HABITAT RESTORATION PLAN

Mercer Creek Floodplain and Riparian Restoration

Ellensburg, WA

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Prepared by:

Mid-Columbia Fisheries Enhancement Group
413 N. Main Street, Suite K
Ellensburg, WA 98926

Table of Contents

1. Overview 3
2. Project Goals 3
3. Site Description 3
   3. 1 Location 3
   3.2 Soils 4
   3.3 Hydrology 4
   3.3 Vegetation 4
4. Aquatic and Wetland Resources 5
5. Watershed context 6
6. Project Design 8
   6.1 Site Preparation 10
   6.2 Invasive Tree Removal 10
   6.3 Sediment Removal from Channel 11
   6.4 Floodplain Connectivity and Habitat 11
      Inset floodplain 11
      Floodplain Habitat Features 12
   6.5 Revegetation 13
      Revegetation of Inset Floodplain and Habitat Features 13
      Seeding Native Bunchgrasses 17
   6.6 Grazing Removal 17
7. Maintenance 18
8. Project Schedule 19

Figures 20

Appendix 1. Wetland Delineation Report 27

1. Overview

In 2019, Mid-Columbia Fisheries Enhancement Group (MCF) was granted non-point source water quality funding from the Washington State Department of Ecology (DOE) to work collaboratively with Kittitas County Public Works (KCPW), the City of Ellensburg, and the Washington Department of Fish and Wildlife (WDFW) to improve riparian, aquatic and wetland conditions of an urban stream in a developed residential area of the City of Ellensburg, in Kittitas County. The project will address water quality impacts of bacterial loading and water temperature impairment, as well as increase native riparian habitat, enhance wetland habitat, reduce local flooding, and exclude grazing on a 1200 ft length of Mercer Creek.

2. Project Goals

Project goals are to enhance riparian and wetland habitat and function, to control and replace invasive crack willow with native riparian forest and shrubland habitat, and to improve flood management on Mercer Creek. Water quality goals of the project are to reduce temperature, fecal coliform, and sediment in Mercer Creek. Proposed actions include:

- Allow for creation of an inset floodplain that increases the frequency and duration of inundation during seasonal high flows, and expansion of native riparian vegetation, by removing crack willow from the left bank and active channel of Mercer Creek;
- Avoid flushing sediments, which have aggraded in crack willow stems and rootwads, downstream during flood events by removing fine sediments from the channel and exposing channel bed cobbles for fish habitat;
- Increase the frequency of floodplain connection, and support conditions for expanded native riparian vegetation, by lowering the elevation of 1.5 acres of floodplain;
- Create a diversity of wetland and riparian habitat types within the 1.5 acre floodplain by creating depressions, backwatered channels, channels that increase floodplain connection, and wood structures;
- Increase roughness, filtration and shading by expanding native riparian and wetland vegetation in the 1.5 acre inset floodplain area;
- Reduce fecal coliform and sediment input by excluding livestock from the stream, wetland and riparian area by installing 1700 ft of fencing on the north, east and south project boundaries;
- Maintain riparian plantings and exclusion fencing for 10 years following project installation; and
- Increase community engagement and investment in future, similar urban riparian and aquatic restoration projects through outreach and community involvement.

3. Site Description

3. 1 Location

The project is located on Mercer Creek at river mile 2.5 in the City of Ellensburg in Kittitas County, Washington (Lat 47.014379°, Long -120.542469), within Watershed Resource Inventory

Area (WRIA) 39 (Figure 1). The project area lies within City of Ellensburg limits and includes 4 participating private landowners and a floodway parcel owned by Kittitas County.

3.2 Soils

Soils are mapped as Opnish Ashy Loam, 0-2% slopes and Nack-Opnish complex, 0-2% slopes (NRCS 2019; Figure 2). Soils are described as moderately to somewhat poorly drained, and gravelly to ashy loams with a clay loam layer. Depth to water table is estimated at 15-40 inches. Soils were textured as sandy clay loam, clay loam, silty clay and clays and sandy clay loam on 2019 site evaluations and wetland mapping (see Appendix 1).

3.3 Hydrology

Mercer Creek is a distributary of Wilson Creek, separating from Wilson Creek approximately 11 miles northeast of Ellensburg in Kittitas County, WA. It travels through agricultural areas, the urban fringe of northern Ellensburg, and then the City of Ellensburg before rejoining Wilson Creek at the City's southwest edge, approximately 2.5 miles downstream of the project area.

Mercer Creek is listed on Washington State's 303 d list of impaired waterbodies for excessive bacterial loads and is included in the 2005 *Wilson Creek Sub-Basin Bacteria Total Maximum Daily Load*. Mercer and Wilson Creeks also experience high summer water temperatures, low dissolved oxygen levels, and the presence of toxins. These impairments combine to reduce the quality of habitat in Mercer and Wilson Creeks for resident and anadromous fish, including rainbow trout, Coho and Chinook salmon, and federally-threatened steelhead.

Inundation was modelled in the project area for depth and velocity at estimated 2-year, 10-year, and 100-year flow events (Watershed Sciences for Kittitas County Public Works, unpublished data). Two-year flow events are difficult to determine in this watershed because of fluctuating flows related to unpredictable agricultural and residential irrigation use and timing. Therefore, the modelled 2-year flow conditions may occur at somewhat greater or lesser frequency than 2 year intervals, and less frequently than 10-year flow conditions. The modelled 2-year flow event shows inundation in depressions, but not extensive floodplain connection (Figure 3).

Modelling concurs with observations during 2018 stream survey and field visits. In addition, a neighbor reports periodic flooding of >2 weeks duration, occurring at <10 yr intervals, in the lower half of the delineated wetland. Aerial imagery from April 21, 2017 shows dark green areas characteristic of high-productivity wetlands within the wetland boundary.

Groundwater is shallow in the wetland occurring in the project area. Visible groundwater or saturated soil was observed in six soil pits associated with wetland delineation in July 2019.

3.3 Vegetation

Vegetation along Mercer Creek is dominated by crack willow (*Salix x fragilis*). Plant species in the project area are predominantly non-native, and the single woody species is crack willow. Structure is limited to a forest canopy where crack willow is present, and an herbaceous layer

that is heavily grazed is present throughout the project area. All but one of the tax parcels in the project area are grazed by livestock that have access to the floodplain, streambanks and channel. In the delineated wetland area, most of the emergent vegetation is <12" height, and very little is >40" height; there is little to no shrub layer present. One parcel was not grazed in 2019 and herbaceous vegetation in the project area was primarily between 12-40" height.

Cowardin classes and plant structure classes found in the delineated wetland are below (see Appendix 1 for the Wetland Report):

Cowardin Class	Percentage
Forested	46.92%
Emergent 0-12"	29.65%
Emergent 12-40"	17.72%
Emergent >40"	5.71%

Plant Structure	Percentage
Forest/Shrub	60.15%
Ungrazed emergent	17.94%

Dominant plant species in the project area are described below:

Species	Wetland indicator status (USACE 2019)	Origin (NRCS 2019)	Location
Agrostis stolonifera	FACW	Non-native	Wetland/riparian
Carex praegracilis	FACW	Native	Upland
Cirsium arvense	FACU	Noxious weed	Upland
Elymus repens	FAC	Noxious weed	Wetland/Upland
Holcus lanatus	FAC	Non-native	Upland
Juncus balticus	FACW	Native	Wetland/riparian
Myosotis scorpioides	FACW	Non-native	Wetland/riparian
Phleum pratensis	FACU	Non-native	Upland
Plantago major	FAC	Non-native	Upland
Poa pratensis	FAC	Non-native	Wetland/Upland
Ranunculus repens	FAC	Non-native	Wetland/riparian
Salix x fragilis	FAC	Non-native	Wetland/riparian
Schedonorus arundianceae	FACU	Non-native	Wetland/Upland
Trifolium repens	FACU	Non-native	Wetland/Upland
Tripleurospermum maritiumum	FACU	Noxious weed	Upland

4. Aquatic and Wetland Resources

The project includes 1200 ft of Mercer Creek and a portion of a riverine wetlands that was delineated in 2019 (Figure 4; also, see Appendix 1). The 3.38-acre riverine wetland is composed of the narrow stream channel corridor upstream and a broad floodplain downstream. The wetland is a Category II wetland based on Functions and on Special Characteristics. It is

classified as a Floodplain Forest due to the location of the forested (crack willow) component in the 100-year floodplain.

Mercer Creek is impaired by bacterial loading and temperature. The floodplain and wetland lack above and below-ground vegetation structure that provides floodplain roughness and slows erosion. Bare soil is exposed throughout grazed areas contributing both fecal coliform and sediments into the creek. Mercer Creek's gravel and cobble channel bed is covered by fine sediments that have been found to contain toxins, and which contribute to increased water temperatures.

The delineated wetland includes both emergent and riparian forest vegetation types. All vegetation in the delineated wetland is moderately to heavily grazed in four of the five parcels in the project area. While the wetland is inundated at <10 yr flow events, ponded depressions are limited. The riparian forest is limited to a single invasive tree species, crack willow, which has a relative short stature and dense canopy, eliminating most other species from the understory. The width of the riparian forest is limited to a single row of trees on each bank of the stream.

5. Watershed context

Mercer Creek is a distributary of Wilson Creek, separating from Wilson approximately 11 miles northeast of Ellensburg in the upper Yakima River watershed. Wilson Creek is designated under WAC 173-201A-602 as serving to provide salmonid spawning, rearing and migration (aquatic life use); primary contract recreation (recreation use); domestic, industrial, agricultural, stock water supply use; and miscellaneous uses including wildlife habitat, harvesting, commerce/navigation, boating, and aesthetics.

Mercer Creek is listed on Washington State's 303 d list of impaired waterbodies for excessive bacterial loads (Category 4A) and is included in the *2005 Wilson Creek Sub-Basin Bacteria Total Maximum Daily Load*. Mercer and Wilson Creeks also experience high summer water temperatures, low dissolved oxygen levels, and the presence of toxins. These impairments combine to reduce the quality of habitat in Wilson Creek for resident and anadromous fish, including rainbow trout, Coho and Chinook salmon, and federally-threatened steelhead. Wilson Creek provides Critical Habitat for steelhead trout, listed as threatened under the Endangered Species Act, and Essential Fish Habitat for Coho and Chinook salmon.

This project is valuable for its potential to reduce pollutions, as the wetland discharges to polluted waters downstream. It is also positioned with development located both upstream and downstream. The project tiers from regional plans for both watersheds and sub-watersheds, and for regional species of importance. The project meets regional high priorities and was developed collaboratively with agencies and land managers including Kittitas County Flood Hazard Zone Management District, City of Ellensburg, and Washington Department of Fish and Wildlife. Following are specific regional planning documents that include problem statements and recommended actions addressed in this project.

(1) *Wilson Creek Sub-basin Bacteria Total Maximum Daily Load (TMDL): Detailed Implementation Plan (DIP)*, (2006). Tables 2 and 3 detail sources of fecal coliform in the Wilson Creek sub-basin. Following are excerpts from these tables that describe contributing issues and recommended actions that are addressed in this project:

> "Table 2. Primary sources of fecal coliform in the Wilson Creek Sub-Basin and recommended actions.
> Source: Livestock
> Recommended Action: Limit access to streams and reduce time livestock spend in all waterways.
> Recommended Action: Protect and/or revegetate riparian areas."
>
> "Table 3. Secondary sources of fecal coliform in the Wilson Creek Sub-Basin and recommended actions.
> Source: Domestic animals walking in waterbody.
> Recommended Action: Limit access to streams and reduce time livestock spend in all waterways."

(2) *Upper Yakima River Basin Suspended Sediment, Turbidity and Organochlorine Pesticide TMDL: Detailed Implementation Plan (2002).* Tables 2 and 3 detail sources of suspended sediment, turbidity and organochlorine pesticides in the Upper Yakima basin. Following are excerpts from these tables of contributing issues and recommended actions that are addressed in this project:

> "Table 2. Sources of suspended sediment and turbidity in the Upper Yakima River Basin and recommended actions.
> Source 1: Unstable streambanks.
> 1.3 Insufficient riparian vegetation to hold soils in place. Implementation Action: Plant and maintain riparian vegetation, where possible and appropriate. Protect riparian vegetation from future degradation.
> 1.4 Excessive use of riparian areas by livestock damages bank structure. Implementation Action: Improved management of livestock in riparian areas: • Managed in-closures and ex-closures of riparian areas."
>
> "Table 3. Sources of Organochlorine pesticides in the Upper Yakima River Basin and recommended actions.
> Source 3. 3. Resuspension from bottom of waterbody. OCP-bearing soil particles at the bottom of waterbodies may be re-suspended when disturbed or during turbulent high flow events."

(3) *Naneum, Wilson, and Cherry Creek Watershed Assessment: Project Data Summary and Recommendations* (June 30, 2017) Jacobs for Kittitas County Public Works. Following are excerpts from Section 5 of the report suggesting implementation actions:

> "Immediate Projects – 5.2.2 Flood Hazard Reduction:
> 5. Develop Strategic Channel Maintenance Program

Because natural fan-building processes have been disrupted, local landowners need a mechanism to deal with excess sedimentation, debris, and undesirable vegetation in a strategic and responsible manner. Channel maintenance, including periodic sediment and wood debris removal, with proper guidance from regulatory agencies, should be considered for specific locations where sediment is problematic. Such activities could improve channel capacity and reduce flood risk, while simultaneously improving low-flow habitat.

The channel maintenance program would be led by FCZD. This would provide a mechanism for vegetation and sediment removal at priority locations throughout the watershed and would include provisions for revegetation that maintain fish habitat and cooler temperatures but do not clog the stream with debris and non-native species such as crack willow, flag iris, and reed canarygrass. The FCZD Advisory Board would help with identification of key locations. WDFW could partner with this effort in developing a General Hydraulic Project Approval to cover maintenance actions while providing guidance and collaboration with the FCZD to residents."

(4) *2009 Yakima Steelhead Recovery Plan.* Developed in alignment with the *USFWS 2009 Middle Columbia River Steelhead DPS Recovery Plan Summary*, the Yakima Steelhead Recovery Plan includes Upper Yakima Recovery Action #15: Restore tributary riparian areas. The plan reads (page 199):

"Due to regulation and artificial confinement of the upper Yakima, the best available locations for rearing fish in normative flow and temperature conditions are in the lower ends of tributaries. Restoring riparian conditions will improve rearing conditions. Lower Reecer, Currier, Whiskey, Mercer, Wilson, Naneum, Coleman, Cherry, Manastash, Taneum, Swauk, and Lmuma Creeks and the Teanaway River are all candidates; some work has been completed. This action should be integrated with the passage restoration efforts identified in other actions."

The project area is also located within a reach of Mercer Creek where residential flooding occurs during <10 yr flow events. Kittitas County Flood Control Zone District and the City of Ellensburg are involved in reduction of flood hazards for neighbors on this project and downstream areas.

6. Project Design

The proposed project offers a unique opportunity within an urban area to improve water quality, aquatic habitat, wetland and riparian forest conditions through habitat restoration and flood management. The project proposes to remove crack willow and aggraded fine sediments containing soil-bound pesticides in the channel bed, and install a contoured inset floodplain that expands the area and duration of seasonal inundation during high spring flows. Additional wetland ponded areas will be created, and riparian shrub and forest habitat will be expanded

into the widened inset floodplain area. The riparian area will be protected from livestock by exclusion fencing.

Due to the dynamic nature of streams and adjacent riverine wetlands, habitat features are expected to change over time within the inset floodplain. Over time (e.g., >30 years), vegetation will mature and the stream will respond to both vegetation and floodplain features through slowed velocities, increased deposition, or concentrated flows. Flood flows (approximate 2 year and 10 year flows) are anticipated to be contained largely within the inset floodplain (Figure 6).

Crack willow removal and inset floodplain creation aims to improve temperature, fecal coliform and sediment conditions in Mercer Creek by increasing the riparian buffer width, attenuating flood flows, reducing the delivery of bacteria, toxins, and sediment to the stream, and reducing the potential for seasonal mobilization of sediment in the channel. The widened and lowered floodplain will provide a larger area for riparian vegetation to establish. The inset floodplain will increase infiltration due to reduced velocity and will impact water quality in two ways: 1) pollutant removal as contaminated sediments settle, and 2) moderation of surface water temperature. An increased residence time of water will also expand the surface area where denitrifying microbes can grow.

The project includes a community outreach component. A successful multi-landowner project within city and urban growth area limits increases the potential for future projects that will also improve wetland, riparian and aquatic habitats.

Project objectives are to:

- Reduce channel constriction by removing left bank crack willow trees along 1,200 ft of Mercer Creek;
- Decrease sediment delivery by excavating 225 cubic yards of accumulated fine sediment;
- Increase filtration by installing a 1.5 acre inset floodplain;
- Increase shade, reduce erosion, and improve sediment capture by installing 2,100 woody riparian species in the inset floodplain;
- Increase wetland and riparian habitat diversity by creating and revegetating floodplain habitat features, including partially connected channels, swales, knolls and wood structures.
- Reduce fecal coliform and protect the riparian area from browse input by installing 1700 feet of fencing;
- Maintain shade by topping and treating right (west) bank crack willow;
- Maintain the revegetated riparian and wetland area through weed control, limited irrigation and fence maintenance.

Project benefits include:

- Reduced fine sediment inputs from mobilization of aggraded sediments during high flows;
- Reduced fecal coliform inputs into the stream channel through livestock fencing;
- Increased filtration of runoff from upland activities (sediments, bacteria, and fertilizers) through expansion of the riparian buffer;
- Increased sediment capture and reduced erosion through the expansion of the riparian buffer;
- Increased floodplain connectivity, improved channel substrate, and enhanced streambank function through the development of the inset floodplain;
- Urban refuge for animals that migrate up the use of stream corridor, including salmonids, amphibians, reptiles, birds, beaver, and invertebrate pollinators; and
- Engagement of the local community in a demonstration of water quality, flood reduction, and riparian habitat benefits associated with urban stream enhancement.

6.1 Site Preparation

The site is currently dominated by non-native plant species. Weed treatment will occur in the 2020 growing season in order to reduce seed set of weed species, which will invade into the open soils created during inset floodplain creation. Reduced reproduction of weed species will reduce competition for space and light with planted native shrubs and trees.

Weed treatment will continue in the maintenance phase, and will focus on suppression of weeds surrounding the transplanted plants during their initial establishment.

6.2 Invasive Tree Removal

Crack willow (*Salix x fragilis*) is a non-native tree species that forms narrow, single-species stands along stream channels in developed areas. In the project area, crack willow is the single tree species present. Due to both crack willow growth structure and the presence of grazing, there is currently very little shrub layer structure and woody stem density, which is important for both habitat and hydraulic roughness along the channel and floodplain. In 2019, 40 individual crack willow trees with multiple stems were mapped occurring in the stream channel and on the left (east) bank of the project reach (Figure 5). Trees on the left (east) bank will be killed using herbicide prior to physical removal of stems and roots. To reduce costs, above-ground material will be removed but not root systems where 1) inset floodplain installation does not require removal, or 2) where rootwads in the channel do not alter flow paths. An additional 53 trees occur on right (west) bank and will be killed in place over 2020-2022. As the right bank trees begin to die, hazard limbs will be removed. Herbicide treatments include injection with herbicide, or frill-cut followed with herbicide application, during winter months. Specific treatments methods will be described in a Department of Ecology Best Management Practices form.

6.3 Sediment Removal from Channel

Crack willow root systems aggrade sediment on the channel bed, covering gravels and cobbles and which can contribute pulses of fine sediments and sediment-bound chemicals during high flow events. During the installation of the inset floodplain, approximately 225 cubic yards of sediment will be removed from the stream channel. Sediments will be removed down to the channel bed, loaded and hauled off the project site.

6.4 Floodplain Connectivity and Habitat

The project components that are designed to increase floodplain connectivity and riparian habitat width and condition are:

- Installation of an inset floodplain;
- Installation of floodplain topographic habitat features; and
- Installation of wood habitat features.

Inset floodplain

The inset floodplain is the primary feature of the restoration and enhancement of the project reach of Mercer Creek. The 1.5 acre inset floodplain is designed to be activated at annual flood flows, resulting in a larger seasonally inundated area that experiences more frequent flooding and periods of saturation than at present.

Benefits associated with inset floodplains are well documented and include infiltration and detention of water during seasonal high flows and stormwater events, increased residence time of water and subsequent retention of suspended sediments, and greater surface area availability for denitrifying microbes to flourish. These areas also lessen flood impacts downstream through water detention and increased residence time.

The surface elevation of the floodplain will be lower than the existing soil surface. The inset floodplain extends approximately 50 ft to the east of Mercer Creek, following the alignment of the creek's eastern bank. The floodplain grades to less than 50 ft at the northern, upstream end of the project area at its initiation; it tapers to approximately 30 ft at the downstream 350 ft of the project area. The inset floodplain extends 30 ft beyond the western bank of the creek in the lower 150 ft of the property; it also includes the 40 ft wide surface of an existing 225 ft length island in the channel.

Following crack willow removal, the inset floodplain will be excavated to 6-12" below the existing surface with a flat cross-section surface. After floodwaters recede, standing water will be limited to depression features (swales, and the deeper portions of the channel features). The inset floodplain and features may not hold water in late summer, however, moist soil is anticipated near the soil surface.

Floodplain Habitat Features

Due to the dynamic nature of streams and adjacent riverine wetlands, habitat features are expected to change over time within the inset floodplain. Deposition is likely in the low velocity stream conditions of project reach. Over time (e.g., >30 years), vegetation will mature and the stream will respond to both vegetation and floodplain features through slowed velocities, increased deposition, or concentrated flows. As such floodplain features are intended to provide habitat complexity that will change over time, rather than be fixed features

Collector Channel

In the northern portion of the inset floodplain, a collector channel will be constructed to collected high flow water and route it into Mercer Creek. The function of the channel is to provide hydraulic diversity on the floodplain. The collector channel is intended to mimic an arrested headcut with a backwatered area. At high flows, the collector channel will collect dispersed floodplain flow from upstream and bring it into defined channel as move downstream.

The collector channel elevation is approximately 100 ft length (1,050 square feet), and grades from the elevation of the inset floodplain in the north to the elevation of the creek channel at its outlet. The lower 30 ft of the channel is anticipated to be seasonally to perennially backwatered, with a narrow portion excavated to the elevation of the existing Mercer Creek thalweg and wetted at the same time as the creek. A secured post-assisted log structure (PALS) will prevent headcutting at the outlet.

Disappearing Side Channels

Two disappearing side channels will be constructed to extend the period that surface water is delivered to the floodplain. These channel features begin as high-flow channels that leave the main channel, gradually becoming wider and shallower until meeting the floodplain surface elevation.

The disappearing channels are connected to the main creek channel at the upstream end, and grade to the elevation of the floodplain at the lower end, without reconnecting to the main channel. The channels are designed at 120 ft and 85 ft lengths. Disappearing channels widths are approximately 5 ft at their initiation, broadening to 20-30 ft at their terminus. The upper 20-30 feet of the channels are designed with a center channel graded approximately 0.5 ft higher than the stream thalweg; at their terminus, the channels lack a deeper center channel and grade to the elevation of the inset floodplain surface.

Swales

Two swales will be constructed in the inset floodplain to increase habitat complexity. The swales are depressions that mimic cut-off meander scrolls. The approximately 70-ft long

crescent-shaped swales will be excavated in the north-south direction of flow; at their broadest point, they will be approximately 7 ft width. The deepest elevation of the swales will be the same as the adjacent channel invert. Approximately 15% of the swales is anticipated to be seasonally to perennially inundated or saturated.

Knolls

Six knolls are designed in the inset floodplain to increase habitat complexity. Knolls will be elevated 6-12" above the inset floodplain (elevation of the existing ground surface), approximately 3-7 ft width and 10-15 ft length.

Post-Assisted Log Structures

Four PALS will be installed in the inset floodplain. PALS create local deposition and floodplain diversity, intended to eventually develop into vegetated islands. A PALS appears similar to a beaver-dam analog check-dam, except that PALS are isolated, small woody debris structures that provide habitat diversity on the floodplain or adjacent to the stream. The PAS are designed to be 10-15 ft length and 2 ft width, positioned generally perpendicular to the north-south flowpath of Mercer Creek. PALS will include 6-10 six-foot posts per structure, and posts will be installed a minimum of half of their length to secure material. Posts will be cut to 12-18" height above the floodplain, and willow stakes or wattles will be installed after posts. Post may begin to decay in as few as five years; over time, interplanted willows are expected to hold brushy material similar to posts.

6.5 Revegetation

Two types of revegetation are planned:

- Revegetation of the inset floodplain and related habitat features; and
- Seeding of areas in the riparian buffer, and access and staging areas, that are disturbed during construction.

Revegetation goals will be achieved using native plant species appropriate to site conditions.

Note that while Pacific willow (*Salix lasiandra*) is a dominant native riparian species in the ecological region of the project area, it is not included in revegetation due to its hybridization with crack willow and difficulties distinguishing the two species for crack willow control purposes.

Revegetation of Inset Floodplain and Habitat Features

Inset Floodplain

The inset floodplain, excluding habitat features, is designed as approximately 56,500 square feet. The revegetation goals of this area are to:

- Increase roughness in the seasonally-flooded floodplain;
- Increase canopy cover to the stream channel;

- Increase density of woody and fibrous roots in the soils; and

Approximately 1,150 plants will be installed on the inset floodplain at an average of 7 ft spacing. Spacings will range from 3-5 ft near the channel margin to 9-11 ft near the eastern edge of the inset floodplain. Species' water use needs range from obligate wetland to facultative upland to accommodate a range in expected moisture levels from near-channel to floodplain margin. Below are species identified for the inset floodplain:

Species	Common Name	Ecological Zone	D40	3 ft tall D40
Alnus incana	Mountain alder	Riparian		115
Amelanchier alnifolia	Service berry	Upland	30	
Cornus sericea	Red-osier dogwood	Riparian	115	
Philadelphus lewisii	Mock orange	Riparian to upland	55	
Pinus ponderosa	Ponderosa pine	Upland		55
Populus trichocarpa ssp. balsamifera	Black cottonwood	Riparian		175
Prunus virginiana	Chokecherry	Riparian to upland	85	
Ribes aureum	Golden currant	Riparian to upland	175	
Rosa woodsii	Wood's rose	Riparian to upland	30	
Salix exigua	Coyote willow	Riparian	175	
Salix amygdaloides	Peachleaf willow	Riparian		115
Sambucus cerulea	Elderberry	Riparian to upland	30	

<u>Collector Channel</u>

The collector channel is approximately 100 ft length and 1,050 square feet. The revegetation goals of the channel are to:

- Increase roughness in the upper portion 2/3 of the channel;
- Provide resilience to sediment accumulation at the lower 1/3 of the channel;
- Increase canopy cover to Mercer Creek; and
- Increase density of woody and fibrous roots in the soils.

In the upper end of the collector channel, plants will be installed at high densities (3-5 ft spacing) to increase roughness. Coyote willow (*Salix exigua*) is the primary species utilized in the upper portion in order to quickly increase stem density from the planted density. In the downstream 1/3 of the collector channel, species will not be planted in the lowest elevations where perennial backwatering is anticipated, and species to be planted surrounding the channel are tolerant of inundation and are able to resprout through sediment accretion associated with active stream processes. Below are species identified for the collector channel:

Species	Common Name	D40	3 ft tall D40

Alnus incana	Mountain alder		10
Cornus sericea	Red-osier dogwood	16	
Populus trichocarpa ssp. balsamifera	Black cottonwood		10
Salix exigua	Coyote willow	34	
Salix amygdaloides	Peachleaf willow	10	

Disappearing Side Channels

The two disappearing side channels are roughly 85 and 120 ft in length and total approximately 2,900 square feet. The revegetation goals of the disappearing side channels are to:

- Increase roughness in the lower 2/3 of the channel to reduce velocities as floodwaters spread out;
- Use increased roughness on the right (west) bank of disappearing channels to push water into the channels.
- Increase canopy cover of Mercer Creek; and
- Increase density of woody and fibrous roots in the soils.

In the upstream 1/3 of the disappearing channels that are excavated to near the depth of the Mercer Creek thalweg, plants will be installed surrounding but not into the deepest portions of the channel. In these areas, plants will be installed at high density (2-4 ft spacing), with highest densities on the right bank to push water into the channel. In the lower 2/3 of the disappearing channels, plants will be installed at moderately high densities (5 ft spacing) to increase roughness. Species planted in the disappearing channels are tolerant of inundation and moderate velocities. Below are species identified for the disappearing side channels:

Species	**Common Name**	**D40**	**3 ft tall D40**
Alnus incana	Mountain alder		17
Cornus sericea	Red-osier dogwood	33	
Populus trichocarpa ssp. balsamifera	Black cottonwood		20
Salix exigua	Coyote willow	50	
Salix amygdaloides	Peachleaf willow	20	

Swales

Two swales are designed in the inset floodplain that are approximately 100 ft length and 7 ft wide at their broadest point. The revegetation goals of the swales are to:

- Provide habitat and wetland plant species diversity; and
- Increase density of fibrous roots in the soils.

Swales are anticipated to be fully inundated during spring flooding. When flooding recedes, the approximately 15% of the lowest elevation surface area may have perennial soil saturation or shallow standing water. The upper portions are anticipated to be seasonally moist and dry by late summer. Emergent herbaceous species will be installed at 1.5 ft spacings. Below are plant species identified for the swales:

Species	Upper zone	Lower zone	Total LT10	Inundation Zone
Carex stipata	110		110	seasonal
Carex utriculata		20	20	seasonal to perennial
Jucus balticus	85	5	90	seasonal to perennial
Juncus effusus	85	5	90	seasonal to perennial
Scirpus microcarpus		20	20	seasonal to perennial

Knolls

Six knolls are planned in the inset floodplain along the length of the channel. Each knoll is 3-7 ft wide and 10-15 ft in length. Knolls will be raised areas approximately 6-12 inches above the excavated inset floodplain that provide habitat complexity. The revegetation goals of the knolls are to:

- Reduce erosion on upstream portion of knolls through increased density of woody and fibrous roots in the soils; and
- Increase canopy cover to Mercer Creek.

The area of the knolls is approximately 200 square feet. Container plants will be installed at 3 ft spacings composed of upper riparian species. Live stakes will be installed at the base of the knolls (elevation of inset floodplain) on the upstream margin. Below are plant materials selections for the knolls:

Species	Common Name	D40	3 ft tall D40	Stakes (3 ft min)
Populus trichocarpa ssp. balsamifera	Black cottonwood		6	
Ribes aureum	Golden currant	10		
Rosa woodsii	Wood's rose	6		
Salix exigua	Coyote willow			30
Salix amygdaloides	Peachleaf willow			30
Sambucus cerulea	Elderberry	6		

Post-Assisted Log Structures

Four PALS will be installed in the inset floodplain. The revegetation goals of the PALS are to:

- Increase canopy cover to the stream channel; and
- Increase density of woody and fibrous roots in the soils.

The PALS will be installed using posts that are pushed into the soil as well as partial burial of live stakes or wattles. Live stakes and wattles will be installed at the time of PALS installation. Stakes will be 4-5 ft length, with 50-70% installed below the ground surface. Wattles are live stake bundles that would be placed horizontally and seated into the saturated surface at a depth that allows that wattle be saturated during the growing season. Material for wattles will be collected by hand crews prior to placement. If live stakes are used, species and number are specified below:

Species	Common Name	No. Stakes
Cornus sericea	Red-osier dogwood	30
Salix exigua	Coyote willow	90
Salix amygdaloides	Peachleaf willow	30

Seeding Native Bunchgrasses

Up to 2 acres may be disturbed, outside of the riparian zone, by equipment access and staging during the creation of the inset floodplain and habitat features. Disturbed areas will be smoothed following equipment work, and areas with bare soil exposed will require reseeding. Seed will be applied manually with a mix of native grass species at a rate of 30 lbs/acre and lightly raked into base soil to increase seed-soil contact. Seeded areas will be covered with weed-free straw at 80% cover. Species and the seed mix rate are below:

Species	Common Name	Percent Mix by Weight
Deschampsia elongata	Slender hairgrass	20.00%
Festuca rubra	Red fescue	40.00%
Hordeum brachyantherum	Meadow barley	25.00%
Leymus cinereus	Basin wildrye	15.00%

6.6 Grazing Removal

Four of the five properties in the project area are currently grazed by domestic livestock (horses and cattle), or the landowners intend to graze the properties in the future. Livestock currently have unlimited access to the floodplain, riparian area and Mercer Creek. All landowners have agreed to the installation of protective fencing for the project area that is 75 feet from the existing east bank of the stream channel.

A perimeter fence will be installed along the riparian buffer using 5-strand barbed wire, with the smooth wire on the top strand to accommodate wildlife movement. The total of 1,700 ft of

fencing includes an eastern boundary of the riparian buffer along the 1,200 ft length of Mercer Creek, a cross fence on the northern project boundary to prevent trespass from neighboring horses, and a cross fence on the south end of the project area boundary to prevent pedestrian entry from Helena Street.

The fence will be constructed to NRCS specifications. H-braces will be constructed with treated posts. Corner posts and brace posts will be a minimum of 8 ft x 5.5 inches. These posts will be buried to a minimum depth of 42 inches. Horizontal brace posts will be a minimum of 6.5 ft x 3 inches. These will be constructed as a double H-brace at any directional change along the fence boundary. During longer stretches, double H-braces will be constructed every 500 ft. The wire will be two-point, 12.5-gauge wire. Fencing t-posts will be placed at a maximum of 15 ft intervals between braces. The maximum wire height will be 48”. The lowest wire height will be 16” off the ground. The lower lines will have a spacing of approximately 8” between strands.

7. Maintenance

Maintenance is critical to the success of installed plant material and protection of riparian areas in the presence of livestock. Maintenance activities are funded and planned for the project area during the 2021 growing season. Maintenance will be sought for subsequent years during plant establishment.

Maintenance in this project includes:

- Weed removal to reduce competition with planted shrubs and trees;
- Limited irrigation of plants during the dry portion of the growing season, June through late September;
- Maintenance of the project perimeter fence to repair holes and prevent livestock from using the project area; and
- Control of crack willow resprouts on the east (left) bank and mature trees on the west (right) bank.

Weed control is important to plant survival and growth by reducing physical competition for light, water, and nutrients while plants are small. Plants that are physically smothered by larger stature, fast-growing weeds have little chance of growth and survival. Optimal maintenance includes weed management in six two-day visits over the growing season in 2021-2025, using brushcutting, hand-pulling and spot-treatment herbicide control as necessary.

Irrigation assists with getting deep roots and adequate fine roots established so that plants can survive annual summer drought conditions in the arid climate of the Kittitas Valley. Plants that are planted at the eastern portion of the inset floodplain farthest from the stream channel may require limited irrigation, depending on soil moisture during the growing season. A hand crew will complete hand-irrigation during up to six visits of two days per visit during summer drought (June through September) of 2021. Water will be provided by landowners through their existing water rights using hoses fed from irrigation spigots and a water truck.

Herbivory can kill plants by the repeated removal of growing material, which require resources for regrowth. Less grazing translates to more energy production per plant via photosynthesis and more energy resources available in rooting structures, resulting in higher survival and vigor. In a planting project on the Gap-to-Gap reach of the Yakima River, riparian plants that were fenced had greater survival and were more than 10 times taller than ungrazed plants. Fence maintenance will consist of walking fencelines throughout the year and completing necessary repairs.

Crack willow have a strong ability to resprout from below-ground root systems, or from wounded trunks, stems and root pieces. Some resprouting from removed crack willow is expected. Optimal maintenance includes cutting and treating resprouting stems, and more kill-in-place treatments for larger diameter trees on the west bank, in 2021-2025.

Funding is currently available for 2021 maintenance activities only; additional funding will be sought for maintenance activities occurring from 2022-2030.

8. Project Schedule

Task	Timing	Responsible Party
Site preparation – weed management	Spring, Summer 2020	MCF
Crack willow control	Spring-Fall 2020	MCF
Crack willow removal	Fall 2020	MCF, Kittitas County, City of Ellensburg
Removal of channel bed sediments	Fall 2020	MCF, Kittitas County, City of Ellensburg
Construction of inset floodplain	Fall 2020	MCF, Kittitas County, City of Ellensburg
Construction of Floodplain Habitat Features	Fall 2020	MCF, Kittitas County
Fence installation	Fall 2020	MCF
Revegetation of inset floodplain, features and disturbed areas	Fall 2020	MCF
Maintenance – Irrigation	2021-2022, July-Sept	MCF/landowners
Maintenance – Weed management	2021-2025, growing season	MCF/landowners
Maintenance – Fencing	2021-2030, year-round	MCF/landowners
Maintenance – Crack willow control	2021-2025, summer and fall	MCF/landownders

Figures

Figure 1

Mercer Creek Floodplain and Riparian Restoration
Vicinity and Project Overview

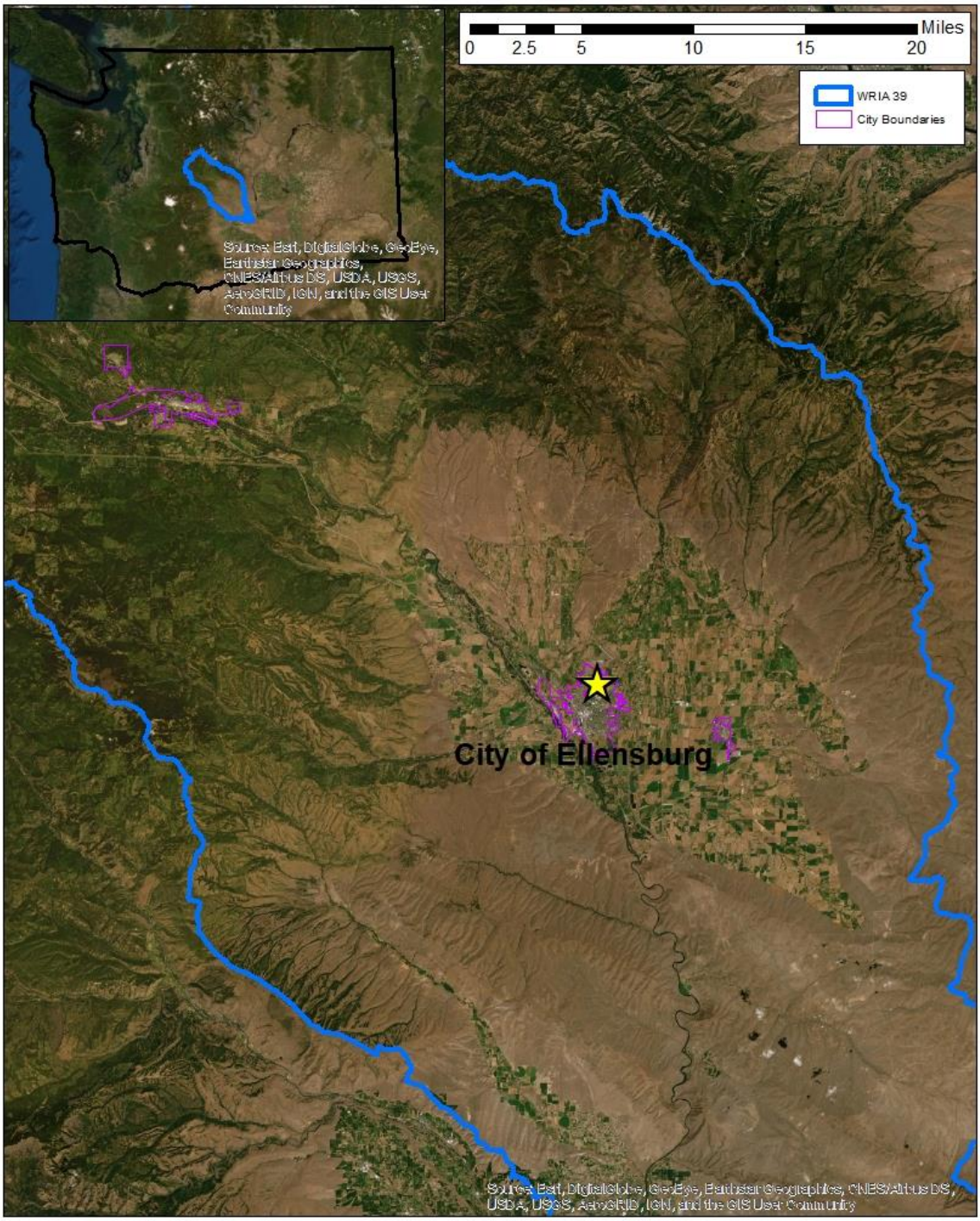


Figure 2

Mercer Creek Floodplain and Riparian Restoration
NRCS Soil Map Units

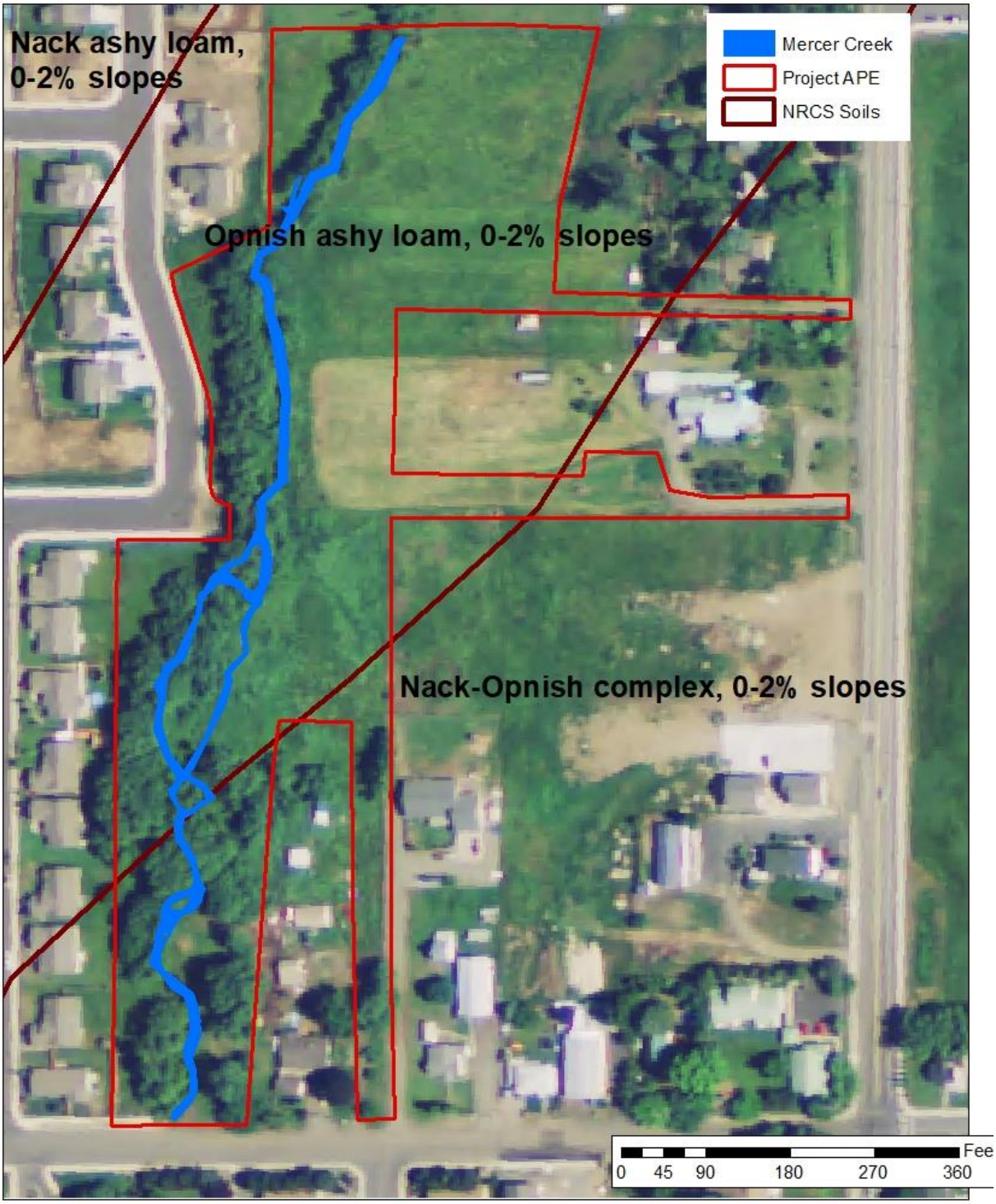


Figure 3

Mercer Creek Floodplain and Riparian Restoration
Existing Conditions -- Modelled 2-yr and and 10-yr Events

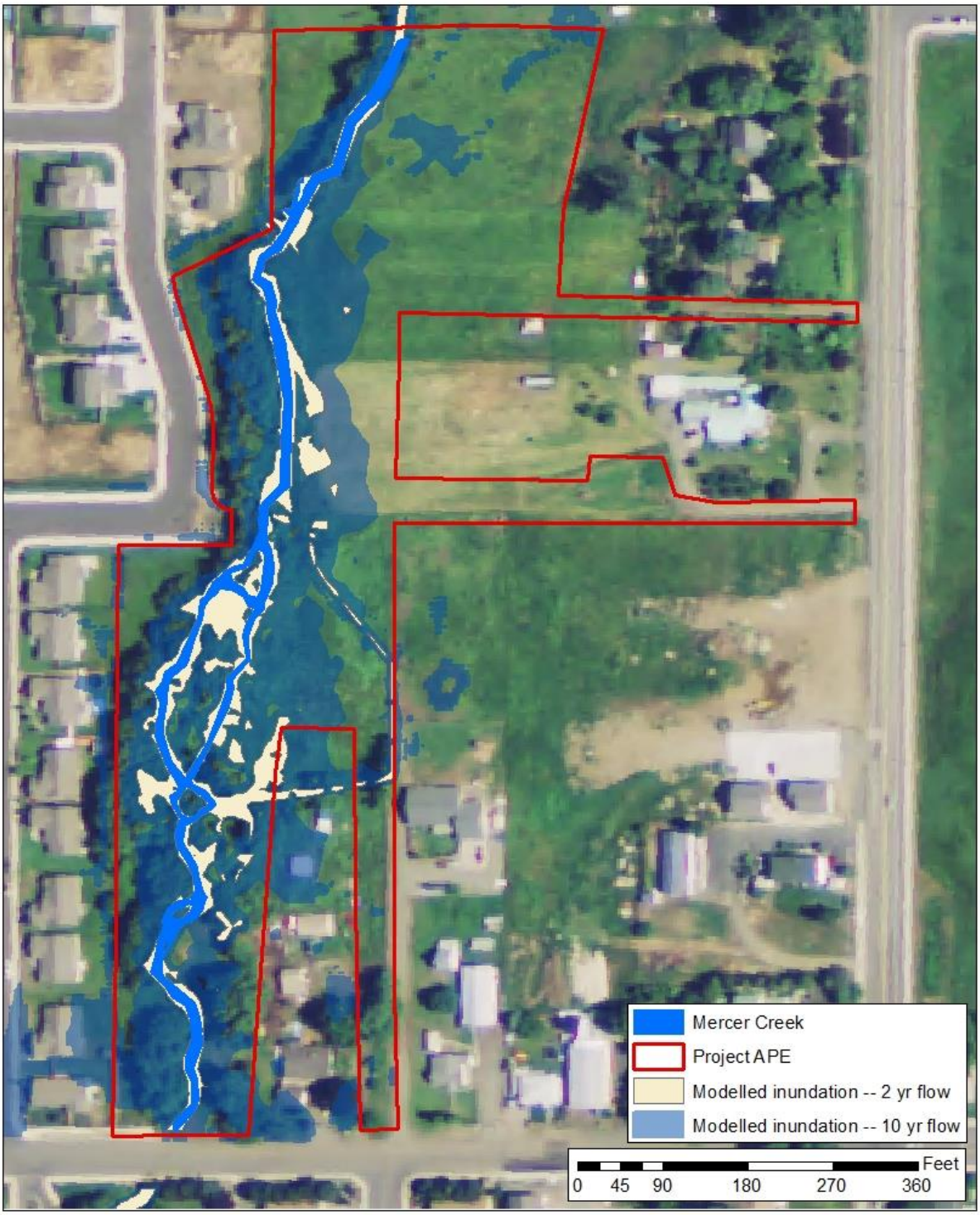


Figure 4

Mercer Creek Floodplain and Riparian Restoration
Site Plan Overview

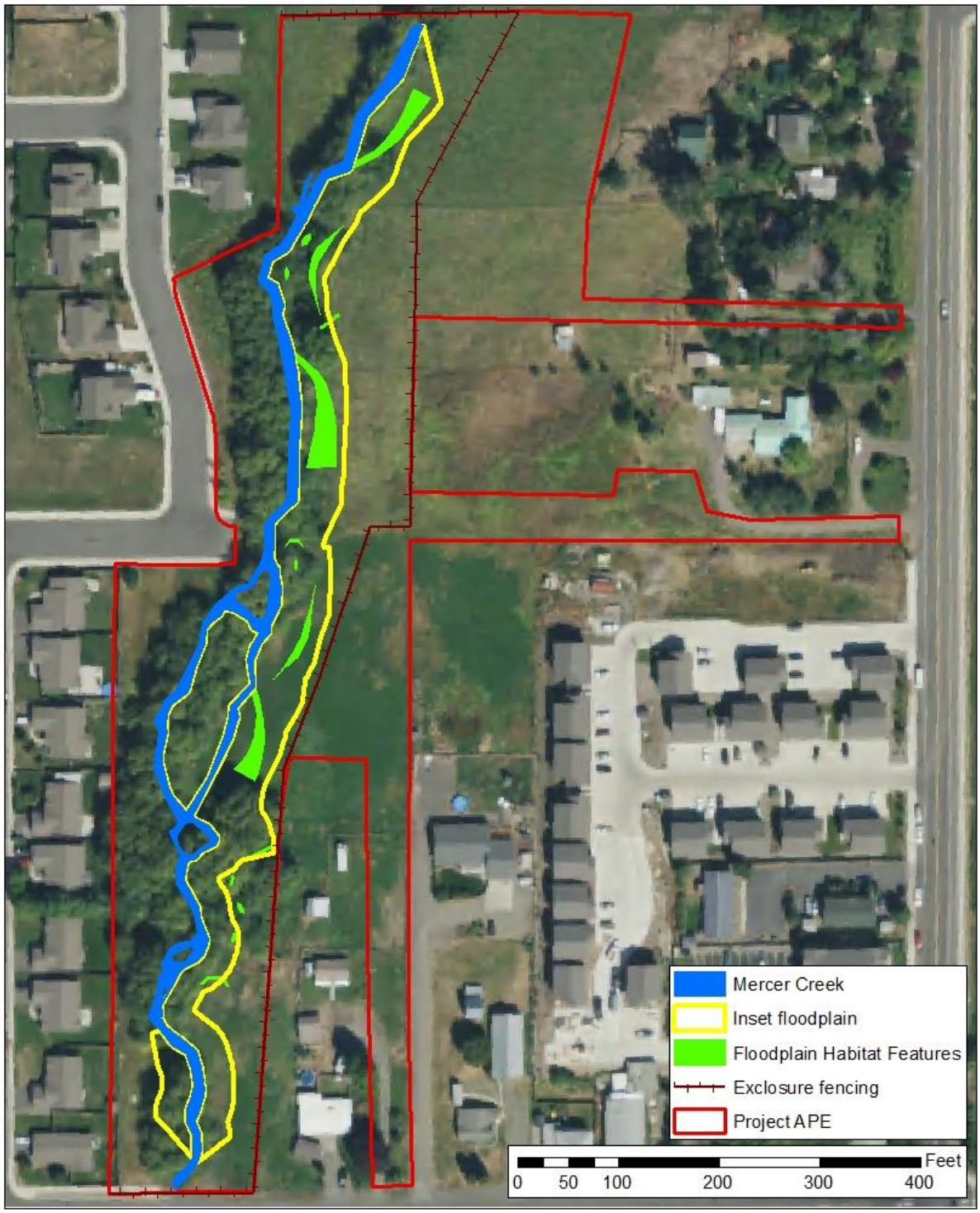


Figure 5

Mercer Creek Floodplain and Riparian Restoration
Crack Willow Removal -- East Bank and Channel

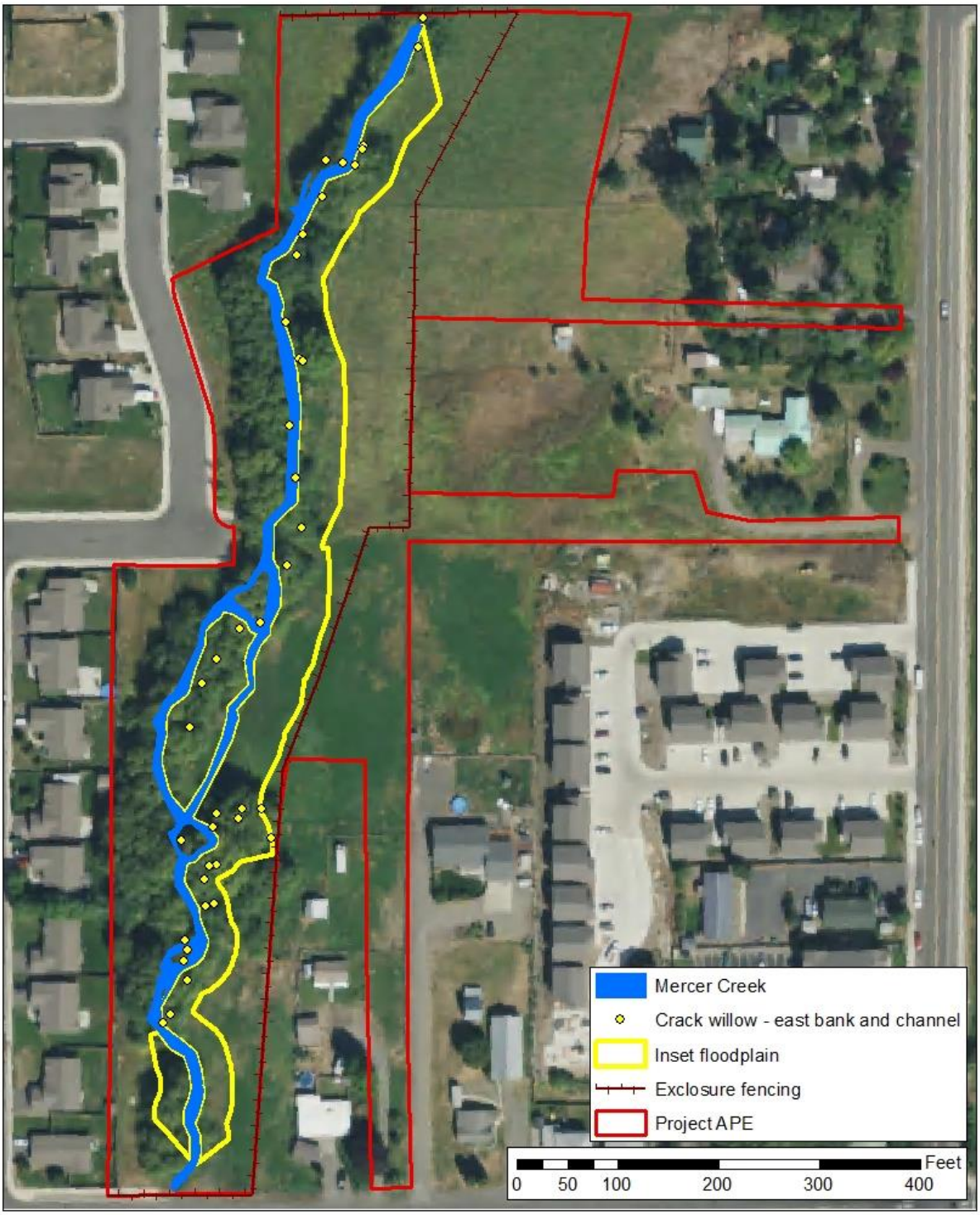
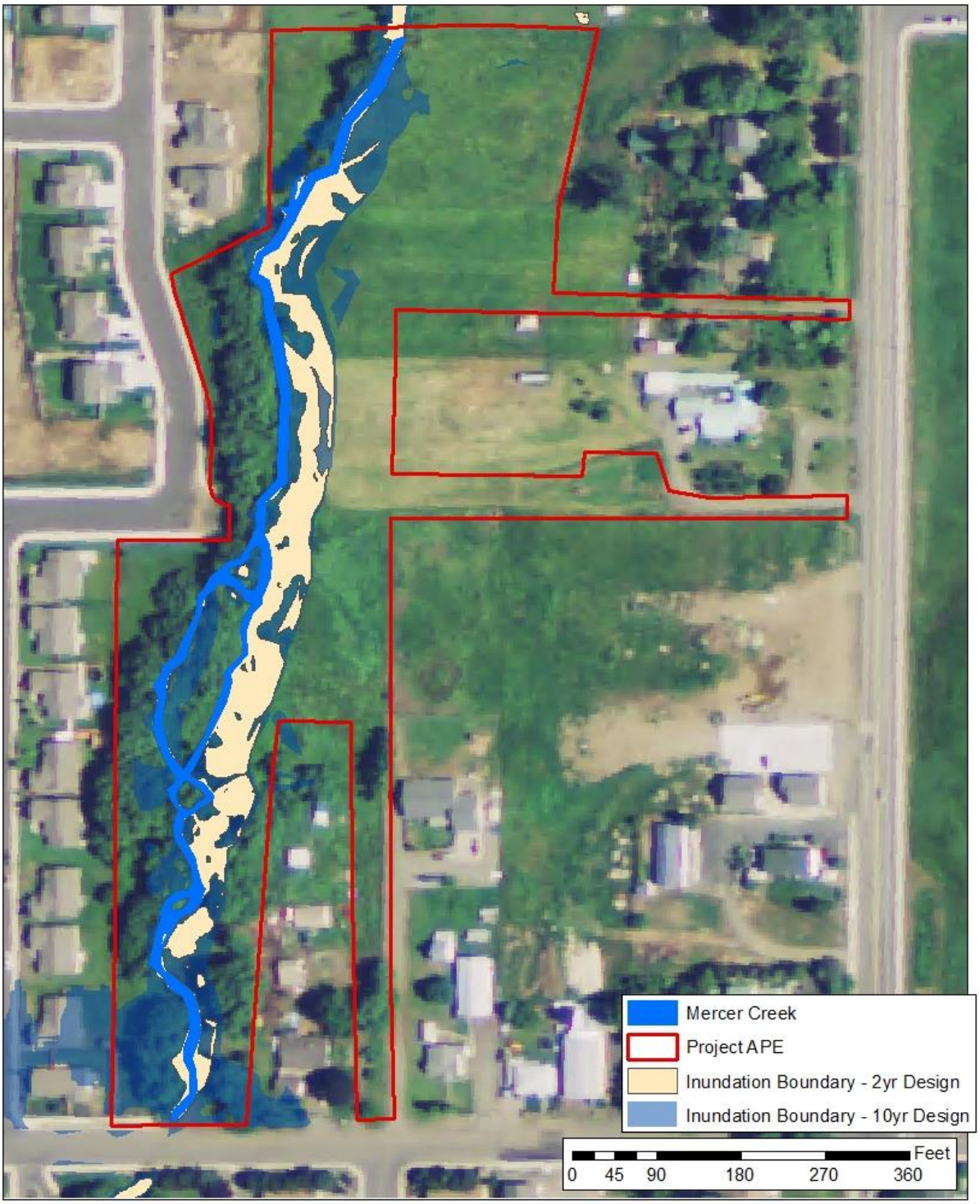


Figure 6

Mercer Creek Floodplain and Riparian Restoration
Designed Inset Floodplain -- Modelled 2-yr and and 10-yr Events



Appendix 1. Wetland Delineation Report