City of Corvallis

Herbert Farm and Natural Area Restoration Plan

Phase 1: 2013-2017

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

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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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Executive Summary

This 5-year restoration plan outlines habitat restoration activities to occur 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, and was 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 is bordered by Marys River and Muddy Creek, and it has remnant flood channels and swales that were formed by the rivers during previous floods. This plan begins the phased conversion of approximately 170 acres of agricultural field to riparian and upland or wet prairie, along with the enhancement of existing upland, riparian and restoration of oak woodland and savanna. This restoration plan includes a description of current and desired future conditions, a restoration strategy for each habitat type that includes site preparation, planting strategy and maintenance, along with a monitoring plan and management activities for the 5 year period. Development and implementation of this plan has been a collaborative process between the City of Corvallis, the Institute for Applied Ecology, ODFW, and the US Fish and Wildlife Service. The project will lay the groundwork for outreach, communication and promote future collaboration with Confederated Tribes of the Grand Ronde, Marys River Watershed Council and Corvallis Public Schools.

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1 Introduction

1.1 Project background

In December 2011, the Institute for Applied Ecology (IAE) was awarded operation and maintenance funding from the ODFW Willamette Wildlife Mitigation Program to prepare a restoration plan for Herbert Farm and Natural Area (HFNA). The objective was to update and expand on the existing site management plan to phase out agricultural use and enhance wildlife habitat.

The HFNA is a 221 acre property in Benton County, Oregon at the southern edge of Corvallis, and was purchased by the City of Corvallis (the City) in 2000. 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. Currently, approximately 147 acres of HFNA is in agricultural production, but areas in the southwest portion have never been cultivated and retain diverse natural features, including upland prairie, oak savanna and forest plant communities (City of Corvallis 2011).

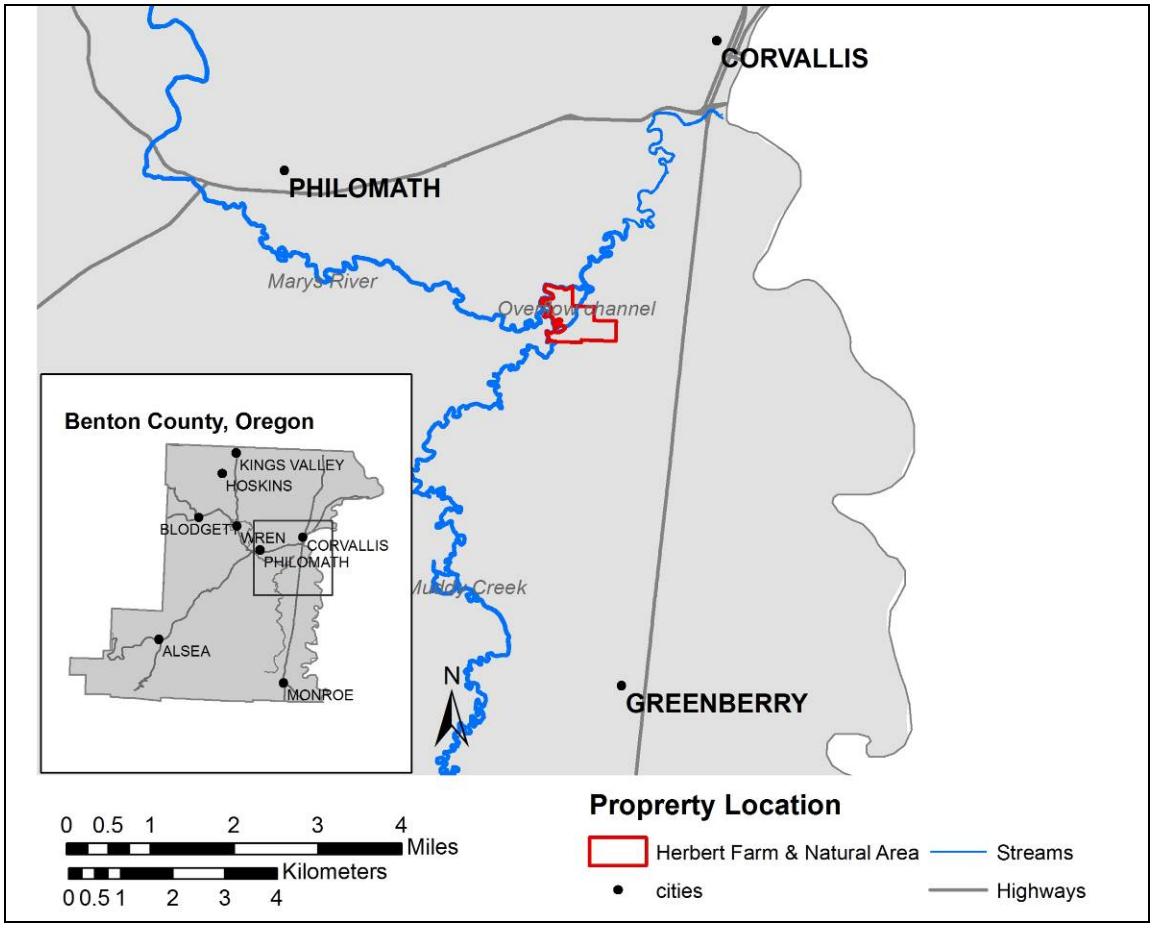

Figure 1. Herbert Farm and Natural Area property location southwest of Corvallis, Oregon. Township 21S, Range 5W, Sections 15, 16, 21, 22.

Natural habitats at HFNA host eight rare plant species, five that are federally or state listed as threatened, endangered or candidate species and three that are considered locally rare (Table 1). Additionally, two of the nine species of amphibians and reptiles observed there have special conservation status, as well as five of the 61 avian species observed (Table 2). Seven additional wildlife species with special conservation status are believed to inhabit the oak woodland, shrubby riparian areas and prairie remnants of the HFNA. 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 a "conservation opportunity area" (COA), and is one of 27 COA's 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, but it is also considered an opportunity for public recreation, so long as it does not interfere with habitat restoration efforts or cultural integrity of the site (City of Corvallis 2011).

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

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

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

Table 2. Sensitive wildlife either present or potentially present at HFNA (Pacific Wildlife Research 2007). Species already observed there are in regular type, those that may potentially be attracted are in italics and their rows are shaded.

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.
Northern red-legged frog	*Rana aurora aurora*	Species of Concern	SV	Yes	Wetlands, ponds.
Pileated woodpecker	*Dryocopus pileatus*		SV	Yes	Large trees. (Evidence of excavations seen).
Streaked horned lark	*Eremophila alpestris strigata*	Proposed	SC	Yes	Large, open, treeless grasslands.
Western pond turtle	*Actinemys marmorata*	Species of Concern	SC	Yes	Water, riparian, upland for nesting.
Slender-billed nuthatch	*Sitta carolinensis aculeata*		SV	Yes	Large diameter open site oaks. Cavity nester.
Willow flycatcher	*Empidonax trailii adastus*	Species of Concern	SV	Yes	Riparian and upland shrub areas, nests close to ground in shrub thickets.
Acorn woodpecker	*Melanerpes formicivorus*	Species of Concern	*SV*	*Yes*	*Oak woodlands, snags, high canopy.*
Oregon vesper sparrow	*Pooecetes gramineus affinis*	Species of Concern	*SC*		*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.*
Yellow-breasted chat	*Icteria virens*	Species of Concern	*SC*	*Yes*	*Shrubby riparian areas, wetlands, forest edges, burned areas.*

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

A Management Plan for Herbert Farm and Natural Area (HFNA) was prepared by the City and its partners to guide restoration and management of the site over a 10 year period (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 combine with 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 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.

Restoration and management will be phased over many years of work at HFNA. The Management Plan (City of Corvallis 2011) proposes to transition some areas out of farming and restore them to native habitat, and retain other areas where sustainable practices are maintained to provide ecological benefits. The transition away from farming was proposed to occur in four stages: Year 1, 1-5 years, 5-10 years and 10-20 years. The first two stages were proposed to be in the western half of the property and the later stages in the eastern half (Figure 1; City of Corvallis 2011: Map 3.5, p.56). Similarly, management and restoration of native habitat will be phased in over five year periods (City of Corvallis 2011: p. 62-64).

This restoration plan outlines the first phase of restoration at HFNA. The Management Plan (City of Corvallis 2011) has been used as the over-arching guiding document for the restoration plan. The latter plan provides the detail for the restoration actions in order to satisfy the overall management goals.

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 (Figure 2).

- Riparian hardwood forest included deciduous trees and shrubs, with species such as alder (*Alnus* sp.), willow (*Salix* spp.), 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 (*Camassia* spp.).

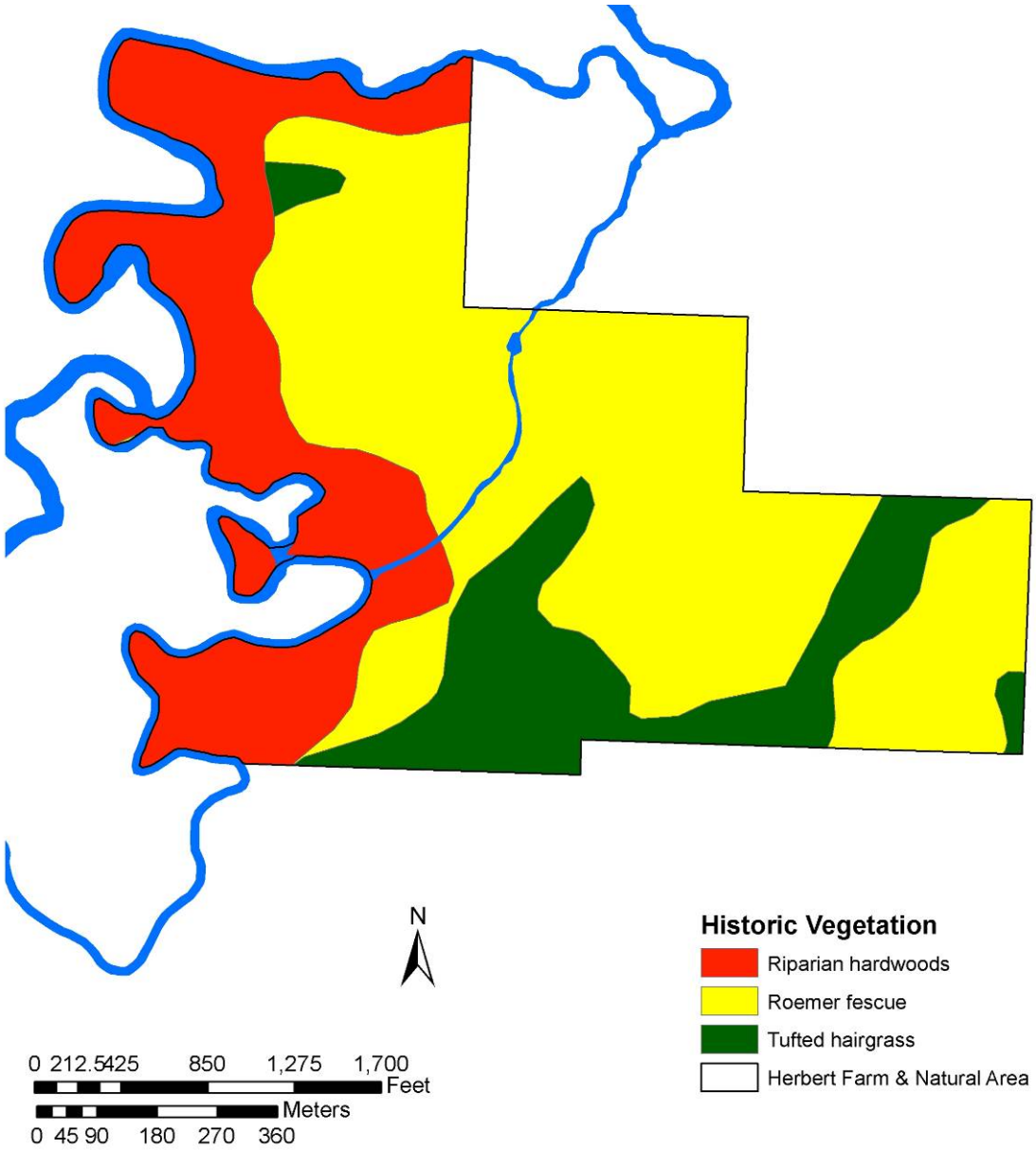

Figure 2. Pre- Euro-American settlement vegetation over Herbert Farm and Natural Area (City of Corvallis, Map 2.9).

1.3 Soils, water and topography

HFNA includes a variety of productive silty clay loams and silt loams (Figure 3). 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 microtopography that creates shallow swales and depressions where water pools during wet periods.

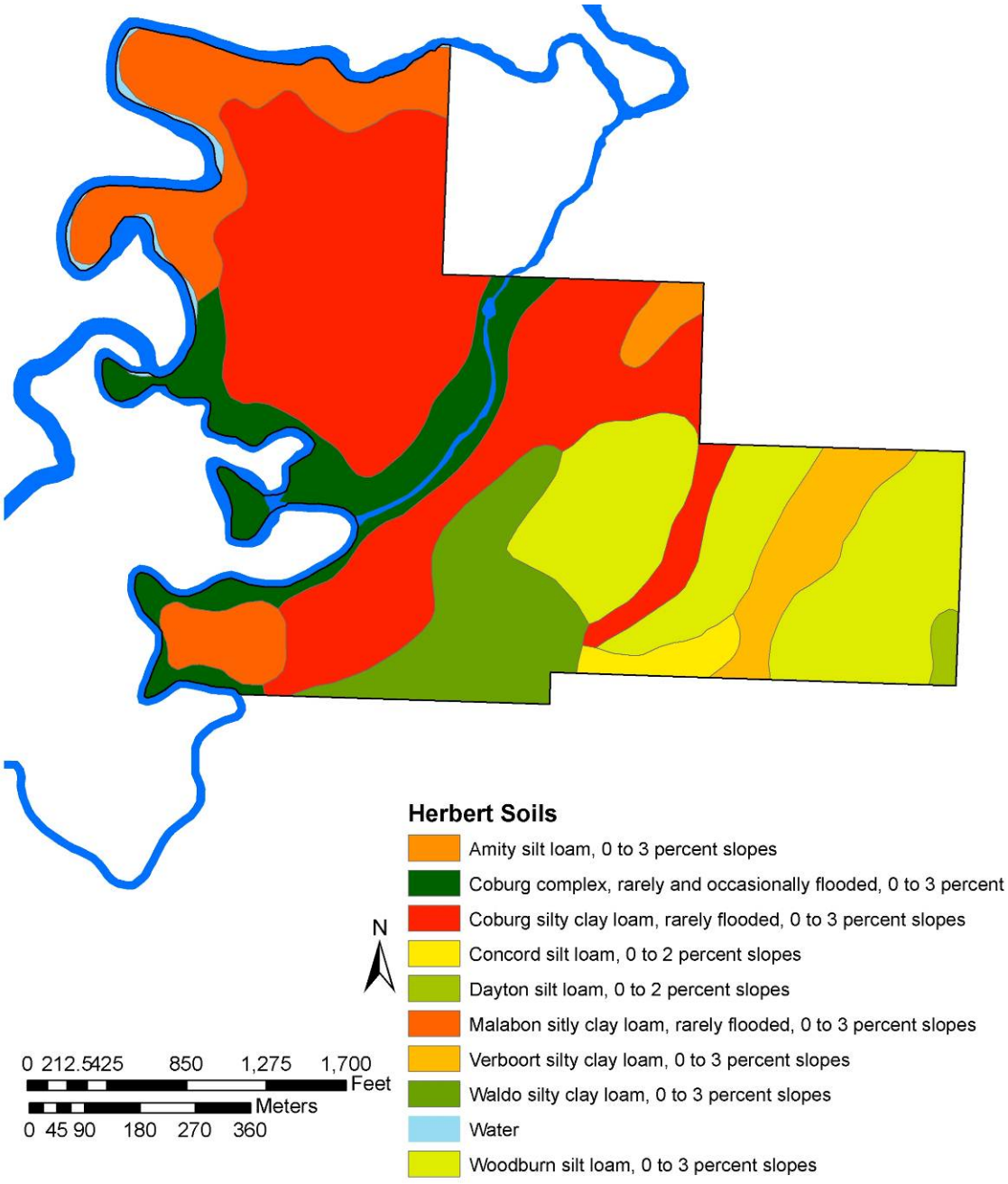

Figure 3. Soil types present in Herbert Farm and Natural Area (NRCS 2012).

1.4 Sensitive species

1.4.0 Rare plants

HFNA supports small populations of Kincaid's lupine (*Lupinus oreganus = Lupinus sulphureus* ssp. *kincaidii*- four square meters of plant cover- Benton County 2010) and one or two plants of Nelson's checkermallow (*Sidalcea nelsoniana*), two species federally listed as threatened. It also includes peacock larkspur (*Delphinium pavonaceum*-115 plants- Benton County 2010) and thin-leaved peavine (*Lathyrus holochlorus*- many patches), two Federal species of concern (Figure 4, Table 1). The peacock larkspur is listed by the State of Oregon as Endangered, and three species are Conservation Strategy Species (Table 1; ODFW 2006). Rare plant surveys were conducted in 2006 (Salix Associates 2008) and 2009 (Benton County 2010).

Figure 4. Rare plant species at Herbert Farm and Natural Area. Clockwise from top left: thin-leaved peavine, peacock larkspur, Kincaid's lupine, and Nelson's checkermallow.

1.4.1 Sensitive Wildlife

The most recent wildlife surveys at HFNA took place in 2007 (Pacific Wildlife Research 2007). Multiple rare and sensitive species were documented, and many of these are Conservation Strategy Species (ODFW 2006). The streaked horned lark was recently proposed for federal listing. 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. Birds, reptiles and amphibians with special conservation status at HFNA are listed in Table 2.

2 Habitats

2.1 Current conditions

Habitat types present at HFNA within the Phase I and Phase II restoration areas have been updated to current conditions from that mapped in the management plan (City of Corvallis 2011: map 2.10, p. 37) and are included in Figure 5 and Table 3. Photos of these habitats are in Figure 6-Figure 12. Descriptions of the current conditions in the Phase I restoration area are included below:

- Agriculture – 37.8 acres are in agriculture, currently growing annual ryegrass (*Lolium multiflorum*).
- Fallow agriculture – 22.2 acres were recently (2-3 years ago) taken out of agricultural production and are now left fallow with annual mowing by the City. There are residual agricultural species (tall fescue (*Festuca arundinacea*) and annual ryegrass) in this area, along with weedy non-native forb species, including St. Johnswort (*Hypericum perforatum*). Several areas have dense natural Oregon ash regeneration.
- Riparian – currently there are 7.7 acres of riparian forest and woodland habitat and scrub-shrub in a thin margin bordering the waterways around the perimeter of much of HFNA. Forest species include Oregon white oak, Oregon ash, bigleaf maple and Douglas-fir. The scrub-shrub includes willows, common snowberry (*Symphoricarpos albus*), Nootka rose (*Rosa nutkana*) and Pacific ninebark (*Physocarpus capitatus*). Roughly 1.5 acres of this is inaccessible on small lobes.
- Forest – currently there are 2.8 acres of upland mixed forest/oak woodlands, mostly near Muddy Creek and Matt Creek. Tree species include oak and Douglas-fir. Understory is primarily shrubs and Armenian blackberry (*Rubus armeniacus)*, but does include some of the rare thin-leaved peavine.
- Savanna – there are 3.9 acres of savanna present at HFNA. The overstory trees are primarily oak, with some Douglas-fir encroachment. Understory plant species include pasture grasses such as orchard grass (*Dactylis glomerata*) and tall fescue. Thin-leaved peavine also occurs in this zone, as well as a single occurrence of Nelson's checkermallow.
- Upland prairie/grassland – currently there are 8.2 acres of prairie/grassland. Of that area 1.8 acres are remnant upland prairie with rare species, such as peacock larkspur, thin-leaved peavine, and Kincaid's lupine. The remaining 6.4 acres are degraded grassland dominated by non-native species.
- Wet prairie – currently there are approximately 0.8 acres of wet prairie in the depression west of Matt Creek. Tufted hairgrass, California oatgrass and native annual forbs are important native components of these wet prairies. This habitat type supports the rare plant Nelson's checkermallow.

Infestations of Armenian blackberry and reed canarygrass (*Phalaris arundinacea*) are common in the riparian areas, as well as in the prairie, oak savanna and forest areas of HFNA. Additional invasive exotic

species include English holly (*Ilex aquifolium*), spurge laurel (*Daphne laureola*), tall oatgrass (*Arrhenatherum elatius*), sweet cherry (*Prunus avium*), domestic plum (*Prunus* spp.), hawthorn (*Crataegus monogyna*), Canada thistle (*Cirsium arvense*), oxeye daisy (*Leucanthemum vulgare*), and meadow foxtail (*Alopecurus pratensis*).

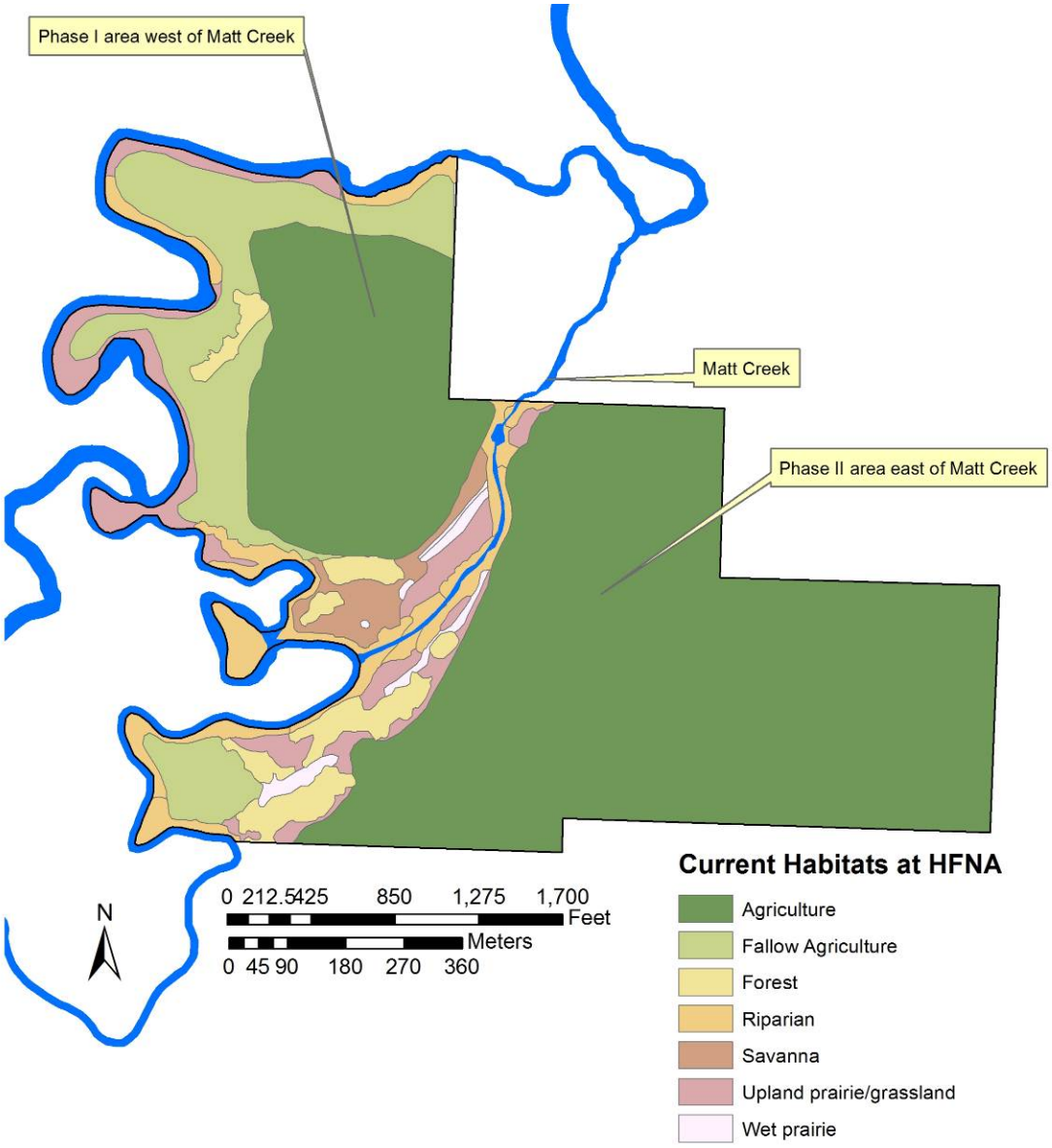

Figure 5. Current habitats at Herbert Farm and Natural Area (updated from City of Corvallis 2011, Map 2.10).

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

Habitat	Phase I Area (acres)	Phase II Area (acres)	Total
Agriculture	37.8	108.9	146.7
Fallow Agriculture	22.2	4.1	26.3
Riparian	7.7	5.4	13.1
Forest	2.8	5.8	8.6
Savanna	3.9	0.0	3.9
Upland Prairie/Grassland	8.2	4.5	12.7
Wet Prairie	0.8	1.4	2.2
Total	83.4	130.1	213.5

Figure 6. Agricultural field after harvest, and mowed perimeter, at Herbert Farm and Natural Area, September 2012.

Figure 7. Riparian forest and mowed fallow agricultural grassland bordering Marys River.

Figure 8. Douglas-fir in riparian zone along Muddy Creek.

Figure 9. Oak savanna at HFNA.

Figure 10. Wet prairie zone amongst oaks, prior to mowing in June 2012.

Figure 11. Reed canary grass and blackberry on riparian border of Marys River.

Figure 12. Thistles and blackberry in fallow agricultural grassland bordering Marys River.

3 Restoration Strategy

Work at Herbert Farm and Natural Area will focus on restoring agricultural lands, degraded grassland, forest and riparian to four main habitat types: Riparian (including hardwood forest and scrub-shrub), Wet prairie, Upland prairie-Oak savanna and Woodland. These broad habitat types follow that outlined in the Management Plan (City of Corvallis, p. 42-49, Maps 3.2-3.4). The pattern of restored habitat types on the ground will closely mimic historical vegetation patterns (Figure 2). The detail of the desired habitats, and the restoration strategy for achieving those habitats, is an amalgam of the management plan, experience from IAE restoration ecologists and advice from other restoration colleagues and partners in this project.

The quantity of existing habitat types converted into the final target habitats is represented in Figure 12. A map of restored habitats is included in Figure 13. This plan focuses on restoring habitats in the Phase I area.

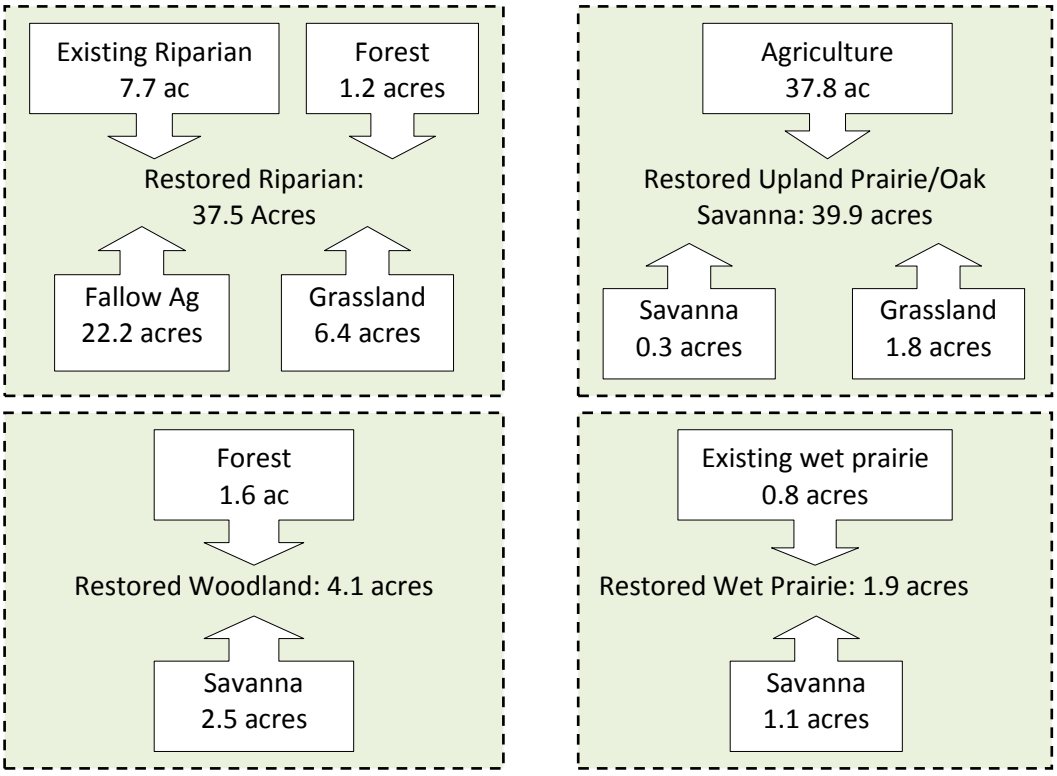

Figure 13. Components and acreages of existing habitats that will be restored to target habitats in the Phase I area of HFNA.

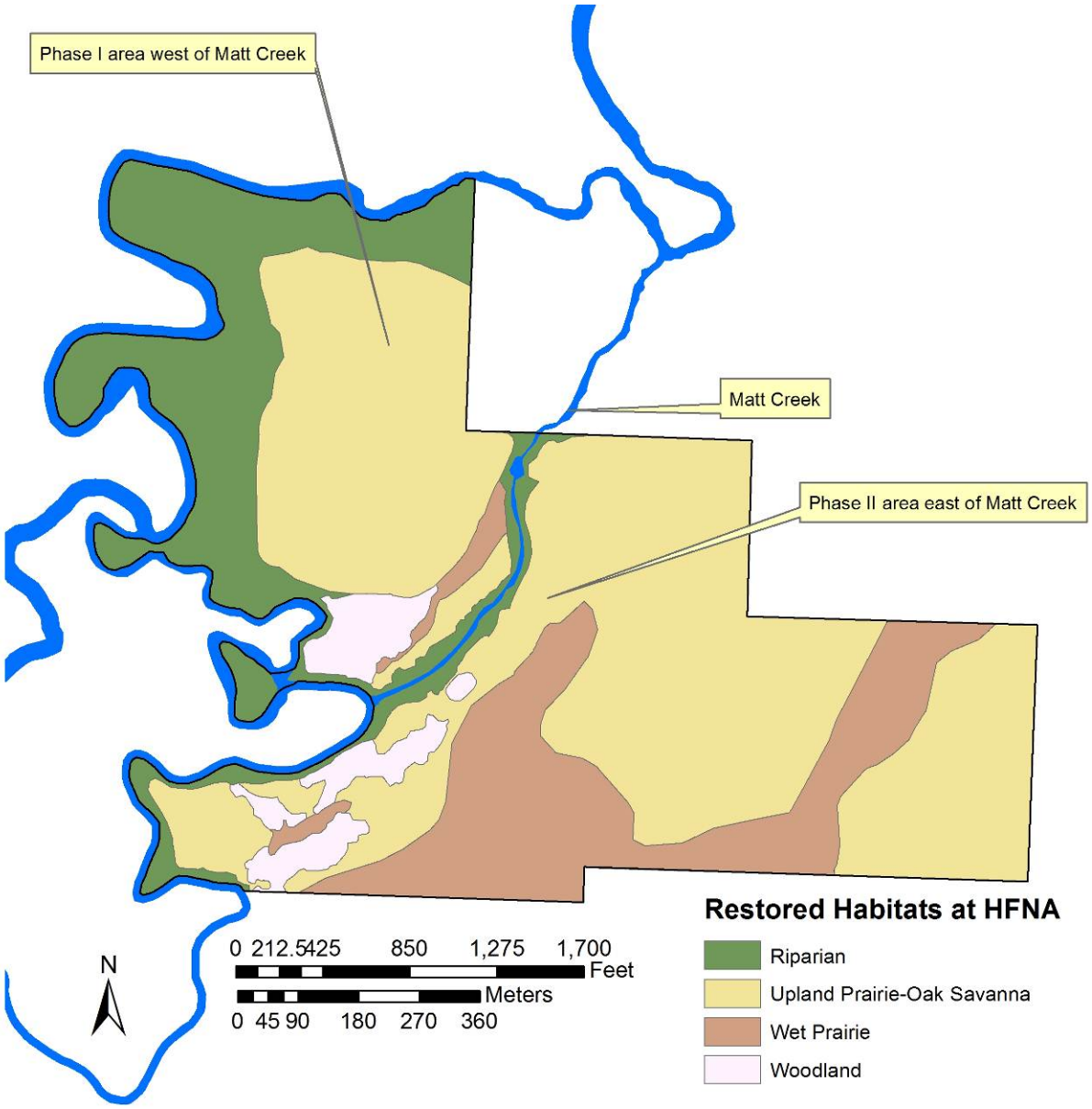

Figure 14. Desired future conditions at Herbert Farm & Natural Area (adapted from City of Corvallis: maps 3.2-3.4).

3.1 Riparian

The riparian areas at HFNA in the Phase I area can be defined into three zones:

- River bank in contact with water.
- Existing riparian terrace edge.
- Expansion area into fallow agriculture.

Work in this plan will focus on the existing riparian edge and expansion into the fallow agriculture areas. While we recognize that the erosion of the steep areas of river bank may eventually result in erosion of the existing riparian terrace edges, modification of the stream bank is outside the scope of this restoration plan. Furthermore, any changes to the channel may have positive benefits such as creation of fish habitat in backwaters. Changes in the river alignment and erosion patterns will be monitored and potential problems will be addressed as needed. 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 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 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 7 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 allow access for mowing and weed control, which may occur for an extended period of time until the canopy closes.

This plan proposes using a combination of high and low density riparian plantings, with highest density near the rivers and low density surrounding the prairie. Roughly 21.8 acres of the riparian restoration will use high density plantings, focusing in the 25 meters adjacent to the riparian terrace edge, and including areas that flood frequently during high water (defined by 1996 flood boundaries and field notes from December 2012). Flood tolerant species will be used in high density areas. Low density plantings will fill in the remainder of the fallow agriculture habitat, approximately 10.4 acres. Species used in the low density areas will have a variety of flooding tolerances. The density of plantings that supplement existing riparian along Matt Creek (3.1 acres) will vary with conditions; low density rates are used for cost estimates. Over the entire riparian area, there will be 62% high density, 29% low density, and 9% variable density in the existing riparian along Matt Creek. Planting densities are mapped in Figure 14.

Target Habitat: *The riparian corridors 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.*

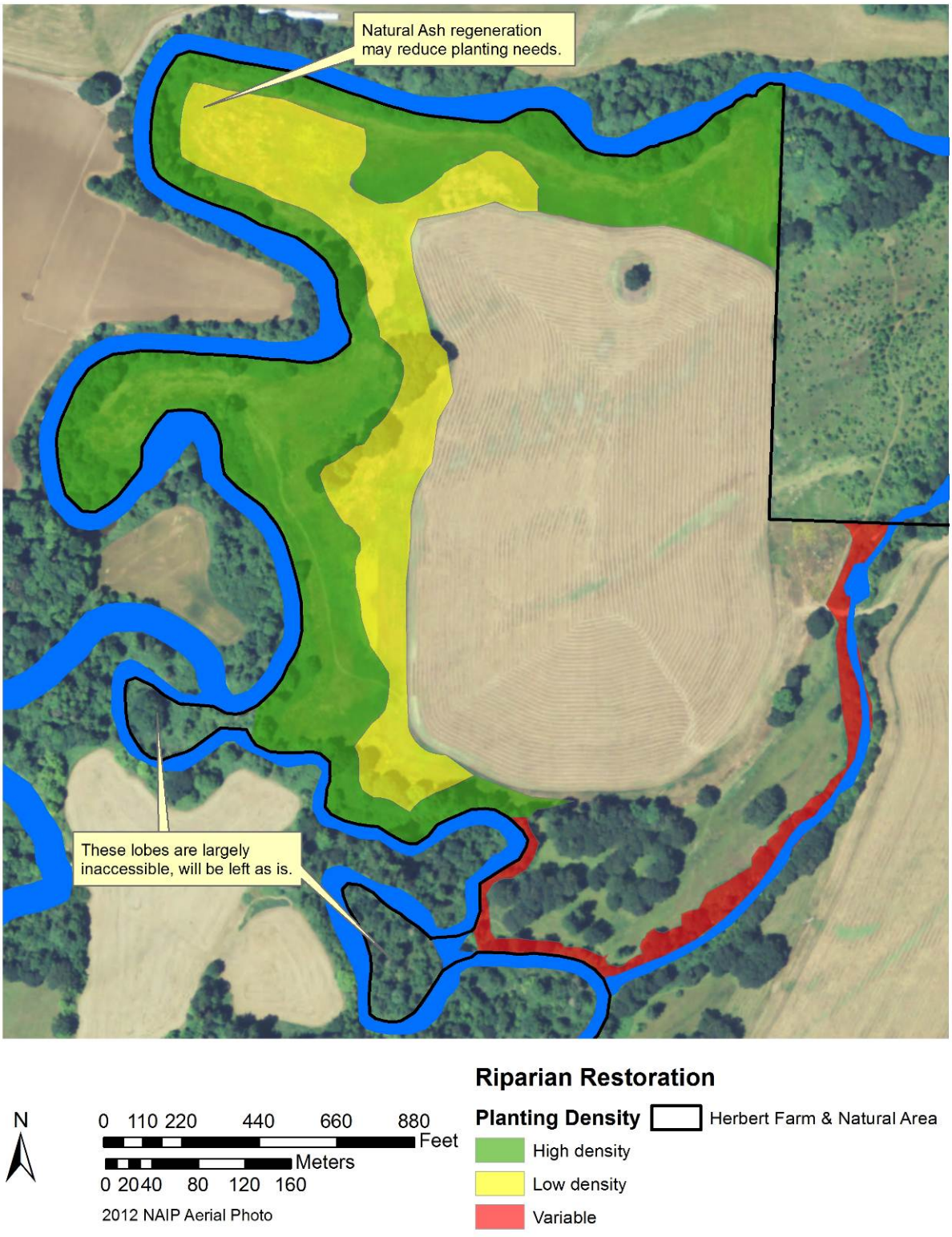

Figure 15. Riparian planting densities for Phase I riparian habitat restoration.

3.1.0 Riparian Restoration Plan

Goal 1: Enhance the existing 7.7 acres of riparian areas (includes existing vegetation bordering Marys River, Muddy Creek and Matt Creek).

Objective 1: Thin hardwoods and remove conifers from riparian areas.

- Retain some conifers to provide source of large wood for future in-stream habitat formation. Some 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).
- If trees will provide wildlife habitat, girdle and convert to snags.
- Remove other trees by cutting flush to ground and removing logs and slash.

Objective 2: Control invasive species, including Armenian blackberry and reed canarygrass, through an aggressive weed program over a two year period.

- Year 1 and Year 2
    - (2 times each year) Mow/cut and treat reed canarygrass and blackberry with stream-safe herbicide. Mechanical removal may be via skid steer mowing attachment in combination with manual chainsaw or weed-eater cutting. Mow should be before June 10, with fall herbicide spray.

Objective 3: Plant diversity of native trees and shrubs in areas reclaimed from weedy species.

- 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), with a density of 2,000 stems/acre. In low density areas, plant native trees and shrubs at a 3:1 tree to shrub ratio, (See species list and costs in Table 3), with a density of 260 stems/acre.
    - (April-May) Ring spray around plantings
    - (May/June, July, October) Spot spray weeds (3x), mow between stems (1x).
- Year 4
    - (Winter) Evaluate mortality and interplant as needed (roughly 25%).
    - (March-April) Ring spray around plantings.
    - (May/June, October) Spot spray weeds (2x).
- Year 5
    - (March/April, May/June, October) Spot spray weeds.
- (Phase II) Year 6
    - (March/April, May/June) Spot spray weeds.
- (Phase II) Year 7
    - (March/April) Spot spray weeds.

Goal 2: Increase the area of the riparian zone in Phase I Area from 7.7 acres to 37.5 acres.

Objective 1: Remove any encroaching conifers and thin existing hardwoods in forest patches of riparian expansion zones.

- Cut trees flush to ground, remove slash material, but consider retaining logs for red legged frog habitat.
- Consider converting large tees to snags for wildlife habitat.

Objective 2: Prepare the area by removing existing non-native vegetation from riparian expansion zones (22.2 acres of fallow agricultural field and 6.4 acres degraded grasslands).

- Year 1
    - (Spring) Apply stream-safe glyphosate to fallow agriculture areas and non-native grasslands.
    - (Fall) Mow fallow ag area.
    - (Fall) Apply a stream-safe pre-emergent herbicide and glyphosate, which will provide immediate control and some control of germinating weeds in Year 2.
- Year 2
    - (Spring) Broadcast application of glyphosate or similar chemical if needed.
    - (Fall) Mow fallow ag area.
    - (Fall) Apply a stream-safe pre-emergent herbicide and glyphosate.

Objective 2: Plant native shrub and tree species to expand multi-layered riparian habitat into riparian expansion zones.

- Year 3
    - (Winter) In high density areas, plant native trees and shrubs at a 1:3 tree to shrub ratio. (See species list and costs in Table 4), with a density of 2,000 stems/acre. In low density areas, plant native trees and shrubs at a density of 260 stems/acre, with a 3:1 tree to shrub ratio.
    - (March/April) Ring spray around plantings
    - (May/June, July, October) Spot spray weeds, mow between stems.
- Year 4
    - (Winter) Evaluate mortality and interplant as needed (roughly 25%).
    - (March-April) Ring spray around plantings.
    - (May/June, October) Spot spray weeds.
- Year 5
    - (March/April, May/June, October): Spot spray weeds.
- (Phase II) Year 6
    - (March/April, May/June) Spot spray weeds.
- (Phase II) Year 7
    - (March/April) Spot spray weeds.

3.1.1 Plant Materials and Labor

Total plant materials costs for the riparian restoration plantings are estimated at $26,500 including the initial planting ($20,943) and interplanting to replace dead trees/shrubs ($5,556; Table 4).

Estimated total planting labor costs in the riparian zone are estimated to be $17,816, with a cost of $14,253 for the initial planting, and $3,563 for the interplanting. We suggest not using protective tubes/netting on plantings to reduce rubbish 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.

Additional detail on habitat restoration costs are provided in Appendix B and C. Projected costs were estimated from current plant materials costs from nursery catalogs and labor and equipment contracting rates from commonly used restoration contractors.

Table 4. Plant materials for riparian restoration plantings. Costs based on 2012 prices from nurseries. Planting labor costs not included.

Species	Scientific Name	Tolerance	Tree or shrub	Stems/ acre	Quantity for 22 acres	Additional # for 25% replant	Cost/ 1000	Cost
White alder	*Alnus rhombifolia*	Wet	Tree	200	4400	1100	$ 410.00	$ 2,255.00
Oregon Ash	*Fraxinus latifolia*	Wet	Tree	200	4400	1100	$ 350.00	$ 1,925.00
Cottonwood	*Populus trichocarpa*	Wet	Tree	100	2200	550	$ 450.00	$ 1,237.50
Pacific Willow*	*Salix lucida*	Variable	Shrub	200	4400	1100	$ 450.00	$ 2,475.00
Sitka willow	*Salix sitchensis*	Wet	Shrub	300	6600	1650	$ 480.00	$ 3,960.00
Ninebark	*Physocarpus capitatus*	Range of soils	Shrub	300	6600	1650	$ 530.00	$ 4,372.50
Ocean Spray*	*Holodiscus discolor*	Range of soils	Shrub	300	6600	1650	$ 450.00	$ 3,712.50
Snowberry	*Symphoricarpos albus*	Very wet to dry	Shrub	400	8800	2200	$ 400.00	$ 4,400.00
Subtotals: High Density				**2,000**	**44,000**	**11,000**		**$ 24,337.50**
Species	**Scientific Name**	**Tolerance**	**Tree or shrub**	**Stems/ acre**	**Quantity for 13.5 acres**	**Additional # for 25% replant**	**Cost/ 1000**	**Cost**
Big leaf maple	*Acer macrophyllum*	Moist, well drained	Tree	40	540	135	$ 530.00	$ 357.75
Oregon Ash	*Fraxinus latifolia*	Wet	Tree	55	743	186	$ 350.00	$ 324.84
Red Alder	*Alnus rubra*	Variable	Tree	50	675	169	$ 350.00	$ 295.31
Oregon white oak*	*Quercus garryana*	Variable	Tree	50	675	169	$ 500.00	$ 421.88
Snowberry	*Symphoricarpos albus*	Very wet to dry	Shrub	25	338	84	$ 400.00	$ 168.75
Scouler willow	*Salix scouleriana*	Variable	Shrub	15	203	51	$ 400.00	$ 101.25
Douglas spiraea*	*Spiraea douglasii*	Moist, well drained	Shrub	15	202.5	51	$ 425.00	$ 107.58
Elderberry	*Sambucus racemosa/cerulea*	Very moist	Shrub (tall)	10	135	34	$ 380.00	$ 384.75
Subtotals: Low Density				**260**	**3,510**	**877.5**		**$ 2,162.11**
Grand Total:				**2,260**	**47,510**	**11,878**		**$ 26,499.61**

*Costs estimated.

3.2 Wet Prairie

Habitat restoration in Phase I will expand the trace of semi-degraded wet prairie that is currently present (0.8 acre) to roughly 1.9 acres through enhancement of adjacent savanna. There is a high level of microtopography at this site, which means it is hard to clearly define distinct wet prairie and upland prairie zones. To maximize seeding success, there should be some overlap in seeding and treatments in transitions between upland and wet habitats, with the expectation that individual species will survive and establish in their preferred habitat.

Target Habitat: Wet prairie dominated by tufted hairgrass, spike bentgrass (*Agrostis exrata*), meadow barley (*Hordeum brachyantherum*) and native forbs. California oatgrass will facilitate transitions from upland to wet prairie. Habitat will support Nelson's checkermallow and provide high quality nesting and rearing habitat for grassland birds and other prairie dependent species.

3.2.0 Wet Prairie Restoration Plan

Goal 1: Restore wet prairie vegetation and its ecological processes to provide habitat for native Willamette Valley wildlife while contributing to the biodiversity and functionality of the watershed.

Objective 1: Minimize woody species cover and reduce competition from non-native plant species, while increasing the diversity and abundance of native grasses and forbs to build in habitat resiliency and meet biodiversity goals.

- All years
    - (Fall) No nests for Western pond turtle and Western meadowlark have been found at this location, however, it is recommended that mowing take place outside the nesting period for these species (after August 1st). Once Nelson's checkermallows are established, mowing should occur after their seed set.
- Year 1 and 2:
    - (Spring and fall) Broadcast spray glyphosate (or similar broad-spectrum herbicide) over 1.2 acres of wet prairie and transitional upland. If Nelson's checkermallow are present and not dormant, they can be covered or mowed to minimize leaf exposure to herbicide and prevent damage to the plants.
- Year 2
    - (Fall) Broadcast seed wet prairie forbs, including species that have cultural significance to local tribes, and grasses (seed mix in Table 5). Gradual slopes could be seeded using the no-till drill already be present on site for seeding the adjacent agricultural field. If this is possible, it would increase efficiency and potentially result in higher establishment of grasses.
- Year 3
    - (Fall) If thatch remains, include wet-prairie in the prescribed burn (scheduled for adjacent remnant upland prairie) to create a seed bed for augmenting sensitive plant species (Goal 2).

Objective 2: Control persistent invasive species, including Armenian blackberry and reed canarygrass.

- Year 1 and 2

- Growing season mow (before June 10th) and additional spot spray of reed canarygrass as needed beyond planned spring and fall glyphosate applications.
- Growing season mow of blackberry, then wait for regrowth then spray with Garlon or similar action chemical depending on stream buffer and IPM constraints (Fall)—if needed beyond scheduled spring and fall glyphosate applications.

Goal 2: Expand populations of sensitive plant species.

Objective 1: Expand the existing populations of Nelson's checkermallow.

- Year 1
  - Coordinate with the U.S. Fish and Wildlife Service to acquire seed harvested from existing Nelson's checkermallow production beds for the Corvallis West Recovery Zone.
- Year 3
  - Grow 1000 Nelson's checkermallow plugs (transplants) from Corvallis West seed source.
  - (Fall) Broadcast seed Nelson's checkermallow. Select areas with suitable habitat near existing populations. This seeding could also occur in Fall of year 2, if seed bed conditions are suitable. Note: checkermallows should only be planted after natives have been established to avoid premature planting in a weedy area.
- Year 4 and 5 (if needed):
  - (Fall) Plant Nelson's checkermallow plugs. Select sites with suitable habitat near existing populations. This planting could also occur in Year 5 if conditions are poor in Year 4.

3.2.1 Plant Materials and Labor

The total cost for (common) native plant materials for use in the wet prairie restoration is estimated at $1,835 (Table 5).

Seeds of Nelson's checkermallow would be provided by the Recovery Project funded by the U.S. Fish and Wildlife Service and transplants are estimated to cost $1000. Labor costs include broadcasting seed in Year 2, at $95 and Year 3 at $100. It is anticipated that labor for Nelson's checkermallow planting will be achieved through K-12 education and outreach programs at no cost. Additional detail on habitat restoration costs are provided in Appendix B and C.

Table 5. Native seed mix for wet prairie enhancement. Costs estimated using 2012 seed prices from nurseries. Planting labor costs not included.

Scientific Name	Species	Growth Form	Lbs. / acre	Lbs. for 1.9 acres	Cost/ lb.	Cost
Achillea millefolium	yarrow	Perennial forb	0.5	0.95	$ 23.52	$ 22.34
*Asclepias speciosus**	showy milkweed	Perennial forb	0.25	0.475	$210.00	$ 99.75
*Camassia leichtlinii**	tall camas	Perennial Forb	0.5	0.95	$117.00	$ 111.15
Epilobium densiflorum	dense flower willow herb	Annual Forb	0.5	0.95	$ 57.00	$ 54.15
Eriophyllum lanatum	Oregon sunshine	Perennial Forb	1	1.9	$100.00	$ 190.00
*Lomatium nudicaule**	Bare stem biscutroot	Perennial forb	1	1.9	$135.00	$ 256.50
Lotus unifoliolatus	Oregon bird's foot trefoil	Perennial forb	0.5	0.95	$ 72.00	$ 68.40
*Perideridia oregana**	Oregon yampah	Perennial forb	0.75	1.425	$175.00	$ 249.38
Plectritis congesta	shortspur seablush	Annual Forb	0.5	0.95	$101.00	$ 95.95
*Potentilla gracilis**	sulphur cinquefoil	Perennial Forb	0.5	0.95	$110.00	$ 104.50
Prunella vulgaris var. lanceolata	common all heal	Perennial Forb	1	1.9	$ 57.00	$ 108.30
Subtotal Forbs			***7***	***13.3***		***$1,360.42***
Agrostis exrata	spike bentgrass	Perennial Grass	2	3.8	$ 19.00	$ 72.20
Danthonia californica	California oatgrass	Perennial Grass	2.5	4.75	$ 43.00	$ 204.25
Deschampsia cespitosa	tufted hairgrass	Perennial Grass	0.75	1.425	$ 10.70	$ 15.25
Hordeum brachyantherum	meadow barley	Perennial Grass	2	3.8	$ 14.25	$ 54.15
Subtotal Grasses			***7.25***	***13.775***		***$ 345.85***
Grand Totals:			**14.25**	**38.95**		**$1,706.27**

*Species of cultural significance.

3.3 Upland Prairie-Oak Savanna

3.3.0 Upland Prairie-Oak Savanna Restoration Plan

Restoration will enhance degraded non-native grassland and convert approximately 37.8 acres of agricultural field into upland prairie-oak savanna, and expand/enhance 2.4 acres of existing upland prairie and oak savanna that supports Kincaid's lupine and peacock larkspur. The eastern side of this habitat, following the property line, can be planted with oaks at a woodland density to create a hedgerow between HFNA and the adjoining private property.

Target Habitat: Upland prairie dominated by Roemer's fescue, California oatgrass and native forbs, including Oregon iris, slender cinquefoil, Oregon sunshine, Oregon geranium (*Geranium oreganum*), and dwarf checkermallow (*Sidalcea virgata = Sidalcea malviflora* ssp. *virgata*). Populations of Kincaid's lupine and peacock larkspur will expand in enhanced prairie, and will be introduced in restored habitat. Prairie will provide high quality nesting and rearing habitat for grassland birds such as the savanna sparrow, and nesting habitat for Western pond turtles and other prairie dependent species. Addition of open grown Oregon white oak at savanna density (1-2 trees per acre) during Phase II restoration will increase wildlife value for species such as the white breasted nuthatch, and provide potential habitat moderation for possible future climate change.

Goal 1: Restore upland prairie-oak savanna vegetation and its ecological processes to provide habitat for native Willamette Valley wildlife while contributing to the biodiversity and functionality of the watershed.

Objective 1: Reduce invasive species.

- Year 1
    - (Spring) Mow blackberry early enough to allow regrowth, then spray with Garlon or similar action chemical depending on stream buffer and IPM constraints (Fall).
    - Conduct regular follow up monitoring to evaluate success.

Objective 2: Enhance existing prairie to increase the abundance and diversity of native plant species, boost insect/pollinator diversity and support grassland birds.

- Year 1 & 2
    - (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.
- Year 3
    - (Fall) Prescribed burn in existing upland prairie. Fire should occur after rare species have set seed and gone dormant (After August 1).
    - (Fall) Broadcast native forb and grass mix (Table 6) to increase native species diversity in areas where satisfactory seed to soil contact can be achieved.
- Year 4 & 5
    - (Fall) Mow.

Objective 3: Convert agricultural field areas to upland prairie, increasing the abundance and diversity of native plant species to boost insect/pollinator diversity and support grassland birds.

- Year 1

    - (Fall) Broadcast spray glyphosate plus a pre-emergent herbicide to remove residual agricultural species. Pre-emergent should reduce need for a spring spray in Year 2, which may be logistically challenging with limited access.
- Year 2
    - (Spring) Broadcast spray a broad spectrum herbicide if needed and possible (depending on access). Additional glyphosate spray (Summer) may be required.
    - (Fall) Broadcast spray a broad spectrum herbicide if needed and possible.
    - (Fall) No till drill a diversity of native forbs and Roemer's fescue (Table 7) to build in habitat resiliency and meet biodiversity goals.
- Year 3
    - (Spring) Broadcast spray a grass specific herbicide to remove residual agricultural grasses, and spot spray glyphosate as needed to control weedy forb species. Consider a weed wipe with a glyphosate if target weedy species are taller than the desired native vegetation.
    - (Fall) No till drill native grass seed mix (see perennial native grasses in Table 7).
- Year 4
    - (As needed) Spot spray weedy species, likely at least twice.
    - (Fall) Mow if needed.
- Year 5
    - (As needed) Spot spray weedy species.

Goal 2: Promote populations of common grassland birds, mammals, reptiles, amphibians and sensitive species including: peacock larkspur, Kincaid's lupine, and western meadowlark.

Objective 1: In existing upland prairie, enhance habitat for sensitive plant species and reduce competition from existing non-natives and shrubs.

- Year 1
    - (Spring) Spot spray or mechanically remove blackberry.
    - (Fall) Spray blackberry with Garlon, or similar action chemical within stream protection and IPM guidelines, with care to avoid sensitive plants.
- Year 1, 2, 4, 5
    - (Fall) Mow.
- Year 3
    - (Fall) Prescribed burn.

Objective 2: Expand populations of Kincaid's lupine and peacock larkspur in enhanced existing upland prairie areas.

- Year 1
    - (Summer) If seed is not available through U.S. Fish and Wildlife Service Recovery Projects, collect Kincaid's lupine and peacock larkspur seeds. Collecting from the City of Corvallis Watershed property population or Finley NWR is suggested to increase quantity and diversity. Store appropriately.
- Year 2
    - (Summer) Collect Kincaid's lupine and peacock larkspur seeds. Store appropriately.
    - (Fall) Plant lupine seeds in areas adjacent to the existing lupine patch.
    - (Fall) Plant peacock larkspur seeds adjacent to existing patches.
- Year 3

    - (Summer) Collect Kincaid's lupine and peacock larkspur seeds. Store appropriately. Seed may also be available from Corvallis West seed increase projects.
    - (Fall) Prescribed burn.
    - (Fall) Seed additional peacock larkspur and Kincaid's lupine into burned areas.
- Year 4 and 5
    - (Spring or Fall, depending on access) Plant Kincaid's lupine transplants with K-12 students.

Objective 3: Introduce populations of Kincaid's lupine and peacock larkspur into the newly restored upland prairie area.

- Year 5
    - If weed issues are under control, seed peacock larkspur and Kincaid's lupine (restored prairie). If weeds and agricultural pests are still a problem, delay this seeding until Phase II.

Objective 4: Add oak savanna elements and to provide habitat elasticity with future climate change and provide habitat for sensitive bird species, e.g., white breasted nuthatch.

- Once upland prairie habitat is established (Phase II and beyond), plant Oregon white oak at low density, with target densities at 1-2 trees per acre.

Objective 5: Create a hedgerow to separate HFNA from the adjoining private property.

- Once upland prairie habitat is established (Phase II and beyond), plant native trees (e.g., Oregon white oak) and shrubs along the eastern border of the property, and in the lobe near the access point across Matt Creek.

3.3.1 Plant Materials and Labor

Plant material (excluding Kincaid's lupine and peacock larkspur) costs for enhancement of the existing HFNA upland prairie area are included in Table 6. Peacock larkspur seeds are not currently available, so they may be collected on site, or at the City of Corvallis Watershed or Finley NWR populations. Kincaid's lupine seeds may be available from US Department of Agriculture's Natural Resources Conservation Service (NRCS) Plant Materials Center (PMC). The Kincaid's lupine transplants will be grown and planted by the K-12 students.

Equipment and labor costs are estimated at $1701/seed drilling event, or $3402 total for the restored prairie area. Broadcast seeding in the enhanced existing upland prairie area is estimated at $100. A summary of habitat restoration costs is provided in Appendix B and C.

Table 6. Plant materials for enhancement of 2.1 acres of existing upland prairie at HFNA. Costs estimated using 2012 seed prices from nurseries.

Scientific Name	Species	Growth Form	Pounds/ acre	Pounds needed for 2.1 acres	Cost/ Pound	Cost
Achillea millefolium	yarrow	Perennial forb	0.75	2	$ 23.52	$ 37.04
*Camassia leichtlinii**	tall camas	Perennial Forb	0.5	1	$117.00	$ 122.85
Clarkia amoena	farewell to spring	Annual Forb	0.5	1	$ 81.00	$ 85.05
Eriophyllum lanatum	Oregon sunshine	Perennial Forb	0.75	2	$100.00	$ 157.50
*Iris tenax**	Oregon iris	Perennial forb	0.5	1	$150.00	$ 157.50
*Lomatium nudicaule**	Bare stem biscutroot	Perennial forb	0.5	1	$135.00	$ 141.75
*Potentilla gracilis**	sulphur cinquefoil	Perennial Forb	0.75	2	$110.00	$ 173.25
Sidalcea virgata	dwarf checkermallow	Perennial Forb	0.75	2	$125.00	$ 196.88
Subtotal Forbs			***5***	***10.5***		***$1,071.82***
Danthonia californica	California oatgrass	Perennial Grass	3.5	7.35	$ 43.00	$ 316.05
Festuca roemeri	Roemer's fescue	Perennial Grass	3.5	7.35	$ 38.00	$ 279.30
Subtotal Grasses			***7***	***14.7***		***$ 595.35***
Grand Totals:			**12**	**34.125**		**$1,667.17**

*Culturally significant species.

Table 7. Plant materials to be drilled into areas converted from agricultural field to upland prairie-oak savanna. Seed costs were estimated based on 2012 prices.

	Scientific Name	Species	Growth Form	Pounds/ acre	Pounds needed for 38 acres	Cost/ Pound	Cost
Native Forbs	*Achillea millefolium*	yarrow	Perennial Forb	0.75	28.5	$ 23.52	$ 670.32
	*Camassia leichtlinii**	tall camas	Perennial Forb	0.25	9.5	$117.00	$ 1,111.50
	Clarkia amoena	farewell to spring	Annual Forb	0.5	19	$ 81.00	$ 1,539.00
	Collomia grandiflora	collomia	Perennial Forb	0.5	19	$ 67.00	$ 1,273.00
	Eriophyllum lanatum	Oregon sunshine	Perennial Forb	0.5	19	$100.00	$ 1,900.00
	*Iris tenax**	tough leaf iris	Perennial Forb	0.5	19	$150.00	$ 2,850.00
	Madia elegans	tarweed	Annual Forb	0.5	19	$ 77.00	$ 1,463.00
	*Potentilla gracilis**	sulphur cinquefoil	Perennial Forb	0.75	28.5	$110.00	$ 3,135.00
	Prunella vulgaris	all heal	Perennial Forb	0.75	28.5	$ 40.00	$ 1,140.00
	Ranunculus occidentalis	western buttercup	Perennial Forb	0.5	19	$ 87.50	$ 1,662.50
	Sidalcea virgata	dwarf checkermallow	Perennial Forb	0.5	19	$125.00	$ 2,375.00
	Subtotal Forbs			***6***	***228***		***$ 19,119.32***
Native Grasses	*Bromus carinatus*	California brome	Perennial Grass	0.5	19	$ 6.40	$ 121.60
	Danthonia californica	California oatgrass	Perennial Grass	3	114	$ 43.00	$ 4,902.00
	Elymus glaucus	Blue wildrye	Perennial Grass	0.5	19	$ 10.00	$ 190.00
	Festuca roemeri	Roemer's fescue	Perennial Grass	3	114	$ 38.00	$ 4,332.00
	Subtotal Grasses			***7***	***266***		***$ 9,545.60***
	Grand Totals:			**13**	**722**		**$ 28,664.92**

* Culturally significant species.

3.4 Woodland

Restoration will enhance approximately 1.6 acres of forest and 3.2 acres of savanna habitat that runs northeast to southwest, roughly paralleling Matt Creek. Most of this area is in fairly good condition, as it has been regularly mowed in the past. Aggressive weedy species like blackberry and hawthorn are primarily restricted to around tree trunks where tractor mowing is limited. 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.

Target Habitat: Mature hardwood forest, dominated by Oregon white oak and including big leaf maple (*Acer macrophyllum*), white alder (*Alnus rhombifolia*) and black cottonwood (*Populus trichocarpa*). Understory will have a minimum of aggressive weed species, with downed logs to provide habitat for red-legged frog and sharptail snake. Area will provide habitat for pileated woodpeckers.

3.4.0 Woodland Restoration Plan

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 & 2
    - (Spring) Spot spray or mechanically remove blackberry and reed canarygrass.
    - (Fall) Spray blackberry regrowth with Garlon or similar action chemical depending on stream buffer and IPM constraints with care to avoid thin-leaved peavine and Nelson's checkermallow.
- Year 2
    - (Fall- Optional) If needed to compete with weedy species, add seed (broadcast application) of native annual forbs and perennial grasses (Table 7).

Objective 2: Remove conifer species and create snags.

- Years 1& 2
    - Cut trees flush to ground and remove branches.
    - Retain logs for red-legged frog habitat and sharp-tailed snake.
    - Girdle and convert trees to snags if they will provide habitat for species like slender billed nuthatch and acorn woodpecker.

Objective 3: Promote healthy hardwood trees with well-developed canopies, maintaining 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.
    - Maintain canopy gaps in areas with thin-leaved peavine or Nelson's checkermallow.

3.4.1 Plant Materials and Labor

The cost for the native seed mix to apply in the woodland areas is included in Table 7. Labor/equipment costs to broadcast the seed over 5 acres is estimated at $500. Additional detail on habitat restoration costs is provided in Appendix B and C.

Table 7. Plant materials to use as needed in relatively sunny woodland openings disturbed by thinning or tree removal. Costs estimated from 2012 seed prices. Planting costs not included.

Scientific Name	Species	Growth Form	Pounds/ acre	Pounds needed for ~4 acres	Cost/ Pound	Cost
Aquilegia formosa	columbine	Perennial forb	1	4	$186.00	$ 744.00
Clarkia amoena	farewell to spring	Annual forb	1	4	$ 81.00	$ 324.00
Madia elegans	Showy tarweed	Annual forb	1	4	$ 77.00	$ 308.00
Subtotal Forbs			***3***	***12***		***$ 1,376.00***
Bromus sitchensis	Alaska brome	Perennial Grass	1	4	$ 6.90	$ 27.60
Elymus glaucus	Blue wildrye	Perennial Grass	1	4	$ 12.00	$ 48.00
Festuca roemeri	Roemer's fescue	Perennial Grass	1	4	$ 38.00	$ 152.00
Subtotal Grasses			***3***	***12***		***$ 227.60***
Grand Totals:			**6**	**28**		**$ 1,603.60**

4 Outreach

As a natural area, Herbert farm'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 for viewing wildflowers, grassland birds, mammals, reptiles, and amphibians.

Objective 1: Coordinate restoration efforts with public trail system.

- Provide interpretive materials or signage that illustrates the habitat restoration process and describes target habitats and species to benefit.

Objective 2: Collaborate with K-12 education programs about habitat restoration.

- Coordinate with ecological education programs to provide field work days and field trips.
- Designate an acre 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, as age appropriate.
- Where possible, use students in monitoring tasks.

Goal 2: Introduce culturally important plant species.

Objective 1: Coordinate restoration efforts with Native American tribal groups.

- Engage with the Confederated Tribes of Grand Ronde in the development of plant materials for production.

Objective 2: Plant culturally important plant species

- Include prairie forbs, shrubs and trees that historically were important resources for Native American people, to provide a modern resource for cultural practices and education.
- Consult with the Confederated Tribes of Grand Ronde regarding landscape designs that simultaneously support ecological functions and cultural values.

5 Schedule

The projected project schedule is included in Table 8. Precise timings may vary with site access, weather conditions, and adaptive management.

Table 8. Overall project schedule.

		Year 1	Year 2	Year 3	Year 4	Year 5
		2013	**2014**	**2015**	**2016**	**2017**
Late Winter & Spring	Riparian-existing	Brush removal	Brush removal	Plant trees/shrubs	Re- plant trees/shrubs as needed	
		Strip spray	Strip spray	Ring spray (1x) Spot Spray (2x)	Ring spray (1x) Spot Spray (1x)	Spot spray (2x)
	Riparian-fallow Ag	Broadcast spray	Broadcast spray if needed	Plant trees/shrubs	Re- plant trees/shrubs as needed	
				Ring spray (1x) Spot Spray (2x)	Ring spray (1x) Spot Spray (1x)	Spot spray (2x)
	Up prairie-existing	Spot spray herbicide	Spot spray herbicide		Plant rare species plugs	Plant rare species plugs
	Up prairie-Ag conv.		Broadcast spray	Herbicide or weed-wipe if needed		
	Wet prairie	Glyphosate spray	Glyphosate spray		Plant rare species plugs	Plant rare species plugs
	Woodland	Spot spray herbicide	Spot spray herbicide			
		Monitoring		Monitoring	Monitoring	Monitoring
Summer & Fall	Riparian-existing			Mow between rows		
		Strip spray	Strip spray	Spot spray (1x)	Spot spray (1x)	Spot spray (1x)
	Riparian-Fallow Ag	Mow	Mow	Mow between rows	Mow between rows (low density)	
		Broadcast glyphosate + pre-emergent herbicide	Broadcast spray	Spot spray (1x)	Spot spray (1x)	Spot spray (1x)
	Up prairie-existing	Collect rare species seeds	Collect rare species seeds	Prescribed burn	Mow	Mow
		Mow	Mow	Broadcast seed native forb-grass mix + rare spp.		
	Up prairie-Ag conversion	Farmer removes crop, residue	Broadcast spray if needed	Spot spray if needed	Spot spray	Plant rare species
		Broadcast pre-emergent	Drill native forbs + fescue	Drill native grasses	Mow	Mow
	Wet prairie	Mow then blanket spray glyphosate	Mow then blanket spray glyphosate	Prescribed burn	Mow	Mow
			Broadcast forbs/grasses	Seed Nelson's		
	Woodland	Thin	Thin			
		Broadcast seed bare areas	Broadcast seed bare areas			
		Mow	Mow	Mow	Mow	Mow

6 Monitoring and Adaptive Management

The Willamette Wildlife Mitigation Program will be developing standard monitoring and reporting protocols during 2013 and these will be adopted for the restoration project as appropriate. Multiple aspects of the monitoring described here are required to meet endangered species habitat restoration permitting obligations under the Benton County HCP (Benton County 2010). These protocols have been developed by IAE ecologists and used on other IAE monitoring programs.

Monitoring will occur to:

- Locate and map invasive 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.
- 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 in Years 1-5. Formal monitoring methods will vary between habitat types. Methods for each type, along with frequency of monitoring, are listed in Table 9.

6.1.0 Rare Plant Species Monitoring

Rare plants (Kincaid's lupine, peacock larkspur, thin-leaved peavine, Nelson's checkermallow) will be monitored using a complete census (count all plants present) with the timing and minimum frequency suggested in Table 9. Methods to quantify these species will follow guidelines identified by the Oregon Department of Agriculture (Currin and Meinke 2012).

- Young seedlings of Kincaid's lupine may be counted, while the abundance of mature species should be assessed using square meters of plant cover (e.g., the area of the ground that is covered with lupine leaves).
- Nelson's checkermallow will be counted, and when plants appear quite large and may be bunched together, each square meter of stems coming out of the ground may be counted as one plant.
- In the case of peacock larkspur, individual plants should be counted. The larkspur is extremely slow growing and takes many years to progress from a seedling to a mature flowering plant; when possible, the census should track both numbers of seedlings, juvenile (non-flowering plants), and flowering plants.

Rare species data will be compared with previous surveys conducted in 2006 and 2009, and summary data will be supplied to the Oregon Biodiversity Information Center. Monitoring data will also be reported to Benton County for HCP endangered species habitat restoration permitting requirements.

Table 9. Vegetation monitoring frequency, layout and methods for Phase I restoration area. Continued monitoring of the Phase I area is recommended once Phase II restoration begins.

Habitat	Year 1 (Baseline)	Year 2	Year 3	Year 4	Year 5	Suggested Monitoring layout	Suggested Monitoring Methods
All	X		X		X	Walk through entire Phase 1 area.	May-August. Locate and map invasive species.
Riparian-enhanced (6.5 acres net)	X			X		Twenty 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.
Riparian-restored (30 acres)	X			X		Sixty 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.
Upland prairie-enhanced (2.1 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.
Upland prairie-restored (37.8 acres)	X				X	Thirty 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.
Wet prairie (1.9 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 (4.1 acres)					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) will be used as baseline for species presence and breeding status, and repeat surveys by Year 5, utilizing the same methodology, are recommended. Students may assist with various scales and levels of wildlife monitoring.

6.3 Adaptive Management

Adaptive management is a process that allows land managers and restoration practitioners to incorporate new information in their 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 project, 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 as monitoring is completed, 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, restoration 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 restoration plan may be modified to reduce the quantity of future transplant efforts, reducing costs.
- If the prescribed fire is extremely effective at removing thatch, the restoration plan schedule may be modified to remove mowing the year following fire.

7 Restoration and Management Challenges

A variety of challenges will be provided by the location and nature of Herbert Farm and Natural Area. They 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 will be required to determine if project methods will have an impact on known cultural resources, as required by the National Historic Preservation Act (1966). If required, a cultural resource survey in accordance with State Historic Preservation Office (SHPO) guidelines will need to occur prior to ground disturbing restoration and enhancement activities. As the majority of the property has been under cultivation for many years, it has already experienced significant ground disturbance. Any archaeological sites that are identified during the review will be avoided during restoration.

7.2 Burning

While an extremely effective habitat restoration tool, prescribed burning 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. Close coordination with the airport and Corvallis Fire Department will be required prior to any burn plan development. Burning will also have to be coordinated with public access and outreach. A flame-weeder could be considered for the smaller burn areas, which would reduce concern about airport safety and simplify burn plans.

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 (Figure 15 and Figure 16).

7.4 Access

The access point to the western part of HFNA is across Matt Creek, which holds water through the spring. High fall and winter/early spring water levels will make access to the northwest sector (Phase I) for restoration activities extremely limited between December and April/May in most years (Figure 16). Crossing Matt Creek with equipment during this high water period will not be possible without a bridge. However, as the required span at the main access point is >60 feet, the cost may be prohibitive for the City. Some phases of restoration, such as riparian tree and shrub planting that has to occur in February or March while Matt Creek is holding water, will have to be achieved by transporting workers and plant materials across via boat, or raft and cable. Transporting materials by boat will reduce efficiency and will likely result in increased costs. In addition, if large equipment is unable access the site in late fall and early spring, the options available for achieving adequate weed control become more limited. Where possible, we have planned the restoration activities to minimize the need for access between November and April.

Figure 16. Flooding of fallow agricultural grassland area of Herbert Farm and Natural Area after fall rains

Figure 17. Matt Creek flooded at access point into Phase I restoration area, December 2012

7.5 Erosion

Stream bank erosion is severe in areas, particularly along the Marys River (Figure 18 and Figure 19). While this project proposes restoring the vegetation structure of the riparian forest adjacent to the stream, we are not proposing actual structural or physical stream bank modification. Left to its own devices, the river may create new channels, islands and backwaters along the HFNA. Allowing the Marys River to develop backwater areas and new channels is viewed by the project partners as a potential enhancement of the natural area. It is unlikely that these changes will impact adjacent properties and may reduce flooding up and down stream. Changes in the river alignment will be monitored and potential problems will be addressed as needed. In some areas, removal of weedy species such as Armenian blackberry and reed canarygrass on or near the steep bank may temporarily increase erosion until native vegetation becomes established.

7.6 Recreation/Trails

The City of Corvallis plans 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. The City will complete a trail plan by March 2013, and begin construction later in the year. Restoration will be able to work around and complement the trail locations, particularly as most plantings are not planned to occur until 2014. Foot traffic that is confined to trails should not threaten sensitive plant or wildlife species. 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.

Figure 18. Several sections of the Marys River Bank have steep eroded banks, as seen in the above view during summer 2012 at Herbert Farm and Natural Area. The same view is repeated in Figure 18.

Figure 19. Marys River can overtop its banks in several places during high fall and winter flows. This corner is actively eroding and may benefit from bank stabilization in addition to the riparian planting if it is desired to maintain the current river channel.

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 programmatic restoration biological opinion for the Partners for Wildlife Program (USFWS 2010a), and for prairie species, the programmatic formal consultation on Western Oregon prairie restoration (USFWS 2008). For example, mowing of prairie areas should generally 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 herbicide used in habitat restoration may have short term impacts on rare plants, a net long term benefit is expected. Under the Endagered Species Act, such work requires 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 will comply with the HCP Cooperative Agreement for Herbert Farm and Natural Area. 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 in years when work occurs in areas with federally listed species.

Acquisition of rare plant materials (seeds or transplants) can be challenging but is possible with advanced planning and coordination with the US Department of Agriculture's Natural Resources Conservation Service (NRCS) Plant Materials Center (PMC) or qualified native seed producers such as Heritage Seedlings. Institute for Applied Ecology is producing plant materials that can also contribute to this effort. 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 and grow out efforts by entities such as PMC.

Streaked horned lark is currently proposed to be federally listed. If they are attracted to the restoration area, this may require a formal consultation by USFWS to determine what restoration activities are allowable.

7.8 Riparian Buffer Zones and Chemical Limitations

All herbicides used in restoration activities will be used within the guidelines of their labeling, particularly relative to required setbacks from water courses. Suggested Integrated Pest Management (IPM) guidelines specific to the species at Herbert are included in Section 8 and Appendix A, and should work in concert with the City of Corvallis' Integrated Vegetation and Pest Management Plan and relevant USFWS-NOAA Biological Opinions for fish species (National Marine Fisheries Service 2009).

7.9 Maintenance

There will be an ongoing need for maintenance within HFNA as restoration proceeds, and after restoration is complete. Maintenance activities will include invasive weed control and regular mowing (Figure 20) as well as sign, trail, parking lot, and access road maintenance.

8 Future Management

8.1 Best Management Practices

The following best management practices include those recommended by the U.S. Fish and Wildlife Service for use in areas with sensitive species of the Willamette Valley in the programmatic formal consultation on Western Oregon prairie restoration (USFWS 2008) and the USFWS programmatic restoration biological opinion for the Partners for Wildlife Program (USFWS 2010a). Use of herbicides in riparian areas should also comply with the Biological Opinions for fish species (National Marine Fisheries Service 2009).

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).

Figure 20. Fallow grassland being mowed in summer at Herbert Farm and Natural Area.

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 an Integrated 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.
- Exposure of non-targeted species to herbicides associated with drift, leaching to groundwater, and surface runoff will be avoided or minimized.
- 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 I restoration area, beyond 2017, 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 annually.
- 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 (Table 5).

9 Cost Summary

The estimated cost to complete the project is included in Table 10 (see Appendix B and C 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);
- labor and equipment (planting labor, tree removal, mowing);
- monitoring (vegetation and wildlife); and
- plant materials (native grass and forb seed, rare species seeds/transplants, riparian trees and shrubs).

Costs were estimated from 2012 labor and contract rates from commonly used restoration contractors, and plant material costs from nursery catalogs (Appendix C). Project management and reporting costs are estimated as 20% of the other direct costs (Table 10). 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. ODFW has funded IAE to start the restoration for the first half of 2013, and further funds from the program will be applied for annually. Project costs will also be supplemented by other grant applications in 2013. We anticipate that rare plant seed will be available at no cost from other grant programs, such as the Nelson's checkermallow Recovery Project, which is funded by OWEB and USFWS. Some other reductions to direct costs of the restoration project may be possible through partner in-kind contributions, such as mowing by the City and labor and equipment from other agencies, for example USFWS and ODFW (see Appendix C).

Table 10. Projected expense to complete Phase I restoration activities at HFNA, including project management, vegetation management, labor and equipment, monitoring and plant materials. All costs in 2012 dollars.

Task	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Project management and reporting	$ 5,849.30	$ 8,716.76	$ 15,193.82	$ 7,648.91	$ 2,370.78	$ 39,779.58
Vegetation Management	$ 13,983.60	$ 14,778.20	$ 14,422.80	$ 12,746.00	$ 3,146.00	$ 59,076.60
Labor and equipment	$ 8,219.30	$ 5,354.30	$ 29,056.10	$ 14,462.15	$ 3,747.90	$ 60,839.75
Monitoring	$ 5,440.00	$ -	$ 960.00	$ 4,480.00	$ 4,960.00	$ 15,840.00
Plant materials	$ 1,603.60	$ 23,451.32	$ 31,530.22	$ 6,556.42	$ -	$ 63,141.56
Total	$ 35,095.80	$ 52,300.58	$ 91,162.95	$ 45,893.49	$ 14,224.68	$ 238,677.50

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Appendix A: Integrated Pest Management (IPM) Guide

IPM refers to pest control strategies that use an ecological approach to reduce chemical pesticide use while also managing pests at acceptable levels. This means that the first action is to identify the pest and the appropriate time within its lifecycle for management. If mechanical control of the pest doesn't work, then chemical control should be used at the appropriate timing.

Table adapted from Northwest Weed Management Partnership IPM Guide for Common Weeds edition June 15th, 2009. *Disclaimer: This document is a basic guide and assumes no liability toward product efficacy, loss of non-targeted plants, or personal safety issues. Always follow label instructions, wear proper safety gear, and avoid herbicide drift. If in doubt as to control practices, consult a licensed treatment contractor.*

Integrated Pest Management (IPM) Guide for Priority Weed Species

Species	Mechanical	Chemical	IPM	Notes/Tips
Armenian Blackberry	- Mow, pull, or burn to remove canes. Mow at least twice a year: May/early June and September. - In small patches, grub roots in the winter and spring when soil is moist. Be sure to remove the root collar. -Graze infestations with sheep or goats. -Shading is the best long-term non-chemical approach	August through October tryclopyr amine ¾ --1 ¼ + non-ionic or MSO/silicon blend surfactant ¼ -- ½ % Fall before hard frost tryclopyr ester ½ -- 1 % + MSO or oil surfactant ¼ -- ½ % In mixed stands of blackberries and snowberries (common in riparian areas) you can spray over the top of both in the fall with tryclpyr amine without damaging the snowberries. Spray using reasonable coverage	-Mow in May/early June and allow for regrowth. -Treat with tryclopyr amine or ester in the fall	- A leaf rust fungus that targets wild blackberry species was accidentally introduced to the United States and was recently discovered in the Pacific Northwest in 2005. It has been used for decades as a biocontrol agent in Chile, Australia, and New Zealand. The fungus (*Phragmidium violaceum*) attacks the leaves of the blackberry, causing defoliation. It can also infect buds, unripe fruit, and the growing parts of the cane. The rust is spreading, but its persistence and subsequent impact on blackberries depends on adequate moisture.
Scot's Broom	-Cut large plants (stem greater than 1 inch) in the driest times of the year. -Pull small plants (less than 1 inch) by hand or with a weed wrench. - Burning can help reduce weed	Can spray any time of growing season, but spring at onset of flowering is best. tryclopyr ester @ 1.5% + aminopyralid @ 7 oz/acre+MSO@1/2%	- Keeping soil disturbance to a minimum and encouraging other plants to grow will help prevent Scot's broom from spreading further while it is being removed. - Mow in early spring and	- Be sure to clean all equipment used at the site. - Don't use contaminated gravel. Ask the supplier if stockpiled gravel is free of broom plants, or check out the piles.

Species	Mechanical	Chemical	IPM	Notes/Tips
	biomass but may encourage sprouting and may not kill large plants. - Mowing should be avoided when seed pods are ripe. Seeds already on the ground may be spread by mowing. Mowing typically results in dense, multi-stemmed regrowth which can be good for spraying, but not good for subsequent mechanical removals.	Spray using full coverage	treat regrowth in the fall or following spring with tryclopyr/aminopyralid combination.	- Don't mow Scot's broom when seed pods are ripe. - Pulling large plants with a weed wrench creates ideal growing conditions for the seed bank – consider cutting instead. - A battery powered "Saws All" is a great tool for cutting large stems.
English Ivy	-Protect trees and prevent seed production by cutting vines around tree trunks. Clear Ivy 3 feet out from the base of the tree. -Vines can be rolled up like a carpet. -Goats and sheep love ivy, and can be used to clear areas prior to pulling of the roots. - Cutting or pulling the vines provides some control but large root systems will resprout. -	Chopper 3% with MSO 10% tryclopyr amine 1 – 2 % + non-ionic or MSO/silicon blend surfactant 4 up to 20 qt/100 gal glyphosate 5% to max label rate + MSO or non-ionic surfactant ½ % or higher (5%) glyphosate 50% solution in water on cut stumps	-Cut ivy away from trees and apply foliar herbicide treatment to leaves on the ground. (Either don't cut into tree bark or don't get herbicide into the cuts.) - Cutting the vines back and then applying herbicide provides the best control.	- If you do nothing else, keep ivy out of the trees to protect the trees and prevent seed production. - Use care with the herbicide treatments around trees and shrubs that you do not want to inadvertently kill.
False-brome	-Mowing, burning, grazing (maybe) can be used to remove/deplete annual seed production. -Mow any time in June and the	Fall glyphosate 2 % gal + oryzalin @ 3.3% + non-ionic or MSO/silicon blend surfactant ½ %	June – mow Fall – spray with glyphosate and oryzalin	Slow the spread of false-brome by making sure clothing and equipment are free of seeds before you leave an infested site.

Species	Mechanical	Chemical	IPM	Notes/Tips
	plants should not resprout and produce seed that year. (Mow in May and false-brome resprouts. Mow after July, you will spread false-brome everywhere you go.) Lay down mulch (clean weed free straw) after mowing to suppress false-brome for one additional year. -Hand pull small patches in April and early May.			
Meadow Knapweed	- Digging plants is effective for small areas - Disking or roto-tilling can control infestations, but established plants can survive if root fragments remain.	- May until flowering is best (before seed set) but could be treated any time during active growing season glyphosate 2-5%+ non-ionic surfactant ¼ -- ½ % 2,4-D 2 % + clopyralid ¼ -- ½ %+ non-ionic or MSO/silicon blend ¼ -- ½ % aminopyralid (7 oz product / ac)+ non-ionic or MSO/silicon blend (1-2 qt/100 gal)	- There are several insects that reduce plant biomass or seed production - An integrated management plan that includes selective herbicides and biological control may show the greatest effectiveness for removal of meadow knapweed.	The smell of some 2, 4-D products does not persist (e.g. “Hardball”).
Canada Thistle, Bull Thistle		May until flowering is best (before seed set) but could be treated any time during active growing season glyphosate 2-5% + nonionic		

Species	Mechanical	Chemical	IPM	Notes/Tips
		surfactant ¼ -- ½ % 2,4-D 2% + clopyralid ¼ -- ½ %+ non-ionic or MSO/silicon blend ¼ -- ½ % aminopyralid (7oz product / ac)+ non-ionic or MSO/silicon blend ¼ -- ½ %		
Reed Canary Grass	- Prescribed burning and disking or plowing, especially in combination with one or more herbicide applications, is very effective at controlling reed canary grass.	Upland areas: glyphosate 2-5% + non-ionic ¼ -- ½ % Riparian and streamside areas: glyphosate labeled for aquatic use 2-5%; 5.4 lb/gal; no surfactant	- Control is difficult and may require treatment for several years. - Removing it may also cause erosion problems so other species must be used to cover the area quickly.	-Removal of old vegetation before herbicide application ensures that the herbicide will contact new growth. -Spray up to the water with aquatic herbicide but not in water without a DEQ discharge permit
Robert's Geranium, Shining Geranium	- Hand pull isolated plants or small populations before they set seed. - Burning with a propane-based flaming unit is effective if done several times each growing season.	Fall glyphosate 2 % gal + oryzalin @ 3.3% + non-ionic or MSO/silicon blend surfactant ½ %		

Herbicide	Trade Name Examples	Activity	Selectivity
2,4-D	Hardball	foliar	grasses generally resistant
aminopyralid	Milestone	foliar	
clopyralid	Transline		
fluazifop	Fusilade DX	foliar	broadleaf and woody plants highly resistant
glyphosate	Round-up, Accord, Rodeo	foliar	
metsulfuron	Escort	foliar and soil	broad-spectrum; grasses can be tolerant
oryzalin	Surflan AS	soil(pre-emergent)	
sulfometuron	Oust	foliar and soil	broad-spectrum; woody perennials resistant
tryclopyr amine	Garlon 3A	foliar	grasses resistant
tryclopyr ester	Garlon 4	foliar	grasses resistant
Surfactant			
Non-ionic	R-11, Induce, Activator 90		
Oil	Agridex, Mor-act, Herbimax		
MSO			
MSO/Silicon blend	Dyn-amic, Syltac, Phase		

Appendix B: Detailed estimated budget for Phase 1 restoration activities at Herbert Farm and Natural Area

Task	Subtask	Habitat	Units	Cost/unit	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Herbicide: Broadcast	Herbicide treatment	Ag & fallow ag areas: Riparian and Upland 66 ac	acres	[illegible] 18/gal *0.5 gal/ac	$ 1,660.00	$ 3,187.20	$ 604.80			$ 5,452.00
Herbicide: ATV Broadcast	Herbicide treatment	Fallow ag areas.	acres	$24/acre + $ 18/gal *0.5	$ 732.60					$ 732.60
Herbicide: Spot Spray	Herbicide treatment	All areas	hours+ chemical	$67/hour + chemical	$ 401.00	$ 401.00	$ 4,218.00	$ 3,146.00	$ 3,146.00	$ 11,312.00
Herbicide- blanket spray	Herbicide treatment	wet prairie- 1.9 acres	acres	$250 +	$ 1,350.00	$ 1,350.00				$ 2,700.00
Strip spray riparian X 2	Herbicide treatment	Riparian edge- 8 ac (10m wide)	hours	$ 205.00	$ 9,840.00	$ 9,840.00				$ 19,680.00
Ring spray	Herbicide treatment	Riparian	acres + chemical	$ 250.00			$ 9,600.00	$ 9,600.00		$ 19,200.00
Riparian tree/shrub Planting	Labor and equipment	Riparian	plants	$ 0.30			$ 14,253.00	$ 3,563.25		$ 17,816.25
Seed drill/planting	Labor and equipment	Upland-Ag	events				$ 1,701.00	$ 1,701.00		$ 3,402.00
Tree removal/thinning	Labor and equipment	Riparian + Woodland	hours	$ 120.00	$ 2,880.00	$ 1,920.00				$ 4,800.00
Broadcast or ATV Seeding	Labor and equipment	wet and up prairie	acres	$50/acre	$ 100.00	$ 195.00	$ 200.00			$ 495.00
Mowing	Labor and equipment	wet and up prairie + fallow ag yr 1+2	acre	$31/hr+$300 mobilization	$ 1,239.30	$ 1,239.30	$ 427.10	$ 1,722.90	$ 1,722.90	$ 6,351.50
Prescribed burn	Labor and equipment	Up prairie					$ 5,000.00			$ 5,000.00
Brush mowing w/ chainsaw- full area year 1, half again year 2.	Labor and equipment	Riparian edge- 8 ac (10m wide)	acres	$ 500.00	$ 4,000.00	$ 2,000.00				$ 6,000.00
Tractor mow between low density stems	Labor and equipment	Riparian- 13.5 ac	acres	$ 150.00			$ 2,025.00	$ 2,025.00	$ 2,025.00	$ 6,075.00
Push mowing between stems: High density	Labor and equipment	Riparian- 21.8 ac	acres	$ 250.00			$ 5,450.00	$ 5,450.00		$ 10,900.00
Monitoring: Vegetation and rare plants	Monitoring	All areas	days	$ 640.00	$ 4,480.00			$ 4,480.00		$ 8,960.00
Monitoring: Weed search	Monitoring	All areas	days	$ 480.00	$ 960.00		$ 960.00		$ 960.00	$ 2,880.00
Monitoring: Wildlife	Monitoring	All areas	days	$ 800.00					$ 4,000.00	$ 4,000.00
Native trees & shrubs	Plant materials	Riparian	plugs	varies			$ 20,943.19	$ 5,556.42		$ 26,499.61
Nelson's checkermallow plugs	Plant materials	Wet prairie- enhanced	project					$ 1,000.00		$ 1,000.00
Upland Forb seed + roemer's	Plant materials	Upland-Ag	acres	$ 292.26		$ 23,451.32				$ 23,451.32
Upland forb/grass mix	Plant materials	Upland-Enhanced	acres	$ 588.35			$ 1,667.17			$ 1,667.17
Upland Grass seed (minus romers)	Plant materials	Upland-Ag	acres	$ 340.40			$ 5,213.60			$ 5,213.60
Wet prairie seed mix	Plant materials	Wet prairie- enhanced	acres	$ 538.56			$ 1,706.27			$ 1,706.27
Woodland annual forb mix	Plant materials	Woodland	acres	varies	$ 1,603.60					$ 1,603.60
Kincaid's lupine seed	Plant materials	Upland					$ 1,000.00			$ 1,000.00
Nelson's checkermallow seed	Plant materials	Wet prairie					$ 1,000.00			$ 1,000.00
	Subtotal				*$ 29,246.50*	*$ 43,583.82*	*$ 75,969.12*	*$ 38,244.57*	*$ 11,853.90*	*$ 198,897.91*
	Project Management	20% of costs			$ 5,849.30	$ 8,716.76	$ 15,193.82	$ 7,648.91	$ 2,370.78	$ 39,779.58
	GRAND TOTAL				$ 35,095.80	$ 52,300.58	$ 91,162.95	$ 45,893.49	$ 14,224.68	$ 238,677.50

Appendix C. Calendar for Phase 1 restoration activities at Herbert Farm and Natural Area 2013-17. Projected tasks and the party responsible to complete them. Contractor generally refers to IAE and includes subcontracted tasks managed by IAE.

	Task	Acres	Hours	Responsible				Description	Cost/Acre or Cost per hour	Cost
				Contractor	City	USFWS	ODFW			
Year 1	Monitoring		56	X	a			Baseline vegetation monitoring.	$80/hr	$ 4,480.00
Year 1	Monitoring weed survey		16	X	a			Weed survey whole site.	$60/hr	$ 960.00
Year 1	Thin trees		24		X	b		Thin trees in riparian and woodland.	$120/hr	$ 2,880.00
Year 1	Buy seed			X				Woodland mix.		$ 1,603.60
Year 1	Broadcast seed	2		X				Broadcast in woodland disturbed areas.	$50/acre	$ 100.00
Year 1	ATV Broadcast herbicide spray	22.2		X				Spray fallow ag area.	$24/acre + $ 18/gal herbicide*0.5 gal/ac	$ 732.60
Year 1	Brush removal	8		X				Chainsaw or skid steer to remove weeds, brush in 10 m strip from riparian edge. 8 acres.	$500/acre	$ 4,000.00
Year 1	Herbicide blanket spray	1.9 x 2		X				Spray 1.9 acres of wet prairie 2 times.	$250/acre + chemical	$ 1,350.00
Year 1	Herbicide broadcast spray	66		X				Fall broadcast spray, glyphosate + preemergent.	$7/acre + $ 18/gal herbicide*1 gal/ac	$ 1,660.00
Year 1	Herbicide spot spray	9.1	3	X				Spot spray 9 acres. Assume 3 ac/hour.	$67/hour+ chemical	$ 401.00
Year 1	Herbicide strip spray	8	24	X				Strip spray existing riparian 2 times.	$205/hour including chemical	$ 9,840.00
Year 1	Tractor mow	30.3			X			Fall mow. Cost estimated from contractor rate.	$31/acre + $300 mobilization	$ 1,239.30
Year 1	Project management			X				Project management and reporting.	20% of direct costs	$ 5,849.30
Year 2	Thin trees		16	X				Thin trees in riparian and woodland.	$120/hr	$ 1,920.00
Year 2	Brush removal	4		X				Repeat Chainsaw or skid steer to remove weeds, brush in 10 m strip from riparian edge. About 4 acres.	$500/acre	$ 2,000.00
Year 2	Herbicide blanket spray	1.9 x 2		X				Spray 1.9 acres of wet prairie 2 times.	$250/acre + chemical	$ 1,350.00
Year 2	Herbicide broadcast spray (3x)	66 x 3		X				Spring and fall broadcast spray, with possible summer spray as well.	$7/acre + $ 18/gal herbicide*0.5 gal/ac	$ 3,187.20
Year 2	Herbicide strip spray	8	24	X				Strip spray existing riparian 2 times.	$205/hour including chemical	$ 9,840.00
Year 2	Herbicide spot spray	9.1	3	X				Spot spray 9 acres. Assume 3 ac/hour.	$67/hour+ chemical	$ 401.00
Year 2	Tractor mow	30.3			X			Fall mow.	$31/acre + $300 mobilization	$ 1,239.30
Year 2	Buy seed			X				Upland forbs and fescue.		$ 23,451.32
Year 2	Broadcast seed	3.9		X				Broadcast in woodland disturbed areas and wet prairie.	$50/acre	$ 195.00

	Task	Acres	Hours	Responsible				Description	Cost/Acre or Cost per hour	Cost
				Contractor	City	USFWS	ODFW			
Year 2	Drill seed	37.8				%	%	No till drill seed in restored upland prairie.	$45/acre	$ 1,701.00
Year 2	Project management			X				Project management and reporting.	20% of direct costs	$ 8,716.76
Year 3	Buy riparian materials			X				First planting.		$ 20,943.19
Year 3	Plant riparian	36		X				Labor to plant about 36 acres of riparian materials.	$0.30 per plant	$ 14,253.00
Year 3	Herbicide ring spray	36		X				Ring spray ~ 36 acres riparian plantings.	$250/acre + chemical	$ 9,600.00
Year 3	Mow high density riparian rows.	21.8		X	b			Push mow.	$250/acre	$ 5,450.00
Year 3	Mow low density riparian rows.	13.5		X	b			Narrow tractor mowing.	$150/acre	$ 2,025.00
Year 3	Monitoring weed survey		16	X				Weed survey whole site.	$60/hr	$ 960.00
Year 3	Herbicide broadcast spray	37.8		X				Spring grass specific broadcast spray.	$7/acre + $ 18/gal herbicide*0.5 gal/ac	$ 604.80
Year 3	Herbicide spot spray	37.7 x 3, 37.8	54	X	b			Spot spray total of 160 acres over multiple visits. Assume 3 ac/hour.	$67/hour+ chemical	$ 4,218.00
Year 3	Obtain rare plant seed.					X		Lupine and checkermallow seed.		$ 2,000.00
Year 3	Buy seed			X				Upland and wetland mixes.		$ 8,587.04
Year 3	Tractor mow	4.1			X			Fall mow.	$31/acre + $300 mobilization	$ 427.10
Year 3	Prescribed Burn					X		Burn and Burn Plan		$ 5,000.00
Year 3	Drill seed	37.8				%	%	No till drill seed in restored upland prairie.	$45/acre	$ 1,701.00
Year 3	Broadcast seed	4		X				Broadcast in existing upland prairie and checkermallow in wet prairie.	$50/acre	$ 200.00
Year 3	Project management			X				Project management and reporting.	20% of direct costs	$ 15,193.82
Year 4	Replant riparian- 25%	36		X				Labor to replant 25% of 36 acres.	$0.30 per plant	$ 3,563.25
Year 4	Buy rare plant plugs			X				Nelson's checkermallows.		$ 1,000.00
Year 4	Buy riparian materials			X				Second planting.		$ 5,556.42

	Task	Acres	Hours	Responsible				Description	Cost/Acre or Cost per hour	Cost
				Contractor	City	USFWS	ODFW			
Year 4	Monitoring-vegetation		56	X				Follow up vegetation monitoring.	$80/hr	$ 4,480.00
Year 4	Mow high density riparian rows.	21.8		X	b			Push mow.	$250/acre	$ 5,450.00
Year 4	Mow low density riparian rows.	13.5		X	b			Narrow tractor mowing.	$150/acre	$ 2,025.00
Year 4	Herbicide ring spray	36		X				Ring spray ~ 36 acres riparian plantings.	$250/acre + chemical	$ 9,600.00
Year 4	Herbicide spot spray	37.7 x 2, 37.8	38	X	b			Spot spray total of 113 acres over multiple visits. Assume 3 ac/hour.	$67/hour+ chemical	$ 3,146.00
Year 4	Tractor mow	45.9			X			Fall mow.	$31/acre + $300 mobilization	$ 1,722.90
Year 4	Project management			X				Project management and reporting.	20% of direct costs	$ 7,648.91
Year 5	Herbicide spot spray	37.7 x 3	38	X	b			Spot spray total of 113 acres over multiple visits. Assume 3 ac/hour.	$67/hour+ chemical	$ 3,146.00
Year 5	Monitoring weed survey		16	X				Weed survey whole site.	$60/hr	$ 960.00
Year 5	Monitoring wildlife		40	X				Wildlife survey whole site.	$100/hr	$ 4,000.00
Year 5	Mow low density riparian rows.	13.5		X	b			Narrow tractor mowing.	$150/acre	$ 2,025.00
Year 5	Tractor mow	45.9			X			Fall mow.	$31/acre + $300 mobilization	$ 1,722.90
Year 5	Project management			X				Project management and reporting.	20% of direct costs	$ 2,370.78
								Subtotal	*Contractor*	*$ 219,044.00*
								Subtotal	*City*	*$ 9,231.50*
								Subtotal	*USFWS*	*$ 8,701.00*
								Subtotal	*ODFW*	*$ 4,458.38*
								Grand Total		$ 238,677.50

[a] City may fund separately.

[b] City or USFWS may be able to contribute if suitable equipment and staff available.

[%] Shared tasks, will assume 50-50 share in subtotals.