Herbert Farm and Natural Area Restoration Plan

Phase II: 2017-2023

Prepared for the City of Corvallis and Oregon Department of Fish and Wildlife
By Institute for Applied Ecology

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This document was prepared for the City of Corvallis and Oregon Department of Fish and Wildlife by staff at
the Institute for Applied Ecology (IAE):

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The Institute for Applied Ecology is a non-profit 501(c)(3) organization whose mission is to conserve native ecosystems through restoration, research, and education.

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Summary

This seven year restoration plan outlines habitat restoration activities to occur in Phase II restoration areas within the City of Corvallis Herbert Farm and Natural Area (HFNA). The HFNA is a 221 acre property in Benton County at the southern edge of Corvallis purchased by the City of Corvallis (the City) in 2000. The Oregon Department of Fish and Wildlife (ODFW) and Bonneville Power Administration (BPA) hold a conservation easement that preserves and protects the conservation values of the property in perpetuity as a BPA mitigation site for the Willamette Basin federal hydro-electric dams and reservoirs. The property, bordered by Marys River and Muddy Creek, has remnant flood channels and swales that were formed by the rivers during previous floods. Habitat restoration in Phase I restoration areas is described in a prior plan. This plan for Phase II areas includes the phased conversion of approximately 84 acres of agricultural field to upland and wet prairie, along with restoration or enhancement of existing upland, riparian, oak woodland and savanna. This document contains a description of current and desired future conditions, a restoration strategy for each habitat type that includes site preparation, planting strategy and maintenance, and a monitoring plan and management activities for the seven year period. Development and implementation of this plan has been a collaborative process between the City, the Institute for Applied Ecology, ODFW, the US Fish and Wildlife Service (USFWS) and streaked horned lark experts (Randy Moore and Bob Altman).

Contents

1 Introduction

1.1 Project background

The Herbert Farm and Natural Area (HFNA), a 221 acre property in Benton County, Oregon at the southern edge of Corvallis, was purchased by the City of Corvallis (the City) in 2000 (Fig. 1). Oregon Department of Fish and Wildlife (ODFW) holds a conservation easement that preserves and protects the conservation values of the property in perpetuity as a Bonneville Power Administration (BPA) mitigation site for the Willamette Basin federal hydro-electric dams and reservoirs. The property is bordered by Marys River and Muddy Creek and has remnant flood channels and swales that were formed by the rivers during previous floods. Farming is gradually being phased out at HFNA as areas are restored to native habitats. Currently, approximately 82.5 acres of HFNA is in agricultural production. Some areas in the southwest portion of the natural area have never been cultivated and retain diverse natural features, including upland prairie, oak savanna and forest plant communities (City of Corvallis 2011).

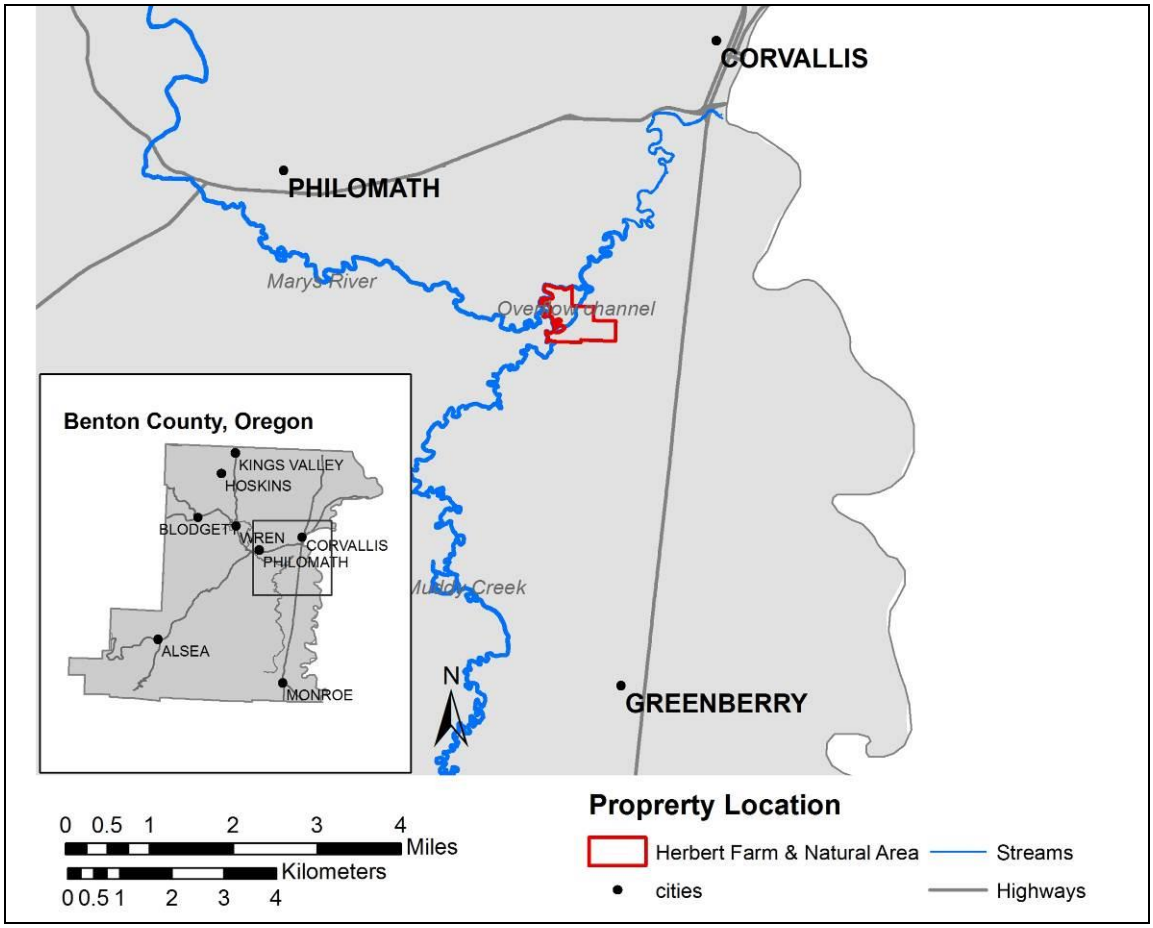

Figure 1. Herbert Farm and Natural Area property location southwest of Corvallis, Oregon. Township 21S, Range 5W, Sections 15, 16, 21, 22.

HFNA provides critical aquatic and terrestrial linkages between the Muddy Creek drainage, the Marys River west to the Coast Range, and downstream habitats to the Willamette River. HFNA lies within one of the 27 "Conservation Opportunity Areas" (COAs), identified in the Willamette Valley by the Oregon Conservation Strategy (ODFW 2006). The COA designation seeks to promote protection and

enhancement of these identified habitats and species, as well as protection of the connectivity between William L. Finley National Wildlife Refuge and the Marys River corridor. Similarly, HFNA is recognized by the Benton County Habitat Conservation Plan as a Prairie Conservation Area with potential to enhance habitat to benefit key species (Benton County 2010). HFNA is identified primarily as a resource conservation natural area, and it is also planned to provide public recreation that is compatible with habitat restoration, interpretation and protection of native habitat (City of Corvallis 2011). The primary site mission is to protect and restore existing high quality native prairie, savanna, oak woodland, riparian areas, and their associated rare species and wildlife habitat (City of Corvallis 2011). Equally important is the preservation of cultural resources, education opportunities, and public access to recreation (City of Corvallis 2011).

The City developed a Management Plan for HFNA to guide restoration and management of the site over a 10 year period (2011-2021, City of Corvallis 2011). Despite previous agricultural use, the property retains areas of high quality native prairie, savanna and riparian ecosystems. These outstanding ecological values provide or enhance recreational, educational, and cultural resources. The Management Plan provides an opportunity for the City to protect and expand rare species populations, and to manage and restore rare habitats of the Willamette Valley. The plan proposed to transition areas out of farming over the course of many years and restore them to native habitat while retaining other areas where sustainable management practices would provide ecological benefits. Restoration partners, including the City, ODFW, the U.S. Fish and Wildlife Service (USFWS), and the Institute for Applied Ecology (IAE), agreed to begin restoring the 84 acre area west of Matt Creek (Fig. 2) as the first phase of restoring HFNA. The Management Plan was used as the guiding document for the Phase I Restoration Plan (IAE 2013a).

Phase I restoration began in 2013 and has been conducted and coordinated by IAE using operations and maintenance funding from the ODFW Willamette Wildlife Mitigation Program (WWMP), the Plants for People project, funded by the Oregon Watershed Enhancement Board, and contributing in-kind efforts from partners in the project, including USFWS, ODFW and the City. Phase I restoration activities included two years of site preparation that were followed by two years of planting of prairie and riparian vegetation and ongoing weed control (see Appendix 1: Summary of Restoration Actions in Phase I Area of HFNA).

An archaeological survey in 2014/15 documented the presence and distribution of cultural resources at HFNA and concluded that the potential impacts of restoration actions on those resources would be minimal and would not adversely affect the archaeological site. Prehistoric artifacts were broadly scattered across the surface of the site, with four concentrations of artifacts in the formerly farmed fields (Applied Archaeological Research 2015). After consulting with tribes and the State Historic Preservation Office, BPA gave permission for actions such as seed drilling, disking, planting, prescribed burning and tree thinning to proceed in Phase I and Phase II restoration areas.

This Restoration Plan for Phase II restoration outlines proposed restoration activities for areas east of Matt and Muddy Creeks. In contrast to Phase I, Phase II will occur in stages and involve multiple projects.

The following four projects have been initiated by IAE and partners in the Phase II restoration area, east of Matt and Muddy Creeks (Fig. 2, Appendix 2).

1. An experiment funded by USFWS is comparing habitat creation techniques for streaked horned lark (*Eremophila alpestris strigata*), including combinations of herbicide, disking and mowing (along the roadside of Herbert Avenue and along the eastern property boundary), while monitoring the lark population response (IAE 2015, 2016).

2. A State Wildlife Grant (SWG), also funded by USFWS, is restoring 24 acres of land in agricultural use to native prairie habitat for the benefit of streaked horned lark and Western pond turtle (*Actinemys marmorata*).
3. Within the SWG project restoration area, USFWS Partners for Fish and Wildlife Program constructed two shallow berms to flood swales in the spring and create more bare ground and sparsely vegetated habitat favored by streaked horned lark habitat.
4. The ODFW WWMP is funding restoration of five acres of fallow agriculture field and riparian margin in the southwest corner of HFNA (Fig. 2).

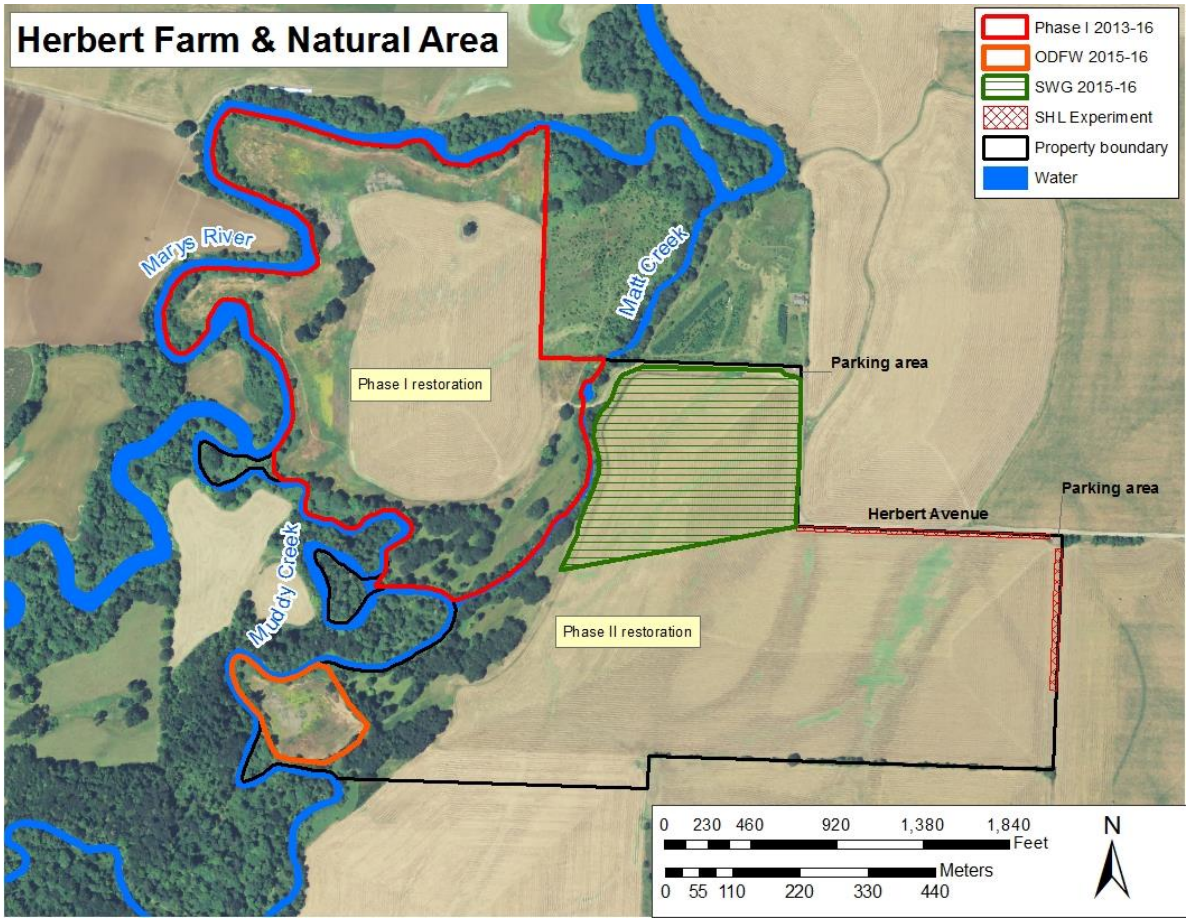

Figure 2. Phase I and II restoration areas of Herbert Farm and Natural Area. Also shown are current restoration projects: Phase I projects (2013-16), ODFW (2015-16), State Wildlife Grant (SWG 2015-16), streaked horned lark experiment (SHL 2015-16).

1.2 Historic vegetation

From 1851 to 1865, the General Land Office surveyed the Willamette Valley in preparation for Euro-American settlement. The surveyors' notes detailed the vegetation, soils, and topography encountered as they crossed the landscape. The Nature Conservancy has used this information to reconstruct the historic vegetation patterns of the Willamette Valley (Christy et al. 2005). This mapping indicates HFNA was a combination of riparian hardwood forest near the waterways, with areas of upland prairie and wet prairie at the time of Euro-American settlement (Fig. 3).

- Riparian hardwood forest included deciduous trees and shrubs, with species such as alder (*Alnus* sp.), willow (*Salix* spp.), black cottonwood (*Populus trichocarpa*), ash (*Fraxinus latifolia*), big leaf maple (*Acer macrophyllum*) and Oregon white oak (*Quercus garryana*).
- Upland prairies were a mix of native bunchgrasses, including Roemer's fescue (*Festuca roemeri*) and California oatgrass (*Danthonia californica*), with native forbs interspersed and few shrubs. A scattering of trees, including Oregon white oak may have been present, but at densities of less than two trees per acre. Historically, these prairies were maintained in an open state by frequent fires lit and managed by the Kalapuya Indians to promote food plants like camas (*Camassia* spp.) and tarweed (*Madia* spp.) and manipulate game behavior. After settlement, wildland burning was largely suppressed, and increases in grasses and woody plants have occurred region-wide. Many areas have also been planted with Douglas-fir (*Pseudotsuga menzeisii*) for small or large scale timber operations.
- Wet prairie was dominated by tufted hairgrass (*Deschampsia cespitosa*), sedges (*Carex* spp.) and rushes (*Juncus* spp.), with a diversity of annual and perennial forbs, often including species of camas.

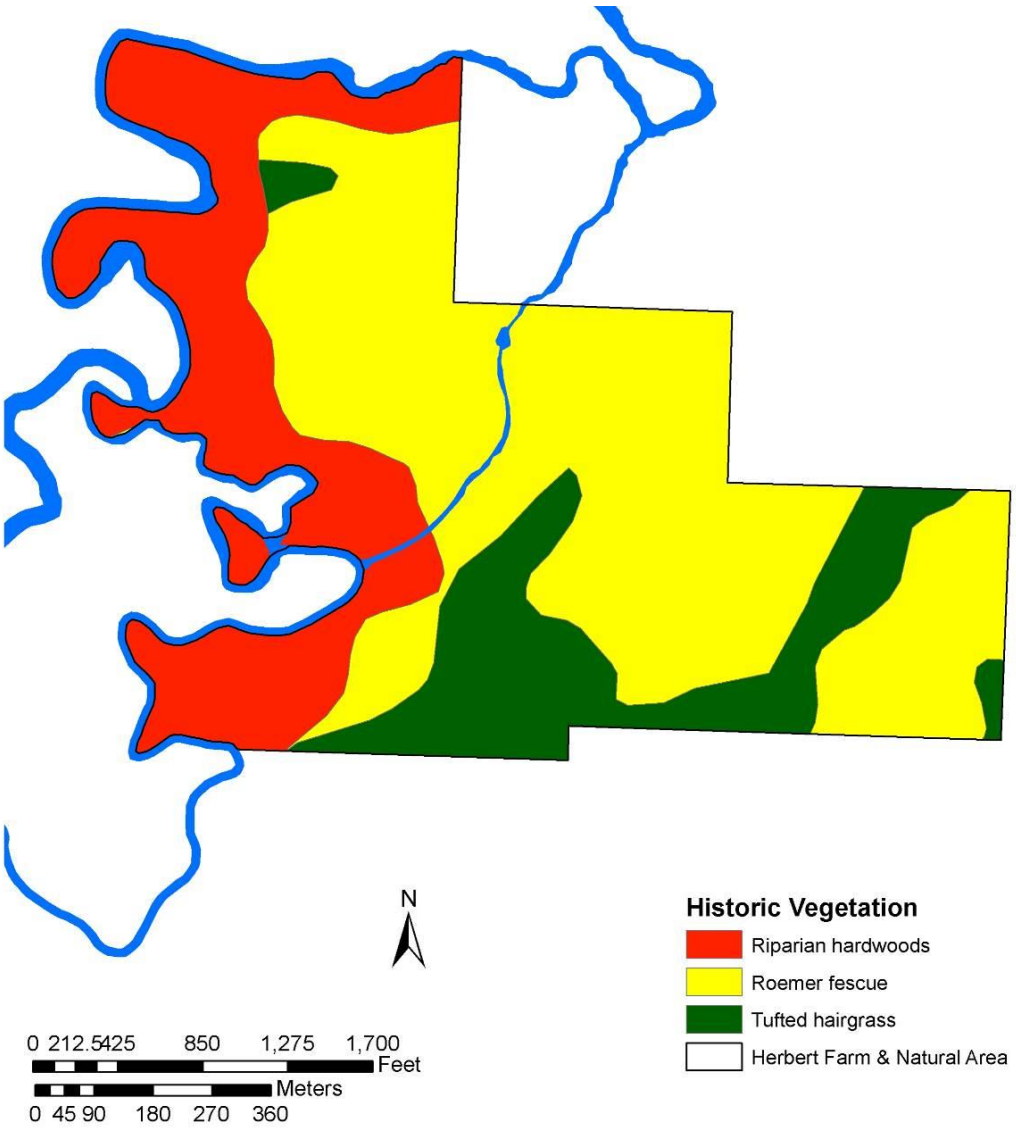

Figure 3. Pre- Euro-American settlement vegetation over Herbert Farm and Natural Area (City of Corvallis 2011, Map 2.9).

1.3 Soils, water and topography

HFNA includes a variety of productive silty clay loams and silt loams (Fig. 4). These soils tend to be deep, and vary from poorly drained to well drained types. Most are capability Class II or III. The site includes the confluence of the Muddy Creek, Marys River and an overflow connector between them, referred to here as Matt Creek. The site is predominantly flat, but has subtle micro-topography that creates shallow swales and depressions where water pools during wet periods.

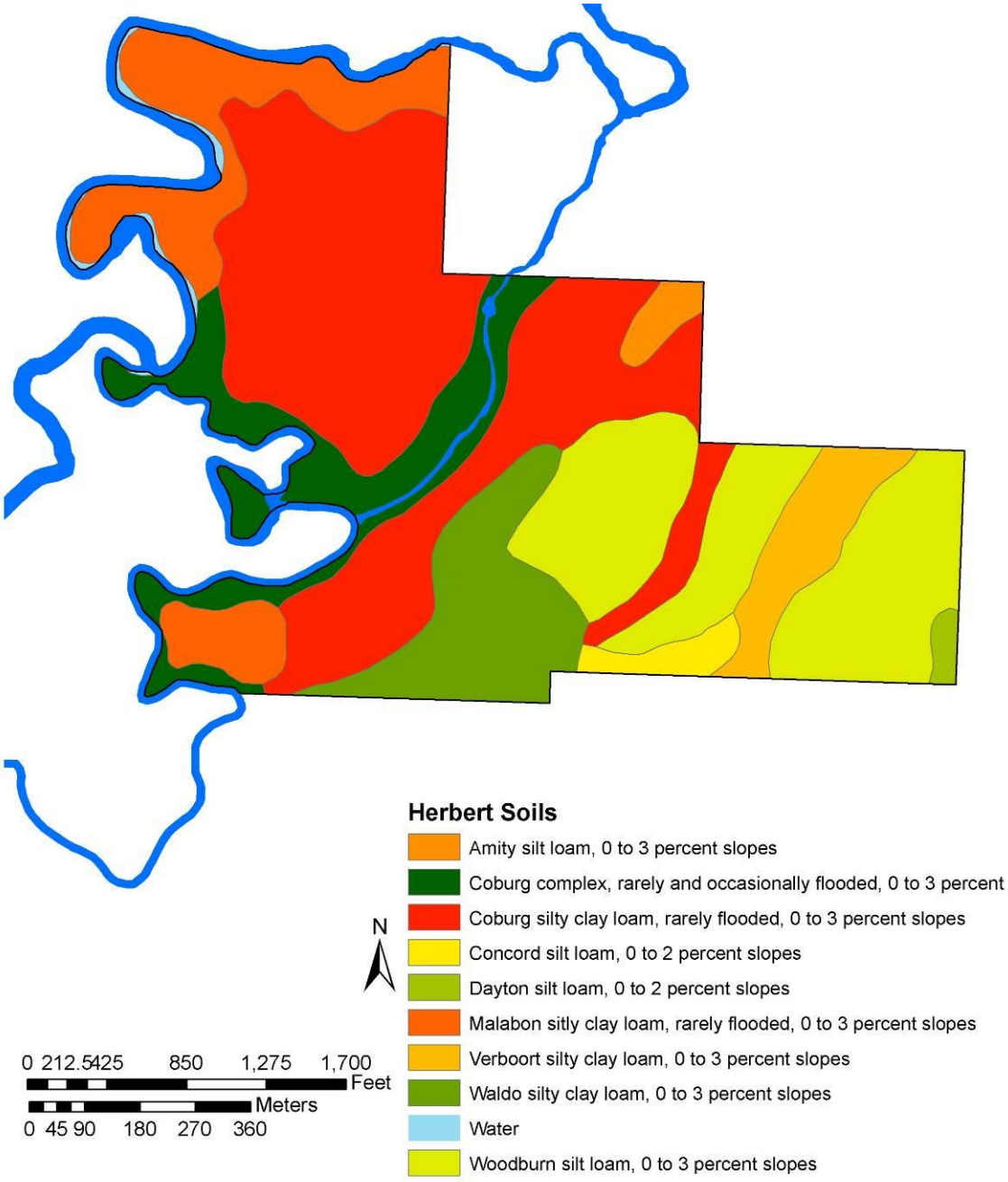

Figure 4. Soil types present in Herbert Farm and Natural Area (NRCS 2012).

1.4 Sensitive species

1.4.0 Rare plants

Natural habitats at HFNA, host eight rare plant species (Table 1), five that are listed federally or by the State of Oregon as threatened, endangered or candidate species and three that are considered locally rare (IAE 2013a, City of Corvallis 2011). Rare plant surveys of HFNA were conducted in 2006 (Salix Associates 2008) and 2009 (Benton County 2010), and repeated for Phase I areas in 2013 (IAE 2013b) and 2016. HFNA Phase II areas support small populations of rare plants, including the thin-leaved peavine (Fig. 5), meadow checkermallow, western geranium and bigseed biscuitroot (Table 1). Of the four species, thin-leaved peavine has the most extensive distribution, with several patches found in the understory of woodland.

Table 1. Rare plants present at HFNA (City of Corvallis 2011).

Species Name	Scientific Name	Federal Status	State Status	Locally rare	Plant Location: Phase I or Phase II Area	Habitat Type
Kincaid's lupine	*Lupinus oreganus*	T	T		Phase I	Upland prairie
Nelson's checkermallow	*Sidalcea nelsoniana*	T	T		Phase I	Wet prairie, savanna
Peacock larkspur	*Delphinium pavonaceum*	SOC	E		Phase I	Upland prairie
Thin-leaved peavine	*Lathyrus holochlorus*	SOC			Phase I and II	Upland prairie, savanna, forest, riparian forest
Meadow checkermallow	*Sidalcea campestris*		C		Phase I and II	Upland and wet prairie, savanna, riparian forest
Western geranium	*Geranium oreganum*			BC	Phase I and II	Upland prairie, savanna, forest
Bigseed biscuitroot	*Lomatium macrocarpum*			WV	Phase II	Upland grassland
Nineleaf biscuitroot	*Lomatium triternatum*			WV	Phase I	Upland prairie

Key: SOC = Species of Concern, C = Candidate, BC = rare in Benton County, WV = rare on Willamette Valley floor.
Federal Status (http://www.fws.gov/oregonfwo/Documents/OregonSpeciesStateList.pdf);
State Status http://www.oregon.gov/ODA/PLANT/CONSERVATION/Pages/statelist.aspx)

1.4.1 Sensitive Wildlife

Multiple rare and sensitive birds, reptiles and amphibian species have been documented at HFNA (Pacific Wildlife Research 2007), and many of these are Conservation Strategy Species (ODFW 2016, Table 2). Of 61 bird species recorded at HFNA over the entire site, six have special conservation status (Table 2). Principal among these is the streaked horned lark (Fig. 6), which was federally listed as threatened in 2013 due to its declining numbers and shrinking range. It has been recorded nesting along Herbert Avenue (Pacific Wildlife Research 2007, City of Corvallis 2011), and another favored area in the past was a seasonally inundated swale in the eastern part of the property (R. Moore, Oregon State

University, pers. comm. 2014). Streaked horned larks were attracted to the Phase I restoration field in 2014 and 2015 (Altman 2015, IAE 2015) and a Phase II restoration field in 2016 (IAE 2016, Moore 2016).

Figure 5. Thin-leaved peavine.

Figure 6. Streaked horned lark (photo by Randy Moore)

Western pond turtles have been observed in Matt Creek, and Northern red-legged frogs in the wet prairie near Muddy Creek. Potential habitat for many other sensitive species is present. Enhancement, restoration and expansion of riparian, wet prairie, upland prairie/oak savanna and oak woodland may be able to attract an even greater diversity of uncommon wildlife.

Two federally threatened fish species occur in rivers adjacent to HFNA (City of Corvallis 2011; Oregon Biodiversity Information Center; Stream Net: www.streamnet.org):

- Chinook salmon (*Oncorhynchus tschawytscha*; spring run) utilizes Marys River and Muddy Creek for migration and rearing.
- Steelhead (*Oncorhynchus mykiss*; winter run) utilizes Marys River for migration and rearing.

Other fish occupying the rivers include coho salmon (*Oncorhynchus kisutch*) and cutthroat trout (*Oncorhynchus clarkia*).

Table 2. Sensitive wildlife either present or potentially present (shaded grey) at HFNA (Pacific Wildlife Research 2007, Bob Altman, pers. comm., 2016).

Species Name	Scientific Name	Federal Status	State Status	Conservation Strategy Species (OR)	Habitat Type
Band-tailed pigeon	*Patagioenas fasciata*	Species of Concern		Yes	Mineral sites, mixed forests.
Chipping Sparrow	*Spizella passerina*			Yes	Open oak woodlands, savanna.
Grasshopper sparrow	*Ammodramus savannarum*		SV	Yes	Dry grassland with low to moderate height and low shrub cover.
Northern red-legged frog	*Rana aurora aurora*	Species of Concern	SV	Yes	Wetlands, ponds.
Olive-sided flycatcher	*Contopus cooperi*	Species of Concern	SV	Yes	A passage migrant, visiting forest edges and openings such as meadows and ponds.
Pileated woodpecker	*Dryocopus pileatus*		SV	Yes	Large trees. (Evidence of excavations seen).
Slender-billed nuthatch	*Sitta carolinensis aculeata*		SV	Yes	Large diameter open site oaks. Cavity nester.
Streaked horned lark	*Eremophila alpestris strigata*	Threatened	SC	Yes	Large, open, treeless grasslands.
Western pond turtle	*Actinemys marmorata*	Species of Concern	SC	Yes	Water, riparian, upland for nesting.
Willow flycatcher	*Empidonax trailii adastus*	Species of Concern	SV	Yes	Riparian and upland shrub areas, nests close to ground in shrub thickets.
Yellow-breasted chat	*Icteria virens*	Species of Concern	SC	Yes	Shrubby riparian areas, wetlands, forest edges, burned areas.
Acorn woodpecker	*Melanerpes formicivorus*	Species of Concern	SV	Yes	Oak woodlands, snags, high canopy.
Oregon vesper sparrow	*Pooecetes gramineus affinis*	Species of Concern	SC	Yes	Herbaceous layer with tall shrubs or small trees. Ground nester.
Western bluebird	*Sialia mexicana*		SV	Yes	Open canopy woodlands, pastures. Cavity nester.
Western gray Squirrel	*Sciurus griseus*		SV	Yes	Closed canopy woodlands.
Western meadowlark	*Sturnella neglecta*		SC	Yes	Prairie-type habitats. Ground nester.

Key: SV= Sensitive Vulnerable, SC= Sensitive Critical.
Federal Status (http://www.fws.gov/oregonfwo/Documents/OregonSpeciesStateList.pdf),
State Status (http://www.dfw.state.or.us/wildlife/diversity/species/sensitive_species.asp)

2 Phase II Current habitats

Habitat types currently present at HFNA within the Phase I and Phase II restoration areas are shown in Fig. 7 and Table 3 and illustrated in Figs 8-25. Habitats are categorized by a combination of type and land use. Descriptions of the current conditions in the Phase II restoration area are included below.

Table 3. Habitat types currently present at Herbert Farm and Natural Area.

Current Habitat	Phase I (acres)	Phase II (acres)	Total
Agriculture	0	**82.5**	82.5
Streaked horned lark experiment	0	**1.1**	1.1
Riparian restoration	0	**4.1**	4.1
Prairie restoration	0	**23.7**	23.7
Upland prairie/grassland	38.7	**5.1**	43.8
Wet prairie/grassland	2.2	**1.1**	3.3
Riparian forest	38.9	**4.1**	43
Riparian scrub/shrub	0	**1.5**	1.5
Fir-dominated woodland	2.0	**6.1**	8.1
Oak woodland	1.9	**0**	1.9
Parking/access	0	**1**	1
Total acres:	83.7	**130.3**	214

2.1 Agriculture

A total of 82.5 acres of the property are farmed by an agreement between a farmer and the City, and currently the crop is annual ryegrass (*Lolium multiflorum*) (Fig. 8). A few wet swales meander through the field and hold water during the winter and spring (Fig. 9).

2.2 Streaked horned lark habitat experiment

A 1.1 acre marginal strip (600 m x 6 m) of farmland adjacent to Herbert Avenue and the eastern property boundary is currently the location for an experiment comparing three treatments (combinations of herbicide, mowing and disking) for creating streaked horned lark habitat (Figs 7, 10). The experiment began in fall of 2015 and will run through 2017, with probable extension for two further years.

2.3 Riparian restoration

An isolated 4.1 acre field was taken out of agricultural production several years ago and was left fallow (Fig. 11). There were residual agricultural species (tall fescue (*Schedonorus arundinaceus*) and annual ryegrass) in this area, but the area was dominated by weedy non-native forb species, including dandelions (*Taraxacum officinale*), Canada thistle (*Cirsium arvense*), tansy ragwort (*Jacobaea vulgaris*),

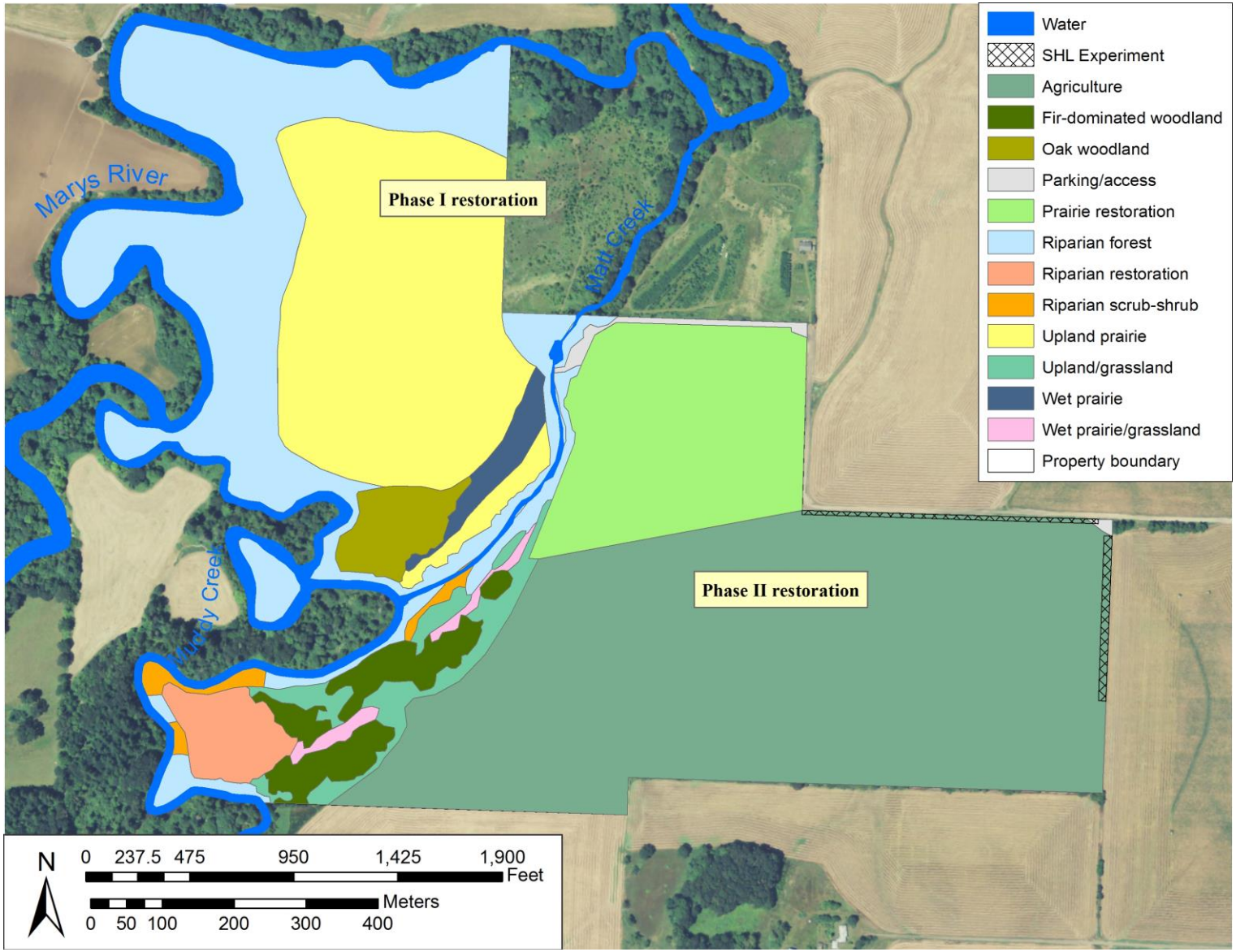

Figure 7. Current habitats at Herbert Farm and Natural Area (updated from City of Corvallis 2011: Map 2.10 and IAE 2013a: Fig. 5).

sow thistle (*Sonchus oleraceus*), prickly lettuce (*Lactuca serriola*), oxeye daisy (*Leucanthemum vulgare*), and non-native grasses, such as velvet grass (*Holcus lanatus*), tall oatgrass (*Arrhenatherum elatius*) and meadow foxtail (*Alopecurus pratensis*). A few false brome (*Brachypodium sylvaticum*) plants were noted in 2015. Several burn piles are spread through the field (Fig. 12). Herbicide treatments occurred in 2015 and 2016 and native grass seed was broadcast in fall of 2016 in preparation for planting of riparian trees and shrubs in winter 2017.

2.4 Prairie restoration

A total of 23.7 acres of previously farmed ryegrass field was taken out of production in 2014 and periodically sprayed with herbicide from fall 2014 through 2016 in preparation for planting (Fig. 13). A potentially long-term way of creating bare ground and sparse vegetation, which is favored by streaked horned larks, is by extending the amount of time in the spring that swales are flooded. Two swales cross the area and two other swales cross the agriculture field (Figs 7, 14). A project was proposed in 2015 to flood the swales by creating 6-12 inch (15-30 cm) berms to create an additional 7 acres of seasonally inundated wetland (Fig. 14, Richardson and Moore 2015). Permits and permissions were obtained in 2016 and two berms were constructed by USFWS Partners for Fish and Wildlife Program in October 2016 (Fig. 15). Construction of the two remaining berms in the agriculture field is planned for fall 2017.

Grasses and forbs were sown in October 2016 and native bulbs and divisions were planted in November 2016. In order to create more favorable habitat for streaked horned larks, a mosaic of bare ground and low stature vegetation was formed by not sowing four acres, and sowing low stature wet prairie and low stature upland prairie species over about 9 acres of the 23.7 acre area. The remaining 10.7 acres was sown with a more standard upland prairie mix (Fig. 16).

2.5 Upland prairie/grassland

Currently there are 5.1 acres of upland prairie/grassland. This includes a grassland border, between the currently farmed field and woodland, which is mowed annually by the City. Most of the remaining grassland lies between woodland patches (Fig. 17) and is dominated by non-native grasses, such as meadow foxtail, annual ryegrass, but includes a variety of native grasses and forbs, such as large camas (*Camassia leichtlinii*) (Fig. 18) and Oregon iris (*Iris tenax*). Oregon yampah (*Perideridia oregana*), Oregon fawn lily (*Erythronium oregonum*), Tolmie star-tulip (*Calochortus tolmiei*) and meadow checkermallow are present. Reed canarygrass (*Phalaris arundinacea*) dominates some grassy patches close to the waterways and wet prairie swales. Some grassland has not been mowed in recent years, resulting in encroachment by shrubby vegetation, such as Nootka rose (*Rosa nutkana*), common snowberry (*Symphoricarpos albus*), English hawthorn (*Crataegus monogyna*) and trailing blackberry (*Rubus ursinus*).

2.6 Wet prairie/grassland

Approximately 1.1 acres of wet prairie swales run parallel to Muddy and Matt Creeks. The largest swale is dominated by reed canarygrass (Fig. 19). Other swales also are vegetated by introduced grasses, such as meadow foxtail, but also include sedges (*Carex sp.*) and buttercups (*Ranunculus sp.*). Broadleaf weeds include Armenian blackberry (*Rubus armeniacus*), curly dock (*Rumex crispus*), vetch (*Vicia spp.*) and wild onion (*Allium spp.*).

2.7 Riparian forest

There are 4.1 acres of riparian forest interspersed with scrub-shrub in a thin margin bordering the Muddy Creek and Matt Creek waterways (Fig. 20). Tree species include Oregon white oak, Oregon ash, bigleaf maple and Douglas-fir, as well as a few Pacific yew trees (*Taxus brevifolia*).

2.8 Riparian scrub-shrub

Approximately 1.5 acres of scrub-shrub occurs within the thin riparian margin bordering the Muddy Creek and Matt Creek waterways (Fig. 20), and includes willows (*Salix* sp.), common snowberry, Nootka rose, Pacific ninebark (*Physocarpus capitatus*), poison oak (*Toxicodendron diversilobum*), thimbleberry (*Rubus parviflorus*) and salmonberry (*Rubus spectabilis*). Some zones are predominantly vegetated by native species and others by non-natives, such as Armenian blackberry (Fig. 21). Open areas in the riparian margin are dominated by reed canarygrass and stinging nettle (*Urtica dioica*). Additional invasive exotic species include English holly (*Ilex aquifolium*), spurge laurel (*Daphne laureola*), sweet cherry (*Prunus avium*), domestic plum (*Prunus* spp.), English hawthorn and Canada thistle.

2.9 Fir-dominated woodland

There are 6.1 acres of fir-dominated woodlands near Muddy Creek and Matt Creek. Tree species include Oregon white oak (Fig. 22) and Douglas-fir. Many old-growth oaks are being over-topped by the fir (Fig. 23) and some groves are almost entirely Douglas-fir (Fig. 24). The understory is primarily native shrubs, such as thimbleberry (Fig. 25) but includes Armenian blackberry. Some forest patches include the rare thin-leaved peavine.

2.10 Parking/access

Two gravel parking areas on Herbert Avenue provide access to the public. The first parking area, at the eastern end of the property, has a kiosk with general information for the public. The second parking area is at the end of the avenue (Fig. 2). A locked gate leads to a gravel and dirt road which extends to the ford across a culvert on Matt Creek (Fig. 7), providing access for management purposes. There are currently no formal trails at HFNA.

Figure 8. Agricultural field planted in ryegrass at HFNA, April 2015.

Figure 9. Wet swale running through ryegrass field, April 2015.

Figure 10. Streaked horned lark experimental strip (herbicide treatment), October 2016.

Figure 11. Riparian restoration area - weedy fallow agriculture field in southwest corner of property prior to herbicide treatments, April 2015.

Figure 12. Burn pile in riparian restoration area, April 2015.

Figure 13. Prairie restoration area after spray treatment, December 2015.

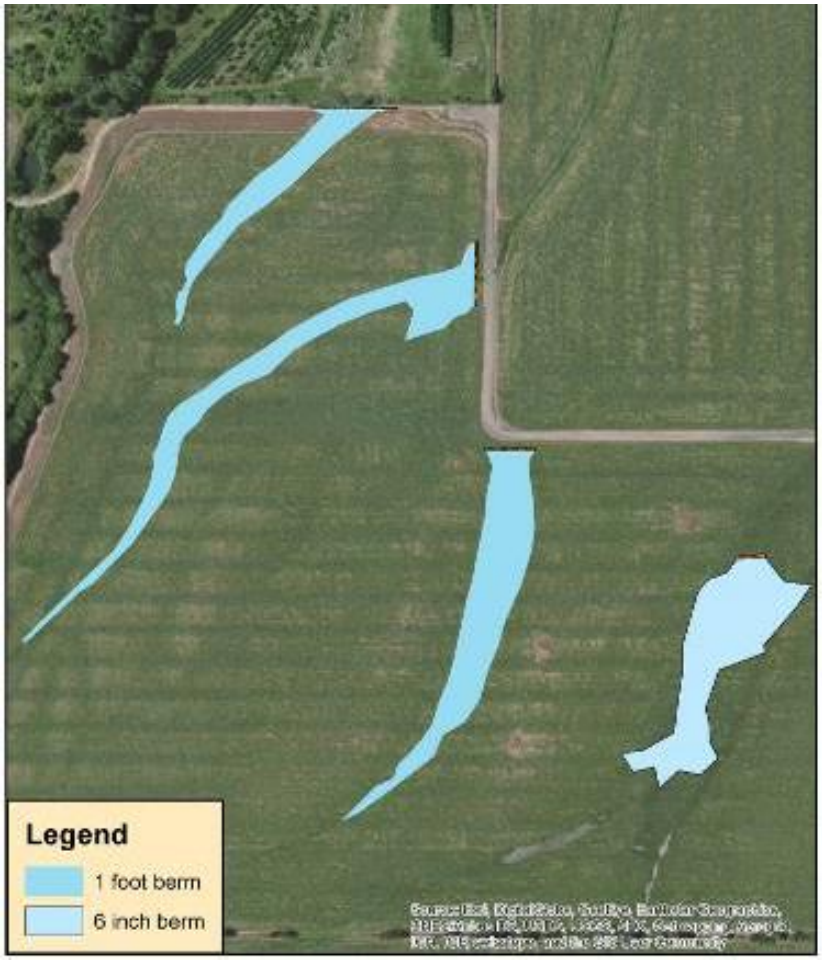

Figure 14. Projected flooding of swales resulting from construction of a four 6-12" berms (Map created by Nate Richardson, USFWS).

Figure 15. Flooded swale in and recently constructed berm in prairie site preparation area, October 2016.

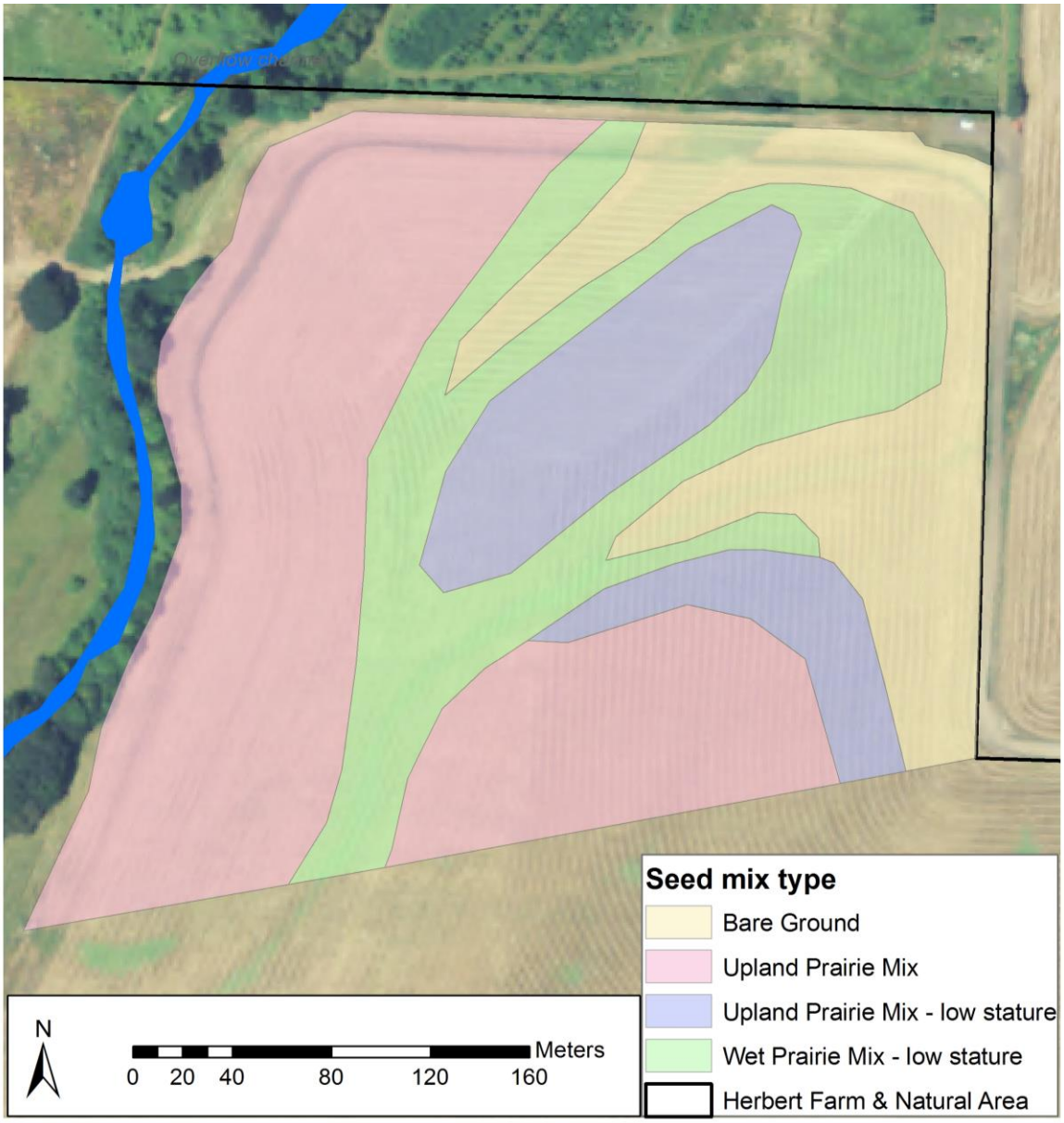

Figure 16. Seed mix types sown in the 24 acre prairie restoration area in 2016.

Figure 17. Upland prairie/grassland amongst fir and oak woodland, April 2015.

Figure 18. Tall camas in upland prairie/grassland, April 2015.

Figure 19. Wet prairie swale dominated by reed canarygrass, April 2015.

Figure 20. Riparian tree and shrub margin between Matt Creek and upland grassland, April 2015.

Figure 21. Blackberry scrub-shrub in riparian margin of Muddy Creek, April 2015.

Figure 22. Oak trees being encroached and over-topped by Douglas-fir, April 2015.

Figure 23. Encroachment of oaks by Douglas-fir.

Figure 24. Douglas-fir-dominated woodland, April 2015.

Figure 25. Thimbleberry in woodland understory.

3 Restoration Strategies by Habitat Type

Phase II of restoration at HFNA will focus on restoring current habitats to four main habitat types: upland prairie, wet prairie, riparian forest and oak woodland (Table 4, Figs. 26 and 27). These broad habitat types follow what is indicated by historical vegetation (Fig. 3) and soil patterns (Fig. 4), as outlined in the Management Plan (City of Corvallis, p. 42-49, Maps 3.2-3.4) and the Phase I Restoration Plan (IAE 2013a). The strategy for achieving the desired restored habitats is an combination of guidance from the Management Plan, successful strategies utilized in the Phase I Restoration Plan (IAE 2013a), and experience from IAE restoration ecologists, other restoration colleagues and partners involved in projects at HFNA.

A focus of the Phase II restoration is to create improved opportunities for streaked horned lark, particularly in upland and wet prairie areas that are associated with an open landscape. HFNA is a known occupied site for streaked horned larks, and its location is within one mile of Oregon's largest population, at the Corvallis airport. Most occupied sites in the Willamette Valley are >100 acres in size, relatively flat, have no trees or buildings interrupting the landscape, and have large habitat patches dominated by short-stature grasses, forbs and bare ground (Anderson & Pearson 2015). Up to 107.3 acres of open landscape occurs in Phase II areas, including 82.5 acres of agriculture, 23.7 acres of prairie restoration and 1.1 acres of streaked horned lark experiment (Table 3).

Restoration of a Phase I areas at HFNA temporarily created bare ground and sparse vegetation which attracted streaked horned larks in 2014-15 (Altman 2015, IAE 2015). One unbanded pair was observed in June-July 2014 in the 37 acre upland prairie west of Matt Creek (Phase I, Fig. 7). A pair of birds, including a male banded as a nestling at Corvallis airport in 2012, was present in the same area in July-August 2015 (Altman 2015, IAE 2015). No larks were observed in this prairie in 2016 due to native vegetation becoming more established and dense. Herbicide applications created sparse vegetation in the 23.7 acre prairie restoration area east of Matt Creek (Phase II) and 5-6 individual birds, including one territorial pair, were present in spring 2016 before moving to newly available habitat adjacent to the airport (IAE 2016, Moore 2016).

Restoration of over 100 acres of prairie, within the context of an open farmed landscape, will increase the opportunities for streaked horned larks to establish territories at HFNA. Creating a mosaic of habitat structure (e.g., varying vegetation density and height) should also attract other grassland birds, such as Western meadowlark, Oregon vesper sparrow and grasshopper sparrow, which have different habitat requirements.

Integrated Pest Management (IPM) techniques will include use of herbicides and non-chemical methods, such as mowing, disking and burning. Restoration and management actions will follow guidelines and restrictions outlined in the USFWS PROJECTS Biological Opinion (USFWS 2015) and will require environmental compliance authorization through BPA and the WWMP.

Table 4. Future habitat types at Herbert Farm and Natural Area.

Future Habitat	Phase I (acres)	Phase II (acres)	Total
Upland prairie – open landscape	36.9	**61.7**	99.0
Wet prairie – open landscape		**45.6**	46.0
Upland prairie – woodland/savanna	1.8	**5.1**	7.0
Wet prairie – woodland/savanna	2.2	**1.1**	3.0
Riparian forest	38.9	**9.7**	49.0
Oak Woodland	3.9	**6.1**	10.0
Parking/access	0	**1.0**	1.0
Total acres:	83.7	**130.3**	214.0

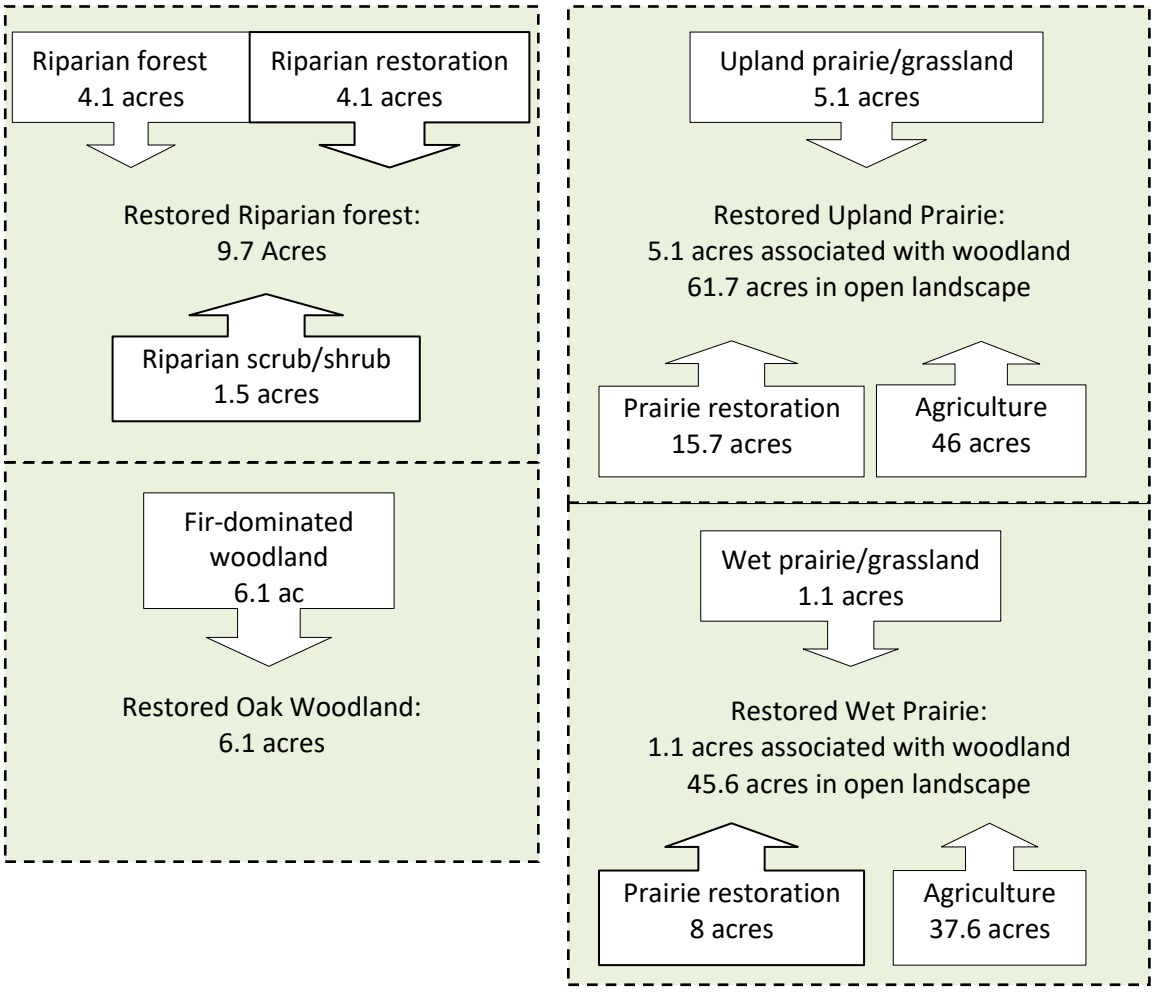

Figure 26. Components and acreages of current habitats that will be restored to target habitats in the Phase II area of HFNA.

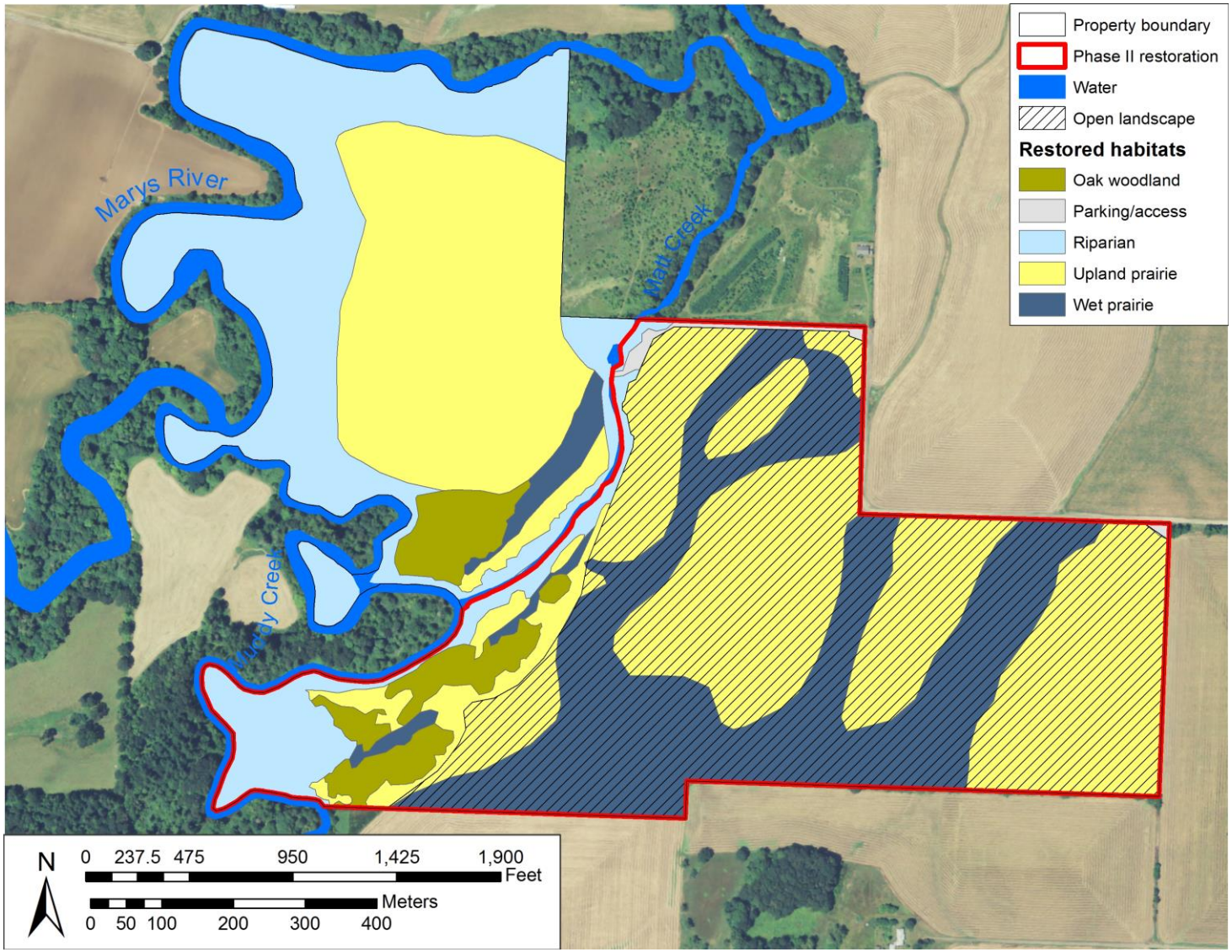

Figure 27. Desired future conditions at Herbert Farm & Natural Area (adapted from City of Corvallis: maps 3.2-3.4, and IAE 2013b: Fig. 14). Note the areas of upland and wet prairie that are associated with an open landscape, and the areas of upland and wet prairie associated with the oak woodland landscape.

3.1 Upland and wet prairie associated with open landscape

Restoration over time will convert current and former agricultural field into approximately 45.6 acres of native wet prairie and 61.7 acres of native upland prairie (Table 4, Figs 26-27).

There will be emphasis on creating nesting and foraging habitat for streaked horned larks in the open prairie landscape. These zones incorporate 82.5 acres of currently farmed agriculture field and 23.7 acres of previously farmed field in which restoration began in late 2014 (Figs 2, 7, 13). The area also includes the 1.1 acre streaked horned lark habitat creation experimental area alongside Herbert Avenue (Figs 2, 7; IAE 2015, 2016). A patchwork of bare ground and sparse vegetation will be encouraged across about 50% of the restoration area, particularly in wet prairie swales, by not seeding some areas, choosing appropriate native plant species and seeding rates, and using a variety and/or combination of disturbance techniques, such as herbicide treatments, flooding of swales, mowing, disking and burning. Grazing could also be considered to maintain a low stature. Less desirable methods, due to cost and potential effects on cultural resources, include sod removal, or addition of soil, gravel or mulch. However, adding inert substrate may be an important way of creating focal points of attraction for larks (B. Kronland, Center for Natural Land Management, pers. comm. 2016).

Prairie vegetation will also create habitat for other more common grassland birds, such as savanna sparrows (*Passerculus sandwichensis*). Since open treeless landscape may be less suitable for attracting Western meadowlark and Oregon vesper sparrow, some shrub perches will be made available in the southern margins of the property. Other wildlife, such as Western pond turtle, may benefit from increased nesting opportunities in the restored prairie. Native pollinators will benefit from the increased diversity and abundance of flowering native forbs.

3.1.0 Desired future conditions

A mosaic of open upland and wet prairie habitat (see approximate configuration in Fig. 27) will be comprised of patches or strips of sparse grassland vegetation less than 15 cm in height, with bare ground comprising at least 17-31% (and up to 50%) of the habitat within the patches. Patches will comprise about 50% of the restoration area (wet and upland prairie combined). Bare ground will occur along wet swales and adjacent to roads, grading into low stature wet prairie vegetation community (before transitioning further upslope to low stature upland prairie vegetation) (Fig. 16).

Planted species on the margins of wet prairie swales will include low stature species such as smallflower lupine(*Lupinus polycarpus*), common monkeyflower (*Mimulus guttatus*), curvepod yellowcress (*Rorippa curvisliqua*), toad rush (*Juncus bufonius*), water foxtail (*Alopecurus geniculatus*) and common spikerush (*Eleocharis palustris*) (Table 5), and California oatgrass will provide a transition from wet to upland prairie. Sparse and/or short vegetation will also develop from natural recruitment of native species (e.g., cudweed *Gnaphalium spp.*).

Low stature upland prairie habitats will include common lomatium (*Lomatium utriculatum*), slender phlox (*Microsteris gracilis*), dwarf checkermallow (*Sidalcea malviflora subsp. virgata*), splitawn sedge (*Carex tumulicola*), and Roemer's fescue (Table 6). This will grade upslope to more standard upland prairie habitat, which will be seeded at higher rates than the low stature vegetation, and include perennial forbs such as common yarrow (*Achillea millefolium*), common woolly sunflower (*Eriophyllum lanatum*), and slender cinquefoil (*Potentilla gracilis*), annuals such as farewell to spring (*Clarkia amoena*), grassy tarweed (*Madia gracilis*) and shortspur seablush (*Plectritis congest*a), and dominated by grasses, including Roemer's fescue, California oatgrass, blue wildrye (*Elymus* glaucus) and meadow

barley (*Hordeum brachyantherum*) (Tables 7 and 8). Some zones, will initially utilize a mix of Roemer's fescue, woodrush (*Luzula comosa*), sedges, such as splitawn sedge and rushes, such as Western rush (*Juncus occidentalis*) (Table 7), prior to introducing other native grasses (Table 8), since these species are resistant to grass-specific herbicides which could be used for a further control of invasive grasses. Some zones may include forbs but no grasses and others may include grasses but no forbs to facilitate different weed control and management strategies.

Considerations: The successful methods of creating streaked horned lark habitat in the experimental area and the current prairie restoration area will be used to guide ongoing restoration. The combination of treatments that attracted larks, or appear to offer the most lark-friendly habitat features, will be continued. Experience from the literature, streaked horned lark experts and restoration partners will be used to refine techniques for creating lark habitat, while minimizing restoration and management costs. As noted earlier, it is likely that ongoing disturbance will be required to maintain lark-friendly habitat.

Grasses can out-compete forbs during the establishment phase, so it may be desirable to delay planting most grasses for the first year (or possibly two), in order to give forbs a competitive advantage. Creating bare ground and sparse vegetation will create a management challenge, since soils are fertile, and space is likely to be invaded by non-native weeds. Roemer's fescue is slow to establish and is resistant to grass-specific herbicides, so planting that species in combination with sedges and rushes allows at least one further year of control of agricultural and weedy grasses with broadcast of chemicals such as clethodim. Phase I restoration prairies were quickly invaded by prickly lettuce, sow thistle and stinking chamomile (*Anthemis cotula*) where native forbs were slow to establish. Since these species are members of the Asteraceae family, which can be controlled with clopyralid herbicide, the sowing of native asters (e.g., *Eriophyllum* and *Madia* sp.) and Fabaceae (e.g., *Lupinus* and *Lotus* sp.) can be delayed for at least one year to allow broadcast herbicide treatments of clopyralid to be conducted.

3.1.1 Goals and objectives for open landscape prairie restoration

Goal 1: Restore prairie vegetation associated with open landscape to provide habitat for native Willamette Valley wildlife, particularly streaked horned lark, while contributing to the biodiversity and functionality of the watershed.

Objective 1: Investigate how to create streaked horned lark habitat using three combinations of herbicide, disking or mowing on six 100 m x 6 m experimental strips along Herbert Avenue during 2017-19.

- Years 1-3 (2017-19, following work already conducted in 2015-16)
    - Two herbicide (glyphosate) treatments – spring and fall (annually).
    - Combination of herbicide in spring and disking in fall (annually).
    - Combination of mowing in spring and disking twice in fall (annually).
    - Monitor population response of larks in experimental area as well as all other restoration areas at HFNA.

Objective 2: Construct berms in 2017 across two swales in the agriculture field to hold water through winter and spring to provide bare ground and sparsely vegetated habitat for streaked horned larks during spring and summer.

- Year 1 (2017)
    - (Spring-Fall) Notify farmer of proposed actions in spring, coordinate farming and construction timetable and modify the next year's farm agreement.
    - (Summer) Farmer harvests crop.

    - (Summer) USFWS Partners for Fish and Wildlife Program construct one 6 inch (15 cm) berm and one 12 inch (30 cm) berm prior to farmer sowing new crop.
    - (Summer) Excavate 6-12 inches depth of soil from areas designated for soil removal. Work to be conducted by USFWS Partners for Fish and Wildlife Program.
    - (Summer) Create berms that are 25-40 feet (8-12 m) wide and 6-12 inches (15-30 cm) high.
    - (Summer) Farmer sows a new crop if farming is continuing.
    - (Fall) Sow seed on berms.
- Year 2-7 (2018-2023)
    - Continue farming across swales and berms, or shift to restoration phase (Objective 4).
    - Monitor use of swale habitat by streaked horned larks.

Objective 3: Continue to restore 23.7 acres of former agricultural field to 8 acres of wet prairie (including 2 acres bare ground and 6 acres low stature vegetation) and 15.7 acres upland prairie (including 2 acres bare ground, 3 acres low stature and 10.7 acres of standard vegetation) during 2017-23, increasing the abundance and diversity of native plant species to support grassland birds.

- Year 1 (2017; 2 years of restoration have already been completed)
    - (Spring-summer) Broadcast glyphosate in bare ground areas.
    - (Summer-fall) Spot spray broadleaf weeds and ryegrass.
    - (Fall) Broadcast grass-specific herbicide.
    - (Fall) Sow supplementary forb and grass seed in selected zones (select species from Tables 5-8).
    - (Fall) Plant plugs, bulbs, bare-root and divisions of native forbs (Table 9).
- Year 2 (2018)
    - (Spring-fall) Broadcast glyphosate or grass-specific herbicide in bare ground areas and other selected zones (x 2 treatments).
    - (Summer-fall) Spot spray broadleaf weeds and ryegrass (x 2 treatments).
    - (Fall) Mow vegetated zones.
- Years 3-4 (2019-20)
    - (Spring-fall) Broadcast glyphosate or grass-specific herbicide in bare ground areas and other selected zones to maintain sparse and low stature vegetation (x 1 treatment).
    - (Summer-fall) Spot spray broadleaf weeds (timing and frequency as needed for different problem weed species).
    - (Fall) Mow vegetated zones. Disk selected zones to suppress vegetation growth
- Years 5-7 (2021-23)
    - (Summer-fall) Spot spray broadleaf weeds (timing and frequency as needed for different problem weed species).
    - (Fall) Create bare ground and suppress vegetation with other techniques, such as prescribed fire or grazing.

Objective 4: Convert up to 82.5 acres of agricultural field to 37.6 acres wet prairie (including 9.4 acres bare ground and 28.2 acres low stature vegetation) and 46 acres upland prairie (including 5.8 acres bare ground, 8.6 acres low stature and 31.6 acres standard vegetation), increasing the abundance and diversity of native plant species to support grassland birds. Select a smaller project area depending on funding availability.

- Year 1 (starting year depending on available funding)

    - (Winter-spring) Coordinate with farmer for phasing out of farming within restored zones.
    - (Summer) Farmer harvests crop and ends the farming agreement with the City.
    - (Fall) Broadcast spray pre-emergent herbicide such as Plateau (Imazapic) to remove residual agricultural species.
- Year 2
    - (Spring) Broadcast spray a broad spectrum herbicide such as glyphosate, if needed. Additional glyphosate spray (summer) may be required.
    - (Spring) Conduct weed and vegetation community monitoring if required as a baseline for quantitatively measuring restoration success.
    - (Fall) Broadcast spray a broad spectrum and/or broadleaf herbicide, such as triclopyr.
- Year 3
    - (Spring) Broadcast spray a broad spectrum herbicide such as glyphosate, if needed, particularly in areas being maintained as bare ground. Additional glyphosate spray (summer) may be required.
    - (Fall) Broadcast spray a broad spectrum and/or broadleaf herbicide, such as triclopyr.
    - (Fall) No-till drill or broadcast a diversity of native forbs (excluding Asteraceae and Fabaceae families) and Roemer's fescue, sedges and rushes (Tables 5-7) to build in habitat resiliency and meet biodiversity goals. Create a mosaic of habitat types using a sowing pattern similar to Fig. 16.
    - (Fall) Plant selected native plugs, bulbs and divisions to encourage species that are slow to establish from seed.
- Year 4
    - (Spring-Fall) Broadcast spray a glyphosate to maintain bare ground areas, grass specific herbicide to remove residual agricultural grasses, broadcast spray clopyralid to target weedy asters, and spot spray glyphosate and/or broadleaf herbicide as needed to control other weedy forb species. If necessary, continue grass and aster control for a second year before introducing other grasses and forbs.
    - (late summer) Mow restoration area to reduce thatch if necessary.
    - (Fall) No-till drill Aster family forbs, supplementary other forbs and native grass mix (see Tables 5, 6 and 8).
    - (Fall) Plant selected native plugs, bulbs and divisions to encourage species that are slow to establish from seed.
- Years 5-7
    - (As needed) Spot spray weedy species, likely at least twice per year.
    - (Fall) No-till drill native grasses and supplementary forb mix if necessary (see Tables 5-8).
    - Repeat weed and vegetation community monitoring.
    - Utilize disturbance to create and maintain lark habitat patches. Methods include:
        - burning (ideally every two years);
        - mowing (once to twice per year in non-burn years);
        - disking;
        - grazing;
        - herbicides (periodic restart with broadcast or strip spraying).
    - Rotate treatments over the years, so as not to over-use herbicides, but periodically start from scratch to maximize sparse vegetation.

Objective 5: Provide singing perches and habitat diversity for grassland birds.

- Year 6-7. Once upland prairie habitat is established, plant shrubs at low density in areas for use as singing perches by streaked horned larks and other grassland birds (e.g., Western meadowlark), with target densities at 1-2 shrubs per acre.
- Consider thinning the trees on the southern property boundary to increase connectivity with neighboring farmland and create more isolated perches for birds.

3.1.2 Plant Materials costs

The costs for plant materials, estimated from nursery costs in 2016, are provided in Tables 5-9. Other restoration costs are summarized in Section 10 and details are provided for individual restoration tasks in Appendix 3.

Table 5. Suggested native seed mixes for the first and second year of planting in wet prairie in 28.2 acres of open landscapes at Phase II areas of HFNA. Species and seeding rates have been chosen to create low stature and sparse vegetation. Costs were estimated using 2016 seed prices from nurseries.

First year seeding

Scientific Name	Common name	Growth Form	Pounds/ acre	Pounds needed for 28.2 acres	Cost/ Pound	Cost
Mimulus guttatus	common monkeyflower	Annual forb	0.003	0.1	$ 368.00	$ 31.13
Perideridia oregana	Oregon yampah	Perennial forb	0.28	7.9	$ 240.00	$ 1,895.04
Plectritis congesta	shortspur seablush	Annual forb	0.10	2.8	$ 116.00	$ 327.12
Ranunculus orthorhynchus	straightbeak buttercup	Perennial Forb	0.92	25.9	$ 135.00	$ 3,502.44
Rorippa curvisiliqua	Curvepod yellowcress	Annual forb	0.03	0.8	$ 240.00	$ 203.04
Saxifraga oregana	Oregon saxifrage	Perennial Forb	0.03	0.8	$ 116.00	$ 98.14
Subtotal Forbs			***1.4***	***38.4***	***$ 157.58***	***$ 6,056.91***
Carex tumulicola	splitawn sedge	Perennial Sedge	0.54	15.2	$ 152.00	$ 2,314.66
Eleocharis palustris	Common spikerush	Perennial rush	0.28	7.9	$ 125.00	$ 987.00
Juncus bufonius	Toad rush	Perennial rush	0.02	0.6	$ 90.00	$ 50.76
Luzula comosa	Pacific woodrush	Perennial rush	0.09	2.5	$ 240.00	$ 609.12
Subtotal Graminoids			***0.9***	***26.2***	***$ 151.05***	***$ 3,961.54***
Grand Totals:			**2.3**	**64.7**	***$ 154.93***	**$ 10,018.44**

2nd year seeding

Scientific Name	Common name	Growth Form	Pounds/ acre	Pounds needed for 28.2 acres	Cost/ Pound	Cost
Achillea millefolium	Common yarrow	Perennial forb	0.10	2.8	$ 60.00	$ 169.20
Eriophyllum lanatum	common woolly sunflower	Perennial forb	0.10	2.8	$ 137.00	$ 386.34
Lupinus polycarpus	smallflower lupine	Annual forb	0.70	19.7	$ 128.00	$ 2,526.72
Potentilla gracilis	Slender cinquefoil	Perennial forb	0.10	2.8	$ 128.00	$ 360.96
various	Supplementary forbs		1.0	28.2	$ 157.58	$ 4,443.81
Subtotal Forbs			***2.0***	***56.4***	***$ 139.84***	***$ 7,887.03***
Alopecurus geniculatus	Water foxtail	Perennial Grass	0.39	10.998	$ 19.90	$ 218.86
Danthonia californica	California oatgrass	Perennial Grass	1.60	45.12	$ 32.50	$ 1,466.40
Total Graminoids			***2.0***	***56.1***	***$ 30.03***	***$ 1,685.26***
Grand Totals:			**4.0**	**112.5**	***$ 85.07***	**$ 9,572.29**

Table 6. Suggested native seed mixes for the first and second year of planting low stature upland prairie in 8.6 acres of open landscapes at Phase II areas of HFNA. Species and seeding rates have been chosen to create low stature and sparse vegetation. Costs were estimated using 2016 seed prices from nurseries.

First year seeding

Scientific Name	Common name	Growth Form	Pounds/ acre	Pounds needed for 8.6 acres	Cost/ Pound	Cost
Camassia quamash	Small camas	Perennial forb	0.2	1.72	$ 155.00	$ 266.60
Clarkia amoena	Farewell to spring	Annual forb	0.08	0.688	$ 90.00	$ 61.92
Collinsia grandifolia	Giant blue eyed Mary	Annual forb	0.2	6.4	$ 90.00	$ 576.00
Iris tenax	Toughleaf iris	Perennial forb	0.5	0.35	$ 158.00	$ 55.30
Lomatium utriculatum	common lomatium	Perennial forb	0.3	9.6	$ 224.00	$ 2,150.40
Microsteris gracilis	Slender phlox	Annual forb	0.2	6.4	$ 144.00	$ 921.60
Prunella vulgaris subsp. lanceolata	Lance selfheal	Perennial forb	0.2	0.3	$ 40.00	$ 12.00
Sidalcea malviflora subsp. virgata	Dwarf checkermallow	Perennial forb	0.3	0.25	$ 128.00	$ 32.00
Subtotal Forbs			***2.0***	***25.7***	***$ 158.54***	***$ 4,075.82***
Carex tumulicola	splitawn sedge	Perennial sedge	0.25	2.15	$ 152.00	$ 326.80
Festuca roemeri	Roemer's fescue	Perennial grass	1.7	14.62	$ 25.00	$ 365.50
Subtotal Graminoids			***2.0***	***16.8***	***$ 41.28***	***$ 692.30***
Grand Totals:			**3.9**	**68.2**	***$ 69.93***	**$ 4,768.12**

2nd year seeding

Scientific Name	Common name	Growth Form	Pounds/ acre	Pounds needed for 8.6 acres	Cost/ Pound	Cost
Achillea millefolium	Common yarrow	Perennial forb	0.06	0.516	$ 60.00	$ 30.96
Eriophyllum lanatum	common woolly sunflower	Perennial forb	0.07	0.15	$ 137.00	$ 20.55
various	Supplementary forbs		2.0	17.2	$ 158.54	$ 2,726.94
Subtotal Forbs			***2.1***	***17.9***	***$ 155.52***	***$ 2,778.45***
Danthonia californica	California oatgrass	Perennial grass	1.5	12.9	$ 32.50	$ 419.25
Hordeum brachyantherum	Meadow barley	Perennial grass	1.5	12.9	$ 13.50	$ 174.15
Subtotal Grasses			***3.0***	***25.8***	***$ 23.00***	***$ 593.40***
Grand Totals:			**5.1**	**60.866**	***$ 55.40***	**$ 3,371.85**

Table 7. Suggested native seed mixes for the first year of planting standard upland prairie in 31.6 acres of open landscapes at Phase II areas of HFNA. Species and seeding rates have been chosen to create more dense vegetation than in Table 5. Costs were estimated using 2016 seed prices from nurseries.

First year seeding						
Scientific Name	**Common name**	**Growth Form**	**Pounds/ acre**	**Pounds needed for 31.6 acres**	**Cost/ Pound**	**Cost**
Camassia leichtlinii	Large camas	Perennial forb	0.25	7.9	$ 130.00	$ 1,027.00
Clarkia amoena	Farewell to spring	Annual forb	0.20	6.32	$ 90.00	$ 568.80
Collinsia grandiflora	Giant blue eyed Mary	Annual forb	0.20	6.32	$ 90.00	$ 568.80
Collomia grandiflora	Grand collomia	Annual forb	0.50	15.8	$ 74.00	$ 1,169.20
Geum macrophyllum	large-leaved avens	Perennial forb	0.10	3.16	$ 100.00	$ 316.00
Gilia capitata	bluehead gilia	Annual forb	0.05	1.58	$ 74.00	$ 116.92
Iris tenax	Toughleaf iris	Perennial forb	0.50	15.8	$ 158.00	$ 2,496.40
Lomatium nudicaule	barestem biscuitroot	Perennial forb	0.30	9.48	$ 160.00	$ 1,516.80
Plectritis congesta	shortspur seablush	Annual forb	0.05	1.58	$ 116.00	$ 183.28
Potentilla gracilis	Slender cinquefoil	Perennial forb	0.30	9.48	$ 128.00	$ 1,213.44
Prunella vulgaris subsp. lanceolata	Lance selfheal	Perennial forb	1.00	31.6	$ 40.00	$ 1,264.00
Ranunculus occidentalis	Western buttercup	Perennial forb	0.50	15.8	$ 125.00	$ 1,975.00
Sidalcea malviflora subsp. virgata	Dwarf checkermallow	Perennial forb	0.70	22.12	$ 128.00	$ 2,831.36
Subtotal Forbs			***4.7***	***146.9***	***$ 103.76***	***$ 15,247.00***
Carex tumulicola	splitawn sedge	Perennial sedge	0.25	7.9	$ 152.00	$ 1,200.80
Festuca roemeri	Roemer's fescue	Perennial grass	5.00	158	$ 25.00	$ 3,950.00
Juncus occidentalis	Western rush	Perennial rush	0.004	0.1264	$ 130.00	$ 16.43
Luzula comosa	Pacific woodrush	Perennial rush	0.050	1.58	$ 240.00	$ 379.20
Subtotal Graminoids			***5.3***	***167.6***	***$ 33.09***	***$ 5,546.43***
Grand Totals:			**10.0**	**461.5**	***$ 45.06***	**$ 20,793.43**

Table 8. Suggested native seed mixes for the second year of planting standard upland prairie in 32 acres of open landscapes at Phase II areas of HFNA. Species and seeding rates have been chosen to create more dense vegetation than in Table 5. Costs were estimated using 2016 seed prices from nurseries.

2nd year seeding						
Scientific Name	**Common name**	**Growth Form**	**Pounds/ acre**	**Pounds needed for 31.6 acres**	**Cost/ Pound**	**Cost**
Achillea millefolium	Common yarrow	Perennial forb	0.30	9.48	$ 60.00	$ 568.80
Eriophyllum lanatum	common woolly sunflower	Perennial forb	0.50	15.8	$ 137.00	$ 2,164.60
Lotus unifoliolatus	American bird's-foot trefoil	Annual forb	0.50	15.8	$ 40.00	$ 632.00
Lupinus rivularis	River lupine	Perennial forb	0.50	15.8	$ 128.00	$ 2,022.40
Madia gracilis	grassy tarweed	Annual forb	0.50	15.8	$ 147.00	$ 2,322.60
Wyethia angustifolia	narrowleaf mule's ears	Perennial forb	0.25	7.9	$ 190.00	$ 1,501.00
various	Supplementary forbs		1.5	47.4	$ 103.76	$ 4,918.39
Subtotal Forbs			***4.1***	***128.0***	***$ 110.41***	***$ 14,129.79***
Agrostis exarata	Spike bentgrass	Perennial grass	0.05	1.58	$ 23.50	$ 37.13
Bromus carinatus	California brome	Perennial grass	0.60	18.96	$ 6.90	$ 130.82
Bromus sitchensis	Alaska brome	Perennial grass	0.60	18.96	$ 6.90	$ 130.82
Danthonia californica	California oatgrass	Perennial grass	3.10	97.96	$ 32.50	$ 3,183.70
Hordeum brachyantherum	Meadow barley	Perennial grass	1.00	31.6	$ 13.50	$ 426.60
Elymus glaucus	Blue wildrye	Perennial grass	1.00	31.6	$ 12.00	$ 379.20
Subtotal Grasses			***6.35***	***200.66***	***$ 21.37***	***$ 4,288.28***
Grand Totals:			**10.4**	**376.04**	***$ 48.98***	**$ 18,418.07**

Table 9. Suggested species for planting as bulbs or bare rooted plants in wet or native prairie at HFNA. Cost per medium sized plant averaged $0.69 in 2016.

Scientific Name	Common name	Type	Habitat
Allium acuminatum	Tapertip onion	bulb	upland
Allium amplectens	Narrowleaf onion	bulb	wet, upland
Brodiaea elegans	Harvest brodiaea	bulb	upland
Calochortus tolmiei	Tolmie star-tulip	bulb	upland
Camassia quamash	Small camas	bulb	wet, upland
Camassia leichtlinii	Large camas	bulb	wet, upland
Dichelostemma congestum	Ookow	bulb	upland
Fragaria virginiana	wild strawberry	bareroot	upland
Geranium oreganum	Oregon geranium	crown	upland
Iris tenax	Toughleaf iris	bareroot	upland
Juncus effusus	Common rush	bareroot	wet
Juncus patens	Spreading rush	bareroot	wet
Lomatium nudicaule	barestem biscuitrot	tuber	upland
Sidalcea malviflora subsp. virgata	Dwarf checkermallow	crown	upland
Triteleia hyacinthina	White brodiaea	bulb	wet, upland
Wyethia angustifolia	California compassplant	crown	upland

3.2 Upland and wet prairie understory associated with woodland/savanna landscape

Restoration will enhance 1.1 acres of wet prairie swale and 5.1 acres of upland prairie/grassland adjacent to Muddy and Matt Creeks.

3.2.0 Desired future conditions

Wet prairie swales dominated by native grasses such as tufted hairgrass, and native forbs, including elegant calicoflower and fragrant popcornflower (Tables 10-11). Upland prairie dominated by Roemer's fescue, California oatgrass and native forbs, including Oregon iris, slender cinquefoil, Oregon sunshine, Oregon geranium, and dwarf checkermallow (Table 12). Prairie will provide high quality nesting and rearing habitat for birds and other wildlife dependent on savanna and forest openings.

3.2.1 Goals and objectives for prairie understory restoration

Goal 1: Restore wet prairie and upland prairie associated with woodland landscapes to provide habitat for native Willamette Valley wildlife, including insect pollinators and grassland birds, while contributing to the biodiversity and functionality of the watershed.

Objective 1: Increase the abundance and diversity of native plant species in wet prairie swales (1.1 acre) and upland prairie (5.1 acres) associated with woodlands, while decreasing prevalence of non-native plants.

- Year 1 & 2 (starting year depending on available funding)
    - (Spring) Broadcast grass-specific herbicide to control the dominant stands of introduced grasses, such as reed canarygrass.
    - (Summer) Spot spray or mechanically remove blackberry.
    - (Fall) Spray blackberry with triclopyr, or similar broadleaf herbicide within stream protection and Integrated Pest Management guidelines, with care to avoid sensitive plants.
    - (Fall) Reduce competition from existing non-native plant species and woody shrubs through mowing.
        - Mowing should occur late enough (after August 1) so as not to damage potential Western pond turtle or grassland bird nesting sites.
        - Do not mow in Year 2 if a prescribed burn is planned in the following year.
- Year 3
    - (Spring) Broadcast grass-specific herbicide.
    - (Spring-fall) Spot spray broadleaf weeds and shrubs.
    - (Summer) Broadcast grass-specific herbicide.
    - (Late summer) Prescribed burn in existing upland prairie.
    - (Fall) broadcast glyphosate two weeks after burn.
    - (Fall) No-till drill or broadcast native forb and graminoid mix (Tables 10, 12).
- Year 4
    - (Spring) Broadcast grass-specific herbicide.
    - (Spring-fall) Spot spray broadleaf weeds and shrubs.
    - (Fall) Broadcast grass-specific herbicide.
    - (Fall) No-till drill or broadcast native forb and grass mix (Tables 11, 12).

- Years 5-7
    - (Spring-fall) Herbicide spot spray (2 x treatments per year).
    - (Fall) Mow.

3.2.2 Plant Materials Costs

Plant material costs for enhancement of the existing HFNA upland prairie area are included in Tables 10-12. Other restoration costs are detailed in Appendix 3 and summarized in Section 10.

Table 10. Suggested native seed mixes for the first year of planting of 1.1 acre of wet prairie in woodland landscape at Phase II areas of HFNA. Costs were estimated using 2016 seed prices from nurseries.

First year seeding						
Scientific Name	**Species**	**Growth Form**	**Lbs. / acre**	**Lbs. for 1.1 acres**	**Cost/ lb.**	**Cost**
Achillea millefolium	Common yarrow	Perennial forb	0.31	0.3	$ 57.00	$ 19.44
Asclepias speciosus	Showy milkweed	Perennial forb	0.30	0.3	$ 221.00	$ 72.93
Camassia leichtlinii	Large camas	Perennial forb	1.75	1.9	$ 208.00	$ 400.40
Clarkia amoena	Farewell to spring	Annual forb	0.42	0.5	$ 130.00	$ 60.06
Downingia elegans	Elegant calicoflower	Annual forb	0.22	0.2	$ 250.00	$ 60.50
Eriophyllum lanatum	common woolly sunflower	Perennial forb	0.40	0.4	$ 192.00	$ 84.48
Epilobium densiflorum	Denseflower willowherb	Annual Forb	0.25	0.3	$ 63.00	$ 17.33
Grindelia integrifolia	Puget Sound gumweed	Perennial forb	0.70	0.8	$ 111.00	$ 85.47
Lomatium nudicaule	Barestem biscuitroot	Perennial forb	1.00	1.1	$ 160.00	$ 176.00
Lotus unifoliolatus	American bird's-foot trefoil	Perennial forb	0.50	0.6	$ 128.00	$ 70.40
Lupinus polyphyllus	bigleaf lupine	Perennial forb	0.75	0.8	$ 116.00	$ 95.70
Perideridia oregana	Oregon yampah	Perennial forb	0.09	0.1	$ 184.00	$ 18.22
Plagiobothrys figuratus	Fragrant popcornflower	Annual forb	0.50	0.6	$ 89.00	$ 48.95
Plectritis congesta	Shortspur seablush	Annual forb	0.20	0.2	$ 110.60	$ 24.33
Potentilla gracilis	Slender cinquefoil	Perennial forb	0.31	0.3	$ 128.00	$ 43.65
Prunella vulgaris var. lanceolata	Lance selfheal	Perennial forb	1.10	1.2	$ 42.00	$ 50.82
Subtotal Forbs			***8.8***	***9.7***	***$ 137.26***	***$ 1,328.67***
Carex unilateralis	one-sided sedge	Perennial sedge	0.40	0.4	$ 130.00	$ 57.20
Eleocharis palustris	Common spikerush	Perennial rush	0.70	0.8	$ 125.00	$ 96.25
Juncus tenuis	Poverty rush	Perennial rush	0.02	0.0	$ 45.00	$ 0.99
Luzula comosa	Pacific woodrush	Perennial rush	0.50	0.6	$ 240.00	$ 132.00
Subtotal Graminoids			***1.6***	***1.8***	***$ 160.74***	***$ 286.44***
Total			***10.4***	***11.5***	***$ 140.91***	***$ 1,615.11***

Table 11. Suggested native seed mixes for the second year of planting of 1.1 acre of wet prairie in woodland landscape at Phase II areas of HFNA. Costs were estimated using 2016 seed prices from nurseries.

2nd year seeding						
Scientific Name	**Species**	**Growth Form**	**Lbs. / acre**	**Lbs. for 1.1 acres**	**Cost/ lb.**	**Cost**
various		Perennial forb	2	2	$ 120.00	$ 264.00
Subtotal Forbs			***2***	***2.2***	***$ 120.00***	***$ 264.00***
Agrostis exrata	Spike bentgrass	Perennial grass	0.08	0.1	$ 19.00	$ 1.67
Danthonia californica	California oatgrass	Perennial grass	3.10	3.4	$ 32.50	$ 110.83
Deschampsia cespitosa	tufted hairgrass	Perennial grass	0.30	0.3	$ 10.70	$ 3.53
Hordeum brachyantherum	meadow barley	Perennial grass	4.40	4.8	$ 13.25	$ 64.13
Subtotal Grasses			***7.9***	***8.7***	***$ 20.78***	***$ 180.16***
Grand Totals:			**9.9**	**13.1**	***$ 33.99***	**$ 444.16**

Table 12. Suggested native seed mixes for the first and second years of planting of 5.1 acres of upland prairie in woodland landscape at Phase II areas of HFNA. Costs were estimated using 2016 seed prices from nurseries.

First year seeding

Scientific Name	Common name	Growth Form	Pounds/ acre	Pounds needed for 5.1 acres	Cost/ Pound	Cost
Achillea millefolium	Common yarrow	Perennial forb	0.61	3	$ 45.00	$ 140.00
Camassia leichtlinii	Large camas	Perennial forb	1.75	9	$ 117.00	$ 1,044.23
Clarkia amoena	Farewell to spring	Annual Forb	0.42	2	$ 81.00	$ 173.50
Eriophyllum lanatum	common woolly sunflower	Perennial forb	0.37	2	$ 125.00	$ 235.88
Iris tenax	Oregon iris	Perennial forb	1.89	10	$ 135.00	$ 1,301.27
Lomatium nudicaule	Barestem biscutroot	Perennial forb	0.55	3	$ 135.00	$ 378.68
Potentilla gracilis	Slender cinquefoil	Perennial forb	0.61	3	$ 116.00	$ 360.88
Sidalcea malviflora subsp. virgata	Dwarf checkermallow	Perennial forb	1.64	8	$ 110.00	$ 920.04
Subtotal Forbs			***7.84***	***39.984***	***$ 113.91***	***$ 4,554.45***
Carex tumulicola	splitawn sedge	Perennial sedge	0.67	3.417	$ 152.00	$ 519.38
Festuca roemeri	Roemer's fescue	Perennial grass	4.35	22.185	$ 25.00	$ 554.63
Juncus occidentalis	Western rush	Perennial rush	0.011	0.0561	$ 130.00	$ 7.29
Luzula comosa	Pacific woodrush	Perennial rush	0.231	1.1781	$ 240.00	$ 282.74
Subtotal Grasses			***5.26***	***26.8362***	***$ 50.83***	***$ 1,364.05***
Grand Totals:			**13.102**	**103.6932**	***$ 57.08***	**$ 5,918.50**

2nd year seeding

Scientific Name	Species	Growth Form	Lbs. / acre	Lbs. for 1.1 acres	Cost/ lb.	Cost
various		Perennial forb	2	10	$ 120.00	$ 1,224.00
Subtotal Forbs			***2***	***10.2***	***$ 120.00***	***$ 1,224.00***
Bromus sitchensis	Alaska brome	Perennial grass	2.45	12.5	$ 19.00	$ 237.41
Danthonia californica	California oatgrass	Perennial grass	3.11	15.9	$ 32.50	$ 515.48
Elymus glaucus	Blue wildrye	Perennial grass	3.63	18.5	$ 10.70	$ 198.09
Subtotal Grasses			***9.2***	***46.9***	***$ 20.29***	***$ 950.98***
Grand Totals:			**11.2**	**67.3**	***$ 32.33***	**$ 2,174.98**

3.3 Riparian Forest

Work in this plan will focus on the existing riparian forest (4.1 acres), scrub-shrub (1.5 acres) and riparian restoration area (4.1 acres). There will be no work in the stream itself or below the high water mark of the bank. Apart from spot spraying with aquatic glyphsate, and hand applications (e.g., wiping, injecting) of other select herbicides, most herbicide applications are only allowed outside a 15-100 foot (spot spraying) or 100 foot (broadcast spraying) buffer width from streams (NMFS 2013, USFWS 2015). While we recognize that bank stabilization and weed control is desirable, this Restoration Plan will use the same strategy as the Phase I restoration and focus on areas above the high water mark. River alignment and erosion in the Phase II area appears to be more stable than along the Phase I Marys River portion of HFNA. It is expected that with time, the riparian plantings will serve to stabilize the banks and overflow areas.

There are two primary approaches to riparian vegetation restoration: High density planting and low density planting. A rationale and description of each strategy is included below:

- **High density planting strategy:** When using this method, bare root riparian trees and shrubs are planted in restoration areas at extremely high densities, ranging from 2,000 to 2,500 stems per acre. Tree to shrub ratios are often 1:3. The rationale of this strategy is that the more closely spaced trees and shrubs (e.g. 6.5 foot spacing between rows and 3 foot spacing within rows) will rapidly produce a closed canopy, which will shade out and limit weed growth. This strategy has a higher initial cost, but will potentially have a lower maintenance cost after seven years.
- **Low density planting strategy:** With this method, bare root riparian trees and occasionally shrubs are planted at low densities into restoration areas, ranging from 200-300 stems per acre. A 3:1 tree to shrub ratio is typically applied. The lower density has a much lower initial planting material and labor cost. The more widely spaced rows (e.g., 10-12 feet) allow access for mowing and weed control, which may occur for an extended period of time until the canopy closes.

This plan proposes use high density riparian plantings to enhance or expand the existing riparian forest along Matt and Muddy Creeks, and reduce the need for weed control and mowing for maintenance of this zone. Flood tolerant species, and those with a wide moisture tolerance, will be used.

During the establishment phase of high density riparian plantings, competition from weeds and grasses can be reduced through a combination of herbicide treatments and mowing. Herbicide treatment of high density plantings is generally achieved by “line spraying”, which refers to hand spraying a broad spectrum herbicide along the planting line and around the tree bases, combined with spot spraying of broadleaf weeds and mowing by tractor or using hand mowers or tools between the sprayed rows.

3.3.0 Desired future conditions

The riparian forest at HFNA will support a diversity of native trees, shrubs and forbs that will provide shade over creeks and reduce erosion. Habitat will benefit many species of birds, reptiles and amphibians, including the willow flycatcher, Western pond turtle, and red legged frog.

3.3.1 Goals, objectives and tasks for riparian restoration

Goal 1: Increase diversity and cover of native trees and shrubs in riparian forest bordering Muddy and Matt Creeks.

Objective 1: Promote native hardwoods by thinning conifers from riparian areas.

- Year 1
    - Retain some conifers to provide source of large wood for future in-stream habitat formation. Some Douglas-fir trees may be tolerated in riparian forest and mixed woodland, where oaks are not being crowded, as suggested by the Management Plan (City of Corvallis 2011).
    - Girdle selected conifers and convert them to snags to provide wildlife habitat.
    - Remove other trees by cutting flush to ground and removing logs and slash.

Objective 2: Reduce prevalence of invasive species, including Armenian blackberry and reed canarygrass, over a two year period.

- Year 1 (starting year depending on available funding)
    - (Summer) Mow or cut reed canarygrass and blackberry and treat with stream-safe herbicides. Mechanical removal may be via skid steer mowing in combination with manual chainsaw or weed-eater cutting. Mow should be before June 10.
    - (Summer) Spray reed canarygrass regrowth with glyphosate.
    - (Fall) Spray blackberry regrowth with broadleaf herbicide such as triclopyr.
- Year 2
    - (Spring-fall) Spray reed canarygrass and blackberry regrowth (at least 2 x).

Objective 3: Increase abundance and diversity of native trees and shrubs within 0.5 acres of weedy shrub/scrub over a five year period.

- Year 3
    - (Feb-March) In high density areas, plant native trees and shrubs at a 1:3 tree to shrub ratio. (See species list and costs in Table 13), with a density of >2,000 stems/acre. Lower densities can be used if inter-planting in existing riparian forest.
    - (April-May) Line spray along planting rows with glyphosate to reduce competitions for seedlings and spot spray for broadleaf weeds in between rows.
    - (June) Tractor mow and/or hand mow between rows. Potentially repeat mow in fall.
    - (May/June, July, October) Spot spray weeds (2-3 x).
- Year 4
    - (Winter) Evaluate mortality and interplant as needed (roughly 25-50% depending on the dryness of the year).
    - (March-April) Line spray along planting rows with glyphosate to reduce competitions for seedlings and spot spray for broadleaf weeds in between rows.
    - (June) Tractor mow and/or hand mow between rows. Potentially repeat mow in fall.
    - (May/June, October) Spot spray weeds (2 x).
- Year 5
    - (March/April, May/June, October) Spot spray weeds (2-3 x).
- Year 6
    - (March/April, May/June) Spot spray weeds (2 x).
- Year 7
    - (March/April) Spot spray weeds (at least 1 x).

Objective 4: Continue to restore 4 acres of former fallow grassland and 1 acre of adjacent shrub-scrub to riparian forest over a seven year period.

- Year 1 (2017 - following 2 years of restoration in 2015-16)
    - (Winter) Plant 7125 riparian trees and shrubs (currently on order from Sevenoaks Native Nursery).
    - (April-May) Line spray along planting rows with glyphosate to reduce competitions for seedlings and spot spray for broadleaf weeds in between rows.
    - (June) Tractor mow and/or hand mow between rows. Potentially repeat mow in fall.
    - (May/June, July, October) Spot spray weeds (2-3 x).
- Year 2 (2018)
    - (Winter) Plant 1781 riparian trees and shrubs to account for mortality in the first year.
    - (April-May) Line spray along planting rows with glyphosate to reduce competitions for seedlings and spot spray for broadleaf weeds in between rows.
    - (June) Tractor mow and/or hand mow between rows. Potentially repeat mow in fall.
    - (May/June, July, October) Spot spray weeds (2-3 x).
- Years 3-4 (2019-20)
    - Hand mow between rows.
    - Line spray and spot spray.
- Year 5-7 (2021-23)
    - Spot spray at least once per year.

Table 13. Plant materials for riparian restoration plantings. Costs based on 2016 prices from nurseries. Planting labor costs not included. Table assumes that 0.5 acres of riparian shrub-scrub will be restored to riparian forest.

Scientific Name	Common name	Tolerance	Tree or shrub	Stems/ acre	Quantity for 0.5 acres	Additional # for 25% replant	Cost per plant	Cost
Alnus rhombifolia	White alder	Wet	Tree	200	100	25	$ 0.75	$ 93.75
Alnus rubra	Red alder	Variable	Tree	50	25	6.25	$ 0.75	$ 23.44
Cornus sericea sericea	Redosier dogwood	Wet but tolerate dry	Shrub	150	75	18.75	$ 0.55	$ 51.56
Fraxinus latifolia	Oregon Ash	Wet, well drained	Tree	200	100	25	$ 0.65	$ 81.25
Holodiscus discolor	Ocean Spray	Range of soils	Shrub	100	50	12.5	$ 0.65	$ 40.63
Oemieria cerasiformis	Indian plum	Wide range	Shrub	100	50	12.5	$ 0.85	$ 53.13
Physocarpus capitatus	Pacific ninebark	Range of soils	Shrub	250	125	31.25	$ 0.65	$ 101.56
Populus trichocarpa	Black cottonwood	Wet	Tree	100	50	12.5	$ 0.60	$ 37.50
Rhamnus purshiana	Cascara	Wet to dry	Shrub	100	50	12.5	$ 0.85	$ 53.13
Rosa nutkana	Nootka rose	Bank	Shrub	50	25	6.25	$ 0.65	$ 20.31
Salix lucida subsp. Lasiandra	Pacific willow	Variable	Shrub	200	100	25	$ 0.65	$ 81.25
Salix scouleriana	Scouler's willow	Variable	Shrub	200	100	25	$ 0.65	$ 81.25
Salix sitchensis	Sitka willow	Wet	Shrub	300	150	37.5	$ 0.65	$ 121.88
Symphoricarpos albus	Snowberry	Very wet to dry	Shrub	250	125	31.25	$ 0.65	$ 101.56
Total				**2,250**	**1,125**	**281**		**$ 942.19**

3.3.2 Plant Materials Costs

Plant materials costs for the riparian restoration plantings are estimated in Table 13 and additional detail on habitat restoration costs are provided in Appendix 3 and summarized in Section 10.

We suggest not using protective tubes/netting on plantings to reduce plastic litter in the riparian area. There is evidence of beaver using the area, which will facilitate the creation of natural openings for wildlife. Excessive herbivory problems will be addressed through adaptive management, however it is hoped that the high density approach will offset potential losses.

3.4 Oak Woodland

Restoration will enhance approximately 6.1 acres of woodland/ savanna habitat that runs northeast to southwest, roughly paralleling Matt and Muddy Creek. It is anticipated in 2017 that the City Parks and Recreation Department will establish a contract with a forestry company to cut and extract commercially valuable logs. The understory will be managed for continued stability under the canopy to provide habitat for birds. A native seed mix will be added in sunny areas where weed control or tree removal creates disturbed or bare soil.

3.4.0 Desired future conditions

Mature hardwood forest, dominated by Oregon white oak and including big leaf maple, white alder (*Alnus rhombifolia*) and black cottonwood. Understory will have a minimum of aggressive weed species, with downed logs to provide habitat for red-legged frog and sharp-tailed snake (*Contia tenuis*). Area will provide habitat for acorn and pileated woodpeckers, slender-billed nuthatch, chipping sparrow and Western gray squirrel.

3.4.1 Goals and objectives for oak woodland restoration

Goal 1: Restore woodland vegetation to provide habitat benefits for woodland birds, mammals, reptiles, and amphibians.

Objective 1: Control invasive species in the understory.

- Year 1 (2017)
    - (Summer) Spot spray or mechanically remove blackberry and other invasive shrubs and reed canarygrass.
    - (Summer) Skid steer mow understory after log harvest if necessary.
    - (Fall) Spray blackberry regrowth with triclopyr or similar chemical, depending on stream buffer and IPM constraints and USFWS Projects Biological Opinion guidance, with care to avoid thin-leaved peavine.
    - (Fall- Optional) If needed to compete with weedy species, add seed (broadcast application) of native annual forbs and perennial grasses (Table 14).
- Year 2-3
    - (Spring-Fall) Spot spray (2 x per year).
- Year 4-7
    - (Spring-Fall) Spot spray (1 x per year).

Objective 2: Remove conifer species and create snags.

- Year 1
    - Cut trees flush to ground and commercially harvest and remove logs and branches.
    - Retain some fallen logs for red-legged frog habitat and sharp-tailed snake.
    - Girdle and convert selected trees to snags to provide habitat for species like slender billed nuthatch and acorn woodpecker.
- Ongoing years
    - Continue to thin colonizing fir trees every few years to prevent competition with oaks.

Objective 3: Promote healthy hardwood trees with well-developed canopies, and create canopy gaps to promote understory species diversity and retain populations of thin-leaved peavine.

- Year 1

- Thin trees to encourage full canopies that will attract Oregon Conservation Strategy species such as acorn woodpeckers, pileated woodpeckers, chipping sparrows, slender billed nuthatch and Western gray squirrel.
- Create canopy gaps in areas with thin-leaved peavine.

- Ongoing years
  - Continue to thin colonizing trees every few years to maintain canopy gaps.

3.4.2 Plant Materials Costs

The cost for the native seed mix to apply in the oak woodland areas is included in Table 14. Additional detail on habitat restoration costs is provided in Appendix 3 and summarized in Section 10.

Table 14. Plant materials to use as needed in relatively sunny woodland openings disturbed by thinning or tree removal. Costs estimated from 2016 seed prices. Planting costs not included.

Scientific Name	Species	Growth Form	Pounds/ acre	Pounds needed for 6.1 acres	Cost/ Pound	Cost
Aquilegia formosa	Columbine	Perennial forb	0.15	1	$ 145.00	$ 132.68
Clarkia amoena	Farewell to spring	Annual forb	1.75	11	$ 81.00	$ 864.68
Madia elegans	Common madia	Annual forb	0.5	3	$ 77.00	$ 234.85
Subtotal Forbs			***2.4***	***14.64***	***$ 84.17***	***$ 1,232.20***
Bromus sitchensis	Alaska brome	Perennial Grass	6	37	$ 6.90	$ 252.54
Elymus glaucus	Blue wildrye	Perennial Grass	3.5	21	$ 12.00	$ 256.20
Festuca roemeri	Roemer's fescue	Perennial Grass	1	6	$ 38.00	$ 231.80
Subtotal Grasses			***10.5***	***64.05***	***$ 11.56***	***$ 740.54***
Grand Totals:			**12.9**	**81.74**	***$ 24.13***	**$ 1,972.74**

4 Outreach

As a natural area, HFNA's primary site mission is to protect and restore natural habitats and associated wildlife, however the ecological and cultural features are also outstanding resources for recreation and education (City of Corvallis 2011).

Goal 1: Provide public recreational and educational opportunities that are compatible with habitat and species management goals for HFNA.

Objective 1: Provide a public trail system.

- Create a trail system that maximizes visitor enjoyment while protecting conservation values, e.g., through loop trails with side branches to viewing areas.
- Provide interpretive materials or signage that illustrates the habitat restoration process and existing and restored conservation values.
- Develop kiosk signage that clearly described the City's expectations of visitors and the City's mission for HFNA.

Objective 2: Support outdoor education opportunities.

- Coordinate with ecological education programs to provide field work days and field trips.
- Designate an area of riparian habitat where students will receive hands-on habitat restoration experience through planting native riparian species.
- Give students hands-on habitat restoration experience through growing and planting rare native prairie species.
- Where possible, use students in monitoring tasks.

Objective 3: Engage volunteers in habitat restoration.

- Provide opportunities for volunteers to assist with planting and weeding activities.

Objective 4: Engage Native American tribes in habitat restoration.

- Invite elders to contribute to restoration planning.
- Utilize culturally important plants.
- Organize volunteer events to plant culturally important plants, including those raised at tribal nurseries, such as the nursery at Confederated tribes of Grand Ronde.
- Designate future harvest areas for culturally important plant species such as large camas.

5 Schedule

The schedule for new restoration projects is shown in Table 15, with more detail and costs provided in Appendix 3. Timing may vary with available funding, weather conditions, and the needs of adaptive management.

Table 15. Overall project schedule.

Year	Habitat	Prairie open landscape	Prairie in woodland landscape	Riparian	Woodland
	acres	82.5	6.2	0.5	6.1
	Season				
Year 1 (2017)	Spring (Mar-May)		Broadcast spray		
	Summer (Jun-Aug)	Harvest crop	Mow or spray blackberry	Skid steer or hand mow Spot spray	Spot spray Skid steer or hand mow
	Fall (Sep-Nov)	Broadcast spray	Tractor & hand mow Spot spray	Spot spray	Spot spray Thin conifers & oaks Create snags Seed broadcast
Year 2 (2018)	Spring (Mar-May)	Broadcast spray Vegetation monitoring	Broadcast spray	Spot spray	
	Summer (Jun-Aug)	Broadcast spray	Mow or spray blackberry		Spot spray
	Fall (Sep-Nov)	Broadcast spray	Tractor & hand mow Spot spray	Spot spray	Spot spray
Year3 (2019)	Winter (Dec-Feb)			Plant trees & shrubs	
	Spring (Mar-May)	Broadcast spray	Broadcast spray Spot spray	Line spray	
	Summer (Jun-Aug)	Broadcast spray	Spot spray	Spot spray Tractor or hand mow	Spot spray
	Fall (Sep-Nov)	Broadcast spray Drill seed Hand plant plugs	Broadcast spray Spot spray Prescribed burn Drill seed	Spot spray Hand mow	Spot spray
Year 4 (2020)	Winter (Dec-Feb)			Plant trees & shrubs	
	Spring (Mar-May)	Broadcast spray	Broadcast spray Spot spray	Line spray	
	Summer (Jun-Aug)	Tractor mow	Spot spray	Spot spray Tractor or hand mow	Spot spray
	Fall (Sep-Nov)	Drill seed Hand plant plugs	Broadcast spray Spot spray Drill seed	Spot spray Hand mow	
Year 5-7 (2021-23)	Spring (Mar-May)	Spot spray Vegetation monitoring	Spot spray	Spot spray	
	Summer (Jun-Aug)	Spot spray	Spot spray	Spot spray	Spot spray
	Fall (Sep-Nov)	Spot spray Disturb habitat e.g., burn, mow, disk, spray, graze	Tractor mow	Spot spray	

6 Monitoring and Adaptive Management

The Willamette Wildlife Mitigation Program is developing standard protocols for monitoring habitat condition over time in relation to conservation values and protected habitats associated with the HFNA conservation easement. Additional monitoring is required to meet endangered species habitat restoration permitting obligations under the Benton County HCP (Benton County 2010). Vegetation monitoring protocols for Phase II restoration areas will follow those used for Phase I areas (IAE 2013a, 2013b).

Monitoring will occur to:

- Locate and map invasive plant species, assess success of invasive species control efforts, and meet Benton County HCP monitoring requirements (Benton County 2010) for invasive species in Prairie Conservation Areas where restoration is occurring.
- Compare vegetation community composition in prairie habitats before and after restoration.
- Evaluate the establishment rates of riparian plantings, the intensity of wildlife browse to plantings, and effectiveness of vegetation control (invasive and otherwise) in riparian planting areas.
- Track rare plant species establishment and persistence in restored and enhanced habitats, as required for HCP Prairie Conservation Area monitoring (Benton County 2010).
- Assess the effects of habitat restoration, management and enhancement tools (e.g., mowing, prescribed burning), on plant community composition (as outlined in the Benton County HCP (2010)).
- Track dynamics of sensitive and common wildlife species using the restored and enhanced habitats at HFNA.

6.1 Vegetation Monitoring Frequency and Methods

Informal monitoring to assess weed control issues, chemical treatment effectiveness and seeding establishment should occur on a regular basis during restoration. Formal monitoring methods will vary between habitat types and will depend on funding being available. Methods for each type, along with frequency of monitoring, are listed in Table 16.

6.1.0 Rare Plant Species Monitoring

Thin-leaved peavine in areas being restored to oak woodland will be monitored using a complete census (count all plants present) with the timing and minimum frequency suggested in Table 16. Methods to quantify these species will follow guidelines identified by the Oregon Department of Agriculture (Currin and Meinke 2012).

Rare species data will be compared with prior surveys (2006 and 2009), with summary data supplied to the Oregon Biodiversity Information Center and Benton County for HCP endangered species habitat restoration permitting requirements.

Table 16. Vegetation monitoring frequency, layout and methods for new Phase II restoration project areas. Continued monitoring of the Phase I area is recommended once Phase II restoration begins.

Habitat	Year 1 (Baseline)	Years 5-7	Suggested Monitoring layout	Suggested Monitoring Methods
All	**X**	**X**	Walk through entire Phase II area.	May-August. Locate and map invasive species.
Riparian-enhanced (0.5 acres)	**X**	**X**	Five 1 square meter plots, random placement throughout riparian zone. GPS position.	Early spring. Stem count by species. Note frequency of severe graze/browse. Percent cover of weed species (e.g., reed canary grass, blackberry), percent ground cover of vegetation.
Prairie in open landscape (84 acres)	**X**	**X**	Thirty 2m x 2m plots, random placement throughout zone. GPS position.	Mid May. Plots: Percent cover by all species, bare ground and plant litter.
Prairie in woodland/savanna(6 acres)	**X**	**X**	Five 2m x 2m plots, random placement throughout zone. GPS position.	Mid May. Census of rare species (entire area). Plots: Percent cover by all species, bare ground and plant litter.
Woodland (6 acres)	**X**	**X**		(May-June) Census of rare species (entire area).

6.2 Wildlife Monitoring

Surveys to detect wildlife species (birds, mammals, reptiles and amphibians should occur every three to four years. Existing work from 2006 (Pacific Wildlife Research 2007), and 2014-16 (Bob Altman, American Bird Conservancy) can be used as baseline for species presence and breeding status. Repeat surveys by Years 5-7, utilizing the same methodology, are recommended. It would be beneficial to instigate monitoring of western pond turtles to determine use of restoration areas. Students may assist with various scales and levels of wildlife monitoring (See Section 4: Outreach).

Presence and breeding status of streaked horned lark at HFNA occurred as part of the habitat experiment in 2014-16 (Altman 2015, IAE 2015, 2016, Moore 2016). It is anticipated that monitoring of larks will occur during 2017-19, and should occur thereafter at least every 3-4 years. Under the USFWS Projects Biological Opinion, monitoring should occur annually where larks are present and active restoration and management actions are occurring (USWFS 2015).

Monitoring of streaked horned larks should occur during the breeding season (April-August) and at a minimum include:

- Transect surveys through the prairie restoration areas and agricultural fields during three visits, equally spaced through May-June of each year to provide indices of abundance and density (Moore 2016).

- Area searches to locate and count nesting pairs during at least six visits per year. Once nests are found, they are visited every few days throughout the breeding season to determine the outcome of the breeding attempt (Moore 2016).

6.3 Adaptive Management

Adaptive management is a process that allows land managers and restoration practitioners to incorporate new information in their management and restoration practices as it becomes available. Information learned from long-term monitoring is especially useful to modify management at a site and help reach project goals. Upland prairie restoration is a relatively novel process, and new information is constantly being acquired. High density riparian planting is also a relatively new concept. This plan, with its monitoring regime, will provide useful information to guide management and restoration at this site and future management of similar sites.

The schedule and techniques presented in this plan may be modified through the adaptive management process. Monitoring results will be reviewed and used to modify upcoming management processes. Examples may include, but are not limited to:

- If a flush of weed species arises following tree thinning, additional spot spray may be required and application of additional native cover crop.
- If rare species establish poorly from seed, the plan may be modified to add additional site preparation for future plantings, and planting plugs may be considered.
- If rare species establish extremely well from seed, the plan may be modified to reduce the quantity of future transplant efforts.
- If prescribed fire is extremely effective at removing thatch, the restoration schedule may be modified to omit mowing the year following fire.

7 Restoration and Management Context

A variety of site-based issues or challenges occur at HFNA, some of which are outlined here to provide the context for restoration activities.

7.1 Cultural Resources

The collaboration with the US Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife program on this restoration project creates a federal nexus. Therefore a cultural resource review and tribal notification by USFWS was required to determine if project methods would have an impact on known cultural resources, as required by the National Historic Preservation Act (1966). As the majority of the property has been under cultivation for many years, it had already experienced significant ground disturbance. A cultural resource survey in accordance with State Historic Preservation Office (SHPO) and BPA guidelines was conducted prior to ground disturbing restoration and enhancement activities being undertaken at Phase I or II sites (Applied Archaeological Research 2015). Further cultural resource surveys were not required by USFWS prior to excavations in the swale flooding project (N. Richardson, pers. comm. 2016).

7.2 Burning

While an extremely effective habitat restoration tool, prescribed burning in Phase II restoration areas may be challenging at HFNA due to the proximity of the Corvallis Airport, which is less than 1 mile from the southern edge of HFNA. Nevertheless, in 2016, the Corvallis Fire Department, with coordination between the City and IAE, successfully conducted a burn on a 2-acre upland prairie in the Phase I area. A flame-weeder could be considered for smaller burn treatments.

7.3 Flooding

Several sections of the Marys River overflow their banks during heavy rain/flow events. The overland flow may reduce plant establishment success during the earlier phases of restoration and increase invasion by reed canarygrass.

Seasonal flooding of swales will limit the ability to conduct spring treatments in parts of the restoration areas, requiring follow-up once soil dries out.

7.4 Access

Access to the east side of HFNA is generally possible year-round, although the peak flooding period in winter may impede travel along the access road for tree-planting. Addition of new gravel on the access road will improve access during the winter-spring period. Once vegetated and consolidated, the new berm across the northern-most swale offers an alternative driving route.

7.5 Erosion

Stream bank erosion appears to be less of an issue on the east side (Phase II areas) than west side (Phase I) of HFNA.

7.6 Recreation/Trails

The City is developing a plan to develop trails that will promote passive recreation at HFNA. This will provide opportunities for interpretive signs or other educational materials with information about habitat restoration. Foot traffic that is confined to trails should not threaten sensitive plant or wildlife species. A monitoring plan should be developed to assess visitor use and identify any potential conflicts with conservation objectives. There may be times when public access may need to be modified, such as during prescribed burning or herbicide treatment. Restrictions on dog access should also be considered to protect wildlife species, particularly during nesting seasons. The City Parks and Recreation Department is currently planning to use signage to encourage visitors to keep dogs on leashes.

7.7 Sensitive Species

Work within areas with sensitive species will need to adhere to best management practices for those species and comply with the USFWS Projects Biological Opinion (USFWS 2015).

In areas where streaked horned larks are present, monitoring is required to determine presence and location of nests in order to direct restoration activities away from nesting areas and/or stagger treatments to allow nests to fledge young – currently this is provided for as part of the habitat creation experiment, as monitoring is being conducted throughout likely habitat at HFNA (IAE 2015, 2016, Moore 2016). Mowing should occur outside the breeding season (April 1 to August 31), although up to 50% of a project site may be mowed during a treatment period within the breeding period, so long as mowing decks are kept at the highest setting. If used, grazing will occur outside the breeding season. A grazing plan may be required by BPA if it is not allowable under the conservation easement for the property. Prescribed fire may be used on 100% of an area. Herbicide treatments with allowable chemicals may also cover 100% of suitable lark habitat, while using wide booms and 4-wheel machines with narrow tires, to limit potential for crushing nests (USFWS 2015).

Under the Endangered Species Act, restoration work may require incidental take permit coverage. HFNA is covered under the Benton County Habitat Conservation Plan (HCP) incidental take permit for habitat restoration in areas with threatened and endangered species (Benton County 2010). Restoration and maintenance work completed within the HCP Prairie Conservation Area (a 10 acre area centered on Matt Creek) complies with the HCP Cooperative Agreement for HFNA. In general, mowing of prairie areas should not occur until the rare plant species have completed seed production and are senescing for the year (usually after August 15). While prescribed fire and herbicides may have short term impacts on rare plants, a net long term benefit is expected. Mowing and burning activities also need to consider grassland bird nesting activities and minimize disturbance between April 15 and July 1. An annual report to Benton County detailing restoration activities is required from the City in years when work occurs in areas with federally listed species, however no federally listed plant species occur in the Phase II part of HFNA.

In the future, it may be appropriate to introduce threatened and endangered species to the east side of HFNA, however, at this stage there are no plans to do so. Instead, augmentation will focus on the Phase I restoration areas. Acquisition of rare plant materials (seeds or transplants) can be challenging but is possible with advanced planning and coordination with qualified native seed producers such as Heritage Seedlings or IAE. Plant material selection should follow guidelines of provenance and seed source in the USFWS Recovery Plan for Prairie Species of Western Oregon and Southwest Washington (USFWS 2010b). Regular collection of seed from rare species growing at HFNA is recommended. Seeds can either be stored and planted by project staff or contributed to seed increase efforts by entities such as IAE.

8 Management

The following best management practices include those recommended by USFWS Projects Biological Opinion for terrestrial species (USFWS 2015) and NOAA Biological Opinion for fish species (National Marine Fisheries Service Projects Biological Opinion (NMFS 2013). Similar practices were required by the BPA Habitat Improvement Program (HIP III) prior to restoration activities at Herbert Farm being covered by the Projects Biological Opinion in October 2015.

8.1 Best Management Practices

8.1.0 Mowing

Mowing shall be completed to reduce competition from introduced perennial grasses and shrubs, and will occur under the following limitations:

- Mowing may be conducted throughout the site after rare plants have senesced and before they re-emerge the following spring (generally August 15 – March 1).

8.1.1 Prescribed Fire

The area burned in any given year (annual burn unit) at each site will be determined yearly based on individual site conditions and population sizes.

- Appropriate barriers will be used to contain burns such as perimeter mowing, wet lines with hose lays, disk lines, foam or other retardants, etc.
- Fire retardant chemicals will be used sparingly near rare plant species and will follow labeled restrictions and state regulations or guidelines for use near water.
- Fire management vehicles will be restricted to areas of dry soil.

8.1.2 Chemical Treatment

Chemical treatments may be used to control aggressive exotic species for which manual control is not logistically efficient or has not proven successful.

- Any herbicide used will be part of The City's Integrated Vegetation and Pest Management Plan which is updated regularly.
- All rare species will be closely monitored following herbicide application to identify any immediate adverse effects.
- Herbicides will be applied by a licensed applicator, using appropriate equipment and best management practices.
- Herbicides will be applied in a manner that prevents drift and exposure of non-target species.
- Chemical treatments will follow labeled restrictions, including limitations for use near water.

Controlling Herbicide Drift

The following procedures will be used to control herbicide drift:

- The lowest effective nozzle pressure and minimum effective nozzle height recommended by the nozzle manufacturer will be used.
- Droplet size shall be at least 500 microns.
- Spraying will not occur where winds exceed the wind limits specified by the manufacturer and in no event shall winds exceed 11 km (7 mi) per hour.
- Spraying shall occur when temperatures are below 30° C (85° F).

- Drift retardant adjuvants may only be used for boom spray applications and must be non-toxic.
- Dyes may be used for applications to ensure complete and uniform application and to observe the amount of drift.

8.2 On-going Maintenance Activities

Primary maintenance activities in the Phase II restoration area, beyond 2020, will include mowing or prescribed burning, removal of encroaching conifers, and control of invasive species. The best management practices described above (Section 8.1) should be followed. General maintenance activities will include the following:

- Fall mowing or prescribed burning will occur each year to reduce competition for native species and minimize tree and woody shrub species encroachment into the prairie.
- Any small conifers that are not eliminated through mowing or fire should be removed every five years.
- Weed control will need to be ongoing. Searches for new exotic species and spot-spraying with herbicide should occur on a regular basis.
- Any areas of bare soil created through tree removal, weed control, or other disturbance should be seeded in October using the species designated for the habitat.

9 Cost Summary

The estimated cost to complete the project is included in Table 17 (see Appendix 3 for details). This includes costs for:

- project management and reporting (coordination, monitoring data analysis, reporting; estimated as 20% of direct project costs);
- vegetation management (herbicide and application costs, tree and brush removal, mowing, prescribed fire, creation of berms);
- monitoring (vegetation and wildlife); and
- planting and plant materials (native grass and forb seed, native plugs and divisions, riparian trees and shrubs, labor and equipment costs for planting).

Costs were estimated from 2016 labor and contract rates from commonly used restoration contractors, and plant material costs from nursery catalogs (Tables 5-14, Appendix 3). Project management and reporting costs are estimated as 20% of the other direct costs (Table 17). Table 17 assumes all Phase II restoration actions identified by year in Appendix 3 will occur simultaneously, whereas it is more likely that individual areas (or parts of areas) will be restored in sequence as funding becomes available.

Table 17. Projected expenses to complete Phase II restoration activities at HFNA, including project management, vegetation management, labor and equipment, monitoring and plant materials.

Task	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Years 5-7**	**Total**
Project management & reporting	$ 14,414	$ 8,530	$ 25,161	$ 24,503	$ 23,988	$ 96,597
Monitoring	$ 1,200	$ 3,840	$ -	$ -	$ 6,000	$ 11,040
Vegetation management	$ 36,254	$ 36,441	$ 37,506	$ 45,431	$ 113,941	$ 269,573
Planting and plant materials	$ 34,615	$ 2,369	$ 88,301	$ 77,086	$ -	$ 202,371
Total	**$ 86,483**	**$ 51,180**	**$ 150,968**	**$ 147,021**	**$ 143,929**	**$ 579,581**
Project category						
Project management & reporting	$ 14,414	$ 8,530	$ 25,161	$ 24,503	$ 23,988	$ 96,597
Supplies	$ 26,055	$ 1,614	$ 70,791	$ 60,569	$ -	$ 159,029
Contracts	$ 37,957	$ 34,820	$ 35,395	$ 42,402	$ 38,524	$ 189,099
City & Partners	$ 11,738	$ 4,718	$ 17,437	$ 24,639	$ 76,324	$ 134,856
Total	**$ 90,164**	**$ 49,682**	**$ 148,785**	**$ 152,114**	**$ 138,836**	**$ 579,581**

It is anticipated that the restoration will be partially funded by the ODFW Willamette Wildlife Mitigation Program, using a basic maintenance fund for the Conservation Easement and operations and maintenance funds from the program, in addition to other grants for other entities. Some other reductions to direct costs of the restoration project will be possible through partner in-kind contributions, such as mowing by the City and labor and equipment from USFWS and ODFW (see Appendix 3).

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Appendix 1: Summary of Restoration actions in Phase I areas of Herbert Farm & Natural Area, 2012-2016

Year	Habitat	Riparian	Restoration prairie	Woodland	Wet prairie	Upland prairie
	acres	28	37	4	2	2
	Season					
2012	Summer (Jun-Aug)	Tractor mow		Tractor mow	Tractor mow	Tractor mow
2013	Spring (Mar-May)	Broadcast spray Monitor weeds	Monitor weeds	Monitor weeds & threatened species	Monitor weeds & threatened species	Monitor weeds & threatened species
	Summer (Jun-Aug)	Spot spray Skid steer mow	Final harvest	Tractor mow	Monitor threatened species Tractor mow	Monitor threatened species Tractor mow
	Fall (Sep-Nov)	Broadcast & spot spray	Broadcast spray		Broadcast spray	Spot spray Plant Nelson's checkermallow rhizomes
2014	Spring (Mar-May)	Broadcast & spot spray				
	Summer (Jun-Aug)	Skid steer mow	Broadcast spray	Tractor mow	Broadcast spray	Spot spray Tractor mow
	Fall (Sep-Nov)	Broadcast & spot spray Seed broadcast	Tribal elder visit Broadcast spray Seed broadcast		Broadcast & spot spray Seed broadcast	Spot spray
2015	Winter (Dec-Feb)	Cultural resource survey	Cultural resource survey	Cultural resource survey	Cultural resource survey	Cultural resource survey
	Spring (Mar-May)	Plant trees & shrubs				
	Summer (Jun-Aug)	Circle, row and spot spray tractor & hand mow Hand water Hand weed	Broadcast spray Spot spray Hand weed		Spot spray	Spot spray
	Fall (Sep-Nov)	Hand mow	Seed drilled		Seed drilled	
2016	Winter (Dec-Feb)	Plant trees & shrubs				
	Spring (Mar-May)	Row spray Monitor weeds & threatened species	Monitor weeds & threatened species	Monitor weeds & threatened species	Monitor weeds & threatened species	Plant Kincaid's lupine plugs Monitor weeds & threatened species
	Summer (Jun-Aug)	Circle & spot spray Hand mow Tractor mow	Spot spray Tractor mow	Girdle fir trees	Spot spray Monitor threatened species	Spot spray Monitor threatened species
	Fall (Sep-Nov)		Spot spray Seed drilled Rushes hand planted	Tractor mow	Tractor mow Plugs hand planted	Spot spray Prescribed burn Broadcast spray Seed drilled Plugs hand planted

Appendix 2: Summary of Restoration actions in Phase II areas of Herbert Farm & Natural Area, 2014-2016

Year	Habitat	Prairie restoration	Riparian restoration	Streaked horned lark habitat experiment
	acres	**24**	**5**	**1**
	Season			
2014	Fall (Sep-Nov)	Broadcast spray		
2015	Winter (Dec-Feb)	Cultural resource & fish survey	Cultural resource survey	Cultural resource survey
	Summer (Jun-Aug)		Broadcast spray Spot spray Skid steer mow	
	Fall (Sep-Nov)	Broadcast spray	Broadcast spray Spot spray	3 treatments (herbicide, mow, disk)
2016	Spring (Mar-May)	Broadcast spray Spot spray	Monitor weeds & threatened species	3 treatments (herbicide, mow, disk)
	Summer (Jun-Aug)	Broadcast, strip & spot spray Tractor mow	Spot spray Tractor mow	
	Fall (Sep-Nov)	Broadcast spray Spot spray 2 berms constructed Seed drilled plugs hand planted	Spot spray Seed drilled Rushes hand planted	3 treatments (herbicide, mow, disk)

Appendix 3. Calendar and costs for Phase II restoration activities at Herbert Farm and Natural Area.

Projected tasks and the party responsible to complete them. Contractor generally refers to IAE and includes subcontracted tasks managed by IAE, but does not include project management costs.. Partner generally refers to ODFW or USFWS.

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	City	Partner	Total
Tree management in fir-dominated woodland			**6.1**			**Remove fir trees in groves that are encroaching on oaks**								
Year 1	spring	Survey & mark trees		16		Mark trees for removal	$ 45.00			$ -	$ -	$ 720	$ -	$ 720
Year 1	summer	Remove firs and thin oaks (if necessary)	6.1	24		Chainsaw or skid steer sheering & removal to piles	$ 109.00	$ 160		$ -	$ 2,776	$ -	$ -	$ 2,776
Year 1	summer	Grapple wood	6.1	10		Grappling and removal to piles or transport of useable logs	$ 90.00	$ 160		$ -	$ 1,060	$ -	$ -	$ 1,060
Year 1	summer	Remove invasive shrubs	6.1	10		Chainsaw and remove to piles	$ 45.00			$ -	$ 450	$ -	$ -	$ 450
Year 1	summer	Treat stumps	6.1	6		Treat stumps of invasives with herbicide	$ 67.00	$ 160	$ 100	$ -	$ 662	$ -	$ -	$ 662
Year 1	summer	Mow	6.1			Skid steer mow.	$ 96.00	$ 160		$ -	$ 2,237	$ -	$ -	$ 2,237
Year 1	fall	Seed	6.1				$ 318.10			$ 1,940	$ -	$ -	$ -	$ 1,940
Year 1	fall	Broadcast seed		6			$ 45.00			$ -	$ 270	$ -	$ -	$ 270
Year 2	spring-fall	Herbicide spot spray	6.1	16		Spot spray 2 x per year	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332
Year 3	spring-fall	Herbicide spot spray	6.1	16		Spot spray 2 x per year	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332
Year 4	spring-fall	Herbicide spot spray		8		Spot spray 1 x per year	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 5-7	spring-fall	Herbicide spot spray		8		Spot spray 1 x per year for 3 years. 8 hours per year.	$ 67.00	$ 160	$ 100	$ -	$ 2,388	$ -	$ -	$ 2,388
						Year 1				$ 1,940	$ 7,455	$ 720	$ -	$ 10,115
						Year 2				$ -	$ 1,332	$ -	$ -	$ 1,332
						Year 3				$ -	$ 1,332	$ -	$ -	$ 1,332
						Year 4				$ -	$ 796	$ -	$ -	$ 796
						Years 5-7				$ -	$ 2,388	$ -	$ -	$ 2,388
						Total				***$ 1,940***	***$ 13,303***	***$ 720***	***$ -***	***$ 15,963***
Wet Prairie (in 23.7 acre prairie restoration area)			**8**			**Continue restoration of 8 acres of wet prairie in 23.7 acre restoration area (after 2 years of initial restoration). Wet prairie habitat includes 2 acres of bare ground and 6 acres of low stature vegetation (Figs 7, 16).**								
Year 1	spring-summer	Broadcast herbicide	8			Broadcast of glyphosate in bare ground areas and other areas as needed	$ 24.00	$ 160	$ 200	$ -	$ 552	$ -	$ -	$ 552
Year 1	summer	Spot spray		8		Spot spray of broadleaf weeds & ryegrass	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 1	fall	Broadcast herbicide	8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 200	$ -	$ 552	$ -	$ -	$ 552
Year 1	fall	Spot spray		8		Spot spray of broadleaf weeds & ryegrass	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 1	fall	Purchase seed	8			Purchase forb and grass seed from nurseries	$ 339.44			$ 2,716	$ -	$ -	$ -	$ 2,716
Year 1	fall	Sow seed	8			Sow seed with no-till drill or spreader	$ 100.00			$ -	$ -	$ -	$ 800	$ 800
Year 1	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	0	$ -	$ -	$ 4,500
Year 1	fall	Plant native plants			6000	Planting crew installs plants	$ 0.32			$ -	$ 1,920	$ -	$ -	$ 1,920

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	City	Partner	Total
Year 2	early spring	Broadcast herbicide	8			Broadcast of glyphosate or grass-specific herbicide in selected zones	$ 24.00	$ 160	$ 200	$ -	$ 552	$ -	$ -	$ 552
Year 2	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 2	fall	Broadcast herbicide	8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 200	$ -	$ 552	$ -	$ -	$ 552
Year 2	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 2	fall	Mow	8			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 1,280	$ 1,280
Year 3	spring	Broadcast herbicide	8			Broadcast of glyphosate or grass-specific herbicide in selected zones	$ 24.00	$ 160	$ 200	$ -	$ 552	$ -	$ -	$ 552
Year 3	fall	Broadcast herbicide	8			Broadcast of glyphosate or grass-specific herbicide in selected zones	$ 24.00	$ 160	$ 200	$ -	$ 552	$ -	$ -	$ 552
Year 3	fall	Mow	8			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 1,280	$ 1,280
Year 3	srping-fall	Spot spray		8		Spot spray of broadleaf weeds as needed	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Mow	8			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 1,280	$ 1,280
Year 4	fall	Broadcast herbicide	8			Broadcast of glyphosate or grass-specific herbicide in selected zones	$ 24.00	$ 160	$ 200	$ -	$ 552	$ -	$ -	$ 552
Year 4	fall	Mow	8			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 1,280	$ 1,280
Year 4	spring-fall	Spot spray		8		Spot spray of broadleaf weeds as needed	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 5-7	fall	Mow	8			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 3,840	$ 3,840
Year 6	fall	Prescribed burn	8			Remove thatch with burn, depending on conditions	$ 250.00			$ -	$ -	$ -	$ 2,000	$ 2,000
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 384	$ -	$ 4,848	$ -	$ -	$ 4,848
						Year 1				$ 7,216	$ 4,616	$ -	$ 800	$ 12,632
						Year 2				$ -	$ 2,696	$ -	$ 1,280	$ 3,976
						Year 3				$ -	$ 1,900	$ -	$ 1,280	$ 3,180
						Year 4				$ -	$ 1,348	$ -	$ 2,560	$ 3,908
						Years 5-7				$ -	$ 4,848	$ -	$ 5,840	$ 10,688
						Total				***$ 7,216***	***$ 15,408***	***$ -***	***$ 11,760***	***$ 34,384***
Wet prairie associated with open landscape			**37.6**			**Convert 37.6 acres of current agriculture field to wet prairie (including up to 28.2 acres low stature vegetation and 9.4 acres bare ground)**								
Year 1	summer	End farm agreement		24		Complete farming in preparation for restoration treatments	$ 60.00			$ -	$ -	$ 1,440	$ -	$ 1,440
Year 1	summer	Build berms		16		USFWS scraper builds berms across 2 swales	$ 225.00	$ 1,200					$ 4,800	$ 4,800
Year 1	fall	Broadcast herbicide	37.6			broadcast of glyphsate or pre-emergent Imazapic herbicide	$ 24.00	$ 160	$ 940	$ -	$ 2,002	$ -	$ -	$ 2,002
Year 2	spring	Broadcast herbicide	37.6			broadcast of glyphosate	$ 24.00	$ 160	$ 940	$ -	$ 2,002	$ -	$ -	$ 2,002
Year 2	summer	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ 480	$ -	$ -	$ 480
Year 2	spring	Monitor vegetation plots		24		Monitor vegetation plots - quantitative	$ 60.00			$ -	$ 1,440	$ -	$ -	$ 1,440
Year 2	summer	Broadcast herbicide	37.6			broadcast of glyphosate	$ 24.00	$ 160	$ 940	$ -	$ 2,002	$ -	$ -	$ 2,002
Year 2	fall	Broadcast herbicide	37.6			broadcast of glyphsate and,or broadleaf-specific combination	$ 24.00	$ 160	$ 940	$ -	$ 2,002	$ -	$ -	$ 2,002
Year 3	spring	Broadcast herbicide	37.6			broadcast of glyphosate	$ 24.00	$ 160	$ 940	$ -	$ 2,002	$ -	$ -	$ 2,002

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	City	Partner	Total
Year 3	summer	Broadcast herbicide	37.6			broadcast of glyphosate	$ 24.00	$ 160	$ 940	$ -	$ 2,002	$ -	$ -	$ 2,002
Year 3	fall	Broadcast herbicide	37.6			broadcast of glyphsate and,or broadleaf-specific combination	$ 24.00	$ 160	$ 940	$ -	$ 2,002	$ -	$ -	$ 2,002
Year 3	fall	Purchase seed	28.2			Purchase seed from nurseries	$ 355.26			$ 10,018	$ -	$ -	$ -	$ 10,018
Year 3	fall	Sow seed	28.2			Sow seed with no-till drill or spreader	$ 100.00			$ -	$ -	$ -	$ 2,820	$ 2,820
Year 3	fall	Purchase native plants			12000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 9,000	$ -	$ -	$ -	$ 9,000
Year 3	fall	Plant native plants			12000	Planting crew installs plants	$ 0.30			$ -	$ 3,600	$ -	$ -	$ 3,600
Year 3	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 3	fall	Mow	37.6			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 6,016	$ 6,016
Year 4	summer	Spot spray		24		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 300	$ -	$ 2,068	$ -	$ -	$ 2,068
Year 4	summer	Broadcast herbicide	9			broadcast of glyphosate	$ 24.00	$ 160	$ 225	$ -	$ 601	$ -	$ -	$ 601
Year 4	summer	Broadcast herbicide	28.2			Broadcast of clopyralid to target weedy asters	$ 24.00	$ 160	$ 705	$ -	$ 1,542	$ -	$ -	$ 1,542
Year 4	fall	Broadcast herbicide	37.6			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 940	$ -	$ 2,002	$ -	$ -	$ 2,002
Year 4	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Mow	37.6			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 6,016	$ 6,016
Year 4	fall	Purchase seed	28.2			Purchase seed from nurseries	$ 339.44			$ 9,572	$ -	$ -	$ -	$ 9,572
Year 4	fall	Sow seed	28.2			Sow seed with no-till drill or spreader	$ 100.00			$ -	$ -	$ -	$ 2,820	$ 2,820
Year 4	fall	Purchase native plants			12000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 9,000	$ -	$ -	$ -	$ 9,000
Year 4	fall	Plant native plants			12000	Planting crew installs plants	$ 0.32			$ -	$ 3,840	$ -	$ -	$ 3,840
Year 5-7	fall	Mow	37.6			Tractor mow for 3 years.	$ 160.00			$ -	$ -	$ -	$ 18,048	$ 18,048
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 200	$ -	$ 4,296	$ -	$ -	$ 4,296
Year 6	fall	Prescribed burn	37.6			Remove thatch with burn, depending on conditions	$ 250.00			$ -	$ -	$ -	$ 9,400	$ 9,400
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ 480	$ -	$ -	$ 480
Year 7	spring	Monitoring vegetation plots		24		Post treatment monitor of veg plots to compare change from	$ 60.00			$ -	$ 1,440	$ -	$ -	$ 1,440
						Year 1				$ -	$ 2,002	$ 1,440	$ 4,800	$ 8,242
						Year 2				$ -	$ 7,927	$ -	$ -	$ 7,927
						Year 3				$ 19,018	$ 10,403	$ -	$ 8,836	$ 38,258
						Year 4				$ 18,572	$ 10,849	$ -	$ 8,836	$ 38,257
						Years 5-7				$ -	$ 6,216	$ -	$ 27,448	$ 33,664
						Total				***$ 37,591***	***$ 37,398***	***$ 1,440***	***$ 49,920***	***$ 126,349***
Wet prairie associated with woodland/savanna			1.1			**Restore 1.1 acre of wetland swale in oak woodland savanna habitat**								
Year 1	spring	Monitoring weed survey		4		Weed survey whole site.	$ 60.00			$ -	$ 240	$ -	$ -	$ 240
Year 1	spring	Monitor vegetation plots		4		Monitor vegetation plots - quantitative	$ 60.00			$ -	$ 240	$ -	$ -	$ 240
Year 1	early spring	Broadcast herbicide	1.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 28	$ -	$ 214	$ -	$ -	$ 214
Year 1	spring-fall	Spot spray		4		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 50	$ -	$ 478	$ -	$ -	$ 478

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	City	Partner	Total
Year 1	fall	Mow	1.1			Tractor mow.	$ 160.00			$ -	$ -	$ 176	$ -	$ 176
Year 1	fall	Broadcast herbicide	1.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 28	$ -	$ 214	$ -	$ -	$ 214
Year 2	early spring	Broadcast herbicide	1.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 28	$ -	$ 214	$ -	$ -	$ 214
Year 2	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 200	$ -	$ 1,432	$ -	$ -	$ 1,432
Year 2	fall	Mow	1.1			Tractor mow.	$ 160.00			$ -	$ -	$ 176	$ -	$ 176
Year 2	fall	Broadcast herbicide	1.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 28	$ -	$ 214	$ -	$ -	$ 214
Year 3	early spring	Broadcast herbicide	1.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 28	$ -	$ 214	$ -	$ -	$ 214
Year 3	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 200	$ -	$ 1,432	$ -	$ -	$ 1,432
Year 3	summer	Broadcast herbicide	1.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 28	$ -	$ 214	$ -	$ -	$ 214
Year 3	late summer	Prescribed burn	1.1			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 110	$ 110
Year 3	early spring	Broadcast herbicide	1.1			Broadcast of glyphosate two weeks after burn	$ 24.00	$ 160	$ 28	$ -	$ 214	$ -	$ -	$ 214
Year 3	fall	Forb and graminoid seed	1.1			Purchase grass seed from nurseries	$ 1,468.28			$ 1,615	$ -	$ -	$ -	$ 1,615
Year 3	fall	Sow seed	1.1			Sow seed with no-till drill or spreader - delay a year if weed control insufficient	$ 45.00			$ -	$ -	$ -	$ 50	$ 50
Year 3	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500
Year 3	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 4	early spring	Broadcast herbicide	1.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 28	$ -	$ 214	$ -	$ -	$ 214
Year 4	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Broadcast herbicide	1.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 28	$ -	$ 214	$ -	$ -	$ 214
Year 4	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 200	$ -	$ 1,432	$ -	$ -	$ 1,432
Year 4	fall	Seed	5.1			Purchase forb & grass seed from nurseries	$ 403.78			$ 2,059	$ -	$ -	$ -	$ 2,059
Year 4	fall	Sow native forbs and Roemer's fescue	1.1			Sow seed with no-till drill or spreader - delay a year if weed control insufficient	$ 45.00			$ -	$ -	$ -	$ 50	$ 50
Year 4	fall	Purchase native plants			3000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 2,250	$ -	$ -	$ -	$ 2,250
Year 4	fall	Plant native plants			3000	Planting crew installs plants	$ 0.32			$ -	$ 960	$ -	$ -	$ 960
Year 5-7	fall	Mow	1.1			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 797	$ -	$ -	$ 797
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 200	$ -	$ 4,296	$ -	$ -	$ 4,296
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 7	spring	Monitoring vegetation plots		8		Post treatment monitor of veg plots to compare change from	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
						Year 1				$ -	$ 4,892	$ 352	$ -	$ 5,244
						Year 2				$ -	$ 428	$ -	$ 110	$ 538
						Year 3				$ 6,115	$ 1,500	$ -	$ 50	$ 7,665
						Year 4				$ 4,309	$ 8,709	$ -	$ 50	$ 13,067

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	City	Partner	Total
						Years 5-7				$ -	$ -	$ 960	$ -	$ 960
						Total				***$ 10,424***	***$ 15,528***	***$ 1,312***	***$ 209***	***$ 27,473***
Upland prairie (in 23.7 acre prairie restoration area)			**15.7**			**Continue restoration of 15.7 acres of upland prairie (including 2 acres bare ground, 3 acres low stature vegetation and 10.7 acres standard vegetation) in 24 acre prairie restoration area (Figs 7, 16).**								
Year 1	early spring	Broadcast herbicide	15.7			Broadcast of glyphosate in bare ground areas and other areas as needed	$ 24.00	$ 160	$ 393	$ -	$ 929	$ -	$ -	$ 929
Year 1	summer	Spot spray		8		Spot spray of broadleaf weeds & ryegrass	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 1	fall	Broadcast herbicide	15.7			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 393	$ -	$ 929	$ -	$ -	$ 929
Year 1	fall	Spot spray		8		Spot spray of broadleaf weeds & ryegrass	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 1	fall	Seed for standard upland	10.7			Purchase forb and grass seed from nurseries for 2nd seeding	$ 582.85			$ 6,236	$ -	$ -	$ -	$ 6,236
Year 1	fall	Seed for low stature upland	3			Purchase forb and grass seed from nurseries for 2nd seeding	$ 391.78			$ 1,175	$ -	$ -	$ -	$ 1,175
Year 1	fall	Sow seed	13.7			Sow seed with no-till drill or spreader	$ 100.00			$ -	$ -	$ -	$ 1,370	$ 1,370
Year 1	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	0	$ -	$ -	$ 4,500
Year 1	fall	Plant native plants			6000	Planting crew installs plants	$ 0.32			$ -	$ 1,920	$ -	$ -	$ 1,920
Year 2	early spring	Broadcast herbicide	15.7			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 393	$ -	$ 929	$ -	$ -	$ 929
Year 2	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 2	fall	Broadcast herbicide	15.7			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 393	$ -	$ 929	$ -	$ -	$ 929
Year 2	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 2	fall	Mow	15.7			Tractor mow.	$ 160.00			$ -	$ -	$ 2,512	$ -	$ 2,512
Year 3	fall	Mow	15.7			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 2,512	$ 2,512
Year 3	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Mow	15.7			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 2,512	$ 2,512
Year 4	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 5-7	fall	Mow	15.7			Tractor mow.	$ 160.00			$ -	$ -	$ 7,536	$ -	$ 7,536
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 200	$ -	$ 4,296	$ -	$ -	$ 4,296
						Year 1				$ 11,912	$ 5,371	$ -	$ 1,370	$ 18,652
						Year 2				$ -	$ 3,451	$ 2,512	$ -	$ 5,963
						Year 3				$ -	$ 796	$ -	$ 2,512	$ 3,308
						Year 4				$ -	$ 796	$ -	$ 2,512	$ 3,308
						Years 5-7				$ -	$ 4,296	$ 7,536	$ -	$ 11,832
						Total				***$ 11,912***	***$ 14,709***	***$10,048***	***$ 6,394***	***$ 43,063***
Upland praire associated with open landscape			46			**Convert 46 acres of current agriculture field to upland prairie (including up to 5.8 acres bare ground, 8.6 acres low stature vegetation and 31.6 acres of standard vegetation)**								
Year 1	summer	End farm agreement		24		Complete farming in preparation for restoration treatments	$ 60.00			$ -	$ -	$ 1,440	$ -	$ 1,440
Year 1	fall	Broadcast herbicide	46			broadcast of glyphsate or pre-emergent Imazapic herbicide	$ 24.00	$ 160	$ 1,150	$ -	$ 2,414	$ -	$ -	$ 2,414
Year 2	spring	Broadcast herbicide	46			broadcast of glyphosate	$ 24.00	$ 160	$ 1,150	$ -	$ 2,414	$ -	$ -	$ 2,414

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	City	Partner	Total
Year 2	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ 480	$ -	$ -	$ 480
Year 2	spring	Monitor vegetation plots		24		Monitor vegetation plots - quantitative	$ 60.00			$ -	$ 1,440	$ -	$ -	$ 1,440
Year 2	summer	Broadcast herbicide	46			broadcast of glyphosate	$ 24.00	$ 160	$ 1,150	$ -	$ 2,414	$ -	$ -	$ 2,414
Year 2	fall	Broadcast herbicide	46			broadcast of glyphsate and broadleaf-specific combination	$ 24.00	$ 160	$ 1,150	$ -	$ 2,414	$ -	$ -	$ 2,414
Year 3	spring	Broadcast herbicide	46			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 1,150	$ -	$ 2,414	$ -	$ -	$ 2,414
Year 3	summer	Broadcast herbicide	46			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 1,150	$ -	$ 2,414	$ -	$ -	$ 2,414
Year 3	fall	Broadcast herbicide	46			broadcast of glyphsate and broadleaf-specific combination	$ 24.00	$ 160	$ 1,150	$ -	$ 2,414	$ -	$ -	$ 2,414
Year 3	fall	Seed for upland	31.6			Purchase seed from nurseries	$ 658.02			$ 20,793	$ -	$ -	$ -	$ 20,793
Year 3	fall	Seed for low stature upland	8.6			Purchase seed from nurseries	$ 535.07			$ 4,602	$ -	$ -	$ -	$ 4,602
Year 3	fall	Sow grass seed	40.2			Sow seed with no-till drill or spreader	$ 100.00			$ -	$ -	$ -	$ 4,020	$ 4,020
Year 3	fall	Purchase native plants			12000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 9,000	$ -	$ -	$ -	$ 9,000
Year 3	fall	Plant native plants			12000	Planting crew installs plants	$ 0.25			$ -	$ 3,000	$ -	$ -	$ 3,000
Year 4	summer	Spot spray		24		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 300	$ -	$ 2,068	$ -	$ -	$ 2,068
Year 4	summer	Broadcast herbicide	8.6			broadcast of glyphosate	$ 24.00	$ 160	$ 215	$ -	$ 581	$ -	$ -	$ 581
Year 4	summer	Broadcast herbicide	40.2			Broadcast of clopyralid to target weedy asters	$ 24.00	$ 160	$ 1,005	$ -	$ 2,130	$ -	$ -	$ 2,130
Year 4	fall	Broadcast herbicide	46			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 1,150	$ -	$ 2,414	$ -	$ -	$ 2,414
Year 4	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Mow	40.2			Tractor mow.	$ 160.00			$ -	$ -	$ -	$ 6,432	$ 6,432
Year 4	fall	Seed for upland	31.6			Purchase seed from nurseries	$ 582.85			$ 18,418	$ -	$ -	$ -	$ 18,418
Year 4	fall	Seed for low stature upland	8.6			Purchase seed from nurseries	$ 391.78			$ 3,369	$ -	$ -	$ -	$ 3,369
Year 4	fall	Sow seed	40.2			Sow seed with no-till drill or spreader	$ 100.00			$ -	$ -	$ -	$ 4,020	$ 4,020
Year 4	fall	Purchase native plants			12000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 9,000	$ -	$ -	$ -	$ 9,000
Year 4	fall	Plant native plants			12000	Planting crew installs plants	$ 0.25			$ -	$ 3,000	$ -	$ -	$ 3,000
Year 5-7	fall	Mow	46			Tractor mow for 3 years.	$ 160.00			$ -	$ -	$ -	$ 22,080	$ 22,080
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 200	$ -	$ 4,296	$ -	$ -	$ 4,296
Year 6	fall	Prescribed burn	46			Remove thatch with burn, depending on conditions	$ 250.00			$ -	$ -	$ -	$ 11,500	$ 11,500
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ 480	$ -	$ -	$ 480
Year 7	spring	Monitoring vegetation plots		24		Post treatment monitor of veg plots to compare change from	$ 60.00			$ -	$ 1,440	$ -	$ -	$ 1,440
						Year 1				$ -	$ 2,414	$ 1,440	$ -	$ 3,854
						Year 2				$ -	$ 9,162	$ -	$ -	$ 9,162
						Year 3				$ 34,395	$ 10,242	$ -	$ 4,020	$ 48,657
						Year 4				$ 30,787	$ 10,989	$ -	$ 10,452	$ 52,229
						Years 5-7				$ -	$ 6,216	$ -	$ 33,580	$ 39,796
						Total				***$ 65,182***	***$ 39,023***	***$ 1,440***	***$ 48,052***	***$ 153,698***

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	City	Partner	Total
Upland prairie associated with woodland/savanna			**5.1**			**Restore 5.1 acres of upland grassland in oak woodland savanna habitat**								
Year 1	spring	Monitoring weed survey		4		Weed survey whole site.	$ 60.00			$ -	$ 240	$ -	$ -	$ 240
Year 1	spring	Monitor vegetation plots		4		Monitor vegetation plots - quantitative	$ 60.00			$ -	$ 240	$ -	$ -	$ 240
Year 1	early spring	Broadcast herbicide	5.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 128	$ -	$ 410	$ -	$ -	$ 410
Year 1	spring-fall	Spot spray		4		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 50	$ -	$ 478	$ -	$ -	$ 478
Year 1	fall	Mow	5.1			Tractor mow.	$ 160.00			$ -	$ -	$ 816	$ -	$ 816
Year 1	fall	Broadcast herbicide	5.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 128	$ -	$ 410	$ -	$ -	$ 410
Year 2	early spring	Broadcast herbicide	5.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 128	$ -	$ 410	$ -	$ -	$ 410
Year 2	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 200	$ -	$ 1,432	$ -	$ -	$ 1,432
Year 2	fall	Mow	5.1			Tractor mow.	$ 160.00			$ -	$ -	$ 816	$ -	$ 816
Year 2	fall	Broadcast herbicide	5.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 128	$ -	$ 410	$ -	$ -	$ 410
Year 3	early spring	Broadcast herbicide	5.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 128	$ -	$ 410	$ -	$ -	$ 410
Year 3	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 200	$ -	$ 1,432	$ -	$ -	$ 1,432
Year 3	summer	Broadcast herbicide	5.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 128	$ -	$ 410	$ -	$ -	$ 410
Year 3	late summer	Prescribed burn	5.1			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 510	$ 510
Year 3	early spring	Broadcast herbicide	5.1			Broadcast of glyphosate two weeks after burn	$ 24.00	$ 160	$ 128	$ -	$ 410	$ -	$ -	$ 410
Year 3	fall	Forb and graminoid seed	5.1			Purchase grass seed from nurseries	$ 1,160.49			$ 5,918	$ -	$ -	$ -	$ 5,918
Year 3	fall	Sow seed	5.1			Sow seed with no-till drill or spreader - delay a year if weed control insufficient	$ 45.00			$ -	$ -	$ -	$ 230	$ 230
Year 3	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500
Year 3	fall	Plant native plants			6000	Planting crew installs plants	$ 0.32			$ -	$ 1,920	$ -	$ -	$ 1,920
Year 4	early spring	Broadcast herbicide	5.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 128	$ -	$ 410	$ -	$ -	$ 410
Year 4	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Broadcast herbicide	5.1			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 128	$ -	$ 410	$ -	$ -	$ 410
Year 4	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 200	$ -	$ 1,432	$ -	$ -	$ 1,432
Year 4	fall	Seed	5.1			Purchase forb & grass seed from nurseries	$ 426.47			$ 2,175	$ -	$ -	$ -	$ 2,175
Year 4	fall	Sow native forbs and Roemer's fescue	5.1			Sow seed with no-till drill or spreader - delay a year if weed control insufficient	$ 45.00			$ -	$ -	$ -	$ 230	$ 230
Year 4	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500
Year 4	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 5-7	fall	Mow	5.1			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 1,949	$ -	$ -	$ 1,949
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 200	$ -	$ 4,296	$ -	$ -	$ 4,296
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 7	spring	Monitoring vegetation plots		8		Post treatment monitor of veg plots to compare change from	$ 60.00			$ -	$ -	$ 480	$ -	$ 480

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	City	Partner	Total
						Year 1				$ -	$ 1,778	$ 816	$ -	$ 2,594
						Year 2				$ -	$ 2,252	$ 816	$ -	$ 3,068
						Year 3				$ 10,418	$ 4,582	$ -	$ 740	$ 15,740
						Year 4				$ 6,675	$ 4,548	$ -	$ 230	$ 11,452
						Years 5-7				$ -	$ 6,245	$ 960	$ -	$ 7,205
						Total				***$ 17,093***	***$ 19,404***	***$ 2,592***	***$ 969***	***$ 40,058***
Riparian restoration area			**5.1**			**Continue to restore 4.1 acres former fallow field and 1.0 acre surrounding scrub/shrub to riparian forest, following on from 2 years of site preparation**								
Year 1	winter	Purchase plants	5.1		7125	Plant diversity of riparian species at high density	$ 0.70	$ -	$ -	$ 4,988	$ -	$ -	$ -	$ 4,988
Year 1	winter	Plant trees	5.1		7125	Contract crew	$ 0.32			$ -	$ 2,280	$ -	$ -	$ 2,280
Year 1	spring	Herbicide spray rows	5.1			Combination spray tree rows	$ 340.00		$ 153	$ -	$ 2,514	$ -	$ -	$ 2,514
Year 1	spring	Mow	5.1			Hand mow between rows	$ 250.00			$ -	$ 1,275	$ -	$ -	$ 1,275
Year 1	summer	Herbicide spray rows	5.1			Combination spray tree rows	$ 340.00		$ 153	$ -	$ 2,514	$ -	$ -	$ 2,514
Year 2	winter	Purchase plants	5.1		1781	Plant diversity of riparian species at high density	$ 0.75	$ -	$ -	$ 1,336	$ -	$ -	$ -	$ 1,336
Year 2	winter	Plant trees	5.1		1781	Contract crew	$ 0.32			$ -	$ 570	$ -	$ -	$ 570
Year 2	spring	Herbicide spray rows	5.1			Combination spray tree rows	$ 340.00		$ 153	$ -	$ 2,514	$ -	$ -	$ 2,514
Year 2	spring	Mow	5.1			Hand mow between rows	$ 250.00			$ -	$ 1,275	$ -	$ -	$ 1,275
Year 2	summer	Herbicide spray rows	5.1			Combination spray tree rows	$ 340.00		$ 153	$ -	$ 2,514	$ -	$ -	$ 2,514
Year 3	spring	Mow	5.1			Hand mow between rows	$ 250.00			$ -	$ 1,275	$ -	$ -	$ 1,275
Year 3	summer	Herbicide spray rows	5.1			Combination spray tree rows	$ 340.00		$ 153	$ -	$ 2,514	$ -	$ -	$ 2,514
Year 4	spring	Mow	5.1			Hand mow between rows	$ 250.00			$ -	$ 1,275	$ -	$ -	$ 1,275
Year 4	summer	Herbicide spray rows	5.1			Combination spray tree rows	$ 340.00		$ 153	$ -	$ 2,514	$ -	$ -	$ 2,514
Year 5-7	summer	Spot spray	5.1			Spot spray at least once per year	$ 340.00		$ 153	$ -	$ 7,543	$ -	$ -	$ 7,543
						Year 1				$ 4,988	$ 8,584	$ -	$ -	$ 13,571
						Year 2				$ 1,336	$ 6,874	$ -	$ -	$ 8,210
						Year 3				$ -	$ 3,789	$ -	$ -	$ 3,789
						Year 4				$ -	$ 3,789	$ -	$ -	$ 3,789
						Years 5-7				$ -	$ 7,543	$ -	$ -	$ 7,543
						Total				***$ 6,323***	***$ 30,579***	***$ -***	***$ -***	***$ 36,902***
Riparian forest			**0.5**			**Restore riparian forest in 0.5 acres of scrub/shrub habitat**								
Year 1	spring	Pre-condition monitoring		4		Monitor vegetation	$ 60.00			$ -	$ 240	$ -	$ -	$ 240
Year 1	summer	Skid steer mow or hand brush removal	0.5			Chainsaw or weed whack in riparian zone where inaccessible to skid steer	$ 500.00			$ -	$ 250	$ -	$ -	$ 250
Year 1	summer	Broadcast or spot spray herbicide	0.5			Broadcast of broad spectrum herbicide targeting reed canarygrass	$ 24.00	$ 160	$ 13	$ -	$ 178	$ -	$ -	$ 178
Year 1	fall	Broadcast or spot spray herbicide	0.5			Broadcast of broadleaf herbicide targeting blackberry	$ 24.00	$ 160	$ 13	$ -	$ 178	$ -	$ -	$ 178
Year 2	spring	Broadcast or spot spray herbicide	0.5			Broadcast of broad spectrum herbicide	$ 24.00	$ 160	$ 13	$ -	$ 178	$ -	$ -	$ 178
Year 2	fall	Broadcast or spot spray herbicide	0.5			Broadcast of broad spectrum and broadleaf herbicide	$ 24.00	$ 160	$ 13	$ -	$ 178	$ -	$ -	$ 178
Year 2	fall	Spot spray	0.5			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 158	$ -	$ -	$ 158

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	City	Partner	Total
Year 2	summer	purchase seed	0.5			Purchase understory seed mix for disturbed soil	$ 556.00			$ 278	$ -	$ -	$ -	$ 278
Year 2	fall	broadcast seed	0.5			broadcast seed, especially in disturbed zones	$ 50.00	$ 160		$ -	$ 185	$ -	$ -	$ 185
Year 3	winter	Purchase plants	0.5		1125	Plant diversity of riparian species at high density	$ 0.75	$ -	$ -	$ 844	$ -	$ -	$ -	$ 844
Year 3	winter	Plant trees	0.5		1125	Contract crew	$ 0.33			$ -	$ 371	$ -	$ -	$ 371
Year 3	spring	Herbicide spray rows	0.5			Combination spray tree rows	$ 340.00		$ 15	$ -	$ 178	$ -	$ -	$ 178
Year 3	spring	Mow	0.5			Hand mow between rows	$ 250.00			$ -	$ 125	$ -	$ -	$ 125
Year 3	summer	Herbicide spray rows	0.5			Combination spray tree rows	$ 340.00		$ 15	$ -	$ 178	$ -	$ -	$ 178
Year 4	winter	Purchase plants	0.5		281	Plant diversity of riparian species at high density	$ 0.80	$ -	$ -	$ 225	$ -	$ -	$ -	$ 225
Year 4	winter	Plant trees	0.5		281	Contract crew	$ 0.35			$ -	$ 98	$ -	$ -	$ 98
Year 4	spring	Herbicide spray rows	0.5			Combination spray tree rows	$ 340.00		$ 15	$ -	$ 178	$ -	$ -	$ 178
Year 4	spring	Mow	0.5			Hand mow between rows	$ 250.00			$ -	$ 125	$ -	$ -	$ 125
Year 4	summer	Herbicide spray rows	0.5			Combination spray tree rows	$ 340.00		$ 15	$ -	$ 178	$ -	$ -	$ 178
Year 5-7	summer	Spot spray	0.5			Spot spray at least once per year	$ 340.00		$ 15	$ -	$ 533	$ -	$ -	$ 533
Year 7	spring	Monitoring vegetation plots	0.5	4		Post treatment monitor of vegetation to compare change	$ 60.00			$ -	$ 240	$ -	$ -	$ 240
						Year 1				$ -	$ 847	$ -	$ -	$ 847
						Year 2				$ 278	$ 699	$ -	$ -	$ 977
						Year 3				$ 844	$ 851	$ -	$ -	$ 1,695
						Year 4				$ 225	$ 578	$ -	$ -	$ 803
						Years 5-7				$ -	$ 773	$ -	$ -	$ 773
						Total				***$ 1,347***	***$ 3,748***	***$ -***	***$ -***	***$ 5,094***

Total Project Costs	Supplies	Contractor	City	Partner	Total
Year 1	$ 26,055	$ 37,957	$ 4,768	$ 6,970	$ 75,750
Year 2	$ 1,614	$ 34,820	$ 3,328	$ 1,390	$ 41,152
Year 3	$ 70,791	$ 35,395	$ -	$ 17,437	$ 123,623
Year 4	$ 60,569	$ 42,402	$ -	$ 24,639	$ 127,610
Years 5-7	$ -	$ 38,524	$ 9,456	$ 66,868	$ 114,848
Grand Total	***$ 159,029***	***$ 189,099***	***$17,552***	***$ 117,304***	***$ 482,984***