DRAFT

Design of Swan Creek Stream and Wetland Enhancement

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INTRODUCTION

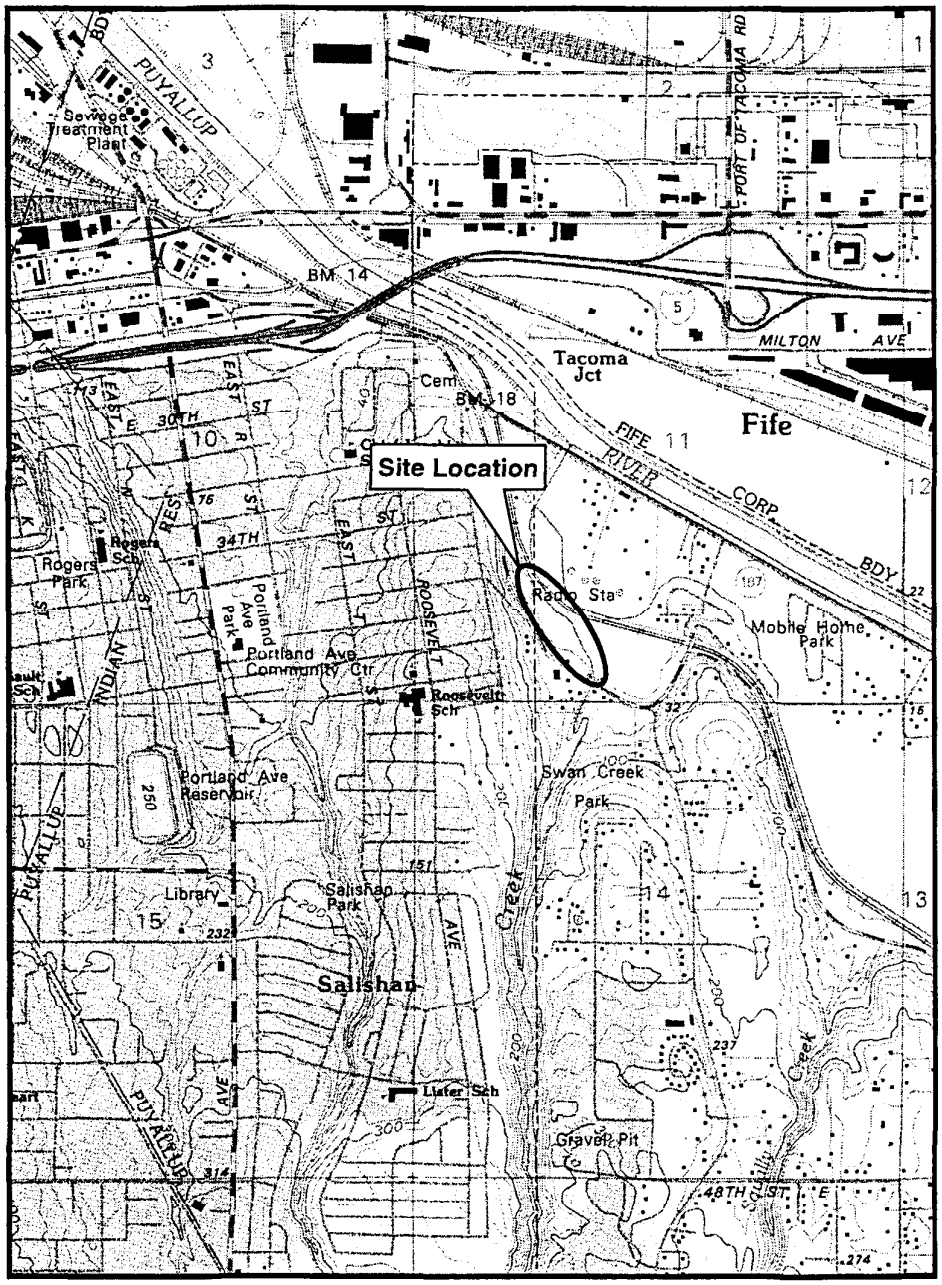
In 1997 the City of Tacoma produced a conceptual plan to restore and enhance a 12-acre site located in Section 11, Township 20N, Range 3E in Tacoma, Washington (Figures 1 and 2) (City of Tacoma 1997). This site contains a 3.0-acre wetland complex named the Haire Wetland and the former 2-acre Walter Wetland. Approximately 1,600 ft of Swan Creek flows through this site. The conceptual plans prepared by the City of Tacoma form the basis for the restoration and enhancement plans described in this document.

In June and July 1999, Pentec Environmental, Inc. (Pentec), completed a fish habitat assessment and a hydrologic evaluation in Swan Creek. Pentec also conducted a reconnaissance-level vegetation investigation to determine the location, extent, and character of vegetation communities in the Haire Wetland and riparian zone of Swan Creek. These studies were carried out to assess the areas of this site where restoration and enhancement was most needed and to provide the baseline data for designing the restoration and enhancement work.

Included in this report are the methods used in, and the results of, the fish habitat, hydrologic, and vegetation studies, and the design description and justification for the restoration work. The monitoring and adaptive management plan and the maintenance plan for the restoration work are included in Appendices A and B, respectively

SITE DESCRIPTION

The site is generally flat and is situated in a low area between a railroad bed (Northern Pacific Railroad) and the slope that forms the southern edge of the Puyallup River valley. The base of the railroad bed is coincident with the eastern property boundary. Pioneer Way defines the western boundary of the site along the base of the slope that forms the southern edge of the Puyallup River valley. The western portion of the site contains the 3.0-acre Haire Wetland complex and what was formerly the 2-acre Walter Wetland, which was filled in the early 1970s. The site's southern boundary is the outlet of the culvert that passes under Pioneer Way and the northern boundary is in line with 34th Street if extended in Tacoma.



Map prepared from
USGS 7.5 Minute Quadrangle
Tacoma South, Washington

APPROXIMATE SCALE IN FEET
0' 1000' 2000' 4000'

Pentec ENVIRONMENTAL	Swan Creek, Haire Wetland Restoration Tacoma, Washington for the City of Tacoma	Figure 1 Site vicinity map.

02/18/2000 fig_1.FH8

Swan Creek flows north through the eastern portion of the site and then passes through a culvert under Northern Pacific Railroad, where it enters Clear Creek. Clear Creek flows into the Puyallup River at river mile 3.

Upland and wetland vegetation on the site is typical of disturbed and urbanized areas within the Puget Lowland region. Upland forests are composed entirely of deciduous tree species that are pioneers and the first to colonize disturbed or previously developed areas. Upland and wetland forest stands on the site are relatively simple, consisting primarily of mature deciduous trees of the same ages and height, and lacking structural diversity. Non-native and invasive plant species commonly found in the region are abundant in both upland and wetland vegetation communities on the site, especially around previously filled areas, existing structures, along Pioneer Way, near the railroad tracks, and on the banks of previously channelized sections of Swan Creek. A more detailed description of the existing upland and wetland vegetation on the site is presented in the Vegetation Section, which is within the Field Investigation Section.

FIELD INVESTIGATION

FISH HABITAT

Fish habitat surveys were conducted to provide baseline environmental data that would form the basis for identifying specific design objectives for the proposed restoration project. The intent of the study was to characterize both positive and negative aspects of the existing habitat conditions on the site. Beneficial habitat conditions would be protected and preserved through the construction process while negative conditions would be specifically targeted by the design effort. Fish habitat was evaluated in Swan Creek from the outlet of the Pioneer Way culvert to the inlet of the Northern Pacific Railroad culvert (Figure 3). This section of Swan Creek was divided into four reaches based on habitat type (Figure 3). Fish habitat was rated based on stream channel types and the conditions of both spawning and rearing habitat.

Methods

The current fish habitat conditions were determined using a habitat unit survey method similar to that described by Hankin and Reeves (1988), and the location of any barriers that could prevent movement of adult or juvenile salmonids were identified during the survey. The following habitat elements were examined: embeddedness (percentage fine sediment composition) of spawning gravel, percentage pool area, pool depth and cover class, dominant and subdominant substrate, and large woody debris (LWD).

In each survey reach, pools were tallied by depth category, pool tailouts were examined for the presence of spawning gravel, and the amount of spawning-gravel embeddedness was visually estimated by a habitat biologist. Pool depth categories were 0 to 7 inches, 7 to 14 inches, 14 to 28 inches, and 28 to 45 inches. Spawning gravel was defined as a patch of gravel containing particles ranging from 1 to 3.5 inches in diameter that covered a minimum area of 0.3 ft^2. Embeddedness estimate categories were less than 30 percent and greater than 30 percent.

An inventory of LWD was performed to provide information for an assessment of LWD functions relative to the formation of fish habitat. In each survey reach, all pieces of LWD observed within the bankfull influence zone were counted. Pieces of LWD were subdivided into three size groups (4.5 to 14 inches, 14 to 28 inches, and greater than 28 inches) based on the estimated diameter at the large end of each piece. Each LWD structure (single piece or logjam) was identified, and the number of LWD pieces in each structure was counted.

Habitat Quality Ratings

Channel Types

Stream channel type influences the amount and quality of fish habitat in a stream. Stream channel types defined by Montgomery and Buffington (1993) based on physical properties and channel dynamics include the following: pool-riffle, forced pool-riffle, plane-bed, step-pool, braided, and regime. Substrate type is also a factor in habitat quality, because it influences invertebrate productivity.

A pool-riffle channel has an undulating bed featuring a sequence of sediment bars, pools, and riffles. Pool-riffle and forced pool-riffle channels tend to have a pool:riffle ratio of 1:1; this ratio

results in sufficient pools to provide spawning and rearing habitat for fish and sufficient riffles to provide fertile habitat for invertebrate populations. The quality of the rearing habitat, however, depends on channel width and depth. A wider channel tends to have deeper pools, which are more beneficial to fish. Gravel substrates common in these two channel types are conducive to invertebrate productivity.

Plane-bed channels have a higher percentage of riffles than of pools; therefore, the amount of fish habitat is lower than in the pool-riffle and forced pool-riffle channels. On the other hand, step-pool channels have a higher percentage of pools than of riffles. Step-pool channels provide good fish rearing habitat but lack the substrate and riffle area needed for adequate invertebrate productivity.

Braided and regime channel types generally do not have a high percentage of spawning and rearing habitat. Braided channels have variable substrate; therefore, invertebrate productivity is also variable. Sandy substrates common to regime channels inhibit invertebrate productivity. A regime channel is a low-gradient channel characterized by sediment deposition.

Spawning Habitat

Ratings of spawning habitat quality were based on the embeddedness of the spawning gravel (Table 1). Embeddedness is subjective and is determined visually by estimating the percent of the substrate that is embedded with silt. When silt is present in spawning gravel in amounts greater than 30 percent, the embryo survival rate can be reduced to as low as 28 percent (Raleigh et al. 1984).

Rearing Habitat

The following rearing habitat parameters were rated according to the criteria shown in Table 1: percentage pool area, pool depth and cover class, dominant and subdominant substrate, and LWD. Pools are important for providing resting areas and refuge for juvenile fish; pool depth influences the area available to fish for refuge. Cover class is dependent on whether a pool is formed by LWD; the presence of LWD in pools increases the amount of cover available to fish for refuge. In addition to providing cover, LWD helps to form pool habitat by influencing

Table 1 Criteria for rating fish habitat quality.

Parameter (source)	Habitat Quality Rating		
	Poor	Fair	Good
Spawning habitat			
Embeddedness (Anonymous 1996)	> 60 percent of sites with embeddedness > 30 percent	> 60 percent of sites with embeddedness < 30 percent	> 60 percent of sites with embeddedness < 5 percent
Rearing habitat			
Percentage pool area (Raleigh et al. 1984)	< 20 percent or > 70 percent	20 - 30 percent	30 - 70 percent
Pool depth and cover class (similar to Raleigh et al. 1984)	> 30 percent are < 7" deep and < 30 percent are LWD-formed	> 30 percent are > 7" deep and 30 - 60 percent are LWD-formed	> 60 percent are > 28" deep and > 60 percent are LWD-formed
Dominant substrate for food production (Raleigh et al. 1984)	Gravel-dominant and sand-subdominant or boulder-dominant	Gravel-dominant and cobble-subdominant or cobble-dominant and boulder-subdominant	Cobble-dominant and gravel-subdominant
LWD (Anonymous 1996)	< 1 pieces/channel width	1 - 2 pieces/ channel width	> 2 pieces/ channel width

channel hydraulics. Dominant and subdominant substrate types influence food production; a substrate that is cobble-dominant and gravel-subdominant provides the best habitat for maintaining a diverse invertebrate population.

Results

Habitat Quality Ratings

The results of the habitat unit survey are presented in Table 2, and the habitat quality ratings are presented in Table 3.

Table 2 Habitat conditions in Swan Creek during summer 1999.

	Reach 1	Reach 2	Reach 3	Reach 4
Channel type	Pool-riffle	Pool-riffle	Regime	Pool-riffle
Gradient range (percent)	1	1	< 1	1
Survey length (ft)	884	369	102	275
Mean bankfull width (ft)	19.2	15.4	9.8	16.2
Percentage of *pool tailouts with* resident trout spawning gravel	58	15	50	25
Percentage of spawning gravel with embeddedness of				
< 30 percent	21	50	0	0
> 30 percent	79	50	100	100
Number of pools	22	13	2	8
Number of riffles	14	7	4	7
Percentage pool area	56	57	26	32
Pool spacing	2.1	1.8	5.2	2.1
Percentage of pools with residual depth of				
0-7 inches	17	23	0	0
7-14 inches	33	8	50	88
14-28 inches	25	38	50	13
28-45 inches	21	31	0	0
> 45 inches	4	0	0	0
***Percentage of* pools with LWD as primary former**	*50*	*85*	*0*	*50*
Dominant/ subdominant substrate	Sand/gravel	Sand/fines	Sand	Cobble/gravel
LWD pieces per channel width	7.6	8.1	1.4	2.9
Total pieces of LWD	352	193	15	50

Table 3 Habitat quality ratings for the four reaches surveyed in Swan Creek during the summer of 1999.

Parameter	Habitat Quality Rating			
	Reach 1	Reach 2	Reach 3	Reach 4
Spawning habitat				
Embeddedness	poor	fair	poor	poor
Rearing habitat				
Percentage pool area	good	good	fair	good
Pool depth and cover class	fair	fair to good	poor to fair	fair
Dominant substrate for food production	poor	poor	poor	good
LWD	good	good	fair	good
Overall habitat quality	fair	fair	poor to fair	good

Channel Types

Reaches 1, 2, and 4 are classified as pool-riffle channels based on the geomorphic classification scheme defined by Montgomery and Buffington (1993), and Reach 3 is classified as a regime channel under this classification scheme. Reach 3 has sand as its dominant substrate and the flow through this area is very slow.

Spawning Habitat Quality

Gravel embeddedness is greater than 30 percent in over 60 percent of the available spawning sites in Reaches 1, 3, and 4 (Table 2). The high levels of embeddedness resulted in poor spawning habitat ratings for these three reaches (Tables 1 and 3). Fifty percent of the spawning habitat in Reach 2 is embedded greater than 30 percent and 50 percent of the spawning habitat is embedded less than 30 percent; therefore, this reach is rated fair for spawning habitat, although the quantity of habitat in this reach is very low. Available spawning habitat exists in only two locations.

Rearing Habitat Quality

Percentage pool area is rated good for Reaches 1, 2, and 4. Percentage pool area for Reach 3, which has a regime channel and consequently a naturally low number of pools, is rated fair. The low amount of pool area in Reach 3 is partly a function of the low gradient and the low amount of LWD.

Pool depth and cover class is rated fair for Reaches 1 and 4. Reach 2 has a fair to good rating for pool depth and cover class because the majority of pools in this reach have depths less than 45 inches. The rating for pool depth and cover class for Reach 3 was poor. Pool depth is directly related to stream size; the pools in Reach 3 are naturally shallow because the stream width in this reach is less than 10 ft.

Dominant and subdominant substrate for food production is rated poor for Reaches 1, 2, and 3 because the dominant substrate in these three reaches is sand. Reach 4 has a good rating for dominant and subdominant substrate because the dominant substrate in this reach is cobble, with gravel as the subdominant substrate. This substrate type is good for invertebrate communities.

LWD is rated good for Reaches 1, 2, and 4, and fair for Reach 3.

Overall Habitat Quality

The pool-riffle channel type of Reach 1 should provide good spawning and rearing habitat for fish, but the spawning gravel is highly embedded and the substrate type does not provide adequate habitat for food production. Therefore, the overall fish habitat rating for this reach is fair.

The overall salmonid habitat rating for Reach 2 is also fair because of the large percentage of sand and silt in the stream. Sand in the spawning areas causes the spawning gravel to be embedded, and as the subdominant substrate, the sand decreases invertebrate productivity. The depth of the pools (< 60 percent were < 28 inches deep) also contributed to the fair salmonid habitat rating.

The overall salmonid habitat rating for Reach 3, which has a regime channel, is poor to fair. Regime channels inherently have sandy bottoms and a low number of pools; Reach 3 has only one spawning habitat site and inadequate habitat for food production.

Reach 4 has a good overall salmonid habitat rating because the pool area, pool depth and cover, and amount of LWD present provides good habitat for salmonid rearing. Additionally, the substrate type provides good habitat for the invertebrate communities that provide a food source for fish. However, the spawning habitat in this reach is embedded and therefore does not provide good spawning habitat for fish living in this system.

Summary of Fish Habitat Conditions

The habitat conditions in Swan Creek between the outlet of the Pioneer Way culvert and the inlet of the Northern Pacific Railroad culvert lack suitable spawning habitat for fish living in this system. Additionally, this portion of Swan Creek does not have suitable substrate to foster invertebrate communities. Based on this information, the enhancement plan for Swan Creek will include the creation of a 530-ft, meandering spawning and rearing channel for coho salmon (*Oncorhynchus kisutch*) and possibly cutthroat trout (*O clarki*). This channel will connect Swan Creek with the Haire Wetland, and will provide coho and cutthroat trout rearing habitat for both summer and winter months. Off-channel winter and summer habitat has been shown to increase coho smolt production (Everest et al. 1985). The enhancement plan also will call for adding gravel and cobble substrate to Swan Creek to enhance the invertebrate populations, which will increase the food available to fish in the system. Additionally, a flow constrictor structure will be placed in conjunction with the cobble and gravel substrate to increase flow, which will flush out fine sediment and slow the sedimentation process.

VEGETATION

Before conducting the site reconnaissance to characterize vegetation of the project area, Pentec reviewed the following sources of information to better understand land use, soils, geology, and site conditions within the Swan Creek watershed that may influence final design of the wetland and stream restoration:

- Pierce County Wetland Atlas (1987)

- Soil Survey of Pierce County, Washington (Zulauf 1979)

- National Wetlands Inventory, Puyallup, Washington, Quadrangle (US Fish and Wildlife Service [USFWS] 1988US Department of Interior 1988)

Methods

Vegetation communities were distinguished by dominant plant species, habitat structure, topography, and apparent hydrologic regime. An area was identified as a wetland if it exhibited the following three characteristics: (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology. Wetland plant communities were classified according to the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). The location and geographic extent of each community was determined by visual estimation and the use of a base map carried during the field investigation. Identification of some plant communities as wetlands is tentative, and will be confirmed using the information gathered during the jurisdictional wetland delineation performed by the City of Tacoma.

Although these plant communities are represented as distinct units, community boundary lines are approximate and are not always abrupt or distinct in the field. This is due to interspersion of plant species between adjacent vegetation communities. In addition, the degree to which the vegetation communities are distinguished from each other varies across the site.

Results

The Haire Wetland and riparian vegetation associated with Swan Creek cover most of the site. In total, eight plant communities were identified within the project area (Figure 3). The communities classified as wetland appeared to meet the criteria for hydrophytic vegetation, hydric soils, and wetland hydrology. The general characteristics of these communities, including plant community composition, topography, soils, and hydrology, are described in this section. In addition, the wildlife habitat and known or likely species present on the site are discussed.

Community A

Community A is an approximately 1-acre upland area located in the southernmost portion of the site. This community is bounded by Pioneer Way to the south and west and Swan Creek to the east.

Much of the area contains a mature, second-growth forest dominated by broad-leaved deciduous trees. It has a fairly open canopy (approximately 50 percent cover) and little undergrowth due in part to the area's abundant dirt and gravel driveways. Black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) is dominant in this community, but scattered throughout are mature Douglas fir (*Pseudotsuga menziesii*), red alder (*Alnus rubra*), and pine (*Pinus* sp.) trees, and a few immature big-leaf maple (*Acer macrophyllum*) and spruce (*Picea* sp.) trees. English ivy (*Hedera helix*) has infested a few of the mature cottonwood trees. Shrubs, including one-seeded hawthorn (*Crataegus monogyna*), cherry laurel (*Prunus laurocerasus*) and red-osier dogwood (*Cornus sericea*) are scattered in this area too. Dense patches of invasive species, including Himalayan blackberry (*Rubus discolor*) and Scot's broom (*Cytisus scoparius*) occur in this community. One patch of Himalayan blackberry is adjacent to Swan Creek. Several large black cottonwood snags also exist in this area. These will either be saved as standing snags or possibly cut down and used as habitat features in the constructed channel or left in upland areas. In addition, this community includes a small area dominated by bentgrass (*Agrostis* sp.) and tall fescue (*Lolium arundinaceum* formerly *Festuca arundinacea*).

Three structures exist within this community, including an approximately 2,500-ft^2 smokehouse, an approximately 120-ft^2 gray shack, and an approximately 1,500-ft^2 white shack. In addition, an approximately 400-ft^2 debris pile consisting of wood, concrete, and some kitchen appliances lies in an open area just north of the white shack. The smokehouse is offsite.

Soil in this community includes fill material from previous development as well as what appear to be well-drained native sandy loam soils. In driveways and around structures, the soil is dense and compacted. Although lower-lying portions of this area adjacent to Swan Creek may occasionally flood from overbank flows, there was no evidence of hydric soil development anywhere in this community.

Community B

Community B is an approximately 3-acre wetland community located in the center of the site. This community shares a boundary with every community except Community A.

Community B is primarily emergent persistent vegetation (PEM1), interspersed with aquatic bed (PAB) and what appear to be permanently inundated areas with unconsolidated bottom (PUB). Standing water appears to exist all year in the PUB portions of this wetland, though water level seems to fluctuate throughout the year. The dominant plant species in the emergent areas are mild waterpepper (*Polygonum hydropiperoides*) and yellow iris (*Iris pseudacorus*). A few other herbaceous plants exist in this community, including marsh cinquefoil (*Comarum palustre*), wool grass (*Scirpus atrocinctus*), and purple loosestrife (*Lythrum salicaria*). Common cattail (*Typha latifolia*), Sitka willow (*Salix sitchensis*), and water starwort (*Callitriche heterophylla*) also occur in shallow (< 2 ft) areas. Aquatic bed communities are dominated by yellow pondlily (*Nuphar lutea* ssp. *polysepala*) and small patches of floating-leaved pondweed (*Potamogeton natans*), which are found in deeper, possibly permanently inundated areas (approximately 2 to 4 ft deep). Algal blooms were observed in some areas that appeared to be unvegetated and composed of unconsolidated bottom substrate, possibly mud. Pacific willow (*Salix lasiandra*), Sitka willow, hardhack (*Spiraea douglasii*), and red-osier dogwood occur along the shore of the Haire Wetland, on small islands or isolated patches, and in what appear to be seasonally inundated areas along the sides of the wetland.

The small islands or isolated patches also supported immature (or stunted) red alder, and mature salmonberry (*Rubus spectabilis*), lady fern (*Athyrium filix femina*), bentgrasses (*Agrostis* sp.), and bittersweet nightshade (*Solanum dulcamara*). The largest red alder is approximately 35 ft tall and 0.75 ft diameter at breast height (dbh), but most are approximately 25 ft tall and about 0.25 ft dbh. Along the margin of this wetland exist a number of mature and immature black cottonwood trees, some of which are dead and exist as snags. The largest black cottonwood is a decadent specimen on the western shore that has only a few live branches and is approximately 130 ft tall and over 4 ft dbh. Most of the black cottonwoods on the west shore of the Haire Wetland are about 100 ft tall and 1.5 to 2 ft dbh. Floating logs up to about 1-ft diameter are found throughout much of the wetland. Some of these appear to have been felled into the wetland by beaver. Although historic beaver activity was evident, Pentec did not observe any recent evidence of beaver activity, such as cuttings or chewings.

On the north end of the wetland, there are two, 100- to 125 ft arms of the wetland with somewhat different vegetation than the rest of Community B (see Figure 3). The western arm possesses plant species and abundance similar to the main body of Community B, but has more black cottonwood snags. The eastern arm is moderately shaded by trees in adjacent communities and supports relatively less vegetation. Standing water appears fairly deep in the western arm, which is dominated by purple-fringed riccia (*Ricciocarpos natans*), a floating aquatic plant. The east arm is dominated by emergent vegetation such as narrowleaf bur-reed (*Sparganium emersum*) and common cattail. It is approximately 7 ft wide, has shallow water (approximately 0.5 ft) that is fairly turbid (visibility to 2 inches), and has deep, silty soil.

Soil below the ordinary high water mark (OHWM) throughout the wetland appears to be silt- and organic-rich and may best be classified as a muck. Soil above the OHWM appears to be a silt loam with little leaf litter or duff and moderate amounts of organic matter. The OHWM appeared to be approximately 6 inches above the water level observed during the time of the investigation. The standing water was fairly turbid during the investigation, permitting visibility to only a 2-inch depth. However, clear pools existed among the more vegetated areas near the western shore. Iron bacteria was observed in some areas, suggesting that groundwater discharge may be an important source of wetland hydrology.

Community C

Community C is an approximately 1.5-acre upland community located in the southern portion of the site. It covers a portion of the east-facing slope below Pioneer Way, the north-facing slope south of Community B, and a portion of the gently sloping area separating Community B from Swan Creek. This community is bounded by Pioneer Way to the west and Community B to the east.

Community C is a mature, second-growth forest dominated by broad-leaved deciduous trees. It has a fairly open canopy (approximately 50 percent cover) dominated by mature and immature black cottonwood, red alder, and big-leaf maple. These trees are 20 to 100 ft tall and 0.3 to 2 ft dbh. Most mature trees are rooted upslope, but many immature and some mature black cottonwood and big-leaf maple trees exist near the edge of this community and Community B. Himalayan blackberry strongly dominates the understory below the canopy and in the relatively abundant open areas; however, there are well-developed patches of common snowberry

(*Symphoricarpos albus*) throughout the area. Community C is not dominated by hydrophytic vegetation.

Both the east-facing and north-facing slopes are about 20 to 30% along much of their length. These slopes appear to consist of moderately well-drained sandy loam to silt loam soils.

Community D

Community D is an approximately 2.4-acre upland community located in the northwestern portion of the site. This community is bounded by Pioneer Way to the west and Communities B and E and the railroad tracks to the east. This community extends off site to the north.

Community D is a mature, second-growth forest dominated by broad-leaved deciduous trees. It has a relatively closed canopy (approximately 80 percent cover) dominated by mature big-leaf maple. A few mature black cottonwoods are scattered throughout the community. Both the big-leaf maples and the black cottonwoods are about 80 to 100 ft tall and about 1 to 2 ft dbh. Many of the black cottonwoods are infested with English ivy. Several immature and mature black cottonwood and big-leaf maple trees exist along the edge of this community near the border of Community B. These trees are 70 to 100 ft tall with 1 to 2-ft dbh.

Beneath the forest canopy is a well-developed shrub stratum dominated by common snowberry. Also present in this stratum are Indian plum (*Oemleria cerasiformes*), Himalayan blackberry, thimbleberry (*Rubus parviflorus*), and red alder saplings. The herb layer, which is very sparse, is dominated by sword fern (*Polystichum munitum*) and trailing blackberry (*Rubus ursinus*).

Most of this community is situated on an east-facing slope that ranges in slope from approximately 5 to 30 percent. Soil in this community was similar to that observed in Community C.

Community E

Community E is an approximately 0.6-acre wetland community located in the northern portion of the site. This community is bounded by Communities B and D to the west and Community F, Swan Creek, and the train tracks to the east.

Community E is a mature, second-growth palustrine forested wetland (PFO1) dominated by broad-leaved deciduous trees. The canopy is dominated by mature black cottonwood and red alder and total vegetation cover is estimated to be over 100 percent. Cover is over 100 percent because of the different tiers of vegetation within this community, including shrubs and trees. The black cottonwood trees are 100 to 120 ft tall and 1 to 2 ft dbh, whereas the red alder trees are 80 to 100 ft tall and 1 to 2 ft dbh. There is also a well-developed midlevel stratum that is dominated by salmonberry. Because of the dense tree and shrub cover, there is no herb layer in this community.

The ground surface is fairly level, but shows evidence of overbank deposition near the creek and pit-and-mound topography farther from the creek. The soil appears to be a hydric silt loam. The source of wetland hydrology in this community appears to be seasonally high groundwater, but may also include periodic overbank flooding from Swan Creek.

Community F

Community F is an approximately 2-acre wetland community oriented parallel to Swan Creek. This community is bounded by Community B to the west and the train tracks to the east.

Community F is a mature, second-growth palustrine forested wetland dominated by broad-leaved deciduous trees. The canopy is dominated by mature Pacific willow, black cottonwood, and red alder trees. Cover is estimated to be over 100 percent. Cover is over 100 percent because of the different tiers of vegetation within this community, including herbs, shrubs, and trees. Most of the trees are 80 to 120 ft tall and 1 to 2-ft dbh. The midstory layer is fairly well developed and dominated by Sitka willow, but also contains common snowberry, Himalayan blackberry, and red-osier dogwood. Bittersweet nightshade is found growing on many of these shrubs, especially in the more open areas. Communities of herbaceous vegetation present, including reed canarygrass (*Phalaris arundinacea*) and marsh skullcap (*Veronica scutellata*), also occur in this area. Reed canarygrass is generally confined to more open areas, whereas marsh skullcap occurs in discrete patches in more shaded areas.

The ground surface is fairly level, but a berm produced by overbank deposition and incision exists near the creek, and pit-and-mound topography produced by tree-fall exists farther from the creek. The soil is likely hydric and appears to be a loam with moderate amounts of organic

matter. Overbank flooding and seasonally high groundwater levels likely are the dominant sources of wetland hydrology.

Community G

Community G is composed of two separate wetland communities that cover approximately 1.2 acres. The northern portion is bounded by Community F to the west and south and the train tracks to the east. The southern portion is bounded by Community F to the west and the train tracks to the north.

Community G is an emergent wetland community dominated by persistent emergent vegetation (PEM1). Reed canarygrass is the only plant species found growing in this community. Several black cottonwood snags ranging from 20 to 100 ft in height were found in both the northern and southern areas containing this community. At least two small (15- to 25-ft-diameter) pools of open water up to 3 ft deep were observed in this community.

The topography in these areas is relatively level and may be the result of flood plain processes. The soil appears to be a silt loam. The source of wetland hydrology in this community appears to be from seasonally high groundwater table and periodic overbank flooding from Swan Creek.

WILDLIFE HABITAT

Swan Creek, the Haire Wetland complex (including Communities B, E, F, and G), and adjacent forested uplands (including Communities A, C, and D), support a diverse array of habitat for fish and wildlife. However, many of these habitats provide relatively limited value due, in part, to relatively low structural and habitat diversity. Dense communities of invasive species, including Himalayan blackberry and reed canarygrass, contribute to the relatively low structural diversity and diminished habitat values.

The wetland on site contains a number of different wetland vegetation classes and habitat types, including forested, emergent, and unconsolidated bottom. Also, there are some other specific habitat features within the wetland complex, including snags, LWD, and apparently permanently inundated areas (sometimes called open water). These features are most abundant in Community B. The relatively large size, edge habitat, and continuity with mature forested