert. This riprap extends 38.8 ft downstream of the crossing structure. Downstream of the riprap and at the time of assessment the channel contains moderately defined active channel margins and steep channel banks. Grass and oak trees cover the channel banks. The active channel contains small pool units between extended riffle units.	Silt/Clay	35.8 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	104.43	
Upstream Channel Point 1	6	103.65	
Upstream Channel Point 2	11	101.95	
Upstream Channel Point 3	26	101.44	
Culvert Inlet	34	100.77	
Culvert Outlet	87.5	100.07	
Outlet Apron (downstream extent)	96.7	99.99	
Outlet Apron Plunge Point	96.8	98.53	
Downstream Max Depth (within 5 ft of structure)	101.7	96.91	
Downstream Boulder Riprap Point 1	112.7	94.89	
Downstream Boulder Riprap Point 2 (downstream extent)	118.4	94.12	
Downstream Max Depth	129	92.13	
Tailwater Control Point	132.5	92.02	
Downstream Channel Point 1	135.5	91.71	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was modeled in FishXing as a box culvert. The outlet apron was factored into the length and slope of the culvert modeled. A plunge of 1.46 ft was applied to the outlet.	None	Insufficient Streamflow Depth Outlet Unit Restriction Impassable Cascade

Crossing Structure Barrier Status

Total Barrier

This crossing structure was predicted to be impassable to all life stages of *O. mykiss* during all rates of streamflow. The main factor preventing *O. mykiss* passage are the conditions predicted to occur downstream of this culvert. If the riprap placed across the downstream channel remains in place it will prevent the formation of an outlet pool unit that may allow *O. mykiss* to jump and gain entry to the culvert. With the boulder riprap in place turbulent cascading streamflow will occur downstream of this culvert and may prevent the ability of *O. mykiss* to gain passage. If a strong swimming *O. mykiss* was able to gain access to this culvert adequate water depth for passage was predicted to occur when streamflow rates are greater than 40.69 ft^3/s. Streamflow velocity was not predicted to prevent passage under streamflow rates of 1,086.75 ft^3/s.

Assessment and Analysis Limitations

There were no limitations in the assessment or analysis of this crossing structure.

Passage Improvement Recommendations

Removing or rearranging the downstream boulder riprap would likely improve the ability of *O. mykiss* to gain access into this culvert and full passage. Although the most effective remediation option to improve passage conditions at this location would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 732067					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	20.24	34.44484, -119.19962	± 9 ft	17.32

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Additioanl Upstream Pipe Culvert

Upstream Water Diversion

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.058 mi²	Thacher Creek	29.0 ft³/s	It is unknown if this stream currently or has historically supported *O. mykiss*. This stream is part of the Ventura River Watershed which has historically supported *O. mykiss*. It is unlikely this stream currently supports *O. mykiss* considering the channel conditions observed during assessment and the low estimated annual mean peak streamflow. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
12/19/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Corrugated Steel Pipe Culvert	1	1	No	No

Crossing Structure Description and Condition
This crossing is a corrugated steel pipe culvert. The inlet of culvert is encased in a small concrete headwall. The outlet is encased in a brick and cement headwall. The outlet is also perched roughly 2.8 ft above the downstream channel. The brick and cement headwall creates a cascade from the outlet to the downstream channel substrate. The base of the culvert contained considerable rust and erosion damage, this damage was more severe at the inlet of the culvert than at the outlet.

Crossing Structure Dimensions				
Segment	**Mean Inlet Diameter** (ft)	**Mean Outlet Diameter** (ft)	**Length** (ft)	**Slope**
Culvert	3 ft	3 ft	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained a narrow, but well-defined active channel. The channel banks were short and steep and contained grass vegetation with dispersed large oak trees. The channel was comprised of many small riffle units with no visible scour points. An additional pipe culvert was located roughly 0.1 miles upstream. Also upstream was a small water diversion intake. This diversion appeared to be for the nearby agricultural fields.	Not measured	Not measured	3.6 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained poorly defined active channel margins. The channel banks were moderate and contained grass vegetation with small trees. The active channel was comprised of riffle units with few areas of scour. Hwy 150 was located above both channel banks.	Silt	A defined tailwater control point was not present at the time of assessment.

Longitudinal Profile Measurements
A longitudinal profile was not able to be completed due to the confined space restrictions.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment.	Unknown, structure is likely not passable under any rate of streamflow.	Unknown, potential for streamflow depth, streamflow velocity, impassable cascade restrictions.

Crossing Structure Barrier Status

Total Barrier

Despite the inability to complete a detailed barrier assessment this crossing structure likely should be considered a total barrier to all life stages of *O. mykiss*. The narrow diameter and damaged base of the culvert likely creates turbulent high velocity streamflow. Additionally, rates of streamflow conducive to allowing an *O. mykiss* to gain entry past the outlet cascade likely rarely occur.

Assessment and Analysis Limitations

A detailed barrier assessment, including a longitudinal profile was not able to be completed for this crossing structure due its small diameter and confined space conditions. As a result, passage assessment through FishXing modeling was unable to be completed for this crossing and the barrier status is based off professional judgement.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. The installation of weirs within the culvert likely would lead to blockage of streambed substrate and debris which would impact passage conditions and potentially lead to structural damage of the crossing structure.

Crossing Site Information for PAD 731958					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Old Hwy 150	23.18	34.43634, -119.17601	14 ft	19.1

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Lion Creek 5.473 mi²	San Antonio Creek	476.1 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Seasonal CDFW spawning surveys have been completed within Lion Creeks tributary San Antonio creek yearly beginning in 2013. Redd and individual *O. mykiss* observations have not been made since 2015. This stream is part of the Ventura River watershed which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/15/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Free Spanning Bridge	N/A	1	No	No

Crossing Structure Description and Condition
This structure is a free spanning concrete bridge over natural streambed substrate. The Caltrans bridge identification number is 52-04192. The bridge connects old Hwy 150 with the current Hwy 150 route. The river left channel bank under the bride is eroded and a portion of the concrete bridge support is undercut.

Crossing Structure Dimensions					
Segment	**Inlet Mean Height** (ft)	**Outlet Mean Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Full Bridge Structure	16.9	16.6	67	28.9	n/a

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At time of assessment, dense grass and brush was present on steep upstream channel banks. This vegetation encroached over the active stream channel, which contained long shallow flat-water units with moderate aquatic vegetation. Streambed substrate included silt and clay with sparse cobbles.	n/a (structure is not a barrier)	n/a (structure is not a barrier)	11.78 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the channel banks contained brush, grass, and sparse mid side trees. Sparse sections of grass was growing within the active channel margins. The active channel consisted of small flatwater and extended riffle units containing areas of thick aquatic vegetation.	Cobble	66.6 ft

Fish Passage Analysis Results & Crossing Structure Barrier Status
This bridge structure was assessed to be free of passage constraints due to the natural channel conditions present under it. As a result, this crossing structure is not considered a barrier to any life stage of *O. mykiss*.

Assessment and Analysis Limitations
No limitations were encountered in assessing or performing fish passage analysis of this crossing structure.

Passage Improvement Recommendations
No barrier remediation actions are recommended for this structure.

Crossing Site Information for PAD 731145					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	23.93	34.43701, -119.16383	± 13 ft	19.9

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Segments Transition Point

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Lion Creek 4.435 mi²	San Antonio Creek	330.8 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is part of the Ventura River watershed which has historically supported anadromous fish. Seasonal CDFW spawning surveys have been completed within Lion Creek's tributary San Antonio creek yearly beginning in 2013. Redd and individual *O. mykiss* observations have not been made since 2015. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2013-2015).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/15/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/15/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Arch Bridge	N/A	2	Yes (only at outlet)	No

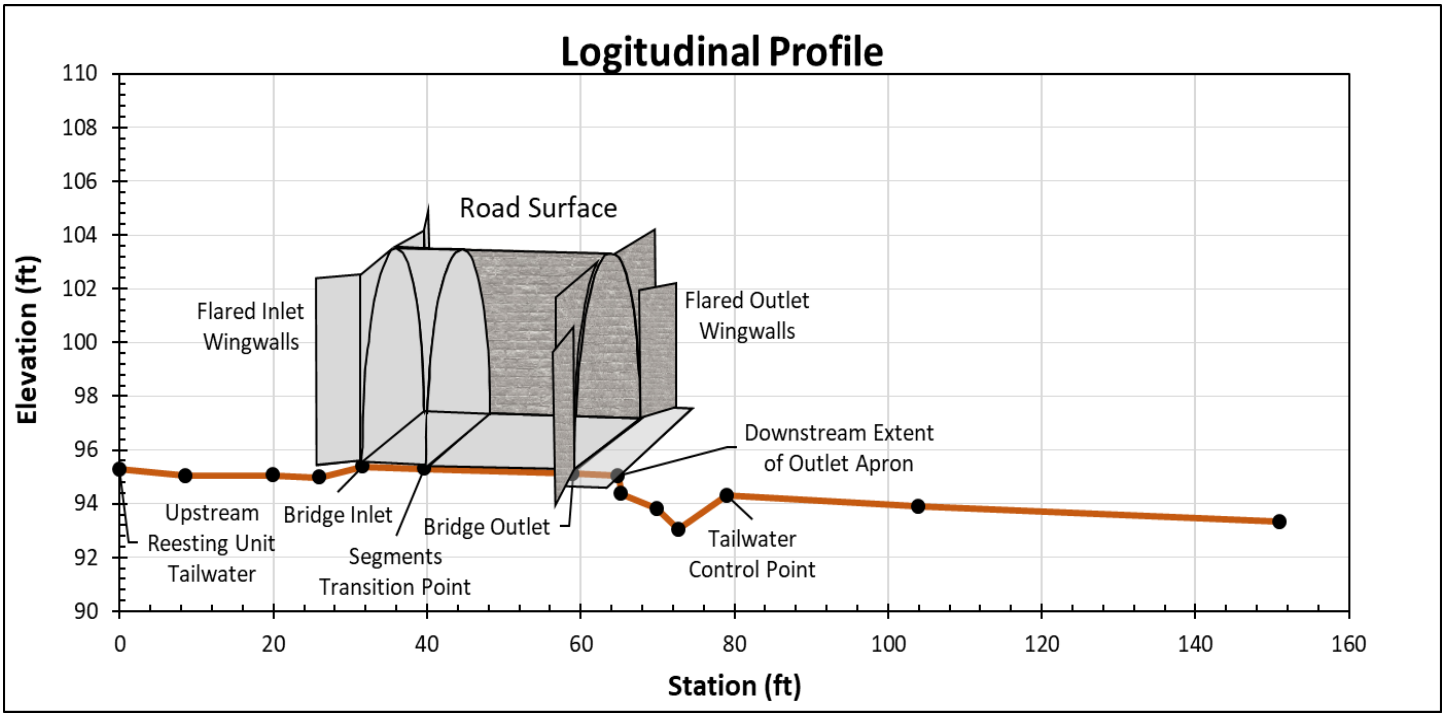
Crossing Structure Description and Condition
This structure is a free spanning concrete and brick arch bridge with concrete lining under the bridge. The Caltrans bridge identification number is 5-0002. The concrete base lining extends 4.9 ft beyond the outlet of the bridge. A small cascade was present downstream of the outlet apron with a mean height of 1.22 ft. The bridge consists of two arch segments. The downstream and larger segment of the bridge is constructed from bricks and mortar. The upstream segment of the bridge is concrete and appears to have been constructed after the downstream segment to widen the bridge. The inlet and outlet both have flared wingwalls. Some minor erosion was present where the base of the concrete segment meets the concrete base lining.

Crossing Structure Dimensions					
Segment	**Apex Inlet Height** (ft)	**Apex Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
1	9.5	9.5	24.8	8	1.1 %
2	9.5	9.8	24.8	19.4	0.9 %
Outlet Apron	n/a (open channel)	n/a (open channel)	24.8	5.9	1.4 %
Full Structure	9.5	9.8	24.8	33.3	1.1 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At time of assessment, the active channel margins upstream of the structure were wide, but well defined. The channel primarily consisted of extended flat riffle units. The channel banks contained thick brush and trees. Some of this vegetation was encroaching over the margins of the active channel.	31.6 ft	0 ft	16.8 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the active channel margin was very wide and not well defined. Sparse brush and grass was present within the channel. A small, but not well-defined pool unit was present from scour occurring below the outlet apron plunge point. Beyond this unit a flat and wide riffle unit was present. The channel banks contained grass and large oak trees.	Gravel	18.3 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	95.28	Resting unit is small and not well defined.
Upstream Channel Point 1	8.6	95.03	
Upstream Channel Point 2	20	95.06	
Upstream Channel Point 3	26	94.98	
Bridge Inlet	31.6	95.39	Upstream substrate is level with structure concrete base lining.
Segment 1 to 2 Transition Point	39.6	95.30	No change in structure orientation.
Bridge Outlet	59	95.12	
Outlet Apron (Downstream Extent)	64.9	95.04	
Downstream Extent of Cascade from Outlet Apron	65.3	94.37	
Downstream Max Depth (within 5 ft of structure)	69.9	93.82	
Downstream Max Depth	72.7	93.04	
Tailwater Control Point	79	94.31	From small scour pool unit.
Downstream Channel Point 1	104	93.9	
Downstream Channel Point 2	151	93.33	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This bridge was modeled in FishXing as a single radius arch culvert. The length of the outlet apron was factored into the structure length value used in FishXing analysis, thus increasing the length from 27.4 ft to 33.3 ft. The mean of the arch apex (9.65 ft) was used in FishXing analysis.	130.05 to 2,228.97	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This crossing structure was assessed to be passable to strong swimming steelhead *O. mykiss* life stages when adequate streamflow is present. As a result, this structure was assigned a temporal and partial barrier status. Due to the low slope (1.05 %), streamflow velocity does not accelerate substantially through the structure. A velocity barrier was not predicted by FishXing analysis below streamflow rates of 2,228.97 ft^3/s. The estimated annual mean peak streamflow rate for this stream at this crossing location is 330.78 ft^3/s so a velocity barrier is likely rarely or never present at this crossing structure.

Assessment and Analysis Limitations

No limitations were encountered in assessing or performing fish passage analysis of this crossing structure.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss*.

Crossing Site Information for PAD 731234					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	24.01	34.43639, -119.16270	± 9 ft	20

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Sycamore Creek 1.537 mi^2	Lion Creek	193.6 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Current presence of *O. mykiss* within this stream is unlikely considering its small drainage area and intermittent streamflow associated with it. This stream is part of the Ventura River watershed which has historically supported anadromous fish. Records indicate historical *O. mykiss* presence to have been widespread in the watershed. Currently *O. mykiss* are present in the watershed, but in far lower numbers than historically documented. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/16/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/16/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (only at outlet)	No

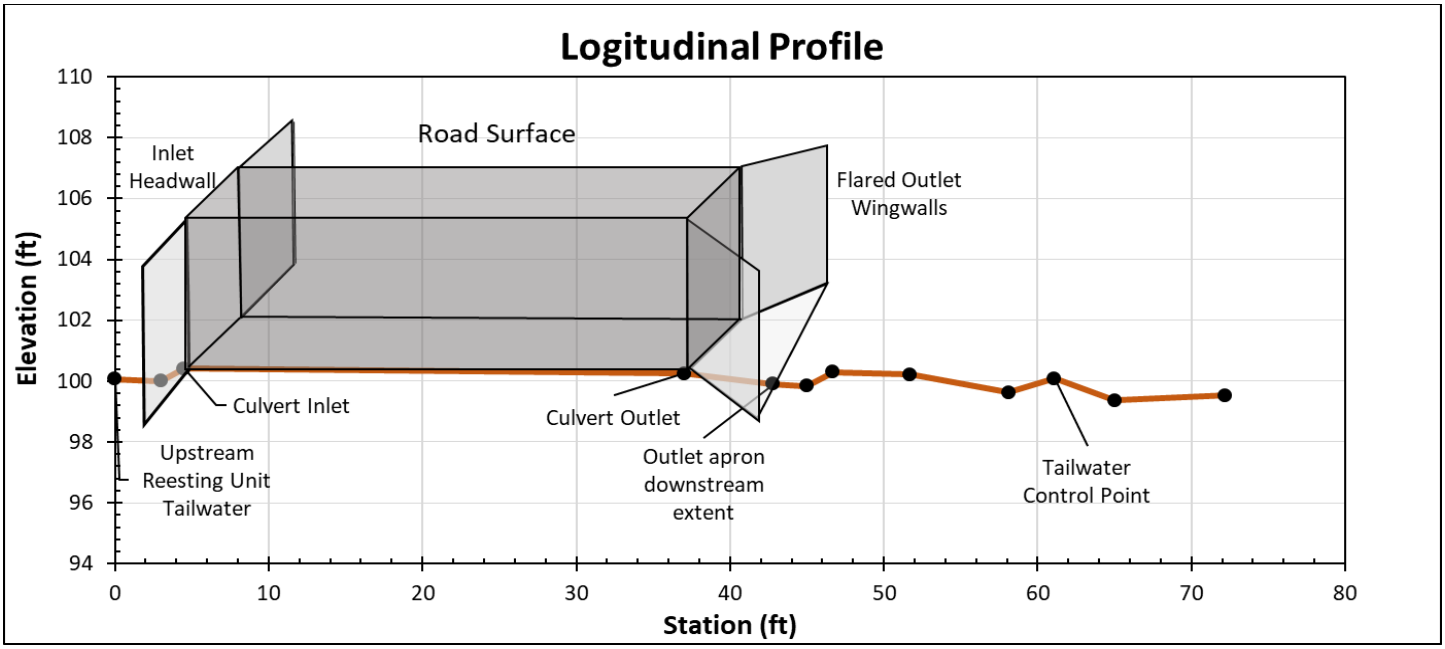
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert. A short apron and short flared wingwalls are present at the outlet. A headwall is present at the inlet. Sections of scattered concrete are present in the downstream channel. No plunge points were present within or near the crossing structure. The lower portion of the culvert walls contained minor cracks and erosion.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	5.7	6.6	11	32.5	0.9 %
Outlet Apron	n/a (open channel)	n/a (open channel)	16	5.8	3.8 %
Full Structure	5.7	6.6	12	38.3	1.3 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At time of assessment, the active channel margins upstream of the structure were well defined. Boulders, gravel, and a single large piece of woody debris were present within the channel. The boulder riprap was present along the channel walls upstream of the culvert. Grass and sparse trees lined the stream channel.	4.5 ft	0 ft	47.6 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the active downstream channel was moderately defined, wide, and relatively flat with boulders and gravel. A small but not well-defined pool unit was present as the tailwater control point. Grass, brush, and sparse brush were present on small channel walls with boulder riprap extending beyond the outlet wingwalls. Some of this vegetation was growing over the active channel.	Boulders	18.3 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	100.07	
Upstream Channel Point 1	3	100	
Culvert Inlet	4.5	100.42	
Culvert Outlet	37	100.13	
Outlet Apron (downstream extent)	42.8	99.91	
Downstream Max Depth (within 5 ft of structure)	45	99.84	
Downstream Concrete Point 1	46.7	100.3	Segmented concrete within natural substrate
Downstream Concrete Point 2	51.7	100.21	
Downstream Max Depth	58.1	99.62	
Tailwater Control Point	61.1	100.08	
Downstream Channel Point 1	65	99.37	
Downstream Channel Point 2	72.2	99.53	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing structure was modeled as a box culvert in FishXing analysis. The length of the outlet apron was factored into the culvert length and slope value modeled. This increased the culvert length from 32.5 ft to 38.3 ft. The mean overall culvert height of 6.15 ft was used in FishXing analysis.	63 – 1,499.6	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This structure was assessed to be passable to strong swimming anadromous *O. mykiss* life stages when adequate streamflow is present, but not to resident life stages of *O. mykiss*. As a result, this structure was assigned a temporal and partial barrier status. Due to the low slope (1.33 %) and short length of the culvert, streamflow velocity does not accelerate substantially through the structure. A velocity barrier was not predicted by FishXing analysis below streamflow rates of 1,499.6 ft^3/s. The estimated annual mean peak streamflow rate for this stream is 193.6 ft^3/s so a velocity barrier is likely rarely or never present at this crossing structure.

Assessment and Analysis Limitations

No limitations were encountered in assessing or performing fish passage analysis of this crossing structure.

Passage Improvement Recommendations

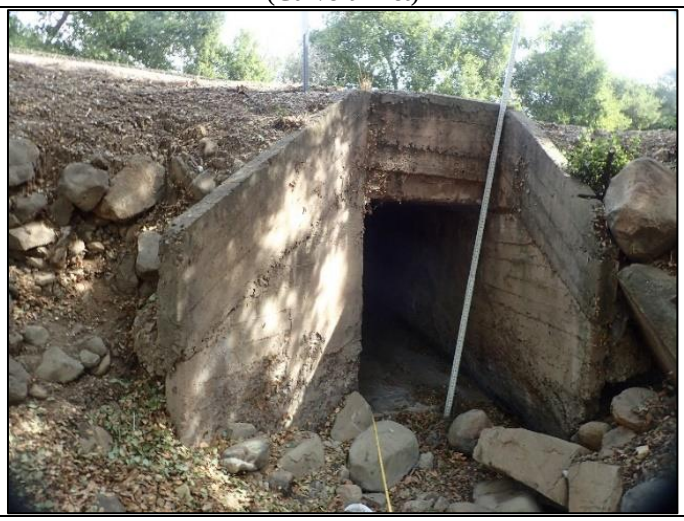
The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss*.

Crossing Site Information for PAD 731271					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	25.93	34.43480, -119.13084	± 13 ft	25.93

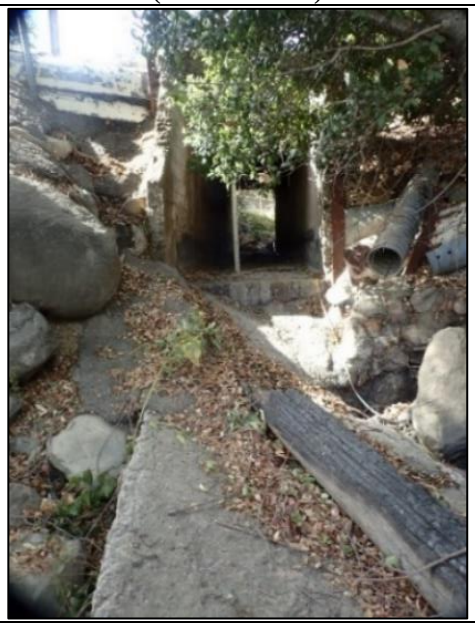
Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)



Downstream Looking Upstream
(Culvert Outlet)



Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Unnamed 0.654 mi²	Sisar Creek	120.0 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Current presence of *O. mykiss* within this stream is unlikely considering its small drainage area and intermittent streamflow associated with it. This stream is part of the Santa Clara River watershed which has historically supported anadromous fish and currently supports resident *O. mykiss* populations within Sisar Creek and Santa Paula Creek. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/16/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/16/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (only at outlet)	No

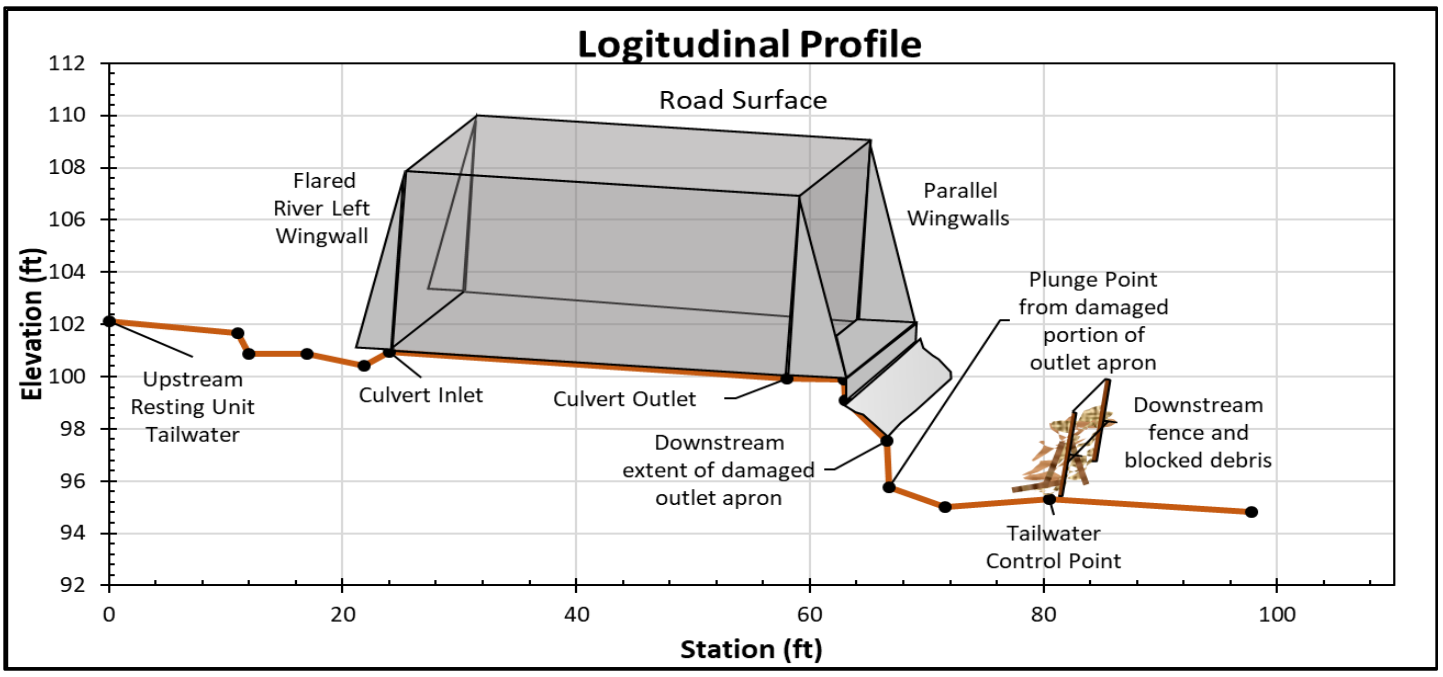
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert. Short wingwalls are present at the inlet and outlet. The outlet wingwalls are oriented parallel to each other. The river right inlet wingwall is oriented in line with the culvert wall and the river left inlet wingwall is flared at a 45° angle from the culvert inlet. A concrete outlet apron is located between the outlet wingwalls. The apron extends beyond the wingwalls, but is not continuous. Due to erosion damage this portion of the apron is lower than the portion of the apron between the wingwalls. This downstream disconnected concrete slab of apron is also tilted towards the river left side and thus creates a streamflow concentration to that side of the channel. Within the culvert minor erosion was present, primarily along the culvert base and lower walls.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	6.9	6.9	5	34	3.0 %
Outlet Apron (wingwall section)	n/a (open channel)	n/a (open channel)	5	4.9	0.8 %
Outlet Apron (damaged section)	n/a (open channel)	n/a (open channel)	5	3.6	47.7 %
Full Structure	6.9	6.9	5	42.5	8.1 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the active channel margins upstream of the structure were well defined. Grass and scattered small boulders were present on the channel banks. A metal horse pasture fence runs along the river right bank. Additionally, two small metal pipes cross the channel roughly 30 ft from the culvert inlet. These pipes are slightly elevated over the active channel and are not believed to present as a barrier to *O. mykiss*.	24 ft	1.17 ft	8.9 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, a barbed wire fence crossed the channel roughly 40 ft downstream of the culvert outlet. Woody debris had been blocked by this fence and filled much of the downstream habitat unit. This buildup of woody debris likely serves as its own barrier possibly preventing *O. mykiss* from gaining access to the downstream extent of the culvert. Additionally, a small steel road drainage pipe drains into the downstream unit and has appeared to contribute to a small scour trench on the river left side of the damaged outlet apron.	Gravel	17.6 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	102.12	
Upstream Channel Point 1	11	101.67	
Upstream Channel Point 2	12	100.88	
Upstream Channel Point 3	17	100.89	
Upstream Channel Point 4	21.8	100.4	Upstream extent of inlet wingwalls
Culvert Inlet	24	100.95	
Culvert Outlet	58	99.94	
Outlet Apron Point 1	62.9	99.9	Downstream extent of outlet wingwalls
Outlet Apron Plunge Point 1	63	99.08	Upstream extent of damaged outlet apron
Outlet Apron Point 2	66.6	97.53	Downstream extent of outlet apron
Outlet Apron Plunge Point 2	66.8	95.78	
Downstream Max Depth	71.6	95	
Tailwater Control Point	80.5	95.31	
Downstream Channel Point 1	97.8	94.81	Downstream of fence and woody debris



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages The length of the undamaged portion of the outlet apron positioned between the outlet wingwalls was factored into the culvert length value used in FishXing analysis. This increased the culvert length from 34 ft to 38.9 ft. The damaged portion of the outlet apron and the 1.75 ft plunge point from it was not factored into FishXing analysis.	None	Insufficient Streamflow Depth Outlet Unit Restriction Impassable Cascade

Crossing Structure Barrier Status

Total Barrier

This structure was assessed to be a total barrier to all life stages of *O. mykiss*. The main factor preventing passage is an obstructed and undefined outlet habitat unit. The damaged portion of the outlet apron likely limits downstream channel scour. This also limits potential downstream water depth and in turn fish are unlikely to achieve the jump height and distance required to gain entry into the culvert. The accumulation of debris upstream of the barbed wire fence crossing the downstream channel likely further obstructs *O. mykiss* jumping and passage abilities.

Assessment and Analysis Limitations

No limitations were encountered in assessing this crossing structure. However, FishXing analysis was limited as only a single outlet plunge point can be assessed. This crossing structure has one plunge point with a mean height of 0.82 ft from the intact portion of the outlet apron and another plunge point with a mean height of 1.75 ft from the damaged portion of the outlet apron. Only the 0.82 ft plunge point was factored into FishXing analysis.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss*. Removal of the damage portion of the outlet apron and downstream barbed wire fence would also improve passage conditions.

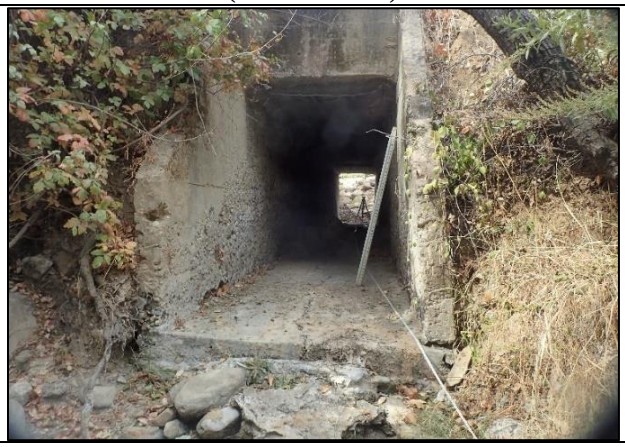
Crossing Site Information for PAD 731462					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	26.02	34.43483, -119.12936	± 9 ft	25.5

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)



Downstream Looking Downstream & Tailwater Contol Tripod Location

Grade Control within Culvert

Erroded Culvert Wall

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Unnamed 0.654 mi²	Sisar Creek	122.6 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Current presence of *O. mykiss* within this stream is unlikely considering its small drainage area and the intermittent streamflow associated with it. This stream is part of the Santa Clara River watershed which has historically supported anadromous fish and currently supports resident *O. mykiss* populations within Sisar Creek and Santa Paula Creek. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/16/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/16/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (only at outlet)	No

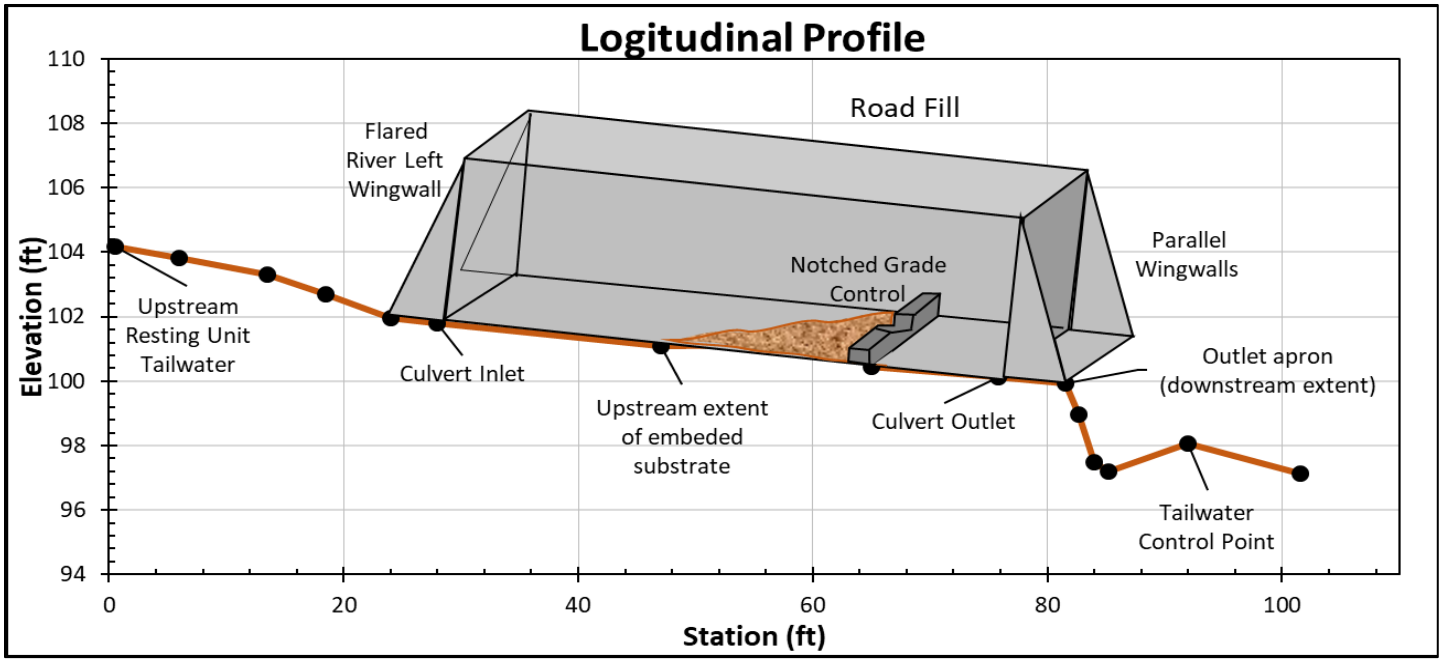
Crossing Structure Description and Condition
Narrow and tall concrete reinforced box culvert. Short wingwalls are present at the inlet and outlet. The outlet wingwalls are oriented parallel to each other. The river left inlet wingwall is oriented in line with the culvert wall and the river right inlet wingwall is flared at a 45° angle from the culvert inlet. A concrete outlet apron is present between the outlet wingwalls. A small 1.5 ft high concrete grade control is located within the culvert. The grade control spans across the width of the culvert and has a small "V" shaped notch at its center. A plunge of 0.72 ft occurs from the center of this notch. At the time of assessment, a small amount of embedded gravel, cobble, and boulder substrate was located upstream of the grade control. There was also moderate erosion present along the base and lower walls of the culvert with portions of exposed rebar.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	7	7	5	47.8	3.5 %
Outlet Apron	n/a (open channel)	n/a (open channel)	5	5.7	3.2 %
Full Structure	7	7	5	53.5	4.4 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel was dominated by small boulders. Little vegetation was present within the active channel margins and grass was the primary vegetation on the channel banks. A barbed wire fence crossed the stream channel roughly 20 ft from the culvert inlet. A small pile consisting of leaves, small woody debris, and a damaged corrugated steel drainage pipe was accumulated upstream of this fence. This fence and debris blockage associated with it could potentially place additional constrains on upstream and downstream *O. mykiss* movements.	27.5 ft	2.38 ft	8.96 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel is more incised than the upstream channel. The channel banks are steep with portions of exposed bedrock. Little vegetation was present within the active channel margins. Sparse brush vegetation was present, primarily on the river left channel bank. Large woody debris from a dead and collapsed oak tree was located within the channel. A small cascade was present from the structure outlet apron with a mean height of 2.46 ft. A small, but well-defined pool unit was located downstream of this cascade.	Gravel	9.5 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit Tailwater	0.5	104.16	
Upstream Channel Point 1	6	103.81	
Upstream Channel Point 2	13.5	103.32	
Upstream Channel Point 3	18.5	102.69	
Upstream Channel Point 4	24	101.96	
Culvert Inlet	28	101.78	
Inside Culvert Point 1	47	101.09	Upstream extent of embedded substrate
Inside Culvert Point 2	64.5	101.15	Low point of grade control notch
Inside Culvert Point 3	65	100.43	Downstream of grade control plunge point
Culvert Outlet	75.8	100.11	
Outlet Apron (downstream extent)	81.5	99.93	
Outlet Cascade Point 1	82.7	98.97	
Outlet Cascade Point 2	84	97.47	
Downstream Max Depth	85.2	97.21	Same point as max depth with 5 ft of structure
Tailwater Control Point	92	98.05	
Downstream Channel Point 1	101.6	97.14	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
<u>Analysis for all *O. mykiss* Life Stages</u> The length of the outlet apron was factored into the culvert length value used in FishXing analysis. This increased the length of the culvert from 47.8 ft to 53.5 ft. Additionally, the height of the plunge point from the grade control within the culvert was added to the height of the outlet cascade for FishXing analysis. This increased the outlet drop height from 2.46 ft to 3.18 ft.	None	Outlet Unit Restriction Insufficient Streamflow Depth

Crossing Structure Barrier Status

<u>Total Barrier</u>

This structure was assessed to be a total barrier to all life stages of *O. mykiss*. The main factors preventing passage through this structure are the outlet cascade and the plunge point from the grade control within the culvert. Although the height of the cascade and plunge point is not significant the conditions below them prevent the adequate water depth required for *O. mykiss* to make successful jumps over these points.

Assessment and Analysis Limitations

No limitations were encountered in assessing this crossing structure. However, due to FishXing limitations only plunge points located at the outlet of a culvert structure can be considered in for fish passage analysis. To ensure the plunge point form the grade control within the culvert was factored into fish passage analysis it was applied to the height of the outlet cascade. Even when the plunge point height was not factored into FishXing analysis the structure was still estimated to be impassable to all life stages of *O. mykiss*.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss*.

Crossing Site Information for PAD 731251					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	26.12	34.43479, -119.12813	± 9 ft	25.4

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Upstream River Right Bankside Oil Seep

Tailwater Contol Tripod Location

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Unnamed 0.654 mi²	Sisar Creek	123.3 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Current presence of *O. mykiss* within this stream is unlikely considering its small drainage area and intermittent streamflow associated with it. This stream is part of the Santa Clara River watershed which has historically supported anadromous fish and currently supports resident *O. mykiss* populations within Sisar Creek and Santa Paula Creek. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008; CDFW unpublished data, 2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/21/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/21/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (only at outlet)	No

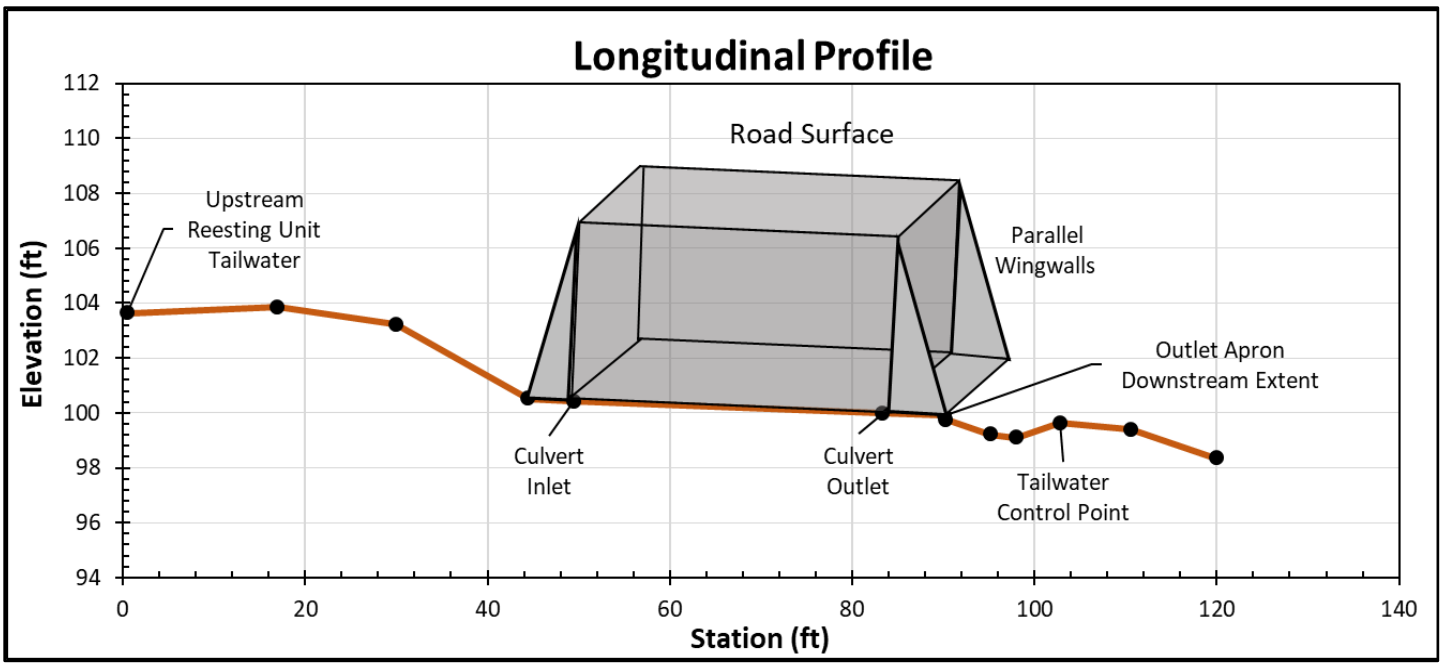
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert. Short wingwalls are present at the inlet and outlet. The outlet wingwalls are oriented parallel to each other. The river right inlet wingwall is oriented in line with the culvert wall and the river left inlet wingwall is flared at a 45° angle from the culvert inlet. A concrete outlet apron is present between the outlet wingwalls. At the time of assessment minor erosion was present at the base of the culvert walls and bottom lining.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	7	6.9	4.9	33.9	0.7 %
Outlet Apron	n/a (open channel)	n/a (open channel)	4.9	6.8	1.3 %
Full Structure	7	6.9	4.9	40.7	0.8 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment sparse grass was growing within the upstream channel. Grass and sparse brush was present on the channel banks. A sizeable oil seep is present on the river right channel bank. Oil from this seep flows into the stream channel and into the crossing structure. No vegetation was present within the oil seep coverage area.	49 ft	3.4 ft	7.42 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel was less defined than the upstream channel and was considerably less incised with lower channel bank walls. Sparse grass and brush was present on each channel bank with scattered small woody debris. Hardened oil from the upstream seep was present within the channel and extended roughly 30 ft downstream of the crossing structure. A small drop of 0.16 was present from the downstream extent of the outlet apron to the downstream channel.	Tar	6.7 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0.5	103.64	
Upstream Channel Point 1	17	103.86	
Upstream Channel Point 2	30	103.21	
Upstream Channel Point 3	44.5	100.42	Upstream extent of inlet wingwalls
Culvert Inlet	49.5	100.24	
Culvert Outlet	83.4	99.99	
Outlet Apron (downstream extent)	90.2	99.9	Outlet apron is between wingwalls
Downstream Channel Point 1	90.3	99.74	
Downstream Max Depth (within 5 ft of structure)	95.2	99.22	
Downstream Max Depth	98	99.1	
Tailwater Control Point	102.8	99.62	
Downstream Channel Point 2	110.6	99.4	
Downstream Channel Point 3	120	98.34	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* The length of the outlet apron was factored into the culvert length value used in FishXing analysis. This increased the culvert length from 33.9 ft to 40.7 ft.	22.93 – 696.5	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This structure was assessed to be passable to strong swimming anadromous *O. mykiss* when adequate streamflow is present, but not to resident life stages of *O. mykiss*. As a result, this structure was assigned a temporal and partial barrier status. Due to the low slope (0.84 %) and short length of the culvert, streamflow velocity does not accelerate substantially through the structure. A streamflow velocity barrier was not predicted by FishXing analysis below streamflow rates of 696.5 ft^3/s. The estimated annual mean peak streamflow rate for this stream is 123.3 ft^3/s so a velocity barrier is likely rarely present at this crossing structure.

Assessment and Analysis Limitations

No limitations were encountered in assessing this crossing structure or in performing FishXing analysis. However, the presence of hardened tar in the upstream channel likely increases streamflow velocities and thus increases the difficultly of passage for *O. mykiss.* These upstream conditions are not factored into FishXing analysis.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss.*

Crossing Site Information for PAD 731724					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	26.5	34.43116, -119.12375	± 19 ft	25

Pictures

Upstream Looking Upstream

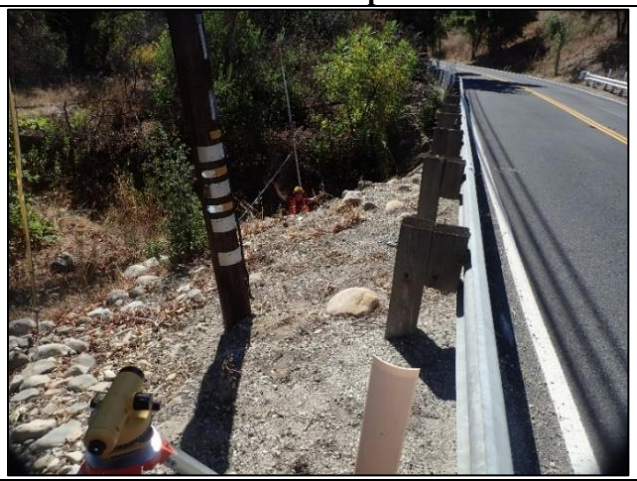
Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Inlet Wingwall Damage

Tailwater Contol Tripod Location



Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* presence**
Unnamed 0.176 mi²	Sisar Creek	102.6 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. Current presence of *O. mykiss* within this stream is unlikely considering its small drainage area and intermittent streamflow associated with it. This stream is part of the Santa Clara River watershed which has historically supported anadromous fish. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/21/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/21/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Reinforced Concrete Box Culvert	1	1	Yes (inlet and outlet)	No

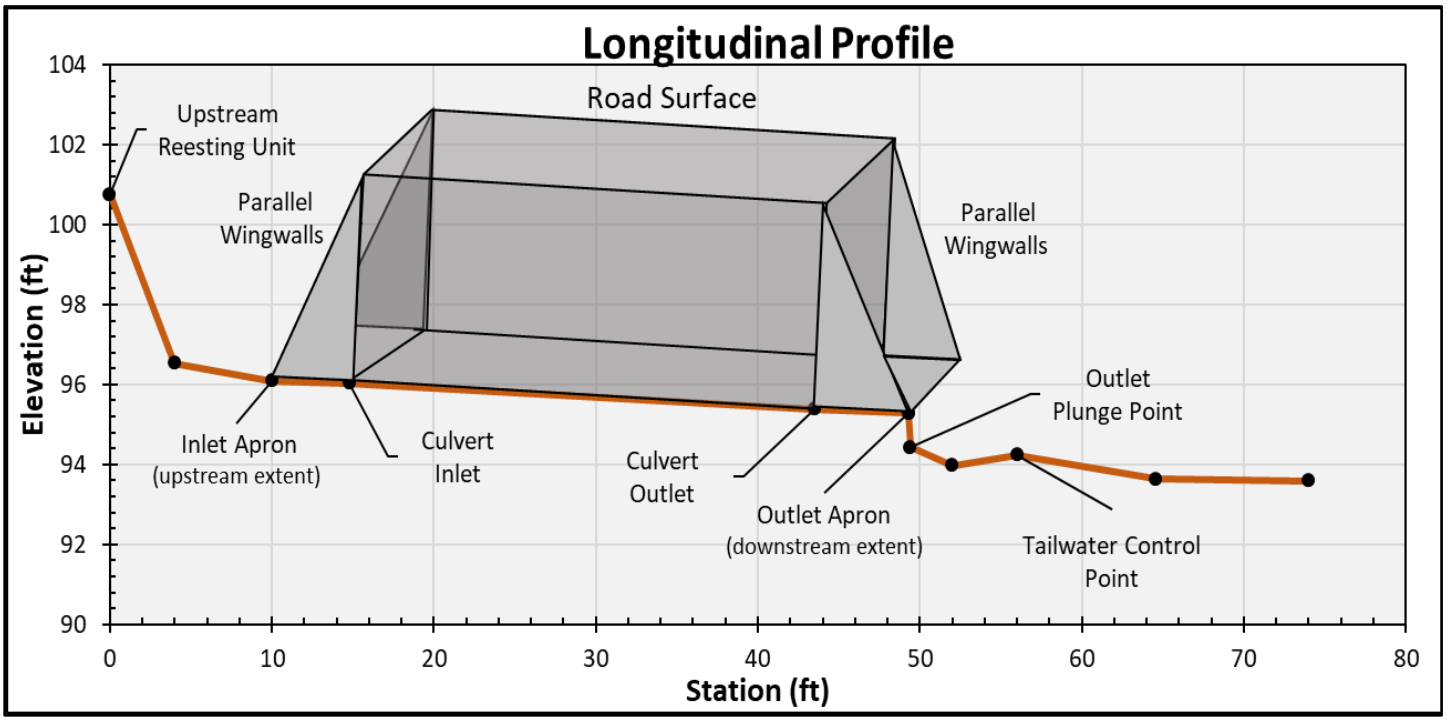
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert. Short wingwalls are present at the inlet and outlet with concrete aprons located between them. The wingwalls are oriented parallel to the walls of the culvert. Both inlet wingwalls have moderate damage with exposed rebar at their upstream extents. Within the culvert minor erosion was present at the base of wingwalls and bottom lining.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	n/a (open channel)	5.25	4.8	1.5 %
Culvert	7.2	7.1	5.25	28.7	2.3 %
Outlet Apron	n/a (open channel)	n/a (open channel)	5.25	5.8	12.9 %
Full Structure	7.2	7.1	5.25	39.3	2.1 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
Considerable grass and brush vegetation was present within the upstream channel at the time of assessment. This indicates streamflow is commonly intermittent. Grass and brush vegetation extended beyond the channel banks with sparse oak and sycamore trees beyond the bankfull margins.	10 ft	4.66 ft	5.8 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel conditions were similar to the upstream channel conditions although the instream grass and brush vegetation was not as dense. A small plunge point (0.86 ft) was present from the outlet apron leading into a small scour pool unit. The bankfull width was 17.5 ft at the downstream tailwater control point.	Gravel	6.7 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Resting Unit	0	100.76	
Upstream Channel Point 1	4	96.54	
Inlet Apron (upstream extent)	10	96.1	Inlet apron is between wingwalls
Culvert Inlet	14.80	96.03	
Culvert Outlet	43.50	95.38	
Outlet Apron (downstream extent)	49.3	95.29	Outlet apron is between wingwalls
Downstream Max Depth	52	93.98	Same as max depth within 5 ft of structure
Plunge Point from Outlet Apron	49.4	94.43	
Tailwater Control Point	56	94.24	
Downstream Channel Point 1	64.6	93.63	
Downstream Channel Point 2	74	93.59	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* The length of the structure inlet and outlet aprons was factored into the culvert length and slope value used in FishXing analysis. This increased the culvert length from 28.7 ft to 39.3 ft. The wingwalls lining the inlet and outlet aprons and their parallel orientation in relation to the culvert walls likely create very similar streamflow hydraulics throughout the enter length of the crossing structure. This makes the culvert length adjustment for FishXing modeling applicable to the actual conditions which occur throughout the entirety of the crossing structure.	32.68 – 76.11	Outlet Unit Restriction Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Outlet Unit Restriction Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

This structure is predicted to be passable to strong swimming anadromous *O. mykiss* under a specific range of streamflow, but not passable to resident *O. mykiss* life stages under any rate of streamflow. For anadromous *O. mykiss* streamflow rates greater than 32.68 ft^3/s were predicted to provide adequate water depth for passage. Although, streamflow rates greater than 76.11 ft^3/s were predicted to prevent passage due the lack of scour downstream of the culvert outlet and its impacts on the ability of *O. mykiss* to jump the small outlet plunge point and gain access the culvert.

Assessment and Analysis Limitations

No limitations were encountered in assessing this crossing structure or in performing FishXing fish passage analysis.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate. A secondary option would be to install weirs or a fishway to create streamflow conditions more conducive to successful upstream migrating *O. mykiss.*

Crossing Site Information for PAD 759945					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	29.51	34.41498, -119.08507	± 9 ft	21.39

Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

No picture taken due to downstream accessibility difficulties.

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.35 mi^2	Santa Paula Creek	67.2 ft^3/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is a tributary to Santa Paula Creek, which currently supports a population of *O. mykiss*. It is highly unlikely that this stream currently supports *O. mykiss* considering it has a small drainage area, has a steep gradient, and has low estimated annual mean peak streamflow. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
10/21/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
10/21/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Pipe Culvert	1	1	Yes (inlet only)	No

Crossing Structure Description and Condition
This crossing structure is a concrete reinforced pipe culvert. The inlet has an extensive concrete apron between cobble cemented wingwalls. These coble cemented wingwalls extend partially across the channel and create a grade controlling notch that is 5 ft wide. The outlet of the culvert is perched over the downstream channel creating a high plunge point. The culvert appeared to be in good condition with no visible damage.

Crossing Structure Dimensions			
Segment	**Mean Diameter** (ft)	**Length** (ft)	**Slope**
Inlet Apron	n/a (open channel)	12	Not measured
Culvert	3.2	Unable to measure	Unable to measure

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
At the time of assessment, the upstream channel contained moderately defined active channel margins and low channel banks. The channel primarily consisted of gravel substrates in extended riffle units without any considerable area of scour. Oak trees were located above the channel banks.	No upstream resting unit visible at the time of assessment.	No upstream resting unit visible at the time of assessment.	7.5 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel was very incised with near vertical channel banks. From the roadway the channel appeared to have a steep gradient and contained extended riffle units with possible plunge points.	Gravel	No definitive control point was able to be identified.

Longitudinal Profile Measurements
A longitudinal profile was not able to be completed due to the confined space restrictions.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment.	Unknown, structure is likely not passable under any rate of streamflow.	Unknown, potential for streamflow depth, streamflow velocity, outlet unit restriction, and excessive leap height restrictions.

Crossing Structure Barrier Status
Total Barrier It is clear this crossing structure is impassible to all life stages of *O. mykiss*. Despite not being able to access the downstream channel it was clear from the roadway that the excessive plunge from the culvert outlet would prevent *O. mykiss* from being able to gain access to the culvert.

Assessment and Analysis Limitations
A detailed barrier assessment, including a longitudinal profile was not able to be completed for this crossing structure due its small diameter and confined space conditions. As a result, passage assessment through FishXing modeling was unable to be completed for this crossing and the barrier status is based off professional judgement.

Passage Improvement Recommendations
The most effective option to improve passage conditions at this crossing location would be to replace this culvert with a free spanning bridge over natural streambed substrate.

Crossing Site Information for PAD 731595					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 150	30.3	34.40411, -119.08199	± 10 ft	19.95

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at crossing structure)	***O. mykiss* Presence**
Unnamed 0.36 mi²	Santa Paula Creek	67.2 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is a tributary to Santa Paula Creek, which currently supports a population of *O. mykiss*. It is highly unlikely that this stream currently supports *O. mykiss* considering it has a small drainage area and has low estimated annual mean peak streamflow. (NMFS Southern California Steelhead Recovery Plan, 2012; Center for Ecosystem Management & Restoration, 2008).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agencies Performing Survey**
12/19/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC
12/19/19	Caltrans Detailed Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Concrete Reinforced Box Culvert	1	1	Yes (only at outlet)	No

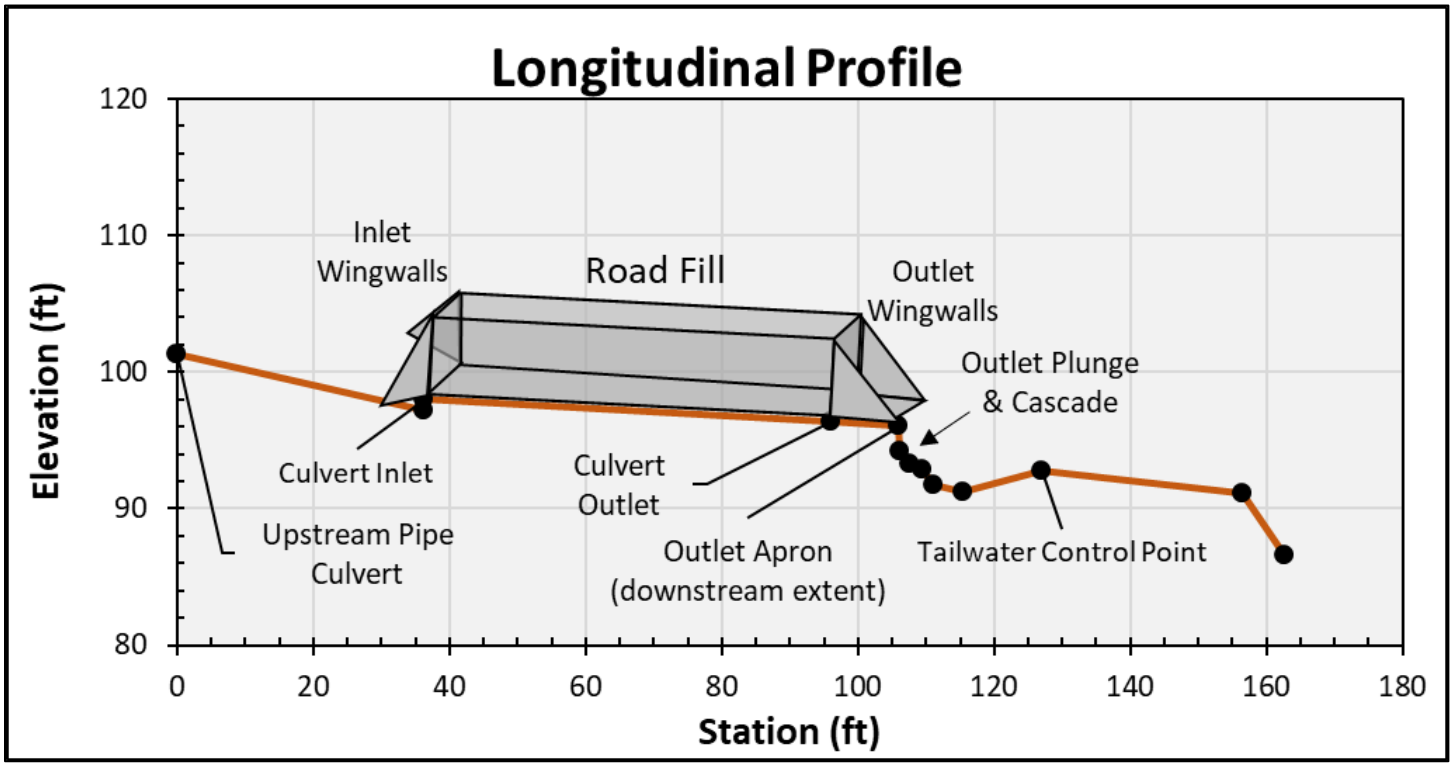
Crossing Structure Description and Condition
This crossing structure is a concrete reinforced box culvert with flared wingwalls at its inlet and parallel wingwalls at its outlet. A concrete apron is located between the outlet wingwalls. There is a short plunge point and cascade over boulders from the outlet apron to the downstream channel with a mean height of 3.5 ft at the time of assessment. The crossing structure appeared to be in good condition with no visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height** (ft)	**Mean Outlet Height** (ft)	**Mean Width** (ft)	**Length** (ft)	**Slope**
Culvert	7	7	5	59.7	2.8 %
Outlet Apron	n/a (open channel)	n/a (open channel)	5	10	3.0 %
Full Structure	7	7	5	69.7	2.8 %

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
A 3.5 ft diameter concrete reinforced pipe culvert is located 36.3 ft upstream of the Hwy 150 culvert. The extent of this pipe culvert was not determined, but its small diameter likely creates *O. mykiss* passage constraints. The short portion of channel between the Hwy 150 culvert and this pipe culvert contained poorly defined active channel margins and low channel banks.	0 ft	0 ft	7.1 ft

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
At the time of assessment, the downstream channel contained moderately defined active channel margins and short steep channel banks. Dense brush vegetation spanned across the channel with large oak trees present above the channel banks.	Bedrock	21 ft

Longitudinal Profile Measurements			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Upstream Pipe Culvert Inlet	0	101.3	
Upstream Resting Unit	36.2	97.21	
Culvert Inlet	36.3	98.01	
Culvert Outlet	96	96.35	
Outlet Apron (downstream extent)	106	96.05	
Outlet Plunge Point	106.1	94.18	
Outlet Cascade Point 1	107.6	93.3	
Outlet Cascade Point 2	109.4	92.89	
Downstream Max Depth (within 5 ft of structure)	111	91.75	
Downstream Max Depth	115.5	91.28	
Tailwater Control Point	127	92.77	
Downstream Channel Point 1	156.5	91.12	
Downstream Channel Point 2	162.6	86.57	



FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for all *O. mykiss* Life Stages This crossing structure was modeled as a box culvert in FishXing. The length and slope of the outlet apron was factored into the	None	Outlet Unit Restriction Insufficient Streamflow Depth

Crossing Structure Barrier Status

Total Barrier

This crossing structure was assessed to be impassable to all life stages of *O. mykiss* over all rates of streamflow. The main factor preventing *O. mykiss* passage is lack of scour downstream of outlet plunge/cascade point. This prevents water from pooling and the ability of *O. mykiss* to achieve adequate jump height to gain access to the culvert. If a strong swimming anadromous *O. mykiss* were able to gain access to the culvert streamflow rates greater than 40.18 ft^3/s are predicted to allow for successful passage. Streamflow rates greater than 775.03 ft^3/s are predicted to create excessive velocity and prevent passage.

Assessment and Analysis Limitations

There were no limitations experiences in the assessment or analysis of this crossing structure.

Passage Improvement Recommendations

The most effective remediation option would be to replace this crossing structure with a free spanning bridge over natural streambed substrate.

Appendix C

Fish Passage Barrier Assessment Data and Analysis Results for Tier 1 Caltrans Stream Crossing Structures in Los Angeles County (Caltrans District 7)

This appendix lists information from the completion of Caltrans reconnaissance and detailed fish passage barriers assessments conducted on Caltrans stream crossing structures listed on the Tier 1 priority list for Los Angeles County dated September 6, 2019. This list only included two Hwy 27 crossing structures. Information included in this appendix includes, collected data points, descriptions of each assessed crossing structure, results of fish passage analysis, and limitations experienced during assessment and analysis. Crossing structure longitudinal profile graphs are also included in this appendix. These graphs are included to serve as visual aids to convey the general shape and orientation of crossing structure segments. The dimensions and shapes depicted in these graphs may not be completely accurate.

Table of Contents

(page listings for each assessed crossing structure are listed in the Assessment Reference Table)

Los Angeles County Tier 1 Caltrans Stream Crossing Structure Assessment Reference Table...369

Highway 27 Assessed Crossing Structures.....370

Los Angeles County Tier 1 Caltrans Stream Crossing Structure Assessment Reference Table

PAD ID Number	Route	Post Mile	Structure Location (location coordinates recorded)	Caltrans Fish Passage Assessments Conducted	Barrier Status Assigned	Crossing Structure Type	Listing Page
759740	Hwy 27	0.5	34.04633, -118.57708 (at inlet)	Reconnaissance Only	Total Barrier	Corrugated Steel Pipe Culvert	370
759746	Hwy 27	5.09	34.09818, -118.59943 (at inlet)	Reconnaissance & Detailed	Temporal & Partial Barrier	Concrete Reinforced Box Culvert	373

Highway 27 Caltrans Crossing Structures

Crossing Site Information for PAD 759740					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Los Angeles	Hwy 27	0.5	34.04633, -118.57708	± 9 ft	0.91

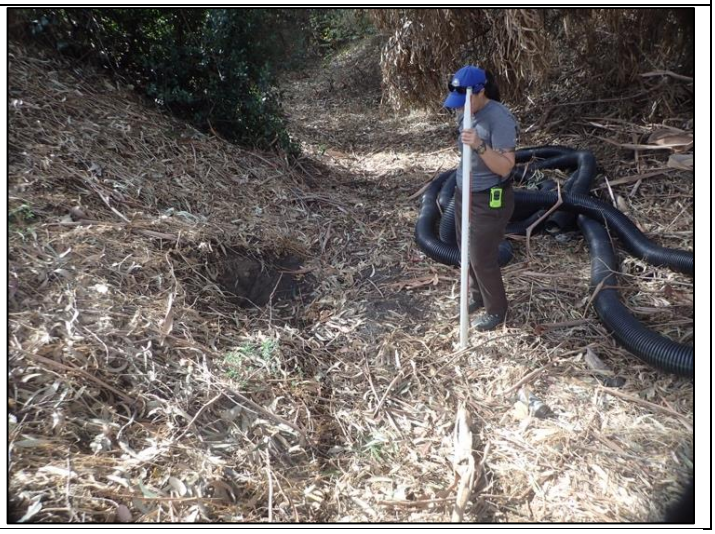
Pictures

Upstream Looking Upstream

Upstream Looking Downstream (Culvert Inlet)

Downstream Looking Upstream (Culvert Outlet)

Downstream Looking Downstream



Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary To**	**Estimated Annual Mean Peak Streamflow** (at structure)	***O. mykiss* Presence**
Unnamed 0.102 mi²	Topanga Canyon Creek	56.4 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is a tributary of Topanga Canyon Creek, which currently supports a population of *O. mykiss*. However, considering the small drainage area, low estimated annual mean peak streamflow, and channel conditions present when assessed it is unlikely that this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008; CDFW unpublished data, 2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
11/26/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Corrugated Steel Pipe Culvert	1	Unknown	No	No

Crossing Structure Description and Condition
This crossing structure is a small corrugated steel pipe culvert with a 2-inch spiral increments. At the time of assessment, the culvert was partially embedded at the inlet and fully embedded at the outlet. A smaller steel pipe sticks out of the road fill on the downstream side of the road. However, due to its angle and size, it could not be determined if this is the actual outlet of the crossing.

Crossing Structure Dimensions				
Segment	**Mean Inlet Diameter**	**Mean Outlet Diameter**	**Length**	**Slope**
1	3 ft	Unknown	Not Recorded	Not Recorded

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The upstream channel is heavily vegetated and has a steep grade. The active channel margins are poorly defined. Most of the stream channel is covered in thick vines, brush, and small woody debris. Due to the overgrown vegetation and steep grade, the upstream channel seems unlikely to contain viable *O. mykiss* habitat.	Not Recorded	Not Recorded	Not Recorded

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominate Substrate**	**Distance to Downstream Control Point**
The downstream channel is broad and had poorly defined active channel margins at the time of assessment. The channel contained a significant amount of small woody debris from fallen eucalyptus leaves and branches.	Silt	Not Recorded

Longitudinal Profile
A longitudinal profile was not completed for this crossing structure due to the confined space restrictions of the crossing structure and upstream accessibility issues.

FishXing Passage Analysis		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
This structure was unable to be modeled within FishXing due to the inability to complete a longitudinal profile associated with a Caltrans detailed fish passage assessment.	This crossing is likely not passable under any rate of streamflow in its assessed condition.	Unknown, insufficient water depth, streamflow velocity, and impassable cascades are likely present at this structure.

Crossing Structure Barrier Status
Total Barrier
Under the fully embedded conditions present at the time of assessment this crossing structure is clearly a total barrier as all life stages of *O. mykiss* are blocked from gaining passage. If the culvert becomes unembedded in the future its small size likely will create streamflow velocity restrictions preventing *O. mykiss* passage.

Assessment and Analysis Limitations
The confined space and full embeddedness of the culvert prevented the completion of a longitudinal profile. As a result, the total barrier status assigned to this crossing structure is based off professional judgement.

Passage Improvement Recommendations
Prior to any remediation efforts taking place the upstream portions of this stream should be surveyed to determine if viable *O. mykiss* habitat is present or if the steep grade would act as a total natural barrier to *O. mykiss* passage. The most effective remediation option would be to remove and replace this culvert with a free spanning bridge.

Crossing Site Information for PAD 759746					
County	**Route**	**Post Mile**	**Location** (at inlet)	**Location Error**	**Stream Miles Inland from Ocean**
Ventura	Hwy 33	5.09	34.09818, -118.59943	± 15 ft	5.52

Pictures

Upstream Looking Upstream

Upstream Looking Downstream
(Culvert Inlet)

Downstream Looking Upstream
(Culvert Outlet)

Downstream Looking Downstream

Outlet of Upstream Crossing Structure

Hydrologic Information			
Stream Name & Drainage Area (upstream of crossing)	**Tributary Of**	**Estimated Annual Mean Peak Streamflow** (at structure)	***O. mykiss* Presence**
Unnamed 0.34 mi²	Topanga Canyon Creek	66.8 ft³/s	It is unknown if this stream has historically or currently supports *O. mykiss*. This stream is a tributary of Topanga Canyon Creek, which currently supports a population of *O. mykiss*. However, considering the small drainage area, low estimated annual mean peak streamflow, and upstream channel conditions present when assessed it is unlikely that this stream currently supports *O. mykiss*. (NMFS Southern California Steelhead Recovery Plan 2012; Center for Ecosystem Management & Restoration 2008; CDFW unpublished data, 2019).

Survey Information		
Survey Date	**Type of Survey Performed**	**Agency Performing Survey**
11/26/19	Caltrans Reconnaissance Fish Passage Assessment	PSMFC & CCC
11/26/19	Caltrans Detailed Fish Passage Assessment	PSMFC & CCC

Crossing Structure Information				
Structure Type	**Number of Culverts**	**Number of Segments**	**Aprons Present**	**Fish Passage Structure(s) Present**
Reinforced Concrete Box Culvert	1	1	No	No

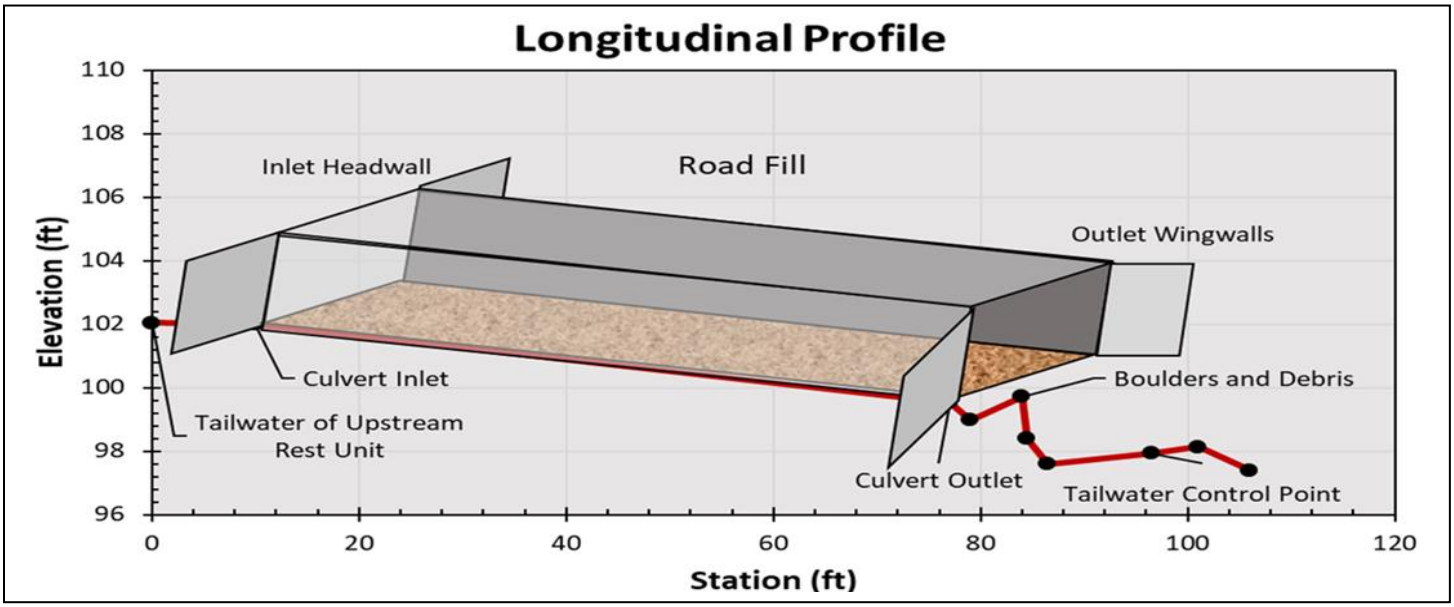
Crossing Structure Description and Condition
This crossing structure is a reinforced concrete box culvert with headwalls the inlet and wingwalls at the outlet. The base of the culvert contains natural streambed substrate. The culvert appeared to be in good condition without any visible damage.

Crossing Structure Dimensions					
Segment	**Mean Inlet Height**	**Mean Outlet Height**	**Mean Width**	**Length**	**Slope**
Culvert	4.2 ft	3.8 ft	8.3 ft	67 ft	3.7 %

Downstream Channel Conditions		
Downstream Channel Description	**Downstream Dominant Substrate**	**Distance to Downstream Control Point**
The downstream channel contained poorly defined active channel margins and considerable woody debris. The channel banks contained dense vegetation, including thick stands of *Arundo donax*. The dominant streambed substrates were boulders and large cobbles.	Cobble	19.5 ft

Upstream Channel Conditions			
Upstream Channel Description	**Distance to Resting Unit** (from structure)	**Height to Resting Unit** (from structure)	**Mean Upstream Active Channel Width**
The main feature of the upstream channel is the presence of an additional reinforced concrete box culvert crossing structure under Highvale Trail Road. This culvert contains is located roughly 100 ft upstream of the Hwy 27 crossing structure and a plunge point with a mean height of 4 ft is present at its outlet. Upstream of the Highvale Trail Road culvert the stream channel has been converted to the concrete lined flood control channel with additional road crossing culverts. The active channel margin of the short section of natural channel upstream of the Hwy 27 crossing was undefined and contained moderate amounts of vegetation indicating minimal streamflow is likely common.	10 ft	0.06 ft	7.68 ft

Longitudinal Profile			
Point	**Station** (ft)	**Elevation** (ft)	**Notes**
Tailwater of Upstream Resting Pool	0	102.05	
Upstream Channel Point 1	5	102.11	
Upstream Channel Point 2	9	102	
Culvert Inlet	10	101.99	
Culvert Outlet	77	99.54	
Downstream Max Depth (within 5 ft of structure)	79	98.98	
Downstream Channel Point 1	84	99.72	Above plunge point in the downstream channel.
Downstream Channel Point 2	84.5	98.39	Below plunge in downstream channel.
Downstream Max Depth	86.5	97.59	
Tailwater Control Point	96.5	97.94	
Downstream Channel Point 3	101	98.14	
Downstream Channel Point 4	106	97.4	



FishXing Passage Analysis Results		
Description of Structure Modeling within FishXing	**Predicted Passable Streamflow Range** (ft^3/s)	**Predicted Passage Restrictions** (when streamflow rates < estimated annual mean peak flow rate)
Analysis for Anadromous *O. mykiss* This crossing structure was modeled as a box culvert within FishXing. A roughness coefficient of 0.04 was selected to represent the cobble and gravel substrate present at the base of the culvert.	31.98 – 657.3	Insufficient Streamflow Depth
Analysis for Resident *O. mykiss*	None	Insufficient Streamflow Depth Excessive Streamflow Velocity

Crossing Structure Barrier Status

Temporal & Partial Barrier

FishXing analysis predicts that anadromous life stages of *O. mykiss* can gain passage through this culvert crossing structure when adequate rates of streamflow (> 31.98 ft^3/s) are present. A streamflow velocity barrier was not predicted to occur below streamflow rates of 657.3 ft^3/s, well below the estimated annual mean peak rate of streamflow. FishXing predicted the structure to be impassable to resident life stages of *O. mykiss*, due to the somewhat steep slope (3.7%) of the substrate within the culvert. Future rearrangement of the substrate within the culvert could potentially improve passage conditions for all life stages of *O. mykiss*. However, if a concrete base is present within the culvert substrate rearrangements also has the potential to further restrict *O. mykiss* passage abilities.

Assessment and Analysis Limitations

The only limitation for conducting a full detailed assessment was determining the depth of substrate embeddedness within the culvert. It is unknown if the culvert contains a concrete or natural substrate base.

Passage Improvement Recommendations

The structure does not pose as a significant barrier to the anadromous life stage of *O. mykiss* in its current configuration. Passage conditions could be improved for the resident *O. mykiss* life stages by replacing this culvert with a free spanning bridge. Remediation efforts should also be focused on the numerous upstream barriers prior to any efforts on this Hwy 27 crossing structure.

Appendix D

Roughness Coefficient Values Utilized for FishXing Analysis

This appendix contains the reference tables relied upon for selecting roughness coefficients (Manning's n) used in FishXing passage analysis. These reference tables are listed in the FishXing User Manual and were established by Ven Te Chow (Open Channel Hydraulics, 1959),

Roughness Coefficient for Stream Channels	**Roughness Coefficient Values (n)**		
1. Main Channels	**Minimum**	**Normal**	**Maximum**
a. clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
b. same as above, but more stones and weeds	0.030	0.035	0.040
c. clean, winding, some pools and shoals	0.033	0.040	0.045
d. same as above, but some weeds and stones	0.035	0.045	0.050
e. same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. same as "d" with more stones	0.045	0.050	0.060
g. sluggish reaches, weedy, deep pools	0.050	0.070	0.080
h. very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
2. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages	**Minimum**	**Normal**	**Maximum**
a. bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
b. bottom: cobbles with large boulders	0.040	0.050	0.070
3. Floodplains	**Minimum**	**Normal**	**Maximum**
a. Pasture, no brush Floodplains			
- short grass	0.025	0.030	0.035
- high grass	0.030	0.035	0.050
b. Cultivated area Floodplains			
- no crop	0.020	0.030	0.040
- mature row crops	0.025	0.035	0.045
- mature field crops	0.030	0.040	0.050
c. Brush Dominated Floodplains			
- scattered brush, heavy weeds	0.035	0.050	0.070
- light brush and trees, in winter	0.035	0.050	0.060
- light brush and trees, in summer	0.040	0.060	0.080
- medium to dense brush, in winter	0.045	0.070	0.110
- medium to dense brush, in summer	0.070	0.100	0.160

Table continues to next page

Roughness Coefficient for Stream Channels	Roughness Coefficient Values (n)		
d. Tree Dominated Floodplains	**Minimum**	**Normal**	**Maximum**
- dense willows, summer, straight	0.110	0.150	0.200
- cleared land with tree stumps, no sprouts	0.030	0.040	0.050
- same as above, but with heavy growth of sprouts	0.050	0.060	0.080
- heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
- flood stage reaching branches	0.100	0.120	0.160
4. Excavated or Dredged Channels	**Minimum**	**Normal**	**Maximum**
a. Earth, straight, and uniform channels			
- clean, recently completed	0.016	0.018	0.020
- clean, after weathering	0.018	0.022	0.025
- gravel, uniform section, clean	0.022	0.025	0.030
- with short grass, few weeds	0.022	0.027	0.033
b. Earth winding and sluggish channels			
- no vegetation	0.023	0.025	0.030
- grass, some weeds	0.025	0.030	0.033
- dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
- earth bottom and rubble sides	0.028	0.030	0.035
- stony bottom and weedy banks	0.025	0.035	0.040
- cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged channels			
- no vegetation	0.025	0.028	0.033
- light brush on banks	0.035	0.050	0.060
d. Rock cut channels			
- smooth and uniform	0.025	0.035	0.040
- jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
- dense weeds, high as flow depth	0.050	0.080	0.120
- clean bottom, brush on sides	0.040	0.050	0.080
- same as above, highest stage of flow	0.045	0.070	0.110
- dense brush, high stage	0.080	0.100	0.140
5. Lined or Constructed Channels	**Minimum**	**Normal**	**Maximum**
a. Cement constructed channels			
- neat surface	0.010	0.011	0.013
- mortar	0.011	0.013	0.015
b. Wood constructed channels			
- planed, untreated	0.010	0.012	0.014

Table continues to next page

Roughness Coefficient for Stream Channels	Roughness Coefficient Values (n)		
5. Lined or Constructed Channels (continued)	**Minimum**	**Normal**	**Maximum**
- planed, creosoted	0.011	0.012	0.015
- unplanned	0.011	0.013	0.015
- plank with battens	0.012	0.015	0.018
- lined with roofing paper	0.010	0.014	0.017
c. Concrete lined channels	**Minimum**	**Normal**	**Maximum**
- trowel finish	0.011	0.013	0.015
- float finish	0.013	0.015	0.016
- finished, with gravel on bottom	0.015	0.017	0.020
- unfinished	0.014	0.017	0.020
- gunite, good section	0.016	0.019	0.023
- gunite, wavy section	0.018	0.022	0.025
- on good excavated rock	0.017		0.020
- on irregular excavated rock	0.022		0.027
d. Concrete channels bottom float finish with sides of:	**Minimum**	**Normal**	**Maximum**
- dressed stone in mortar	0.015	0.017	0.020
- random stone in mortar	0.017	0.020	0.024
- cement rubble masonry, plastered	0.016	0.020	0.024
- cement rubble masonry	0.020	0.025	0.030
- dry rubble or riprap	0.020	0.030	0.035
e. Gravel channels bottom with sides of:			
- formed concrete	0.017	0.020	0.025
- random stone mortar	0.020	0.023	0.026
- dry rubble or riprap	0.023	0.033	0.036
f. Brick channels			
- glazed	0.011	0.013	0.015
- in cement mortar	0.012	0.015	0.018
g. Masonry channels			
- cemented rubble	0.017	0.025	0.030
- dry rubble	0.023	0.032	0.035
h. Dressed ashlar/stone paving channels	0.013	0.015	0.017
i. Asphalt channels	**Minimum**	**Normal**	**Maximum**
- smooth	0.013	0.013	0.013
- rough	0.016	0.016	0.016

Table continues to next page

Roughness Coefficient for Conduits	Minimum	Normal	Maximum
1. Brass Conduits	0.009	0.010	0.013
2. Steel Conduits			
a. Lock Bar and welded	0.010	0.012	0.014
b. Riveted and spiral	0.013	0.016	0.017
3. Cast Iron Conduits			
a. Coated	0.010	0.013	0.014
b. Uncoated	0.011	0.014	0.016
4. Wrought Iron Conduits			
a. Black	0.012	0.014	0.015
b. Galvanized	0.013	0.016	0.017
5. Corrugated Metal Conduits			
a. Subdrain	0.017	0.019	0.021
b. Storm Drain	0.021	0.024	0.030
6. Cement Conduits			
a. Neat Surface	0.010	0.011	0.013
b. Mortar	0.011	0.013	0.015
7. Concrete Conduits			
a. Culvert, straight and free of debris	0.010	0.011	0.013
b. Culvert with bends, connections, and some debris	0.011	0.013	0.014
c. Finished	0.011	0.012	0.014
d. Sewer with manholes, inlet, etc., straight	0.013	0.015	0.017
e. Unfinished, steel form	0.012	0.013	0.014
f. Unfinished, smooth wood form	0.012	0.014	0.016
g. Unfinished, rough wood form	0.015	0.017	0.020
8. Wood Conduits			
a. Stave	0.010	0.012	0.014
b. Laminated, treated	0.015	0.017	0.020
9. Clay Conduits			
a. Common drainage tile	0.011	0.013	0.017
b. Vitrified sewer	0.011	0.014	0.017
c. Vitrified sewer with manholes, inlet, etc.	0.013	0.015	0.017
d. Vitrified Subdrain with open joint	0.014	0.016	0.018
10. Brickwork Conduits			
a. Glazed	0.011	0.013	0.015
b. Lined with cement mortar	0.012	0.015	0.017
c. Sanitary sewers coated with sewage slime with bends and connections	0.012	0.013	0.016
d. Paved invert, sewer, smooth bottom	0.016	0.019	0.020
e. Rubble masonry, cemented	0.018	0.025	0.030