Fish Passage Assessment of Private Stream Crossings on Lower Stonybrook Creek

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1) Overview

This report summarizes the assessment of existing fish passage conditions for two privately maintained stream crossing on Stonybrook Creek, a tributary to Alameda Creek. A third privately maintained crossing on Stonybrook Creek is briefly discussed but a full assessment was not possible due to the land owner not allowing site access. This work was performed in conjunction with development of conceptual designs for replacing two Stonybrook Creek crossings on the County of Alameda maintained Palomares Road. Alternatives for replacing the County crossings are being explored as part of efforts to eliminate barriers to migrating steelhead trout within Stonybrook Creek. This assessment was undertaken to evaluate whether steelhead migration is being blocked by any of the downstream private crossings.

2) Background

The Alameda Creek Watershed once supported large runs of native steelhead trout. However, the placement of numerous dams, culverts, and other structures on Alameda Creek and its tributaries has resulted in the complete blockage of anadromous fish runs. In 2000 an assessment of the potential for restoring viable steelhead trout runs to the Alameda Creek Watershed was completed (Gunther et. al, 2000). The report identified Stonybrook Creek as being the lowest tributary in the watershed containing suitable rearing and spawning habitat for steelhead.

Stonybrook Creek is a tributary to Alameda Creek, which drains into 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. Its mouth joins Alameda Creek in Niles Canyon, approximately 13 river miles upstream from San Francisco Bay.

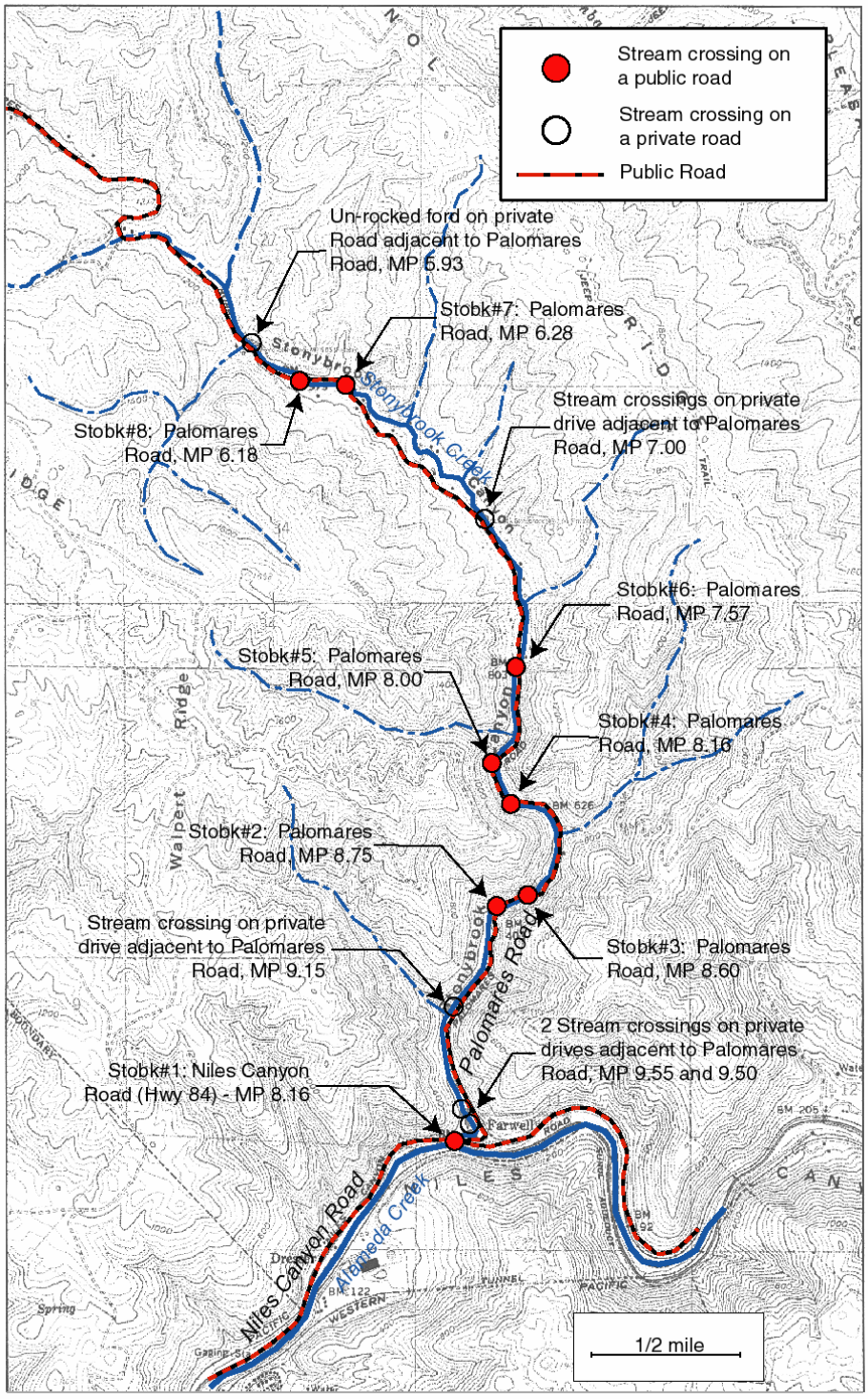


Figure 1 – Site map of stream crossings identified on Stonybrook Creek (from Love, 2001).

In 2001 Michael Love & Associates (MLA) completed a fish passage assessment of County and State maintained road-stream crossings (Love, 2001). The report identified seven crossing that posed substantial blockages to migrating adult steelhead. Additionally, three privately maintained stream crossings within the lower stream reaches were located and the report recommended they be assessed for fish passage.

CalTrans has begun designing a new crossing to replace the lowest blockage on Stonybrook Creek at Highway 84. This should provide fish unimpeded access to the private crossings evaluated as part of this assessment.

Beginning in 2004 the Center for Ecosystem Management and Restoration (CEMAR) obtained funding to complete an alternatives analysis and develop conceptual designs for replacing two of the County maintained crossings on Palomares Road, at mile posts 8.60 and 8.75 (Figure 1). CEMAR hired Winzler & Kelly Consulting Engineers and MLA to develop the conceptual designs. Additionally, MLA was asked to assess fish passage conditions at the three privately maintained stream crossings, each located adjacent to Palomares Road at mile posts 9.55, 9.50, and 9.15. Site access was only obtained for two of the three privately maintained crossings, at mile posts 9.50 and 9.55. The third privately maintained crossings located at mile post 9.15 was not formally evaluated as part of this report but this crossing is briefly discussed based on a prior site visit by MLA in 2000.

This report summarizes the fish passage conditions at each of these three privately maintained stream crossings.

2) Activities

Gorden Becker with CEMAR obtained permission to survey the two private crossings in the lower portion of the stream. Both are owned and maintained by the resident at 37,789 Palomares Road. The owner of the third crossing was unwilling to provide access, preventing a quantitative fish passage assessment. However, from observations of the crossing, a qualitative description and assessment of the crossing was completed.

The lower two crossings were surveyed on February 24, 2005. The survey followed the California Department of Fish and Game (CDFG) fish passage assessment protocol (Taylor and Love, 2002). Tasks included taking standard measurements of the culvert, surveying a longitudinal profile through each culvert, surveying a channel cross section at the tailwater control below each crossing, and measuring active channel widths upstream of each crossing.

The data from the field survey of the two sites was entered into spreadsheets for analysis. Culvert slopes and outlet drops were calculated and plots were made of the longitudinal profiles. Using the CDFG protocol for analyzing passage conditions, we calculated the fish migration flow range for adult steelhead, adult rainbow trout, and juvenile trout. Then, using CDFG prescribed swimming and leaping speeds and minimum water depth requirements, we analyzed fish passage conditions through each culvert using FishXing 3.0 (USFS, 2004).

4) Hydrology and Fish Passage Flows

Peak Flow Estimates

As part of the CDFG fish passage inventory protocol, the capacity of the crossing is assessed to determine its ability to accommodate peak flood flows. Magnitudes of peak flows associated with varying recurrence intervals were estimated using two different methods: (1) regional flood estimation equations provided by the USGS for the Central Coast region, which includes the San Francisco Bay area (Waananen and Crippen, 1977) and (2) a probabilistic analysis using annual peak flow records adjusted by drainage area from eight local small streams gaged by the USGS (1982). Figure 2 shows the estimated flows associated with the 2 to 100 year recurrence intervals using the two techniques.

For evaluating capacity of each assessed crossing's we used the flows predicted using the local streamflow records (Table 1).

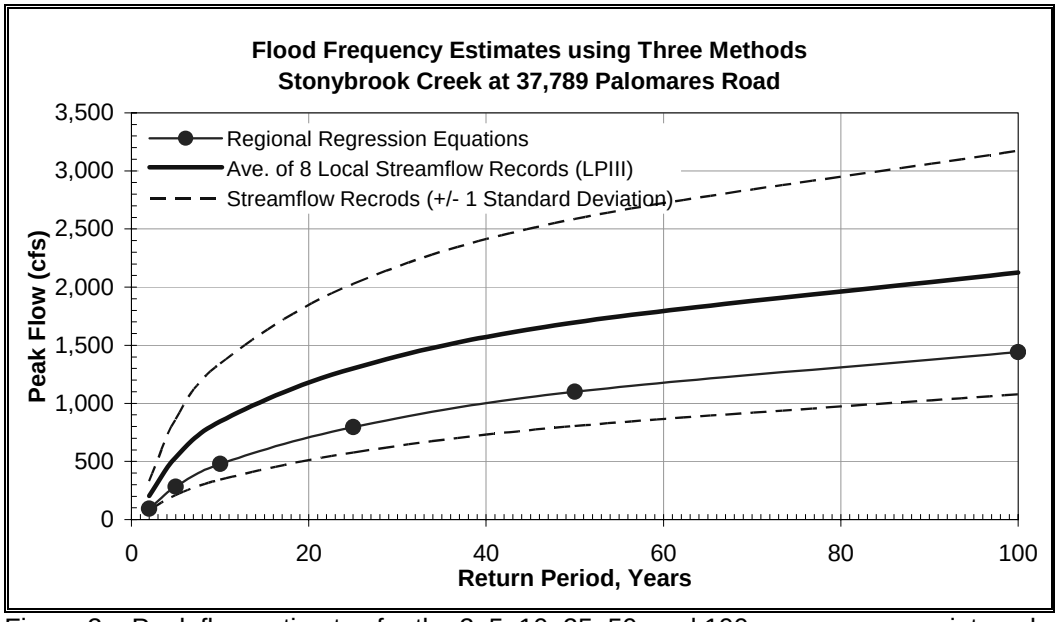


Figure 2 – Peak flow estimates for the 2, 5, 10, 25, 50, and 100 year recurrence intervals for the two private stream crossings at 37,789 Palomares Road. Estimates were derived from regional flood estimation equations and analysis of peak flows from eight local streams.

Table 1 - Peak flow estimates for stream crossings on Stonybrook Creek at 37,789 Palomares Road for various recurrence intervals.

Q_2	=	200	cfs
Q_5	=	540	cfs
Q_{10}	=	840	cfs
Q_{25}	=	1,300	cfs
Q_{50}	=	1,700	cfs
Q_{100}	=	2,130	cfs

Calculated using probabilistic analysis of peak flow record from eight local streams, adjusted by drainage area. Analysis followed USGS Bulletin 17B procedures (USGS 1982).

Fish Passage Flows

Analyzing fish passage conditions requires defining a range of flows for which passage should be provided. Generally, passage is not required at extremely low or high flows, when fish are not expected to be moving. Methods for determining the lower and upper passage flows are defined by NOAA Fisheries (2001) and CDFG (2002) for adult steelhead, adult resident rainbow trout, and juvenile trout. Between the lower and upper passage flows hydraulic conditions at the stream crossing should be adequate to allow for passage of the specific age-class/life-history of fish (juvenile trout, resident adult trout, or adult anadromous steelhead trout). A stream crossing that provides adequate passage conditions at all flows between the lower and upper fish passage flow is considered to be "100% passable". Most culverts are not 100% passable, but fall into the partial or complete barrier categories.

The lower and upper passage flows are defined in terms of exceedance flows (Table 2). Exceedance flows, which are obtained from flow duration curves (FDC's), express the average amount of time within a year that flows are above a certain threshold. For example, flows within the stream are greater than the 50% exceedance flow on average half of the time during the course of a year.

Since no stream flow gage is maintained on Stonybrook Creek, FDC's from seven nearby streams were used to estimate exceedance flows (Table 3). By adjusting for differences in drainage area a synthetic FDC for the two stream crossings was created (Figure 3). Using the FDC and the fish passage design flow criteria from NOAA and CDFG (Table 2), we estimated lower and upper fish passage flows for steelhead, adult resident rainbow trout, and juvenile trout (Table 4).

Table 2 - Fish Passage Design Flow Criteria as defined by NOAA Fisheries and CDFG.

Species and Lifestage	Lower Design Flow	Upper Design Flow
Adult Steelhead	50% exceedance flow or 3 cfs (whichever is greater)	1% exceedance flow
Adult Rainbow Trout	90% exceedance flow or 2 cfs (whichever is greater)	5% exceedance flow
Juvenile Trout	95% exceedance flow or 1 cfs (whichever is greater)	10% exceedance flow

Table 3 - Streamflow gaging stations used to develop a regional flow duration curve for estimating fish passage flows on Stonybrook Creek.

USGS Station No.	Station Name
11172945	ALAMEDA C AB DIV DAM NR SUNOL CA
11173200	ARROYO HONDO NR SAN JOSE CA
11180810	PALOMARES C NR HAYWARD CA
11180825	SAN LORENZO C AB DON CASTRO RES NR CASTRO V CA
11180900	CROW C NR HAYWARD CA
11180960	CULL C AB CULL C RES NR CASTRO VALLEY CA

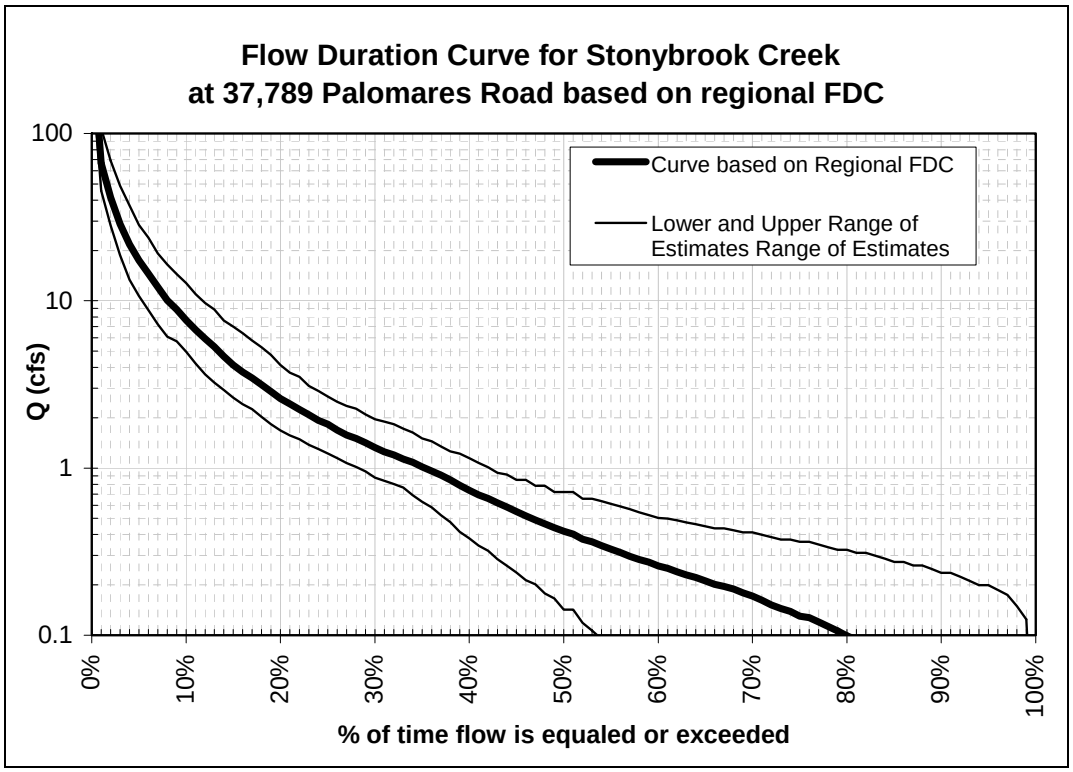


Figure 3 - Flow duration curve for the assessed stream crossings on Stonybrook Creek, constructed from flow records from seven near-by streams.

Table 4 - Fish passage design flows for Stonybrook Creek at 37,789 Palomares Road.

Species and Lifestage	Lower Fish Passage Flow	Upper Fish Passage Flow
Adult Steelhead	3.0 cfs (0.4 cfs)	66.4 cfs
Adult Rainbow Trout	2.0 cfs (0.05 cfs)	17.4 cfs
Juvenile Trout	1.0 cfs (0.03 cfs)	7.7 cfs

5) Fish Passage Assessment Criteria

The CDFG fish passage assessment protocol prescribes minimum required water depths and maximum swimming and leaping speeds for adequate fish passage (Table 5). Swimming speeds are divided into two categories; prolonged speeds, which can be maintained for long periods of time, and burst speeds, which are equivalent to sprinting and can only be maintained for a few seconds. Leap speed is the speed a fish can leap out of the water to enter a perched culvert outlet. To meet fish passage criteria (1) the fish must be able leap or swim into the culvert, (2) water depths must be adequate throughout the culvert, and (3) the fish must be able swim through the entire stream culvert without becoming overwhelmed by the water velocities.

Table 5 - CDFG prescribed water depth and swimming criteria for assessing fish passage at stream crossings using the FishXing software.

Fish Species and Lifestage	Minimum Water Depth	Prolonged Swimming		Burst Swimming		Maximum Leap Speed
		Maximum Swim Speed	Time to Exhaustion	Maximum Swim Speed	Time to Exhaustion	
Adult Steelhead	0.8 ft	6.0 ft/sec	30 min	10.0 ft/sec	5.0 sec	15.0 ft/sec
Adult Rainbow Trout	0.5 ft	4.0 ft/sec	30 min	5.0 ft/sec	5.0 sec	6.0 ft/sec
Juvenile Trout	0.3 ft	1.5 ft/sec	30 min	3.0 ft/sec	5.0 sec	4.0 ft/sec

The swim speeds and minimum water depths prescribed by CDFG are relatively conservative, meant to represent the needs and abilities of the weaker swimming individual fish. Many individual fish are able to swim faster and swim through shallower flows than indicated in Table 5. Therefore, it is not uncommon for some fish to pass through stream crossings that fail to meet fish passage criteria.

For the two crossings, fish passage was assessed between the lower and upper fish passage flows using the CDFG criteria. Additionally, other potential hindrances or obstructions to upstream migrating fish were qualitatively assessed. Other potential obstructions to fish passage include:

1. Steep drops in the channel just upstream of the inlet due to deposition of sediment associated with undersized culverts and frequent ponding of water,
2. Debris caught at the inlet or within the stream crossing,
3. Exiting water cascading over rip rap or bedrock before entering the downstream pool, and
4. Insufficient pool depth for fish to leap from if the culvert outlet is perched.

6) Findings

Lower Crossing at 37,789 Palomares Road (near Mile Post 9.55)
The lower crossing consisted of three 7-foot diameter circular concrete culverts with approximately 3-feet of fill above the culverts (Figure 4). Each culvert was 16-feet long and had slopes of 0.13%, 1.70%, and 2.20%. The outlets of all three culverts were at stream grade, allowing fish to swim, rather than leap, into the culvert.

The crossing appears to be for providing access for horses between a barn and a field located on the opposite bank. The crossing is not suited for vehicles due to extremely steep approaches. It also appears that the crossing has not been used for some time.

Figure 4 - Inlet of Lower Crossing, consisting of three 7-foot diameter concrete culverts.

During the field visit we found several small diameter logs lodged across the inlet of the left and center culverts (Figure 4). There was a substantial amount of large bedload aggraded at the culvert inlets, which is often associated with backwater effects resulting from undersized or debris plugged culverts. Although the flows were relatively high during the field visit, no flow was observed in the left (looking downstream) culvert due to the aggraded material at the inlet. The average actively scoured channel width was 27-feet while the combined width of the culvert openings was 21-feet, constricting the active channel by 22%.

Assessment of the crossing using FishXing found that it satisfied adult steelhead passage criteria between 32 and 131 cfs (Table 6). This represents 54% of the flows between the lower and upper fish passage flows of 3 and 66.4 cfs. This is a relatively good window of passage in comparison to the majority of stream crossings on Stony brook Creek. Unfortunately, there is no passage window for resident rainbow trout and juvenile trout. For these fish, the water velocities become excessive before water depths become sufficient.

Table 6 – Fish passage conditions at lower stream crossing. Results are for the middle culvert, which provided the best passage conditions between the lower and upper fish passage flows.

Fish Species and Age Class	**Fish Passage Design Flows**	**Insufficient Depth below**	**Excessive Velocity above**	**Percent Passable** between lower and upper passage design flows
Adult Steelhead	3 cfs – 66.4 cfs	32.4 cfs	131.2 cfs	**54%**
Adult Rainbow Trout	2 cfs – 17.4 cfs	9.9 cfs	8.0 cfs	**0%**
Juvenile Trout	1 cfs – 7.7 cfs	2.9 cfs	1.0 cfs	**0%**

Using standard Federal Highways charts the capacity of the crossing was estimated to be 930 cfs when the headwater (water at the inlet) is at the top of the culvert and 1,320 cfs when the headwater is at the top of the road fill. Based on the estimated peak flows in Table 1, the crossing is able to pass the 25-year peak flow without overtopping the road but unable to pass the estimated 50-year peak flow. Additionally, having multiple culverts generally increases the likelihood of plugging by debris and becoming overwhelmed by large slugs of sediment moving down the channel (Furniss et. al, 1998).

Upper Crossing at 37,789 Palomares Road (near Mile Post 9.55)

The upper crossing consisted of three 6-foot diameter circular concrete culverts with approximately 1-foot of fill placed above the culverts (Figure 5). Each culvert was 16-feet long and had slopes of -0.70%, 2.41%, and 7.97%. The outlet of the left culvert was at stream grade, allowing fish to swim, rather than leap, into the culvert. The other two culverts were perched about 0.3-feet above the downstream channel and are within the leaping ability of juvenile trout.

Assessment of the crossing using FishXing found that it satisfied adult steelhead passage criteria between 32 and 131 cfs (Table 7). This represents 45% of the flows between the lower and upper fish passage flows of 3 and 66.4 cfs. This is a relatively good window of passage in comparison to the majority of stream crossings on Stonybrook Creek examined in previous assessments. Unfortunately, there exists no passage window for rainbow trout and juvenile trout. For these fish, the water velocities become excessive before the water depths become sufficient.

Table 7 – Fish passage conditions at lower stream crossing. Results are for the middle culvert, which provided the best passage conditions between the lower and upper fish passage flows.

Fish Species and Age Class	**Fish Passage Design Flows**	**Insufficient Depth below**	**Excessive Velocity above**	**Percent Passable** between lower and upper passage design flows
Adult Steelhead	3 cfs – 66.4 cfs	38.1 cfs	150.1 cfs	**45%**
Adult Rainbow Trout	2 cfs – 17.4 cfs	14.0 cfs	11.4 cfs	**0%**
Juvenile Trout	1 cfs – 7.7 cfs	4.5 cfs	1.1 cfs	**0%**

Figure 5- Inlet of Upper Crossing, consisting of three 6-foot diameter concrete culverts.

The channel immediately upstream of the crossing showed obvious signs of aggradation, with large bedload deposited and a steep drop in the channel bed at the culvert inlets. The average actively scoured channel width was 27-feet while the combined width of the culvert openings was 18-feet, constricting the active channel by 33%. Although not accounted for in the FishXing analysis, this artificially steep slope near the culvert inlet along with the backwater affects caused by the constriction of the channel likely impedes fish passage too.

Using charts provided in the CDFG fish passage assessment protocol the capacity of the crossing was roughly estimated to be 624 cfs when the headwater (water at the inlet) is at the top of the culvert and 720 cfs when the headwater is at the top of the road fill. Based on the estimated peak flows in Table 1, the crossing is unable to pass the 10-year peak flow without overtopping the road. The land owner, as well as observations of debris lines made at the site, confirmed that the crossing has been overtopped at least once within the past five years. The potential increase in bedload size and volume transported downstream as a result of upstream culvert replacement projects could overwhelm this crossing, leading to frequent plugging and overtopping.

Un-surveyed Third Crossing (near Mile Post 9.15)

The privately maintained crossing adjacent to Palomares Road mile post 9.15 could not be accessed for surveying due to the land owner not granting site access. However, during the assessment of the County maintained stream crossing in fall of 2000, Michael Love met with the land owner to discuss the crossing that serves as his driveway. During the meeting they examined the culvert. It appeared to be a single 7 to 8 foot diameter corrugated metal culvert. Above the culvert were several smaller overflow culverts with gravel deposited along their inverts. There was a substantial amount of fill above the culverts.

The main culvert appeared to be much smaller than the channel and a substantial amount of bedload had accumulated immediately upstream. The land owner stated that he had used heavy equipment on several occasions to clear out the accumulated cobbles and boulders at the culvert inlet. Given that the active channel width at the County crossing just upstream is 24-feet, it appears likely that the existing main culvert may only pass annually occurring peak flows under pressurized flow conditions.

The main culvert appeared quite short, likely less than 30-feet. The culvert outlet was at-grade with the downstream channel and scour pool. During low and moderate flows the culvert is likely passable by adult steelhead and rainbow trout. However, they may have difficulty swimming over the accumulated bedload at the inlet. At higher migration flows, due to the small size of the culvert, velocities likely become excessive for fish passage.

Given the relatively small conveyance area associated with this existing culvert, release of larger bedload from replacement of the undersized upstream County culverts could exacerbate the problem of this culvert being hydraulically undersized. Increased size and volume of bedload being transported down the channel could lead to plugging of the culvert. Sediment plugged culvert inlets can lead to erosion, scour, and loss of the fill prism above the culvert.

7) Summary

Each of the two privately maintained crossings at 37,789 Palomares Road consists of multiple circular concrete culverts. Passage conditions for smaller resident trout and juvenile salmonids are relatively poor at the two assessed crossings due to excessive water velocities. Both crossings provide suitable hydraulic conditions for passage of adult steelhead at moderate to high flows. At lower flows water depth within the culverts are less than ideal for adult steelhead passage. However, the fish would likely have little trouble swimming through the culvert at low flows given they are both only 16 feet in length.

The third crossing was not assessed due to lack of landowner cooperation. However, from an earlier site visit the crossing appears to hinder passage of juvenile and resident trout, but adult steelhead would likely have little difficulty swimming through the short culvert.

All three crossings have relatively small peak flow capacity and constrict the natural channel. All three display signs of upstream aggradation due to frequent ponding at storm flows, thus decreasing their ability to transport larger bedload. The upstream County maintained crossings currently retains much of the large boulders that would naturally move down the channel, as is evident by the large deposit of boulders upstream of the County crossing at mile post 8.75. Replacement of that crossing could increase the amount and size of bedload that is transported downstream. In such cases, the increase in bedload could overwhelm these three private crossings, which could result in plugging of the inlet with sediment and potential loss of the crossings. To avoid this, the owners of the three private crossings should be notified well in advance so that the undersized crossings could be replaced with substantially larger culverts or bridges.

8) References

Taylor, Ross and Michael Love. 2002. Part IX – Fish passage evaluation at stream crossings. In California Salmonid Stream Habitat Restoration Manual. CA Dept of Fish and Game. 17 pages.

Furniss, Michael J., Tyler S. Ledwith, Michael A. Love, Bryan C. McFadin, and Sam A. Flanagan. 1998. Response of Road-Stream Crossings to Large Flood Events in Washington, Oregon, and Northern California. USDA Forest Service, San Dimas Technology and Development Center, 9877-1806, 14pp.

NOAA Fisheries. 2001. *Guidelines for salmonid passage at stream crossings*. NMFS SW Region. 14 pages

Waananen, A. O. and J.R. Crippen. 1977. Magnitude and frequency of floods in California. USGS, Water Resources Investigation 77-21, Menlo Park, CA 96 pages.

USGS. 1982. Guidelines for determining flood flow frequency. Bulletin #17B of the Hydrology Subcommittee. Interagency Advisory Committee on Water Data, US Dept. of Interior, Geological Survey, Virginia.

STREAM CROSSING SUMMARY SHEET

Site: Upper Private Crossing on Stonybrook Creek
Road: 37,789 Palomares Road

General Information

Survey Date:	02/24/05	7.5 Minute Quad Name:	Niles
Survey Team:	Mike Love, Tom Grey	Lattitude:	37.599° N
Stream Name:	Stonybrook Canyon	Longitude:	121.946° W
Land Ownership:	Nathan Gregory	Tributary to:	Alameda Creek

Culvert Information

Shape:	Circular
Material:	Concrete
Roughness (n):	0.018
Inlet Type:	Wingwall 30-70°
Outlet Type:	at Stream Grade
Diameter:	6 ft
Bankfull Width:	26.7

Culvert 1 of 3

Length:	15.8 ft
Constant Slope:	7.97%
Residual Inlet Depth:	-0.4 ft
Residual Outlet Depth:	0.8 ft
Retrofit:	No

Culvert 2 of 3

Length:	15.8 ft
Constant Slope:	-0.70%
Residual Inlet Depth:	-0.1 ft
Residual Outlet Depth:	-0.2 ft
Retrofit:	No

Hydrology

Drainage Area:	6.87 mi^2
Estimated 100-yr Flow*:	2,130 cfs

Culvert Capacity based on FHWA Chart 1(2)

ENTRANCE TYPE: Wingwall 30-70°

Crossing Peak Flow Capacity

Top of Inlet (HW/D = 1.0) =	624 cfs
Top of Road (HW/D = 1.1) =	720 cfs
Mean Reach Slope:	4.03%

Culvert 3 of 3

Length:	15.8 ft
Constant Slope:	2.41%
Residual Inlet Depth:	-0.3 ft
Residual Outlet Depth:	0.1 ft
Retrofit:	No

*Value derived from average of Log-Pearson Type III using local stream gage records

Fish Passage Conditions

Fish Passage Criteria From CA Salmonid Stream Habitat Restoration Manual Chapter IX- DFG

Species or Lifestages	Minimum Water Depth	Prolonged Swimming Mode		Burst Swimming Mode		
		Maximum Swim Speed	Time to Exhaustion	Maximum Swim Speed	Time to Exhaustion	Maximum Leap Speed
Adult Anadromous Salmonids	0.8 feet	6.0 ft/sec	30 minutes	10.0 ft/sec	5.0 sec	15.0 ft/sec
Resident Trout and Juvenile Steelhead >6"	0.5 feet	4.0 ft/sec	30 minutes	5.0 ft/sec	5.0 sec	6.0 ft/sec
Juvenile Salmonids <6"	0.3 feet	1.5 ft/sec	30 minutes	3.0 ft/sec	5.0 sec	4.0 ft/sec

Fish Passage Design Flows

Design Flow Window Limits	Adult Anadromous Salmonids	Resident Trout and Juvenile Steelhead >6"	Juvenile Salmonids <6"
Lower Passage Flow (Qlp)	3.0 cfs	2.0 cfs	1.0 cfs
Upper Passage Flow (Qhp)	66.4 cfs	17.4 cfs	7.7 cfs

Existing Conditions at Fish Passage Design Flows

Existing Conditions for Culvert 1 of 3

Fish Passage Flow Window	Qlp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	3.0	0.35	0.49	0.0
Adult Rainbow Trout	2.0	0.31	0.25	0.0
Juvenile Salmonids	1.0	0.00	0.00	0.0

Fish Species and Age Class	Qhp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	66.4	0.74	9.25	0.0
Adult Rainbow Trout	17.4	0.30	7.42	0.0
Juvenile Salmonids	7.7	0.17	6.23	0.0

STREAM CROSSING SUMMARY SHEET

Site: Upper Private Crossing on Stonybrook Creek
Road: 37,789 Palomares Road

Existing Conditions for Culvert 2 of 3

Fish Species and Age Class	Qlp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	3.0	0.45	1.57	0.3
Adult Rainbow Trout	2.0	0.39	1.37	0.3
Juvenile Salmonids	1.0	0.31	1.02	0.3

Fish Species and Age Class	Qhp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	66.4	1.49	4.63	0.3
Adult Rainbow Trout	17.4	0.87	2.86	0.3
Juvenile Salmonids	7.7	0.63	2.22	0.3

Existing Conditions for Culvert 3 of 3

Fish Species and Age Class	Qlp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	3.0	0.20	4.07	0.0
Adult Rainbow Trout	2.0	0.16	3.72	0.0
Juvenile Salmonids	1.0	0.12	3.21	0.0

Fish Species and Age Class	Qhp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	66.4	1.00	7.37	0.0
Adult Rainbow Trout	17.4	0.49	5.72	0.0
Juvenile Salmonids	7.7	0.32	4.91	0.0

Flows Meet Fish Passage Criteria

Fishxing Results for Culvert 1 of 3

Fish Species and Age Class	Insufficient Depth below	Excessive Velocity above	Excessive Outlet Drop below	Flows Passable between Lower and Upper Fish Passage Flows
Adult Steelhead	90.0 cfs	28.8 cfs	0.0 cfs	0%
Adult Rainbow Trout	42.0 cfs	3.0 cfs	0.0 cfs	0%
Juvenile Salmonids	18.2 cfs	1.2 cfs	0.0 cfs	0%

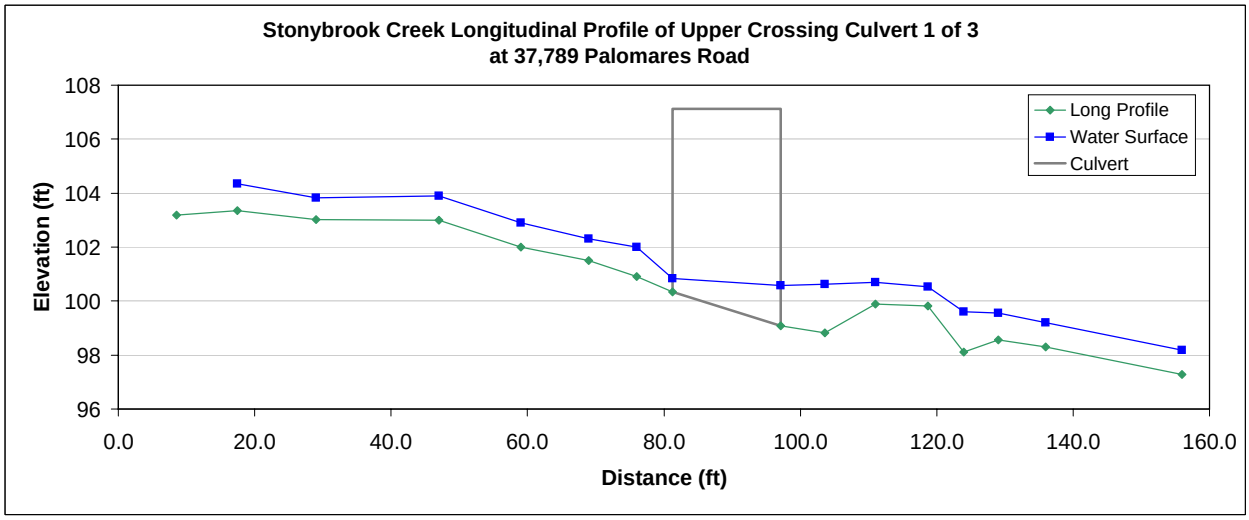
Fishxing Results for Culvert 2 of 3

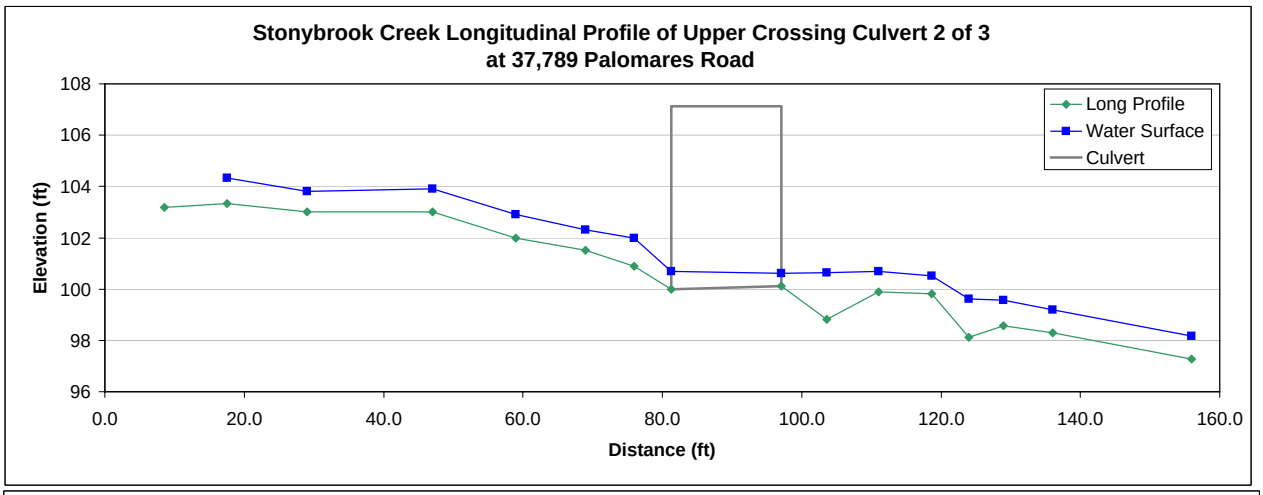
Fish Species and Age Class	Insufficient Depth below	Excessive Velocity above	Excessive Outlet Drop below	Flows Passable between Lower and Upper Fish Passage Flows
Adult Steelhead	38.1 cfs	150.1 cfs	0.0 cfs	45%
Adult Rainbow Trout	14.0 cfs	11.4 cfs	0.0 cfs	0%
Juvenile Salmonids	4.5 cfs	1.1 cfs	0.0 cfs	0%

Fishxing Results for Culvert 3 of 3

Fish Species and Age Class	Insufficient Depth below	Excessive Velocity above	Excessive Outlet Drop below	Flows Passable between Lower and Upper Fish Passage Flows
Adult Steelhead	50.0 cfs	55.5 cfs	0.0 cfs	8.7%
Adult Rainbow Trout	20.0 cfs	2.5 cfs	0.0 cfs	0.0%
Juvenile Salmonids	7.6 cfs	0.1 cfs	0.0 cfs	0.0%

Passage windows overlap for adults in barrels 2 of 3 and 3 of 3 therefore maximum adult passage at this crossing is 44.7%. No passage is permitted at this crossing for resident trout or juvenile salmonids.


Stonybrook Creek Longitudinal Profile of Upper Crossing Culvert 1 of 3
at 37,789 Palomares Road
Elevation (ft)
108
106
104
102
100
98
96
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
Distance (ft)
Long Profile
Water Surface
Culvert


Stonybrook Creek Longitudinal Profile of Upper Crossing Culvert 2 of 3
at 37,789 Palomares Road
Elevation (ft)
108
106
104
102
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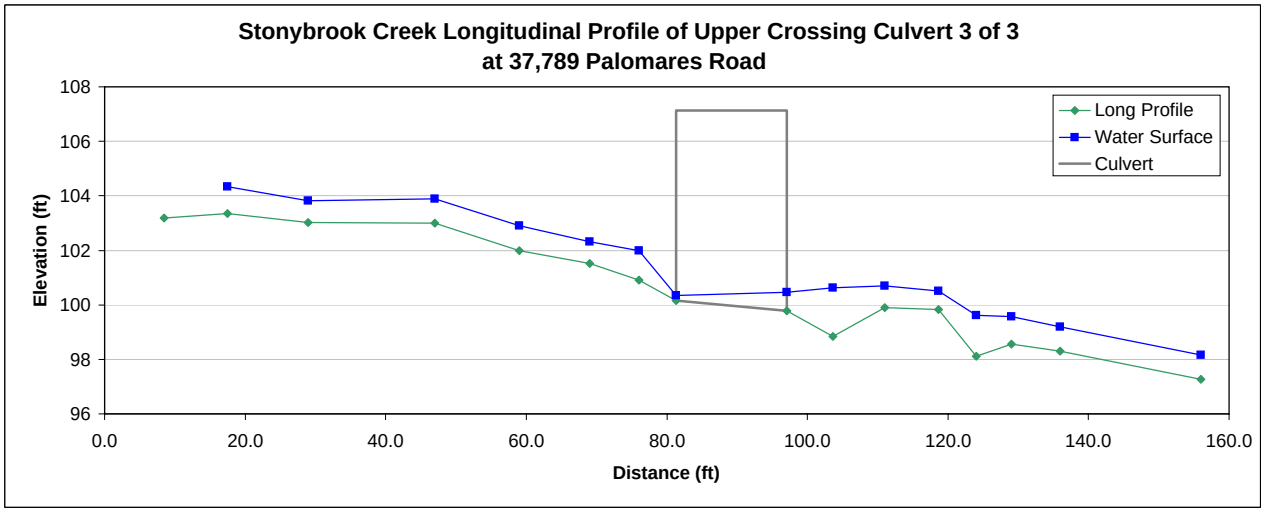
120.0
140.0
160.0
Distance (ft)
Long Profile
Water Surface
Culvert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Culvert

STREAM CROSSING SUMMARY SHEET

Site: Lower Private Crossing on Stonybrook Creek
Road: 37,789 Palomares Road

General Information

Survey Date:	02/24/05	7.5 Minute Quad Name:	Niles
Survey Team:	Mike Love, Tom Grey	Lattitude:	37.599° N
Stream Name:	Stonybrook Canyon	Longitude:	121.946° W
Land Ownership:	Nathan Gregory	Tributary to:	Alameda Creek

Culvert Information

Shape:	Circular
Material:	Concrete
Roughness (n):	0.018
Inlet Type:	Headwall
Outlet Type:	at Stream Grade
Diameter:	7 ft
Bankfull Width:	26.7

Culvert 1 of 3

Length:	15.9 ft
Constant Slope:	1.70%
Residual Inlet Depth:	-1.3 ft
Residual Outlet Depth:	-1.0 ft
Retrofit:	No

Culvert 2 of 3

Length:	15.9 ft
Constant Slope:	0.13%
Residual Inlet Depth:	-0.6 ft
Residual Outlet Depth:	-0.6 ft
Retrofit:	No

Hydrology

Drainage Area:	6.87 mi^2
Estimated 100-yr Flow*:	2,130 cfs

Culvert Capacity based on FHWA Chart 1(2)

ENTRANCE TYPE: Headwall

Crossing Peak Flow Capacity

Top of Inlet (HW/D = 1.0) =	930 cfs
Top of Road (HW/D = 1.3) =	1320 cfs

Mean Reach Slope: 2.98%

Culvert 3 of 3

Length:	15.9 ft
Constant Slope:	2.20%
Residual Inlet Depth:	-0.8 ft
Residual Outlet Depth:	-0.5 ft
Retrofit:	No

*Value derived from average of Log-Pearson Type III using local stream gage records

Fish Passage Conditions

Fish Passage Criteria From CA Salmonid Stream Habitat Restoration Manual Chapter IX- DFG

Species or Lifestages	Minimum Water Depth	Prolonged Swimming Mode		Burst Swimming Mode		
		Maximum Swim Speed	Time to Exhaustion	Maximum Swim Speed	Time to Exhaustion	Maximum Leap Speed
Adult Anadromous Salmonids	0.8 feet	6.0 ft/sec	30 minutes	10.0 ft/sec	5.0 sec	15.0 ft/sec
Resident Trout and Juvenile Steelhead >6"	0.5 feet	4.0 ft/sec	30 minutes	5.0 ft/sec	5.0 sec	6.0 ft/sec
Juvenile Salmonids <6"	0.3 feet	1.5 ft/sec	30 minutes	3.0 ft/sec	5.0 sec	4.0 ft/sec

Fish Passage Flows

Fish Passage Flow Window	Adult Anadromous Salmonids	Resident Trout and Juvenile Steelhead >6"	Juvenile Salmonids <6"
Lower Passage Flow (Qlp)	3.0 cfs	2.0 cfs	1.0 cfs
Upper Passage Flow (Qhp)	66.4 cfs	17.4 cfs	7.7 cfs

Existing Conditions at Fish Passage Design Flows

Existing Conditions for Culvert 1 of 3

Fish Species and Age Class	Qlp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	3.0	0.00	0.00	0.72
Adult Rainbow Trout	2.0	0.00	0.00	0.78
Juvenile Salmonids	1.0	0.00	0.00	0.85

Fish Species and Age Class	Qhp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	66.4	0.76	4.07	0.38
Adult Rainbow Trout	17.4	0.22	1.67	0.47
Juvenile Salmonids	7.7	0.00	0.00	0.55

STREAM CROSSING SUMMARY SHEET

Site: Lower Private Crossing on Stonybrook Creek
Road: 37,789 Palomares Road

Existing Conditions for Culvert 2 of 3

Fish Species and Age Class	Qlp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	3.0	0.43	2.38	0.60
Adult Rainbow Trout	2.0	0.37	2.15	0.66
Juvenile Salmonids	1.0	0.29	1.82	0.70

Fish Species and Age Class	Qhp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	66.4	1.46	5.10	0.52
Adult Rainbow Trout	17.4	0.85	3.69	0.55
Juvenile Salmonids	7.7	0.63	3.04	0.58

Existing Conditions for Culvert 3 of 3

Fish Species and Age Class	Qlp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	3.0	0.14	3.39	0.33
Adult Rainbow Trout	2.0	0.10	2.76	0.48
Juvenile Salmonids	1.0	0.03	1.19	0.57

Fish Species and Age Class	Qhp (cfs)	Mid Barrel Water Depth (ft)	Mid Barrel Velocity (ft/s)	Outlet Drop (ft)
Adult Steelhead	66.4	0.97	7.15	0.23
Adult Rainbow Trout	17.4	0.47	5.51	0.26
Juvenile Salmonids	7.7	0.29	4.61	0.30

Flows Meet Fish Passage Criteria

Fishxing Results for Culvert 1 of 3

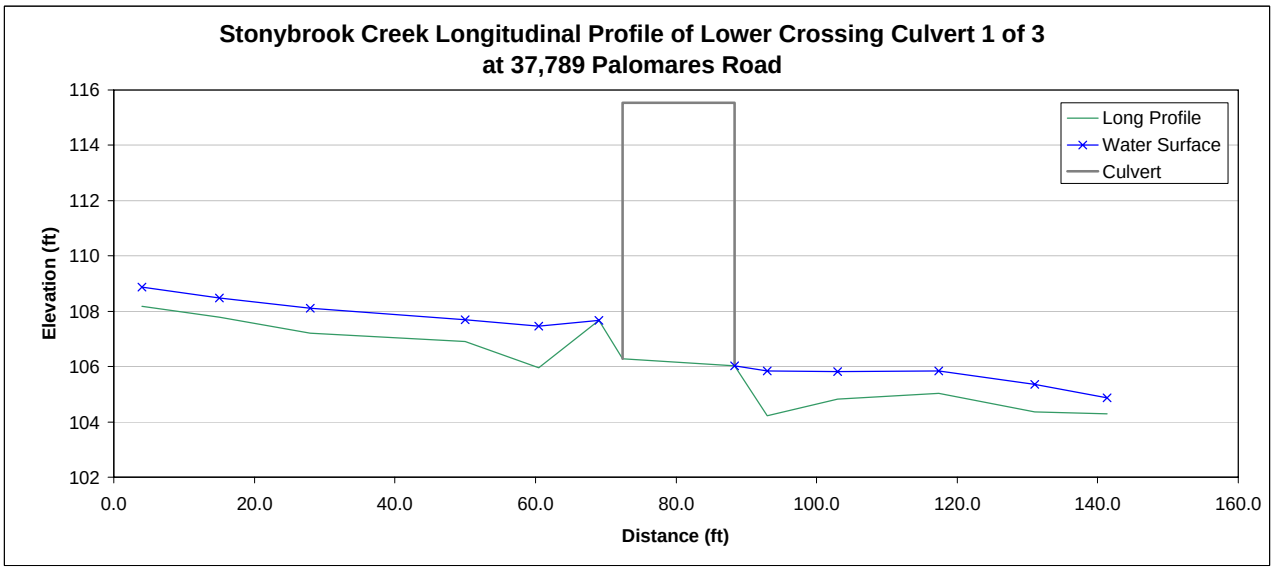
Fish Species and Age Class	Insufficient Depth below	Excessive Velocity above	Excessive Outlet Drop below	Flows Passable between Lower and Upper Fish Passage Flows
Adult Steelhead	111.4 cfs	242.2 cfs	0.0 cfs	0%
Adult Rainbow Trout	61.0 cfs	39.0 cfs	0.0 cfs	0%
Juvenile Salmonids	35.0 cfs	15.6 cfs	0.4 cfs	0%

Fishxing Results for Culvert 2 of 3

Fish Species and Age Class	Insufficient Depth below	Excessive Velocity above	Excessive Outlet Drop below	Flows Passable between Lower and Upper Fish Passage Flows
Adult Steelhead	32.4 cfs	131.2 cfs	0.0 cfs	54%
Adult Rainbow Trout	9.9 cfs	8.0 cfs	0.0 cfs	0%
Juvenile Salmonids	2.9 cfs	1.0 cfs	0.0 cfs	0%

Fishxing Results for Culvert 3 of 3

Fish Species and Age Class	Insufficient Depth below	Excessive Velocity above	Excessive Outlet Drop below	Flows Passable between Lower and Upper Fish Passage Flows
Adult Steelhead	52.4 cfs	69.4 cfs	0.0 cfs	22%
Adult Rainbow Trout	21.9 cfs	4.3 cfs	0.0 cfs	0.0%
Juvenile Salmonids	8.7 cfs	1.2 cfs	0.0 cfs	0.0%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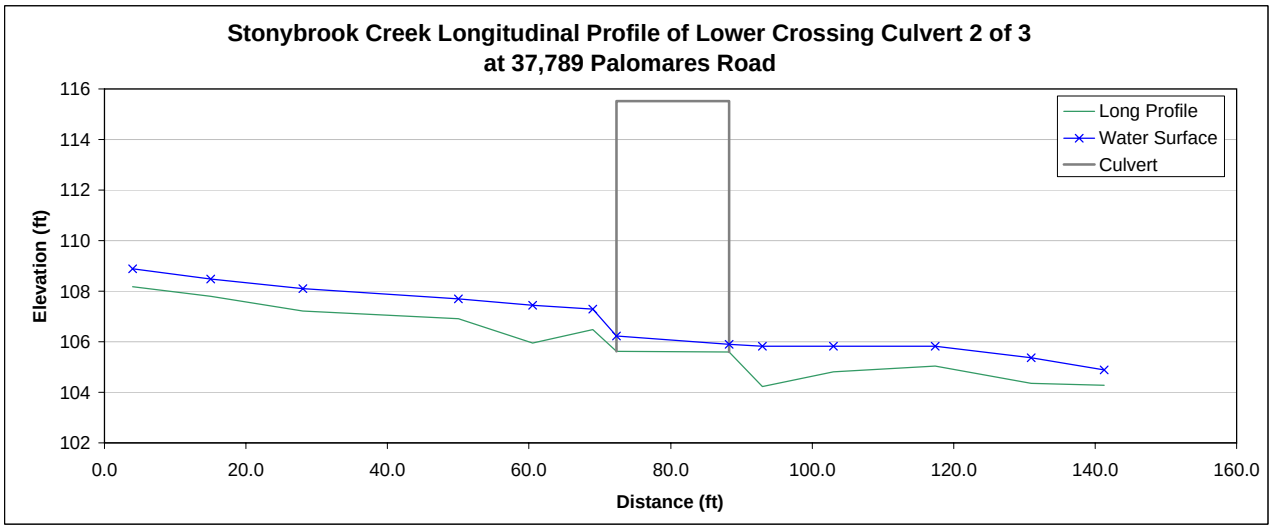
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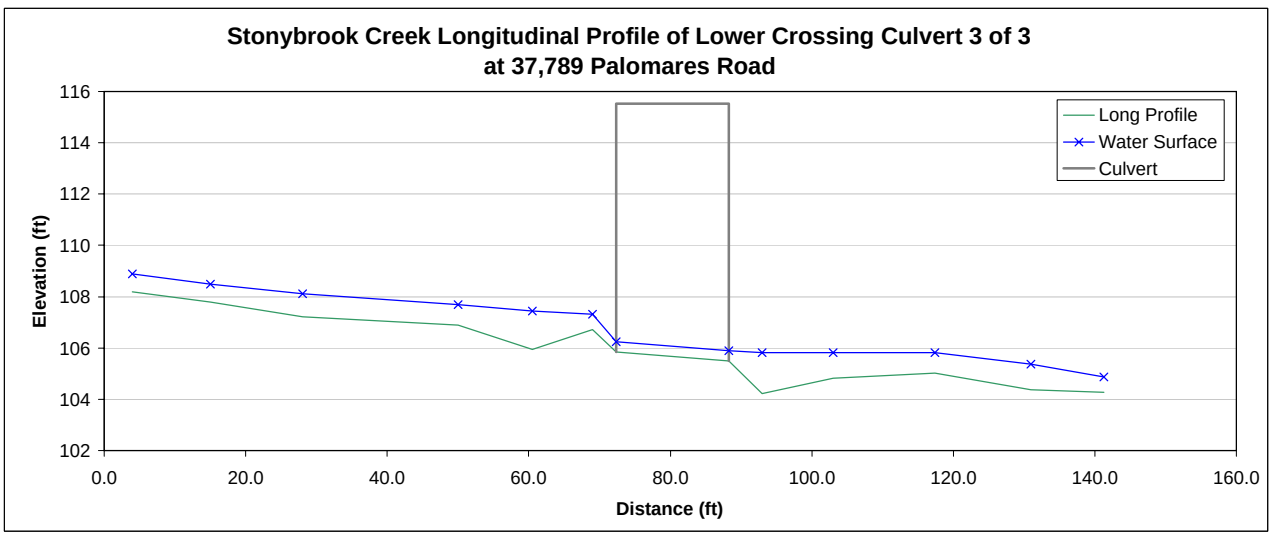
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