Coos Bay Lowland Assessment and Restoration Plan

Chapter 2:
Larson Creek Sub-basin Assessment

Larson Creek tidal reach from tide gate. Photo CoosWA, 2006.

Table of Contents

Larson Creek Sub-basin

Introduction

Landform

The Larson sub-basin (see Figure L-1) is long, narrow and orientated northeast to southwest. Larson Slough, the head of which is tide-gated, drains into the north end of Coos Bay through Haynes Inlet and there are tidal and high salt marsh areas near the mouth. Sullivan Creek, Larson's main tributary, flows into the mainstem about midway up the sub-basin.

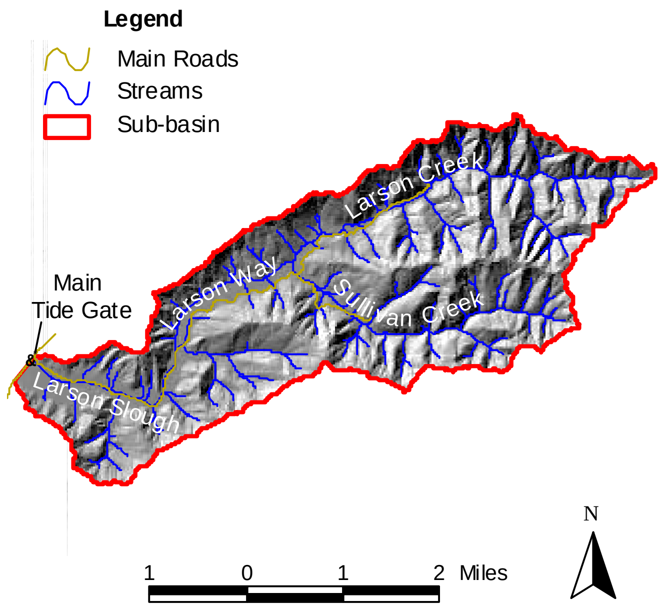


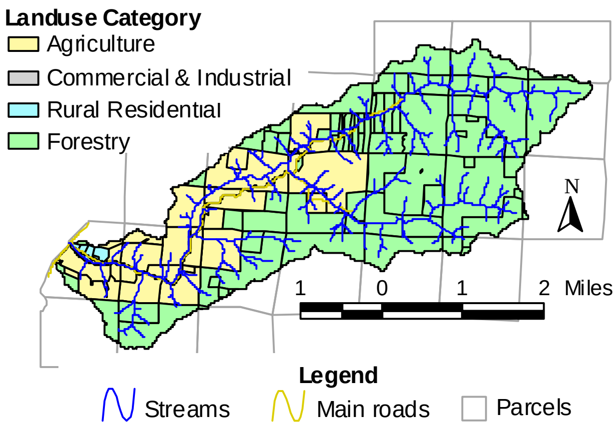
Figure L-1 General Sub-basin

Both Larson and Sullivan Creeks are dendritic river systems. Larson Creek is a fourth order stream, while Sullivan is a third order stream. The drainage area of the sub-basin is approximately 6944 acres (10.85 miles^2), which is the third largest in the lowlands assessment area. The total river miles of streams within the Larson watershed is approximately 47.2 miles, including every section of stream from mainstems to very small intermittent headwater streams. From the tide gate at North Bay Drive, the Larson mainstem is approximately 8 miles long, and Sullivan Creek mainstem is 3.4 miles long. The elevation in the basin ranges from 0 to 1383 feet above sea level (OWRD, 2005).

Larson is the only sub-basin in the assessment area whose underlying geology is composed entirely of Tyee silt/sandstone, which forms an erosive, landslide-formed topography. Weathered into this are the following three general soil types. Dune land-Waldport-Heceta, which is common to dune areas with Waldport being excessively drained, while the Heceta is poorly drained, Templeton-Salander, common to the lowland area, which is well drained and loamy, and Milbury-Bohannon-Umpcoos, found in the uplands, which is moderately deep and shallow, gravely and loamy (Haagen, 1989).

Landuse and Ownership

Figure L-2 Landuse Distribution



Landuse in the Larson sub-basin (see Figure L-2) is 69% forestry, which covers most of the uplands and head waters. Larson contains the highest percentage, 31%, of agricultural lands within the assessment area. These spread across the lowlands of the Larson mainstem and slough, and are mainly dedicated to grazing and hay crops for dairy and cattle operations. Rural residential land use, located near the mouth of the slough, is very minimal, and there is virtually no commercial or industrial land use present in the sub-basin (see Table L-1).

Table L-1 Landuse Area (Coos County Assessor, 2004)

Landuse	Acres	Percent
Agriculture	2,146	31
Forestry	4,845	69
Rural Residential	34	<1
Commercial & Industrial	-	
Total	7,025[1]	

[1] Note: Totals differ between the county assessors parcel aggregate areas and the sub-basin area. The county assessors database has many duplicate records which were removed based on identical areas, map numbers, and parcel numbers, and may not include area of roads or streams.

Hydrology

Precipitation

Annual precipitation is 69 inches in the lowest elevation in the Larson sub-basin. Due to the west facing orientation, rainfall gradually increases as the elevation increases to a maximum of 73 inches, averaging 71 inches for the whole sub-basin (OCS, 2003). The precipitation intensity for a 2-year 24-hour event is 3.01 inches (OWRD, 2005).

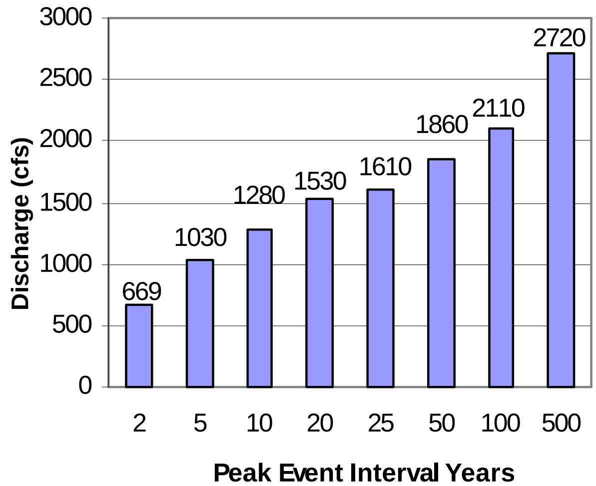


Figure L-3 Annual Peak Discharge Estimates

Stream flow

Annual peak stream flow (Figure L-3) was obtained from the Peak Flow Estimation Program (OWRD, 2005). They use hydrologic prediction equations and physical watershed characteristics to estimate peak flows. Table L-2 shows the estimated discharge at the mouth of Larson Creek for storm events at two to five hundred year reoccurrence intervals. The bankfull storm event is estimated to be 669 cfs. On the other extreme, a maximum discharge of 2720 cfs is estimated for a 500-year storm event in Larson Creek.

Miscellaneous summer flow measurements were collected on Larson Creek in 1998 to 2002 (OWRD), and in 2003 (Coos WA). Table L-2 shows the summer flows on Larson Creek at Winter 1 and at Winter 2 site from 1998 to 2003. In 2003, meas-

Table L-2. Discharge Measurements (1998–2003)

Location	Year	Date	CFS
Winter 1	1998	1-Jun	37.0
		1-Jul	11.00
		3-Aug	2.20
		1-Sep	1.20
Winter 1	1999	29-Jun	5.32
		19-Jul	1.70
		2-Aug	1.35
		16-Aug	1.31
Winter 2	2000	21-Aug	2.01
		29-Aug	0.69
		20-Sep	0.37
		19-Oct	4.64
Winter 2	2001	17-Sep	1.19
		22-Jul	1.34
Winter 2	2002	11-Oct	8.47
		2-Jul	1.26
Main 4	2003	18-Aug	0.14
		24-Sep	0.20
Winter 1		18-Aug	0.70
Sullivan 1		29-Aug	0.71

urements were taken at the Main 4, Winter 1, and at the Sullivan 1. The lowest flow was taken at the Main 4 site (0.14 cfs), however this site is in a much smaller section of stream than the other sites. Based on these measurements the base summer stream flow for the Winter 1 site ranges between 1.20 and 11.00 cfs. At the Winter 2 site the stream flow ranges from 0.69 and 2.01 cfs. A high flow of 37.00 cfs was taken at the Winter 2 site in June 1998.

Land Use Effects on Hydrology

Land uses, as they affect surface conditions, can be used to make general evaluations of the hydrologic condition of a watershed. Of particular concern is the effect of land uses on peak stream flow, since increases in runoff can contribute to flooding, erosion, and culvert failures. The most important determinant for peakflow increases is the ability of soils to absorb rainfall.

The main types of hydrologic soil groups (HSG) present in the agriculture lands are, 61% of HSG Class D, and 39% of HSG Class B. The HSG Class D has very slow infiltration rates and high runoff rates. The HSG Class B has moderate infiltration rates and moderate runoff. Agriculture has a greater affect on runoff in areas where soils have a high infiltration rate compared to areas where soils are relatively impermeable in their natural state (USDA, 1986). Because of the soils, potential risk of peak-flow increases is moderate in the Larson sub-basin.

Within the forest land use area, there are 36.75 linear miles of forest roads. These roads take up approximately 2.0 percent of the forested area. If the percentage of forest area rises above 8 percent, the potential risk of increasing peak-flow moves to high (OWEB, 1999). Because of the low percentage, the relative potential risk for peak-flow enhancement is low.

There are approximately 7.62 linear miles of rural roads in the Larson Creek. Of this area, there is 5 percent area in roads. This percentage ranks Larson Creek residential and area as a relatively moderate potential risk for peak-flow enhancement.

Included within the rural road area, there are some impervious surfaces, but no urban roads. Because of the small amount of impervious surfaces, the potential risk for peak-flow enhancement from urban roads is low.

Overall, Larson sub-basin’s potential risks of peak-flow increase from land use impacts are low to moderate.

Water rights

There are three main sources of water rights in Larson Creek: surface water, groundwater, and instream. The most senior water right in was established in 1924 for domestic use of surface water. Table L-3 displays the different types of water use in Larson Creek. There are no storage rights for Larson sub-basin. Total water rights for the entire sub-basin are 43.92 cfs. The total consumptive use is 1.51 cfs. The instream rights extend 4.0 river miles from the tide gate at North Bay Drive to the Sullivan Creek tributary. Sullivan Creek instream rights extend for 3.5 miles. However, there are no instream rights for Larson Creek above the confluence of Sullivan Creek. A maximum instream water right of 40.00 cfs was established for the purpose of providing optimum stream flow for migration, spawning and juvenile rearing of anadromous and resident fish, and supporting aquatic life. Of the 40.00 cfs maximum reserved instream flow, 14.00 cfs is for Sullivan Creek.

Type of Use	CFS	Ac-ft
Domestic	0.17	0.00
Irrigation	3.08	0.00
Instream	40.00	0.00
Livestock	0.67	0.00
Total	43.92	0.00

Table L-3 Maximum Water Use

Water Availability

Water availability for the mouth of Larson sub-basin is estimated using the Water Availability Report System (OWRD, 2005). The average water available is based on the 50% annual exceedance level. The expected Flow, shown in Table L-4 for Larson Creek and Table L-5 for Sullivan Creek, was derived by subtracting the consumptive uses from the estimated natural stream flow. In Larson sub-basin, has less than 2 cfs of expected stream flow for the months of August through October. However, in Larson Creek, the consumptive water use has not increased by more than 10% since 1993 (OWRD, 2005).

Month	Natural Flow	Consumptive Uses	Reserved Instream Flow	Expected Flow (cfs)
Jan	55.50	0.16	26.00	55.34
Feb	59.70	0.18	26.00	59.52
Mar	43.90	0.10	26.00	43.8
Apr	30.60	0.05	26.00	30.55
May	15.90	0.06	15.90	15.84
Jun	7.90	0.12	10.00	7.78
Jul	3.81	0.21	3.70	3.6
Aug	1.98	0.14	2.00	1.84
Sep	1.57	0.06	2.00	1.51
Oct	1.89	0.01	15.00	1.88
Nov	12.80	0.01	15.00	12.79
Dec	46.10	0.12	26.00	45.98

Table L-4 Larson Creek Monthly Net Water Available (OWRD, 2005)

Table L-5 Sullivan Creek Monthly Net Water Available (OWRD, 2005)

Month	Natural Flow	Consumptive Uses	Reserved Instream Flow	Expected Flow (cfs)
Jan	14.70	0.00	14.00	14.70
Feb	15.90	0.00	14.00	15.90
Mar	11.80	0.00	11.80	11.8
Apr	8.22	0.00	8.22	8.22
May	4.28	0.02	4.28	4.26
Jun	2.05	0.06	2.06	2.0
Jul	0.91	0.10	0.93	.81
Aug	0.44	0.08	0.45	.36
Sep	0.33	0.03	0.34	.3
Oct	0.40	0.00	0.41	.4
Nov	3.09	0.00	3.12	3.09
Dec	12.00	0.00	12.00	12.0

In Sullivan Creek, the natural stream flows become very low in the summer months of July through October, dropping below 1 cfs for the entire period. With consumptive uses, Sullivan Creek is expected to reach 0.3 cfs low summer flows in the month of September. Also, the consumptive water use has increased in Sullivan Creek by more than 10% since 1993 (OWRD, 2005)

Aquatic Habitat

Aquatic habitat surveys addressed in this assessment include unit type, substrate type, riffle sediment, pool depth, large wood, and bank stability (bank stability is presented in Sediment Sources).

Larson's stream reaches extend upstream constrained by terraces in a low gradient, broad valley. Farther upstream the channel becomes constrained by hillslopes and the valley becomes narrower and steeper. See Appendix A for specific channel morphology metrics.

The Larson sub-basin aquatic habitat survey is a combination of 2001 survey data from ODFW covering reaches Main 5, Main 6, and all three Sullivan reaches. Coos WA performed aquatic habitat surveys on reaches Winter 1 and Winter 2 in the winter 2000, and Main 3 and Main 4 in 2003. The first reach on the Larson aquatic habitat survey starts approximately one kilometer above the tide gate. A moderate portion of the lower mainstem and lower Sullivan Creek were not surveyed because of landowner denials. Aquatic habitat survey reaches are shown in Figure L-4. These reach names will be used to describe locations within the Larson sub-basin throughout this assessment.

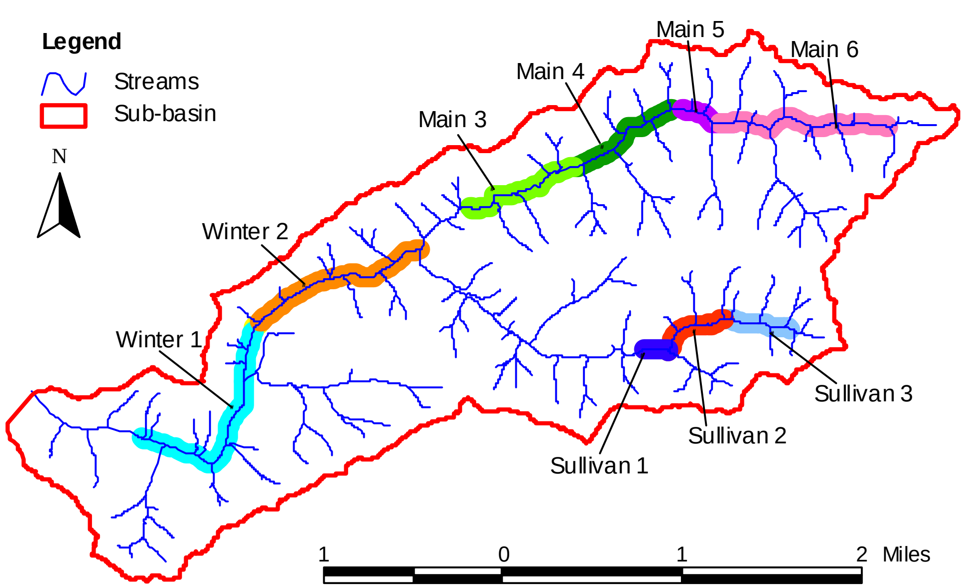


Figure L-4 Aquatic Habitat Study Reaches

Figure L-5, unit types, shows the percentage of unit area per unit type for each of the surveyed reaches. The mainstem reaches are dominated by pools, riffles and glides with rapids in the upper reaches and Sullivan Creek. Small amounts of dry units are spotted in the upper mainstem and upper Sullivan.

Figure L-5
Unit Types

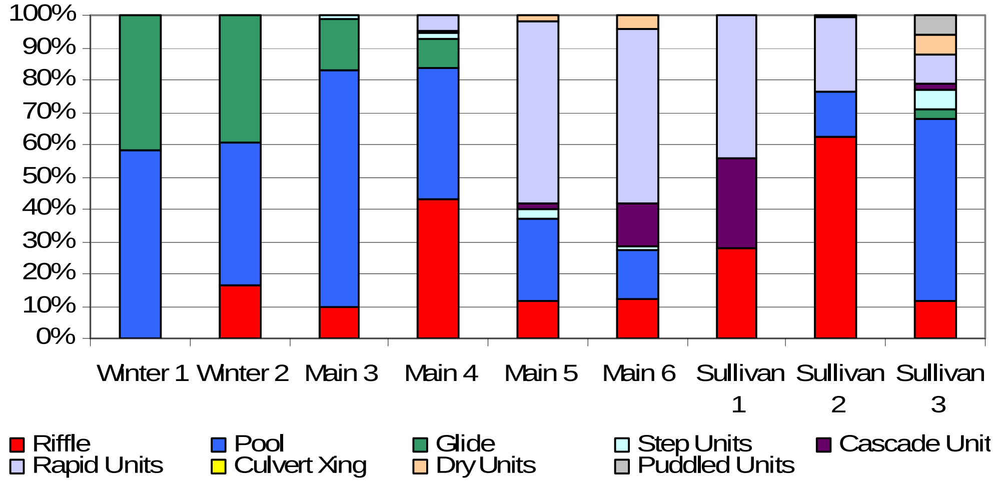


Figure L-6, substrate types, shows the percent of substrate types found in each reach. The upper mainstem and Sullivan reaches have more cobble, boulders, and bedrock. Sullivan 3 has a high amount of silt/organics likely being caught in the large pool area shown in Figure L-5. The lower reaches, less varied in substrate types, are dominitated by sand, gravel and relatively smaller amounts of silt/organics.

Figure L-6
Substrate Types

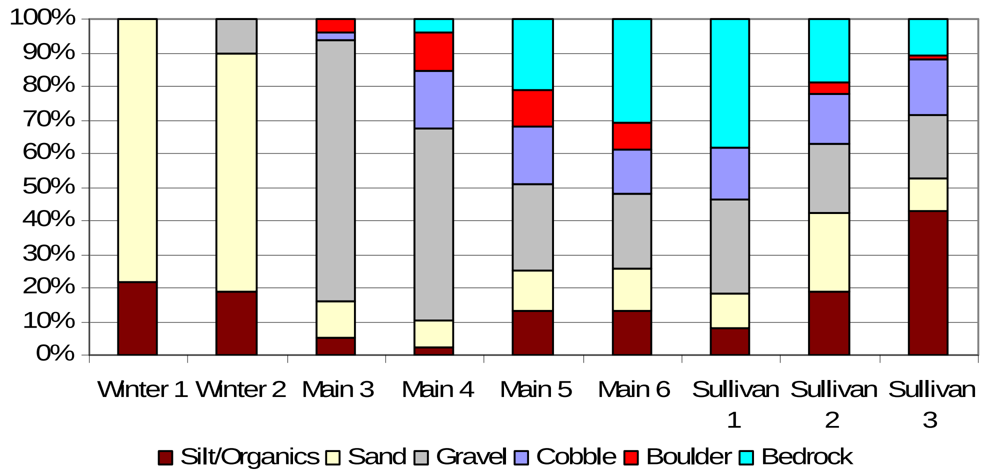


Figure L-7, riffle sediment, shows that most reaches, except Winter 1 which didn't have any riffles, have good amounts of gravel. Main 3, and to a lesser degree Main 4, have extremely high amounts of gravel and little fine sediment – making them excellent for spawning. Winter 2, however, has extremely embedded gravel

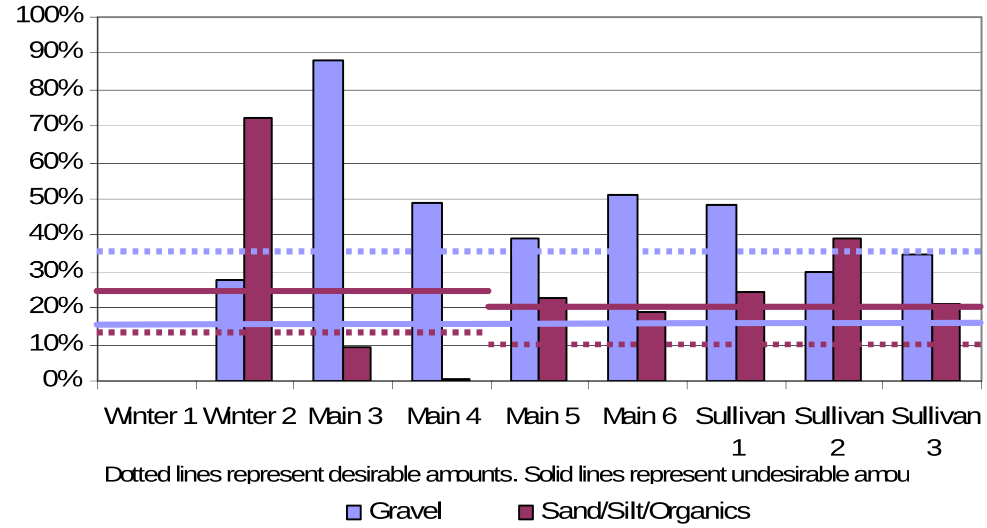


Figure L-7 Riffle Sediment

Figure L-8, pool depth, shows that only Main 3, 5 and 6 and Sullivan 2 and 3 had good pool and residual pool depths. Pool depth was not applicable for Sullivan 1 because there were no pools within that reach. Average residual pool depths were not available for three reaches. Winter 1 and Winter 2 had extremely deep pools.

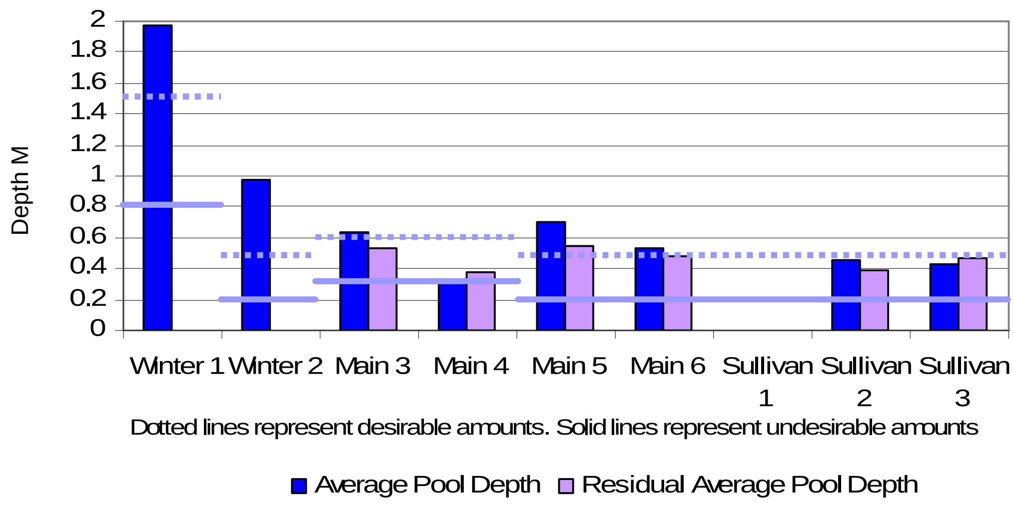
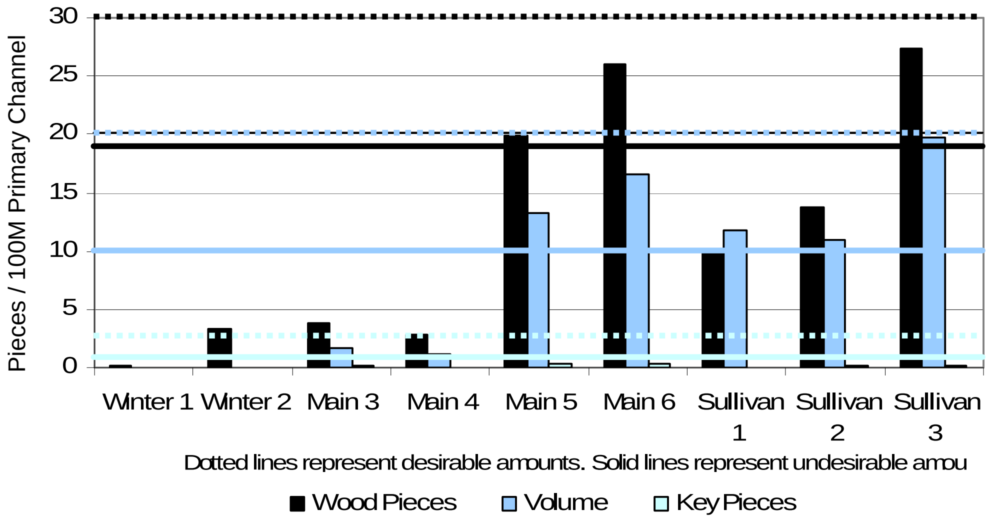


Figure L-8 Pool Depth

Figure L-9, large wood, shows that large wood increases drastically in the upper mainstem and Sullivan reaches, yet wood pieces and volume in these upper areas are still not to desirable levels. Sullivan 3 has the best amount of large wood. Key pieces of wood are very low to none in all reaches.

Figure L-9
Large Wood



Sediment Sources

Sediment sources considered in this assessment include unstable stream banks, unstable slopes, erosion associated with roads, and stream crossings with road fill at risk of failure.

Bank Stability

Bank stability surveys are now conducted as part of the aquatic habitat surveys, however, this was not routine until after 2000 and ODFW surveys do not include bank stability. Therefore, only reach Main 3 and Main 4 were surveyed for bank stability. Figure L-10 shows the bank stability ratings for each aquatic habitat reach. In the Larson sub-basin, only two reaches were surveyed for bank stability. In each reach, nearly 15% of the bank area was uncovered unstable and another 5% uncovered stable.

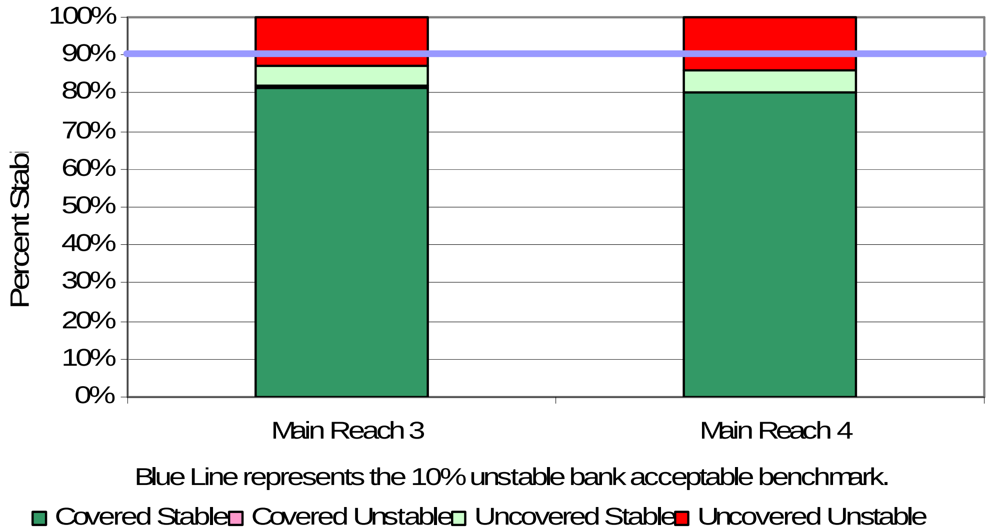


Figure L-10 Bank Stability

Slope Stability

The slope analysis, shown in Figure L-11, determined that the area in the low risk category for landslide potential is approximately 66.4%, the moderate risk area is 25.9%, the high risk area is 5%, and the extremely high risk area is 2.7%. The data show that the Larson sub-basin has a total of 7.7% in the high and very high risk range. The most un-

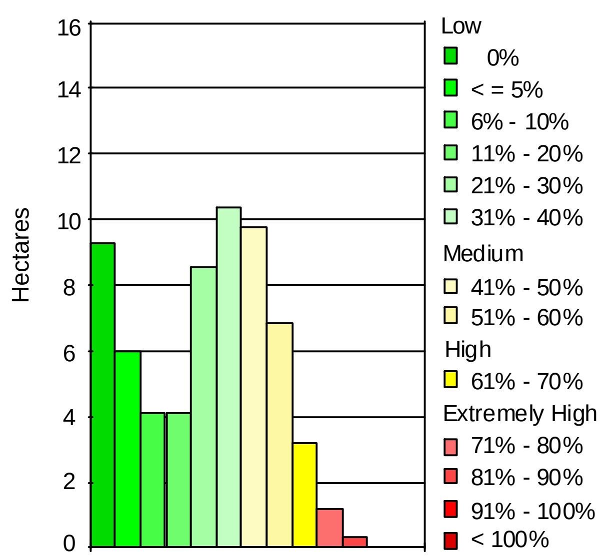


Figure L-11 Slope Stability Risk Classifications

stable slopes are located in the headwaters of Larson and Sullivan Creek, in the highest elevations of the most eastern part of the sub-basin.

Road-Related Erosion

Larson Creek road and landing survey was conducted between February 2001 and October 2004. The survey was divided into two groups, county roads and private roads. The county survey started at the junction of North Bay Drive and Larson Lane and ended at the 5.4 mile marker on the county road. All private roads were surveyed where landowner permission was granted. Table L-5 provides a brief summary of the data collected.

Table P-5 Road and Landing Survey Results

Site Type	Number of Sites	Number of Ditches	Existing Ditch Lengths (ft)
Stream Crossing	51	75	Avg. 401 Min.30 Max.2270
Ditch Relief	82	112	Avg. 416 Min. 50 Max. 1600
Ditch Out	51	76	Avg. 472 Min. 70 Max. 1350
Potential Landslide	1	1	Avg. 80 Min. 80 Max. 80
Ponding/ Gullied Road Surface	1	2	Avg. 220 Min. 140 Max. 300
Totals	186	266	

A total of 29.4 miles of road were surveyed. The average number of drainage sites per mile was 6.3. Within the Larson survey, there were 51 stream crossings, 82 ditch relief culverts, 51 ditch outs, one potential landslide and one ponding road surface site. See Discussion and Restoration Opportunities for recommended drainage feature upgrades.

Stream Crossing Drainage Evaluation

The 51 stream crossing culverts addressed in the road and landing survey were ranked for their ability to drain the area upstream during a 50-year rain event (see Table L-6). Eighteen (35.3%) of the stream crossings in this survey are considered at risk for improper drainage or failure because they are undersized.

At-risk culverts are further ranked in Table L-6 based on the percentage of associated drainage area they can properly drain during a 50-year rainfall event. The number of culverts in each failure risk level (left column) spread across the table depending on the associated fill volume size class. It is important to consider both failure risk and fill volume since it is the fill that becomes the sediment source upon failure of the crossing.

Table L-6 At-risk Stream Crossing Evaluation and Fill Volume

50-Yr. Rainfall Fill Failure Risk	Fill Volume Size Class									
	Minimal		Small		Medium		Large		Very Large	
	Sites	Yds ^{3}	Sites	Yds ^{3}	Sites	Yds ^{3}	Sites	Yds ^{3}	Sites	Yds ^{3}
Low	-	-	2	61	1	87	1	204	-	-
Moderate	-	-	1	44	-	-	1	157	-	-
High	-	-	2	58	-	-	3	632	-	-
Very High	-	-	5	161	1	97	1	156	-	-

Failure Risk, Low = 76% - 100%; Moderate = 51% - 75%; High = 26% - 50%; Very High = 0% - 25%
Fill Volumes, Minimal = $\leq$ 10 yds.^{3}; Small = 10 - 50 yds.^{3}; Medium = 51 - 100 yds.^{3}; Large = 101 - 500 yds.^{3}; and Very Large = > 500 yds.^{3}.

In the Larson sub-basin, seven of the 18 culverts ranked as having very high risk of failure, potentially releasing 414 yd^3 of fill. Five of them ranked as having high risk, potentially releasing 690 yd^3 of fill. Two of them ranked as having moderate risk, potentially releasing 201 yd^3 of fill, and four of them ranked as having low risk, potentially releasing 352 yd^3. There is a total of 1657 yds^3 of fill at these 18 at-risk culverts.

Stream Temperatures

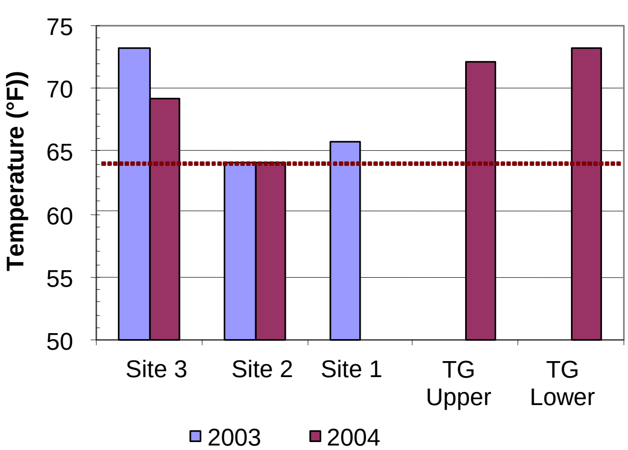
Three temperature logging units were placed in the upper and middle reaches in Larson Creek in 2003. Six temperature loggers were placed in Larson Creek in 2004 (two in the same locations as 2003). Four of these were successfully retrieved, one was lost during high flows (anchor was recovered), and the other was not found. Two of the sites were at the tide gate, one above the gate, and one just below the mouth in the bay. These sites can be used to evaluate temperature differences between the bay and the backwater pool of the tide gate. The other two sites were in the wooded upper reaches of the valley. Sullivan Creek enters Larson mid-way up the valley, but was not monitored due to landowner permission issues.

Table L-7 Temperature Summary and Exceedance of Standards

Site	Year	7-Day averages			Days >64°F	Days >70°F	Hours >64°F	Hours >70°F
		Max.	Min.	Daily D T				
Site 3	2003	73.2	58.5	14.7	83	35	374.5	71.0
	2004	69.2	59.7	9.5	59	3	184.5	6.0
Site 2	2003	64.1	58.5	5.6	7	0	18.5	0.0
	2004	64.1	60.0	4.0	8	1	12.5	4.5
Site 1	2003	65.8	59.2	6.6	18	0	102.0	0.0
TG Upper	2004	72.1	70.0	2.1	94	27	2110.0	317.0
TG Lower	2004	73.2	70.4	2.9	98	38	2184.0	457.5

Table L-7 shows the 7-day average maximum and minimum temperatures, and the number of days and hours spent exceeding 64 and 70 °F for each temperature logging site on Larson Creek. Exceedance of standards is shown in Figure L-12, below. The data indicate that in 2003, all sites in Larson Creek were above 64 °F, but only site 3 reached temperatures over 70. In 2004 all temperature loggers registered maximum temperatures over both 64 and some over 70 °F. The sites with elevated temperatures during the longest period of time were the ones on either side of the tide gate.

Figure L-12 7-Day Moving Averages of Daily Maximum Temperatures



Red dotted line represents 64 °F std, higher temperatures undesirable

Figure L-13, below, illustrates the temperature trends within the sub-basin using 7-day average maximums, and colors them according to salmonid suitability. The map shows that temperature increases from 55 °F at the headwaters to 72 °F at the tide gate in

2004. In 2003, the Larson Creek overall downstream change in temperature from the uppermost site (3) to the mouth was 0.905 °F per 1000 ft. The average daily high temperature change slightly decreased going from the most upstream site (3) to the next downstream site (2). The 2004 average overall downstream change in temperature from the most upstream site (3) to the lower tide gate site was 0.242 °F per 1000 ft. In both years the average daily high water temperature decreased slightly between site 3 and site 2 likely due to the fact that site 2 was in a meter-deep, shaded pool that was quite cold.

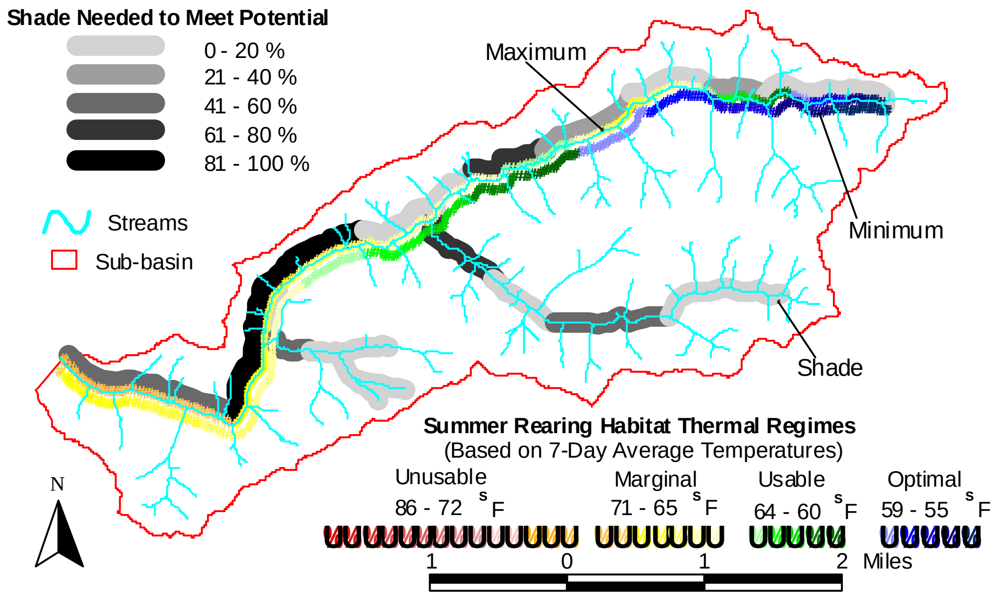


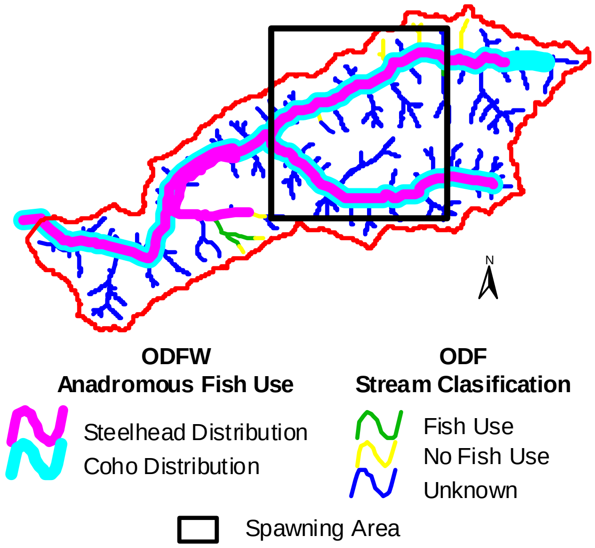
Figure L-13 Temperature Trends and Riparian Shade Condition

Riparian Shade

The difference between current and potential shade is shown in Figure L-13, above, and is expressed as shade needed to meet potential. The darker riparian areas on the map have the least amount of current shade. Current and potential shade values in the Larson sub-basin are 80% and 97%, respectively, in the upper-most, steep canyon areas. The upper valley has 51% and 91% respectively, and the lower valley area has 50% and 93% respectively.

Salmonid Distribution

Figure L-14 Salmonid Distribution



Coho, fall Chinook, winter steelhead, and chum salmon are present in the Larson sub-basin. Figure L-14 shows the distribution of steelhead and coho according to ODFW. However, based on the high stream gradients in the upper reaches of these streams, the coho extent is likely exaggerated. Oregon Department of Forestry (ODF) classifies general fish use streams including cutthroat trout (green line is hidden under the steelhead and coho lines). The spawning survey area is enlarged below in Figure L-15.

Other fish and amphibian species observed in Larson Creek, based on incidental catch at the fish traps, include cottids, brook lamprey, Pacific lamprey, stickleback, Pacific Giant salamander, Dunn's salamander, Roughskin newt, tailed frogs, Red-legged frog, Pacific tree frog, and Foothill Yellow-legged frog (CWA 2005).

Stocking Records

Larson Creek and its major tributaries have been stocked throughout the 1980's with both steelhead and coho juveniles (see Table L-8). Both smolt and fry juveniles were distributed into the Larson sub-basin, with the majority of the stocked fish being released by the use of hatchboxes. From 1980-1989 nearly 120,000 juvenile salmonids were released into the sub-basin, with 90% of them being steelhead. The largest fish release of any species reported in the

Table P-8 Stocking Records

Creek	Species	Year	Juveniles Released
Larson Slough	Steelhead	1980	12,542
Larson Slough	Steelhead	1981	29,719
Larson Cr.	Steelhead	1982	10,229
Larson Cr.	Steelhead	1983	11,928
Larson Cr.	Steelhead	1984	7,496
Larson Cr.	Steelhead	1985	7,444
Larson Cr.	Steelhead	1986	7,500
Larson Cr.	Steelhead	1987	7,625
Larson Cr.	Steelhead	1988	7,530
Larson Cr.	Steelhead	1989	5,155
Sullivan Cr.	Coho	1989	9,928
			117,096

lowlands assessment area was conducted in Larson slough in 1981 when almost 30,000 juvenile steelhead were released in the lower reaches of the stream. The only stocking other than steelhead was in 1987 when almost 10,000 juvenile coho were released into Sullivan Creek. According to ODFW, in the last five to ten years very few fish if any have been stocked into the Larson sub-basin.

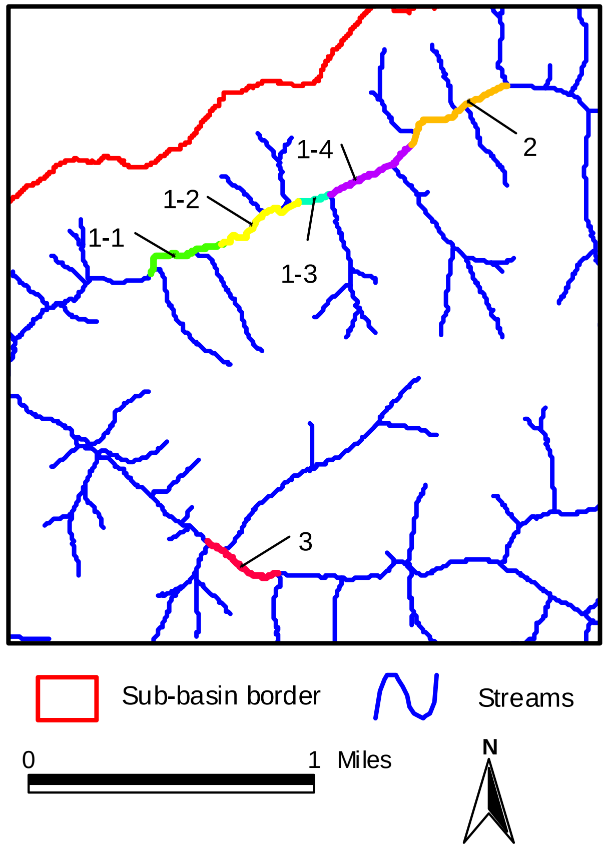


Figure L-15 Coho Spawning Survey Reaches

Spawning Surveys

Coho spawning surveys were preformed on the mainstem of Larson Creek (see Figure L-15), for reaches 1-1 through reach 2, in 2002 - 2004 by the Coos WA. A section of Sullivan Creek (reach 3) was surveyed in 2001 by ODFW, and in 2004 by the Coos WA.

Larson Creek consistently has had the second highest number of spawning coho in the assessment area, and in recent years, the population has been increasing. In 2002, there was a total of 406 coho surveyed in the Larson reaches, in 2003, there were 598 coho (AUC), and in 2004 there were 757 coho (AUC). This was an 86% increase in returning coho spawners in the Larson Creek mainstem reaches, from 2002 to 2004.

Table L-9 Spawning Density

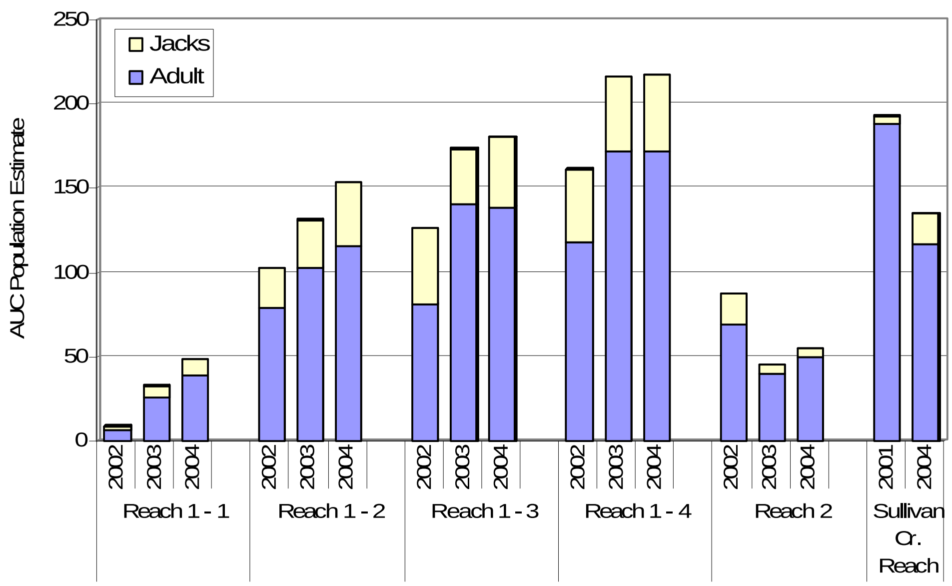
Reach	YEAR	Total AUC/Km	Gravel (m^2)	Gravel (m^2)/ Female
1-1	2002	21	612	136.0
	2003	75	422	32.5
	2004	110	430	22.6
1-2	2002	251	446	11.2
	2003	319	318	6.2
	2004	372	388	6.7
1-3	2002	434	540	13.3
	2003	596	424	6.1
	2004	621	366	5.3
1-4	2002	378	477	8.1
	2003	505	709	8.2
	2004	503	287	3.4
2	2002	167	76	2.2
	2003	87	239	12.0
	2004	106	189	7.6
3	2001	139	No Data	No Data
	2004	126	121	2.1

Examining the density of spawning coho by reach (See Table L-9), indicates which parts of the stream are preferentially selected by the fish and whether the existing habitat is being fully utilized. Reaches 1-3 and 1-4 consistently had the most spawning coho/km. In 2004, the year with the highest number of spawners, there were only 5.3 and 3.4 m^2 of suitable spawning gravel available per female. It has been estimated that 11.7 m^2 is needed for each spawning pair to avoid displacing eggs deposited by other pairs (Sandercoch, 1991). According to this estimate, most of the spawning habitat in the Larson sub-basin was fully seeded each survey year.

In Sullivan Creek, there were 192 coho (AUC) in 2001, and 135 coho (AUC) in 2004. The 2004 gravel per female data show that the spawning habitat on Sullivan Creek is highly utilized.

Other anadromous fish have been observed during the spawning surveys on Larson Creek. In 2002, a pair of chum were observed spawning in reach 1-3. Also, in 2004 one chum carcass was recovered in reach 1-4. Steelhead and cutthroat trout were observed in both Larson and Sullivan Creeks.

Figure L-16 Coho spawning AUC population estimates



Coho Habitat Limiting Factors

The limiting factors analysis (based on Reeves et al., 1989), shown in Table L-11, below, indicates that both summer and winter rearing habitats are in short supply for coho juveniles. Current useable area of winter rearing habitat is only 10% of the area needed to support potential populations, and represents the most severe bottleneck to smolt production. Winter rearing habitat, however, is not clearly understood in this sub-basin as quite often when flows (and velocity) increase the stream has greater connectivity with the majority of its flood plain (visual observations by Coos WA staff). The usable summer habitat is approximately 50% of the area needed to support the potential coho population. Summer temperatures were within acceptable parameters for salmonid survival. Current spawning area is more than sufficient for potential populations.

Table L-11 Limiting Factors to Coho Populations

Larson Habitat Component	Potential Summer Population	Area/ Survival Factor	Area Needed (M^2)	Current Usable Area (M^2)	Smolt Factor	Smolts Produced
Spawning	43,539	0.006	261	2,337	95.5	22,3184
Spring Rearing	43,539	0.3	13,062	12,509	1.7	21,266
Summer Rearing	43,539	0.6	26,123	12,509	0.9	11,258
Winter Rearing	43,539	0.4	17,416	1670	1.2	2,004

Resource Issues

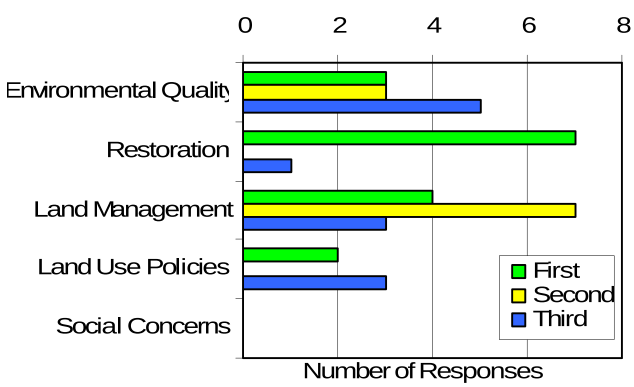
Larson Creek's tide gate was replaced in 2001 to improve fish passage. The older, failing top-hinge tide gate on Larson was replaced with a side-hinge gate that opens with much less hydraulic head differential to open (Giannico et al 2005). The lowering of the invert elevation has also likely increased sediment transport through the tide gate. Monitoring of the gate, however, has indicated that some of the changes made are not necessarily beneficial. For instance, even though the water velocities are much lower for the new gate, the drainage is so efficient that the period that the gate is open is significantly reduced. Another consequence of unknown ramifications is the filling of the large backwater tide gate pool. "diking of tidal marshes, and loss of shallow subtidal and deep channel habitats through sedimentation have significantly reduced the biological productivity of many estuaries." (Pacific 1994)

Landowner Concerns and Desired Future Conditions

Private landowners in the Larson sub-basin expressed concerns regarding land management in the area at a Coffee Klatch meeting on April 26, 2005. Like other sub-basins in the lowland area, many of the attending landowners in Larson are concerned about drainage of the bottom land. Many once-productive grazing lands now remain wet to the point of supporting wetland vegetation over pasture. Larson slough was last dredged in 1967, and since then a lot of silt has built up in the lower watershed due to upland logging practices, the 1996 landslides, and unstable stream banks. Landowners are concerned about sediment causing blockage of agricultural 'ditches' and culverts, and the permit process that often delays maintenance of these structures.

Landowners in Larson also expressed concerned for stream bank conditions and several meeting attendees were very supportive of riparian restoration efforts by the Coos WA. As in other sub-basins, concerns over sediment introduction from stream-side roads were also raised.

Figure L-17 Landowner Concerns



As shown in Figure L-17, landowners' concerns spread more evenly across the spectrum of categories, with the exception of social concerns, than in other sub-basins. Landowners here were also worried about the threat of new development spurred by the 2004 Oregon Measure 37, and coalbed methane wells. Several meeting attendees expressed concern over the heavy use of fertilizers and herbicides by the timber industry in the area.

Apart from improved drainage, landowners attending the Larson Coffee Klatch agreed they would like to see little change in the area for the future. Positive changes would be reduced flooding, a healthier ecosystem including free-roaming wildlife, stabilization of the stream channel, and improved logging practices.