Attachment 14

DRIFT CREEK HABITAT SURVEYS
2009 AND 2010

DRIFT CREEK DAM PROJECT,
MARION COUNTY, OREGON

ASSESSING FISH HABITAT IN DRIFT CREEK AND ITS TRIBUTARIES

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1.0 INTRODUCTION

This report describes physical habitat conditions in mainstem Drift Creek and those sections of its tributaries that are potentially accessible to native migratory fishes. The purpose of the habitat survey was to provide a description of existing habitat conditions prior to development of the proposed Drift Creek Dam at River Mile (RM) 6.5 on Drift Creek. The information will be used to evaluate the effects of the proposed dam on fish habitat and to provide required input for an Oregon Department of Fish and Wildlife (ODFW) "fish passage waiver" if it is found that providing fish passage at the dam is not feasible. Habitat surveys of the lower 6.5 miles of Drift Creek, between the dam site and the confluence of Drift Creek with the Pudding River, were completed in 2009. Surveys within the 2.3-mile footprint of the proposed reservoir were completed in conjunction with fish surveys in 2006. The East Fork of Drift Creek upstream to an impassible falls at RM 1.5 and the West Fork of Drift Creek upstream to the upper limit of potential fish migration at RM 4.5 were surveyed in 2010. As is described in detail below, the surveys included both detailed data collection at selected representative reaches and general observations of substrate, riparian zones, stream morphology, and large woody debris (LWD) throughout all remaining sections of the streams.

2.0 GENERAL DESCRIPTION OF THE STUDY AREA AND FISH USE

At its confluence with the Pudding River, Drift Creek is a fourth order stream. It drains a watershed of approximately 24.8 square miles on the west slope of the Cascade Mountain Range.

Drift Creek and its tributaries are known to provide spawning, holding, and rearing habitats for resident and possibly migratory cutthroat trout (*Oncorhynchus clarki*), non-native coho salmon (*Oncorhynchus kisutch*), Pacific lamprey (*Lampetra tridentata*), largescale sucker (*Catastomus macrochilus*), redside shiner (*Richardsonius balteatus*), northern pikeminnow (*Ptychocheilus oregonensis*), speckled dace (*Rhinichthys osculus*) and sculpins (Cottus spp). Upper Willamette River Chinook salmon (*Oncorhynchus tshawytscha*), and upper Willamette River steelhead (*Oncorhynchus mykiss)* occur in the greater Pudding River basin, but have not been reported in Drift Creek. Steelhead trout may have historically been present in Drift Creek and could potentially still utilize Drift Creek, since coho salmon (which have similar habitat requirements) do occur upstream of the dam site, at least during some years. However, Drift Creek is not listed as a steelhead-bearing stream by Streamnet, and extensive sampling by Ellis Ecological Services, Inc. in 2005, 2006 and 2009 did not identify any steelhead or rainbow trout. Habitat conditions for spring chinook salmon (i.e. deep, cool pools for summer holding) are lacking in Drift Creek and the Pudding River and therefore, it is doubtful that chinook salmon were ever present in the Drift Creek drainage.

Steelhead require cold water, with deep pools for juvenile rearing, and access to tributaries for high-flow refugia in winter or cold water refugia in summer. Steelhead spawning habitat tends to have gradients from 1% to 5%, in unconstrained channels with alluvial deposits and cobble substrates (Steel et al., 2004). Biological requirements for upstream adult salmonid migration include clean, cool, oxygenated water, low turbidity, sufficient pool habitat and sufficient flows to allow passage to spawning sites. Spawning areas are selected based on

species-specific substrate size, flow and temperature requirements. Substrate conditions such as porosity, sediment size, and permeability are critical to embryo survival and fry emergence, and water temperature (of 13°C or less for most species) is also of primary importance. Based on State of Washington guidance documents, optimal substrate size for salmon and steelhead spawning is between 0.5 inches and six inches in diameter although they may use substrate as small as 0.1inch and as large as 12 inches (WDFW and WDE, 2008).

Coho salmon were not present in the basin prior to the laddering of Willamette Falls, and their stocking into Butte, Abiqua and Silver Creeks beginning in 1958 (Runyon et al., 2006). Coho salmon stocking ended in 1998, but coho continue to return and spawn in Pudding River tributaries (Wevers et al., 1992). Coho salmon have been observed in Drift Creek during the last several years (Wayne Hunt, ODFW, personal communication, Salem, 2005, cited in Runyon et al., 2006), and three juvenile coho were collected in Fox Creek by EES in June 2006. Fox Creek is a small tributary of Drift Creek within the proposed reservoir footprint. Coho spawning was also observed in Fox Creek by landowners in November 2009. Optimum rearing habitat for coho consists of a mix of deep pools (40-60% of stream) and riffles, cover, water averaging between 10 and 15 °C in the summer, high oxygen concentrations and little fine sediment.

Pacific lamprey also occur in the Pudding River basin. The majority of fine sediments required for ammocoete development present within the system are located within the low gradient footprint of the proposed reservoir.

3.0 METHODS

The creek beds were walked during summer low flows in 2009 (September 16-18) and 2010 (October 6-8) by Ellis Ecological Services (EES) personnel wherever access was granted by landowners. This included all but approximately 450 feet of creek upstream from Drift Creek RM 1.14 in an agricultural area, and a 2,000 foot segment upstream of West Fork RM 1.9. Because of a lack of initial landowner access, a portion of the steep canyon section of mainstem Drift Creek was not walked until later in the year (October 28, 2009), after fall rains had begun. Figures 1 and 2 illustrate the areas that were walked, and the reaches where detailed habitat observations were made (described below).

Two survey methods were utilized: detailed reach surveys and general observation of habitat conditions while walking the creek bed. Each method is described below.

3.1 DETAILED REACH SURVEYS

Reach survey methods were based on Oregon Department of Fish and Wildlife (ODFW) habitat survey methods for the aquatic inventory project (ODFW, 2008). The ODFW methods collect data on habitat segments termed “reaches.” A reach is a length of stream defined by its functional characteristic. Typically, reaches are delineated by named tributaries, changes in valley and channel form, major changes in vegetation type, or changes in land use or ownership. However, reaches can also be defined simply as the distance surveyed.

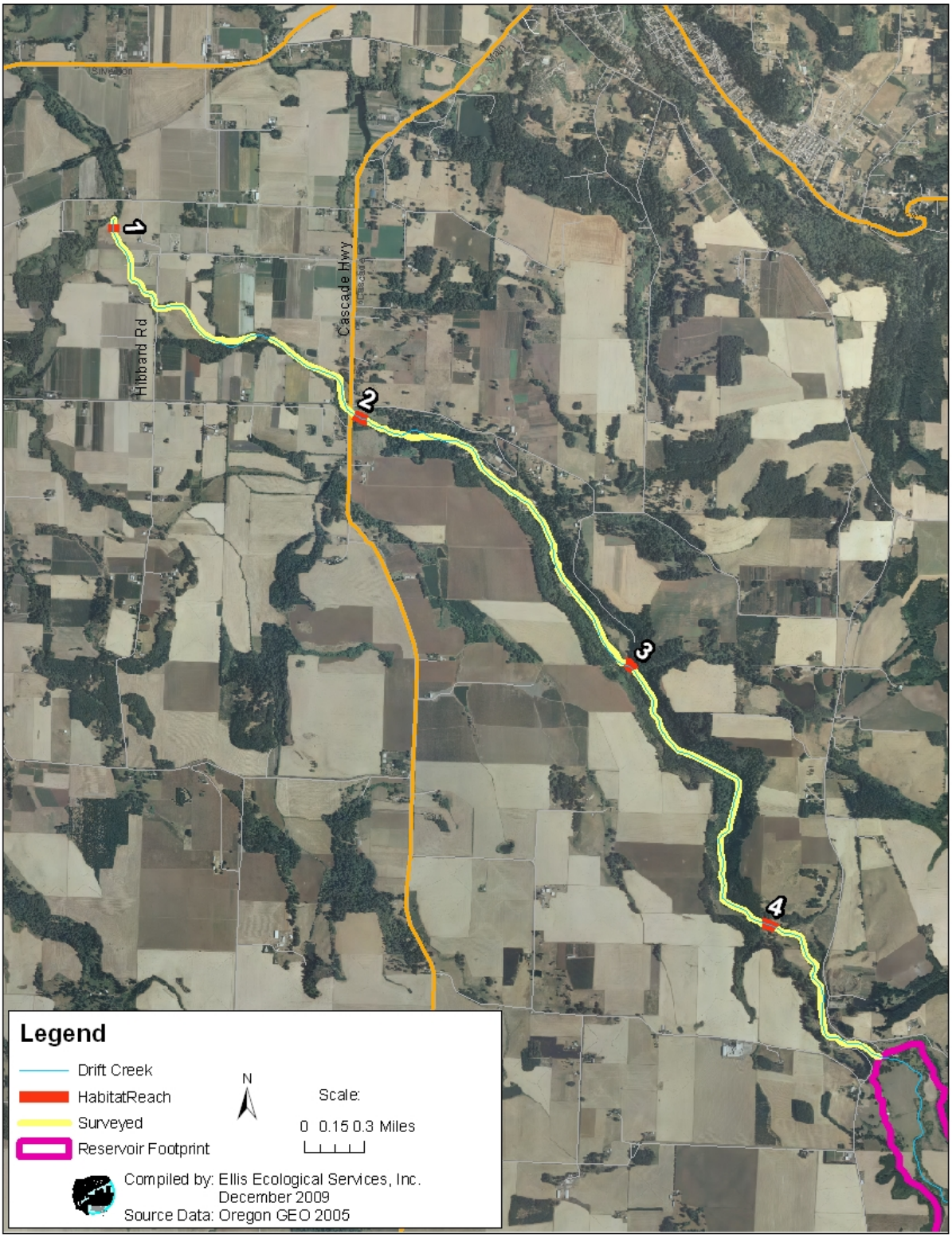

Figure 1. Habitat survey and detailed study reach locations in the Drift Creek mainstem

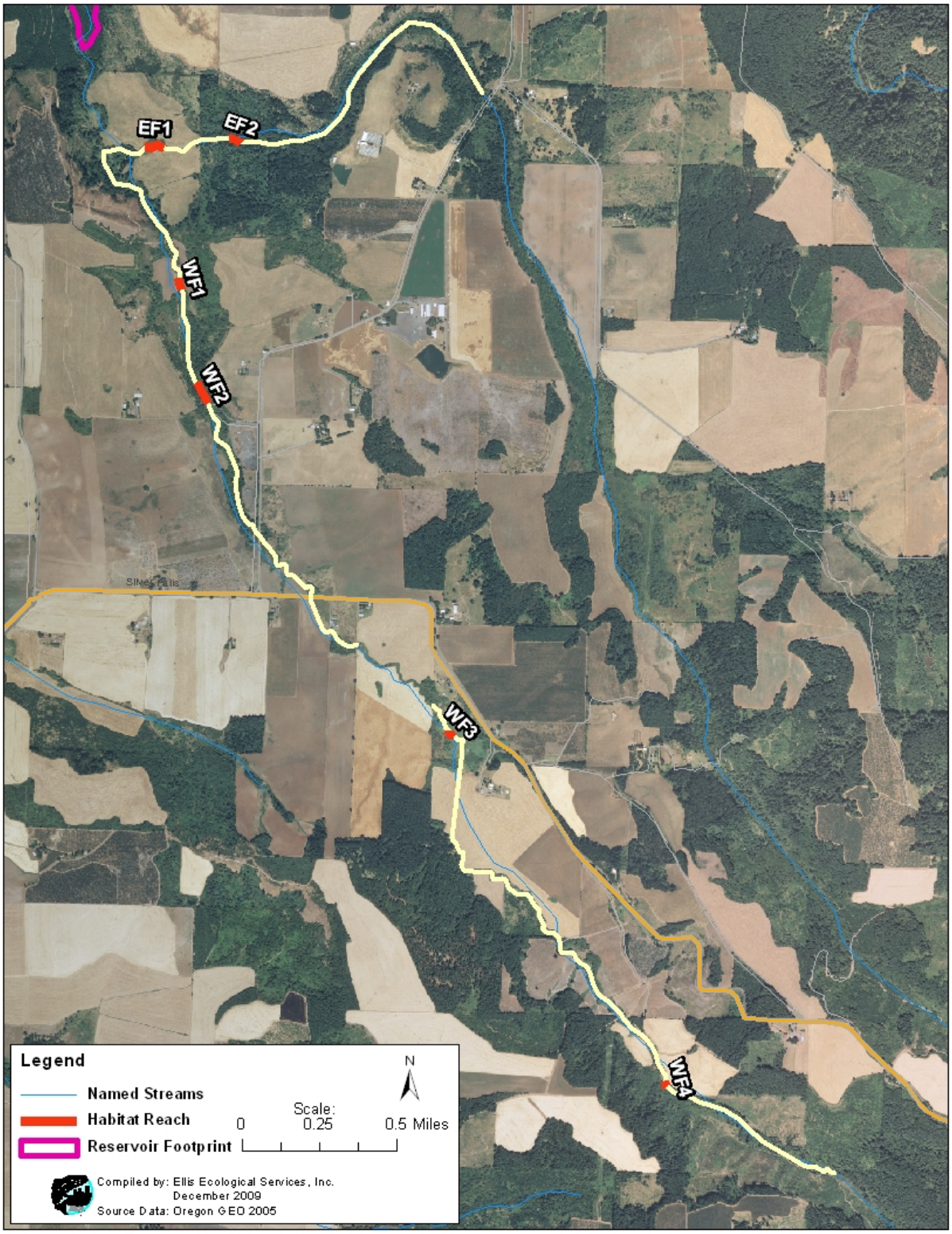

Figure 2. Habitat survey and detailed study reach locations in the East and West Forks.

Within the reaches are individual habitat units. Units are relatively homogeneous lengths of stream that are classified by channel bed form, flow characteristics, and water surface slope. Individual units are formed by the interaction of discharge and sediment load with the channel resistance (roughness characteristics such as bedrock, boulders, and large woody debris). Channel units are defined (in priority order) based on characteristics of (1) bedform, (2) gradient, and (3) substrate. The typical channel morphologies used to describe habitat are riffles, runs (or glides) and pools. However, the ODFW methodology also includes cascades, steps and rapids, and further sub-categorizes each of these morphologies. For instance, within the larger "pool" unit class are: plunge pools, straight scour pools, lateral scour pools, trenched pools, dammed pools and beaver dam pools. In addition to data on stream morphology, information is collected on valley form, channel shade, substrate makeup, large woody debris (LWD), and riparian conditions. A detailed description of the ODFW methodology can be obtained from:
http://www.science.oregonstate.edu/~madsenl/TIESNA2009/Habitat_protocol.pdf.

The ODFW methods were designed to survey an entire stream, from mouth to headwaters. Because collecting data on all units over the entire length of each creek was beyond the scope of this survey, reaches were defined a priori as segments of stream equal in length to 20 stream widths. The locations of the reaches were selected to be representative of different habitats present within the study area as follows.

Mainstem Drift Creek: Reach 1 was located in the lower agricultural region, approximately 25 feet upstream of the confluence with the Pudding River and continuing upstream for 390 feet; Reach 2 (650 feet in length) was located at approximately RM 1.8, outside the flood plain and silt/clay deposits of the Pudding River, where relief in the Drift Creek valley is slightly higher, but land use is still agricultural; Reach 3 was located in a steep wooded valley at approximately RM 3.7, continuing upstream for 440 feet; and reach 4 was located in flatter topography above the steep valley at approximately RM 5.6, continued upstream for 300 feet. The reaches were 1.8 to 1.9 miles apart.

West Fork Drift Creek: Reach 1 was located in a low gradient agricultural area approximately 0.5 miles upstream of the confluence with East Fork Drift Creek; Reach 2 was located in a steep boulder/bedrock area at RM 0.9; Reach 3 was located in a flat wetland area upstream of Silver Falls Highway at RM 2.5; and Reach 4 was located in a forested canyon at the upper end of West Fork Drift Crek at RM 4.0.

East Fork Drift Creek: Reach 1 was located in a flat grass seed field approximately 750 feet upstream from the confluence with the West Fork; and Reach 2 was located in a steeper, forested area at RM 0.5.

Pebble counts were also conducted at each reach using the methodology described in Bauer and Burton (1993). The pebble count data were compiled and a cumulative frequency graph was constructed for each creek (also using the methods described in Bauer and Burton, 1993) to calculate the median particle size (D50).

Following fieldwork, the data were entered into ODFW excel and access programs, which were used to create reach and unit summaries. Summary data for each stream were compared to "reference values" established for streams in the North Cascades (Kavanaugh et al., 2006). These reference values are derived from streams in areas with low impact from human activities (e.g. wilderness or roadless area, late successional forest or mature forest). A total of 68 reference sites were surveyed and the results of these surveys were used to establish benchmarks for the habitat variables of interest. The North Cascades study region included tributaries to the North Santiam and Pudding Rivers west of the Cascade Mountains in Oregon. Some of these streams (including Silver and Abiqua Creeks) are very near the study area and should therefore provide applicable reference values. Table 1 illustrates the West Cascades reference values from Kavanaugh et al (2006).

Table 1. Reference values for the West Cascades.

Parameter	Definition	Low Value	High Value
% pools	Percent primary channel area represented by pool habitat	<7%	>24%
Deep pools/km	Pools > 1 m deep per kilometer of primary channel	0	>4
% slackwater pools	Percent primary channel area in slackwater pool habitat	0%	>0.5%
% secondary channels	Percent total channel area represented by secondary channels	0%	>4%
% fines in riffles	Visual estimate of substrate composed of <2 mm diameter particles	>19%	0%
% gravel in riffles	Visual estimate of substrate composed of 2-64 mm diameter particles	<25%	>49%
% bedrock in streams	Visual estimate of substrate composed of bedrock	>35%	<13%
Pieces lwd/100 m	# of pieces of wood >0.15m diameter and >3m length per 100 meters of primary stream channel	<7	>21
Volume lwd/100 m	Volume (m^3) of wood >0.15m diameter and >3m length per 100 meters of primary stream channel	<23	>68
Key pieces of lwd/100 m	# of pieces of wood > 60 cm diameter and >12 m long per 100 meters of primary stream channel	<1	>4
# conifers >50 cm dbh	Number of conifer trees larger than 50 cm dbh within 30m on both sides of stream per 305 m of primary channel	0	>284
# conifers > 90cm dbh	Number of conifer trees larger than 90 cm dbh within 30m on both sides of stream per 305 m of primary channel	0	>151
% shade	Percent of 180 degree sky that is shaded. Includes topographic and tree shade.	<80%	>92%

3.2 General observations

Outside of the detailed reach locations, the creek beds were walked, and notes were taken on the general habitat conditions, including bank erosion, substrate type, condition of the riparian zone, locations of significant LWD, beaver dams, obstructions and other features likely to influence the suitability of Drift Creek and its tributaries as fish habitat. Photographs were taken both within the detailed reaches and throughout the surveyed areas.

4.0 RESULTS

4.1 MAINSTEM DRIFT CREEK

4.1.1 General habitat description

In general, Drift Creek offers some salmonid habitat, based on the documented presence of cutthroat trout and coho salmon. Water temperature during the summer has been identified as a problem (see the accompanying fish survey report) and based on visual observation the creek appears to be lacking in abundant spawning substrate, pool habitat, and LWD. Furthermore, numerous partial man-made and natural barriers exist.

Only one tributary capable of supporting anadromous fish was observed during field surveys. Fox Creek originates at a dammed pool above the reservoir footprint and enters Drift Creek (RM 8.1) from the northeast at the approximate midpoint of the reservoir footprint. It provides nearly 1,400 ft of accessible salmonid habitat before gradient becomes a barrier to fish access. The majority (742 ft) of this consists of slow moving shallow water with silt bottom and undercut banks; however the last 233 ft of accessible habitat is well shaded, with clean gravel to cobble substrate.

Morphology

Drift Creek, below the proposed reservoir, can be morphologically divided into two distinct zones (with differing gradient and land use), with a short transition zone between the two. The low-gradient and transition zones occupy the lower approximately 0.7 miles of the river. This area is topographically flat and in agricultural production (nursery crops, Christmas trees, and small grains). For the first approximately 2,300 feet of Drift Creek (upstream from the mouth), the stream is morphologically uniform, with straight incised banks and a flat bottom. For the entirety of this segment, Drift Creek is one long glide, bisected approximately 1,225 feet upstream from the mouth by an irrigation dam (discussed below). The dam impounds water such that downstream of the dam, water depth is from 2.5 to 3 feet during summer low flows, while upstream of the dam, water depth is 3 to 4 feet.

Just downstream of the Hibbard Road bridge, the effects of the dam are no longer apparent, and the stream transitions from a uniform clay hardpan bottom to a riffle/glide dominated stream with cobble, gravel and bedrock substrate. From approximately RM 0.7 to the proposed dam site, the gradient of Drift Creek is remarkably consistent, rising 450 feet over 5.6 miles, or 80 feet per mile (a 1.5% slope). Figure 3 illustrates the gradient of Drift Creek from its mouth to the proposed dam site. In this higher gradient reach, the stream is dominated by riffles, glides and steps over bedrock. Pools are very limited, and in fact the only section where significant pool habitat was noted was in a steep-sided canyon from approximately RM 3.4 to RM 3.8. Several “push-up” dams (described below), also create small pools, as does a beaver dam just upstream of the Hibbard Road bridge at RM 0.62.

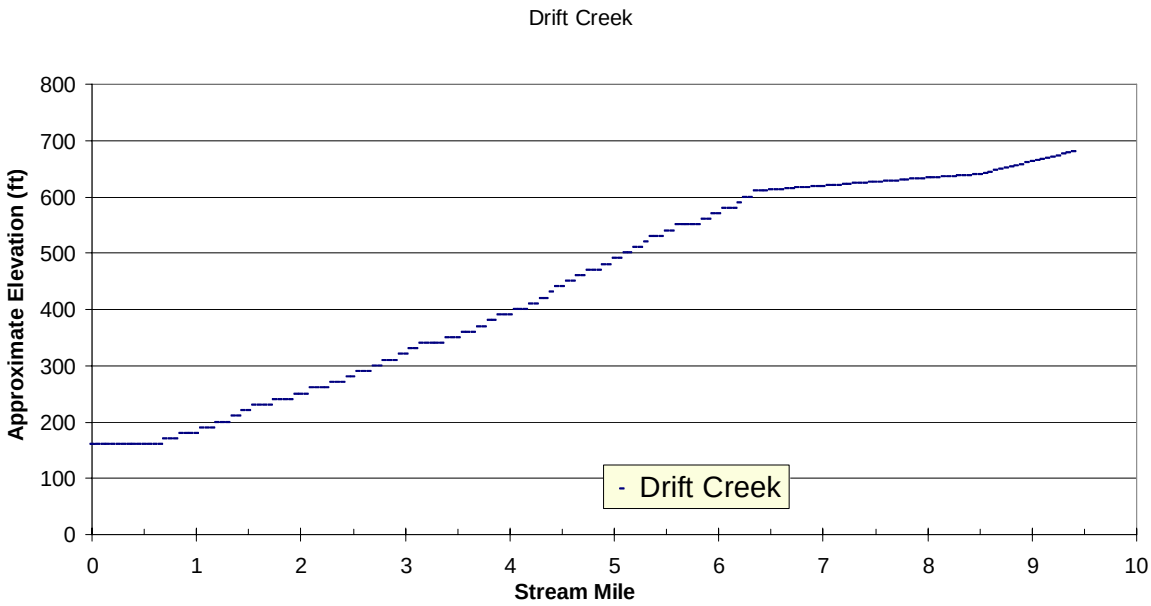

Figure 3. Drift Creek Gradient

Within the footprint of the proposed reservoir (approximately RM 6.5 to 9.0) Drift Creek occupies a flat area (less that 0.4% slope) used for grass seed farming, cow pastures and managed timber. The creek banks are nearly vertical and actively eroding throughout the proposed reservoir. Summer low-flow depths are variable, ranging from less than a foot deep in some places to extensive areas where depth exceeds four feet. Run/glide habitat dominates with ample lateral scour pools present. Numerous small drainages exist throughout the proposed footprint, however most connect to Drift Creek via small wetland areas or seeps that do not allow for fish access.

Fox Creek, within the reservoir footprint is divided by a low water crossing approximately 740 ft above the confluence with Drift Creek. Below this road crossing the channel divides two actively farmed grass fields and is deeply incised, with soft, undercut banks. Run habitat dominates this reach. Above the road crossing the channel is not incised and consists of riffle/run habitat with intact banks. Slope is less than 1% for the first 970 ft when the gradient abruptly increases to nearly 9%slope.

Substrate

Substrate for the first 2,300 feet of Drift Creek (moving upstream from the mouth) is uniformly hard silt and clay. At 2,300 feet from the mouth (in the vicinity of the Hibbard Road Bridge), the packed silt and clay transitions to medium and large gravel. In a short stretch of creek from the first appearance of the gravel to a beaver dam at approximately 3,250 feet upstream of the mouth, the creek contains areas of gravel appropriate for salmonid spawning. In this segment, and continuing upstream to at least RM 1.0 there is a seam of small gravel to medium cobble eroding from the bank, providing a source of gravel recruitment. At approximately RM 1.2, the first bedrock-dominated creek bed was observed. From that point upstream, the creek is primarily bedrock, large cobble and boulder with

scattered small patches of gravel. In many areas, the stream transitions from large bedrock dominated areas to areas with greater concentrations of cobble/boulder, then back to bedrock. Areas with gravel appropriate for salmonid spawning are few and widely spaced throughout the creek. In the deep canyon portion of the creek from RM 3.4 upstream, fine sediments have deposited in the few pools that are present. Elsewhere below the proposed dam, embeddedness is not an issue due to a lack of fine sediment.

The lower 0.9 miles of Drift Creek within the reservoir footprint has fine sediment substrates. Some gravel and small cobble is present at and above this point, but is significantly embedded. Embeddedness decreases upstream of the Fox Creek confluence. One isolated patch of gravel estimated to be 40-50 feet in length with approximately 20 percent embeddedness, was observed at the upper end of the reservoir footprint.

Fox creek substrate is entirely silt for the first 740 ft above the confluence with Drift Creek. A vehicle crossing at this point marks the transition to approximately 200 ft of gravel and cobble substrate. Within this stretch is a small patch (approximately 30 ft long) of clean gravel suitable for salmonid spawning. Local residents observed Coho spawning at that location in 2009. Just above this gravel, the substrate abruptly transitions to bedrock at a gradient change and remains bedrock for the last 430 ft of Fox Creek (moving upstream) within the reservoir footprint. .

Riparian zone

From the mouth of Drift Creek to the Hibbard Road bridge (RM 0.4), riparian vegetation is sparse and dominated by reed canary grass and blackberries. Upstream of the Hibbard Road bridge to the Cascade Highway bridge (RM 1.8), the riparian zone ranges between one and two trees wide to areas with intact riparian zones extending several hundred feet laterally from the stream bank. However, the majority of the riparian areas in this segment are only a few trees in width. Nonetheless, canopy cover in this zone is at least 50% and trees consist of cottonwoods and alders, some of which are very large (up to 48” diameter at breast height [dbh]). Interspersed with the large cottonwoods and alders are smaller alders, ash and scattered conifers. In the stream section upstream of the Cascade Highway bridge to approximately RM 3.0, the riparian zone consists primarily of deciduous trees, and is wide, with good canopy cover over the stream.

At approximately RM 3.0. to RM 5.7, the river flows through a steep-walled canyon with riparian zones in excess of 500 feet on either side of the river. There is a variety of tree sizes represented, and the species mix is predominantly deciduous, but with a significant coniferous component. In many areas within this reach, the stream is covered with low-growing willows and other shrubs. The floor of the valley is broad in many places (in excess of 100 feet wide), with the canyon walls rising steeply on either side.

From RM 5.7 upstream to the proposed dam site, the riparian zone is narrower, but still typically several trees wide. Cleared or grazed terraces are often present beyond the immediate riparian zone, with additional wooded areas on hillslopes beyond. Canopy cover within this reach is also good.

Upstream of the proposed dam, the wooded riparian zone transitions to reed canary grass. Where scattered deciduous shrubs and trees are present, the riparian zone is rarely wider than one or two trees. At approximately RM 8.6 the riparian zone is again a robust deciduous stands but then transitions (upstream) to industrial forest.

The riparian zone along the lower end of Fox Creek is nearly void of trees or shrubs and is dominated by thick stands of reed canary grass. The upper end of Fox Creek is well shaded with mature deciduous stands.

Large woody debris

In general, large woody debris is sparse throughout the system. There are numerous areas with debris jams on either side of the river consisting of multiple small branches and logs, but large stream-spanning wood is rare. There is one significant large woody debris jam at approximately RM 6.3, just downstream from the Victor Point Road bridge. The jam was five feet high, and nearly impermeable (see Appendix A photo 16). Water was flowing primarily under/through, but also around one end of the debris dam. Elsewhere in the system, large wood is generally restricted to scattered smaller logs that did not appear to be trapping sediment or otherwise contributing significantly to stream complexity. In many cases, the LWD was outside the wetted width (at the time of the survey), and is not submerged during low summer flows. LWD within the reservoir footprint, including Fox Creek, is nearly absent.

4.1.2 Detailed habitat data

Detailed data were collected in four reaches below the proposed dam as described above. Summary reports for each reach are provided in Appendix B. Results for each of the parameters used in the evaluation are presented in Table 2.

As can be seen on the table, the lower reach of Drift Creek is quite degraded, scoring low on 12 of the 13 rankings. Its only high ranking was on the % of bedrock metric. However, the substrate of lower Drift Creek is hard clay and silt, which is functionally equivalent to bedrock for salmonid habitat. The upper reaches are somewhat better fish habitat, although still limited in their amount and size of large woody debris, pool habitat, and the availability of gravel in riffles. In general, the data collected reinforced the subjective observational data that Drift Creek is lacking in LWD, gravel and pool habitat, and could benefit from the additional of LWD, and possibly gravel placement.

Table 2. Habitat rankings for the individual reaches

Parameter	Reach #							
	Reach 1		Reach 2		Reach 3		Reach 4	
	Value	Ranking	Value	Ranking	Value	Ranking	Value	Ranking
% pools	0	Low	0	Low	8.82	Moderate	0	Low
Deep pools/km	0	Low	0	Low	0	Low	0	Low
% slackwater pools	0	Low	0	Low	0	Low	0	Low
% secondary channels	0	Low	0	Low	0	Low	1.8	Moderate
% fines in riffles	N/A	Low	2	Moderate	1	Moderate	0	High
% gravel in riffles	N/A	Low	3	Low	3	Low	0	Low
% bedrock in streams	0	High	5	High	21	Moderate	65	Low
Pieces lwd/100 m	4.2	Low	14.1	Moderate	2.8	Low	4.8	Low
Volume lwd/100 m	1.3	Low	1.1	Low	0.8	Low	1	Low
Key pieces of lwd/100 m	0	Low	0	Low	0	Low	0	Low
# conifers >50 cm dbh	0	Low	0	Low	0	Low	0	Low
# conifers > 90cm dbh	0	Low	0	Low	0	Low	0	Low
% shade	42	Low	83	Moderate	65	Low	80	Moderate
Low rankings	12		9		10		10	
Moderate rankings	0		3		3		2	
High rankings	1		1		0		1	

Pebble counts indicated that the median particle size (D50 - the size at which half the particles are smaller and half the particles are larger), ranged from just over 60 mm in Reach 2, Unit 5 (at the upper end of reach two), to just over 600 mm in Reach 4 (which was dominated by bedrock). The median particle size at Reach 3 and at Reach 2, Unit 1 (at the beginning of Reach 2) was between 70 and 80 mm (Figure 4). The median particle size for gravel bed streams ranges from about 0.1 (2.5 mm) to about 2.5 inches (63.5 mm), and anything over 2.5 inches (63.5 mm) is considered a coarse bed stream. Reach 2 unit 5 was the only surveyed area that fell within the gravel bed category, while the other two upstream samples fell within the coarse bed category. From our visual observations, coarse bed conditions apply to all but the lower 0.5 miles of the survey reach. A pebble count was not conducted in Reach 1 since the entire substrate is silt/clay hardpan, which functions much as

a bedrock streambed. As stated above, the ideal substrate for steelhead and coho spawning is from 0.5" to 6" in diameter (13 to 152 mm). At three of the reaches, the median particle size was within this range, but based on subjective observations, suitable spawning gravel beds were few and widely spaced.

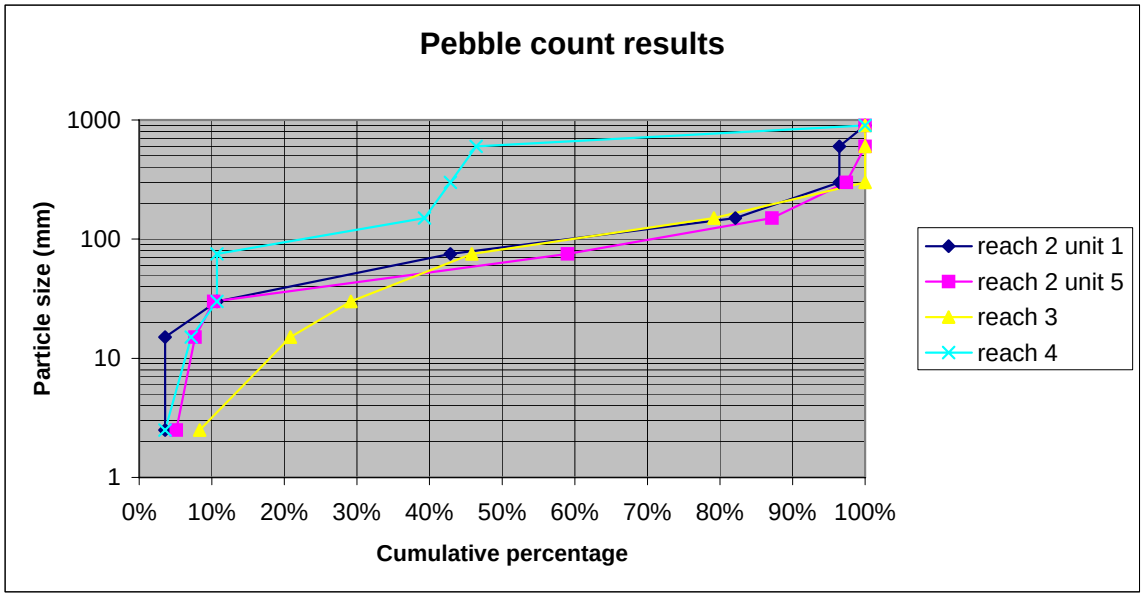

Figure 4. Pebble count results.

4.2 West Fork Drift Creek

4.2.1 General habitat description

West Fork Drift Creek provides salmonid habitat for most of its length due to an abundance of pool habitat, LWD, shade and cool water. The exception to this observation includes portions of the creek that have been heavily impacted by agricultural practices. Small, widely dispersed patches of spawning substrate were observed in the upper reaches. There are many private and public road crossings in the lower to mid section and a falls that could represent a partial barrier during some times of the year.

Morphology

West Fork Drift Creek consists of four distinct morphological units. The first (most downstream) zone begins at the confluence with East Fork Drift Creek and extends approximately 0.6 miles upstream. This area has relatively flat topography (slope 2%) and is currently farmed for grass seed. The reach is dominated by glide habitat with incised banks and a flat stream bottom. Pool habitat is also relatively abundant. Measured depths ranged from 0.3 feet to 3 feet and widths were generally about 6 feet. Two low water vehicle crossings used to access fields are present within this reach. Figure 5 illustrates the gradient by stream mile of West Fork Drift Creek.

The second morphological unit is defined by a higher gradient (3.2% slope) and largely intact banks. This stream reach is approximately one mile long and terminates at Silver Falls

Highway located near RM 1.7. Riffles dominate the mesohabitat during low flow conditions, but chutes, rapids and boulder steps are also abundant. Scattered scour and lateral pools were observed. A small falls, which is likely a seasonal barrier to upstream migration was noted at approximately RM 1.5.

Above Silver Falls Hwy, the landscape has only a slight gradient (<1% slope). Creek banks are incised with little undercutting. The lower end of this reach is largely uniform, consisting mainly of shallow riffles with widely scattered pools mainly resulting from prolific beaver activity. At approximately RM 2.4 the creek has been confined to a quarter-mile long ditch. The banks are clay and greater than six feet in height. Upstream of this ditch, the creek is incised and sinuous, hidden within thick banks of reed canary grass.

The last morphological unit of West Fork creek begins at approximately RM 3.2 and extends to the termination of perennial flow at RM 4.5. It is defined by a sharp and continued rise in gradient and an increase in active channel width. Long riffles separated by steps or cascades over boulders are typical. Banks were generally undercut. Pools, though relatively abundant, decrease in frequency as elevation increases.

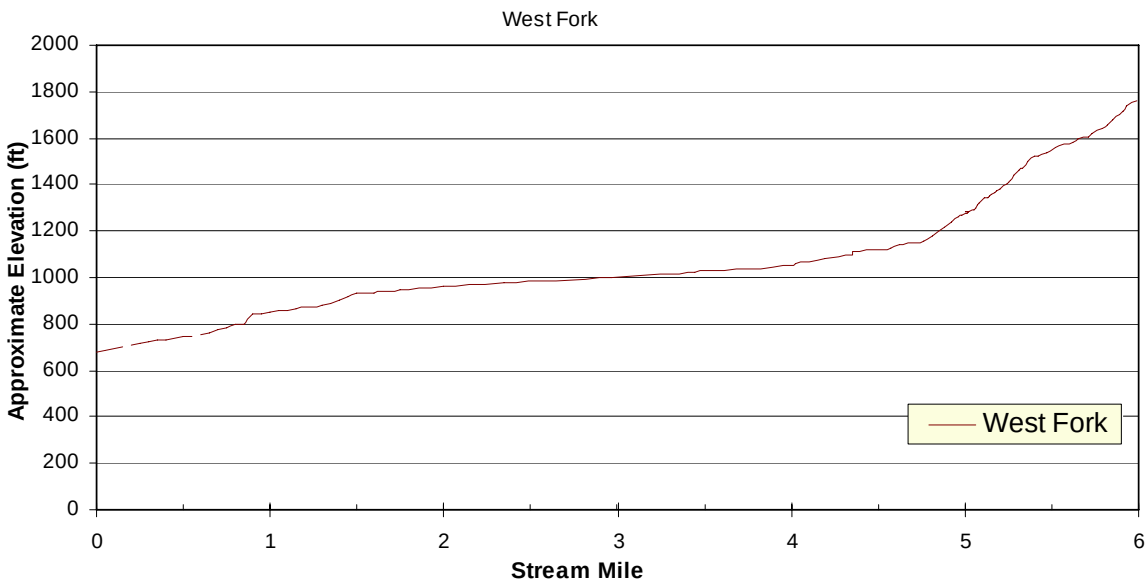

Figure 5. West Fork Drift Creek Gradient.

Substrate

Substrate in West Fork Drift Creek at and near its confluence with Drift Creek primarily consists of large to small cobble with a few bedrock outcroppings. Large amounts of silt were also observed in concentrated pockets and also embedded much of the available cobble and gravel. At approximately RM 0.6 a sudden transition to boulder and clean bedrock which continues for the next 0.4 miles of creek bed. The numerous pools in this reach were usually silt bottomed. Above RM 1.0, large gravel to small cobble over bedrock is characteristic of the substrate until just below Silver Falls Hwy (RM 1.6), at which point the channel becomes

incised and soft bottomed. Upstream of Silver Falls Hwy the substrate is gravel/cobble mixed with varying degrees of sand and silt until RM 2.5 when substrate composition abruptly changes again to hard yellow clay for approximately 1,600 ft. As elevation increases beyond this point, the substrate steadily trends towards cleaner and smaller gravel producing the only significant areas of suitable spawning gravel observed within West Fork. This upper reach also possesses deeper silt-bottomed pools and long runs of clean bedrock.

Riparian zone

From the mouth of West Fork Drift Creek to RM 0.4, riparian vegetation consists of a 65 foot-wide mix of perennial grasses and small to medium deciduous trees and shrubs. Canopy cover is approximately 70%. When the creek begins to rise above the grass fields, the riparian zone widens considerably for the next 0.6 miles and transitions into a mature deciduous stand without notable presence of invasive species. From RM 1.0 to 1.6 the riparian zone consists of deciduous trees and shrubs that extend approximately 65 feet laterally from either stream bank. For most of this reach the canopy has completely enclosed the creek bed providing 100% shade. Upstream of Silver Falls Hwy the creek passes through open fields and grassy wetlands, the riparian vegetation is largely limited to small shrubs and robust stands of reed canary grass providing little to no canopy cover. At approximately RM 4.25 the trees along the bank begin to increase in size and number until approximately RM 4.50 when the riparian zone is dominated by mature mixed stands and deciduous shrubs extending at least 70 feet laterally from each bank.

Large woody debris

Small amounts of large woody debris were available, except for the 1.4 mile stretch of creek immediately upstream of Silver Falls highway, within which no LWD was observed. Numerous debris jams large enough to create upstream pools and sediment traps were observed during the survey. Downed logs of varying sizes were also frequently observed spanning the streambed.

4.2.2 Detailed habitat data

Results for each of the four surveyed reaches are shown in Table 3. Habitat in all reaches received generally low rankings, the exception being pool habitat, which was present at moderate to high levels in all reaches. Also, percent shade and bedrock were ranked as moderate to high in all but one reach. As can be seen in the table, Reach 2 received the highest overall ranking within West Fork, scoring moderate to high in five of the 13 rankings. In general, the data collected reinforced the subjective observational data that pool habitat in West Fork Drift Creek was abundant but that significant concentrations of gravel and LWD are lacking.

Table 3. Habitat rankings for the individual reaches within West Fork

Parameter	Reach #							
	Reach 1		Reach 2		Reach 3		Reach 4	
	Value	Ranking	Value	Ranking	Value	Ranking	Value	Ranking
% pools	59	High	11	Moderate	53	High	72	High
Deep pools/km	0	Low	0	Low	0	Low	0	Low
% slackwater pools	0	Low	0	Low	53	High	4	High
% secondary channels	0	Low	0	Low	0	Low	0	Low
% fines in riffles	14-16	Moderate	0-5	Low	NA	NA	37	Low
% gravel in riffles	5-14	Low	8-10	Low	NA	NA	15	Low
% bedrock in streams	2	High	18	Moderate	0	High	44	Low
Pieces lwd/100 m	1.1	Low	25.7	High	4.1	Low	39.9	High
Volume lwd/100 m	0.5	Low	2.9	Low	0.7	Low	11.8	Low
Key pieces of lwd/100 m	0	Low	0	Low	0	Low	0	Low
# conifers >50 cm dbh	0	Low	122	Moderate	0	Low	0	Low
# conifers > 90cm dbh	0	Low	0	Low	0	Low	0	Low
% shade	70	Low	100	High	88	Moderate	100	High
Low rankings	10		8		7		9	
Moderate rankings	1		3		1		0	
High rankings	2		2		3		4	

Pebble counts conducted in the West fork are depicted in Figure 6. A pebble count was not conducted in Reach 4 because, although gravel was present, sand and bedrock patches were present in equal amounts and a representative cross section could not be identified. An alternate cross section upstream of reach 4 was counted and is included in Figure 6 as representative of conditions in upper West Fork. In all other cases the pebble count was conducted at the downstream end of the associated reach. Median particle size ranged from just over 10 mm in the extreme upper end of West Fork, to nearly 900 mm in Reach 2. The median particle size at Reach 1 and at Reach 3, was 50 mm and 38 mm respectively. These two reaches represent the only sections of coarse bed (2.5mm to 63.5mm) surveyed in West

fork and fall within the range of ideal substrate for steelhead and coho spawning described above (13 to 152mm). However, such gravel only occurred in small patches that were not large enough to provide suitable spawning habitat for either steelhead trout or coho salmon.

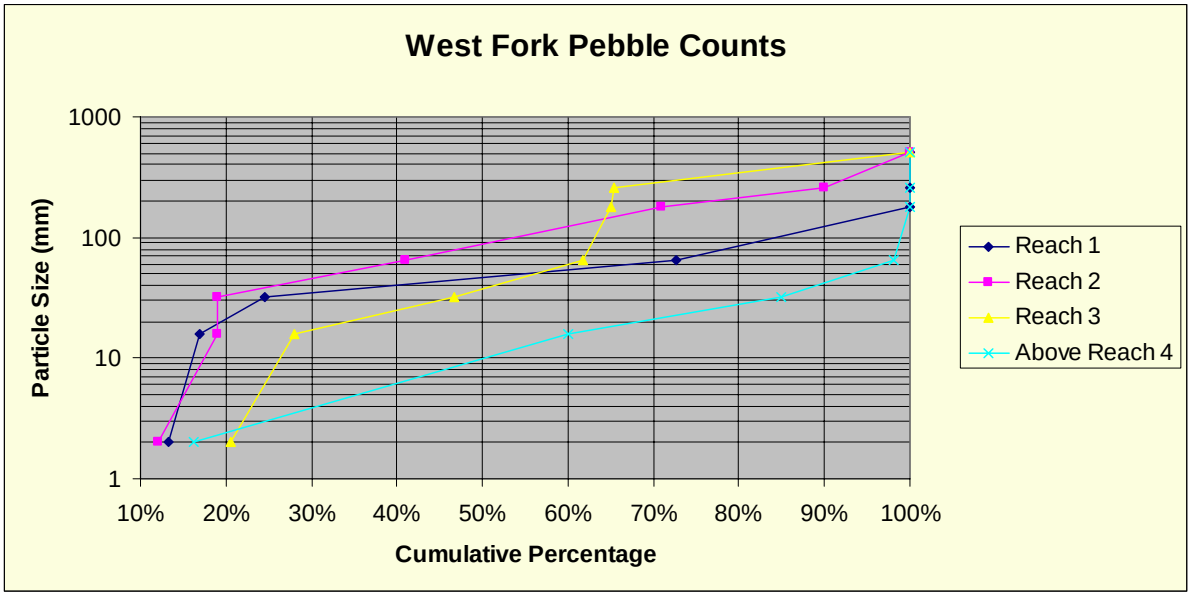

Figure 6. Pebble count results for West Fork Drift Creek.

4.3 EAST FORK DRIFT CREEK

4.3.1 General habitat description

East Fork Drift Creek from Drift Creek to the falls, provides approximately 1.6 miles of potential salmonid rearing habitat. It is generally well shaded and is not temperature limited. No suitable spawning habitat was noted during the recent survey.

Morphology

Within the study area, East Fork Drift Creek can be divided into two distinct morphological units based on channel morphology. The entire creek from its mouth to the falls at Drift Creek Road is uniformly sloped (approximately 3.5%, illustrated on Figure 7). However at MR 0.35 the habitat transitions abruptly. The creek downstream of this point is an incised channel running through a wide flood plain surrounded by agricultural fields. Banks are actively eroding for most of the reach. Habitat is dominated by long glides interspersed with shallow riffles. Pools were scattered throughout the reach. Above RM 0.35 the thickly wooded landscape rises steeply away from the left bank of the creek. The right bank terrace gradually moves closer to the active channel as elevation increases. By the time the creek reaches Drift Creek Road the channel is at the bottom of a steep canyon. Banks throughout this upper reach are largely intact with only occasional evidence of undercutting in outer bends. Instream habitat consists mainly of riffles separated by cascades and steps. Scour pools are moderately abundant.

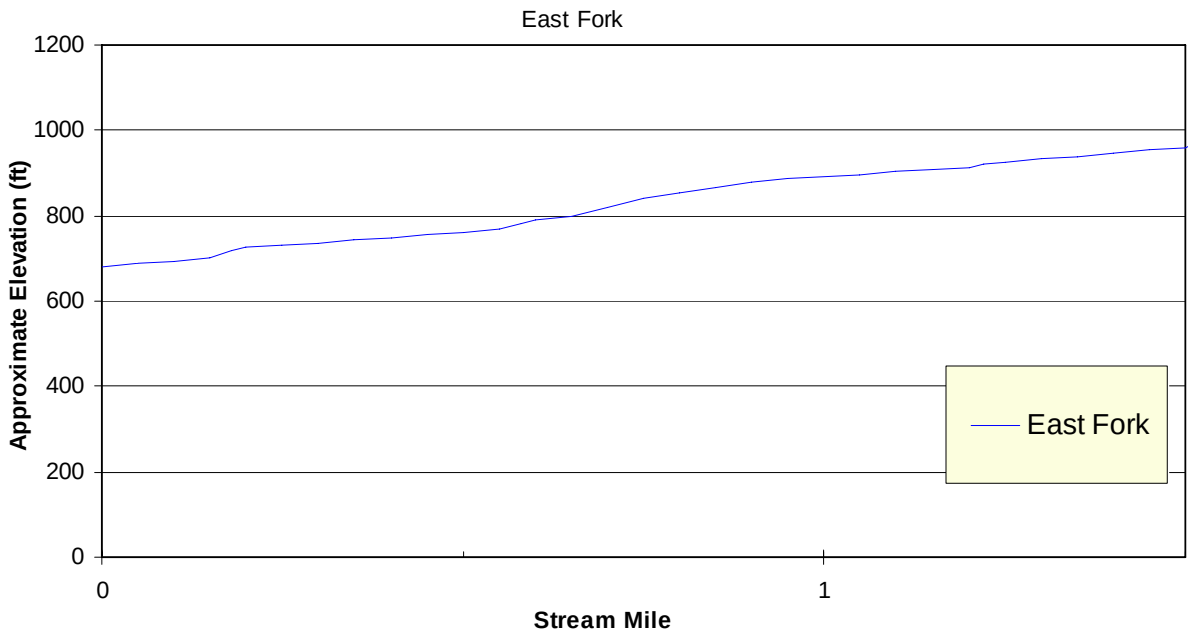

Figure 7. East Fork Drift Creek Gradient.

Substrate

Substrate below RM 0.35 of East Fork Drift Creek is dominated by large gravel to small cobble. Some of these areas are heavily silted and what pools are present are silt bottomed. Above RM 0.35 the substrate consists primarily of large cobble and bedrock with scattered boulders. Sand deposits line the waters edge. Silt in this reach is sparse and generally confined to the few lateral scour pools.

Riparian zone

Below RM 0.35 the band of riparian vegetation ranges from approximately 50 ft wide to completely absent. Where deciduous shrubs and trees are present they provide 70 % canopy cover, however stream banks for approximately 400 ft of this reach are vegetated only by reed canary grass with 10 to 20% canopy cover. Above RM 0.35 shade and canopy cover increase significantly as riparian vegetation is largely intact. Except for a left bank clearcut at RM 1.0 the wooded riparian zone is considerably wider than in the lower reach, and ranges between 300 and 1,700 ft on either side. Although the percentage of conifers increases with elevation, deciduous trees and shrubs dominate the riparian vegetation. Significant stands of invasive plants were not observed within this reach during the survey.

Large woody debris

Large woody debris is generally sparse throughout the system. No debris jams or stream spanning logs were present below RM 0.35. Upstream to the falls there was an increase in LWD and debris jams, however they were small and widely spaced.

4.3.2 Detailed habitat data

Detailed data were collected in two reaches using the methodology described above.

Table 4 illustrates the results for each parameter within the upper and lower reaches of East Fork Drift Creek. The scores indicate generally low quality habitat throughout. In the upper reach, shade was robust and moderate amounts of LWD were present. However, substrate, though largely lacking in fines, was predominantly bedrock and no spawning gravels were observed. The lower reaches of East Fork have been impacted by agricultural practices. Shade has been greatly reduced and LWD is nearly absent. Sediment composition is more varied as bedrock gives way to gravel, cobble and more fines. The habitat rankings are in agreement with the subjective observations described in the general habitat description above.

Pebble counts results for the two East Fork survey reaches were fairly similar with median particle size (D50) ranging from just over 50mm in the downstream reach to 60 mm in the upstream reach (Figure 8). Although both counts fall within the range for gravel bed streams (2.5mm to 63.5mm) copious amounts of bedrock were observed in the upper reaches of East Fork and moderate levels of fines were observed in the lower reaches. Additionally, field surveys did not find any suitable spawning gravel beds for coho or steelhead.

5.0 SUMMARY

Although Drift Creek and its tributaries do provide some salmonid habitat, the capacity to support spawning, rearing and holding is limited by a stream-wide deficiency in pool habitat, LWD, gravel substrate and shade. The above analysis indicates that habitat quality is low compared to reference values used by ODFW to rate North Cascade streams. In general, conditions are slightly better in East and West Fork as measurable habitat characteristics within the system improve with elevation. However, the only two patches of gravel suitable for salmonid spawning were found in the Drift Creek mainstem and Fox Creek.

Table 4. Habitat rankings for the individual reaches within East Fork Drift Creek

Parameter	Reach #			
	Reach 1		Reach 2	
	Value	Ranking	Value	Ranking
% pools	44	High	29	High
Deep pools/km	0	Low	0	Low
% slack water pools	0	Low	0	Low
% secondary channels	0	Low	0	Low
% fines in riffles	0-5	Moderate	0	High
% gravel in riffles	5-10	Low	0	Low
% bedrock in streams	7	High	56	Low
Pieces lwd/100 m	0	Low	13	Moderate
Volume lwd/100 m	0	Low	1.4	Low
Key pieces of lwd/100 m	0	Low	0	Low
# conifers >50 cm dbh	0	Low	0	Low
# conifers > 90cm dbh	0	Low	0	Low
% shade	60	Low	100	High
Low rankings	10		9	
Moderate rankings	1		1	
High rankings	2		3	

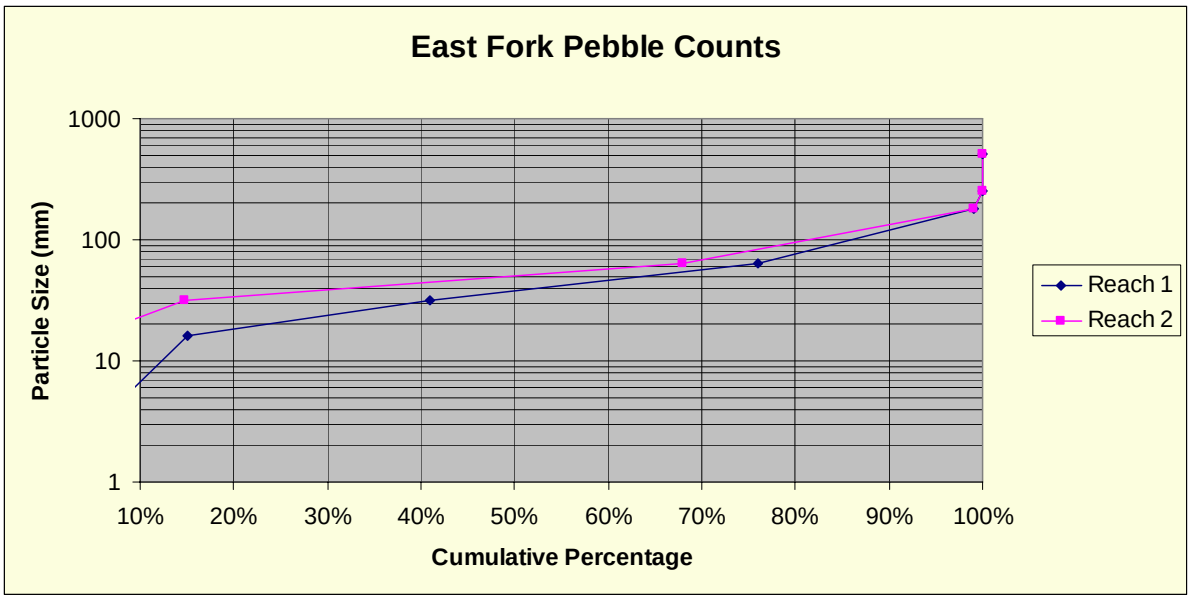

Figure 8. Pebble count results for East Fork Drift Creek

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APPENDIX A. Photolog

APPENDIX B. Detailed reach data