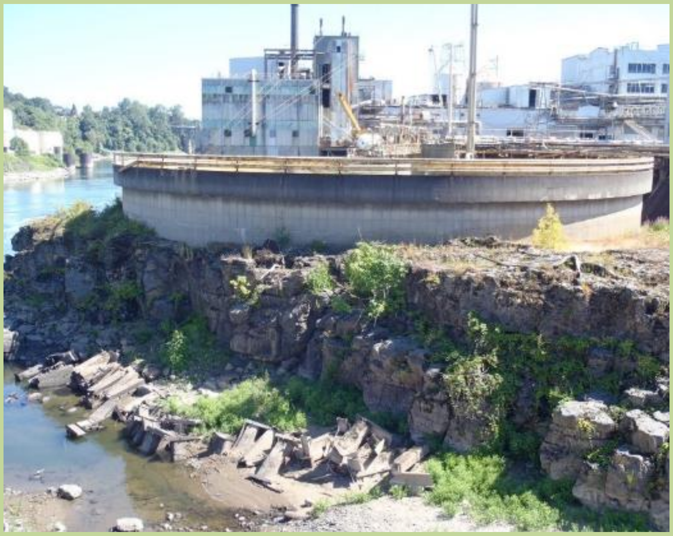
TECHNICAL REPORT ◦ OCTOBER 2017

Willamette Falls Legacy Project Baseline Habitat Conditions



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Cover photos: Northern face of basalt outcroppings at the Willamette Falls Legacy Project site (top left); adult lamprey (top right); juvenile steelhead (bottom left), *Sedum stenopetalum* observed at Willamette Falls Legacy Project site (bottom right).

Table of Contents

1 INTRODUCTION AND PURPOSE 1

2 EXISTING CONDITIONS 1

2.1 Geology and Soils 2
2.2 Hydrology and Water Quality 4
2.3 Primary Habitat Types 6
2.3.1 In-channel river 8
2.3.2 Off-channel alcove 8
2.3.3 Riparian basalt 9
2.3.4 Riparian forest 10
2.3.5 Upland forest 11
2.3.6 Oak woodland and savannah 11
2.4 Vegetation 11
2.5 Fish and Wildlife Species 11
2.5.1 Fish 12
2.5.2 Birds 19
2.5.3 Reptiles and Amphibians 19
2.5.4 Invertebrates 19
2.5.5 Mammals 19
2.5.6 Marine Mammals 20

3 CONSERVATION PRIORITIES 20

4 CONSIDERATIONS FOR CONCEPTUAL DESIGN 25

4.1 General Concepts 25
4.2 Increase Shoreline Complexity 26
4.3 Fish Passage and Behavior 26
4.4 Improve Water Quality 26
4.5 Protect and Restore Riparian Habitat 27
4.5.1 Riparian forest 27
4.5.2 Riparian basalt 28
4.5.3 Off-channel alcove habitat and river shoreline 29

5 SUMMARY OR CONCLUSION 30

6 REFERENCES 30

Tables

Table 1. Timing of anadromous species and life stages in the Lower Willamette River to Willamette Falls 14

Figures

Figure 1. Geologic map of the Project site 3
Figure 2. Site bathymetry and topography 5
Figure 3. Habitat types known to occur at the Project site 7
Figure 4. In-channel river habitat adjacent to the northern end of the Project site. 8
Figure 5. Off-channel alcove habitat on the Project site. 9
Figure 6. Riparian basalt habitat adjacent to the clarifier on the Project site. 10
Figure 7. Riparian forest habitat of the Project site near the lagoon. 10
Figure 8. Total UWR Spring Chinook over Willamette Falls, 1980–2015. 15
Figure 9. Total UWR Steelhead over Willamette Falls, 1971–2015. 16
Figure 10. Total coho salmon over Willamette Falls, 1971–2015. 17

Appendices

Appendix A. Special-status and Non-special Status Species that Have the Potential to Occur or Have Been Documented within or Adjacent to the Project site
Appendix B. Important Plant Species Present or Historically Present at the Site

1 INTRODUCTION AND PURPOSE

The following report provides a documentation of existing environmental conditions and species known to occur at the Willamette Falls Legacy Project site (Project site). Developed in support of the Riverwalk Project, the report is based on the compilation of existing studies, site visits, agency consultation and professional expertise. It also highlights regional conservation priorities and key environmental factors to be considered in the conceptual design process for the Riverwalk. The report purpose is to deepen the scientific knowledge of the site habitat, species and priorities in support of future site restoration and development alternatives.

2 EXISTING CONDITIONS

Situated along the Willamette River's right bank, the Project site is located just downstream of the Willamette Falls, the largest waterfall by volume in the Pacific Northwest dropping 42 feet in a horseshoe with a crest length of approximately 1,700 feet (World Waterfall Database, http://www.worldwaterfalldatabase.com/waterfall/Willamette-Falls-4074/). The site encompasses the 23-acre former Blue Heron Paper Company plus an existing Portland General Electric (PGE) dam.

The Project site has a history of commercial and industrial uses going back more than 100 years. The site is characterized by a riprap shoreline, tailraces used to power various mill operations, a dam, lagoon, clarifier, buildings and associated infrastructure. The site operations have altered all native habitat with the exception of a limited extent of basalt outcroppings.

As described in the 2014 Vision document, the Riverwalk Project will provide public access to the riverfront and Willamette Falls for the first time in over 100 years, thereby becoming a driver for future site development and private investment. It will create public access to view and experience the river and an opportunity to improve fish and wildlife habitat and water quality. In order to appropriately design the Riverwalk Project, it is essential to understand the physical and biological conditions of the site and species it supports. The following sections of the report document site geology and soils, hydrology, key habitats, vegetation, and fish and wildlife species known to date.

2.1 Geology and Soils

The Willamette Falls area expresses the sequential effects of two catastrophic geologic events—the eruption of many hundreds of cubic miles of flood basalts that blanketed much of what is now the states of Washington and Oregon about 15 million years ago; and the voluminous release of floodwaters across much of the same region, previously impounded by the melting North American ice sheet between about 18,000 and 13,000 years ago. Subsequent erosion by the Willamette River, localized landsliding, and human modification of the landscape have resulted in only modest changes to this geologic template (Figure 1).

The Columbia River Basalts are a sequence of lava flows that erupted from vents in eastern Washington and Oregon, mainly between about 17 and 14 million years ago. In total they cover more than 60,000 mi^2 in Idaho, Washington, and Oregon, extending from the Sawtooth Range in Idaho to the Pacific Ocean. In the Project site, two distinct flow sequences of Columbia River Basalts have been mapped (Madin 2009):

- The Grande Ronde Basalt, whose primary flow within the Project site (the Sentinel Bluffs Member, unit Tgsb on the geologic map, Figure 1) underlies the northwest shore of the Willamette River and the falls itself;
- The Wanapum Basalt-Frenchman Springs Basalts (units Twfs and Twfg on the map), which sit immediately on top of the Grand Ronde Basalts and form much of the southeast shore of the Willamette River.

The contact between the Wanapum and Sentinel Bluffs flows is only slightly above river level, where more rapid erosion of the overlying Wanapum has left an exposed bench of the (presumably more resistant) Sentinel Bluffs rocks, over which the river spills to form the falls. Madin (2009) speculates that the falls originated about a mile downstream where the river crosses the trace of the episodically active Bolton Fault, with their present position reflecting progressive headward erosion since their initial formation.

At the close of the last global glacial era, the ice sheet that covered much of northwestern North America began retreating from its terminal position in northeastern Washington state. The Columbia River and its tributaries, long-dammed by the ice to form a voluminous lake in eastern Washington and Idaho, discharged catastrophically beneath the thinning ice margin to create the Missoula Floods, best known for their formation of the Channeled Scablands of eastern Washington. Although the primary flood bore continued down the Columbia River to the Pacific Ocean, discharges were so great that water backed up the Willamette River up to and well south of the project site, depositing extensive terraces of silt, sand, and gravel. Because of the dynamics of ice-dammed lakes, this flooding occurred many dozens of times over a period of at least several thousand years, with multiple iterations of scour and deposition resulting from them. In the Project site, deposits are recognized that lie up to 380 feet above modern river level, mantling hilltops and high terraces (unit Tff on the geologic map).

Modern geologic processes in the Project site include ongoing river erosion and deposition (which has left floodplain deposits in the less confined reaches of the river immediately downstream) (unit Qal); landslides (unit Qls) associated with failures at the eroded edge of basalt flows, possibly triggered primarily by saturation from Missoula Floods (Madin 2009); and artificial fill (unit af), of which the right-bank landfill downstream of the project site is the most prominent. Soil formation has also proceeded in the area, with lower elevations seeing significant development only since the last of the Missoula Flood backwater deposits were laid down. Soils types along the Willamette River are reported as being of the Newberg series (Natural Resources Conservation Service 2009 – new reference), silt loams to gravelly loams that are reportedly common throughout the Willamette Valley (ESA 2012) and presumably developed on the regionally extensive Missoula Flood backwater sediments. Their Hydrologic Soil Groups are predominantly types "D" and "C," indicating very slow infiltration rates for these shallow soils derived from silty sandy deposits and overly the low-permeability basaltic material (ICF 2010).

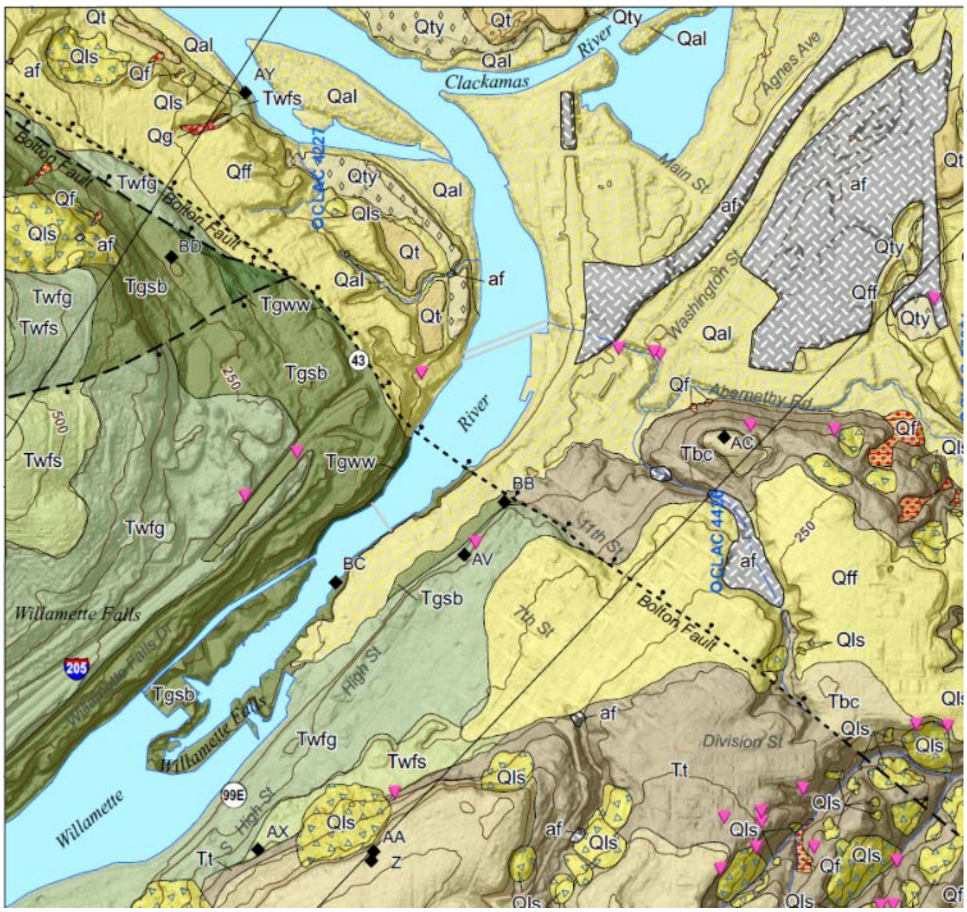


Figure 1. Geologic map of the Project site (excerpted from Madin 2009). Units are as follows (oldest to youngest): Tbc = ; Tgww and Tgsb = flow members of the Grande Ronde Basalt; Twfs and Twfg = flows of the Wanapum Basalt-Frenchman Springs Basalt; Tt = mudstone and sandstone of the Troutdale Formation, alluvial sediments of paleo-Cascade Range drainages; Qg = conglomerate of an ancestral Willamette River; Qff = backwater deposits of the Missoula Floods; Qls = landslide deposits; Qt and Qty = terraces deposits lying 30 to 50 feet above the modern Willamette River (i.e., too high to be modern floodplain deposits, but likely too low to be Missoula Flood deposits); Qal = modern alluvial deposits; af = artificial fill from human activity.

2.2 Hydrology and Water Quality

The Willamette River is tidally influenced up to the Willamette Falls and flow rates downstream of the project site (which includes Clackamas River) range from an average of 8,390 cfs in August to 76,100 cfs in December (SGS Station 14211720, Calculation Period 1972-10-01: 2016-09-30). Located on the right bank of the Willamette River, a significant portion of the Project site, 12.5 acres, is within a City-designated flood management area (WFLP 2014). The southern portion is subject to flooding and last experienced a major flood event in 1996, and 1964 before that. Site bathymetry and topography are illustrated in Figure 2 along with key site features known to affect flow.

The Project site itself is largely impervious being directly underlain by basalt bedrock. It also contains areas of historical grading and filling completed to facilitate the large, flat property parcel containing the manufacturing facility. Surface water is generally the result of treated stormwater that flows through historic channels, small waterfalls, and alcoves. Seepage below outcrops and spillways are additional hydrologic characteristics of the site (ESA 2012, Christy 2015) and these springs and seeps could provide cold water input to the Willamette River (WFLP 2014).

Groundwater, obtained from aquifers in the terrace deposits (ERM 2012), is relatively shallow across much of the site with an inferred flow to the northwest based on the local topography and adjacent surface water body (Mudge and Ipsen 2012). The occurrence and movement of groundwater is difficult to predict on a small scale due to the erratic nature of the secondary openings that control ground water flow in bedrock. Small surface water features generally do not provide an accurate indication of the direction of ground water movement in bedrock. However, on a regional scale, the direction of ground water movement will generally be from upland areas to major surface streams downgradient (ERM 2012).

After over a hundred years of industrial and agricultural use along the Willamette's length, the Environmental Protection Agency (EPA) started a clean-up program in the 1960s and 1970s to reduce point source pollution, improve water quality, and protect beneficial uses of the river. Though efforts have been made to reduce point and non-point source pollution and improve its water quality, currently the Willamette River is 303(d) listed for biological criteria, aldrin, dieldrin, DDT/DDE, iron, and PCBs (ODEQ 2010). Though not effective for Clean Water Act purposes until final review and approval by the Environmental Protection Agency (EPA), the Oregon Department of Environmental Quality (DEQ) modified the state's 2012 303(d) list to include copper, cyanide, lead, PAHs, chlorophyll a, mercury for the lower Willamette River (ODEQ website). Increased levels of sodium, dissolved oxygen, pH, temperatures, and dissolved gas are additional effects caused by an adjacent Portland General Electric (PGE) dam and operations of it facilities (ESA 2012).

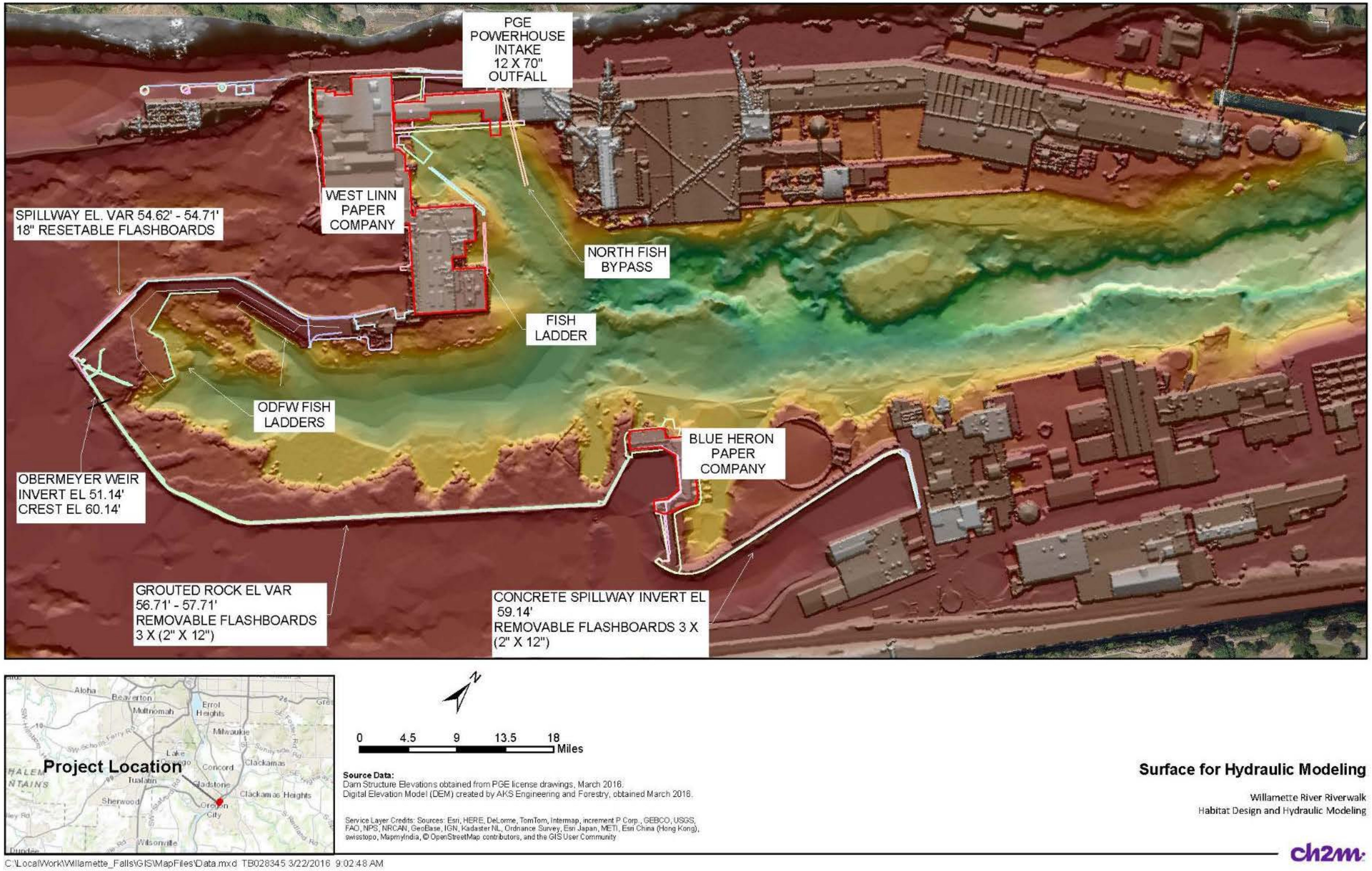


Figure 2. Site bathymetry and topography (source: CH2M 2016).

2.3 Primary Habitat Types

The site is located within the Willamette Greenway and serves as a linkage to other natural areas in the lower Willamette such as the Canemah Bluff Natural Area, Camassia Nature Preserve, Coalca Landing, West Linn Oak Savanna, the Willamette islands, and the Willamette Narrows. These natural areas, including the project site, provide linkages from central and south valley woodlands and savanna to the Puget Trough area and are essential to regional biodiversity conservation in an area of urbanization.

Currently, habitats on the site are relatively small and highly fragmented due to the presence site development, highways (I-205 and SR 99E) and the adjacent railroad. Historic fill and grading of the site have further decreased the amount of natural habitat available at the site. Remaining habitat in natural or semi-natural condition includes areas hydrated by tidal action of the Willamette River, areas of seasonal or perennial seepage below spillways, and basalt outcrops with varying exposures. (Allen et al. 1986).

Due to these processes and physical characteristics, six main major habitats types are present/potentially present (*pp*) at the site; in-channel river; off-channel aquatic; riparian basalt; riparian forest; upland forest (*pp*); and oak woodland and savannah (*pp*). These habitat types are depicted in the Riverwalk Milestone 2 report (Figure 3).

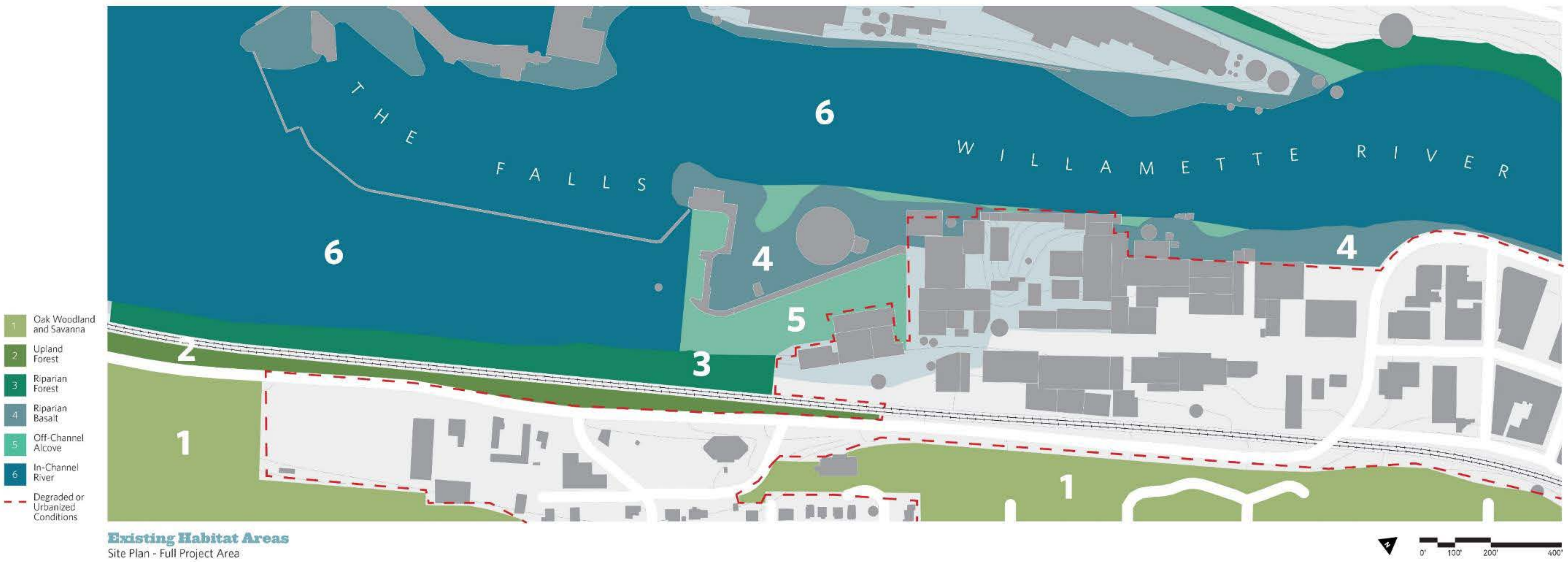


Figure 3. Habitat types known to occur at the Project site (source: Riverwalk Milestone 3 report. Snohetta and Mayer Reed 2016).

2.3.1 In-channel river

In-channel river habitat areas on the Willamette River are important to a wide range of native fish and wildlife species. Integrating tributary headwaters down to the valley floor, this habitat type serves as an iconic feature of the Northwest landscape. It includes open water riverine areas with no vegetation and islands of basalt rock formed in-channel at low water. In general rivers, streams, and open waters provide multiple ecological services, including: attenuating flood flows, recharging ground water, sediment storage and transport, diluting and converting harmful nutrients, water delivery and atmospheric heat moderation. Mainstem rivers such as the Willamette also support high levels of biodiversity and provide critical migration and movement corridors for fish, wildlife and birds (Intertwine Alliance 2012).

Figure 4. In-channel river habitat adjacent to the northern end of the Project site.

2.3.2 Off-channel alcove

Off-channel alcove habitat areas on the Willamette River are important to native fish. Emergent native wetland and floating aquatic plant communities are associated with off-channel alcove areas. (Milestone 2 report)

In the lagoon, vegetation covers an estimated 5–10% of its extent and is a mix of floating aquatic plants, algae, and weedy herbs and forbs along the fringes as well as a few shrubs and saplings growing out of a berm in the lagoon. A dense mat of vegetation has formed at the north end of the lagoon and consists of water primrose (*Ludwigia hexapetala*), marsh pennyroyal (*Hydrocotyle ranuncuuloides),* an introduced aquatic perennial; water-parsley (*Oenanthe sarmentosa*), a semi-aquatic plant; and yellow touch-me-not (*Impatiens capensis*) (ESA 2012).

Figure 5. Off-channel alcove habitat on the Project site.

2.3.3 Riparian basalt

The basalt outcrops and rocky substrate along the shoreline contribute to the mosaic of rocky habitats located to the north and south of the project site in and along the Willamette River. The outcrops are a relic of the Bretz or Missoula Floods, and exposures along this part of the Willamette River provide outlier habitat for both mesic and xeric species more common in the Columbia River Gorge. (Christy 2015). The vegetation assemblages found on basalt outcropping of the site are similar to those found in neighboring oak habitat and key habitat for pollinators and birdsProject site. Such linkages enhance biodiversity and resilience within the Willamette Greenway.

In riparian basalt habitat, bryophytes are critical keystone ecosystem builders because of their ability to create soils and trap sediments on these otherwise barren substrates. Establishment and spread of bryophyte mats is an essential first step in creating habitat for vascular plants. This could be accomplished by transplanting moss mats and excluding trampling from foot traffic. With proper management, the basalt bluffs at Blue Heron could become a showcase for all of these plants (Christy 2015).

Native herbs and forbs adapted to rocky, dry conditions would have grown in the crevices and pockets in the cliff faces. Native plant diversity is relatively high on some of the undeveloped rock islands in the area upstream of the site, which support drought-tolerant species such as Oregon white oak, Pacific madrone as well as native wildflowers and other herbaceous plants including delphinium, sedums, and cluster lilies (ESA 2012). Additional species diversity is achieved in shallow depressions of the basalt layer that hold water and thereby form unique wetland habitats.

Preserving habitat and increasing the diversity of native historical species on basalt outcrops at Willamette Falls is a primary restoration target. Although portions of the rocks are subject to periodic scouring by high river flows, higher ledges and cliffs are free of scour and could support an array of species that probably once occurred there (Christy 2015).

Figure 6. Riparian basalt habitat adjacent to the clarifier on the Project site.

2.3.4 Riparian forest

Riparian forest plant community areas are associated with alluvial soil and springs and seeps emerging from the site. Large areas of the Project site may have been historically dominated by this habitat but due to significant alterations and industrial development, this habitat has been reduced to small patches.

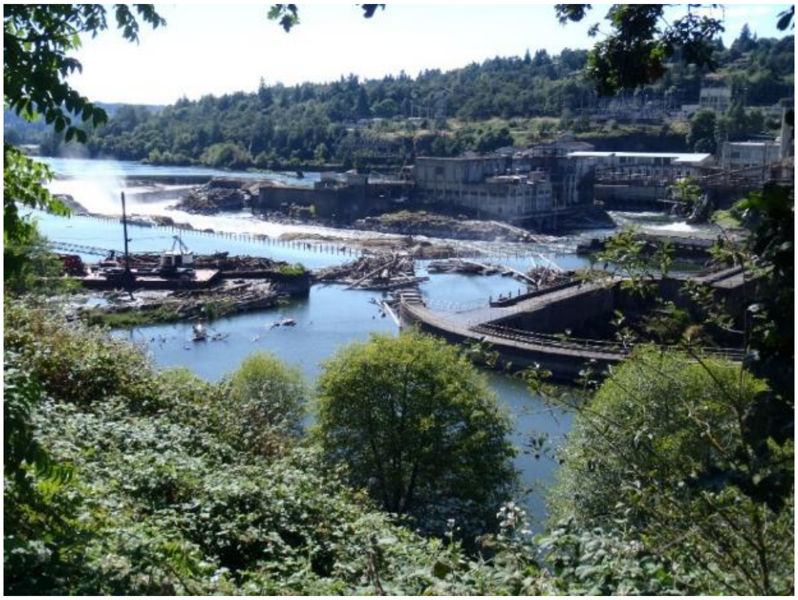


Figure 7. Riparian forest habitat of the Project site near the lagoon. Willamette Falls in the background.

2.3.5 Upland forest

Upland forest areas with large conifer and deciduous trees are found on mid to toe of slopes on valley floors as exemplified at the Canemah Bluff and Willamette Narrows natural areas immediately upstream of the site. The interior portions of the Project site may have been historically dominated by this habitat but due to significant alterations and industrial development this habitat is now limited to a narrow corridor alongside the railroad spur.

2.3.6 Oak woodland and savannah

Oak woodland and savannah is an Oregon Department of Fish and Wildlife (ODFW) conservation strategy habitat and known to occur on the nearby Canemah Bluffs and Camassia Preserve. Hilltops and slopes of dry to mesic grasslands along with patches of shrubs and Oregon white oak (*Quercus garryana)*, this habitat type does not current exist at the Project site. Nevertheless, similar vegetation and associated pollinators and birds are found onsite in the riparian basalt habitat.

Though the historical landscape of the Willamette Valley preceding settlement was once characterized by a matrix of prairie and Oregon white oak vegetation, oak savannas are in decline throughout major portions of their range with estimates of habitat loss as high as 85 percent in some areas (Buechling 2008). The open nature of the oak savanna results in the establishment of numerous kinds of prairie plants, both grasses and forbs, providing biodiversity and resiliency of the landscape.

2.4 Vegetation

Historical and current site vegetation was documented in a 2015 site survey and report (Christy and Gaddis 2015). Although the site is highly altered, the survey reports native vegetation as being in good condition relative to elsewhere in the metro area. At least sixteen plant species rare to the Portland metropolitan area were observed at the Blue Heron mill site in 2015 (Christy and Gaddis 2015). *Cystopteris fragilis* and *Penstemon richardsonii* are the most significant finds at these rocky outcrops because few sightings are known from the Portland metro area, particularly for the *Penstemon* that had not been seen since 1976, and otherwise is known locally only from Elk Rock. Four historically documented bryophyte species within this habitat are the only known occurrences in the Portland metropolitan area or are known from only one other site in the metro area (Christy and Gaddis 2015). Appendix B provides additional detail on key species documented at the site

2.5 Fish and Wildlife Species

To evaluate existing wildlife and fish use at the Riverwalk Project, an initial desktop exercise was conducted. A data source review of the sources listed below identified species with the potential to occur within the Project site.

- Species list provided by ODFW (Susan Barnes, wildlife biologist) on 24 August 2016.
- Federal or state listed as threatened or endangered, federal species of concern, and state sensitive (critical or vulnerable) as identified by Oregon Biodiversity Information Center (ORBIC 2016) for Clackamas County (http://inr.oregonstate.edu/sites/inr.oregonstate.edu/files/2016-rte-book.pdf)

- Special and/or non-special-status species identified in ESA 2012, Riverwalk Milestone Report 2, Willamette River Basin Planning Atlas (Hulse et al. 2012), the Willamette Subbasin Plan (NWPCC 2004), and Canemah Bluff Natural Area Plan (Metro 2011).

The desktop exercise resulted in identifying the potential for special and non-special-status species to occur in the Project site, and by habitat type (Appendix A). To evaluate the likelihood for a species to occur in the Project site, the following categories were identified:

- High: The species has been documented in the Project site and/or its required habitat occurs in the Project siteand is of high quality.
- Moderate: The species' known distribution or elevation range overlaps with the Project site and/or the species' required habitat occurs in the Project site.
- Low: The species' known distribution or elevation range overlaps with the Project region but not the Project site, and/or the species' required habitat is of very low quality or quantity in the Project site.

Fish and wildlife species that were considered to have no potential to occur in the Project site(either outside the species' current distributional or elevation range and/or the species' required habitat is lacking from the Project site) were noted in a footnote, and were not assessed further.

The purpose of compiling the list was to provide a compilation of species that may be present; however, the results are not comprehensive of all species present. Fish and wildlife species and use of associated habitat types, identified within the Project site, are summarized below.

2.5.1 Fish

2.5.1.1 Fish population

The Willamette River Basin contains 31 native fish species and 29 exotic or introduced species (Hulse et al. 2002). Appendix A contains a list of species classified as occurring in the mainstem Willamette River. Seven native species (more than a fifth of the total) are listed by either the federal or state government as threatened, endangered, or sensitive. Willamette Falls is located in the Tanner Creek subwatershed (6th field Hydrologic Unit Code 170900070405) a subset of the Mid-Willamette and Abernathy Creek watersheds. Within the Tanner Creek subwatershed, there are 31 to 35 fish species, of which 21 to 25 are native. Only two subwatersheds (of 170 total subwatersheds) within the Willamette Basin have a higher number of fish species, and only one subwatershed has a higher number of native species (Hulse et al. 2002).

ODFW conducted an extensive study of the Lower Willamette through Portland in 2000 – 2004, collecting fish with beach seines and electrofishing (Freisen 2005). Although the survey did not extend upstream as far as Willamette Falls, the fish assemblage at the falls is expected to be similar. Electrofishing surveys revealed that suckers, Chinook (and unidentified) salmonids, and peamouth were the most commonly present native species, while yellow perch and smallmouth bass were the most commonly present non-native species. Native three-spine stickleback were patchily distributed, but when present were highly abundant, with more total individuals captured than all other species except unidentified suckers and salmonids. Results indicated extensive use of the lower river by juvenile salmonids with most (87%) being Chinook salmon, while 13% were steelhead, and nine percent were coho salmon. Other salmonids present, but at much lower densities, included mountain whitefish, sockeye salmon, and cutthroat trout (Freisen 2005).

Juvenile salmonids were present in every month sampled from May 2000 to July 2003. Outmigrating juvenile Chinook increased in late autumn and persisted into the next summer. Juvenile coho salmon and steelhead were generally present only during winter and spring (ODFW 2005). Studies conducted in the mainstem Willamette by the City of Portland from 2014 to 2016 (Portland BES 2016) as far upstream as Lake Oswego, show similar results to the ODFW surveys, with largescale sucker and Chinook salmon being the most commonly encountered species. Likewise, smallmouth bass, yellow perch and carp were the most commonly encountered and abundant non-native species. However, contrary to the earlier results, prickly sculpin (a native species) was more commonly found than in the ODFW surveys.

2.5.1.2 Significance of Willamette Falls with respect to fish species

Historically, Willamette Falls was an impassable barrier to upstream movement for all freshwater species, and all but a few anadromous species. Upper Willamette River (UWR) winter steelhead Distinct Population Segment (DPS) and UWR spring Chinook Evolutionarily Significant Unit (ESU)migration timing was (and is) such that they arrive at the falls when discharge was consistently high, allowing them to ascend the falls. The UWR Chinook ESU includes naturally spawned spring-run Chinook salmon originating from the Clackamas River and from the Willamette River and its tributaries above Willamette Falls, along with spring-run Chinook salmon from six artificial propagation programs (79 FR 20802, http://www.westcoast.fisheries.noaa.gov/publications/frn/2014/79fr20802.pdf). The UWR steelhead DPS includes naturally spawned anadromous winter-run *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Willamette River and its tributaries upstream of Willamette Falls to and including the Calapooia River (*ibid*.).

Pacific lamprey were also able to pass the falls, even though they arrive during lower flow periods of the year, by clinging to the rocks with their mouths and ascending the falls in a stepwise fashion. Because lamprey historically congregated at the falls in large numbers, native peoples also gathered at the falls to harvest lamprey and engage in trade. Native American lamprey harvest continues at Willamette Falls although declining lamprey numbers have significantly reduced that harvest.. Tribal harvest is primarily focused at Willamette Falls during the springtime when water levels drop in the river.

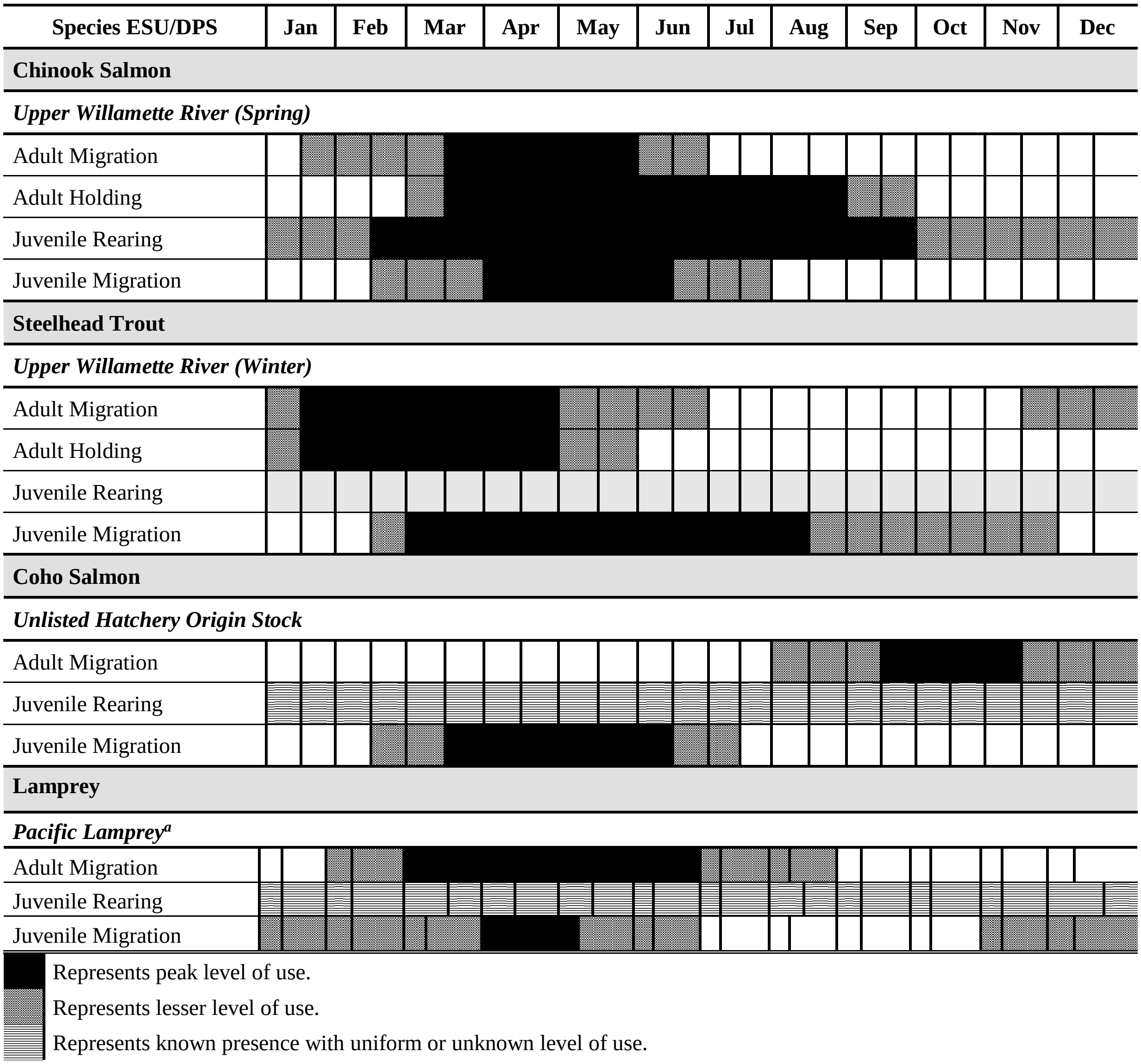
Prior to human alteration of the falls beginning in mid-1800s, coho salmon, sea-run cutthroat trout, fall Chinook, and other temporal runs of steelhead, were unable to pass the falls and there were thus no populations of any of these species in the Willamette or any of its tributaries above the falls. Significant stocking operations (which were curtailed in the 1990s) established a self-sustaining population of coho upstream of Willamette Falls in many tributaries. Likewise, fall Chinook, and early winter and summer steelhead have also become established with returning adults now ascending the falls via fish ladders.

In addition to its importance as a significant impediment, and thus gatekeeper, for what anadromous species could occur above the falls, investigators have recently discovered that the falls also provide unique habitat that is important for white sturgeon spawning.

2.5.1.3 Selected species descriptions

From an historical, recreational, cultural and economic perspective, the most “important” species that traverse or are affected by Willamette Falls include: UWR steelhead, UWR Chinook, coho salmon, Pacific lamprey, and white sturgeon. Timing of each of these species at the falls is presented in Table 1, and each of these species is discussed in detail below.

Table 1. Timing of anadromous species and life stages in the Lower Willamette River to Willamette Falls (ODFW 2003 unless otherwise noted).



[a] Beamish, 1980; Starke and Dalen, 1995; Moser and Close, 2003; Kostow, 2002.

UWR Chinook. UWR Chinook were listed under the endangered species act as threatened in March 1999. Fish counts at Willamette Falls indicate that adult spring Chinook begin passing the falls in February and the migration continues through June, with the peak occurring from mid-March through May (ODFW 2003). Wild spring Chinook smolts typically pass Willamette Falls from January to July, with peak migration occurring from mid-April to mid-June (Domina 1997, 1998). A smaller out-migration occurs later in the year (peaking in October and November). This smaller outmigration is not included on Table 1 above.

The 2005 status review (Good et al. 2005) stated that “most natural-origin spring-run Chinook populations [in the upper Willamette River ESU] are likely extirpated, or nearly so. The only population considered potentially self-sustaining is the McKenzie River population. However, its abundance has been relatively low (low thousands), with a substantial number of these fish being of hatchery origin." McElhany et al. (2007) analyzed the population criteria (diversity, spatial structure, and abundance and productivity) for UWR Chinook salmon and found that the risk of extinction is high. Due to the location of the falls, the entire population of UWR Chinook salmon, minus those that occur in the Clackamas River, migrate over the falls. The population of fish passing Willamette Falls has fluctuated widely since 1950, generally around a mean of 40,000 fish (most of which are likely hatchery-origin). Figure 8 illustrates the total spring Chinook over Willamette Falls from 1980 to 2015.

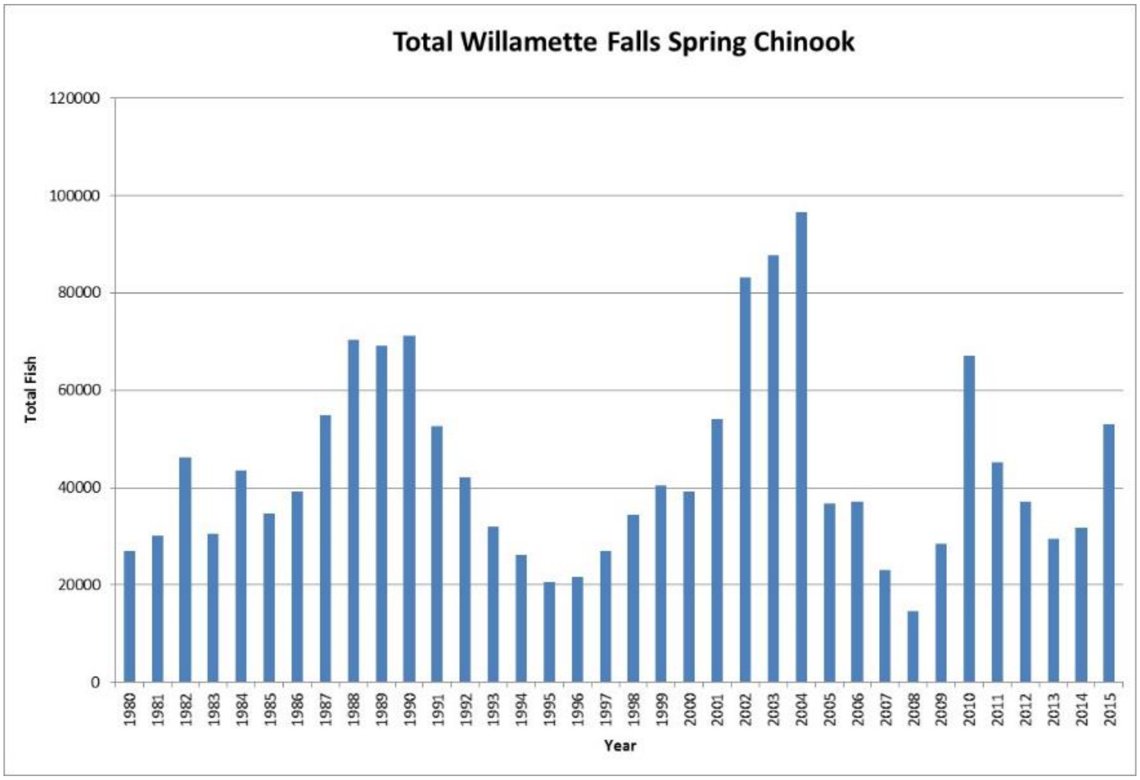


Figure 8. Total UWR Spring Chinook over Willamette Falls, 1980–2015.

UWR steelhead. Like UWR Chinook, UWR steelhead were listed as threatened under the endangered species act in March 1999. Of the three steelhead temporal runs (winter, late winter and summer) currently found in the Upper Willamette River, only the late winter steelhead is considered to be native. Adult steelhead that pass Willamette Falls from 15 February through mid-May of each year are considered wild, winter UWR steelhead. UWR steelhead adults enter the Willamette River beginning in January and February, but they do not ascend to their spawning areas until late March or April through mid-May (Myers et al. 2006). Wild steelhead smolt out-migration starts in mid-February, peaks in May, and is essentially complete by mid-July (Domina, 1997, 1998).

The entire population of UWR steelhead pass over Willamette Falls. Good et al. (2005) could not conclusively identify a single population that was naturally self-sustaining. All populations were described as relatively small, with the recent mean abundance of the entire ESU at less than 6,000. Over the period of the available time series, most of the populations were in decline. At

Willamette Falls between 1980 and 2015, late winter steelhead returns ranged from 1,322 in 1996 to 16,097 in 1980. Figure 9 illustrates adult returns at Willamette Falls from 1971 to 2015.

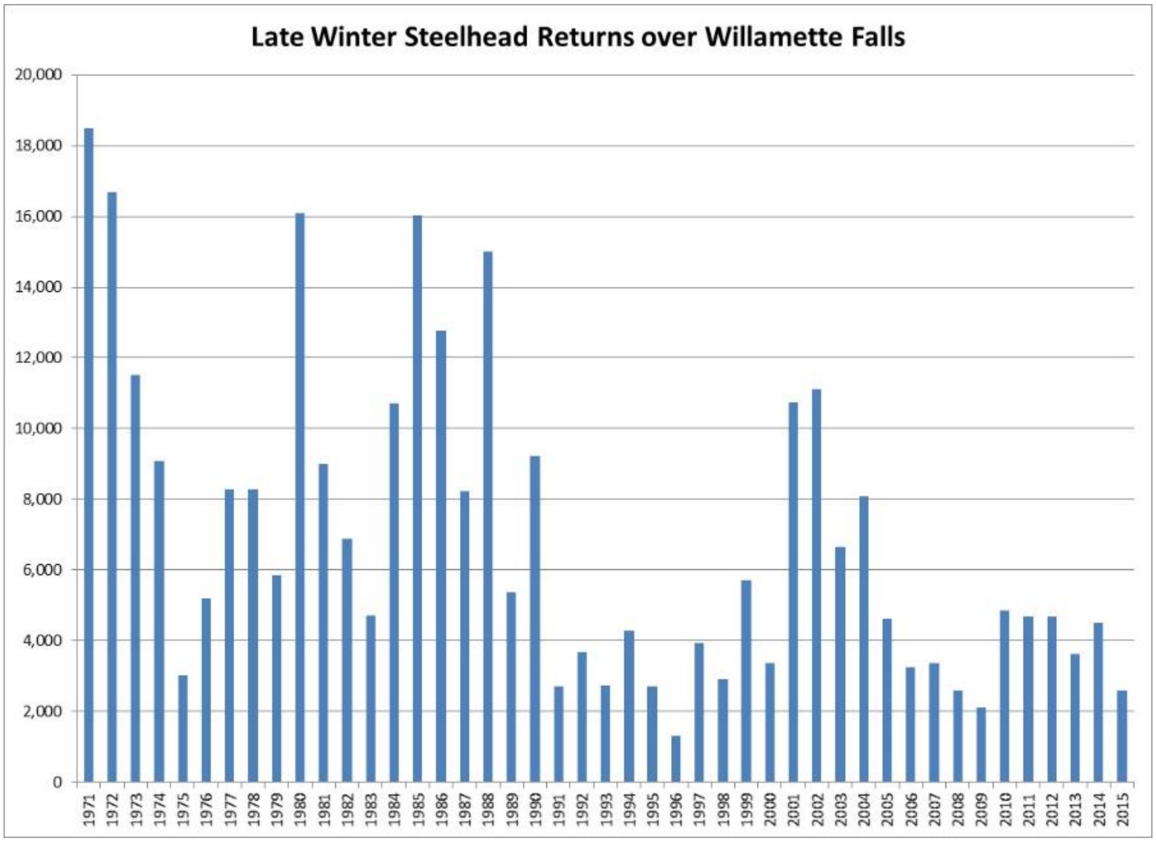


Figure 9. Total UWR Steelhead over Willamette Falls, 1971–2015.

Coho salmon. Most adult coho salmon migrate through the lower Willamette River from August through December, with the peak occurring from mid-September through mid-November (ODFW 2003).

Juveniles generally spend about one year in fresh water before migrating to the ocean. Juvenile coho salmon migrate through the lower Willamette River throughout their downstream migration, which begins in late March, peaks in April and May, and declines through June (Domina 1997, 1998; ODFW 2003).

As stated above, coho salmon did not historically occur above Willamette Falls. However, beginning in the early 1950s, ODFW began to release coho fry and presmolts widely throughout Willamette River tributaries above the falls. Stocking upstream of the falls dropped significantly through the 1980s but continued until the last release was made in the Tualatin River in 1997. The reduced releases resulted in much reduced migration of adults over the falls, to less than 1,000 fish annually through 1999 (Alsbury and Murtagh 2012). Counts increased noticeably in 2000 when 2,839 adults moved upstream. Numbers peaked in 2009 at over 25,000 fish and have been generally high but variable since that time (Figure 10).

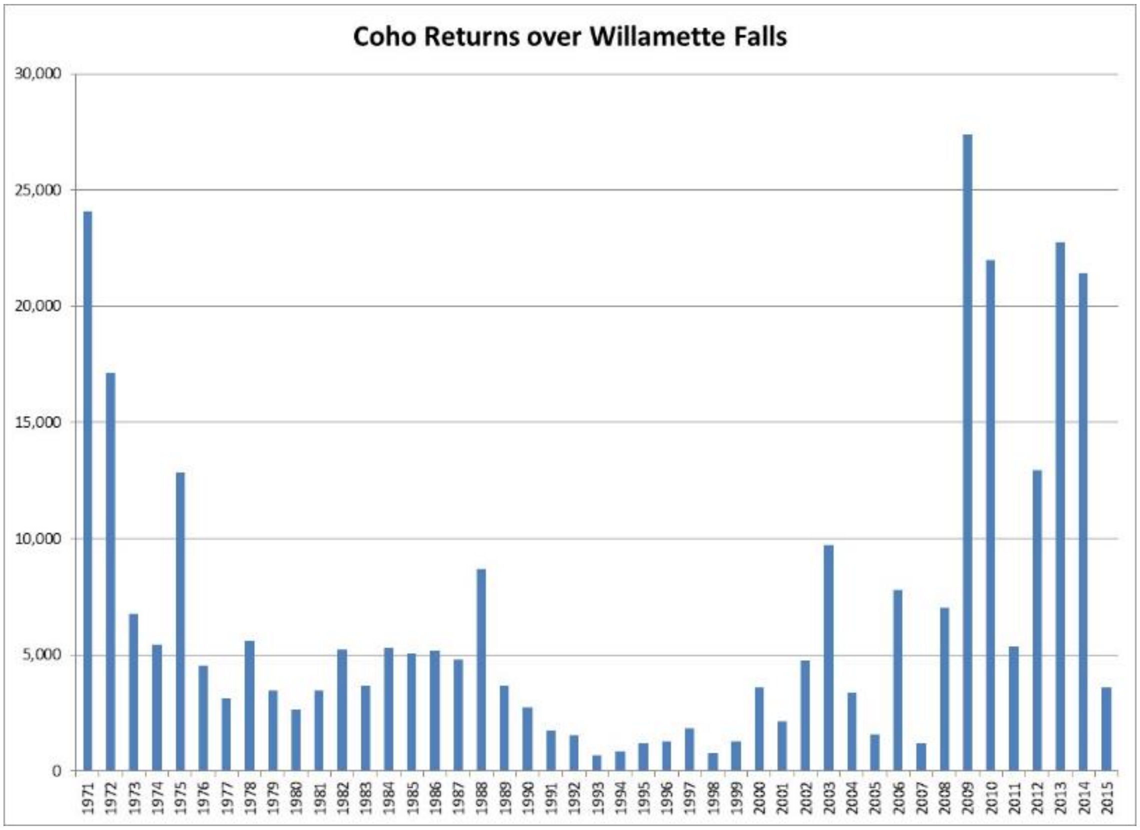


Figure 10. Total coho salmon over Willamette Falls, 1971–2015.

Pacific Lamprey. The Pacific lamprey is a large, widely distributed anadromous species that rears in fresh water before outmigrating to the ocean, where it grows to full size (approximately 400–700 mm [16–28 in]) prior to returning to freshwater streams to spawn and ultimately die. The species is distributed across the northern margin of the Pacific Ocean, from central Baja California north along the west coast of North America to the Bering Sea in Alaska and off the coast of Japan (Ruiz-Campos and Gonzales-Guzman 1996, Lin et al. 2008). Adults migrate into and spawn in a wide range of river systems, from short coastal streams to tributaries of the Snake River in Idaho, where individuals may migrate over 1,450 km (900 mi) (Claire 2004).

Pacific lampreys typically spawn from March through July depending on water temperatures and local conditions such as seasonal flow regimes (Kan 1975, Brumo et al. 2009, Gunckel et al. 2009). More inland, high-elevation, and northerly populations generally initiate spawning considerably later than southerly populations (Kan 1975, Beamish 1980, Farlinger and Beamish 1984, Chase 2001, Brumo et al. 2009), presumably due to cooler water temperatures. Spawning generally occurs at daily mean water temperatures from 10–18°C (50–64°F), with peak spawning around 14–15°C (57–59°F) (Stone 2006, Brumo 2006). Redds are typically constructed by both males and females in gravel and cobble substrates within pool and run tailouts and low gradient riffles (Stone 2006, Brumo et al. 2009, Gunckel et al. 2009). During spawning, eggs are deposited into the redd and hatch after approximately 15 days, depending on water temperatures (Meeuwig et al. 2005, Brumo 2006). Pacific lampreys are highly fecund: depending on their size, females lay between 30,000 and 240,000 eggs (Kan 1975). Adults typically die within a few days to two weeks after spawning (Pletcher 1963, Kan 1975, Brumo 2006).

After hatching, the egg-sac larval stage, known as prolarvae, spend another 15 days in the redd gravels, during which time they absorb the remaining egg sac, until they emerge at night and drift downstream (Brumo 2006). After drifting downstream, the eyeless larvae, known as ammocoetes, settle out of the water column and burrow into fine silt and sand substrates that often contain organic matter. Within the stream network they are generally found in low-velocity, depositional areas such as pools, alcoves, and side channels (Torgensen and Close 2004). Depending on factors influencing growth rates, they rear in these habitats from 4 to 10 years, filter-feeding on algae and detrital matter prior to metamorphosing into the adult form (Pletcher 1963, Moore and Mallatt 1980, van de Wetering 1998). During metamorphosis, Pacific lampreys develop eyes, a suctoral disc, sharp teeth, and more-defined fins (McGree et al. 2008). After metamorphosis, smolt-like individuals known as macrophthalmia migrate to the ocean—typically in conjunction with high-flow events between fall and spring (van de Wetering 1998, Goodman et al. 2015). In the ocean, Pacific lampreys feed parasitically on a variety of marine fishes (Richards and Beamish 1981, Beamish and Levings 1991, Murauskas et al. 2013). They are thought to remain in the ocean, feeding for approximately 18–40 months before returning to fresh water as sexually immature adults, typically from winter to early summer (Kan 1975, Beamish 1980, Starcevich et al. 2014, Stillwater Sciences and WNRD 2016). In the Klamath and Columbia rivers, they have been reported to enter fresh water year-round (Kan 1975, Larson and Belchik 1998, Petersen Lewis 2009). Notably, recent research suggests that two distinct life history strategies, analogous to summer and winter steelhead, may occur in some river systems: one, an “ocean maturing” life history that likely spawns several weeks after entering fresh water, and two, a “stream-maturing” life history—the more commonly recognized life history strategy of spending one year in fresh water prior to spawning (Clemens et al. 2013). The adult freshwater residence period for the stream-maturing life history can be divided into three distinct stages: (1) initial migration from the ocean to holding areas, (2) pre-spawning holding, and (3) secondary migration to spawning sites (Robinson and Bayer 2005, Clemens et al. 2010, Starcevich et al. 2014).

White Sturgeon. White sturgeon, the largest fish species found in North American rivers, occur in the ocean inside the 50-fathom line (500 feet depth) and in estuaries and rivers along the Pacific coast. In Oregon, they are an important recreational and commercial fishery resource in the mainstem Columbia and Willamette Rivers. White sturgeon adults, juveniles and sub-adults can be found in the Willamette River year round. White sturgeon spawning in the greater Columbia River system was previously known to occur in only one location: downstream of Bonneville Dam. Spawning ground characteristics include swift, turbulent, moderately deep water (2.5–3 feet/second, 6–80 feet in depth); temperatures of 50–64 F (Peak is 57 F), and bedrock, boulder or cobble substrates—conditions which are found immediately downstream of Willamette Falls. And indeed, in 2009, researchers discovered sturgeon spawning in that location (Chapman and Jones 2010).

White sturgeon broadcast spawn in close proximity to bottom structures during May and June. It has been estimated that white sturgeon reach maturity in 15 to 25 years, with females spawning every 4 to 11 years, producing from 100,000 to several million eggs per spawning event as they grow older (ODFW, 2005). Their fertilized eggs sink rapidly and adhere to cobble, rocks, and other bottom structure. The eggs hatch in 4 days to 2 weeks, depending on water temperature. The young fry move into the water column to feed and may be found in the Willamette River throughout the year.

2.5.1.4 Fish use in proximity to the Project site

The Project site has a number of aquatic habitats and features that are important to fish. These include the in-channel river and off channel alcove habitats. Fish species at various lifestages from juvenile to adult likely use each of these habitat areas during at least some portions of the year. The river immediately below the dam is an important holding area for adult salmon, steelhead and lamprey before they ascend the falls. As noted above, the area downstream of the falls has also recently been identified as a spawning area for white sturgeon. The alcove habitats are likely important off-channel habitat where juvenile salmonids can find food resources and refuge during high flow events. The lagoon has been shown to have some water quality problems, but nonetheless may contain fine sediments and could be an important rearing area for Pacific lamprey ammocoetes.

2.5.2 Birds

Numerous bird species are likely to be present throughout the Project site. Within the in-channel river habitat of the Willamette River, bald eagles, gull spp., and double-crested cormorants may be foraging for fish and using the river as a daily migration corridor. Within the shallow and slow-moving off-channel alcove habitat, shorebirds including, but not limited to spotted sandpiper, green heron and great blue herons may be wading and foraging for fish or aquatic invertebrates in the water or sediment. Along the rocky riparian basalt outcrops, ledges may provide nesting habitat for cliff dwelling species (e.g., peregrines) and a vantage point while foraging along the Willamette River. The diversity of vegetation of shrubs and trees within the riparian forest habitat has the greatest potential to support nesting of numerous passerines. Birds are also known to nest in man-made structures, and species such as barn swallows and european starlings may be found roosting underneath eves, in gaps of rooflines, and within buildings.

2.5.3 Reptiles and Amphibians

Suitable habitat for reptiles and amphibians includes slow-moving lagoon and seep habitat found within the off-channel alcove habitat and at in-channel river habitat, along the edge of the Willamette River. Floating logs within the warm lagoon habitat provide basking habitat for turtles (e.g., Western Painted and Western Pond Turtle). The Western toad and common garter snake may also be found basking along the riprap shoreline of the Willamette River. Breeding habitat for Northern red-legged and Pacific chorus frogs may be found in any backwater ponded habitat. These reptiles and amphibians may disperse from the off-channel alcove and lagoon habitats into adjacent riparian basalt and riparian forest habitats to find cover under rocks, logs, or vegetation.

2.5.4 Invertebrates

In-channel river habitat and off-channel alcove habitats support aquatic invertebrates while upland habitats (e.g., riparian forest) may support terrestrial invertebrates. Although not identified in Table A-1 (Appendix A), in-channel river species may include crayfish and daphnia, which in a Lower Willamette River dominated diets of Northern pikeminnow and Chinook salmon, respectively (https://www.portlandoregon.gov/bes/article/79249). Off-channel alcove habitat may provide low-flow, cold-water habitat for Oregon fairy shrimp while upland habitats (e.g., riparian forest) may provide habitat for earthworms in addition to aerial pollinators such as butterflies and bees.

2.5.5 Mammals

All habitat types present within the Project site provide opportunities to support mammals. Along the off-channel alcove area, the Northern river otter, American beaver and common raccoon are expected to use the site for foraging or loafing as they move through the Willamette Basin and into tributary drainages. Denning sites for furbearers are limited along the cliffs and rocky shore of the riparian basalt and riparian forest. Bats may forage for emerging aquatic insects over the in-channel river and Off-channel Alcove habitats, or glean prey from foliage, tree trunks, and rocks along the riparian basalt and riparian forest habitats. Roosting habitat for bats may be found in riparian basalt cracks and within crevices or on walls of man-made structures. Some of the bats in the area that may roost in these buildings include California myotis, Yuma myotis, long-eared myotis, fringed myotis, long-legged myotis, and Townsend's big-eared bat.

2.5.6 Marine Mammals

The in-channel river habitat provides seasonal foraging opportunities for marine mammals, including primarily California sea lions, but also smaller numbers of Stellar sea lions and harbor seals. According to ODFW, California sea lions have expanded along the West Coast over the past four decades to a population of nearly 300,000 animals coast-wide. Steller sea lions are becoming more frequent visitors to the falls, and are seen sporadically. Pacific harbor seals are abundant in coastal areas, but relatively rare at upriver sites such as Willamette Falls (Wright et al., 2016). During studies in 2016, the maximum single-day observation totals were 35 California sea lions on April 22, and one Steller sea lion (many dates from February 4 to April 16); no harbor seals were observed in 2016 (ibid). Sea lions were present from at least February to May. Consequently, sea lions will likely rest or haul out in the adjacent slow-moving waters of the off-channel alcove habitat or along riprap lining the Willamette River from late Winter through Spring.

3 CONSERVATION PRIORITIES

Species recovery plans, conservation strategies, local and regional watershed plans, and other conservation documents have been created for multiple regions and species, by multiple governmental and non-governmental entities. Many of these plans either encompass the project site or involve species that are present at the project site. Willamette Falls is the head of tide in the Willamette River and its unique geographic location and physical features make it an important habitat element delineating the upper and lower mainstem Willamette River. The falls also historically severely restricted upstream movement of fish and other aquatic biota, creating one-of-a-kind habitat elements that have been significantly altered over years of modification for human use. Below is a discussion of how the habitat elements present at the site and the proposed habitat enhancements relate to selected planning and framework documents.

Endangered species act recovery plan for Lower Columbia River Coho Salmon, Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, and Lower Columbia River Steelhead (NMFS 2013)

The base of Willamette Falls is the upstream extent of multiple Evolutionary Significant Units (ESUs) of salmon and Distinct Population Segments (DPSs) of steelhead that are found in the lower Willamette and Columbia Rivers. In fact, the Columbia River Estuary is defined as extending up-river in the Willamette to the head of tide, which is at Willamette Falls. As stated in the recovery plan, estuary habitat strategies focus on providing adequate off-channel and intertidal habitats, such as tidal swamp and marsh; restoring habitat complexity in areas modified by agricultural or rural residential use; decreasing exposure to toxic contaminants; and lowering late summer and fall water temperatures. These goals will be accomplished over the long term by restoring hydrologic, sediment, and riparian processes that structure habitat in the estuary.

Representative actions include protecting and restoring high-quality off-channel habitats and riparian areas; and identifying and reducing current sources of pollutants. The enhancement of the off-channel rearing habitats, especially in areas of coldwater seeps and springs, as well as the improvement of water quality and decrease in contaminants, fits into these recovery goals.

Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011)
As stated above, UWR Chinook and steelhead were historically the only salmonids able to navigate the falls. There are many identified limiting factors for UWR Chinook and steelhead populations, including hydrograph alterations, competition, disease and food web effects, which will be unaffected by the project. However, the proposed project does have the potential to improve habitat access and physical habitat quality and quantity. Specifically, elements of the proposed project could improve floodplain connectivity and function, channel structure and complexity, channel morphology, riparian condition, large wood recruitment, sediment routing (fine and coarse sediment), and upland processes.

Oregon Conservation Strategy (ODFW, 2016).
The Oregon Conservation Strategy summarizes information on the issues facing Oregon's species, habitats, and people. Statewide Key Conservation Issues include: Land use changes; Climate change; Water Quality and Quantity, Disruption of disturbance regimes; Invasive Species; Barriers to animal movement; and Challenges for Private Landowners to engage in voluntary conservation. The project site is located in the Lower Willamette Floodplain Conservation Opportunity Area, within which the recommended conservation actions include:

- Improve aquatic and riparian habitat complexity and diversity.
- Improve riparian buffers.
- Maintain and enhance isolated wetlands to provide habitat for amphibians and turtles.
- Maintain and expand Oregon white oak habitat
- Protect and improve water quality.
- Protect and restore shallow water and off-channel habitats.
- Remove fish and wildlife passage barriers.
- Restore floodplain function and connectivity.
- Restore riparian and wetland plant communities.

The proposed project activities will include each of these actions to at least a small degree.

Also included as "strategy habitats" are natural lakes, oak woodlands, flowing water and riparian habitats, and wetlands. Identified, "specialized local habitats" include: basalt cliffs, bottomland hardwood forest, off-channel habitat, riverine islands (Ross Island, Elk Rock Island, Rock Island, Cedar Island, Clackamette Island), and shoreline and sandy beaches.

Identified limiting factors in flowing water and riparian areas habitats include:

- Water quantity
- Pollution
- Sedimentation
- Water Temperature
- Invasive species

- Water temperature
- Sedimentation
- Passage barriers and channel complexity
- Loss of Riparian Habitat, Floodplain Function, and Habitat Complexity
- Riparian Habitat Degradation
- Invasive Plants in Riparian Areas

Limiting factors for wetlands include:

- Habitat loss
- Water Availability
- Degraded water quality
- Invasive Species

Limiting factors for oak woodlands include:

- Fires Suppression and Fir Encroachment
- Land Use Conversion and Continued Habitat Loss
- Loss of Habitat Structure
- Invasive Species
- Climate Change

The strategy also states that the lower Willamette Valley is an, important movement corridor for migratory and resident fish and wildlife, and that restoration of the Lower Willamette River and associated floodplain and uplands has important implications not only for fish and wildlife, but also for the social and economic factors resulting from restoring ecological functions such as flood control and water quality. Again, restoration at the project site will improve many of the limiting factors in each of strategy habitats where they occur at the project site.

Regional Conservation Strategy for the Greater Portland-Vancouver Region (Intertwine Alliance, 2012).

The Regional Conservation Strategy for the Greater Portland-Vancouver Region, is consistent with two statewide plans—the Oregon Conservation Strategy (discussed immediately above) and Washington Comprehensive Wildlife Conservation Strategy. However, the regional conservation strategy is unique among similar plans in its focus on urban ***and*** rural lands and its bi-state scope. It builds on existing local planning and implementation efforts and strives to strengthen regional cooperation

Both the conservation strategy and its associated Biodiversity Guide for the Greater Portland-Vancouver Region are further differentiated by taking a long view and focusing on biodiversity. The guidance documents clearly describe the biodiversity of the region, while laying out the challenges facing local wildlife and ecosystems.

The Regional Conservation Strategy does the following:

- Describes the historical, current, and desired future conditions for fish and wildlife habitat across urban and rural landscapes, both inside and outside the Portland–Vancouver metropolitan area.
- Identifies conservation opportunities within these urban and rural landscapes

- Describes the threats to potential conservation areas, and presents strategies to protect and restore biodiversity.
- Demonstrates how the greater Portland/Vancouver region fits into—and is crucial to— the larger landscape and how the Regional Conservation Strategy nests within the Oregon and Washington state conservation strategies and existing federal and local planning efforts and strategies.

One goal of the Regional Conservation Strategy is to describe the desired future conditions of natural ecosystems of the region. This would be an interconnected system of functional natural areas across the urban and rural landscapes managed in such a way as to do the following:

- Protect the water and air quality of the region
- Provide other important ecosystem services, such as flood control, water storage, and pollination
- Support at least the current level of biodiversity
- Help species and habitats recover from historical losses or degradation
- Increases natural systems' resilience and their ability to adapt to an unpredictably changing climate
- Provide opportunities for people to access natural areas for local recreation, research, and appreciation

The Willamette Falls Legacy Project has the opportunity to advance toward those desired future conditions – especially by providing a very unique opportunity for people to finally access a one-of-a-kind feature forrestoration andeducation.

Draft Willamette Subbasin Plan (NWPCC 2004)

The Willamette Subbasin Plan is a widespread and comprehensive plan with multiple focal species and habitats. It also contains many conservation guidelines and strategies for aquatic and terrestrial areas. These strategies are many and varied and are designed to benefit multiple focal species. Those strategies relevant to the project site include:

1. Aquatic strategies:
    - Restore physical habitats
        - Increase interaction of rivers and floodplains by removing or altering:
            - selected revetments and
            - selected off-channel blockages
        - Increase supply and recruitment of large wood by improving riparian composition and extent and providing for flows to capture wood.
        - Improve water quality, especially temperature problems, by
            - Improve riparian shading
            - Increasing extent and duration of flow interaction with hyporheic zone.
    - Conserve and restore biological communities
        - Control the most damaging terrestrial and aquatic invasive species
        - Control temperatures which favor nonnative species
    - Connect favorable habitats
        - Connect fish to off-channel habitat by reconnecting rivers with floodplains and improved flow management

2. Terrestrial strategies
   - Increase extent and distribution of focal habitats by:
     - Increase interaction of rivers and floodplains by removing or altering:
       - selected revetments and
       - selected off-channel blockages
     - Improve extent and composition of riparian areas
     - Achieve an adequate and sustainable supply of standing and downed dead wood in upland and streamside environments
   - Conserve and restore biological communities
     - Protect existing high quality habitats and consider restoration, including
       - Maintaining or improving existing land use and forest practice laws, mitigation requirements, and landowner conservation incentives
       - Remove and control the most harmful invasive species, including by responding rapidly to new plant pathogens.
     - Increase supply and recruitment of large wood by improving riparian composition and extent and providing for flows to capture wood.
     - Maintain natural water level and soil moisture regimes
   - Connect Favorable Habitats
     - Avoid barriers to wildlife movement.
     - Minimize extent of new road construction

Willamette Valley-Puget Trough Ecoregional Assessment (Floberg et al. 2004)

The Willamette Falls Legacy site lies within the Willamette Valley-Puget Trough-Georgia Basin ecoregion, a long ribbon of broad valley lowlands and inland sea flanked by the rugged Cascade and coastal mountain ranges of British Columbia, Washington, and Oregon. It encompasses some 21,431 square miles of Pacific inlet, coastal lowlands, islands, and intermontane lowland, and extends from the Sunshine Coast and eastern lowland of Vancouver Island along Georgia Strait, south through Puget Sound and the extensive plains and river floodplains in the Willamette Valley. Relative to its size, the Willamette Valley-Puget Trough-Georgia Basin ecoregion has a large number of species (526 species targets) that are imperiled, declining, or endemic to the ecoregion and of conservation concern. It is highly likely that many more species for which we lack distribution and abundance data (especially invertebrates, fungi and non-vascular plants) are of concern. The ecoregion also has an exceptional diversity of habitats including 217 nearshore, terrestrial, and freshwater ecological systems, and 90 imperiled terrestrial plant communities.

Oregon/Washington Partners in Flight (PIF) Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington. (Altman 2000)

PIF has identified priority species and completed a conservation strategy that relies on four principal components:

- identify habitats and habitat attributes important to landbirds,
- describe the desired habitat conditions based on the habitat relationships of a select group of priority species,
- provide interim management targets (i.e., biological objectives) to achieve the desired conditions, and
- recommend management actions (i.e., conservation strategies) that can be implemented by various entities at multiple scales to achieve the biological objectives

The diversity of landbird species and habitats in the Westside Lowlands and Valleys, required a conservation strategy for an array of habitat conditions. Management goals would be designed and integrated across multiple species and landscapes. The authors stated that landbird conservation would require reserves, and areas with variety of management activities in differing landscapes. Their suggested conservation focus included:

- initiate conservation actions in accordance with the ecological potential of the site (i.e., within the framework of potential natural vegetation and natural ecosystem processes),
- emphasize conservation within high priority designated conservation areas and where opportunities exist (i.e., receptive land owners and land managers), and
- emphasize conservation at multiple scales such that habitat conditions for one or a few species are nested within a landscape that provides a mosaic of conditions for multiple species.

Toward that end, the authors selected four priority habitats:

- grassland-savanna
- oak woodland
- riparian
- chaparral

Restoration and enhancement of these habitats where present at the project site will mesh with the landbird conservation strategy.

4 CONSIDERATIONS FOR CONCEPTUAL DESIGN

In the process of developing this report and in consultation with key project stakeholders, the following considerations have been identified as important for the development of a Riverwalk Project design. The points below are evolving alongside our understanding of the site constraints, conditions and opportunities.

4.1 General Concepts

- Maintain and improve existing habitats
- Prioritize preservation of riparian basalt areas with unique native plants.
- Add new habitat for native fish and riparian dependent speciesWhere feasible, connect the Riverwalk Project site to adjacent open areas such as the Canemah Bluffs and Camassia Preserve to benefit pollinators and migratory bird species
- Remove invasive species and alter conditions at site to encourage native species over non-native species
- Avoid direct impacts to key species during construction by timing activities to occur when species are not present or breeding
- Minimize impact to existing recreational salmon fishing and tribal lamprey harvest during construction activities and resulting from changes to the site
- Avoid unintended consequences to migratory fish behavior (e.g., stranding, entrainment, or increased predation risk) through alteration of “attraction” flows. e.g., new tail races, construction impacts

- Seek opportunities to educate the public with respect to the ecological value of the site, key habitats, fish and wildlife use of the site and elements that make it unique such as riparian basalt outcroppings, lamprey passage, sturgeon spawning.

4.2 Increase Shoreline Complexity

- Create vertically and horizontally complex river margins
- Create alcove-like habitat features
- Create of shallow edgewater habitats
- Create more gradually sloped banks, including replacing riprap with native soils where possible
- Encourage low flow velocities along channel margins.
    - Resting and holding for native adult migratory fish
    - High velocity refuge and cover from predators for native juvenile fish
    - Improved turtle and amphibian habitats (e.g., stillwater areas, basking structure)
    - Improved waterfowl and wading bird habitats (e.g., improved water quality, nesting and foraging habitat)

4.3 Fish Passage and Behavior

- Evaluate potential consequences of altered hydraulics related to designs on fish passage ability and behavior at the falls.
- Look for opportunities to add slow water resting habitat for migratory fish, especially salmon and steelhead. Lamprey are able to rest in fast water areas by latching onto rocks and cement, and therefore cover is a more important habitat element for lamprey resting.
- Remove metal and debris in off-channel alcove habitat that may pose adverse impacts to lamprey and other fish species
- In any instance where water flow direction and velocities are altered, it may alter existing fish behavior or migrator pathways. This can be both beneficial (e.g., providing resting or alternative migration pathways) and detrimental (attracting fish to undesirable areas or creating predation hot-spots). Another important element of altering flow pathways and hydrology is that it may change preferred Pacific lamprey holding and migrating locations, potentially impacting Tribal harvest. An adaptive approach, whereby fish behavior and habitat use are monitored and flow paths and velocities (as well as potential use of fish screens) are refined as needed in response is recommended.
- Avoid building structures that could be used by California sea lion for resting (e.g., accessible docks and walkways). Consider seasonal and tidal variation in flow levels.

4.4 Improve Water Quality

As noted in the Vision document, the Willamette River is identified under the Clean Water Act for violations of water quality standards including temperature, bacteria, and mercury. As such, the following objectives should be considered:

- Minimize sedimentation associated with construction to avoid impacts on water quality and fish and amphibian habitat particularly in off-channel alcove habitat.

- Ensure storm water pollution prevention plan is developed and followed during construction
- Locate point source and non-point source pollution (e.g., municipal storm water) at site.
    - Water temperature: promote water temperature refuges for fish by identifying coldwater springs and seeps and promoting fish access and habitat improvements. Provide shade through riparian plantings.
    - Potential soil contamination – ensure soil toxicity levels (current or during construction) do not pose a risk to water quality resulting from urban runoff
- Improve water circulation within the lagoon to improve water quality, allow downstream passage and reduce invasive plant species. Be sure to avoid the attraction of both upstream and downstream migrating fish (salmon, steelhead, and lamprey) that may be trapped and subject to increased predation.

4.5 Protect and Restore Riparian Habitat

Restoration of riparian habitat has a number of benefits. In addition to creating conditions that allow more natural plant communities to establish, including rare plants native to the site, healthy riparian habitat are important for native birds, amphibians, reptiles, insects, and small mammals. Furthermore, riparian restoration complements other key habitat restoration strategies by promoting shoreline complexity (i.e., roughness) and improving important fish habitat elements (e.g., shade for cooler water temperature, low velocity refuge alcoves, additional substrate for cover).

Potential habitat restoration opportunities for riparian habitats are described below.

4.5.1 Riparian forest

- Much of the natural bank habitat along some areas of the Willamette have been replaced by artificial habitats including riprap, which previous studies have shown to decrease aquatic species richness and diversity in the middle Willamette River (Friesen 2005).
- Riparian scrub/forest habitat is degraded, patchy or absent along the shoreline terraces adjacent to the Riverfront and riparian areas above the falls. It would be beneficial to preserve and enhance this habitat. Along the shoreline downstream of the falls is mostly a narrow band of riprap, rock, and concrete between the water's edge and industrial buildings (not including the rip habitats listed described below).
- Presence of various willows, Pacific ninebark, and red-osier dogwood were a likely component of the original riparian vegetation at the Project. Invasive plants including Himalayan blackberry, morning glory, English ivy and other invasive plants occur in patches along the shoreline.
- The removal of invasive plants and replanting with native plants will increase the habitat value.
- The narrow band of riparian vegetation above the falls can be widened where possible, with non-natives removed and a native shrub layer encouraged.
- Industrial debris should be removed and pavement disassembled.
- Opportunities for improving future raptor habitat are available on-site and include installing native trees along the upper shoreline or erecting a nesting platform for use by osprey.

- Increasing the shrub and tree layer along the shoreline would also improve foraging and stop-over habitat for songbirds such as Wilson's warbler, yellow warbler, evening grosbeak, and western tanagers.
- Riprap and concrete should be removed where feasible above the falls, especially in locations where soils exist over bedrock and infiltration could be encouraged. Revegetating with native trees, such as red alder, big-leaf maple, black cottonwood, and native shrubs such as red-osier dogwood, salmonberry, or Douglas hawthorne can reduce impervious surface area on the site, provide a place for localized stormwater infiltration, and provide shade along the bank.
- Expose and Restore Historic Shoreline – Restoration and enhancement of existing shoreline habitat could best be achieved by making available as much of the historic shoreline as possible and restoring the riparian forest habitat along the shoreline. By removing buildings and platforms along the shoreline, valuable shoreline habitat would be exposed below the falls for fish, invertebrates, small mammals and birds.

4.5.2 Riparian basalt

Protection and restoration of the unique rocky basalt outcrops and associated plant and animal species is a high priority for the project area.

- Riparian basalt outcrops surround the Falls and PGE Dam Area.
- Basalt and rock outcroppings (balds and bluffs) are a habitat feature along the Willamette River, and are listed as a specialized and local habitat for the Willamette Valley ecoregion in the Oregon Conservation Strategy. These habitats are critical for many species including red-legged frogs, salamanders, herons, migratory songbirds, water voles, weasels, native turtles and pollinators.
- At the site many of these outcrops have been impacted by industrial development, and presumably by decades of poor air quality. However, there are significant remnants of undisturbed cliff faces.
- Native vegetation on the cliffs and outcrops is well preserved at the Project site. This greatly increases their conservation value.
- Increasing the diversity of native historical species on basalt outcrops at Willamette Falls is a desirable restoration target. Although portions of the rocks are subject to periodic scouring by high river flows, higher ledges and cliffs are free of scour and could support an array of species that probably once occurred there. In this habitat, bryophytes are critical keystone ecosystem builders because of their ability to create soils and trap sediments on these otherwise barren substrates. Establishment and spread of bryophyte mats is an essential first step in creating habitat for vascular plants. This could be accomplished by transplanting moss mats and excluding trampling from foot traffic. With proper management, the basalt bluffs at Willamette Falls Legacy site could become a showcase for all of these plants.
- Native plant diversity is relatively high at the Willamette Narrows natural area upstream of the site, which support drought-tolerant species such as Oregon white oak, Pacific madrone as well as native wildflowers and other herbaceous plants including state listed *Delphinium leucophaeum*, sedums, and *Brodiaea* (Houck and Cody 2000).
- Records from Willamette Narrows and Elk Rock Island natural areas indicate that a number of vascular species are missing from today's Willamette Falls Legacy site, but could be targets for restoration. These would include *Agrostis pallens, Allium amplectens,*

Allium acuminatum, Arctostaphylos uva-ursi, Arnica amplexicaulis, Bolandra oregana, Brodiaea coronaria, Castilleja hispida, Cascadia nuttallii, Ceanothus cuneatus, Delphinium leucophaeum, Grindelia integrifolia, Heuchera micrantha, Lithophragma parviflorum, Lomatium dissectum, Lomatium triternatum, Micranthes gormanii, Micranthes integrifolia, Micranthes fragosa, Micranthes marshallii, Micranthes rufidula, Penstemon serrulatus, Rupertia physodes, Silene antirrhina, Silene douglasii, Silene menziesii, Sullivantia oregana, and *Viburnum ellipticum*. Because Willamette Falls is the type locality of *Arnica amplexicaulis*, special effort should be made to reestablish this species at the falls (Christy and Gaddis 2015).

- Bryophyte species suitable for reintroduction at Willamette Falls Legacy site include *Racomitrium, Grimmia, Dicranum howellii*, *Polytrichum juniperinum*, and *Homalothecium megaptilum* (Christy and Gaddis 2015).
- Removal of the clarifier and exposing other riparian basalt areas would restore unique basalt rock outcroppings along the shoreline at the site. With removal of industrial structures, there may be opportunities to promote shorebird habitat and local native wildflower species diversity on the outcroppings (ESA 2012).

4.5.3 Off-channel alcove habitat and river shoreline

- Off channel alcoves are situated throughout both the Project site, within the falls and adjacent to the PGE dam.
- The off-channel alcoves contain industrial structures, concrete and debris, some of which are of considerable cultural interest. However, sand and cobble substrates, as well as areas hydrated by springs and seeps at the site support a diverse array of native wetland plants, although they are subject to considerable disturbance during peak river flows.
- Removal of some buildings would allow for the day lighting of historic tailraces and the establishment of a riparian community and off channel alcoves. Tailrace #2 is already the location of a small alcove, which can be enhanced to provide resting places for fish, as well as habitat for small mammals, amphibians, and invertebrates.
- The river shoreline rocks are surprisingly devoid of bryophyte species. Above ordinary high water, moist and shaded rock habitats are dominated by dense monocultures by one bryophyte species. At other, more protected sites outside the project area, similar habitats are densely covered with many bryophyte species. This community type can be several inches deep and support habitat for many vascular plants of conservation concern such as *Comandra umbellata*, *Allium acuminatum*, *Allium amplectens*, *Brodiaea coronaria*, *Piperia transversa*, *Lomatium triternatum*, and *Lomatium utriculatum* (Christy and Gaddis 2015)
- Wetland invasive species of particular concern include *Iris pseudacorus, Ludwigia hexapetala*, *Lythrum salicaria*, and *Phalaris arundinacea*. The *Lythrum* is quite abundant on cobble areas of river alcoves among the basalt bluffs, and can easily spread downstream by seed and fragmentation. *Carduus pycnocephalus* and *Verbena brasiliensis* may be weeds of emerging concern, the latter also on cobble and capable of dispersal downstream. *Verbena brasiliensis* needs verification, but seems distinct from *V. bonariensis* that has also been found in the metro area. Treatment of these species in advance of development would be an early action item to improve habitat at the site.

5 SUMMARY OR CONCLUSION

The next phase of work will focus on refining design ideas and concepts for the Riverwalk Project and continuing engagement with interested stakeholders. As the conceptual designs are advanced, it would be valuable to engage staff from the ODFW, National Marine Fisheries Service, U.S Fish and Wildlife Service and others in a site survey to further document restoration opportunities and constraints. During that survey, it would be beneficial to map basalt outcroppings and bat use at the site, as well as the presence of amphibian and reptiles.

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Appendices

Appendix A

Special-status and Non-special Status Species that Have the Potential to Occur or Have Been Documented within or Adjacent to the Project site

Table A-1. Special-status and non-special status species that have the potential to occur or have been documented within or adjacent to the Project site.

Species	Status[1] Federal/State	Source	Habitat type: In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	Likelihood of Occurrence (none, low, mod, high)[2]	
INVERTEBRATES										
Oregon Giant Earthworm *Driloleirus macelfreshi*	SOC/–	ORBIC 2016	--	--	--	X	X	--	Low	
Oregon Fairy Shrimp	–/–	Milestone 2	--	X	X	--	--	--	Moderate	
Oregon Snail (Dalles Sideband) *Monadenia fidelis minor*	SOC/–	ORBIC 2016	--	X	X	--	--	--	Low	
FISH									**Above Falls**	**Below Falls**
Sand Roller *Percopsis transmontana*	–	Hulse et al. 2002	X	X	--	--	--	--	Moderate	Moderate
Starry Flounder *Platichthys stellatus*	–/–	Hulse et al. 2002	X	X		--	--	--	Low	None
Pacific Lamprey *Entosphenus tridentatus*	SOC/SV	ESA 2012 Milestone 2 ORBIC 2016	X	X	--	--	--	--	High	High
Western Brook Lamprey *Lampetra richardsoni*	–/SV	ORBIC 2016	X	X		--	--	--	Moderate	High
River Lamprey *Lampetra ayresi*	SOC/–	Hulse et al. 2002	X	X		--	--	--	Low	Low
White Sturgeon *Acipenser transmontanus*	–/–	ESA 2012	X	X	--	--	--	--	Moderate	High
Northern Pikeminnow *Ptychocheilus oregonensis*	–/–	Hulse et al. 2002	X	X	--	--	--	--	High	High

Species	Status[1] Federal/State	Source	Habitat type						Likelihood of Occurrence (none, low, mod, high)[2]	
			In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	Above Falls	Below Falls
Leopard Dace *Rhinichthys falcatus*	–/–	Hulse et al. 2002	X	X	--	--	--	--	Low	Low
Longnose Dace *Rhinichthys cataractae*	–/–	Hulse et al. 2002	X	X	--	--	--	--	Moderate	Moderate
Speckled Dace *Rhinichthys osculus*	–/–	Hulse et al. 2002	X	X	--	--	--	--	High	High
Redside Shiner *Mylocheilus caurinus*	–/–	Hulse et al. 2002	X	X	--	--	--	--	Moderate	Moderate
Largescale Sucker *Catostomus macrocheilus*	–/–	Hulse et al. 2002	X	X	--	--	--	--	High	High
Mountain Sucker *Catostomus platyrhynchus*	–/–	Hulse et al. 2002	X	X	--	--	--	--	High	High
Chinook Salmon (Lower Columbia River ESU [fall and spring run] *Oncorhynchus tshawytscha*	T/SC	Milestone 2 ORBIC 2016 ESA 2012	X	X		--	--	--	Low	None
Chinook Salmon (Unlisted hatchery origin) *Oncorhynchus tshawytscha*	–/–	Hulse et al. 2002	X	X					High	High
Chinook Salmon (Upper Willamette River ESU [spring run]) *Oncorhynchus tshawytscha*	T/SC	Milestone 2 ORBIC 2016 ESA 2012	X	X		--	--	--	High	High
Coho Salmon (Lower Columbia River ESU) *Oncorhynchus kisutch*	T/E	Milestone 2 ORBIC 2016 ESA 2012	X	X		--	--	--	Moderate	None

Species	Status[1] Federal/State	Source	Habitat type: In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	Likelihood of Occurrence (none, low, mod, high)[2]: Above Falls	Below Falls
Coho Salmon (unlisted hatchery stock) *Oncorhynchus kisutch*	–/–	Hulse et al. 2002	X	X					High	High
Coastal Cutthroat Trout (Southwestern Washington/Columbia River ESU) *Oncorhynchus clarkii*	SOC/SV	ORBIC 2016 ESA 2012	X	X		--	--	--	Low	None
Coastal Cutthroat Trout (Upper Willamette River ESU) *Oncorhynchus clarkii*	SOC/–	ORBIC 2016 ESA 2012	X	X		--	--	--	Moderate	Moderate
Steelhead (Lower Columbia River ESU [summer and winter run] *Oncorhynchus mykiss*	T/SC	Milestone 2 ORBIC 2016	X	X		--	--	--	Moderate	None
Steelhead (Upper Willamette River ESU) *Oncorhynchus mykiss*	T/SV	Milestone 2 ORBIC 2016	X	X		--	--	--	High	High
Bull Trout (Coastal population) *Salvelinus confluentus*	T/SC	ESA 2012 ORBIC 2016	X			--	--	--	Low	Low
Mountain Whitefish Prosopium williamsoni	–	Hulse et al. 2002	X	X		--	--	--	High	High
Rainbow Trout *Oncorhynchus mykiss*	–	Hulse et al. 2002	X	X		--	--	--	Low	Low

Species	Status[1] Federal/State	Source	Habitat type						Likelihood of Occurrence (none, low, mod, high)[2]	
			In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	Above Falls	Below Falls
Sockeye Salmon *Oncorhynchus nerka*	–/–	ESA 2012	X	X		--	--	--	Low	Low
Threespine Stickleback *Gasterosteus aculeatus*	–	Hulse et al. 2002	X	X	--	--	--	--	High	High
Paiute Sculpin *Cottus beldingi*	–/–	Hulse et al. 2002	X		--	--	--	--	Low	Low
Prickly Sculpin *Cottus asper*	–/–	Hulse et al. 2002	X		--	--	--	--	High	High
Reticulate Sculpin *Cottus perplexus*	–/–	Hulse et al. 2002	X		--	--	--	--	High	High
Torrent Sculpin *Cottus rhotheus*	–/–	Hulse et al. 2002	X		--	--	--	--	High	High
Chiselmouth *Acrocheilus alutaceus*	–/–	Hulse et al. 2002	X	X	--	--	--	--	High	High
Peamouth *Mylocheilus caurinus*	–/–	Hulse et al. 2002	X	X	--	--	--	--	High	High
Eulachon *Thaleichthys pacificus*	T/–	Hulse et al. 2002	X	X	--	--	--	--	Low	None
Non-native species[3]	–/–	Hulse et al. 2002	X	X		--	--	--	High	High

AMPHIBIANS

Larch Mountain Salamander *Plethodon larselli*	SOC/SV	ORBIC 2016	--	--	X	X	X	--	Low	
Clouded Salamander *Aneides ferreus*	–/SV	ORBIC 2016	--	--	--	X	X	--	Low	

Species	Status[1] Federal/State	Source	Habitat type: In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	Likelihood of Occurrence (none, low, mod, high) [2]
Oregon Slender Salamander *Batrachoseps wright*	SOC/SV	ORBIC 2016	--	--	--	--	X	--	Low
Pacific Chorus Frog *Pseudacris regilla*	–/–	Milestone 2	--	X	X	X	X	--	High
Northern Red-legged Frog *Rana aurora*	SOC/SV	Milestone 2 ODFW 2016 ORBIC 2016	--	X	X	X	X	--	Moderate
Western Toad *Anaxyrus boreas*	–/SV	ORBIC 2016	X	X	X	X	--	--	Low
American Bullfrog *Lithobates catesbeianus*	–/–	ESA 2012	X	X	--	--	--	--	Moderate
REPTILES									
Western Painted Turtle *Chrysemys picta*	–/SV	Milestone 2 CDFW 2016 ORBIC 2016	X	X	X	X	--	X	Moderate
Western Pond Turtle *Actinemys marmorata*	SOC/SV	ESA 2012 ORBIC 2016	X	X	X	X	--	X	Moderate
Common Garter Snake *Thamnophis sirtalis*	–/–	Metro 2011	X	X	X	X	X	X	Moderate
Rubber Boa *Charina bottae*	–/–	Metro 2011	--	--	--	X	X	X	Moderate
BIRDS									
Double-crested Cormorant *Phalacrocorax auritus*	–/–	Milestone 2	X	X	--	--	--	--	High
Green Heron *Butorides virescens*	–/–	Milestone 2	--	X	--	X	--	--	High

Species	Status[1] Federal/State	Source	Habitat type						Likelihood of Occurrence (none, low, mod, high) [2]
			In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	
Great Blue Heron *Ardea herodias*	–/–	Milestone 2 ESA 2012	--	X	--	X	--	--	High
Canada Goose *Branta canadensis*	–/–	ESA 2012		X	--	--	--	--	High
Wood Duck *Aix sponsa*	–/–	Milestone 2		X	--	X	--	--	Moderate
Osprey *Pandion haliaetus*	–/–	Milestone 2 ESA 2012	X	--	--	X	X	--	High
Bald Eagle *Haliaeetus leucocephalus*	–/–	Milestone 2 ORBIC 2016 ESA 2012	X	--	--	--	X	--	Moderate
American peregrine falcon *Falco peregrinus anatum*	–/SV	ORBIC 2016	--	--	X	X	X	X	High
Spotted Sandpiper *Actitis macularius*	–/–	Milestone 2	--	X	--	--	--	--	Moderate
Ring-billed Gulls *Larus delawarensis*	–/–	Milestone 2	X	X	--	--	--	--	Moderate
Band-tailed Pigeon *Patagioenas fasciata*	SOC/–	ORBIC 2016	--	--	--	X	X	X	High
Yellow-billed Cuckoo *Coccyzus americanus*	T/SC	ORBIC 2016	--	X	--	X	--	--	Low
Common Nighthawk *Chordeiles minor*	–/SC	ODFW 2016 ORBIC 2016	--	X	--	X	?	?	Moderate
Belted Kingfisher *Megaceryle alcyon*	–/–	ESA 2012	--	X	--	X	--	--	High
Anna's Hummingbird *Calypte anna*	–/–	Milestone 2	--	X	--	X	X	X	Moderate
Acorn Woodpecker *Melanerpes formicivorus*	SOC/SV	CDFW 2016 ORBIC 2016	--	--	--	--	X	X	Moderate

Species	Status[1] Federal/State	Source	Habitat type						Likelihood of Occurrence (none, low, mod, high)[2]
			In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	
Lewis's Woodpecker *Melanerpes lewis*	SOC/SC	ORBIC 2016	--	--	--	--	X	X	Moderate
Downy Woodpecker *Picoides pubescens*	–/–	Milestone 2	--	--	--	--	X	X	Moderate
Black-backed Woodpecker *Picoides arcticus*	–/SV	ORBIC 2016	--	--	--	--	X	X	Moderate
Pileated Woodpecker *Dryocopus pileatus*	–/SV	ORBIC 2016	--	--	--	--	X	X	Moderate
American Three-toed Woodpecker *Picoides dorsalis*	–/SV	ORBIC 2016	--	--	--	--	X	X	Moderate
Red-breasted Sapsucker *Sphyrapicus ruber*	–/–	Metro 2011	--	--	--	--	X	X	Moderate
Willow Flycatcher *Empidonax traillii*	SOC/SV	Milestone 2 ODFW 2016	--	X	--	X	X		Low
Olive-sided Flycatcher *Contopus cooperi*	SOC/SV	ORBIC 2016	--	--	--	X	X	x	Low
Little willow Flycatcher *Empidonax traillii brewsteri*	–/SV	ORBIC 2016	--	X	--	X	--	x	Low
Cliff Swallow *Petrochelidon pyrrhonota*	–/–	EPIC 2012	--	X	--	X	--	--	Low
Purple Martin *Progne subis*	SOC/SC	ORBIC 2016	--	X	--	?	?	?	Low
Black-capped Chickadee *Poecile atricapillus*	–/–	Metro 2011	--	--	--	X	X	x	Moderate
Bushtit *Psaltriparus minimus*	–/–	Metro 2011	--	--	--	X	X	x	Moderate

Species	Status[1] Federal/State	Source	Habitat type						Likelihood of Occurrence (none, low, mod, high)[2]
			In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	
Slender-billed Nuthatch (also known as white-breasted nuthatch) *Sitta carolinensis aculeata*	–/SV	Milestone 2 ODFW 2016 ORBIC 2016	--	--	--	--	X	X	Moderate
House Wren *Troglodytes aedon*	–/–	Metro 2011	--	--	--	X	X	X	High
Ruby-crowned Kinglet *Regulus calendula*	–/–	Milestone 2	--	--	--	X	X	X	Low
Evening Grosebeak *Coccothraustes vespertinus*	–/–	ESA 2012	--	--	--	X	X	x	Low
Lesser Goldfinch *Spinus psaltria*	–/–	Milestone 2	--	X	--	X	X	x	Low
Cedar Waxwing *Bombycilla cedrorum*	–/–	Milestone 2	--	X	--	X	X	X	Moderate
Yellow Warbler *Setophaga petechia*	–/–	Milestone 2 ESA 2012	--	X	--	X	X	X	Moderate
Wilson's Warbler *Cardellina pusilla*	–/–	Milestone 2. ESA 2012	--	X	--	X	X	X	Moderate
Yellow Warbler *Setophaga petechia*	–/–	Milestone 2 ESA 2012	--	X	--	X	X	X	Moderate
Wilson's Warbler *Cardellina pusilla*	–/–	Milestone 2. ESA 2012	--	X	--	X	X	X	Moderate
Orange-crowned Warbler *Oreothlypis celata*	–/–	Metro 2011	--	X	--	X	X	X	Moderate
Black-throated Gray Warbler *Setophaga nigrescens*	–/–	Metro 2011	--	X	--	X	X	X	Moderate
Yellow-breasted Chat *Icteria virens*	SOC/SC	ORBIC 2016	--	X	--	X	--	--	Low

Species	Status[1] Federal/State	Source	Habitat type						Likelihood of Occurrence (none, low, mod, high) [2]
			In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	
Western Tanager *Piranga ludoviciana*	–/–	Milestone 2 ESA 2012	--	--	--	--	X	--	Low
Oregon Vesper Sparrow *Pooecetes gramineus affinis*	SOC/SC	ORBIC 2016	--	--	--	--	--	X	Low
Chipping Sparrow *Spizella passerina*	–/CS	ODFW 2016 ORBIC 2016	--	--	--	X	X	X	Moderate
Lesser Goldfinch *Spinus psaltria*	–/–	Milestone 2	--	X	X	X	X	x	Low
MAMMALS									
California Myotis *Myotis californicus*	–/–	CDFW 2016	X	X	X	X	X	X	High
Yuma Myotis *Myotis yumanensis*	SOC/–	ORBIC 2016	X	X	X	X	X	X	High
Long-eared Myotis *Myotis evotis*	SOC/–	ORBIC 2016	X	X	X	X	X	X	High
Fringed Myotis *Myotis thysanodes*	SOC/SV	CDFW 2016 ORBIC 2016	X	X	X	X	X	X	High
Long-legged Myotis *Myotis volans*	SOC/SV	ORBIC 2016	X	X	X	X	X	X	High
Hoary Bat *Lasiurus cinereus*	–/SV	CDFW 2016 ORBIC 2016	X	X	X	X	X	X	High
Silver-haired Bat *Lasionycteris noctivagans*	SOC/SV	CDFW 2016 ORBIC 2016	X	X	X	X	X	X	High
Townsend’s Big-eared Bat *Corynorhinus townsendii*	SOC/SC	CDFW 2016 ORBIC 2016	X	X	X	X	X	X	High
Black-tailed Jack Rabbit *Lepus californicus*	–/SV	ORBIC 2016	--	--	--	X	X	X	Low

Species	Status[1] Federal/State	Source	Habitat type						Likelihood of Occurrence (none, low, mod, high)[2]
			In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	
Western Gray Squirrel *Sciurus griseus*	–/SV	CDFW 2016	--	--	--	X	X	X	Low
American Beaver *Castor canadensis*	–/–	Milestone 2	X	X	X	x	--		High
Common Muskrat *Ondatra zibethicus*	–/–	ESA 2012	?	X	X	--	--	--	High
Coyote *Canis latrans*	–/–	Metro 2011	--	X	X	X	X	X	Moderate
Sierra Nevada Red Fox *Vulpes vulpes necator*	–/–	ORBIC 2016	--	X	--	X	X	X	Low
Common Raccoon *Procyon lotor*	–/–	ESA 2012	--	X	X	X	X	X	High
Long-tailed Weasel *Mustela frenata*	–/–	ESA 2012	--	--	--	--	X	X	Moderate
Northern River Otter *Lontra canadensis*	–/–	Milestone 2 ESA 2012	X	X	X	x	--	--	High
California Sea Lion *Zalophus californianus*	–/–	CDFW 2106	X	X					High

Species	Status[1] Federal/State	Source	Habitat type						Likelihood of Occurrence (none, low, mod, high)[2]
			In-channel River	Off-channel Alcove	Riparian Basalt	Riparian Forest	Upland Forest	Oak woodland and Savannah	
Black-tailed Deer *Odocoileus hemionus*	–/–	Metro 2011	--	X	X	X	X	X	Low

[1] Status:
– None
Federal
SOC Species of Concern
T Threatened
C Candidate
State
SC Sensitive – Critical
SV Sensitive – Vulnerable

[2] Species with no likelihood of occurring in the project area: Beller's Ground Beetle (*Agonum belleri*), Scott's Apatanian Caddisfly (*Allomyia scotti*), Cascades Apatanian Caddisfly (*Apatania tavala*), Mt. Hood Brachycentrid Caddisfly (*Eobrachycentrus gelidae*), Mt. Hood Farulan Caddisfly (*Farula jewetti*), Cascade Torrent Salamander (*Rhyacotriton cascadae*), Cope's Giant Salamander (*Dicamptodon copei*), Cascades Frog (*Rana cascadae*), Coastal Tailed Frog (*Ascaphus truei*), Oregon Spotted Frog (*Rana pretiosa*), Harlequin Duck (*Histrionicus histrionicus*), Mountain Quail (*Oreortyx pictus*), American Peregrine Falcon (*Falco peregrinus anatum*), Great Gray Owl (*Strix nebulosi*), Northern Spotted Owl (*Strix occidentalis caurina*), Northern Goshawk (*Accipiter gentilis*), Streaked Horned Lark (*Eremophila alpestris strigata*), Western Bluebird (*Sialia Mexicana*), American Pika (*Ochotona princeps*), Fisher (Martes pennant), Canada Lynx (Lynx canadensis), Gray Wolf (Canis lupus), Camas Pocket Gopher (*Thomomys bulbivorus),* Red Tree Vole (*Arborimus longicaudus). G*rizzly Bear (*Ursus arctos horribilis)*

[3] Non-native species known to occur in the lower Willamette River include*:* Black crappie *(Pomoxis nigromaculatus)*, Bluegill *(Lepomis macrochirus)*, Largemouth bass *(Micropterus salmoides),* Pumpkinseed *(Lepomis gibbosus)*, Smallmouth bass *(Micropterus dolomieui)*, Warmouth *(Lepomis gulosus)*, White crappie *(Pomoxis annularis)*, American shad *(Alosa sapidissima)*, Goldfish *(Carassius auratus)*, Banded killifish *(Fundulus diaphanous)*, Brown bullhead *(Ameiurus nebulosus)*, Yellow bullhead *(Ameiurus natalis)*, Black bullhead *(Ameiurus melas)*, Yellow perch *(Perca flavescens),* Walleye *(Stizostedion vitreum),*Western mosquitofish *(Gambusia affinis).*

Appendix B

Important Plant Species Present or Historically Present at the Site (Christy 2015)

Important plant species present or historically present at the site (Christy 2015).

Status	Latin Name
Present	*Agrostis pallens* *Eriogonum compositum* *Eriophyllum lanatum* *Festuca roemeri* *Penstemon richardsonii* *Philadelphus lewisii* *Physocarpus capitatus* *Poa secunda,* *Saxifraga mertensiana* *Sedum spathulifolium* *Sedum stenopetalum* *Selaginella wallacei* *Symphyotrichum subspicatum Tolmiea menziesii* *Triteleia hyacinthina.* Five species of willows: (*Salix exigua, S. hookeriana, S.lasiandra, S. scouleriana, S. sitchensis)*
Historically present and potential target species to restore	*Agrostis pallens* *Allium amplectens* *Allium acuminatum* *Arctostaphylos uva-ursi* *Arnica amplexicaulis* [1] *Bolandra oregana* *Brodiaea coronaria* *Castilleja hispida* *Cascadia nuttallii,* *Ceanothus cuneatus* *Delphinium leucophaeum* *Grindelia integrifolia* *Heuchera micrantha,* *Lithophragma parviflorum* *Lomatium dissectum* *Lomatium triternatum* *Micranthes gormanii,* *Micranthes integrifolia* *Micranthes fragosa* *Micranthes marshallii* *Micranthes rufidula* *Penstemon serrulatus* *Rupertia physodes* *Silene antirrhina* *Silene douglasii* *Silene menziesii,* *Sullivantia oregana* *Viburnum ellipticum.* Bryophyte species suitable for reintroduction at Project site include *Racomitrium, Grimmia, Dicranum howellii*, *Polytrichum juniperinum*, and *Homalothecium megaptilum.*

[1] Because Willamette Falls is the type locality of *Arnica amplexicaulis*, special effort should be made to reestablish this species at the falls.