RIPARIAN CORRIDOR WOOD SURVEY IN THE SAN LORENZO, SOQUEL AND CORRALITOS WATERSHEDS, 2012

Instream Wood- Soquel Creek Mainstem Reach 7; December 2012

Prepared by
Donald Alley, D.W. ALLEY & Associates

With Field Assistance from
Chad Steiner

Prepared for the
Santa Cruz County Department of Environmental Health
Santa Cruz, California 95060

February 2013 **Project # 200-10b**

Scope of Work

Three half-mile stream segments previously habitat typed and sampled for steelhead were surveyed for wood in 2012. In the San Lorenzo watershed they included Branciforte 21a-2 (**Appendix A**). In the Soquel watershed they included Mainstem Soquel 7. In the Corralitos sub-watershed they included Corralitos 5/6. Live and dead wood greater than 1 foot in diameter was tallied according to size, location (low-flow channel, bankfull channel, perched riparian, riparian and upslope) and habitat function for salmonids (structure forming for rearing and overwinter or extra). Results were compared to survey data collected from 6 segments in 2010 (**Alley 2011a**), 3 segments in 2011 (**Alley 2012**) and other Central Coast steelhead/coho streams in San Mateo County in 2002, using the same methodology developed by Smith and Leicester (**2005**).

Project Relevance

Instream wood has been identified as critically important in providing overwintering and rearing habitat for juvenile steelhead and especially coho salmon (**Alley et al. 2004; Alley 2011b**). These wood surveys provide baseline information about the density of instream wood and natural recruitment potential in reaches that could greatly benefit steelhead and coho salmon from wood enhancement projects. In 2012, wood surveys were performed in Branciforte Reach 21a-2 and Soquel Reach 7 to provide data in likely reaches of the San Lorenzo and Soquel systems to provide future habitat for coho salmon. This is an Endangered species which NOAA Fisheries will focus recovery activities for in both watersheds. Branciforte Creek was previously used by coho salmon, based on anecdotal accounts of streamside residents and anglers. It is the first tributary in the San Lorenzo system and would be most accessible to coho salmon if the 1 mile of flood control channel was made more passable to adult salmonids. Branciforte reach 21a-2 is low gradient with pool habitat that could potentially provide coho rearing habitat. It is isolated enough from streamside residences in places to allow wood projects and instream wood without jeopardizing structures. The mainstem of Soquel Creek was once utilized by coho salmon for rearing, based on anecdotal evidence by John Getzschmann, old-time angler on Soquel Creek and former resident of Soquel Village. The Soquel mainstem reach 7 is upstream of the Moores Gulch confluence where the stream travels through shaded canyon habitat with redwood and Douglas fir forest before it flows into less canyon-like open valley. Pool development is good in this low-gradient reach, offering potential coho salmon habitat. Here again, this reach is isolated enough from streamside residences in places to allow wood projects and instream wood without jeopardizing structures. It was also identified as a reach that could be utilized by coho salmon if water temperatures were sufficiently low (**Alley 2003a**). Portions of reaches 5 and 6 in Corralitos Creek were surveyed in 2012 because they are in one of the most productive steelhead streams in Santa Cruz County and they are in the most remote stretch of Corralitos Creek that could have wood added far from residences. However, it is in a deep canyon where logs, although they could be easily dropped into the stream channel from the road above, would require hand crews to maneuver them into place except near the one access road.

Methods
Each 1/2 –mile surveyed segment was divided into two 1,000-foot sub-segments and one 600-foot sub-segment. For all segment in 2012, two, 200-foot sites in each 1000-foot sub-segment and one 200-foot site in the furthest upstream 600 feet were selected in a stratified random manner and inventoried for live trees and dead wood, totaling 5 sites. Distance was measured with a hip chain. The beginning and ending points of each segment was located with a Garmin GPS unit. A Large Woody Debris (LWD) inventory form was used (**Figure 1**) that was similar to the Flosi form in the 1998 California Salmonid Stream Habitat Restoration Manual, but provided more functional habitat information, and was developed by Master's graduate student Michelle Leicester and Dr. Jerry Smith, fishery professor at San Jose State University. Large wood pieces and standing trees (alive and dead) were inventoried according to 1-foot diameter size increments for pieces =>1 foot, length (6-20 feet and >20 feet), species and location (within stream bankfull channel and 75 feet beyond bankfull channel on left and right bank). Trees were measured with graduated rulers.

The bankfull channel was divided into the low flow channel (wood as structure forming/ enhancing or extra) and the bankfull channel beyond the low-flow channel (wood as backwater forming/ enhancing or extra) (**Figure 2**). Wood that was part of jams was denoted. Old wood was denoted when bark was absent. The right and left banks were divided into perched (standing within the channel or on the edge of the bankfull (active) channel and likely to be recruited at high flows), riparian and upslope zones within 75 feet beyond the bankfull width. Distances were measured with a rangefinder. Wood was categorized as dead-down, dead-standing and live within the 75-foot riparian/upslope widths beyond the bankfull channel on either side of the creek. The boundary between riparian and upslope zones was based on distribution of typical riparian broadleaf species.

In addition, the amount of entrenchment was measured (ratio of the flood-prone width divided by the bankfull width). Widths were measured with a tape measure. The Width/Depth ratio was measured (ratio of the bankfull width divided by the average bankfull depth) with the stream gradient estimated from map contours. The most common streambed particle size was visually estimated. Depths were measured with a graduated stadia rod. Using these stream characteristics, each inventoried segment was classified into Rosgen channel types (**Rosgen 1996**). Upslope angles were measured with clinometers. All significant logjams found in each ½-mile segment was inventoried and located by GPS coordinates, when possible. Field tallies (piece/tree counts) were organized by 200-foot surveyed sites, and total piece counts were compiled and multiplied by a factor of 2.5 to represent 1,000 ft segments and added together to represent the entire reach. Densities of logs and trees/1,000 feet were grouped as conifer and hardwood and graphed for the entire reach for comparisons with other reaches and streams previously surveyed. Densities of logs and trees were also graphed by 1,000 foot sub-segment by component within the bankfull channel, perched and upslope zones.

Relative proportions of in-channel wood providing structure-forming habitat function versus that providing nonfunctional extra wood were graphed for the reach to compare with other previously surveyed reaches and streams, using Microsoft EXCEL software. In-channel wood (functional and extra) was graphed by 1000-foot sub-segment.

Results and Discussion

In-channel Wood Density. Gazos, Waddell and Scott creeks were the last creeks south of the San Francisco Bay to have coho salmon populations and presently retain steelhead populations. Coho salmon are more exclusively pool-dwelling than steelhead and require more escape cover, which is usually provided by instream wood. Though not necessarily ideal in-channel wood densities exist in these 3 streams, a management goal should be to establish structure-forming in-channel wood densities in our Santa Cruz Mountain surveyed segments comparable with the best conditions in these 3 streams. All 3 surveyed reaches in 2012 (Branciforte 21a-2, Soquel 7 and Corralitos 5/6) had total in-channel wood densities much below the range of Gazos, Waddell and Scott creeks, (**Table 1; Figures 3 and 4**). In decreasing order of in-channel wood densities, the 2012 segments were Corralitos 5/6 (9 pieces/ 1000 ft), Soquel 7 (8 pieces) and Branciforte 21a-2 (7 pieces). Gazos and Waddell creeks had 30+ pieces/1,000 ft.

In comparing densities of the longer-lasting, in-channel conifer pieces, Branciforte 21a-2 (4 pieces), Soquel 7 (5 pieces) and Corralitos 5/6 (9 pieces) had lower densities per 1,000 ft than either Gazos (21.5 pieces) or Waddell (18.4 pieces) (**Table 1; Figure 3**). However, Corralitos 5/6 had higher densities of in-channel conifers than Scott Creek but lacked a hardwood complement. Branciforte 21a-2 had the same low in-channel conifer densities as Bear 18a and Zayante 13i and more than Bean 14b (1.9 pieces) and Zayante 13c (1 piece) in the San Lorenzo system. Soquel 7 had similarly low densities as East Branch reaches Soquel 9a (6 pieces) and Soquel 12a (5 pieces) and more than the overall density of the lower 10 miles of the Soquel drainage (0.9 pieces). Corralitos 5/6 had slightly lower densities than Corralitos 3 (11 pieces).

Maximum density of in-channel conifers in 200-ft sites in Corralitos 5/6 (15 pieces) was comparable to maximum densities in individual reaches of Scott Creek, but maximum in-channel conifer densities in Branciforte 21a-2 (7.5 pieces) and Soquel 7 (7.5 pieces) were much less than the maxima in reaches of Gazos, Waddell and Scott creeks. Reaches 5, 6 and 8 in Scott Creek had 10−15 pieces/1,000 ft. Reaches 3 and 6 in Gazos Creek had as many as 50−60 instream conifer pieces/1,000 ft, while Reach W1 in Waddell Creek had 50+ pieces/1,000 ft (**Leicester 2005**). While Gazos, Waddell and Corralitos 5/6 were clearly dominated by in-channel conifers pieces, the other 2012 surveyed segments had similarly low densities of in-channel hardwood pieces (**Table 1; Figure 3**).

Regarding in-channel densities per 1,000 ft of the shorter-lasting hardwood pieces, Branciforte 21a-2 (3 pieces), Soquel 7 (3 pieces) and Corralitos 5/6 (0 pieces) had much lower densities compared to overall densities in Gazos (9.4 pieces), Scott (10.6 pieces) and (13.9 pieces) creeks (**Table 1; Figure 3**).

Table 1. 2010−2012 Densities of IN-CHANNEL WOOD in Santa Cruz Mountain Stream Reaches Compared to Gazos, Waddell, Scott and Lower Soquel Creeks in 2001-2002.

	Conifer In-channel (pieces/ 1000 ft)	Hardwood In-channel (pieces/ 1000 ft)	Total In-channel (pieces/ 1000 ft)
Gazos (4.5 mi.)	21.5	9.4	30.9
Waddell (6.4 mi.)	18.4	13.9	32.3
Scott (7.8 mi.)	5.9	10.6	16.5
Lower Soquel (10.2 mi.)	0.9	1.2	2.1
Zayante 13i >Mt. Charlie- 2010	4	9	13
Zayante 13c- 2010	1	4	5
Bean 14b- 2010	1.9	6.3	8.2
Bean 14c- 2011	12	11	23
Bear 18a- 2011	4	7	11
Branciforte 21a-2 – 2012	4	3	7
Soquel 7- 2012	5	3	8
Soquel 8- 2011	15	16	31
Soquel 9a- 2010	6	11	17
Soquel 12a- 2010	5	5	10
Corralitos 3- 2010	11	4	15
Corralitos 5/6- 2012	9	0	9

In-channel Structural Wood Density. An even more important management goal than enhancing overall in-channel wood density should be to increase densities of in-channel conifer pieces which actually provide habitat structure comparable to the best densities found in reaches of Gazos, Waddell and Scott creeks. Densities per reach were not provided in Leicester (**2005**), but may be available from the author. Overall creek densities were provided. Creek densities of conifer vs. hardwood pieces per 1,000 feet were provided for Gazos (8.3 vs. 3.5), Waddell (5 vs. 3) and Scott (2.8 vs. 3.9) creeks (**Table 2; Figure 4**). Overall, densities of structure-forming conifer and hardwood pieces in Branciforte 21a-2 (4 vs. 2), Soquel 7 (3 vs. 3) and Corralitos 5/6 (5 vs. 0) compared favorably with overall Scott densities of structure-forming conifers, while

Corralitos 5/6 had the same density as Waddell. None of the 3 segments surveyed in 2012 had as high structural conifer density as Gazos Creek.

According to NOAA Fisheries restoration guidelines (**Jonathan Ambrose, personal communication**), the frequency of structural in-channel wood is within the "good" range when it reaches 18‒34 pieces/ 1,000 ft (6-11 pieces/ 100 meters) for streams with bankfull widths of 1-10 meters and 4‒12 pieces/ 1,000 ft (1.3‒4 pieces/ 100 meters) for streams with bankfull widths of >10 meters. By this standard, Soquel 7 (6 pieces) and Corralitos 5/6 (5 pieces) are rated at the lower end of the "Good" range for structural wood in larger channels. Both are just over 10 meters in bankfull width. Branciforte 21a-2 (10 pieces) has much less than "good" densities of structural wood for smaller channels. This reach is close to 10 meters bankfull width.

In our habitat typing of Gazos Creek in 2001 (**Alley 2003b**), it was determined that 56% of the inventoried pools (184 of 327) were scoured and formed by instream wood that was mostly previously cut redwood stumps and redwood logs resulting from past logging and past stream channel clearing activities. None of the Santa Cruz Mountain segments surveyed in 2010‒2012 went above 28% (Soquel 9a) for wood scour pools, and most ranged 10‒15% (**Table 2**).

<u>Perched Riparian Wood Density.</u> Density of perched riparian trees/logs was above average for Soquel 7 (53) and below the average (36) for Branciforte 21a-2 (29) and Corralitos 5/6 (14) (**Table 3 and Figure 5; Leicester 2005**). Soquel 7 and Branciforte 21a-2 compared favorably to Gazos (24), Waddell (20) and Scott creeks (37). As might be expected in a steep canyon setting, Corralitos 5/6 had relatively fewer perched trees. The Zayante 13i reach had the highest density of perched conifer and hardwood trees/logs by far (89) of any reach or overall stream surveyed thus far, and, therefore, had the highest potential recruitment of perched trees/logs to the active channel in the event of a large stormflow capable of undermining those trees. In 2012, Branciforte 21a-2 (13) had much higher perched densities of conifers than Gazos (4.8), Waddell (4.4) and Scott creeks (6.4). It had comparable densities of perched hardwoods compared to those in Waddell and Gazos creeks but about half the density as in Scott Creek. Corralitos 5/6 had average (6) and similar densities of perched conifers to the 3 northern creeks but lower densities of perched hardwoods. Soquel 7 (53) had much above average and higher hardwood densities than Gazos (19), Waddell (15) and Scott (30) creeks and was second only to Zayante 13i (68) of recently surveyed reaches. However, Soquel 7 had no perched conifers.

The relatively higher densities of perched trees in surveyed upper reaches of some watersheds in 2010‒2012 are to be expected when compared to perched densities in Gazos, Waddell and Scott creeks because lower reaches of watersheds that are included in those 3 creeks' overall densities tend to have lower perched tree densities, especially conifers. Eight of 12 reaches surveyed in 2010-2012 had higher perched tree densities than those 3 creeks.

Table 2. 2010−2012 Densities (pieces/ 1000 ft) of In-channel Wood Providing HABITAT STRUCTURE in Santa Cruz Mountain Stream Reaches Compared to Gazos, Waddell, Scott and Lower Soquel Creeks in 2001-2002.

Stream or Reach (large >10m BF width; small<= 10m BF width)	Conifer Structure (pieces/ 1000 ft)	Hardwood Structure (pieces/ 1000 ft)	Total Structural (pieces/ 1000 ft)	Percent of Pools With Wood Structures Creating Scour
Gazos (4.5 mi.*) (large)	8.3	3.5	11.8**	56 (**Alley (2003b)**)
Waddell (6.4 mi.*) (large)	5	3	8**	–
Scott (7.8 mi.*) (large)	2.8	3.9	6.7**	–
Lower Soquel (10.2 mi.*) (large)	0.3	0.3	0.6	–
Zayante 13i >Mt. Charlie-2010 (small)	2.5	6	8.5	16
Zayante 13c-2010 (large)	1	3	3	5
Bean 14b-2010 (small- barely)	1.3	5.6	6.9	11
Bean 14c-2011 (small)	11	9	20**	10
Bear 18a-2011 (small- barely)	4	5	9	0
Branciforte 21a-2- 2012 (small- barely)	4	2	6	10
Soquel 7- 2012 (large)	3	3	6**	12
Soquel 8-2011 (large)	14	14	28**	11
Soquel 9a-2010 (large)	4	10	14**	28
Soquel 12a-2010 (large)	5	4	9**	21
Corralitos 3-2010 (large)	8	4	12**	13
Corralitos 5/6- 2012 (large- barely)	5	0	5**	10
Average	5	5	10	16

*** From Leicester (2005).**

****Good Rating by NOAA Fisheries Standards (no conifer vs. hardwood discrimination).**

Table 3. Wood Density in the PERCHED Riparian Zone of Surveyed Streams and Reach Segments.

Stream or Reach Segment (Year)	Zone	Conifer Density (trees/logs per 1000 ft)	Hardwood Density (trees/logs per 1000 ft)	Total Density (trees/logs per 1000 ft)
Gazos (2002*)	Perched Riparian	4.8	19.1	23.9
Waddell (2002*)	Perched Riparian	4.4	15.2	19.6
Scott (2002*)	Perched Riparian	6.4	30.1	36.5
Lower Soquel (2002*)	Perched Riparian	0.5	2.1	2.6
Zayante 13i (2010)	Perched Riparian	21.5	67.5	89
Zayante 13c (2010)	Perched Riparian	2	43	45
Bean 14b (2010)	Perched Riparian	0	24	24
Bean 14c (2011)	Perched Riparian	7	30	37
Bear 18a (2011)	Perched Riparian	1	28	29
Branciforte 21a-2 (2012)	Perched Riparian	13	16	29
Soquel 7 (2012)	Perched Riparian	0	53	53
Soquel 8 (2011)	Perched Riparian	10	28	38
Soquel 9a (2010)	Perched Riparian	6	31	37
Soquel 12a (2010)	Perched Riparian	5	45	50
Corralitos 3 (2010)	Perched Riparian	11	39	50
Corralitos 5/6 (2012)	Perched Riparian	6	8	14
Average	Perched Riparian	6	30	36

*** From Leicester (2005).**

Riparian Wood Density Beyond the Perched Zone. Of the 2012 surveyed segments, all 3 had much higher riparian densities beyond the perched zone of conifers and hardwoods compared to Gazos Waddell and Scott creeks (**Table 4 and Figure 5**). All 2010−2012 surveyed segments except Zayante 13i and Bear 18a (with their narrow riparian widths) had higher hardwood riparian densities than those 3 creeks, especially Soquel 7, Soquel 9a, Soquel 12a and Bean 14b, all with 2–3 times as much. The 4 reach segments with 2−4 times the densities of conifer riparian trees beyond the perched zone compared to those 3 creeks were Branciforte 21a-2, Soquel 12a, Corralitos 3 and Corralitos 5/6, two of which were surveyed in 2012.

Table 4. Wood Density in the RIPARIAN ZONE BEYOND PERCHED Zone of Surveyed Streams and Reach Segments.

Stream or Reach Segment (Year)	Zone	Conifer Density (trees/logs per 1000 ft)	Hardwood Density (trees/logs per 1000 ft)	Total Density (trees/logs per 1000 ft)
Gazos (2002*)	Riparian Beyond Perched	19.9	25.9	45.8
Waddell (2002*)	Riparian Beyond Perched	25.6	35.6	61.2
Scott (2002*)	Riparian Beyond Perched	18.7	49.1	67.8
Lower Soquel (2002*)	Riparian Beyond Perched	1.1	9	10.1
Zayante 13i (2010)	Riparian Beyond Perched	7	13.5	20.5
Zayante 13c (2010)	Riparian Beyond Perched	7	94	101
Bean 14b (2010)	Riparian Beyond Perched	11.3	116.3	127.6
Bean 14c (2011)	Perched Beyond Riparian	42	56	98
Bear 18a (2011)	Riparian Beyond Perched	6	33	39
Branciforte 21a-2 (2012)	Riparian Beyond Perched	54	72	126
Soquel 7 (2012)	Riparian Beyond Perched	38	124	162
Soquel 8 (2011)	Riparian Beyond Perched	25	67	92
Soquel 9a (2010)	Riparian Beyond Perched	27	114	141
Soquel 12a (2010)	Riparian Beyond Perched	92	158	250
Corralitos 3 (2010)	Riparian Beyond Perched	73	62	79
Corralitos 5/6 (2012)	Riparian Beyond Perched	70	43	113
Average	Riparian Beyond Perched	32	67	96

*** From Leicester (2005).**

Upslope Wood Density. Upslope wood density is largely dependent on the width of the riparian corridor and the level of streamside development, which has resulted in tree clearing. If the riparian corridor is wide and/or development is high, the upslope density of trees is less and vice versa. Of the 3 segments surveyed for upslope densities in 2012, Branciforte 21a-2 had the highest (107 trees/logs per 1,000 feet; 52 as conifer) Corralitos 5/6 was second (78 trees/logs per 1,000 feet; 75 as conifer) and Soquel 7 had the lowest density (23 pieces per 1,000 feet; 22 as conifer). The upslope densities of trees/logs in Branciforte 21a-2 and Corralitos 5/6 are in the range of densities for Gazos, Waddell and Scott creeks (**Table 5 and Figure 5**). However, the hardwood complement in Branciforte 21a-2 was more than triple (55) (above average (27)), with about average conifer upslope density (52 compared to an average of 58). Corralitos 5/6 had an above average conifer upslope density within the range of the 3 conifer-dominated comparison creeks to the north (Gazos, Waddell and Scott) but had one of the lowest upslope hardwood density yet measured. Low upslope hardwood density in Corralitos 5/6 resulted from steep canyon terrain dominated by conifers on one side and a road bordering it and extending the riparian zone on the other, with steep terrain. Soquel 7 had very low upslope densities because on the left bank (looking downstream) the riparian corridor was flat and wide, or the upslope was cliff-like with few trees or very steep with few trees and substantial landsliding. Then on the right bank there had been substantial clearing and likely previous logging of large conifers, combined with a wide, flat riparian corridor.

If riparian or upslope conifers were to be cut to supply instream structures or catcher logs, ample conifers (primarily redwoods) would be available in all 2010−2012 surveyed segments except Zayante 13c, Bean 14b and Soquel 7.

Table 5. Wood Density in the UPSLOPE BEYOND THE RIPARIAN Zone and Within 75 Feet of the Bankfull Channel of Surveyed Streams and Reach Segments.

Stream or Reach Segment (Year)	Zone	Conifer Density (trees/logs per 1000 ft)	Hardwood Density (trees/logs per 1000 ft)	Total Density (trees/logs per 1000 ft)
Gazos (2002*)	Upslope	49.5	8.6	58.1
Waddell (2002*)	Upslope	93.8	19.8	113.6
Scott (2002*)	Upslope	55.4	3.3	58.7
Lower Soquel (2002*)	Upslope	4.9	1.9	6.8
Zayante 13i (2010)	Upslope	115.5	28.5	144
Zayante 13c (2010)	Upslope	6	64	70
Bean 14b (2010)	Upslope	1.3	4.4	5.7
Bean 14c (2011)	Upslope	82	17	99
Bear 18a (2011)	Upslope	101	88	189
Branciforte 21a-2 (2012)	Upslope	52	55	107
Soquel 7 (2012)	Upslope	22	1	23
Soquel 8 (2011)	Upslope	76	64	140
Soquel 9a (2010)	Upslope	75	15	90
Soquel 12a (2010)	Upslope	81	25	106
Corralitos 3 (2010)	Upslope	42	30	72
Corralitos 5/6 (2012)	Upslope	75	3	78
Average	Upslope	58	27	85

*** From Leicester (2005).**

Recommendations

1. Protect natural recruitment of wood pieces to the stream channel. If concern develops for manmade structures possibly jeopardized by instream wood, seek county and fishery biologist guidance on any proposed wood removal. Wood recruitment is likely to occur primarily during large flood events and must be judiciously managed so that adequate wood remains in the stream channel between large, episodic recruitment events.

2. If it is decided that naturally occurring wood clusters must be modified for safety reasons, cut and remove a minimum of instream wood.

3. If funds are available, initiate a program to artificially introduce secured redwood logs (preferably with attached rootwads) to the stream channel, with a goal of increasing wood-scoured pools containing structure-forming wood to at least 50%. An additional goal should be to increase the frequency of structural in-channel wood to within the "good" range (NOAA Fisheries restoration guidelines (**J. Ambrose, personal communication**) of 18−34 pieces/ 1,000 ft (6-11 pieces/ 100 meters) for streams with bankfull widths of 1-10 meters and 4−12 pieces/ 1,000 ft (1.3−4 pieces/ 100 meters) for streams with bankfull widths of >10 meters. This should be done for every 1,000 feet of stream.

4. Establish an educational outreach program for streamside residents in the vicinity of intended enhancement to facilitate local cooperation.

5. The intent of habitat enhancement with wood should be to place the most wood into the channel as cheaply as possible. Onsite sources of logs are preferable to offsite. Engineered, cabled wood clusters should be avoided due to their relatively high cost/ benefit ratio. Placement of secured catcher logs which will gradually accumulate instream wood during ensuing winter stormflows is the preferred technique.

6. Felling of large, tall redwood trees in close proximity to the stream channel is recommended to make vehicular access less important for wood placement. It may be possible to wench cut logs into place without the need for heavy equipment. Felling of a relatively small number of redwoods in each reach will not significantly reduce stream shading or increase streambank erosion.

7. Position catcher logs that extend into the low-flow channel where they may be wedged between existing trees to help secure them in place most cheaply by cabling. These locations would preferably be at the heads of existing pools or where new pools may be scoured, allowing high flows to spread out to provide backwaters for overwintering fish. If trees may be felled into place, so much the better. Bedrock streambed should be avoided because added wood would have the lowest potential to create complexity.

8. Prior to introducing wood to the stream and floodplain, collect fall baseline salmonid density and habitat data in the stream segments to be enhanced.

9. Annually monitor salmonid density and habitat in enhanced segments to assess benefits of wood placement.

REFERENCES AND COMMUNICATIONS

Alley, D.W. 2003a. Appendix C. Fisheries Assessment. Contained in the Soquel Creek Watershed Assessment and Enhancement Project Plan. November 2003. Prepared by D.W. ALLEY & Associates for the Resource Conservation District of Santa Cruz County.

Alley, D.W. 2003b. Gazos Creek Assessment and Enhancement Plan, San Mateo County, California−Fishery Assessment. Prepared by D.W. ALLEY & Associates for the Coastal Watershed Council, Coastal Conservancy and California Dept. of Fish and Game.

Alley, D.W., J. Dvorsky, J. Ricker, K. Schroeder and J.J. Smith. 2004. San Lorenzo River Enhancement Plan. Prepared for Santa Cruz County by D.W.ALLEY & Associates and Swanson Hydrology and Geomorphology.

Alley, D.W. 2011a. Riparian Corridor Wood Survey in the San Lorenzo, Soquel and Corralitos Watersheds, 2010.

Alley, D.W. 2011b. 2010 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California, With San Lorenzo and Soquel Trend Analysis.

Alley, D.W. 2012a. Riparian Corridor Wood Survey in the San Lorenzo, Soquel and Corralitos Watersheds, 2011.

Ambrose, Jonathan. 2011. Personal Communication. NOAA Fisheries. Santa Rosa, CA Office.

Leicester, M.A. 2005. Recruitment and Function of Large Woody Debris in Four California Coastal Streams. Master's Thesis. Dept. of Biological Sciences. San Jose State University.

Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology. Pagosa Springs, Colorado.

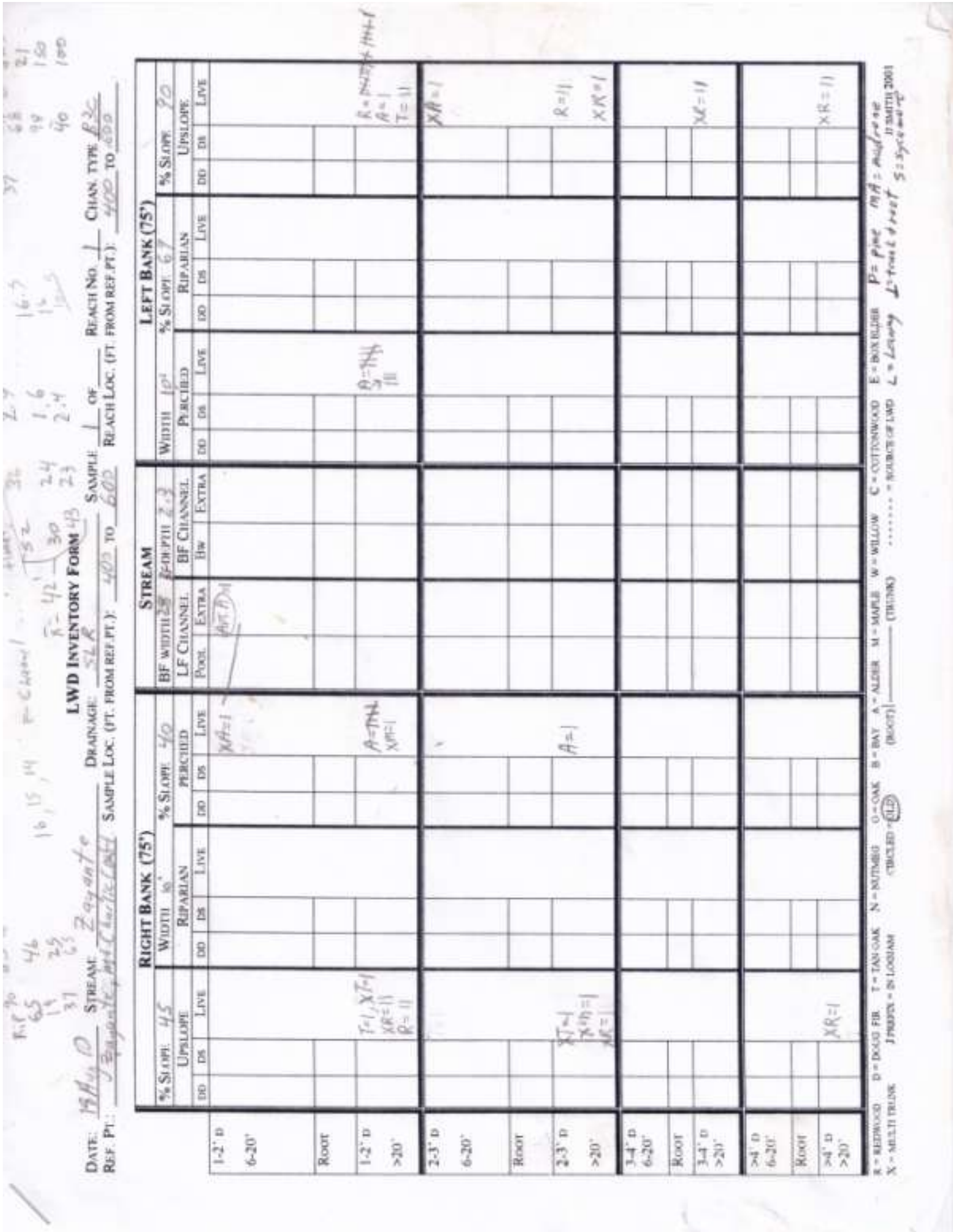


Figure 1. Wood Survey Data Sheet (from Leicester's Thesis (2005)).

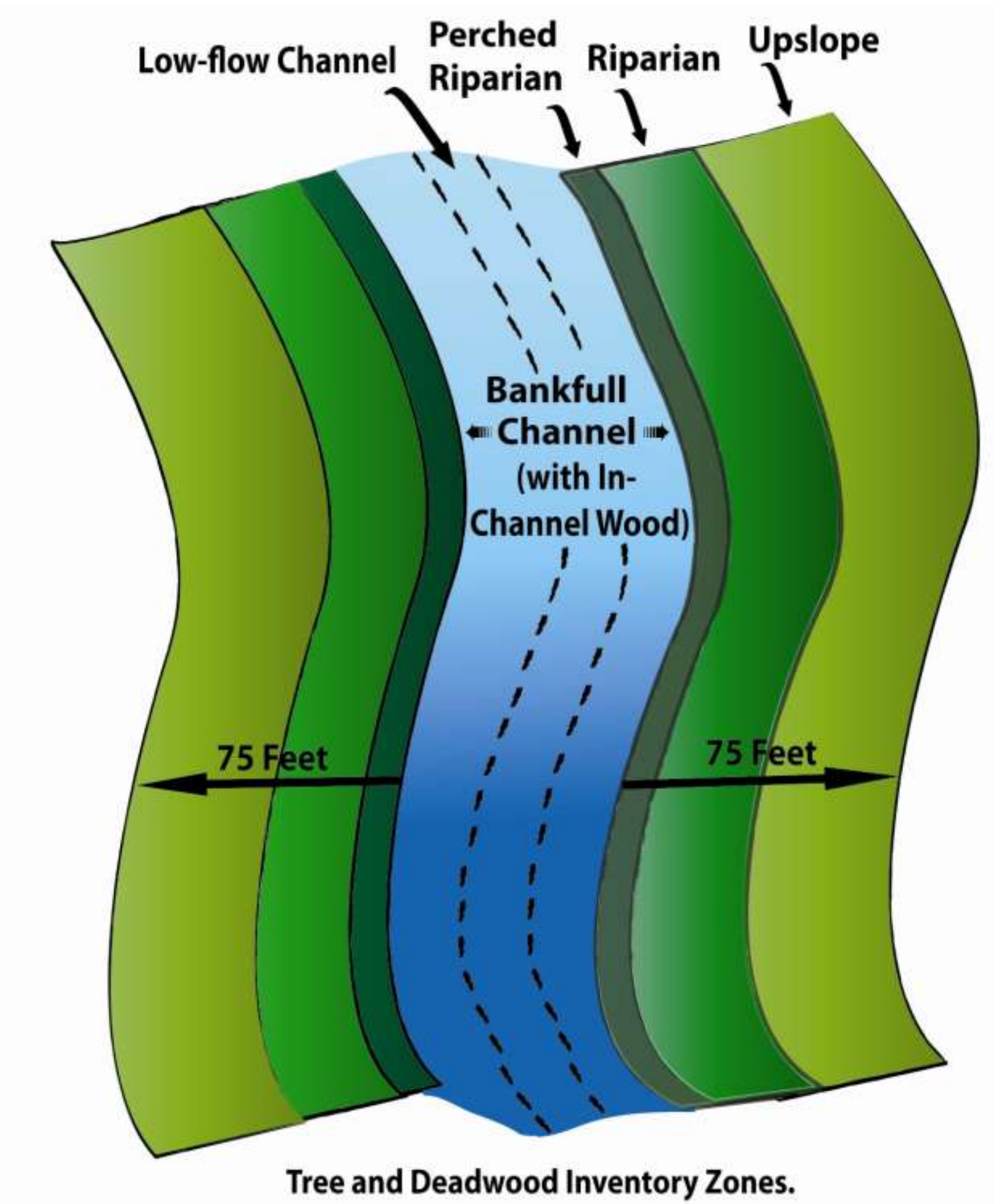


Figure 2. Tree and Deadwood Inventory Zones.

Figure 3. 2010–2012 Densities of In-channel Wood in Santa Cruz Mountain Stream Reaches Compared to Gazos, Waddell, Scott and Lower Soquel Creeks in 2001-2002.

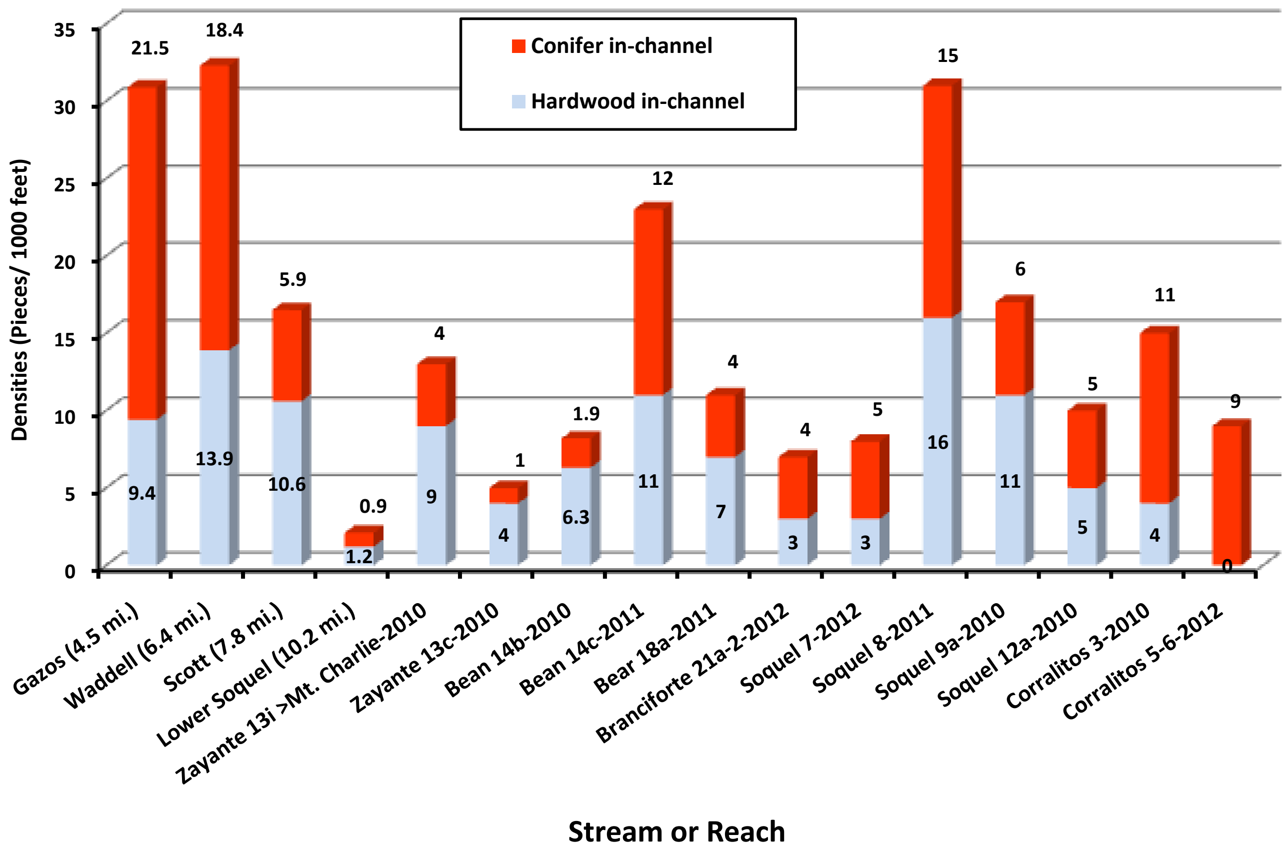


Figure 4. 2010–2012 Densities of In-channel Wood Providing Habitat Structure in Santa Cruz Mountain Stream Reaches Compared to Gazos, Waddell, Scott and Lower Soquel Creeks in 2001-2002.

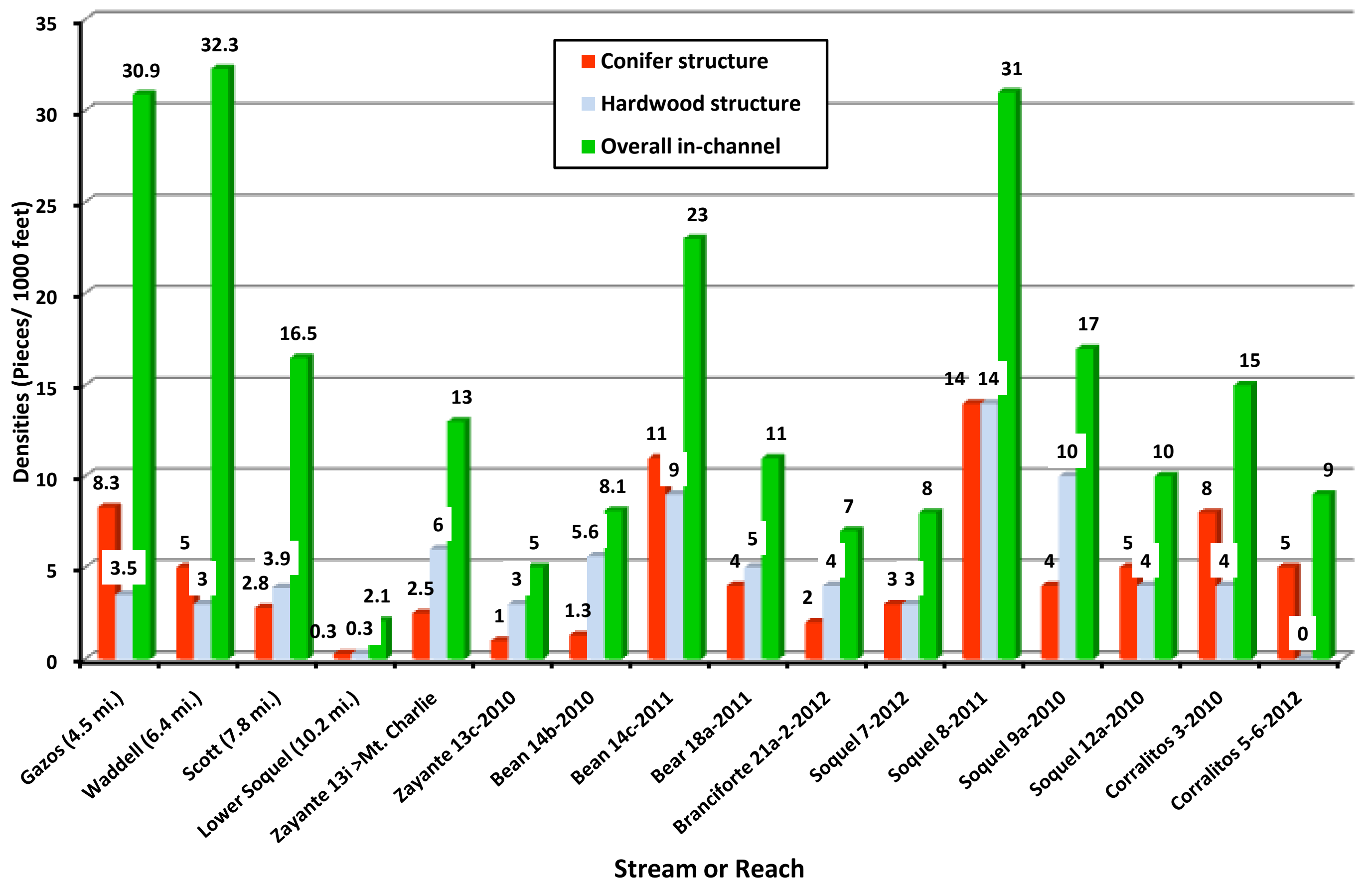


Figure 5. 2010 Densities of Trees/Logs in Perched, Riparian or Upslope Zones of Santa Cruz Mountain Stream Reaches Compared to Gazos, Waddell, Scott and Lower Soquel Creeks in 2001-2002.

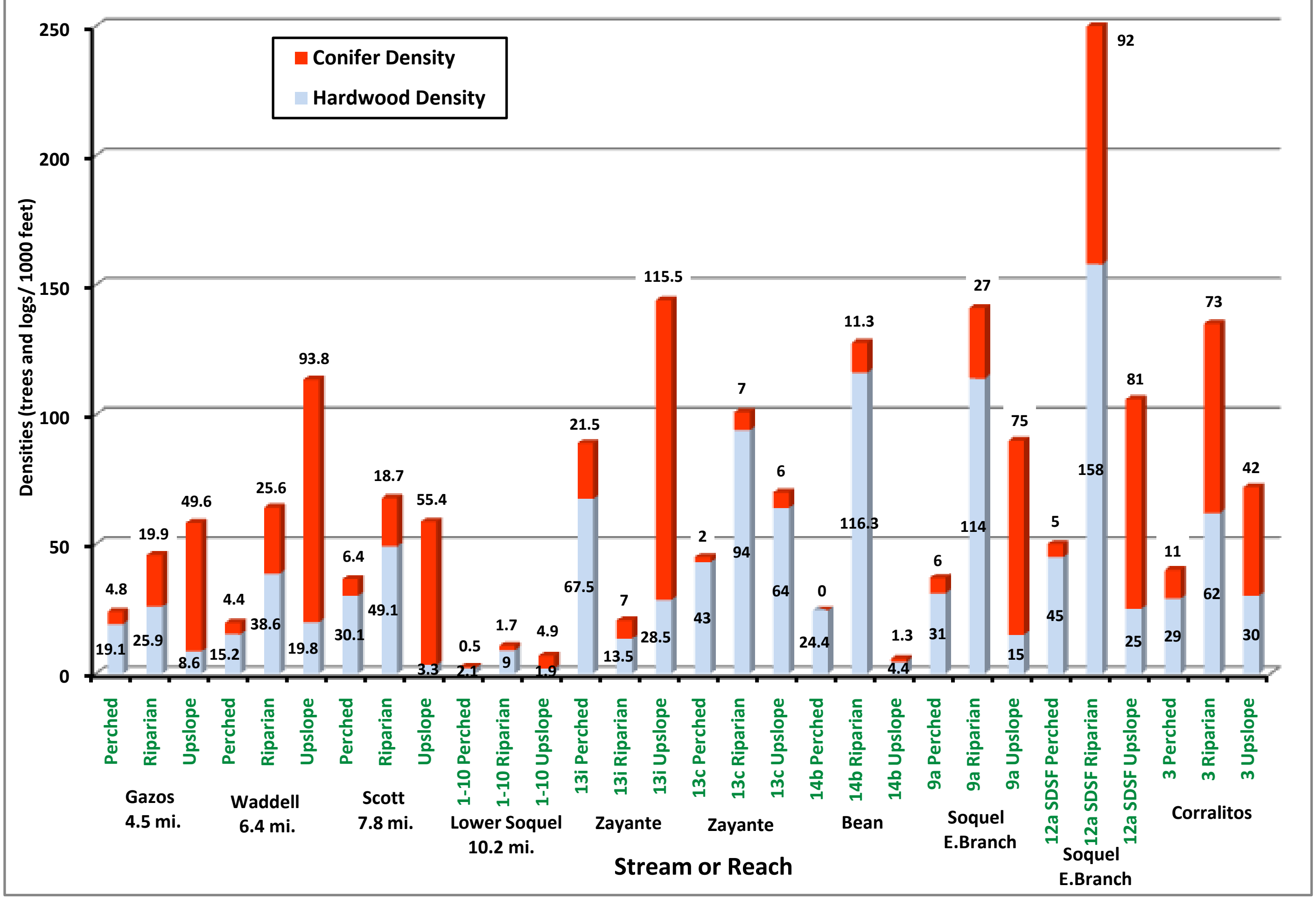
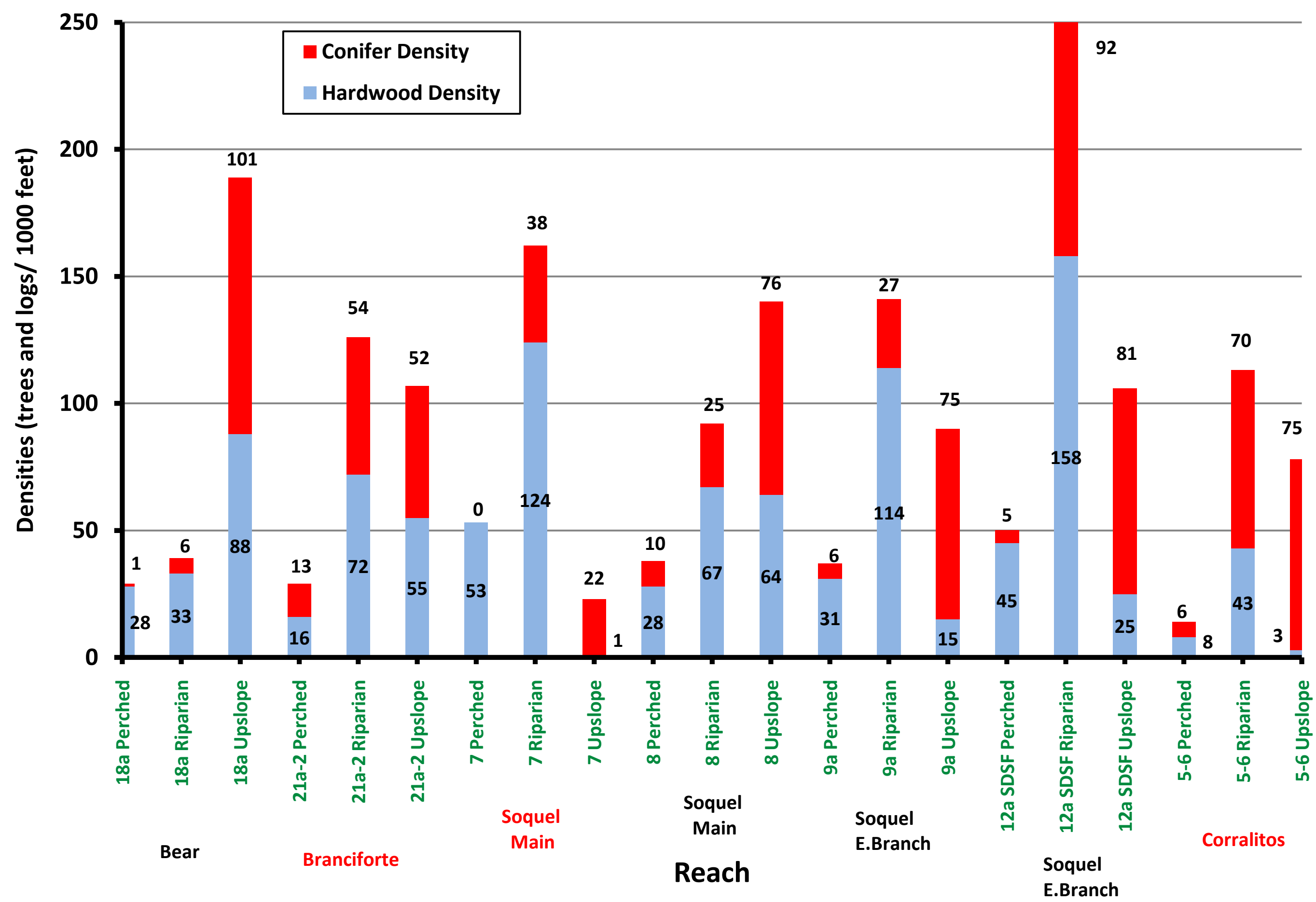


Figure 6. 2011–2012 Densities of Trees/Logs in Perched, Riparian or Upslope Zones of Santa Cruz Mountain Stream Reaches .



APPENDIX A. WATERSHED MAPS

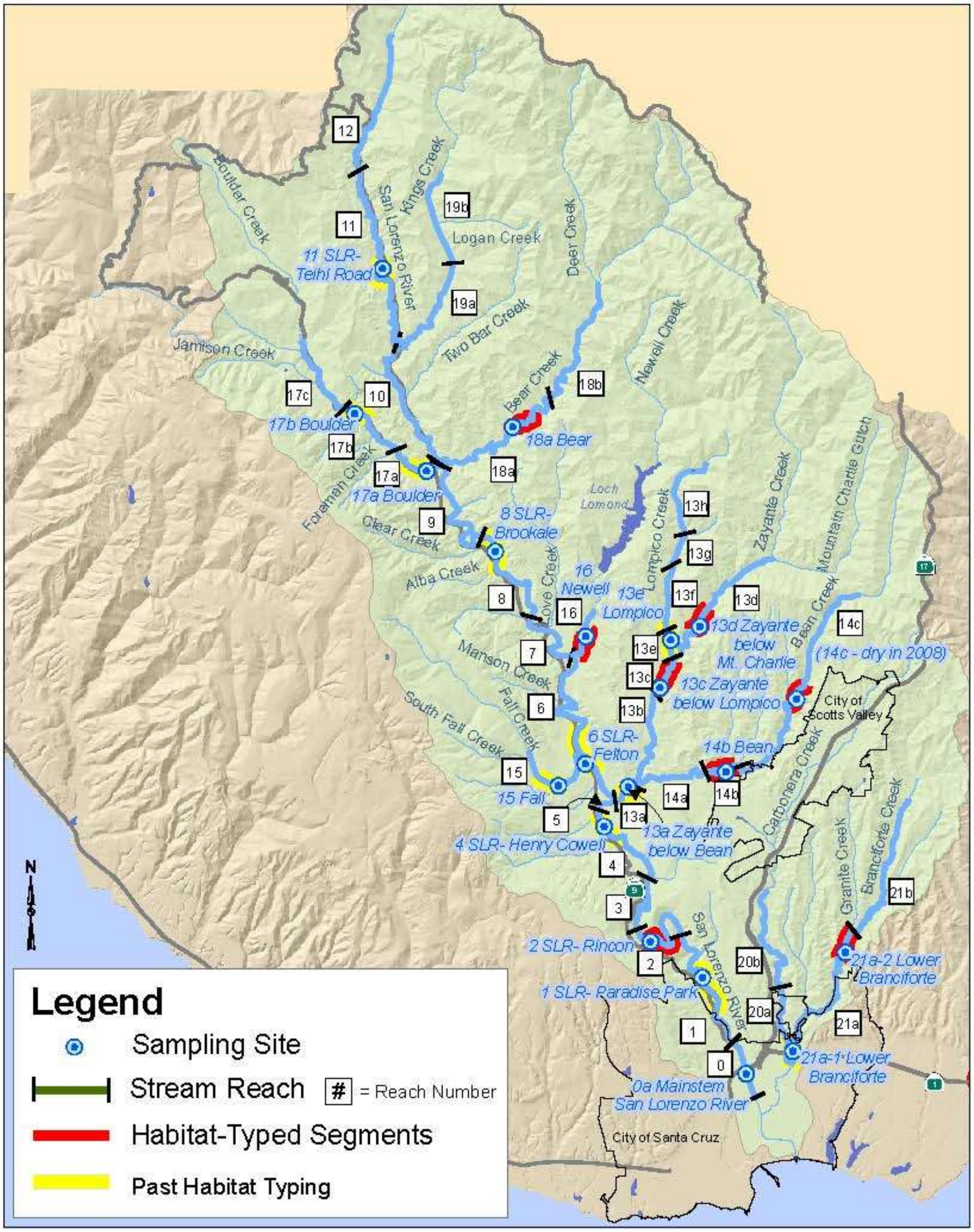


Figure 1. San Lorenzo River Watershed, Showing Wood Survey Segments in Zayante 13c, Bean 14b and unmarked Reach 13i (where Zayante Creek is Labeled Above Reach 13d and Upstream of Mountain Charlie Gulch Confluence).

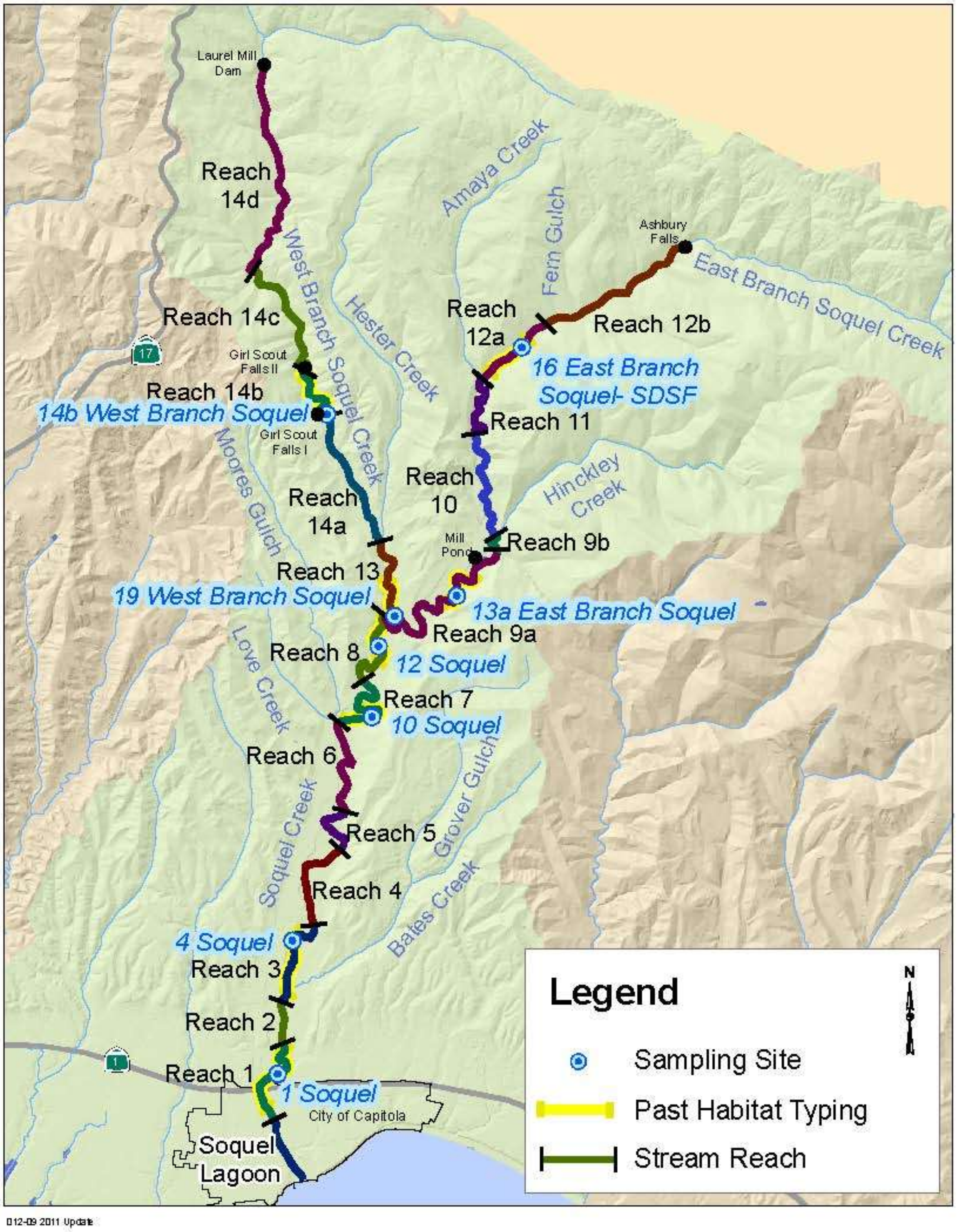
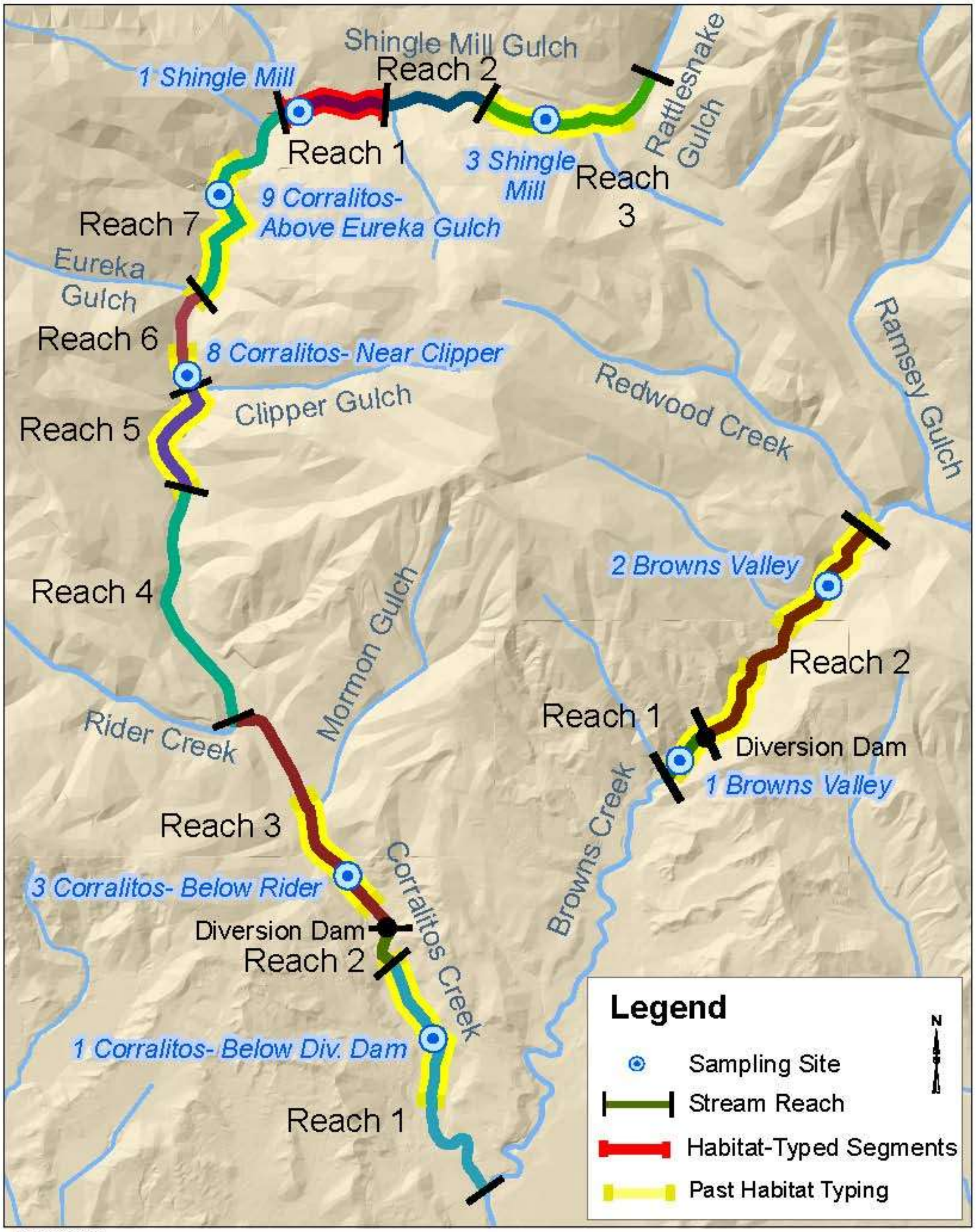


Figure 2. Soquel Creek Watershed, Showing Wood Survey Segments in Reaches 9a and 12a (yellow).



012-09 2011 Update

Figure 3. Upper Corralitos Creek Sub-Watershed, Showing Wood Survey Segment 3 (yellow) Above Diversion Dam.