



West Fork Cow Creek Habitat and Fish Surveys

West Fork Cow Creek Watershed Action Plan

Partnership for the Umpqua Rivers

Roseburg, Oregon

September 9, 2016



Contents

1	Introduction.....	1
2	Study Area.....	1
3	Methods.....	1
	3.1 Habitat.....	1
	3.2 Fish.....	2
	3.2.1 Electroshocking.....	2
	3.2.2 Snorkeling.....	2
	3.2.3 Environmental DNA.....	3
4	Results.....	5
	4.1 Habitat.....	5
	4.1.1 West Fork Cow Creek.....	5
	4.1.2 Bear Creek.....	10
	4.1.3 Goat Trail Creek.....	10
	4.1.4 Slotted Pen Creek.....	10
	4.1.5 Hayes Creek.....	11
	4.1.6 Bobby Creek.....	11
	4.1.7 Elk Valley Creek.....	11
	4.1.8 Panther Creek.....	12
	4.1.9 Gold Mountain Creek.....	12
	4.1.10 Walker and Wallace Creeks.....	12
	4.1.11 Slide Creek.....	13
	4.1.12 Stanley Creek.....	13
	4.1.13 Black Creek.....	13
	4.1.14 Grant Creek.....	14
	4.1.15 Ashur Creek.....	14
	4.1.16 Wilson Creek.....	14
	4.1.17 Bolivar Creek.....	14
	4.2 Fish.....	15
	4.2.1 Electrofishing and Snorkeling.....	15
	4.2.2 Environmental DNA.....	17
5	Discussion.....	17
6	References.....	19

Tables

Table 4-1. Locations, general characteristics, and riparian features at 50 sites in the West Fork Cow Creek watershed, summer 2016.....	6
Table 4-2. Stream habitat features at 50 sites in the West Fork Cow Creek watershed, summer 2016..	8
Table 4-3. Fish observed during electroshocking and snorkeling surveys at 16 sites in the West Fork Cow Creek watershed, summer 2016.	16
Table 4-4. Presence or absence of DNA from Coho Salmon, Chinook Salmon, Steelhead, and Pacific Lamprey at 18 sites in the West Fork Cow Creek watershed, summer 2016.....	17

Figures

Figure 3-1. Snorkeling in a small stream (tributary to Bear Creek; above) and a larger stream that sometimes required a zig-zag pattern (West Fork Cow Creek; below). 4

Appendices

See separate document for appendices.

1 Introduction

The Partnership for the Umpqua Rivers (Partnership) is developing a watershed action plan (Plan) for the West Fork Cow Creek watershed in southwestern Oregon. The focus of the Plan is to direct restoration project funding to recover or restore native fish populations in the watershed. The first step in developing the plan was to develop a framework for scoring and ranking potential restoration projects. The framework includes metrics for native fish species potentially enhanced, amount and type of habitat enhanced or made available, and relative difficulty of site access. The second step in developing the Plan was to collect information on current habitat and fish presence throughout the watershed to inform the scoring of metrics included in the framework. This report summarizes the information collected. The final steps will be to develop a list of potential projects and score each project based on information collected and summarized in this report. These steps will be completed in fall 2016.

2 Study Area

West Fork Cow Creek is a tributary of Cow Creek, which is a tributary of the South Fork Umpqua River. The West Fork Cow Creek watershed is located in Douglas County, Oregon, and is about 55,914 acres (Appendix A). No major highways or population centers occur in the watershed, although an extensive network of both paved and unpaved logging roads is present. In addition to West Fork Cow Creek, the watershed includes a number of fish-bearing streams, many of which support anadromous salmonids. Native fish species known or presumed to occur in the watershed include Coho Salmon (*Oncorhynchus kisutch*), Chinook Salmon (*O. tshawytscha*), steelhead (*O. mykiss*), Coastal Cutthroat Trout (*O. clarkii*), Pacific lamprey (*Entosphenus tridentatus*), Western Brook Lamprey (*Lampetra richardsoni*), Umpqua Dace (*Rhinichthys cataractae*), and Umpqua Chub (*Oregonichthys kalawatseti*). Coho Salmon are listed as threatened under the Endangered Species Act.

3 Methods

Habitat and fish presence data were collected between July 12 and August 16, 2016. Data were collected at sites pre-determined by The Partnership and a Technical Workgroup. Sites were not selected to provide a scientifically rigorous sampling plan, but rather to provide general information on habitat characteristics and fish presence for most fish-bearing streams in the watershed. Habitat sites were assumed to be representative of streams or stream reaches. Fish sites were selected to focus on streams or reaches for which existing knowledge was limited or contradictory, and to collect information from as many streams as possible.

3.1 Habitat

Information on habitat was collected at 50 sites distributed throughout the watershed from July 12 through August 17, 2016 (see Table 4-1). Information collected was similar to that of standardized aquatic habitat inventories in Oregon (ODFW 2015); however, specific information

collected and length of reaches surveyed were adjusted to facilitate collection of data at as many sites as possible throughout the watershed. Survey parameters and protocols for collecting information were developed by the TWG prior to initiation of data collection (Appendix B).

Habitat data were collected for a 200-meter reach at each site, with the pre-determined GPS coordinate serving as the mid-point of the reach. Habitat data collection focused on two primary areas, in-stream geomorphology, and riparian/floodplain characteristics. As described in detail in Appendix B, in-stream information included channel type (mesohabitat), channel complexity, substrate composition, active channel width and depth, stream gradient, presence of refugia, evidence of beaver activity, channel confinement, and large woody debris (LWD) and log jams. Riparian and floodplain information included presence of landslides or slumps, downed wood, composition of riparian vegetation, amount of shading, presence of key-in points, presence of invasive species, and presence of human-made infrastructure. Numerous photos were taken throughout each site to aid in site characterization.

3.2 Fish

Information on fish presence and relative abundance was collected at 34 sites from July 26 through August 24, 2016. A backpack electroshocker was used at 9 sites, snorkeling was conducted at 7 sites (see Table 4-3), and environmental DNA (eDNA) samples were collected at 18 sites (see Table 4-4).

3.2.1 Electroshocking

Electroshocking was originally planned to occur at eight sites; however, low flow and related stream depth precluded snorkeling at two designated sites so shocking was substituted for snorkeling. A temporary malfunction of the electroshocker required that snorkeling be substituted at one site designated for shocking. Therefore, electroshocking was conducted at nine sites rather than the eight pre-determined sites.

Electroshocking was conducted in a reach of approximately 100 meters at each site, with the pre-determined GPS coordinate serving as the mid-point of the reach. Each site was surveyed twice. During the first pass, the electroshocker was set to stun juvenile salmonids. During the second pass, the electroshocker was set to focus on drawing larval lamprey out of the substrate.

One person operated the electroshocker and a second person used a net to collect stunned fish. Block nets were not used to prevent fish from leaving the survey area. Stunned fish were placed in a bucket of stream water with aeration. Fish were identified to species when possible, measured and apportioned into two-inch categories, and then released back into the stream.

3.2.2 Snorkeling

Snorkeling was originally planned to occur at eight sites; however, as described in Section 3.2.1, stream and equipment conditions required changes to the sampling scheme resulting in snorkeling being conducted at seven sites rather than eight. Snorkeling was conducted in a

reach of approximately 100 meters at each site, with the pre-determined GPS coordinate serving as the mid-point of the reach.

One person snorkeled each designated reach starting at the downstream end, and a second person recorded data as described by the snorkeler. Streams were generally small enough that one snorkeler could easily see all fish while moving upstream in the middle of the channel (Figure 3-1). In larger pools (primarily in West Fork Cow Creek), the snorkeler utilized a “zig-zag” pattern to ensure all fish were observed (Figure 3-1). Fish were identified to species when possible and apportioned into two-inch categories.

3.2.3 Environmental DNA

Collection of water samples for eDNA analysis was originally planned to occur at 14 sites; however four additional sites were added to bring the total up to 18 sites. Methods followed the protocols developed by the U.S. Forest Service Rocky Mountain Research station (Carim et al. 2015).

After collection and brief storage in a freezer, samples were shipped to the Rocky Mountain Research Station in Bozeman, Montana for analysis. Samples were analyzed for the presence of DNA from Coho salmon, Chinook salmon, steelhead, and Pacific Lamprey.



Figure 3-1. Snorkeling in a small stream (tributary to Bear Creek; above) and a larger stream that sometimes required a zig-zag pattern (West Fork Cow Creek; below).

4 Results

4.1 Habitat

Stream and riparian habitat conditions varied substantially among the 50 sites surveyed (Table 4-1; Table 4-2). Streams in the watershed are generally confined by valley form unless otherwise noted. Little human-created infrastructure was observed other than nearby roads and an occasional culvert. Representative photos of each site surveyed are in Appendix C.

4.1.1 West Fork Cow Creek

Seventeen of the 50 habitat surveys were conducted on West Fork Cow Creek. Survey sites were distributed throughout the length of the creek (Appendix A). Sites in the upper watershed were generally closer to a road and easier to access than sites further downstream (Table 4-1).

Water temperature varied widely among sites (Table 4-1). Temperatures were high throughout the lower sites, and although no clear downstream to upstream pattern was apparent, temperatures were lowest at some upstream sites. Riparian composition and shade varied among sites, but canopy cover was generally lowest at sites in the middle reach of the stream. Only seven of the 17 sites had large useable wood in riparian areas. Invasive plant species including Himalayan blackberry, Scotch broom, and Canada thistle were observed at a number of sites, mostly in the lower portion of the watershed. Current or old roads are near some of the sites.

As would be expected, the active channel was generally widest and deepest at downstream sites (Table 4-2). Substantial differences were noted between sites H24 and H27 (separated by the confluence with Panther Creek), and between sites H48 and H50 (separated by the confluences with Bolivar and Fuller creeks). Gradient was generally low to moderate throughout, but was steepest at the middle sites. Cobble and gravel substrates were observed at most sites. The stream is confined primarily by valley form throughout, although presence of roads contributes to confinement. The confining valley sometimes is in the form of bedrock walls at the upper sites. Large woody debris is totally lacking throughout lower sites, present in small amounts in middle sites, and becomes substantial in the upper-most sites. Abundant in-stream wood at the upper sites coincided with useable wood in riparian areas.

Some type of fish refugia was present at 16 of the 17 sites, including backwaters, eddies, alcoves, undercut banks, and overhanging vegetation. Some signs of beaver activity were noted at four of the sites between Elk Valley and Walker creeks.

Table 4-1. Locations, general characteristics, and riparian features at 50 sites in the West Fork Cow Creek watershed, summer 2016.

Stream, site	GPS Coordinates (UTM)		Temp. (°C)	Distance from Road (m)		Riparian Composition (%)			Shade (%)	Downed Wood ^a	Key-in points	Invasive Plants	Slumps
	North	East		Run	Rise	Con.	Decid.	Shrub					
West Fork Cow Creek													
H1	42.80458	-123.61150	21.9	46	30	54	35	10	50-75	U; A; R; H; S	Boulders	Yes	No
H7	42.80477	-123.65123	18.2	107	24	70	20	8	75-100	H; S	None	Yes	No
H12	42.82423	-123.68799	19.6	253	122	60	25	5	50-75	R; S	Boulders	No	No
H13	42.82437	-123.70282	19.4	198	76	65	25	8	50-75	R; S	Narrow points	Yes	No
H14	42.82730	-123.71683	17.1	52	24	50	20	10	50-75	R; S	Narrow points	Yes	No
H24	42.84157	-123.73241	16.3	152	73	35	50	15	75-100	A; R; S	Narrow points	Yes	No
H27	42.84652	-123.76076	19.6	76	24	60	30	5	50-75	U; R; S	Narrow points	Yes	No
H31	42.83500	-123.76916	18.4	55	14	65	20	10	75-100	A; R; H; S	Narrow points	Yes	No
H34	42.83438	-123.78508	16.2	30	--	30	20	10	0-25	None	None	No	Yes
H36	42.83916	-123.79793	15.6	30	--	30	50	20	25-50	U; A; R	Boulders	No	No
H37	42.84849	-123.81491	17.5	15	--	10	60	30	25-50	U; A; R	None	No	Yes
H40	42.84788	-123.82197	14.9	30	--	40	40	20	25-50	None	None	No	No
H43	42.84412	-123.82747	12.7	30	--	40	40	20	25-50	None	None	No	No
H45	42.83194	-123.83475	23.9	--	--	15	50	30	25-50	A; S	Boulders	Yes	No
H46	42.81598	-123.84387	18.1	--	--	60	30	10	75-100	U; A; R; S	Boulders; trees	No	No
H48	42.81060	-123.84525	16.1	--	--	40	40	20	75-100	U; A; R	Boulders; trees	Yes	No
H50	42.80730	-123.86075	13.9	30	--	40	40	20	75-100	U; A; R	Trees; nooks	No	Yes
Bear Creek													
H2	42.79747	-123.63786	17.3	73	36	20	25	25	50-75	R; S	Narrow points	Yes	Yes
H3	42.75647	-123.64692	15.0	76	36	15	50	25	75-100	A; R; S	Narrow points	No	Yes
H4 (Tributary)	42.78260	-123.64846	13.6	380	200	20	65	15	75-100	U; A; R; H; S	Log jams	No	Yes
H5	42.78065	-123.66327	12.6	305	245	27	55	18	75-100	R	Narrow points	Yes	Yes
H6	42.76720	-123.67440	12.7	335	125	50	20	30	75-100	U; A; R; S	Confined channel	No	No
Goat Trail Creek													
H8	42.80580	-123.66375	13.8	130	24	40	40	18	75-100	U; R; S	Narrow points	No	No
Slotted Pen Creek													
H9	42.82064	-123.65892	--	45	24	25	25	45	75-100	R; H; S	Narrow points	Yes	Yes
H10	42.83304	-123.65549	12.6	15	15	30	50	20	75-100	A; R; H; S	Narrow points	Yes	No
Hayes Creek													
H11	42.82361	-123.67673	13.2	300	130	20	72	5	75-100	U; A; R; S	Narrow points	No	No
Bobby Creek													
H15	42.82747	-123.71895	13.3	460	110	65	22	8	75-100	A; R; S	Narrow points	No	No
H16 (West Fork)	42.80407	-123.73416	12.4	250	120	55	20	23	75-100	U; A; R; H; S	Narrow points	No	No
H17 (East Fork)	42.80038	-123.72741	12.8	610	183	72	5	20	75-100	U; R; H; S	Narrow points	No	No

Stream, site	GPS Coordinates (UTM)		Temp. (°C)	Distance from Road (m)		Riparian Composition (%)			Shade (%)	Downed Wood ^a	Key-in points	Invasive Plants	Slumps
	North	East		Run	Rise	Con.	Decid.	Shrub					
Elk Valley Creek													
H18	42.83716	-123.72308	12.8	305	153	20	80	0	75-100	R; S	Falls; narrow points	No	No
H19	42.84466	-123.71437	13.8	67	49	10	90	0	75-100	R; S	Narrow points	No	No
H20 (East Fork)	42.86595	-123.68601	11.7	305	190	70	30	0	75-100	U; A; R	Logs, boulders, narrow points	No	Yes
H21	42.86236	-123.71174	15.6	107	46	10	75	5	50-75	R; S	Logs, falls	No	No
H22 (Steelhead Creek)	42.86722	-123.70821	14.4	24	6	50	50	0	75-100	R; S	None	No	Yes
H23	42.87908	-123.70951	13.3	55	6	50	25	25	75-100	A; R	Log jams	No	No
Panther Creek													
H25	42.85775	-123.75153	14.1	305	60	45	50	5	75-100	U; A; R; H; S	Narrow points	Yes	Yes
H26	42.86846	-123.74828	11.7	15	9	45	50	5	75-100	U; R; H; S	Narrow points	No	No
Gold Mountain Creek													
H28	42.86240	-123.78030	15.8	305	--	50	30	10	25-50	U; R; S	Bedrock	Yes	Yes
H29	42.86774	-123.77836	14.1	6	--	20	40	20	25-50	U; A; R; S	Boulders	Yes	Yes
H30 (Lipp)	42.88023	-123.78460	14.2	305	--	5	60	10	75-100	U; A; R; S	Boulders; roots	Yes	Yes
Walker/Wallace Creeks													
H32 (Walker)	42.82191	-123.76236	15.7	400	70	40	40	20	75-100	U; A; R	Boulders; wood	No	No
H33 (Wallace)	42.82802	-123.77383	11.8	--	--	40	40	20	75-100	U; A; R	Boulders; wood	Yes	No
Slide Creek													
H35	42.82947	-123.79440	15.5	800	--	5	80	15	75-100	U; A; R; S	None	No	Yes
Stanley Creek													
H38	42.85343	-123.81449	13.6	--	--	5	75	20	75-100	None	None	Yes	Yes
H39	42.86068	-123.81401	13.2	--	--	40	40	20	75-100	U; A; R	Trees	Yes	Yes
Black Creek													
H41	42.85510	-123.82706	11.8	30	--	10	60	20	50-75	A; S	Log jams	Yes	Yes
Grant Creek													
H42	42.84674	-123.82960	13.6	400	--	5	75	15	50-75	U; A; S	Boulders	Yes	No
Ashur Creek													
H44	42.84248	-123.83027	14.0	480	--	25	40	30	50-75	U; A; R; S	Boulders	Yes	Yes
Wilson Creek													
H47	42.81062	-123.84215	17.1	330	--	60	30	10	75-100	U; A; R	None	No	No
Bolivar Creek													
H49	42.80638	-123.84755	15.4	30	--	33	33	33	25-50	U; A; R	Narrow points	Yes	No

^a U = useable; A = attached; R = rotten; H = hardwood; S = small

Table 4-2. Stream habitat features at 50 sites in the West Fork Cow Creek watershed, summer 2016. ACW= active channel width; ACD = active channel depth.

Stream, site	ACW (m)	ACD (m)	Gradient	Primary Channel Form	Mesohabitat (%) ^a			Substrate (%) ^b				Wood ^c	
					R/F	Glide	Pool	B/B	C	G	F	LWD	Jams
West Fork Cow Creek													
H1	21.6	1.56	2.5%	Straight	10	90	--	30	30	25	15	0	0
H7	27.7	1.95	<1.0%	Straight	30	70	--	4	75	10	11	0	0
H12	17.7	1.41	2.0%	Straight	20	80	--	15	50	15	20	0	0
H13	17.0	1.23	3.0%	Straight	20	80	--	20	20	50	10	0	0
H14	23.8	1.49	3.0%	Straight	10	90	--	65	25	5	5	0	0
H24	27.9	1.59	2.5%	Sinuuous	60	30	10	25	40	20	15	0	3
H27	13.9	1.50	3.0%	Straight	5	95	--	30	15	50	5	0	0
H31	13.7	0.96	2.5%	Straight	25	75	--	25	50	20	5	4	0
H34	10.3	0.35	2.5%	Meandering	30	70	--	55	20	20	5	2	0
H36	8.3	0.28	1.0%	Meandering	15	30	50	30	40	15	15	1	0
H37	10.0	0.42	<1.0%	Straight	20	--	80	70	5	20	5	7	0
H40	10.0	0.30	<1.0%	Straight	10	80	10	10	40	40	10	2	0
H43	7.5	0.28	<1.0%	Straight	50	50	--	27	25	25	23	1	0
H45	8.2	0.48	1.5%	Straight	30	60	10	25	15	40	20	1	1
H46	7.0	0.27	1.2%	Meandering	65	35	--	65	10	20	5	4	0
H48	8.0	0.27	2.0%	Meandering	70	--	30	30	25	40	5	20	1
H50	1.5	0.15	1.2%	Meandering	47	8	45	15	5	65	15	72	6
Bear Creek													
H2	5.1	0.70	2.0%	Straight	30	50	20	50	35	15	--	0	1
H3	5.9	0.64	2.2%	Straight	50	45	5	30	60	10	--	2	1
H4 (Tributary)	5.6	0.85	1.5%	Straight	58	40	2	10	80	10	--	10	5
H5	6.4	0.51	3.0%	Straight	45	45	10	38	60	2	--	0	0
H6	5.3	0.55	2.0%	Straight	50	45	5	2	90	7	1	4	2
Goat Trail Creek													
H8	4.5	0.69	2.5%	Straight	65	35	--	30	60	10	--	2	2
Slotted Pen Creek													
H9	5.9	0.85	4.0%	Straight	65	20	15	53	35	10	2	2	1
H10	5.0	0.59	1.0%	Straight	48	50	2	10	75	15	--	1	1
Hayes Creek													
H11	5.4	0.82	9.0%	Meandering	40	60	<1	40	45	15	--	12	4
Bobby Creek													
H15	6.4	0.70	5.5%	Straight	55	40	5	70	20	10	--	4	1
H16 (West Fork)	6.8	0.53	5.0%	Meandering	80	20	--	25	55	15	5	17	8
H17 (East Fork)	5.6	0.92	5.5%	Meandering	30	60	10	35	45	20	--	2	3
Elk Valley Creek													
H18	7.4	0.53	4.0%	Meandering	21	79	--	25	65	10	<1	4	1
H19	9.7	0.59	4.5%	Straight	30	60	10	29	23	43	5	4	1
H20 (East Fork)	4.3	0.50	3.5%	Sinuuous	66	14	20	8	75	15	2	14	5
H21	7.2	0.77	1.0%	Straight	61	39	--	12	72	10	6	4	2

Stream, site	ACW (m)	ACD (m)	Gradient	Primary Channel Form	Mesohabitat (%) ^a			Substrate (%) ^b				Wood ^c	
					R/F	Glide	Pool	B/B	C	G	F	LWD	Jams
H22 (Steelhead Creek)	3.4	0.59	1.5%	Straight	40	60	--	60	20	20	--	1	0
H23	2.8	0.97	1.0%	Meandering	10	43	47	--	70	25	5	3	1
Panther Creek													
H25	7.0	1.10	7.0%	Straight	47	43	10	40	45	15	--	4	1
H26	6.0	0.70	5.5%	Straight	30	60	10	17	41	40	2	13	5
Gold Mountain Creek													
H28	8.2	0.27	2.0%	Straight	25	45	30	40	20	20	20	5	1
H29	8.1	0.05	5.5%	Straight	30	40	30	20	40	--	40	16	7
H30 (Lipp)	5.7	0.32	3.5%	Straight	40	--	60	20	20	20	40	27	7
Walker/Wallace Creeks													
H32 (Walker)	8.7	0.29	9.0%	Meandering	50	--	50	35	5	30	30	76	4
H33 (Wallace)	5.1	0.20	9.5%	Meandering	50	--	50	40	20	20	20	20	6
Slide Creek													
H35	5.6	0.20	3.0%	Straight	40	--	60	20	50	30	--	2	1
Stanley Creek													
H38	11.2	0.25	2.0%	Meandering	60	20	20	5	5	40	50	34	7
H39	6.3	0.22	1.5%	Meandering	25	60	15	5	10	40	45	30	7
Black Creek													
H41	5.6	0.17	1.0%	Straight	50	10	40	1	9	80	10	21	9
Grant Creek													
H42	3.2	0.15	2.0%	Straight	20	50	30	40	20	10	30	2	1
Ashur Creek													
H44	5.4	0.18	7.5%	Straight	30	50	20	45	30	10	15	19	5
Wilson Creek													
H47	7.7	0.60	1.5%	Straight	60	10	30	35	30	30	5	7	0
Bolivar Creek													
H49	3.7	0.33	5.5%	Meandering	75	5	20	20	35	40	5	41	5

^a R/F = riffles/falls

^b B/B = bedrock/boulders; C = cobble; G = gravel; F = fines (sand, silt, clay)

^c LWD = pieces of large wood; jams = number of log jams

4.1.2 Bear Creek

Bear Creek is the lowermost major tributary to West Fork Cow Creek; five sites were surveyed in this sub-watershed. Sites in the upper sub-watershed were far from the nearest road (Table 4-1) and extremely difficult to access. Water temperature was lower than that in West Fork Cow Creek, and generally decreased from downstream to upstream sites. Riparian composition varied among sites, but canopy cover was generally very high. Only two of the five sites had large useable wood in riparian areas. Invasive plant species were noted at two sites, but were generally isolated and not widespread. The exception was Himalayan blackberry, which was observed in various patches at the lowermost site (H2).

Active channel width was fairly consistent among sites, but active channel depth decreased at the two most upstream sites (Table 4-2). Stream gradient was low to moderate at all sites. Riffles and glides were the dominant habitat types, and substrate was primarily cobble or larger rock. The stream was confined by very steep valley walls on both banks throughout. A noticeable floodplain was present only at the upper portion of the uppermost site (H6). Large wood was present in moderate abundance. Presence of large wood in the stream coincided with presence of downed wood in the riparian area. Although the channel was predominately straight, some meandering and braiding were noted. Refugia were present in the form of side channels, log jams, and boulders. No signs of beaver activity were observed.

4.1.3 Goat Trail Creek

Only one site was surveyed on Goat Trail Creek. The site was of moderate distance from the nearest road (Table 4-1) and ease of access was also moderate. Water temperature was similar to the upper sites of Bear Creek. Canopy cover was high, and useable wood was observed in the riparian area.

The active channel was a little smaller than that of Bear Creek, but with a similarly low to moderate gradient (Table 4-2). Habitat types and substrate are also similar to Bear Creek, with substrate being cobble or larger rock. Large wood and log jams are present in the stream.

4.1.4 Slotted Pen Creek

Two sites were surveyed on Slotted Pen Creek. One was below a waterfall considered not to be a fish barrier; the other was above the falls. The lower site was devoid of water. Sites were relatively close to the nearest road (Table 4-1) and relatively easy to access. Water temperature at the upper site was among the lowest in the entire West Fork Cow Creek watershed. Riparian composition varied between sites, but canopy cover was generally very high. Neither of the sites had large useable wood in riparian areas. Invasive plant species were noted at both sites, predominately along roadsides. Old bridge abutments and a concrete culvert were observed at the lower site.

Channel size was similar to that of the other tributaries to West Fork Cow Creek in the area, although gradient at the lower site was slightly steeper (Table 4-2). Substrate was primarily cobble or larger rock, although gravel was present. Although the channel was predominately

straight, some meandering and braiding were noted. Wood was abundant at both sites, although few pieces met the criteria of being functional. The channel is confined by a road and by steep banks. Refugia were present in the form of small side channels and pools, with one root wad observed. No signs of beaver activity were noted.

4.1.5 Hayes Creek

Only one site was surveyed on Hayes Creek. The site was relatively far from the nearest road (Table 4-1) and access was difficult. Water temperature was relatively cool. Riparian trees were primarily deciduous, canopy cover was high, and useable wood was observed in the riparian area.

The active channel was similar in size to other tributaries in the general area, but with a much steeper gradient (Table 4-2). Unlike most other sites surveyed at tributaries further downstream, the stream channel was predominately meandering. Substrate was mostly cobble or larger rock and wood is abundant in the stream.

4.1.6 Bobby Creek

Three sites were surveyed in the Bobby Creek sub-watershed. All three sites were far from the nearest road (Table 4-1) and difficult to access. Water temperatures at all three sites were among the lowest in the entire West Fork Cow Creek watershed. Riparian areas were dominated by conifers, and canopy cover was high at all three sites. Two of the three sites had large useable wood in riparian areas. No invasive plant species were observed.

The active channel was similar in size to most other tributaries (Table 4-2). Gradient at all sites was moderately steep, but the channel was predominately meandering. As with most streams, riffles and glides were the dominant habitat types. Substrate was mostly cobble and larger rock, but gravel was present. Refugia were abundant in the form of log jams, alcoves, pools, and undercut boulders and banks. Multiple log jams were present with very large pieces of functional wood. No signs of beaver activity were observed.

4.1.7 Elk Valley Creek

Elk Valley is a relatively large and complex sub-watershed relative to most others; therefore six sites were surveyed. Two sites in the lower sub-watershed were far from the nearest road (Table 4-1) and difficult to access, whereas sites in the upper sub-watershed were easier to access. Water temperatures varied among sites, ranging from the lowest measured at any site in the West Fork Cow Creek watershed in the East Fork Elk Valley Creek to among the highest measured in any tributary in the mainstem Elk Valley Creek. Riparian composition varied among sites, but canopy cover was generally very high. Only one of the six sites had large useable wood in riparian areas. No invasive plant species were observed.

The active channel in the mainstem was wider than that in most other tributaries (Table 4-2). Gradient was moderately steep in the lower watershed but less steep at upstream sites. Multiple channel forms were observed including meandering, sinuous, and straight. In some areas, braided channels would be flooded during high water. Although habitat type was predominantly riffle or glide at most sites, pools were relatively common. Refugia were abundant in the form of

boulders, undercut banks, pools, LWD, and overhanging vegetation. Beaver activity was apparent at the uppermost site.

Substrate was highly varied, but included abundant gravel and cobble. Wood was relatively abundant, with log jams observed at most sites. Severe bank erosion was noted at one site. The streams are confined by bedrock at some sites.

4.1.8 Panther Creek

Two sites were surveyed in Panther Creek. The lower site was far from the road (Table 4-1) and difficult to access. The upper site was easier to access. Water temperature differed substantially between sites, with temperature at the upper site the lowest measured at any site in the West Fork Cow Creek watershed. Riparian composition varied, but canopy cover was high at both sites. Both sites had large useable wood in riparian areas. Invasive plant species including Himalayan blackberry and Canada thistle were observed at the lower site. A culvert was also present at the lower site.

Panther Creek has a relatively large flow capacity as demonstrated by a relatively wide and deep active channel (Table 4-2). Relatively high flow capacity is also inferred by the difference in the size of the active channel of the West Fork of Cow Creek above and below the confluence. Channel and habitat types at the two sites surveyed were similar to those at most other sites, although some pools were observed at both sites. Gravel and cobble substrates were also found at both sites. Refugia were abundant in the form of undercut banks, exposed root wads, log jams, and overhanging vegetation. No sign of beaver activity was observed. Wood was abundant and log jams were observed at both sites.

4.1.9 Gold Mountain Creek

Three sites were surveyed in the Gold Mountain Creek sub-watershed. Two sites were far from the nearest road (Table 4-1) but were not difficult to access. Water temperatures at all three sites were relatively high compared to other tributaries. Riparian composition varied, and canopy cover at two sites was relatively low. However, all three sites had large useable wood in riparian areas. Himalayan blackberry was observed at all three sites. A culvert was observed at the upper site on Gold Mountain Creek (H29).

The active channel was relatively wide but shallow, and gradient was moderate (Table 4-2). The channel was predominately straight at each site, but areas with meandering, sinuous, and braided channels were also observed. Pools were common, and unlike most other sites, silt and clay composed a relatively large portion of the substrate. Refugia were formed mostly by large wood and log jams, which were abundant. No signs of beaver activity were observed.

4.1.10 Walker and Wallace Creeks

One site each was surveyed on Walker and Wallace creeks. The site on Walker Creek was far from the nearest road (Table 4-1) and access was relatively difficult. Water temperature at the Walker Creek site was relatively high, whereas temperature in Wallace Creek was among the lowest observed in the West Fork Cow Creek watershed. Riparian composition was equally deciduous and conifers, and canopy cover was high. Large useable wood was observed in the

riparian areas of both sites. Himalayan blackberry was observed at the site on Wallace Creek. A culvert is also present on Wallace Creek that may hinder fish migration.

Gradient in both streams was steep, but pools were numerous (Table 4-2). Stream channels meandered through a relatively straight valley. Gravel substrate was found in both streams. Large wood and log jams were abundant. No beaver activity was observed, but large wood and pools provided many refugia. Wood and log jams were very abundant.

4.1.11 Slide Creek

One site was surveyed on Slide Creek. The site was far from the nearest road (Table 4-1) but access was not difficult. Water temperature was high relative to most tributaries. The riparian area was predominately deciduous, and canopy cover was high. Large useable wood was observed in the riparian area. No invasive plant species were observed.

Channel size and gradient were moderate (Table 4-2). The channel was predominately straight, with some meandering. The site was dominated by a series of step-pools, and substrate was mostly cobble and gravel. Gravel floodplains were also observed. Refugia were formed by undercut banks, root wads, boulders, and overhanging vegetation. Some large wood and one log jam were observed. No signs of beaver activity were noted.

4.1.12 Stanley Creek

Two sites were surveyed in Stanley Creek. Both sites were near roads (Table 4-1) and easy to access. Water temperature was relatively low at both sites. Riparian composition varied, but canopy cover was high at both sites. The upper site had large useable wood in the riparian area. Invasive plant species including Himalayan blackberry and Scotch broom were observed at both sites.

The active channel is relatively wide but shallow at both sites (Table 4-2). Channel gradient is relatively low. The channel meanders through broad valley, with some braiding through gravel, sand, and fines. Gravel and finer material comprise most of the substrate, although some cobble is present. Glides and riffles dominant the habitat, with some pools present near large wood. Refugia are formed by large wood and scour pools. Large wood and log jams are plentiful, and provide stability. No beaver activity was observed.

4.1.13 Black Creek

One site was surveyed on Black Creek that was near a road (Table 4-1) and easy to access. Water temperature was among the lowest observed in the West Fork Cow Creek watershed. The riparian area was predominately deciduous, and canopy cover was moderate. No large useable wood was observed in the riparian area. Himalayan blackberry was observed.

The site had a relatively shallow active channel and a low gradient (Table 4-2). The channel was mostly straight with riffles and pools. Gravel dominated the substrate, but sand and cobble were present. Refugia were formed by large wood, which was abundant and included numerous log jams. No sign of beaver activity was observed.

4.1.14 Grant Creek

One site was surveyed on Grant Creek that was relatively far from a road (Table 4-1) but to which access was not difficult. Water temperature was similar to that of most tributaries. The riparian area was predominately deciduous, and canopy cover was moderate. Large useable wood was observed in the riparian area. Himalayan blackberry was also observed.

The site had a narrow and shallow active channel and relatively low gradient (Table 4-2). The channel was mostly straight with a few meanders, and included mostly glides and pools, although riffles were also present. Sand was the dominant substrate in pools, with cobble and larger rock present in other areas. Banks were disturbed from previous logging. Refugia were formed by undercut banks and over hanging vegetation. Some wood and a log jam were present. No signs of beaver activity were observed.

4.1.15 Ashur Creek

One site was surveyed on Ashur Creek that was relatively far from a road (Table 4-1) but to which access was not difficult. Water temperature was similar to that of most tributaries. The riparian composition was mixed, and canopy cover was moderate. Large useable wood was observed in the riparian area. A small amount of Himalayan blackberry was also observed. An old road bed and bridge were observed just downstream of the site.

The site had a shallow active channel with a relatively steep gradient (Table 4-2). The channel was mostly straight with a few meanders, and included mostly glides and riffles, although pools were also present. Substrate was primarily cobble and larger rock, but gravel and fines were also present. The channel was confined in part by an old road. Refugia were formed by large wood and over hanging vegetation. Large wood and log jams were abundant. No signs of beaver activity were observed; however, signs of beaver activity were prevalent at the snorkeling site in Ashur Creek (SN6).

4.1.16 Wilson Creek

One site was surveyed on Wilson Creek that was relatively far from a road (Table 4-1) but to which access was not difficult. Water temperature was among the highest observed in any tributary. The riparian area was predominately conifers, and canopy cover was high. Large useable wood was observed in the riparian area. No invasive plant species were observed.

The site had a wider and deeper active channel than other nearby tributaries (Table 4-2). Gradient was relatively low. The channel was straight and included mostly riffles and pools. Gravel, cobble, and bedrock substrates were evenly dispersed, and the channel was confined primarily by bedrock. Refugia were primarily pools about 1 m in depth. Large wood was present but no log jams were observed. No signs of beaver activity were observed.

4.1.17 Bolivar Creek

One site was surveyed on Bolivar Creek that was close to a road (Table 4-1) and easily accessed. Water temperature was moderately high. The riparian area was evenly mixed and canopy cover was low. Large useable wood was observed in the riparian area. Himalayan blackberry was also observed.

The site had a relatively narrow active channel with a moderately steep gradient (Table 4-2). The channel meandered through a fairly straight, narrow valley, and was dominated by riffles. Substrate was primarily gravel and cobble. The channel was confined in part by an old road. Some refugia are available from large wood and adjacent scour pools. Large wood and log jams were abundant. No signs of beaver activity were observed.

4.2 Fish

4.2.1 Electrofishing and Snorkeling

Juvenile salmonids dominated the fish catch during electrofishing and snorkeling. Unidentified sculpins were the only other fish species observed. collected or observed at 12 of 16 sites (

Table 4-3). Fish less than 2 inches in length were often difficult to identify to species. The majority of fish identified were cutthroat trout, but steelhead dominated observations in West Fork Cow Creek. Steelhead were positively identified in only one stream other than West Fork Cow Creek. Coho salmon were observed in a number of streams throughout the watershed, including all snorkeling sites in West Fork Cow Creek. No individuals were confirmed to be Chinook salmon. Only 7 of 281 salmonids were longer than 6 inches.

Table 4-3. Fish observed during electroshocking and snorkeling surveys at 16 sites in the West Fork Cow Creek watershed, summer 2016.

Site	Stream	GPS Coordinates (UTM)		Coho			Steelhead			Cutthroat			Unidentified Salmonids		
		North	East	<2"	2-6"	>6"	<2"	2-6"	>6"	<2"	2-6"	>6"	<2"	2-6"	>6"
Electroshocking															
SH1	Bear Creek									4	4				
SH2	Slotted Pen Creek	42.82771	-123.65498												
SH3	EF Elk Valley Creek	42.86942	-123.68281							13	12	2	4		
SN3	Wallace Creek ^a	42.82082	-123.77383	2						3	17		1		
SH4	Walker Creek	42.82191	-123.76236	2				8			2		16		
SH5	Slide Creek	42.81456	-123.79886												
SH6	Black Creek	42.85885	-123.83082							2	1	1	1		
SN6	Ashur Creek ^a	42.84123	-123.84879												
SH7	Grant Creek	42.85256	-123.84204												
Snorkeling															
SN1	WF Bear Creek	42.78513	-123.64910	4	2					19	5		21	1	0
SN2	Steelhead Creek	42.87103	-123.70712										6	3	1
SN4	Stanley Creek	42.86068	-123.81401		2								6	2	0
SN5	WF Cow Creek	42.84552	-123.82522	4			7	29	2				11		
SN7	WF Cow Creek	42.81598	-123.84387	9	1			1			4		15	1	
SN8	WF Cow Creek	42.80902	-123.84867	1			1	2			2	1	15		
SH8	Fuller Creek ^b	42.80926	-123.85876										6	2	

^a Originally designated as snorkeling sites

^b Originally designated as electroshocking site

4.2.2 Environmental DNA

Placeholder for text about eDNA results.

Table 4-4. Presence or absence of DNA from Coho Salmon, Chinook Salmon, Steelhead, and Pacific Lamprey at 18 sites in the West Fork Cow Creek watershed, summer 2016.

Site	Stream	GPS Coordinates (UTM)		Coho Salmon	Chinook Salmon	Steelhead	Pacific Lamprey
		North	East				
E1	Bear Creek	42.80199	-123.63727				
E2	Goat Trail Creek	42.80371	-123.66579				
E3	Sweat Creek	42.82151	-123.69715				
E4	No Sweat Creek	42.82581	-123.71201				
E5	Bobby Creek	42.80589	-123.73075				
E6	West Fork Elk Valley Creek	42.87408	-123.71132				
E7	Gold Mountain Creek	42.86751	-123.77836				
E8	Slide Creek	42.82883	-123.79474				
E9	Black Creek	42.85510	-123.82706				
E10	Grant Creek	42.84621	-123.82962				
E11	Ashur Creek	42.84271	-123.83092				
E12	Wilson Creek	42.80849	-123.83627				
E13	Bolivar Creek	42.80491	-123.84664				
E14	West Fork Cow Creek	42.80442	-123.86824				
E15	Hayes Creek	42.49263	-123.40405				
E16	Steelhead Creek	42.52403	-123.42157				
E17	East Fork Panther Creek	42.52150	-123.44568				
E18	West Fork Panther Creek	42.52257	-123.44807				

5 Discussion

In addition to helping inform the ranking of potential restoration actions, data collected as part of this effort adds to the existing database of information for the West Fork Cow Creek watershed. Information on habitat conditions in many streams was especially lacking. Information on fish distribution often differed among sources. Supplementing electrofishing and snorkeling survey information with eDNA results will add valuable information.

The objective of this report is to summarize conditions observed during surveys, not to begin the process of prioritizing potential restoration projects. However, a few overarching habitat conditions as they relate to native fish species are apparent:

- Summer water temperatures at most sites in the lower reaches of West Fork Cow Creek are higher than optimal for native fish species; downed wood is also lacking at most sites.
- Cobble and gravel are available throughout the West Fork of Cow Creek; therefore, actions to decrease temperature and increase wood may benefit various life stages of salmonids.
- Many tributaries consist mostly of glides and riffles; increases in pool habitat could improve rearing conditions for juvenile fish.
- Most streams have “key-in points” that could be used to facilitate placement of in-stream habitat restoration structures.
- Summer temperatures in a small number of tributaries are higher than optimal; causes should be investigated and ameliorated if possible.
- Presence of invasive plants is somewhat limited and could possibly be eliminated at some sites.
- Few sites had substantial substrate consisting of silt, clay, or organic material; therefore, abundance of Pacific Lamprey (or other lamprey species) ammocoetes would be expected to be low.

Paragraph about eDNA results compared to physical surveys and previously documented distribution.

Relative abundance and diversity of fish species was low, being limiting primarily to Coho Salmon, steelhead, and cutthroat trout. This is due in part to fish surveys focusing on areas approaching the upstream limits of distribution of Chinook Salmon and other species. It is also likely that juvenile Chinook Salmon may have emigrated from the areas surveyed prior to the start of surveys. No sites were surveyed in downstream areas of the West Fork of Cow Creek where species diversity may be higher.

6 References

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