FINAL REPORT ◦ MARCH 2017

Willamette Falls Riverwalk, Habitat Restoration Conceptual Design

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1 INTRODUCTION

The conceptual design for habitat restoration of the Willamette Falls Legacy Project site and riverwalk project provides key information to support and guide one of the four core values—healthy habitat. Development of the habitat restoration design entailed a series of site visits, engagement and consultation from stakeholders and the documentation of baseline conditions. The resulting information was then distilled into a useful form for the core design team (Snøhetta, Mayer/Reed and DIALOG) to incorporate into riverwalk conceptual design and master plan.

The following elements are being developed to support the habitat conceptual design: conservation planning, desired future habitat conditions, typical details and cross sections for habitat types, and mapping of natural riparian basalt features. These products, contained herein, will serve to inform, engage discussion and facilitate the riverwalk conceptual design.

2 PROJECT LOCATION AND HISTORY

Situated in Oregon City south of Portland, OR, the Project site is located on the riverbank right just downstream of the Willamette Falls (Figure 1), the largest waterfall by volume in the Pacific Northwest dropping 42 feet in a horseshoe with a crest length of approximately 1,700 feet.

The Project site has a history of commercial and industrial uses going back more than 100 years. It encompasses the 23-acre former Blue Heron Paper Company plus an existing Portland General Electric (PGE) dam. Characterized by a riprap shoreline and tailraces used to power various mill operations, the site also includes a backwater lagoon, clarifier, buildings and associated infrastructure. The intensive, industrial site operations have altered native habitat with the exception of a limited portion of the riparian basalt outcroppings.

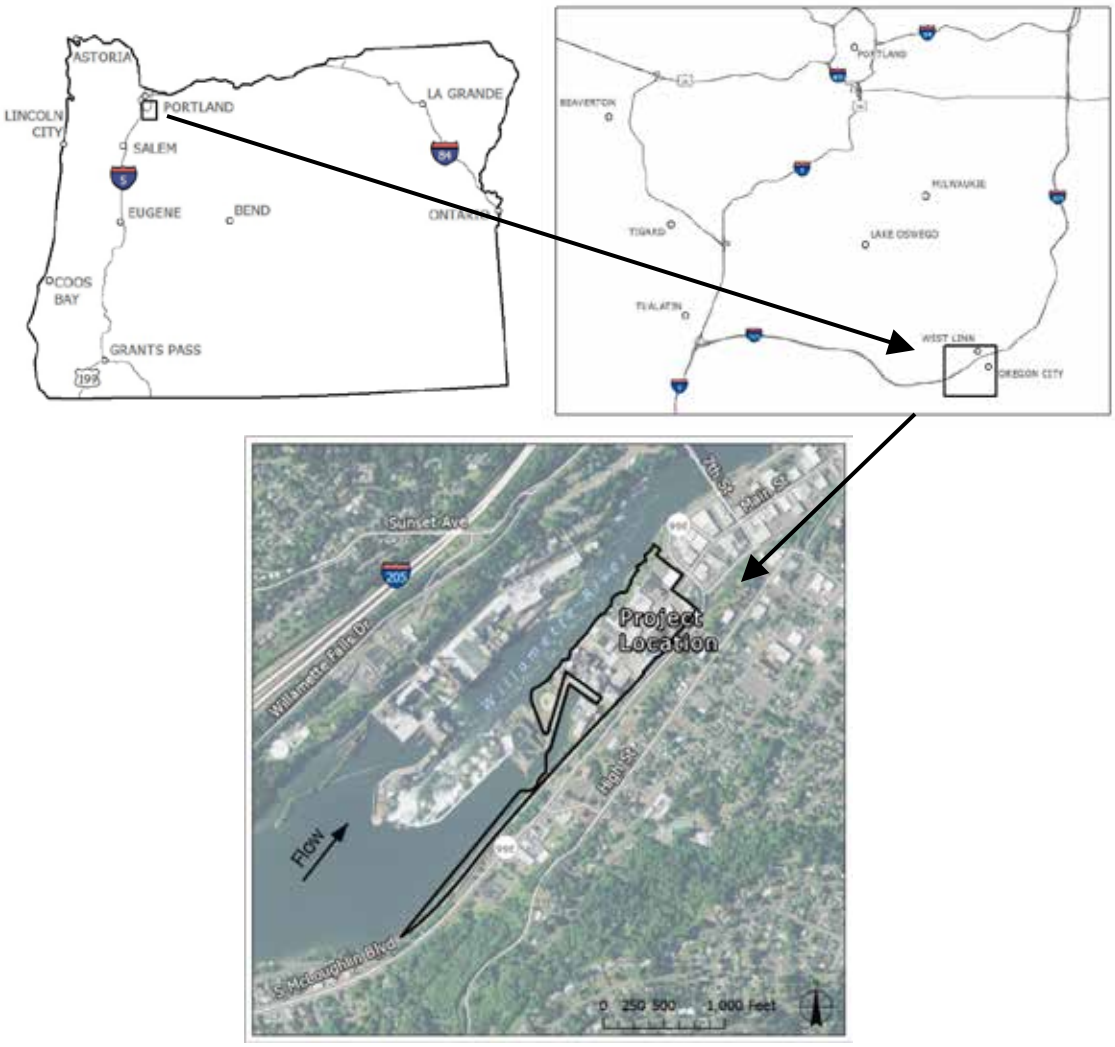

Figure 1. Regional location, vicinity and project location maps.

3 EXISTING CONDITIONS

Existing environmental conditions and species known to occur at the Willamette Falls Legacy Project site were documented in a baseline report (Stillwater Sciences 2016) with an overview and key species provided below. The report purpose was to deepen the scientific knowledge of site habitat, species and priorities in support of future site restoration and public access. It additionally highlighted regional conservation priorities and key environmental factors to be considered in the conceptual design process.

3.1 Terrestrial Habitat Types

Existing habitats on the project 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. The

following terrestrial habitat types are found on the project site or immediate vicinity. Examples of plants, invertebrates, fish, amphibians, reptiles, and mammals that have a moderate to high likelihood of occurrence in terrestrial habitats are provided below. It is worth noting that species are not always exclusive to a singular habitat type, as each habitat may provide multiple life requirements for individual species. For example, bats may forage for aquatic and terrestrial insects in each of the habitats, while roosting in basalt cracks, riparian forest and upland forests.

3.1.1 Riparian basalt

The project site and vicinity are predominantly underlain with basalt bedrock similar to the falls and bluff. As such, nearly all habitat types found on site intersect with the occurrences of exposed or soil-mantled basalt bedrock. Industrial developments within the project area have significantly altered these habitats primarily through fragmentation from the many facilities whose construction covered, removed, and filled large portions of the basalt-dominant floodplain-terrace between the river and the bluffs (Stillwater Sciences 2016). The locations of basalt bedrock exposures were mapped to assist with identifying existing and desired future habitat conditions throughout the project area. The methods and results of the basalt mapping are presented on Appendix A.

Native plant diversity is relatively high for some of the riparian basalt habitat found on site including drought-tolerant and herbaceous plant species such as delphinium, sedums, and cluster lilies. Additional species diversity is achieved in shallow depressions of the basalt layer that hold water and thereby form unique wetland habitats.

Key plant species: Idaho fescue (formerly Roemer's fescue), arrow-leaf wild buckwheat, Richardson's penstemon, broadleaf stonecrop, wild mock orange, various mosses

Key wildlife species: *special-status* Western pond turtle and fringed myotis (bat). *non-special status* Oregon fairy shrimp, Pacific chorus frog, and American beaver.

Figure 2. Riparian basalt habitat adjacent to the clarifier and along the shoreline of the project site.

3.1.2 Riparian forest

Riparian forest habitat is found along the streambank and channel margins of the Willamette River and subject to moist, saturated conditions and associated with alluvial soil.

Figure 3. Riparian forest habitat of the Project adjacent to the lagoon. Willamette Falls in the background.

Key plant species: red alder, white alder, big-leaf maple, Pacific ninebark, Oregon ash, various willows (Pacific, Sitka, Scouler's), American dogwood, Douglas spirea

Key wildlife species: *special-status* band-tailed pigeon, chipping sparrow. *non-special status* wood duck, Anna's hummingbird, black-capped chickadee, coyote, and common raccoon.

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.

3.1.3 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.

Figure 4. Mature upland forest habitat typical of conditions historically found in the Willamette Valley.

Key plant species: Douglas fir, Western red cedar, big-leaf maple, oso berry, thimbleberry, holly-leaved Oregon grape

Key wildlife species: *special-status* acorn woodpecker, slender-billed nuthatch, silver-haired bat. *non-special status* house wren, orange-crowned warbler, red-breasted sapsucker, and long-tailed weasel

3.1.4 Oak woodland savanna

Oak woodland savanna is an Oregon Department of Fish and Wildlife (ODFW) conservation strategy habitat and known to occur on the nearby Canemah Bluffs and Camassia Preserve. Comprised of 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.

Key plant species: Oregon white oak, slender hair grass, Idaho fescue

Key wildlife species: *special status* American peregrine falcon, Lewis's woodpecker, and long-legged myotis (bat). *non-special status* Wilson's warbler, rubber boa, and bush tit.

3.2 Aquatic Habitat Types

The following aquatic habitat types are found on the project site or immediate vicinity: in-channel river and off-channel aquatic. Habitat descriptions along with examples of plants, invertebrates, fish, amphibians, reptiles, and mammals that have a moderate to high likelihood of occurrence in aquatic habitats are provided below.

3.2.1 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).

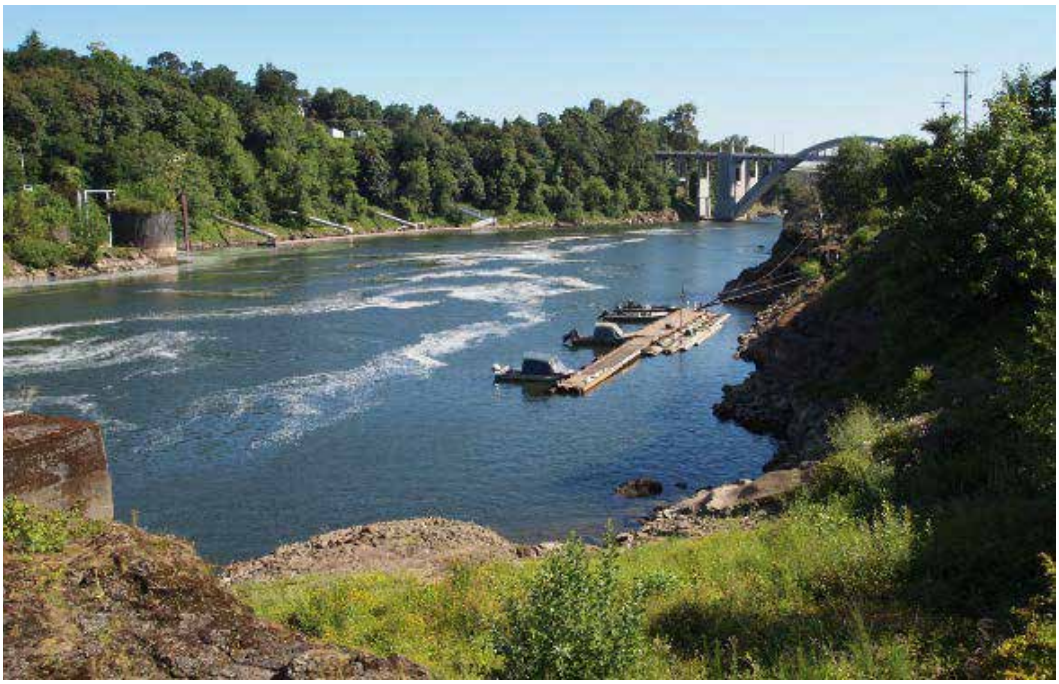

Figure 5. In-channel river habitat adjacent to northern end of the project site.

Key wildlife species: *Special status* Pacific Lamprey, Spring-run Chinook Salmon, Steelhead, and Western painted turtle. *non-special-status* white sturgeon, Osprey, double-crested cormorants, and California sea lion

3.2.2 Off-channel alcove

Off-channel alcove habitat areas on the Willamette River are important for native fish, amphibians and birds seeking habitat diversity as well as refuge from high flow conditions. Emergent native wetland as well as floating aquatic plant communities are associated with off-channel alcove areas. 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.

Figure 6. Off-channel alcove habitat surrounded by riparian basalt and remnant infrastructure.

Key plant species: lateral sedge, marsh spike-rush, soft rush, spreading rush, rice cutgrass, Douglas spiraea

Key wildlife species: *Special-status* Pacific lamprey, coho salmon, Northern red-legged frog, common nighthawk. *Non-special status* common garter snake, green heron, great blue heron, belted kingfisher, and river otter.

4 STAKEHOLDER ENGAGEMENT

The development of habitat design ideas and conservation targets for the riverwalk project included consultation with staff from Oregon Department of Fish and Wildlife, NOAA Fisheries, Portland General Electric, U.S. Army Corps of Engineers, US Fish and Wildlife Service, City of Oregon City's Natural Resource Committee, Greater Oregon City Watershed Council, Clackamas River Basin Watershed Council (December 2016) and the public at multiple workshops. The resulting feedback was carefully considered and incorporated into the restoration approach where feasible. There will be continued opportunity for engagement and input from additional stakeholders as the design for phase one is developed.

Key stakeholder feedback included the following:

- Site development creates a unique opportunity to improve essential mainstem river habitat
- Water and basalt are key site elements
- Protection and restoration of riparian basalt habitat is a high priority
- An ideal site for public engagement and education of fish and wildlife species
- Lamprey are a significant species at this culturally important site
- Willamette Falls is a well-documented staging area for fish species with abundant opportunities to educate the public

- Willamette Falls is the only known spawning area for White Sturgeon in the Willamette River
- Enhancing riparian areas will enhance migration corridors for otter, beaver, mink, turtles and other wildlife species

In general, agency staff found the site to be an intriguing opportunity for habitat enhancements and especially public education and involvement.

5 CONSERVATION

The following sections describe the conservation planning process and resulting habitat design and details developed to support the conceptual design of the riverwalk project. The products and perspective herein are intentionally focused on conservation and restoration of priority habitat and species with limited consideration of other development priorities such as public access or economic redevelopment. Such elements will be incorporated into the conceptual design by the core design team.

5.1 Conservation Planning

Development of the Willamette Falls Legacy Project site and riverwalk project are led by an explicit and transparent conservation planning process and framework. This framework, established by Metro and based on The Nature Conservancy's Conservation Action Planning template (The Nature Conservancy 2007), includes conservation targets, key ecological attributes for each target, threats affecting conservation targets and action plans to abate serious threats.

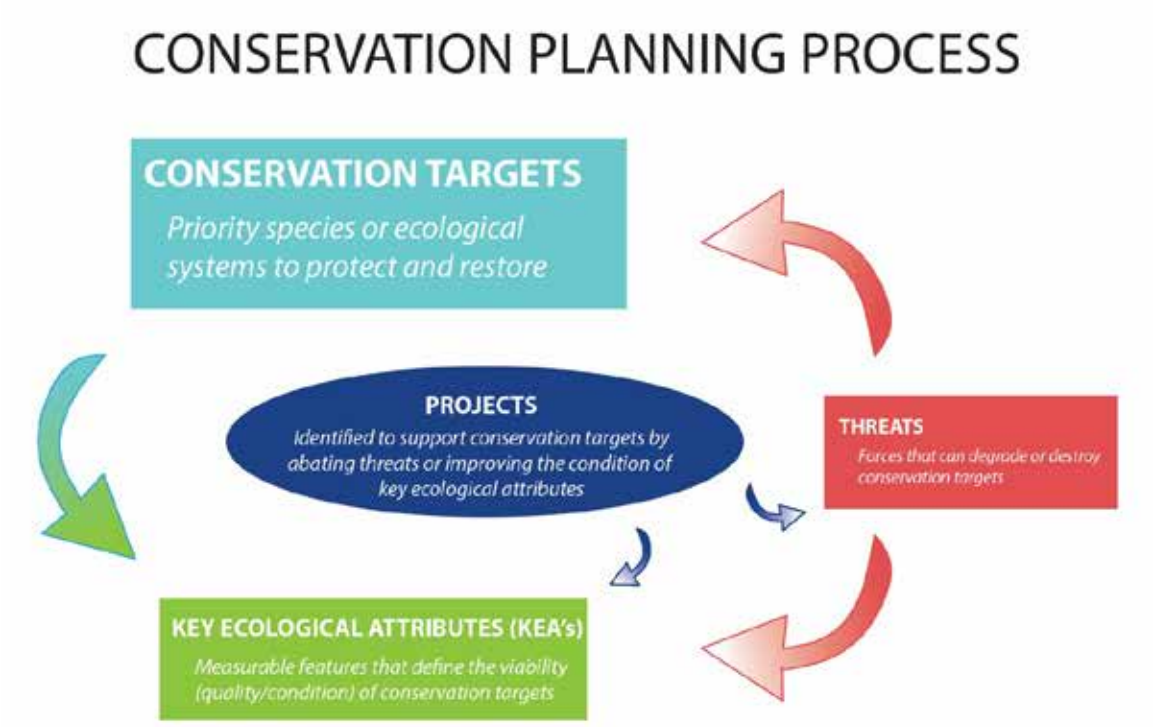

Figure 7. Metro's Conservation Planning Process.

While scientific study is ongoing at the project site, conservation targets defined below will guide the conservation planning process and development of the riverwalk project concept design.

5.2 Prioritizing Strategic Restoration and Stewardship Actions

Using onsite natural habitat types and regional conservation planning efforts as guides, conservation targets were selected that encompass the site's biodiversity values and regional conservation priorities. Prioritizing the resulting conservation targets is essential for several reasons: (1) Budgetary or time constraints are likely to limit how much work can be accomplished at a given site, and (2) Specific actions may rise to the top due to the scarce or unique nature of a habitat type or because abating a certain threat now will save time and money in the future. Table 1 identifies conservation targets, associated habitat types and assigns priority rankings to conservation targets with rationale. The rankings do not imply that the other actions are not important, simply that they are not the most important actions within the next 3–5 years.

Table 1. Priority status for riverwalk project conservation targets.

Conservation target	Habitat Type	Priority	Rationale for prioritization rank
Native Fish	Off-channel alcove/In-channel river	High	Federal and state listing of Chinook and trout species by the Endangered Species Act
Riparian Basalt	Riparian basalt	Medium–High	Unique and high value habitat (ODFW Conservation Strategy)
Riparian Forest	Riparian forest	Medium	Valued habitat, but rated lower due to site constraints
--	Upland forest	Low	Not linked to a conservation target
--	Oak woodland savanna	Low	Not linked to a conservation target

5.3 Key Ecological Attributes

An essential component of the conservation planning process, key ecological attributes (KEAs) are aspects of a conservation target's biology or ecology that, if missing or altered, would lead to the loss of that target over time (The Nature Conservancy 2007). KEAs determine the conservation target's viability. They are the biological or ecological components that most clearly define or characterize the conservation target, limit its distribution, or determine its variation over space and time. Table 2 documents the KEAs associated with conservation targets at the Willamette Falls Legacy Project Site.

Table 2. Riverwalk project conservation target and key ecological attributes.

Conservation target	Attributes of healthy habitat
Native fish	The Willamette River provides important habitat to native salmonids, sturgeon, lamprey and other resident native fish. Native fish require habitat complexity along the mainstem and alcove areas for resting during high flow conditions, an intact riparian area to provide shade and organic matter, and instream structure (large woody debris and boulders) to reduce predation.
Riparian basalt	Basalt outcrops and rocky substrate along the shoreline provide outlier habitat for both mesic and xeric species, similar to vegetation assemblages found in neighboring oak habitat and key habitat for pollinators and birds. Depressional areas within the riparian basalt surface also create unique and highly valued vernal pool habitat.
Riparian forest	Healthy riparian forests are relatively wide (typically 100-200+ feet each side of stream) with a dense mix of native trees and shrubs with rich native species diversity in all layers. Downed wood and snags are important components of riparian forest composition to support wildlife diversity.

5.4 Threats to Conservation

An effective conservation strategy requires an understanding of threats to targets and the sources of those threats. Adjacent development and subsequent disruption of natural systems place stress on the resource and its inhabitants and threaten the health of the greater ecosystem. At the Willamette Falls Legacy Project Site, the following threats are evident:

- Competition by invasive plant species
- Altered vegetation structure
- Human disturbance (historical use by industry and future development)
- Altered hydrology both at a watershed scale and reach scale
- Simplified and filled shorelines

6 RESTORATION

This restoration plan outlines strategic actions to be carried out at the Willamette Falls Legacy Project Site over the next 10 years. Actions are based on the short- and long-term goals established for each of the conservation targets. The strategic actions described herein are general courses of action to achieve objectives and should not be considered highly prescriptive. Additional and more specific prescriptions will be developed to address site-specific conditions encountered in the areas targeted for restoration action.

Approximately 9.2 acres of habitat are in need of restoration throughout the Willamette Falls Legacy Project Site.

Conservation Target: Native Fish Habitat

Short-term goals 2017–2022

- Restore habitat health and complexity along shoreline areas given current and foreseeable land use and recreational regimes.
- Increase habitat complexity within the off-channel alcove areas.
- Educate the public about the native fish populations and benefits of improved habitat.

Long-term goal

- Restore habitat suitable for native and ESA listed fish species present in the Willamette River and at the Willamette Falls Legacy Project Site.

Strategic restoration actions

- Restoration actions should be initiated to restore habitat suitable for native fish species present in the Willamette River and associated river habitats.
- Expose historic shoreline and create additional off-channel alcove habitat.
- Install large wood jams (pieces > 24 inches in DBH, length > 30 ft) and boulders (> 52cm) within off-channel alcove habitat to increase complexity.
- Remove structures and industrial debris along the shoreline and in-water areas that is not necessary for re-use or historic and cultural preservation.

Conservation Target: Riparian Basalt

Short-term goals 2017–2022

- Limit new impacts to riparian basalt habitat.
- Reduce the presence of non-native invasive species
- Increase percent cover of native herbaceous plants in all existing riparian basalt habitat areas.
- Limit or discourage public access to riparian basalt habitat areas.

Long-term goal

- Restore basalt habitat for dependent wildlife species and to protect this uncommon habitat.
- Preserve unique and visually defining geological features that provide habitat and connectivity to neighboring conservation areas.

Strategic restoration actions

- Restoration actions will be initiated to control non-native invasive species and increase the cover of native herbaceous species on riparian basalt habitat areas.
- Remove structures and industrial debris from riparian basalt habitat that is not necessary for re-use or historic and cultural preservation.
- Repair damage or altered riparian basalt habitat with concrete patches and creation of vernal pools.

Conservation Target: Riparian Forest

Short-term goals 2017–2022

- Increase percent cover of native trees and shrubs in all riparian forest habitat areas.
- Limit or discourage public access to select shoreline habitat areas to allow natural establishment of riparian forest habitat plant species.
- Limit introduction and development of invasive and undesirable plant and wildlife species populations through education and weed management.

Long-term goal

- Restore habitat suitable for riparian forest-dependent wildlife species. Healthy riparian areas are also linked to native fish conservation listed above.

Strategic restoration actions

- Restoration actions will be initiated to control non-native invasive species and increase the cover of native trees and shrubs.
  - New native tree and shrub plantings should be focused in riparian areas that have less than 30% canopy cover or less than 30% shrub cover.
- Invasive species management of reed canarygrass, blackberry, Scots broom, thistle and other common broadleaf weeds should be focused in areas of restoration plantings.
- Early detection and treatment of invasive species such as ludwigia and knotweed. Treatments would occur between 1 and 2 year intervals. Treatment on adjoining private and public lands should be explored to reduce long term risks of re-establishment.
- Install and maintain invasive species educational signage.
- Expose historic shoreline and create additional riparian forest habitat.
- Remove structures and fill from riparian forest habitat and floodplain areas that are not necessary for re-use or historic and cultural preservation.

6.1 Desired Future Conditions

The Desired Future Conditions (DFC) map (Appendix B) was developed by Metro and the core design team and then further refined by Stillwater Sciences. The map illustrates six primary habitat types and their proposed locations designed to support the conservation targets and KEAs listed above. The habitat types include (1) in-channel river, (2) off-channel alcove, (3) riparian basalt, (4) riparian forest, (5) upland forest, and (6) oak woodland and savanna (Stillwater Sciences 2016). The DFC map is currently focused on shoreline habitat, but may be expanded to the full site in future revisions. Areas on the river side of the basalt shoreline were classified as in-channel river habitat. Areas on the landward side of the basalt shoreline within known topographically low areas (i.e., on river-side of the red-lined cliff margin) were assigned as alcove. Areas on the landward side of the cliff margin were assigned as one of the other habitat types – i.e., riparian forest or upland forest. The DFC map is a living document that will be advanced throughout the course of the conceptual design. When considering other core values of the site restoration such as public access, it is important to consider the sensitivity of the proposed habitats. Where possible, public access through the restoration areas should be on restricted pathways and boardwalks that enable visitors to experience the site with minimal disturbance. Riparian basalt and the steep slopes surrounding alcove habitat are particularly vulnerable to anthropogenic impacts.

The following subsections identify the restoration priorities for each habitat type followed by site-specific revegetation recommendations in Section 6.2.

6.1.1 Off-channel alcove habitat

Alcove habitat historically existed in greater abundance along the site shoreline. Much of the former off-channel habitat has been filled in and covered by infrastructure. Restoration of alcove habitat serves as a key opportunity for enhancing slow water refuge for native fish (i.e. Chinook steelhead and Pacific lamprey) as well as other aquatic species. Appendix C illustrates elements of typical alcove habitat including revegetation with native species, increased habitat complexity with instream structure, and the addition of planting substrate on the underlying basalt to support the development of surrounding riparian and upland forest habitat. The proposed longitudinal gradient of alcove habitat has yet to be illustrated as it requires further consultation with agency staff from ODFW and NOAA fisheries. The gradient could be designed to provide pool habitat for amphibians, reptiles and birds. Such conditions currently exist in the alcove habitat south of the clarifier; however, replicating such conditions would create a stranding risk for native fish and thus a continuous slope down to the shoreline may be preferred.

6.1.2 Riparian basalt habitat

Preserving habitat and increasing the diversity of native historical species on basalt outcrops at Willamette Falls is a primary conservation and 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 sensitive species. As listed above, strategic restoration actions for this habitat include: (1) control of non-native invasive species and increase the cover of native herbaceous species on riparian basalt habitat areas, (2) removal of structures and industrial debris from riparian basalt habitat not necessary for re-use or historic and cultural preservation, (3) repair of damaged riparian basalt habitat with concrete patches and (4) creation of vernal pools.

6.1.3 Riparian forest habitat

Riparian forest, a once abundant habitat type on the banks of the Willamette River, is degraded and largely absent from the site. Proposed restoration would improve the health of existing riparian forest as well as expand the existing footprint. As listed above, strategic restoration actions for this habitat type includes: (1) control of non-native invasive species, (2) increase in cover of native trees and shrubs with a focus on riparian areas that have less than 30 percent canopy cover or less than 30% shrub cover, (3) installation and maintenance of invasive species educational signage, (4) exposure of historic shoreline and the creation of additional riparian forest habitat, and (5) removal of structures and fill from riparian forest habitat and floodplain areas that are not necessary for re-use or historic and cultural preservation

6.1.4 Upland forest habitat

Upland forest habitat is proposed in two areas of the site as shown in Appendix B and will provide important diversity and connectivity to neighboring habitats. Although it is not listed as a conservation target, restoration of this habitat type is recommended for later phases of the site development.

6.1.5 Oak woodland and savanna habitat

Oak woodland and savanna existing on the bluffs overlooking the project site as well as downstream in the Willamette Narrows. Current restoration plans for the site do not include the addition of oak woodland and savanna habitat; however, should that change, revegetation recommendations are provided in Section 6.2 of this report

6.2 Revegetation Plans

Revegetation plans were generated for the five habitats shown in the Desired Future Conditions map: riparian forest, oak woodland, upland forest, riparian basalt, and off channel alcove. Each plan provides key native plant species best suited for these habitats based on soil moisture, flood tolerance, shade competition, riparian wildlife habitat, and sediment retention/streambank protection. Native vegetation was selected for the appropriate Willamette Valley seed zone and elevation. In addition, vegetation in the physiographic region were reviewed to confirm selected species were appropriate for the site and to ensure successful establishment.

Revegetation of the five habitats is intended to restore site conditions to healthy, resilient ecosystems, a process similar to the Rapid Riparian Revegetation (R3) developed in the Portland Metro region. This approach aims to promote the rapid transition of degraded riparian areas to those characterized by high diversity and function and by lowering the unit cost of revegetation through greater efficiency in site-appropriate implementation. It includes one to three years of site preparations, largely treating invasive weeds, implementation, followed by three to five years of maintenance to establish the plantings to a free to grow state.

Prior to planting, site preparation of the planting areas will include the manual (e.g., uprooting plants, hand cutting), mechanical (e.g., mowing, flail mowing), and chemical (i.e., herbicide treatment) removal and control of nonnative and invasive weed vegetation to decrease competition for future planted native species. To the extent possible, existing patches of native trees and shrubs (*Salix* spp. [various willows]) will be retained. Soil amelioration following construction activities may be required. Prior to planting the soils surface will be inspected and surface ruts, slope, and compaction corrected while following appropriate erosion and sediment control practices. If possible, topsoil and leafy organic matter removed from these activities should be staged for later re-application. In areas of basalt substrate, soil augmentation at appropriate depths suitable herbaceous grass and wildflower establishment and sustained growth will be required. Specific soil and sediment application methods, composition, slope angle of channel margins, bank stabilization and other details will be developed in later stages of the restoration design for each habitat type. Furthermore, plantings will be appropriately matched to planting basins based on soil composition, depth to water table, and rooting depth. If planting efforts do not immediately follow site preparation, a locally sourced native grass seed mix customized for site conditions will be dispersed at roughly 8 to 12 pounds per acre to provide temporary cover, stabilize banks, minimize loss of exposed soils and suppress annual forb and weed establishment. Additional erosion control measures, (e.g., jute, straw, erosion control fabric, coir logs straw, etc.) may be installed for areas with high flood occurrence.

Plantings will consist of seeds, plugs, cuttings, bare root shrubs and trees, and container stock of shrubs and trees. Each propagule form will be planted within its associated planting window following the specific care instructions for the species. Depending on conditions, supplemental water may be required to encourage successful establishment and rooting of plantings throughout the early stages of growth. Plantings will follow a meandering row design to create more natural looking forests while still facilitating maintenance activities.

Key native plant species and their associated minimum soil depth are listed by habitat type in the following tables (Tables 3-8). A comprehensive list of recommended plant species by habitat type is provided in Appendix D.

6.2.1 Off-channel alcove habitat

Off-channel alcove habitat is situated along inlets of the shoreline and once restored will provide habitat for wildlife and other aquatic species. To increase habitat complexity and instream structure, revegetation by native, emergent plant species suitable to alcove habitat is planned. After fine sediment accumulation and infrastructure is removed from this habitat, addition of suitable substrate will be required. Key plant species selected for this habitat along with their minimum soil depth requirement is provided in Table 8. Seeds can be directly sown into the planting substrate. Plug and bare root plantings will be manually planted in a hole dug large enough to entirely contain the seedling roots including lateral roots and ensuring proper root-soil contact. Additionally, the contractor will limit exposure of the seedling, re-wet roots prior to planting, adjust planting depth based on site soils (well-drained, poorly drained), and backfill the basin with weed-free substrate. Recommended plug spacing for emergent plant species is typically 12 inches.

Table 3. Key native plant species selected for revegetation in the off-channel alcove habitat of the Willamette Falls Legacy Project Site.

Scientific name	Common name	Form	Minimum soil depth (cm)
Carex unilateralis	lateral sedge	perennial (per.) grasslike herb	-
Eleocharis palustris	marsh spike-rush	per.grasslike herb	24
Eleocharis ovata	ovate spike-rush	per. grasslike herb	-
Juncus effusus	soft rush	per. grasslike herb	33
Juncus patens	spreading rush	per. grasslike herb	22
Scirpus microcarpus	panicled bulrush	per. grasslike herb	18
Leersia oryzoides	rice cutgrass	grass	26
Apocynum cannabinum	Indian hemp	forb	45
Cornus sericea	American dogwood	shrub	32
Spiraea douglasii	Douglas spiraea	shrub	44

Based on plant tolerances for recommended species in off-channel alcove habitat, soils should have a fine and medium to coarse texture with a pH range of 4.3–8.4.

6.2.2 Riparian basalt habitat

Riparian basalt habitat is prevalent throughout the site, most visually evident along the river margin comprised of bluffs and cliff habitat. Portions of the riparian basalt is subject to scour during high river flows which will be a key consideration during revegetation. As described in Christy and Gaddis 2015, bryophytes (moss) are critical for creating habitat for successful vascular plant establishment. Various mosses associated with rocky cliffs and outcrops in the Blue Heron site (e.g., *Scleropodium*, *Racomitrium*, and *Grimmia* spp.), will be transplanted in mats throughout this habitat. To assist with the successful establishment of these transplanted moss mats, treated areas will be installed with exclusion measures (e.g., fencing, rope, signs) to protect against potential human disturbance (e.g., trampling by foot traffic). Planting native herbs

and forbs adapted to rocky, dry conditions is planned along the outcrops, crevices and pockets in the cliff faces, as well as shallow depressions of the basalt layer that hold water. Application of planting substrate at depths suitable for key species (noted in Table 3) is required for vascular plant establishment in this habitat. Key plant species selected for revegetation are provided in Table 3. Plantings will be manually planted in a hole dug large enough to entirely contain the seedling roots including lateral roots while avoiding the "J-root" and "L-root" of the taproot, ensuring proper root-soil contact. Additionally, the contractor will limit exposure of the seedling, re-wet roots prior to planting, adjust planting depth based on site soils (well-drained, poorly drained), and backfill the basin with weed-free substrate. Planting densities will be determined by the contractor for each location based on individual plant spacing requirements and available area for planting.

Table 4. Key native plant species selected for revegetation in the riparian basalt habitat of the Willamette Falls Legacy Project Site.

Scientific name	Common name	Form	Minimum soil depth (cm)
Festuca idahoensis (formerly *F. roemeri*)	Idaho fescue	grass	28
Polypodium glycyrrhiza	licorice fern	fern	54
Eriogonum compositum var. *compositum*	arrow-leaf wild buckwheat	forb	-
Eriophyllum lanatum var. *integrifolium*	Oregon sunshine	forb	24
Penstemon richardsonii	Richardson's penstemon	forb	-
Saxifraga mertensiana	Mertens's saxifrage	forb	50
Sedum spathulifolium	broadleaf stonecrop	forb	16
Philadelphus lewisii	wild mock orange	shrub	35
Scleropodium, *Racomitrium*, and *Grimmia* spp.	various mosses	moss	-

Based on plant tolerances for recommended species in riparian basalt habitat, soils should range from medium to coarse texture with a pH range of 5–7.5.

6.2.3 Riparian forest habitat

Riparian forest is positioned along the streambank and channel margins of the Willamette River and is subject to moist to saturated conditions. Riparian plant species well-adapted to this setting were selected for below and above the delineation of ordinary high water (Tables 4 and 5). Multiple native and tree species will be planted to achieve a diverse plant community that will provide key habitat functions (riparian wildlife cover and forage, etc.). Riparian forest will be comprised of moderate to tall trees (up to <30 m at maturity) with at least 30% cover intermixed with shorter shrubs for an overall cover of at least 70% to provide varied vegetation structure. Tree and large shrub species will be planted with 10–15 ft spacing and smaller shrubs with ~6 ft spacing, majority in clusters of 2–5 seedlings to account for possible mortality. The interstices will be seeded or planted with various grasses and forbs well suited to riparian soil conditions (>20% relative cover). Research suggests supplementing riparian tree plantings with grasses may provide additional soil reinforcement in the early years of tree establishment (Pollen-Bankhead and Simon 2010). Streamside edge planting, selected of species with rapid root development and high tolerance to wet conditions with spacing ranging from 2–6 ft, will be applied to achieve bank stabilization and shaded stream surface and banks.

Table 5. Key native plant species selected for revegetation in the riparian forest habitat below ordinary high water of the Willamette Falls Legacy Project Site.

Scientific name	Common name	Form	Minimum soil depth (cm)
Fraxinus latifolia	Oregon ash	tree	32
Salix lasiandra	Pacific willow	tree	36
Salix scouleriana	Scouler's willow	shrub/tree	27
Salix sitchensis	Sitka willow	shrub/tree	90
Cornus sericea	American dogwood	shrub	32
Physocarpus capitatus	Pacific ninebark	shrub	41
Spiraea douglasii	Douglas spiraea	shrub	44
Agrostis exarata	spike bent grass	grass	14
Deschampsia elongata	slender hair grass	grass	26

Based on plant tolerances for recommended species in riparian forest (below OHW) habitat, soils should have a medium to coarse texture with a pH range of 5.1–7.6.

Table 6. Key native plant species selected for revegetation in the riparian forest habitat above ordinary high water of the Willamette Falls Legacy Project Site.

Scientific name	Common name	Form	Minimum soil depth (cm)
Alnus rhombifolia	white alder	tree	18
Alnus rubra	red alder	tree	47
Acer macrophyllum	big-leaf maple	tree	15
Fraxinus latifolia	Oregon ash	tree	32
Salix scouleriana	Scouler's willow	shrub/tree	27
Physocarpus capitatus	Pacific ninebark	shrub	41
Ribes sanguineum	red-flowering currant	shrub	28
Rosa pisocarpa	cluster rose	shrub	81
Deschampsia elongata	slender hair grass	grass	26
Agrostis exarata	spike bent grass	grass	14

Based on plant tolerances for recommended species in riparian forest (above OHW) habitat, soils should have a medium to coarse texture with a pH range of 4.8–8.0.

6.2.4 Upland forest habitat

Upland forest is directly up gradient to the riparian forest at dryer, higher elevations. This habitat is comprised of a mixed coniferous forest. Conifers and mixed deciduous hardwoods comprise majority of the canopy cover in this habitat type (>50% relative cover). The understory will be limited to shrub species well adapted to shade. Conifer and hardwood species will be planted 10–15 ft based on 200–440 stems per acre, with conifers at least 15 ft from the faster growing hardwoods to encourage growth for both species and decrease impacts caused by shade. To achieve a moderate cover of shrub and fern species (40–65% relative cover), seedlings will be spaced in 6–8 ft apart from one another. Herbaceous flowering and fruiting species over 1+ will be planted throughout to provide adequate ground cover (2–4 ft spacing), wildlife and pollinator habitat, and species diversity.

At both riparian and upland forest habitats, bare root, container stock, cuttings, and plugs will be manually planted in a hole dug large enough to entirely contain the seedling roots including lateral roots while avoiding the "J-root" and "L-root" of the taproot, ensuring proper root-soil contact. Additionally, the contractor will limit exposure of the seedling, re-wet roots prior to planting, adjust planting depth based on site soils (well-drained, poorly drained), and backfill the basin with weed-free topsoil. Tree shelters will be installed or ring spray treatments will be applied for species most at risk by wildlife browsing or damage, as well as to reduce competition for resources (e.g., water). The inter-planting and vegetation control (i.e., early season ring spray) at these locations should eliminate the need for irrigation, as observed in sites managed using the R3 approach in the Willamette Valley (Guillozet et al. 2014)

Table 7. Key native plant species selected for revegetation in the upland forest habitat of the Willamette Falls Legacy Project Site.

Scientific name	Common name	Form	Minimum soil depth (cm)
Acer macrophyllum	Big leaf maple	tree	15
Pseudotsuga menziesii	Douglas fir	tree	23
Thuja plicata	western red cedar	tree	41
Berberis aquifolium	holly-leaved Oregon grape	shrub	36
Oemleria cerasiformis	oso berry	shrub	13
Ribes sanguineum	red-flowering currant	shrub	28
Rosa pisocarpa	cluster rose	shrub	81
Rubus parviflorus	thimbleberry	shrub	27

Based on plant tolerances for recommended species in upland forest habitat, soils should have a medium to coarse texture with a pH range of 4.2–7.9.

6.2.5 Oak woodland savanna habitat

Oak woodland is positioned along an upper terrace with limited water availability as it is disconnected from the riparian zone by Highway 99. It is primarily composed of 30 to 70% cover of Oregon white oak. The understory includes native grasses and herbs for 30–60% relative cover with some small scattered, woody shrub plantings (<10% cover) (located between oak plantings to avoid competition) to replicate natural conditions of oak woodland (Vesley and Tucker 2004). Using container stock, Oregon white oaks will be planted approximately 15 ft apart from one another in the fall. To achieve full crowns and attain the fastest possible growth for this species, early thinning may be required as young oaks which grow under crowded conditions develop small, lopsided crowns (Vesley and Tucker 2004). The ground at each planting location will be prepared by clearing grass, thatch, and any herbaceous vegetation in a three-foot diameter circle and digging or augering a planting basin deeply enough to contain the entire rootball plus surrounding soil up to the base of the seedlings/saplings trunk. If soils are rocky, stones will be removed from planting basins and replaced with extra-fine textured soil. When planting the taproot should be directed straight down and avoid "J-rooting" which decreases chance of survival (Vesley and Tucker 2004). Planting basins will be backfilled so that the root crown is level with the ground with a weed-free topsoil mix (sand and topsoil) in order to discourage weed competition at each planting site. The 3-foot diameter area around each planting will be covered with weed inhibiting fabric and a thick layer (4–6 inches deep) of oak/manzanita chippings obtained locally. Tree shelters will be used to protect seedlings from animal browse damage,

wind, and other natural occurrences. In addition, the greenhouse environment created by the shelter can promote seedling growth. Plant protectors will remain in place until saplings reach a height of approximately three feet. Unless the ground is saturated at the time of planting, all planting locations will be "watered in" with supplemental irrigation immediately following planting. Grass and herbaceous plantings (~ 2–4 ft spacing) and/or seed will be dispersed between oak plantings with special care in spacing to eliminate competition to oak seedlings. Selected herbaceous plants include those that will provide important habitat for pollinators.

Table 8. Key native plant species selected for revegetation in the oak woodland savanna habitat of the Willamette Falls Legacy Project Site.

Scientific name	Common name	Form	Minimum soil depth (cm)
Quercus garryana	Oregon white oak	tree	42
Festuca idahoensis (formerly *F. roemeri*)	Idaho fescue	grass	28
Deschampsia elongata	slender hair grass	grass	26
Achillea millefolium	common yarrow	forb	13
Balsamorhiza deltoidea	deltoid balsam-root	forb	29
Eriophyllum lanatum var. *integrifolium*	Oregon sunshine	forb	24
Plectritis congesta	rosy seablush	forb	20

Based on plant tolerances for recommended species in oak woodland savanna habitat, soils should have a fine to medium texture with a pH range of 5–7.2.

It is recommended a monitoring plan and program be developed to measure survivorship and vigor of plantings, and address any potential issues and subsequent adaptive management or remediation required to ensure the successful establishment of the revegetated habitats.

7 REFERENCES

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Appendices

Appendix A

Riparian Basalt Mapping of the Willamette Falls Legacy Project Site

1 INTRODUCTION

This appendix summarizes the methods and results from an evaluation of basalt bedrock exposures at the Willamette Falls Legacy Project Site. The Baseline Habitat Conditions report prepared for the project identified six primary habitat types as being present and/or potentially present within the project area: (1) in-channel river, (2) off-channel aquatic (alcove), (3) riparian basalt, (4) riparian forest, (5) upland forest, and (6) oak woodland and savannah (Stillwater Sciences 2016). Because the project site and vicinity are mostly underlain with basalt bedrock similar to the falls and bluff, nearly all of these habitat types intersect with the occurrences of exposed or soil-mantled basalt bedrock. The industrial developments within the project area have significantly altered these habitats primarily through fragmentation from the many facilities whose construction covered, removed, and filled large portions of the basalt-dominant floodplain-terrace between the river and the bluffs (ESA 2012, Stillwater Sciences 2016).

2 METHODS

The locations of basalt bedrock exposures were mapped to assist with identifying existing and desired future habitat conditions throughout the project area. The mapping effort primarily drew upon available historical documentation to ascertain locations of basalt bedrock that is or could readily be re-exposed at the surface following removal of existing buildings, platform structure, or urban fill areas. The information review included numerous historical topographic maps, aerial photographs, survey design sheets, technical reports, and miscellaneous untitled photographs (Table A-1). Repeat views of the project area, showing basalt bedrock exposures along the river margins based on a historical ground-based photograph taken in 1892 and contemporary imagery from 2016 is presented in Figure A-1.

The mapping effort was aided by a limited field reconnaissance of the project area conducted on November 17, 2016 by Stillwater Sciences. The field reconnaissance was conducted by Senior Ecologist Jody Lando, PhD, and Senior Geomorphologist/Geologist Glen Leverich, MS (Oregon Registered Geologist #2401). Photographs taken during the field reconnaissance are presented in Figure A-2 through A-5. Exposures of basalt bedrock and rocky debris were observed along the riverbank where existing structures were setback from the shoreline thereby allowing the exposures to be easily viewed from multiple perspectives. Other exposures were also noted beneath several buildings that were constructed above the underlying floodplain terrace as a single-level platform, such as along that section of riverbank between Mill O and the Rejects Building (i.e., “South Riverfront”). Sub-level areas were accessed beneath the Hawley Building, Mill H, Boiler Plant, Pipe Shop, Pipe Chase, Mill O, and No. 3 Paper Machine. The foundations of several of these buildings comprised vertical concrete piers. A mix of basalt bedrock and artificial fill composed of basalt rock debris and alluvial soils was observed beneath the buildings. Several of these exposures were noted in the historical ground-based photographs that pre-date construction of several of the existing buildings (see Figure A-1). The mapping effort therefore has attempted to delineate exposures of basalt bedrock that presently support any of the six habitat types, as well as areas where basalt is presently covered by existing buildings which, if removed, could enable the additional restoration of the habitat types. Areas where artificial fill, even if composed of basalt-rock debris, were not included with the mapped areas of basalt bedrock.

Table A-1. Historical and contemporary information sources reviewed to develop the basalt map.

Survey/ Publication date	Document type	Document title	Scale/ Resolution	Source
1800s–present	Oblique Aerial and Ground-based Photos	Miscellaneous Untitled Photographs	N/A	Metro Archives
1852	Map	General Land Office Survey Plat Map, Township No. 2 South, Range No. 2 East, Willamette Meridian, Oregon. John B. Preston, Surveyor General.	N/A	Bureau of Land Management General Land Office Records website: http://www.glorecords.blm.gov/
1914	Map	U.S. Geological Survey Topographic Quadrangle for Oregon City, OR	1:62,500	U.S. Geological Survey, The National Map: Historical Topographic Map Collection website: http://nationalmap.gov/historical/index.html
1936	Aerial Photo	U.S. Army Corps of Engineers Willamette Valley Project	1:15,000	Metro Archives
1952	Aerial Photo	U.S. Geological Survey Aerial Photography, July 13, 1952	1:24,000	U.S. Geological Survey Earth Explorer website: http://earthexplorer.usgs.gov/
1954	Map	U.S. Geological Survey Topographic Quadrangle for Oregon City, OR	1:24,000	U.S. Geological Survey, The National Map: Historical Topographic Map Collection website: http://nationalmap.gov/historical/index.html
1947	Map	U.S. Coast and Geodetic Survey Planimetric Map of Oregon City, Clackamas County, Oregon.	1:9600	National Oceanic and Atmospheric Administration, Office of Coast Survey Historical Map and Chart Collection website: https://historicalcharts.noaa.gov/
1980	Site Survey Design Sheets	Topographic Survey Publisher's Paper Co., Oregon City, Oregon	1:120	Jim Weddle and Associations, Inc.
2009	Map	Geologic Map of the Oregon City 7.5' quadrangle, Clackamas County, Oregon	1:24,000	Oregon Department of Geology and Mineral Industries Publications Center website: http://www.oregongeology.org/pubs/gms/GMS-119.zip

Survey/ Publication date	Document type	Document title	Scale/ Resolution	Source
2012	Site Survey Design Sheets	Blue Heron Paper Mill / Willamette Falls Survey, Oregon City, Oregon, Boundary Survey, 16 sheets	1:600–1:2400	AKS Engineering & Forestry Willamette Falls Legacy Project website: http://www.rediscoverthefalls.com/wp-content/uploads/2015/06/Boundary-Survey.pdf
2012	General Purpose Report	Willamette Falls Legacy Project Habitat and Water Resources Opportunities	N/A	ESA Willamette Falls Legacy Project website: http://www.rediscoverthefalls.com/wp-content/uploads/2015/06/Habitat-and-Water-Resources-Opportunities.pdf
2013	General Purpose Report	Willamette Falls Legacy Project Existing Conditions Report	N/A	Walker|Macy Willamette Falls Legacy Project website: http://www.rediscoverthefalls.com/wp-content/uploads/2015/06/Existing-Conditions.pdf
2014	Aerial Photo	U.S. Department of Agriculture, National Agriculture Imagery Program, Clackamas County, Oregon	1 meter	U.S. Department of Agriculture ArcGIS REST Services Directory website: https://gis.apfo.usda.gov/arcgis/rest/services/NAIP/Oregon_2014_1m/ImageServer
2015	Site Survey Design Sheets	Blue Heron Paper Mill / Willamette Falls Survey, Oregon City, Oregon, Existing Conditions Survey, 25 sheets	1:240–1:600	AKS Engineering & Forestry
2016	Aerial Photo	U.S. Department of Agriculture, National Agriculture Imagery Program, Clackamas County, Oregon	1:12,000	U.S. Department of Agriculture Geospatial Data Gateway website: https://gdg.sc.egov.usda.gov/
2016	Topographic Surface	Willamette Falls Digital Terrain Model Surface	≤1 meter	CH2M
2016	General Purpose Report	Willamette Falls Legacy Project Baseline Habitat Conditions	N/A	Stillwater Sciences
2016	Aerial Photo / Topographic Survey	Google Earth: Imagery July 23, 2016 / 3-Dimensional Buildings on 30-meter Terrain	≤1 meter	Google Earth Application https://www.google.com/earth/

Figure A-1. Repeat views of the project area, showing basalt bedrock exposures along the river margins based on a historical ground-based photograph taken in 1892 looking toward the unpaved 3rd Street (source: Metro archives) (top), and contemporary imagery from 2016 with 3-dimensional topography and buildings rendered in Google Earth (bottom).

Figure A-2. Photographic views of basalt outcrop located near the north (downstream) end of the Project site.

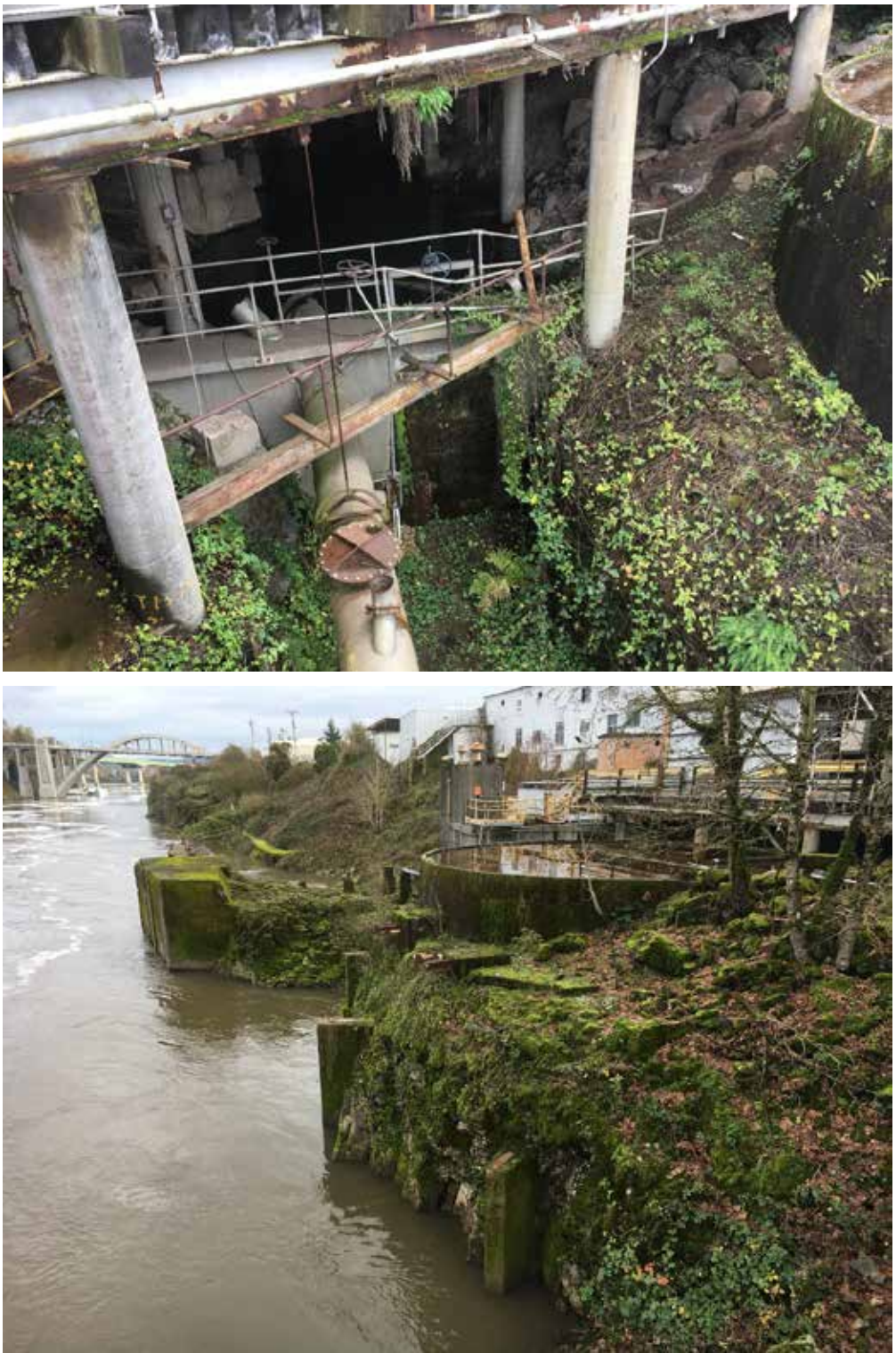

Figure A-3. Photographic views of basalt outcrops and rock debris located near the millrace outlet beneath No. 3 Paper Machine Building #2 (top) and the Circular Tank Foundation 1 (bottom).

Figure A-4. Photographic views of basalt rock debris and fill material located near the tailrace channel beneath the Boiler Plant.

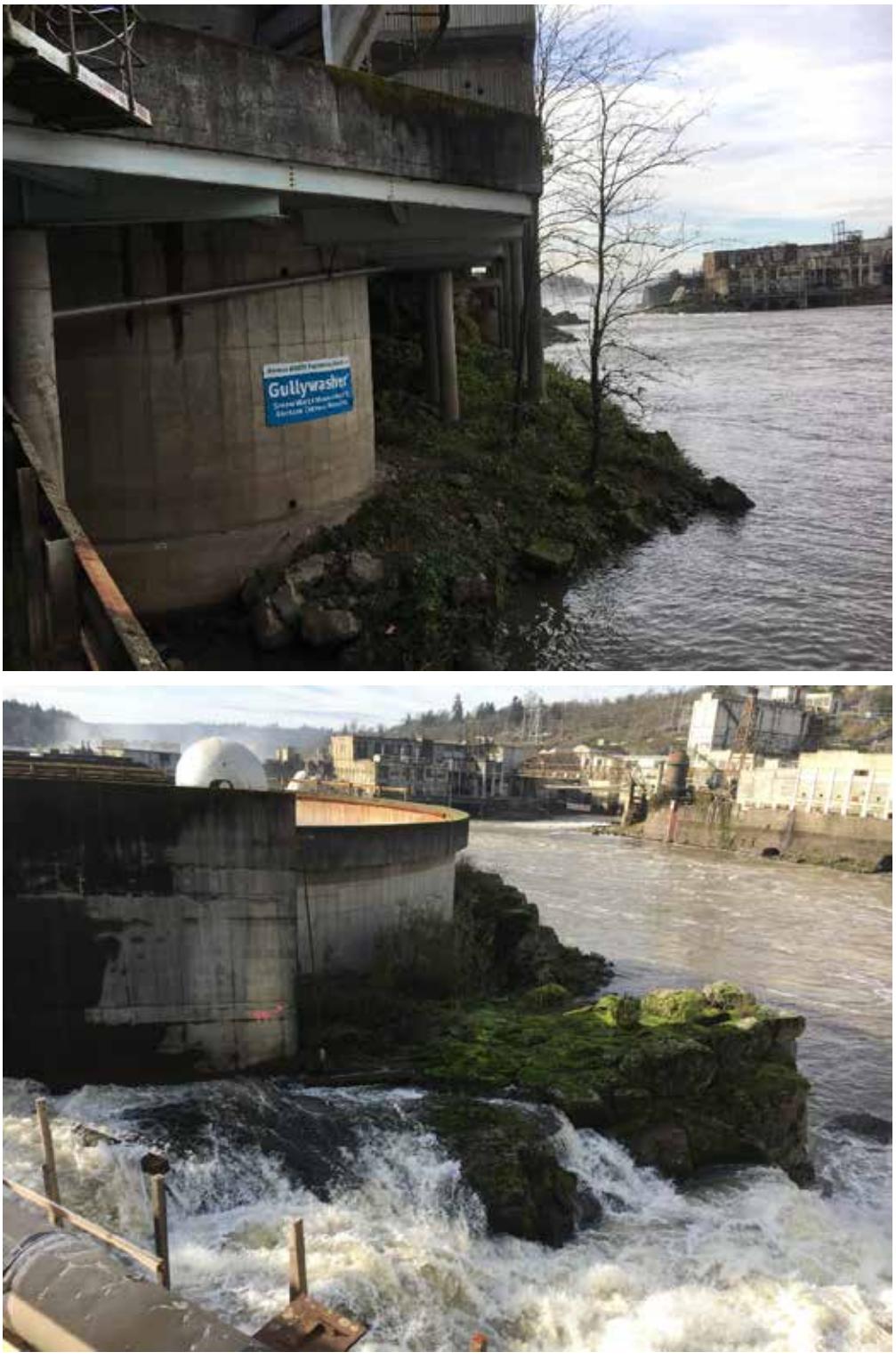

Figure A-5. Photographic views of basalt outcrop and rock debris located near the Boiler Plant and Tank 3 (top) and the Clarifier (bottom).

To the extent practical, the historical and contemporary aerial imagery and topographic survey maps were utilized in a geographic information system (GIS) to assist with delineation of basalt exposures protruding above the presumed low-water line, which was estimated to be approximately 9.0 feet in elevation, as referenced to the North American Vertical Datum of 1988, in the project reach of the Willamette River (AKS Engineering 2015). To record these areas, polygons were initially digitized around basalt features visually confirmed in the 2016 aerial imagery and topography at a scale of 1:500 in the GIS. Other areas not visible in the remote-sensing data, such as those sub-level areas beneath the existing buildings, were inferred based on interpretation of historical data and the November 2016 field reconnaissance. The polygons presented in resulting map were saved in an ESRI shapefile format (.shp), as originally digitized. Spatial errors in the polygon delineation likely resulted from unknown spatial errors inherent to the remote-sensing data and due to difficulties in interpreting features of interest. The polygon dataset was checked extensively for spatial and interpretive accuracy by a GIS supervisor who was not associated with the digitization process.

3 RESULTS

The results of the basalt mapping are presented on Figure A-6. Areas of exposed basalt are depicted with elevation contours to illustrate the local topography. The existing low-flow shoreline of the basalt exposures is demarcated with the solid black lines. In areas where the basalt shoreline was not visible in the field or remote-sensing data, a dashed black line was used to delineate the assumed water-side margin of basalt obfuscated by fill material and/or building infrastructure. The top edge of the exposed basalt cliffs are demarcated with the solid red line, which was based on an abrupt transition in the topographic elevation contours. Finally, the sub-level basalt areas are identified generally by the dark gray polygon, which represents the assumed extent of shallow basalt that is presently covered by fill material and/or building infrastructure. The landward, or southeastern, margin of this area is artificially bounded by the dashed gray line, which is artificially and only meant to indicate that the true lateral and vertical extents are not known as they are obfuscated by the existing buildings and related developments (e.g., the Hawley Building), many of which appear to have existed as early as the oldest available historical records and photographs.

The final mapping product as presented in Figure A-6 is only intended to inform the development of a conceptual-level desired future conditions map and should not be used for engineering design purposes due to the limited nature of the field reconnaissance. A more accurate characterization of the underlying bedrock and soil substrates throughout the project area will require geotechnical explorations utilizing exploratory drilling and/or near-surface geophysical methods.

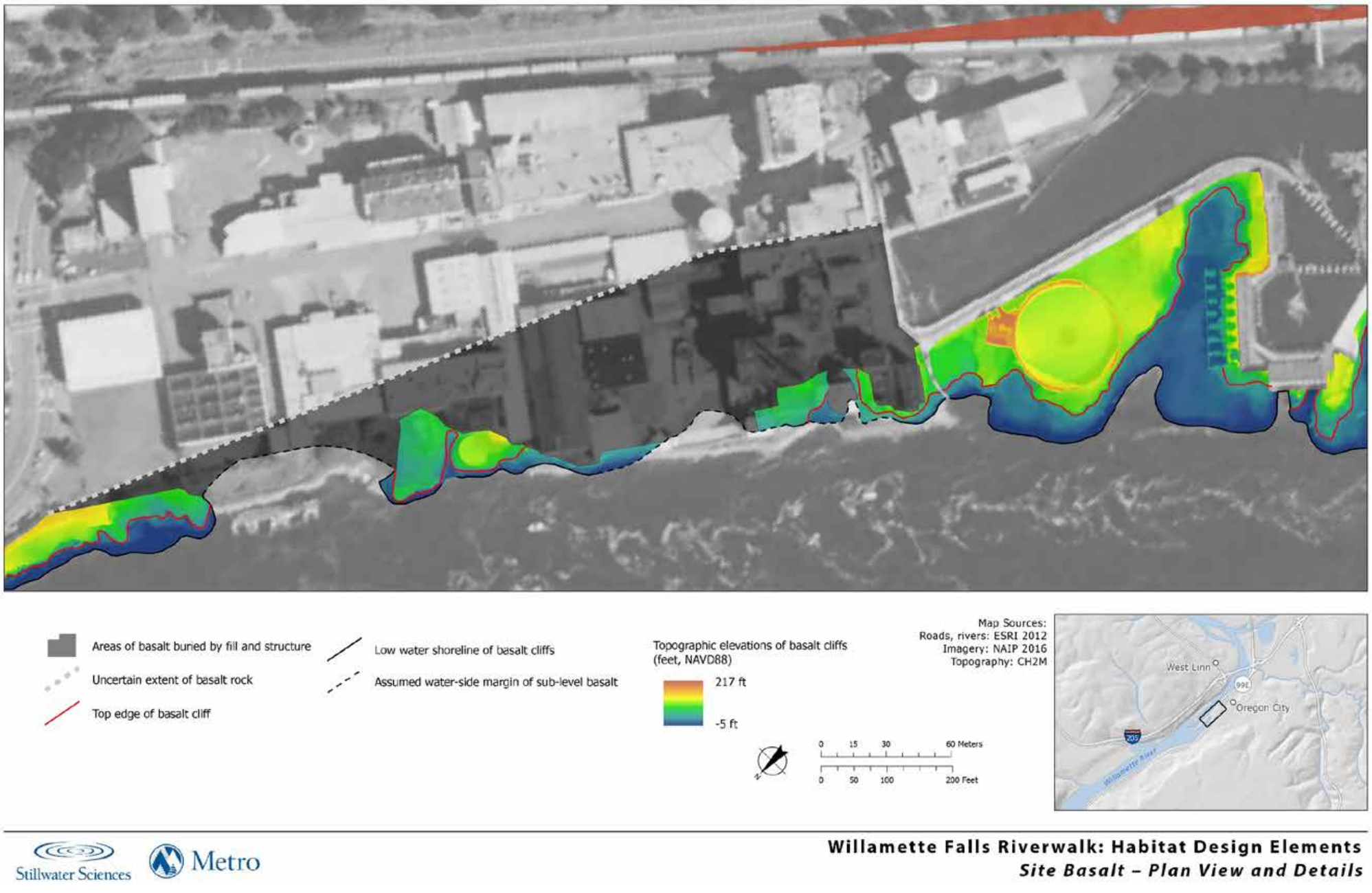

Figure A-6. Plan view map of basalt outcrops mapped at the Project site.

4 REFERENCES

AKS (AKS Engineering and Forestry). 2015. Blue Heron Paper Mill/Willamette Falls Survey, Oregon City, Oregon, Existing Conditions Survey.

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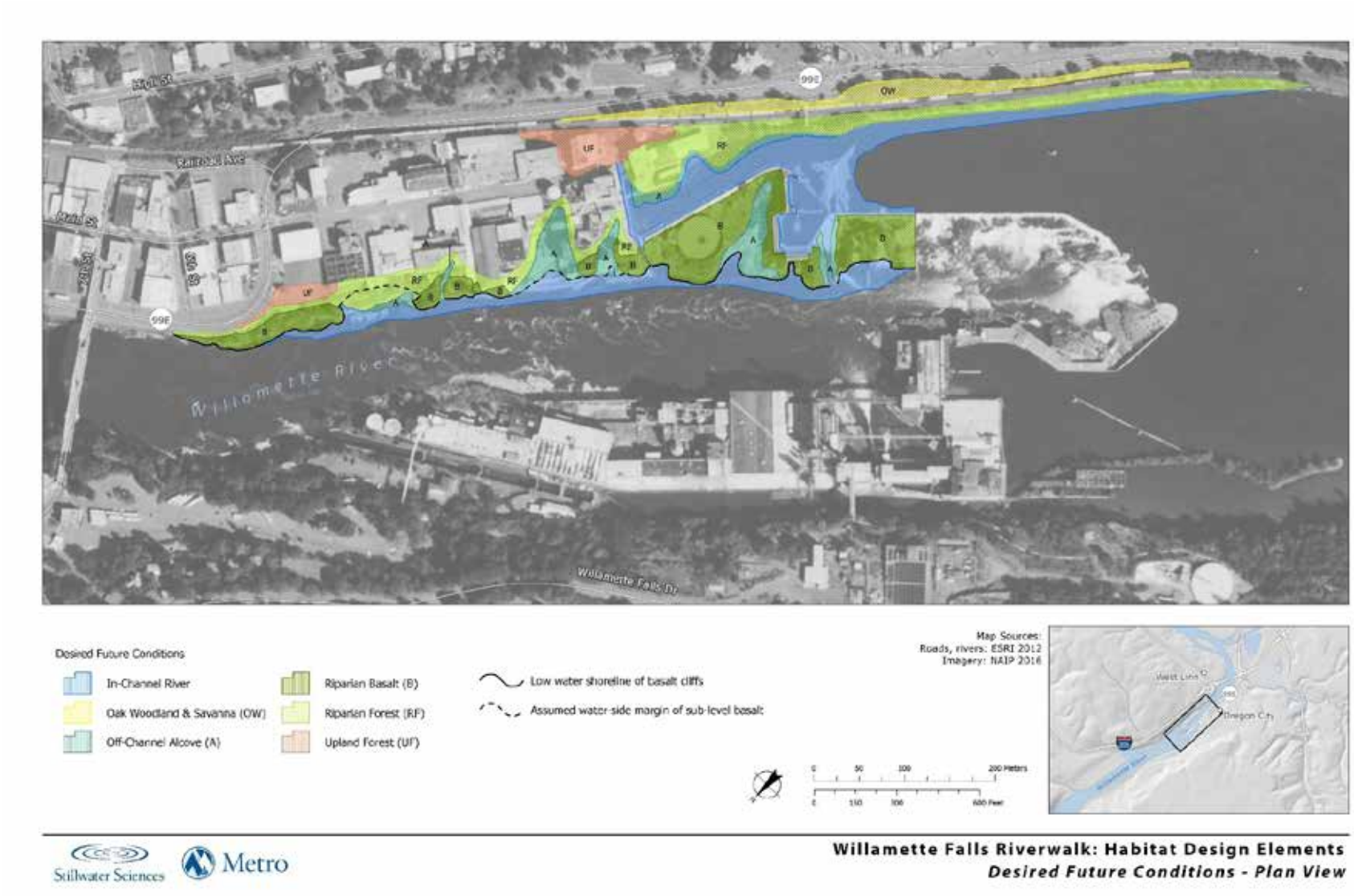
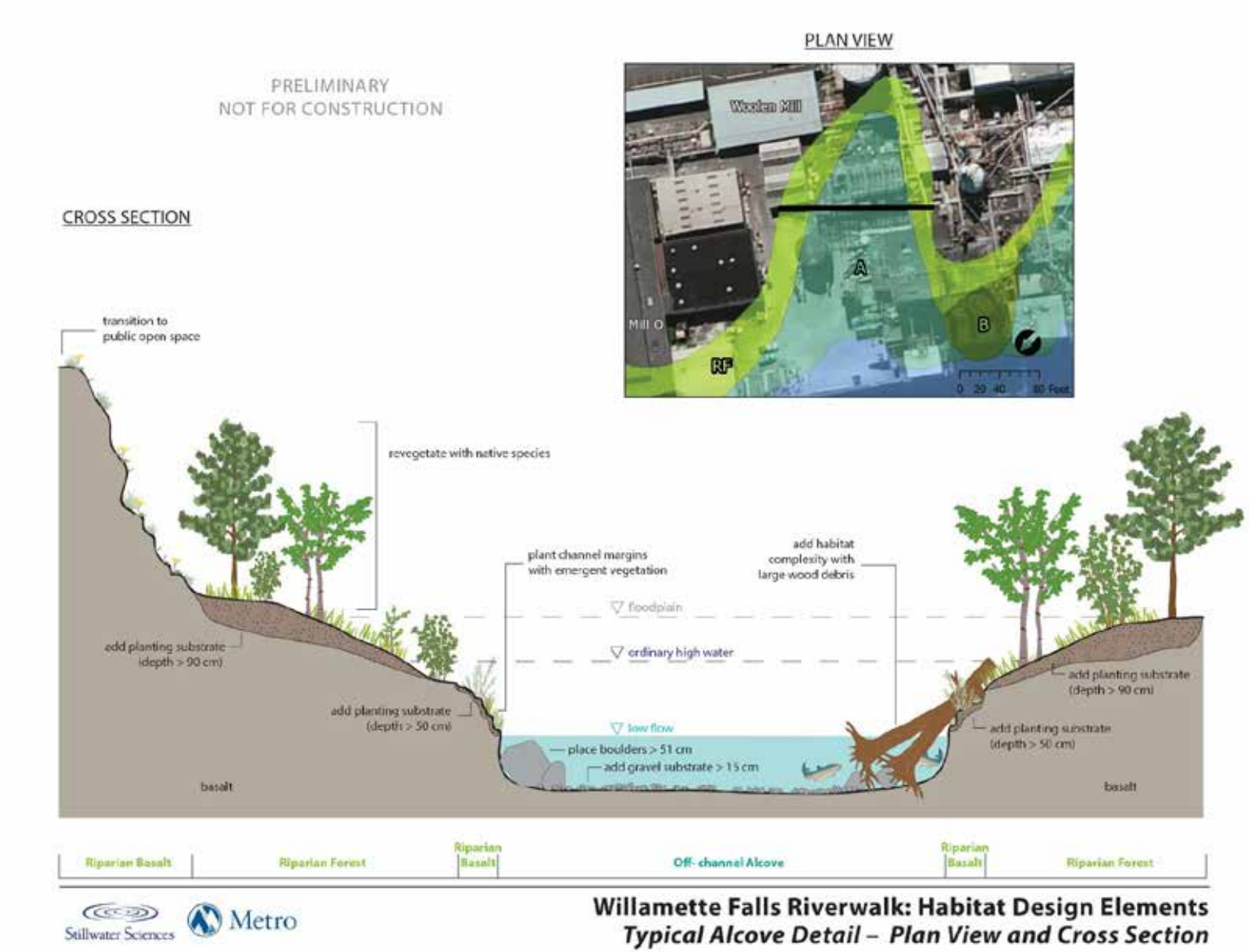
Appendix B

Desired Future Conditions for Habitat Restoration of the Willamette Falls Riverwalk


Main St
Railroad Ave
Water St
5th St
99E
OW
UF
RF
A
B
D
Willamette River
Willamette Falls Dr
Desired Future Conditions
In-Channel River
Oak Woodland & Savanna (OW)
Off-Channel Alcove (A)
Riparian Basalt (B)
Riparian Forest (RF)
Upland Forest (UF)
Low water shoreline of basalt cliffs
Assumed water-side margin of sub-level basalt
Map Sources:
Roads, rivers: ESRI 2012
Imagery: NAIP 2016
West Linn
Oregon City
0 50 100 200 Meters
0 150 300 600 Feet
Stillwater Sciences
Metro
Willamette Falls Riverwalk: Habitat Design Elements
Desired Future Conditions - Plan View

Appendix C

Typical Alcove Detail applicable to the Willamette Falls Legacy Project Site


PRELIMINARY
NOT FOR CONSTRUCTION
PLAN VIEW
Woolen Mill
Mill O
A
B
RF
0 20 40 80 Feet
CROSS SECTION
transition to public open space
revegetate with native species
plant channel margins with emergent vegetation
add habitat complexity with large wood debris
floodplain
ordinary high water
low flow
add planting substrate (depth > 90 cm)
add planting substrate (depth > 50 cm)
place boulders > 51 cm
add gravel substrate > 15 cm
basalt
Riparian Basalt
Riparian Forest
Riparian Basalt
Off- channel Alcove
Riparian Basalt
Riparian Forest
Stillwater Sciences
Metro
Willamette Falls Riverwalk: Habitat Design Elements
Typical Alcove Detail – Plan View and Cross Section

Appendix D

Comprehensive List of Plant Species Recommended for Revegetation at the Willamette Falls Legacy Project Site

Table D-1. Comprehensive list of plant species recommended for revegetation by habitat type.

Scientific name	Form	Habitat				
		Riparian basalt	Off channel alcove	Oak woodland	Upland forest	Riparian forest
Tree						
Acer macrophyllum	tree				x	x
Alnus rhombifolia	tree					x
Alnus rubra	tree					x
Frangula purshiana	tree				x	x
Fraxinus latifolia	tree					x
Populus trichocarpa	tree					x
Pseudotsuga menziesii	tree				x	
Quercus garryana	tree			x		x
Thuja plicata	tree				x	
Shrub						
Amelanchier alnifolia	shrub			x		
Berberis aquifolium	shrub	x			x	
Cornus sericea subsp. *sericea*	shrub		x		x	x
Gaultheria ovatifolia	shrub				x	
Lonicera involucrata	shrub/vine			x	x	
Oemleria cerasiformis	shrub				x	
Philadelphus lewisii	shrub	x			x	
Physocarpus capitatus	shrub				x	x
Ribes sanguineum	shrub				x	x
Rosa pisocarpa	shrub	x			x	x
Rubus parviflorus	shrub/vine				x	
Salix sitchensis	shrub					x
Salix lasiandra	shrub					x
Salix scouleriana	shrub					x
Sambucus racemosa	shrub					x
Sambucus caerulea	shrub					x
Spiraea douglasii	shrub		x			x
Symphoricarpos albus	shrub			x		
Polypodium glycyrrhiza	fern	x		x		
Polystichum munitum	fern				x	
Herbaceous						
Achillea millefolium	forb			x		
Agrostis exarata	grass				x	x
*Allium amplectens**	forb	x	x			
Apocynum cannabinum	forb		x			
Balsamorhiza deltoidea	forb			x		

Scientific name	Form	Habitat				
		Riparian basalt	**Off channel alcove**	**Oak woodland**	**Upland forest**	**Riparian forest**
*Brodiaea coronaria**	forb	x	x			
*Brodiaea elegans**	forb	x	x			
*Calochortus tolmiei**	forb	x				
*Camassia leichtlinii**	forb	x				
*Camassia quamash**	forb	x				
Carex lenticularis var. *lipocarpa**	perennial grasslike herb		x			x
*Carex pachystachya**	perennial grasslike herb		x			x
*Carex cusickii**	perennial grasslike herb		x			
Carex unilateralis	perennial grasslike herb		x			
Clarkia purpurea ssp. *quadrivulnera**	forb	x				
*Collinsia grandiflora**	forb	x				
*Comandra umbellata ssp. californica**	forb	x				
*Crocidium multicaule**	forb	x				
*Danthonia californica**	grass	x		x		
*Daucus pusillus**	forb	x				
Delphinium leucophaeum	forb	x		x		
*Deschampsia danthonioides**	grass	x				
Deschampsia elongata	grass			x	x	x
*Drymocallis glandulosa **	forb	x				
Eleocharis palustris	perennial grasslike herb		x			
Eleocharis ovata	perennial grasslike herb		x			
*Elymus glaucus**	grass	x		x		x
*Epilobium torreyi**	forb		x			
Eriogonum compositum var. *compositum*	forb	x				
Eriophyllum lanatum var. *integrifolium*	forb	x		x		
Festuca idahoensis (formerly *F. roemeri*)	grass	x		x		
Heterotheca villosa var. *villosa**	forb	x				
*Heuchera micrantha**	forb	x		x		
Juncus effusus	rush		x			
Juncus patens	rush		x			

Scientific name	Form	Habitat				
		Riparian basalt	**Off channel alcove**	**Oak woodland**	**Upland forest**	**Riparian forest**
Leersia oryzoides	grass		x			
*Lindernia dubia**	forb		x			
*Lithophragma parviflorum**	forb	x				
*Lomatium utriculatum**	forb	x				
*Lomatium triternatum**	forb	x				
*Madia gracilis**	forb	x				
Maianthemum racemosum	forb				x	
Maianthemum dilatatum	forb				x	
Micranthes (*Saxifraga*) *integrifolia**	forb	x				
Micranthes gormanii (*occidentalis*)*	forb	x				
*Mimulus alsinoides**	forb	x				
*Mimulus guttatus**	forb	x				
*Montia parvifolia**	forb	x				
*Myosotis laxa**	forb		x			
*Navarretia intertexta**	forb	x	x			
*Navarretia squarrosa**	forb	x	x			
*Penstemon serrulatus**	forb	x				
Penstemon richardsonii	forb	x				
Plectritis congesta	forb	x		x		
Prosartes hookeri var. *oregana*	forb				x	
Saxifraga mertensiana	forb	x				
Scirpus microcarpus	sedge		x			
Sedum spathulifolium	forb	x				
Sedum stenopetalum	forb	x				
*Symphyotrichum subspicatum**	forb		x			
Trifolium willdenovii (*obtusiflorum, tridentatum*)*	forb	x				
*Triteleia hyacinthina**	forb	x	x			

* Species recommendation subject to review by Metro staff.