Washington County
Local Wetland and Riparian Inventory for the Bonny Slope West Urban Growth Boundary (UGB) Expansion Area

Prepared for

Washington County Department of Land Use & Transportation
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1.0 INTRODUCTION

The Washington County Department of Land Use & Transportation hired Pacific Habitat Services, Inc. (PHS) to conduct a Local Wetlands and Riparian Inventory (LWI) for Bonny Slope West, an area brought into the Urban Growth Boundary (UGB) in 2002. Bonny Slope West was transferred from Multnomah County to Washington County on January 1, 2014. Washington County is collecting information about Bonny Slope West in preparation for the development and adoption of an urbanization plan for the area. The Bonny Slope West study area is located west of the City of Portland and north of the City of Beaverton. The subject parcels are situated north of NW Thompson Road and east of NW 125th Avenue. NW Laidlaw Road passes through the northern portion of the study area and defines its southeastern edge. There are 75 contiguous tax lots included in the Bonny Slope West study area (approximately 160 acres). The study area is shown on Figure 1 (Appendix A).

The goal of the study was to address the wetland requirements of Statewide Planning Goal 5 (*Natural Resources, Scenic and Historic Areas, and Open Spaces),* Oregon Administrative Rule (OAR) Section 660, Division 23. The objective of Goal 5 is to "protect natural resources and conserve scenic, historic and open space resources for present and future generations."

1.1 Report Format

This report begins with definitions used in the report and inventory (Section 2). Section 3 includes a discussion of the methodology used to conduct the field work for the LWI; the wetland assessment methodology; and the methodology used to produce the maps for the inventory. Section 4 is a brief discussion of project cartography. Section 5 describes general conditions within the study area, addressing climate, topography, soils and vegetation. Section 6 is a more detailed discussion of wetlands within the study area and addresses wetland acreage and Cowardin classification. Section 7 discusses the results of the *Oregon Freshwater Wetland Assessment Methodology* and Section 8 lists Locally Significant Wetlands in the study area. Section 9 presents the results of the Riparian Corridor study. Section 10 presents staff qualifications. Section 11 provides a list of the references used in the report.

There are six appendices to the report. Appendix A contains figures illustrating general location (Figure 1), soils (Figure 2), and National Wetland Inventory map (Figure 3) of the study area. The report figures are followed by the LWI map (Figures 4-4C) and a riparian inventory map (Figure 5).

Appendix B contains the wetland summary sheets for each wetland, organized by wetland code. The summary sheets note wetland location, tax lots, acreage, Cowardin classification, Hydrogeomorphic (HGM) classification, soil series, wetland and adjacent upland vegetation, and other unique or clarifying notes related to the wetland. Locally significant wetlands are also noted on the wetland summary sheet. A wetland summary sheet was completed for each wetland unit (including wetland units of greater than or less than one-half acre in size).

Sample points were collected for wetland units greater than one-half acre in size. Sample point numbers are noted on the wetland summary sheets, and the wetland determination data forms for each sample point are included in Appendix C. These data forms document wetland and upland conditions where access was granted for wetlands greater than one-half acre in size. Hydrology, soils, and dominant vegetation are recorded for each sample point where wetland or upland data was collected.

Appendix D is the *Oregon Freshwater Wetland Assessment Methodology* (OFWAM) data and summary for each wetland unit. Each wetland's functions and conditions are assessed according to an established state methodology. The results and rationale are also summarized for each wetland unit.

Appendix E contains the determination of significance for each wetland unit.

Appendix F includes OFWAM field forms and watershed summary tables that aided in answering many of the questions in OFWAM.

Appendix G includes riparian data forms and results sheets.

2.0 DEFINITIONS

These terms helped define the methodology used for the Bonny Slope West Local Wetlands and Riparian Inventory and may be referred to in this report.

1987 Manual and Regional Supplement

The primary source documents for wetland delineations within Oregon is the *Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0).* (Regional Supplement; U.S Army Corps, 2010).

These manuals are used by the Army Corps of Engineers ("Corps") and the Oregon Department of State Lands ("DSL") to document the location of wetlands within the State of Oregon. The 1987 manual, along with regional supplement, provide technical criteria, field indicators, and recommended procedures to be used in determining whether an area is a jurisdictional wetland. Undisturbed areas require three criteria for them to be classified as wetland. These criteria are hydric soils, a dominance of hydrophytic vegetation, and wetland hydrology.

Cowardin Wetland Classification

The classification of wetlands as defined by plants, soils and the frequency of flooding is described in "*Classification of wetlands and deepwater habitats of the United States."* (Cowardin, et. al. 1979) See also "Palustrine Wetlands".

Visually confirm or visual confirmation

To walk over and/or visually check an area to make a wetland determination and map wetlands and other waters (OAR 141-086-0200 (16)).

Goal 5

Goal 5 (OAR 660, Division 23) is intended "to protect natural resources, and conserve scenic and historic areas and open spaces." (LCDC, 1996)

Growing Season

The growing season has begun and is ongoing when either of the two following conditions is met:

1) Two or more non-evergreen vascular plant species growing in the wetland or surrounding areas exhibit one or more of a specific list of indicators of biological activity (such as leaf emergence; appearance of new growth; emergence or opening of flowers; etc.)
2) When soil temperature measured at a depth of 12 inches is 41ºF (5ºC) or higher

Hydric Soils

Soils “that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (NRCS, 2013).

Periodic saturation of soils causes alternation of reduced and oxidized conditions which leads to the formation of redoximorphic features (gleying and mottling). Mineral hydric soils will be either gleyed or will have bright mottles and/or low matrix chroma. The redoximorphic feature known as gley is a result of greatly reduced soil conditions, which result in a characteristic grayish, bluish or greenish soil color. The term mottling is used to describe areas of contrasting color within a soil matrix. The soil matrix is the portion of the soil layer that has the predominant color. Soils that have brightly colored mottles and a low matrix chroma are indicative of a fluctuating water table.

Hydric soil indicators include: organic content of greater than 50% by volume, sulfidic material or “rotten egg” smell, and/or presence of redoximorphic features and dark soil matrix, as determined by the use of a Munsell Soil Color Chart. This chart establishes the chroma, value and hue of soils based on comparison with color chips. Mineral hydric soils usually have a matrix chroma of 2 or less in mottled soils, or a matrix chroma of 1 or less in unmottled soils.

Hydrogeomorphic (HGM) Wetland Classification

A method of assessing wetlands using the physical, chemical, and biological functions of wetlands. It is based on the relationship of geomorphic setting, water source, and hydrodynamics. (Brinson, 1993)

Hydrophytic Vegetation

"Plant life growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content." (National Resource Council, 1995)

The U.S. Fish and Wildlife Service, in the *National List of Plant Species that Occur in Wetlands*, has established five basic groups of vegetation based on their frequency of occurrence in wetlands. These categories, referred to as the "wetland indicator status," are as follows: obligate wetland plants (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU), and obligate upland (UPL).

Local Wetlands Inventory (LWI)

An inventory of all wetlands within a local jurisdiction using the standards and procedures of OAR 141-086-0180 through 141-086-0240.

In 1989, the Oregon State legislature authorized DSL to develop a statewide wetlands inventory for planning and regulatory purposes. Accordingly, DSL established Local Wetlands Inventory (LWI) standards and guidelines under ORS 196.674. An approved LWI replaces the National Wetlands Inventory map (see Figure 3 in Appendix A) and is incorporated into the statewide wetlands inventory.

An LWI is conducted using color or color infrared aerial photographs taken within 5 years of the inventory initiation and at a minimum scale of 1 inch = 400 feet (1" = 400'). Wetlands are located using the on-site option where access to property is allowed or off-site where access is denied. Wetlands can be mapped off-site by using information such as topographic and National Wetlands Inventory maps, aerial photographs, and soils surveys.

The approximate location of wetlands is placed on a parcel-based map. The parcel-based map allows the property owner, the local jurisdiction, and DSL, to know which tax lots may contain wetlands.

The maps and documents produced for the LWI are intended for planning purposes only. Mapped wetland boundaries are accurate to within 5 meters; however, there may be unmapped wetlands that are subject to regulation. In all cases, actual field conditions determine wetland boundaries.

Palustrine Wetlands (e.g. PEM)

"All nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens and all such wetlands that occur in tidal areas where salinity is less than 0.5%. This includes areas traditionally called swamps, marshes, fens, as well as shallow, permanent or intermittent water bodies called ponds." (Cowardin et. al. 1979)

- **Palustrine Unconsolidated Bottom (PUB)**

A wetland or deepwater habitat with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%.

- **Palustrine Emergent Wetland (PEM)**

These wetlands have rooted herbaceous vegetation that stand erect above the water or ground surface.

- **Palustrine Scrub-shrub Wetland (PSS)**

Wetlands dominated by shrubs and tree saplings that are less than 20 feet high.

- **Palustrine Forested Wetland (PFO)**

Wetlands dominated by trees that are greater than 20 feet high.

Probable Wetland (PW)

An area noted during the course of LWI field work that appears to meet, or does meet, wetland criteria but is small and of undetermined size, and is mapped as a point rather than a polygon on the LWI maps. Probable wetlands may be identified in the inventory through the use of the abbreviation '-PW'.

Riparian Area

"The area immediately adjacent to a water resource, which affects or is affected by the water resource. Riparian areas do not include the water resource itself." (PHS, 1998)

Riverine System

"The riverine system includes all wetlands and deepwater habitats contained within a channel." (Cowardin, et. al. 1979)

Waters of this State

"All natural waterways, tidal and nontidal bays, intermittent streams, constantly flowing streams, lakes, wetlands, that portion of the Pacific Ocean that is in the boundaries of this state, all other navigable and nonnavigable bodies of water in this state and those portions of the ocean shore, as defined in ORS 390.605, where removal or fill activities are regulated under a state-assumed permit program as provided in 33 U.S.C. 1344(g) of the Federal Water Pollution Control Act, as amended. " (ORS 196.800 (15))

Water Resource

"An intermittent or perennial stream, pond, river, lake including their adjacent wetlands." (PHS, 1998)

Wetland

"Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." (Federal Register 1982).

Wetland Assessment

Determining the relative quality of a wetland by assessing its functions and conditions. The methodology generally used to determine the relative quality of wetlands for purposes of an LWI is the *Oregon Freshwater Wetland Assessment Methodology*. (Roth, et. al. 1996)

Wetland Condition

"The integrity of a wetland's physical and biological structure. This determines the ability of the wetland to perform specific functions, as well as its resilience and enhancement opportunities." (Roth et al., 1996)

Wetland Function

"A characteristic action or behavior associated with a wetland that contributes to a larger ecological condition such as wildlife habitat, water quality and/or flood control." (Roth, et. al. 1996)

Wetland Hydrology

"Permanent or periodic inundation or prolonged soil saturation sufficient to create anaerobic conditions in the upper soil profile." (COE, 1987)

Wetland hydrology is related to duration of saturation, frequency of saturation, and critical depth of saturation. The Regional Supplement defines wetland hydrology as 14 or more consecutive days of flooding or ponding, or a water table 12 inches or less below the soil surface, during the growing season at a minimum frequency of 5 years in 10.

Wetlands Regulation

Wetlands in Oregon are regulated by the Department of State Lands (DSL) under the Removal-Fill Law (ORS 196.800-196.990) and by the U.S. Army Corps of Engineers (Corps) through Section 404 of the Clean Water Act.

Wetland Unit

An area noted during the course of LWI field work that appears to meet, or does meet, wetland criteria. Wetland units include areas that are greater than or less than one half of an acre in size and are mapped as polygons on the LWI maps. The quality/condition of wetland units was determined by applying the Oregon Freshwater Wetland Assessment Methodology (OFWAM; see Section 3.3) where appropriate. Wetland units were then evaluated to determine whether they are locally significant by applying the criteria contained in State administrative rules (OAR 141-086-0300-0350).

3.0 PROJECT METHODOLOGY

3.1 Public Involvement

Prior to beginning the inventory field work, landowners within the Bonny Slope West study area were mailed notices describing the project and asking permission to enter their property. Right of access was granted to PHS by landowner permission only. The properties of those not responding were not accessed. Access information was collected in a database by Washington County and provided to PHS for incorporation into project field maps.

Washington County maintains a Bonny Slope West project website accessible through their Land Use and Transportation Department website. The website provides general information for the Bonny Slope West project, as well as various maps, documents, and related links. The website also provides a forum for online public comments and the opportunity for community members to sign up to receive project updates.

Washington County hosted an open house for the Bonny Slope West project on April 10, 2014. The open house was a forum for citizens to discuss the previous Multnomah County Concept Plan and help guide the creation of Washington County plans based on community interests and planning constraints. The County held additional public meetings on October 21, 2014, and January 26, 2015. At these subsequent open house meetings, the County presented the planning work to date, the preliminary results of the wetlands and natural resource inventory, and draft Community Plan alternatives. The County will use community feedback gained through these public meetings to form the Draft Community Plan.

A draft LWI for Bonny Slope West was posted on Washington County's website in June 2015. All Bonny Slope West property owners of record were mailed a postcard to notify them of the draft LWI posting and its 30-day comment period. In addition, Bonny Slope West interested parties were sent an e-newsletter to notify them of the draft LWI posting and its 30-day comment period. Washington County received five comments during the 30-day comment period:

- Two property owners asked Washington County staff whether areas within identified riparian corridors would be subject to development restrictions, and Washington County staff responded to those questions;
- One property owner expressed a general concern that wildlife ("deer, coyotes, other creatures") in the area will be displaced by future urban development. PHS addressed wildlife in a Significant Wildlife Habitat memorandum (September 29, 2015);
- One resident to the west of Bonny Slope West stated that Columbia white-tailed deer; cutthroat trout and brook lamprey have been observed in the wetland area within and near Bonny Slope West. PHS addressed wildlife in a Significant Wildlife Habitat memorandum (September 29, 2015);
- One property owner questioned the LWI's mapping of a wetland on his property. PHS confirmed the wetland determination boundaries on this parcel.

3.2 Local Wetlands Inventory Methodology

Within the study area, PHS determined the location of wetlands and assessed the quality/condition of each wetland unit. All mapped wetlands and probable wetlands were determined using off-site and/or on-site determinations (see Section 3.2.1 & 3.2.2 for more details). The quality/condition of wetland units was determined by applying the Oregon Freshwater Wetland Assessment Methodology (OFWAM; see Section 3.3) where appropriate, and then determined whether wetlands were locally significant by applying the criteria contained in State administrative rules (OAR 141-086-0300-0350).

3.2.1 Routine Off-site Determination

Prior to beginning field work, off-site mapping was reviewed to determine the approximate location of wetland boundaries based on available information. This information included the USGS topographic quadrangles, soil survey maps for Washington County, the *National Wetlands Inventory* maps, Washington County's digital aerial imagery (6-inch pixel, high resolution), and when available, existing DSL files.

If access was allowed, the property was walked over and wetland boundaries were visually confirmed (see Section 3.2.2). If access was not granted, the boundaries were based on the mapping conducted in the office, or on the observation of wetland boundaries from adjacent roads, right-of-ways, or properties, if possible. Some of the larger wetlands may have been partially visually confirmed, denoting access to and/or visual confirmation of a portion, but not all of the wetland.

3.2.2 Routine On-site Determination

Where property access permission was granted, on-site observation and inspection of soils, vegetation, and hydrology were made using the required methodology outlined in the Regional Supplement of the 1987 Manual. Soil pits were excavated up to a depth of approximately 18-inches in selected locations. The soil profiles were examined for hydric soils and wetland hydrology field indicators.

A visual percent-cover estimate of the dominant species of the plant community for a maximum 30-foot radius was conducted at each sampling location. Sampling locations were chosen to document a change in the wetland boundary and a particular plant community. Data was recorded in the field and transferred to computer-generated wetland delineation data sheets (Appendix C).

Field work for the inventory was conducted between June 12, 2014 and January 29, 2015. No wetland boundaries were staked or flagged in the field as part of this LWI. If access was granted, a site visit was conducted on the property, regardless of the status or date of any previous DSL files for a parcel. As many parcels included permission only if site visits were scheduled in advance, additional follow up was necessary.

3.3 Wetland Quality Assessment

3.3.1 The *Oregon Freshwater Wetland Assessment Methodology*

The quality of wetland units in the study area was assessed using the *Oregon Freshwater Wetland Assessment Methodology* (OFWAM) (Roth et al. 1996). OFWAM was developed by an interagency committee to assess the relative quality of wetlands primarily for planning and educational purposes. OFWAM does not assign a numeric ranking to the wetlands, but does determine the relative quality of six functions and three conditions for each of the wetlands. A description of each of the functions to be assessed by DSL is included below. The three conditions; *Sensitivity to Impact, Enhancement Potential,* and *Aesthetic Quality,* are part of the OFWAM but are not required as part of the inventory process for DSL; these conditions were therefore not assessed.

Wetland Functions

Wildlife habitat: Evaluates the habitat diversity for species usually associated with wetlands, without emphasizing one particular species. Wetlands assessed by OFWAM can provide diverse habitat for wildlife, habitat for some wildlife species, or does not provide habitat.

Fish habitat: Evaluates how a wetland contributes to fish habitat in streams, ponds or lakes associated with a wetland. The questions are suitable for both warmwater and coldwater fish, and no particular species is emphasized. Wetlands assessed by OFWAM can have fish habitat function intact, impacted or degraded, or lost or not present. Only wetlands with water bodies with the potential for fish habitat were assessed for this function; ponds used solely for irrigation purposes were not assessed for fish habitat.

Water Quality: Evaluates the potential of a wetland to reduce the impacts of excess nutrients in storm water runoff on downstream waters. A wetland's water quality function can be assessed by OFWAM as intact, impacted or degraded, or lost or not present.

Hydrologic control: Evaluates the effectiveness of a wetland to reduce downstream flood peaks and store floodwaters. A wetland's hydrologic control functions can be assessed by OFWAM as intact, impacted or degraded, or lost or not present.

Education: Evaluates the suitability of a wetland to provide educational opportunity and act as an "outdoor classroom." A wetland assessed by OFWAM can have educational uses, have the potential to provide, or not be appropriate for educational uses.

Recreation: Evaluates the suitability of a wetland and associated watercourses for non-powered boating, fishing, and similar recreational activities. A wetland assessed by OFWAM can provide, have the potential to provide, or not provide recreational opportunities.

3.3.2 Wetlands of Special Interest for Protection

The first filter in OFWAM is to determine whether the wetland is in a management plan, is protected by regulatory rules or statutes, or is uncommon in Oregon. Ten questions are answered for each wetland and a "yes" answer to any of the questions puts the wetland into the "special interest for protection" category. If the wetland falls into this category, it is noted on the wetland characterization sheet.

3.3.3 Field Methodology

During the process of determining the boundaries for the LWI, data was also collected for the process of determining its relative quality. Data collected for this purpose is explained in the *Wetland Characterization* section of OFWAM. Data collected in the field included the Cowardin classes, the types of disturbance (if any) in the wetland area, the hydrology of the wetland area (e.g. the location of constrictions), the presence of fish, large woody debris, the degree of vegetative cover, and other information necessary to complete the assessment of the wetland in the office.

If the wetland determination was off-site, the OFWAM section and wetland characterization was based on review of the aerial photographs and knowledge of other similar or adjacent wetlands.

3.3.4 Office Assessment

Subsequent to the field work, the data collected for each wetland were used to answer questions for each function and condition. Additional information on the wetlands, the landscape and the general area were gathered in the office. The answers within each function and condition section of the methodology were entered into a computer spreadsheet, which automatically displays the results of the assessment methodology.

4.0 CARTOGRAPHY

Natural color, ortho-rectified digital aerial imagery was obtained from Washington County for use in the field. These photos are 6-inch pixel high resolution, taken during a 2013 flight. Preliminary wetland boundaries and data point locations were drawn directly onto field maps at the time of assessment. In addition to the aerial background, these field maps included tax lots, topography, and status of site access. A second set of maps of the study area also included mapped soils, as well as National Wetland Inventory mapping. Wetland boundaries were drawn onto the first set of maps, and are intended to be accurate to within 5 meters. The wetland boundaries were transferred into a digital format and inserted into a computer-based map derived from GIS data provided by Washington County.

Each wetland was assigned a code beginning with a letter code associated with the name of the drainage basin or tributary (WC for Ward Creek, WLC for Willow Creek, and T for tributary) and ending with a unique number between 1 and the total number of wetlands in the study area. Small potential wetlands that could not be accurately assessed are shown on the maps with a designation of "probable wetland" (PW).

Additional layers added to the GIS base map included streams with stream names (when known) or assigned stream names, wetland codes, and sample point locations. The final maps include the location of all streams and wetlands (those assessed with OFWAM and PW's). They also include the location of sample points, legend, north arrow, scale, and a DSL required disclaimer.

5.0 STUDY AREA CHARACTERISTICS AND EXISTING INVENTORY INFORMATION

5.1 Setting

The Bonny Slope West study area is approximately 160 acres that became part of Washington County on January 1, 2014. The unincorporated community was previously under the jurisdiction of Multnomah County. The study area is characterized by low density development, natural resource areas, and undeveloped land.

5.2 Topography

The Bonny Slope West study area is situated on the western flank of the Tualatin Hills (Figure 1). General site topography is moderately sloped to the northwest, with very steep slopes (greater than or equal to 25 percent) in the ravines cut by Ward Creek and its tributaries. Ground elevations range from approximately 580 feet North American Vertical Datum of 1988 (NAVD88) in the northeastern corner of the site to approximately 310 feet NAVD88 in the northwest where Ward Creek flows out of the study area. Nearly all of the Bonny Slope West study area drains to Ward Creek, with the exception of the southwestern corner, which drains toward Willow Creek to the south.

5.3 Hydrology

5.3.1 Hydrologic Features of Bonny Slope West Area

Hydrologic features within the study area include Ward Creek and six unnamed tributaries. With the exception of Tributary 3, which is intermittent, Ward Creek and tributaries are presumed to be perennial based upon the confirmed presence of flowing water into August 2014. Ward Creek flows northwest through the central portion of the study area, south of the right-of-way for NW Old Laidlaw Road. Tributary 1 flows northwest in the southeastern portion of the study area, draining to Ward Creek immediately south of the intersection of NW Laidlaw Road and NW Old Laidlaw Road. Tributary 2 is conducted into the study area through a culvert under NW Laidlaw Road, where it drains directly into Tributary 1. Tributaries 3, 4, and 6 flow southwest towards the northern bank of Ward Creek. Tributaries 3 and 4 pass under NW Old Laidlaw Road and Tributary 6 passes under NW Laidlaw Road via culverts. The culvert that conducts Tributary 6 under NW Laidlaw Road discharges 10 to 15 feet above its ordinary high water. As such, the culvert is considered a fish passage barrier. Tributary 5 flows north towards the southern bank of Ward Creek.

Streams in the study area were part of the base map used for field work. Washington County and Metro provided LiDAR and mapping that identified the approximate location of the larger streams. As part of the field work, PHS reviewed the LiDAR and stream mapping and modified it as necessary to more appropriately identify the actual location of existing waterways. This included adding stream segments where none were previously mapped and moving stream sections that were inaccurately placed.

5.3.2 Watershed Designation

Watersheds within the study area are defined by the boundaries of the 6th field hydrologic unit (HUC). The entire study area is located within the Beaverton Creek 6th field HUC (170900100401). The majority of the study area, including all six unnamed tributaries (abbreviated as T1 through T6) drains to Ward Creek (WC), with only the southwestern corner draining toward Willow Creek (WLC). Ward Creek is a tributary to Bronson Creek, Willow Creek and Bronson Creek are tributaries to Beaverton Creek.

5.4 Natural Resource Conservation Service Soils

Soil units mapped within the Bonny Slope West project area are primarily Cascade silt loam, with smaller areas of Cornelius silt loam and Helvetia silt loam. None of the mapped soil units is considered hydric, though Cornelius silt loam and Helvetia silt loam have minor hydric components comprising less than five percent of the overall map unit area.

6.0 LWI DISCUSSION AND CONCLUSIONS

6.1 U.S. Fish & Wildlife Service National Wetland Inventory

The U.S. Fish and Wildlife Service, as part of the National Wetlands Inventory (NWI) program, have mapped wetland in the study area (Figure 3). The NWI maps are generated primarily on the basis of interpretation of relatively small-scale color infrared aerial photographs (e.g., scale of 1:58,000) with limited "ground truthing" conducted to confirm the interpretations.

The only mapped feature shown on the digital version of the NWI maps are Ward Creek and Tributary 1. The paper NWI map only shows Ward Creek as a riverine, intermittent, stream bed, seasonally flooded (R4SBC) feature. The location as shown on the NWI agrees well with the actual location.

6.2 Local Wetlands Inventory Results

6.2.1 Wetland Acreage and Distribution

Six wetlands were identified during the LWI with a total area of 3.97 acres (Figures 4-4C). One wetland totaling 2.66 acres (mapped as WC-W-1) was identified along Ward Creek and Tributary 5 in the central portion of the study area. Five wetlands, each with an individual area of less than 0.5 acre (mapped as WC-W-2(a-d), T4-W-1, T6-W-1, T6-W-2, and WLC-W-1) were also identified within the study area. The combined area of these smaller wetlands is 1.31 acres.

There are also three small potential wetlands (PW's), which were not included in the overall wetland acreage. As can be seen on the overview map of wetlands in the Bonny Slope West study area, five of the six wetlands are immediately adjacent to waterways. These wetlands are most often directly associated with stream channels, though wetland T4-W-1 defines the headwater area for Tributary 4.

Wetland WLC-W-1 is in the southwestern portion of the study area, south of NW Thompson Road. It enters a storm drain near the southwestern corner of the study area. Based on the evaluation of local topography, WLC-W-1 historically drained to Willow Creek south of the study area.

6.2.2 Wetland Classification

Tables 1 and 2 summarize the Cowardin classifications for wetlands in the LWI study area. Table 1 includes the total acreage of each wetland class; Table 2 includes the acreage of Cowardin classification for each wetland.

Table 1. Types of Wetlands within the Bonny Slope West LWI Study Area

Cowardin Classification	Area (acres)	Percent of Wetlands
Palustrine forested (PFO)	3.16	80%
Palustrine scrub-shrub (PSS)	0.03	1%
Palustrine emergent (PEM)	0.78	19%
Total	**3.97**	**100**

Each wetland was classified according to the Cowardin system. The palustrine forested (PFO) class is by far the most dominant type within the study area at 80 percent, totaling 3.16 acres. The palustrine scrub-shrub (PSS) class is found in only one wetland (WLC-W-1) within the study area, comprising 1 percent (0.03 acres) of the total wetland acreage. Palustrine emergent (PEM) wetlands or portions of wetlands comprise 19 percent (0.78 acre) of the total wetland acreage. Only one PEM area within wetland WC-W-1 was large enough to be mapped as a sub-area within the wetland unit. All other PEM areas within wetlands were indistinguishable at the mapping scale.

Table 2. Cowardin Classification of Wetland Units in the Bonny Slope West LWI Study Area

Wetland Code	USFWS Wetland Classification			Total Acreage
	PFO	PSS	PEM	
WC-W-1	2.44		0.22	2.66
WC-W-2(a-d)	0.27			0.27
T4-W-1			0.29	0.29
T6-W-1	0.24		0.03	0.27
T6-W-2	0.21		0.21	0.42
WLC-W-1		0.029	0.031	0.06
TOTAL	**3.16**	**0.03**	**0.78**	**3.97**

7.0 OREGON FRESHWATER WETLAND ASSESSMENT METHODOLOGY RESULTS

7.1 Wetland Quality Assessment

An assessment of the quality for the wetlands identified through the inventory was conducted using the *Oregon Freshwater Assessment Methodology* (OFWAM) (Roth et al, April 1996). Appendix D contains OFWAM data and results for the wetlands assessed by the methodology.

Although OFWAM provides qualitative information on the relative value of wetlands and does not have a numerical ranking, numbers were assigned to the assessment criteria to easily compare the results. A number 1 was assigned to wetlands receiving the highest function or condition result (e.g. intact, diverse), a number 3 was assigned to the wetlands receiving the lowest result (lost or not present, not appropriate), and a number 2 was assigned to the results which do not fit the other criteria (potential, impacted or degraded). This system is summarized in Table 3.

Table 3. Key to the Oregon Freshwater Wetland Assessment Methodology Numerical Ranking

Wildlife Habitat	1. *Wetland provides diverse wildlife habitat* 2. *Wetland provides habitat for some wildlife species* 3. *Wetland does not provide wildlife habitat*
Fish Habitat	1. *Wetland's fish habitat function is intact* 2. *Wetland's fish habitat function is impacted or degraded* 3. *Wetland's fish habitat function is lost or not present*
Water Quality	1. *Wetland's water-quality function is intact* 2. *Wetland's water-quality function is impacted or degraded* 3. *Wetland's water-quality function is lost or not present*
Hydrologic Control	1. *Wetland's hydrologic control function is intact* 2. *Wetland's hydrologic control function is impacted or degraded* 3. *Wetland's hydrologic control function is lost or not present*
Education	1. *Wetland has educational uses* 2. *Wetland has potential for educational use* 3. *Wetland is not appropriate for educational use*
Recreation	1. *Wetland provides recreational opportunities* 2. *Wetland has the potential to provide recreational activities* 3. *Wetland is not appropriate for or does not provide recreational opportunities*

Table 4 shows the results of the quality assessment conducted on wetland units within the study area. Wetlands that may qualify as a Locally Significant Wetland due to education or recreation use must also be evaluated for those social functions (values). These conditions only apply if the site is publicly owned and used by a school or organization is documented.

Table 4. Oregon Freshwater Wetland Assessment Methodology Numerical Ranking Results for the Bonny Slope West LWI

Wetland Code	Wildlife Habitat	Fish Habitat*	Water Quality	Hydrologic Control	Education	Recreation	Size (acres)
WC-W-1	2	1	2	2	3	3	2.66
WC-W-2(a-d)	2	1	2	3	3	3	0.27
T4-W-1	2	2	2	3	3	3	0.29
T6-W-1	2	2	2	2	3	3	0.27
T6-W-2	1	1	2	3	3	3	0.42
WLC-W-1	2	N/A	2	2	3	3	0.06

Wetland T6-W-2 is the only wetland within the Bonny Slope West study area that provides diverse wildlife habitat. Although the wetland is relatively small and does not contain a large area of un-vegetated open water, it is dominated by woody species, has moderate vegetation type interspersion, and is connected to a perennial stream, which connects it to other wetlands in the area. In addition, the surrounding landscape is largely undeveloped and does not contain water quality limited streams. The remaining wetlands provide wildlife habitat for some species. Wildlife habitat in these wetlands is limited by the low level of interspersion of vegetation types and wetland classes, and by its lack of open water. A high degree of interspersion creates a great deal of edges, which provide habitat for a greater diversity of wildlife species. Open water areas are essential to a number of wetland wildlife species, including waterfowl, wading birds, amphibians, and some reptiles.

The fish habitat function of wetlands WC-W-1, WC-W-2(a-d), and T6-W-2 is intact. The adjacent stream is in a natural channel with a direct connection to the wetlands. Vegetation within the wetland provides extensive shade and is a source of large woody debris that provides fish cover within the wetland and the adjacent channel. Water quality in the stream and upstream watershed is good, with low-intensity land use in the surrounding area limiting the amount of surface run-off that reaches the stream. Wetlands T4-W-1 and T6-W-1 fish habitat function is impacted or degraded as the adjacent stream does not support fish species and less than 10 percent of the channel has instream structures. The fish habitat function for wetland WLC-W-1 was not assessed as it has no surface connection to a stream, lake, or pond.

The water quality function for wetland units within the Bonny Slope West study area is considered impacted or degraded. For all but wetland WLC-W-1, this is not a reflection of anticipated poor water quality, but rather the result of good water quality in relatively undeveloped areas. As such, the wetlands have little capacity to enhance or maintain water

quality because the existing quality is not degraded to the point that water quality needs improving. Without the need, the wetlands cannot provide this function. For wetland WLC-W-1, surrounding land use is largely developed, providing the wetland the opportunity to provide a water quality function. However, the wetland is relatively small and has a large proportion of its hydrology from groundwater rather than surface water. The Bonny Slope West Community Plan may allow for urbanization of portions of the study area. The capacity of wetlands within the area to enhance or maintain water quality following urbanization would increase as the contributing watershed would have increased impervious surface area and decreased water quality.

Hydrologic control was also assessed as impacted or degraded in all wetland units within the Bonny Slope West study area. Similar to water quality, for all but wetland WLC-W-1 this is not a reflection of poor hydrologic condition, but rather that the wetlands cannot perform this function and the function is not necessary in the given landscape. Water flow restrictions between the wetlands and adjacent stream that would increase water residence time in the wetlands are absent. The lack of a natural floodplain and the lack of development or agricultural lands within 500 feet upstream and downstream of the wetlands make the hydrologic control function unnecessary. If for example the wetlands were upstream of development, their ability to control floods would be more important and the hydrologic function would increase. Under existing condition there is limited realized benefit of these wetlands' capacity to retain flood water because they are located upstream from areas where flooding is less likely to pose a threat to development or infrastructure and downstream from forested areas that contribute relatively little runoff. In contrast, Wetland WLC-W-1 is surrounded by more development than the other wetlands in the study area. However, the dominance of emergent vegetation, the wetland's small size, and its lack of water outflow restriction impact or degrade the ability of this wetland to perform the hydrologic control function.

As the wetland units within the study area are not on public property, their potential for recreational or educational opportunities is very low.

7.2 Wetlands of Special Interest for Protection

The wetlands were assessed according to the ten questions in this section of OFWAM. These questions are regarding the presence of Federal or State listed threatened, endangered or sensitive species, existing management plans, conservation plans, protected mitigation areas, critical habitat, wetland reserve areas and the presence of uncommon wetland plant communities in Oregon. These questions were answered "no" for all wetlands within the Bonny Slope West study area. Though populations or individuals of several state or federally threatened, endangered, or sensitive species are known to exist within a few miles, the wetland could not be confirmed to contain such species.

8.0 SIGNIFICANT WETLANDS DETERMINATION

8.1 Goal 5 Locally Significant Wetlands Criteria

On September 1, 1996, the Land Conservation and Development Commission adopted a revised Statewide Planning Goal 5. The goal requires local jurisdictions to inventory the natural resources covered under the goal, determine the significance of these resources, and develop plans to achieve the goal. In other words, local jurisdictions must adopt land use ordinances regulating development in and around significant areas.

Local jurisdictions determining significant wetlands must use the criteria adopted by the Oregon Department of State Lands (OAR 141-086-0300). These criteria identify *Locally Significant Wetlands.* The significance criteria are divided into three sections, as shown in Table 5.

Table 5. Criteria for Determining Goal 5 Locally Significant Wetlands

***Exclusions*:**	**A wetland cannot be designated as significant if the answer to any of the criteria below is "Yes".**
1	Is this wetland artificially created entirely from upland and:
a.	created for the purpose of controlling, storing, or maintaining storm water
b.	is used for active surface mining or as a log pond
c.	is a ditch without a free and open connection to natural waters of the state
d.	is less than 1 acre and created unintentionally from irrigation or construction
e.	created for the purpose of wastewater treatment, cranberry production, farm watering, sediment settling, cooling industrial water, or a golf hazard
2	Is the wetland or portion of the wetland contaminated by hazardous substances, materials or wastes as per the conditions of OAR 141-086-0350 1(b)
***Mandatory Locally Significant Wetland Criteria*:**	**A wetland is locally significant if "Yes" is the answer to any of the criteria below.**
1	Does the wetland provide *diverse wildlife habitat*?
2	Is the wetland's *fish habitat function intact*?
3	Is the wetland's *water quality function intact*?
4	Is the wetland's *hydrologic control function intact*?
5	Is the wetland less than 1/4 mile from a water body listed by DEQ as a water quality limited water body (303(d) list) and is the wetland's *water quality function intact, or impacted or degraded*?
6	Does the wetland contain a rare plant community?
7	Is the wetland inhabited by any species listed federally as threatened or endangered, or state listed as sensitive, threatened or endangered?
8	Does the wetland have a direct surface water connection to a stream segment mapped by ODFW as habitat for indigenous anadromous salmonids and is the wetland's *fish habitat function intact, or impacted or degraded*?

Table 5. Criteria for Determining Goal 5 Locally Significant Wetlands (continued)

***Optional Locally Significant Wetland Criteria*:** **Local governments may identify a wetland as significant if "Yes" is the answer to the criteria below**
1 Does the wetland represent a locally unique native plant community and provides *diverse wildlife habitat or habitat for some species* or has an *intact, or impacted or degraded fish habitat function* or has an *intact, or impacted or degraded water quality function* or has an *intact, or impacted or degraded hydrologic control function*.
2 Is the wetland publicly owned and used by a school or organization and does the wetland provide *educational uses*?

The committee that created the Goal 5 significance criteria determined that even relatively small wetlands might provide an important (or major) function in their particular landscape position. For example, a small wetland in an urban area may provide habitat for a rare, threatened, or endangered species.

8.2 Applying Significant Wetland Criteria to the LWI Study Area

8.2.1 Goal 5 Significant Wetlands

Based on the Locally Significant Wetlands criteria, the wetland units WC-W-1, WC-W-2(a-d), and T6-W-2 were determined to be locally significant. These wetlands met the criteria for significance because the fish habitat function is intact, a “mandatory” criteria for significance. Wetland T6-W-2 also provides diverse wildlife habitat, which is also a “mandatory” criteria for significance. The results of the significance evaluation associated with the wetlands can be found in Appendix E. Although probable wetlands within the Goal 5 area are relatively valuable for some functions, they were not assessed for significance due to their small size.

9.0 RIPARIAN CORRIDORS

A "riparian area" is defined as the area adjacent to a river, lake, or stream, consisting of the area of transition from an aquatic ecosystem to a terrestrial ecosystem. A "riparian corridor" is a Goal 5 resource that includes the water areas, fish habitat, adjacent riparian areas, and often wetlands, within the riparian boundary.

Goal 5 Administrative Rules require local governments to inventory and determine significant riparian corridors by following the standard process. Goal 5 does not establish specific criteria for determining significant riparian areas and all water areas may be included and assessed for significance. Local jurisdictions establish their own criteria for significance, but must complete an analysis of environmental, social, economic, and energy (ESEE) consequences that could result from a decision to allow, limit, or prohibit a conflicting use within the riparian resource.

The methods and results of this evaluation are described below.

9.1 Methodology

An assessment of riparian corridor condition was completed via the methodology of the *Urban Riparian Inventory and Assessment Guide* (URIAG) (PHS 1998). This riparian assessment methodology was developed by PHS for DSL. The URIAG was used to determine the riparian width on all streams and waterways. With URIAG, riparian corridors are broken into “reaches” with similar characteristics, such as vegetation patterns or land use. It relies on a combination of available knowledge, field observations, and best professional judgment. Each riparian reach has a right (R) and left (L) side, which is defined by looking downstream. If the riparian information is different for the left and right sides, there are two forms, respectively. If conditions were similar, or comparable on both sides, then there is only one form for a given reach. All of the riparian data forms can be found in Appendix G.

The methodology is comprised of a riparian inventory and a riparian assessment. The riparian inventory involves gathering and assimilating information pertinent to the project site, developing a base map, and completing the riparian characterization form.

The riparian characterization form includes a determination of the riparian width. The riparian width is measured from the edge of the water resource, typically either the top of a streambank or the outer edge of a wetland, lake, or pond. Riparian areas on both sides of a stream channel are assigned separate widths. The potential width of the riparian area is based on the dominant riparian tree species within 100 feet of the water resource. The height of the dominant tree species at maturity is used as a distance to define the outer riparian boundary. The height of the tree species at maturity is called the site potential tree height (SPTH).

SPTH is used as the potential riparian width because it represents a distance in which a tree can still affect the water resource (e.g. provide shade, provide organic material). Where riparian area trees have been eliminated by land-use activities, such as development, farming, or by natural causes, such as landslides, it may be necessary to extrapolate tree heights from a reference site. Although the riparian widths never exceed the potential tree height (PTH), they can be less than the PTH if impervious surfaces or permanent structures (e.g. buildings or roads) are inventoried within the SPTH.

As with the LWI, a part of the riparian inventory process is determining the quality of the riparian area. In URIAG this is accomplished by reviewing functions including water quality, flood management, thermal regulation, and wildlife habitat. The riparian assessment was completed by answering a series of questions for each function. Because certain elements or characteristics of a riparian area are more critical to its function, the answers are "weighted". The points are then totaled for each reach and for each function. The results indicate whether the functional integrity of each riparian area is high, medium, or low. Thirteen riparian reaches were assessed.

9.2 Results

Using URIAG, four tree species were determined to be the dominant native trees within riparian areas within the study area. The majority of riparian vegetation is dominated by Douglas-fir or Western red cedar, though big-leaf maple and red alder are dominant along one or more reaches.

Other tree species, such as Oregon ash, Oregon white oak, and Pacific willow are common, but are not generally dominant within the assessed riparian area along the assessed stream sections. Table 6 details the potential tree heights of the four dominant native trees within the Bonny Slope West area.

Table 6. Dominate Tree Species and Potential Tree Heights Determining Riparian Widths in the Bonny Slope West area

Common Name	Botanical Name	Potential Tree Height / Riparian Corridor Widths (ft)
Big-leaf maple	*Acer macrophyllum*	90
Red alder	*Alnus rubra*	65
Douglas-fir	*Pseudotsuga menziesii*	120
Western red cedar	*Thuja plicata*	120

Table 7 summarizes the riparian area widths, lengths and potential tree heights for each of the coded riparian areas identified in the Bonny Slope West area. The thirteen coded riparian reaches are shown on Figure 5.

Table 7. Riparian Corridor PTH and Actual Widths in the Bonny Slope West Area

Riparian Area Code	Potential Tree Height (PTH) (ft)	Actual Riparian width (ft)	Riparian Area length (ft)
WC-R-1	120	50 to 120+	3,300
T1-R-1	120	40 to 100	800
T3-R-1	120	60 to 120+	300
T4-R-1	65	40 to 70	600
T4-R-2	120	60 to 120+	650
T5-R-1	120	60 to 110	800
T5-R-2	90	60 to 110	770
T6-R-1	120	90 to 120+	450
T6-R-2	120	30 to 120+	850
T6-R-3	120	60 to 100	350
T6-R-4	65	50 to 80	250
T6-R-5	120	80 to 120+	450
T6-R-6	65	100 to 120+	250

The quality of the riparian corridors using URIAG indicate that all but one of the inventoried riparian areas rate “high” for water quality functioning. This rating is despite the high water erosion hazard ranking assigned by the NRCS for soils in the Bonny Slope West area, and is rather a result of the presence of complete vegetative cover dominated by woody species, and the near lack of impervious areas within the riparian corridors. The one “medium” rating was due to extreme slopes (greater than 20 percent) in reach T6-R-1.

In the flood management category, ratings are either "low" or "medium." Flood management is determined by the presence of flood prone areas, the dominance of woody vegetation in flood prone areas, and whether the water resource is constricted by man-made features. Low scores in the Bonny Slope area were associated with a lack of flood prone areas and man-made constrictions to the stream channel.

All riparian reaches within the Bonny Slope West area rate high for thermal regulation and wildlife habitat. Abundant trees in the riparian areas provide shade and cover along the stream. The buffer of riparian forest for wildlife is wide (meets or exceeds the potential tree height distance) and has a variety of plant species and layers.

Table 8 summarizes the results of the URIAG functional assessment. A copy of the datasheets can be found in Appendix G.

Table 8. Summary of the Bonny Slope West Area's Riparian Functional Assessments

Riparian Code	Water Quality	Flood Management	Thermal Regulation	Wildlife Habitat
WC-R-1	H	M	H	H
T1-R-1	H	L	H	H
T3-R-1	H	L	H	H
T4-R-1 (L)	H	L	H	H
T4-R-2 (R)	H	L	H	H
T5-R-1 (R)	H	M	H	H
T5-R-2 (L)	H	M	H	H
T6-R-1	M	M	H	H
T6-R-2	H	M	H	H
T6-R-3	H	L	H	H
T6-R-4 (R)	H	M	H	H
T6-R-5 (L)	H	M	H	H
T6-R-6	H	M	H	H

H = High M = Medium L = Low

10.0 STAFF QUALIFICATIONS

John van Staveren: President; Senior Scientist;
Professional Wetland Scientist

Project Role: Project Manager
Project Responsibility: Contract negotiations, monthly billing
Public presentations
Quality control
Regulatory agency coordination

Mr. van Staveren has over 25 years of natural resource consulting experience throughout the Pacific Northwest and California. As Pacific Habitat Services' President, he has managed the 20 person company for the past 16 years. He has managed hundreds of projects for public and private clients. His expertise includes wetland science, endangered species consulting, state, federal and local permitting, and restoration ecology. He has managed over 30 local wetland and riparian inventories, provided expert witness testimony, testified at numerous public hearings and regularly presents at conferences. He has served on four state-appointed Technical Advisory Committees concerning wetland and environmental policy in the State of Oregon, authored a methodology for defining riparian areas for Statewide Planning Goal 5 and is the chair of a statewide non-profit organization.

Tina Farrelly: Environmental Scientist

Project Role: Wetland Scientist
Project Responsibility: Wetland and riparian inventory field work and assessment
Report Writing
Data input

Tina provides consulting services for a wide range of projects in both the public and private sectors, regularly conducting wetland delineations and functional assessments, monitoring, and wildlife habitat assessments. She prepares joint permit applications, natural resource assessments, NEPA documentation, and other environmental compliance documents to ensure compliance with federal, state, and local regulations. Tina conducts rare, threatened, endangered plant and weed surveys throughout Oregon and has extensive knowledge of invasive plant species management.

Amy Hawkins: Professional Wetland Scientist

Project Role: Wetland Scientist
Project Responsibility: Wetland and riparian inventory field work and assessment

For over fifteen years, Amy has conducted wetland delineations and functional assessments, assessed impacts to endangered species, and prepared natural resource assessments to comply with local land use ordinances. She is certified as a Professional Wetland Scientist and is certified by the Oregon Department of Transportation to prepare endangered species effects assessments. At PHS, she regularly prepares biological assessments, no effects determinations, and joint permit applications. Amy is very familiar with local sensitive/critical areas ordinances and works with local jurisdictions to ensure our clients comply with and understand local development codes.

Jane Le Blanc

Project Role:	Technical Editor
Project Responsibility:	Graphics
	Report editing, formatting and layout
	Data input

Jane is a technical editor and provides permitting support for PHS. Her duties include formatting and editing wetland and natural resource assessment reports, permitting documents, local wetland inventories, proposals, and letters as well as data input.

Lisa Bosca

Project Role:	GIS Cartographer
Project Responsibility:	Mapping
	GIS database management

Lisa's experience is in AutoCad and Geographic Information Systems (GIS) mapping. Her specialties include Geodatabase development and management, and data preparation. Her roles in this project include the database management and preparation of final wetland maps.

11.0 REFERENCES

Brinson, Mark. 1993. *A Hydrogeomorphic Classification for Wetlands*. Technical Report WRP-DE-4. Wetlands Research Program. U.S. Army Corps of Engineers. Washington D.C.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. U.S. Fish and Wildlife Service, Office of Biological Services, FWS/OBS-79/31. 103 pp.

Federal Register. 1982, *Title 33: Navigation and Navigable Waters, Chapter II, Regulatory Programs of the Corps of Engineers*, Vol. 47, No. 138, p31810, US Government Printing Office, Washington, D.C.

LCDC (Land Conservation and Development Commission), 1996. *Statewide Planning Goal 5. Amended Administrative Rules OAR 660, DSL 23*.

Lichvar, R.W., M. Butterw ick, N.C. Melvin, and W.N. Kirchner. 2014. *State of Oregon 2014 Plant List. The National Wetland Plant List*: 2014 Update of Wetland Ratings. *http://wetland_plants.usace.army.mil*

Natural Resources Conservation Service. 2014. Web Soil Survey. Website accessed June 2014.

Natural Resources Conservation Service. 2014. Online resource; *Hydric Soils*. Website accessed October, 2014. http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/use/hydric/

Oregon Department of Environmental Quality, 2014. *2012 Section 303(d) list* Oregon's 2012 Integrated Report Assessment Database and 303(d) List. http://www.deq.state.or.us/wq/assessment/rpt2012/search.asp#db; website accessed October 2014.

Oregon Department of States Lands, 2001. Oregon Administrative Rules 141-086-0180 for Local Wetlands Inventory Standards and Guidelines.

Pacific Habitat Services, Inc., 1998. *Urban Riparian Inventory and Assessment Guide* (URIAG)

Roth E.M., R.D. Olsen, P.L. Snow, and R.R. Sumner. 1996. *Oregon Freshwater Wetland Assessment Methodology*. Ed. by S.G. McCannell. DSL. Salem, OR.

Streamnet, 2014. StreamNet; an online fisheries information management and data source. *http://www.streamnet.org*. Website accessed June 2014.

US Army Corps of Engineers, Environmental Laboratory, 1987. *Corps of Engineers Wetland Delineation Manual. Technical Report Y-87-1*.

US Army Corps of Engineers, Environmental Laboratory, 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0).*

U.S. Fish and Wildlife Service. *National Wetlands Inventory, Digital Wetlands Data.* 2014.

U.S.G.S. *7.5-minute topographic quadrangle*, 2014. Linton, OR. 1:24,000.