Coos Bay Lowland Assessment and Restoration Plan

Chapter 2:
Willanch Creek Sub-basin Assessment

Willanch Creek upstream from the tide gate. Photo CoosWA, 2006.

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Willanch Creek Sub-basin

Introduction

Landform

The Willanch sub-basin, shown in Figure W-1, is the second smallest stream system in the assessment area. Located south of Kentuck, it is oriented east to west, and drains into Coos Bay. Willanch Slough also empties into Coos Bay through a tide gate and there is a high salt marsh area near its mouth. Willanch Creek's main tributary is Johnson Creek which converges from the south approximately 3.5 miles upstream from the mouth.

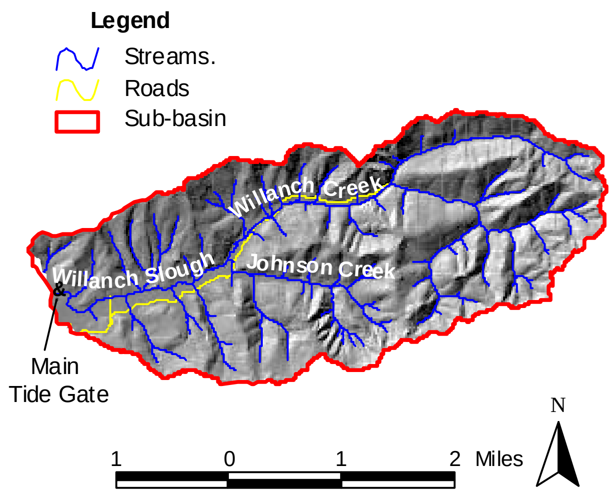


Figure W-1 General Sub-basin

Willanch sub-basin is a dendritic, forth order stream system. The drainage area of Willanch is approximately 5369 acres (8.39 miles^2), which is the second smallest in the assessment area. The total length of streams within the Willanch sub-basin is approximately 33.8 miles, this including mainstems to very small intermittent headwater streams. From the tide gate at East Bay Drive, Willanch mainstem is approximately 6 miles in length. The elevation in the basin ranges from 0 to 1209 feet above sea level. (OWRD, 2005)

Underlying geology of the Willanch sub-basin consists of the Tyee silt/sandstone (43%), Tuffaceous siltstone/sandstone (38%), and Siletz River Volcanic (19%). General soil types, weathered into this sandstone geology, are Templeton-Salander, which is well drained and loamy, and Preacher-Bohannon, which is deep, steep, gravelly and loamy. (Haagen, 1989)

Landuse and Ownership

Forestry is the dominate landuse in the Willanch sub-basin, comprising 76% of the area. The forest lands are managed by both small woodlot owners and larger, private industrial timber operators, which dominate the headwater areas of Willanch Creek and its tributaries (see Figure W-3 and Table W-1). Agricultural landuse, primarily for grazing and hay cropping, makes up 20% of the area and is concentrated in the lower-gradient bottom lands. Rural residential land use is 4% of the area and is largely clustered around the small community of Cooston and along the bay.

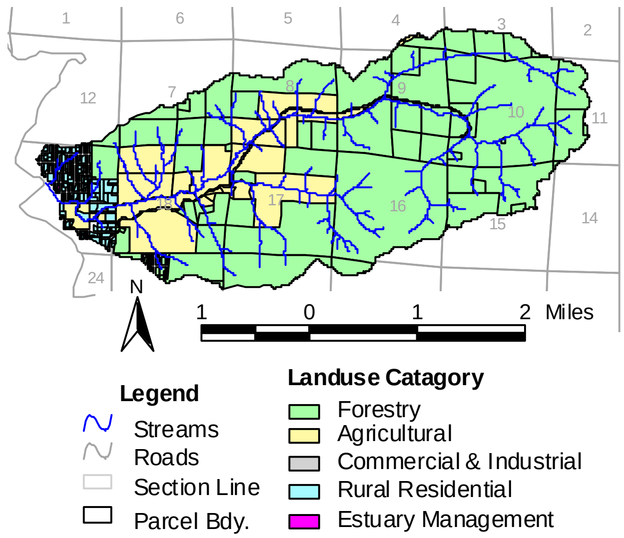


Figure W-3 Landuse Distribution

Landuse	Acres	Percent
Agriculture	998	20
Forestry	3745	76
Rural Residential	179	4
CBEMP	5	<1
Unclassified	0.5	<1
Total	4,927[1]	

Table W-1 Landuse Area

[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 65 inches at the lowest elevations in the Palouse sub-basin. Due to the west facing orientation, rainfall gradually increases as the elevation increases to a maximum of 69 inches, averaging 67 inches for the whole sub-basin (OCS, 2003). The precipitation intensity for a 2-year 24-hour event is 2.86 inches. OWRD, 2005)

Stream flow

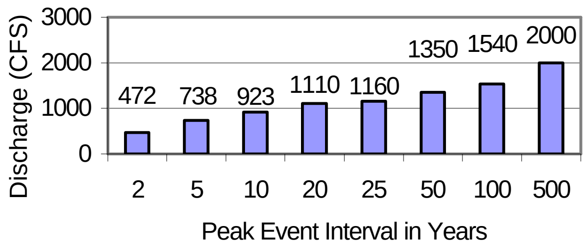


Figure W-3 Peak Discharge Estimates (OWRD, 2005)

Annual peak stream flow for Willanch creek was obtained using Peak Flow Estimation Program (OWRD, 2005). They use hydrologic prediction equations and physical watershed characteristics to estimate peak flows. Figure W-3 shows the estimated discharge at the mouth of Willanch creek for storm events at two to five hundred year reoccurrence intervals. The bankfull storm event is estimated to be 472 cfs. On the other extreme, a maximum discharge of 2000 cfs is estimated for a 500-year storm event in Willanch Creek.

Miscellaneous summer flow measurements were collected on Willanch Creek in 2000 to 2004 (CoosWa). Table W-2 shows the summer flows on Willanch Creek at various locations during this time. The highest flow was collected on June 15, 2004 at the Tidal site, with a discharge of 9.89 cfs. The lowest flow was collected on August 11, 2003 at the Lower Valley site, with a discharge of 0.69 cfs. Based on these measurements the base summer stream flow range is between 0.88 and 9.89 cfs.

Table W-2 Discharge Measurements

Location	Year	Date	CFS
Lower Valley	2000	7-Aug	1.75
	2001	10-Jul	2.5
	2002	22-Jul	1.48
Lower Forest	2003	11-Aug	0.88
		25-Sep	0.74
Lower Valley		11-Aug	0.69
		27-Jun	6.05
		25-Sep	2.3
Tidal	2004	15-Jun	9.89
Upper Valley (Upper Part)		10-Jun	5.49
Upper Valley (Upper Part)		4-Aug	1.61
Lower Valley		15-Jun	5.54
		5-Aug	1.98
Upper Valley (Lower Part)		10-Jun	6.05
Upper Valley (Lower Part)		10-Jun	5.25
		4-Aug	1.73
		5-Aug	1.92
Right Fork 1		4-Aug	1.38
Lower Forest		10-Jun	1.54
Right Fork 1		10-Jun	4.17

Landuse Effects on Hydrology

Landuses, 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, 77% of HSG Class D, and 23% 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, the potential risk of peak-flow enhancement is low in the Willanch sub-basin.

Within the forest use area there are 38.43 linear miles of forest roads. These roads take up approximately 3.3 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 this low percentage, the relative potential risk for peak-flow enhancement is low in Willanch Creek.

There are approximately 9.13 linear miles of rural roads in the residential and industrial area, which comprise 3.9%. This percentage ranks the Willanch residential and industrial area as a relatively low 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, Willanch sub-basin’s potential risks of peak-flow increase from landuse impacts are low.

Water rights

There are three main sources of water rights in Willanch Creek, surface water, groundwater, and instream. The most senior water right in was established in 1932 for irrigation use of surface water. Table W-3 displays thedifferent types of water use in Willanch Creek. The total storage rights including ponds and reservoirs are 2.30 acre feet, for wildlife use. Total water rights for the entire watershed are 93.78 cfs. The total consumptive use is 1.49 cfs. The instream rights were established in 1993, and extend 4.1 river miles from Coos Bay to the end of the county road. A maximum instream water right of 92.2 cfs was established for the purpose of providing optimum stream flow for migration, spawning and juvenile rearing of anadromous and resident fish

Table W-3 Maximum Water Use

Type of Use	CFS	Ac-ft
Domestic	0.08	0.00
Irrigation	1.49	0.00
Instream	92.2	0.00
Livestock	0.01	0.00
Wildlife	0.00	2.30
Total	93.78	2.30

Water Availability

Water availability for the mouth of Willanch 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 W-4, was derived by subtracting the consumptive uses from the estimated natural stream flow. Willanch creek has a three month period from July to September when the stream flows are critically low (.76 to 1.1 cfs) and has from .16 o .43 cfs of consumptive use during the low-flow period. Also, the consumptive water use has increased by more than 10% since 1993 and is the largest increase of all of the lowlands area.

Table W-4 Estimated Net Water Available (OWRD, 2005)

Month	Natural Flow	Consumptive Uses	Instream Flow	Expected Flow (cfs)
Jan	35.60	0.02	26.00	35.58
Feb	38.60	0.02	26.00	38.58
Mar	28.10	0.02	26.00	28.08
Apr	9.65	0.03	9.65	9.62
May	5.24	0.11	5.25	5.13
Jun	2.66	0.28	2.67	2.38
Jul	1.43	0.43	1.43	1.0
Aug	1.11	0.35	1.12	.76
Sep	1.26	0.16	1.27	1.1
Oct	7.84	0.03	7.85	7.81
Nov	7.84	0.02	7.86	7.82
Dec	29.10	0.02	26.00	29.08

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 on page 12).

The Tidal reach is in a low gradient, small flood plain with a wide valley floor. As the reaches progress upstream the channel becomes moderately confined, and the valley gradually changes from moderate to steep and narrow. See Appendix A for specific channel morphology metrics.

Aquatic habitat study reaches are shown below in Figure W-4. These reach names will be used to describe locations within the Willanch sub-basin throughout this assessment. Data from 2001, 2003, and 2004 were combined to run consecutively from the mouth to the upper reaches.

Figure W-4 Aquatic Habitat Study Reaches

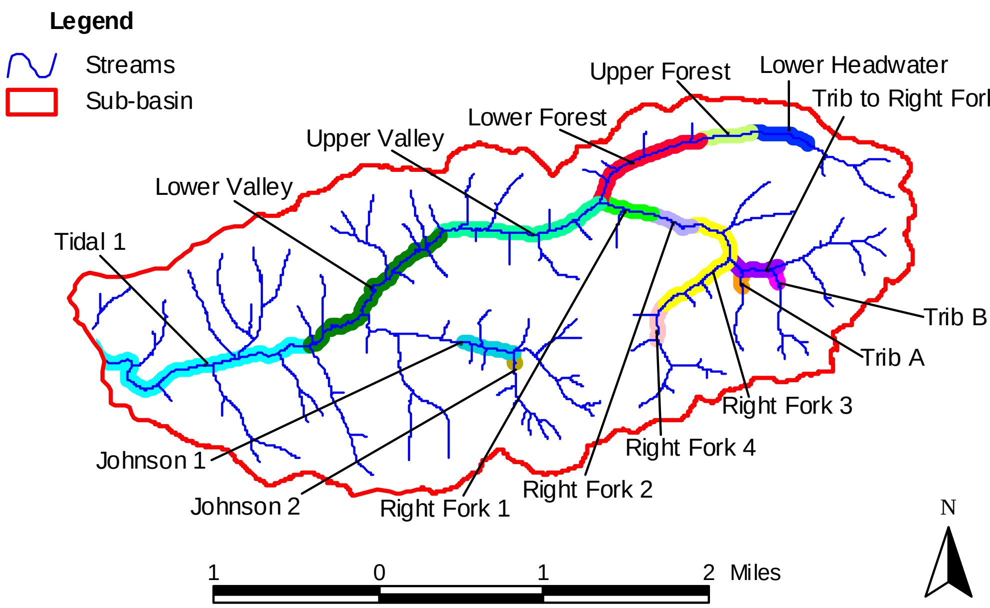


Figure W-5, below, shows the percent of unit types for each reach. The habitat quality benchmark set by ODFW is that pools should comprise 35% of the habitat in reaches with less than 4% gradient and an active channel width (ACW) of less than 12 meters. (Moore, 1997) The only reaches in this basin that reach this benchmark are Tidal, both Valley reaches, Right Fork Reach 2, and Right Fork Reach 4.

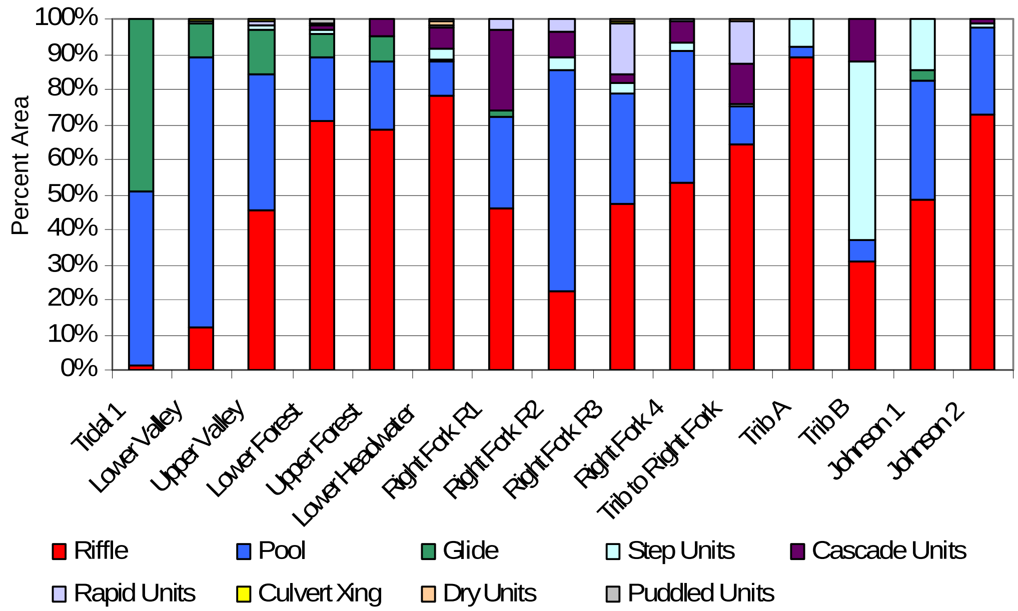


Figure W-5
Unit Types

Figure W-6, below, shows average percentage of substrate for each reach. Higher gradient reaches tend to have more cobble, boulders, and bedrock. Lower tidal areas tend to have higher sand/silt/organic substrates.

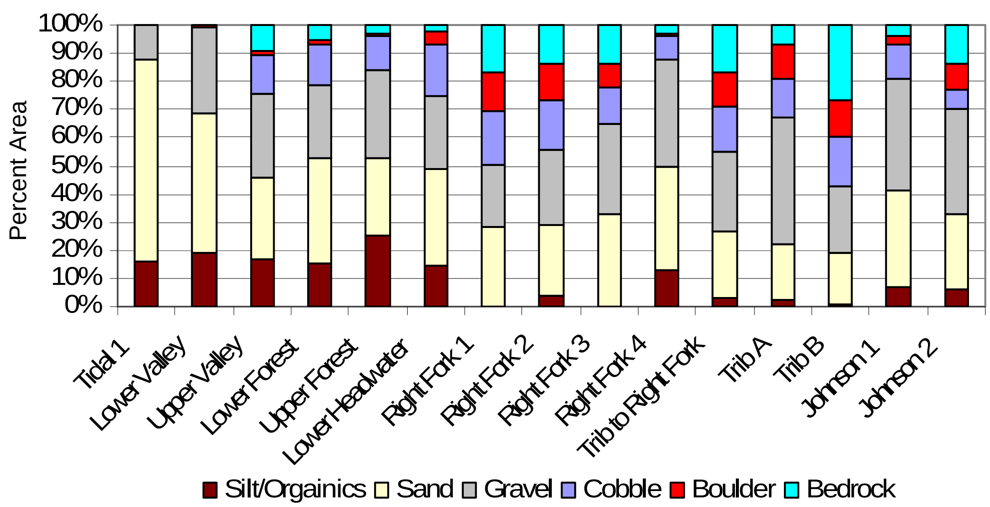


Figure W-6
Substrate Types

Figure W-7, below, shows that riffles in all but the Lower Forest and the Lower Headwaters have excellent levels of gravel, while all reaches have less than desirable amounts of fine sediment.

Figure W-7 Riffle Sediment

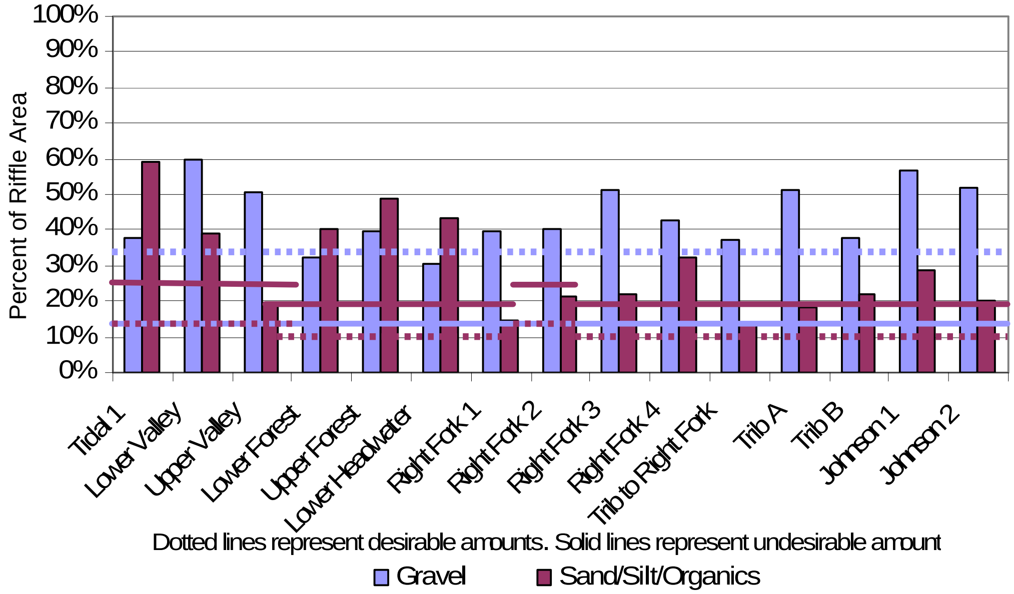
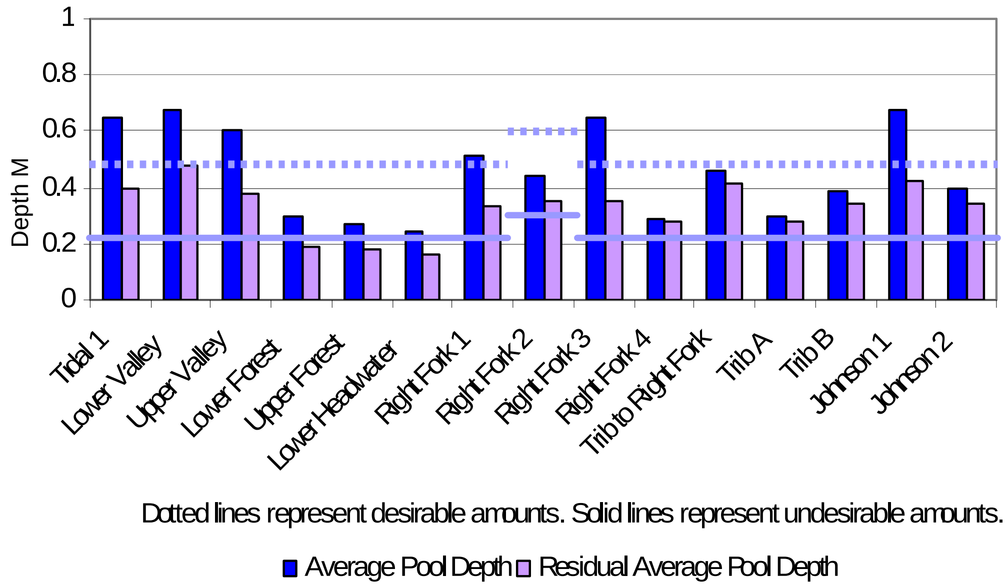


Figure W-8, below, shows that all the reaches are below the ODFW desirable benchmark for residual average depth. The entire basin, except the Right Fork, Reach 2, is considered to be a small channel—this reach is an anomaly attributed to either surveyor error or an unusual landform.

Figure W-8 Pool Depth



As shown in Figure W-9, below, none of the mainstem reaches have desirable amounts of large wood. Only three of the fifteen reaches have desirable levels of wood pieces and volume; none of the reaches has desirable amounts of key pieces

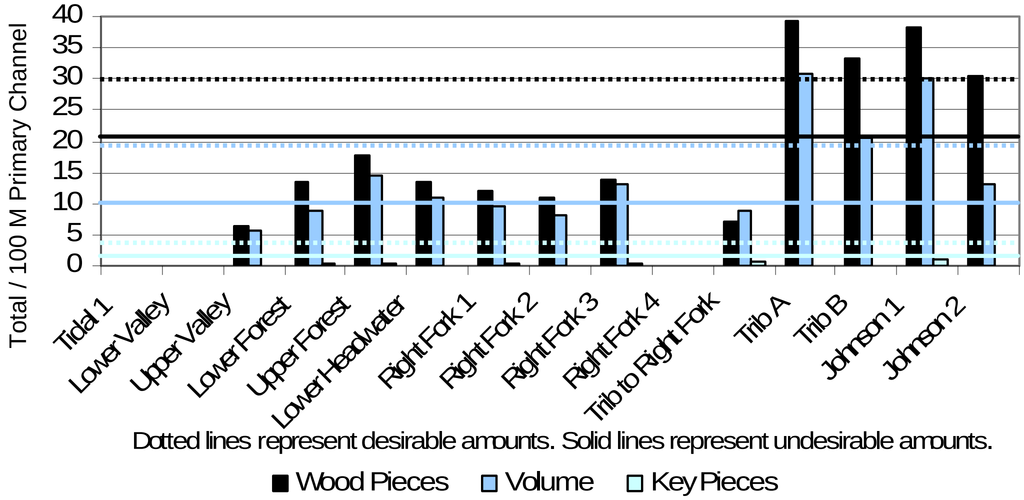


Figure W-9 Large Wood

Wetlands

Historic, current and potentially restored wetlands in the Willanch sub-basin are shown in Figure W-10. The current (2005) wetland extent, determined by CoosWA using aerial photography analysis, is land presently dominated by wetland vegetation and not showing signs of recent agricultural production. In most cases, however, 'current wetland' is not a properly functioning wetland and is included in the area of potential wetland restoration. The area considered current wetland is 7% of the historic wetland extent in this sub-basin. Historic wetland extents are based on soil type and plant characteristics. Thirty-three percent (85 acres) of the historic wetlands in this sub-basin are described in the National Wetland Inventory as 'emergent', meaning they were dominated by rooted herbaceous plants, and are seasonally flooded. It is the emergent seasonally flooded areas, not currently functioning as wetland, that CoosWA recommends for restoration consideration as these areas are often more difficult to manage for crop production. Wetland restoration is discussed in more depth in Chapter 3, and National Wetland Inventory categories are provided in Appendix A.

Table W-5
Wetland Areas

Wetland Type	Acres
Historic wetlands	256
Current wetlands	17
Potential wetland restoration	86

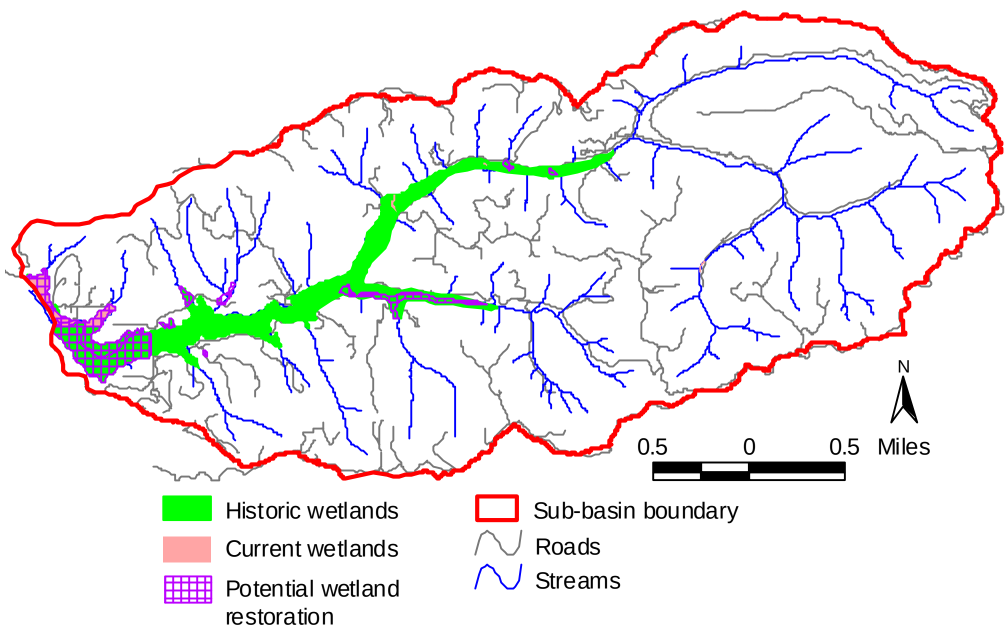


Figure W-10
Wetlands

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 conducted as part of the aquatic habitat surveys. Figure W-10 shows the bank stability ratings for each aquatic habitat reach. Of the reaches surveyed for bank stability in the Willanch sub-basin, four were unacceptable with a range of 19.2% to 25% unstable banks. Figure W-10 shows missing data because bank stability data was not available for three reaches.

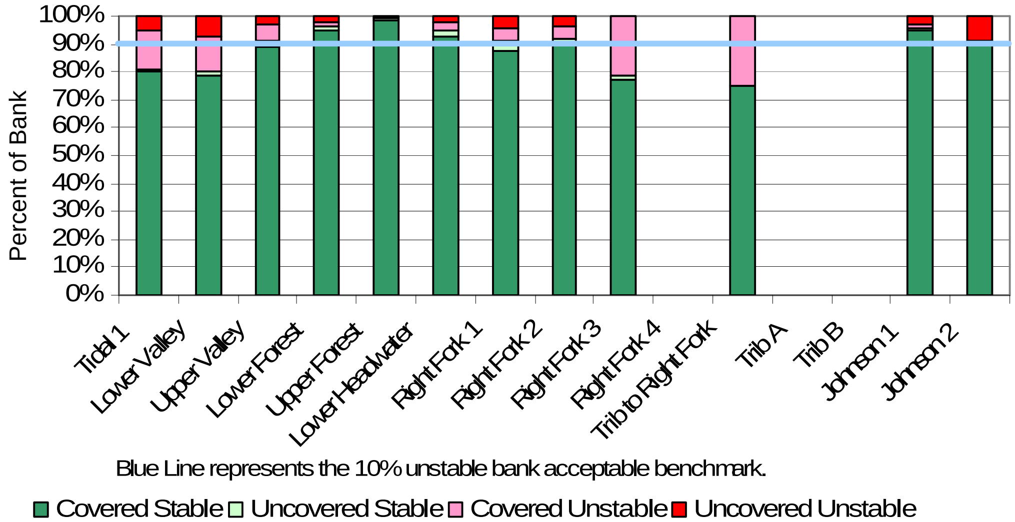


Figure W-10 Bank Stability

Slope Stability

The slope stability analysis, see Figure W-11, shows the area in the low risk category for landslide potential is approximately 85.9%, the moderate risk is 11.9%, high risk is 1.4%, and the extremely high risk is 0.08%. Based on the data, Willanch sub-basin has a relatively low amount of area in the medium to extremely high risk range (13.38%). The

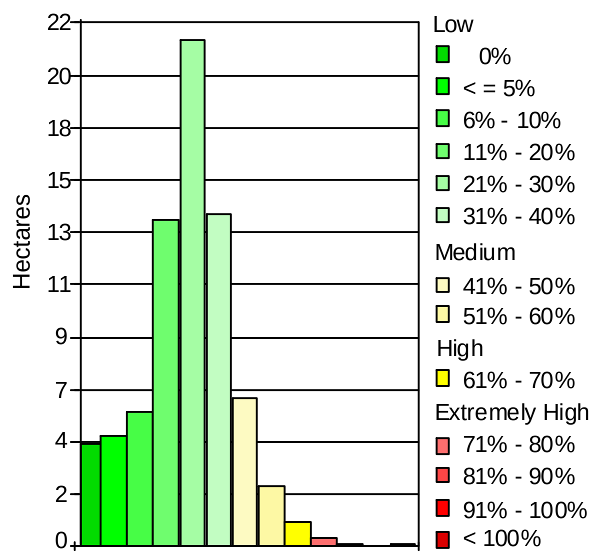


Figure W-11 Slope Stability Risk Classifications

most unstable slopes are located in the headwaters of Willanch Creek, in the highest elevations of this sub-basin. The highest slopes are found in areas of Tyee silt/sandstone, which means that there is high potential for slope failure in these areas.

Road-Related Erosion

Table W-5 Road and Landing Survey Results

Site Type	Number of Sites	Number of Ditches	Existing Ditch Lengths (ft)
Stream Crossing	88	99	Avg. 314 Min. 10 Max.1150
Ditch Relief	73	85	Avg. 315 Min. 50 Max 1000
Abandoned Road	1	2	Avg. 1450 Min. 1450 Max. 1450
Totals	162	186	

The Willanch Creek road and landing survey was conducted between April 2001 and July 2004. The survey was divided into two groups, county roads and private roads. The county survey started at the junction of East Bay Drive and Willanch Way and ended at the junction with the Weyerhaeuser 0240 road. All private roads were surveyed where landowner permission was granted. Table W-5 provides a brief summary of the data collected.

A total of 25 miles of road were surveyed in the Willanch sub-basin, including 3.65 miles of county roads and 21.3 miles of private roads. The average number of drainage sites per mile on county roads is 10.8 and 4.2 per mile on private roads. One reason for the different density is the ridge roads are on private lands and they do not need as many drainage features as the midslope or valley locations.

Within the survey there were 88 stream crossings, 73 ditch relief culverts and one gullied road surface site (see Table W-5). There were no future landslide sites found. See Discussion and Restoration Opportunities for recommended drainage feature upgrades.

Stream Crossing Drainage Evaluation

The 88 stream crossing sites studied in the road and landing survey were also evaluated for their ability to drain the area upstream during a 50-year peak rain event. Of those 88 sites, 27, or 31%, are at risk of failing during such an event.

At-risk culverts are ranked in Table W-6 for failure risk based on the percentage of associated drainage area they can properly drain during a 50-year rain 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 a major sediment source upon failure of the crossing.

Table W-6 At-Risk Stream Crossing Evaluation

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	51	-	-	2	655	1	649
Moderate	-	-	1	48	-	-	-	-	-	-
High	-	-	1	14	1	72	3	503	-	-
Very High	5	0	5	155	1	71	5	721	-	-

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

There is a total of 2939 yards^3 of fill at these 27 at-risk culverts. Sixteen of the 27 at risk culverts ranked as having very high risk of failure, potentially releasing 947 yards^3 of fill. Five ranked as having high risk of failure, potentially releasing 589 yards^3 of fill. One site ranked as having moderate risk of failure, potentially releasing 48 yards^3 of fill. Five of them ranked as having low risk of failure, potentially releasing 1355 yards^3 of fill downstream.

Stream Temperatures

Eight temperature gauging sites were located within the Willanch sub-basin, including a forested upland tributary site on the upper right fork of the mainstem. Data at Site 2, on the wooded upper valley, were lost due to equipment failure. Willanch stream temperatures have been monitored at various sites since 1997 and several of these locations were still used in 2004, offering a good comparison of temperature trends over the years.

Table W-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 ? T				
Site 8	2003	59.5	54.2	5.3	0	0	0.0	0.0
Site 7	2003	61.7	55.2	6.5	0	0	0.0	0.0
	2004	62.1	56.5	5.5	0	0	0.0	0.0
Site 6	2003	62.0	55.4	6.6	0	0	0.0	0.0
Site 5	2003	61.5	55.8	5.7	0	0	0.0	0.0
	2004	61.9	57.3	4.6	0	0	0.0	0.0
Site 4	2003	64.5	56.4	8.0	10	0	29.0	0.0
Site 3	2003	67.4	56.6	10.9	46	0	215.5	0.0
	2004	65.7	59.2	6.5	25	0	142.0	0.0
Site 2	2003	63.3	55.8	7.5				
Site 1	2003	66.6	57.4	9.3	38	0	193.0	0.0
	2004	64.9	59.3	5.7	19	0	94.5	0.0
Site 0	2003	72.5	56.3	16.2	58	14	275.5	41.0
	2004	74.5	59.8	14.7	43	13	230.0	29.5
Upper L Fork	2004	60.0	55.8	4.2	0	0	0.0	0.0
Upper R Fork	2004	61.5	56.6	4.9	0	0	0.0	0.0

Table W-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 in the Willanch sub-basin. Exceedance of standards is shown in Figure W-12, below. The data indicate that during 2003 and 2004, only the lower sites on Willanch creek logged any days exceeding the 64 °F standard, and only the unit near the mouth recorded any days above 70 °F.

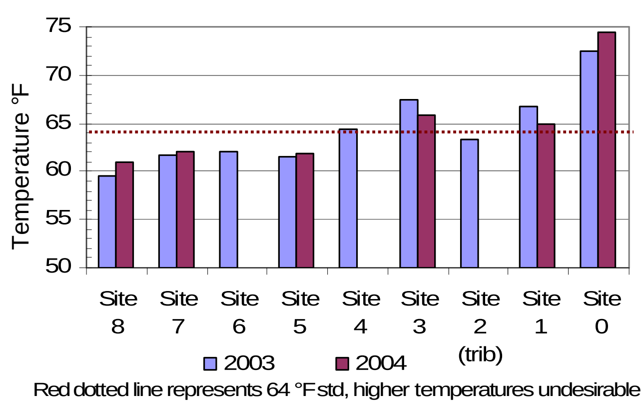
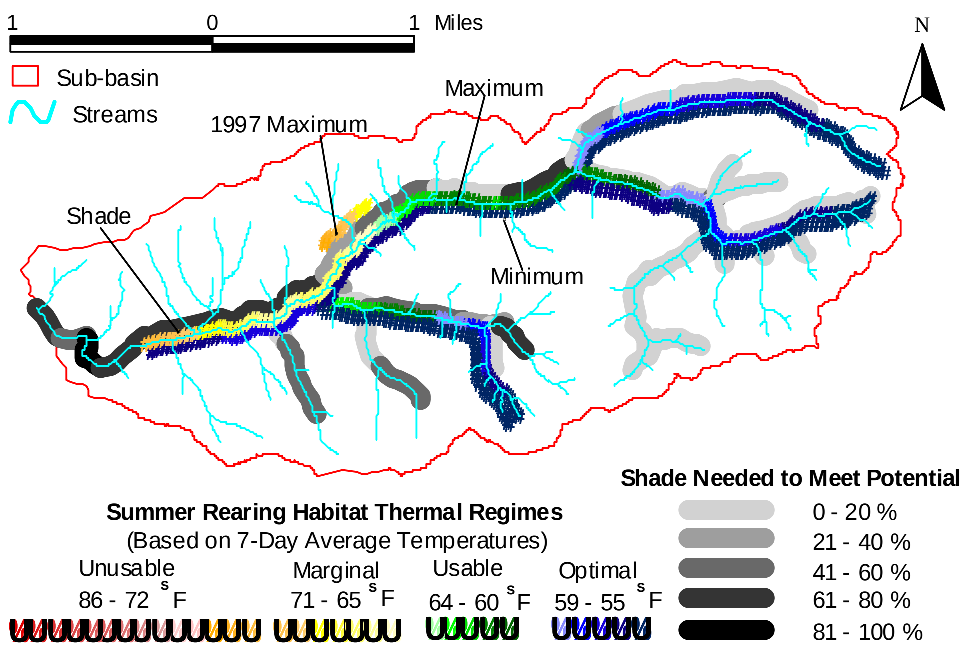


Figure W-12 7-Day Moving Averages of Daily Maximum Temperatures

Figure W-14, 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 temperatures increase from 55 °F at the headwaters to 74.5 °F in the lowlands just above the tide gate in 2004. The lower tributary data are from 2003. Temperatures on Willanch were first recorded in 1997, and displaying these data alongside the recent data shows a cooling trend over the years. In 1997 the temperature increased from 55 °F at the headwaters to 69 °F in the middle segments of the stream where a riparian planting project was installed that year. In 2003, that same station recorded a 7-day average maximum of 64.5 °F, and the stream does not reach 69 °F until it enters the lowest section.

Figure W-13 Temperature Trends and Riparian Shade Condition



Riparian Shade

The difference between current and potential shade is shown in Figure W-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 Willanch sub-basin are 82% and 97%, respectively, in the upper-most, steep canyon areas. The upper valley has 42% and 92% respectively, and the lower valley area has 35% and 92% respectively. Willanch's current upper valley shade is the lowest in the assessment area.

Salmonid Distribution

Coho and winter steelhead distribution, according to ODFW, is shown in Figure W-14. 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 W-15.

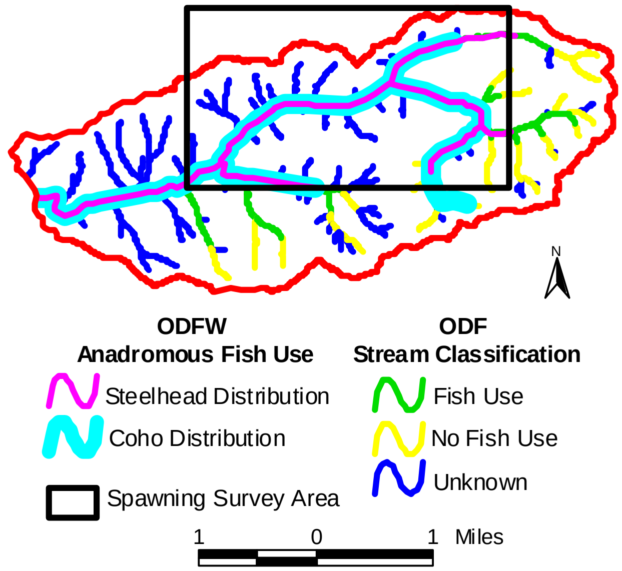


Figure W-14 Salmonid Distribution

Stocking Records

There were only a few releases of hatchery stocks into the Willanch system (see Table W-8). These consisted of releases of both coho and cutthroat into Willanch Creek and one of its major tributaries, Johnson creek. The Willanch mainstem was stocked in 1983 and 1990. In these two years almost 23,000 juvenile coho fry were placed into hatchboxes, until they were released. The only other stocking was conducted between 1947 and 1948. This release is the oldest record of hatchery releases into the lowlands assessment area. There were a total of 3,942 juvenile cutthroats placed into Johnson creek. In all almost 27,000 juvenile fish were released into the Willanch sub-basin.

Table W-8 Stocking Records

Creek	Species	Year	Juveniles Released
Willanch	Coho	1983	1,000
Willanch	Coho	1990	21,699
Johnson Cr. (trib to Willanch)	Cutthroat	1947-1948	3,942
			26,641

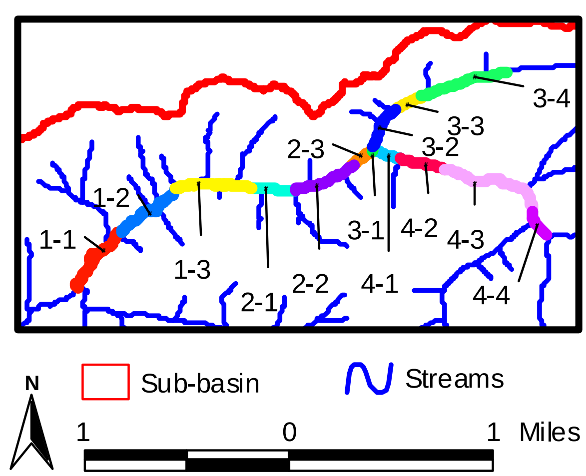


Figure W-15 Spawning Survey Area

Spawning Surveys

On Willanch Creek, coho spawning surveys were conducted by the Coos WA from 2002 to 2004. In 2002, the survey was conducted on reaches 2-1 through 3-3 (see Figure W-15 above).

In 2003 the spawning survey included the same two reaches and included a third reach, immediately downstream, with three segments (3-1, 3-2, 3-3). In 2004, another reach was added with four segments (4-1, 4-2, 4-3, 4-4), upstream from the other reaches, on the right tributary. However in 2004, segment 1-1 was not repeated due to poor spawning habitat, and low counts of fish in the previous survey years. Also, another segment (3-4) was added to reach three. Spawning population estimates are shown in Figures W-16 and 17 below.

Although the culvert was not a complete passage barrier, it was definitely an impediment. The long riffles in segment two and three had relatively little productive spawning habitat. In segment 3-4 there was only a fair amount of fish counted.

Figure W-16 Lower Willanch Spawning Survey AUC Population Estimate

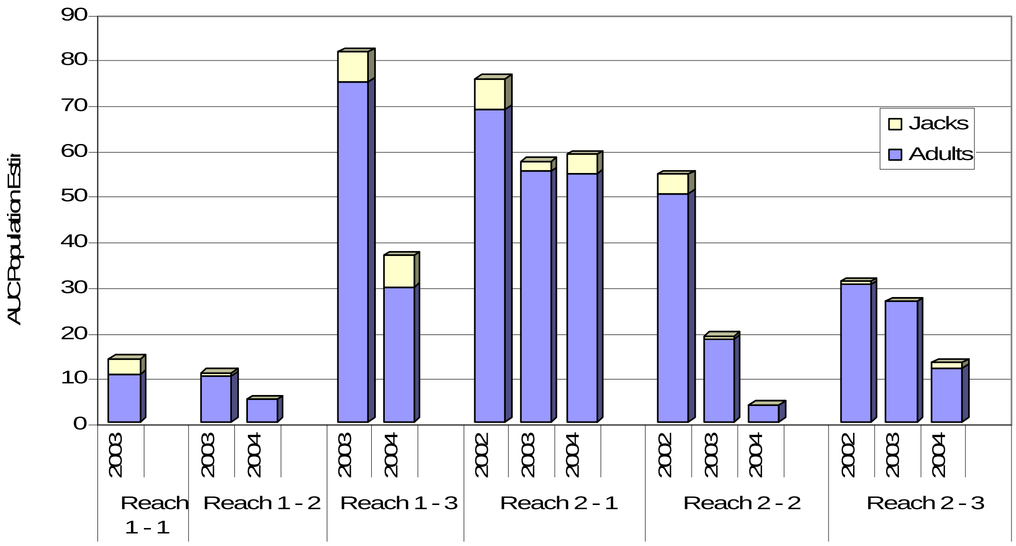
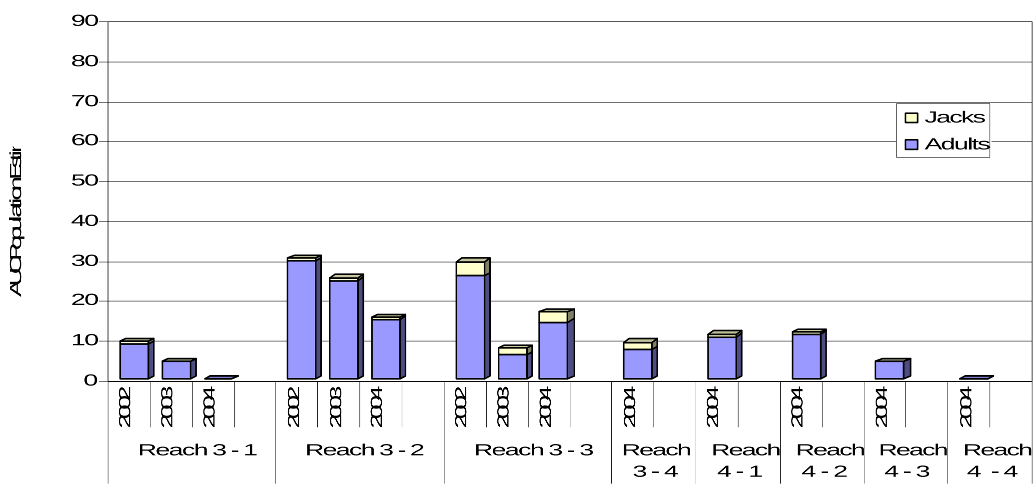


Figure W-17 Upper Willanch Spawning Survey AUC Population Estimate



During the high flow events of the winter of 2002, an undersized culvert on the upper end of segment 2-2 became blocked, and became a migration barrier to coho. High stream velocities resulting from the culvert failure resulted in scouring of redds and substrate downstream, exposing bedrock. The Coos WA and Menasha Forest Products removed the culvert during the summer of 2003 in order to remove the passage barrier. The stream crossing was rebuilt with a bridge in 2004.

The Coos Watershed has invested considerably in the restoration of Willanch Creek, including fish passage and riparian restoration efforts. In the summer of 2004, projects were implemented, including stream crossing upgrades, wood placement, and road decommissioning. There were three bridges put in, one where the culvert was removed from the upper segment of 2-2 in 2003, and two on the main county road that were fish passage impediments. There was also large wood placement in segments 2-3, 3-1, 3-2, 3-3, and 4-1, and an abandoned streamside road was decommissioned.

Table W-9 Spawning Density

Reach	YEAR	Total AUC/Km	Gravel (m^2)	Gravel (m^2)/ Female
1 - 1	2003	14	20	4.0
1 - 2	2003	20	95	19.0
	2004	9	231	92.4
1 - 3	2003	138	358	9.7
	2004	62	419	27.9
2 - 1	2002	261	118	3.5
	2003	198	314	11.4
	2004	203	231	8.6
2 - 2	2002	126	53	2.1
	2003	44	103	11.4
	2004	9	182	91.0
2 - 3	2002	249	41	2.7
	2003	147	46	3.5
	2004	72	49	8.2
3 - 1	2002	314	8	2.0
	2003	143	12	6.0
	2004	0	9	0.0
3 - 2	2002	104	67	4.5
	2003	87	147	12.3
	2004	53	134	19.1
3 - 3	2002	95	60	4.6
	2003	25	92	30.7
	2004	54	79	11.3
3 - 4	2004	30	48	13.7
4 - 1	2004	47	65	13.1
4 - 2	2004	29	133	22.2
4 - 3	2004	5	50	25.2
4 - 4	2004	0	17	0.0

Each year that the stream was surveyed, the highest densities of fish were observed reaches 2-1 through 3-1 (see Table W-9). The spawning population The 2002 surveys had 314 AUC/Km; in 2003 there were 198 AUC/Km, and 203 AUC/Km in 2004. Also, the greatest change in the amount of gravel per female was recorded in 1-2 and 2-2. These reaches also had a decrease in the number of AUC/Km. This may be due to better accessibility to more desirable fish habitat in other areas of the stream.

During the Coho spawning surveys, there were also other types of anadromous fish observed. Sea-Run Cutthroat trout were noted in the lower reaches on a number of surveys. Chinook and steelhead were observed at the very top of reach 2. Also, steelhead were counted in segments 1-3, 2-1 and 2-2. They were not observed spawning, and were most likely migrating through these segments.

Intrinsic Potential for Coho Smolt Production

The intrinsic potential for streams in the Lowlands area to produce coho smolts was estimated based on digital elevation models, channel widths, known natural barriers and coho life histories. The values indicate the number of coho smolts supported by historic, pre-settlement stream conditions. Intrinsic potential for the Willanch sub-basin, shown in Figure W-18, indicates that the lower mainstem reaches have higher potential, up to 2500 smolts per 100 meters of stream, while potential in the upper mainstem and tributaries drops off abruptly. This pattern reflects the coho preference of lower-gradient, slow moving streams. Many of the first and second order streams, the thin blue lines, indicate zero intrinsic potential due to gradients above 20% and known natural migration barriers.

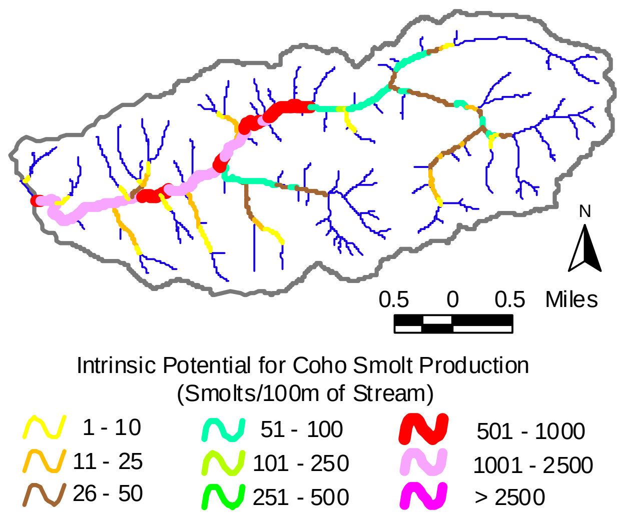


Figure W-18 Intrinsic potential for coho smolt production

While restoring coho smolt populations to these levels is unlikely given current land uses and infrastructure, understanding intrinsic potential for a particular stream will help to inform restoration efforts and to set realistic coho population goals.

Habitat Limiting Factors to Coho

The limiting factors analysis (based on Reeves et al., 1989) calculates potential smolt populations based on current, surveyed stream conditions (rather than digital elevation models used for calculating intrinsic potential). The limiting factors analysis shown in Table W-10, below, indicated that both winter and summer rearing habitats were limiting coho productivity. Current useable area of winter rearing habitat was only 42% of the area needed to support potential populations. The current useable area of summer rearing habitat was 48% of what was needed to support potential coho populations. Summer temperatures were within acceptable parameters for salmonid survival. Current spawning area is more than sufficient for potential populations.

Willanch Habitat Component	Potential Summer Population	Area/ Survival Factor	Area Needed (M^2)	Current Usable Area(M^2)	Smolt Factor	Smolts Produced
Spawning	23,272	0.006	140	1,638	95.5	156,429
Spring Rearing	23,272	0.3	6,982	6,682	1.7	11,360
Summer Rearing	23,272	0.6	13,963	6,682	0.9	6,014
Winter Rearing	23,272	0.4	9,309	3,947	1.2	4,737

Table W-10 Limiting Factors to coho populations

Resource Issues

Although watershed improvements have been made in places within Willanch, the sub-basin is affected by many of the same resource issues found in the other lowland sub-basins. Sediment introduced from logging operations, and unstable stream banks is stored in the lowland reaches and does not flush out as it would in natural conditions due to the low gradient and the tide gate at the mouth of the system. The present tide gate is in need of repair, and the mainstem dike is not functioning properly. The first tide gate was installed in the Willanch area in 1945 or 1948.

Maintaining bottom land for pasture remains high on land management priorities and therefore, landowners are faced with issues of saltwater intrusion, drainage problems and the need for land use permits to perform maintenance on drainage structures.

Landowner Concerns and Desired Future Conditions

Landowners in the Willanch sub-basin expressed their concerns about land management issues at a Coffee Klatch meeting on April 14, 2005. Nineteen percent of landowners contacted attended the meeting. As shown in Figure W-19 below, social concerns were much

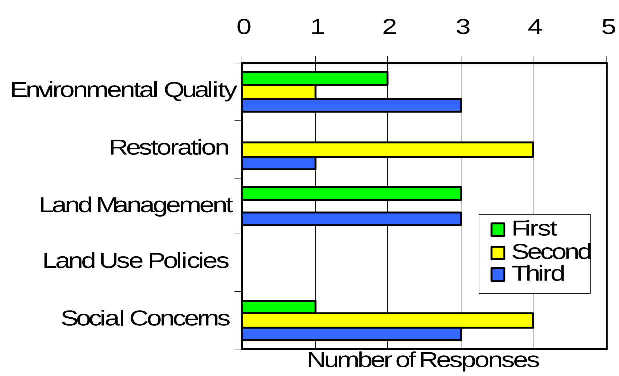


Figure W-19 Landowner Concerns

higher here than in other sub-basins. The top social concern was the problem of garbage dumping, which, landowners agreed had decreased over the last year since certain roads had been closed to the public. Other concerns expressed included control of blackberries and beaver.

In the future, landowners in the Willanch sub-basin would like to see more-productive pasture land, healthy fish populations, improved logging practices, and better maintenance of drainage structures.

Several Coffee Klatch attendees had personally participated in the draining of the Willanch area in the 1940's and 50's. They had seen farm productivity on the land improve greatly, and then dwindle in recent years.