Aquatic Habitat Inventory

for

Large Wood Placement Effectiveness Monitoring

funded by

U.S. Fish and Wildlife Service Jobs in the Woods Program

and

Oregon Watershed Enhancement Board

Prepared by:
South Coast and Lower Rogue Watershed Councils

Cindy Ricks Myers
Monitoring Program Manager
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Summary

Pre- and post-large wood placement habitat conditions are compared on nine projects surveyed during low flow from 1998 to 2001. Survey measurements are based on ODFW's Aquatic Inventory Project methods. Conditions are also compared with Benchmark definitions for Desirable, Between, and Undesirable habitat. Each of the post-placement surveys was completed in the year following the project, and it is likely that longer periods of time or larger streamflows are required to detect major channel and habitat changes.

Stream reaches that were chosen for large wood placement projects clearly lack riparian conifers for large wood recruitment. Wood volumes were generally Undesirable prior to large wood placement and all but one site met the Desirable benchmark following treatment. The numbers of pieces of wood before and after treatment did not meet the Desirable benchmark on any of the treated sites. The frequency of "key" pieces of wood increased from Undesirable to Desirable on eight treated reaches, and from Undesirable to Between on five treated reaches. Key pieces are likely to trap additional wood, thereby improving the number of pieces over time. Projects implemented in 1998 and 1999 have large wood pieces that average double the active channel width, and 2000 project wood pieces average the active channel width.

Post-placement surveys found wood frequently associated with lateral scour pools. Comparing habitat types before and after treatment shows that wood is often placed in lateral scour pools, but that lateral scour pools are also created from other habitat types. A few reaches gained low gradient riffles where they were lacking prior to the placement of wood. Storage of gravel was noted above several of the wood structures.

Streamflow during the winter of 2000-2001 was considerably below normal, and where wood was placed in 2000, there was little change in the numbers of scour pools. More response was measured on streams surveyed in 1999-2000, when average winter flows followed wood placement. Residual pool depth increased most on the widest channels. Smaller streams gained in numbers of pools and percent pool area, but not in pool depth. On the one project with a control and treatment reach, increased numbers of pools and substrate changes in the low-gradient riffles were similar on both reaches.

Increases in the percent gravel in low-gradient riffles may be within the survey error. The highest gravel values occur in one stream where cobbles are lacking, and gravels are supplied by conglomerate and marine terraces. Relatively high percentages of fines in low-gradient riffles in another stream may be related to the presence of deep-seated landslides, road-related erosion, or bank instability.

Dan's Creek differs from the other streams by having a lower gradient, narrower channel, influenced by beaver activity and located in an agricultural/wetland setting. This site had a substantial increase in the amount of fines and decrease in gravel in low-gradient riffles. The riffles are downstream of a bridge installed for fish passage, and downstream of two beaver dam pools.

Recommended survey protocol modifications include providing a control reach upstream of the project whenever possible, increasing the frequency of active channel width measurements, measuring unit lengths and widths, documenting wood locations relative to pre-placement habitat units, tagging wood pieces and establishing and matching photo points under better light conditions. Future effectiveness monitoring will test highly repeatable measurement techniques such as longitudinal profiles, cross-sections, and pebble counts combined with more visual documentation such as schematic mapping.

Introduction/Purpose

Stream surveys were initiated to document changes in stream habitat resulting from the placement of large wood. Expected changes included increased numbers and depths of pools caused by scour below steps, reduced lengths of uniform riffles and glides, capture of gravel upstream of wood, improved sorting of gravel in pool tailouts below wood, and increased complexity of wood accumulations that would provide cover and nutrient storage. Ideally, an untreated control reach would be established on each stream to determine the magnitude of change, independent of the large wood placements. In reality, few untreated control reaches were available to monitor, and only one is comparable to the corresponding treated reach.

The South Coast and Lower Rogue Watershed Councils have tabulated at least 31 instream wood placement projects involving 16 different landowners between 1991 and 2000. Four of thirteen projects funded by the Oregon Watershed Enhancement Board have been monitored with stream surveys. Stream surveys were completed on 5 of 10 projects funded by US Fish and Wildlife (Jobs in the Woods), National Fish and Wildlife Foundation (Bring Back the Natives), and Fish America Foundation. Stream surveys were completed on 2 of 8 additional projects that were not financed through the watershed council (and at least two of these were also monitored by ODFW). Nine of the eleven projects that we monitored have pre- and postproject surveys completed to date.

Methods

Large wood placement projects were selected for monitoring based primarily on the advice of the ODFW Habitat Biologist. Unmonitored projects include older sites where pre-project surveys were not available, short reaches with few structures, or sites that had difficult access.

The two-person survey crew spent one day of training at the beginning of each season with ODFW Habitat Biologist, Howard Crombie. Pre-and post-surveys for the same stream were conducted at similar times during the summer to reduce variability due to flow. Pre-project surveys began on Crook Creek in 1998. In 1999, the same crew returned for a post-project survey on Crook Creek, and added pre-project surveys on "Dan's" Creek (tributary to Fourmile Creek), Indian Creek (on Elk), Farmer Creek, and Jacks Creek (Phase II). In 2000, we had a new crew member as numerator (Form 2) to complete post-project surveys on the above streams and to begin pre-project surveys on Jacks Creek (Phase III), Mill Creek, Indian Creek (on Rogue), Boulder Creek, and Edson Creek (on Sixes). In 2001, the same crew completed post-project surveys on Jacks (Phase III), Mill Creek and Indian Creek (on Rogue).

Survey techniques were taken from Methods for Stream Habitat Surveys: ODFW Research Station Aquatic Inventory Project (Version 6.1, June 1996, Moore, Jones, and Dambacher) starting in 1998. The same protocol was used in 1999, except that lengths and widths were measured rather than estimated. In 2000, the protocol was updated to measure the pool tailout to obtain residual depths, measure floodprone width at every 10th unit, and estimate percent of actively eroding banks. Lengths and widths were again estimated in 2000, but measured in 2001. In 2001, percent of active erosion was estimated for the left and right banks separately. The crew assigned pieces of wood to the size class exceeded by the wood, rather than to the

nearest size class as specified in the 1996 protocol. Riparian transects were completed during one survey on each stream reach, but these were discontinued during the 2000-2001 surveys.

In all surveys, the desire to detect changes from placement of large wood resulted in more splitting of habitat units than is specified by the protocol. In particular, pool types were delineated even though they were shorter than the active channel width (ACW).

The channel, wood, and riparian survey data were entered into Excel spreadsheets and analyzed using pivot tables. Chris Massingill processed the Edson Creek survey using ODFW macros, and subdivided reaches to correspond to a survey completed by an ODFW crew in the same year (Appendix A). Reaches were not delineated for Crook Creek, but could be subdivided in the future based on more frequent ACW measurements.

The primary variables used to compare pre- and post-wood conditions shown in Table 1 are from the Aquatic Inventory Project Benchmarks as defined in Foster, Stein, and Jones, 2001 (table 2). Pools shorter than the ACW were excluded from the pool frequency calculation to make the results comparable to ODFW surveys. Benchmark values for pools that are spaced more frequently than 5-8 channel widths are not listed in table 2. Reaches having pools spaced as frequently as every two active channel widths are assumed to classify under Desirable, based on the natural range depicted in Keller and Melhorn (1978).

Where too few ACWs were measured at riffles to calculate an average, active channel width/depth values were calculated for the range of widths measured at all habitat types. For variables that are referenced to the ACW, we assumed the channel did not widen or narrow, and compared pre- and post- surveys using the same averaged ACW. "Key" pieces of wood are longer than the ACW and larger than 50 cm in diameter (using a previous definition provided by ODFW). Upon re-examining five reaches that did not meet the Desirable benchmark for key pieces, results from the old and new (table 2) definitions were essentially the same.

Wood volumes were estimated using the lower length of the class (ODFW method). To estimate volumes for rootwads <3m long, lengths of 2 meters were assigned (per phone communication with ODFW). Shade was converted from degrees of shade to the right and left (from the center of the wetted channel), to a percentage of the 180-degree open sky.

Longitudinal profiles constructed from gradients and lengths of primary channels differ enough between surveys to suspect inaccurate clinometer measurements or poor distance corrections. Applying ODFW analysis methods would adjust the surveys to a common map-based reach slope and length.

In 1999 and 2000, slides were taken during pre-surveys at habitat units where wood was anticipated to be placed and during post-surveys at wood sites. Digital photos were taken in 2001. Matching pre- and post-project photos was more difficult than expected. Pre-project prints were not available at the site to match with post-project photos. Most of the photos provided in Appendix B are from Medium streams where light conditions were consistently better than on Small streams.

Table 1: ODFW Benchmarks: Pre- and Post-Large Wood Projects

Desirable
Between
Undesirable

Measurements in meters

Column Notes: see below

		Channel/Valley Characteristics				(1)	(2)		(3)	(4) Pools		(5)	(6) Riffles (.5-2%)			(7) Shade	Large Wood			Rip Conifers	
Stream/Reach	Year	Gradient	VWI	Channel Form	Valley Type	Reach Length	% Primary	AC W	pools >AC	% Area	Pool Freq	Resid Depth	AC W/D	% grvl	% fines	Avg %	#/ 100m	vol/ 100m	key/ 100m	>20'/ 1000'	>35'/ 1000'
Dan's on Fourmile	1999	0.5%	100s	Confined by	Broad	364	90	2	4	5	23-41	0.14	ND	59	41	32	2	1	0.0	0	0
Dan's on Fourmile	2000	0.3%		terraces		257	91	4	2	23	11-23	0.28	ND	5	95	22	12	44	5.7		
Indian Cr (Elk) R1	1999	3.1%	100s	Confined by	Elk	160	98	2	6	17	7-16	0.17	-	80	15	60	5	3	0.0	0	0
Indian Cr (Elk) R1	2000	1.9%		terraces	floodplain	146	92	4	6	30	6-12	0.18	3-8	85	15	60	3	6	1.3		
Indian Cr (Elk) R2	1999	2.2%	6	Confine by alt	Multiple	340	95	5	10	33	5-7	0.26	8-19	79	17	89	7	6	0.6	0	0
Indian Cr (Elk) R2	2000	1.9%		terr &hillslopes	terraces	255	91	7	7	44	5-7	0.28	6-10	90	10	90	18	104	11.4		
Indian Cr (Elk) R3	1999	2.3%	5	Unconfined	Wide-active	304	73	6	6	22	9	0.23	11	78	17	98	10	16	0.5	0	0
Indian Cr (Elk) R3	2000	2.1%		single channel	floodplain	284	76	6	5	43	10	0.24	5	93	5	98	13	17	0.8		
Farmer Creek R1	1999	1.8%	1	Confined by	Steep	186	77	9	5	73	3-4	0.54	18	no riffle .5-2		84	6	3	0.0	46	15
Farmer Creek R1	2000	2.2%		hillslopes	V-shaped	141	90	13	6	62	2-3	0.56	-	80	10	79	20	69	3.8		
Farmer Creek R2	1999	1.8%	7	Unconfined	Multiple	87	78	8	3	58	2-4	0.06	-	no riffle .5-2		92	3	1	0.0	46	15
Farmer Creek R2	2000	2.7%		single channel	terraces	81	86	12	2	60	3-5	0.19	-	15	5	97	4	33	2.1		
Farmer Creek R3	1999	2.1%	1.5	Confined by	Mod	248	81	12	4	59	4-5	0.24	19	no riffle .5-2		97	4	2	0.0	46	15
Farmer Creek R3	2000	1.9%		hillslopes	V-shaped	213	65	15	4	46	4	0.33	10	30	5	95	6	19	2.1		
Farmer Creek R4	1999	2.1%	6	Unconfined	Multiple	167	86	10	3	65	4-6	0.43	13	no riffle .5-2		92	10	15	0.0	46	15
Farmer Creek R4	2000	1.7%		single channel	terraces	129	96	13	3	66	3-4	0.25	12	no riffle .5-2		83	18	49	2.3		
Crook Creek 1& 2	1998	2.3%	1-13			1187	78	5	47	40	5	0.37	2-15	57	18	84	13	10	1.0	20	10
Crook Creek 1& 2	1999	2.5%				1157	74	5	62	48	4	0.37	2-25	65	21	91	15	39	4.4		
Jacks Creek R 1	1999	1.2%	6	Unconfined	Multiple	142	57		3	66	3	0.35		75	15	82	13	54	0.0	0	0
Jacks Creek R 1	2000	1.7%		single channel	terraces	136	66	15	0	59	none	0.44	6	80	5	82	15	84	5.9		
Jacks Creek R 2	1999	1.1%	1.5-8			972	68	11	20	57	3-4	0.41	15-25	63	14	86	2	2	0.1	0	0
Jacks Creek R 2	2000	1.2%				973	76	18	17	43	3-5	0.48	9-12	71	2	88	4	52	1.4		
Jacks Creek R 2X	2000	0.9%		Confine by alt	Open	259	78	-	5	30		0.51		60	1	81	2	5	0.3		
Jacks Creek R 2X	2001	1.3%	6	terr &hillslopes	V-shaped	271	65	8-22	3	43*	3-6*	0.56		76	1	76	7	42	4.1		
Jacks Creek R 3	2000	1.5%		Confined by	Mod	494	87	11	12	39	4-5	0.41	9	27	1	97	4	21	1.8		
Jacks Creek R 3	2001	1.4%	2	hillslopes	V-shaped	572	93	9	14	53	4-5	0.34	6-14	51	2	98	12	66	9.1		
Edson (Sixes) R1	2000	0.8%	11.8	Confined by	Broad	1835	66	33	1	66	66	0.61	18	78	4	69	19	15	0		
Edson (Sixes) R1	2001			terraces																	
Edson (Sixes) R2	2000	1.4%	1	Confined by	Mod	1877	75	16	8	56	14	0.73	10	40	1	81	8.2	7	0		
Edson (Sixes) R2	2001			hillslopes	V-shaped																
Boulder Creek	2000	3.1%				167	54	14	1	30**	12	0.21	18	69	0	92	7	4	0		
Boulder Creek	2001	ODFW survey available?																			

Table 1: ODFW Benchmarks: Pre- and Post-Large Wood Projects

Desirable
Between
Undesirable

Measurements in meters
Column Notes: see below

		Channel/Valley Characteristics				(1)	(2)		(3)	(4) Pools		(5)	(6) Riffles (.5-2%)			(7) Shade	Large Wood			Rip Conifers	
Stream/Reach	Year	Gradient	WWI	Channel Form	Valley Type	Reach Length	% Primary	AC W	pools >AC	% Area	Pool Freq	Resid Depth	AC W/D	% gvl	% fines	Avg %	#/ 100m	vol/ 100m	key/ 100m	>20'/ 100'	>35'/ 100'
Mill Cr on Chetco	2000	1.8%		Confined by	Mod	511	77	10	16	36	3-4	0.32	9	52	4	96	15	16	0.2		
Mill Cr on Chetco	2001	2.1%	2	hillslope	V-shaped	498	82	8	19	48	3-4	0.28	10	51	1		16	37	1.5		
Indian (Rogue) R1	2000	3.1%		Confined by	Confining	92	68	14	0	25	none	0.22	8	32	3	84	10	6	0		
Indian (Rogue) R1	2001	3.0%	3.5	alluvial fan	terraces	88	66	11	0	28	none	0.22	7	42	8	97	6	5	0		
Indian (Rogue) R2	2000	3.8%		Confined by	Steep	207	90	9	3	54	6-8	0.51	-	no riffle	.5-2	86	17	11	0		
Indian (Rogue) R2	2001	5.0%	1	bedrock	V-shaped	198	93	12	2	45	9-11	0.46	-	no riffle	.5-2	98	10	11	0		
Indian (Rogue) R3	2000	3.8%		Confined by	Steep	156	86	7	5	51	5	0.42	6	no riffle	.5-2	97	23	9	0		
Indian (Rogue) R3	2001	5.2%	1	bedrock	V-shaped	156	89	7	5	54	4	0.54	-	no riffle	.5-2	94	19	18	1.1		
Indian (Rogue) R4	2000	3.0%		Confined by	Multiple	330	68	10	9	28	4-5	0.37	5-7	no riffle	.5-2	97	10	9	0		
Indian (Rogue) R4	2001	3.1%	2.5	earthflow	terraces	374	86	7	10	28	4-5	0.39	5-6	no riffle	.5-2	98	11	42	4.2		
Beaver Cr on Sixes		ODFW survey available?																			

* not including 25% of survey length in puddled or dry channel types
**not including 22% of survey length in dry channel type on secondary channel

Column Notes:
(1) Primary length, not including multiple channels or tributaries
(2) Percent of single and primary channels of total channel length, including multiple channels
(3) Based on all pools, not just pools with lengths > active channel width
(4) Range for average active channel width for each year of survey, pools with lengths > active channel width
(5) For surveys in 1998-1999, Residual pool depth estimated by subtracting depth of downstream riffle
(6) Active Channel Width/Depth ratio. Depth = riffle depth + active channel height
(7) Shade converted from degrees to percentage of 180 degrees on Left and Right sides

From Foster, Stein, and Jones, 2001

Table 2 ODFW Aquatic Inventory and Analysis Project: Habitat Benchmarks.

	UNDESIRABLE	DESIRABLE
POOLS		
POOL AREA (% Total Stream Area)	<10	>35
POOL FREQUENCY (Channel Widths Between Pools)	>20	5-8
RESIDUAL POOL DEPTH (m)		
SMALL STREAMS (<7m width)	<0.2	>0.5
MEDIUM STREAMS (≥ 7m and < 15m width)		
LOW GRADIENT (slope <3%)	<0.3	>0.6
HIGH GRADIENT (slope >3%)	<0.5	>1.0
LARGE STREAMS (≥15m width)	<0.8	>1.5
COMPLEX POOLS (Pools w/ LWD pieces ≥3) / km	<1.0	>2.5
RIFFLES		
WIDTH / DEPTH RATIO (Active Channel Based)		
EAST SIDE	>30	<10
WEST SIDE	>30	<15
GRAVEL (% AREA)	<15	≥35
SILT-SAND-ORGANICS (% AREA)		
VOLCANIC PARENT MATERIAL	>15	<8
SEDIMENTARY PARENT MATERIAL	>20	<10
CHANNEL GRADIENT <1.5%	>25	<12
SHADE (Reach Average, Percent)		
STREAM WIDTH <12 meters		
WEST SIDE	<60	>70
NORTHEAST	<50	>60
CENTRAL - SOUTHEAST	<40	>50
STREAM WIDTH >12 meters		
WEST SIDE	<50	>60
NORTHEAST	<40	>50
CENTRAL - SOUTHEAST	<30	>40
LARGE WOODY DEBRIS* (15cm x 3m minimum piece size)		
PIECES / 100 m STREAM LENGTH	<10	>20
VOLUME / 100 m STREAM LENGTH	<20	>30
"KEY" PIECES (>60cm dia. & ≥10m long)/100m	<1	>3
RIPARIAN CONIFERS (30m FROM BOTH SIDES CHANNEL)		
NUMBER >20in dbh/ 1000ft STREAM LENGTH	<150	>300
NUMBER >35in dbh/ 1000ft STREAM LENGTH	<75	>200

* Values for Streams in Forested Basins

Results and Discussion

Channel characteristics and changes in the Benchmarks between pre- and post-large wood placement surveys are shown in Table 1 and summarized by stream in bullet text format. Changes in habitat type frequency, wood distribution among different habitat types, and substrate changes for habitat types covering the largest area are reported in the Habitat Type Tables (Appendix C). Results of large wood placement projects may vary by channel gradient,

ACW, and channel form (confined vs. unconfined). Changes in channel morphology and substrate should develop over time as streamflow interacts with the wood. All of the projects were surveyed in the summer following their initial placement, and thus have not yet fully adjusted to the wood. This is particularly true for the 2000-2001 surveys since the flows of winter of 2000 were below normal.

Adding large wood to stream channels provides roughness that interacts with the flowing stream to convert some of the available potential energy (that varies with the gradient of the stream) to kinetic energy as local turbulence. The channel may respond by increasing frequency or sizes of pools, increasing the depth (and thus decreasing the width) of the channel, and/or changing the local slope and particle size distribution. When large roughness elements are present, coarse materials in the stream bed no longer provide the primary source of friction. As water slows behind the wood, gravels tend to accumulate where cobbles formerly dominated. This aggradation raises the bed elevation and decreases the slope, thereby increasing floodplain connectivity and sinuosity. As flow constricts adjacent to and plunges over the wood, flow depth, velocity and turbulence increase, forming pools that store fine sediments (deposited during lower flows).

Streamflow during the winter of 2000-2001 was considerably below normal, and for those streams surveyed in 2000-2001(Indian on Rogue, Mill Creek and Jacks Creek Phase III), changes in the numbers of scour pools were minor (Appendix C: Habitat Type Tables). More response was measured on streams surveyed in 1999-2000, when average winter flows followed wood placement. Numbers of scour pools decreased markedly for reach 3 on Farmer Creek and on Jacks Creek Phase II, but residual pool depths increased in these areas. Residual pool depth increased most on the widest channels, which presumably have greater stream power to interact with the placed wood.

Numbers of scour pools of all sizes increased on reaches 2 & 3 on Indian Creek on Elk and on Crook Creek, with little change in residual pool depth. Thus, the medium streams consolidated and deepened their pools, while small streams increased the numbers of pools. However, the observed response may be unrelated to the treatment as shown below in the comparison for Indian Creek on Elk.

On both treated and untreated reaches of Indian Creek on Elk River, the numbers of pools and pool area increased (Table 1). Large scour pools (longer than ACW) decreased from 56% to 26% of total pools in reach 2, and decreased from 30% to 18% in reach 3. Thus, the increased numbers of total pools and the decreased number and proportion of larger pools is similar for the two reaches.

Indian Creek (Elk River): Straight Scour and Lateral Pools

	ACW	1999 pools	2000 pools	1999 pools >ACW	2000 pools >ACW
Reach 2 Treated	5	16	27	9	7
Reach 3 Untreated	6	20	28	6	5

Treated and untreated reaches can also be compared on Indian on the Rogue, but numbers of pools changed very little between 2000 and 2001. Untreated reaches 2 and 3 are confined by bedrock and are expected to remain relatively stable. Only 56-59% of the scour pools in treated reach 4 are longer than the ACW.

Dan's Creek differs from the other streams by having a lower gradient, narrower channel, influenced by beaver activity and located in an agricultural/wetland setting (Appendix B: Photo Plate 1). Pool areas and pool frequency increased on Dan's Creek due to the addition of two beaver dam pools in a relatively short reach (figure 1). More glide units were identified on Dan's than on other streams due to the slow-moving water at low gradient over a fine-textured substrate. Below the bridge, many of the glides are deeper than riffles.
It is difficult to interpret the significance of changes in the numbers of habitat units and percent areas of pools or riffles. Subjective determinations of habitat types and boundaries appear to affect repeatability and precision for monitoring time trends (Poole, Frissell and Ralph, 1997). Standard deviations of 8.1 for percent pools were obtained by repeat surveys by different crews (Thom and Jones, 1999). The error associated with the same crew repeating surveys in different years could be less, but is unknown. Evidence from one pair of treated and untreated reaches indicates that the apparent changes in pool frequency and area may not be the result of large wood placement. However, changes in the sequence and types of habitat units may aid in interpretation (see graphic example from a 100-meter reach of Dan’s Creek, figure 1).

Post-placement wood is most frequently associated with lateral pools (Appendix C: Habitat Type Tables). Pre- and post-habitat types were compared on five reaches where corresponding large wood sites could be identified. Changes were noted to determine whether streams scoured lateral pools around wood initially placed in other habitat types, or if wood was placed in lateral pools initially. On reach 2 of Indian Creek (Elk River), wood was placed primarily in riffles and lateral pools. A few of the riffles converted to lateral pools, and one long riffle developed three lateral pools at wood sites. Gravel increased and fines decreased in the riffles, but fines tended to increase in the deepest pools. However, similar changes in the overall substrate composition were also observed in the untreated reach 3 (table 1).

On reach 4 of Indian Creek (Rogue), large wood was placed in lateral pools, riffles, straight scour pools, and one riffle with pockets. At wood-placement sites riffles converted to riffles with pockets (Appendix B: Photo Plate 2), while riffles with pockets and straight scour pools converted to lateral pools. The highest percentages of fines were found in the deepest pools. On Farmer Creek, lateral scour pools developed adjacent to six of the ten large wood sites, mostly occupied by straight scour pools prior to wood placement (Appendix B: Photo Plate 3). Storage of gravel was noted above several of the wood structures.

Explanation for Figure 1:

Sequence of Habitat Units, "Dan's" Creek, tributary to Fourmile Creek.

Includes equivalent habitat units downstream of bridge site, lengths adjusted to measured 1999 survey. Total survey approximately 100 meters.
Note that "SP w/ Beaver" refers to Straight Scour Pools associated with a note of beaver activity in 1999.

Legend

Riffle, not labeled

Riffle with Pockets, labeled RP

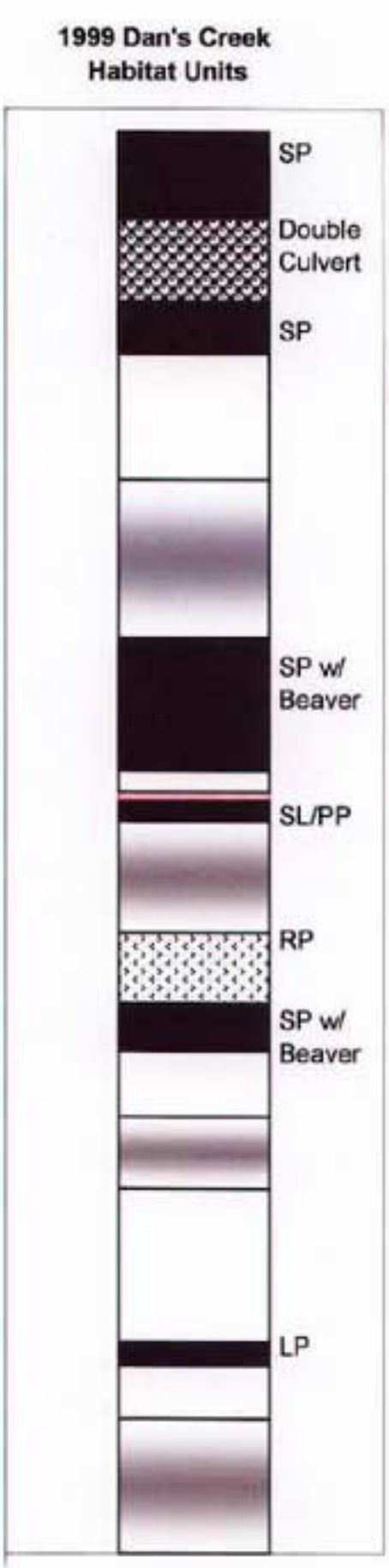
Glide, not labeled

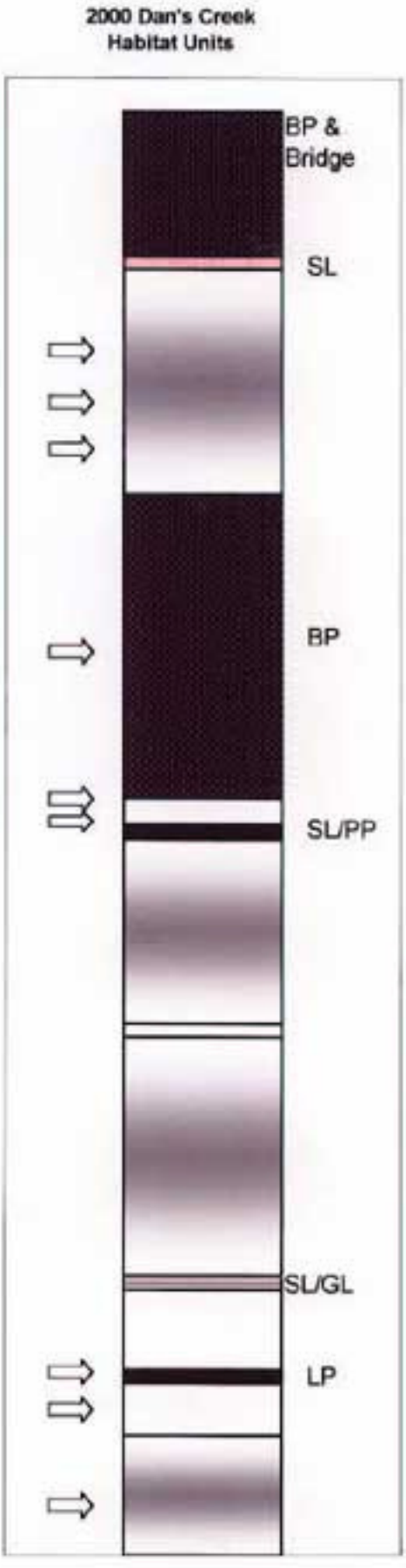
Pool, labeled

- SP Straight Scour Pool
- PP Plunge Pool
- LP Lateral Pool
- BP Beaver dam Pool

Step over Log, labeled SL

Large wood placement site, located within habitat unit (approximate location)


1999 Dan's Creek
Habitat Units
SP
Double
Culvert
SP
SP w/
Beaver
SL/PP
RP
SP w/
Beaver
LP


2000 Dan's Creek
Habitat Units
BP &
Bridge
SL
BP
SL/PP
SL/GL
LP

On Mill Creek, large wood was placed in lateral scour pools, and in a riffle with pockets, a straight scour pool, a backwater pool, and a puddled unit. The other units all converted to lateral scour pools (Appendix B: Photo Plate 2), and one lateral scour pool converted to a straight scour pool. Again, the deepest pools had the highest percentage of fines. On reach 3 of Jacks Creek phase III, large wood was placed in scour pools (Appendix B: Photo Plate 4), riffles (Photo Plate 5), and one riffle with protruding boulders. Two of the straight scour pools converted to lateral scour pools, and all of the riffles converted to riffles with pockets or lateral or straight pools. The deeper pools contained the highest percentage of fines. At the upstream end of the reach, a deep straight pool with 80% fines was converted to a lateral pool with 25% fines.

When interpreting changes in substrate composition in low-gradient riffles, it should be noted that repeat surveys by different crews produced standard deviations of 7.6 for percent fines (sand, silt and organics) in riffles and 9.5 for percent gravel in riffles (Thom and Jones, 1999).

Dan's Creek had a surprising increase in the amount of fines and decrease in gravel in riffles following the large wood placement and bridge installation for fish passage. The riffles are downstream of the bridge installation site and downstream of the two beaver dam pools (figure1). It is suspected that widening the channel at the bridge site may have allowed some stored fines to move downstream into the riffles.

Indian Creek on Elk has the highest percent gravel in riffles, and fewer cobbles than the other streams. Gravel and sand-rich rock types in the watershed include conglomerates and marine terrace deposits. It is interesting to note that the decrease in fines for the untreated reach 3 is greater than for the treated reach 2. On three of the four reaches on Farmer Creek, lowgradient riffles developed where none were present in the first survey. In the steep riffles on Farmer Creek, an abundance of cobble replaces the gravel content (Appendix B: Photo Plate 6). Crook Creek has the highest percentage of fines in low-gradient riffles (except for Dan's Creek), which could be attributed to deep-seated landslides, road-related erosion and/or bank instability. All of the reaches in Jacks Creek gained gravel at the expense of cobble in the lowgradient riffles, with the most dramatic changes in the upstream-most reach. Appendix B: Photo Plate7 illustrates the abundance of gravel available in Jacks Creek that develop into lowgradient riffles. Reach 4 of Indian on Rogue is confined by an earthflow, and tributaries to this reach have relatively high percentages of fines in their low-gradient riffles.

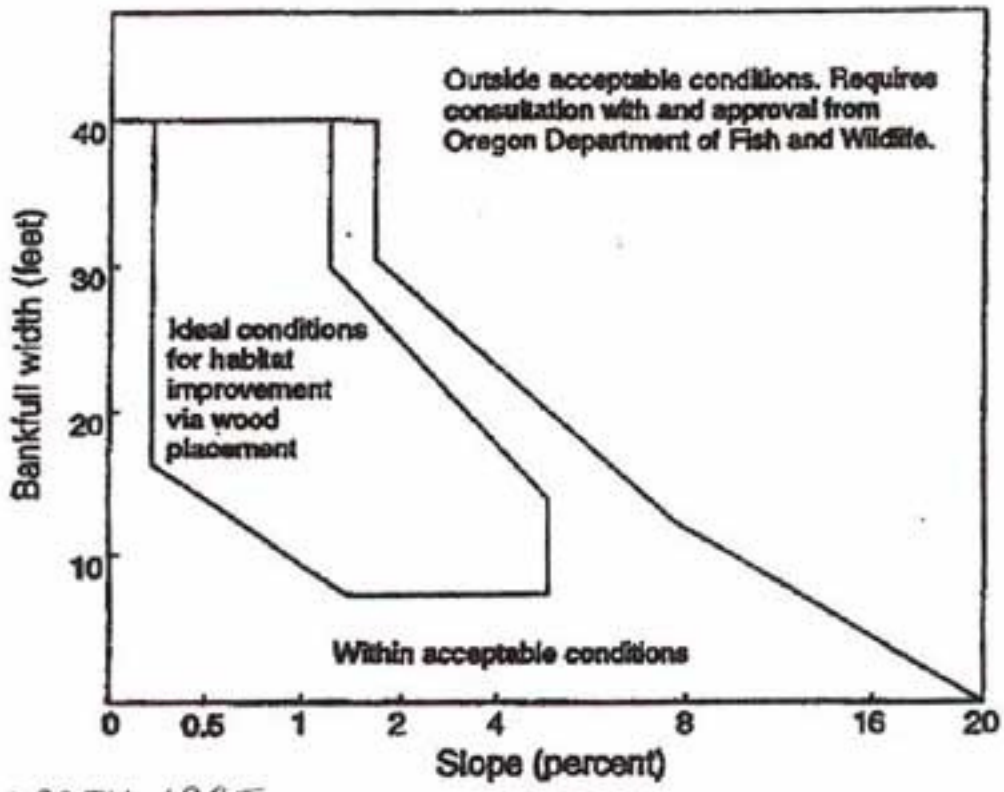
Riparian conifers are clearly lacking for large wood recruitment in the stream reaches that were chosen for large wood placement projects (table 1). Volumes of wood were generally Undesirable prior to large wood placement and all but one site met the Desirable benchmark following treatment. Note that reach 1 of Jacks Creek had a previous large wood project that met the Desirable volume, but had no key pieces. Numbers of pieces of wood did not meet the Desirable benchmark after treatment. The frequency of "key" pieces of wood increased from Undesirable to Desirable on eight treated reaches, and from Undesirable to Between on five treated reaches. Key pieces are likely to trap additional wood, thereby improving the number of pieces over time.

Large wood placement guidelines established by Oregon Department of Forestry and Oregon Department of Fish and Wildlife specify ideal, acceptable, and outside acceptable conditions for channel slope and bankfull width (figure 2). More expertise is required to place wood on steeper and wider streams. Figure 2 is based on literature review and experience, but is subject to change as more wood placement projects are monitored. Streams fully within the ideal range include Crook Creek and Indian Creek on Elk. Mill Creek and Indian Creek on Rogue (reach 4) are marginal between ideal and acceptable. Dan's Creek is within acceptable conditions on the lower end of the graph. Farmer, Jacks, Boulder and Edson Creeks are wide enough to plot outside acceptable conditions, and thus are the most likely to have wood moving out of the reach where it was placed. Projects implemented in 1998 and 1999 had average lengths of large wood that doubled the ACW, with the longer pieces placed in downstream locations. Projects implemented in 2000 average lengths that are approximately equal to the ACW. At this time it is unknown whether the survey crew and the habitat biologist who implemented the project interpreted the ACW differently. The residence time of the shorter pieces will be tested by winter 2001-2002 streamflow.

The percent of wood pieces incorporated into jams (prior to the large wood placement) varied by stream size and gradient: Farmer at 65%, Jacks at 21%, Indian on Elk and Crook at 8%, Dan's at 0%. Adding single pieces of wood should have decreased the percentage in jams, unless instream wood was mobilized into new jams. Farmer decreased to 55%, but Jacks increased to 29%. Indian decreased to 5%, while Crook increased to 17%.

Relatively high shade values are likely a function of the forested setting and narrow channel widths. Streams that are narrower than approximately 10 meters can be shaded to their maximum extent with alder stands (based on local measurements of stand structure and shade curves calculated from SHADOW, Park, 1993). The lowest shade values are from two reaches with agricultural land use, Dan's Creek (Appendix B: Photo Plate 1) and reach 1 of Indian Creek on Elk. Shade is also reduced along two reaches adjacent to campgrounds, along reach 1 of Indian Creek on Rogue and reach 1 of Edson Creek. Edson Creek still ranks as Desirable because the standard is lower for channels wider than 12 meters.

The overall picture emerging from these surveys is one of dynamic and interactive responses to the placement of wood. Responses differ as expected based on channel gradient, active channel width, and sediment supply. At this time evidence is lacking to determine whether channel adjustments are just beginning after one year, or are well underway. Because the magnitude of the changes we hope to detect may be small relative to year-to-year survey error and bias, supplemental monitoring techniques have been initiated.



ODF and ODFW, 1995

Figure 2. Stream slope and width dimensions that constitute "ideal," "acceptable," and "unacceptable" conditions for large woody debris placement under these guidelines.

Dan's Creek

Large wood project accompanied by fish passage improvement project (bridge replacing culverts). See Figure 1.

Channel Characteristics:

- Small stream, low gradient, incised into a wetland converted to agricultural uses, fine materials in streambanks

Pools:

- gained two beaver dam pools with residual depths of 0.4 and 0.5 meters
- pool area, frequency and residual pool depth changed from Undesirable to Between.

Substrate

- gravel in riffles decreased substantially from 57% to 5% (Desirable to Undesirable) and
- fines increased from 43% to 95% (remaining Undesirable).
- riffles are downstream of the bridge installation site, and downstream of the two beaver dam pools, but the cause of the deposition of fines is unknown

Wood:

- added pieces range from 6-12 meters in length, more than twice the ACW
- placed mostly in units now classified as beaver dam pools and glides
- number of pieces increased from Undesirable to Between
- large volume/piece changed the volume and key pieces from Undesirable to Desirable

Shade/Conifers

- Percent shade and Riparian conifers are at Undesirable levels

Indian Creek (on Elk)

Channel Characteristics:

- Small stream, similar to Crook Creek in size and gradient, but less confined
- Reach 1 is incised into Elk River floodplain
- Reach 2 was treated with large wood; Reach 1 and 3 are untreated

Pools:

- gained considerable numbers of pools, many smaller than the ACW, but pool frequency remains at Between or Desirable
- pool area remains at Between and residual pool depth remains Undesirable on reach 1
- pool area improved from Between to Desirable, and residual pool depth remains Between on reaches 2 and 3

Substrate

- gravel in riffles increased in treated and untreated reaches, remaining Desirable, highest of all streams (channel lacks cobbles)
- fines in riffles improved from Undesirable to Between on reaches 2 and 3

Wood - treated reach 2 only:

- most pieces 12-15 meters long, two 21 meter pieces at downstream end, twice the ACW
- placed mostly in riffles and lateral scour pools, some riffles converted to lateral pools
- number of pieces increased from Undesirable to Between
- large volume/piece changed the volume and key pieces from Undesirable to Desirable

Shade/Conifers

- Percent shade at Desirable while Riparian conifers are at Undesirable levels

Indian Creek (on Lower Rogue) - Treated Reach 4 (unless noted)

Channel Characteristics:
- Medium stream (except Small on reach 3), steepest gradients within bedrock confined reaches 2 and 3

Pools:
- no change in pool area, remains Between
- pool frequency remains Desirable
- slight increase in residual pool depth, remains Undesirable

Substrate:
- no low gradient riffles

Wood:
- placed mostly in lateral pools, straight pools, and riffles
- riffles converted to riffles with pockets
- added pieces primarily 9 meters long (approximately the ACW)
- number of pieces remains Between
- untreated reaches 1-3 lost pieces of wood
- large volume/piece changed the volume and key pieces from Undesirable to Desirable

Shade/Conifers
- shade remains Desirable
- riparian conifers not surveyed

Farmer Creek

Channel Characteristics:
- Medium stream, similar in channel width to Jacks Creek, but is steeper at 2% gradient

Pools:
- pool area decreased primarily in reach 3 and reach 1; insignificant change in frequency of pools longer than ACW; pool area and frequency remain Desirable in all reaches
- residual pool depth increased in reaches 1-3, and decreased in reach 4; reach 1 remains Desirable, reach 2 remains Undesirable, reach 3 increased from Undesirable to Between and reach 4 decreased from Between to Undesirable

Substrate
- gained a low-gradient riffle in reaches 1, 2 & 3, ranked as Between gravel and fines (reach 1 ranked as Desirable gravel)

Wood:
- added pieces 21-24 meters long, nearly double the ACW of 8-15 meters
- placed mostly in straight scour pools, now classified as lateral pools
- number of pieces increased, but still rated as Undesirable or Between
- volume increases from Undesirable to Desirable (reach 3 remains Undesirable)
- key pieces increase from Undesirable to Between (reach 1 increases to Desirable)
- relatively high percentage of pieces located in wood jams

Shade/Conifers
- Percent shade at Desirable
- Riparian conifers at Undesirable levels, but higher than four other surveyed streams

Crook Creek

Channel Characteristics:
- Small stream, similar in width and gradient to Indian Creek on Elk, but more confined
- reaches were delineated due to lack of ACWs, channel and valley form information

Pools:
- gained a substantial number of pools, pool frequency remains Desirable
- gained the highest number of pools greater than the ACW
- pool area increased somewhat, and remains Desirable
- residual pool depth remains Between

Substrate
- gravel in riffles increased from 57% to 68%, remaining Desirable
- fines in riffles increased from 18% to 28%, remaining Undesirable

Wood:
- added pieces average 9-12 meters in length, ranging from 6-28 meters, double the ACW
- placed mostly in units now classified as lateral pools and straight scour pools
- number of pieces increased slightly, remaining Between
- large volume/piece shifts volume from Undesirable to Desirable
- key pieces increase from Between to Desirable

Shade/Conifers
- Percent shade Desirable while Riparian conifers at Undesirable levels

Mill Creek

Channel Characteristics:
- Medium stream, similar in channel width to Jacks Creek Reach 3, but is steeper at 2% gradient

Pools:
- pool area increased, but no change in pool frequency, remains Desirable
- residual pool depth decreased from Between to Undesirable

Substrate
- little change in gravels or fines in riffles, remains Desirable

Wood:
- added pieces range from 3-21 meters long, average 9-12 meters (approximately the ACW)
- placed in various units, three converted to lateral pools, and one lateral pool converted to straight scour pool
- number of pieces remained Between, some natural pieces lost (possibly pieces were present but too difficult to count in a large jam)
- large volume/piece changed the volume from Undesirable to Desirable
- key pieces increase from Undesirable to Between

Shade/Conifers
- percent shade at Desirable
- riparian conifers not surveyed

Jacks Creek (Phase II) - 1999-2000 comparison

Channel Characteristics (compared to other streams):
- Medium stream, similar in width to Farmer Creek, but is flatter at 1.1% gradient

Pools:
- lost some pools, pool frequency remains Desirable
- pool area decreased by 7% in reach 1 and by 14% in reach 2, but remains Desirable
- residual pool depth increased, but remains Undesirable

Substrate
- gravel in riffles increased (within the measurement error), remaining Desirable
- fines in riffles decreased by 10% to 12%, shifting from Between to Desirable.

Wood:
- added pieces average 21-24 meters (exceeds ACW of 11-18 meters)
- placed mostly in units now classified as lateral pools
- number of pieces increased, but remain Between on reach 1, Undesirable on reach 2
- Prior to 1999, Phase I on reach 1 increased volume to Desirable, but key pieces were absent
- large volume/piece changed the volume to Desirable
- Phase II increased reach 1 key pieces from Undesirable to Desirable, Between on reach 2

Shade/Conifers
- Percent shade Desirable while riparian conifers at Undesirable levels

Jacks Creek (Phase III) - 2000-2001 comparison

Channel Characteristics:
- Medium stream, similar in channel width to Farmer Creek, but is flatter

Pools: (excludes more than 25% of the primary channel length that was in puddled or dry channel types in 2001, thus reaches are not the same)
- pool area increased from Between to Desirable on reach 2X, and increased on reach 3
- pool frequency remains Desirable
- residual pool depth increased on reach 2X, and decreased on reach 3

Substrate
- gravel in riffles increased at the expense of cobbles, changing reach 3 from Between to Desirable
- fines remain Desirable
- higher fines concentrated in deepest pools

Wood:
- on reach 2X, added pieces range from 9-18 meters and average 12-15 meters (ACW varies from 8-22 meters)
- on reach 3, added pieces are 9-12 meters long, approximately the ACW
- placed mostly in straight pools, lateral pools, and riffles
- number of pieces increased reach 3 from Undesirable to Between
- large volume/piece changed the volume and key pieces to Desirable

Shade/Conifers
- percent shade Desirable
- riparian conifers not surveyed

Recommendations

Monitoring of the existing large wood projects has documented baseline conditions, and a strategic schedule may be developed for future surveys. Longer periods of time or larger streamflows are required to detect major channel changes. One outcome of monitoring large wood project effectiveness is to reconsider the suitability of the Aquatic Habitat Inventory for detecting changes. Future effectiveness monitoring will focus on highly repeatable measurements such as longitudinal profiles and cross-sections. Following wood placement, the wood form and protocol may be used to document numbers of pieces, volumes, and key pieces. Tracking changes at each wood site with habitat type, dimensions, photo-points and pebble counts upstream and downstream of each piece or grouping of wood can document channel conditions. In 2001, schematic mapping was initiated to provide a more visual record of the wood sites.

If stream surveys are performed for future wood projects, wood locations should be identified by habitat unit after placement. Marking the habitat structures at this time would help to determine the distance of travel if the pieces move. Selecting a period of optimal light conditions for taking photo-points, and matching pre-project photos on site would enhance the quality of the visual record. These improvements may require the crew to complete the habitat survey earlier when flows are favorable, and to return to the site after wood placement to document wood locations, tag pieces and establish photo points.

Every effort should be made to provide a control reach upstream of the project to account for the magnitude of change occurring from year to year in untreated reaches. Habitat unit lengths and widths should be measured rather than estimated to improve the resolution for percent pool area and weighted average substrate values. This modification of the protocol has been adopted by ODFW for effectiveness monitoring (Jacobsen and Thom, 2001). Active channel widths are variable enough that they need to be measured more frequently than every 10th channel unit. Active channel width/depth ratios varied within some stream reaches enough that values could not be assigned to benchmark categories. Infrequent widths also make it more difficult to determine whether large wood meets the desired criteria of as long as twice the active channel width. More frequent widths would allow delineation of reaches for comparing values in future Crook Creek surveys.

Acknowledgements

Baseline data and photographs provided in this report were collected by the dedicated crews of Matt Swanson and John T. Wilson (1998-1999), and Matt Swanson and Andy Gross (2000-2001). It is their commitment to the surveys that will allow us to further our understanding of the effects of large wood on Curry County streams. Howard Crombie, habitat biologist for ODFW, implemented the large wood projects and trained the crews in Aquatic Inventory Project monitoring protocols. Matt Swanson and Chris Massingill improved the clarity and content of this report with their review comments.

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Appendix A

Survey Comparison between South Coast Watershed Council on July 27, 2000 and Oregon Department of Fish and Wildlife on August 7, 2000.

Edson Creek, tributary to Sixes River

Two reaches in Edson Creek were inadvertently surveyed during the same period in 2000. Differences between the two surveys center on the interpretation of the location of the active channel (Table A). The Watershed Council crew included units in multiple channels that were either in the active channel (and ignored by the ODFW crew), or were formed during the November 1996 flood and misinterpreted as being within the active channel. The Watershed Council crew measured many more multiple channels, including almost 13% Dry unit types in Reach 1 and over 4% in Reach 2. The Watershed Council crew subdivided more units (Table B), so that the frequency of habitat units is greater. The results in the Tables below include all surveyed pools, and do not exclude pools shorter than the ACW. The longer average riffle length in the ODFW survey would be expected to reduce the percent pool area in comparison to the Watershed Council Survey, where shorter pools were subdivided. This effect is observed in Reach 2, but not in Reach 1. It is suspected (but not yet verified) that proportionally less pool area occurs within the multiple channels, which would reduce the pool area more in Reach 1. Identifying shorter pools tends to decrease the average residual pool depth.

Table A

	WSC Reach 1	ODFW Reach 1	WSC Reach 2	ODFW Reach 2
Active Channel Width, m	32.5	12.2	16.3	10.5
Habitat Units/ 100 m	6.1	5.0	5.6	4.3
Primary Length, m	1836	1802	1877	1362
Secondary Length, m	1418	433	613	101
Scour Pool, average length	22	28	22	25
Riffle, average length, m	11	20	18	31
Percent Pool Area	66	65	56	45
Residual Pool Depth, m	.61	.68	.73	.79
Shade, percent	69	62	81	75
Large wood pieces	348	379	154	132
Wood volume, cu m	283	151	124	92
Key Pieces	5	6	0	1
Actively Eroding, percent	38	4	19	2

Substrate percentages for the habitat types covering the largest area in each survey are shown in Table C below.

Differences in wood volume between the two surveys are significant, especially considering that the ODFW survey has more pieces. This inconsistency needs further investigation. Differences in active erosion may relate to the somewhat subjective nature of the interpretation, and to features that are more prevalent along multiple channels.

Classifying Edson Creek as a Medium rather than a Large stream improves the residual pool depth rating to Desirable, based on the benchmarks. Using a narrower ACW also affects values for pool frequency, width/depth, and key pieces (using the former definition, referenced to ACW).

Table B

Habitat Type	WSC Reach 1 #	ODFW Reach 1 #	WCS Reach 2 #	ODFW Reach 2 #
Alcove Pool	2	1		
Backwater Pool	1	3		1
Beaver Dam Pool	1	2		
Cascade over Boulders			2	14
Dammed Pool	4	3	1	
Dry Channel	4		3	
Dry Unit	21	5	5	
Glide		6	1	
Isolated Pool	22	5	7	
Lateral Scour Pool	50	31	35	18
Pool-Riffle			1	
Pool-Step-Pool			3	
Puddled	7	3	1	1
Rapid w/ Boulders		1	13	
Riffle	58	28	29	12
Riffle w/ Pockets	6	3	10	9
Step over Beaver Dam		2		
Step over Boulders	1	1	5	1
Step over Cobble Bar	2	4	4	
Step over Log	2	1		
Step over Structure		3		
Straight Scour Pool	17	9	18	7
Trench Pool			1	
Total	198	111	139	63

It is difficult to interpret differences in substrate between the surveys without separating the multiple channels. Dry units within multiple channels average 60% gravel (Table C), and if these channels also contain proportionally more riffle units, they could account for the higher gravel content in the Watershed Council survey. Deeper pools tend to have higher percentages of fines, so that including shorter, shallower pools (especially in reach 2) could reduce the estimate for fines in pools. The ODFW survey riffles would include small pools that would increase their estimate of fines. However, the percentages of substrate for all units should reflect the larger area in pools for the watershed council and agree more closely. The uncertainty associated with substrate estimates might be addressed using pebble counts.

Table C: Reach 1

Habitat Type	WSC Ave Fines	WSC Ave Gravel	WSC Ave Cobble	ODFW Ave Fines	ODFW Ave Gravel	ODFW Ave Cobble
Riffle	4	78	16	12	51	35
Glide				17	52	29
Lateral Scour Pool	32	57	8	27	41	28
Straight Scour Pool	22	55	20	38	36	24
Dry Units	28	60	12			
All Units	25	60	13	26	41	30

Table C: Reach 2

Habitat Type	WSC Ave Fines	WSC Ave Gravel	WSC Ave Cobble	ODFW Ave Fines	ODFW Ave Gravel	ODFW Ave Cobble
Cascade over Boulders				8	24	32
Rapid over Boulders	0	13	49			
Riffle	1	40	49	13	33	35
Riffle w/ Pockets	3	23	54	15	27	30
Lateral Scour Pool	14	37	31	39	23	24
Straight Scour Pool	12	29	41	30	25	26
All Units	8	34	40	23	26	29

Appendix B: Photo Plates

Plate 1: Dan's Creek, tributary to Fourmile, July 21, 2000

looking downstream from beaver dam pool, unit 16A

looking upstream from beaver dam pool, unit 16C

looking upstream from plunge pool, unit 10

looking downstream from beaver dam pool, unit 16C

Plate 2:
Left: Indian Creek (Rogue), Reach 4, riffle converted to riffle with pockets
Right: Mill Creek straight scour pool converted to lateral scour pool

Indian Creek (Rogue), July 25, 2000, view upstream @ IDC-8 Mill Creek, July 24, 2000, view upstream @ MC-3

Indian Creek (Rogue), August 2, 2001, view as above Mill Creek, July 25, 2001, view as above slower velocity depositing gravels

Plate 3: Farmer Creek Reach 1

Left: Straight scour pool deepened from 0.1 to 0.4 meters
Right: Straight scour pool converted to lateral pool, 0.6 to 0.7 meters

Farmer Creek, July 19, 1999, looking downstream @ FMC-3

Farmer Creek, July 19, 1999, looking upstream @ FMC-4

Farmer Creek, July 12, 2000, looking downstream @ FMC-3

Farmer Creek, July 12, 2000, looking upstream @ FMC-4

Plate 4: Jacks Creek Phase III, Reach 3
Left: Wood providing cover on straight scour pool
Right: Wood providing cover on lateral scour pool

Jacks Creek, August 3, 2000, looking upstream @ SAC-34

Jacks Creek, August 3, 2000, looking upstream @ SAC-40

Jacks Creek, July 26, 2001, looking as above, cover for pool

Jacks Creek, July 26, 2001, looking as above, cover for pool

Plate 5:
Left: Left: Jacks Creek Phase II, Reach 2, gravel deposition
Right: Jacks Creek Phase III, Reach 3, future lateral scour pool developing from straight pool and riffle

Jacks Creek, July 22, 1999, looking downstream @ SAC-6

Jacks Creek, August 3, 2000, looking upstream @ SAC-45

Jacks Creek, July 14, 2000, looking as above, gravel deposit

Jacks Creek, July 26, 2001, looking as above, future lateral pool

Plate 6: Farmer Creek Reach 4, dry unit converted to lateral scour pool

1999, FMC-10, looking upstream

2000, FMC-10, looking upstream

Plate 7: Jacks Creek Phase II, Reach 2

Left: Large volumes of mobile gravel near lateral scour pool

Right: Lateral scour pool converted to straight scour pool and deepened from 0.3 to 0.6 meters

Jacks Creek, July 22, 1999, looking upstream @ SAC-12

Jacks Creek, July 22, 1999, looking downstream @ SAC-13

Jacks Creek, July 14, 2000, looking upstream @ SAC-12

Jacks Creek, July 14, 2000, looking downstream @ SAC-13

Plate 8: Jim Hunt Creek, tributary to Lower Rogue, July 31, 2001

Lower wood site looking upstream

Lower wood site looking downstream

Upper wood site looking downstream

Appendix C: Habitat Type Tables

Tributary to Fourmile Creek ("Dan's Creek")

Habitat Type	1999 #	2000 #	1999 Natural Wood	1999 Natural Rootwad	2000 Natural Wood	2000 Natural Rootwad	2000 Artificial Wood
Beaver dam Pool		2			1		13
Culvert Crossing	2	*					
Glide	7	9	4		2	1	13
Lateral Pool	1	1					1
Plunge Pool	1	1					1
Riffle	5	4	1				2
Riffle w/ Pocket	1		1				
Step over Logs	1	3		1			
Straight Scour Pool	4		1				
Total	22	20	7	1	3	1	30

* culverts replaced by bridge for fish passage

Common Habitat Types – Percent Substrate, Area Weighted

Habitat Type	1999 Ave Fines	1999 Ave Gravel	2000 Ave Fines	2000 Ave Gravel
Glide	94	6	99	1
Riffle	41	59	96	4
Beaver dam Pool	-	-	100	0
Straight Pool	92	8	-	-

Indian Creek, Tributary to Elk River

Habitat Type	1999 #	2000 #	1999 Natural Wood	2000 Natural Wood	2000 Natural Rootwad	2000 Artificial Wood
Braided (small channel)	1					
Backwater Pool	6	4	1			
Dry Channel	2	2				
Dry Unit	1	3				
Glide	1	3		1		
Lateral Pool	30	53	16	23	6	22
Plunge Pool	4	4	9	2	2	
Pool-Step-Pool		1				
Puddled	2	1		1		
Riffle	50	76	43	15	3	7
Riffle w/ Pocket		2		2		
Step over Cobble Bar		3		1		1
Step over Logs		1				
Straight Scour Pool	12	17	6	6	2	6
Total	109	170	75	51	13	36

Common Habitat Types – Percent Substrate, Area-Weighted

Reach 1

Habitat Type	1999 Ave Fines	1999 Ave Gravel	2000 Ave Fines	2000 Ave Gravel
Riffle	15	85	15	85
Lateral Pool	70	30	37	63
Straight Pool	55	40	20	80

Reach 2

Habitat Type	1999 Ave Fines	1999 Ave Gravel	2000 Ave Fines	2000 Ave Gravel
Riffle	17	78	9	91
Lateral Pool	55	44	32	68
Straight Pool	47	53	42	56

Reach 3

Habitat Type	1999 Ave Fines	1999 Ave Gravel	2000 Ave Fines	2000 Ave Gravel
Riffle	19	75	4	92
Lateral Pool	46	50	21	77
Straight Pool	57	40	19	78

Indian Creek, Tributary to Lower Rouge River

Comparison for Treated Reach (R4) only

Habitat Type	2000 #	2001 #	2000 Natural Wood	2000 Root-wad	2000 Cut End Wood	2001 Natural Wood	2001 Root-wad	2001 Cut & Artific
Cascade over Boulders		1				1		
Lateral Scour Pool	7	10	7	11	1	3	4	7
Puddled		1						
Pool-Riffle	2		2					
Rapid w/ Protruding Boulders	4	3	1	3			4	
Riffle	8	6	1	1		1		
Riffle w/ Pockets	6	11	5	4		2	4	12
Step over Boulder	1	1		1				
Step over Cobble Bar	2	2		1			1	
Straight Scour Pool	8	7	7	3	1	2	3	1
Step over Bedrock	1							
Total	39	42	23	23	2	9	16	20

Common Habitat Types – Percent Substrate, Area-Weighted

Comparison for Treated Reach (R4) only

Habitat Type	2000 Ave Fines	2000 Ave Gravel	2001 Ave Fines	2001 Ave Gravel
Riffle	2	30	4	38
Riffle w/Pocket	2	33	7	33
Lateral Pool	21	41	31	36
Straight Pool	15	42	24	26

Farmer Creek, Tributary to Pistol River

Habitat Type	1999 #	2000 #	1999 Natural Wood	1999 Cut End Wood	2000 Natural Wood	2000 Natural Rootwad	2000 Cut End Wood	2000 Artifi Wood
Backwater Pool	1	1	1					
Cascade over Boulders		1						
Dry Channel	4	2	4		2			
Dry Unit	1	0	5					
Isolated Pool	3	3						
Lateral Pool	4	16	8	1	25	6	3	
Puddled	5	3	2					
Plunge Pool	1	1	1				1	
Rapid w/ Protruding Boulders	3	2	1					
Riffle	7	12			1			
Riffle w/ Pocket	17	13	5		5	2		
Step over Cobble Bar	1	4						
Straight Scour Pool	29	13	23		18	5		
Total	76	71	50	1	51	13	4	

Common Habitat Types – Percent Substrate, Area-Weighted

Reach 1

Habitat Type	1999 Ave Fines	1999 Ave Gravel	2000 Ave Fines	2000 Ave Gravel
Riffle	15	35	6	20
Riffle w/Pocket	12	28	8	10
Lateral Pool	36	36	40	14
Straight Pool	29	26	21	53

Reach 2

Habitat Type	1999 Ave Fines	1999 Ave Gravel	2000 Ave Fines	2000 Ave Gravel
Riffle			5	13
Riffle w/Pocket	17	42	5	20
Lateral Pool			32	34
Straight Pool	11	50	9	9

Reach 3

Habitat Type	1999 Ave Fines	1999 Ave Gravel	2000 Ave Fines	2000 Ave Gravel
Riffle	15	61	5	33
Riffle w/Pocket	11	34	7	45
Lateral Pool	40	40	28	34
Straight Pool	35	31	10	28

Reach 4

Habitat Type	1999 Ave Fines	1999 Ave Gravel	2000 Ave Fines	2000 Ave Gravel
Riffle	16	0	12	44
Riffle w/Pocket	6	0	8	40
Lateral Pool	60	0	32	40
Straight Pool	38	0	39	28

Crook Creek, Tributary to Pistol River

Habitat Type	1998 #	1999 #	1998 Natural Wood	1998 Nat Root-wad	1998 Cut End & Root	1999 Natural Wood	1999 Nat Root-wad	1999 Cut End & Root	1999 Artificial Wood
Backwater Pool	9	5	1						1
Cascade over Bldrs	1		2		2				
Dry Channel	6		6	1	1	1			
Dry Unit	2	3	2						
Glide	3	1				3			2
Isolated Pool	4	4				1			
Lateral Pool	32	48	48	3	13	44	2	9	41
Puddled	7	13	4		2			1	
Plunge Pool	4	4	11		1	4			
Rapid w/ Protruding Boulders	4	1	6		1				
Riffle	54	81	23	2	7	32	2	3	6
Riffle w/ Pocket	13	13	23	4	2	6	1	4	3
Step over Boulders	1	1							
Step over Cobble Bar		1				8			
Straight Scour Pool	21	48	19	3	9	35	4	5	19
Total	160	227	145	13	38	134	9	22	72

Change in Area of Habitat Types by Channel Type: see graph

Common Habitat Types – Percent Substrate, Area-Weighted

Reach 1 and 2

Habitat Type	1998 Ave Fines	1998 Ave Gravel	1999 Ave Fines	1999 Ave Gravel
Riffle	19	54	13	63
Riffle w/Pocket	23	52	17	48
Lateral Pool	73	17	61	29
Straight Scour Pool	62	26	57	31

Mill Creek, Tributary to Chetco River

Habitat Type	2000 #	2001 #	2000 Natural Wood	2000 Root-wad	2000 Artific/Cut Wood	2001 Natural Wood	2001 Root-wad	2001 Artificial /Cut Wood
Backwater Pool	2		2					
Dry Channel	3	1	3	1				
Dry Unit		1						
Glide								
Isolated Pool	3		1					
Lateral Pool	22	20	30	11	4	28	13	17
Plunge Pool	2		1		4			
Puddled	2	1	2			4		1
Pool-Step-Pool								
Pool-Riffle								
Riffle w/ Boulders	5	3						
Riffle	25	19	9		1	3	2	4
Riffle w/ Pocket	6	8	3			2	1	
Step over Cobble Bar		4				1		
Step over Log	1							
Straight Scour Pool	12	15	15	8	2	6	5	5
Total	83	72	66	20	11	44	21	27

Common Habitat Types – Percent Substrate, Area-Weighted
Reach 1

Habitat Type	2000 Ave Fines	2000 Ave Gravel	2001 Ave Fines	2001 Ave Gravel
Riffle	1	45	3	48
Riffle w/ Pockets	1	51	6	63
Lateral Pool	19	49	24	53
Straight Scour Pool	29	43	18	41

Jacks Creek, Tributary to Chetco River, Phase III, 2000-2001 comparison

General Description

Habitat Type	2000 #	2001 #	2000 Natural Wood	2000 Root-wad	2000 Artific Wood	2001 Natural Wood	2001 Natural Root-wad	2001 Artificial Wood
Backwater Pool	2	1	1					5
Dry Channel	1	3						
Dry Unit								
Glide	2	1						1
Isolated Pool	1							
Lateral Pool	14	17	9	3	5	4	3	34
Puddled	1	3						5
Pool-Step-Pool	1	4	1					
Pool-Riffle		2						4
Riffle w/ Boulders	7			1				2
Riffle	24	18						1
Riffle w/ Pocket	2	8			1			22
Step over Cobble Bar	8	1	1					
Straight Scour Pool	12	11	3	1	2			18
Total	78	72	15	5	8	4	3	92

Common Habitat Types – Percent Substrate, Area-Weighted

Reach 2x

Habitat Type	2000 Ave Fines	2000 Ave Gravel	2001 Ave Fines	2001 Ave Gravel
Riffle	0	58	1	77
Glide	7	62	10	75
Lateral Pool	19	67	25	63
Straight Pool	0	94	10	90

Reach 3

Habitat Type	2000 Ave Fines	2000 Ave Gravel	2001 Ave Fines	2001 Ave Gravel
Riffle	1	31	2	49
Riffle w/ Pockets	0	52	6	44
Lateral Pool	7	62	18	45
Straight Pool	18	34	13	46