STREAM INVENTORY REPORT
for
LA HONDA CREEK

Prepared For:

Midpeninsula Regional Open Space District

By:

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INTRODUCTION

The La Honda Creek watershed has been documented as historically supporting a salmonid population, including steelhead (*Oncorhynchus mykiss)* and potentially coho salmon (*Oncorhynchus kisutch*). Although salmonids are still found in the creek, multiple factors have contributed to the reduction in their numbers. Understanding the quality and quantity of habitat provided by La Honda Creek will help current and future efforts to protect the population. The California Department of Fish and Game's (CDFG) Stream Inventory report provides a robust methodology to document current habitat within a creek. Stream Inventory reports have been completed for other San Gregorio Creek tributaries, including El Corte de Madera, but no such report has been completed for La Honda Creek.

During 2002 and 2003, the San Francisco Estuary Institute (SFEI) worked with California State University at Fresno to develop a data set and interpretive report on the geomorphology, hydrology, and riparian habitat of La Honda Creek along the Highway 84 transportation corridor. The objective of that work was to assist the California Department of Transportation (Caltrans) and CDFG to design and permit preemptive road corridor fixes in biologically sensitive areas along La Honda Creek where road failure has occurred or is eminent. The study included detailed descriptions of the geology, geomorphology, hydrology, macroinvertebrate biology, and anadromous fish habitat along the lowest 5 km (3.1 mi) of La Honda Creek following accepted methodologies. It did not, however, include a CDFG Level IV Stream Inventory Assessment.

To ensure that information on La Honda Creek is consistent with that collected on other creeks, and to allow easier cross-comparisons and management prioritization, the Midpeninsula Regional Open Space District (MROSD) requested that SFEI develop a report consistent with the CDFG Level IV Stream Inventory Assessment. A portion of the data collected in 2002/2003 is relevant to this assessment, including flow, air and stream temperatures, substrate composition, large woody debris, bank composition, and bank vegetation. SFEI recommended that a small amount of additional data (two days fieldwork) would need to be collected to supplement the 2002/2003 dataset, to create a complete CDFG Level IV Stream Inventory Assessment. This report includes a physical habitat inventory of La Honda Creek, but does not include a biological inventory.

The primary objective of this report is to document the current physical fish habitat conditions in La Honda Creek using the 2002/2003 and the 2007 data. Secondarily, this report makes recommendations for the enhancement of anadromous fish habitat based upon target values suitable for salmonids in California's central coast streams.

WATERSHED OVERVIEW

The La Honda Creek watershed is located in the western Santa Cruz Mountains of the Coast Ranges, in San Mateo County, California (Figure 1). The watershed occupies an area of 31.8 km^2 (12.3 mi^2), extending southward from State Highway 35 (Skyline Drive) to San Gregorio Creek near the town of La Honda, approximately 19 km (11.8 mi) inland from the Pacific Ocean (Figure 2). La Honda Creek is a perennial, third-order channel (Strahler, 1957) with approximately 10.25 km (6.37 mi) of blue line stream length shown on the USGS La Honda and Woodside 7.5 minute quadrangles. The average channel gradient is 4.5%, ranging between 9.7% at the headwaters and 1.2% at the confluence with San Gregorio Creek. Elevation in the La Honda watershed ranges from 707 m (2,320 ft) near Highway 35 to 110 m (360 ft) at the confluence with San Gregorio Creek. Four named tributaries, Woodhams, Langley, Woodruff and Weeks Creeks, flow into La Honda Creek.

Vegetation types in the watershed vary with elevation and aspect. Two vegetation types predominate: California coastal redwood forest with smaller numbers of other conifers and hardwoods, and grasslands with patches of chaparral-scrub. Particularly in the middle watershed, the ridge tops and some hill slopes have been converted from a chaparral-scrub ecosystem to open grasslands (Wieczorek et al., 1989). Analysis of aerial photographs taken in 2000 show that the La Honda Creek watershed is approximately 84% forest and chaparral-scrub, and 15% open grasslands.

Land use in the watershed has undergone a series of changes through time, including Native American management, logging, grazing, horticulture, viticulture, and rural residential use. Currently, the MROSD owns a large portion of the watershed, with the remainder owned by a number of private owners. Current land use is primarily open space watershed lands, with smaller portions used for agricultural uses (grazing, viticulture, tree farming, etc.) and rural residential areas. Highway 84 is the primary transportation route through the watershed, paralleling La Honda Creek through most of the watershed, especially in the lowest reach near the town of La Honda.

This assessment covers portions of the lowest 5 km (3.1 mi) of La Honda Creek, between the confluence with San Gregorio Creek, upstream to the tributary confluence of Weeks Creek. The area is located in Sections 22, 23, 14, 11, and 2, T. 7 S., R. 4 W on the La Honda 7.5 minute USGS quadrangle, and lies between latitude 37^{o} 18' 35" and 37^{o} 20' 48" North, and longitude 122^{o} 16' 05" and 122^{o} 16' 40" West.

METHODS

Data contributing to this stream inventory report was collected during two time periods. Reach based data collected by SFEI in 2002 and 2003 was presented and interpreted in a report titled, “Fluvial geomorphology, hydrology, and riparian habitat of La Honda Creek along the Highway 84 transportation corridor, San Mateo County, California" (Brady et al., 2004). A portion of the data from this previous report including air and stream temperatures, substrate composition, canopy cover, bank composition, bank vegetation, and large woody debris (LWD) is utilized in this stream inventory report. In 2007, an additional two days of fieldwork was completed to collect data specific to the CDFG Level IV Stream Inventory Assessment. These data were collected in the same sample reaches employed during the 2002/2003 collection period and included flow estimates, Rosgen channel types, habitat types, substrate embeddedness, and habitat shelter ratings.

SAMPLE REACH SELECTION, POSITION, AND LENGTH

Sample reach selection was based on channel slope. A longitudinal profile of La Honda Creek was plotted using the Woodside and La Honda USGS 7.5 minute topographic quadrangles (Figure 3). Because channel slope is known to be a good predictor of channel morphology (e.g. Montgomery and Buffington, 1997; Rosgen, 1996), the study reach was divided into three distinct segments based upon significant breaks in slope in the longitudinal profile. The exact start location of each sample reach was randomly selected within each segment to characterize a representative portion of the larger segment (Figure 4). Segment I contains three sample reaches (1A, 1B, and 1C); Segment II contains two sample reaches (2A and 2B); and Segment III contains two sample reaches (3A and 3B); for a total of seven sample reaches. The distance to the start point of each sample reach was measured from a mapped benchmark location such as a bridge, a property boundary, or a tributary confluence to allow for re-occupation in the future as necessary (Table 1). The length of sample reach necessary to capture in-channel features such as pool-riffle sequences, and an adequate sample of pools is 25 times the measured bankfull width (Leopold, 1994), thus the reach length typically decreases in an upstream direction. Bankfull width was determined using visual field indicators (e.g. Harrelson et al., 1994) at the randomly selected starting point for each sample reach. Indicators of bankfull include, but are not limited to: the break in slope between the bank and the floodplain, a small break in slope of the bank, a change in vegetation type or density, the top of a bar surface, or the change from absence to presence of leaf litter. Flagging was then placed along the channel until a total of 25 bankfull widths had been flagged. Longitudinal channel distances were measured using a metric HipChain (calibrated to 0.1m). Over a distance of 200 m, the accuracy of the hip chain is +/- 2%.

HABITAT INVENTORY COMPONENTS

Nine major habitat components are surveyed in the CDFG Level IV Stream Inventory Assessment protocol. In addition, a detailed survey of LWD within the bankfull channel was completed. This section describes the methodology used in collecting data for each component. Most components followed methods described in the *California Salmonid*

Stream Habitat Restoration Manual (Flosi and Reynolds, 1994), however, where methods deviate from this protocol, greater detail is presented.

1) Flow

Estimates of flow were made in each sample reach without the use of standard flow measuring equipment. The furthest downstream representative run or low-gradient riffle within the reach was chosen for measurement, taking care to avoid large boulders, wood, or other flow obstructions. Surface floats were timed over a measured 5 m distance, and the mean of three trials at each location was used to calculate the flow velocity. The wetted channel width and average depth was measured and used to calculate water volume. No correction was made for velocity measures taken at the surface (rather than at 6/10 depth) because the flow depth was often less than 0.10 m.

2) Channel Type

Channel typing methods, described in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994), follow the classification system developed by David Rosgen. According to this system, five parameters are assessed to determine channel type: 1) water slope gradient, 2) entrenchment, 3) width/depth ratio, 4) substrate composition, and 5) sinuosity. Channel type was assessed in March 2007, following the Rosgen methodology. Measurements to determine channel type were taken at both the downstream and upstream ends of each sample reach. Field observations confirm that within each sample reach the channel type remained consistent throughout the entire reach length.

3) Temperatures

Water temperature data were measured hourly from December 17th, 2002 to October 25th, 2003 at Delay's bridge (just upstream of reach 1C). Temperature was measured in the thalweg of the upper third of a pool that has perennial flow, has ample shading, is not affected by direct groundwater inflows, and generally represents average conditions. A continuous temperature sensor (Hobo Optic StowAway Temp sensor, Onset Computer Corporation) was placed in a steel tube with holes drilled for continual water through-flow, and anchored to the abandoned bridge footing immediately upstream of the bridge. The sensor remained in the water column during all flow levels, while being protected from LWD and bedload moving in the channel. The sensor hung freely and did not contact the bed surface, the steel tube, or the bridge footing. Air temperature data was recorded hourly by the California Department of Forestry for the La Honda (LAH) Station (Lat. 37.3053°N, Long. 122.2539°W) and retrieved for the same time period as the SFEI water temperature data.

4) Habitat Type

Physical habitat was described using the 24 classification types defined in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994) (Table 2). For the entire length of each reach, habitat units were assigned a type identification number selected from a standard list, and numbered sequentially from downstream to upstream. If an encountered unit did not contain any flow, it was labeled as “dry”. The minimum length of a described habitat unit was equal to or greater than the mean wetted width. Channel dimensions, including unit length, width and depth, were measured using hip chains, tape measures, and stadia rods. Pool tail crest depth at each pool unit was measured in the thalweg.

5) Embeddedness

The depth of embeddedness of the cobbles in pool tail out locations was measured by the percent of cobble that was surrounded or buried by fine sediment. In La Honda Creek, five clasts were removed from the bed of each pool tail out and visually estimated for embeddedness. Data were captured using the following ranges of embeddedness: 0-25% (value 1), 26-50% (value 2), 51-75% (value 3), 76-100% (value 4). If the tail outs were entirely unsuitable for salmonid spawning due to an inappropriate substrate (i.e. boulder or bedrock) or another consideration, a “not suitable” (NS) rating was assigned.

6) Shelter Rating

Instream shelter is composed of the elements within a stream channel that provide salmonids protection from predation, reduce water velocities so fish can rest and conserve energy, and allow separation of territorial units to reduce density related competition. Using an overhead view, a quantitative estimate of the percentage of the habitat unit covered was made, and that total percentage was broken down and classified according to a list of nine cover types (undercut banks, small woody debris, large woody debris, root balls, terrestrial vegetation, aquatic vegetation, bubble curtains, boulders, and bedrock ledges). Additionally, a standard qualitative shelter value of 0 (none), 1 (low), 2 (medium), or 3 (high) was assigned to each unit according to the complexity of the cover. Shelter ratings were calculated for each habitat unit by multiplying total percent cover by the shelter value. Thus, shelter ratings in this report can range from 0-300 and are expressed as mean values by habitat type within the creek.

7) Substrate Composition

Detailed quantitative data on substrate composition were collected in 2002/2003. Surface grain size distributions were characterized in each sample reach by performing pebble counts at five locations corresponding to every fifth bankfull width, according to methods in Bunte and Abt (2001). A systematic random sampling approach was used wherein 100 clasts were measured in a grid pattern scaled to the local bankfull width and maximum particle size, and centered on the five cross-section locations in each sample reach. A total of 500 clasts per sample reach were measured producing a statistically robust estimate of surface sediment size distribution for the sample reach.

Clasts located at each grid node were measured using an aluminum gravel template (US SAH-97TM Hand-held Size Analyzer) and reported as the phi sieve mesh on which the particle was caught (2 mm or 0.08 in, 4 mm or 0.16 in, 5.6 mm or 0.22 in , 8 mm or 0.31 in, 11 mm or 0.43 in, 16 mm or 0.63 in, 22 mm or 0.87 in, 32 mm or 1.26 in, 45 mm or 1.77 in, 64 mm or 2.52 in, 90 mm or 3.54 in, 128 mm or 5.04 in and 180 mm or 7.09 in). Clasts finer than 2 mm (0.7 in) were reported as < 2 mm (<0.7); clasts larger than 180 mm (7.09 in) were measured with a ruler and placed in the appropriate phi size class. This method provides high quality data for grain sizes larger than 8 mm (0.31 in), however, quality decreases at <8 mm (< 0.31 in) because it is difficult to select a single clast from the bed by hand. Also, surface pebble counts tend to overestimate coarse clasts, while underestimating the grain sizes that are sand and finer.

During March 2007, further data on substrate composition were collected using methods defined in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994). In each habitat unit the dominant and sub-dominant substrate elements were visually estimated. Seven standard size classes, ranging from silt/clay to boulder and bedrock were used. This new data, although not as quantitative as the 2002/2003 data, provides substrate size information for each individual habitat unit identified, allowing analysis of separate habitat types.

8) Canopy

Canopy cover in each habitat unit was visually estimated in March 2007. A spherical densiometer was not used, however every effort was made to make our visual estimates comparable. Estimates reflect the percent cover that would be present when the deciduous trees are fully leafed-out. Each total canopy cover estimate was sub-divided into a deciduous and an evergreen component. The recorded estimates were the integrated average of variation in cover along the entire length of each habitat unit.

9) Bank Composition and Vegetation

Bank composition and vegetation data were collected in 2002/2003. Data were collected on the composition of the bank and terrace, the extent of riparian forest, and the type of plant species for both the right and left banks at every fifth bankfull width in each sample reach. Observations of bank composition were limited to the area of the bank and terrace within half of a channel bankfull width on either side of the cross-section. Bank vegetation was documented for approximately 10m on either side of the creek. Dominant and subdominant species were recorded for both the overstory and understory vegetative component. The complete bank composition and riparian vegetation datasets from

2002/2003 are reported in Appendices A and B. However, in this report we reinterpret the data using CDFG protocols (Flosi and Reynolds, 1994).

Additional bank composition and vegetation data were collected in March 2007. The dominant bank composition type and the dominant vegetation type of both banks were recorded for every third habitat unit, giving an approximate 30% sub-sample. Composition and vegetation types were selected from a standard list presented in the *California Salmonid Stream Habitat Restoration Manual* (Flosi and Reynolds, 1994). The percent of each bank covered by vegetation was also estimated and recorded.

10) Large Woody Debris

In addition to the nine major habitat components prescribed by the CDFG Level IV Stream Inventory Assessment, detailed data on every large woody debris (LWD) piece within the bankfull channel were collected. This data, although not typically reported in standard stream inventory reports, is very useful in understanding the habitat elements and functions provided by La Honda Creek. In 2002/2003, characteristics of large woody debris (LWD) were measured continuously along the entire length of each sample reach (Appendix C). Data collected on LWD and living trees that affected flow within the bankfull channel, included only pieces larger than 20 cm (8 in) in diameter and 1.8 m (6 ft) in length. Live, upright trees were included in the data if their trunk or root systems significantly affected the bankfull flow. Other data collected included: 1) the position of the piece relative to the bankfull channel; 2) the species; 3) the state of decay, here referred to as the decay class; 4) if the piece was associated with a pool; 5) the entry process for the piece; 6) whether the piece was a part of a debris jam; and 7) if it was a key structural piece in the debris jam. Based on these data, we assessed the role of LWD in channel morphology, including formation of pools, sediment storage sites, and the effects on flow hydraulics and roughness.

HABITAT INVENTORY RESULTS

On March 24th and 31st of 2007, a stream habitat inventory of La Honda Creek was conducted. The total length of the stream surveyed was 4,357 feet (1,328 m) in seven representative stream reaches, comprising 27% of the lowest 5.0 km of La Honda Creek. The area sampled in this study is nearly three times that in DFG basin-level habitat unit inventory protocol. This method states, “During basin-level habitat typing, full sampling of each habitat unit requires recording all characteristics of each habitat unit. After DFG analysis of over 200 stream habitat inventory data sets, it was determined that similar stream descriptive detail could be accomplished with a sampling level of approximately 10 percent” (Flosi et al., 1998). While stream inventory data collection occurred only within the seven sample reaches, the entire channel length was previously walked several times, with observations and photos documenting the channel condition outside of the sample reaches playing an important role in understanding the entire study area.

In the seven sample reaches surveyed, flow and channel type measurements were taken, and a total of 70 distinct habitat units were identified. For each of the 70 units, channel dimensions were measured, instream shelter and substrate were described, and canopy cover was estimated. Twenty-nine of the 70 units were also measured for bank composition and vegetation type. Results of this inventory are presented below.

1) Flow

Flow was estimated in each of the seven reaches (Table 3). Flow appeared consistent throughout all seven reaches at approximately 1 cfs, representing groundwater recharge into the stream at the end of the winter wet season. On the dates that flow was measured, a storm with significant rainfall had not occurred in the previous four weeks. In addition to these baseflow measures, high flow event stream discharge was measured in 2002/2003 at Delay's Bridge (just upstream of reach 1C). The peak discharge observed at Delay's Bridge during the 2002/2003 wet season was 353 cfs at a stage of 2.50 feet. The complete methodology and results can be found in Brady et al. (2004).

2) Channel Type

La Honda Creek has varying channel types in the seven sample reaches (see Table 4 for measurements contributing to channel type designations). Reaches 1A, 1B, and 2A are all a B3 channel type. B3 channels are moderately entrenched, riffle dominated with a moderate gradient. B3 channels tend to have a very stable plan, profile, and banks. Reaches 1C and 2B are an E3 channel type. An E3 channel is slightly entrenched with a low width to depth ratio. E3 channels are very efficient and have stable bed and banks. These channels generally have higher sinuosities and meander width ratios than the other channel types found in La Honda Creek. The upper two reaches, reach 3A and 3B are A3 channels. A3 channels are entrenched, narrow, step-pool streams with high energy and transport capacity. All three channel types have cobble dominated substrates.

3) Temperatures

Although water temperatures were not measured in March 2007, field observations confirm that cool water was flowing in each sample reach. Because no major changes in land use, water source or water storage has occurred in the watershed, this report relies upon the data collected in 2002/2003. In this dataset, temperatures were measured continuously from December 17th, 2002 to October 25th, 2003, and ranged from 4 – 20° C (40 - 68° F) (Figure 5). Generally, temperatures are consistent, with small fluctuations due to changing air temperature or flow. The seven-day average water temperature generally follows the air temperature trend, but with a lesser magnitude of change. The maximum seven-day water temperature (16.6° C or 61.9°F) occurred in the last week of July of 2003. A good correlation between air and water temperature exists, allowing future predictions of seven-day average water temperatures at Delay's bridge in the absence of water temperature data. The 2002/2003 temperatures dataset is reported in Appendix D.

4) Habitat Type

In the seven sample reaches surveyed, 70 distinct habitat units were identified. Pool habitat units had both the greatest occurrence (47%) and represented the greatest amount of channel length (41%) in the reaches surveyed. Riffles comprised one-third of the habitat occurrences (33%) and channel length (32%), while flatwater made up 20% of the habitat occurrence and 27% of the channel length. Table 5 and Figures 6 and 7 summarize these Level II habitat types. Thirteen distinct Level IV habitat types were identified in the 70 units (Table 6). Low-gradient riffles are the single-most frequent habitat type by percent occurrence (31%) and total stream length (also 31%), followed by lateral scour pools formed by bedrock (20% occurrence, 21% total length) (Figure 8). A total of 33 pools were identified and measured (Table 7). Nearly all were a type of scour pool (91% occurrence, 88% total length), with backwater and main channel pools comprising only a minor portion of the units measured (Figure 9). Pool depths by pool habitat types are summarized in Table 8. Pool depths are normally distributed, with the most frequent pool depth between two and three feet (Figure 10). About one-quarter of the pools were greater than three feet deep. If instream shelter is present, habitat quality for salmonids will increase with pool depth.

5) Embeddedness

The depth of cobble embeddedness was visually estimated at all 33 pool tail crests. Measures of embeddedness in pool tail out locations show that over one-third of all pool tail crests were 25-50% embedded (38%), and just over one-third were 50-75% embedded (34%) (Figure 11). Sixteen percent of the pool tail outs were 0-25% embedded; these pool units represent the highest quality spawning grounds. The poorest quality spawning grounds (13% of the units) have 75-100% cobble embeddedness.

Although embeddedness was not directly measured in the previous Brady et al. (2004) study, field observations during bulk sediment sampling allowed qualitative assessment. In 2002/2003 the gravel and cobble substrate in most pool tail locations was found to be moderately to highly embedded. During bulk sediment sampling, many of the larger clasts in the bed had to be pried out using the blade of a rock hammer. In addition, the fine component of each sample often formed a dense cement-like slurry, which was extremely difficult to remove from sample containers. The bulk sediment sampling data is reproduced in Appendix E. Brady et al. (2004) concluded that embeddedness of the substrate in these pool tail out locations was a significant factor limiting salmonid success. They suggested that the high values of embeddedness were due to in-situ breakdown of mudstone clasts, due to the clay particles swelling and shrinking during wetting and drying. We have observed similar in-situ breakdown of clasts in several other

Bay Area watersheds (e.g. Alameda Creek in Alameda County and Pinole Creek in Contra Costa County).

6) Shelter Rating

Shelter ratings (based on complexity and percent cover) were determined for each habitat unit, with the mean value for each habitat type reported. Based on a scale of 0-300 with 300 representing full instream cover and greatest complexity, the measured pools had a rating of 66, followed by flatwater at 34, and riffles at 25 (Table 5). Of the pool types, the dammed pool (DPL) and lateral scour boulder-formed (LSBo) pools had shelter ratings greater than 100. The mean rating of all scour pools was 86, followed by backwater pools (77) and main channel pools (20) (Table 7). The mean percent cover by habitat type is summarized in Table 9. Root masses are the dominant cover type in all habitat units in La Honda Creek (23%). Root masses also are the dominant cover types in pools specifically, followed by large woody debris, bedrock ledges, and undercut banks (Figure 12).

7) Substrate Composition

The March 2007 qualitative visual estimates of dominant and subdominant substrate composition by habitat type are summarized in Table 10. In all habitat units, large cobble has the greatest occurrence as the dominant substrate, found in 31% of the units. Sand closely follows as the dominant substrate in 27% of the units. Low-gradient riffles are consistently dominated by cobble, with 70% dominated by large cobble and 20% by small cobble (Figure 13). Gravel and boulders dominate the remaining low-gradient riffle units measured.

The March 2007 visual estimates are complimented with quantitative pebble count data collected in the previous Brady et al. (2004) study. Because of the sampling frame methodology used, this data includes clasts from many different habitat unit types (riffles, pools, and flatwater units), not just in low-gradient riffle units, as shown in Figure 13. After aggregating and categorizing the surface particle size data for all 35 pebble count locations into CDFG Level IV Stream Inventory Assessment substrate types, we find that gravel is the dominant substrate type, comprising 54% of all sampled clasts (Figure 14). Sand and small cobble are the next most common substrate types, representing 17% and 16% each, respectively.

If the 2002/2003 pebble count data is analyzed without aggregating and categorizing it, we find that the median grain size (D_{50}) ranges from 10 mm (0.4 in) in reaches 3A and 3B to 26 mm (1.02 in) in reach 1A. Grain size in La Honda Creek primarily reflects the underlying bedrock lithology. The upper reaches (reaches 3A and 3B) have a fine grain size distribution because they are underlain by mudstones, which are friable, and will decrepitate upon wetting and drying. The relatively fine grain size distribution in the upper reaches of the study area is maintained by a continual supply of small clasts formed by this process. The middle reaches (reaches 2A, 2B and 1C) are underlain by basalt, which is more resistant to erosion and supplies coarser clasts to the creek. The lower reaches (reaches 1A and 1B) are underlain by sandstone and siltstone, which supply finer grain sizes than the basalt. Surface particle size distribution curves and summary tables for the pebble count data are located in Appendix F.

8) Canopy

The percentage of canopy cover was estimated in all 70 units in March 2007. The mean percentage of canopy cover throughout all 70 units is 53% (Table 11). Approximately 70% of that canopy cover is from deciduous species, while the remaining 30% is due to coniferous species (Figure 15). These observations are similar to those made in the previous Brady et al. (2004) study, in which they found that the majority of the La Honda Creek corridor contains a continuous riparian canopy. Bank and riparian vegetation is generally similar throughout most of the study reach. Typically, at least 50% of the channel is shaded from the mid-day sun by the riparian canopy. Locations having less than 50% shading were usually caused by landslides that removed the canopy vegetation from the banks and adjacent slopes, bringing it into the channel along with the slide debris.

9) Bank and Vegetation Composition

The composition of the banks, and the type and percent of vegetative cover affect the resistance to erosion during high flow events, the types of cover elements that are available for salmonids, and the amount of stream shading and LWD recruitment. The data collected in March 2007 for a subsample of the habitat units shows that sand/silt/clay was the dominant element composing the bank structure (46%), while cobble/gravel and bedrock split the remaining dominant bank composition (Figure 16). Similar bank composition data was collected for the Brady et al. (2004) study. When the data is categorized into CDFG Level IV Stream Inventory Assessment bank composition types, the most frequent dominant bank composition is silt/clay/sand (54%), followed by cobble/gravel (24%), bedrock (19%), and then boulder (3%) (Figure 17). However, if the data is analyzed without categorizing into broad composition types, the highly variable bank composition from reach to reach becomes evident from the detailed descriptions, including highly plastic, silty, terrace deposits; cobble fluvial deposits; plastic, silt-to-sand, colluvial deposits and associated soils; weathered bedrock; and intact bedrock. The raw data is reproduced in Appendix A at the end of this report. Also, a map of bank material composition for the entire 5 km study reach is available as a Map Plate in the Brady et al. (2004) report.

The March 2007 vegetation data broadly groups bank vegetation into a few categories following the CDFG Level IV methodology. We found that deciduous trees represent 40% of the bank vegetation and coniferous trees and brush each compose about one-fourth of the bank vegetation (Figure 18). The left bank on average had 59% vegetative cover and the right bank averaged 62% cover. These percentages are slightly lower than one might expect from a densely-vegetated watershed; in many reaches the bank was composed of bedrock and was only covered with moss, not trees or any other vegetation. These bedrock banks, when combined with the heavily vegetated banks, bring the average down to the reported percentile. The 2002/2003 bank vegetation dataset provides greater species detail, and lists species in the order of dominance for each sample location. It shows that the overstory is mainly deciduous, including oak, maple, bay, alder, willow, ash and buckeye, with subordinate redwood and conifer species (Figure 19). The understory consists primarily of ferns, moss, sedge, blackberry, grasses, fleshy vines and woody shrubs (Figures 20 and 21). Invasive species include broom, German and English ivy, and Vinca major. The full 2002/2003 dataset is included in Appendix B at the end of this report.

10) Large Woody Debris

Large woody debris (LWD) including logs and rootwads is common in La Honda Creek because nearly continuous riparian corridor exists, the valley width is not much wider than the channel width in many reaches, and large landslides that convey wood into the channel are common in the watershed. The pieces are typically very large in comparison to channel dimensions, forming stable scour-causing elements. For this reason, nearly three-quarters of all pools measured in La Honda Creek are formed by, or contain significant LWD. LWD in pools is important to salmonids because each piece can shade, cover, or add complexity, increasing the habitat quality. Analysis of 2002/2003 data shows that in all sample reaches combined, 50% of pools measured are directly formed by LWD, and 22% contain LWD (Figure 22).

The number of pieces of LWD in each reach is fairly consistent, typically between 10 and 30, reflecting the nearly continuous riparian vegetation corridor. LWD loads range from 54 m^3/km (114 yd^3/mi) in reach 1A to 655 m^3/km (1379 yd^3/mi) in reach 2B (Figure 23). Reach 2B has the largest number of LWD pieces (99). This reach contains an unusually large LWD jam at the base of a shallow landslide. Many different species of LWD and live, upright trees were identified along La Honda Creek (Figure 24). Redwood and conifer trees are abundant in-channel LWD species because they are large, plentiful, and decay slowly. Other reaches contain large numbers of live, upright alders and other hardwoods whose roots extend into the bankfull channel, adding to the channel's roughness. Most hardwood logs in the channel have decayed beyond positive identification.

DISCUSSION

La Honda Creek is a prime example of a picturesque San Mateo County watershed where the coastal microclimate supports regrowth redwood trees, lush grazing lands, and dense chaparral-scrub and woodlands. Once highly productive, the salmonid habitat provided by the watershed is recovering from the severe impacts of historic logging and poor stream management that prevailed between 1855 and 1910. As noted in the *Draft Strategic Plan for Restoration of Endangered Coho Salmon South of San Francisco Bay* (1998), the primary threats to salmonid habitat in La Honda Creek caused by logging were excessive siltation and destruction of habitat. Without taking directed restoration and management actions, the fishery may gradually recover, however there appears to be feasible management opportunities to speed up the recovery of the salmonid population providing the limiting factors for various life stages are understood specifically for this watershed.

Based upon our observations, currently the primary factors limiting salmonid success are substrate quality and flow conditions. There are a number of other factors that could potentially limit the success of steelhead or coho populations if substrate quality were to improve and low flow conditions were maintained or enhanced, but presently there is evidence that these other factors are subordinate. These other factors include LWD removal, bank revetments that decrease channel complexity or potentially create migration barriers, pool volume and quality (area of rearing habitat), cover elements, riffle area and morphology (spawning habitat), water temperature, riparian canopy, inputs of garbage, and degradation of water quality through leaking septic systems and illicit disposal. Although limited LWD removal to protect bridges or other structures does occur, sufficient in-channel LWD currently exists due to nearly continuous riparian canopy providing the source, landslides providing the transport mechanism, and the species controlling the slow decay rates of in-channel pieces. Because supply well exceeds removal, LWD is presently not a primary limiting factor. Many locations in the study reach contain various types of bank revetment. Although the majority of these locations are poorly designed or currently failing, because of the limited length and discontinuous occurrence of these structures, bank revetments are not a primary limiting factor. Also, in the 5 km study reach, no complete physical migration barriers were observed, including barriers associated with either massive wood jams, dysfunctional revetments, or drop structures (although we caution that new barriers could be created during each successive wet season). Water quality is likely not significantly limiting success. Despite observation of many inputs of garbage, highway runoff, the smell of leaky septic systems and household influent, and the likelihood of nutrient supplies from grazing, these inputs are small compared to the amount of “clean” runoff from the watershed. Also, riparian canopy shading may be presently limiting growth of plants or algae directly related to the input of nutrients. It is important to note that our assessment is based solely on physical habitat measures. To date, a biological inventory or more detailed bioenergetic study has not been completed, allowing for a more robust assessment of other potential limiting factors. And to our knowledge, there have been no in- or out-migration surveys completed and little or no monitoring of redds. Despite these gaps, based upon the presently available data collected in 2002/2003 and in 2007, the primary factors limiting salmonid success in La Honda Creek are substrate quality (mainly for spawning, but secondarily in riffles) and flow conditions (particularly low flow persistence).

The quality of substrate in La Honda Creek limits salmonid success primarily by affecting spawning, and secondarily by affecting rearing. Successful salmonid spawning requires habitat units with appropriate hydraulics and gravels. The data shows that a suitable number of pool tail out locations exist, with a variety of pool formative mechanisms, sizes, and complexity. At these locations, the spawning gravels must have the appropriately-sized framework clasts, a low percentage of material finer than 1 mm and 6.35 mm, and low levels of embeddedness. Substrate data collected in 2007 is not adequate to determine if the gravels meet these criteria, however the more detailed 2002/2003 data allowed assessment of the gravel quality. Data from surface pebble counts and subsurface bulk sampling indicate that appropriate framework gravels are provided, and that with moderate removal during redd construction, the percentage of fine material is within the range that will not negatively affect egg incubation or fry emergence. However, because La Honda Creek is moderately to highly embedded, we suggest that adult salmonids may not be able to move the gravels and construct a redd in many of the pool tail out locations. Embeddedness, the primary substrate quality limiting factor, is due to the in-situ breakdown of mudstone clasts, rather than hydraulic deposition of fine sediment. This process is essentially self-driven because the fine sediment is supplied from the in-channel mudstone clasts containing the clay mineral montmorillonite that break down because of continual wetting and drying. Currently the primary source of sediment supply to the channel is from shallow landslides and headwardly extending gullies. Landslides that impinge directly on the creek provide a fresh source of gravel that is loose enough initially for successful spawning. However, landslides that occur in the mudstone unit (Lambert Shale/San Lorenzo Formation) directly supply the creek with mudstone clasts, continually driving the mechanism for embeddedness (Figure 25). Although inputs of fine sediment from Highway 84 road drains were observed, the total volume of sediment from these sources is orders of magnitude less than that supplied by landslides. In addition, the Butano Sandstone formation, which outcrops in the upper portion of the watershed (Figure 25), is regionally known to be an erosion-prone unit, especially in areas where the landscape has been disturbed. Because the area within the watershed where this geologic unit outcrops is outside of our study area, we have no direct observation of erosion styles or magnitudes within this unit. However, further field observation may conclude that erosion occurring within this unit is contributing to the degraded quality of the substrate, in addition to contributions from the mudstone unit.

The success of rearing salmonids is also affected by substrate quality. The breakdown of mudstone clasts provides fine sediment which is easily transported in suspension, even by low to moderate flows. Measures of turbidity taken in 2002/2003 show that La Honda Creek can become very turbid, even in late season small rain events. High levels of turbidity may be affecting success by causing gill trauma and decreased feeding success in rearing salmonids. Embeddedness also affects the food supply of rearing fish by reducing the richness and abundance of benthic macroinvertebrate (BMI) taxa in riffles with high embeddedness values. Previous sampling suggests that the BMI community is being somewhat negatively affected by fine sediment deposition.

Flow conditions in La Honda Creek include not just volume of water conveyed by the channel, but also the timing and persistence of flow, water temperature, and water quality. We suggest that the volume and persistence of flow is the primary flow-related limiting factor in La Honda Creek. The effects of flow on temperature are secondary to flow volume. The water temperature dataset shows that over most of the year, La Honda Creek conveys cool water. However, during the critical summer and fall months water temperatures occasionally approach levels known to stress rearing salmonids. The effects of temperature are likely minimal because the creek has nearly continuous riparian canopy cover, limiting insolation, and maintains at least minimal flow fed by cool groundwater recharge during the dry season. Flow volume also affects water quality because as discharge decreases, the concentration of any contaminants (e.g. influent from leaking septic systems) increases, but these effects are tertiary in comparison to flow volume and temperature. La Honda Creek is likely not impacted by poor water quality; for example, we did not observe significant algae growth reflecting input of excess nutrients into the creek. However, we do not know the effect of other contaminants likely present in the creek such as copper sources from Highway 84 runoff, or PCBs, dioxins, and xeno-estrogens (all known endocrine disruptors found in sewage effluent) (Pait and Nelson, 2002). And finally, the timing of flow directly affects many salmonid life stages, but does not appear to be a limiting factor in La Honda Creek.

The primary effect of flow conditions limiting salmonid success is flow volume and persistence, especially during the critical summer and fall months. As the volume of flow decreases, the amount of habitat provided by the creek decreases, including wetted channel width and water depth. Decreased water depth reduces pool residual volume and flow over riffles. The 2007 data reveals that most pools are between two and three feet deep; reduced flow would cause water depths in many pools to decrease to one to two feet. Smaller pools typically are less complex, have fewer cover elements, and have less thermal stratification. In addition, reduced flow over riffles affects the BMI population, the food source for rearing salmonids. Less flow reduces the transport of these organisms downstream into pool units, and a cessation of flow may even cause the collapse of the population in the dry riffle units. Although our observations suggest that La Honda Creek maintains at least minimal flow throughout the year, we also observed locations of localized water diversion from the creek. Even just a handful of diversions can extract enough water to cause short reaches of the creek to completely dry up. Given that low flows are approximately only 1 cfs, water diversions have the potential to significantly increase stress on the salmonid population.

Data collected in 2002/2003 and 2007 allow for the documentation of current physical fish habitat conditions in La Honda Creek. Our data and observations suggest that the primary factors limiting the success of salmonids in the watershed are substrate quality and flow conditions. Embeddedness of gravels in pool tail locations likely makes redd construction difficult or impossible in some locations, and also is negatively affecting the BMI population. The volume and persistence of flow, especially during summer and fall months, is likely limiting rearing habitat and reducing the abundance and diversity of the BMI population. Although we recognize that multiple factors play a role in the quality and quantity of physical habitat provided by La Honda Creek, presently embeddedness and low dry-season flow conditions are primary limiting factors. Once these limiting factors are addressed in a manner determined to be practical and cost-effective by land managers, additional effort might be placed toward addressing water quality issues, localized bank erosion, and decreased channel complexity caused by poorly-designed or failing bank revetments. Given the amount of riparian vegetation and exposed in-channel bedrock, it seems unlikely that the quantity, quality and complexity of scour elements, habitat units, and cover elements will ever become primary limiting factors.

RECOMMENDATIONS

La Honda Creek has been targeted for recovery by the *Draft Strategic Plan for Restoration of Endangered Coho Salmon South of San Francisco Bay* (1998). CDFG has been monitoring the salmonid population since at least the 1950s (Appendix G). Despite declines in habitat quality, the data indicate there is still great potential for recovery. If current land management trends allow continued natural reforestation, the fishery may gradually recover, however with added effort, the speed of the recovery is likely to increase. Based on our observations and review of local watershed information over the last four years, and experience in other Bay Area watersheds, we make the following general recommendations.

1. Reduce sediment supply from the mudstone geology unit (Lambert Shale/San Lorenzo formation) found in upper portion of the study reach (central part of La Honda Creek watershed). In addition, reduce sediment supply from the Butano Sandstone formation (upper part of La Honda Creek watershed). Although this portion of the watershed is outside of the observations made in our study area, this unit is regionally known to be a significant source of erosion and sedimentation where the landscape is disturbed, including areas within the adjacent El Corte de Madera Creek Open Space Preserve (Matt Baldzikowski, pers. comm.).
   a) Encourage land management to enhance perennial grasses, shrub, and tree species in an effort to modify the hill slope water budget to increase water infiltration, retention, and interception, and to decrease quick-flow runoff. This will have the most benefit in areas impacted by land use-related shallow landslides and gully development.
   b) Review cattle grazing practices, and where possible, implement measures that reduce soil compaction and runoff, to reduce sediment supply from shallow landslides, gullies, and drainages.
   c) Enhance drainage of key deep seated landslides to dewater and reduce pore pressures in the slide mass and surrounding hillslope, to reduce the potential for recurring failure.
   d) Continue road assessments within the watershed (including both active roads and historic logging roads) that identify active and future sediment sources, and implement recommended treatments to reduce sediment generated from road networks.

2. Maintain or increase summertime flow volume in the creek.
   a) Evaluate water use within the La Honda Creek Open Space Preserve (LHCOSP) and designate any unused allocation to stream flow.

b) Continue to participate in the San Gregorio Environmental Resource Center's current watershed assessment effort, particularly in any flow-related measurement activities.
c) Manage watershed lands to enhance wet season infiltration and aquifer recharge (e.g. 1a, 1b, 1c).

3. Develop a focused monitoring program to assist land management.
   a) Work with appropriate agencies to accommodate desired stream gage installations at appropriate locations within the LHCOSP, and the larger La Honda Creek Watershed.
   b) Perform an annual post-wet season 1-day creek walk to check for migration barriers such as major bank or revetment failures, and massive debris jams.
   c) Once every three years, perform a 1-day survey of the embeddedness of pool tail locations (an improving trend over several decades would indicate success).
   d) Continue to work with appropriate fisheries agencies to monitor fish populations as an indicator of success.

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FIGURES

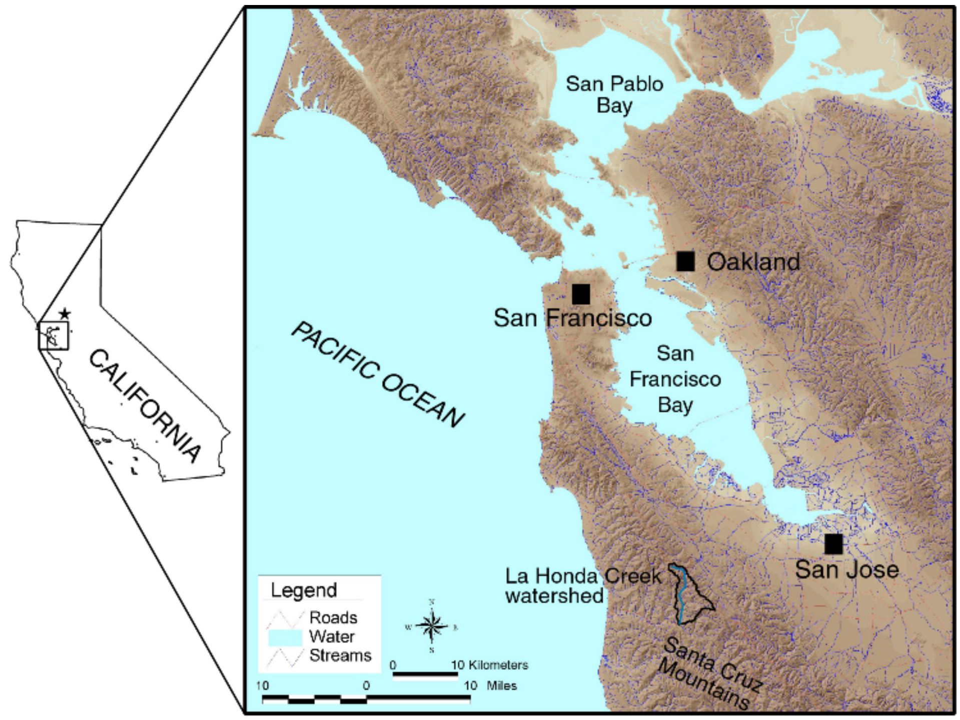

Figure 1. Location of the La Honda Creek watershed, San Mateo County, California.

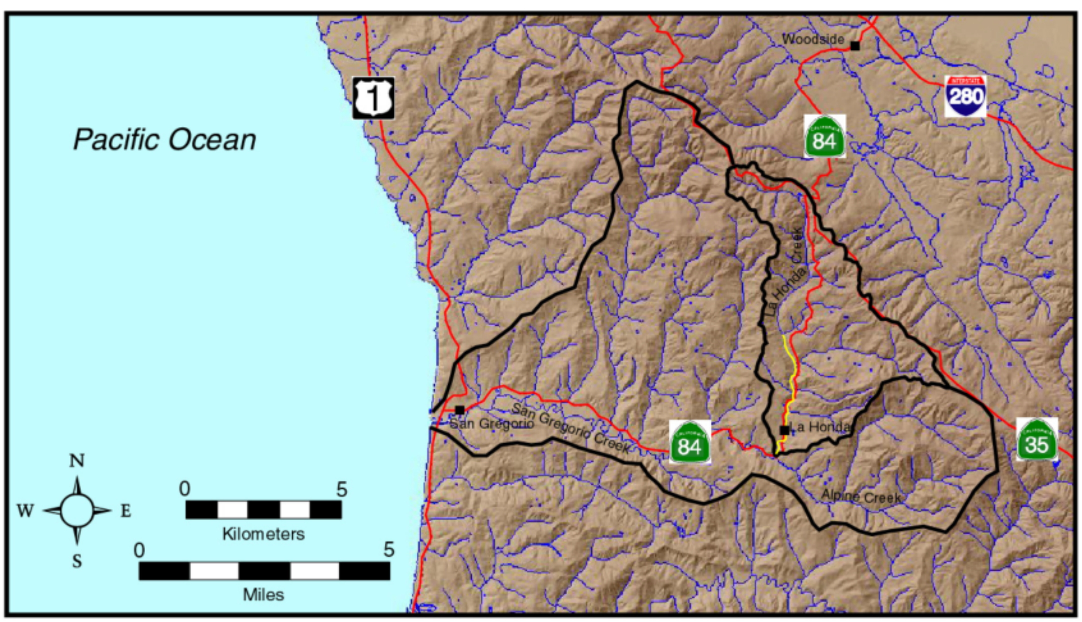

Figure 2. Map of the San Gregorio and La Honda watersheds. Watershed boundaries are shown in heavy black lines, highways are shown in red, and the study area of La Honda Creek is highlighted in yellow.

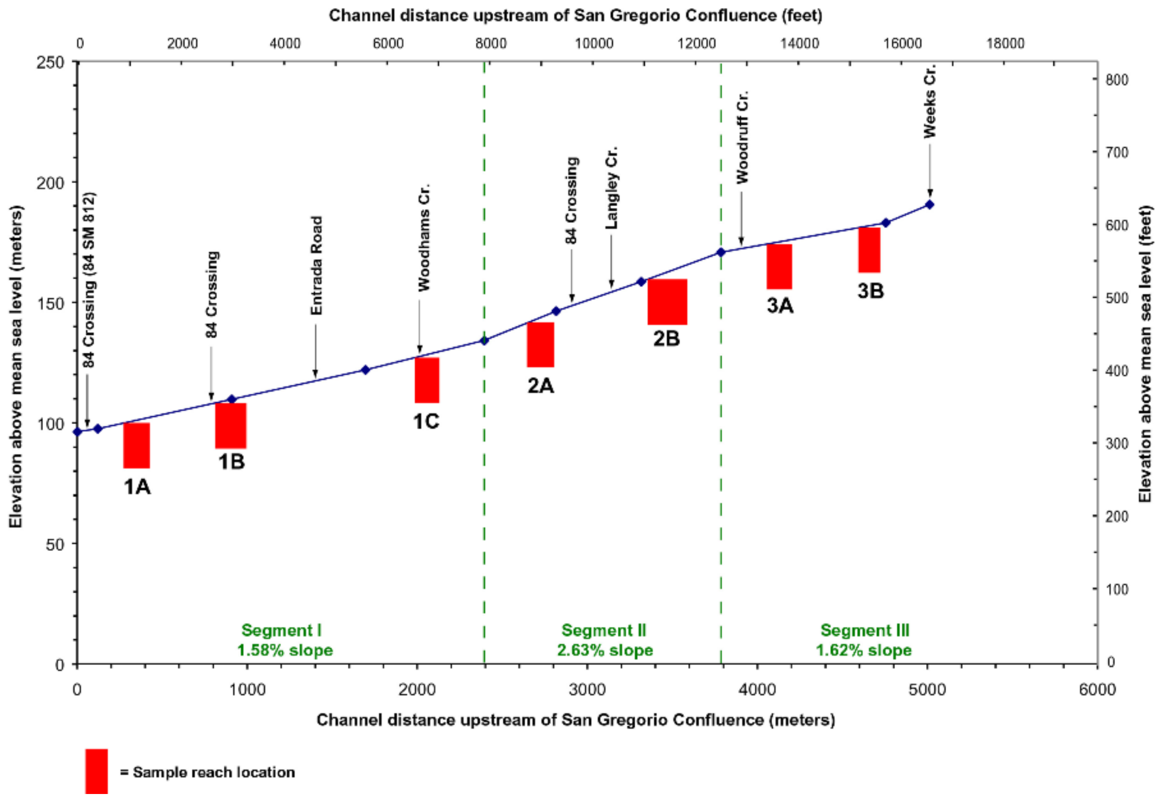

Figure 3. La Honda Creek longitudinal profile from the San Gregorio confluence to Weeks Creek. The channel profile is shown in the solid blue line, segment boundaries are shown in green dashed lines, and sample reach locations are represented by red bars.

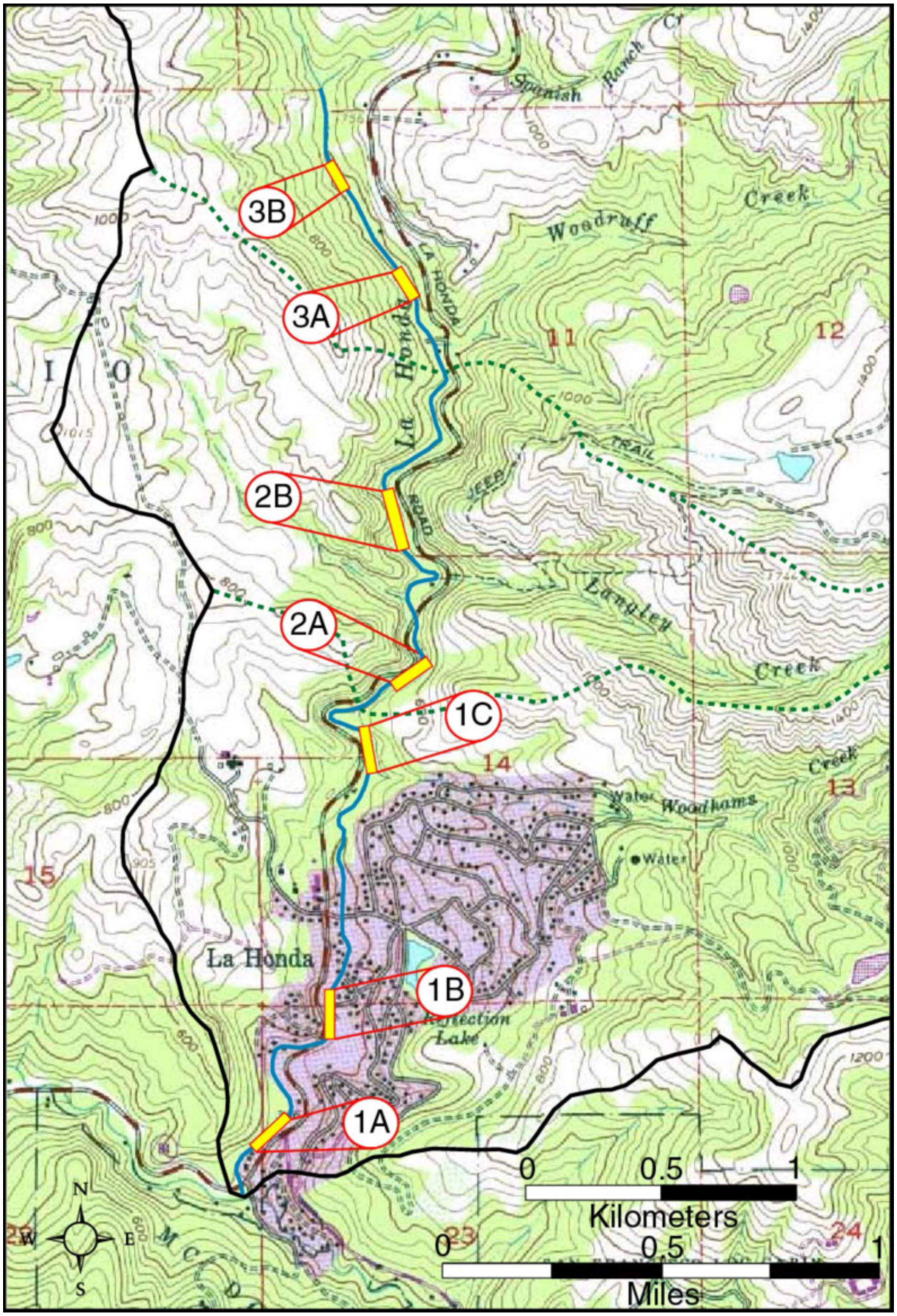

Figure 4. Topographic map of the lower portion of the La Honda Creek watershed. The watershed boundary is shown by a solid black line, the stream length in the study area is highlighted in blue, sample segments are shown in green dashed lines, and sample reach locations are shown in yellow.

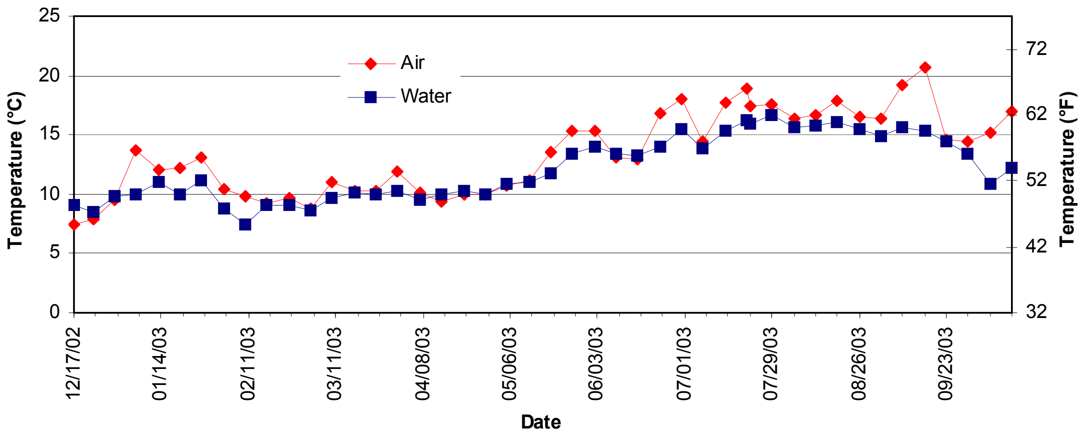

Figure 5. La Honda Creek water temperatures at Delay's bridge. Data is collected hourly from December 17, 2002 to October 24, 2003. Air temperatures for the same time period are from the California Department of Forestry La Honda (LAH) Station.

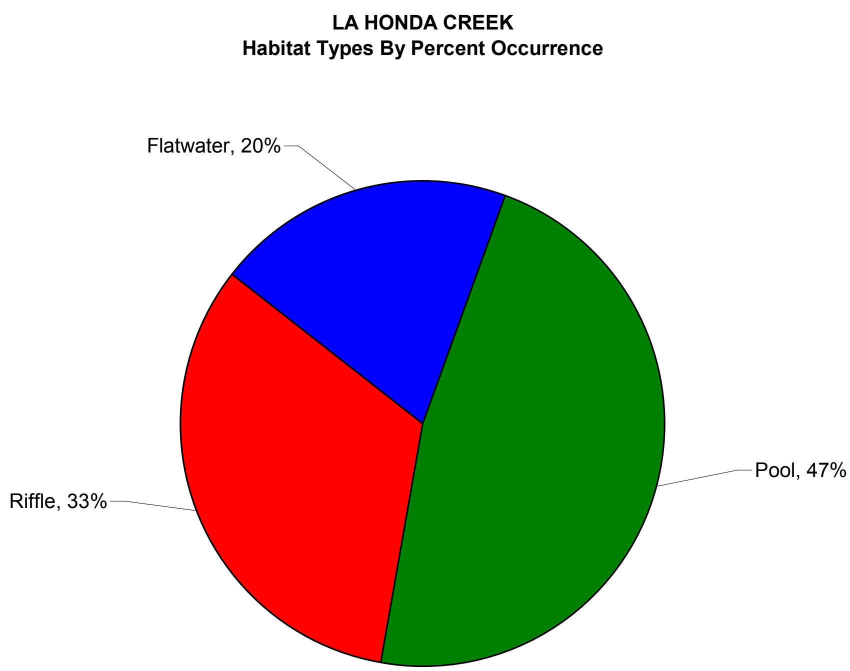

Figure 6. La Honda Creek habitat types by percent occurrence.

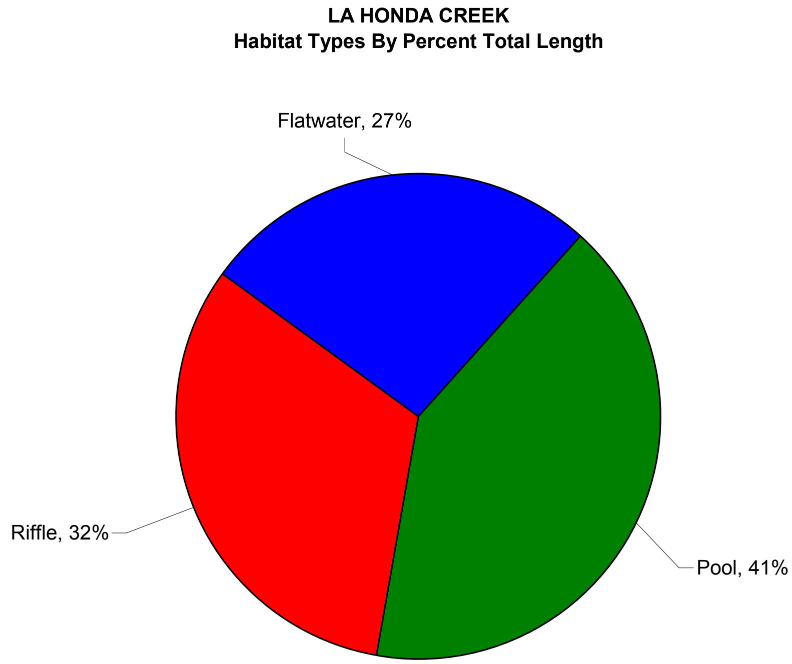

Figure 7. La Honda Creek habitat types by percent total length.

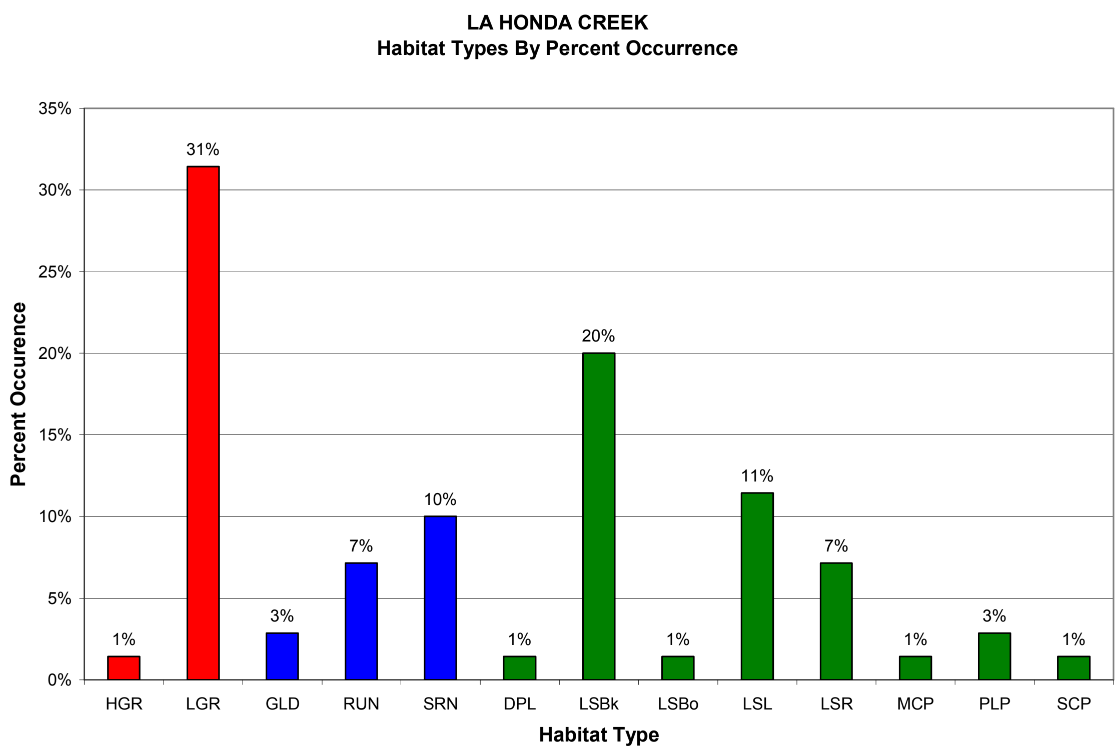

Figure 8. La Honda Creek habitat types by percent occurrence.

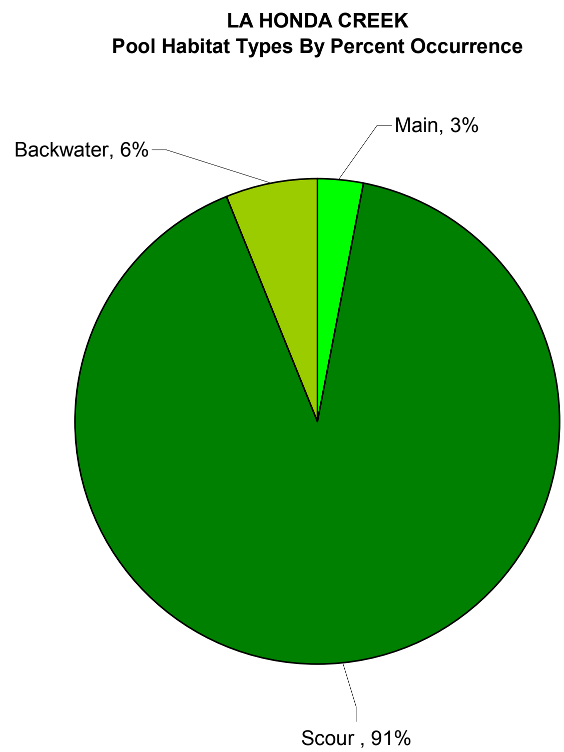

Figure 9. La Honda Creek pool habitat types by percent occurrence.

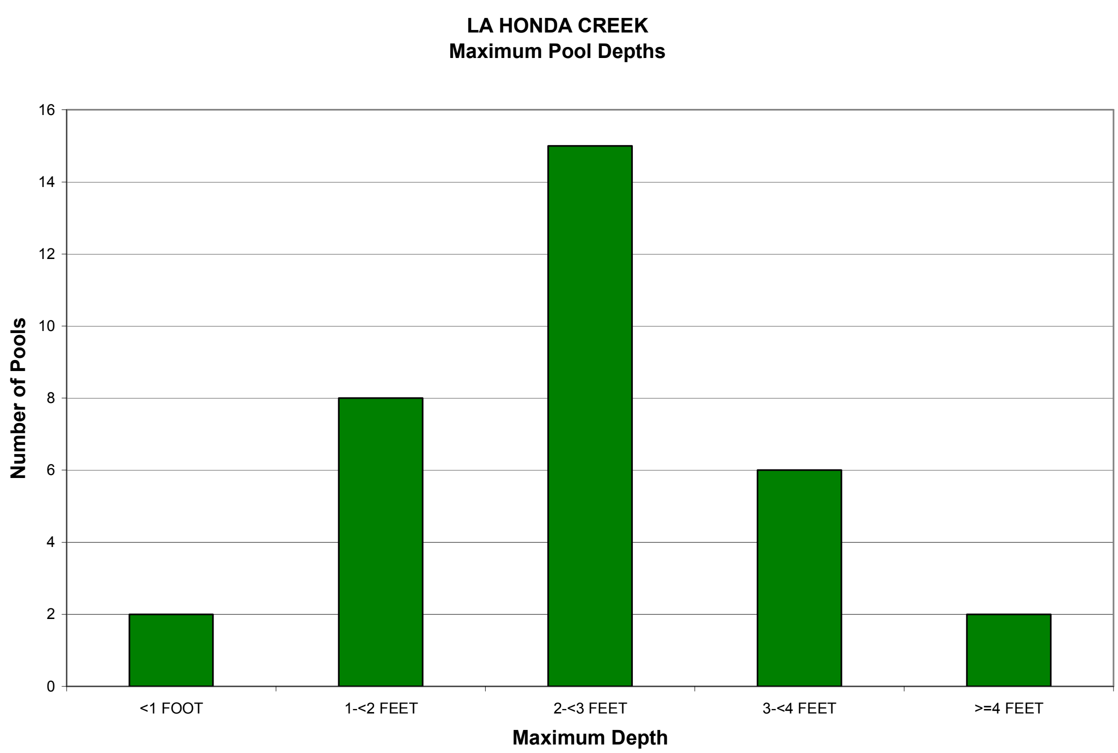

Figure 10. La Honda Creek maximum pool depths.

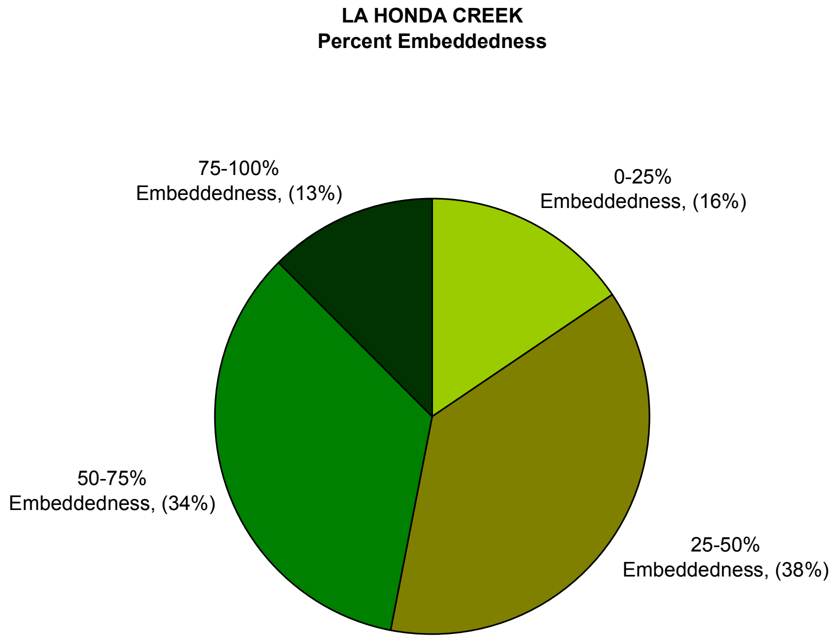

Figure 11. La Honda Creek percent embeddedness.

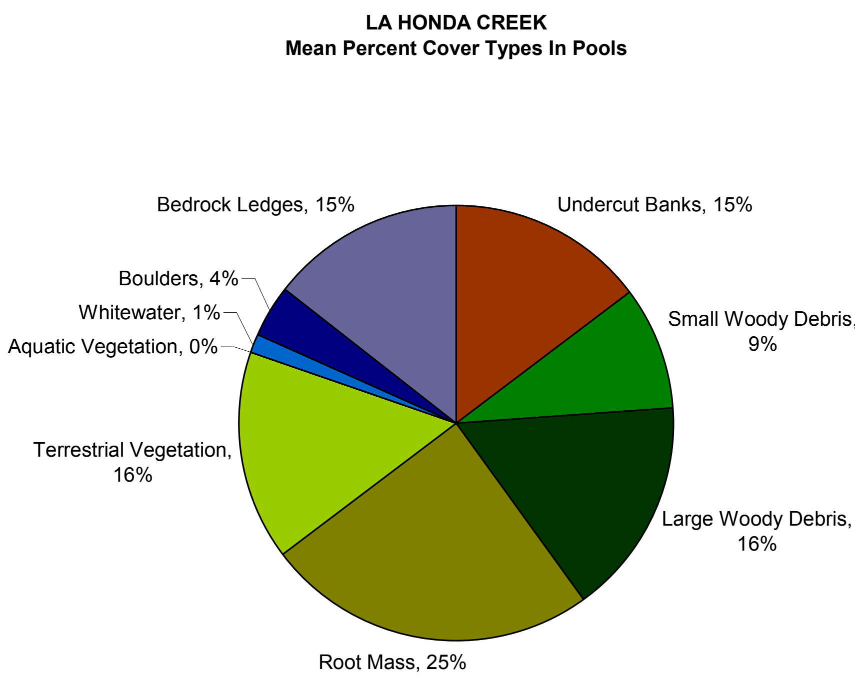

Figure 12. La Honda Creek mean percent cover types in pools.

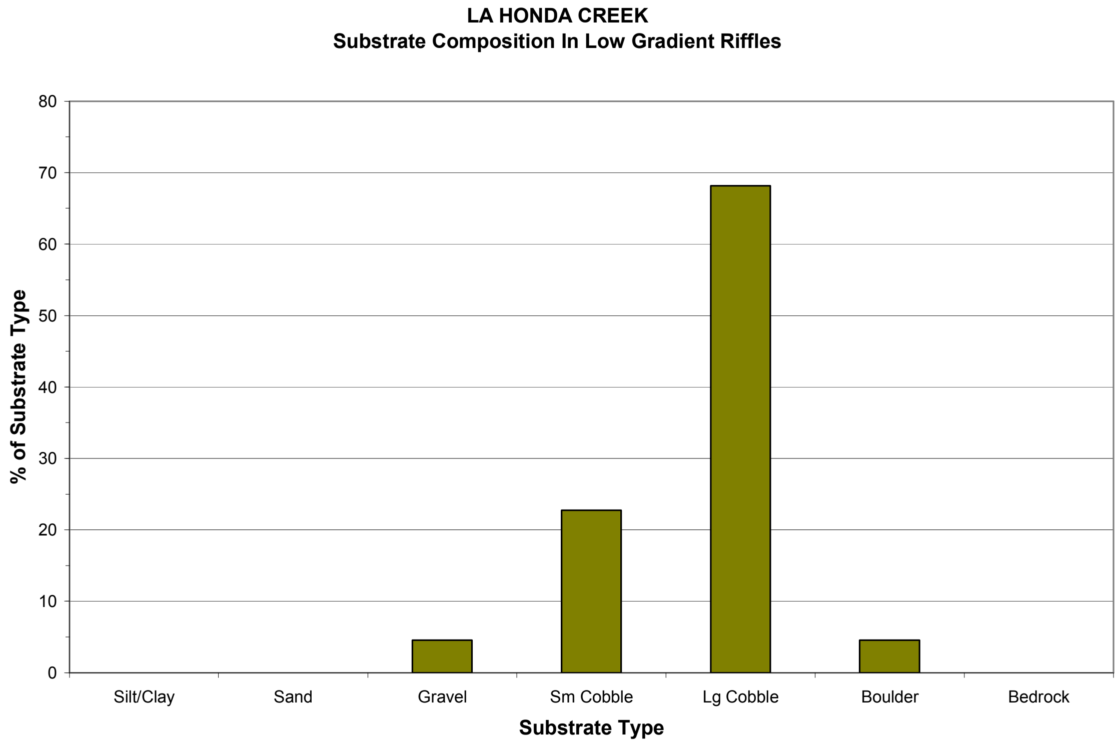

Figure 13. La Honda Creek substrate composition in low gradient riffles.

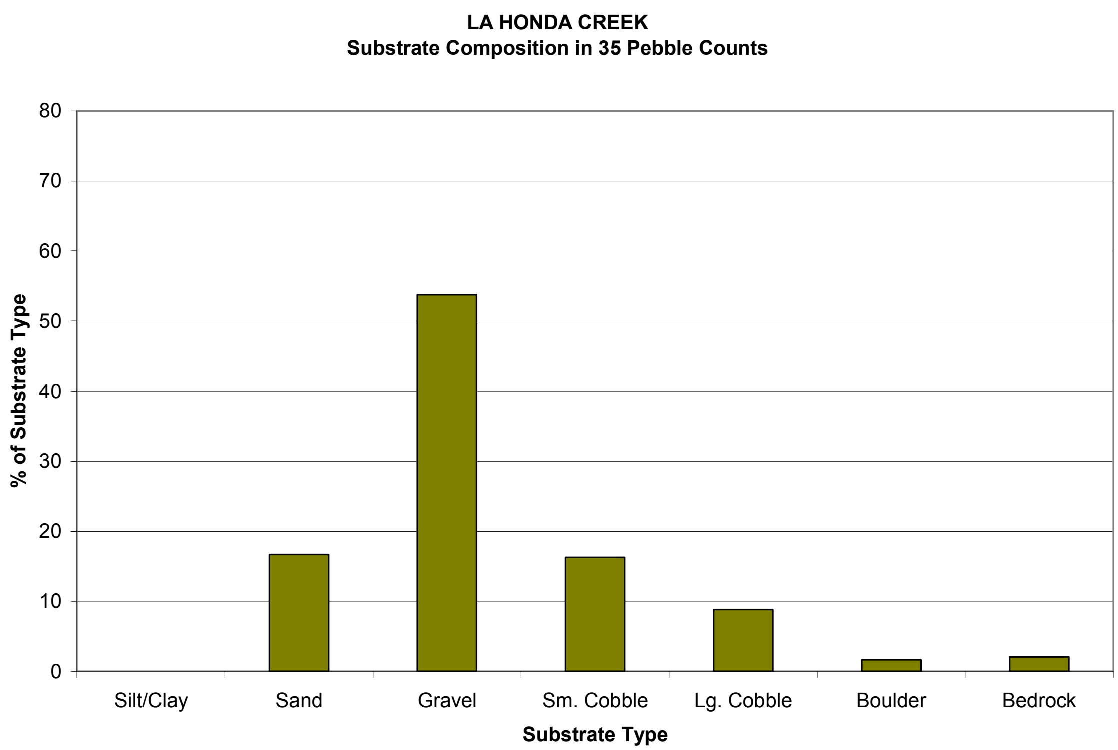

Figure 14. La Honda Creek substrate composition for all seven sample reaches combined as measured from 35 pebble counts sampled in 2002/2003.

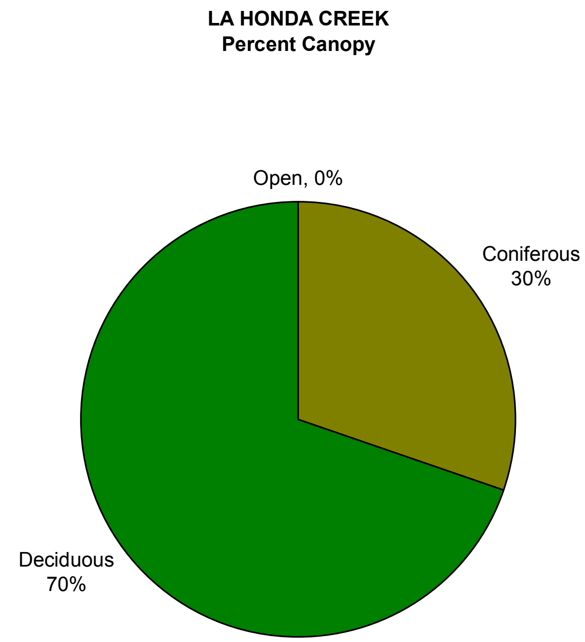

Figure 15. La Honda Creek percent canopy.

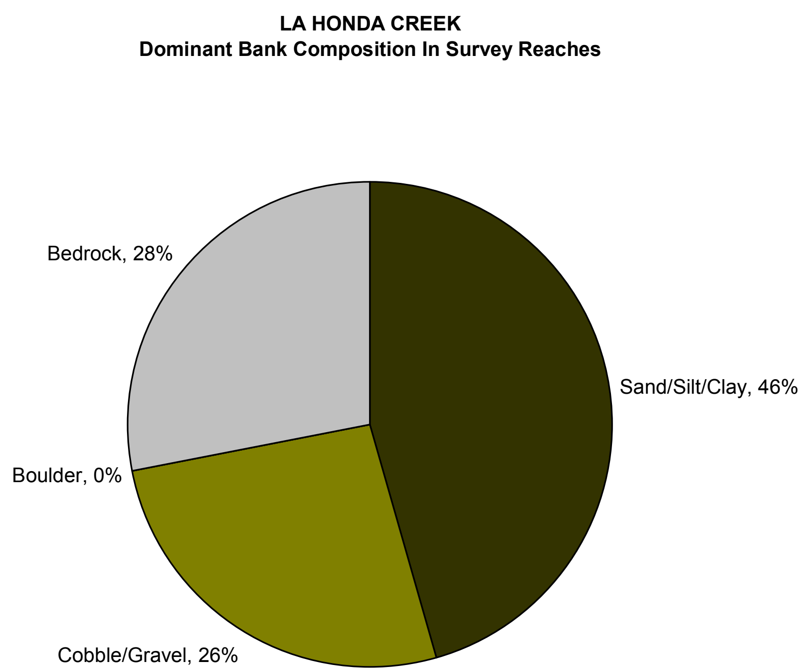

Figure 16. La Honda Creek dominant bank composition in survey reaches.

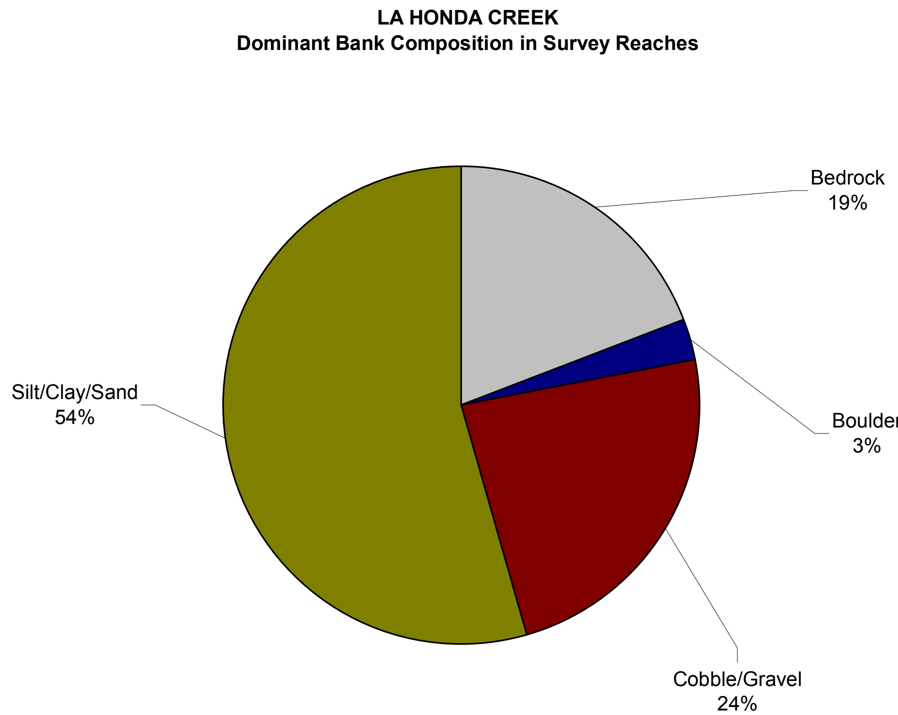

Figure 17. La Honda Creek dominant bank composition in survey reaches as measured in 2002/2003.

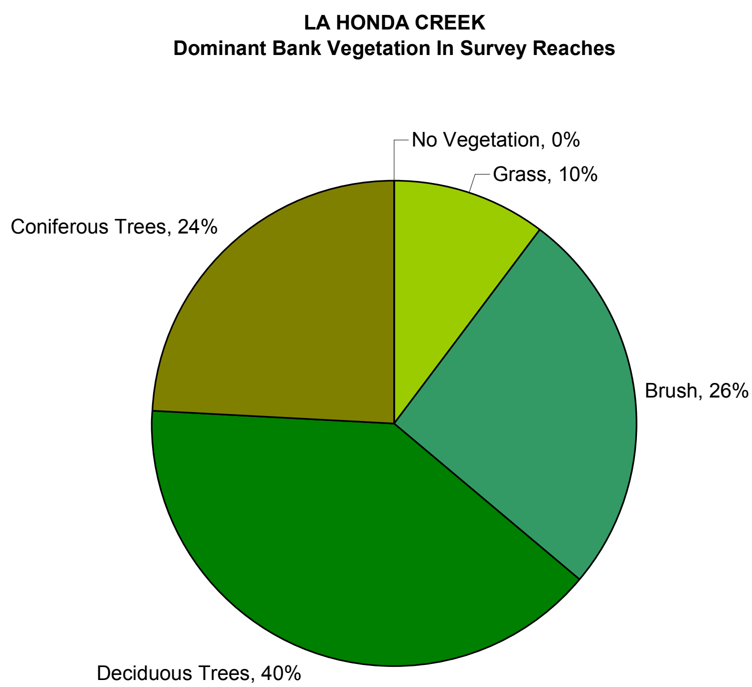

Figure 18. La Honda Creek dominant bank vegetation in survey reaches as measured in 2002/2003.

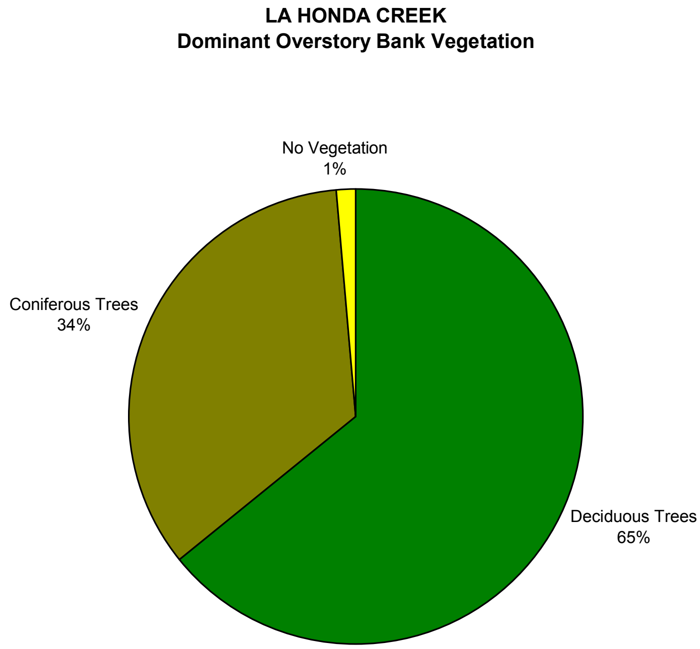

Figure 19. La Honda Creek dominant overstory bank vegetation as measured in 2002/2003.

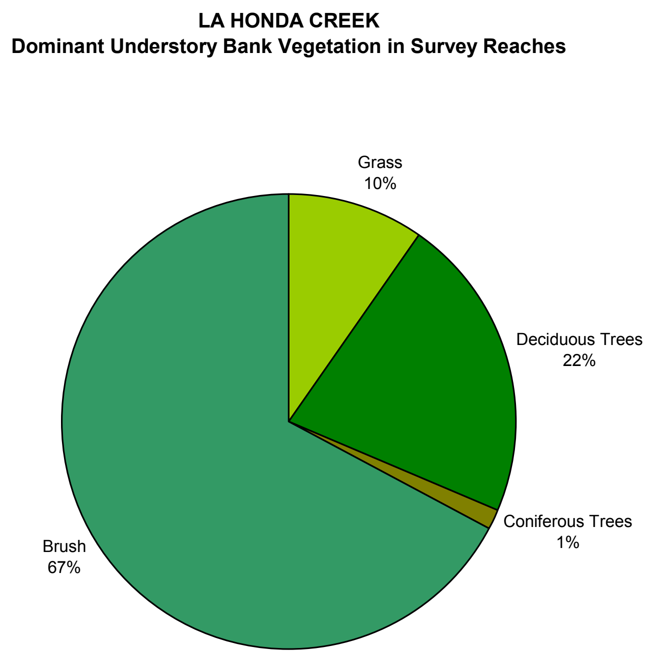

Figure 20. La Honda Creek dominant understory bank vegetation as measured in 2002/2003.

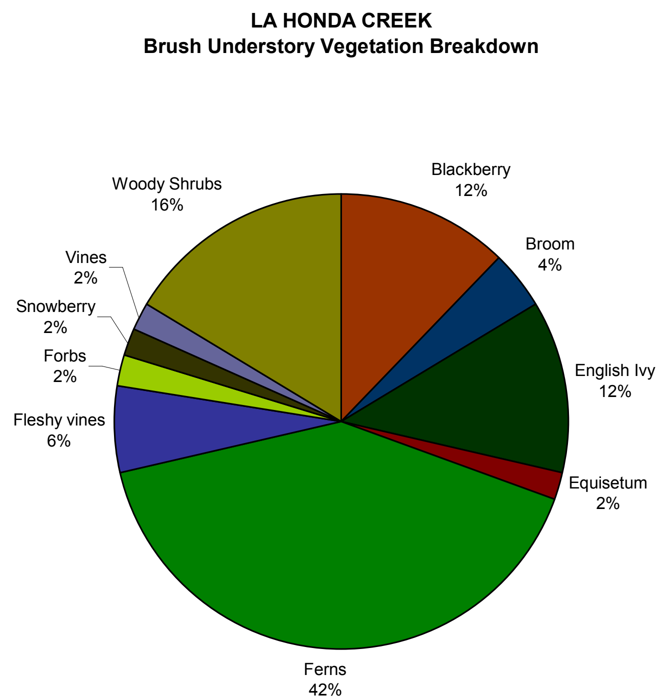

Figure 21. La Honda Creek brush understory vegetation as measured in 2002/2003.

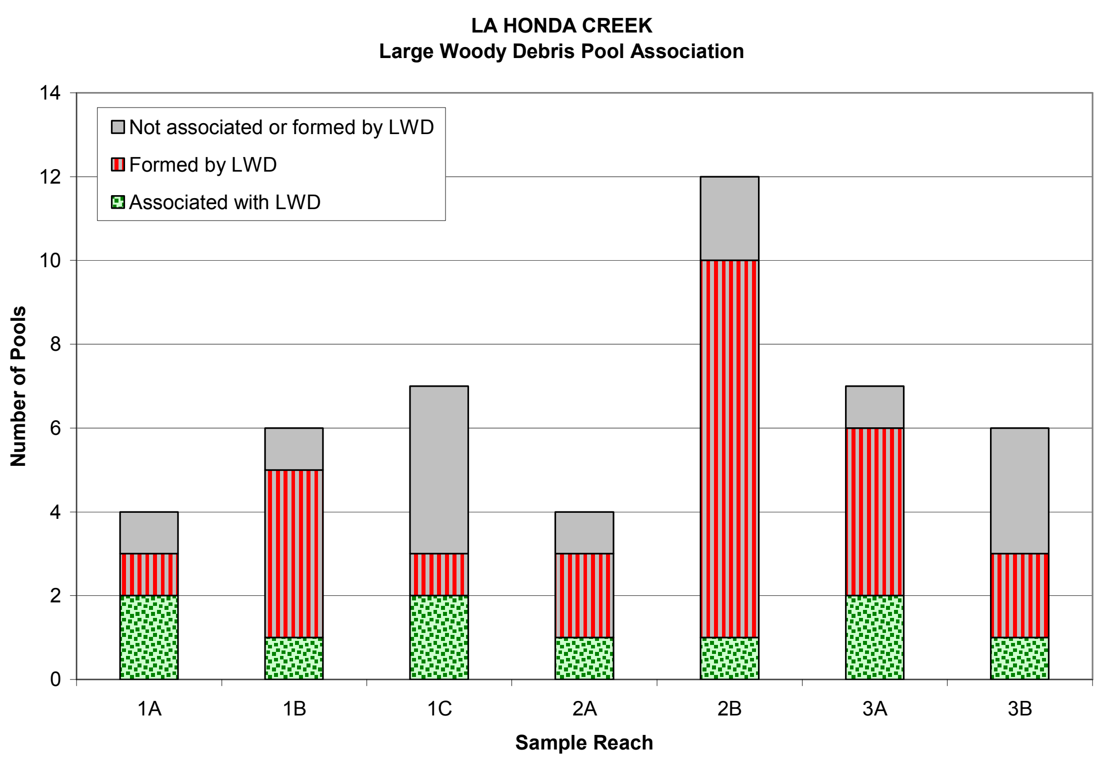

Figure 22. La Honda Creek number of pools associated with large woody debris in each survey reach as measured in 2002/2003.

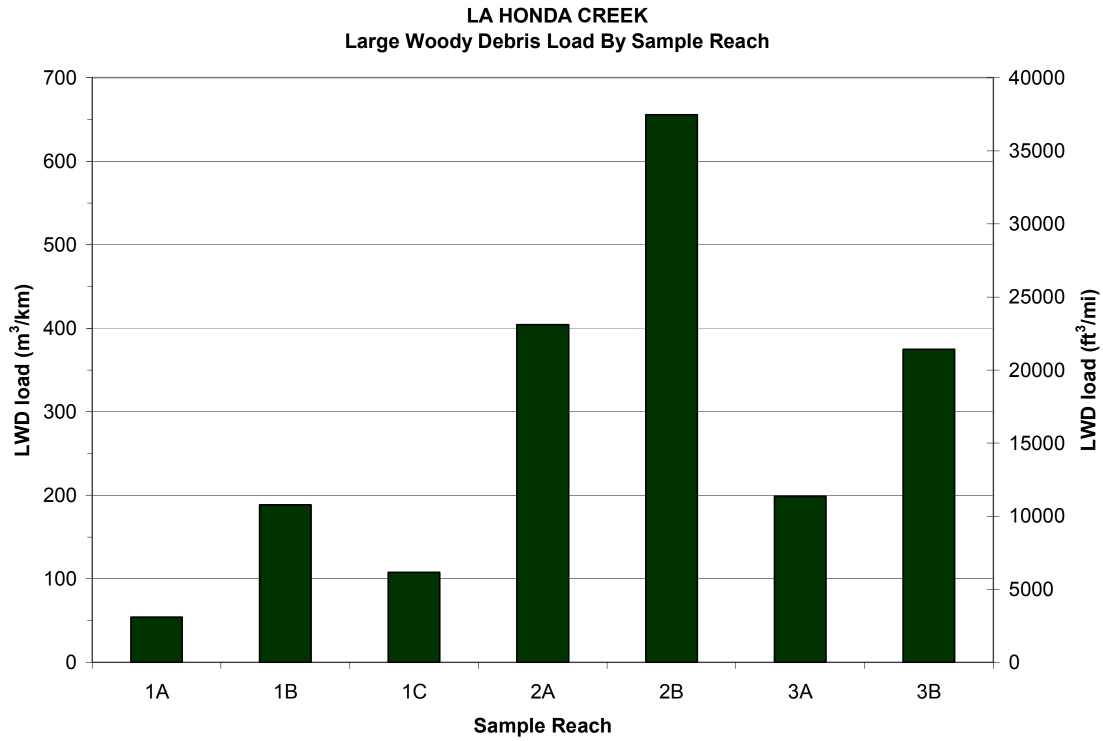

Figure 23. La Honda Creek large woody debris load by sample reach as measured in 2002/2003.

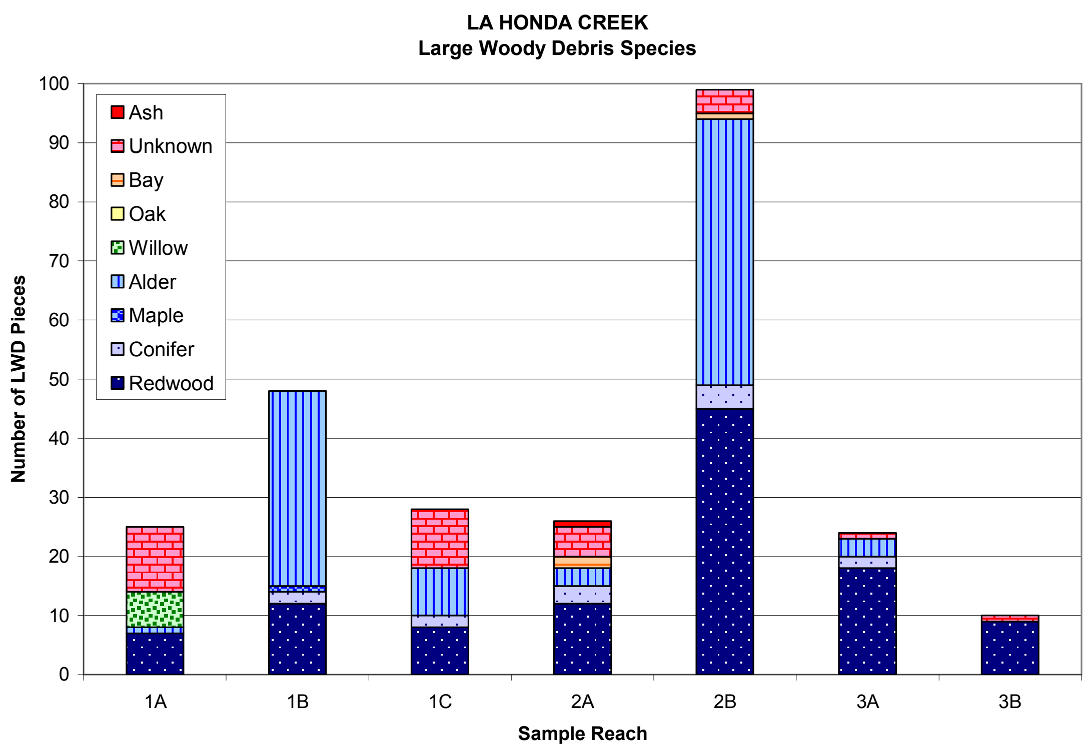

Figure 24. La Honda Creek large woody debris species by sample reach as measured in 2002/2003.

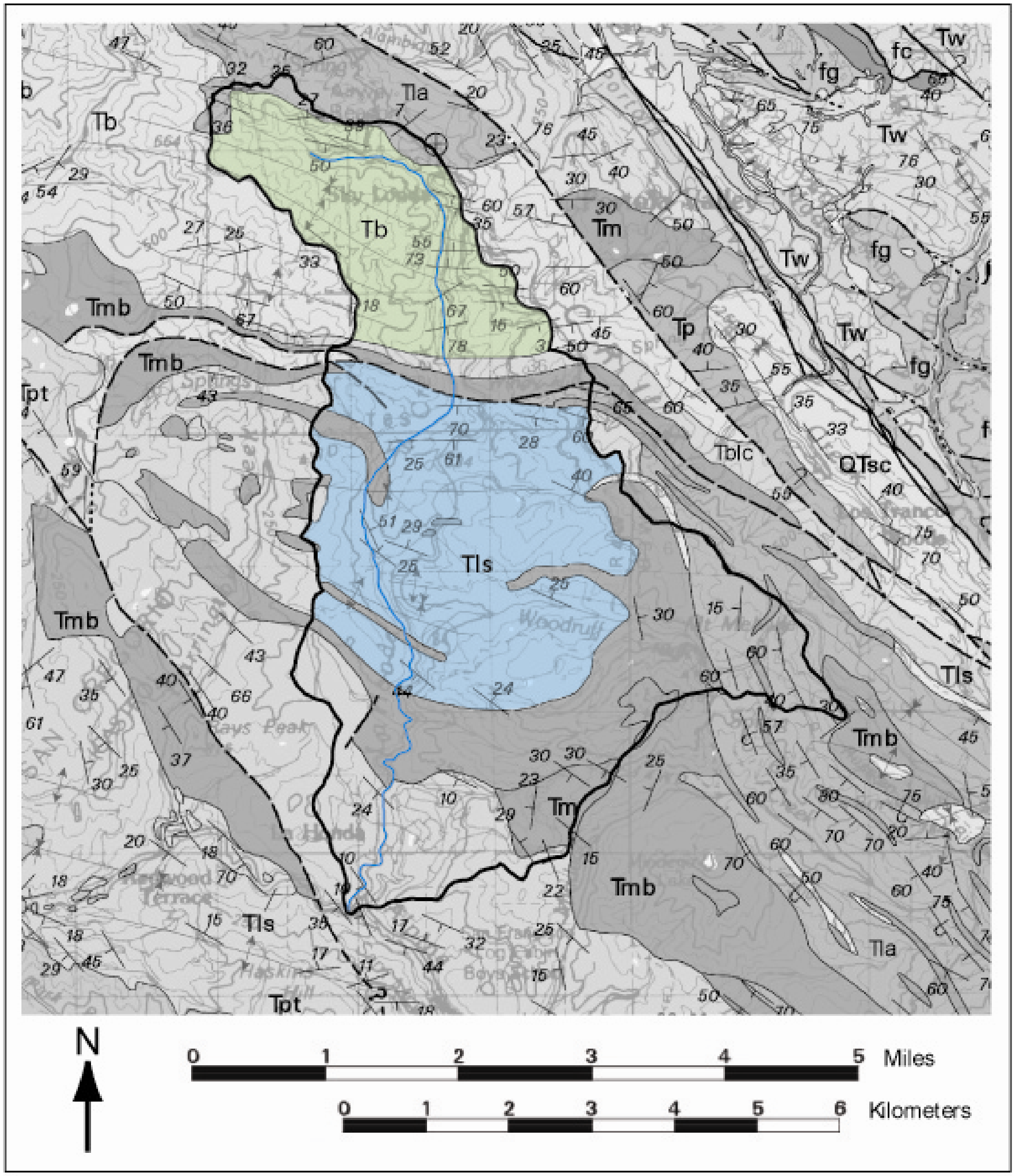

Figure 25. Geologic map of the La Honda Creek watershed; boundary shown by heavy black line. From a portion of the Palo Alto quadrangle (Brabb et al., 2000). Tls=Lambert Shale/San Lorenzo Fm., Tb=Butano Sandstone, Tmb=Mindego Basalt, Tpt=Purisma Fm. Tehana Mbr., Tm=Monterey Fm., Tla=Lambert Shale, QTsc=Santa Clara Fm., fg=greenstone. The Lambert Shale/San Lorenzo Fm. unit (Tls) is highlighted in blue as the mudstone lithology that is contributing to the high values of embeddedness in La Honda Creek. The Butano Sandstone unit (Tb) is highlighted in green as a lithology that regionally has been shown to be erosion-prone, especially in disturbed areas.

Figure 26. Low-gradient riffle in reach 1A (S. Pearce, 2007).

Figure 27. Low-gradient riffle in reach 2B (S. Pearce, 2007).

Figure 28. Side channel unit in reach 1A. Main channel is on the right of the photo, side channel is on the left (S. Pearce, 2007).

Figure 29. Example of the scale of some LWD pieces in comparison to channel dimensions; reach 2A (S. Pearce, 2007).

Figure 30. Plunge pool in reach 2A (S. Pearce, 2007).

Figure 31. An example of small woody debris providing cover in a pool unit in reach 1A (S. Pearce, 2007).

Figure 32. A lateral scour pool–bedrock formed in reach 1C (S. Pearce, 2007).

Figure 33. An example of an undercut bank in reach 2A (S. Pearce, 2007).

Figure 34. A lateral scour pool–rootwad enhanced in reach 2A (S. Pearce, 2007).

Figure 35. An example of a deep (3-4 feet) pool in reach 3A (S. Pearce, 2007).

Figure 36. An example of a LWD jam in reach 3A (S. Pearce, 2007).

Figure 37. Channel bank revetment (sacrete) along the outside of a meander bend in reach 3A (S. Pearce, 2007).

Figure 38. Example of multiple cover elements in a pool in reach 3A (S. Pearce, 2007).

Figure 39. Example of an undercut bank providing cover in reach 2B (S. Pearce, 2007).

Figure 40. Example of a lateral scour pool–log enhanced in reach 2B (S. Pearce, 2007).

Figure 41. Average channel in reach 1B (S. Pearce, 2007).

Figure 42. Average channel in reach 2B (S. Pearce, 2007).

Figure 43. Average channel in reach 3A (S. Pearce, 2007).

Figure 44. Average channel in reach 3B (S. Pearce, 2007).

Figure 45. Photograph looking upstream at two fallen redwoods at Landslide Bend pressure point. The new Caltrans retaining wall for Highway 84 is visible in the upper right of the photograph (S. Pearce, 2007).

Figure 46. Close-up photograph looking upstream at Landslide Bend pressure point. This location is not currently a migration barrier for salmonids (S. Pearce, 2007).

Figure 47. Steelhead carcass found on March 31, 2007 in reach 2B. Stadia rod in meters. (S. Pearce, 2007).

Figure 48. Close-up of steelhead carcass (S. Pearce, 2007).

TABLES

Table 1. Starting location and total length of each sample reach.

Reach	Downstream Start Location	Total Reach Length (ft)	Notes
1A	30 mph bend monument, near the Pescadero Road intersection.	597	* This reach contains an additional 69 ft of side channel
1B	Highway 84 crossing at Memory Lane, 47 meters upstream of the upstream face of bridge.	643	
1C	30 meters downstream of Woodhams Creek confluence.	587	* This reach contains an additional 69 ft of side channel
2A	295 meters downstream of Highway 84 crossing near 9755 La Honda Rd.	571	
2B	188 meters upstream of Langley Creek confluence.	833	* This reach contains an additional 98 ft of side channel
3A	212 meters upstream of Woodruff Creek confluence, near 10520 La Honda Rd.	436	
3B	360 meters downstream of Weeks Creek confluence.	453	

Table 2. Level III and Level IV Habitat Type Key

HABITAT TYPE	LETTER	NUMBER
RIFFLE		
Low Gradient Riffle	[LGR]	1.1
High Gradient Riffle	[HGR]	1.2
CASCADE		
Cascade	[CAS]	2.1
Bedrock Sheet	[BRS]	2.2
FLATWATER		
Pocket Water	[POW]	3.1
Glide	[GLD]	3.2
Run	[RUN]	3.3
Step Run	[SRN]	3.4
Edgewater	[EDW]	3.5
MAIN CHANNEL POOLS		
Trench Pool	[TRP]	4.1
Mid-Channel Pool	[MCP]	4.2
Channel Confluence Pool	[CCP]	4.3
Step Pool	[STP]	4.4
SCOUR POOLS		
Corner Pool	[CRP]	5.1
Lateral Scour Pool - Log Enhanced	[LSL]	5.2
Lateral Scour Pool - Root Wad Enhanced	[LSR]	5.3
Lateral Scour Pool - Bedrock Formed	[LSBk]	5.4
Lateral Scour Pool - Boulder Formed	[LSBo]	5.5
Plunge Pool	[PLP]	5.6
BACKWATER POOLS		
Secondary Channel Pool	[SCP]	6.1
Backwater Pool - Boulder Formed	[BPB]	6.2
Backwater Pool - Root Wad Formed	[BPR]	6.3
Backwater Pool - Log Formed	[BPL]	6.4
Dammed Pool	[DPL]	6.5

Table 3. Flow on a reach basis in La Honda Creek on March 24 and 31, 2007.

Date	Reach	Flow (cfs)
March 24, 2007	1A	0.47
March 24, 2007	1B	0.92
March 24, 2007	1C	0.88
March 24, 2007	2A	0.58
March 31, 2007	2B	1.41
March 31, 2007	3A	0.19
March 31, 2007	3B	0.46

Table 4. Summary of measurements contributing to Rosgen channel type designations.

Reach	Channel Type	Single Thread	Multiple Channel	Dominant Substrate	Subdominant Substrate	Entrenchment (Downstream)	Entrenchment (Upstream)	Width/Depth Ratio (Downstream)	Width/Depth Ratio (Upstream)	Sinuosity	Channel Gradient (%)
1A	B3c	Y	N	Cobble	Sand	1.9	1.9	8.6	18.5	<1.2	1.2
1B	B3c	Y	N	Cobble	Gravel	1.7	1.3	14.8	17.7	<1.2	1.2
1C	E3	Y	N	Cobble	Sand	1.3	4.5	8.7	11	<1.2	1.6
2A	B3c	Y	N	Cobble	Boulder	2.3	1.5	8.8	9.8	<1.2	1.8
2B	E3b	Y	N	Cobble	Sand	3.6	4.1	8.0	7.2	<1.2	2.4
3A	A3	Y	N	Cobble	Sand	1.2	1.6	7.3	6.3	<1.2	1.4
3B	A3	Y	N	Cobble	Sand	1.4	1.3	5.4	7.6	<1.2	2.0

LA HONDA CREEK

Drainage: SAN GREGORIO CREEK

Table 5 - SUMMARY OF RIFFLE, FLATWATER AND POOL HABITAT TYPES

Survey Dates: 03/24/07 AND 03/31/07

Confluence Location: QUAD: LA HONDA LEGAL DESCRIPTION; T. 7 S., R. 4 W

LATITUDE: 37º 18' 35" to 37º 20' 48" North LONGITUDE: 122º 16' 05" to 122º 16' 40" West

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT % OCCURRENCE	MEAN LENGTH (ft)	TOTAL LENGTH (ft)	% TOTAL LENGTH	MEAN WIDTH (ft)	MEAN DEPTH (ft)	MEAN AREA (sq.ft)	ESTIMATED TOTAL AREA (sq.ft)	MEAN VOLUME (cu.ft)	ESTIMATED TOTAL VOLUME (cu.ft)	MEAN RESIDUAL POOL VOL (cu.ft)	MEAN SHELTER RATING
23	9	Riffle	33%	61	1399	32%	14.3	0.4	867	19940	326.5	7509	0	25
14	6	Flatwater	20%	83	1161	27%	12.8	0.5	1059	14820	497.4	6963	0	34
33	14	Pool	47%	54	1796	41%	13.0	1.0	705	23269	725.6	23944	2.1	66
Total Units	**Total Units**				**Total Length (ft)**					**Total Area (sq. ft)**		**Total Vol (cu. ft)**		
70	**29**				**4357**					**58029**		**38416**		

LA HONDA CREEK

Table 6 - SUMMARY OF HABITAT TYPES AND MEASURED PARAMETERS

Confluence Location: QUAD: LA HONDA LEGAL DESCRIPTION; T. 7 S., R. 4 W

Drainage: SAN GREGORIO CREEK

Survey Dates: 03/24/07 AND 03/31/07

LATITUDE: 37º 18' 35" to 37º 20' 48" North LONGITUDE: 122º 16' 05" to 122º 16' 40" West

HABITAT UNITS #	UNITS FULLY MEAS-URED	HABITAT TYPE	HABITAT % OCCUR-RENCE	MEAN LENGTH (ft)	TOTAL LENGTH (ft)	% TOTAL LENGTH	MEAN WIDTH (ft)	MEAN DEPTH (ft)	MAX. DEPTH (ft)	MEAN AREA (sq.ft)	ESTIMATED TOTAL AREA (sq.ft)	MEAN VOLUME (cu.ft)	ESTIMATED TOTAL VOLUME (cu.ft)	MEAN RESIDUAL POOL VOL (cu.ft)	MEAN SHELTER RATING	MEAN CANOPY (%)
1	1	HGR	1%	52	52	1%	12.1	0.4	0.4	637	637	272	272	0	65	20
22	8	LGR	31%	61	1347	31%	14.3	0.4	1.5	876	19261	328	7210	0	23	47
2	1	GLD	3%	115	230	5%	18.7	0.4	1.7	2147	4295	881	1761	0	39	45
5	3	RUN	7%	43	217	5%	11.4	0.4	1.3	492	2458	213	1065	0	16	66
7	2	SRN	10%	102	715	16%	12.1	0.5	1.6	1233	8632	633	4430	0	47	56
1	1	DPL	1%	43	43	1%	15.4	0.7	0.5	658	658	475	475	0.20	120	50
14	7	LSBk	20%	65	906	21%	12.0	1.1	4.1	778	10886	853	11939	2.14	55	53
1	1	LSBo	1%	79	79	2%	11.8	0.8	2.6	930	930	732	732	2.26	110	50
8	1	LSL	11%	39	313	7%	14.2	1.1	3.4	557	4459	594	4754	1.95	65	57
5	2	LSR	7%	47	233	5%	13.8	1.1	4.9	642	3210	682	3412	2.72	97	59
1	1	MCP	1%	95	95	2%	15.4	0.5	1.2	1467	1467	770	770	0.79	20	80
2	1	PLP	3%	30	59	1%	13.6	1.2	2.3	402	804	475	950	1.56	56	35
1	0	SCP	1%	69	69	2%	6.6	0.4	0.8	452	452	163	163	0.39	55	70
Total Units	**Total Units**				**Total Length (ft)**						**Total Area (sq. ft)**		**Total Vol (cu. ft)**			
70	**29**				**4357**						**58148**		**37933**			

LA HONDA CREEK
Table 7 - SUMMARY OF POOL TYPES
Confluence Location: QUAD: LA HONDA LEGAL DESCRIPTION; T. 7 S., R. 4 W

Drainage: SAN GREGORIO CREEK
Survey Dates: 03/24/07 AND 03/31/07
LATITUDE: 37º 18' 35" to 37º 20' 48" North LONGITUDE: 122º 16' 05" to 122º 16' 40" West

HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	HABITAT % OCCURRENCE	MEAN LENGTH (ft)	TOTAL LENGTH (ft)	% TOTAL LENGTH	MEAN WIDTH (ft)	MEAN DEPTH (ft)	MEAN AREA (sq.ft)	ESTIMATED TOTAL AREA (sq.ft)	MEAN VOLUME (cu.ft)	ESTIMATED TOTAL VOLUME (cu.ft)	MEAN RESIDUAL POOL VOL (cu.ft)	MEAN SHELTER RATING
1	1	Main	3%	95	95	5%	15.4	0.5	1467	1467	770	770	0.79	20
30	12	Scour	91%	53	1590	88%	11.0	0.5	582	17471	315	9458	2.15	86
2	1	Backwater	6%	56	112	6%	13.0	1.1	725	1450	782	1564	0.30	77
Total Units	**Total Units**				**Total Length (ft)**					**Total Area (sq. ft)**		**Total Volume (cu. ft)**		
33	**14**				**1796**					**20388**		**11792**		

LA HONDA CREEK

Drainage: SAN GREGORIO CREEK

Table 8 - SUMMARY OF MAXIMUM POOL DEPTHS BY POOL HABITAT TYPE

Survey Dates: 03/24/07 AND 03/31/07

Confluence Location: QUAD: LA HONDA LEGAL DESCRIPTION; T. 7 S., R. 4 W

LATITUDE: 37º 18' 35" to 37º 20' 48" North LONGITUDE: 122º 16' 05" to 122º 16' 40" West

UNITS MEASURED	HABITAT TYPE	HABITAT % OCCUR-RENCE	<1 FOOT MAX. DEPTH (# UNITS)	<1 FOOT PERCENT OCCUR-RENCE	1-<2 FEET MAX. DEPTH (# UNITS)	1-<2 FEET PERCENT OCCUR-RENCE	2-<3 FEET MAX. DEPTH (# UNITS)	2-<3 FEET PERCENT OCCUR-RENCE	3-<4 FEET MAX. DEPTH (# UNITS)	3-<4 FEET PERCENT OCCUR-RENCE	>=4 FEET MAX. DEPTH (# UNITS)	>=4 FEET PERCENT OCCUR-RENCE
1	MCP	3%	0	0%	1	100%	0	0%	0	0%	0	0%
1	SCP	3%	1	100%	0	0%	0	0%	0	0%	0	0%
1	DPL	3%	1	100%	0	0%	0	0%	0	0%	0	0%
14	LSBk	42%	0	0%	3	21%	7	50%	3	21%	1	7%
1	LSBo	3%	0	0%	0	0%	1	100%	0	0%	0	0%
8	LSL	24%	0	0%	3	38%	3	38%	2	25%	0	0%
5	LSR	15%	0	0%	0	0%	3	60%	1	20%	1	20%
2	PLP	6%	0	0%	1	50%	1	50%	0	0%	0	0%
Total Units			**Total Units**		**Total Units**		**Total Units**		**Total Units**		**Total Units**	
33			**2**		**8**		**15**		**6**		**2**	

LA HONDA CREEK

Table 9 - SUMMARY OF MEAN PERCENT COVER BY HABITAT TYPE

Confluence Location: QUAD: LA HONDA LEGAL DESCRIPTION; T. 7 S., R. 4 W

Drainage: SAN GREGORIO CREEK

Survey Dates: 03/24/07 AND 03/31/07

LATITUDE: 37º 18' 35" to 37º 20' 48" North LONGITUDE: 122º 16' 05" to 122º 16' 40" West

UNITS MEASURED	UNITS FULLY MEASURED	HABITAT TYPE	MEAN % UNIT COVERED	MEAN % UNDERCUT BANKS	MEAN % SWD	MEAN % LWD	MEAN % ROOT MASS	MEAN % TERRESTRIAL VEGETATION	MEAN % AQUATIC VEGETATION	MEAN % WHITE WATER	MEAN % BOULDERS	MEAN % BEDROCK LEDGES
1	1	HGR	65	0	5	20	0	0	0	30	10	0
22	8	LGR	24	2	6	4	3	4	0	1	2	2
2	1	GLD	26	0	5	7.5	10	0	0	0	3.5	0
5	3	RUN	25	2	5	5	4	3	0	2	3	1
7	2	SRN	41	4	8	4	6	2	0	2	2	13
1	1	DPL	60	0	5	15	30	0	0	0	5	5
14	7	LSBk	43	10	4	3	7	3	0	0	1	15
1	1	LSBo	55	15	5	0	5	0	0	0	0	30
8	1	LSL	47	6	15	19	7	0	0	0	0	1
5	2	LSR	54	13	2	3	26	5	0	0	2	3
1	1	MCP	20	10	0	0	5	0	0	0	5	0
2	1	PLP	37	1	2.5	20	7.5	0	0	5	1	0
1	0	SCP	55	0	0	0	5	50	0	0	0	0

Total Units	**Total Units**
70	**29**

LA HONDA CREEK

Drainage: SAN GREGORIO CREEK

Table 10 - SUMMARY OF DOMINANT SUBSTRATES BY HABITAT TYPE

Survey Dates: 03/24/07 AND 03/31/07

Confluence Location: QUAD: LA HONDA LEGAL DESCRIPTION; T. 7 S., R. 4 W

LATITUDE: 37º 18' 35" to 37º 20' 48" North LONGITUDE: 122º 16' 05" to 122º 16' 40" West

TOTAL HABITAT UNITS	UNITS FULLY MEASURED	HABITAT TYPE	% TOTAL SILT/CLAY DOMINANT	% TOTAL SAND DOMINANT	% TOTAL GRAVEL DOMINANT	% TOTAL SMALL COBBLE DOMINANT	% TOTAL LARGE COBBLE DOMINANT	% TOTAL BOULDER DOMINANT	% TOTAL BEDROCK DOMINANT
1	1	HGR	0	0	0	0	0	100	0
22	8	LGR	0	0	5	23	68	5	0
2	1	GLD	0	0	50	50	0	0	0
5	3	RUN	0	20	0	40	40	0	0
7	2	SRN	0	0	0	29	71	0	0
1	1	DPL	100	0	0	0	0	0	0
14	7	LSBk	7	64	21	7	0	0	0
1	1	LSBo	0	100	0	0	0	0	0
8	1	LSL	13	75	13	0	0	0	0
5	2	LSR	20	60	20	0	0	0	0
1	1	MCP	0	0	100	0	0	0	0
2	1	PLP	50	0	0	50	0	0	0
1	0	SCP	0	100	0	0	0	0	0
Total Units	**Total Units**								
70	**29**								

LA HONDA CREEK

Drainage: SAN GREGORIO CREEK

Table 11 - SUMMARY OF MEAN PERCENT VEGETATIVE COVER FOR THE SAMPLE REACHES

Survey Dates: 03/24/07 AND 03/31/07

Confluence Location: QUAD: LA HONDA LEGAL DESCRIPTION; T. 7 S., R. 4 W

LATITUDE: 37º 18' 35" to 37º 20' 48" North LONGITUDE: 122º 16' 05" to 122º 16' 40" West

MEAN PERCENT CANOPY COVER	MEAN PERCENT CONIFER CANOPY	MEAN PERCENT DECIDUOUS CANOPY	MEAN PERCENT OPEN CANOPY	MEAN % RIGHT BANK VEGETATION COVER	MEAN % LEFT BANK VEGETATION COVER
53	30	70	0	62	59

Note:
Mean percent conifer and deciduous are means of canopy components from units with canopy values greater than zero.
Open units represent habitat units with zero canopy cover.
Left and Right bank vegetation cover only estimated for 29 of the 70 total units.

APPENDICES

Appendix A – Sample Reach Bank Condition Data, 2002/2003

Table A-1. Bank characteristics for every fifth bankfull width for each sample reach 1A.

Meter	Bank	Bank composition	Bank slope	Bank height (m)	Bank vegetation type	Bank vegetation age (years)	Bank vegetation condition
32.5	Left	Silty terrace deposit	22°	2.0	Blackberry, nettle, young willow, fleshy vines	1-5	Dense
32.5	Right	Plastic silt and clay terrace deposit	35°	2.5	Sedge, young ash	5-10	Sparse
65	Left	Silty and cobble terrace deposit	80°	3.0	Redwood roots	100+	Sparse
65	Right	Silty and gravel terrace deposit	38°	0.8	Young willow, broom, thistle, weeds	1-5	Dense
97.5	Left	Plastic silty terrace deposit	32°	3.0	Blackberry	1-5	Dense
97.5	Right	Plastic silty terrace deposit	80°	1.2	Young willow, broom, fleshy vines, grasses	1-5	Dense
130	Left	Sandy terrace deposit	25°	1.5	Blackberry, young willow, broom	1-5	Dense
130	Right	Plastic silty terrace deposit	30°	2.0	Grasses, redwood rootball	10-20 rootball is 100+	Moderate
162.5	Left	Silty matrix supported terrace deposit	34°	0.8	Blackberry, young maple, willow, grasses	1-5	Dense
162.5	Right	Low plasticity silty to sandy terrace deposit	47°	1.2	Sedge, grasses, broom, young willow, young ash	5-10	Dense

Table A-2. Bank characteristics for every fifth bankfull width for each sample reach 1B.

Meter	Bank	Bank composition	Bank slope	Bank height (m)	Bank vegetation type	Bank vegetation age (years)	Bank vegetation condition
37.5	Left	Plastic silty colluvium, some cobbles	60°	7.0	Alder	20-50	Sparse
37.5	Right	Plastic silty to sandy soil	45°	7.0	English ivy, young redwood, alder	20-50	Moderate
75	Left	Massive bedrock	55°	8.0	Moss, fleshy vines	1-5	Moderate
75	Right	Cobble and silty to sandy soil	25°	5.0	English ivy, alder	20-50	Moderate
112.5	Left	Cobble and silty terrace deposit	20°	1.0	Roots of alder, fleshy vines	20-50	Moderate
112.5	Right	Cobble fluvial deposit	10°	2.5	English ivy, young hardwoods, broom	1-5	Moderate
150	Left	Cobble fluvial deposit and silty to sandy terrace deposit	10°	1.5	English ivy, young hardwoods, poison oak	1-5	Moderate
150	Right	Cobble fluvial deposit overlain by silty soil	20°	6.0	Roots of alder, English ivy	10-20	Moderate
187.5	Left	Bedrock overlain by cobble and silty soil	70°	4.0	Roots of redwood and buckeye	20-50	Sparse
187.5	Right	Cobble and silty soil	25°	7.0	English ivy, alder	20-50	Dense

Table A-3. Bank characteristics for every fifth bankfull width for each sample reach 1C.

Meter	Bank	Bank composition	Bank slope	Bank height (m)	Bank vegetation type	Bank vegetation age (years)	Bank vegetation condition
35	Left	ML or silty CL	70°	2.5	Roots of alder, oak	20-50	Sparse
35	Right	Well graded matrix supported cobble and silt	25°	2.0	Roots of alder, ferns	20-50	Sparse
70	Left	Matrix supported graded cobble to silt	45°	20	Fleshy ground cover, moss, ferns	1	Moderate
70	Right	Graded low plasticity silt, few cobbles	55°	2.0	Hardwood roots	10-20	Sparse
105	Left	SC	30°	3.0	Forbs, poison oak	1	Moderate
105	Right	GW, sandy to silty matrix	60°	3.0	Roots of alder, maple, bay	10-20	Sparse
140	Left	Cobble and sand fluvial deposit	10°	0.5	Nettle, ferns, grasses	1	Moderate
140	Right	Cobble and sand fluvial deposit	15°	0.6	Young willow, nettle	1	Sparse
175	Left	Well graded boulder and cobble fluvial deposit	20°	1.0	Roots of maple	10-20	Sparse
175	Right	Clayey pebble and sand colluvium with CL matrix	50°	8.0	English ivy, fleshy ground cover, roots of redwood	1	Moderate

Table A-4. Bank characteristics for every fifth bankfull width for each sample reach 2A.

Meter	Bank	Bank composition	Bank slope	Bank height (m)	Bank vegetation type	Bank vegetation age (years)	Bank vegetation condition
32.5	Left	Silty and cobble colluvium	25°	1.5	Fleshy vines, equisetum, moss	1	Moderate
32.5	Right	Fractured bedrock	50°	3.0	Roots of ash	20-50	Sparse
65	Left	Silty and cobble colluvium	40°	25	Roots of redwood, equisetum	100+	Sparse
65	Right	Silty colluvium and soil	15°	1.5	Grasses, equisetum, young ash	1	Moderate
97.5	Left	Silty colluvium and soil	35°	25	Willow, fleshy vines, clover	10-20	Moderate
97.5	Right	Bedrock overlain by soil	60°	5.0	Roots of redwood, ferns	100+	Moderate
130	Left	Bedrock	70°	4.0	Moss, ferns, roots of ash	10-20	Moderate
130	Right	Bedrock	60°	10.0	Moss, maple	10-20	Moderate
162.5	Left	Bedrock	60°	6.0	Moss, ferns, woody shrubs	1-5	Moderate
162.5	Right	Bedrock	45°	15	Moss, willow, ferns, roots of redwood	10-20	Moderate

Table A-5. Bank characteristics for every fifth bankfull width for each sample reach 2B.

Meter	Bank	Bank composition	Bank slope	Bank height (m)	Bank vegetation type	Bank vegetation age (years)	Bank vegetation condition
45	Left	Silty to sandy colluvium and soil	59°	12.0	Fleshy vines, roots of maple	10-20	Sparse
45	Right	Cobble and silt fluvial deposit	52°	1.5	Fleshy vines, nettle, ferns, roots of alder	1 roots 20-50	Moderate
90	Left	Cobble and boulder fluvial deposit, landslide debris	40°	1.5	Grasses, nettle, sedge, broom, fleshy vines	1	Sparse
90	Right	Landslide debris, weathered bedrock	15°	1.5	Blackberry, fleshy vines, sedge, young ash, equisetum	1-5	Dense
135	Left	Plastic silty soil with some boulders	-20° undercut	2.0	Roots of conifer	100+	Sparse
135	Right	Cobble and boulder fluvial deposit	10°	0.9	Sedge, fleshy vines, nettle, young willow	1-5	Moderate
180	Left	Plastic silty colluvium and soil	55°	8.0	Blackberry, nettle, fleshy vines, equisetum	1-5	Moderate
180	Right	Plastic silty colluvium and soil	35°	2.5	Blackberry, equisetum, fleshy vines, nettle, ferns	1-5	Dense
225	Left	Boulder and cobble fluvial deposit	30°	0.6	Sedge, fleshy ground cover	1	Sparse
225	Right	Weathered bedrock	66°	20	Moss, roots of maple	1	Sparse

Table A-6. Bank characteristics for every fifth bankfull width for each sample reach 3A.

Meter	Bank	Bank composition	Bank slope	Bank height (m)	Bank vegetation type	Bank vegetation age (years)	Bank vegetation condition
25	Left	Low plasticity sandy graded soil	80°	3.0	Roots of redwood	100+	Sparse
25	Right	Plastic silty and gravel soil	30°	2.0	Moss, vines, roots of ash	1-5 roots 20-50	Moderate
50	Left	Sacrete wall	45°	4.0	Young alder	5-10	Sparse to none
50	Right	Silt and clay soil	40°	2.5	Roots of alder	10-20	Sparse
75	Left	Sacrete wall	50°	4.0	None	none	None
75	Right	Fractured bedrock and clayey soil	65°	5.0	Roots of ash	20-50	Sparse
100	Left	Plastic silty soil	50°	2.5	Roots of redwood	100+	Sparse
100	Right	Fractured bedrock	30°	6.0	None	none	None
125	Left	Clayey sandy soil	60°	2.5	Roots of redwood	100+	Sparse
125	Right	Clayey soil	35°	2.0	Roots of redwood	100+	Sparse

Table A-7. Bank characteristics for every fifth bankfull width for each sample reach 3B.

Meter	Bank	Bank composition	Bank slope	Bank height (m)	Bank vegetation type	Bank vegetation age (years)	Bank vegetation condition
22.5	Left	Sandy colluvium and soil	50°	5.0	Roots of redwood	20-50	Sparse
22.5	Right	Bedrock overlain by silty soil	75°	6.0	Roots of redwood	100+	Dense in soil profile
45	Left	Landslide debris	30°	15.0	Grasses, weeds	1	Moderate
45	Right	Sandy to silty colluvium and soil	15°	3.0	Grasses, fleshy vines, blackberry, willow	10-20	Dense
67.5	Left	Silty to sandy colluvium	40°	2.0	Moss, roots of willow, equisetum, sedge, fleshy vines	1-5	Moderate
67.5	Right	Bedrock	80°	4.0	Moss, ferns	1	Sparse
90	Left	Cobble and silt fluvial deposit	15°	1.5	Sedge	1	Sparse
90	Right	Landslide debris	20°	1.5	Grasses, equisetum, ferns, fleshy vines	1	Moderate
112.5	Left	Cobble and silty colluvium and soil	40°	4.5	Roots of redwood and willow	20-50	Sparse
112.5	Right	Cobble and silty colluvium and soil	60°	5.0	Roots of redwood, moss, ferns	100+	Moderate

Appendix B – Sample Reach Riparian Condition Data, 2002/2003

Table B-1. Riparian characteristics at every fifth bankfull width for sample reach 1A.

Meter	Bank	Riparian vegetation overstory	Riparian vegetation understory	Riparian vegetation age (years)	Riparian width (bankfull widths)	Terrace/ Hillslope land use	% canopy cover	Potential # of LWD recruits
32.5	Left	Bay, maple, redwood	Broom, blackberry, nettle, young willow	20-50	1-5	Natural terrace and highway 84	50	4-6
32.5	Right	Ash, redwood	Fleshy vines	100+	5-10	Natural terrace	50	4-6
65	Left	Redwood, ash	Young redwood	100+	1-5	Natural terrace	50	4-6
65	Right	Redwood	Grasses	100+	1	Cleared terrace	50	1-3
97.5	Left	Redwood	Blackberry	100+	1-5	Natural terrace	25	1-3
97.5	Right	Redwood	Young willow, broom, grasses	100+	1	Cleared terrace, recreation	25	1-3
130	Left	Redwood	Blackberry, grasses	100+	1-5	Natural terrace	25	1-3
130	Right	Redwood	Young willow	50-100	1	Cleared terrace, recreation	25	1-3
162.5	Left	Maple	Blackberry, fleshy vines	20-50	1-5	Natural terrace	25	4-6
162.5	Right	Alder, ash, redwood	Grasses, blackberry, vines, broom	20-50	1-5	Trailer park	25	4-6

Table B-2. Riparian characteristics at every fifth bankfull width for sample reach 1B.

Meter	Bank	Riparian vegetation overstory	Riparian vegetation understory	Riparian vegetation age (years)	Riparian width (bankfull widths)	Terrace/ Hillslope land use	% canopy cover	Potential # of LWD recruits
37.5	Left	Alder, redwood, maple	Sedge, ferns, vines	100+	5-10	Natural hillslope	100	4-6
37.5	Right	Alder, maple	English ivy, young redwood, young hardwood	20-50	2	Channel bank and highway 84	100	7-9
75	Left	Ash, redwood	Sedge, ferns, vines, moss, young hardwood	100+	5-10	Natural hillslope	50	1-3
75	Right	Maple, alder, redwood	English ivy, young maple, young redwood	100+	1-5	Channel bank and highway 84	50	4-6
112.5	Left	Alder, redwood	Young redwood, young hardwoods	100+	5-10	Park	75	4-6
112.5	Right	Alder, redwood	Woody shrubs, English ivy, broom	100+	1-5	Natural terrace, channel bank and highway 84	75	4-6
150	Left	Redwood, alder	English ivy, woody shrubs, young maple	20-50	5-10	Park	100	4-6
150	Right	Alder, ash, maple, buckeye	English ivy, young maple, woody shrubs, young redwood	20-50	2	Channel bank and highway 84	100	1-3
187.5	Left	Redwood, buckeye, ash	English ivy, ferns, woody shrubs	50-100	5-10	Park	100	4-6
187.5	Right	Alder, maple, redwood	English ivy, young hardwoods	20-50	2	Channel bank and highway 84	100	1-3

Table B-3. Riparian characteristics at every fifth bankfull width for sample reach 1C.

Meter	Bank	Riparian vegetation overstory	Riparian vegetation understory	Riparian vegetation age (years)	Riparian width (bankfull widths)	Terrace/ Hillslope land use	% canopy cover	Potential # of LWD recruits
35	Left	Alder, bay, redwood, oak	Woody shrubs, ferns, fleshy vines	50-100	20+	Natural hillslope	75	1-3
35	Right	Alder, maple, ash	Woody shrubs, ferns, fleshy vines	20-50	10-20	Natural terrace	75	1-3
70	Left	Maple, alder, redwood, bay	Ferns	20-50	20+	Natural hillslope	75	4-6
70	Right	Bay, ash, redwood	Woody shrubs, moss	10-20, redwood 100+	10-20	Dirt road, recreation	75	1-3
105	Left	Conifer, alder, oak, bay	Forbs, poison oak, woody shrubs	20-50	10-20	Natural hillslope	75	4-6
105	Right	Bay, alder, maple	Woody shrubs, vines	10-20	1-5	Recreation, natural	75	7-9
140	Left	Redwood, bay	Young willow, woody shrubs	100+	5-10	Natural hillslope	75	1-3
140	Right	Alder, maple, bay	Young hardwoods	20-50	5-10	Natural terrace	75	4-6
175	Left	Maple, alder, redwood	Woody shrubs, fleshy vines	100+	10-20	Natural hillslope	50	7-9
175	Right	Redwood, maple	Fleshy vines, woody shrubs	100+	1-5	Dirt pulloff	50	1-3

Table B-4. Riparian characteristics at every fifth bankfull width for sample reach 2A.

Meter	Bank	Riparian vegetation overstory	Riparian vegetation understory	Riparian vegetation age (years)	Riparian width (bankfull widths)	Terrace/ Hillslope land use	% canopy cover	Potential # of LWD recruits
32.5	Left	Oak, redwood, bay	Equisetum, ferns	20-50, redwood 100+	5-10	Natural hillslope	50	7-9
32.5	Right	Ash, bay	Ferns, woody shrubs, clover	20-50	1-5	Bank and highway 84	50	1-3
65	Left	Redwood, ash	Ferns, young maple	100+	5-10	Natural hillslope	50	4-6
65	Right	Bay, redwood	Young bay, ferns, clover	20-50, redwood 100+	1-5	Bank and highway 84	50	7-9
97.5	Left	Bay, willow, redwood	Ferns, vines, moss, woody shrubs	20-50, redwood 100+	5-10	Natural hillslope	25	7-9
97.5	Right	Redwood	Ferns, clover, woody shrubs	100+	1-5	Natural hillslope	25	4-6
130	Left	Ash, redwood	Ferns, moss, woody shrubs	100+	10-20	Natural hillslope	75	7-9
130	Right	Redwood, maple, bay	Moss, woody shrubs, ferns	100+	1	Bank and highway 84	75	1-3
162.5	Left	Alder, redwood, bay, oak	Ferns, woody shrubs, young redwood, young bay	20-50	5-10	Natural hillslope	75	1-3
162.5	Right	Bay, redwood	Ferns, woody shrubs, young ash	20-50, redwood 100+	1-5	Bank and highway 84	75	4-6

Table B-5. Riparian characteristics at every fifth bankfull width for sample reach 2B.

Meter	Bank	Riparian vegetation overstory	Riparian vegetation understory	Riparian vegetation age (years)	Riparian width (bankfull widths)	Terrace/ Hillslope land use	% canopy cover	Potential # of LWD recruits
45	Left	Bay, maple, redwood	Ferns, fleshy vines	20-50, redwood 100+	1-5	Natural hillslope and highway 84	25	4-6
45	Right	Alder	Young maple, young ash, fleshy vines	20-50	5-10	Natural terrace and hillslope	25	4-6
90	Left	Alder, conifer	Blackberry, broom, fleshy vines, young hardwoods	20-50	1-5	Natural terrace	25	4-6
90	Right	Alder, redwood	Moss, sedge, vines, nettle, equisetum, ferns	20-50	1	Toe of landslide	25	1-3
135	Left	Conifer, ash, alder	Fleshy vines, young hardwoods, moss	100+	1-5	Natural terrace	75	4-6
135	Right	Ash, alder, redwood	Sedge, fleshy vines	100+	5-10	Natural hillslope	75	4-6
180	Left	Bay, maple, redwood	Woody shrubs, fleshy vines, blackberry	20-50	1	Natural hillslope and highway 84	25	1-3
180	Right	Bay, willow, redwood	Blackberry, ferns, vines	50-100	5-10	Natural hillslope	25	1-3
225	Left	Alder, conifer, redwood	Broom, young alder, nettle, blackberry, fleshy vines	50-100	1-5	Natural terrace and highway 84	75	7-9
225	Right	Maple, bay, redwood	Moss, woody shrubs	20-50, redwood 100+	5-10	Natural hillslope	75	4-6

Table B-6. Riparian characteristics at every fifth bankfull width for sample reach 3A.

Meter	Bank	Riparian vegetation overstory	Riparian vegetation understory	Riparian vegetation age (years)	Riparian width (bankfull widths)	Terrace/ Hillslope land use	% canopy cover	Potential # of LWD recruits
25	Left	Redwood, alder, maple, ash	Ferns, clover, fleshy vines	100+	5-10	Natural terrace	100	1-3
25	Right	Ash, redwood	Ferns, moss, woody shrubs	100+	10-20	Natural terrace and hillslope	100	4-6
50	Left	Alder	Young maples	1-5	0	Abandoned road	100	0
50	Right	Alder, redwood	Ferns, woody shrubs	100+	5-10	Natural hillslope	100	4-6
75	Left	Redwood	Grasses	100+	1-5	Abandoned road	50	7-9
75	Right	Ash	Ferns, woody shrubs	20-50	5-10	Natural hillslope	50	4-6
100	Left	Redwood	Woody shrubs	100+	1-5	Cleared terrace, recreation	75	7-9
100	Right	Ash, redwood	Ferns, woody shrubs	50-100	5-10	Natural hillslope	75	7-9
125	Left	Redwood	Ferns, woody shrubs	100+	1-5	Terrace, recreation	75	4-6
125	Right	Redwood, ash	Ferns	100+	20+	Natural hillslope	75	1-3

Table B-7. Riparian characteristics at every fifth bankfull width for sample reach 3B.

Meter	Bank	Riparian vegetation overstory	Riparian vegetation understory	Riparian vegetation age (years)	Riparian width (bankfull widths)	Terrace/ Hillslope land use	% canopy cover	Potential # of LWD recruits
22.5	Left	Redwood	Ferns, young redwood	20-50	1-5	Natural hillslope	75	1-3
22.5	Right	Redwood, maple	Ferns, young redwood	100+	10-20	Natural hillslope	75	7-9
45	Left	None	Grasses	Na	Na	Landslide	25	0
45	Right	Willow, redwood	Blackberry, fern, sedge, rush	10-20, redwood 100+	5-10	Natural terrace	25	1-3
67.5	Left	Willow	Ferns, sedge, blackberry, vines, woody shrubs	20-50	5-10	Natural terrace	50	1-3
67.5	Right	Willow, redwood	Snowberry, ferns, young maple	100+	1-5	Natural terrace, ranch road	50	1-3
90	Left	Willow, redwood	Oak	20-50, redwood 100+	5-10	Natural terrace and hillslope	50	1-3
90	Right	Willow	Vines, grasses, ferns	20-50	1	Natural hillslope	50	1-3
112.5	Left	Redwood, willow	Young ash, ferns	100+	1-5	Natural terrace	100	4-6
112.5	Right	Redwood	Ferns, young redwood	100+	5-10	Natural hillslope	100	7-9

Appendix C – Sample Reach Large Woody Debris (LWD) Data, 2002/2003

Table C-1. Large woody debris (LWD) field survey abbreviation key.

<table>
<tr><td colspan="3">LWD Survey Abbreviation Key
(minimum LWD dimension = >20 cm diameter and 1.8 m length)</td></tr>
<tr><td>Mid-point diameter</td><td rowspan="4">Type
1 = log
2 = snag
4 = live log up
5 = rootwad
6 = live log down
7 = log with rootwad</td><td rowspan="4">Species
1 = redwood
2 = conifer
3 = maple
4 = alder
5 = buckeye
6 = willow
7 = oak
8 = bay laurel
9 = unknown hardwood
10 = ash</td></tr>
<tr><td>Length</td></tr>
<tr><td>Distance fell from</td></tr>
<tr><td>Position
1 = in low-flow channel (LF)
2 = portions in both LF & BF
3 = in bankfull channel (BF)
4 = portions in both BF & above BF
5 = above the BF channel
6 = portions in LF, BF & above BF</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="2">Decay Class
1 = bark intact, limbs, twigs, and needles present
2 = bark intact, limbs and twigs present
3 = bark intact, limbs absent
4 = bark loose or absent
5 = bark absent, surface slightly rotted
6 = surface extensively rotted
7 = surface completely rotted, center solid
8 = surface and center completely rotted</td><td>Pools (2 letter code)
First letter
A = LWD associated
F = formed by LWD
NN = no pool

Second letter
S = shallow, depth < 1 m
D = deep, depth > 1 m</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="2">Entry Process
If logging debris (sawmark) add 0.5
1 = bank erosion
2 = windthrow
3 = mortality
4 = landslide
5 = enhancement structure
6 = unknown</td><td colspan="2">Key Piece
Independently stable and in bankfull width or is retaining other pieces of organic debris</td></tr>
<tr><td colspan="2">Debris Jam
(must satisfy 3 criteria below)
1 = contains at least one key piece
2 = spans at least half the bankfull channel
3 = contains 10 or more LWD pieces</td></tr>
</table>

Table C-2. Reach 1A large woody debris data.

Reach	Meter	Position	Type	Species	Decay Class	Diameter (m)	Length (m)	Length (not including live upright trees)	Pool	Distance fell from	Entry process	Debris jam	Key piece	Volume
1A	7	2	7	9	5	0.31	2.9	2.9	N	U	U	N	N	0.22
1A	7	2	7	9	5	0.22	2.9	2.9	N	U	U	N	N	0.11
1A	15.5	1	1	1	7	0.36	2	2	N	5	1	N	N	0.20
1A	16.1	5	7	9	5	0.47	1.8	1.8	N	5	1	N	N	0.31
1A	15.9	5	7	9	5	0.36	1.8	1.8	N	5	1	N	N	0.18
1A	16.2	5	7	9	5	0.2	2.5	2.5	N	5	1	N	N	0.08
1A	16.2	5	7	9	5	0.35	1.8	1.8	N	5	1	N	N	0.17
1A	23	2	7	9	4	0.34	3.8	3.8	N	U	U	N	N	0.34
1A	23.8	2	7	9	5	0.27	2.7	2.7	N	U	U	N	N	0.15
1A	23.9	3	1	9	5	0.2	2.5	2.5	N	U	U	N	N	0.08
1A	24	2	1	9	7	0.3	1.9	1.9	N	U	U	N	N	0.13
1A	26	4	1	9	4	0.45	5.5	5.5	N	U	U	N	N	0.87
1A	58	6	1	4	0	1.8	2+	0	AS	NA	NA	N	N	0.00
1A	103	4	7	6	3	0.26	10	10	N	0	3	N	N	0.53
1A	108.6	5	1.5	1	4	0.76	5.5	5.5	N	U	U	N	N	2.49
1A	109.3	5	1	1	6	0.7	2.6	2.6	N	U	U	N	N	1.00
1A	111.1	5	1	6	4	0.25	2.6	2.6	N	U	U	N	N	0.13
1A	124	2	1	6	4	0.24	3.1	3.1	N	U	U	N	N	0.14
1A	135	6	4	1	0	0.5	2+	0	AS	NA	NA	N	N	0.00
1A	138.9	2	1	1	4	0.37	2.5	2.5	N	U	U	N	N	0.27
1A	143.6	2	5	6	4	0.22	1.9	1.9	AS	2	1	N	N	0.07
1A	145.6	1	1	1	4	0.56	3.5	3.5	AS	U	U	N	N	0.86
1A	148.7	2	4	6	3	0.72	2+	0	AS	NA	NA	N	N	0.00
1A	152.1	3	1	6	4	0.33	2.2	2.2	N	U	U	N	N	0.19
1A	164.6	4	1	1	8	0.32	3.6	3.6	N	U	U	N	N	0.29

Table C-3. Reach 1B large woody debris data.

Reach	Meter	Position	Type	Species	Decay Class	Diameter (m)	Length (m)	Length (not including live upright trees)	Pool	Distance fell from	Entry process	Debris jam	Key piece	Volume
1B	0	2	1	1	3	0.6	3.7	3.7	AS	U	4	N	N	1.05
1B	0	3	5	1	5	1	1	1	N	U	4	N	N	0.79
1B	1	4	5	1	5	1	1	1	N	U	4	N	N	0.79
1B	4.2	2	5	4	5	0.36	2	2	AS	U	4	N	N	0.20
1B	4.2	2	5	4	5	0.22	2	2	AS	U	5	N	N	0.08
1B	6.5	4	1	1	3	0.68	20	20	N	U	4	N	N	7.26
1B	11.9	6	4	4	0	0.38	2+	0	AS	NA	NA	N	N	0.00
1B	10	1	1	2	7	0.26	2.8	2.8	N	U	U	N	N	0.15
1B	15.6	1	1	2	7	0.48	2.6	2.6	N	U	U	N	N	0.47
1B	23	6	5	1	5	3.5	1+	1	FD	3	1	N	N	9.62
1B	25	5	1	4	4	0.37	2.2	2.2	N	U	U	N	N	0.24
1B	25.7	5	1	4	4	0.26	1.8	1.8	N	U	U	N	N	0.10
1B	26	5	7	4	6	0.2	1.8	1.8	N	U	U	N	N	0.06
1B	27	3	1	1	6	0.3	7	7	N	U	U	N	N	0.49
1B	27	3	1	1	4	0.53	5	5	N	U	U	N	N	1.10
1B	32	4	1	3	2	0.3	12	12	N	U	U	N	N	0.85
1B	32.5	4	1	1	3	0.44	6	6	N	U	U	N	N	0.91
1B	40	6	4	4	0	0.28	2+	0	N	NA	NA	N	N	0.00
1B	47	4	7	4	3	0.32	9.5	9.5	AS	U	U	N	N	0.76
1B	47	5	1	4	4	0.22	6	6	N	U	U	N	N	0.23
1B	46.8	4	4	4	0	0.4	2+	0	N	NA	NA	N	N	0.00
1B	46.8	4	4	4	0	0.32	2+	0	N	NA	NA	N	N	0.00
1B	53	6	4	4	0	0.47	2+	0	N	NA	NA	N	N	0.00
1B	55	6	4	4	0	0.45	2+	0	AS	NA	NA	N	N	0.00
1B	58.3	6	1	4	4	0.34	7.3	7.3	N	U	U	N	N	0.66
1B	60	5	1	1	3	0.45	15	15	N	U	U	N	N	2.39
1B	67.5	6	4	4	0	0.44	2+	0	N	NA	NA	N	N	0.00
1B	69	6	4	4	0	0.45	2+	0	N	NA	NA	N	N	0.00
1B	69	5	1	1	6	0.48	4	4	N	U	U	N	N	0.72
1B	77.2	6	4	4	0	0.6	2+	0	N	NA	NA	N	N	0.00

1B	69	5	1	1	6	0.21	3.4	3.4	N	U	U	N	N	0.12
1B	75	2	1	4	5	0.25	4.2	4.2	N	U	U	N	N	0.21
1B	101.6	2	1	4	4	0.31	16.5	16.5	N	U	U	N	N	1.25
1B	112	6	4	4	0	0.32	2+	0	N	NA	NA	U	U	0.00
1B	117	6	4	4	0	0.47	2+	0	N	NA	NA	U	U	0.00
1B	122	1	1	4	4	0.21	3.5	3.5	N	U	U	N	N	0.12
1B	128.9	6	4	4	0	0.54	2+	0	N	NA	NA	N	N	0.00
1B	134.3	6	4	4	0	0.29	2+	0	N	NA	NA	N	N	0.00
1B	138	5	7	1	4	0.85	8.5	8.5	N	U	U	N	N	4.82
1B	142	6	4	4	0	0.28	2+	0	N	NA	NA	N	N	0.00
1B	147.7	6	4	4	0	0.39	2+	0	N	NA	NA	N	N	0.00
1B	149.2	6	4	4	0	0.28	2+	0	N	NA	NA	N	N	0.00
1B	158.2	6	4	4	0	0.7	2+	0	N	NA	NA	N	N	0.00
1B	165	6	4	4	0	0.34	2+	0	N	NA	NA	N	N	0.00
1B	168.9	6	4	4	0	0.34	2+	0	N	NA	NA	N	N	0.00
1B	172	6	4	4	0	0.39	2+	0	N	NA	NA	N	N	0.00
1B	180	6	4	4	0	0.48	2+	0	N	NA	NA	N	N	0.00
1B	188.2	6	4	4	0	0.48	2+	0	N	NA	NA	N	N	0.00

Table C-4. Reach 1C large woody debris data.

Reach	Meter	Position	Type	Species	Decay Class	Diameter (m)	Length (m)	Length (not including live upright trees)	Pool	Distance fell from	Entry process	Debris jam	Key piece	Volume
1C	11.7	4	4	4	0	0.3	2+	0	N	NA	NA	NA	N	0.00
1C	12	1	1	1	6	0.6	8	8	N	1	1	N	N	2.26
1C	18	3	1	3	3	0.35	15	15	N	2	1	N	N	1.44
1C	18.5	3	1	3	3	0.34	15	15	N	2	1	N	N	1.36
1C	40	4	4	4	0	0.22	2+	0	N	0	NA	N	N	0.00
1C	49	4	4	9	0	0.2	2+	0	N	0	NA	N	N	0.00
1C	74	4	1	4	5	0.45	7	7	AS	U	U	Y	N	1.11
1C	74	6	1	4	5	0.3	5	5	AS	U	U	Y	N	0.35
1C	74	6	1	4	5	0.23	6.7	6.7	AS	U	U	Y	N	0.28
1C	75.2	4	1	9	5	0.5	12.5	12.5	AS	0	4	Y	Y	2.45
1C	75.5	6	1	9	3	0.2	4.5	4.5	AS	U	U	Y	N	0.14

1C	75.5	4	1	9	4	0.25	8.5	8.5	AS	U	U	Y	N	0.42
1C	76	5	1	1	5	0.42	3	3	AS	U	U	Y	N	0.42
1C	76	5	1	1	5	0.28	4.3	4.3	AS	U	U	Y	N	0.26
1C	77.4	2	1	9	3	0.29	8.5	8.5	AS	U	U	Y	N	0.56
1C	76	1	1	9	3	0.32	5	5	AS	U	U	Y	N	0.40
1C	77.5	3	1	9	5	0.2	9.7	9.7	AS	U	U	Y	N	0.30
1C	77.5	2	1	1	7	0.3	3.2	3.2	AS	U	U	Y	N	0.23
1C	78	5	1	9	4	0.28	12	12	N	U	U	N	N	0.74
1C	87.5	1	1	9	5	0.32	3.5	3.5	N	U	U	N	N	0.28
1C	93	6	7	9	4	0.26	8.5	8.5	N	U	U	N	N	0.45
1C	98	6	5	1	6	0.2	6	6	N	U	U	N	N	0.19
1C	103	5	1	1	5	0.65	9.5	9.5	N	1	1	N	N	3.15
1C	103	4	4	4	0	0.4	2+	0	N	NA	NA	N	N	0.00
1C	103	5	1	1	5	0.57	4.5	4.5	N	U	U	N	N	1.15
1C	110	1	1	1	4	0.5	4.5	4.5	N	U	U	N	N	0.88
1C	119	4	4	4	0	0.45	2+	0	N	NA	NA	N	N	0.00
1C	144	5	4	4	0	0.5	2+	0	N	0	NA	N	N	0.00

Table C-5. Reach 2A large woody debris data.

Reach	Meter	Position	Type	Species	Decay Class	Diameter (m)	Length (m)	Length (not including live upright trees)	Pool	Distance fell from	Entry process	Debris jam	Key piece	Volume
2A	30.2	2	1	1	7	0.37	2	2	N	U	U	N	N	0.22
2A	42.1	6	1	1	1	1.05	25	25	FS	3	1	N	Y	21.64
2A	41.5	2	1	9	7	0.2	2.6	2.6	AS	U	U	N	N	0.08
2A	41.5	2	7	4	5	0.35	4.4	4.4	AS	U	U	N	N	0.42
2A	42.5	2	1	4	4	0.35	3.9	3.9	AS	U	U	N	N	0.38
2A	45.5	3	1	1	8	0.22	1.8	1.8	N	U	U	N	N	0.07
2A	48	4	1	1	3	0.48	10	10	N	U	U	N	N	1.81
2A	47.2	1	1	1	5	0.2	1.9	1.9	N	U	U	N	N	0.06
2A	46	1	5	1	6	0.3	1.8	1.8	AS	U	U	N	N	0.13
2A	50.7	6	7	2	2	0.77	23	23	N	0	1	N	N	10.71
2A	52.2	1	1	4	5	0.25	6	6	N	U	U	N	N	0.29
2A	59	4	7	1	2	0.8	15	15	N	0	1	N	N	7.54

2A	61	4	1	1	4	1	10	10	N	U	U	N	N	7.85
2A	61	4	6	8	1	0.32	15	15	N	0	1	N	N	1.21
2A	73	2	1	2	6	0.28	3.5	3.5	N	U	U	N	N	0.22
2A	74.7	5	7	9	6	0.27	7	7	N	U	U	N	N	0.40
2A	74.7	4	1	8	5	0.35	4	4	N	U	U	N	N	0.38
2A	74.7	4	1	1	4	0.7	15	15	N	U	U	N	N	5.77
2A	76.5	6	5.5	1	4	1.25	2	2	FS	U	4	N	Y	2.45
2A	78.2	6	1	9	8	0.25	2.1	2.1	AS	U	U	N	N	0.10
2A	79	4	1	1	3	0.34	10	10	N	U	U	N	N	0.91
2A	78.5	5	1	2	4	0.41	7.5	7.5	N	U	U	N	N	0.99
2A	113.7	4	1	9	7	0.29	2.3	2.3	N	U	U	N	N	0.15
2A	138.9	4	1	1	3	0.23	6.5	6.5	N	U	U	N	N	0.27
2A	139.5	6	2	10	1	0.23	5.5	5.5	N	U	U	N	N	0.23
2A	142.9	4	1	9	3	0.35	15	15	N	U	1	N	N	1.44

Table C-6. Reach 2B large woody debris data.

Reach	Meter	Position	Type	Species	Decay Class	Diameter (m)	Length (m)	Length (not including live upright trees)	Pool	Distance fell from	Entry process	Debris jam	Key piece	Volume
2B	1	6	7	1	1	1	35	35	FD	2	1	N	Y	27.49
2B	3.7	4	1	4	6	0.24	3.5	3.5	N	U	U	N	N	0.16
2B	8.3	6	7	1	1	0.75	25	25	FS	3	4	N	N	11.04
2B	1.5	4	4	4	0	0.29	2+	0	N	NA	NA	N	N	0.00
2B	22	4	4	4	0	0.37	2+	0	N	NA	NA	N	N	0.00
2B	22	4	4	1	0	0.72	2+	0	N	NA	NA	N	N	0.00
2B	17	1	1	1	7	0.7	10	10	N	U	U	N	N	3.85
2B	28	4	4	4	0	0.3	2+	0	N	NA	NA	N	N	0.00
2B	32.3	6	1	4	4	0.25	13	13	N	U	U	N	N	0.64
2B	39.8	5	1	4	7	0.2	6	6	N	U	U	Y	N	0.19
2B	40	4	1	4	4	0.4	15	15	N	U	U	Y	N	1.88
2B	40	2	1	4	4	0.2	5.5	5.5	N	U	U	Y	N	0.17
2B	41	2	1	4	4	0.2	1.8	1.8	N	U	U	Y	N	0.06
2B	41.1	2	7	1	7	0.42	2	2	FS	U	U	Y	N	0.28
2B	41.9	2	1	4	5	0.35	7	7	FS	U	U	Y	N	0.67

2B	42	4	1	4	5	0.28	14	14	N	U	U	Y	N	0.86
2B	42.5	6	1	4	3	0.24	17	17	N	U	U	Y	N	0.77
2B	43	2	1	1	7	0.4	1.8	1.8	N	U	U	Y	N	0.23
2B	43.1	2	1	1	7	0.27	2.4	2.4	N	U	U	Y	N	0.14
2B	43.1	6	5	1	6	1.5	1.5	1.5	N	U	U	Y	N	2.65
2B	44	6	1	1	3	0.98	16.5	16.5	AS	U	U	Y	Y	12.44
2B	45	3	1	4	5	0.23	7	7	N	U	U	Y	N	0.29
2B	45.5	2	1	1	5	0.82	6.8	6.8	N	U	U	Y	N	3.59
2B	50.7	4	4	4	0	0.28	2+	0	AS	NA	NA	N	N	0.00
2B	66.6	4	4	4	0	0.63	2+	0	N	NA	NA	N	N	0.00
2B	69.1	3	1	1	7	0.65	2	2	N	U	U	N	N	0.66
2B	70.5	2	5	1	6	2	2.5	2.5	N	U	U	N	N	7.85
2B	70.5	5	1	1	8	0.45	12	12	N	3	3	N	N	1.91
2B	75	1	1	1	6	0.45	2.3	2.3	N	U	U	N	N	0.37
2B	76	1	1	4	6	0.2	4	4	N	U	U	N	N	0.13
2B	80.5	1	1	4	5	0.23	4	4	N	U	U	N	N	0.17
2B	85.3	6	4	4	0	0.7	2+	0	AS	NA	NA	Y	Y	0.00
2B	85.5	4	5	1	6	1.6	2	2	AS	U	U	Y	N	4.02
2B	86	1	1	1	7	0.26	2.4	2.4	AS	U	U	N	N	0.13
2B	85.7	6	1	1	8	0.4	2	2	N	U	U	Y	N	0.25
2B	84	4	1	4	4	0.2	4.1	4.1	N	U	4	N	N	0.13
2B	85	4	1	2	4	0.26	3.1	3.1	N	U	4	Y	N	0.16
2B	85.5	4	1	1	4	0.23	1.8	1.8	N	U	4	Y	N	0.07
2B	86	4	1	4	3	0.36	3.5	3.5	N	U	4	Y	N	0.36
2B	86.5	4	1	1	8	0.45	1.8	1.8	N	U	4	Y	N	0.29
2B	87	4	1	4	4	0.25	3.8	3.8	N	U	4	N	N	0.19
2B	87	4	1	1	6	0.35	3	3	N	U	4	Y	N	0.29
2B	87	4	1	4	5	0.4	5	5	N	U	4	Y	Y	0.63
2B	88	5	1	1	8	0.32	2.5	2.5	N	U	4	Y	N	0.20
2B	88	4	1	4	5	0.4	6.8	6.8	N	U	4	Y	N	0.85
2B	88	4	1	1	7	0.5	5	5	N	U	4	Y	Y	0.98
2B	90	5	1	9	8	0.22	2.1	2.1	N	U	4	Y	N	0.08
2B	90	4	1	1	6	0.3	2.5	2.5	N	U	4	Y	N	0.18
2B	91	4	7	4	4	0.45	12	12	N	U	4	Y	Y	1.91
2B	92	4	1	1	6	0.35	5	5	N	U	4	Y	N	0.48

2B	92	4	1	1	7	0.21	3.4	3.4	N	U	4	Y	N	0.12
2B	92.5	4	1	1	6	0.3	3.5	3.5	N	U	4	Y	N	0.25
2B	92	4	1	1	6	0.33	3.5	3.5	N	U	4	Y	N	0.30
2B	93	4	1	9	7	0.32	4.5	4.5	N	U	4	Y	N	0.36
2B	93	4	1	1	7	0.35	5	5	N	U	4	Y	N	0.48
2B	93.5	4	1	1	7	0.3	2.4	2.4	N	U	4	Y	N	0.17
2B	93	4	1	1	7	0.4	1.8	1.8	N	U	4	Y	N	0.23
2B	93	4	1	1	7	0.6	2	2	N	U	4	Y	N	0.57
2B	95	4	1	1	6	0.33	2.6	2.6	N	U	4	Y	N	0.22
2B	95	4	1	1	6	0.5	2.2	2.2	N	U	4	Y	N	0.43
2B	95	4	7	2	5	0.55	12	12	N	U	4	Y	Y	2.85
2B	95	4	1	1	8	0.24	3.4	3.4	N	U	4	Y	N	0.15
2B	98	4	1	4	5	0.5	20	20	N	U	4	N	N	3.93
2B	97	4	1	1	6	0.6	4	4	N	U	4	Y	N	1.13
2B	100	4	1	1	6	1.35	3.4	3.4	N	U	4	Y	N	4.87
2B	101	4	1	4	3	0.25	10	10	N	U	4	Y	N	0.49
2B	101	4	1	4	5	0.34	16	16	N	U	4	Y	N	1.45
2B	101	4	4	4	0	0.68	2+	0	N	NA	NA	Y	Y	0.00
2B	102	4	1	4	5	0.3	7	7	N	U	4	Y	N	0.49
2B	102	2	1	4	5	0.37	15	15	N	U	4	Y	Y	1.61
2B	104	6	7	4	2	0.3	12	12	FS	U	4	Y	Y	0.85
2B	104.5	6	7	4	3	0.3	20	20	FS	U	4	Y	Y	1.41
2B	100	3	1	1	8	0.26	2.2	2.2	N	U	4	Y	N	0.12
2B	98	4	1	1	8	0.52	2.3	2.3	N	U	4	Y	N	0.49
2B	110.8	5	1	1	8	0.55	6	6	N	U	4	Y	N	1.43
2B	110.5	5	1	1	6	0.4	2.6	2.6	N	U	4	Y	N	0.33
2B	113.6	6	7	9	3	0.35	10.3	10.3	N	U	4	Y	N	0.99
2B	118	2	1	4	3	0.33	16.5	16.5	N	U	U	N	N	1.41
2B	119.2	6	1	4	2	0.23	18.5	18.5	N	U	U	N	N	0.77
2B	123.2	4	4	4	0	0.22	2+	0	N	NA	NA	N	N	0.00
2B	131.7	3	1	1	4	0.55	3.8	3.8	N	U	U	N	N	0.90
2B	133.5	3	7	9	4	0.47	6	6	N	U	U	N	N	1.04
2B	137	4	4	4	0	0.3	2+	0	N	NA	NA	N	N	0.00
2B	137.3	4	6	4	3	0.37	10	10	N	0	U	N	N	1.08
2B	137.3	6	1	4	5	0.2	7.5	7.5	N	U	U	N	N	0.24

2B	144.1	2	1	1	4	0.33	7.8	7.8	N	0	U	N	N	0.67
2B	150	2	1	4	4	0.42	12.5	12.5	N	U	U	N	N	1.73
2B	150	4	4	4	0	0.5	2+	0	N	NA	NA	N	N	0.00
2B	166	4	6	8	1	0.42	15	15	N	3	4	N	N	2.08
2B	182.3	4	4	1	0	0.7	2+	0	AS	NA	NA	N	N	0.00
2B	189.2	4	4	4	0	0.58	2+	0	AS	NA	NA	N	N	0.00
2B	189.2	4	4	4	0	0.46	2+	0	AS	NA	NA	N	N	0.00
2B	213	4	4	4	0	0.67	2+	0	AS	NA	NA	N	N	0.00
2B	213.5	2	1	2	4	0.28	10	10	N	U	U	N	N	0.62
2B	213.5	2	1	1	7	0.6	9	9	N	U	U	N	N	2.54
2B	214	5	1	4	3	0.24	6	6	N	U	U	N	N	0.27
2B	214.5	2	5	1	4	2.4	2	2	AS	U	U	N	N	9.05
2B	217.5	6	1	2	1	0.57	36	36	N	0	3	N	N	9.19
2B	221	4	7	4	4	0.26	10.5	10.5	N	U	U	N	N	0.56

Table C-7. Reach 3A large woody debris data.

Reach	Meter	Position	Type	Species	Decay Class	Diameter (m)	Length (m)	Length (not including live upright trees)	Pool	Distance fell from	Entry process	Debris jam	Key piece	Volume
3A	0	1	1	1	6	0.61	3.8	3.8	FS	U	U	N	N	1.11
3A	16	4	4	4	0	0.42	2+	0	N	NA	NA	N	N	0.00
3A	20.7	1	1	1	8	0.49	2.1	2.1	N	U	U	N	N	0.40
3A	22.3	1	1	1	8	0.38	3.4	3.4	N	U	U	N	N	0.39
3A	54.5	4	4	4	0	0.29	2+	0	N	NA	NA	N	N	0.00
3A	79	4	1	1	6	0.47	4.1	4.1	N	U	U	Y	N	0.71
3A	79	4	1	1	5	0.3	2.7	2.7	N	U	U	Y	N	0.19
3A	79	4	1	9	4	0.2	6	6	N	U	U	Y	N	0.19
3A	79	4	1	1	5	0.2	5.5	5.5	N	U	U	Y	N	0.17
3A	79	4	1	1	5	0.41	4	4	N	U	U	Y	N	0.53
3A	80	4	5	1	3	1.1	2	2	N	10	1	Y	Y	1.90
3A	80	5	4	1	0	0.32	2+	0	N	10	1	Y	N	0.00
3A	84	5	7	1	4	0.9	13.5	13.5	N	U	U	Y	N	8.59
3A	84	4	1	1	5	0.29	3.5	3.5	N	U	U	Y	N	0.23
3A	84	5	1	1	8	0.3	3.3	3.3	N	U	U	Y	N	0.23

3A	98	1	1	1	8	0.65	2.4	2.4	N	U	U	N	N	0.80
3A	102	5	1	4	5	0.25	5	5	N	U	U	N	N	0.25
3A	103.7	1	1	2	5	0.2	3	3	N	U	U	N	N	0.09
3A	110	2	7	2	3	0.73	16	16	N	U	U	N	N	6.70
3A	107.9	2	1	1	7	0.57	3.6	3.6	N	U	U	N	N	0.92
3A	108.5	2	1	1	8	0.41	3.4	3.4	N	U	U	N	N	0.45
3A	122.3	2	1	1	8	0.38	3.9	3.9	AS	U	U	N	N	0.44
3A	125	3	7	1	5	0.34	3.7	3.7	N	U	U	N	N	0.34
3A	125	3	7	1	5	0.26	3.7	3.7	N	U	U	N	N	0.20

Table C-8. Reach 3B large woody debris data.

Reach	Meter	Position	Type	Species	Decay Class	Diameter (m)	Length (m)	Length (not including live upright trees)	Pool	Distance fell from	Entry process	Debris jam	Key piece	Volume
3B	0	6	5	1	5	3	2	2	FS	0	4	N	N	14.14
3B	0	6	7	1	4	0.8	31	31	N	10	1	Y	Y	15.58
3B	0	2	1	1	4	0.38	17	17	N	U	1	Y	N	1.93
3B	1.4	6	5	1	5	1.3	3	3	N	U	U	Y	Y	3.98
3B	0	3	5	1	6	0.37	2	2	N	U	U	Y	N	0.22
3B	6.4	4	5	1	7	1.2	2.5	2.5	N	U	U	Y	N	2.83
3B	36.4	4	1	1	5	0.41	3	3	N	U	U	N	N	0.40
3B	84.5	6	7	9	4	0.25	10	10	FS	U	4	N	N	0.49
3B	84.5	3	5	1	7	0.52	4	4	FS	U	4	N	N	0.85
3B	84.5	3	5	1	7	0.75	4	4	FS	U	4	N	N	1.77

Appendix D – La Honda Creek Water and Air Temperature Data, 2002/2003

Table D-1. 7-Day air and water temperatures measured at La Honda.

Week Beginning Monday	7 Day Average Air Temperature °F	7 Day Average Water Temperature °F	7 Day Average Air Temperature °C	7 Day Average Water Temperature °C
6/23/03	69.0	59.5	20.5	15.3
9/15/03	67.8	58.8	19.9	14.9
9/8/03	67.6	60.5	19.8	15.9
7/14/03	65.4	59.9	18.6	15.5
7/21/03	64.5	61.4	18.0	16.3
8/18/03	63.9	61.1	17.7	16.2
7/28/03	63.8	61.4	17.7	16.3
10/20/03	63.4	53.9	17.5	12.2
8/4/03	62.2	60.7	16.8	16.0
9/22/03	61.8	59.5	16.5	15.3
9/1/03	61.6	59.3	16.4	15.1
8/11/03	61.3	60.1	16.3	15.6
8/25/03	61.2	60.1	16.2	15.6
10/13/03	61.1	52.3	16.2	11.3
6/2/03	60.3	57.9	15.7	14.4
7/7/03	60.0	58.1	15.6	14.5
5/26/03	59.4	56.4	15.2	13.5
6/30/03	59.3	57.9	15.2	14.4
10/6/03	58.2	53.9	14.6	12.2
5/19/03	58.2	54.7	14.6	12.6
9/29/03	57.9	57.0	14.4	13.9
1/6/03	55.7	51.1	13.1	10.6
1/20/03	54.9	51.9	12.7	11.1
6/16/03	54.9	55.8	12.7	13.2
6/9/03	54.8	55.4	12.7	13.0
3/24/03	54.5	50.3	12.5	10.2
1/13/03	54.2	50.0	12.3	10.0
1/27/03	53.8	51.3	12.1	10.7
3/10/03	53.0	51.3	11.6	10.7
5/12/03	52.4	51.9	11.3	11.0
12/30/02	51.7	49.4	11.0	9.7
4/28/03	51.7	51.3	10.9	10.7
2/10/03	51.1	48.3	10.6	9.1
4/7/03	51.1	50.0	10.6	10.0
5/5/03	50.6	51.1	10.4	10.6
3/17/03	49.7	49.6	9.8	9.8
4/14/03	49.6	49.9	9.8	9.9
4/21/03	49.1	50.1	9.5	10.0
2/24/03	48.8	48.6	9.4	9.2
2/17/03	48.8	47.1	9.3	8.4
3/31/03	48.2	49.2	9.0	9.6
2/3/03	48.2	44.7	9.0	7.1
3/3/03	47.6	47.3	8.7	8.5
12/23/02	47.3	48.1	8.5	9.0
12/16/02	46.2	48.5	7.9	9.2

Appendix E – Bulk Sediment Sampling Data, 2002/2003

In 2002/2003, five bulk samples were collected, weighed and measured. The median grain size (D_{50}) ranged from a low of 14 mm (0.55 in) in reach 3B to a maximum of 90 mm (3.5 in) in reach 2B.

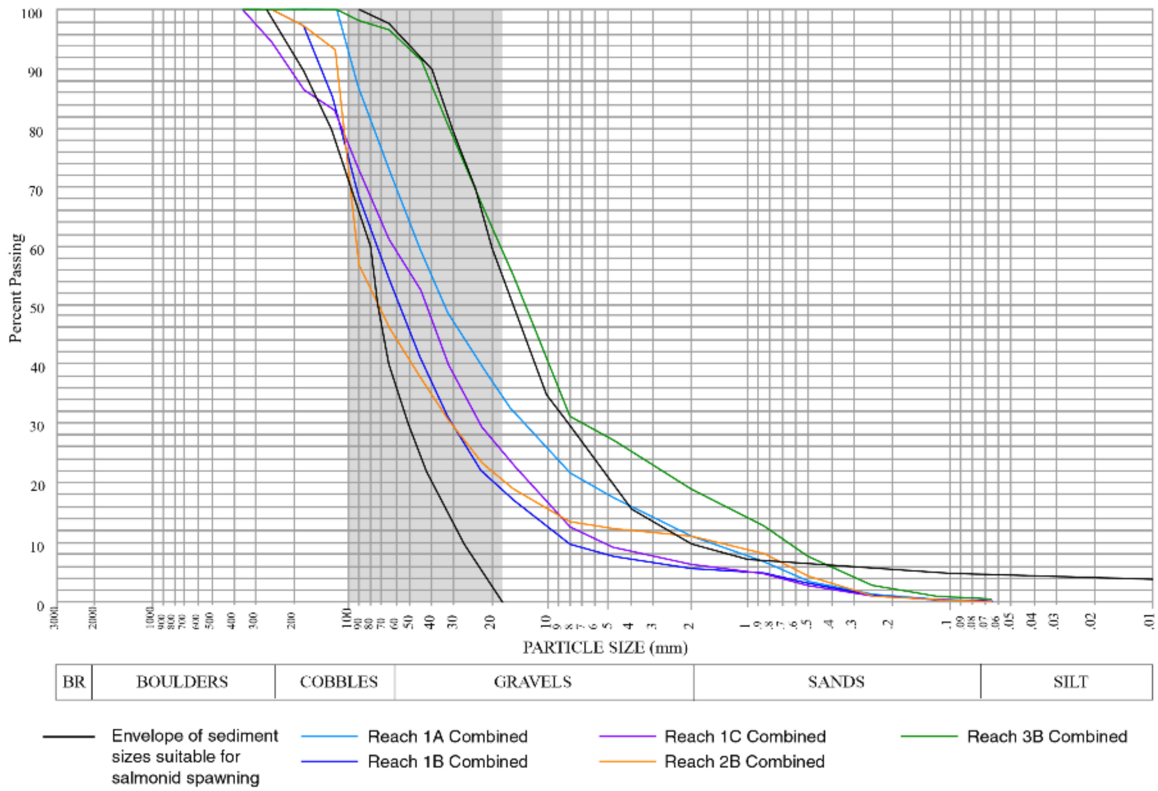

Figure E-1. Particle size distribution curves of combined (surface and subsurface) bulk sediment samples in sample reaches in all three study segments. Shaded area highlights framework grain sizes utilized by steelhead for spawning (Kondolf and Wolman, 1993). Envelope of sediment sizes suitable for salmonid spawning is shown in black (Bjorn and Reiser, 1991; Kondolf 2000; Shirazi and Siem, 1979). BR = bedrock.

Table E-1. Grain size distribution for bulk sediment samples.

Sample location	% < 1mm (0.04 in)	% < 6.35 mm (0.25 in)	D_{16} (mm)	D_{16} (in)	D_{50} (mm)	D_{50} (in)	D_{84} (mm)	D_{84} (in)
1A surface	6.0	16.5	5.9	0.0	43	1.7	92	3.6
1A subsurface	9.8	23.5	2.7	0.1	26	1.0	73	2.9
1B surface	1.5	2.9	25	1.1	69	2.7	140	5.5
1B subsurface	8.8	15.0	7.5	10.4	47	1.9	105	4.1
1C surface	3.4	9.0	11	0.1	38	1.5	96	3.8
1C subsurface	7.0	13.0	8.7	0.0	55	2.2	155	6.1
2B surface	4.2	8.2	16	0.8	59	2.3	105	4.1
2B subsurface	12.5	19.0	1.9	0.0	90	3.5	115	4.5
3B surface	12.5	28.2	1.8	0.0	15	0.6	34	1.3
3B subsurface	16.2	30.1	0.95	0.1	14	0.6	36	1.4

Appendix F – Pebble Count Data, 2002/2003

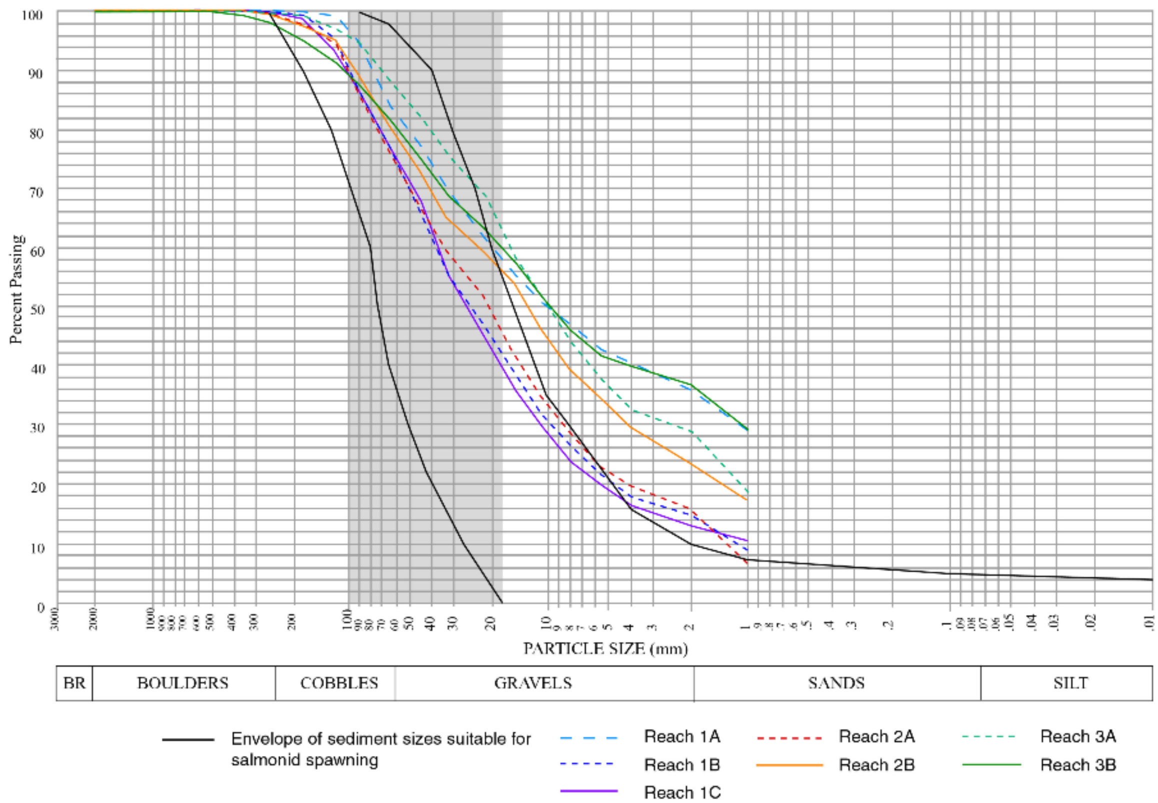

Figure F-1. Surface particle size distribution curves of samples in all three study segments. Shaded area highlights framework grain sizes utilized by steelhead for spawning (Kondolf and Wolman, 1993). Envelope of sediment sizes suitable for salmonid spawning is shown in black (Bjorn and Reiser, 1991; Kondolf 2000; Shirazi and Siem, 1979). BR = bedrock.

Table F-1. Percent by count of each grain size class in surface grain size distributions for each sample reach.

Grain size (mm)	1A	1B	1C	2A	2B	3A	3B
<2	28.48	9.15	10.28	6.42	17.25	17.85	27.47
2	7.27	4.88	2.43	9.14	6.40	8.39	7.08
4	4.24	3.05	3.36	3.50	5.62	3.44	2.15
5.6	2.22	3.86	3.55	3.11	5.04	5.16	2.79
8	4.24	4.47	1.87	5.84	4.84	5.59	3.86
11	3.64	5.49	7.85	5.84	6.78	7.31	5.15
16	4.85	6.71	5.98	7.98	7.95	5.81	5.58
22	6.67	7.72	9.16	8.95	5.04	9.68	6.01
32	7.88	8.54	10.28	7.00	6.20	6.24	4.72
45	7.88	9.76	12.52	7.20	7.95	6.24	6.44
64	6.46	11.18	9.35	9.92	7.36	5.59	5.79
90	10.91	9.15	8.97	9.14	8.53	6.02	5.58
128	4.04	9.15	7.66	8.37	6.40	2.15	3.86
180	1.01	3.46	4.86	3.31	2.33	1.94	3.43
256	0.20	0.61	0.93	1.36	1.94	0.43	3.00
360	0.00	0.00	0.37	0.58	0.39	0.22	0.86
512	0.00	0.20	0.00	0.00	0.00	0.00	0.64
1024	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2056	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bedrock	0.00	2.24	0.00	1.95	0.00	5.59	4.72

Table F-2. Surface grain size data for each sample reach.

Reach	% <2mm	% <8mm	D_{16} (mm)	D_{50} (mm)	D_{84} (mm)	% Bedrock
1A	28.5	42.2	<2	11	64	0
1B	9.4	21.5	2.7	25	82	2.2
1C	10.3	19.7	3.8	26	82	0
2A	6.6	22.7	2.1	21	84	1.9
2B	17.2	34.3	<2	14	72	0
3A	19.3	37.9	<2	10	49	5.6
3B	29.1	41.8	<2	10	72	4.7

Appendix G – Previous CDFG Observational Stream Surveys, 2002/2003

Six stream surveys of La Honda Creek covering the 1950's to 1997 describe the channel condition and fish habitat provided during that time frame. In addition, a single fish survey from 1978, and electrofishing as a part of the 1997 survey provide some data on numbers of fish present.

The first stream survey is not dated, however, based upon reading stream surveys of similar style and content from other locations in the Bay Area, this survey was likely completed in the 1950's. The survey makes a statement about current average annual rainfall measuring 24 inches (610 mm), but ten years earlier, annual rainfall totaled 30 inches (762 mm). An analysis of long-term rainfall records for the area shows a period in the 1940's where rainfall was approximately 30 inches annually, and a period in the mid-1950's where rainfall was near 24 inches annually, following the trend described in the survey, and helping to identify the date of the survey. The survey covers six miles of La Honda Creek, all of which contains flow, with an average of 270 gallons per minute (approximately 0.02 cms, 0.6 cfs), and water temperature of 54° F (12.2° C). The channel is fed by springs, and averages 4 ft (1.2 m) in width, and 4 in (10 cm) in depth. The channel bed consists of gravel and silt, and only a single obstruction (a dam at Troutmere that has a fish ladder) is noted downstream on San Gregorio Creek. The only fish found in the creek were steelhead, however past data indicates that both steelhead and King salmon (stocked in 1932 sourced from an aquarium in San Francisco) were stocked. La Honda Creek and other tributaries are noted for containing good spawning substrate, but heavy fishing pressures typically take fish that were planted in the previous year.

The second survey, a field note from a Department of Fish and Game warden in 1962, is included in the stream surveys. Warden Peek reports that past logging in the watershed is causing a siltation problem for the bed of La Honda Creek. Peek states that perennial flow maintains a fish population, but the numbers returning to spawn have been decreasing, despite reduced fishing pressure. Decreased populations are attributed to the siltation and destruction of habitat. He also notes that Alpine Creek supports a population of steelhead, with adults regularly returning to spawn.

The third survey was completed on August 3, 1964 by two Department of Fish and Game employees, Parker and Primbs. They walked the entire length of La Honda Creek, noting continual flow throughout, fed by eight distinct springs. The surveyors describe the lowest three miles (4.8 km) of creek as a highly productive spawning and nursery area for steelhead and potentially silver salmon. The upper four miles (6.4 km) have larger boulders, more bedrock and many LWD jams that act as migration barriers, thus having a lesser importance as spawning and rearing habitat. Channel width ranges from one to 20 ft (0.3 to 6.1 m), with an average of five feet (1.5 m), while depth ranges from one inch to five ft (0.03 to 1.5 m), with an average of four inches (0.1 m). Stream flow is measured as 0.5 cfs (0.01 cms) at the mouth of the confluence, but evidence of high winter flows (high water mark at eight ft (2.4 m)) is also noted. The channel bed in the lowest three miles is described as consisting of 40% coarse gravel, 40% fine gravel, 5% fine rubble, 10% silt, and 5% sand. Approximately 1/3 of the loose gravel bed appears to be suitable for spawning. Three distinct areas of spawning ground are noted on the map between the Woodruff and Weeks Creek tributaries. Pool development is classified as good, with average pool lengths of 10 ft (3.0 m), widths of five ft (1.5 m), and depths of 1.5 ft (0.5 m). Abundant stream-side vegetation including ferns, vines, alders and redwoods is present, and supports the lizards, salamanders, frogs, deer and raccoons that are observed. Twenty partial log jams and three complete log jams (all upstream of Weeks Creek) are noted along with many undercut banks, logs and roots for shelter. A water temperature of 60° F (15.6 °C) is measured at the headwaters, and 67° F (19.4° C) is measured at the mouth. Stonefly, mayfly and caddisfly nymphs are observed throughout the creek, and algae is observed in the lower gradient, lower velocity areas. Silt from past logging operations is the only pollution source noted. In the lowest three miles, both steelhead and stickleback fish are observed, with an average of 50 steelhead per 100 ft (30.5 m). Steelhead range from 0.5 - 5 in (13 - 127 mm), with good condition, good natural propagation and success noted in the lowest three miles. Recommendations include reducing the silt contributed from logging because it appears to be polluting spawning gravels, establishing a silver salmon run through fish planting, and removing log jams to help fish habitat. Removal of wood was a common practice in many California streams up until the 1970's when its in-stream value was discovered.

The fourth stream survey was completed on September 27, 1973 by Department of Fish and Game personnel Stuparich and Meints. The entire channel length (approximately 7.8 mi, 12.5 km) was surveyed. Perennial flow (fed by springflow), abundant riparian vegetation (alder, bay, tan oak, willow, redwood, ferns, and poison oak), and many short, hardened bank stabilization efforts are observed. Channel width in the lowest three miles (4.8 km) varies from five to 15 ft (1.5 to 4.6 m), while depth varies from one to six inches (0.03 to 0.15 m) in riffles and six to 40 inches (0.15 to 1.02 m) in pools. The channel bed in the middle five miles (8.0 km) consists of coarse sand, fine gravel, coarse gravel, both fine and coarse rubble, boulders, and a high percentage of clay and silt from past logging activities. The lowest 1.5 mi (2.4 km) consists of sand, fine and coarse gravel, fine and coarse rubble, with silt, mud, and clay associated with the construction of the culvert under Entrada Road. The average composition of the channel bed consists of: 15% bedrock, 15% boulders, 15% coarse rubble, 10% fine rubble, 10% coarse gravel, 10% fine gravel, 7% sand, 5% mud, 8% silt, and 5% clay. The channel is noted as providing good to excellent spawning habitat for steelhead and silver salmon, with an abundance of gravel and rubble in the lower four miles (6.4 km). The DFG personnel state that spawning materials were loose, without noticeable compaction, except in the areas where logging operations have destroyed the spawning and nursery habitats. The lowest 2.8 miles (4.5 km) of creek have a pool:riffle ratio of 40:60, with pools three to nine ft (0.9 to 2.7 m) in width, four to 30 ft (1.2 to 9.1 m) in length, six to 48 in (0.15 to 1.22 m) in depth, and spaced 25 to 60 ft (7.6 to 18.3 m) apart. Water flowing over the riffles is between two and eight inches (0.05 to 0.20 m) in depth. Whereas no mention of pool forming process is made for the lower reach, pools in the middle reaches were noted as being formed mainly by logjams and bedrock outcrops. Abundant riparian growth provides nearly complete shading of the stream, while bedrock, boulders, roots, logs and undercut banks provide fish shelter. Eleven barriers in the entire channel length are described, including fencing across the streambed, logjams, a collapsed logging bridge, a landslide, logging slash buildup, silt buildup, a flashboard dam, a small concrete and stone dam, and a landslide caused by logging road construction. Six diversions are observed, most being single small diameter pipes diverting for residential use, but also included diversions for agriculture, and an unused flashboard dam diversion for the Sky-L'Onda Mutual Water Company. Water temperatures range from 11.7 to 15.0° C (53 to 59°F), and are generally warmer near the channel mouth. Numerous aquatic fish foods including caddis flies, caddisfly larvae, centipedes, diptera pupae, earthworms, gnats, isopods, stone flies, water boatman, beetles, and water striders are observed throughout the stream, along with filamentous algae in the lower stream reaches. In-stream pollution includes bath soap and shampoo from people bathing in the stream, silt, log and slash debris from logging activities, fine sediment from a dirt road crossing the channel, and a large amount of urban debris including: auto bodies, domestic garbage, cow dung, refrigerators, oil barrels, and tires. In the lowest 5.5 mi (8.9 km) of channel, numerous juvenile steelhead are observed, with schools of 15 to 20, ranging from two to four inches (0.05 to 0.10 m) in length in the middle reaches, and schools of 20 to 50, ranging from two to four inches (0.05 to 0.10 m) in length, with an occasional six to seven inch (0.15 to 0.18 m) trout in the lower reaches. No other fish species are observed, but many *Pacifastacus leninsculus* crayfish are observed. The personnel conclude that La Honda Creek is an important anadromous fish producing stream, providing ample food, and good to excellent spawning and rearing habitat for steelhead and silver salmon. They also recommend that the stream be managed as a steelhead spawning and rearing stream, existing log jams should be removed, flashboard dam use should be reviewed, residents should be cited for dumping garbage, diversions should be screened, and any new water diversion requests should be protested.

The fifth stream survey was completed July 19th and 20th, 1985 by Department of Fish and Game aides Ford and Bordenave. Almost the entire channel length was walked, with the exception of a quarter mile (0.4 km) section near the headwaters. Channel width ranges from zero (in dry sections) to 15 ft (4.6 m)(the widest pool), with an average width of three ft (0.9 m), and channel depth ranges from zero (a dry riffle) to eight ft (2.4 m)(a bedrock pool), with an average of 1.5 ft (0.5 m). Stream flow is measured as 0.6 cfs (0.02 cms) at the confluence with San Gregorio Creek. The channel bed consists of rubble and bedrock in riffles and runs, and sand and silt in the pools, especially in the lower reaches. Approximately 25% of the entire channel bed is composed of rubble. The aides classify overall spawning habitat as fair, with poor spawning gravels in most reaches and scattered areas of excellent gravels. They believe that the amount of spawning habitat available is enough to produce numbers of fish that will saturate the available rearing habitat. They classify rearing habitat as fair, with food availability (low flow over riffles) being the limiting factor. Moderate food sources are observed, including caddis fly larvae, water boatman, and water striders throughout the stream, and abundant filamentous algae in the non-shaded lower reaches. Abundant shelter consisting of undercut banks, logs, overhanging vegetation, boulders and water turbulence is observed. Pool frequency in the lower reaches is approximately 18%, increasing to 41% upstream of Woodruff Creek, with many of the pools being created by scour around logs and hard banks throughout the creek. Pools appear to be deep and have associated cover for good rearing habitat. Log jams and other barriers are not noted in the reaches downstream of Woodruff Creek, however four log jams are observed between Woodruff and Weeks Creeks, and many more partial and complete log jams are observed upstream of Weeks Creek. Five diversions are observed, but only one is active (upstream of Weeks Creek). The water temperature at the confluence with San Gregorio is 16.1° C (61° F) at 11:00 AM. One area is identified as a pollution source, inputting sediment from construction, trash, and vegetation clippings into the channel. Fish (likely steelhead) are observed in all reaches of the stream, even up to two miles (3.2 km) upstream of Weeks Creek. In deeper pools, steelhead up to eight inches (0.20 m) in length are observed. The aides also observed crayfish, California newts, frogs, a single red legged frog, and salamander larvae. The aides conclude that

La Honda Creek provides spawning and rearing habitat for steelhead downstream of Woodruff Creek, and resident rainbow trout upstream of Woodruff Creek. Removal of the many log jams would not be cost effective, as it would only open a small portion of the creek, and the sediment trapped behind the jam would have to be removed as well.

Table G-1. Bank failure locations noted in the 1995 CDFG La Honda Creek stream assessment. Locations given upstream from confluence of La Honda Creek and San Gregorio Creek.

Location (m)	Location (ft)	Comment
120.1	394.0	Left bank eroded
2286.5	7499.8	Right bank failure, 40 by 60 feet
2504.9	8216.0	Left bank sliding
2645.3	8676.6	Right and left banks failing
2906.2	9532.3	Eroded right bank
2913.2	9555.3	Right bank failing
2976.3	9762.4	Eroded right bank
2992.8	9816.4	Eroded right bank
3166.0	10384.5	Right bank bare and failing
3282.3	10766.1	Right bank failing
3673.7	12049.6	Banks eroding
3713.6	12180.6	Right bank failing
4467.1	14652.0	Left bank failing, 45 by 30 feet
4593.7	15067.2	Left bank with gabion stabilization, still failing
4943.4	16214.2	Eroded left bank
4962.0	16275.2	Right bank failing
5154.9	16908.2	House on left bank. Bank is bare and failing for 80 feet
5187.0	17013.2	Large slide on right bank
5473.4	17952.9	Old bridge, both banks eroding
5497.3	18031.1	Left bank failing
5631.5	18471.4	Right bank eroded
5680.1	18630.7	Right bank eroded
5709.8	18728.1	Right bank eroded
5720.6	18763.7	Right bank eroded
5840.7	19157.6	Right and left banks failing
5863.8	19233.3	Landslide on right bank, 25 by 40 feet
5924.0	19430.6	Right bank failing
6162.6	20213.2	Right bank eroded, 20 by 8 feet
6205.5	20354.2	Right bank eroded, 40 by 8 feet
6285.7	20617.2	Left bank eroded, 47 by 7 feet

The sixth stream survey was completed on February 10, 1997, surveying approximately four miles (6.4 km) of channel, beginning at the confluence with San Gregorio Creek. Habitat in the creek was inventoried following Department of Fish and Game methodologies in September 1995, and fish sampling was conducted in October and November of 1995 to determine the number and species of fish present. Stream flow was measured as 0.33 cfs (0.01 cms) on August 7, 1995 at the confluence with San Gregorio Creek, and 0.33 cfs (0.01 cms) on September 7, 1995 downstream of the confluence with Woodhams Creek. Based upon the inventory of riffle, flatwater, and pool habitat units, habitat in the lower four miles of La Honda Creek is classified and assessed. Riffle habitat constitutes 31% of the total surveyed length, with 172 separate riffles identified, averaging 38 ft (11.6 m) in length, 12 ft (3.7 m) in width, and 0.4 ft (0.1 m) in depth. Substrate consists of 9% gravel, 29% cobble, 45% large cobble, 14% boulder and 3% bedrock. Approximately 24% of the riffle habitat is associated with shelter, including boulders, bubble curtain, small woody debris, undercut banks, overhanging vegetation, and aquatic vegetation. Flatwater habitat constitutes 33% of the total surveyed length, with 131 separate units identified, averaging 55 ft (16.8 m) in length, 10 ft (3.0 m) in width, and 0.5 ft (0.2 m) in depth. Substrate consists of 19% gravel, 28% small cobble, 41% large cobble, 9% boulders, and 3% bedrock. Approximately 16% of the flatwater habitat is associated with shelter, including boulders, undercut banks, woody debris, and overhanging vegetation. Pool habitat constitutes 36% of the total surveyed length, with 139 separate pools identified, averaging 54 ft (16.5 m) in length, 13 ft (4.0 m) in width, and 1.1 ft (0.3 m) in depth. Pool average maximum depth is 2.2 ft (0.7 m), ranging from 0.9 to 4.5 ft (0.3 to 1.4 m). Substrate consists of 69% silt, 22% sand, 7% small cobble, and 2% large cobble. Approximately 27% of pools have associated cover, including undercut banks, roots, woody debris, boulders, overhanging vegetation, and bubble curtains. Substrate at potential spawning locations is also sampled for grain sizes and embeddedness. Substrate consists of 3% sand, 35% gravel, 29% small cobble, 24% large cobble and 9% boulders. Embeddedness is divided into quarters, with 51% of the sites embedded between 26 and 50%, 37% of the sites embedded between 51 and 75%, 10% of the sites embedded between 0 and 25%, and 2% of the sites embedded between 76 and 100%. Riparian canopy cover averages 69%, primarily provided by deciduous trees, bay laurel, and oaks, and secondarily by coniferous trees. Throughout the creek many springs, prolific algae growth in five separate locations, and five in-stream diversions are observed. Pollution in the creek includes observed oil sheen, soapsuds, a sewage odor, and domestic garbage. Many bank stabilization efforts including concrete and boulder riprap are observed, along with four in-stream cobble dams that limit low-flow migration of juvenile fish. A partial logjam is observed at mile 3.8, and 22 bank failures or landslides are found to be contributing sediment to the creek. Water temperatures taken September 5th through 14th, 1995 ranged from 10 to 16° C (50 to 61° F). Fish stocking occurred in San Gregorio Creek up until 1974, but this survey does not report any stocking occurring in La Honda Creek. A fish survey was conducted on the lowest four miles (6.4 km) of creek in 1995, using electrofishing methods. Steelhead, stickleback, sculpin, and one pacific giant salamander were sampled.

Recommendations for La Honda Creek include maintaining adequate perennial flow levels for migration, spawning and rearing; retaining in-stream cover, especially large woody debris, and only removing log jams that are a complete barrier to fish migration; enhancing and maintaining the riparian corridor; removal of invasive non-native species including Eucalyptus, Acacia, German and English ivy, periwinkle and nasturtiums; reducing the amount of fine sediment supplied to the stream from human land uses and natural bank erosion and landsliding.

In addition to these six stream surveys, a coho salmon survey was conducted on Alpine, La Honda and Mindego Creeks on January 17th, 1978. Although no fish or carcasses were observed, the following measurements were made at the Entrada Road crossing: water temperature 11.7° C (53° F), width 18 ft (5.5 m), average depth 9 in (23 cm), estimated flow of 25 to 30 cfs (0.71 to 0.85 cms).