

Herbert Farm and Natural Area Restoration – 2022 Annual Report



1/11/2023

Report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife

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PREFACE

IAE is a non-profit organization whose mission is conservation of native ecosystems through restoration, research and education. IAE provides services to public and private agencies and individuals through development and communication of information on ecosystems, species, and effective management strategies. Restoration of habitats, with a concentration on rare and invasive species, is a primary focus. IAE conducts its work through partnerships with a diverse group of agencies, organizations and the private sector. IAE aims to link its community with native habitats through education and outreach.



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ACKNOWLEDGMENTS

A key to the overall success of restoration work at Herbert Farm has been the collaboration between IAE and its funders and restoration partners, several of which have contributed important on-the-ground actions and project support. Funding was provided by the Oregon Department of Fish and Wildlife (ODFW) through Grant Agreement Number 107-22, and we thank ODFW's Willamette Wildlife Mitigation Program staff, Laura Tesler, Ann Kreager, and Owen Cass for their help administering the grant and providing support. Additional funding for plant materials came from the Plants for People Phase III (Oregon Watershed Enhancement Board grant #221-3007-19001) and the City of Corvallis. Other important restoration activities were coordinated or conducted by staff from partner agencies, particularly Jude Geist, Emily Day, and Jennifer Killian (Parks and Recreation Department, City of Corvallis) and Nate Richardson (Partners for Fish and Wildlife Program, U.S. Fish and Wildlife Service). Plant materials support came from Morgan Franke, Emily Wittkop and Mara Friddle. Photos in this report were taken by Peter Moore, unless otherwise stated.

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Cover photograph: Restored prairie at Hebert Farm and Natural Area, May 23, 2022.

Suggested citation

Alaica, S, P. Moore and A. Esterson. 2023. Herbert Farm and Natural Area restoration – 2022 annual report. Unpublished report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, OR. 38 pp. plus appendices.

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Herbert Farm and Natural Area Restoration – 2022 Annual Report

REPORT FOR THE WILLAMETTE WILDLIFE MITIGATION PROGRAM,
OREGON DEPARTMENT OF FISH AND WILDLIFE

1. EXECUTIVE SUMMARY

Herbert Farm and Natural Area, a 221-acre property near Corvallis in Benton County, Oregon, is owned by the City of Corvallis, and has a conservation easement held by Oregon Department of Fish and Wildlife through the Willamette Wildlife Mitigation Program. Since 2013, the Institute for Applied Ecology (IAE), with assistance and funding from several agencies, has restored formerly farmed areas to natural habitats. In spring 2022, contractors conducted herbicide spot sprays, focusing primarily on the Phase II area (130 acres) east of Matt Creek, while IAE ecologists surveyed four threatened and endangered species on the property. In summer 2022, the City of Corvallis mowed the entirety of the site. In fall 2022, IAE ecologists used a no-till drill to seed 184.5 pounds of native grasses across the 49-acre upland prairie in Phase II. An additional 28 pounds of native seed were broadcast across the 2.5-acre wet swale in Phase II, and included 13 forb, one rush, one sedge, and one grass species.

2. INTRODUCTION

Herbert Farm and Natural Area (HFNA) is a 221-acre property located south of Corvallis in Benton County, Oregon (Figure 1). The property is owned and administered by the Parks and Recreation Department of the City of Corvallis (City) and has a conservation easement with Oregon Department of Fish and Wildlife (ODFW) through the Willamette Wildlife Mitigation Program (WWMP), which is funded by the Bonneville Power Administration (BPA).

The City developed a management plan for HFNA to guide restoration and management over a 10-year period (2011-2021, City of Corvallis 2011). The Institute for Applied Ecology (IAE) developed habitat restoration plans with guidance from the management plan and collaboration with restoration partners including the City, ODFW, BPA, and the U.S. Fish and Wildlife Service (USFWS) for two phases of habitat restoration at HFNA (Menke et al. 2013, Moore 2017a). Restoration of Phase I, 84 acres north-west of Matt Creek, and Phase II, 130 acres east of Muddy and Matt creeks, began in 2013 and 2015, respectively (Figure 1).

Despite previous agricultural use, the property retains areas of high-quality native prairie, oak savanna, and riparian forest. Three threatened and endangered plant species were already present on the site, including Kincaid's lupine (*Lupinus oregonus*), Nelson's checkermallow (*Sidalcea nelsoniana*), and peacock larkspur (*Delphinium xpavonaceum*), as well as several rare species and species of concern (Institute for Applied Ecology 2013).

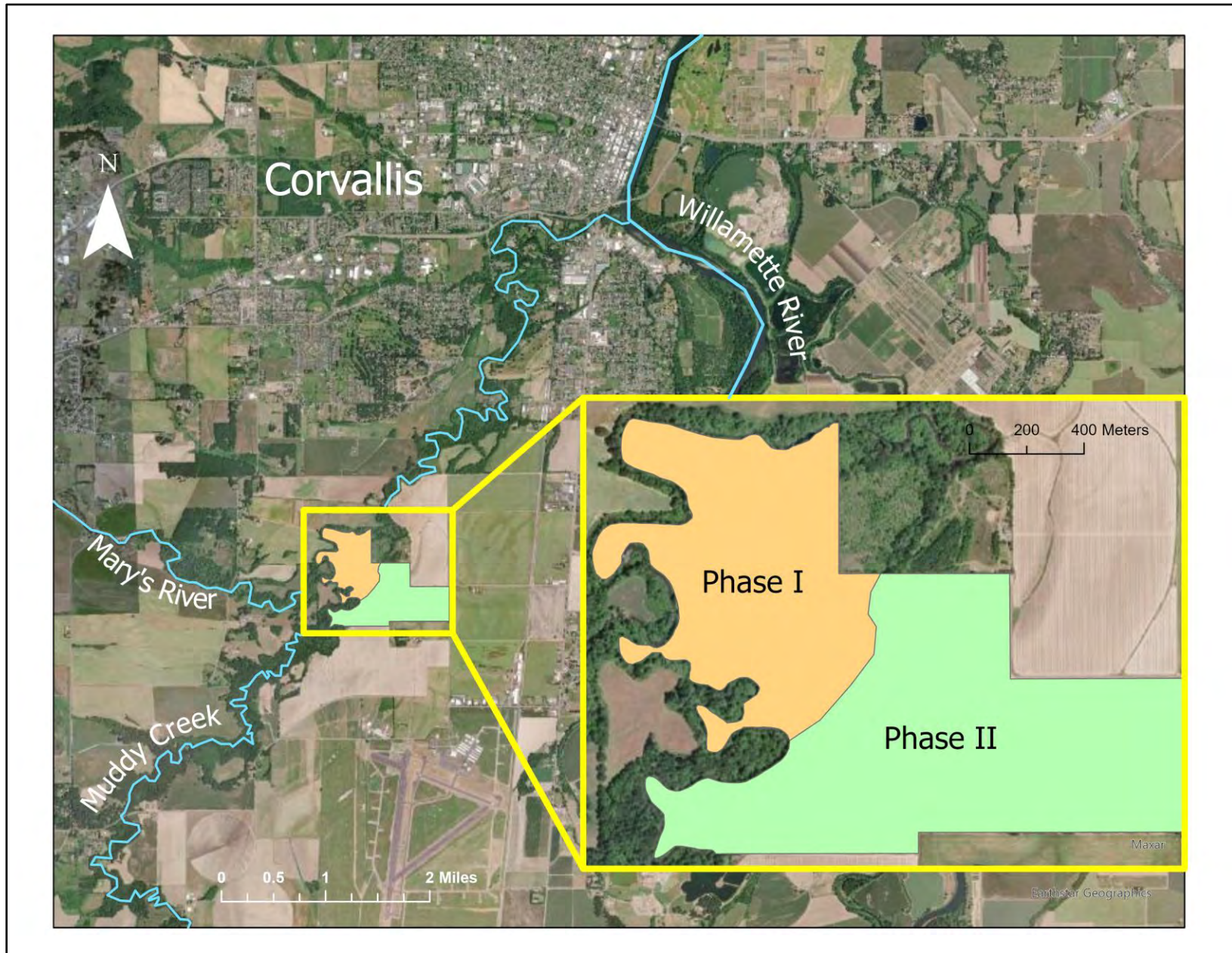


Figure 1. Herbert Farm and Natural Area location, southwest of Corvallis, Benton County, Oregon.

HFNA is also an important site for streaked horned larks (*Eremophila alpestris strigata*), a threatened species which is found at the nearby Corvallis Municipal Airport. Restoration east of Matt Creek focused in part on creating habitat for streaked horned larks. An Endangered Species Conservation Recovery Implementation grant (funded by USFWS) was implemented in 2016-2017 to compare restoration treatments for creating streaked horned lark habitat and to monitor the population at HFNA (Moore 2017b).

The USFWS Partners for Fish and Wildlife Program constructed berms in 2016 to flood two swales and promote bare ground and sparse vegetation for streaked horned lark habitat (Moore 2017c). Separate projects (funded by the Federal Aviation Administration and managed by City of Corvallis, Precision Approach and Ecological Assessment and Restoration Services of AECOM and IAE) fallowed 23 acres of former farmland for three years (2018-2020) to attract streaked horned larks and mitigate for impacts to the species during runway improvements at Corvallis Municipal Airport. This project, with additional funding from City of Salem and USFWS, included monitoring of streaked horned larks and testing of decoys and a sound attraction system at HFNA (Lapinski and Bahm 2018).

Restoration was conducted and coordinated by IAE using operations and maintenance funding from the WWMP, as well as several other grants including three Plants for People grants (funded by the Oregon Watershed Enhancement Board) and three State Wildlife Grants (funded by USFWS through the Center for Natural Lands Management [CNLM]). Other partner agencies, including the USFWS Partners for Fish and Wildlife Program, ODFW, the City, and Confederated Tribes of Grand Ronde (CTGR) contributed in-kind efforts.

Since active restoration efforts began in 2012, all former-agricultural fields have transitioned into prairie habitat. Threatened and endangered species have been augmented with plantings and seedings, and riparian areas have been revegetated with trees and shrubs. In the forest, conifers were felled and girdled to open the canopy. A prescribed burn was conducted in 2020. For a complete list of restoration actions conducted to date, see Appendix 1. Summary of restoration actions at Herbert Farm and Natural Area conducted from 2012-2022..

3. GOALS AND OBJECTIVES

The City's overall mission for HFNA includes maintaining and restoring the site's ecological attributes, managing agriculture to be compatible with natural and cultural resources, encouraging recreation while protecting rare species and their habitat, and supporting education projects (City of Corvallis 2011).

The City's restoration goals (City of Corvallis 2011) include:

- Conserve, protect, and enhance natural functioning habitats of HFNA, in particular the prairie, oak savanna, oak woodland, and riparian corridors.
- Manage HFNA agricultural lands in a sustainable manner that affords protection and restoration of natural habitat functions.

Management Plan restoration objectives (City of Corvallis 2011):

- Restore prairie structure, diversity, and plant community composition by reducing encroachment of woody vegetation, controlling non-native invasive plant species, and increasing native plant and animal species abundance.
- Enhance oak savanna habitat by improving stand composition and structure and expanding the presence of rare and native plant and animal species.
- Improve health and vigor of upland forest and oak woodland.

- Increase native plant abundance, vigor, and diversity of riparian corridors and buffers, increase stream bank shading and reduce erosion.

This report summarizes restoration work completed at HFNA in 2022. It also summarizes actions achieved under other grants and in-kind actions by partner agencies to recognize the multiple contributions to restoration at HFNA. The current habitat conditions at HFNA are shown in Figure 2, with map codes provided for interpretation of tables and the text. Previous years’ restoration actions are summarized in Appendix 1 and described in previous reports (Moore 2017c, 2018, 2019, 2020, 2021, Moore & Currin 2021).

4. 2022 RESTORATION ACTIONS

Restoration actions conducted in each restoration unit during 2022 are summarized in Table 1 and Table 2 with more detail provided in the text. Restoration units are separated by habitat type (e.g., prairie, woodland, riparian) with map codes for individual areas (Figure 2).

Table 1. Summary of restoration actions completed in Phase I areas of Herbert Farm and Natural Area in 2022 (see Figure 2 for map code locations).

Month	Riparian forest (28 acres)	West prairie (37 acres)	Woodland (4 acres)	Wet prairie (2 acres)	Upland prairie (2 acres)
	Map code 1	2	3	4	5
May		Spot spray; Survey golden paintbrush and peacock larkspur			Survey golden paintbrush and peacock larkspur
Jun	Spot spray, Hand mow, photo points	Mow perimeter; Photo points; Survey Kincaid's lupine & Nelson's checkermallow; Survey vegetation plots; Weed mapping		Photo points; Survey Nelson's checkermallow; Survey vegetation plots; Weed mapping	Photo points; Survey Kincaid's lupine & Nelson's checkermallow; Survey vegetation plots; Weed mapping
Aug		Mow	Mow	Mow	Mow

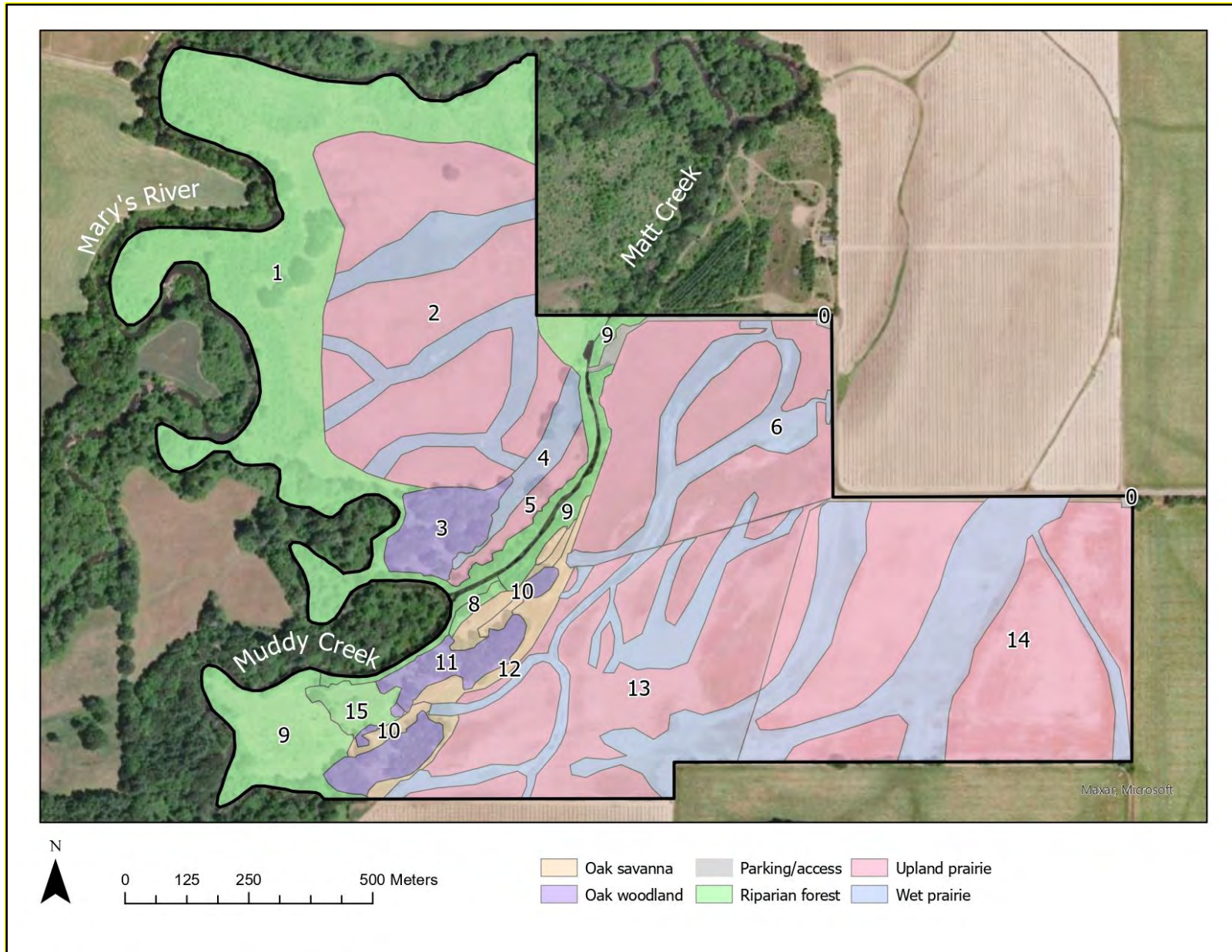


Figure 2. Current habitats at Herbert Farm and Natural Area in 2022 with map codes for individual areas that are referred to in Tables 1 and 2 and the text.

Table 2. Summary of restoration actions completed in Phase II areas of Herbert Farm and Natural Area in 2022 (see Figure 2 for map code locations).

Month	North prairie (25 acres)	South prairie (35 acres)	East prairie (49 acres)	Oak savanna (4 acres)	Riparian forest (6.6 acres)	Oak woodland (5 acres)
	Map code 6	13	14	10, 12	8, 9, 15	11
Apr	Spot spray	Spot spray edges; Monitor streaked horned larks	Spot spray edges; Broadcast spray; Monitor streaked horned larks; Volunteer event	Spot spray	Spot spray	
May	Spot spray; Survey peacock larkspur	Spot spray; Monitor streaked horned larks	Spot spray; Monitor streaked horned larks	Spot spray	Spot spray	Spot spray
Jun	Mow berms; Photo points; Survey Kincaid's lupine & Nelson's checkermallow, vegetation plots and weed mapping	Photo points; Monitor streaked horned larks	Photo points; Monitor streaked horned larks		Hand mow; Photo points	
Aug	Broadcast spray wet swale in preparation for planting	Monitor streaked horned larks	Monitor streaked horned larks			
Oct	Broadcast seed native forbs and grasses in wet swale		No-till drill seed native grasses			
Nov				Spot spray	Spot spray	

4.1. Vegetation management

Riparian forest (Phase I: 28 acres; Figure 2: map code 1)

R. Franco Restoration, an IAE subcontractor, conducted spring treatments within the riparian plantings including:

- Spot spraying with Rodeo (glyphosate) and Vastlan (triclopyr) on June 1, 2022 to target invasive grasses such as reed canarygrass (*Phalaris arundinacea*), and broadleaf weeds including Canada thistle (*Cirsium arvense*) and bull thistle (*C. vulgare*) (Figure 3).
- Mowing low-density riparian rows with brush mowers June 10, 2022.



Figure 3. Crewmembers from R. Franco Restoration spot spraying broadleaf weeds (left, June 1, 2022) and mowing (right, June 10, 2022), in low-density riparian area at Herbert Farm and Natural Area.

West prairie and wet swales (Phase I: 37 acres; Figure 2: map code 2)

R. Franco Restoration conducted treatments in spring including:

- Spot spraying thistles, particularly Canada thistle, with Transline (clopyralid); other broadleaf weeds with Vastlan (triclopyr); and common velvetgrass (*Holcus lanatus*) and reed canarygrass with Rodeo (glyphosate) on May 17, 2022. These herbicide treatments keep common weed species from expanding in the restored prairie.
- Mowing the prairie perimeter on June 10, 2022 to allow easier equipment access and reduce the risk of fire.

Owen Cass from ODFW mowed most of the upland areas and wet swales to a height of 6-8 inches on August 16-30, 2022, to reduce the amount of thatch build-up and create more space for a diverse forb-rich native plant community. Variable patches of un-mowed vegetation were left to allow shelter for animals and insects.

Woodland, upland and wet prairies (Phase I: 8 acres; Figure 2: map codes 3, 4, 5)

City staff mowed the woodland, upland, and wet prairies on August 18, 2022. Mowing is essential for preventing encroachment of shrubs such as common snowberry (*Symphoricarpos albus*), Pacific poison oak (*Toxicodendron diversilobum*), Nootka rose (*Rosa nutkana*), and oneseed hawthorn (*Crataegus monogyna*). In addition, mowing helps maintain an understory herb community including a dense population of large camas (*Camassia leichtlinii* var. *suksdorfii*).

North prairie and wet swales (Phase II: 25 acres; Figure 2: map code 6)

R. Franco Restoration conducted spring treatments including:

- Spot spraying prickly lettuce (*Lactuca serriola*), thistles, oxeye daisy (*Leucanthemum vulgare*), pennyroyal (*Mentha pulegium*) and other broadleaf weeds with Transline (clopyralid) and/or Vastlan (triclopyr); and common velvetgrass, ryegrass (*Lolium* sp.) and other non-native grasses with Rodeo (glyphosate) on May 23, 2022 (Figure 4). These treatments helped keep non-native plants from spreading.
- Mowing grass and thatch near the stream crossing and on the berms on June 10, 2022.

IAE staff conducted weed control treatments:

- Spot spraying ryegrass and reed canarygrass with Rodeo (glyphosate) on April 6, and April 7, 2022. The focus was along the access road and property line on the north side of the restoration unit.

Brady Russell from Habitat Restoration LLC broadcast sprayed Rodeo (glyphosate) in August 2022 on a 2.5-acre portion of the wet swale (Figure 7). Native species had failed to establish in the swale, possibly because the swale held water longer than other areas, drowning the seeds.

Owen Cass from ODFW mowed most of the upland areas between August 16-30, 2022. Owen left a mosaic of un-mowed patches to allow shelter and late-season food for animals and insects.



Figure 4. Crewmembers from R. Franco Restoration spot spraying the 25-acre Phase II prairie at Herbert Farm and Natural Area (left, May 23, 2022) and mowing along the stream and berms (right, June 10, 2022).

Oak woodland and savanna (Phase II: 9 acres; Figure 2: map codes 10, 11, 12)

R. Franco Restoration spot sprayed Himalayan blackberry (*Rubus bifrons*) and oneseed hawthorn with Garlon 3A (triclopyr) on May 11, 2022. IAE staff also spot sprayed Himalayan blackberry with Garlon 3A (triclopyr) around the periphery on November 8, 2022.

Riparian forest (Phase II: 4.5 acres, Figure 2: map code 9; 2.1 acres, Figure 2: map codes 8, 15)

R. Franco Restoration conducted spring treatments within the riparian plantings to reduce the competition from grasses and control common broadleaf weeds. Treatments included:

- Line spraying with Rodeo (glyphosate) and spot spraying with Vastlan or Garlon 3A (triclopyr) on June 1, 2022 to target invasive grasses, such as velvetgrass and reed canarygrass, and broadleaf weeds including Canada thistle, bull thistle, Fuller’s teasel (*Dipsacus fullonum*), tansy ragwort (*Jacobaea vulgaris*) and oxeye daisy.
- Mowing high-density riparian rows with brush mowers, chainsaws and weed whackers on June 10, 2022.

IAE staff spot sprayed Himalayan blackberry and Canada thistle with Garlon 3A (triclopyr) on November 8, 2022.

South prairie and wet swales (Phase II: 35 acres; Figure 2: map code 13)

Habitat Restoration LLC conducted spring treatments that included:

- Spot spraying prickly lettuce, thistles, oxeye daisy, pennyroyal and other broadleaf weeds with Transline (clopyralid) on May 26, 2022.

ODFW staff mowed the south prairie from August 16-30, 2022, leaving habitat patches as refugia for wildlife (Figure 5).



Figure 5. Owen Cass from the Oregon Department of Fish and Wildlife mowing the 35-acre south prairie (left, August 17, 2022), and leaving habitat patches (right).

East Prairie (Phase II: 49 acres; Figure 2: map code 14)

Habitat Restoration LLC completed spring treatments including:

- Spot spraying prickly lettuce, thistles and other broadleaf weeds with Transline (clopyralid) and Vastlan (triclopyr); and common velvetgrass, ryegrass and other non-native grasses with Rodeo (glyphosate) on June 1, 2022.

4.3. Planting

IAE staff purchased seed from multiple commercial nurseries, including Heritage Seedlings Inc., Kenagy Family Farm Inc., Pacific Northwest Natives, River Refuge Seed Company, Friends of Buford Park, Silver Falls Seed Company and Oregon Wholesale Seed Company. Seed was also purchased from the Willamette Valley Native Plant Partnership and from IAE. Bare-root plants were donated by Sevenoaks Native Nursery near Corvallis, Oregon.

4.3.1. Seed

Native seed was sown in two restoration areas at HFNA on October 5 and 6, 2022 as described below.

WET SWALE (PHASE II: 2.5 ACRES; FIGURE 2: MAP CODE 6)

The wet swale was broadcast with a diverse mix of wet prairie forbs and graminoids (Figure 7, Table 3) using hand-crank belly bags operated by IAE and City staff.

EAST PRAIRIE AND WET SWALES (PHASE II: 49 ACRES; FIGURE 2: MAP CODE 14)

Seed was sown with a no-till drill supplied by USFWS Partners for Fish and Wildlife Program and ODFW. A second-year grass seed mix was sown to the upland areas to increase diversity since only forbs were sown in fall 2021 (Table 3), and wet prairie forbs and graminoids were seeded in the swale.

4.3.2. Bare-root plants

On April 4, 2022, four IAE staff and 13 volunteers attended an Earth Day planting day at HFNA (Figure 6). Volunteers planted 100 strawberry (*Fragaria virginiana*), and 300 each of Oregon geranium (*Geranium oregonum*), self-heal (*Prunella vulgaris*), and narrow-leaved mule’s ears (*Wyethia angustifolia*) throughout the 25-acre north prairie (Figure 2: map code 6; Table 4).



Figure 6. Michel Wiman (IAE) and volunteers planting bare-root plants donated by Sevenoaks Native Nursery at Herbert Farm and Natural Area (April 4, 2022).

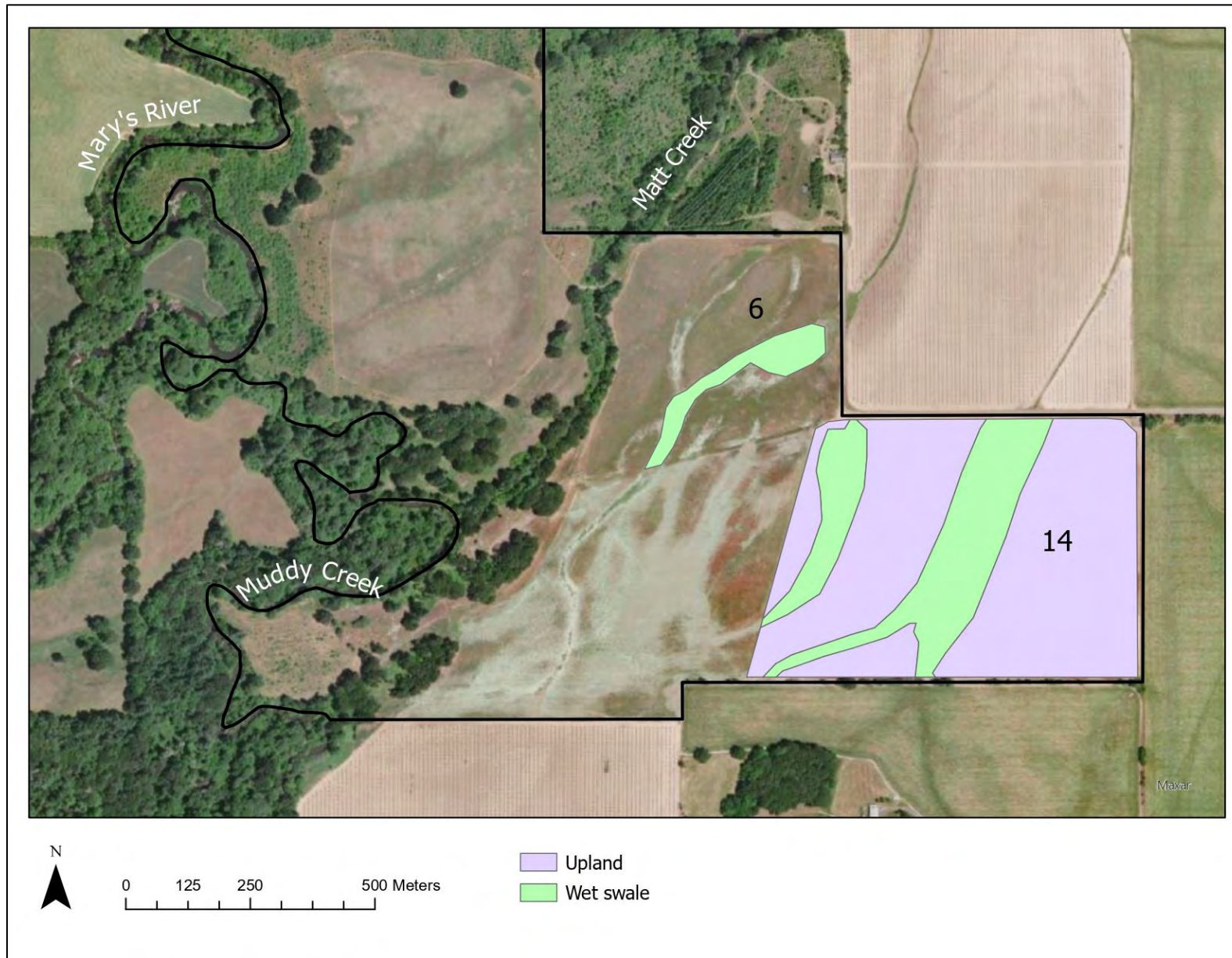


Figure 7. Areas where seed was sown in October 2022 at Herbert Farm and Natural Area. Numbers refer to restoration units mentioned in text (see Figure 2).

Table 3. Native seed mixes drilled or broadcast at Herbert Farm and Natural Area in October 2022.

Scientific name	Common Name	Duration	Growth habit	Pounds of seed per mix	
				Upland 49 acres	Wet swales 6.5 acres
<i>Agrostis exarata</i>	spike bentgrass	perennial	grass	1.3	
<i>Alopecurus geniculatus</i>	water foxtail	perennial	grass		2.61
<i>Beckmannia syzigachne</i>	American sloughgrass	annual	grass	4.6	
<i>Bromus sitchensis</i>	Alaska brome	perennial	grass	103.1	
<i>Camassia leichtlinii</i> var. <i>suksdorfii</i>	large camas	perennial	forb		1.7
<i>Carex densa</i>	dense sedge	perennial	sedge	1.5	
<i>Carex tumulicola</i>	splitawn sedge	perennial	sedge	1.9	
<i>Carex unilateralis</i>	lateral sedge	perennial	sedge	1.9	
<i>Clarkia amoena</i> ssp. <i>lindleyi</i>	farewell to spring	annual	forb		1.65
<i>Danthonia californica</i>	California oatgrass	perennial	grass	87.1	
<i>Deschampsia cespitosa</i>	tufted hairgrass	perennial	grass	4.1	
<i>Downingia elegans</i>	elegant calicoflower	annual	forb		0.87
<i>Eleocharis ovata</i>	ovate spikerush	perennial	sedge		1.70
<i>Elymus glaucus</i>	blue wildrye	perennial	grass	55.9	
<i>Epilobium densiflorum</i>	denseflower willowherb	annual	forb		2.80
<i>Grindelia integrifolia</i>	Puget Sound gumweed	perennial	forb		2.66
<i>Hordeum brachyantherum</i>	meadow barley	perennial	grass	40.7	
<i>Juncus bufonius</i>	toad rush	annual	rush	0.1	0.20
<i>Juncus occidentalis</i>	poverty rush	perennial	rush	0.1	
<i>Koeleria macrantha</i>	prairie junegrass	perennial	grass	0.5	
<i>Microsteris gracilis</i>	slender phlox	annual	forb		1.63
<i>Mimulus guttatus</i>	common monkeyflower	perennial	forb		0.07
<i>Plagiobothrys figuratus</i>	fragrant popcornflower	annual	forb		3.85
<i>Plectritis congesta</i>	shortspur seablush	annual	forb		0.52
<i>Potentilla gracilis</i>	slender cinquefoil	perennial	forb		2.40
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	common self-heal	perennial	forb		5.09
<i>Poa secunda</i>	pine bluegrass	perennial	grass	1.0	
<i>Rorippa curvisiliqua</i>	western yellowcress	annual	forb		0.21
<i>Veronica peregrina</i> var. <i>xalapensis</i>	hairy purslane speedwell	annual	forb		0.11
Total pounds per acre				6.2	4.3
Total pounds				303.8	28.07

Table 4. Bareroot species planted at Herbert Farm and Natural Area in April 2022.

Scientific name	Common name	Type	Size	Quantity
<i>Fragaria virginiana</i>	Strawberry	Bare root	-	100
<i>Geranium oreganum</i>	Oregon geranium	Crown	Medium	300
<i>Prunella vulgaris</i>	Self-heal	Seedling	Medium	300
<i>Wyethia angustifolia</i>	Narrow-leaved mule’s ears	Crown	Small	300
Total				1000

5. MONITORING

5.1 Observations by habitat type

Informal monitoring of restoration progress and invasive plants occurred on a regular basis during 2022 to guide restoration treatments. Some observations of vegetation establishment are included below.

Riparian forest (Phase 1: 28 acres, Figure 2: map code 1)

The riparian trees and shrubs installed in 2015-2016 continue to do well, achieving canopy cover in high-density areas, while remaining open in low-density areas (Figure 8). The tallest trees are black cottonwoods (*Populus balsamifera* ssp. *trichocarpa*), many of which are more than 10 meters tall.



Figure 8. Established riparian trees and shrubs in high density planting areas (left, June 1, 2022) and low-density planting areas (right, June 1, 2022).

West prairie and wet swales (Phase 1: 37 acres, Figure 2: map code 2)

Perennial forbs such as dwarf checkermallow (*Sidalcea malviflora*) continue to establish in the west prairie (Figure 9). The vetch (*Vicia* spp.) infestation that occurred in 2020 had a resurgence in 2022 (Figure 9). It is possible that vetch peaks on biennial cycles, or that climactic variations such as the wet 2022 spring resulted in a robust summer bloom.



Figure 9. Perennial dwarf checkermallow (*Sidalcea malviflora*, left) and vetch (*Vicia* spp., right) in the Phase I restoration prairie at Herbert Farm and Natural Area, June 1, 2022.

Woodland (Phase I: 4 acres, Figure 2: map code 3)

Mowing shrubs in 2021 led to an increased open understory in 2022. The shrubs will need ongoing control to prevent encroachment.

Upland and wet prairies (Phase I: 4 acres, Figure 2: map codes 4,5)

Species planted and seeded in fall of 2021 following the prescribed burn were present in 2022, including peacock larkspur (*Delphinium* × *pavonaceum*, Figure 10). The wet prairie continues to see a high concentration of native species, including Nelson’s checkermallow (*Sidalcea nelsoniana*; Figure 10).



Figure 10. Flowering peacock larkspur (*Delphinium* × *pavonaceum*, left), and a diversity of native forbs in the wet prairie, including Nelson’s checkermallow (*Sidalcea nelsoniana*, right), June 1, 2022.

North prairie and wet swales (Phase II: 25 acres, map code 6)

Most of the north prairie has a large component of established, perennial native vegetation such as woolly sunflower and common monkeyflower (*Mimulus guttatus*; Figure 11). In August 2022, while mowing the north prairie, Owen Cass from ODFW mapped weeds and found the three most common non-native species to be prickly lettuce, Queen Anne’s lace (*Daucus carota*), and tansy ragwort (Figure 13).



Figure 11. North prairie covered in woolly sunflower (*Eriophyllum lanatum*, left, June 6, 2022) and common monkeyflower (*Mimulus guttatus*, right, May 11, 2022).

Oak woodland (Phase II: 5 acres, Figure 2: map code 11)

The understory includes Himalayan blackberry and oneseed hawthorn, which need further control.

Oak savanna (Phase II: 4 acres, Figure 2: map codes 10, 12)

This area was seeded with grasses in 2021, augmenting forbs sown in 2020. The additional seeding resulted in good coverage of bare patches seen in 2021 (Figure 12). Reed canarygrass is an ongoing concern in this area and should be managed regularly to prevent encroachment into the savanna.



Figure 12. Bare patches in the oak savanna in 2021 (left, April 15, 2021) had an increase in vegetative cover in 2022 following second-year seeding paired with a wet spring (right, May 11, 2022).

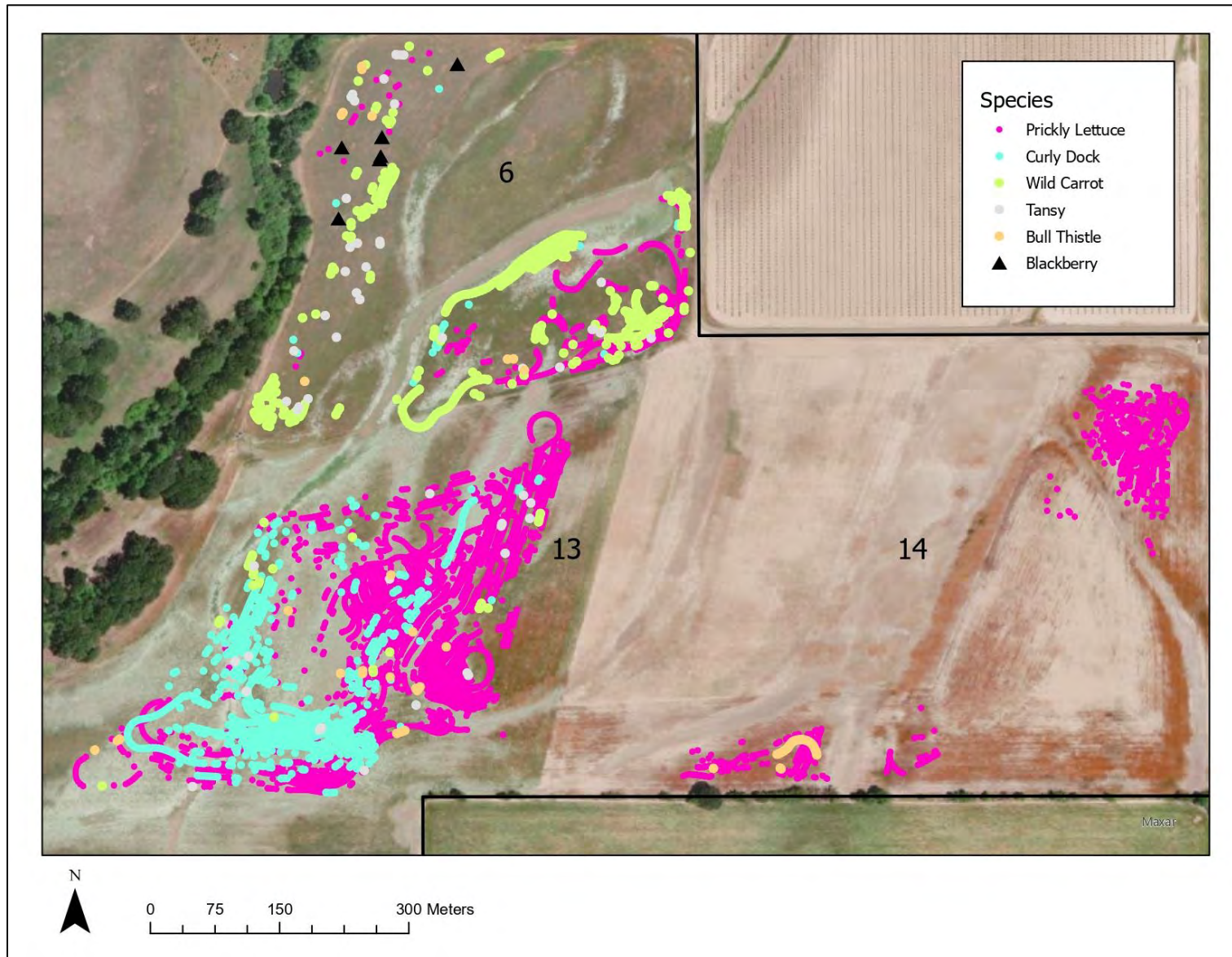


Figure 13. Locations of weeds at Herbert Farm and Natural Area as mapped by Owen Cass from the Oregon Department of Fish and Wildlife, August 2022. Numbers refer to restoration units mentioned in the text (see Figure 2).

Riparian forest (Phase II: 6.5 acres, Figure 2: map codes 8, 9, 15)

The riparian trees and shrubs planted in 2017-2018 (map code 9) are well-established and have achieved dense canopy cover (Figure 14). Those planted in 2020-2021 (map code 8, 15) are still being established. The newer planting area continues to see weed infestations, particularly of oxeye daisy, Himalayan blackberry, and Canada thistle.



Figure 14. Riparian plantings of 4-5-year-old trees and shrubs (left) and 2-3-year-old trees and shrubs (right, November 8, 2022).

South prairie and wet swales (Phase II: 35 acres, Figure 2: map code 13)

The second year seeding of grasses in 2021 resulted in good native grass coverage in 2022, as well as continued establishment of native perennial forbs such as woolly sunflower (Figure 15). Weed mapping in August 2022 revealed a high density of prickly lettuce in the south prairie (Figure 13), followed by curly dock (*Rumex crispus*) and bull thistle.



Figure 15. South prairie after first-year seeding (left, June 4, 2021), and after second-year seeding of grasses (right, June 1, 2022).

East prairie and wet swales (Phase II: 49 acres, Figure 2: map code 14)

Following the first-year seeding in 2021, the east prairie experienced a “super bloom” in 2022 (Figure 16). The upland areas saw a flush of native annuals, including rusty popcorn flower (*Plagiobothrys*

nothofulvus) and shortspur seablush (*Plectritis congesta*), and a high density of perennials such as common monkeyflower (Figure 16). The two berms constructed in 2021 successfully retained water over the winter, creating wet swales (Figure 17). Weed mapping in August 2022 revealed a small patch of prickly lettuce in the northeast portion of east prairie (Figure 13).



Figure 16. Diverse native forbs flowering in the upland areas of east prairie (left, June 1, 2022) and in the swales (right, May 23, 2022).



Figure 17. Eastern (left) and western (right) berms (March 30, 2022), both constructed in 2021, successfully held water and created habitat diversity.

5.2 Waterways

Photopoints taken on Marys River (Figure 18; Appendix 2. Photo point locations at Herbert Farm and Natural Area, RB1, RB2) reveal undercutting of the banks and erosion in at least one location leading to sediment being inputted into the river. There has been some natural shrub establishment, and the top of the ridge is now well-vegetated from plantings, however, this stretch of the river remains unshaded and eroded. As only one photopoint is established on the river, it is not known how much erosion is occurring on other stretches of Marys River, Muddy Creek, or Matt Creek.



Figure 18. Photopoints RB1 (left) and RB2 (right) on Marys River, show erosion and undercutting of the banks. For precise location, see Appendix 2. Photo point locations at Herbert Farm and Natural Area.

5.3 Streaked horned lark

Bob Altman monitored streaked horned larks from April-August 2022 (Altman 2022). Altman detected 25 males, 11 females, and 3 unidentified streak horned larks. The constructed swales at HFNA were designed to create bare ground nesting habitat for streaked horned larks once the water in the swales receded. However, in 2022, one swale revegetated quickly and the other retained water, so most streaked horned larks (50%) were detected either on the road, or on the neighboring property. A single nest was located on the adjacent hazelnut farm but was destroyed by harvesting equipment (Altman 2022).

5.4 Threatened and endangered species

As part of the Benton County Prairie Species Habitat Conservation Plan, IAE staff monitored six threatened and endangered plant species from May-August 2022 (Wiebush 2022). Staff counted 1,905 golden paintbrush (*Castilleja levisecta*), 184 peacock larkspur, 192 m² cover of Kincaid's lupine (*Lupinus oreganus*), and an estimated 1,227 Nelson's checkermallow, as taken from a sample. An individual Willamette daisy (*Erigeron decumbens*) was also detected (Wiebush 2022).



Figure 19. Scott Harris (IAE) monitoring golden paintbrush (*Castilleja levisecta*) (left, May 24, 2022), and flowering Nelson’s checkermallow (*Sidalcea nelsoniana*) (right, June 21, 2022).

5.5 Photo points and aerial views

Photographs were taken at 18 photo points (Appendix 2. Photo point locations at Herbert Farm and Natural Area) on June 1, 2022 for comparison with photos taken prior to or during restoration.

These photographs help illustrate changes that occurred during restoration. For example, the Phase I prairie transitioned from a ryegrass field in 2013 to a well-established native prairie in 2022 (Figure 20). Restored riparian areas show a similar trajectory from fallow grassland to partially closed canopy within high-density plantings in 2022 (Figure 21). A full set of photos are on file at IAE and available upon request.

These restoration progressions are also illustrated by Google Earth photographs (Figure 22, Figure 23, Figure 24 and Figure 25) with changes described in the captions.

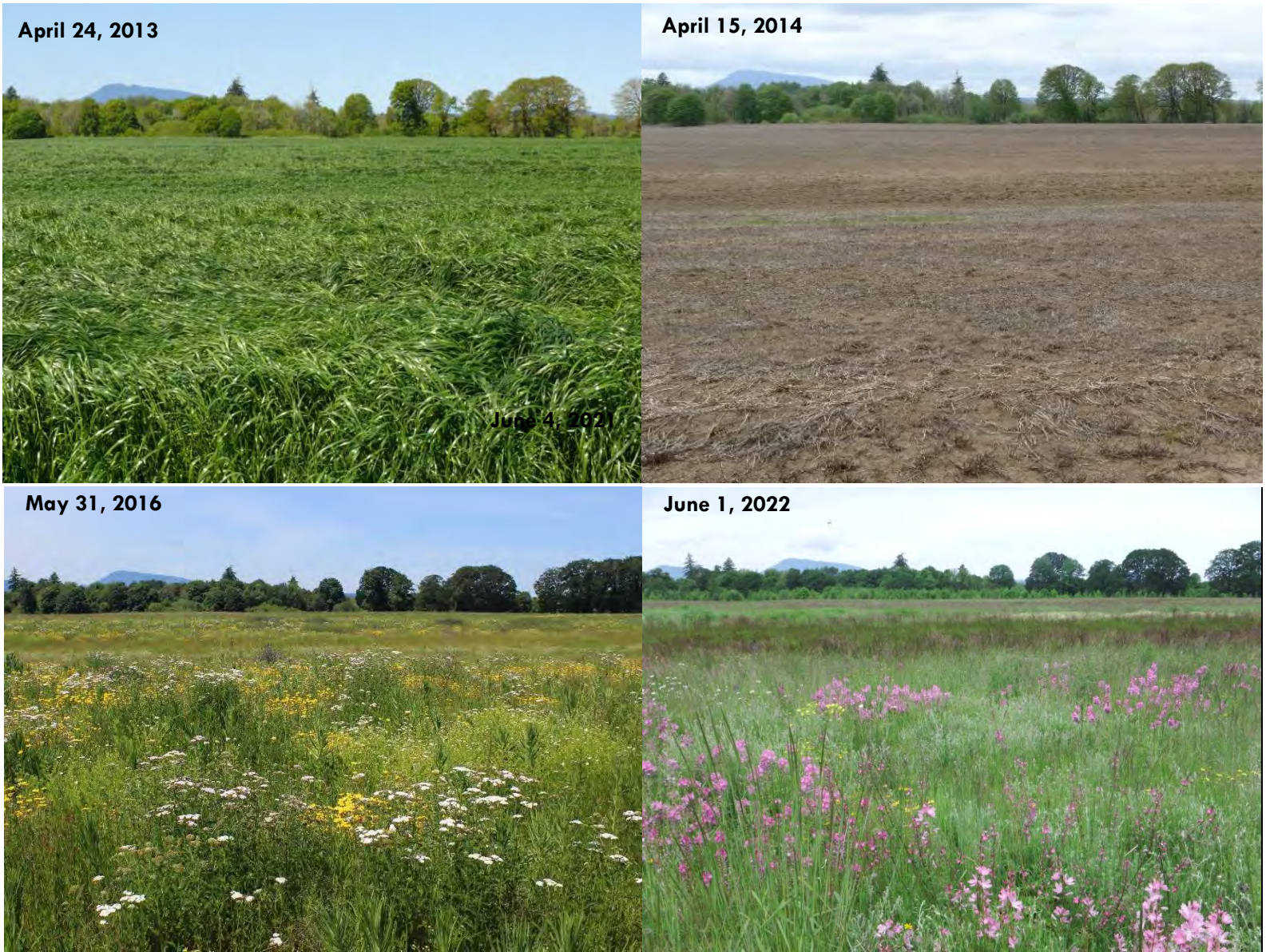


Figure 20. Photo point 1: Progression of upland prairie restoration at Herbert Farm and Natural Area, showing the ryegrass (*Lolium* sp.) field prior to restoration in 2013 (top left); during site preparation (top right); after second year of seeding native forbs and grasses, including common madia (*Madia elegans*, not yet flowering), woolly sunflower (*Eriophyllum lanatum*) and common yarrow (*Achillea millefolium*; bottom left); and well-established meadow checkermallow (*Sidalcea campestris*) and native grasses in 2022 (bottom right).



Figure 21. Photo point 7: Progression of riparian tree and shrub restoration at Herbert Farm and Natural Area, showing: fallow grassland after one year of site preparation (top left); during the first year of establishing riparian trees and shrubs (top right), two years after planting (bottom left); and canopy closure in 2022 (bottom right).

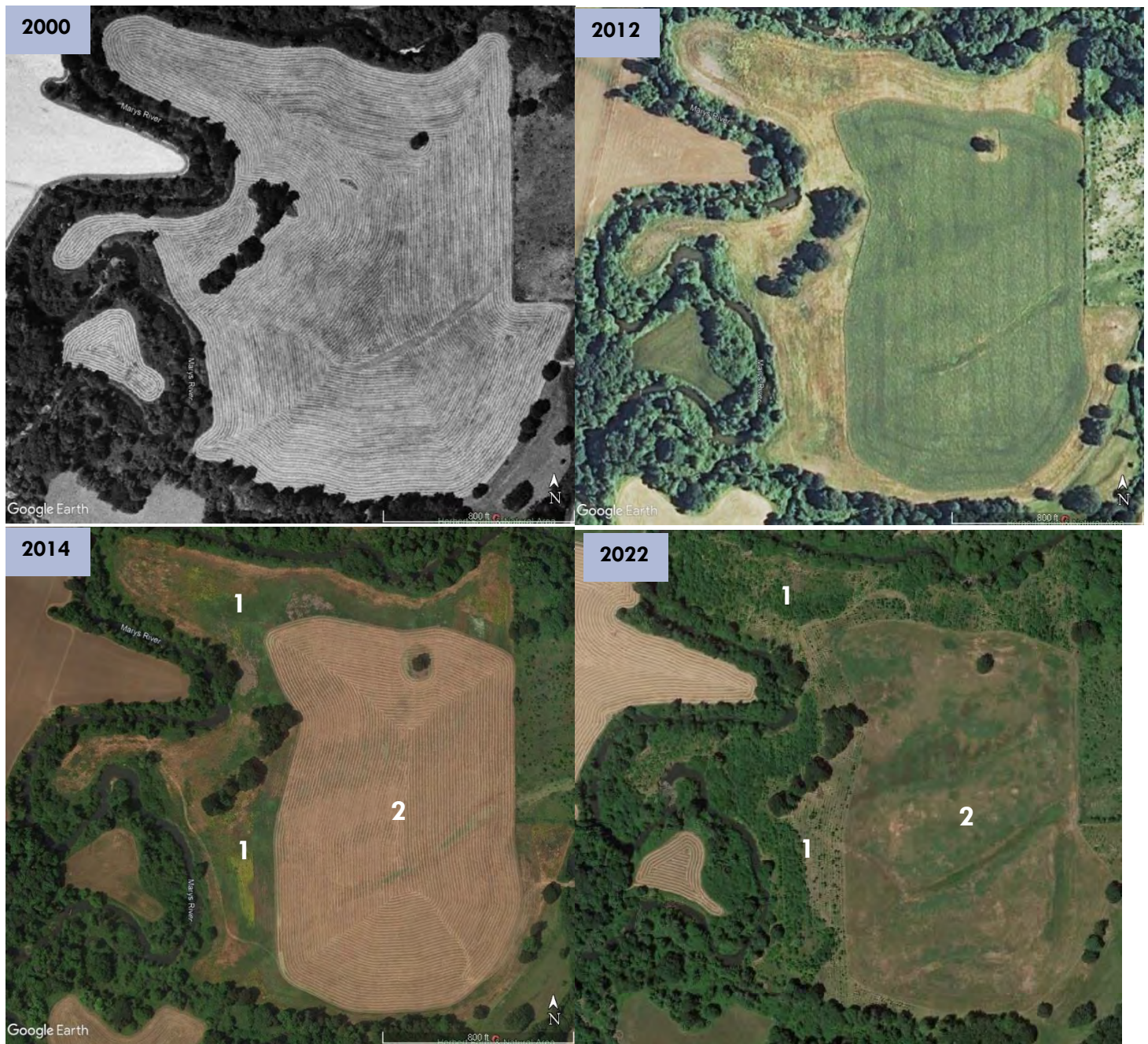


Figure 22. A Google Earth view of Phase I areas in 2000 (upper left), at the time when the City of Corvallis acquired the property, most of which was actively farmed; 2012 (upper right), when farming was restricted to the central 37-acre field and the outer 28-acre portion was fallow grassland; 2014 (lower left) during site preparation before riparian planting (map code 1); and 2022 (lower right) after riparian (map code 1) and prairie restoration (map code 2).



Figure 23. Google Earth view of Phase I riparian plantings (map code 1) in July 2022, showing canopy closure in low-lying parts of the high-density planting areas to the center-left and wider spacing between rows in the low-density plantings to the right.



Figure 24. Google Earth view of Phase II riparian plantings in July 2022 showing early stages of establishment of trees and shrubs. The first plantings were in 2017-2018 (map code 9) and are visible as horizontal lines with scattered larger trees visible as green blobs. The most recent plantings were in 2020-2021 (map codes 8, 15) and now lines between rows are visible as parallel diagonal lines. Other restoration units are labelled including oak savanna (map codes 10, 12), oak woodland (map code 11) and upland prairie (map code 13).



Figure 25. Google Earth view of Phase II restoration areas in 2012 (left), when most of the area was farmed and after restoration in 2022 (right).

6. OUTREACH AND MEDIA ARTICLES

Online articles:

- “AmeriCorps: restorative power of collective labor,” Institute for Applied Ecology, January 10, 2022. <https://appliedeco.org/ameri-corps-restorative-power-of-collective-labor/>
- “How to celebrate Earth Day in the mid-Willamette Valley,” Corvallis Gazette Times, April 22, 2022. https://www.gazettetimes.com/corvallis/calendar/how-to-celebrate-earth-day-in-the-mid-willamette-valley/article_610233c8-035f-550b-954c-05103c0c513d.html
- “Celebrating Earth Day at Herbert Farm”, Institute for Applied Ecology, May 2022. <https://appliedeco.org/celebrating-earth-day-at-herbert-farm-and-natural-area/>
- “Restoring Herbert Farm & Natural Area”, Society for Ecological Restoration, July 1, 2022. <https://www.ser.org/news/610275/Restoring-Herbert-Farm--Natural-Area.htm>

Social Media:

- “Planting native plants for Earth Day”, IAE Instagram post, April 8, 2022 https://www.instagram.com/p/CcHDuYIBtU8/?utm_source=ig_web_copy_link
- “Take a walk through Herbert Farm”, IAE Instagram post, May 31, 2022 https://www.instagram.com/p/CePIJOTBFLq/?utm_source=ig_web_copy_link
- “Take a walk through Herbert Farm,” IAE Facebook post, May 31, 2022 <https://www.facebook.com/plugins/post.php?href=https%3A%2F%2Fwww.facebook.com%2FApplied.Ecology%2Fposts%2Fpfbid0FxW6j9KNszLQQ7eyg1FqfJrKE1XkyZa89rQNY7Kie75rzrcvJkBLMnETZEnamDDTI>
- “Wildflower season at Herbert Farm”, IAE Facebook post, June 6, 2022 <https://fb.watch/gHHR1o-vhC/>
- “Guess the native wildflower”, IAE Facebook post, July 6, 2022 <https://www.facebook.com/plugins/post.php?href=https%3A%2F%2Fwww.facebook.com%2FApplied.Ecology%2Fposts%2Fpfbid02U4cXJscHwRtNigHpTAU3vkQ5hQ5KxW84v4XXiu3ay1MubwScAzJXFbxfntpChr7MI>
- “Guess the native wildflower”, IAE Instagram post, July 6, 2022 https://www.instagram.com/p/CfrzPcQBk6w/?utm_source=ig_web_copy_link
- “Peter Moore’s decade of work”, IAE Facebook post, July 21, 2022 <https://www.facebook.com/plugins/post.php?href=https%3A%2F%2Fwww.facebook.com%2FApplied.Ecology%2Fposts%2Fpfbid0V1DgBRsmZ1eAizXAqFg5PUXLf3f5X68igozgd8MbY3dtoq8S8Jb8nNGN2Kmon23il>

7. MANAGEMENT RECOMMENDATIONS/NEXT STEPS

7.1 Manage non-native species

As this project transitions from the restoration to maintenance phase, it is critical that non-natives species continue to be managed. Seasonal spot spray treatments and mowing will help reduce non-native species abundance and distribution. Regular weed mapping coupled with an Early Detection Rapid Response

(EDRR) program should be implemented to reduce the chance of new, problematic populations becoming established, especially Oregon Department of Agriculture “A-list” species.

Recommendations for 2023

- In spring and fall, spot spray weeds across the site, in particular Canada thistle, Himalayan blackberry, Queen Anne’s lace, velvetgrass, vetch, and reed canarygrass
- In summer, mow between rows in riparian and low-density planting areas (Figure 2, map code 1, 8 and 15)
- Mow all Phase II prairies (Figure 2, map code 6, 13, 14) after August 15
- Update existing non-native species distribution map (Figure 13)

7.2 Conduct prescribed burn

Burning prairie habitat has numerous benefits for HFNA habitats, including reducing woody encroachment, improving soil health, strengthening fire resiliency, and allowing greater seed-to-soil contact through the creation of bare ground.

Recommendations for 2023

- Burn 37 acres of West Prairie (Figure 2, map code 2)
- Establish 5-year burn rotation, starting with North Prairie in 2024 (Figure 2, map code 6), South Prairie in 2025 (Figure 2, map code 13), East Prairie in 2026 (Figure 2, map code 14), Upland Prairie in 2027 (Figure 2, map code 5), and West Prairie in 2028 (Figure 2, map code 2)
- Develop partnerships with organizations that can perform prescribed burns such as the Confederated Tribes of Grand Ronde and Ecostudies Institute. These partnerships have the potential to increase the likelihood of successfully implementing prescribed burns each year by having multiple resources available

7.3 Increase native species diversity

Since 2016, populations of endangered Kincaid’s lupine and Nelson’s checkermallow have increased significantly at HFNA (Wiebush 2022). As HFNA was home to remnant populations prior to restoration, continuing to plant and expand the range of these species would help create resiliency for the future.

Recommendations for 2023

- Plant 300 Nelson’s checkermallow plugs in North Prairie to augment population (Figure 2, map code 6)
- Add additional native seed to post-burn fields

7.4 Monitor for Emerald Ash Borer

The arrival of the emerald ash borer (*Agrilus planipennis*, EAB) to Oregon in June 2022 will have profound effects on the Oregon ash (*Fraxinus latifolia*) population at HFNA. Oregon ash is both present in mature stands along Matt Creek and in the riparian areas planted between 2015-2019. With a nearly 100% mortality rate once infected, it is likely that HFNA ash forests will experience crown dieback and eventual loss of canopy cover. Regular monitoring of Oregon ash trees could help in early detection of EAB and should become part of the regular monitoring at HFNA.

Recommendations for 2023

- Install EAB funnel traps and conduct bimonthly monitoring from May to July
- Survey riparian areas to collect baseline data of high-priority ash populations
- Use trap and survey data to develop EAD plan for HFNA, including ways to minimize spread and how to manage infected trees

7.5 Stabilize banks

Bank erosion leads to sediment input that negatively impacts fish, eggs, as well as aquatic plants and invertebrates. This is visible at one photopoint location on Marys River and others may be found in the watershed.

Recommendations for 2023

- Install willow stakes on eroded banks
- Survey all banks along Marys River, Muddy River, and Matt Creek, taking photos and identifying high-priority areas for restoration

7.6 Manage streaked horned lark habitat

To create bare ground needed for streaked horned lark, swales were created at HFNA to hold water and restrict vegetation growth. In 2022, however, one swale revegetated quickly and the other retained water late in the season, preventing streaked horned larks from using either area for nesting in 2022.

Recommendations for 2023

- Discuss future of swales as streaked horned lark habitat with City of Corvallis, ODFW, and USFWS and whether a new direction is needed
- Create long-term plan for managing swales as either bare-ground, wetland, or wet prairie habitat

8. REFERENCES

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Institute for Applied Ecology. 2013. City of Corvallis Herbert Farm and Natural Area Restoration Plan. 45 pp., plus appendices.

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- Moore, P. and R. Currin. 2022. Herbert Farm and Natural Area restoration – 2021 annual report. Unpublished report for the Willamette Wildlife Mitigation Program, Oregon Department of Fish and Wildlife. Institute for Applied Ecology, Corvallis, OR. 38 pp.
- Wiebush, M. 2022. 2022 City of Corvallis HCP Effectiveness Monitoring. Unpublished report for the City of Corvallis. Institute for Applied Ecology, Corvallis, OR. 29 pp.

APPENDICES

Appendix 1. Summary of restoration actions at Herbert Farm and Natural Area conducted from 2012-2022.

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2012	Agriculture, fallow grassland, woodland, upland and wet prairies	1, 2, 3, 4, 5	84	X	X	X	X	A meeting of partner groups was held on site to discuss plans for restoration.
2012	Agriculture, fallow grassland, woodland, upland and wet prairies	1, 2, 3, 4, 5	84	X				A draft restoration plan was prepared for Phase I areas.
2012	Grassland and prairie areas	1, 3, 4, 5, 9, 12	40		X			Fallow grassland, some field edges, oak woodland and prairies were mowed with a tractor, as part of the annual mowing maintenance.
2012	Agriculture	2, 6, 7, 13, 14	84		X			Areas farmed in annual ryegrass under an annual agreement with a local farmer.
2013	Agriculture, fallow grassland, woodland, upland and wet prairies	1, 2, 3, 4, 5	83	X	X	X	X	Phase I restoration plan was finalized.
2013	Agriculture, fallow grassland, woodland, upland and wet prairies	1, 2, 3, 4, 5	83	X				Surveys of baseline vegetation, threatened species and weed distribution were conducted.
2013	Fallow grassland - site preparation for riparian forest	1	22	X				Two broadcast herbicide (Aquamaster) treatments >100 feet from Marys River and three spot spray (Aquamaster & Transline) treatments <100 feet from water.
2013	Riparian shrub-scrub - site preparation for riparian forest	1, 3	7	X				The weedy sections of riparian border, vegetated primarily with blackberry and reed canarygrass, were mowed with a skid steer in summer and regrowth was spot sprayed (Opensight & Rodeo) in the fall.
2013	Wet prairie	4	2	X				Broadcast and spot spray herbicide (Rodeo).

Herbert Farm and Natural Area restoration – 2022 annual report

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2013	Upland prairie	5	2	X				Nelson's checkermallow rhizomes were planted along the bank between the upland and wet prairies.
2013	Grassland and prairie areas	3, 5, 9, 12	16		X			Annual mowing maintenance.
2013	Agriculture - site preparation for prairie	2	37	X	X			Farming ceased after the 2013 harvest and pre-emergent herbicide was broadcast in the fall.
2014	Riparian shrub-scrub - site preparation for riparian forest	1, 3	29	X			X	Two broadcast (Rodeo and Rodeo/Escort) and spot spray herbicide treatments (Rodeo and Renovate). Selected portions of riparian margin were mowed with a skid steer. A native grass seed mix was prepared and broadcast in the fall.
2014	Former agriculture converted to upland prairie and wet prairie swales	2	37	X			X	Two broadcast herbicide (Rodeo and Rodeo/Escort) treatments. A seed mix of native forbs and Roemer's fescue was prepared and broadcast in the fall.
2014	Wet prairie	4	2	X				Two broadcast and spot spray herbicide treatments. Native seed was broadcast in the fall.
2014	Upland prairie	5	2	X				Seed of threatened species was collected for propagation.
2014	Agriculture - site preparation for prairie	6	25		X		X	Farming ceased after the 2014 harvest and the area was broadcast with herbicide in the fall.
2014	Restoration areas	1, 2, 3, 4, 5	83	X	X			IAE and the City hosted a visit by elders of the Confederated Tribes of Grand Ronde as part of the Plants for People project. Photo points were established for restoration monitoring.
2014	Grassland and prairie areas	3, 4, 5, 9, 12	18		X			Annual mowing maintenance.
2014 /2015	Agriculture, fallow grassland, riparian forest and shrub-scrub, woodland, upland and wet prairies	All zones		X			X	An archaeological survey was conducted to identify cultural resources. After consultation, Bonneville Power Administration gave permission for the use of ground-disturbing restoration techniques. Planning started for Phase II restoration.

Herbert Farm and Natural Area restoration – 2022 annual report

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2015	Former fallow grassland and shrub-scrub converted to riparian forest	1, 3	29	X	X		X	Trees and shrubs were planted in 22 acres of high density and 7 acres of low density plantings in March. Competition from weeds and grasses was reduced for the new seedlings by spot spraying and mowing (by hand and tractor) in summer and fall. Some hand watering in the low density plantings helped alleviate drought conditions. Tree survival was monitored.
2015	Upland prairie and wet prairie swales	2	37	X		X		Herbicide treatments included broadcast spraying (Select Max) of grasses over the whole prairie and sow thistle/prickly lettuce in the northern 13 acres (Stinger), and spot spraying (and dead-heading) of thistles throughout. Native forb and grass seed mixes for upland and wet swales were prepared and drilled in the fall.
2015	Upland and wet prairie	4, 5	4	X		X		Limited spot spraying of reed canarygrass and thistles occurred. A fire line was mowed around the upland prairie in anticipation of a prescribed burn, but the burn was not achieved. Native seed, including Nelson's checkermallow, was drilled in the wet prairie in the fall.
2015	Agriculture - site preparation for prairie	6	25	X				A broadcast herbicide (Rodeo) treatment was conducted in the fall.
2015	Fallow grassland and shrub-scrub - site preparation for riparian forest	9	4.5	X				Blackberry and reed canarygrass patches in the riparian edge were mowed with a skid steer. Weedy fallow grassland was treated by broadcasting and spot spraying herbicide (Rodeo, Habitat, Renovate).
2015	Streaked horned lark experiment	7	1	X	X		X	Farming ceased in October and experimental plots marked out for comparing combinations of herbicide, mowing and disking to create streaked horned lark habitat. Herbicide and harrow (in lieu of disking) treatments commenced in November.
2015	Grassland and prairie areas	3, 4, 5, 12	14		X			Annual mowing maintenance.

Herbert Farm and Natural Area restoration – 2022 annual report

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2016	Riparian forest	1	27	X			X	A second cohort of trees and shrubs were inter-planted to offset mortality from the first year. Ongoing spot spraying and mowing maintenance, including mowing high-density area twice. Tree survival was monitored. Additional spot spraying and dead-heading of thistles occurred in summer-fall.
2016	Riparian, woodland, upland and wet prairies	1, 2, 3, 4, 5	83	X				Surveys of riparian vegetation, threatened species and weed distribution were conducted for comparison with 2013 baseline.
2016	Upland prairie and wet prairie swales	2	37	X		X		The northern 13 acres was mowed to limit flowering of an infestation of stinking chamomile, prickly lettuce and sow thistle. Two spot spray treatments and dead-heading of thistles occurred in summer-fall in this zone. Supplementary seed of forb and grasses in upland and wet swale mixes was broadcast in the 13-acre area. Rushes were planted in the southern swales.
2016	Fir-dominated woodland	3	4		X			Douglas fir trees were girdled to release oaks from competition.
2016	Wet prairie	4	2	X				Limited spot spraying of reed canarygrass patches. Bulbs and bare root of native forbs were planted in the fall.
2016	Upland prairie	5	2	X	X	X	X	Seedling shrubs were spot sprayed, a fire line was mowed, and a prescribed burn conducted in late September. Emerging weeds and non-native grasses were treated by broadcasting herbicide (Rodeo). Seed of native forbs, including Kincaid's lupine and golden paintbrush, and grasses were drilled in October. Kincaid's lupine plugs were planted in spring and peacock larkspur plugs, and bulbs and bare root of other native forbs, were planted in fall.

Herbert Farm and Natural Area restoration – 2022 annual report

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2016	Former agriculture - site preparation for prairie	6	25	X		X	X	A survey of anadromous fish using two swales was conducted in February. Three broadcast and spot spray treatments targeted weedy forbs and regrowth of ryegrass. Berms were constructed to flood swales in the winter and create streaked horned lark habitat. Three seed mixes, including forbs of low stature, were drilled on 20 acres in the fall. Bulbs and bare root of native forbs were also planted.
2016	Fallow grassland and shrub-scrub - site preparation for riparian forest	9	4.5	X				Two broadcast (Rodeo/Renovate, Stinger) and three spot spray herbicide treatments were conducted through the year, and a graminoid seed mix was broadcast in the fall.
2016	Streaked horned lark experiment	7	1	X			X	Spring and fall treatments comparing combinations of herbicide, mowing and disking. The streaked horned lark population was monitored here and throughout Herbert Farm (April-August).
2016	Grassland and prairie areas	3, 4, 12	10		X			Annual mowing maintenance.
2017	Agriculture, fallow grassland, woodland, upland and wet prairies	6, 7, 8, 9, 10, 11, 12, 13, 14	130	X	X	X	X	Phase II restoration plan was finalized.
2017	Upland and wet prairies	2, 4, 5	41	X				Surveys of prairie vegetation were conducted for comparison with 2013 baseline. Photo points were repeated in all restoration areas.
2017	Riparian forest	1	27	X				Ongoing spot spraying and mowing maintenance occurred, and tree survival was monitored. Additional spot spraying and dead-heading of thistles occurred in summer-fall, and blackberry in the fall.

Herbert Farm and Natural Area restoration – 2022 annual report

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2017	Upland prairie and wet prairie swales	2	37	X		X		Spot spray treatments targeted thistles and velvet grass in spring and summer. A fire line was mowed in August and the whole prairie mowed high prior to a prescribed burn in September. In the fall, upland areas were drilled with a native forb/grass mix, including Kincaid's lupine and golden paintbrush in the southern zones. Wet swales were broadcast seeded. Bulbs and bare roots of native plants were also planted in the fall.
2017	Wet prairie	4	2	X				Spot spray treatments targeted reed canarygrass. Milkweed was planted in spring.
2017	Upland prairie	5	2	X	X	X	X	Kincaid's lupine plugs were planted in spring.
2017	Former agriculture - site preparation for prairie	6	24	X		X	X	The fall seeding was unsuccessful because of heavy flooding in the winter. Site preparation resumed with three broadcast (Rodeo) and spot spray herbicide treatments.
2017	Riparian forest	9	4.5	X				Trees and shrubs were planted in high density rows in February. Competition from weeds and grasses was reduced for the new seedlings by spot spraying and hand mowing in summer and fall.
2017	Streaked horned lark experiment	7	1	X			X	Spring and fall treatments comparing combinations of herbicide, mowing and disking. The streaked horned lark population was monitored here and throughout Herbert Farm (April-August).
2017	Agriculture - site preparation for prairie	14	23		X			Farming ceased after the 2017 harvest and the area was partially broadcast with herbicide in the winter as part of mitigation for airport runway development on streaked horned lark habitat. This area was managed by City staff from the airport.
2017	Grassland and prairie areas	3, 4, 12	18		X			Annual mowing maintenance.

Herbert Farm and Natural Area restoration – 2022 annual report

Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2018	Riparian forest	1	27	X				Ongoing spot spraying and mowing maintenance occurred, and tree survival was monitored. Additional spot spraying and dead-heading of thistles occurred in summer-fall.
2018	Upland prairie and wet prairie swales	2	37	X			X	Spot spray treatments and mowing. Plant and seed Kincaid's lupine, plant Nelson's checkermallow, bare root materials, including camas and yampah.
2018	Wet prairie	4	2	X				Spot spray treatments.
2018	Upland prairie	5	2	X				Spot spray treatments.
2018	Former agriculture converted to upland prairie and wet prairie swales	6	25	X		X		Site preparation continued with three broadcasts (Rodeo, Rodeo/Escort, Rodeo) and one spot spray herbicide treatment. Two low density/low stature seed mixes of native forbs and Roemer's fescue were drilled or broadcast in the fall.
2018	Riparian forest	9	4.5	X				A second cohort of trees and shrubs were inter-planted in February to offset mortality from the first year. Ongoing spot spraying and mowing maintenance occurred, and tree survival was monitored.
2018	Riparian shrub-scrub - site preparation for riparian forest	8	0.5	X				Blackberry and reed canarygrass patches in the riparian edge were mowed with a skid steer.
2018	Oak woodland	11	6	X	X			Douglas fir trees were felled and removed to release oaks from competition. A woodland forb/grass seed mix was broadcast in the understory.
2018	Grassland - site preparation for prairie	10, 12	6	X				Grassland was broadcast with herbicide (Rodeo/Escort) in fall.
2018	Fallow grassland	7	1	X	X			The streaked horned lark habitat experiment ended in 2017 and this area became fallow grassland in 2018. The strips were mowed in late summer and treated with herbicide in fall as part of the larger prairie site preparation area (below).

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2018	Agriculture - site preparation for prairie	13	61	X				Farming ceased after the 2018 harvest and the area was broadcast with pre-emergent herbicide (Rodeo/Plateau) in fall.
2018	Agriculture - site preparation for prairie	14	23		X			No treatments occurred during 2018.
2018	Grassland and prairie areas	3	18		X			Annual mowing maintenance by City was limited to Phase I oak woodland. Existing prairies were not mowed.
2019	Riparian forest	1	27	X				Ongoing spot spraying maintenance of riparian plantings in May and mowing in June. Other spot spraying and hand weeding in Sep-Oct. Tree survival was monitored in November.
2019	Upland prairie and wet prairie swales	2	37	X			X	Golden paintbrush was surveyed in May. Spot spray treatments in May-August and most of the prairie was mowed in August. 54 peacock larkspur were planted in October.
2019	Oak woodland	3	4	X				Thin-leaved peavine plots were monitored in May.
2019	Wet prairie	4	2	X				Spot spray treatments in August-September targeted reed canarygrass, thistles and encroaching shrub and tree seedlings. A fire line was mowed in late August in preparation for a prescribed burn which was deferred until 2020. Tall meadow-rue were planted in November.
2019	Upland prairie	5	2	X				Golden paintbrush was surveyed in May. Spot spray treatments in August targeted shrub and tree seedlings. A fire line was mowed in preparation for a prescribed burn which was deferred until 2020. Woodland strawberry was planted in November.

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2019	Upland prairie and wet prairie swales	6	25	X		X	X	Three partial broadcast treatments with grass-specific herbicide (Poast, Select Max and Fusilade) in April, June and October, and glyphosate on 2-3 acres to maintain bare ground areas. Spot spraying broadleaf weeds in May, June and September and mowing in late August. Native seed mixes were drilled or broadcast seeded over 21 acres in Sep-Oct. Kincaid's lupine was also seeded.
2019	Riparian forest	9	4.5	X				Ongoing spot spraying in May and mowing maintenance of riparian plantings in June, with further spot spraying in July. Tree survival was monitored in November.
2019	Oak woodland	11	6	X				Limited spot spraying of blackberry and broadleaf weeds in July.
2019	Prairie and riparian site preparation	8, 10, 12, 15	6	X				Broadcast spray of Rodeo on 6 acres in April and June, Rodeo/Escort on 3.5 acres and Rodeo on 2.5 acres in October. Spot spraying of reed canarygrass, seedling shrubs and broadleaf weeds in August-September. Wood debris cleared. Native grass seed was broadcast over 2 acres of riparian site preparation area.
2019	Prairie site preparation	7, 13	61	X				Broadcast spray of Rodeo in June, partial spray of swales in August, and broadcast of Rodeo/Escort mix in October.
2019	Airport mitigation prairie site preparation	14	23	X	X			Partial broadcast herbicide spray in winter, mow and harrow in late May, partial broadcast in July. IAE start managing. Broadcast spray of Rodeo/Escort mix in October and a mow in late November over the whole field. A sound and decoy system and streaked horned lark monitoring program ran from April-August.
2020	Riparian forest	1	27	X				Ongoing spot spraying maintenance of riparian plantings in May and mowing in June. Other spot spray in October. A partner tour of all areas was held in August.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2020	Upland prairie and wet prairie swales	2	37	X			X	Golden paintbrush and Kincaid's lupine populations were surveyed in May. Infestation of vetch hand weeded or weed-whacked near these rare species. Spot spray treatments in May-June and October. Perimeter was mowed in June and whole prairie in October.
2020	Wet prairie	4	2	X	X		X	Prescribed burn planning meeting held in August, but burn was deferred to 2021. Spot spray treatments in August targeted reed canarygrass, thistles and encroaching shrub and tree seedlings. Mowed in October.
2020	Upland prairie	5	2	X			X	Golden paintbrush and Kincaid's lupine were surveyed in May. Spot spray treatments in August targeted shrub and tree seedlings. Mowed in October.
2020	Upland prairie and wet prairie swales	6	25	X		X	X	Two broadcast herbicide treatments (Rodeo) in one swale and a fallow area near road in June and October. Spot spraying broadleaf weeds in March, May, June, September, and October. Mow berms in June and 20 acres in October. Native seed mixes were drilled or broadcast seeded over 5 acres in October. Kincaid's lupine seed was sown in October. Bare root native plants were planted in February, Kincaid's lupine plugs planted in March-April, and Nelson's checkermallow and peacock larkspur were planted in November.
2020	Riparian forest	8, 9, 15	4.5	X				Plant trees and shrubs in new area. Line spray and spot spraying in May and mowing maintenance of riparian plantings in June. Further spot spray around perimeter in October. Tree survival was monitored in November.
2020	Oak woodland	11	5	X				Limited spot spraying of blackberry in October.
2020	Oak savanna	10, 12	4	X		X		Broadcast spray (Rodeo) in June and October. Spot spray in October. Native forb and grass seed was drilled and broadcast in October.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2020	Prairie site preparation	13	61	X		X		Streaked horned larks monitored April-August. Broadcast spray (Rodeo) all or partial areas in April, June, August, and October (Rodeo for seeding areas and Rodeo/Escort in fallow field). Native forbs and Roemer's fescue was seeded by no-till drill and hand broadcast swales in October.
2020	Airport mitigation prairie site preparation	14	23	X				Streaked horned larks monitored April-August. Broadcast spray all or partial areas in April, June, August (Rodeo) and October (Rodeo/Escort).
2021	Riparian forest	1	27	X				Ongoing spot spraying maintenance of riparian plantings in May and limited mowing in June. Other spot spray in September.
2021	Upland prairie and wet prairie swales	2	37	X			X	Spot spray treatments in May-June and September. Perimeter was mowed in June and the whole prairie in October.
2021	Oak woodland	3	4		X			Mowed in November to control shrub encroachment of open areas and camas field. 6 Douglas-fir trees re-girdled and 8 more girdled to release oaks.
2021	Wet prairie	4	2	X	X		X	Spot spray treatments in August targeted reed canarygrass, thistles and encroaching shrub and tree seedlings. A fire line was mowed, and a prescribed burn was conducted in September. Native forbs and grasses were sown with no-till drill and additional grasses hand broadcast in October. Camas and other bulb species were planted in November.
2021	Upland prairie	5	2	X	X		X	Spot spray treatments in August-September targeted shrub and tree seedlings. A fire line was mowed, and a prescribed burn was conducted in September. Post-burn glyphosate spray of upland. Native forbs and grasses were sown with no-till drill and additional grasses hand broadcast in October. Brodiaea bulbs and yampah roots were planted in November.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2021	Upland prairie and wet prairie swales	6	25	X		X	X	Spot spray periphery in March. Two broadcast herbicide treatments (Rodeo) in one swale in June and October. Spot spraying broadleaf weeds in May and grasses in June. Mow berms in June and 20 acres in September. Native seed was broadcast by hand and ATV over 5 acres in October.
2021	Riparian forest	8, 9, 15	6.6	X				Interplanting of trees and shrubs in January in new 2.1-acre riparian restoration area in January. Spot spraying of oxeye daisy in March. Line spray and spot spraying in May and mowing maintenance of riparian plantings in June.
2021	Oak savanna	10, 12	4	X	X	X		Spot spray in March. Broadcast spray patches of reed canarygrass in September. Mowed in September. Grass seed was drilled in October.
2021	Prairie	13	35	X		X	X	Streaked horned larks were monitored April-August. Broadcast spray grass-specific herbicide in April and June. Spot spraying broadleaf weeds in June. Mowed in September. Native grasses seeded by no-till drill in October.
2021	Prairie site preparation	13, 14	49	X	X	X	X	Streaked horned larks monitored April-August. Broadcast herbicide spray in May (Rodeo/Escort) and October (Rodeo). Native grasses and forbs were seeded by no-till drill on the uplands and ATV broadcast in swales in October. A native grass mix was drilled around the field perimeter. Camas planted in November. Damage by vehicle repaired and re-seeded in December.
2022	Riparian forest	1	27	X				Ongoing spot spraying (Rodeo/Vastlan) maintenance of riparian plantings in May and limited mowing in June.
2022	Upland prairie and wet prairie swales	2	37	X	X		X	Spot spray treatments (Transline/Vastlan) in May. Perimeter was mowed in June. HCP area was surveyed for threatened plant species, vegetation plots and weed mapping in May-June. Mowed in August.

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Year	Habitat type	Map code	Acres	IAE/Contractor	City/Contractor	USFWS	ODFW	Description
2022	Oak woodland	3	4		X			Mowed in August.
2022	Wet prairie	4	2	X	X			HCP area was surveyed for threatened plant species, vegetation plots and weed mapping in May-June. Mowed in August.
2022	Upland prairie	5	2	X	X			HCP area was surveyed for threatened plant species, vegetation plots and weed mapping in May-June. Mowed in August.
2022	Upland prairie and wet prairie swales	6	25	X	X			Spot spray (Transline/Vastlan) periphery in April. Spot spray (Rodeo) broadleaf weeds and grasses in May. Mow berms and access road in June. HCP area was surveyed for threatened plant species, vegetation plots and weed mapping in May-June. Mowed in August. Wet swale sprayed out (Rodeo) and broadcast seeded in October.(
2022	Riparian forest	8, 9, 15	6.6	X				Line spray and spot spraying in May and mowing maintenance of riparian plantings in June. Spot spray in November.
2022	Oak savanna	10, 12	4	X	X			Spot spray (Garlon 3A) in April and May. Mowed in August. Spot sprayed perimeter (Garlon 3A) in November.
2022	Prairie	13	35	X			X	Streaked horned larks were monitored April-August. Spot spray broadleaf weeds in May. Mowed in August.
2022	Prairie	13, 14	49	X			X	Streaked horned larks monitored April-August. Spot spray (Transline/Vastlan) periphery in April-May. Spot spray grasses (Rodeo) in June. Mowed in August. Native grasses seeded by no-till drill in October.

Appendix 2. Photo point locations at Herbert Farm and Natural Area

Photo point coordinates (projection is WGS 1984) and direction of one to four photographs taken at each point.

Photopoint number	Latitude	Longitude	Directions of photos (degrees)			
1	44.521444	-123.295944	186	284	346	84
2	44.520806	-123.295556	210	26	158	
3	44.519833	-123.296361	28	217	300	
4	44.520139	-123.298833	296	12	100	260
5	44.5205	-123.301167	24	75	105	190
6	44.521833	-123.301056	320	17	84	150
7	44.523167	-123.30175	90	120	165	240
RB1	44.523278	-123.300944	55			
RB2	44.523333	-123.300583	282	27	140	175
8	44.524139	-123.296167	180	225	285	326
9	44.524167	-123.300028	200	320	25	95
10	44.522139	-123.299861	346	335	15	80
11	44.516727	-123.299486	220	266	314	
12	44.516859	-123.300122	0	90	180	270
13	44.522015	-123.290778	210	255		
14	44.519009	-123.295266	25	80		
15	44.518323	-123.296837	0	90	180	270
16	44.517308	-123.298805	0	90	180	270
17	44.518403	-123.292639	0	90	180	270
18	44.519695	-123.285466	180	225	265	

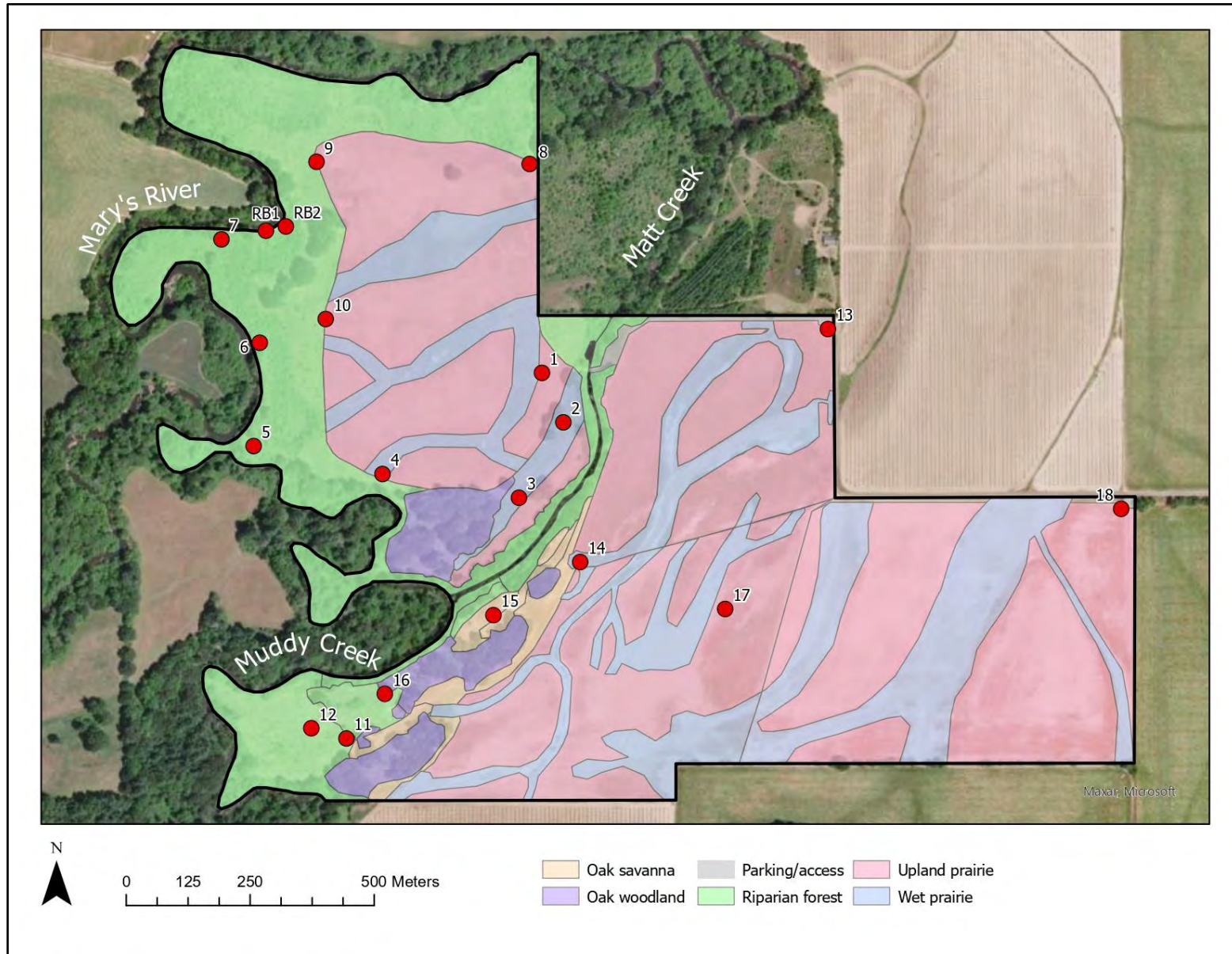


Photo point locations at Herbert Farm and Natural Area.