Willamette University at Zena: Restoration Plan for Prairies and Oak Savannas and Woodlands

Phase 1: 2015-2020

Prepared for Oregon Department of Fish and Wildlife and Willamette University by the Institute for Applied Ecology

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Executive Summary

This restoration plan outlines recommendations for habitat restoration activities to occur over the next seven years within the Willamette University at Zena (WUZ). WUZ is a 305-acre property in the Eola Hills, Polk County, Oregon, eight miles northwest of Willamette University's main campus in Salem. The University sustainably manages WUZ with the goal of using it as an educational facility. The University initiated restoration efforts in 2009, with a focus on prairie and oak woodland habitats. 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 restoration plan outlines a seven-year strategy for restoring the conservation values of 180 acres of prairies, oak savanna and oak woodlands. The plan includes a description of current and desired future conditions, and a restoration strategy for each habitat type that includes site preparation, planting plan and maintenance and monitoring for a seven-year period.

Contents

1 Introduction

1.1 Project background

Willamette University at Zena (henceforth WUZ) is a 305-acre property in the Eola Hills, Polk County, Oregon, eight miles northwest of Willamette University's main campus in Salem (Figure 1). Prior to 2008, the property was part of the 1638-acre Zena Forest (Zena Forest Complex), which was owned by Count Hermann Hatzfeldt of Germany and managed by the Deumling family using uneven-age management and selective cutting forestry practices. The forest was purchased by the Trust for Public Land in 2006 and ownership was transferred to the University (305 acres) and Sarah Deumling (1,333 acres) in 2008 (Figures 1 and 2). Bonneville Power Administration (BPA) holds a conservation easement (CE 2007) on the Zena Forest Complex as part of the Willamette Wildlife Mitigation Program, administered by the Oregon Department of Fish and Wildlife (ODFW). The easement preserves and protects the conservation values (Appendix 1) of the properties in perpetuity. Since 2008 management of WUZ has been guided by the conservation easement and by the forest stewardship plan (Sims 2009). In 2014 the Institute for Applied Ecology (IAE) received funding from ODFW to develop a restoration plan for approximately 180 acres of prairie, oak savanna and oak woodlands at WUZ. Concurrently, Trout Mountain Forestry (TMF), with funding from the Oregon Department of Forestry (ODF), developed a management plan for the 116 acres designated for sustainable forestry. Currently, the University is combining elements of the two documents to create an updated site management plan.

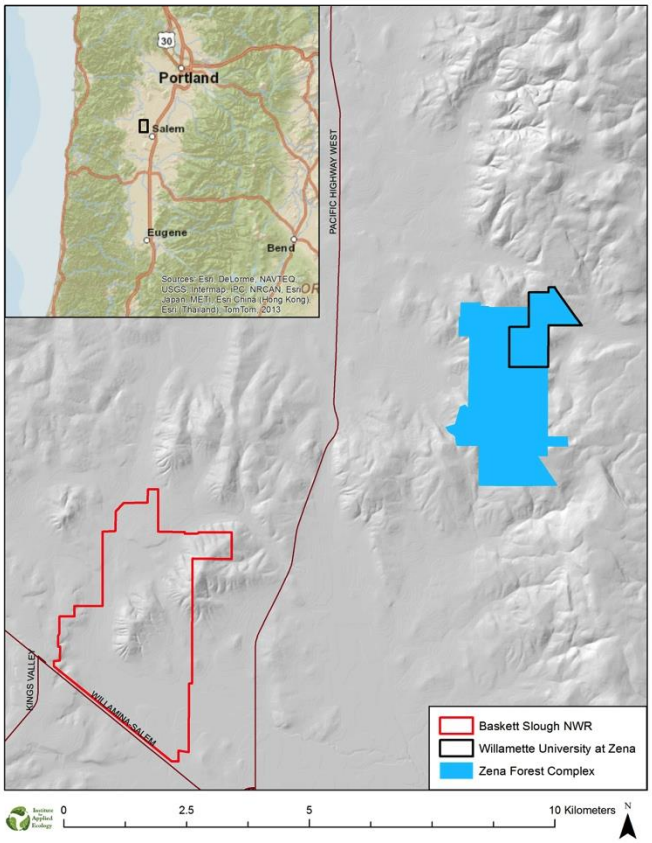


Figure 1. Location of the Willamette University at Zena within the Zena Forest Complex.

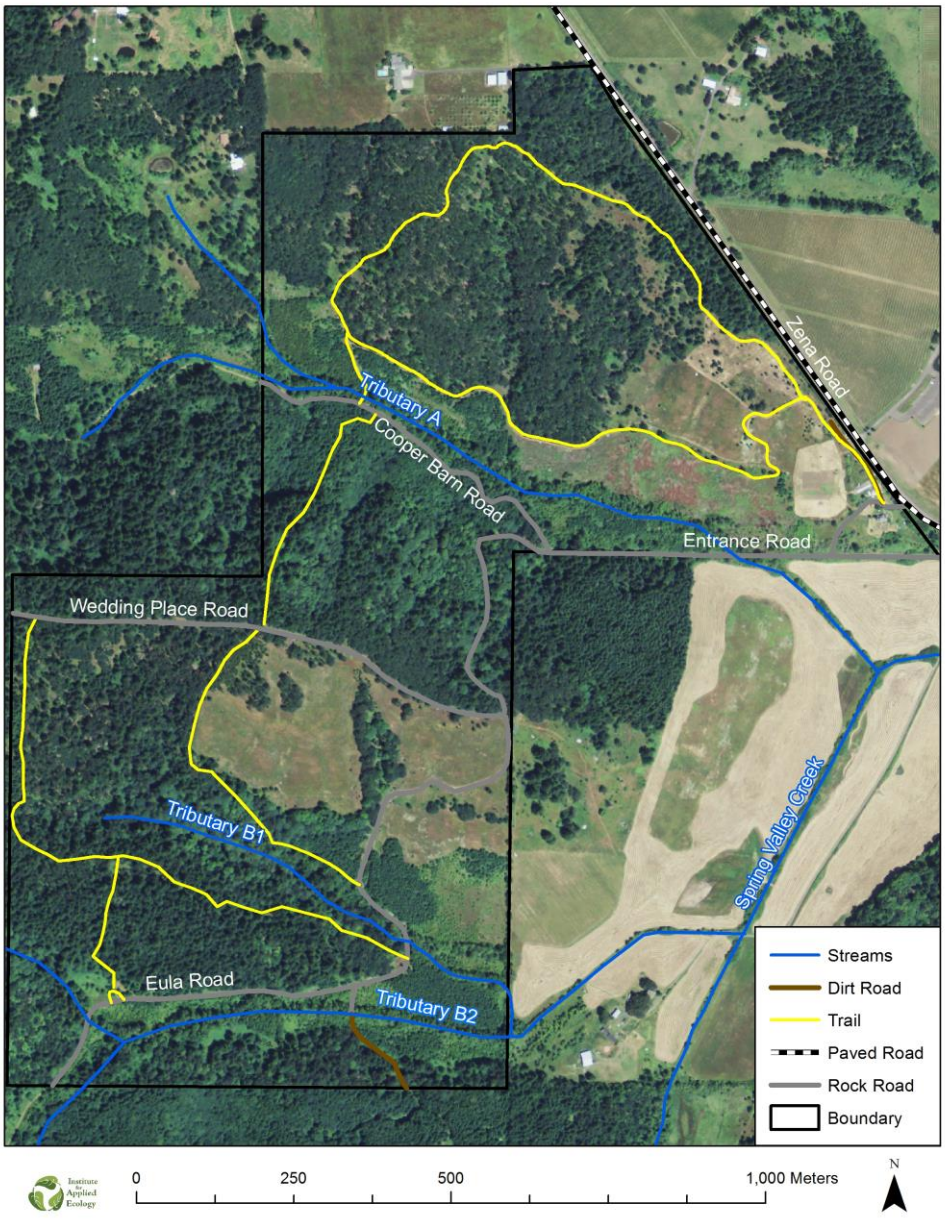


Figure 2. Aerial view of Willamette University at Zena showing the property boundary, roads, trails and streams

1.2 Historic context

WUZ lies in the Eola Hills just northwest of Salem, Oregon, in an area dominated by agriculture and vineyards. It is the largest remaining contiguous block of forested land in the Eola Hills, comprised of important oak savanna, woodland and wet prairie habitat. These oak habitats came to dominate the Willamette Valley 7,800-11,000 years ago following a shift to a warm, dry climate (Whitlock and Knox 2002). Although the primary explanation for the presence of open oak woodland and savanna is climate (Whitlock and Knox 2002), there is ethnographic and historical evidence that indigenous people kept these areas open by frequent, low-intensity burning of the understory (Boyd 1986, 1999).

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 coarse-scale mapping identifies the pre-settlement vegetation at WUZ as almost entirely Oregon white oak (*Quercus garryana*) savanna, with a smaller area of upland prairie in the eastern corner of the property (Figure 3).

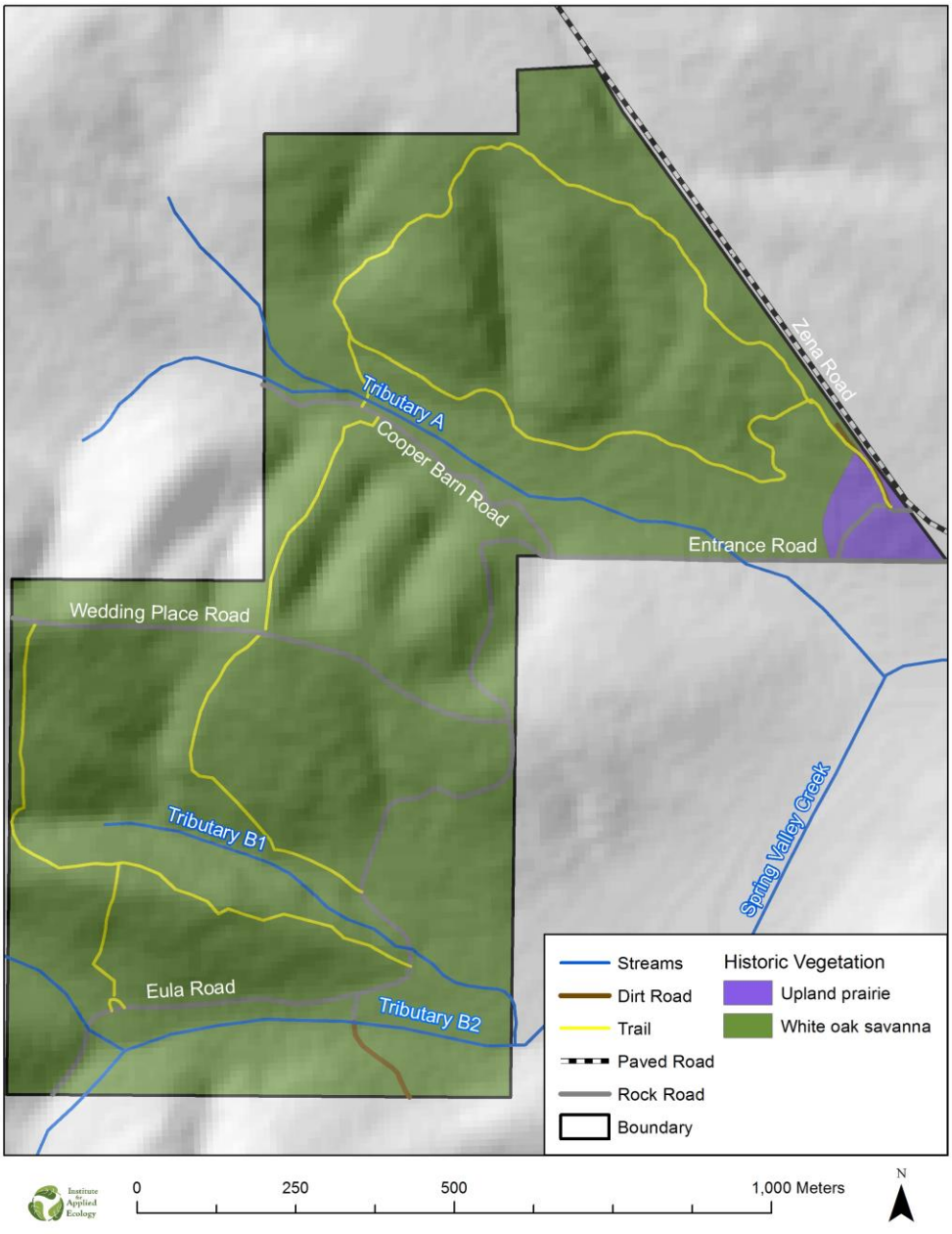


Figure 3. Pre-Euro-American settlement vegetation at Willamette University at Zena (Christy et al. 2005) and shaded topography.

Recent research describes an almost 90% reduction in prairie and savanna acreage in the Willamette Valley between 1850 and the present (Hulse et al. 1998). This is most likely a result of a combination of the collapse of the Kalapuyan populations and their burning practices, the natural succession of Douglas-fir and big leaf maple in the absence of native American fire, the loss of oak habitat with development and conversion to agriculture, as well as the intentional planting of commercial timber species such as Douglas-fir (Habeck 1961, Hadley 1994, Franklin and Dyrness 1988). At WUZ, European-American settlement patterns of livestock grazing and farming for grain changed much of the savanna and prairie grasslands into non-native pastures (Hulse et al. 2002). Over the remainder of the property, fire suppression and plantation forestry allowed Douglas-fir (*Pseudotsuga menziesii*) to expand and dominate over oaks (Copes-Gerbitz et al. in prep, Sims 2009). By the 1930s, the property was a mix of forest and farmland, and there was an orchard in the northeast portion (Figure 4). Large areas of agricultural land have been planted in Douglas-fir over the last 30 years and the mixed-species woodlands have been selectively harvested since the late 1990s (Sims 2009). Tree species include bigleaf maple (*Acer macrophyllum*), ponderosa pine (*Pinus ponderosa*), western redcedar (*Thujar plicata*), Oregon ash (*Fraxinus latifolia*), Pacific madrone (*Arbutus menziesii*), black cottonwood (*Populus trichocarpa*) , Pacific willow (*Salix lasiandra*) and non-native cherry (*Prunus avium*).

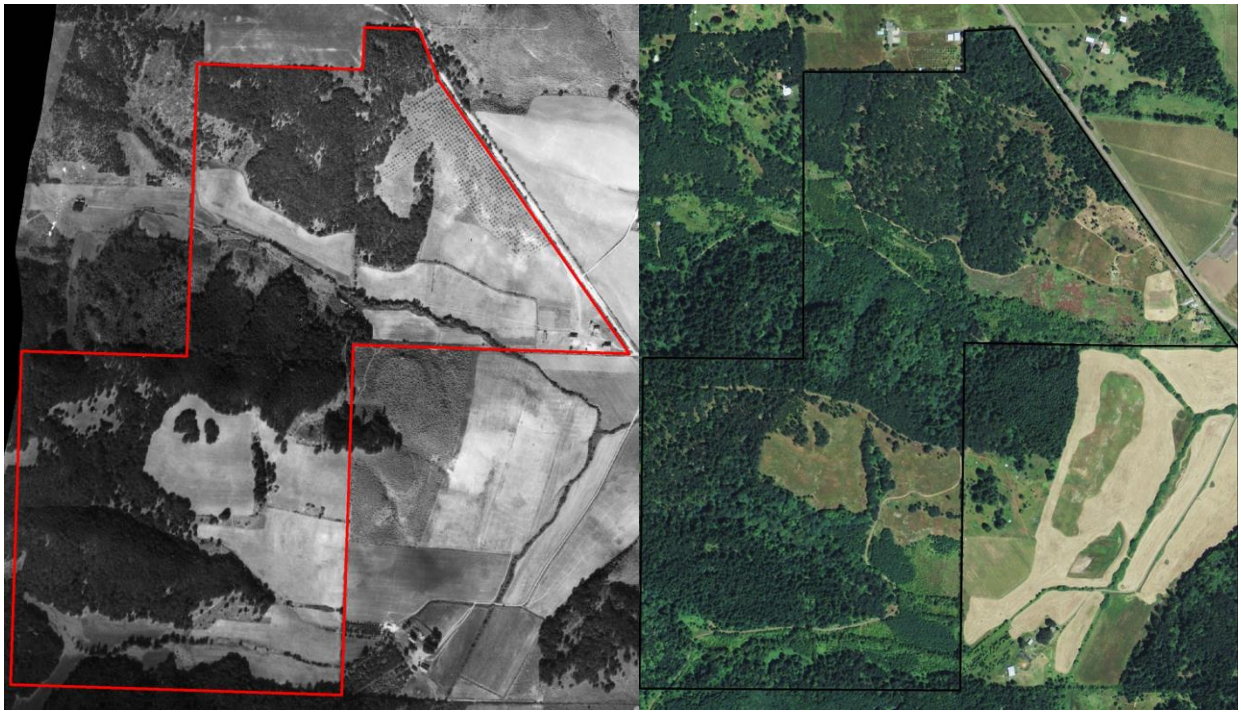


Figure 4. Comparison of aerial photographs of Willamette University at Zena taken in 1935 and 2012.

1.3 Current context

Currently WUZ encompasses five of the eleven "Strategy Habitats" identified by ODFW's Oregon Conservation Strategy (ODFW 2006a), two of which are specifically related to oak habitats (Table 1). The Oregon Conservation Strategy is a comprehensive assessment of key habitats throughout the state. The fact that the WUZ contains five of the Strategy Habitats is a testament to the ecological significance of the property.

Table 1. Strategy habitats at Willamette University at Zena.

Oregon Conservation Strategy "Strategy Habitats"*	Relevance to WUZ
Freshwater aquatic habitats	In-stream aquatic habitat on small streams
Grasslands	Upland prairie and oak savanna
Oak woodlands	Oak woodlands
Riparian habitats	Stream-side forested areas
Wetlands	Wet prairie

**Source:* ODFW 2006a

WUZ lies less than five miles from Baskett Butte, part of the Basket Slough National Wildlife Refuge (Figure 1). Baskett Butte has been identified as a Conservation Opportunity Area within the Willamette Valley Ecoregion in the Oregon Conservation Strategy because it includes a relatively rare large community of upland prairie and oak woodland and savanna (ODFW 2006a). Wetland restoration on the National Wildlife Refuge has dramatically increased waterfowl and shorebird use, and nearby private landowners are cooperating to expand these habitats. The U.S. Fish and Wildlife Service (USFWS) has reintroduced prescribed burning to maintain high quality prairie/savanna habitat on the refuge (Goodridge and Clark 2001, Wilson and Clark 1997, 2000). Protection and restoration of the Strategy Habitats at WUZ will support and enhance the efforts on the refuge and other surrounding lands. Neighboring properties to the east of WUZ are cooperating with state and federal agencies on stream restoration work.

1.4 Landowner objectives

1.4.0 Mission and goals

Willamette University's mission is educational with a vision that Willamette University at Zena will be an exemplary model for the integration of experiential, problem-based, place-based, transformational learning experiences across disciplines and within the liberal arts traditions. The university's commitment "to preserve and protect the conservation values of the property in perpetuity" is the context for teaching, research and learning at WUZ and form the basis for conservation and restoration.

1.4.1 Adaptive ecosystem management model

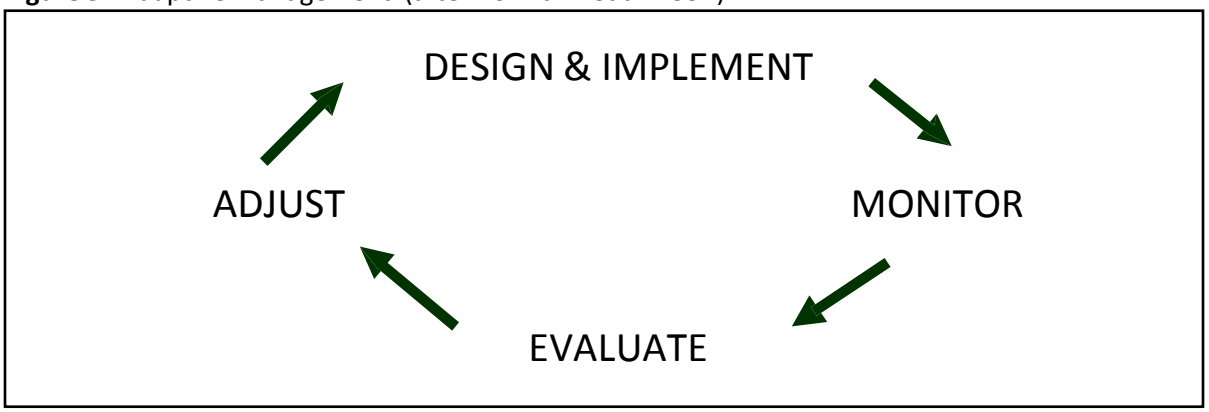
Willamette's approach to protecting, restoring, managing, and enhancing the natural resources and ecosystem services of WUZ follows an adaptive ecosystem management model executed in conjunction with the support of our community partners. An adaptive ecosystem management approach will rely heavily upon quantitative monitoring of experimental manipulation of the natural and human components of the WUZ ecosystem. Knowledge gained through experimentation will feed back into further management considerations (Figure 5). Developed by C.S. Holling (1978), adaptive ecosystem management has been implemented regionally through the Northwest Forest

Plan (FEMAT 1993) and the Oregon Plan for Salmon and Watersheds (OWEB 2008) and is the guiding strategy for several national natural resources management agencies, including the Department of the Interior.

The specific strategies for management are outlined later in this plan. The basic goals under our adaptive ecosystem management protocol at WUZ are to:

1) Consider both the biotic and abiotic elements of habitats, their interconnections, and their dynamics when designing a management protocol
2) Design and implement a number of experimental management strategies (prescribed fire, selective thinning, etc.)
3) Monitor the results (e.g. reduction of invasive species, increase in native plant cover, growth rates of oak and Douglas-fir) through data collection
4) Quantify and evaluate these results
5) Adjust the management strategies to reflect what we have learned
6) Continue monitoring and evaluating

Figure 5. Adaptive management (after Bormann et al. 1994).



Likewise, the restoration plan for WUZ will be re-assessed periodically. Typically, restoration plans have a 5-10 year life span. At the end of that period, most inventory information upon which the plan was based is getting out of date, and it is time for a reappraisal of the total property, ownership objectives, and implementation successes and challenges. We recommend a 5-year review and 10-year update.

A management plan review should assess and evaluate:

- implementation of the plan and strategies
- effectiveness of the strategies in achieving the expected results
- assumptions built into the plan and evaluate the extent to which goals are being met
- adaptive management, and
- impact of allowed uses such as public access, forestry and grazing.

1.4.2 Research approach

Recognizing that questions about ecological restoration are often inter- and cross-disciplinary in nature, Willamette University will encourage collaborative research projects as well as individual investigations. We envision researchers pursuing two threads of study at WUZ; both applied and pure research related to questions of ecological restoration.

As an example of a project underway, University students and faculty have begun to analyze vegetation change and land use history at WUZ over the past 150 years (Gildehaus et al. 2015, Copes-Gerbitz et al. in prep, Savoca 2009). These results will contribute to a growing body of knowledge about how natural (e.g., precipitation, climate change, disturbance) and anthropogenic (e.g., land use and land tenure) events have influenced forest and prairie development in the Willamette Valley. These results will also provide valuable information to land managers and policy makers with respect to management strategies for maintaining biological diversity and ecological integrity in the Willamette Valley. In addition, Willamette University students have designed and implemented a variety of applied research projects on bird diversity (Chiono et al. 2005, Lugg 2010, Edwards 2013), invasive species (Wright 2009, Michelotti 2011), native species (Bower 2012, Sullivan 2010), soils and restoration (Faciszewski 2012, Banks Rusby 2013), and aquatic systems (Ninneman 2010, Sunken 2010).

1.5 Soils, water and topography

There are a wide variety of soils at WUZ (Table 2, Figure 6). Within the restoration area boundaries, the primary soils are Chehulpum silt loams and Chehulpum-Stelwer complex, which are well-drained soils on the higher slopes. The lower slopes and riparian margins have Hazelair silt loams, which are moderately to somewhat poorly drained soils, or Waldo silty clay loams, which are poorly drained.

There are two tributaries of Spring Valley Creek that run to the east and join the main stem off the property. The tributaries will be referred to as Tributary A in the north and B in the south. The streams are intermittent, and have minor channels, and dry out during the summer during most years (Appendix 2, Figure A2.16).

The restoration areas that are the subject of this plan are largely on the northern slopes of the stream catchments. Hence the majority of the area is on south-facing slopes (Figure 6), with inclinations ranging from 0-3 to 40% (Table 2).

1.6 Sensitive species

1.6.0 Rare plants

A rare plant survey of the Zena Forest Complex (WUZ and Deumling properties) found no state or federally-listed plant species (Salix Associates 2008). One specimen of meadow checkermallow (*Sidalcea campestris*) was found on the Deumling property in 2008. This is listed as a Candidate species by the State of Oregon (ODA 2014).

1.6.1 Sensitive fish and wildlife

No formal fish surveys have been conducted at WUZ (Karen Hans, ODFW, pers. comm.). The tributaries of Spring Valley Creek that originate in WUZ may have potential fish habitat (woody debris, pools, and rearing areas) that could suit cutthroat trout (*Oncorhynchus clarkii*) if culverts were improved to allow

Table 2. Soils present within the restoration project area at WUZ (NRCS 2012).

Map Unit Name	Map Unit Symbol	Slopes	Hydric Class	% of Restoration Area	Soil Description
Bellpine silty clay loam	8E	20-30%	Non-hydric	1.4%	Moderately deep, well-drained soils that formed in colluvium and residuum derived from sedimentary rocks. Vegetation is Douglas-fir, Oregon white oak, wild rose, Pacific poison oak, snowberry, brackenfern, and grasses.
Chehulpum silt loam	15C	3-12%	Non-hydric	46.6%	Well-drained soils that formed in mixed material that contains loess and is underlain by sandstone or shale. The vegetation is mainly oak, poison oak, wild rose, and grasses.
	15E	12-40%		0.01%	
Chehulpum-Steiwer complex	16E	12-40%	Non-hydric	26.3%	See Chehulpum and Steiwer Soil Descriptions
Hazelair silt loam	29C	3-12%	Non-hydric	12.8%	Moderately deep, moderately well drained to somewhat poorly drained soils that formed in the colluvium weathered from sedimentary bedrock. Where these soils are not cultivated, the vegetation is Oregon white oak, grass, poison oak, and wild rose.
	29D	12-20%		1.6%	
	29E	20-30%		0.4%	
Helvetia silt loam	31C	0-12%	Partially hydric	0.9%	Very deep, moderately well drained soils that formed in glaciolacustrine deposits over silty and clayey alluvium. Native vegetation is mainly Douglas fir, bigleaf maple, hazelbrush, poison oak, and other shrubs and grasses.
	31D	12-20%	Non-hydric	0.8%	
Steiwer silt loam	67E	20-50%	Non-hydric	1.2%	Well-drained soils that formed from old alluvium and colluvium. In areas that are not cultivated, the vegetation is grasses, oak, and poison oak.
Waldo silty clay loam	72	0-3%	Hydric	1.0%	Deep, poorly drained soils that formed in recent alluvium. Where the soils are not cultivated, the vegetation is tussock, sedge, willow, ash, and grass.
	73	0-3%	Hydric	7.0%	Deep, poorly drained soils that formed in mixed alluvium. Where these soils are not cultivated, the vegetation is willow, ash, tussock, sedge, and grass.

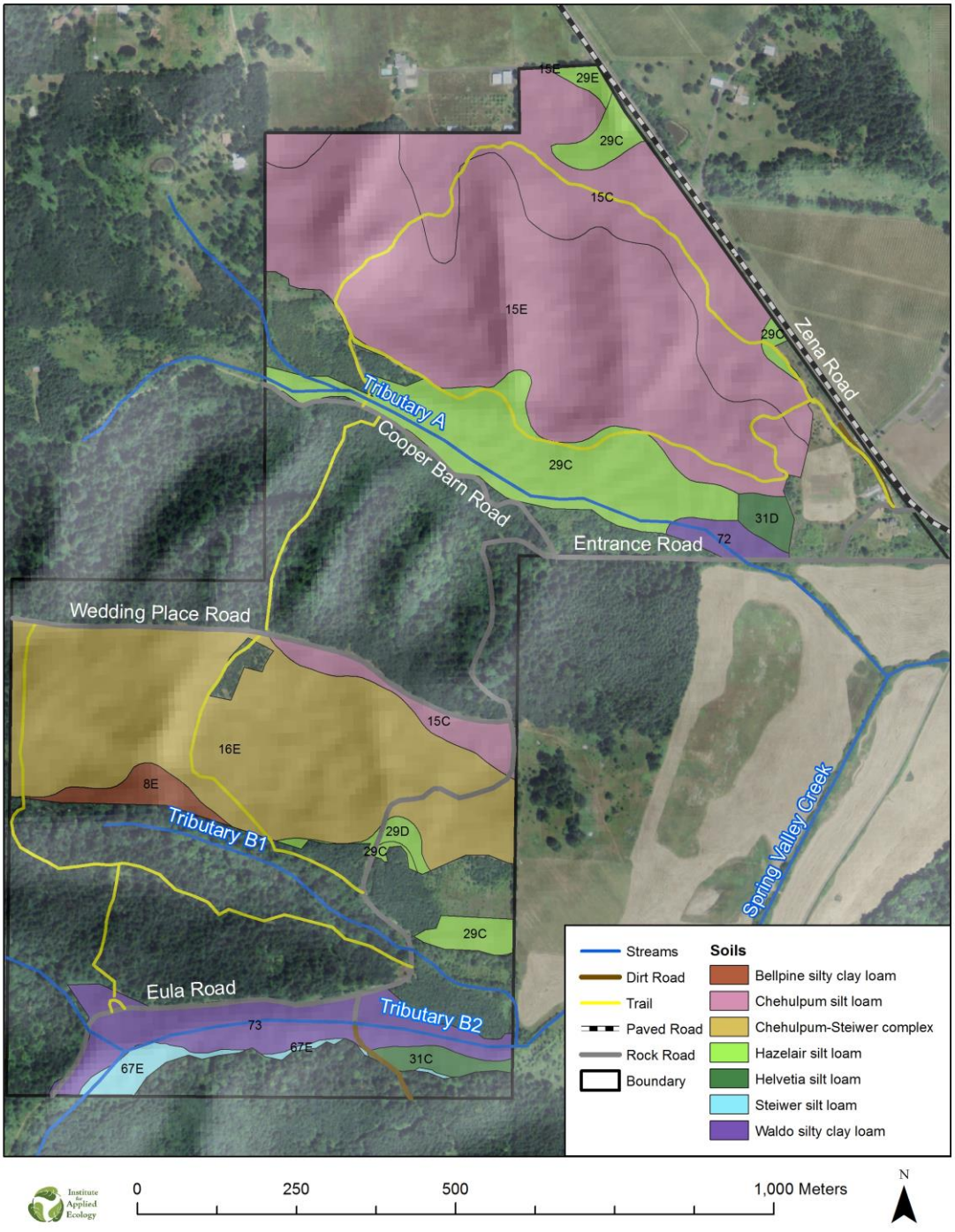


Figure 6. Soil types within the main restoration area boundaries of Willamette University at Zena (NRCS 2012).

migration into WUZ from downstream (K. Hans, pers. comm.). However, although obstructions have been removed from reaches of Spring Valley Creek on properties adjacent to WUZ, there are still a number of barriers between WUZ and the Willamette River, ranging from non-passable culverts to irrigation weirs (Sims 2009). Although the streams are seasonal, it is likely that they provide good riparian habitat for other wildlife, such as amphibians and turtles.

The most recent wildlife surveys were conducted across the Zena Forest Complex, and so there is no survey specific to WUZ. A bird and habitat analysis was conducted by Oregon Natural Heritage Information Center in August 2006 and a rare plant and butterfly survey was conducted by Salix Associates in April-June 2008 (Salix Associates 2008). Neither survey identified any sensitive species at WUZ (with the exception of the one individual of the state candidate species, meadow checkermallow), but the property does contain a diverse mix of forested and open habitats supporting a rich array of wildlife species that is potential habitat for a number of rare species. For example, Western pond turtles (*Actinemys marmorata*) are known from ponds 0.5 miles to the east of WUZ, so there may be opportunities to establish additional habitat for this species along the tributaries of Spring Valley Creek (Sims 2009).

No rare butterflies are present at WUZ, probably because of isolation from other populations, and lack of habitat, suitable native host plants, and nectar sources. Narrow-leaved plantain (*Plantago lanceolata*), an introduced species that is used by larvae of Taylor's checkerspot butterfly (*Euphydryas editha taylori*) is dominant in medium-dry parts of the prairies at WUZ.

Some uncommon and rare bird species have been noted during surveys of the Zena Forest Complex (Table 3), including Oregon Conservation Strategy (ODFW 2006a) species such as the slender-billed nuthatch (*Sitta carolinensis aculeate*) and the western bluebird (*Sialia mexicana*).

Table 3. Sensitive wildlife present at the Zena Forest Complex (Salix Associates 2008, Sims 2008, Galitsky and Lawler 2015, Edwards 2013).

Species Name	Scientific Name	Federal Status	State Status	Conservation Strategy Species (OR)	Habitat Type
Chipping sparrow*	*Spizella passerina*			Yes	Open woodlands and forests with grassy clearings.
Pileated woodpecker*	*Dryocopus pileatus*		SV	Yes	Older forest with large standing dead trees and downed wood.
Slender-billed nuthatch*	*Sitta carolinensis aculeata*		SV	Yes	Large diameter open site oaks. Cavity nester.
Western bluebird*	*Sialia mexicana*		SV	Yes	Open canopy woodlands, pastures. Cavity nester.
Western meadowlark*	*Sturnella neglecta*		SC	Yes	Open grasslands.
Western gray Squirrel	*Sciurus griseus*		SV	Yes	Closed canopy woodlands.
Willow flycatcher*	*Empidonax trailii adastus*	Species of Concern	SV	Yes	Riparian and upland shrub areas, nests close to ground in shrub thickets.
Yellow-breasted chat*	*Icteria virens*	Species of Concern	SC	Yes	Shrubby riparian areas, wetlands, forest edges, burned areas.

Key: * Species observed at WUZ
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)

Restoration at WUZ could benefit many other Oregon Conservation Strategy species, such as northern red-legged frog (*Rana aurora*), acorn woodpecker (*Melanerpes formicivorus*), Oregon vesper sparrow (*Pooecetes gramineus affinins*) and Townsend's big-eared bat (*Corynorhinus townsendii*). Ultimately, a healthy riparian zone should also include North American beaver (*Castor canadensis*) (Bolye & Owens 2007).

2 Current conditions in restoration units

This restoration plan addresses areas that were identified by Willamette University as priorities for restoration, based on recommendations from the stewardship plan (Sims 2009). These priority areas encompass approximately 180 acres.

Habitat types present at WUZ within the project area are described briefly below and shown in Table 4 and Figure 7. Four of the habitat types are Oregon Conservation Strategy (ODFW 2006a) habitats (wetlands, grasslands, oak woodland, and riparian). Example photographs are shown in Appendix 2, Figures A2.1-A2.18. Invasive plant species, or those of management concern, are shown in Table 5. For additional species, see Appendix 4.

Table 4. Approximate areas (acres) of restoration units by habitat types at Willamette University at Zena.

Habitat	Acres per Restoration Unit											Total acres
	B	C	D	E	F	G	H	M	P	Q	V	
Wet prairie-grassland		9.8										9.8
Oak savanna-grassland	11.1							20.5				31.6
Oak woodland					51.2			5.1			2.3	58.6
Mixed woodland					5.4	7					25.8	38.2
Riparian forest-shrubland			10.9						4	12.5		27.4
Plantation forest				4.2			6.4			3.7		14.3
Total	**11.1**	**9.8**	**10.9**	**4.2**	**56.6**	**7**	**6.4**	**25.6**	**4**	**16.2**	**28.1**	**179.9**

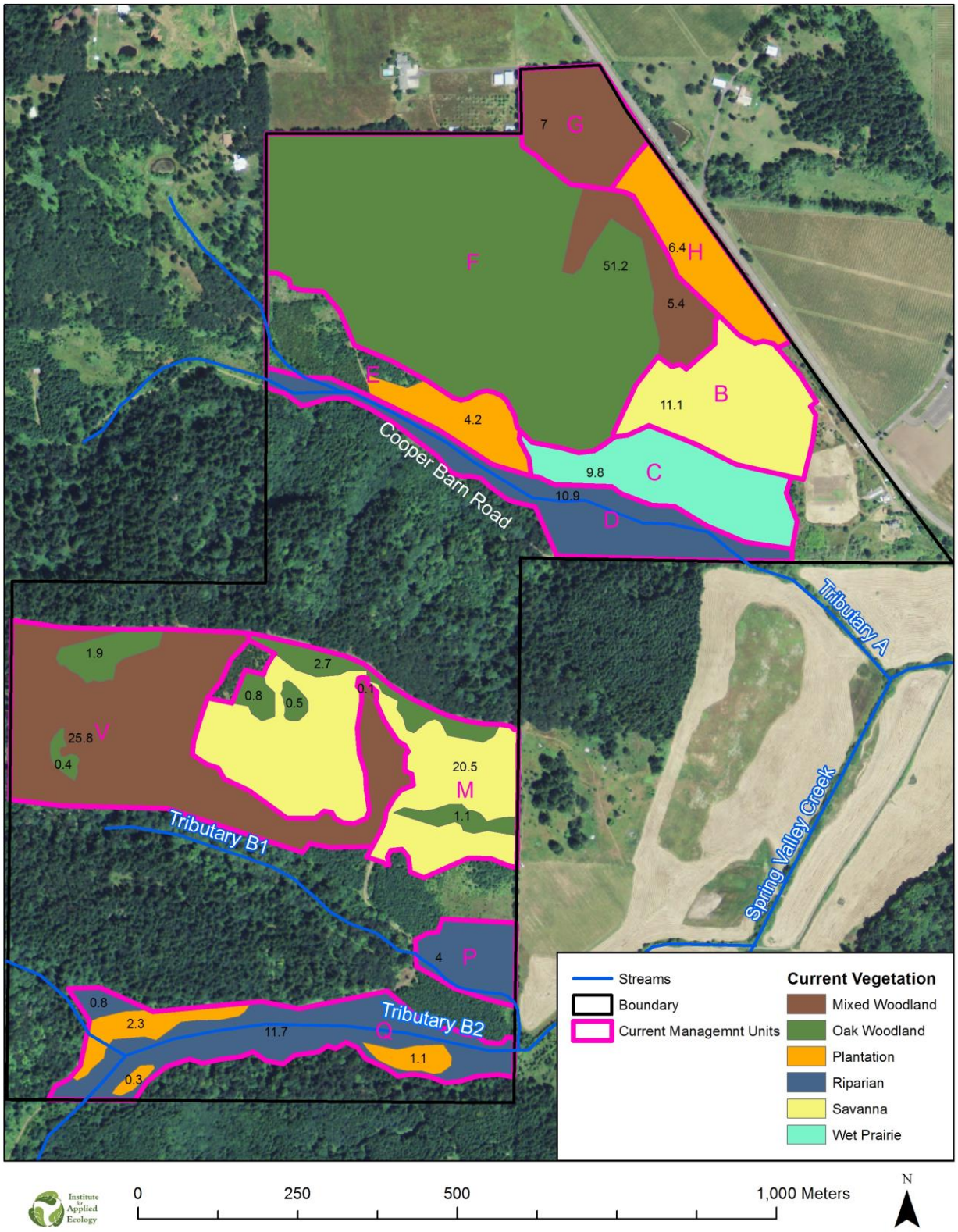


Figure 7. Current habitats within the restoration area at Willamette University at Zena, with restoration units delineated (pink lines and letters) and acreages (black numbers).

Table 5. Invasive species and species of management concern at Willamette University at Zena.

Growth form	Scientific name	Common name
Shrubs	*Crataegus monogyna*	Hawthorn
	Cytisus scoparius	Scotch broom
	Prunus avium	Cherry
	Rubus armeniacus	Himalayan blackberry
	Toxicodendron diversilobum	Poison oak
Grasses	*Agrostis gigantea*	Redtop
	Arrhenatherum elatius	Tall oatgrass
	Bromus hordeaceus	Soft brome
	Holcus lanatus	Velvetgrass
	Schedonorus arundinaceus	Tall fescue
	Taeniatherum caput-medusae	Medusahead
	Vulpia myuros	Rat-tail fescue
Forbs	*Cirsium canadense*	Canada thistle
	Cirsium vulgare	Bull thistle
	Dipsacus fullonum	Fuller's teasel
	Geranium dissectum	Cutleaf geranium
	Geranium lucidum	Shining geranium
	Leucanthemum vulgare	Oxeye daisy

2.1 Wet prairie-grassland (Unit C)

One 10-acre area of wet prairie grassland (Unit C, Figure A2.1), is bordered by oak savanna (Unit B) and oak woodland (Unit F) to the north, and a riparian forest margin and Tributary A (Unit D) to the south (Figure 7). Aerial photography shows the area was actively farmed as far back as 1935 (Figure 4), and also reveals that Douglas-fir plantations were established in the 1980s.

Douglas-fir plantation and shrubs were removed and burned in 2012. The unit was also treated with a broadcast of glyphosate prior to seeding in fall 2012, and Scotch broom (*Cytisus scoparius*), Himalayan blackberry (*Rubus armeniacus*) and Fuller's teasel (*Dipsacus fullonum*) were spot sprayed in 2013 and 2014. In addition, the prairie was mowed in 2014. Seeding of tufted hairgrass (*Deschampsia caespitosa*), California oatgrass (*Danthonia californica*), meadow barley (*Hordeum brachyantherum*) and Roemer's fescue (*Festuca roemeri*) occurred in fall 2012. Islands of native grasses were established on burn piles areas and 2000 forb plugs were planted in these patches in 2013.

Currently the wet prairie is dominated by velvetgrass (*Holcus lanatus*), redtop (*Agrostis gigantea*) and some tall fescue (*Schedonorus arundinaceus*), oxeye daisy (*Leucanthemum vulgare*), blackberry and Scotch broom. There is a scattering of ash saplings and small trees through the prairie that were not removed during the clearing of the plantation trees (Figure A2.2). Due to poor site preparation and ineffective herbicide follow up, less than 10% of the unit is comprised of native grass, mostly tufted hairgrass. A few of the burn piles did well and have 100% native grass cover, mostly consisting of tufted hairgrass. A drainage feature runs through the prairie (Figure A2.3) from the west side of Unit B, which may be the result of subsurface drainage from the hillslope that pools at the surface of the more gently sloping wet prairie.

2.2 Oak savanna-grassland (Units B and M)

Two main areas of Oak savanna-upland prairie-grasslands are in restoration Units B (12 acres) and M (21 acres) (Figure 7). Because oaks and some trees will be retained, these units are referred to in this plan as savannas, rather than prairies.

Dendroecological data collected by Willamette University indicates that these areas were oak savannas in the 1800s prior to European settlement (Copes-Gerbitz et al. in prep). There were open farm fields or orchards in the areas during the 1930s, but as farming activity decreased during the 1950s-70s, trees and shrubs encroached and the areas became more wooded. Plantation forest was established in the 1980s-90s.

The young Douglas-fir, ponderosa pine, and invasive shrubs were removed in 2009 or 2010 (depending on the sub-unit), and between 2010 and 2014 a series of treatments included broadcast and spot spraying of herbicide, a prescribed burn, and seeding of Roemer's fescue. Most sub-units received a single broadcast of glyphosate and grass seeding in the first year, annual mowing for the next two years, and then a grass-specific herbicide treatment and spot spraying of shrubs in 2014 (see Appendix 3).

Native forb planting occurred in 2012, 2013, and 2014, including small numbers of the threatened Nelson's checkermallow (*Sidalcea nelsoniana*). More native forb plugs were planted in B-North than other sub-units.

Current conditions vary by sub-unit. In general, introduced grasses dominate, particularly redtop, soft brome (*Bromus hordeaceus*), common velvetgrass and rat-tail fescue (*Vulpia myuros*), as well as tall oatgrass (*Arrhenatherum elatius*), tall fescue and medusahead (*Taeniatherum caput-medusae*). The native Roemer's fescue is widespread, as a result of the seeding at the site, and California oatgrass is moderately abundant. Of the smaller component of forbs, introduced forbs dominate over natives, e.g., Queen Anne's lace (*Daucus carota*), pale flax (*Linum bienne*) and hairy vetch (*Vicia villosa*), and thistles (*Cirsium spp.*), geraniums (*Geranium spp.*) and false dandelion (*Hypochaeris radicata*) are other abundant weeds. There are localized infestations of Fuller's teasel and oxeye daisy. Planted forbs that are common (in all of Unit B and parts of Unit M) are common yarrow (*Achillea millefolium*), Oregon sunshine (*Eriphyllum lanatum*), common selfheal (*Prunella vulgaris*), sticky cinquefoil (*Potentilla glandulosa*), slender cinquefoil (*Potentilla gracilis*) and dwarf checkermallow (*Sidalcea virgata*). Meadow checkermallow (*S. campestris*), Western columbine (*Aquilegia formosa*), Virginia strawberry (*Frageria virginiana*), balsamroot (*Balsamorhiza*), barestem biscuitroot (*Lomatium nudicaule*), common lomatium (*L. utriculatum*), Puget Sound gumweed (*Grindelia integrifolia*), narrowleaf onion (*Allium amplectens*) and Tolmie star-tulip (*Calochortus tolmiei*) have also been planted, but mostly in B-north and some in B-south. Native tree seedlings occur at low density and invasive shrubs such as Scotch broom and Himalayan blackberry continue to both sprout from the seed bank and seed in from edges, though rates of sprouting and encroachment have declined as a result of restoration activities.

Sub-units of restoration units B and M are shown in Figures 8 and 9, respectively. All sub-units for these two units are described briefly in the sections below.

Figure 8. Sub-units of restoration Unit B at Willamette University at Zena

2.2.0 B – North

B-North sub-unit is a four-acre area in the northern part of Unit B (Figure 8). Initial restoration cleared plantation trees and invasive trees and shrubs, a controlled burn, mowing and herbicide treatments. Oaks that established since the 1970s were thinned to 36 trees per acre (90 trees per hectare). Some other trees, including heritage apples, also were retained (Figure A2.4). Roemer's fescue (sown at 1 lb per acre) and forbs (sown at 3 lbs per acre), including yarrow , farewell to spring (*Clarkia amoena*), Oregon sunshine, barestem biscuitroot, American bird's-foot trefoil (*Lotus unifoliolatus*), sicklekeel lupine (*Lupinus albicaulis*), showy tarweed (*Madia elegans*), grassy tarweed (*Madia gracilis*), slender cinquefoil (*Potentilla gracilis*), common selfheal and dwarf checkermallow (*Sidalcea virgata*) were seeded over five acres, and 15,000 native forb plugs, including yarrow, Oregon sunshine,

checkermallows, balsamroot (*Balsamorhiza*), showy milkweed (*Asclepias speciosa*) were planted, creating a diversity of forbs. A one-acre section contains a high density of planted plugs and serves as the University's demonstration native garden. Infestations of Scotch broom and non-native grasses, particularly a heavily infested area of tall oatgrass, have received herbicide treatments and require ongoing control. The sub-unit includes monitoring plot B1.

2.2.1 B – South

This four-acre sub-unit is in the south part of Unit B (Figures 8, A2.5). Trees and invasive shrubs (e.g., Scotch broom) were removed, although there is some on-going reinvasion, albeit at a lower rate than prior to restoration. There was also a controlled burn, mowing and herbicide treatments. Roemer's fescue was sown at 5lb per acre and 5000 native forb plugs were planted. A dense infestation of oxeye daisy is a problem area. The sub-unit includes monitoring plot B2.

2.2.2 B – East

This one-acre sub-unit is in the east part of Unit B (Figures 8, A2.6). Apart from clearing of trees and shrubs and some herbicide treatments, restoration actions have been more limited than other parts of the unit. Consequently, the vegetation is dominated by redtop, velvetgrass and oxeye daisy.

A line of oak trees in Unit C separates Unit B from the wet prairie.

2.2.3 B – West

This two-acre sub-unit is in the west part of Unit B (Figure 8). No regular restoration treatments have occurred, apart from clearance of trees and shrubs and some herbicide applications. Consequently, the vegetation is dominated by redtop, velvetgrass and oxeye daisy.

A small patch of ponderosa pine is at the south-western corner.

2.2.4 M – East upper

Sub-unit M-East upper is a four-acre area in the north-east part of oak savanna Unit M (Figures 9, A2.7). Initial restoration efforts included clearing the young Douglas-fir plantation and shrubs, broadcast herbicide, a controlled burn, mowing, grass-specific herbicide and spot spraying of Scotch broom. Roemer's fescue was seeded in 2011 and 3000 native forb plugs (mainly in burn piles) were planted in 2012-13. The sub-unit includes monitoring plots M4 and M5.

2.2.5 M – East middle

Sub-unit M-East middle (Figure 9) is a three-acre area which includes an oak stand approximately 50 years old with an understory of tall fescue and redtop. As yet, no restoration has occurred. The sub-unit includes monitoring plot M3.

2.2.6 M – East lower

This three-acre sub-unit (Figure 9) was broadcast with herbicide, and patchily burned before seeding with Roemer's fescue. Since then 2000 forbs have been planted. Follow-up treatments included mowing and grass-specific herbicide. The bottom third of this sub-unit has infestations of teasel and oxeye daisy.

Figure 9. Sub-units of restoration Unit M at Willamette University at Zena.

2.2.7 M – West

Initial restoration of this 11-acre sub-unit (Figures 9, A2.8) included clearing trees and shrubs, broadcast herbicide and a burn before seeding of Roemer's fescue. Ridges across the slope in M-West have made treatments with equipment, such as ATVs, problematic. Follow-up treatments included mowing, grass-specific broadcast herbicide and spot spray of Scotch broom. University monitoring plots M2 is found in this sub-unit.

2.2.8 M – Oak buffer

A buffer strip lies on the north side of M along Wedding Place Road and includes open growth form oaks dating from the 1700s, as well as younger cohorts of oak. Tree density has been reduced by thinning out the younger oaks and shrubs in favor of open grown oak and madrone, followed by glyphosate broadcast, mowing and spot spraying. A velvet grass patch at the east end of the buffer has developed where herbicide was applied with no follow-up seeding of ground cover.

2.2.9 M – Oak islands

Two oak islands in Unit M-West (Figures 9, A2.9), totaling approximately 1.3 acres, have trees dating from the 1800s, but by the 2000s Douglas-fir was encroaching and shrub density was high, particularly of poison oak (*Toxicodendron diversilobum*), snowberry (*Symphoricarpos albus*), Scotch broom and blackberry. Oak was thinned to 50-100 trees per acre and fir removed in 2010, and invasive shrub density was reduced by chemical control in following years. This sub-unit includes monitoring plot M1. A ponderosa pine plantation adjacent to the western oak island is not part of the restoration unit.

2.3 Oak woodland (Units F & V)

Oregon white oak dominates many parts of the restoration areas, as a result of historic vegetation patterns, natural regeneration, and human restoration activities.

The largest continuous woodland (51 acres) occurs in Unit F (Figures 7, 10, A2.10-11). During pre-European times, frequent burning would have maintained savanna conditions. Aging of trees shows that oaks were recruiting at the rate of about 4-8 per acre (10-20 per hectare) during the 1800s. Few oaks recruited during the early 1900s, as a result of farming activities, but they established at higher rates (>160/acre or 400 per ha) in the 1950s-70s, due to lack of fire and decrease in farming pressure (Copes-Gerbitz et al. in prep). Closing of the canopy encouraged cohorts of Douglas-fir and cherry, and a smaller component of ash and big leaf maple. Scattered remnants of Gardner's yampah (*Perideridia gairdneri*), white brodiaea (*Triteleia hyacinthina*), Tolmie star-tulip (*Calochortus tomiei*), and larkspur (*Delphinium* sp.), provide further evidence for a more open savanna in the past.

Oaks were thinned to 250 oaks/acre in a 40 acre area (mature oak woodland and oak with 1940s and 1960s cohorts, Figure 10) and 125 oaks/acre in 6 acres (northeast corner of oak with 1940s and 1960s cohorts, Figure 10) of Unit F in 2010-13. Invasive shrubs and cherry were cut and treated on all 57 acres during the same period, with follow-up spot spraying in 2014. As a result of the oak release and reduction in cover of invasive shrubs, there has been an increase in forbs (half native species). The northwestern section has not been thinned. Monitoring plots include F1, F2, F3 and F4 (Figure 10).

Two areas of dense young oak (2.3 acres) in Unit V (Figures 11, A2.12) were thinned to 300 trees per acre in 2010-13. Additional oak patches in Units B and M are described above in the oak savanna section.

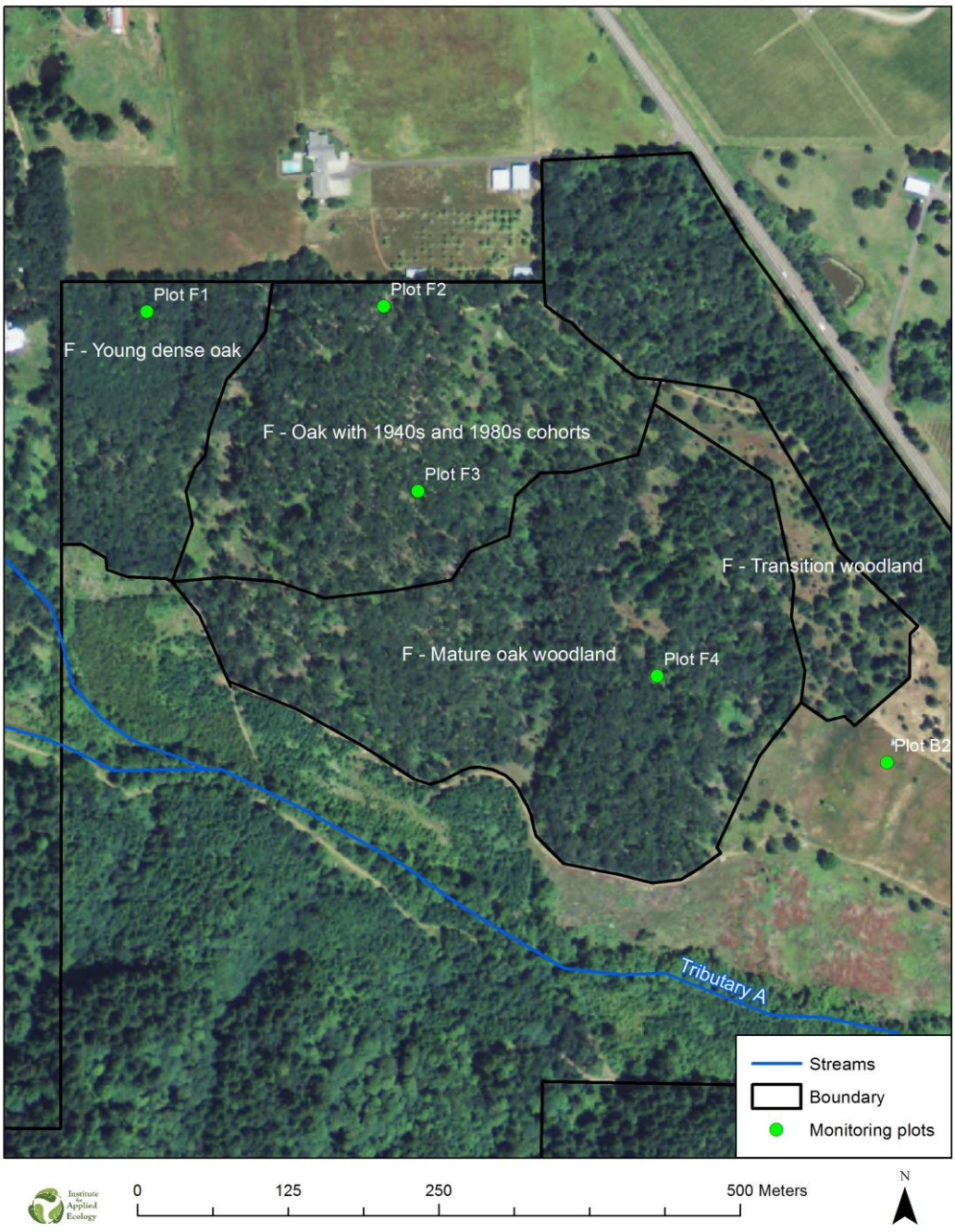


Figure 10. Sub-units of restoration Unit F at Willamette University at Zena.

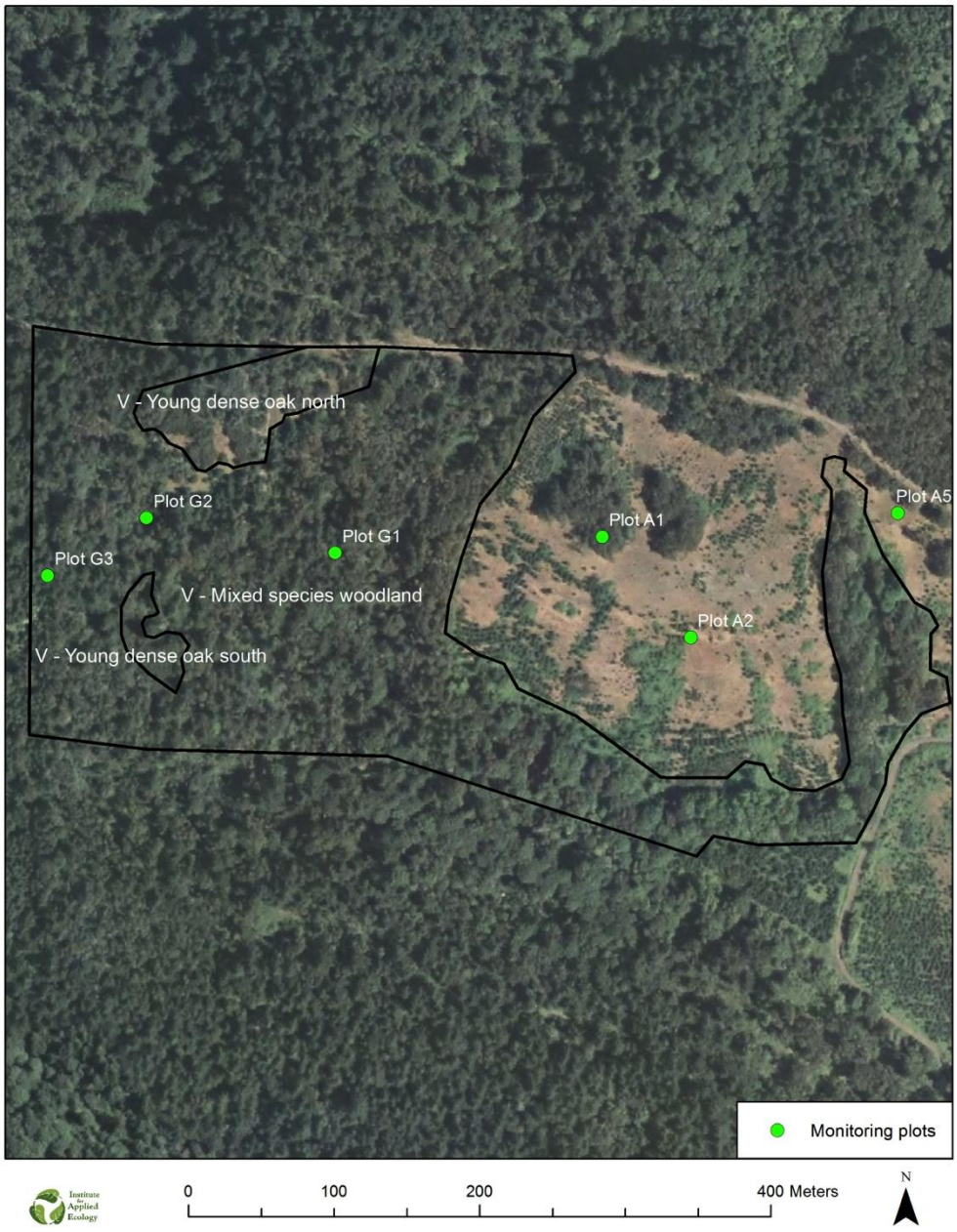


Figure 11. Sub-units of restoration Unit V at Willamette University at Zena (part of M is also shown).

2.4 Mixed species woodland (Units F & V)

There is five-acre Transition Woodland in Unit F (Figures 7, 10, A2.13-14) leading upslope from the northwest corner of B, creating a transition between savanna and the more dense woodland of F. Aerial photography indicates this area was open pasture and orchard during the 1930s, remained open until the 1970s, but more recently became overgrown with invasive shrubs (blackberry and Scotch broom) and trees (cherry, Douglas-fir). Some shrub management occurred in 2010-13 and mowing occurred in

2014. Currently the sub-unit is weedy with a mix of oak, Douglas-fir, shrubs, and some legacy apples from the original orchard.

One large area of mixed species woodland (26 acres) occurs in the restoration Unit V (Figures 7, 11, A2.15). At least part of the unit was open oak savanna in the 1930s, but began to fill in with Douglas-fir, cherry and maple, during the 1950s-80s. Douglas-firs were thinned throughout the unit in 2010-13, with a more intensive restoration harvest on 10 acres on the eastern edge of the unit. Snags were created in 2012 and understory shrubs planted on one acre in 2013. Invasive shrubs and cherry were treated over the whole unit in 2010. As a result of the decrease in hardwoods and fir, there has been an increase in regeneration of oaks, forbs and shrubs. There is still a Douglas-fir component to the forest.

2.5 Riparian forest-shrubland (Units D, P & Q)

Riparian forest and shrubland borders the tributaries of Spring Valley Creek (Figures A2.16-18) in Units D, P and Q (Figure 7). The areas were cultivated for farming since at least the 1930s, but were planted with Douglas-fir, ponderosa pine, and western redcedar (especially along Tributary B in Unit Q) in more recent years. Plantings had mixed success and Oregon ash dominates in wetter soils, although significant patches of young fir, pine, and redcedar are present within the riparian zone (see below). Himalayan blackberry and Scotch broom are dominant invasive species. Hawthorn and exotic grasses dominate much of Unit P. Apart from the creation of the wet prairie in Unit C, on the north side of Tributary A, no restoration treatments have been undertaken in the riparian areas.

2.6 Plantation forest (Units E, H and Q)

Plantation forests in the restoration areas of WUZ (Units D, H and Q; Figure 7) tend to be Douglas-fir and western redcedar, planted in the early 1980s by the previous owners for timber production. These stands are of mixed age, roughly between 15 and 35 years of age, and often have formed a dense canopy, with few understory species.

2.6.0 Unit E – Douglas-fir

These stands were planted in the 1980s and are mixed with other species.

2.6.1 Unit H – Douglas-fir

This stand was probably planted in the 1980s after the apple orchard was abandoned in the 1950s-70s.

2.6.2 Unit Q – Western redcedar

These stands were probably planted in the 1990s, and are mixed or surrounded by ash forest (Figure A2.17).

3 Restoration strategy

3.1 Overview

3.1.0 Goals

The goal of restoration work is to restore and enhance riparian forest, oak woodland, prairie vegetation, and oak savanna and their ecological processes to provide habitat for native Willamette Valley wildlife while contributing to the biodiversity and functionality of the Spring Valley Creek watershed.

The restored prairie and savanna habitats will support a diversity of forbs and grasses, and forests will support a diversity of native trees, shrubs and forbs that will provide shade over creeks and minimize erosion. The native plant community within the range of restored habitats will benefit many species of invertebrates, birds, reptiles, amphibians, mammals, and fish, including the current resident sensitive wildlife species, such as slender-billed nuthatch, western bluebird, western gray squirrel, willow flycatcher (*Empidonax trailii adastus*), and yellow-breasted chat (*Icteria virens*). There is also potential to attract and benefit other Oregon Conservation Strategy species, such as cutthroat trout, western pond turtle, northern red-legged frog, acorn woodpecker, Oregon vesper sparrow, and Townsend's big-eared bat.

We recommend that culvert replacement proceed in addition to the vegetation enhancements of this plan, as outlined in the 2011 amendment to the forest stewardship plan (Sims 2009), in order to improve overall habitat conditions, reduce stream sedimentation, and potentially allow fish passage in the future.

3.1.1 Priorities

Work can be prioritized in order to plan restoration in phases. The most urgent work (Priority 1) should be started as soon as possible in 2015, by weaving the work into the current restoration schedule, and by applying for funds for continued work. Lower priority work (Priority 2) can be phased in at a later date once more funding becomes available. Priority 3 work should be considered for future expansion of the restoration program. Note: Priority 3 work is not included in the overall cost estimates for this project.

3.1.2 Restoration target overview

Restoration targets for habitat quality of prairies and savannas are based on the USFWS prairie recovery plan minimum thresholds for managed prairies (USFWS 2010). These thresholds include:

- At least 50% relative cover of native vegetation
- Less than 15% absolute cover of woody vegetation (25% for savanna)
- Less than 5% cover of woody species of management concern
- An average of at least 10 native species present in $25m^2$ plots (5m x 5m plots; including at least seven forbs and one bunch grass species)
- No single non-native species will have more than 50% cover and no non-native species of concern will have more than 5% cover

Sites that satisfy these criteria support a diversity of native plants necessary to attract and maintain pollinator populations, and have low levels of invasion by non-native species. Since these are minimum

criteria, and restoration sites often have higher standards (USFWS 2010), we recommend setting the native vegetation cover target at 60% for WUZ. For a description of monitoring protocols, see Silvernail et al. (2012) and Section 4.

Density targets for oak savanna and woodland are based on published guides (Harrington & Devine 2006, Vesley & Tucker 2004) in combination with targets currently adopted by the University.

Restoration targets for oak savanna include:

- Oak spacing of 40, 25 or 10 trees/acre, depending on the unit or sub-unit
- Selection of the best formed trees for release

Restoration targets for oak woodlands include:

- Variable density of trees, ranging from 125-250 trees/acre, depending on sub-unit
- A diversity of tree and shrub species
- Approximately 250 shrubs per acre
- Less than 15% absolute cover of invasive shrubs

Restoration target for riparian areas:

- High density of 2000 trees and shrubs per acre in areas where plantation patches are removed to out-complete non-native vegetation and quickly form a canopy (see Section 3.1.4).

3.1.3 Start-over strategy

A start-over strategy may be necessary for some savanna and prairie units at WUZ because initial site preparation may not have been intensive enough to reduce the dominance of introduced and invasive weeds. The decision to restart restoration may be hampered by lack of funds, or the perception of losing some of the investment to date. However, it is likely to be more effective, both in terms of cost and results, to start again in these units rather than continuing to expand resources over a period of years without achieving the desired results.

Because of the timing of site visits for preparation of this plan (late summer 2014), it was not possible to fully gauge the relative quality of the vegetation or success of plantings in the sub-units. Consequently, an assessment should be made in springtime to objectively determine which units, or sub-units, should be re-done. These assessments should be on a coarse scale, e.g., >1 acre, as larger scale treatments are more cost effective than creating a patchwork of sub-units with different management needs. Seed bank tests could be considered to obtain more information on what weed seeds are present in the soil.

Table 6 provides guidelines for classifying current site conditions (high, moderate or low quality) and determining a restoration approach for classification.

Current evidence suggests that oak savanna units B-West, B East, and most of M, and the wet prairie Unit C, are of low quality and should begin with a new phase of chemical fallow. This may not be necessary in higher quality sub-units such as B-North, and possibly B-South and M-East, where there has been better establishment of Roemer's fescue and greater effort in establishing native forbs. However, a higher quality, and longer-lasting restoration outcome is more likely in sub-units that have comprehensive site preparation.

Table 6. Guidelines for classifying habitat quality and determining restoration approach within each unit or sub-unit.

Habitat quality	Criteria for classification	Restoration approach
High	• > 60% native cover, AND • < 5% cover of individual invasive species cover, AND • > 10 native species	Maintenance phase, restoration goals reached
Moderate	Either: • 40-60% native cover, AND • 5-10% invasive species cover, AND • 5-10 native species Or: • 40-60% cover of Roemer's fescue	Continue with current restoration trajectory
Low	• < 40% native cover • > 10% cover of individual invasive species cover • < 10 native species	Begin new restoration trajectory (start over with chemical fallow)

Other considerations also come into play when choosing whether to start-over. There is strong interest by the University to continue applications of grass-specific herbicide and spot spraying for invasive shrubs though the summer of 2016 in sub-units where Roemer's fescue has established. If by then the exotic perennial grasses still dominate, then the University will consider a start-over.

The areas where Nelson's checkermallow have been planted (in a small ravine of Unit B) will have to be avoided during any broad spectrum or broadleaf herbicide treatments.

3.1.4 Planting densities

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 seven years.

- **Low density planting strategy:** With this method, bare root riparian trees and occasionally shrubs are planted at low densities into restoration areas, ranging from 200-300 stems per acre. A 3:1 tree to shrub ratio is typically applied (i.e., the reverse radio to the high density strategy). 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 density (2000 stems per acre) in riparian areas to replace patches of plantation forest, and planting lower densities to add diversity and understory cover for oak and mixed woodlands.

3.2 Restoration targets by WUZ Unit

Work at WUZ will focus on restoring the savannas, improving the quality of oak woodland and removing plantation trees. The restoration strategy for achieving the desired future conditions of these habitat types is an amalgam of the strategy used to date, guidance from the management and stewardship plans, experience from IAE restoration ecologists, Willamette University, other restoration colleagues and partners in this project, and restoration guides, such as Krueger et al. (2014).

The work outlined in this plan seeks to restore and enhance the condition of habitat types described below and identified in Table 7 and Figure 12.

Table 7. Proposed areas (acres) of restored habitat at Willamette University at Zena (black numbers), and relative change shown from current conditions (red numbers)

Habitat	Acres per Restoration Unit											Total acres
	B	C	D	E	F	G	H	M	P	Q	V	
Wet prairie		9.8										9.8
Oak savanna	11.1				5.4 +5.4			25.6 +5.1				31.6
Oak woodland					51.2			0 -5.1			2.3	58.6
Mixed woodland					0 -5.4	7					25.8	38.2
Riparian forest			15.1 +4.2						4	16.2 +3.7		27.4
Plantation forest				0 -4.2			6.4			0 -3.7		14.3
Total	**11.1**	**9.8**	**10.9**	**0**	**56.6**	**7**	**6.4**	**25.6**	**4**	**16.2**	**28.1**	**179.9**

3.2.0 Wet prairie

The wet prairie in Unit C will have a diversity of native species and a minimal cover of invasive species as a result of restoration treatments. There will be no trees within the prairie.

Goal: >60% native cover, <5% invasive species cover and >10 native species.

Recommended native wet prairie plant community elements are tufted hairgrass (*Deschampsia cespitosa*) and meadow barley (*Hordeum brachyantherum*). Native forbs could include species such as yarrow (*Achillea millefolium*), selfheal (*Prunella vulgaris* ssp. *lanceolata*), and dense spike primrose (*Epilobium densiflorum*) (see Table 8 in Restoration Tasks Section below for more information on

recommended species). These species are targeted because they are good colonizers and competitors and are relatively inexpensive. Willamette Valley sources of seed should be used for best success and genetic integrity (Willamette Valley Native Plant Materials Partnership, Strategic Plan 2013-17). A fully-functioning wet prairie will develop a productive invertebrate community, which in turn will support a range of common and uncommon wildlife, including Oregon Conservation Strategy (ODFW 2006a) species. The proximity to restored riparian and savanna areas will have additional beneficial effects, for wildlife such as raptors, swallows and songbirds. Western pond turtles will benefit from nesting habitat near their riparian habitat, including in open grassy areas of the wet prairie. Wet prairie habitat will provide high quality habitat for grassland-dependent species, such as savannah sparrow (*Passerculus sandwichensis*) and short-eared owl (*Asio flammeus*)(ODFW 2006b).

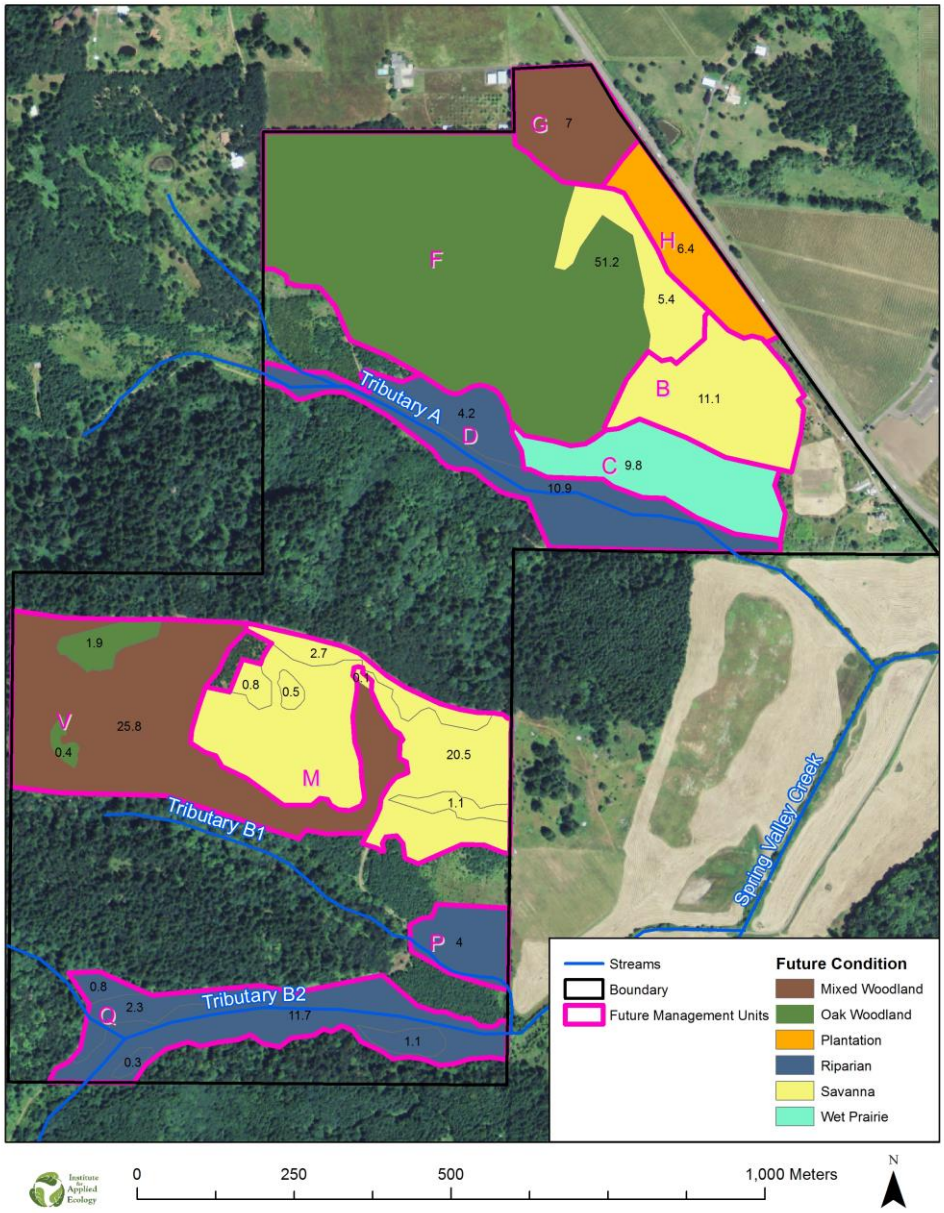


Figure 12. Proposed restored habitats at Willamette University at Zena. Pink letters are unit designations. Black numbers are target acreage for habitat types within each unit or sub-unit.

3.2.1 Oak savanna

Restoration will create a diverse upland prairie community with many native species. There will be reduced exotic perennial and annual grasses, broadleaf weeds, and invasive shrub species. Connectivity between patches in Unit M will be improved, for the benefit of grassland birds (ODFW 2006b). Oaks will be retained in current patches, but at reduced densities to encourage open-growth habit and benefit for wildlife (Harrington & Devine 2006, Vesley & Tucker 2004). Undergrowth will have reduced shrub component in favor of a prairie-savanna forb and grass community.

> Goal: >60% native cover and 10 native species. Low density of oaks with open-growth characteristics (<10 oaks per acre for open savanna and <25 oaks per acre in islands and patches).

Oak savanna habitat will provide high quality foraging, nesting and rearing habitat for upland prairie and savanna grassland-associated wildlife. For example, western bluebirds require grasslands and oak savannas for foraging and nesting, and scattered trees and shrubs for perching (ODFW 2006a). Other grassland birds, such as Oregon vesper sparrows, will benefit from open grassy habitat and the transition between grass and wooded areas. Improving connectivity between open grassland patches within WUZ and nearby habitats may benefit species that have large territories, such as Western meadowlark. Future addition of threatened plant species may attract threatened invertebrates such as Fender's blue and Taylor's checkerspot butterflies.

Transition woodland: The transition woodland in Unit F will be managed as an oak savanna, and continue to be a transition between more open savanna in B and the oak woodland in F. Tree density will be reduced but selected fruit trees may be retained for historical reasons.

> Goal: densities of oak (20 trees per acre). Native grass and forbs > 60% cover and woody vegetation <25% cover. Dominant exotic perennial grasses should be present in less than 10% of plots.

Recommended native grasses include California oatgrass, blue wildrye, and California brome (*Bromus carinatus*). Native forb species will include yarrow, farewell to spring (*Clarkia amoena*), Western buttercup (*Ranunculus occidentalis*), and selfheal (see more species recommendations in Table 9). Some shade tolerant species can be added to the mix for the more wooded oak buffers and patches. As the site improves and stabilizes, adding further native plant species to enhance diversity would further support pollinator and wildlife habitat and complement restoration work in other areas of WUZ and nearby protected areas.

3.2.2 Oak woodland

Stands of varying oak densities will be maintained over the whole Unit F and selected patches of V. There will be a low cover of invasive understory shrubs and an increase in diversity of native shrubs and forbs. Future restoration should consider creating more open woodland/savanna in areas of F that were more open during the 1930s (e.g., continuing down the ridge from the Transition Woodland, and the far western sector of F.

> Goal: Maintain current densities of 250 oaks/acre on approximately 45 acres and 125 oaks/acre on 6 acres (demonstration stand, see Figure 13 below) in F, and 125 oaks/acre in 2.3 acres (see green patches in Figure 12) of V.

Oak woodland habitat will provide high quality foraging, nesting and rearing habitat for a wide range of wildlife, including strategy species (ODFW 2006a). For example, western grey squirrel habitat requirements include oak and mixed woodlands with closed canopy, as well as a savanna component. Slender-billed nuthatches will benefit from having mature oaks for foraging and nesting, and chipping sparrows will benefit from the creation of open herbaceous understory within the woodland.

3.2.3 Mixed woodland

In the short term current conditions should be maintained in Unit V and the patch of mixed woodland G, just north of F. These units will continue to be managed for both habitat and high value single-tree selection harvesting as indicated in the WUZ Forestry Plan. Future restoration should consider creating more open woodland/savanna in areas of V that were more open during the 1930s. This work should focus initially on creating open woodland in approximately 8 acres on the northern part along the road and between M and the young oak stands. Douglas fir trees may be removed over time to prevent over-topping competition with oaks.

Maintaining older forest with standing dead and hollow trees and downed wood will benefit strategy species such as Pileated woodpecker and Townsend's big-eared bat, as well as a variety of more common forest species.

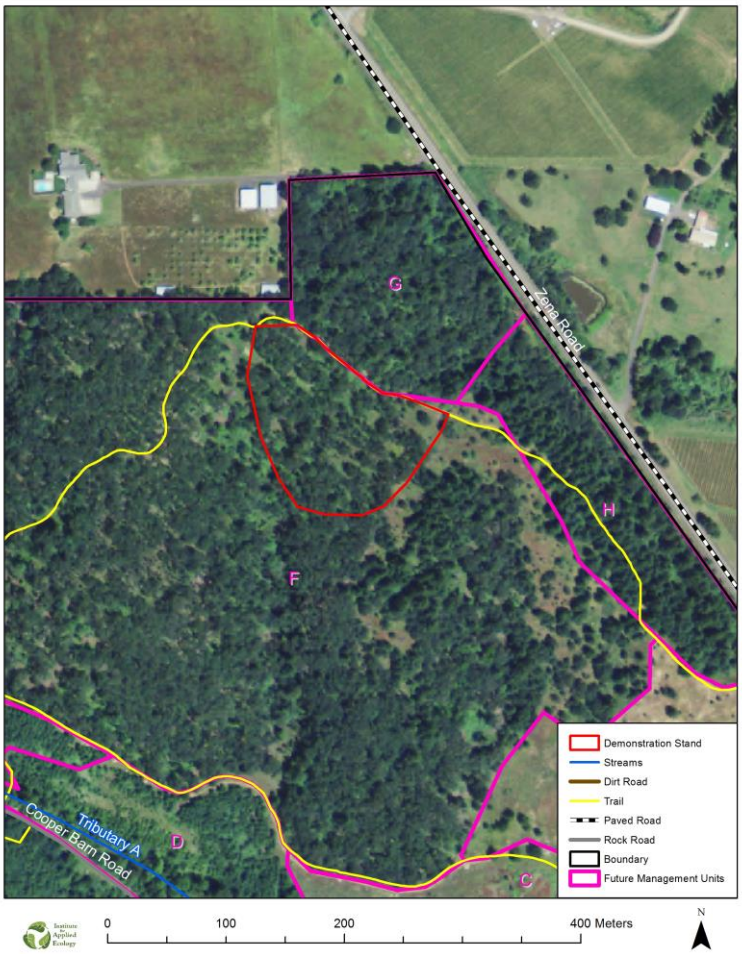


Figure 13. Location of demonstration stand thinned to 125 oaks/acre (red line) in Unit F.

3.2.4 Riparian forest

The riparian forest in Tributary B (Unit Q) of Spring Valley Creek will include areas of currently existing riparian vegetation that will be enhanced, as well as newly planted riparian vegetation that will be established in areas of cleared plantation forest. Similarly, the 4 acre area of plantation forest in Unit E will be converted to riparian forest and become part of Unit D (Figs. 7, 12, Table 7). A multi-layered canopy of native trees and shrubs will include species such as Oregon ash, sitka and pacific willow (*Salix sitchensis* and *S. lucida*), ocean spray (*Holodiscus discolor*), and snowberry (Table 11).

The creation of a healthy riparian forest will have great benefits to strategy wildlife, such as cutthroat trout, red-legged frog, western pond turtle, willow flycatcher and yellow-breasted chat, as well as a range of more common species.

3.2.5 Plantation forest

Plantation forest in Unit H will be maintained as a buffer zone on the property boundary in the medium term. Plantation patches will be removed from savannas and riparian zones, although individual trees of mixed species may be retained to provide for natural recruitment of large woody debris over time.

3.3 Restoration work elements

The work elements designed to achieve the restoration strategy are briefly outlined below. More detail on restoration tasks, areas treated per unit, estimated costs and schedules are provided in Appendix 6.

3.3.0 Monitoring and weed surveys

Conduct any weed assessment and pre- and post-condition monitoring required for the restoration project. Weed assessment includes inventory and GIS mapping of key invasive species. Pre- and post-condition monitoring includes vegetation plots for measuring percent cover of and stem counts of species. These assessments should also guide decision making for start-over strategies at sub-units that fall below minimum quality thresholds. See Section 4 for more details.

- Quantitative monitoring (spring of Year 1 and Year 7, at a minimum)
    - Pre and post-condition cover and frequency of native and introduced plants
    - Pre and post-condition weed survey
- Qualitative monitoring for adaptive management (all years)

3.3.1 Wet prairie

Wet prairie Unit C (Priority 1):

- Remove trees within the prairie but not on the northern border with B (Year 1).
- Assess drainage issues, or erosion potential during chemical fallow (Year 1).
- Install erosion baffles and/or sow cover crop (e.g., non-native winter wheat, or fast growing native forbs or grasses) in gullies if erosion is a concern (Year 1 & 2).
- Create chemical fallow with two broad-spectrum herbicide applications per year, and a total of at least four treatments (Year 1 & 2). Consider a third treatment per year if necessary. See section 3.4.2 for suggested herbicides.

- Assess success of weed control (annually). Adjust schedule accordingly i.e., delay planting native seed until the site is relatively weed free.
- Prescribed burn (fall of Year 2) to remove thatch.
- Sow native forbs (Table 8) and Roemer's fescue, depending on timing of earlier treatments and results of assessment (fall of Year 2).
- Plant plugs of native plants (fall of Year 2 onwards).
- Grass-specific herbicide treatments twice per year (Year 3 and 4).
- Sow native grasses (fall of Year 4).
- Mow annually except in year of prescribed burn (Year 5-7).
- Prescribed burn (fall of Year 6 or 7)
- Spot spray weeds (Years 4-7).

Table 8. Native grass and forb species to be added as seed to wet prairie Unit C.

Scientific Name	Common name	Growth Form	Value of species
Achillea millifolium	Common yarrow	Perennial forb	Nectar
Camassia leichtlinii	Tall camas	Perennial forb	Nectar, cultural importance
Epilobium densiflorum	Denseflower willowherb	Annual forb	Early seral
Eriophyllum lanatum	Oregon sunshine	Perennial forb	Nectar
Grindelia integrifolia	Gumweed	Perennial forb	Nectar
Lomatium nudicaule	Barestem biscuitroot	Perennial forb	Nectar
Lotus unifoliolatus	American bird's-foot trefoil	Perennial forb	Nectar
Madia elegans	Common tarweed	Perennial forb	Nectar, cultural importance
Perideridia oregana	Oregon yampah	Perennial forb	Nectar, cultural importance
Plectritis congesta	Seablush	Annual forb	Early seral
Potentilla gracilis	Slender cinquefoil	Perennial forb	Nectar
Prunella vulgaris var. lanceolata	Lance selfheal	Perennial forb	Nectar
Agrostis exarata	Spike bentgrass	Perennial grass	Graminoid diversity, structure
Danthonia californica	California oatgrass	Perennial grass	Graminoid diversity, structure
Deschampsia caespitosa	Tufted hairgrass	Perennial grass	Graminoid diversity, structure
Hordeum brachyantherum	Meadow barley	Perennial grass	Graminoid diversity, structure

3.3.2 Oak savanna

Tree management (Priority 1)

- Remove trees and shrubs to expand savanna:
    - Unit B-West - remove small patch of ponderosa pine in southwest corner (Year 1).
    - Unit B-North - thin oaks to <10 stems/acre to achieve more open structure and remove most young apple trees and other trees.
    - Unit F Transition Woodland - thin oaks and other trees to 20 trees/acre.
    - Unit M-East Middle - thin oaks to encourage open grown structure (remove approximately 20 trees)
    - Unit M - remove trees and shrubs from northern part of the gully to join the western and eastern halves of the unit.
    - Maintain open oak buffer and oak patches in Unit M.
    - Consider using mowing, prescribed fire, or grazing (goats) to reduce understory vegetation (see Section 3.4 Restoration methods for more information).

Low quality savanna (Priority 1 – start-over strategy)

- Assess which sub-units are of low quality and require a start-over of restoration actions (see criteria in Section 3.1.3). A start-over strategy is summarized here, and a continuation strategy is described below for the moderate quality savanna. See also the alternative strategies that are provided in more detail in Appendix 6, arbitrarily assuming half the savannas will be re-starts and half will continue with grass specific treatments for two or more years.
- Assess potential for drainage or erosion problems during chemical fallow and have contingency plan in place (Year 1); e.g., see Krueger et al. (2014). Install erosion baffles and/or sow cover crop (e.g., non-native winter wheat, or fast growing native forbs or grasses) in gullies if erosion is a concern (Year 1 & 2). Alternatively, do not spray out the gullies, to retain grass cover in erosion-prone areas – note that this may create weed islands.
- Create chemical fallow with two broad-spectrum (glyphosate) herbicide applications per year (total of 4 applications over 2 years) in whole units, including under oak patches (Year 1 and 2). Consider adding a third broadcast application per year to improve control of invasive weeds.
- Assess success of weed control (Year 2). Adjust schedule accordingly i.e., delay planting native seed until the site is relatively weed free.
- Prescribed burn (fall of Year 2) to remove thatch.
- Sow native forbs and Roemer's fescue, depending on results of assessment (fall of Year 2). Include shade tolerant species for oak patches.
- Plant plugs of native plants (fall of Year 2 onwards).
- Grass-specific herbicide treatments twice per year (Year 3 and 4).
- Sow native grasses (fall of Year 4).
- Mow annually except in year of prescribed burn (Year 5-7).
- Prescribed burn (fall of Year 6 or 7)
- Spot spray weeds (Years 4-7).

Moderate quality savanna (Priority 1)

- Assess which sub-units are of moderate quality (see criteria in section 3.1.3), and continue with current restoration trajectory – these will include areas that have the most successful establishment of Roemer's fescue to date.
- Grass-specific herbicide treatments and spot spraying of broadleaf weed and shrubs (Years 1-4).

- Assess success of weed control (Year 2 and 4). Adjust schedule accordingly i.e., delay planting native seed until the site is relatively weed free. Waiting until year 4 gives greater chance of success and matches the schedule for low quality sub-units. May have to revert to a start-over, if introduced grasses continue to dominate.
- Prescribed burn (fall of year 4).
- Sow native forbs and grasses (Table 9)(fall of Year 4).
- Plant plugs of native plants (Years 4-5).
- Mow annually except in year of prescribed burn (Year 5-7).
- Spot spray weeds (Years 4-7).

Table 9. Native grass and forb species to be added as seed to savannas.

Scientific Name	Common name	Growth Form	Value of species
Achillea millefolium	Commom yarrow	Perennial forb	Nectar
Camassia quamash	Common camas	Perennial forb	Nectar, cultural importance
Clarkia amoena	Farewell-to-spring	Annual forb	Nectar, early seral
Clarkia purpurea	Winecup clarkia	Annual forb	Nectar, early seral
Collomia grandiflora	Grand collomia	Annual forb	Early seral
Eriophyllum lanatum	Wooly sunflower	Perennial forb	Nectar
Iris tenax	Tough-leaved iris	Perennial forb	Nectar
Lotus unifoliolatus	American bird's-foot trefoil	Annual forb	Nectar
Madia elegans	Common tarweed	Annual forb	Nectar, cultural importance
Potentilla gracilis	Slender cinquefoil	Perennial forb	Nectar
Prunella vulgaris	Common selfheal	Perennial forb	nectar
Ranunculus occidentalis	Western buttercup	Perennial forb	Nectar
Sidalcea virgata	dwarf checkermallow	Perennial forb	Nectar
Bromus sitchensis	Sitka brome	Perennial Grass	Graminoid diversity, structure
Carex tumulicola	Foothill sedge	Perennial Graminoid	Graminoid diversity, structure
Danthonia californica	California oatgrass	Perennial Grass	Graminoid diversity, structure
Elymus glaucus	Blue Wildrye	Perennial Grass	Graminoid diversity, structure
Festuca roemeri	Roemer's fescue	Perennial Grass	Graminoid diversity, structure

3.3.3 Oak woodland

Understory restoration (Priority 1)

- Spot spray introduced shrubs, poison oak, and weedy forbs (Year 1 and 2).
- Prescribed burn in selected areas, mow, and graze in lowest density areas.
- Plant diversity of native shrubs and forbs (Year 3 and 4).
- Continue spot spraying for weed control.

Tree management (Priority 2)

- Thin oaks as required to maintain mixed-age forest and density goals - includes occasional sustainable harvest of oaks.
- Methods as outlined in section 3.4.0.

Tree Management (Priority 3)

- Convert sectors of oak to open woodland or savanna in the future.
- Note: Priority 3 actions are not included in cost estimates and strategies would need to be fleshed out for future restoration.

3.3.4 Mixed woodland

Understory restoration (Priority 1)

- Spot spray introduced shrubs, poison oak, and weedy forbs (Year 1 and 2).
- Prescribed burn in selected areas, mow and graze in lowest density areas.
- Plant diversity of native shrubs and forbs (Year 3 and 4).
- Continue spot spraying for weed control.

Tree management (Priority 2)

- Thin oaks and maples as required to maintain mixed-age forest and density goals - includes occasional sustainable harvest of oaks and maples.
- Gradually remove fir trees over time to prevent over-topping competition with oaks.

Tree management (Priority 3)

- In the future, consider creating open woodland/savanna in approximately 8 acres on northern Unit V between Unit M and the young oak stands.
- Further thin the young oak stands.
- Note: Priority 3 actions are not included in cost estimates

3.3.5 Riparian forest

Understory restoration Unit D (Priority 1) and Unit Q (Priority 2)

- Spot spray introduced shrubs, poison oak, and weedy forbs (Year 1 and 2).
- Plant diversity of native shrubs and grasses (Year 3 and 4, see Tables 10 and 11).
- Ring spray around newly planted shrubs (Year 4-6)
- Continue spot spraying for weed control.

Tree management Unit E (Priority 1), P (Priority 2) and Q (Priority 2)

- Remove and treat stumps of non-native and invasive tree and shrub species (Year 3).

- Clear or selectively cut plantation trees from riparian areas in units E and Q (Year 3). (Note: Unit E becomes part of Unit D after restoration).
- Mow cleared area and treat understory weeds (Year 3-4).
- Plant riparian trees and shrubs at high density (Year 5, see Table 11 for species).
- Mow between rows of new plantings (Year 5 and 6).

Table 10. Native grass and forb species to be added as seed to riparian forest prior to planting

Scientific Name	Common name	Growth Form	Value of species
Aquilegia formosa	Red columbine	Perennial forb	Nectar
Camassia leichtlinii	Large camas	Perennial forb	Nectar, cultural importance
Clarkia amoena	Farewell to spring	Annual forb	Nectar, early seral
Collinsia grandiflora	Blue-eyed Mary	Annual forb	Nectar, early seral
Collomia grandiflora	Grand collomia	Annual forb	Nectar, early seral
Heracleum lanatum	Cow parsnip	Perennial forb	Nectar
Iris tenax	Oregon iris	Annual forb	Nectar
Perideridia oregana	Oregon yampah	Perennial forb	Nectar, cultural importance
Bromus sitchensis	Sitka brome	Perennial grass	Graminoid diversity, structure
Carex stipata	Sawbeak sedge	Perennial graminoid	Graminoid diversity, structure
Deschampsia elongata	Slender hairgrass	Perennial grass	Graminoid diversity, structure
Elymus glaucus	Blue wildrye	Perennial grass	Graminoid diversity, structure

3.3.6 Plantation forest

- Manage weeds in fir plantation forest in Unit H.

Table 11. Potential native tree and shrub species to be planted in the riparian forest restoration area. (Note that availability of particular species from nurseries will vary between years).

Common name	Scientific Name	Tolerance	Tree or shrub
Big leaf maple	*Acer macrophyllum*	Moist, well drained	Tree
White alder	*Alnus rhombifolia*	Wet	Tree
Red alder	*Alnus rubra*	Variable	Tree
Serviceberry	*Amelanchier alnifolia*	Range of soils	Shrub
Red osier dogwood	*Cornus sericea occidentalis*	Moist	Shrub
California hazelnut	*Corylus cornuta*	Moist but well-drained	Tree
Oregon Ash	*Fraxinus latifolia*	Wet	Tree
Ocean Spray	*Holodiscus discolor*	Range of soils	Shrub
Oregon grape	*Mahonia aquifolium*	Range of soils	Shrub
Pacific ninebark	*Physocarpus capitatus*	Range of soils	Shrub
Black cottonwood	*Populus trichocarpa*	Wet	Tree
Pacific Willow	*Salix lucida*	Variable	Shrub
Scouler willow	*Salix scouleriana*	Variable	Shrub
Sitka willow	*Salix sitchensis*	Wet	Shrub
Red elderberry	*Sambucus racemosa/cerulea*	Very moist	Tall shrub
Douglas spiraea	*Spiraea douglasii*	Moist, well drained	Shrub
Snowberry	*Symphoricarpos albus*	Very wet to dry	Shrub

3.4 Restoration methods

3.4.0 Tree removal

- A tracked skid steer with a shearing device can be used to cut trees <10” in diameter and a grapple used to remove material to piles.
- Hand-cut with chain saws any trees >10” in diameter and in places that are inaccessible to the skid steer.
- Create snags for wildlife habitat.
- Cut all stumps at ground level and mow or burn undergrowth to facilitate access for other treatments.
- Remove logs if merchantable.
- Utilize logs for instream enhancements.
- Piles of brush and logs can be burnt or removed to facilitate access for other treatments. Where appropriate retain some piles for wildlife habitat - leaving piles intact provides many habitat benefits to a range of invertebrates, amphibians, birds, and mammals.

3.4.1 Mowing

- A tracked skid steer with a rotary mower attachment can be used to mow grassland to reduce thatch and seeding of weeds during preparation and establishment phase.
- A tractor-mounted mower can be used for areas of lesser slope to increase efficiency and decrease cost.

- In areas where there are substantial native forbs, mowing should be conducted throughout site after most native forbs have senesced (or at least have set mature seed) and before they re-emerge in the spring (generally August 15 – March 1).

3.4.2 Prescribed fire

- Prescribed fire can be an effective tool for reducing understory density. Any burning should continue to be coordinated with public access and outreach.
- The area burned in any given year (annual burn unit) should be determined yearly based on site conditions.
- When conducting a prescribed burn, appropriate barriers should be used to contain burns such as perimeter mowing, wet lines with hose lays, disk lines, foam, or other retardants, etc.
- Fire retardant chemicals should follow labeled restrictions and state regulations or guidelines for use near water.
- Fire management vehicles should be restricted to areas of dry soil.
- A flame weeder could be considered for smaller burn areas.

3.4.3 Grazing

- If using grazing to reduce understory density, the area grazed in any given year should be determined yearly based on site conditions and habitat needs. Targeted management with stock will provide thatch reduction or individual species control while maintaining native species diversity.
- Summer and fall grazing are generally most effective at reducing thatch and nonnative species while maintaining natives.
- Erect appropriate and temporary barriers to contain stock, as per the conservation easement.
- Stock species selection will be guided by management objective; however, the use of goats would probably be the best grazing method at WUZ because of their propensity to browse woody vegetation, such as blackberry and poison oak.
- Stocking rates should be designed to accomplish specific goals (e.g. 80% reduction of thatch in 1 week).
- Stock must be given a weed free feed rest before being moved on site. Seeds can pass through ruminant digestive tracts and remain viable.
- Standing water and wet soils should not be grazed to limit soil disturbance.

3.4.4 Herbicide Treatments

Treat stumps of trees and shrubs that are thinned and removed.

- Following tree and shrub removal, species with a tendency to re-sprout and coppice (such as Oregon ash, hawthorn, holly, and Scotch broom) should have their stumps treated
- Suggested herbicide: triclopyr (e.g. Garlon 3A).

Broadcast spray of prairies and savannas

- ATV and boom spray attachment.
- Suggested herbicides for site preparation: glyphosate (e.g. Roundup) or stream-safe glyphosate (e.g. Aquamaster or Rodeo) for wet prairie.
- Consider a fall treatment of a pre-emergent herbicide such as imazapic (e.g. Plateau), for a longer period of control through winter and spring in the year prior to planting natives.
- Suggested herbicides for grass-specific treatments include Clethodim (e.g. Select Max) and Sethoxydim.

Spot spray teasels and thistles and other problem weeds.

- Following mowing, treat regrowth of teasels and thistles. Generally it is best to treat teasel at the rosette to young bolting stage, and thistles from full emergence to the bud stage (i.e. spring-early summer). However, there may be sufficient re-growth to spray in the fall during the first year.
- Suggested herbicides: clopyralid (e.g. Transline, Stinger) or aminopyralid (e.g. Milestone).

Spot spray blackberries.

- Following mowing, treat regrowth of blackberries. Generally it is best to treat regrowth in the fall. If cane growth is slow, wait until the spring.
- Suggested herbicides: triclopyr (e.g. Garlon 3A, Element 3A).

Ring spray around new trees and shrubs.

- Following planting riparian trees in winter, ring spray around each plant in early spring for the first two years to prevent smothering from grasses and weeds. Use a screen (e.g. inverted bucket) around each plant to protect from herbicide damage.
- Suggested herbicides: stream-safe glyphosate (e.g. Aquamaster or Rodeo).

All herbicides used in restoration activities should be used within the guidelines of their labeling, particularly relative to required setbacks from water courses. Funding agencies may also have additional restrictions for herbicide use, for example projects funded by federal agencies must use the herbicides, methods and restrictions that are outlined in the appropriate Biological Opinion.

3.4.5 Plant materials and installation

Sow native grasses and forbs in prairies and savannas and areas disturbed by invasive species removal.

- Following two years of ground preparation, sow seeds and forbs in prairies/savanna and understory of riparian forest in the fall of Year 2 (Tables 8, 9 and 12, Appendix 5).
- Sow seeds by using a no-till drill towed behind a tractor.
- Note, that if using a no-till drill, it is important to make sure that all stumps and woody debris is removed, so as not to damage equipment. Alternatively, particularly over difficult terrain, broadcast with an ATV-mounted seed spreader, or by dropping seed from a no-till drill. Soil contact by seeds can be improved by following with a roller.

Install native trees and shrubs in riparian zone.

- Following two years of ground preparation, plant trees and shrubs at 2000 stems/acre in the winter of Year 3 in the riparian zone and 250 stems/acre in the woodlands (Tables 10, 11 and 13, Appendix 5).
- Plant in sinuous rows (approx. 5-7 foot between rows and 3-4 feet between trees on the row) to facilitate mowing (and create a more natural appearance) in the initial establishment years until sufficient canopy closure is attained. The rows between trees are mowed for the first two years, so it is important to space the rows to suit the widths of the available mowing equipment.
- Plant up to 25% replacement trees and shrubs in Year 4 in order to maintain planting densities in the initial establishment period.

Native grass and forb seed costs are included in Table 12. Total estimated native tree/shrub plant material costs plantings are included in Table 13. Specific seed mixes/costs are included in Appendix 5.

Table 12. Estimated costs for native grass and forb seed, by option and habitat, based on average 2014 prices at Willamette Valley native seed producers. Actual costs may vary with source.

Unit	Habitat	Acres	Grass Seed $/Acre	Grass-Forb Mix $/acre	Total Cost
C	Wet Prairie	9.8	$ 135.17	$ 763.80	$ 8,809.93
B	Oak savanna	11.1	$ 243.80	$ 781.85	$ 11,384.72
M	Oak savanna	25.6	$ 231.90	$ 781.85	$ 20,781.88
F	Oak savanna transition woodland	5.4	$ 257.25	$ 735.60	$ 6,949.95
D, P, Q	Riparian	11.9		$6,211.00	$ 6,211.10
Total		63.8			$ 54,137.58

Table 13. Estimated costs for native tree and shrub plant materials by option and habitat, based on average 2014 costs per stem at Willamette Valley nurseries. Actual costs will vary with species selected, size and age of plant and nursery source. Up to 25% further re-planting might be expected to replace trees that do not survive the first year (these costs have not been included).

Unit	Habitat	Stems/acre	Acres	Cost/Stem	# Stems Needed	Total Cost
F, V	Oak woodland	125	20	$0.683	2500	$ 1,707.00
G,V	Mixed woodland	125	15	$0.685	1875	$ 1,284.00
D, P,Q	Riparian	2000	10	$0.59	23,800	$ 14,087.00
Total			45		28,175	$ 17,078.00

We suggest not using protective tubes/netting on riparian plantings to reduce labor costs and the eventual creation of plastic rubbish in the riparian area. There is evidence of deer and elk using the area, which will facilitate the creation of natural vegetation openings for plant diversity and use by wildlife. Excessive herbivory problems will be addressed through adaptive management. Ultimately, there should be natural thinning through competition for space and light as the forest matures.

3.5 Work schedule

The projected project schedule is included in Table 14. Precise timings may vary with site access for equipment, weather conditions, and adaptive management.

Table 14. Overall project schedule over a seven-year period for restoration at WUZ (see Appendix 6 for prescriptions at specific habitat zones)

	Year 1	Year 2	Year 3	Year 4	Year 5-7
	2015	**2016**	**2017**	**2018**	**2019-21**
Monitoring	Monitor current baseline conditions and assess options for re-start in prairies/savannas	Monitor progress	Monitor progress	Monitor progress	Monitor weeds and plant establishment, monitor plots
Wet prairie	Remove trees	Broadcast herbicide x 2, prescribed burn	Broadcast grass-specific x 2, spot spray x 2	Broadcast grass-specific x 2, spot spray x 2	Spot spray x 2 per year
	broadcast herbicide x 2	Sow native forbs & Roemer's, plant plugs	Plant plugs	Sow native grasses, plant plugs	Mow annually, prescribed burn
Oak savanna	Thin trees	Broadcast herbicide x 2, Prescribed burn	Broadcast grass-specific x 2, spot spray x 2	Broadcast grass-specific x 2, spot spray x 2	Spot spray x 2 per year
	Broadcast herbicide x 2	Sow native forbs & Roemer's, plant plugs	Plant plugs	Sow native grasses, plant plugs	Mow annually, prescribed burn
Oak woodland	Thin trees	Spot spray	Spot spray	Spot spray	Spot spray
	Spot spray, mow		Plant understory shrubs		
Mixed woodland	Thin trees	Spot spray	Spot spray	Spot spray	Spot spray
	Spot spray, mow		Plant understory shrubs		
Riparian	Remove trees	Broadcast herbicide x 2	Plant trees		
	Mow & clear brush	Spot spray	Ring spray, spot spray	Ring spray, spot spray	Spot spray
	Broadcast & spot spray	Sow seed ground cover	Mow		

4 Monitoring and adaptive management

4.1 Monitoring

Willamette University will develop, modify, or supplement their existing monitoring program in order to evaluate the effects of restoration actions. At minimum, there should be baseline data collected during the first year documenting current, pre-treatment conditions, and post-restoration data collected in Year 7 in order to evaluate treatment results.

Monitoring should be achieved through a combination of formal (quantitative) and informal (qualitative) monitoring. Informal monitoring to assess weed control issues, chemical treatment effectiveness and seeding establishment should occur on a regular (annual) basis. Formal monitoring can occur less frequently, and methods will vary with habitat types and objectives, although the University may choose to do more frequent formal monitoring, partly as a teaching exercise for students.

The WUZ monitoring program should include collection of data in four general categories: invasive species, vegetation composition, riparian planting success, and threatened and endangered species. Specific objectives and methodology for each category are described below.

4.1.0 Invasive species monitoring

Objectives:

- Locate and map invasive species
- Assess success of invasive species control efforts

Formal surveys for new populations of invasive species will involve grid searches for noxious weeds and other species identified as problematic (e.g., the woody species of management concern identified in the USFWS guidelines for recovery site quality). When targeted plants are found, their abundance will be assessed and the spatial extent will be mapped via GIS. Invasive species surveys should occur, at a minimum, every 2 years in order to locate and eradicate small infestations before they spread. Informal searches for new populations of invasive species can occur more frequently (especially in areas with higher probability of invasion, such as along roads or trails), and include mapping, but will not necessarily cover the entire property with the same intensity.

Formal monitoring to assess the success of invasive species control or eradication efforts will involve revisiting sites where weed control or eradication treatments have been applied, and making careful searches of the treatment area and adjacent habitat for the target species. Any target individuals should be quantified (to evaluate success) and either treated immediately (if appropriate) or mapped for re-treatment.

4.1.1 Vegetation composition monitoring

Objective:

- Estimate cover and frequency of native plants (grasses, forbs, shrubs and trees) in each sub-unit to evaluate progress towards vegetation composition goals (e.g., USFWS prairie habitat quality guidelines)

Vegetation composition monitoring should include a statistically sound randomized sampling design that incorporates replicated vegetation plots or transects. Data collected in sample units should include the

percent cover of each grass, forb, and shrub species, along with plant litter, bare ground, and moss cover. See Silvernail et al. (2012) for a description of monitoring of prairie quality and diversity. Species frequency data may also be sampled. An overall species list should also be compiled or updated for each sub-unit, in order document presence of species not occurring in plots. Formal vegetation monitoring should occur every 3-5 years. Informal vegetation monitoring will likely occur more frequently, particularly to assess establishment rates in plantings and the general response of the plant community to restoration actions.

4.1.2 Riparian planting success monitoring

Objectives:

- Evaluate the establishment rates of riparian plantings
- Determine the intensity of wildlife browse to plantings
- Examine the effectiveness of vegetation control (invasive and otherwise) in riparian planting areas.

Formal monitoring of riparian plantings will include measures of survival, browse/animal damage, and underlying vegetation. This may be achieved through a statistically sound randomized sampling design that includes replicated transects or plots as sample units. Sample units will be assessed for the density of stems for each planted species, with data regarding browse or other animal effects. Underlying vegetation can be assessed by percent cover of functional groups (native or introduced grasses, forbs, shrubs) or target species. Formal riparian planting monitoring should occur annually the first three years after planting, then on a 3-5 year interval. Informal riparian planting monitoring will likely occur more frequently, particularly to assess establishment rates in plantings and the general response of the underlying vegetation to site preparation and planting maintenance actions.

4.1.3 Threatened and endangered species monitoring

Objectives:

- Quantify size and reproductive success of populations of threatened or endangered species present at WUZ
- Evaluate success of efforts to introduce threatened or endangered species
- Evaluate effects of management treatments on listed species

Currently, only one listed species has been introduced at WUZ – Nelson's checkermallow (*Sidalcea nelsoniana*). Formal monitoring of the existing population should be conducted every three years, at a minimum. The population should be censused (counting every individual) during the time of year with Nelson's checkermallow is flowering, typically June-July. Note: if no other checkermallows are present in the area where the Nelson's checkermallow is growing, and reproduction data is not desired, monitoring can occur earlier in the spring (April) before competing vegetation heights make location of vegetative plants difficult.

Because Nelson's checkermallow can spread rhizomatously, making it difficult to distinguish between closely spaced individuals, a Nelson's checkermallow "individual" is defined as being separated from other Nelson's checkermallow plants by at least 30 cm (12 in). Because this species is gynodioecious, with plants that are either pistillate (female, lacking stamens) or perfect (having both male and female parts), pistillate and perfect individuals located within 30 cm of each other are still considered two individuals. For more information about Nelson's checkermallow monitoring, see *Developing*

standardized survey and monitoring protocols for four threatened and endangered Willamette Valley prairie plant species (Currin and Meinke 2013).

4.2 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 new weed species arises following blackberry and teasel removal, additional spot spraying and heavier application of a native cover crop may be required.
- The success of riparian plantings and species selected for re-planting/interplanting should be evaluated alongside their soil moisture tolerances.

5 Costs

The estimated cost to complete the project is included in Appendix 6. Total estimated costs over a seven year period is $319,092 for Priority 1 actions and $165,880 for Priority 2 actions, making a grand total of $484,972. This total does not include costs for project management, which is often 10-20% of the on-the-ground project expenses, but does include a cost estimate for University and partner activities.

The plan also does not include any costs that might be required for culvert replacement or drainage modifications.

The estimated costs include:

- vegetation management (herbicide and application costs)
- labor and equipment (planting labor, tree removal, mowing)
- plant materials (native grass and forb seeds, riparian trees and shrubs)

Costs were estimated from 2014 labor and contract rates from commonly used restoration contractors, and plant material costs from nursery catalogs. Total costs over a seven year period for contracts and supplies are estimated at $438,101 (i.e., excluding University and partner (e.g., USFWS) costs).

It is anticipated that the restoration will be partially funded by the ODFW Willamette Wildlife Mitigation Program, using a basic operations and maintenance fund for the Conservation Easement. Additional funding sources (i.e. grant applications) will be required to fund the bulk of the restoration work, although substantial cost savings may be possible through in-kind contributions of labor and equipment from the landowner and partners, such as USFWS and ODFW.

6 Post-restoration maintenance

Once restoration goals have been met in each of the restoration units, maintenance activities will include mowing, haying or grazing; removal of encroaching conifers and other unwanted woody species, and control of invasive species. The best management practices are described above in Section 3.4 (Restoration methods). General maintenance activities will include the following:

- Fall mowing, prescribed burning, or grazing of the prairie and savanna should occur each year to reduce competition for native species, decrease thatch, and minimize tree and woody shrub species encroachment into the prairie. These activities should only occur on 1/3 of the entire site area in any given year. This will result in a three year disturbance interval for any given area which will allow refugia for plants and animals.
- Any small conifers that are not eliminated through mowing or fire should be removed annually. The edges will be the primary area of concern for conifers.
- Weed control will need to be ongoing. Searches for new exotic species and spot-spraying with herbicide should occur on a regular basis. Weed surveys should be completed twice yearly to inform control efforts.
- Any areas of bare soil created through tree removal, weed control, or other disturbance should be seeded in September or October using the species designated for the habitat in the seeding list.

These tasks will be able to be more accurately targeted to individual units at the end of the restoration phase. At that point, needs for the individual areas will be more apparent and a more reliable management guide can be created.

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8 Appendices

Appendix 1: Conservation values of Zena Forest Complex, as identified in the Conservation Easement (excerpt from CE 2007)

a. Water quality, healthy watershed functions, and the wetlands they can provide for mitigation: Approximately 1 mile of perennial stream (Richard's Creek on the West side of the Property) and an additional 2 miles of seasonal streams will be protected (Riparian forest priority area). Three watersheds (Yamhill, Rickreall, and Spring Valley) have tributaries originating on the Property. Conserving the Property would protect ground water infiltration and help maintain base flows for fish listed for federal protection under the Endangered Species Act like steelhead in the Rickreall.

b. Specific habitat types: Five high priority ecological systems as identified in the Willamette Subbasin Plan—as adopted by the Council in December 2004—and the Oregon Conservation Strategy (Feb. 2006) occur on the Property:
   i. oak woodland:
   ii. upland prairie/savanna/rock outcrops;
   iii. wetland prairie/seasonal marshes;
   iv. perennial ponds/riparian areas; and
   v. old growth conifer

   And four Strategy habitats identified in the Oregon Conservation Strategy (2006) the Willamette ecoregion occur on the property:
   i. aquatic;
   ii. grasslands/oak savanna;
   iii. oak woodlands; and
   iv. riparian.

c. Specific plant community types and the extensive area for carbon sequestration that they provide, contributing to clean air and national efforts to moderate the pace of global warming: Douglas fir, big leaf maple, and other hardwoods.

d. Animals and their habitat: *Plebejus icarioides fenderi* (Fender's blue butterfly), *Melanerpes formicivorus* (acorn woodpecker), *Progne subis* (Purple martins), *Sitta carolinensis* (white-breasted nuthatches), *Sialia mexicana* (Western bluebirds), *Pooecetes gramineus affinis* (Oregon vesper sparrow) and Sciurus griseus (western gray squirrels)

e. The specific Conservation Values on the Property will be further documented in the Approved Management Plan as an"Inventory of Relevant Features". Grantor and Grantee intend that the Inventory of Relevant Features to serve as an objective informational baseline for purposes of monitoring compliance with the terms of this Easement.

Appendix 2: Photographs of current habitats at Willamette University at Zena

Figure A2.1. Wet prairie Unit C

Figure A2.3. Wet prairie Unit C drainage feature

Figure A2.2. Wet prairie Unit C northern border of trees

Figure A2.4. Oak savanna Unit B – North

Figure A2.5. Oak savanna Unit B – South

Figure A2.8. Oak savanna Unit M – West

Figure A2.6. Oak savanna Unit B – East

Figure A2.9. Oak savanna Unit M – oak island

Figure A2.7. Oak savanna in Unit M – East Upper

Figure A2.10. Oak woodland in Unit F with sprayed understory

Figure A2.11. Oak woodland in Unit F

Figure A2.14. Transitional mixed woodland in Unit F

Figure A2.12. Oak woodland in Unit V

Figure A2.15. Mixed woodland in Unit V

Figure A2.13. Transitional mixed woodland in Unit F

Figure A2.16. Narrow stream channel of tributary A in riparian forest in Unit D

Figure A2.17. Riparian forest in Unit Q

Figure A2.18. Clearing at west end of riparian forest in Unit Q

Appendix 3. Summary of previous restoration actions at Willamette University at Zena

DATE	UNIT	PHASE	ACTIVITY
2009	Prairie B	SP	• mechanically cleared fir and pine plantations and shrubs, burned slash
2010	Prairie M	SP	• mechanically cleared fir and pine plantations and invasives, burned slash
	Prairie B	SP SP SP	• broadcast Glyphosate in May • burned in summer • seeded *Festuca roemeri* (North and South) and grass and forbs (North) • chemically controlled sprouting invasives in fall
	Woodland F	SP SP	• cut and stump treated invasives (40 acres) • thinned to release oaks to 125 trees/acre (6 acres)
	Woodland V	SP	• chemically treated cherry and hawthorn
	All units	SP M	• permanent monitoring plots established, data collected • informal observation completed with partners
	Site	SP	• created Oak Loop Trail
2011	Prairie M	SP SP SP	• broadcast Glyphosate in May • burned in summer •seeded *Festuca roemeri* in fall (West, East-Upper, East-Lower) • prescribe burned in summer and reseeded in fall • chemically controlled sprouting shrubs in fall
	Prairie B	NE	• planted 2,000 forb plugs (*Achillea, Eriophyllum, Prunella*) • mowed
	Woodland F	SP SP	• cut and stump treated invasives (20 acres) • thinned to release oaks to 250 trees/acre (16 acres)
	Woodland V	SP	• thinned to release oak (9 acres)
	All units	M M	• permanent monitoring plots censused • informal observation completed with partners
	Site	M M	• mowed trails • chemically controlled invasives along roads and trails
2012	Prairie M	SP/M SP/M SP/M NE	• mowed June • spot sprayed Scotch broom • planted 2,000 forb plugs in burn piles (Upper East; species as above plus Sidalcea, Potentilla)
	Prairie B	SP/M SP/M SP/M SP/M NE	• mowed • spot herbicided broom • applied Poast grass specific herbicide in November (all), spot sprayed Scotch broom, *Agrostis* with Glyphosate (North). • broadcast seeded native grass in bare areas (*Festuca roemeri*) • Planted 8,000 forb plugs (North, many species)
	Woodland F	SP SP	• inventoried downed wood and snags • thinned to release oak to 250 trees/acre (12 acres)
	Woodland V	M	• created snags
	Wet Prairie C	SP	• removed Douglas-fir plantation and shrubs, burned • Glyphosate application • broadcast planted with *Deschampsia, Danthonia,* Meadow barley, FERO
	All units	M M	• permanent monitoring plots censused • informal observation completed with partners
	Site	M M	• mowed trails • chemically controlled invasives along roads and trails

2013	Prairie M	M SP	• mowed • planted 1,000 forb plugs (Upper and Lower East)
	Prairie B	M SP SP	• mowed • spot sprayed (Glyphosate for *Agrostis* North; ??? for Scotch broom throughout) • planted 8,000 forb plugs (Lower North, many species)
	Woodland F	SP	• thinned to release oak to 250 tree/acre (10 acres)
	Woodland V	NE SP	• planted 1 acre with understory shrubs • thinned to release oak (11 acres)
	Wet Prairie C	SP/M	• planted plugs and grass in burn piles • spot sprayed Scotch broom, blackberry, teasel • mowed (all)
	All units	M M	• permanent monitoring plots censused • informal observation completed with partners
	Site	M M	• mowed trails • chemically controlled invasives along roads and trails
2014	Prairie M	M M M	• grass specific herbicide (East Upper and Lower, West) (Fusilade) • mowed (West, East, Oak buffer) • spot sprayed Scotch Broom (West, East, Oak buffer)
	Prairie B	M	• grass specific herbicide (South, North) (Fusilade) • spot herbicide Scotch Broom (all) (what chemicals?) • mowed (all)
	Wet Prairie C	SP	• herbicided Scotch broom, blackberry, teasel • mowed (all)
	Transition Woodland	M	• mowed (all)

Appendix 4: Preliminary plant species list for Willamette University at Zena

Data from K. Arabas and B. Lindh, 2014. Nat=native; Ex=exotic, Unk=unknown, Inv=invasive, R=rare.

Scientific name	Common Name	Status		Unit				
		Nat/Ex/ Unk	Inv/R	M	B	C/D	F	V
SHRUBS								
Amelanchier alnifolia	Saskatoon or service berry	N		X			X	X
Corylus California.	Hazelnut	N						X
Crataegus laevigata	Hawthorn, smooth	E		X	X		X	X
Cytisus scoparius	Scotch broom	E	I	X	X	X	X	X
Oemleria cerasiformis	Indian Plum	N		X			X	X
Prunus sp.?	Spiny plum	U		X			X	
Rhamnus purshiana	Cascara buckthorn	N		X				X
Rosa spp.	Rose	N		X		X	X	X
Rubus armeniacus	Blackberry, Himalayan	E	I	X	X	X	X	X
Rubus ursinus	Blackberry, trailing	N				X	X	X
Symphoricarpos albus	Snowberry, common	N		X		X	X	X
Toxicodendron diversiloba	Poison oak	N		X	X		X	X
Viburnum spp.	Common viburnum	N					X	
GRAMINOIDS								
Agrostis gigantea	Agrostis	E	I	X	X	X		
Bromus hordaceus	Soft brome	E		X	X			
Bromus sterilis	Poverty brome	E		X	X			
Bromus sitchensis	Sitka brome	N			X			
Vulpia myuroides	Rat-tail fescue	E	I	X	X			
Arrhenatherum elatius	Tall Oat Grass	E	I	X	X	X		
Avena barbata	Wild oats	E			X			
Briza minor	Small rattelsnake grass	E		X	X			
Cynosurus echinatus	Dogtail	E	I	X	X			
Danthonia californica	California oatgrass	N		X	X	?		
Schenodorus arundinacea	Tall fescue	E	I	X	X	X		
Festuca roemeri	Roemer's fescue	N		X	X	X		
Holcus lanatus	Velvet grass	E	I	X	X	X		
Hordeum brachyantherum	Meadow barley	N		X	X	X		
Juncus bufonius	Toad Rush	N		X	X			
Deschampsia caespitosa	Needlegrass	N				X		
Taeniatherum caput-medusae	Medusahead	E	I	X	X			

Appendix 4, continued: Preliminary plant species list for Willamette University at Zena

Scientific name	Common Name	Status		Unit				
		Nat/Ex/ Unk	Inv/R	M	B	C/D	F	V
FORBS								
Achillea millefolium	Yarrow, Commom	N		X	X		X	
Adenocaulon bicolor	Pathfinder	N						X
Agoseris grandiflora	Agoseris, big flower	N		X				
Allium amplectens	Narrowleaf onion	N		X	X			
Anagallis arvensis	Scarlet pimpernel	E		X	X			
Anthemis cotula	Stinking Chamomile	E		X	X			
Aphanes microcarpa	Parsely slender	E		X	X			
Asclepias speciosa	Showy milkweed	N			X			
Balsamorhiza	Balsamroot	N			X			
Brodiaea elegans	Harvest brodiaea	N		X	X			
Calochortus tolmiei	Lily, Tolmie cat's ear	N			X		X	X
Camassia quamash	Common camas	N				X		
Camassia leichtlinii	Great camas	N				X		
Cardamine hirsuta	Bittercress, hairy	E		X	X			X
Centaurea cyanus	Cornflower, garden	E		X				
Centaurium erythraea	Common or European Centaury	E		X	X			
Cerastium glomeratum	Chickweed, mouse eared or sticky	E		X	X		X	X
Circaea alpina	Enchanter's-Nightshade	N						X
Cirsium canadense and *vulgare*	Thistle	E	I	X	X	X	X	X
Clarkia purpurea or *amoena*	Clarkia	N		X	X			
Claytonia perfoliata	Miner's lettuce	N					X	X
Claytonia sibirica	Candy Flower/springbeauty	N					X	X
Collomia grandiflora	Collomia, grand	N		X	X			
Convolvulus arvensis	Bindweed, field	E	I	X	X			X
Crepis setosa	Dandelion, red hairy (rough hawksbeard)	E		X	X			
Daucus carota	Queen Anne's Lace (field parsely)	E	I	X	X	X	X	X
Dichelostemma congestum	Ookow	N		X	X		X	X
Dipsacus fullonum	Teasel, Fullers	E	I	X	X	X		X

Appendix 4, continued: Preliminary plant species list for Willamette University at Zena

Scientific name	Common Name	Status		Unit				
		Nat/Ex/ Unk	Inv/R	M	B	C/D	F	V
FORBS, continued								
Epilobium brachycarpum	Tall annual willowherb (skinny red epil)	N		X	X			
Epilobium ciliatum	Willowherb, fringed	N		X				
Eriophyllum lanatum	Woolly sunflower	N		X	X			
Erythronium oregonum	Lily, fawn	N					X	
Fragaria virginiana var. platyphylla	Wildstrawberry	N			X	X	X	
Galium aparine	Bedstraw, cleavers (stickywilly)	N		X	X		X	X
Galium parisiense	Bedstraw, wall (tall skinny)	E		X	X		X	X
Geranium bicknellii	Bicknells cranesbill	N		X	X		X	
Geranium dissectum	Geranium, cutleaf	E	I	X	X		X	X
Geranium lucidum	Geranium, Shining	E	I	X	X		X	X
Geranium molle	Geranium, dovefoot	E						
Geum macrophyllum	Large leaved avens	N			X	X		
Gilia captitata	Bluehead gilia	N		X				
Goodyera oblongifolia	Plantain, rattlesnake	N						X
Heracleum lanatum	Cow parsnip	N			X	X		
Hypericum perforatum	St. John's wort, common	E	I	X	X		X	X
Hypochaeris radicata	Dandelion, false, hairy (hairy cat's ear)	E	I	X	X	X	X	X
Iris tenax	Iris, toughleaf	N		X	X		X	
Lactuca serriola	Lettuce, prickly	E						
Lapsana communis	Nipplewort, common	E					X	X
Lathryus angulatus	Pea, angled (purple linear)	E		X	X			
Lathryus sphaericus	Pea, grass (red linear)	E		X	X		X	X
Lathyrus aphaca	Pea, yellow	E	I	X	X		X	
Leptosiphon bicolor	Babystar, true	N			X			
Leucanthemum taraxacoides	Hawkbit, hairy	E		X	X			
Leucanthemum vulgare	Daisy, ox-eye	E	I	X	X	X	X	X
Linum bienne	Flax, narrow-leaved	E		X	X			
Lomatium nudicaule	Common lomatium	N		X	X			

Appendix 4, continued: Preliminary plant species list for Willamette University at Zena

Scientific name	Common Name	Status		Unit				
		Nat/Ex/ Unk	Inv/R	M	B	C/D	F	V
FORBS, continued								
Lomatium utriculatum	Bladder parsnip, hog fennel	N		X	X			
Lomatium dissectum	Fernleaf biscuitroot	N			X			
Lonicera hispidula	Honeysuckle	N					X	X
Lotus micranthus	Lotus, small-flowered	N		X	X			
Lotus purshiana	American birds foot trefoil	N			X			
Lupinus albicaulis	Lupine, sicklekeel	N		X				
Lupinus latifolia	Lupine, wide-leafed	N			X			
Lupinus polycarpus	Lupine, small flower	N		X	X			
Madia glomerata	Tarweed (also called Plantain, soft)	N		X	X			
Marah oreganus	Cucumber, wild	N		X	X		X	
Melissa officinalis	Balm, common or lemon	E	I			X		X
Micranthes integrifolia	Saxifrage	N		X				
Moenchia erecta ssp. *Erecta*	Chickweed, munchkin	E		X	X			
Mycelis muralis	Lettuce, wall	E						X
Myosotis discolor	Forget-me-not, yellow and blue	E		X	X		X	X
Navarretia interteXta	Needlebeard	N		X	X			
Navarettia squarrosa	Skunkweed	N		X	X			
Nemophila parviflora	Nemophila, small-flowered	N					X	X
Osmorhiza berterio	Sweet cicely	N		X			X	X
Parentucellia viscosa	Glandweed, yellow	E	I	X	X		X	
Perideridia gairdneri	Gardner's yampah	N				X		
Plantago lanceolata	Plantain, narrow-leaved (ribwort)	E		X	X			
Polypodium glycyrrhiza	Fern, licorice	N					X	X
Polystichum munitum	Fern, sword	N					X	X
Potentilla glandulosa	Sticky cinquefoil	N		X	X			
Potentilla gracilis	Cinquefoil, slender	N		X	X			
Prunella vulgaris ssp *lanceolata*	Self-heal	N		X	X	X		X

Appendix 4, continued: Preliminary plant species list for Willamette University at Zena

Scientific name	Common Name	Status		Unit				
		Nat/Ex/ Unk	Inv/R	M	B	C/D	F	V
FORBS, continued								
Pteridium aquilinum	Fern, bracken	N						
Ranunculus occidentalis	Buttercup, western	N					X	
Ranunculus orthyrinchus	Buttercup, birdbeak	N				X		
Ranunculus uncinatus	Buttercup, woodland	N					X	X
RumeX acetosella	Sheep sorrel, common	E		X	X		X	X
Sanicula crassicaulis	Snakeroot, Pacific black	N		X	X		X	X
Sanicula bipinnatifida	Snakeroot	N			X			
Satureja douglasii	Yerba buena	N		X	X	X	X	X
SaXifraga	Saxifrage	?			X			
ScandiX pecten-veneris	Shepherd's needles	E		X				
Scleranthus annuus	Knotgrass, German	E		X	X			
Senecio jacobaea	Tansy ragwort	E	I	X	X		X	X
Senecio vulgaris	Groundsel, old man in the spring	E		X	X			
Sherardia arvensis	Field madder, blue	E	I	X	X		X	X
Sidalcea campestris	Checkerbloom, meadow	N	R	X	X	X		
Sidalcea malviflora	Checkerbloom	N		X	X			
Sidalcea nelsoniana	Checkermallow, Nelson's	N			X			
Silybum marianum	Thistle, milk	E	I	X	X			X
Sonchus asper	Sow thistle, prickly	E		X	X		X	
Sonchus oleraceus	Sow thistle, common	E		X	X			X
Taraxacum officinale	Dandelion, common	E		X	X		X	
Tellima grandiflora	Fringecup	N				X		X
Torilis arvensis	Torillis or Woodland Parsely	E					X	X
Tragopogon dubius	Salsify, yellow (goatsbeard)	E		X	X			
Tragopogon porrifolius	Salsify, purple (goatsbeard)	E		X	X			
Trifolium dubium	Clover, least hop or suckling	E	I	X	X		X	X
Trifolium subterraneum	Clover, subterranean (white)	E	I	X	X			
Trifolim wildenovii	Clover, tomcat	N			X			

Appendix 4, continued: Preliminary plant species list for Willamette University at Zena

Scientific name	Common Name	Status		Unit				
		Nat/Ex/ Unk	Inv/R	M	B	C/D	F	V
FORBS, continued								
Triphysaria versicolor	Owls clover	N		X				
Vicia americana	Vetch, American	N		X	X		X	
Vicia sativa	Vetch, common	E	I	X	X		X	X
Vicia tetrasperma	Vetch, slender or lentil (white)	E	I	X	X		X	
Vicia villosa	Vetch, hairy	E	I	X	X		X	

Appendix 5: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Wet Prairie (Unit C)						
Scientific Name	**Species**	**Growth Form**	**Lbs. / acre**	**Lbs. for Total acres (9.8)**	**Cost/ lb.**	**Cost**
Achillea millefolium	yarrow	Perennial forb	0.45	4.41	$ 45.00	$ 198.45
Camassia leichtlinii	tall camas	Perennial Forb	0.6	5.88	$ 117.00	$ 687.96
Epilobium densiflorum	denseflower willowherb	Annual Forb	0.5	4.90	$ 60.00	$ 294.00
Eriophyllum lanatum	Oregon sunshine	Perennial Forb	0.8	7.84	$ 133.00	$ 1,042.72
Grindelia integrifolia	Puget Sound gumweed	Perennial Forb	0.4	3.92	$ 106.00	$ 415.52
Lomatium nudicaule	Barestem biscuitroot	Perennial forb	1	9.80	$ 135.00	$ 1,323.00
Lotus unifoliolatus	American bird's-foot trefoil	Perennial forb	0.65	6.37	$ 76.00	$ 484.12
Madia elegans	Common tarweed	Perennial forb	0.4	3.92	$ 90.00	$ 352.80
Perideridia oregana	Oregon yampah	Perennial forb	0.75	7.35	$ 175.00	$ 1,286.25
Plectritis congesta	Shortspur seablush	Annual Forb	0.4	3.92	$ 101.00	$ 395.92
Potentilla gracilis	Slender cinquefoil	Perennial Forb	0.5	4.90	$ 125.00	$ 612.50
Prunella vulgaris var. lanceolata	Lance selfheal	Perennial Forb	1	9.80	$ 40.00	$ 392.00
Subtotal Forbs			***7.45***	***73.01***		***$ 7,485.24***
Agrostis exarata	Spike bentgrass	Perennial Grass	1	9.80	$ 19.00	$ 186.20
Danthonia californica	California oatgrass	Perennial Grass	2.5	24.50	$ 32.50	$ 796.25
Deschampsia cespitosa	Tufted hairgrass	Perennial Grass	0.75	7.35	$ 10.70	$ 78.65
Hordeum brachyantherum	Meadow barley	Perennial Grass	2.03	19.89	$ 13.25	$ 263.60
Subtotal Grasses			***6.28***	***61.54***		***$ 1,324.69***
Grand Totals:			**13.73**	**134.55**		**$ 8,809.93**

Appendix 5, continued: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Oak Savanna (Unit B)							
Scientific Name	**Species**	**Growth Form**	**Pounds/ acre**	**Pounds needed for 11.1 acres**	**Cost/ Pound**	**Cost: Year 1**	**Cost: Year 2**
Achillea millefolium	yarrow	Perennial forb	0.75	8.33	$ 45.00	$ 374.63	$ -
Camassia quamash	common camas	Perennial forb	0.75	8.33	$ 117.00	$ 974.03	$ -
Clarkia amoena	farewell to spring	Annual forb	0.40	4.44	$ 81.00	$ 359.64	$ -
Clarkia purpurea	winecup clarkia	Annual forb	0.40	4.44	$ 110.00	$ 488.40	$ -
Collomia grandiflora	grand collomia	Perennial forb	0.40	4.44	$ 59.00	$ 261.96	$ -
Eriophyllum lanatum	Oregon sunshine	Perennial forb	0.75	8.33	$ 125.00	$ 1,040.63	$ -
Iris tenax	Oregon iris	Perennial forb	0.50	5.55	$ 135.00	$ 749.25	$ -
Lotus unifoliatus	American birdsfoot trefoil	Annual forb	0.50	5.55	$ 135.00	$ 749.25	$ -
Madia elegans	Common tarweed	Annual forb	0.40	4.44	$ 99.00	$ 439.56	$ -
Potentilla gracilis	Slender cinquefoil	Perennial forb	0.75	8.33	$ 116.00	$ 965.70	$ -
Ranunculus occidentalis	Western buttercup	Perennial forb	0.50	5.55	$ 125.00	$ 693.75	$ -
Sidalcea virgata	dwarf checkermallow	Perennial forb	0.75	8.33	$ 110.00	$ 915.75	$ -
Subtotal Forbs			***6.85***	***76.04***		***$ 8,012.54***	***$ -***
Bromus sitchensis	Sitka brome	Perennial grass	2.00	22.20	$ 6.90	$ -	$ 153.18
Carex tumulicola	Splitawn Sedge	Perennial graminoid	1.00	11.10	$ 145.00	$ -	$ 1,609.50
Danthonia californica	California oatgrass	Perennial grass	2.00	22.20	$ 32.50	$ -	$ 721.50
Elymus glaucus	Blue wildrye	Perennial grass	2.00	22.20	$ 10.00	$ -	$ 222.00
Festuca roemeri	Roemer's fescue	Perennial grass	3.00	33.30	$ 20.00	$ 666.00	$ -
Subtotal Grasses			***10.00***	***111.00***		***$ 666.00***	***$ 2,706.18***
Grand Totals by Year:						**$ 8,678.54**	**$ 2,706.18**
Grand Total:			**16.85**	**187.04**		**$**	**11,384.72**

Appendix 5, continued: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Oak Savanna (Unit M)							
Scientific Name	**Species**	**Growth Form**	**Pounds/ acre**	**Pounds needed for 25.6 acres**	**Cost/ Pound**	**Cost: Year 1**	**Cost: Year 2**
Achillea millefolium	yarrow	Perennial forb	0.75	19.20	$ 45.00	$ 864.00	$ -
Camassia quamash	common camas	Perennial forb	0.75	19.20	$ 117.00	$ 2,246.40	$ -
Clarkia amoena	farewell to spring	Annual forb	0.40	10.24	$ 81.00	$ 829.44	$ -
Clarkia purpurea	winecup clarkia	Annual forb	0.40	10.24	$ 110.00	$ 1,126.40	$ -
Collomia grandiflora	grand collomia	Perennial forb	0.40	10.24	$ 59.00	$ 604.16	$ -
Eriophyllum lanatum	Oregon sunshine	Perennial forb	0.75	19.20	$ 125.00	$ 2,400.00	$ -
Iris tenax	Oregon iris	Perennial forb	0.50	12.80	$ 135.00	$ 1,728.00	$ -
Lotus unifoliatus	American birdsfoot trefoil	Annual forb	0.50	12.80	$ 135.00	$ 1,728.00	$ -
Madia elegans	Common tarweed	Annual forb	0.40	10.24	$ 99.00	$ 1,013.76	$ -
Potentilla gracilis	Slender cinquefoil	Perennial forb	0.75	19.20	$ 116.00	$ 2,227.20	$ -
Ranunculus occidentalis	Western buttercup	Perennial forb	0.50	12.80	$ 125.00	$ 1,600.00	$ -
Sidalcea virgata	dwarf checkermallow	Perennial forb	0.75	19.20	$ 110.00	$ 2,112.00	$ -
Subtotal Forbs			***6.85***	***175.36***		***$ 18,479.36***	***$ -***
Bromus sitchensis	Sitka brome	Perennial grass	1.00	25.60	$ 6.90	$ -	$ 176.64
Carex tumulicola	Splitawn Sedge	Perennial graminoid	1.00	25.60	$ 145.00	$ -	$ 3,712.00
Danthonia californica	California oatgrass	Perennial grass	2.00	51.20	$ 32.50	$ -	$ 1,664.00
Elymus glaucus	Blue wildrye	Perennial grass	1.50	38.40	$ 10.00	$ -	$ 384.00
Festuca roemeri	Roemer's fescue	Perennial grass	3.00	76.80	$ 20.00	$ 1,536.00	$ -
Subtotal Grasses			***8.50***	***217.60***		***$ 1,536.00***	***$ 5,936.64***
Grand Totals by Year:						**$20,015.36**	**$ 5,936.64**
Grand Total:			**15.35**	**392.96**		**$**	**25,952.00**

Appendix 5, continued: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Transitional Woodland (Unit F): Seed List							
Scientific Name	**Species**	**Growth Form**	**Pounds/ acre**	**Pounds needed for 5.4 acres**	**Cost/ Pound**	**Cost: Year 1**	**Cost: Year 2**
Achillea millefolium	yarrow	Perennial forb	0.50	2.70	$ 45.00	$ 121.50	$ -
Aquiligia formosa	red columbine	Perennial forb	0.25	1.35	$ 186.00	$ 251.10	$ -
Camassia quamash	common camas	Perennial forb	0.75	4.05	$ 117.00	$ 473.85	$ -
Clarkia amoena	farewell to spring	Annual forb	0.40	2.16	$ 81.00	$ 174.96	$ -
Collomia grandiflora	grand collomia	Perennial forb	0.40	2.16	$ 59.00	$ 127.44	$ -
Eriophyllum lanatum	Oregon sunshine	Perennial forb	0.75	4.05	$ 125.00	$ 506.25	$ -
Iris tenax	Oregon iris	Perennial forb	0.50	2.70	$ 135.00	$ 364.50	$ -
Lotus unifoliatus	American birdsfoot trefoil	Annual forb	0.50	2.70	$ 135.00	$ 364.50	$ -
Madia elegans	Common tarweed	Annual forb	0.40	2.16	$ 99.00	$ 213.84	$ -
Potentilla gracilis	Slender cinquefoil	Perennial forb	0.75	4.05	$ 116.00	$ 469.80	$ -
Ranunculus occidentalis	Western buttercup	Perennial forb	0.50	2.70	$ 125.00	$ 337.50	$ -
Sidalcea virgata	dwarf checkermallow	Perennial forb	0.50	2.70	$ 110.00	$ 297.00	$ -
Subtotal Forbs			***6.20***	***33.48***		***$ 3,702.24***	***$ -***
Bromus sitchensis	Sitka brome	Perennial grass	2.50	13.50	$ 6.90	$ -	$ 93.15
Carex tumulicola	Splitawn Sedge	Perennial graminoid	1.00	5.40	$ 145.00	$ -	$ 783.00
Danthonia californica	California oatgrass	Perennial grass	2.00	10.80	$ 32.50	$ -	$ 351.00
Elymus glaucus	Blue wildrye	Perennial grass	3.00	16.20	$ 10.00	$ -	$ 162.00
Festuca roemeri	Roemer's fescue	Perennial grass	2.50	13.50	$ 20.00	$ 270.00	$ -
Subtotal Grasses			***11.00***	***59.40***		***$ 270.00***	***$ 1,389.15***
Grand Totals by Year:						**$ 3,972.24**	**$ 1,389.15**
Grand Total:			**17.20**	**92.88**		**$**	**5,361.39**

Appendix 5, continued: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Riparian Woodland (Unit D)						
Scientific Name	**Species**	**Growth Form**	**Pounds/ acre**	**Pounds needed for 4.2 acres**	**Cost/ Pound**	**Cost**
Aquilegia formosa	red columbine	perennial forb	0.50	2.10	$ 186.00	$ 390.60
Camassia quamash	common camas	perennial forb	0.75	3.15	$ 128.00	$ 403.20
Clarkia amoena	farewell to spring	annual forb	0.50	2.10	$ 81.00	$ 170.10
Collinsia grandiflora	blue-eyed mary	annual forb	0.50	2.10	$ 70.00	$ 147.00
Collomia grandiflora	grand collomia	annual forb	0.50	2.10	$ 65.00	$ 136.50
Heracleum lanatum	cow parsnip	perennial forb	0.25	1.05	$ 200.00	$ 210.00
Iris tenax	Oregon Iris	annual forb	0.50	2.10	$ 150.00	$ 315.00
Perideridia oregana	Oregon yampah	perennial forb	0.75	3.15	$ 175.00	$ 551.25
Subtotal Forbs			***3.00***	***12.60***		***$ 1,457.40***
Bromus sitchensis	Sitka brome	perennial grass	2.00	8.40	$ 6.90	$ 57.96
Carex stipata	sawbeak sedge	perennial graminoid	0.50	2.10	$ 138.00	$ 289.80
Deschampsia elongata	slender hairgrass	perennial grass	1.00	4.20	$ 9.70	$ 40.74
Elymus glaucus	blue wildrye	perennial grass	2.00	8.40	$ 10.00	$ 84.00
Subtotal Grasses			***5.50***	***23.10***		***$ 472.50***
Grand Totals by Year:			**8.50**	**35.70**		**$ 1,929.90**

Appendix 5, continued: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Riparian Woodland (Unit P and Q)						
Scientific Name	**Species**	**Growth Form**	**Pounds/ acre**	**Pounds needed for 7.7 acres**	**Cost/ Pound**	**Cost**
Aquilegia formosa	red columbine	perennial forb	0.75	5.78	$ 186.00	$ 1,074.15
Camassia quamash	common camas	perennial forb	0.75	5.78	$ 128.00	$ 739.20
Clarkia amoena	farewell to spring	annual forb	0.50	3.85	$ 81.00	$ 311.85
Collinsia grandiflora	blue-eyed mary	annual forb	0.50	3.85	$ 70.00	$ 269.50
Collomia grandiflora	grand collomia	annual forb	0.50	3.85	$ 65.00	$ 250.25
Heracleum lanatum	cow parsnip	perennial forb	0.50	3.85	$ 200.00	$ 770.00
Iris tenax	Oregon Iris	annual forb	0.50	3.85	$ 150.00	$ 577.50
Perideridia oregana	Oregon yampah	perennial forb	0.75	5.78	$ 175.00	$ 1,010.63
Subtotal Forbs			***3.50***	***26.95***		***$ 3,414.95***
Bromus sitchensis	Sitka brome	perennial grass	2.00	15.40	$ 6.90	$ 106.26
Carex stipata	sawbeak sedge	perennial graminoid	0.50	3.85	$ 138.00	$ 531.30
Deschampsia elongata	slender hairgrass	perennial grass	1.00	7.70	$ 9.70	$ 74.69
Elymus glaucus	blue wildrye	perennial grass	2.00	15.40	$ 10.00	$ 154.00
Subtotal Grasses			***5.50***	***42.35***		***$ 866.25***
Grand Totals by Year:			**9.00**	**69.30**		**$ 4,281.20**

Appendix 5, continued: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Riparian Trees and Shrubs (Unit D)						
Common name	**Scientific name**	**Type**	**Size**	**Quantity**	**Price each**	**Total Cost**
bigleaf maple	*Acer macrophyllum*	1yr bare rt	12-18"	105	$ 0.60	$ 63.00
white alder	*Alnus rhombifolia*	1yr bare rt	12-18"	770	$ 0.58	$ 446.60
red alder	*Alnus rubra*	1yr bare rt	12-18"	175	$ 0.55	$ 96.25
Oregon ash	*Fraxinus latifolia*	1yr bare rt	12-18"	910	$ 0.55	$ 500.50
ocean spray	*Holodiscus discolor*	1yr bare rt	12-18"	385	$ 0.65	$ 250.25
Pacific ninebark	*Physocarpus capitatus*	1yr bare rt	12-18"	1155	$ 0.65	$ 750.75
black cottonwood	*Populus trichocarpa*	1yr bare rt	12-18"	385	$ 0.50	$ 192.50
Pacific willow	*Salix lucida lassiandra*	1yr bare rt	12-18"	770	$ 0.50	$ 385.00
Scouler willow	*Salix scouleriana*	1yr bare rt	12-18"	35	$ 0.55	$ 19.25
Sitka willow	*Salix sitchensis*	1yr bare rt	12-18"	1155	$ 0.50	$ 577.50
red elderberry	*Sambucus racemosa/cerulea*	1yr bare rt	12-18"	53	$ 0.75	$ 39.75
Douglas spiraea	*Spiraea douglasii*	1yr bare rt	12-18"	35	$ 0.50	$ 17.50
snowberry	*Symphoricarpos albus*	1yr bare rt	12-18"	805	$ 0.55	$ 442.75
serviceberry	*Amelanchier alnifolia*	1yr bare rt	12-18"	35	$ 0.90	$ 31.50
Redosier dogwood	*Cornus sericea occidentalis*	1yr bare rt	12-18"	560	$ 0.50	$ 280.00
California hazelnut	*Corylus cornuta*	1yr bare rt	18-24"	52	$ 1.35	$ 70.20
Oregon grape	*Mahonia aquifolium*	1yr bare rt	9-12"	35	$ 0.75	$ 26.25
Indian plum	*Oemleria cerasiformis*	1yr bare rt	12-18"	385	$ 0.85	$ 327.25
cascara	*Rhamnus purshiana*	1yr bare rt	12-18"	420	$ 0.85	$ 357.00
Nootka rose	*Rosa nutkana*	1yr bare rt	12-18"	175	$ 0.65	$ 113.75
Total				**8400**		**$ 4,987.55**
Totals based on 2,000 stems/acre for 4.2 acres						

Appendix 5, continued: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Riparian Trees and Shrubs (Unit P and Q)						
Common name	**Scientific name**	**Type**	**Size**		**Price each**	**Total Cost**
bigleaf maple	*Acer macrophyllum*	1yr bare rt	12-18"	190	$ 0.60	$ 114.00
white alder	*Alnus rhombifolia*	1yr bare rt	12-18"	1435	$ 0.58	$ 832.30
red alder	*Alnus rubra*	1yr bare rt	12-18"	380	$ 0.55	$ 209.00
Oregon ash	*Fraxinus latifolia*	1yr bare rt	12-18"	1625	$ 0.55	$ 893.75
ocean spray	*Holodiscus discolor*	1yr bare rt	12-18"	670	$ 0.65	$ 435.50
Pacific ninebark	*Physocarpus capitatus*	1yr bare rt	12-18"	2105	$ 0.65	$ 1,368.25
black cottonwood	*Populus trichocarpa*	1yr bare rt	12-18"	670	$ 0.50	$ 335.00
Pacific willow	*Salix lucida lassiandra*	1yr bare rt	12-18"	1435	$ 0.50	$ 717.50
Scouler willow	*Salix scouleriana*	1yr bare rt	12-18"	145	$ 0.55	$ 79.75
Sitka willow	*Salix sitchensis*	1yr bare rt	12-18"	2105	$ 0.50	$ 1,052.50
red elderberry	*Sambucus racemosa/cerulea*	1yr bare rt	12-18"	145	$ 0.75	$ 108.75
Douglas spiraea	*Spiraea douglasii*	1yr bare rt	12-18"	50	$ 0.50	$ 25.00
snowberry	*Symphoricarpos albus*	1yr bare rt	12-18"	1435	$ 0.55	$ 789.25
serviceberry	*Amelanchier alnifolia*	1yr bare rt	12-18"	60	$ 0.90	$ 54.00
Redosier dogwood	*Cornus sericea occidentalis*	1yr bare rt	12-18"	1050	$ 0.50	$ 525.00
California hazelnut	*Corylus cornuta*	1yr bare rt	18-24"	35	$ 1.35	$ 47.25
Oregon grape	*Mahonia aquifolium*	1yr bare rt	9-12"	35	$ 0.75	$ 26.25
Indian plum	*Oemleria cerasiformis*	1yr bare rt	12-18"	765	$ 0.85	$ 650.25
cascara	*Rhamnus purshiana*	1yr bare rt	12-18"	720	$ 0.85	$ 612.00
Nootka rose	*Rosa nutkana*	1yr bare rt	12-18"	345	$ 0.65	$ 224.25
Total				**15400**		**$ 9,099.55**
Totals based on 2,000 stems/acre for 7.7 acres						

Appendix 5, continued: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Oak woodland Trees and Shrubs (Unit F and V)						
Common name	**Scientific name**	**Type**	**Size**	**Quantity**	**Price each**	**Total Cost**
ocean spray	*Holodiscus discolor*	1/0 seedling	12-18"	350	$ 0.65	$ 227.50
Pacific ninebark	*Physocarpus capitatus*	1/0 seedling	12-18"	500	$ 0.65	$ 325.00
red elderberry	*Sambucus racemosa/cerulea*	1/0 seedling	12-18"	75	$ 0.75	$ 56.25
Douglas spiraea	*Spiraea douglasii*	1/0 seedling	12-18"	30	$ 0.50	$ 15.00
snowberry	*Symphoricarpos albus*	1/0 seedling	12-18"	750	$ 0.55	$ 412.50
serviceberry	*Amelanchier alnifolia*	1/0 bareroot	12-18"	30	$ 0.90	$ 27.00
California hazelnut	*Corylus cornuta*	1/0 bareroot	18-24"	20	$ 1.35	$ 27.00
Oregon grape	*Mahonia aquifolium*	1/0 bareroot	9-12"	20	$ 0.75	$ 15.00
Indian plum	*Oemleria cerasiformis*	1/0 bareroot	12-18"	300	$ 0.85	$ 255.00
cascara	*Rhamnus purshiana*	1/0 bareroot	12-18"	350	$ 0.85	$ 297.50
Nootka rose	*Rosa nutkana*	1/0 bareroot	12-18"	75	$ 0.65	$ 48.75
Total				**2500**		**$ 1,706.50**
Totals based on 125 stems/acre for 20 acres						

Appendix 5, continued: Suggested plant materials and estimated costs for restoration at Willamette University at Zena

Mixed species woodland Trees and Shrubs (Unit G and V)						
Common name	**Scientific name**	**Type**	**Size**	**Quantity**	**Price each**	**Total Cost**
ocean spray	*Holodiscus discolor*	1/0 seedling	12-18"	275	$ 0.65	$ 178.75
Pacific ninebark	*Physocarpus capitatus*	1/0 seedling	12-18"	375	$ 0.65	$ 243.75
red elderberry	*Sambucus racemosa/cerulea*	1/0 seedling	12-18"	50	$ 0.75	$ 37.50
Douglas spiraea	*Spiraea douglasii*	1/0 seedling	12-18"	25	$ 0.50	$ 12.50
snowberry	*Symphoricarpos albus*	1/0 seedling	12-18"	560	$ 0.55	$ 308.00
serviceberry	*Amelanchier alnifolia*	1/0 bareroot	12-18"	25	$ 0.90	$ 22.50
California hazelnut	*Corylus cornuta*	1/0 bareroot	18-24"	25	$ 1.35	$ 33.75
Oregon grape	*Mahonia aquifolium*	1/0 bareroot	9-12"	15	$ 0.75	$ 11.25
Indian plum	*Oemleria cerasiformis*	1/0 bareroot	12-18"	225	$ 0.85	$ 191.25
cascara	*Rhamnus purshiana*	1/0 bareroot	12-18"	250	$ 0.85	$ 212.50
Nootka rose	*Rosa nutkana*	1/0 bareroot	12-18"	50	$ 0.65	$ 32.50
Total				**1875**		**$ 1,284.25**
Totals based on 125 stems/acre for 15 acres						

Appendix 6: Task chronology and estimated costs for restoration at Willamette University at Zena.

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Tree management in wet prairie C, oak savanna B & M, transition woodland (Priority 1)			**15**			**Remove trees from within wet prairie and thin trees in oak savannas**								
Year 1	spring	Survey & mark trees		16		Mark trees for removal	$ 40.00			$ -	$ -	$ 640	$ -	$ 640
Year 1	summer	Thin oaks and remove plantation trees	15	14		Chainsaw or skid steer sheering & removal to piles	$ 109.00	$ 160		$ -	$ 1,686	$ -	$ -	$ 1,686
Year 1	summer	Grapple wood	15	10		Grappling and removal to piles or transport of useable logs	$ 90.00	$ 160		$ -	$ 1,060	$ -	$ -	$ 1,060
Year 1	summer	Treat stumps	15	6		Treat stumps with herbicide	$ 67.00	$ 160	$ 100	$ -	$ 662	$ -	$ -	$ 662
Year 1	summer	Mow	15			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 4,800	$ -	$ -	$ 4,800
						Year 1				$ -	$ 8,208	$ 640	$ -	$ 8,848
						Total				***$ -***	***$ 8,208***	***$ 640***	***$ -***	***$ 8,848***
Tree management in oak woodlands Unit F and V (Priority 2)			**48.3**			**Thin trees, and sustainably harvest oaks, to maintain density and composition goals, 46 acres of oak woodland in Unit F and 2.3 acres in Unit V. Timing depending on funding and forestry cycle.**								
Year 1	spring	Survey & mark trees		40		Mark trees for removal	$ 40.00			$ -	$ 1,600	$ -	$ -	$ 1,600
Year 1	summer	Thin oaks and remove selected trees	48.3	160		Chainsaw or skid steer sheering & removal to piles	$ 109.00	$ 160		$ -	$ 17,600	$ -	$ -	$ 17,600
Year 1	summer	Grapple wood	48.3	160		Grappling and removal to piles or transport of useable logs	$ 90.00	$ 160		$ -	$ 14,560	$ -	$ -	$ 14,560
Year 1	summer	Mow	20			Skid steer mow selected area for enhancement	$ 96.00	$ 160		$ -	$ 6,240	$ -	$ -	$ 6,240
						Year 1				$ -	$ 40,000	$ -	$ -	$ 40,000
						Total				***$ -***	***$ 40,000***	***$ -***	***$ -***	***$ 40,000***
Tree management in mixed woodlands Unit G and V (Priority 2)			**33**			**Thin trees, and sustainably harvest oaks, to maintain density and composition goals, 46 acres of oak woodland in Unit F and 2.3 acres in Unit V. Timing depending on funding and forestry cycle.**								
Year 1	spring	Survey & mark trees		40		Mark trees for removal	$ 40.00			$ -	$ 1,600	$ -	$ -	$ 1,600
Year 1	summer	Thin oaks and remove selected trees	33	120		Chainsaw or skid steer sheering & removal to piles	$ 109.00	$ 160		$ -	$ 13,240	$ -	$ -	$ 13,240
Year 1	summer	Grapple wood	33	120		Grappling and removal to piles or transport of useable logs	$ 90.00	$ 160		$ -	$ 10,960	$ -	$ -	$ 10,960
Year 1	summer	Mow	15			Skid steer mow selected area for enhancement	$ 96.00	$ 160		$ -	$ 4,800	$ -	$ -	$ 4,800
						Year 1				$ -	$ 30,600	$ -	$ -	$ 30,600
						Total				***$ -***	***$ 30,600***	***$ -***	***$ -***	***$ 30,600***
Tree management in riparian Unit E and Unit P (Priority 2)			**8.2**			**Remove plantation trees from riparian zone**								
Year 1	spring	Survey & mark trees		12		Mark boundaries for removal	$ 40.00			$ -	$ 480	$ -	$ -	$ 480
Year 1	summer	Thin oaks and remove plantation trees	8.2	42		Chainsaw or skid steer sheering & removal to piles	$ 109.00	$ 160		$ -	$ 4,738	$ -	$ -	$ 4,738
Year 1	summer	Grapple wood	8.2	42		Grappling and removal to piles or transport of useable logs	$ 90.00	$ 160		$ -	$ 3,940	$ -	$ -	$ 3,940
Year 1	summer	Treat stumps	8.2	18		Treat stumps with herbicide	$ 67.00	$ 160	$ 100	$ -	$ 1,466	$ -	$ -	$ 1,466
Year 1	summer	Mow	8.2			Skid steer mow of undergrowth.	$ 96.00	$ 160		$ -	$ 2,842	$ -	$ -	$ 2,842
						Year 1				$ -	$ 13,466	$ -	$ -	$ 13,466
						Total				***$ -***	***$ 13,466***	***$ -***	***$ -***	***$ 13,466***
Tree management in riparian Unit Q (Priority 2)			**4**			**Remove plantation tree patches from riparian zone**								
Year 1	spring	Survey & mark trees		8		Mark boundaries for removal	$ 40.00			$ -	$ 320	$ -	$ -	$ 320

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 1	summer	Thin oaks and remove plantation trees	4	28		Chainsaw or skid steer sheering & removal to piles	$ 109.00	$ 160		$ -	$ 3,212	$ -	$ -	$ 3,212
Year 1	summer	Grapple wood	4	28		Grappling and removal to piles or transport of useable logs	$ 90.00	$ 160		$ -	$ 2,680	$ -	$ -	$ 2,680
Year 1	summer	Treat stumps	4	12		Treat stumps with herbicide	$ 67.00	$ 160	$ 100	$ -	$ 1,064	$ -	$ -	$ 1,064
Year 1	summer	Mow	4			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 1,632	$ -	$ -	$ 1,632
						Year 1				$ -	$ 8,908	$ -	$ -	$ 8,908
						Total				***$ -***	***$ 8,908***	***$ -***	***$ -***	***$ 8,908***
Wet Prairie C (Priority 1)			**9.8**			**Restart of restoration**								
Year 1	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring	Monitoring vegetation plots		8		Monitor vegetation plots - quantitative	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring	Assess drainage		4			$ 60.00			$ -	$ -	$ 240	$ 240	$ 480
Year 1	spring	Broadcast herbicide	9.8			broadcast of glyphosate	$ 24.00	$ 160	$ 175	$ -	$ 570	$ -	$ -	$ 570
Year 1	summer	Conduct drainage improvements		8		Adjust drainage or remove any tiles	$ 60.00			$ -	$ 480	$ 480	$ 480	$ 1,440
Year 1	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	summer	Broadcast herbicide	9.8			broadcast herbicide, if required, glyphosate + broadleaf-specific combination	$ 24.00	$ 160	$ 200	$ -	$ 595	$ -	$ -	$ 595
Year 1	fall	Broadcast herbicide	9.8			broadcast of glyphsate or pre-emergent Imazapic herbicide	$ 24.00	$ 160	$ 300	$ -	$ 695	$ -	$ -	$ 695
Year 2	spring	Broadcast herbicide	9.8			broadcast of glyphsate	$ 24.00	$ 160	$ 175	$ -	$ 570	$ -	$ -	$ 570
Year 2	spring	Order plant materials		16		Order seed and plugs from native plant nurseries	$ 60.00			$ -	$ -	$ 960	$ -	$ 960
Year 2	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 2	summer	Broadcast herbicide	9.8			broadcast of glyphsate or other herbicide depending on need. Omit if control is good.	$ 24.00	$ 160	$ 175	$ -	$ 570	$ -	$ -	$ 570
Year 2	fall	Broadcast herbicide	9.8			Broadcast of glyphsate and broadleaf-specific combination	$ 24.00	$ 160	$ 200	$ -	$ 595	$ -	$ -	$ 595
Year 2	fall	Prescribed burn	9.8			Remove thatch with burn, depending on conditions	$ 100.00						$ 980	$ 980
Year 2	fall	Purchase seed	9.8			Purchase seed from nurseries	$ 763.80			$ 7,485	$ -	$ -	$ -	$ 7,485
Year 2	fall	Sow native forbs	9.8			Sow seed with no-till drill or spreader - in-kind activity?	$ 45.00			$ -	$ -	$ -	$ 441	$ 441
Year 2	fall	Purchase native plants			6000	Plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500
Year 2	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 3	early spring	Broadcast herbicide	9.8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 615	$ -	$ -	$ 615
Year 3	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 3	fall	Broadcast herbicide	9.8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 615	$ -	$ -	$ 615
Year 3	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 3	fall	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 3	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	0	$ -	$ -	$ 4,500
Year 3	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 4	early spring	Broadcast herbicide	9.8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 615	$ -	$ -	$ 615
Year 4	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Broadcast herbicide	9.8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 615	$ -	$ -	$ 615
Year 4	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Purchase seed	9.8			Purchase grass seed from nurseries	$ 135.17			$ 1,325	$ -	$ -	$ -	$ 1,325
Year 4	fall	Sow native grasses	9.8			Sow seed with no-till drill or spreader - in-kind activity?	$ 45.00			$ -	$ -	$ -	$ 441	$ 441
Year 5-7	fall	Mow	9.8			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 3,302	$ -	$ -	$ 3,302
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 100	$ -	$ 3,996	$ -	$ -	$ 3,996
Year 6	fall	Prescribed burn	9.8			Remove thatch with burn, depending on conditions	$ 100.00						$ 980	$ 980
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 7	spring	Monitoring vegetation plots		8		Post treatment monitor of veg plots to compare change from pre-treatment	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
						Year 1				$ -	$ 2,341	$ 2,160	$ 720	$ 5,221
						Year 2				$ 11,985	$ 3,236	$ 1,440	$ 1,421	$ 18,082
						Year 3				$ -	$ 2,822	$ -	$ -	$ 2,822
						Year 4				$ 5,825	$ 4,322	$ 480	$ 441	$ 11,068
						Years 5-7 (sum)				$ -	$ 7,298	$ 960	$ 980	$ 9,238
						Total				***$ 17,810***	***$ 20,019***	***$ 5,040***	***$ 3,562***	***$ 46,431***
Oak Savanna B (Priority 1)			**5.55**			**Start-over strategy on 5 acres low quality area (estimated) of the 11.1 acre unit**								
Year 1	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring	Monitor vegetation plots		8		Monitor vegetation plots - quantitative	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring	Broadcast herbicide	5.55			broadcast of glyphosate	$ 24.00	$ 160	$ 175	$ -	$ 468	$ -	$ -	$ 468
Year 1	fall	Drainage protection		8		install coir logsor wattles, sow cover crop in gullies if necessary	$ 60.00			$ 1,000	$ 480	$ 480	$ 480	$ 2,440
Year 1	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	summer	Broadcast herbicide	5.55			broadcast herbicide, if required, glyphosate + broadleaf-specific combination	$ 24.00	$ 160	$ 200	$ -	$ 493	$ -	$ -	$ 493
Year 1	fall	Broadcast herbicide	5.55			broadcast of glyphsate or pre-emergent Imazapic herbicide	$ 24.00	$ 160	$ 300	$ -	$ 593	$ -	$ -	$ 593
Year 2	spring	Broadcast herbicide	5.55			broadcast of glyphosate	$ 24.00	$ 160	$ 175	$ -	$ 468	$ -	$ -	$ 468
Year 2	summer	Drainage protection		8		install coir logsor wattles, sow cover crop in gullies if necessary	$ 60.00			$ 1,000	$ 480	$ 480	$ 480	$ 2,440
Year 2	spring	Order plant materials		16		Order seed and plugs from native plant nurseries	$ 60.00			$ -	$ -	$ 960	$ -	$ 960

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 2	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 2	fall	Broadcast herbicide	5.55			broadcast of glyphsate and broadleaf-specific combination	$ 24.00	$ 160	$ 200	$ -	$ 493	$ -	$ -	$ 493
Year 2	fall	Prescribed burn	5.55			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 555	$ 555
Year 2	fall	Purchase seed	5.55			Purchase seed from nurseries	$ 781.85			$ 4,339	$ -	$ -	$ -	$ 4,339
Year 2	fall	Sow native forbs and Roemer's fescue	5.55			Sow seed with no-till drill or spreader - delay a year if weed control insufficient	$ 45.00			$ -	$ -	$ -	$ 250	$ 250
Year 2	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500
Year 2	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 3	early spring	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 3	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 3	fall	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 3	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 3	fall	Monitor weed control		8		Assess effectiveness of treatments and adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 3	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500
Year 3	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 4	early spring	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 4	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 4	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Purchase seed	5.55			Purchase grass seed from nurseries	$ 243.80			$ 1,353	$ -	$ -	$ -	$ 1,353
Year 4	fall	Sow native grasses	5.55			Sow seed with no-till drill or spreader - in-kind activity?	$ 45.00			$ -	$ -	$ -	$ -	$ -
Year 5-7	fall	Mow	5.55			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 2,078	$ -	$ -	$ 2,078
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 100	$ -	$ 3,996	$ -	$ -	$ 3,996
Year 6	fall	Prescribed burn	5.55			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 555	$ 555
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ -	$ -	$ -
Year 7	spring	Monitoring vegetation plots		8		Post treatment monitor of veg plots to compare change from	$ 60.00			$ -	$ -	$ -	$ -	$ -
						Year 1				$ 1,000	$ 2,035	$ 1,920	$ 480	$ 5,435
						Year 2				$ 9,839	$ 2,941	$ 1,920	$ 1,285	$ 15,985
						Year 3				$ 4,500	$ 4,118	$ 480	$ -	$ 9,098
						Year 4				$ 1,353	$ 2,618	$ -	$ -	$ 3,971
						Years 5-7 (sum)				$ -	$ 6,074	$ -	$ 555	$ 6,629
						Total				***$ 16,692***	***$ 17,787***	***$ 4,320***	***$ 2,320***	***$ 41,119***

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Oak Savanna B (Priority 1)			5.55			**Continuation strategy on 5.5 acres moderate quality area (estimated) of the 11.1 acre unit**								
Year 1	spring	Survey & mark trees		4		Mark ponderosa pines for removal	$ 40.00			$ -	$ -	$ 160	$ -	$ 160
Year 1	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring	Monitor vegetation plots		8		Monitor vegetation plots - quantitative	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	early spring	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 1	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332
Year 1	fall	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 2	early spring	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 2	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 2	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332
Year 2	fall	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 3	early spring	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 3	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332
Year 3	fall	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 3	fall	Monitor weed control		8		Assess effectiveness of treatments and adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 4	early spring	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 4	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Broadcast herbicide	5.55			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 513	$ -	$ -	$ 513
Year 4	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332
Year 4	fall	Prescribed burn	5.55			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 555	$ 555
Year 4	fall	Purchase seed	5.55			Purchase grass seed from nurseries	$ 243.80			$ 1,353	$ -	$ -	$ -	$ 1,353
Year 4	fall	Purchase seed	5.55			Purchase forb seed from nurseries	$ 781.85			$ 4,339	$ -	$ -	$ -	$ 4,339
Year 4	fall	Sow native forbs and Roemer's fescue	5.55			Sow seed with no-till drill or spreader - delay a year if weed control insufficient	$ 45.00			$ -	$ -	$ -	$ 250	$ 250
Year 4	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500
Year 4	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 5-7	fall	Mow	5.55			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 2,078	$ -	$ -	$ 2,078
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 100	$ -	$ 3,996	$ -	$ -	$ 3,996
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 7	spring	Monitoring vegetation plots		8		Post treatment monitor of veg plots to compare change from	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
						Year 1				$ -	$ 2,358	$ 1,600	$ -	$ 3,958
						Year 2				$ -	$ 2,358	$ 480	$ -	$ 2,838
						Year 3				$ -	$ 2,358	$ 480	$ -	$ 2,838
						Year 4				$ 10,192	$ 4,654	$ -	$ 805	$ 15,652
						Years 5-7 (sum)				$ -	$ 6,074	$ 960	$ -	$ 7,034
						Total				***$ 10,192***	***$ 17,804***	***$ 3,520***	***$ 805***	***$ 32,321***
Oak Savanna M (Priority 1)			**12.8**			**Start-over strategy on 13 acres low quality area (estimated) of the 25.6 acre unit, including oak buffers and islands**								
Year 1	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring	Monitor vegetation plots		8		Monitor vegetation plots - quantitative	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring	Broadcast herbicide	12.8			broadcast of glyphosate	$ 24.00	$ 160	$ 175	$ -	$ 642	$ -	$ -	$ 642
Year 1	fall	Drainage protection		8		install coir logsor wattles, sow cover crop in gullies if necessary	$ 60.00			$ 1,000	$ 480	$ 480	$ 480	$ 2,440
Year 1	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	summer	Broadcast herbicide	12.8			broadcast herbicide, if required, glyphosate + broadleaf-specific combination	$ 24.00	$ 160	$ 200	$ -	$ 667	$ -	$ -	$ 667
Year 1	fall	Broadcast herbicide	12.8			broadcast of glyphsate or pre-emergent Imazapic herbicide	$ 24.00	$ 160	$ 300	$ -	$ 767	$ -	$ -	$ 767
Year 2	spring	Broadcast herbicide	12.8			broadcast of glyphosate	$ 24.00	$ 160	$ 175	$ -	$ 642	$ -	$ -	$ 642
Year 2	summer	Drainage protection		8		install coir logsor wattles, sow cover crop in gullies if necessary	$ 60.00			$ 1,000	$ 480	$ 480	$ 480	$ 2,440
Year 2	spring	Order plant materials		16		Order seed and plugs from native plant nurseries	$ 60.00			$ -	$ -	$ 960	$ -	$ 960
Year 2	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 2	fall	Broadcast herbicide	12.8			broadcast of glyphsate and broadleaf-specific combination	$ 24.00	$ 160	$ 200	$ -	$ 667	$ -	$ -	$ 667
Year 2	fall	Prescribed burn	12.8			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 1,280	$ 1,280
Year 2	fall	Purchase seed	12.8			Purchase seed from nurseries	$ 781.85			$ 10,008	$ -	$ -	$ -	$ 10,008
Year 2	fall	Sow native forbs and Roemer's fescue	12.8			Sow seed with no-till drill or spreader - delay a year if weed control insufficient	$ 45.00			$ -	$ -	$ -	$ 576	$ 576
Year 2	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500
Year 2	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 3	early spring	Broadcast herbicide	12.8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 687	$ -	$ -	$ 687
Year 3	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 3	fall	Broadcast herbicide	12.8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 687	$ -	$ -	$ 687
Year 3	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 3	fall	Monitor weed control		8		Assess effectiveness of treatments and adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 3	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 3	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 4	early spring	Broadcast herbicide	12.8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 687	$ -	$ -	$ 687
Year 4	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Broadcast herbicide	12.8			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 687	$ -	$ -	$ 687
Year 4	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Purchase seed	12.8			Purchase grass seed from nurseries	$ 231.90			$ 2,968	$ -	$ -	$ -	$ 2,968
Year 4	fall	Sow native grasses	12.8			Sow seed with no-till drill or spreader - in-kind activity?	$ 45.00			$ -	$ -	$ -	$ -	$ -
Year 5-7	fall	Mow	12.8			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 4,166	$ -	$ -	$ 4,166
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 100	$ -	$ 3,996	$ -	$ -	$ 3,996
Year 6	fall	Prescribed burn	12.8			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 1,280	$ 1,280
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ -	$ -	$ -
Year 7	spring	Monitoring vegetation plots		8		Post treatment monitor of veg plots to compare change from	$ 60.00			$ -	$ -	$ -	$ -	$ -
						Year 1				$ 1,000	$ 2,557	$ 1,920	$ 480	$ 5,957
						Year 2				$ 15,508	$ 3,289	$ 1,920	$ 2,336	$ 23,053
						Year 3				$ 4,500	$ 4,466	$ 480	$ -	$ 9,446
						Year 4				$ 2,968	$ 2,966	$ -	$ -	$ 5,935
						Years 5-7 (sum)				$ -	$ 8,162	$ -	$ 1,280	$ 9,442
						Total				***$ 23,976***	***$ 21,441***	***$ 4,320***	***$ 4,096***	***$ 53,833***
Oak Savanna M (Priority 1)			13			**Continuation strategy on 13 acres moderate quality area (estimated) of the 26 acre unit**								
Year 1	spring	Survey & mark trees		4		Mark ponderosa pines for removal	$ 40.00			$ -	$ -	$ 160	$ -	$ 160
Year 1	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring	Monitor vegetation plots		8		Monitor vegetation plots - quantitative	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	early spring	Broadcast herbicide	13			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 692	$ -	$ -	$ 692
Year 1	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332
Year 1	fall	Broadcast herbicide	13			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 692	$ -	$ -	$ 692
Year 2	early spring	Broadcast herbicide	13			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 692	$ -	$ -	$ 692
Year 2	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 2	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332
Year 2	fall	Broadcast herbicide	13			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 692	$ -	$ -	$ 692
Year 3	early spring	Broadcast herbicide	13			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 692	$ -	$ -	$ 692
Year 3	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 3	fall	Broadcast herbicide	13			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 692	$ -	$ -	$ 692
Year 3	fall	Monitor weed control		8		Assess effectiveness of treatments and adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 4	early spring	Broadcast herbicide	13			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 692	$ -	$ -	$ 692
Year 4	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Broadcast herbicide	13			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 692	$ -	$ -	$ 692
Year 4	spring-fall	Spot spray		16		Spot spray of broadleaf weeds & shrubs	$ 67.00	$ 160	$ 100	$ -	$ 1,332	$ -	$ -	$ 1,332
Year 4	fall	Prescribed burn	13			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 1,300	$ 1,300
Year 4	fall	Purchase seed	13		65	Purchase grass seed from nurseries	$ 231.90			$ 3,015	$ -	$ -	$ -	$ 3,015
Year 4	fall	Purchase seed	13		130	Purchase forb seed from nurseries	$ 781.85			$ 10,164	$ -	$ -	$ -	$ 10,164
Year 4	fall	Sow native forbs and Roemer's fescue	13			Sow seed with no-till drill or spreader - delay a year if weed control insufficient	$ 45.00			$ -	$ -	$ -	$ 585	$ 585
Year 4	fall	Purchase native plants			6000	Plant plugs, bulbs, bare-root or divisions of native forbs	$ 0.75			$ 4,500	$ -	$ -	$ -	$ 4,500
Year 4	fall	Plant native plants			6000	Planting crew installs plants	$ 0.25			$ -	$ 1,500	$ -	$ -	$ 1,500
Year 5-7	fall	Mow	13			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 4,224	$ -	$ -	$ 4,224
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 100	$ -	$ 3,996	$ -	$ -	$ 3,996
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 7	spring	Monitoring vegetation plots		8		Post treatment monitor of veg plots to compare change from	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
						Year 1				$ -	$ 2,716	$ 1,600	$ -	$ 4,316
						Year 2				$ -	$ 2,716	$ 480	$ -	$ 3,196
						Year 3				$ -	$ 2,716	$ 480	$ -	$ 3,196
						Year 4				$ 17,679	$ 5,012	$ -	$ 1,885	$ 24,576
						Years 5-7 (sum)				$ -	$ 8,220	$ 960	$ -	$ 9,180
						Total				***$ 17,679***	***$ 21,380***	***$ 3,520***	***$ 1,885***	***$ 44,464***
Transition Woodland F (Priority 1)			**5.4**			**Start-over strategy on entire 5.4 acres low quality area**								
Year 1	spring	Pre-condition monitoring		8		Monitor vegetation	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	spring	Broadcast herbicide	5.4			broadcast of glyphosate	$ 24.00	$ 160	$ 175	$ -	$ 465	$ -	$ -	$ 465
Year 1	fall	Drainage protection		8		install coir logsor wattles, sow cover crop in gullies if necessary	$ 60.00			$ 1,000	$ 480	$ 480	$ 480	$ 2,440
Year 1	summer	Broadcast herbicide	5.4			broadcast herbicide, if required, glyphosate + broadleaf-specific combination	$ 24.00	$ 160	$ 200	$ -	$ 490	$ -	$ -	$ 490
Year 1	fall	Broadcast herbicide	5.4			broadcast of glyphsate or pre-emergent Imazapic herbicide	$ 24.00	$ 160	$ 300	$ -	$ 590	$ -	$ -	$ 590
Year 2	spring	Broadcast herbicide	5.4			broadcast of glyphosate	$ 24.00	$ 160	$ 175	$ -	$ 465	$ -	$ -	$ 465
Year 2	summer	Drainage protection		8		install coir logsor wattles, sow cover crop in gullies if necessary	$ 60.00			$ 1,000	$ 480	$ 480	$ 480	$ 2,440
Year 2	spring	Order plant materials		16		Order seed and plugs from native plant nurseries	$ 60.00			$ -	$ -	$ 960	$ -	$ 960

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 2	summer	Monitor weed control		8		Assess treatments and/or adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 2	fall	Broadcast herbicide	5.4			broadcast of glyphsate and broadleaf-specific combination	$ 24.00	$ 160	$ 200	$ -	$ 490	$ -	$ -	$ 490
Year 2	fall	Prescribed burn	5.4			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 540	$ 540
Year 2	fall	Purchase seed	5.4		54	Purchase seed from nurseries	$ 735.60			$ 3,972	$ -	$ -	$ -	$ 3,972
Year 2	fall	Sow native forbs and Roemer's fescue	5.4			Sow seed with no-till drill or spreader - delay a year if weed control insufficient	$ 45.00			$ -	$ -	$ -	$ 243	$ 243
Year 3	early spring	Broadcast herbicide	5.4			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 510	$ -	$ -	$ 510
Year 3	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 3	fall	Broadcast herbicide	5.4			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 510	$ -	$ -	$ 510
Year 3	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 3	fall	Monitor weed control		8		Assess effectiveness of treatments and adjust schedule	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 4	early spring	Broadcast herbicide	5.4			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 510	$ -	$ -	$ 510
Year 4	summer	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Broadcast herbicide	5.4			Broadcast of grass-specific herbicide	$ 24.00	$ 160	$ 220	$ -	$ 510	$ -	$ -	$ 510
Year 4	fall	Spot spray		8		Spot spray of broadleaf weeds	$ 67.00	$ 160	$ 100	$ -	$ 796	$ -	$ -	$ 796
Year 4	fall	Purchase seed	5.4		54	Purchase grass seed from nurseries	$ 257.25			$ 1,389	$ -	$ -	$ -	$ 1,389
Year 4	fall	Sow native grasses	5.4			Sow seed with no-till drill or spreader - in-kind activity?	$ 45.00			$ -	$ -	$ -	$ -	$ -
Year 5-7	fall	Mow	5.4			Skid steer or tractor mow.	$ 96.00	$ 160		$ -	$ 2,035	$ -	$ -	$ 2,035
Year 5-7	spring-fall	Herbicide spot spray		16		Spot spray 2 x per year for 3 years. 16 hours per year.	$ 67.00	$ 160	$ 100	$ -	$ 3,996	$ -	$ -	$ 3,996
Year 6	fall	Prescribed burn	5.4			Remove thatch with burn, depending on conditions	$ 100.00			$ -	$ -	$ -	$ 540	$ 540
Year 7	spring	Monitoring weed survey		8		Weed survey whole site.	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 7	spring	Monitoring vegetation plots		8		Post treatment monitor of veg plots to compare change from	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
						Year 1				$ 1,000	$ 2,024	$ 960	$ 480	$ 4,464
						Year 2				$ 4,972	$ 1,434	$ 1,920	$ 1,263	$ 9,589
						Year 3				$ -	$ 2,611	$ 480	$ -	$ 3,091
						Year 4				$ 1,389	$ 2,611	$ -	$ -	$ 4,000
						Years 5-7 (sum)				$ -	$ 6,031	$ 960	$ 540	$ 7,531
						Total				***$ 7,361***	***$ 14,712***	***$ 4,320***	***$ 2,283***	***$ 28,676***
Oak Woodland Unit F and V (Priority 1)			**51.3**			**Understory restoration - selected 20 acres**								
Year 1	spring	Pre-condition monitoring		16		Monitor vegetation	$ 60.00			$ -	$ -	$ 960	$ -	$ 960
Year 1	summer	Spot spray	20			Spot spray introduced shrubs, poison oak and weedy forbs	$ 275.00		$ 40	$ -	$ 6,300	$ -	$ -	$ 6,300
Year 1	summer	mow				Mow understory targeting sprayed areas - included in tree management section								

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 2	summer	Spot spray	20			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 6,300	$ -	$ -	$ 6,300
Year 3	winter	Purchase plants	20		2500	Plant diversity of understory shrub species	$ 0.683	$ -	$ -	$ 1,707	$ -	$ -	$ -	$ 1,707
Year 3	winter	Plant understory			2500	Contract crew	$ 0.33			$ -	$ 825	$ -	$ -	$ 825
Year 3	summer	Spot spray	20			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 6,300	$ -	$ -	$ 6,300
Year 4	summer	Spot spray	20			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 6,300	$ -	$ -	$ 6,300
Year 5	summer	Spot spray	20			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 6,300	$ -	$ -	$ 6,300
Year 7	spring	Monitoring vegetation plots		16		Post treatment monitor of vegetation to compare change	$ 60.00			$ -	$ -	$ 960	$ -	$ 960
						Year 1				$ -	$ 6,300	$ 960	$ -	$ 7,260
						Year 2				$ -	$ 6,300	$ -	$ -	$ 6,300
						Year 3				$ 1,707	$ 7,125	$ -	$ -	$ 8,832
						Year 4				$ -	$ 6,300	$ -	$ -	$ 6,300
						Years 5-7 (sum)				$ -	$ 6,300	$ 960	$ -	$ 7,260
						Total				***$ 1,707***	***$ 32,325***	***$ 1,920***	***$ -***	***$ 35,952***
Mixed Woodland Unit G and V (Priority 1)			**33**			**Understory restoration - selected 15 acres**								
Year 1	spring	Pre-condition monitoring		16		Monitor vegetation	$ 60.00			$ -	$ -	$ 960	$ -	$ 960
Year 1	summer	Spot spray	15			Spot spray introduced shrubs, poison oak and weedy forbs	$ 275.00		$ 40	$ -	$ 4,725	$ -	$ -	$ 4,725
Year 1	summer	mow				Mow understory targeting sprayed areas - included in tree management section								
Year 2	summer	Spot spray	15			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 4,725	$ -	$ -	$ 4,725
Year 3	winter	Purchase plants	15		1875	Plant diversity of understory shrub species	$ 0.68	$ -	$ -	$ 1,284	$ -	$ -	$ -	$ 1,284
Year 3	winter	Plant understory			1875	Contract crew	$ 0.33			$ -	$ 619	$ -	$ -	$ 619
Year 3	summer	Spot spray	15			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 4,725	$ -	$ -	$ 4,725
Year 4	summer	Spot spray	15			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 4,725	$ -	$ -	$ 4,725
Year 5	summer	Spot spray	15			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 4,725	$ -	$ -	$ 4,725
Year 7	spring	Monitoring vegetation plots		16		Post treatment monitor of vegetation to compare change	$ 60.00			$ -	$ -	$ 960	$ -	$ 960
						Year 1				$ -	$ 4,725	$ 960	$ -	$ 5,685
						Year 2				$ -	$ 4,725	$ -	$ -	$ 4,725
						Year 3				$ 1,284	$ 5,344	$ -	$ -	$ 6,628
						Year 4				$ -	$ 4,725	$ -	$ -	$ 4,725
						Years 5-7 (sum)				$ -	$ 4,725	$ 960	$ -	$ 5,685
						Total				***$ 1,284***	***$ 24,244***	***$ 1,920***	***$ -***	***$ 27,448***
Riparian Unit D (Priority 2)			**4.2**			**Restore vegetation after tree removal from plantation patches (formerly in Unit E)**								
Year 1	spring	Pre-condition monitoring		8		Monitor vegetation	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
Year 1	summer	tree removal	4.2			see tree management section				$ -	$ -	$ -	$ -	$ -
Year 1	summer	mow	4.2			Mow understory targeting sprayed areas - included in tree management section				$ -	$ -	$ -	$ -	$ -

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 1	summer	hand brush removal	1			Chainsaw or weed whack in riparian zone where inaccessible to skid steer	$ 500.00			$ -	$ 500	$ -	$ -	$ 500
Year 1	fall	Broadcast herbicide	4.2			Broadcast of broad spectrum pre-emergent herbicide	$ 24.00	$ 160	$ 18	$ -	$ 336	$ -	$ -	$ 336
Year 2	spring	Broadcast herbicide	4.2			Broadcast of broad spectrum herbicide	$ 24.00	$ 160	$ 18	$ -	$ 336	$ -	$ -	$ 336
Year 2	fall	Broadcast herbicide	4.2			Broadcast of broad spectrum herbicide	$ 24.00	$ 160	$ 18	$ -	$ 336	$ -	$ -	$ 336
Year 2	fall	Spot spray	4.2			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 1,323	$ -	$ -	$ 1,323
Year 2	summer	purchase seed	4.2			Purchase understory seed mix for disturbed soil	$ 459.50			$ 1,930	$ -	$ -	$ -	$ 1,930
Year 2	fall	broadcast seed	4.2			broadcast seed, especially in disturbed zones	$ 50.00	$ 160		$ -	$ 370	$ -	$ -	$ 370
Year 3	winter	Purchase plants	4.2		8400	Plant diversity of riparian species at high density	$ 0.59	$ -	$ -	$ 4,988	$ -	$ -	$ -	$ 4,988
Year 3	winter	Plant trees	4.2		8400	Contract crew	$ 0.33			$ -	$ 2,772	$ -	$ -	$ 2,772
Year 3	spring	ring spray	4.2			Ring spray around trees	$ 260.00		$ 20	$ -	$ 1,176	$ -	$ -	$ 1,176
Year 3	spring	Mow	4.2			Hand mow between rows	$ 250.00			$ -	$ 1,050	$ -	$ -	$ 1,050
Year 3	summer	Spot spray	4.2			Spot spray - approx acre cost for crew	$ 275.00		$ 20	$ -	$ 1,239	$ -	$ -	$ 1,239
Year 4	spring	ring spray	4.2			Ring spray around trees	$ 260.00		$ 20	$ -	$ 1,176	$ -	$ -	$ 1,176
Year 4	spring	Mow	4.2			Hand mow between rows	$ 250.00			$ -	$ 1,050	$ -	$ -	$ 1,050
Year 4	summer	Spot spray	4.2			Spot spray - approx acre cost for crew	$ 275.00		$ 20	$ -	$ 1,239	$ -	$ -	$ 1,239
Year 5-7	summer	Spot spray	4.2			Spot spray at least once per year	$ 275.00		$ 40	$ -	$ 3,969	$ -	$ -	$ 3,969
Year 7	spring	Monitoring vegetation plots		8		Post treatment monitor of vegetation to compare change	$ 60.00			$ -	$ -	$ 480	$ -	$ 480
						Year 1				$ -	$ 836	$ 480	$ -	$ 1,316
						Year 2				$ 1,930	$ 2,366	$ -	$ -	$ 4,296
						Year 3				$ 4,988	$ 6,237	$ -	$ -	$ 11,225
						Year 4				$ -	$ 3,465	$ -	$ -	$ 3,465
						Years 5-7 (sum)				$ -	$ 3,969	$ 480	$ -	$ 4,449
						Total				***$ 6,918***	***$ 16,873***	***$ 960***	***$ -***	***$ 24,751***
Riparian Unit P and Q (Priority 2)			**7.7**			**Restore vegetation after tree removal from plantation patches in Q and tree and shrub removal from P**								
Year 1	spring	Pre-condition monitoring		12		Monitor vegetation	$ 60.00			$ -	$ -	$ 720	$ -	$ 720
Year 1	summer	tree removal	7.7			see tree management section				$ -	$ -	$ -	$ -	$ -
Year 1	summer	mow	7.7			Mow understory targeting sprayed areas - included in tree management section				$ -	$ -	$ -	$ -	$ -
Year 1	summer	hand brush removal	7.7			Chainsaw or weed whack in riparian zone where inaccessible to skid steer	$ 500.00			$ -	$ 3,850	$ -	$ -	$ 3,850
Year 1	fall	Broadcast herbicide	7.7			Broadcast of broad spectrum pre-emergent herbicide	$ 24.00	$ 160	$ 18	$ -	$ 483	$ -	$ -	$ 483
Year 2	spring	Broadcast herbicide	7.7			Broadcast of broad spectrum herbicide	$ 24.00	$ 160	$ 18	$ -	$ 483	$ -	$ -	$ 483
Year 2	fall	Broadcast herbicide	7.7			Broadcast of broad spectrum herbicide	$ 24.00	$ 160	$ 18	$ -	$ 483	$ -	$ -	$ 483
Year 2	fall	Spot spray	7.7			Spot spray - approx acre cost for crew	$ 275.00		$ 40	$ -	$ 2,426	$ -	$ -	$ 2,426
Year 2	summer	purchase seed	7.7			Purchase understory seed mix for disturbed soil	$ 556.00			$ 4,281	$ -	$ -	$ -	$ 4,281
Year 2	fall	broadcast seed	7.7			broadcast seed, especially in disturbed zones	$ 50.00	$ 160		$ -	$ 545	$ -	$ -	$ 545

Year	Timing	Task	Acres	Hours	Number	Description	Approximate cost breakdown			Costs				
							Rate	mobilize	chemical	Supplies	Contractor	University	Partner	Total
Year 3	winter	Purchase plants	7.7		15400	Plant diversity of riparian species at high density	$ 0.59	$ -	$ -	$ 9,100	$ -	$ -	$ -	$ 9,100
Year 3	winter	Plant trees	7.7		15400	Contract crew	$ 0.33			$ -	$ 5,082	$ -	$ -	$ 5,082
Year 3	spring	ring spray	7.7			Ring spray around trees	$ 260.00		$ 20	$ -	$ 2,156	$ -	$ -	$ 2,156
Year 3	spring	Mow	7.7			Hand mow between rows	$ 250.00			$ -	$ 1,925	$ -	$ -	$ 1,925
Year 3	summer	Spot spray	7.7			Spot spray - approx acre cost for crew	$ 275.00		$ 20	$ -	$ 2,272	$ -	$ -	$ 2,272
Year 4	spring	ring spray	7.7			Ring spray around trees	$ 260.00		$ 20	$ -	$ 2,156	$ -	$ -	$ 2,156
Year 4	spring	Mow	7.7			Hand mow between rows	$ 250.00			$ -	$ 1,925	$ -	$ -	$ 1,925
Year 4	summer	Spot spray	7.7			Spot spray - approx acre cost for crew	$ 275.00		$ 20	$ -	$ 2,272	$ -	$ -	$ 2,272
Year 5-7	summer	Spot spray	7.7			Spot spray at least once per year	$ 275.00		$ 40	$ -	$ 7,277	$ -	$ -	$ 7,277
Year 7	spring	Monitoring vegetation plots	7.7	12		Post treatment monitor of vegetation to compare change	$ 60.00			$ -	$ -	$ 720	$ -	$ 720
						Year 1				$ -	$ 4,333	$ 720	$ -	$ 5,053
						Year 2				$ 4,281	$ 3,937	$ -	$ -	$ 8,219
						Year 3				$ 9,100	$ 11,435	$ -	$ -	$ 20,534
						Year 4				$ -	$ 6,353	$ -	$ -	$ 6,353
						Years 5-7 (sum)				$ -	$ 7,277	$ 720	$ -	$ 7,997
						Total				***$ 13,381***	***$ 33,334***	***$ 1,440***	***$ -***	***$ 48,155***
						Priority 1 Costs								
						Year 1				$ 3,000	$ 33,263	$ 12,720	$ 2,160	$ 51,143
						Year 2				$ 42,304	$ 27,000	$ 8,160	$ 6,305	$ 83,769
						Year 3				$ 11,991	$ 31,562	$ 2,400	$ -	$ 45,952
						Year 4				$ 39,406	$ 33,210	$ 480	$ 3,131	$ 76,227
						Years 5-7 (sum)				$ -	$ 52,886	$ 5,760	$ 3,355	$ 62,001
						Grand Total				***$ 96,701***	***$ 177,920***	***$29,520***	***$14,951***	***$ 319,092***
						Priority 2 Costs								
						Year 1				$ -	$ 98,143	$ 1,200	$ -	$ 99,343
						Year 2				$ 6,211	$ 6,303	$ -	$ -	$ 12,514
						Year 3				$ 14,088	$ 17,672	$ -	$ -	$ 31,759
						Year 4				$ -	$ 9,818	$ -	$ -	$ 9,818
						Years 5-7 (sum)				$ -	$ 11,246	$ 1,200	$ -	$ 12,446
						Grand Total				***$ 20,299***	***$ 143,181***	***$ 2,400***	***$ -***	***$ 165,880***
						Total Project Costs								
										Supplies	Contractor	University	Partner	Total
						Year 1				$ 3,000	$ 131,406	$ 13,920	$ 2,160	$ 150,486
						Year 2				$ 48,516	$ 33,303	$ 8,160	$ 6,305	$ 96,283
						Year 3				$ 26,078	$ 49,233	$ 2,400	$ -	$ 77,712
						Year 4				$ 39,406	$ 43,027	$ 480	$ 3,131	$ 86,044
						Years 5-7 (sum)				$ -	$ 64,131	$ 6,960	$ 3,355	$ 74,446
						Grand Total				***$ 117,000***	***$ 321,101***	***$31,920***	***$14,951***	***$ 484,972***