DRAFT

Stonybrook Creek Watershed

A Strategic Plan for Eliminating Barriers to Steelhead Migration

June 4, 2010

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1 Purpose

Several fish passage barrier assessments within the Stonybrook Creek Watershed have been conducted during the past decade and numerous crossings have been identified as either complete or partial barriers to upstream migrating steelhead. The Alameda County Department of Public Works (ACDPW) has requested the services of Michael Love & Associates (MLA), working with the Center for Ecological Management and Restoration (CEMAR), to develop a watershed wide barrier remediation strategy and estimate potential cost for implementation of the strategy. This involves identifying priority crossings for fish passage improvement, recommending the order in which they should be treated, and developing planning-level cost estimates to address them.

2 Background

Stonybrook Creek is a tributary to Alameda Creek, which drains into San Francisco Bay (Figure 1). The confluence of the two creeks is located in Niles Canyon, approximately 13 river miles upstream from San Francisco Bay. The Stonybrook Creek watershed lies within Alameda County, about 7 miles east of Hayward. The watershed runs north to south and has a drainage area of 6.9 square miles. Elevations within the basin range from 160 feet at its mouth to 2,191 feet at its highest crest.

There are ongoing efforts to restore runs of anadromous steelhead trout (*Onchorhynchus mykiss*) to the Alameda Creek Watershed. These efforts are coordinated by the Alameda Creek Fisheries Restoration Working Group and have lead to the removal of several small dams and other steelhead migration barriers, and the completion of numerous studies investigating fisheries habitat condition and potential, water resources management strategies, and barrier assessments and remediation strategies.

The lower 12 miles of Alameda Creek is a flood control channel with little viable habitat for steelhead. The keystone barriers preventing steelhead from reaching spawning and rearing habitat are located within the upper section of the flood control channel and consist of a concrete drop structure and two inflatable rubber dams. The Alameda County Flood Control and Water Conservation District (ACFCWCD) and the Alameda County Water District (ACWD) are committed to constructing fishways around these barriers within the next several years, to provide steelhead access to upstream habitat.

Stonybrook Creek is the first tributary to Alameda Creek upstream of the flood control channel capable of supporting steelhead spawning and rearing. This was supported when a pair of Alameda Creek steelhead captured in the flood control channel, radio-tagged, and released in Niles Canyon were found to have spawned in Stonybrook Creek and their likely offspring were later found rearing in a nearby pool (Alexander, 1999).

2.1 Previous Fish Passage Assessments

A 2001 barrier assessment (MLA, 2001) evaluated fish passage conditions at the eight publically maintained crossings on Stonybrook Creek; the Highway 84 crossing maintained by the California Department of Transportation (CalTrans) at Stream Mile 0.00 and seven County-maintained crossings at Stream Mile 1.04, 1.21, 1.65, 1.84, 2.25, 3.81, and 3.93. The assessment used a draft version of the California Department of Fish and Game fish passage assessment protocol (CDFG, 2003) to evaluate passage for both juvenile and adult steelhead and adult resident trout. Of the eight evaluated crossings, seven were identified as full barriers for fish passage and one (Stream Mile 3.93) was deemed passable for all steelhead lifestages considered. The study also identified, but did not assess fish passage at numerous privately owned crossings.

ACDPW conducted a rapid habitat and barrier survey of Stonybrook Creek in October 2002 (ACPWD, 2002). The survey was conducted to identify the presence of fish, late-summer pools and natural and manmade features in the channel that may be barriers for steelhead migration. Potential fish passage barriers were visually assessed, and their location was given by stream distance from the confluence as measured in the field with a hip-chain. The survey identified 28 public and privately owned road-stream crossings on Stonybrook Creek. Of the 28 crossings, nine were culverts, five were concrete or masonry channels with bridge decks, and 13 were bridges over the natural stream channel. They identified concrete rubble within the channel at Stream Mile 1.64 that may also hinder fish passage.

A review of aerial photographs found two additional private crossings that have been constructed since 2002. The type and fish passage status of these crossings is unknown, but from the photographs, they appear to be bridges.

Figure 1 shows the location of each crossing on Stonybrook Creek. Table 1 lists each crossing by its distance from the confluence with Alameda Creek, and describes the type of structure and the degree to which it is a barrier for passage of juvenile and adult steelhead. Appendix A presents photographs of some of the crossings. The visual assessment concluded that the private bridge crossings between Stream Mile 2.35 and 3.73 were not barriers to fish migration. Fish passage was not visually assessed at one private bridge under construction (Stream Mile 3.08) and a privately owned dirt-surface low-water (ford) crossing at Stream Mile 4.18. ACDPW considered the four culvert crossings within Stonybrook Valley are not barriers. However, based on photographs of these sites, they appear to constrict the flow and are likely partial barriers, blocking juvenile steelhead during higher flows.

A 2005 study prepared by MLA (MLA, 2005) evaluated fish passage at the two lowermost privately owned stream crossing identified in the 2001 study (at Stream Mile 0.17 and 0.23) using the 2003 CDFG assessment procedures. These crossings were identified as complete barriers to juvenile salmonids and adult resident trout, and partial barriers for adult steelhead. Site access was not granted by the landowner of the privately owned crossing at Stream Mile 0.58. However, a visual assessment of this crossing found that fish passage conditions are similar to the two downstream privately owned crossings.

In addition to the fish passage assessments, preliminary engineering designs were developed for crossing replacements at Stream Mile 1.04 and 1.21 (W&K et al., 2005) to restore fish passage at these locations.

2.2 Geomorphic and Fisheries Habitat Conditions

There has been some characterization of the geomorphic and fisheries habitat conditions within the watershed, which was used in developing a barrier remediation strategy. A channel profile was developed using the USGS 1:24,000 quadrangles with 40-foot contour spacing to show the channel reaches and relative locations of the stream crossings (Figure 2).

The following sections summarize the geomorphic and fisheries habitat characterizations by channel reach.

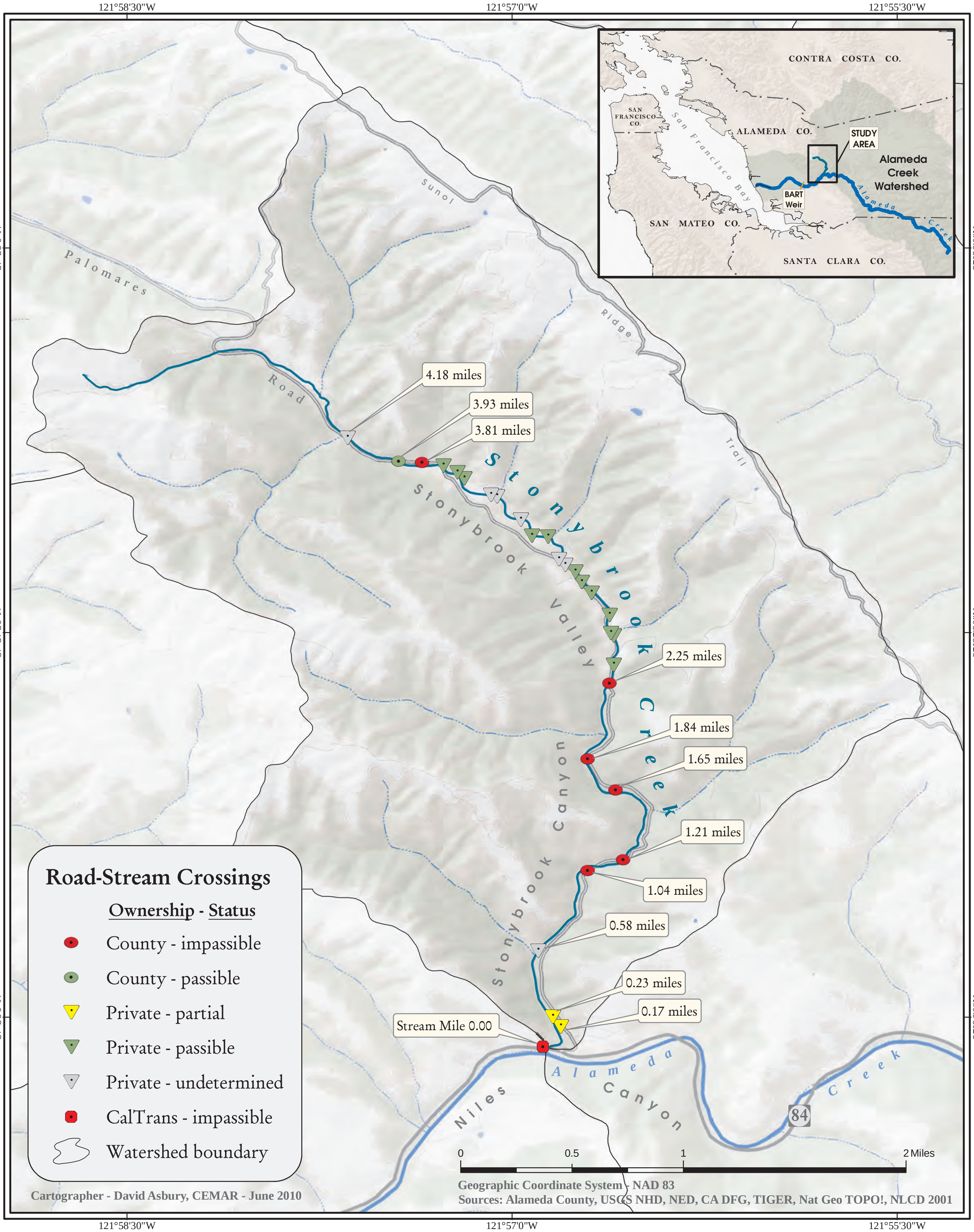

Figure 1. Location of known road-stream crossings within the Stonybrook Creek watershed and their fish passage status.

Table 1. List of road-stream crossings on Stonybrook Creek with results from previous fish passage assessments.

Stream Distance from Alameda Creek[3] (Miles)	Ownership	Crossing Type and Dimensions (Including constructed channels and aprons)	Barrier Assessment Results	
			Juvenile Steelhead	Adult Salmonid
0.00	CalTrans (Highway 84)	Culvert: 57.5' long, 10'x7' concrete box. (Stobk#1).	Complete Barrier[1]	Complete Barrier[1]
0.17	Private	Culvert: 16' long, triple 7' dia. RCP.	Complete Barrier[2]	54% Passable[2]
0.23	Private	Culvert: 16' long, triple 6' dia. RCP.	Complete Barrier[2]	45% Passable[2] Visually not a barrier[3]
0.58	Private	Culvert: 30' long, 4' wide x 5' high CMP, and overflow pipes - 9' wide x 7' wide CMP, 3' dia. RCP, 3.5' dia. RCP.	Not Assessed	Visually not a barrier[3]
1.04	County (Mile Post 8.75)	Culvert: 89' long, 8'x9' concrete box. (Stobk#2)	Complete Barrier[1]	Complete Barrier[1]
1.21	County (Mile Post 8.60)	Bridge: 77' long concrete and masonry trapezoidal channel with concrete bridge deck. Opening of 9' bottom width and 14.5' top width, 8' tall (Stobk#3)	Complete Barrier[1]	Complete Barrier[1]
1.65	County (Mile Post 8.16)	Bridge: 86' long Masonry/riprap/gabion/bedrock trapezoidal channel with concrete bridge deck. Opening of 8' bottom width and 12.5' top width, 8' tall (Stobk#4)	Complete Barrier[1]	Complete Barrier[1]
1.84	County (Mile Post 8.00)	Bridge: 101' long masonry/bedrock trapezoidal channel with concrete bridge deck. Opening of 8.5' bottom width and 14.5' top width, 8.5' tall. (Stobk#5)	Complete Barrier[1]	Complete Barrier[1]
2.25	County (Mile Post 7.75)	Bridge: 56' long stone/masonry trapezoidal channel with concrete bridge deck. Opening of 7' bottom width and 28' top width, 10' tall. (Stobk#6)	Complete Barrier[1]	Complete Barrier[1]
2.35	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
2.49	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
2.50	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
2.60	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
2.72	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
2.78	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
2.84	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
2.88	Private	Culvert: 12' long double RCP (No size given)	Visually not a barrier[3]	Visually not a barrier[3]
2.92	Private	Bridge: Natural channel bottom with rock/masonry grade control structure. Dimensions not surveyed.	Not Assessed	Not Assessed

Table 1. Continued.

Stream Distance from Alameda Creek[3] (Miles)	Ownership	Crossing Type and Dimensions (Including constructed channels and aprons)	Barrier Assessment Results	
			Juvenile Steelhead	Adult Salmonid
3.01	Private	Unknown, constructed since 2002[4]	Not Assessed	Not Assessed
3.08	Private	Bridge: dimensions not surveyed	Not Assessed	Not Assessed
3.12	Private	Unknown, constructed since 2002[4]	Not Assessed	Not Assessed
3.15	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
3.27	Private	Culvert: 6.8' dia. RCP	Visually not a barrier[3]	Visually not a barrier[3]
3.42	Private	Culvert: 56' long , 5.4' tall x 7' wide CMPA	Visually not a barrier[3]	Visually not a barrier[3]
3.44	Private	Culvert: 33' long 5' CMP	Visually not a barrier[3]	Visually not a barrier[3]
3.57	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
3.65	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
3.73	Private	Bridge: Natural channel bottom. Dimensions not surveyed.	Visually not a barrier[3]	Visually not a barrier[3]
3.81	County (Mile Post 6.28)	Bridge: 47' long masonry trapezoidal channel with concrete deck. Opening of 10.5' bottom width and 15' top width, 7' tall (Stobk#7)	Complete Barrier[1]	Complete Barrier[1]
3.93	County (Mile Post 6.18)	Bridge: 33' bridge: natural channel with masonry walls. Opening of 7' bottom width and 14' top width, 10.5' tall (Stobk#8)	100% Passable[1]	100% Passable[1]
4.18	Private	Low-water crossing (ford): Gravel surface. Dimensions not surveyed	Not Assessed	Not Assessed

[1] MLA, 2001

[2] MLA, 2005

[3] Visual Assessment, ACPW, 2002

[4] Identified from post 2002 aerial photographs.

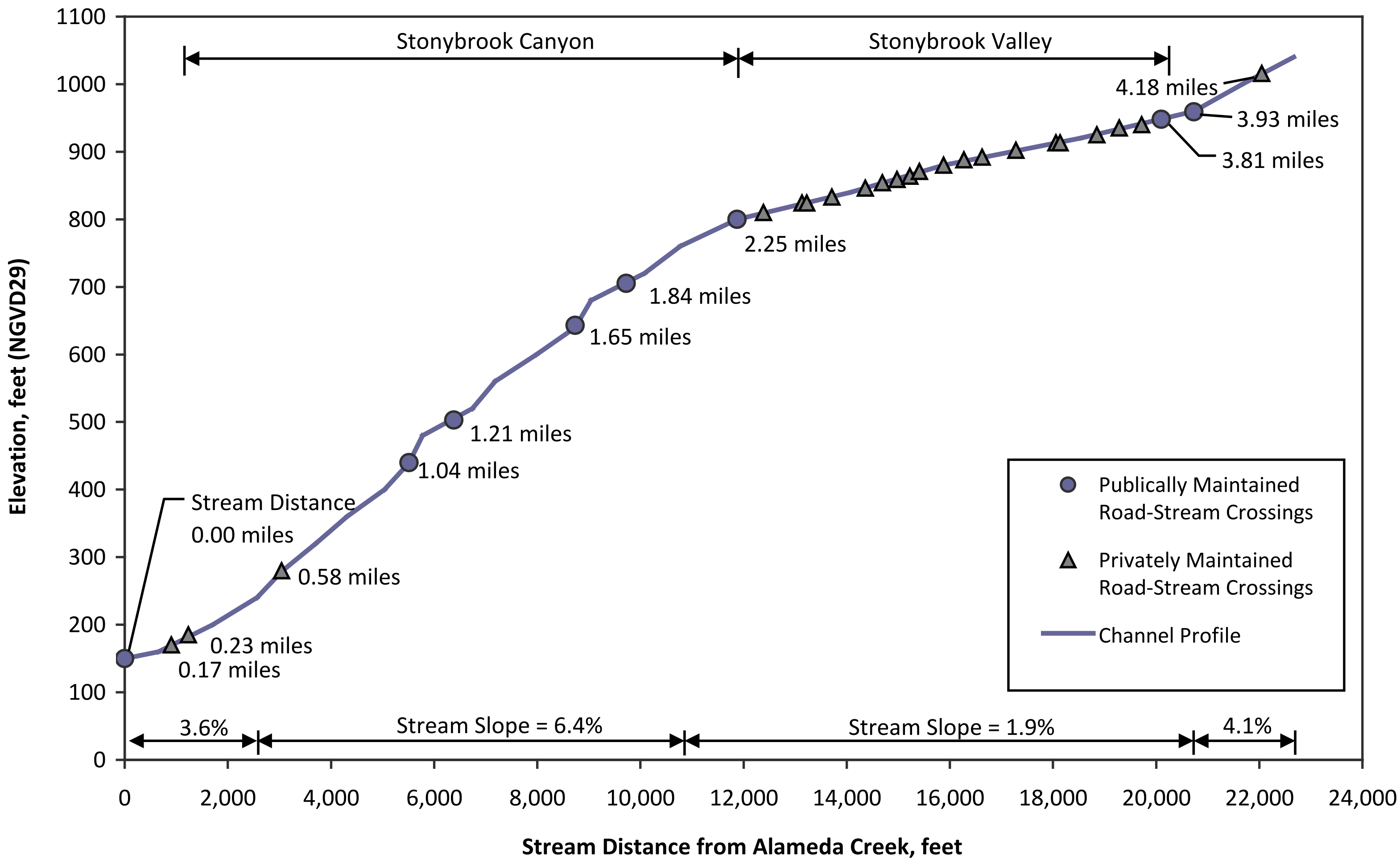

Figure 2. Longitudinal profile of Stonybrook Creek based from the USGS Niles and Dublin Quadrangles with 40-foot contour spacing. Location of public and privately maintained road-stream crossings, given in Stream Miles, is based on hip-chain distance measured by ACPW (2002).

2.2.1 Lower Stonybrook Creek

Michael Love & Associates performed a visual geomorphic evaluation of the stream channel as part of a fish passage assessment project (MLA, 2001). They found that the lowest reach of the stream (Stream Mile 0 to 0.38) has a moderate gradient (approximately 3.5%) and the stream substrate consists mostly of large cobbles, with some gravels. The downstream end of this reach is depositional, causing flow to go subsurface during late summer. The geomorphic and intermittent flow conditions in this reach suggest that it may contain potential spawning grounds but poor summer rearing habitat due to the lack of pools and surface water in late-summer.

2.2.2 Stonybrook Canyon

The MLA (2001) study characterized the lower-middle reach of Stonybrook Creek (Stream Mile 0.38 to 2.24) as a steep gradient channel (average of 6.4%) with boulder-controlled morphology and numerous deep perennial pools.

A preliminary habitat assessment of Stonybrook Creek was conducted by the East Bay Regional Park District (Alexander, 1999). The assessment identified the habitat within the Stonybrook Canyon as good, with perennial pools. MLA (2001) described this reach as having a dense tree canopy and steep canyon walls that provide ample shade. The substrate throughout the reach is comprised mostly of boulders and large cobbles, not suitable for spawning. Many of the pools become isolated during late summer months but maintain cool surface water, suggesting this reach may provide good rearing habitat for steelhead. Recorded summer water temperatures in a pool near Stream Mile 1.1 showed only minor fluctuation and were consistently below 18^{o}C in pools (ACFCWCD, 1999). In contrast, water temperatures measured in 2008 and 2009 in a pool located approximately 300 feet upstream of the confluence with Alameda Creek were consistently over 15^{o}C throughout the summer months, occasionally reaching 20^{o}C (data provide by San Francisco Public Utilities Commission, 2010)

2.2.3 Stonybrook Valley

Upstream of the canyon, in Stonybrook Valley, the gradient decreases to approximately 1.9 percent and MLA (2001) characterized this reach of Stonybrook Creek as a lower gradient alluvial channel containing numerous riffles and runs, but few pools and limited surface water during late summer. MLA (2001) suggested that the presence of numerous low gradient, gravel riffles characterizes this reach as potentially suitable spawning habitat for rainbow trout and steelhead, although the percent of fines in the channel bed appears high. Alexander (1999) described the habitat as marginal to poor due to little to no surface water in the late summer-early fall, that is further reduced by residential and agricultural withdrawals. Streamside canopy is less than that found in Stonybrook Canyon . These conditions would force young-of-the-year fish to migrate downstream for summer rearing.

2.2.4 Upstream of Stonybrook Valley

The upper reach of Stonybrook Creek has a moderate gradient and lies in a ravine east of Palomares Road. This reach appears to be heavily impacted by grazing and during summer months has no surface water (MLA, 2001). Because no stream surveys have been conducted within this reach, the upper extent of steelhead habitat is unknown, but thought to be marginal or nonexistent.

3 Selecting Priority Crossings

Priorities for remediation of the existing barriers within Stonybrook Creek were developed based on the goal of restoring steelhead spawning and rearing within the watershed. This required consideration of the most viable life history strategy for steelhead utilizing the watershed, and identification of which migration barriers must be eliminated to facilitate this life history.

3.1 Viable Steelhead Life History Strategies for Stonybrook Creek

As previously described, the majority of low gradient spawning habitat is located in the alluvial channel reaches within Stonybrook Valley, while habitat suitable for summer rearing of juvenile steelhead is limited to the perennial pool habitat located downstream in Stonybrook Canyon. The canyon contains numerous boulder steps and cascades that are passable by adult steelhead but beyond the leaping and swimming abilities of juvenile steelhead.

The canyon functions as a one-way conduit for juvenile steelhead, allowing them to move downstream but not upstream. Juveniles that remain within the pools within the canyon could rear year-round. However, juvenile steelhead that find themselves within the lowest reach of Stonybrook Creek would be unable to over-summer within this reach due to drying of the channel. They would likely not be able to move upstream into suitable over-summering habitat within the canyon due to natural barriers, and Alameda Creek within Niles Canyon does not have viable over-summering habitat due to very high summer water temperatures (Gunther, 2000.

Based on the location of habitat and natural barriers to juvenile steelhead, the most viable life history strategy for steelhead in Stonybrook Creek may be:

1. Adult steelhead migrate upstream through Stonybrook Canyon and spawn within the alluvial reach of Stonybrook Valley

2. The offspring move downstream in the spring as the alluvial reach warms and dries

3. The offspring rear in the deep perennial pools within Stonybrook Canyon, eventually outmigrating as smolts during the spring.

3.2 Priority Crossings

To support the life history strategy described above, the barriers within Stonybrook Creek that must be addressed are those located between the confluence with Alameda Creek (Stream Mile 0.00) and Stonybrook Valley (Stream Mile 2.25). Within this section of channel there are a total of nine road-stream crossings. Fish passage conditions for eight of the nine sites were assessed (MLA 2001, 2005). Six were identified as complete barriers to fish passage and two were identified as partial barriers. Access was not granted by the landowner to the ninth crossing, but visual inspection suggests that it is a partial barrier and extremely undersized for conveyance of flood flows, debris, and sediment.

4 Replacement Recommendations

The fish passage assessments for the eight priority crossings on Stonybrook Creek recommended that the crossings be replaced, if feasible (MLA 2001, 2005). In general, most of the crossings are substantially undersized, causing occasional overtopping and erosion of the roadway, and sediment aggradation in the stream channel. Most of the crossings have large drops at their outlet and/or an extremely steep gradient, making retrofit of the crossing problematic and costly. Given that the CDFG and the National Marine Fisheries Service (NOAA-NMFS) preferred stream crossing type is a structure that spans the bankfull channel and has a natural bottom, the planning-level cost estimates for restoring fish passage were developed assuming that each crossing would be replaced with a full spanning structure and a natural channel bed.

Using the stream simulation approach (CDFG, 2009 and USFS, 2008), a preliminary size was estimated for a clear-spanning replacement bridge or open-bottom arch culvert for each site. The premise of stream simulation is that the channel under a crossing mimics the morphology of the adjacent natural channel. Therefore, the crossing will prove to be no more of an impediment to movement of aquatic organisms than the natural channel upstream and downstream of the crossing.

It is understood that CalTrans is currently developing a replacement project for the Highway 84 stream crossing at Stream Mile 0.00. Therefore, design and cost estimates were not developed for this site.

4.1 Sizing of Stream Crossings

To estimate a range of probable cost for replacing the priority crossings required estimating the size and type of crossing that may be suitable for each site. Items that can substantially influence the cost of a stream crossing replacement project include the type and size of structure to be used. In general, both CDFG (2003) and NOAA (2001) typically require new crossings on fish bearing streams to span the bankfull channel width and convey at least the 100-year flow without submerging the culvert inlet or bottom of the bridge deck. To guide cost development, peak flows were estimated and preliminary structure size and type were identified for each priority site.

4.1.1 Peak Flows

For each crossing, peak flows were estimated using procedures described in MLA 2005 and W&K et al. 2005. It involved a probabilistic analysis of peak flow records from eight nearby streams, adjusted by drainage area (USGS 1982). Table 2 presents the drainage area for each priority stream crossing and the estimated peak flows associated with various return periods.

Table 2. Peak Flow Estimates for the 10, 25 and 100-year recurrence interval flow for various stream crossings on Stonybrook Creek.

Location of Crossing (Stream Mile/Mile Post)	Drainage Area (mi^2)	10-Year Flow (cfs)	25-Year Flow (cfs)	50-Year Flow (cfs)	100-Year Flow (cfs)
Private Crossing (SM 0.17)	6.87	853	1,317	1,713	2,143
Private Crossing (SM 0.23)	6.87	853	1,317	1,713	2,143
Private Crossing (SM 0.58)	6.87	853	1,317	1,713	2,143
Palomares Road (SM 1.04/MP 8.75)	5.72	710	1,096	1,427	1,784
Palomares Road (SM 1.21/MP 8.6)	5.68	705	1,089	1,417	1,771
Palomares Road (SM 1.65/MP 8.16)	4.78	593	916	1,192	1,491
Palomares Road (SM 1.84/ MP 8.0)	4.74	588	909	1,182	1,478
Palomares Road (SM 2.25/ MP 7.57)	4.14	514	794	1,032	1,291

4.1.2 Channel Profile

A natural channel bed appears to be feasible at each of the crossings. To estimate the channel elevation for each replacement crossing, a straight line was drawn from upstream to downstream of the existing channel. Although some of the crossings have a drop at their outlet, the presence of bedrock and large colluvium makes upstream channel incision that could result from the removal of the crossings unlikely.

4.1.3 Crossing Type and Dimensions

Size of each replacement crossing was based on conveying the 100-year peak flow without submerging the crossing inlet, where feasible. Allowing this freeboard avoids pressure flow that may compromise channel stability and reduces the potential for debris blockage. Freeboard also minimizes backwater effects that can cause deposition upstream of the crossing.

The span of each replacing crossing was preliminarily sized using the HY-8 Culvert Analysis Program (FHWA, 2009). Channel cross section, slope, and height of the road surface above the channel bed were obtained from the initial fish passage surveys at each site (MLA, 2001 and MLA 2005). Size of the replacement crossings for Palomares Road were developed assuming roadway alignment and profile remains the same. Available survey data and photographs were used to estimate the amount of change to the roadway elevation that might be acceptable for the private crossings.

At one of the private crossings (Stream Mile 0.23) conveyance of the 100-year flow under the roadway appears to be infeasible. A suitable alternative that would satisfy fish passage objectives and have minimal impact on geomorphic process is a vented low-water crossing using a large low-profile open-bottom culvert designed to convey flows exceeding the bankfull flood. Larger flows would overtop the roadway but stay within the downstream channel. A vented low-water crossing designed to provide flow conveyance and unimpeded sediment transport during more frequent flow events (i.e. less than the 5-year peak flow), have been shown to be capable of maintaining a natural channel bed and having minimal impacts on the upstream channel (USFS, 2006).

4.2 Recommendations for Priority Crossings

Preliminary replacement recommendations and are given below. Recommended order for treatment and estimates of probable cost for each site are discussed in the following sections and summarized in Table 3 and 4.

4.2.1 Highway 84 Crossing at Stream Mile 0.00

Existing Conditions

The road-crossing on Highway 84 is located at the confluence of Stonybrook Creek with Alameda Creek and is maintained by the CalTrans. The crossing was surveyed and assessed for fish passage in 2005 (MLA, 2005). The existing crossing is a 10-foot by 7-foot concrete box culvert (Appendix A). The existing crossing is undersized, conveying approximately the 5-year peak flow before the inlet becomes submerged. Channel bedload has accumulated approximately 100 feet upstream of the crossing, causing the channel bed elevation to be higher than the adjacent roadway elevation in one location. A berm has been constructed to contain flows within the channel.

According to the CDFG fish passage protocol, the crossing is considered a complete barrier for all steelhead life stages due to an approximately 1.2-foot drop at the outlet combined with excessive water velocities and shallow water depths during migration flows. However, the pair of radio tagged adult steelhead released into Alameda Creek in 1999 were able to pass through this crossing.

Recommendations

CalTrans is aware of the fish passage problems at this site and is planning to replace the crossing. Replacement should address the aggraded stream channel immediately upstream of the crossing and the poor alignment of the channel with the culvert inlet. Because this is the most downstream barrier on Stonybrook Creek, it should be given a high priority for replacement. The preferred crossing type, schedule for implementation, and cost for replacement is unknown at this time.

4.2.2 Private Crossing at Stream Mile 0.17

Existing Conditions

A private crossing is located approximately 900 feet upstream from the confluence of Stonybrook Creek and Alameda Creek. The crossing was surveyed and assessed for fish passage in 2005 (MLA, 2005). The existing crossing consists of three 7-foot concrete culverts with approximately 3-feet of cover (Appendix A). The crossing appears to be an infrequently used agricultural/horse crossing over Stonybrook Creek, and the approach slopes and crossing surface are not suitable for vehicular traffic. The existing crossing is undersized, conveying approximately the 10-year peak flow before the inlet becomes submerged. Channel bedload and large woody debris have accumulated upstream of the crossing because of the backwater created by crossing at higher flows. It is uncertain whether this crossing may become overwhelmed with coarse bed material if the upstream County crossing at Stream Mile 1.04 is replaced and unobstructed sediment transport is provided.

The crossing fails to meet CDFG fish passage assessment criteria for juvenile and resident trout at all flows, and is a barrier for adult steelhead 54% for of the migration flows. The radio tagged adult steelhead released into Alameda Creek in 1999 were able to pass through this crossing.

Recommendations

A 12-foot wide prefabricated concrete arch culvert with a 28-foot span and 10-foot rise will convey the 100-year flow at this site. We assumed that temporary access was not necessary during construction.

4.2.3 Private Crossing at Stream Mile 0.23

Existing Conditions

A private driveway crossing is located approximately 1,200 feet upstream of the confluence with Stonybrook Creek and Alameda Creek. The crossing was surveyed and assessed for fish passage in 2005 (MLA, 2005). The existing crossing consists of three 6-foot concrete pipes with approximately 1-foot of cover over the culverts (Appendix A). The existing crossing is undersized, conveying approximately the 10-year peak flow before the inlet becomes submerged and the driveway overtops. The landowner has indicated that this crossing had overtopped at least twice in recent years. Channel bedload and large woody debris have accumulated upstream of the crossing because of the backwater created by the undersized crossing. about it is uncertain whether this crossing may become overwhelmed with coarse bed material if the upstream County crossing at Stream Mile 1.04 is replaced and unobstructed sediment transport is provided.

The crossing fails to meet CDFG fish passage assessment criteria for juvenile and resident trout at all flows, and is a barrier for adult steelhead for 45% of migration flows. The pair of radio tagged adult steelhead released into Alameda Creek in 1999 were able to pass through this crossing.

Recommendations

It appears necessary to design this crossing as a low-water crossing. A free-span structure that conveys the 100-year flow would require substantially raising the existing roadway elevation, which is not feasible given existing site topography. The elevation of the driveway, adjacent house, and floodplain all limit raising the road to no more than approximately 1 foot.

A 16-foot wide prefabricated concrete arch culvert with a 24-foot span and 7-foot rise will convey the 10-year peak flow at this site if the new crossing is raised approximately 1 foot. To create the necessary flow area and minimize the amount of roadway work, it will be necessary to use a prefabricated structure of minimal thickness and minimal cover.

We assumed that temporary access was not necessary during construction.

4.2.4 Private Crossing at Stream Mile 0.58

Existing Conditions

A private driveway crossing is located approximately 3,000 feet upstream from the confluence of Stonybrook Creek and Alameda Creek. Permission to survey the crossing was not granted, but MLA (2001) and ACDPW (2002) visually inspected the site with the owners permission. The crossing consists of a single at-grade 4-foot by 5-foot corrugated metal culvert, and three overflow pipes set 7 to 9 feet above the stream channel. The crossing has a substantial amount of fill above the culverts.

The crossing was not assessed for flow capacity. Channel bedload and debris have accumulated upstream of the crossing resulting from the backwater created by the crossing at higher flows and the landowner has indicted that he has dredged the channel upstream of the culvert several times. There was also gravel deposited within the upper overflow culverts, positioned as high as 9 feet above the channel bed. Due to the undersized nature of the crossing, there is substantial concern that this crossing may become overwhelmed with coarse bed material if the upstream County crossing at Stream Mile 1.04 is replaced and unobstructed sediment transport is provided.

This crossing was only assessed visually for fish passage. It appears passable for adult steelhead at moderate fish passage flows, though water velocities through the single undersized culvert will likely be too great at higher fish passage flows. Accumulated sediment at the upstream end of the crossing may cause an impediment for passage. This crossing is likely not passable for juvenile trout at any flow. The pair of radio tagged adult steelhead released into Alameda Creek in 1999 were able to pass through this crossing.

Recommendations

Because this crossing was not surveyed, developing planning level recommendations and cost estimate was limited to assuming this replacement crossing would be similar to the replacement of the private crossing at Stream Mile 0.23. However, the depth of roadway fill is deeper and will likely require additional excavation.

4.2.5 Palomares Road Crossing as Stream Mile 1.04 (MP 8.75)

Existing Conditions

The Palomares Road crossing at Mile Post 8.75 is located approximately 5,500 feet upstream from the confluence with Stonybrook Creek and Alameda Creek. The crossing was surveyed and assessed for fish passage in 2000 (MLA, 2001). The existing crossing consists of an 89-foot long 8-foot by 8-foot concrete box culvert in good condition, and with a large amount of road fill above it. The existing culvert is undersized; able to convey less than the 10-year peak flow before the inlet becomes submerged. The culvert creates a backwater during large flows, which has caused boulders to deposit in front of the culvert inlet, and created an 11-foot drop in the channel profile over a short distance.

The crossing and the drop upstream of the inlet is a complete barrier for all life stages of steelhead due to insufficient flow depths and excessive water velocities during migration flows. The pair of radio tagged adult steelhead released into Alameda Creek in 1999 were unable to pass through this crossing, making it a keystone barrier within Stonybrook Creek watershed.

Recommendations

Conceptual designs for this crossing were prepared in 2005 (CEMAR et. al, 2005). The conceptual design includes replacement of the culvert with an 80-foot span pre-fabricated steel bridge with a sheet-pile retaining wall foundation. The conceptual design also included regrading 250 feet of stream channel to a similar slope and morphology as the stable channel upstream and downstream of the crossing. A steel bridge was selected for this site because the roadway elevation is well above the 100-year water-surface elevation, therefore not likely to collect debris. Steel bridges are substantially less expensive than pre-stressed concrete structures.

Although there has not been a geomorphic assessment of the downstream channel, it appears that the existing culvert may substantially reduce the amount of large boulder-sized bedload transported downstream. There is a concern that replacing this crossing may cause the downstream private crossings, if not replaced, to become overwhelmed by the bedload. The first crossing downstream, at Stream Mile 0.58, is most at risk.

4.2.6 Palomares Road Crossing as Stream Mile 1.21 (MP 8.60)

Existing Conditions

The Palomares Road crossing at Mile Post 8.60 is located approximately 6,400 feet upstream from the confluence of Stonybrook Creek and Alameda Creek. The crossing was surveyed and assessed for fish passage in 2000 (MLA, 2001). The existing crossing consists of grouted masonry channel and a concrete bridge deck in good condition. The masonry channel under the bridge was constructed in the 1930's and has since been grouted. The concrete bridge deck has been more recently replaced. The existing crossing is substantially undersized, conveying less than the 10-year peak flow before the inlet becomes submerged. The road prism for Palomares Road encroaches into the stream channel upstream of the crossing.

The crossing is a complete barrier for all steelhead lifestages due to an approximately 4.8-foot drop at the outlet combined with excessive water velocities and shallow water depths during migration flows.

Recommendations

Conceptual designs for this crossing were prepared in 2005 (W&K et. al, 2005). The conceptual design includes replacement of the culvert with a 32-foot span pre-fabricated concrete bridge with strip footings keyed into bedrock. The concept plan also included regrading 140 feet of stream channel to a similar slope as the stable channel upstream and downstream of the crossing.

4.2.7 County Crossing #4 (MP 8.16)

Existing Conditions

The Palomares Road crossing at Mile Post 8.16 is located approximately 8,700 feet upstream of the confluence of Stonybrook Creek and Alameda Creek. The crossing was surveyed and assessed for fish passage in 2000 (MLA, 2001). The existing crossing consists of grouted masonry channel and a concrete bridge deck. The masonry channel under the bridge was constructed in the 1930's. Since then, the channel has been grouted and rip-rapped, and a gabion apron placed at the outlet. This gabion apron was failing during the time of the survey. The concrete bridge deck has been more recently replaced.

The existing crossing is substantially undersized, conveying approximate the 7-year peak flow before the inlet becomes submerged. A substantial amount of channel bedload has aggraded upstream of the crossing resulting from the culvert backwater at higher flows. The crossing is a complete barrier for all steelhead lifestages due to excessive water velocities and shallow water depths during migration flows. Additionally, at lower flows all of the water flows through the gabions rather than on the surface.

Recommendations

A 36-foot span, 8-foot high, prefabricated concrete bridge will convey the 100-year flow at this site. Approximately 240 feet of stream channel restoration is recommended to restore the channel profile and remove the bedload aggradation upstream of the crossing.

4.2.8 County Crossing #5 (MP 8.00)

Existing Conditions

The Palomares Road crossing at Mile Post 8.00 is located approximately 9,200 feet upstream from the confluence of Stonybrook Creek and Alameda Creek. The crossing was surveyed and assessed for fish passage in 2000 (MLA, 2001). The existing crossing consists of grouted masonry channel and a concrete bridge deck. The masonry channel was constructed in the 1930's. Since then, the channel bottom under the bridge has been grouted. The concrete bridge deck has been more recently replaced. The grouted outlet apron is severely undercut.

The existing crossing is substantially undersized, conveying approximately the 7-year peak flow before the inlet becomes submerged. The crossing is a complete barrier for all steelhead lifestages due to high water velocities and insufficient water depths on the steep outlet apron during migration flows. Approximately 200 feet upstream there is a jam of concrete rubble would likely hinder fish passage (ACPW, 2002).

Recommendations

A prefabricated concrete arch culvert with a 16-foot span and 13-foot rise will convey the 100-year flow at this site. Approximately 135 feet of stream channel restoration is recommended to restore the channel profile through the crossing. The concrete rubble in the channel approximately 200 feet upstream of the crossing should be removed as part of the crossing replacement project

4.2.9 County Crossing #6 (MP 7.57)

Existing Conditions

The Palomares Road crossing at Mile Post 7.57 is located approximately 12,000 feet upstream from the confluence of Stonybrook Creek and Alameda Creek. The crossing was surveyed and assessed for fish passage in 2000 (MLA, 2001). The existing crossing consists of grouted masonry channel and a concrete bridge deck. The masonry channel was constructed in the 1930's. Since then, the channel bottom under the bridge has been grouted and the concrete deck replaced. The outlet apron is severely undercut.

The existing crossing is slightly undersized, conveying approximately the 25-year peak flow before the inlet becomes submerged. The crossing is a complete barrier for all steelhead life stages due to an approximately 3-foot drop at the outlet and excessive water velocities and shallow water depths in the downstream portion of the culvert and across the outlet apron during migration flows.

Recommendations

The preferred treatment for this site is replacement of the crossing with an open bottom structure. However, it is feasible to retrofit the structure to eliminate the outlet drop and improve hydraulic conditions within the crossing.

Replacement of the crossing could utilize a 20-foot span and 11-foot rise prefabricated concrete arch that conveys the 100-year peak flow at this site. Approximately 200 feet of stream channel restoration is recommended to restore the channel profile through the crossing.

The crossing conveys the 25-year peak flow before the inlet becomes submerged. If the crossing's hydraulic capacity and associated risk posed to the roadway is viewed as acceptable by the County and regulatory agencies, a fish passage retrofit may be a more cost effective approach for the site. This retrofit could consist of several boulder weirs or a roughened rock channel that would steepen the channel profile and eliminate the drop at the crossing outlet. Several baffles or sills installed on the outlet apron may also be required to increase water depths and decrease water velocities in the crossing. However, before a retrofit is selected, a structural analysis of the existing crossing should be performed to assess structural integrity and identify any necessary repairs.

5 Implementation Strategy and Other Recommendations

5.1 Geomorphic Characterization

A geomorphic investigation of Stonybrook Creek between the confluence with Alameda Creek and the outlet of Stonybrook Valley should be conducted prior to implementing barrier removal projects. The investigation should locate and characterize geomorphic controls to the channel profile within the canyon. This characterization will help determine:

- If a crossing replacement will cause incision within the upstream channel,
- If channel-forcing features (such as bedrock or large colluvium) may arrest the incision and limit the length of channel affected,
- If the incision may create a fish migration barrier, such as increasing the drop over an existing bedrock falls, and
- If the incision may extend upstream to the next crossing, and affect the design of that crossing.

The investigation should also include a prediction of the mobility for boulder-sized bedload downstream of the crossing at Stream Mile 1.04 after its replacement. This will help determine if the amount of large bedload transported downstream of Stream Mile 1.04 will increase following replacement of the County crossing, and if this may place any of the three downstream private crossings at a higher risk of failure.

5.2 Order for Treating Existing Barriers

The strategy described here for addressing fish passage between the confluence and Stonybrook Valley is based on location and severity of each barrier, and does not consider the stream crossing capacity and risk of crossing failure. Table 3 lists the recommended order for treatment of fish passage barriers within the Stonybrook Creek watershed. . The geomorphic assessment may change the order that barriers should be treated.

Of the nine road-stream crossings between the confluence and Stonybrook Valley, the six publicly maintained crossings were found to be complete barriers, as defined by CDFG (2003), and should be addressed systematically from downstream to upstream. Replacement of the County crossings should not be limited by the schedule for replacement of the Highway 84 crossing, which has proven to be passable by some adult steelhead during some flow conditions (See Section 2.0).

The three private crossings downstream of Stonybrook Valley are all partial barriers. The crossing at Stream Mile 0.58 appears to be the most limiting for fish passage, and is recommended for treatment before the downstream private crossings. If the geomorphic assessment finds replacement of the crossing at Stream Mile 1.04 will substantially increase the risk of a downstream private crossing becoming overwhelmed by large bedload, then its order for treatment may need to be moved forward.

Table 3. Recommended order for treatment of existing barriers within the Stonybrook Creek Watershed.

Recommended Order for Treatment	Stream Miles from Confluence	Ownership (Mile Post)
1[1]	0.00	CalTrans Highway 84
2	1.04	County (Mile Post 8.75)
3	1.21	County (Mile Post 8.60)
4	1.65	County (Mile Post 8.16)
5	1.84	County (Mile Post 8.00)
6	2.25	County (Mile Post 7.57)
7[2]	0.58	Private
8[2]	0.17	Private
9[2]	0.23	Private

[1] Assumed to be on a separate planning schedule than the other crossings, and should be treated as soon as possible.

[2] May need to be moved forward if geomorphic assessment concludes that the existing crossing is placed at substantial risk resulting from replacement of the County crossing at Stream Mile 1.04 (Mile Post 8.75).

5.1 Watershed Assessment and Management Plan

In addition to addressing fish passage barriers, existing watershed conditions and potential limiting factors for steelhead within Stonybrook Creek should be assessed. These include identifying sources of chronic and episodic sediment delivery to Stonybrook Creek, characterizing aquatic habitat quality and riparian conditions, and determining current and projected water usage within the watershed and impacts to the stream. The assessment should also include evaluation of fish passage conditions at the private road-stream crossings and a habitat assessment of the stream channel upstream of Stonybrook Valley. Findings from these assessments should be used to develop a watershed management plan for improving physical and biological conditions. This plan should be developed in part through a work group comprised of residents of the watershed.

6 Estimated Costs

6.1 Estimating Implementation Cost

A planning level cost estimate was developed for design and construction of the eight priority crossings (excluding the Highway 84 crossing). This involved estimating quantities and cost-specific items, including but not limited to:

- Mobilization
- Erosion and sediment control
- Water management
- Clearing and grubbing
- Traffic control
- Demolition
- Structure material and installation
- Excavation and structural backfill
- Structural concrete
- Roadway reconstruction
- Guard rail
- Channel excavation and rock placement

For the crossings on Palomares Road, it was assumed that the road could not be closed for extended periods during construction and a temporary crossing would be required. This adds substantial cost to these project sites.

The unit costs for each item were based on material and installation costs from bid tabulations of similar projects recently completed in nearby counties. A 20% contingency was included in each cost estimate to account for the large degree of uncertainty associated with planning level recommendations.

To estimate cost projections for project completion between 2010 and 2020, the total cost was escalated by 5% annually (State of California, 2009). Cost estimates are summarized in Table 4 for completion in 2010, 2015, and 2020.

Table 4. Estimated costs for final design and construction for treatment of existing barriers within the Stonybrook Creek Watershed. Construction costs shown for 2010 and escalated at a 5% annual rate to 2020.

Crossing Name (Stream Mile from Confluence)	Recommended Order for Treatment	Ownership (Mile Post)	2010 Costs	2015 Costs	2020 Costs
0.00	**1**[1]	CalTrans Highway 84	To Be Determined by CalTrans	To Be Determined by CalTrans	To Be Determined by CalTrans
1.04	**2**	County (Mile Post 8.75)	$1,470,000	$1,900,000	$2,400,000
1.21	**3**	County (Mile Post 8.60)	$1,040,000	$1,330,000	$1,700,000
1.65	**4**	County (Mile Post 8.16)	$1,000,000	$1,280,000	$1,630,000
1.84	**5**	County (Mile Post 8.00)	$940,000	$1,200,000	$1,530,000
2.25	**6**	County (Mile Post 7.57)	$830,000 ($230,000 Retrofit)	$1,060,000 ($300,000 Retrofit)	$1,360,000 ($380,000 Retrofit)
0.58	**7**[2]	Private	$700,000	$900,000	$1,150,000
0.17	**8**[2]	Private	$640,000	$820,000	$1,050,000
0.23	**9**[2]	Private	$560,000	$720,000	$920,000
Total Estimated Cost for Replacing Priority Crossings, Excluding Highway 84			**$7,180,000**	**$8,150,000**	**$11,740,000**

[1] Assumed to be on a separate planning schedule than the other crossings, and should be treated as soon as possible.

[2] May need to be moved forward if geomorphic assessment concludes that the existing crossing is placed at substantial risk resulting from replacement of the County crossing at Stream Mile 1.04 (Mile Post 8.75).

7 References

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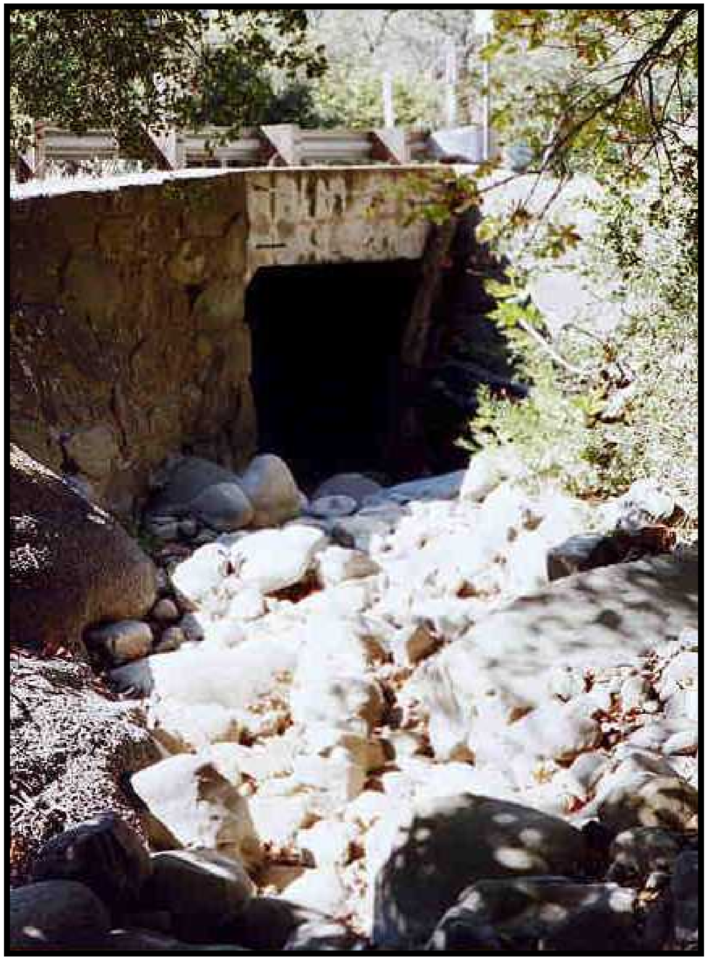
Appendix A

Site Descriptions and Analysis

Stream Mile 0.00 (Stobk#1): Highway 84 CalTrans Culvert (Niles Canyon Road), Milepost 12.90



Culvert Inlet

Culvert Outlet

Stream Mile 0.17 Private Culvert

Culvert Outlet

Stream Mile 0.23 Private Culvert

Culvert Inlet

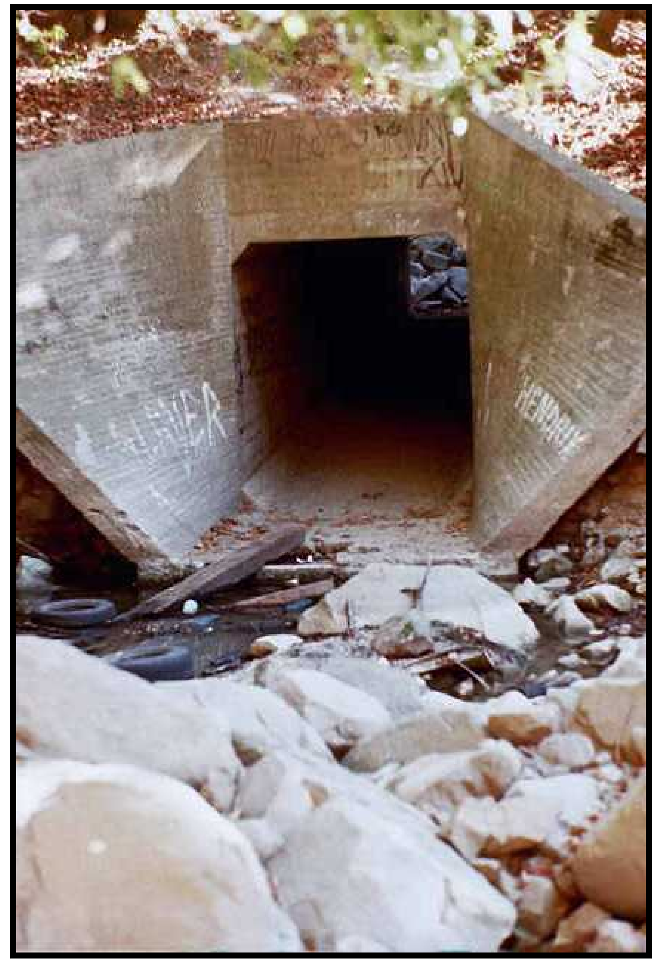
Stream Mile 0.58 Private Culvert

Left Three Culvert Outlets

Right Culvert Outlet

Stream Mile 1.04 (Stobk#2): Alameda County Culvert
Palomares Road, Milepost 8.75

Culvert Inlet



Culvert Outlet

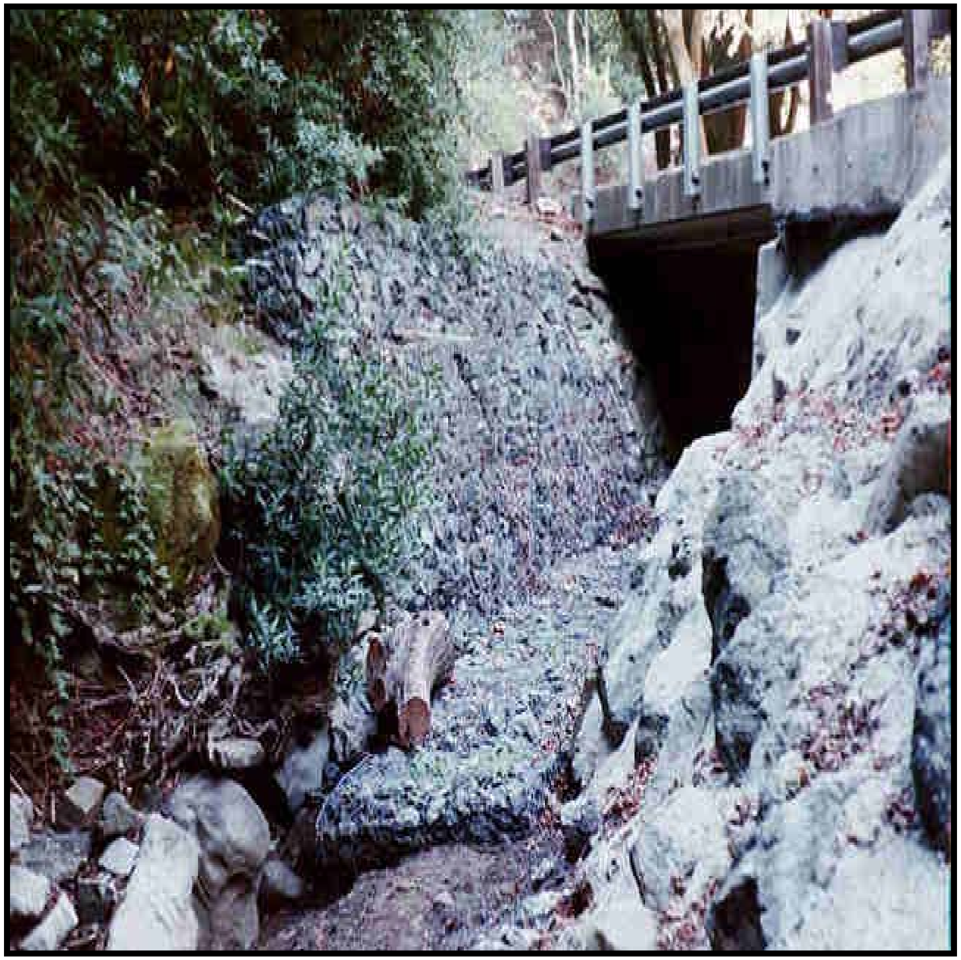
Stream Mile 1.21 (Stobk#3): Alameda County Bridge
Palomares Road, Milepost 8.60

Crossing Inlet

Crossing Outlet

Stream Mile 1.65 (Stobk#4): Alameda County Bridge
Palomares Road, Milepost 8.16

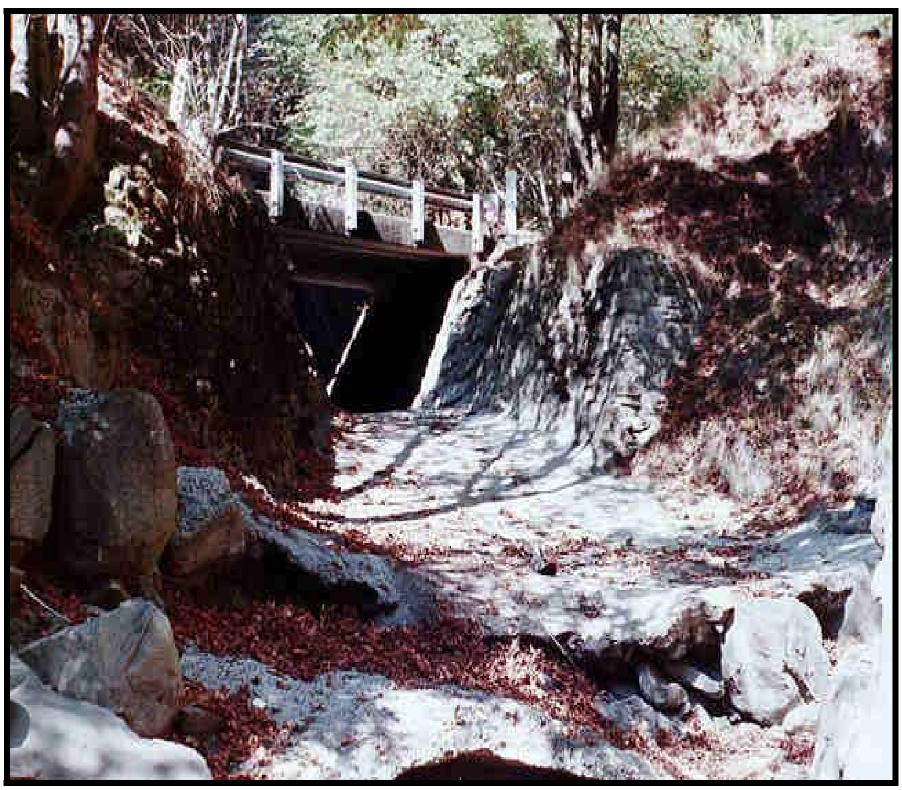
Crossing Inlet



Crossing Outlet

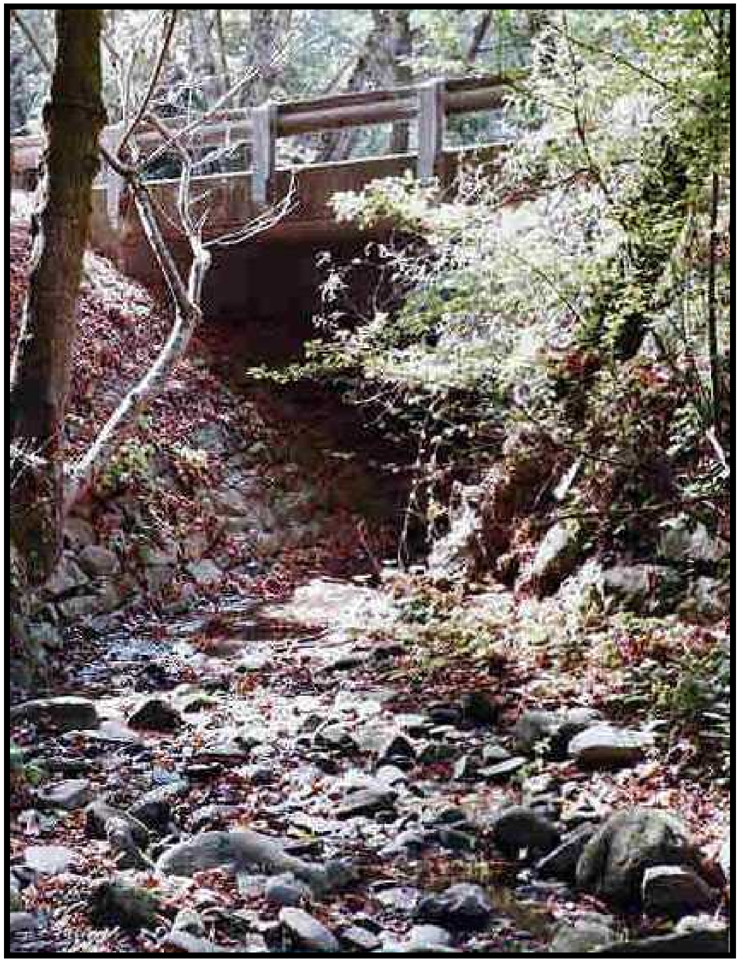
Stream Mile 1.84 (Stobk#5): Alameda County Bridge Palomares Road, Milepost 8.00

Crossing Inlet

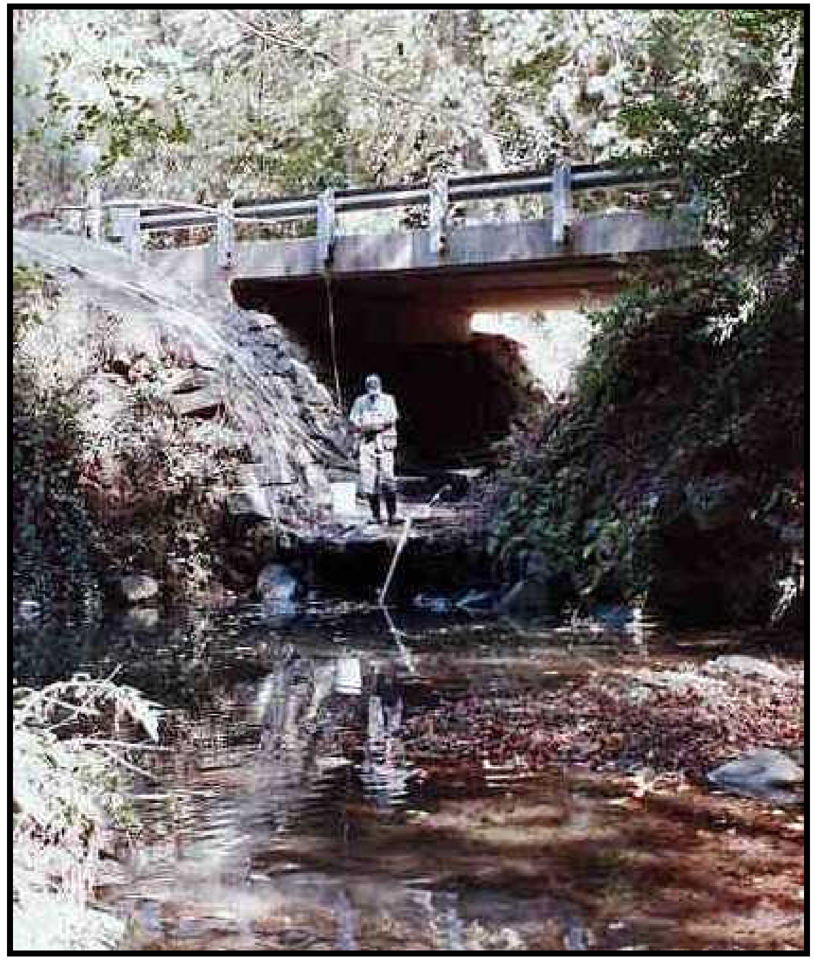


Crossing Outlet

Stream Mile 2.25 (Stobk#6): Alameda County Bridge
Palomares Road, Milepost 7.57



Crossing Inlet



Crossing Outlet

Stream Mile 2.88 Private Culvert

Culvert Inlet

Culvert Outlet

Stream Mile 2.91 Private Bridge with Masonry Grade Control Structure

Crossing Outlet

Stream Mile 3.27 Private Culvert

Culvert Outlet

Stream Mile 3.42 Private Culvert

Culvert Inlet

Stream Mile 3.44 Private Culvert

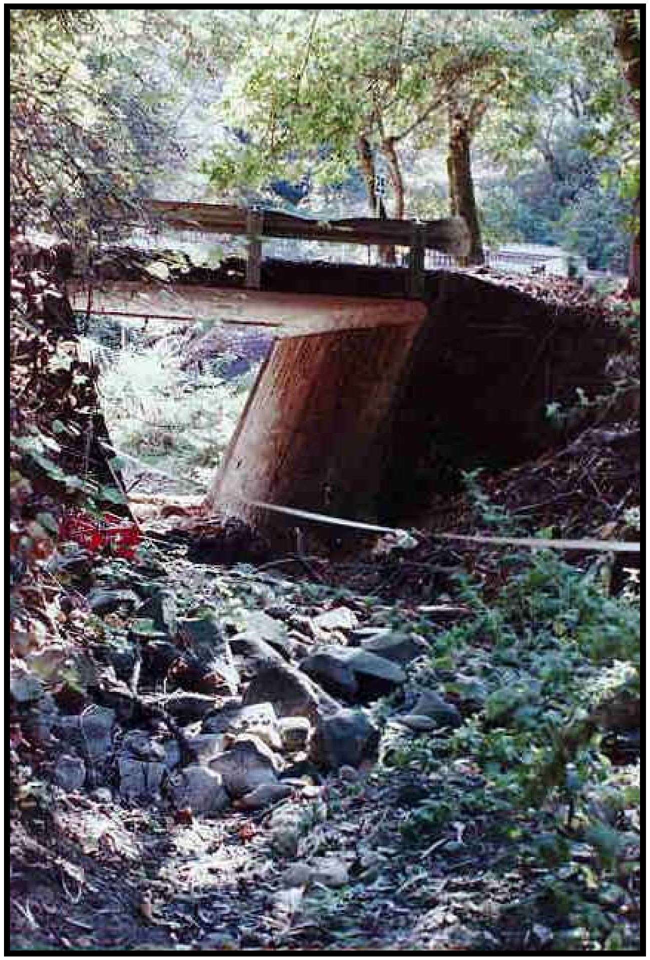
Culvert Outlet

Stream Mile 3.81 (Stobk#7): Alamdea County Bridge
Palomares Road, Milepost 6.28

Crossing Inlet

Crossing Outlet

Stream Mile 3.93 (Stobk#8): Alameda County Bridge
Palomares Road, Milepost 6.18



Crossing Inlet

Crossing Outlet