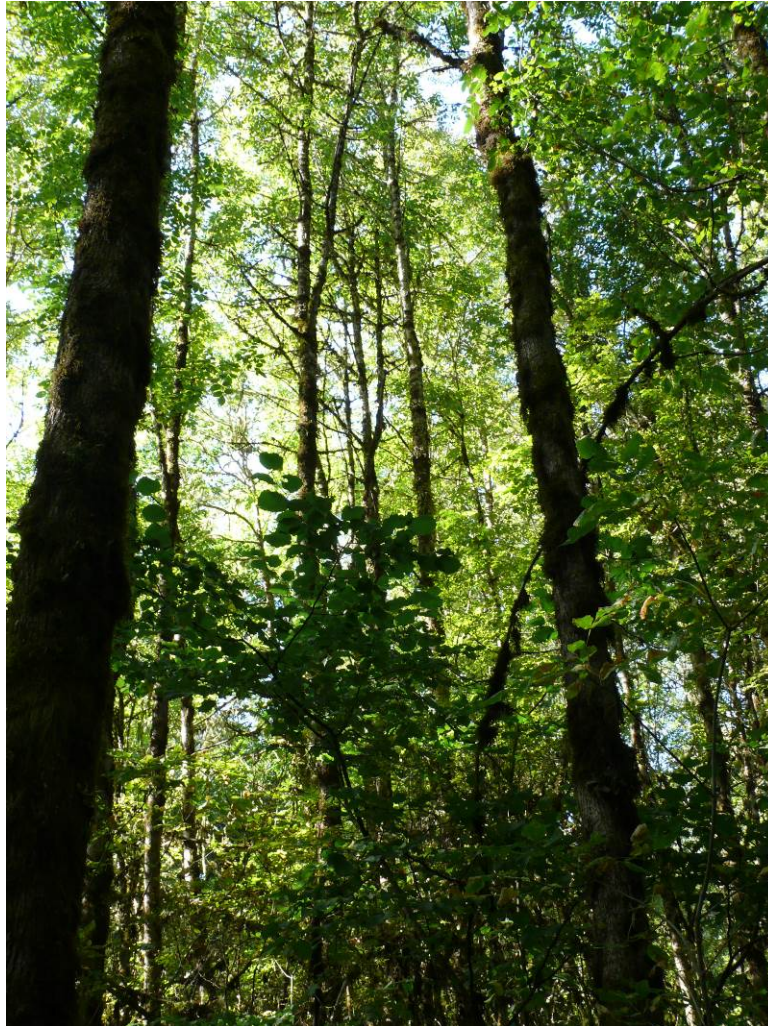


Oregon Department of Fish and Wildlife
**Zena Forest: Richards Creek Riparian
Restoration Plan**

Phase 1: 2014-2020



Prepared for Oregon Department of Fish and Wildlife and Zena Forest Products
By Institute for Applied Ecology



June 2013

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Executive Summary

This 7-year restoration plan outlines habitat restoration activities to occur within the Richards Creek catchment of Zena Forest. Zena Forest is a privately owned 1162 acre property in the Eola Hills, Polk County, Oregon, five miles north-west of Salem. The property is sustainably managed using uneven-age management and selective cutting. 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 7-year strategy for restoring the conservation values of 24 acres of main-stem and tributaries of Richards Creek, in the south-west of Zena Forest. This restoration plan includes a description of current and desired future conditions, a restoration strategy for each habitat type that includes site preparation, planting strategy and maintenance and monitoring for a 7-year period.

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1 Introduction

1.1 Project background

Zena Forest is a 1162 acre property in the Eola Hills, Polk County, Oregon, five miles north-west of Salem. The property is owned by the Deumling family, who also own a 172 acre parcel on the west side of the forest. The Deumlings have been stewards of the forest since the mid-1980s when they managed the property for its previous owner using uneven-age management and selective cutting. In 2007 the Deumlings took ownership of the forest and sustainably manage the forest under the guidance of the management plan (Sims 2008) and Forest Stewardship Council practices.

Bonneville Power Administration (BPA) holds a conservation easement on Zena Forest 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 of the property in perpetuity, and restoration of Richards Creek is part of that process.

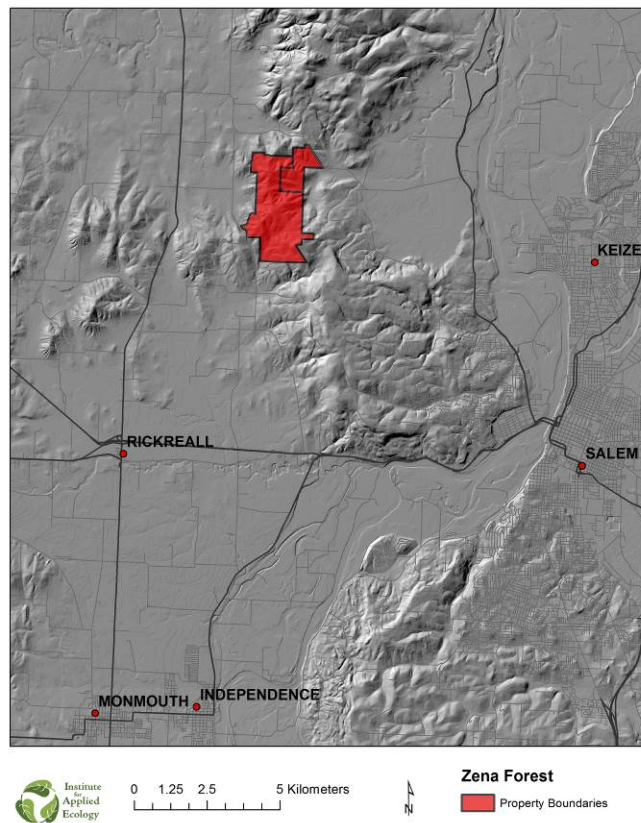


Figure 1. Location of Zena Forest

In 2012/13 the Institute for Applied Ecology (IAE) received funding to develop a restoration plan for approximately 24 acres of (1.1 stream miles) of riparian habitat at Zena Forest. The objective is to expand on the restoration objectives of the existing Zena Forest Management Plan (Sims 2008) and to prescribe specific habitat restoration and enhancement measures to enhance wildlife habitat and

promote diversity. The management plan outlined the desired future conditions for the forest, including 50.9% component of Douglas-fir, 11.5% oak savanna, 29.4% oak woodland, 2.5% older forest and 5.8% wetland/riparian (Sims 2008). The Richards Creek catchment in the south-west of the property is one of the prime areas where restoration and enhancement of wetland/riparian and oak savanna habitats can take place in order to meet those desired future condition goals (Figs 2 and 3).



Figure 2. Aerial view of Zena Forest, showing the property boundary and location of Richards Creek in the south-west portion of the property

Three restoration areas are the subject for this restoration plan (Fig. 3):

- Main Stem (of Richards Creek)- 20.1 acres
- the Orchard- 1.6 acres
- Western branch (of Richards Creek)- 1.9 acres

1.2 Historic vegetation

From 1851 to 1865, the General Land Office surveyed the Willamette Valley in preparation for Euro-American settlement. The surveyors' notes detailed the vegetation, soils, and topography encountered as they crossed the landscape. The Nature Conservancy has used this information to reconstruct the historic vegetation patterns of the Willamette Valley (Christy et al. 2005). This mapping identifies the pre-settlement vegetation at Zena Forest to be primarily white oak savanna, with smaller areas of white oak-Douglas-fir savanna and upland prairie. Pre-settlement vegetation is shown for the project area in Fig. 3.

After settlement, livestock grazing and farming changed the savanna and prairie grasslands into non-native pastures, and fire suppression and plantation forestry allowed Douglas-fir to expand and dominate over oaks. Large areas of agricultural land have been planted in Douglas-fir over the last 30 years (Sims 2008).

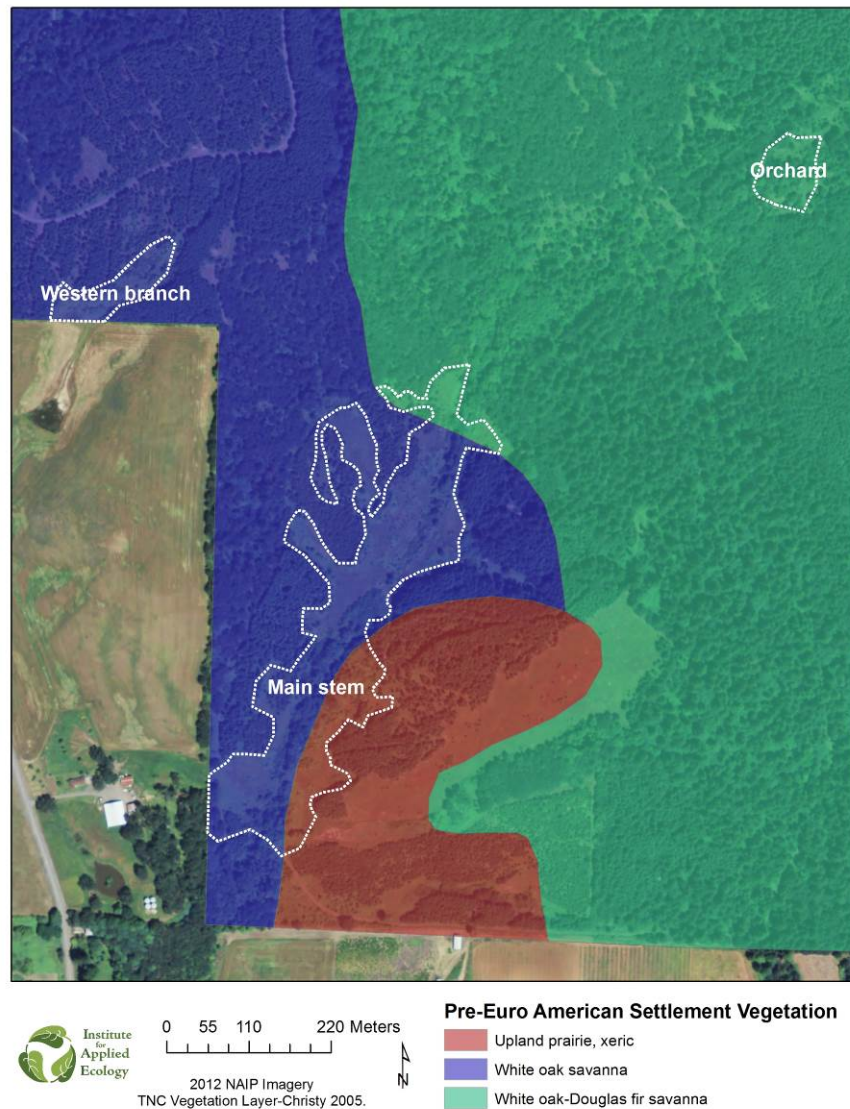


Figure 3. Pre- Euro-American settlement vegetation over Zena Forest (Christy et al. 2005). Project areas are indicated by white borders

1.3 Soils, water and topography

There are a wide variety of soils within the Zena Forest property. Specifically within the riparian restoration area, along the main stem of Richards Creek, the primary soils (71 % of the planned restoration area) are Helmick silt loams and Hazelair silt loams. In the “orchard”, soils are Bellpine silty clay loams. In the western fork of Richards Creek, soils include Hazelair silt loams and Chehulpum silt loams. Soils are shown in Figure 4 and described in Table 1.

Richards Creek is one of two main stream catchments in Zena Forest and it drains towards the south-west of the property. The creek is intermittent – in some years it retains water flow during the dry seasons, but in other years the creek dries out, except for pools in some spring areas (S. Deumling, pers. comm.).

Most slopes in the immediate area of the main stem of Richards Creek are between 0 and 30%, with more gentle rolling topography to the east, and a steeper east facing slope to the west (Fig. 5). The orchard is situated on a gentle west south west facing slope, and the western branch of Richards creek is the top of a small and shallow drainage running southwest (Fig. 5).

Table1. Soils present within the restoration project area of Zena Forest (NRCS 1988).

MUKEY	Mapunit Name	Hydric Classification	Description
62308	Chehulpum silt loam, 12 to 40 percent slopes	Not hydric	Shallow 12-20” deep soils, well drained. Tends to occur on low foothills. More suitable for pasture than timber because of slope and droughtiness.
62309	Chehulpum-Stelwer complex, 12 to 40 percent slopes	Not hydric	This complex consists of shallow and moderately deep, well drained soils. Not used for timber because of droughtiness and slope.
62329	Hazelair silt loam, 3 to 12 percent slopes	Partially hydric	Moderately well drained to somewhat poorly drained soil is on low, convex foothills.
62330	Hazelair silt loam, 12 to 20 percent slopes	Not hydric	Seasonally high water table makes it problematic for timber.
62333	Helmick silt loam, 3 to 12 percent slopes	Partially hydric	Somewhat poorly drained soil common on slightly convex foot slopes and ridges. 20-40” deep. Not suited for timber because of seasonal high water table and clayey subsoil.
62334	Helmick silt loam, 12 to 20 percent slopes	Not hydric	
62412	Steiwer silt loam, 3 to 12 percent slopes	Not hydric	This well-drained soil is on low foothills and higher into rolling uplands. 20-40” depth to bedrock. Not suited for timber due to droughtiness
62413	Steiwer silt loam, 12 to 20 percent slopes	Not hydric	
62446	Bellpine silty clay loam, 12 to 20 percent slopes	Not hydric	This well-drained soil is on low foothills and higher, rolling uplands. 12-20” deep. Used for Douglas-fir and mixed fir-oak stands.

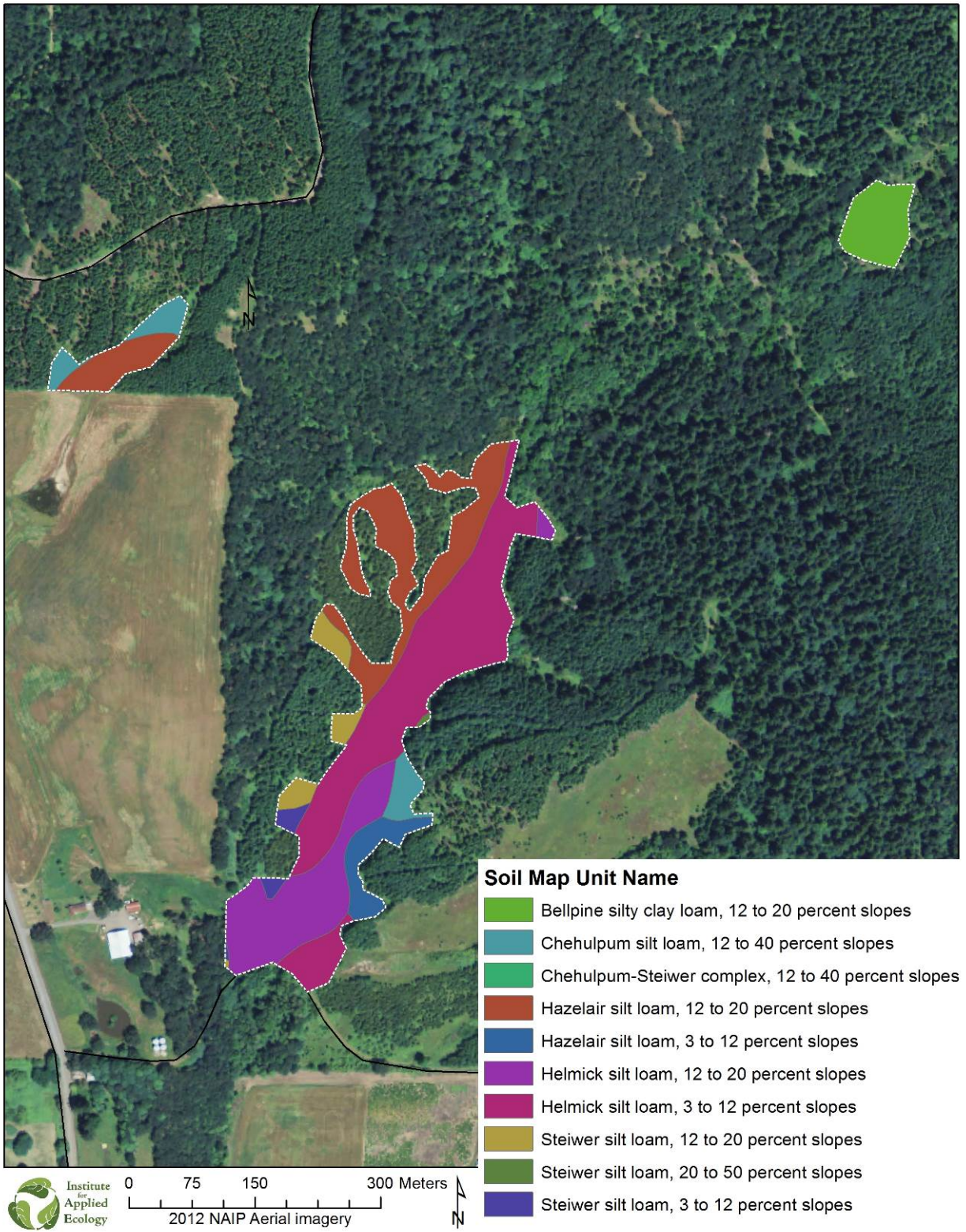


Figure 4. Soil types present in restoration area of Zena Forest (NRCS 2012).

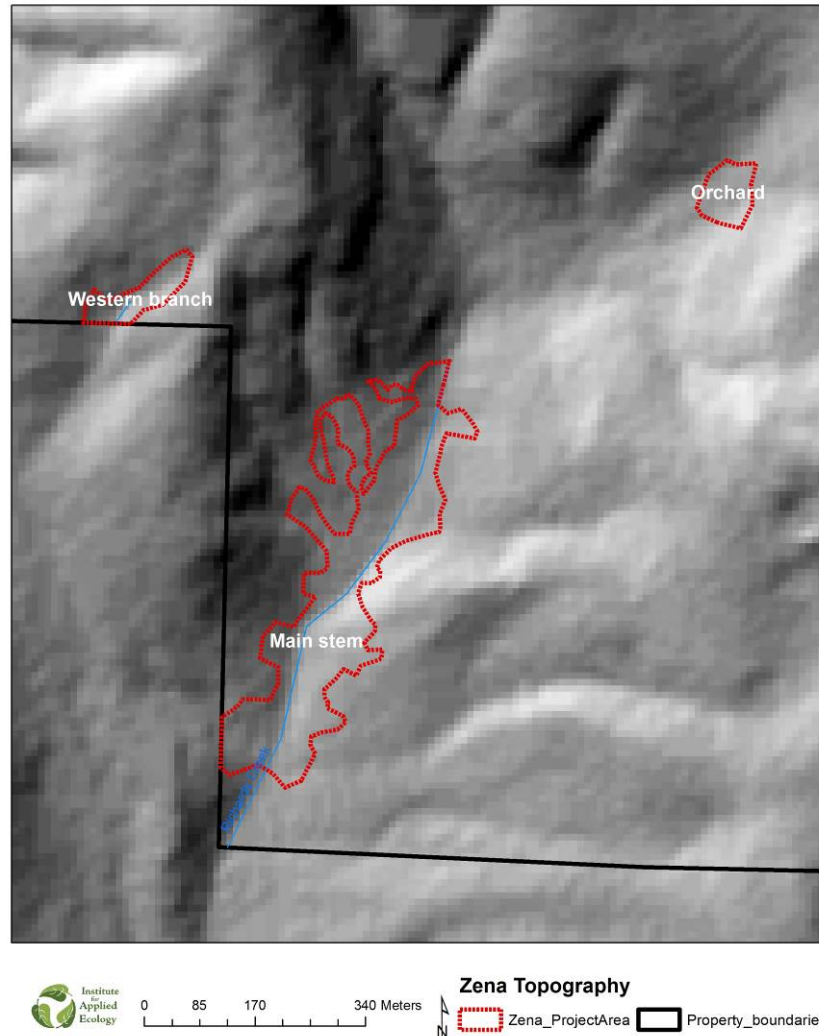


Figure 5. Topography in the restoration areas at Zena Forest.

1.4 Sensitive species

1.4.0 Rare plants

A rare plant survey of Zena Forest in 2008 (Salix Associates 2008) found no sensitive plant species, though a very small patch of Willamette Daisy (*Erigeron decumbens*), an endangered and federally listed species endemic to the Willamette Valley of Oregon, has subsequently been discovered on the adjacent 172 acre Deumling parcel.

One specimen of meadow checkermallow (*Sidalcea campestris*) was found in Zena Forest in 2008. This is listed as a Candidate species by the State of Oregon.

1.4.1 Sensitive Fish & Wildlife

No formal fish surveys have been conducted at Zena Forest (Karen Hans, ODFW, pers. comm.). However, the streams are not considered to be fish-bearing due to barriers to migration and the ephemeral nature of the streams (Sims 2008). Richards Creek has relatively good potential fish habitat (woody debris,

pools and rearing areas) that would suit cutthroat trout (*Oncorhynchus clarkii*) if culverts were improved to allow their migration into Zena Forest (K. Hans, pers. comm.; Fig. 6). The species was undoubtedly present historically. There is a culvert under the access road at the south end of the access area, and a second culvert on an abandoned skid road further up Richards Creek (K. Hans, ODFW, pers. comm.), the location of which is yet to be determined.



Figure 6: Upstream view of the Richards Creek culvert which crosses below the road at the south end of the main stem restoration area. This is a barrier to fish migration because the downstream side is perched above the stream

The most recent wildlife surveys at Zena Forest were conducted by Oregon Natural Heritage Information Center in August 2006 (Sims 2008: Appendix A) and by Salix Associates in April-June 2008 (Salix Associates 2008). Western pond turtles (*Actinemys marmorata*) are known from ponds 0.5 miles to the east of Zena Forest, so there is a small possibility that the turtles may travel uphill to nest on the property (Sims 2008). Western gray squirrels are reportedly common at Zena Forest (Sims 2008). A number of other uncommon or rare wildlife species are potentially present, although the habitat requirements may not currently be available (Sims 2008).

No rare butterflies are present at Zena, potentially due to isolation by forest or lack of 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 abundant, but no butterflies have been observed.

Some uncommon and rare bird species have been noted during surveys (Table 2), including Oregon Conservation Strategy Species (ODFW 2006).

Restoration at Zena Forest 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 affinis*) and Townsend's big-eared bat (*Corynorhinus townsendii*).

Ultimately, a healthy riparian zone should also include North American beaver (*Castor canadensis*), although re-introduction of this species should wait until riparian vegetation is well established.

Table 2. Sensitive wildlife present at Zena Forest (Salix Associates 2008, Sims 2008).

Species Name	Scientific Name	Federal Status	State Status	Conservation Strategy Species (OR)	Habitat Type
Slender-billed nuthatch	<i>Sitta carolinensis aculeata</i>		SV	Yes	Large diameter open site oaks. Cavity nester.
Western bluebird	<i>Sialia mexicana</i>		SV	Yes	Open canopy woodlands, pastures. Cavity nester.
Western gray Squirrel	<i>Sciurus griseus</i>		SV	Yes	Closed canopy woodlands.
Willow flycatcher	<i>Empidonax traillii adastus</i>	Species of Concern	SV	Yes	Riparian and upland shrub areas, nests close to ground in shrub thickets.
Yellow-breasted chat	<i>Icteria virens</i>	Species of Concern	SC	Yes	Shrubby riparian areas, wetlands, forest edges, burned areas.

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

2 Habitats

2.1 Current conditions

Habitat types present at Zena Forest within the project area are described briefly below and shown in Figure 7 and Table 3. For additional detail, see Sims (2008). Example photographs are shown in Figures 8-15.

Table 3. Approximate areas of habitat types currently present at three restoration areas at Zena Forest

Habitat	Main Stem (acres)	W Branch (acres)	Orchard (acres)	Total
Grassland-meadows	14.8	1.4		16.2
Disturbed shrubland	0	0	1.6	1.6
Plantation forest	0.5	0.5		1.0
Riparian forest-shrubland	4.8	0		4.8
Total	20.1	1.9	1.6	23.6

2.1.0 Grassland-Meadows

The grassland meadows are dominated by introduced pasture grass species such as tall fescue (*Schedonorus arundinaceus*), meadow foxtail (*Alopecurus pratensis*), velvet grass (*Holcus lanatus*) and bentgrass (*Agrostis capillaris*). Meadows on the east side of the creek tend to be wetter and support a scattering of native sedges and rushes, such as dense rush (*Carex densa*), foothill sedge (*C. tumulicola*), soft rush (*Juncus effusus* var. *pacificus*), dagger leaf rush (*J. ensifolius*), spreading rush (*J. patens*), slender rush (*J. tenuis*), and western rush (*J. occidentalis*) (Fig. 10). Areas of Armenian and European blackberry (*Rubus armeniacus* and *R. vestitus*) are present throughout the grassland types, in addition to some areas of native shrub species (Figs 9, 13). Teasel (*Dipsacus fullonum*), a non-native weed found in moist areas, is also common on both the east and west sides of the creek (Fig. 9). Relatively isolated patches of Scotch broom (*Cytisus scoparius*) are also present. Some areas have natural regeneration/encroachment of Oregon ash (*Fraxinus latifolia*).

2.1.1 Disturbed Shrubland

Within the project area of this plan, this habitat type is primarily found in the Orchard (Fig. 14). Modified by past management disturbance, this area includes mostly non-native plant species, with blackberry, teasel, Canadian thistle (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*). Horsetail (*Equisetum arvense*), cow parsnip (*Heracleum maximum*), velvetgrass (*Holcus lanatus*) and poison oak (*Toxicodendron diversilobum*) are also abundant. Patches of native shrubs, including pacific ninebark (*Physocarpus capitatus*) and snowberry (*Symphoricarpos albus*) are scattered over the area. Some native forbs and grasses are present, including blue wildrye (*Elymus glaucus*). Trees include occasional Douglas-fir, various fruit trees, planted cedar and walnuts.

2.1.2 Plantation Forest

Plantation forests in this area of Zena, near the main stem of Richards creek and the western branch, tend to be primarily ponderosa pine (*Pinus ponderosa*), planted for timber production (Fig. 9). These stands are of mixed age roughly between 15-35 years old, and have formed a dense canopy in most places; few understory species are present.

2.1.3 Riparian forest

Oregon Ash dominates the overstory of the riparian forest (Fig. 11). Areas of native shrubs, including willows (*Salix* sp.) (Fig. 10) and hazel (*Corylus cornuta*) area also present, with occasional Oregon white oaks (*Quercus garryana*) and Douglas-fir. The understory includes blackberry and pasture grasses in addition to ferns (e.g., *Polystichum munitum*) and patches of native sedges and rushes.

2.2 Invasive species

Infestations of Armenian blackberry mixed with European blackberry are common in the riparian areas, as well as in the prairie, oak savanna and forest areas. Richards Creek lies within a major area of infestation of blackberries at Zena Forest. Reed canarygrass (*Phalaris arundinacea*) is present in isolated patches. Additional invasive exotic species include English holly (*Ilex aquifolium*), Iris ivy (*Hedera hibernica*), sweet cherry (*Prunus avium*), hawthorn (*Crataegus monogyna*), Canada thistle (*Cirsium arvense*), and bull thistle (*C. vulgare*). Small patches of false brome (*Brachypodium sylvaticum*) have been located and are treated by the landowner (S. Deumling pers. comm.).

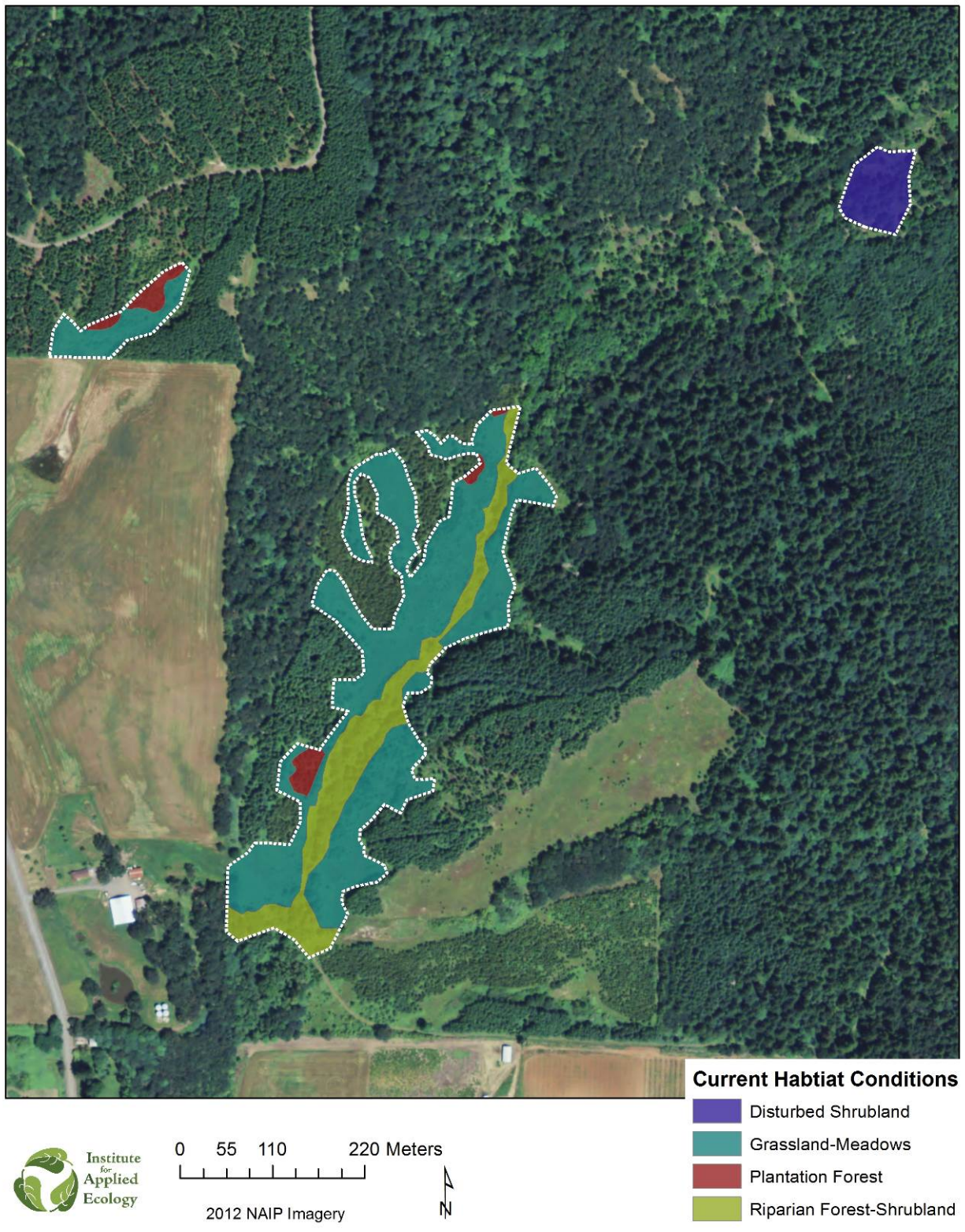


Figure 7. Current habitats within the Richards Creek riparian restoration area at Zena Forest.



Figure 8: Riparian forest bordering a stretch of Richards Creek north of the main stem restoration area, August 2012



Figure 9: Blackberry and teasel bordering an upland meadow on the west side of Richards Creek. Plantation forest is in the right background, March 2013. This area would be restored to mixed savanna in Option A.



Figure 10: Willows and rushes in wet meadow on the east side of Richards Creek, March 2013. This area will be restored to riparian forest with wet-loving species such as willows.

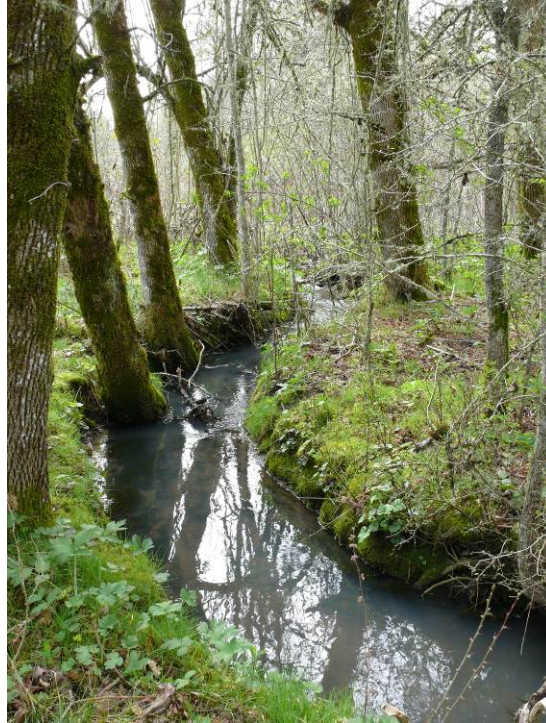


Figure 11: A narrow band of riparian forest along a lower stretch of Richards Creek, March 2013. Riparian forest will be enhanced and expanded.



Figure 12: Lower meadow and riparian forest on east side of Richards Creek, August 2012. This area would be restored to wet prairie and riparian forest in Option A.



Figure 13: Blackberry thicket bordering a meadow on the west side of Richards Creek, looking towards riparian trees bordering the creek, Aug. 2012. This area would be restored to upland prairie in Option A.



Figure 14: “The Orchard” restoration area, August 2012



Figure 15: Western branch Richards Creek

2.3 *Restored habitats*

Work at Zena Forest will focus on restoring the riparian corridor habitat along the main stem of Richards Creek. Additional restoration work will occur at “the orchard” and a small drainage on the western branch of Richards Creek. Fish passage will also be restored to the main stem of Richards Creek.

Two options are presented and described below:

Option A provides a restoration strategy for achieving habitat types that is an amalgam of historical vegetation patterns, soil types, guidance from the management plan, experience from IAE restoration ecologists, the landowner, other restoration colleagues and partners in this project.

Option B eliminates open habitats in favor of riparian trees and shrubs. This option might be chosen if it is not practical to conduct long-term maintenance of savanna and prairie habitats through mowing and weed control, as suggested by the landowner (S. Deumling pers. comm.).

Option A is recommended as it provides a variety of habitats, including the oak savanna and prairie habitats, which were more widespread at Zena Forest in pre-European times. Option B should improve canopy cover in some areas but might have mixed success in areas that are less suited to forest or shrub cover, and result in a higher level of re-invasion of weed species.

2.3.0 Option A

The work outlined in this plan for Option A seeks to restore and enhance current conditions to the habitat types described below and identified in Table 4 and Figure 16.

Table 4. Proposed areas (acres) of restored habitat at three restoration areas at Zena Forest (Option A)

Habitat	Main Stem (acres)	NW Branch (acres)	Orchard (acres)	Total
Wet prairie	0.3	0	0	0.3
Upland prairie	1.4	0	0	1.4
Mixed savanna	7.2	0	0	7.2
Upland shrubland	2.1	1.9	1.6	5.6
Riparian forest	9.1	0	0	9.1
Total	20.1	1.9	1.6	23.6

2.3.0.0 Wet prairie

The small wet prairie area will have minimal cover of invasive species, such as teasel. 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*) (Table 5). 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.

Table 5. Native grass and forb species to be added as seed to wet prairie restoration area.

Scientific Name	Species	Growth Form
<i>Achillea millefolium</i>	yarrow	Perennial forb
<i>Epilobium densiflorum</i>	Dense spike primrose	Annual Forb
<i>Lotus unifoliolatus</i>	American bird's foot trefoil	Annual forb
<i>Prunella vulgaris</i> var. <i>lanceolata</i>	common selfheal	Perennial Forb
<i>Deschampsia cespitosa</i>	tufted hairgrass	Perennial Grass
<i>Hordeum brachyantherum</i>	meadow barley	Perennial Grass

2.3.0.1 Upland prairie

Restoration will reduce blackberry and teasel while increasing native grasses and forbs. Recommended native grasses include California oatgrass (*Danthonia californica*), blue wildrye, and California brome (*Bromus carinatus*). Native forb species will include yarrow, farewell to spring (*Clarkia amoena*) and selfheal (Table 6). 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 Zena Forest by Willamette University.

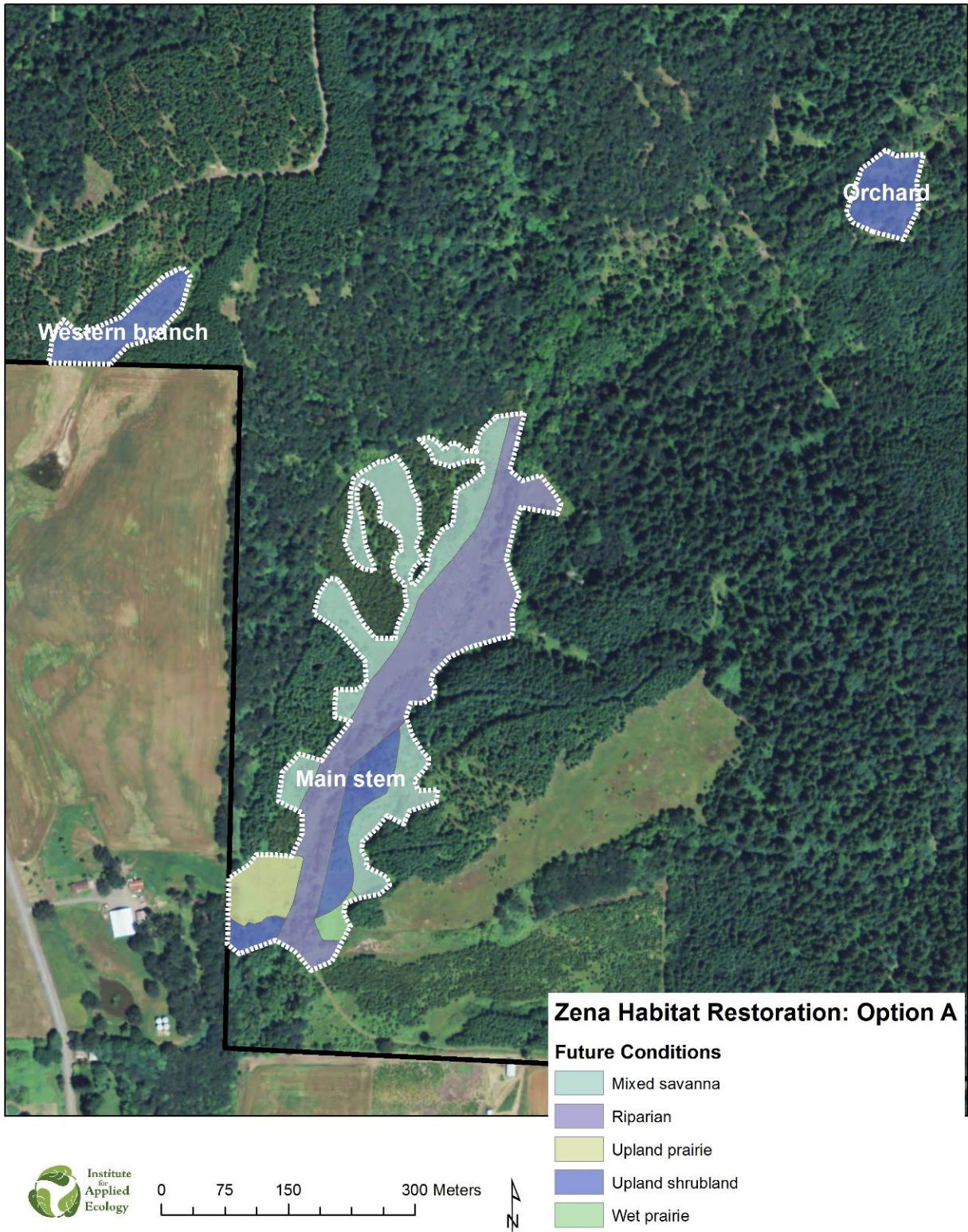


Figure 16. Proposed restored habitats within the main stem Richards Creek riparian restoration area at Zena Forest (Option A).

Table 6. Native grass and forb species to be added as seed to upland prairie, mixed savanna and mixed shrubland areas.

Scientific Name	Species	Growth Form
<i>Achillea millefolium</i>	yarrow	Perennial Forb
<i>Clarkia amoena</i>	farewell to spring	Annual Forb
<i>Prunella vulgaris</i>	Common selfheal	Perennial Forb
<i>Ranunculus occidentalis</i>	western buttercup	Perennial Forb
<i>Bromus carinatus</i>	California brome	Perennial Grass
<i>Danthonia californica</i>	California oatgrass	Perennial Grass
<i>Elymus glaucus</i>	Blue wildrye	Perennial Grass

2.3.0.2 Mixed savanna

The mixed savanna areas will retain existing oak and ash trees at relatively low densities (fewer than 5 trees per acre), and surround small inclusions of existing ponderosa pine plantations. Areas of blackberry and teasel will be removed, and native forb and grass diversity will be enhanced with species such as California oatgrass, western buttercup (*Ranunculus occidentalis*) and farewell to spring (See Table 6 for additional species).

2.3.0.3 Mixed shrubland

This habitat type will transition between riparian forest and wet prairie or mixed savanna in the main stem area, and will cover the entire orchard and western branch restoration areas. Plantings will complement existing native shrubs and trees. Wetter microhabitats will support willows (*Salix* spp.) and naturally regenerating ash, while more upland areas will include snowberry and ninebark (Table 7). Native forb and grass species diversity in the understory and openings will be increased through the addition of species such as California oatgrass, blue wildrye and yarrow (see Table 6).

2.3.0.4 Riparian forest

The riparian forest in the main stem of Richards Creek will include areas of currently existing riparian vegetation that will be enhanced, as well as newly planted riparian vegetation that will be established adjacent to existing riparian forest. 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 7).

Table 7. 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).

Species	Scientific Name	Tolerance	Tree or shrub
Big leaf maple	<i>Acer macrophyllum</i>	Moist, well drained	Tree
Cottonwood	<i>Populus trichocarpa</i>	Wet	Tree
Douglas spiraea	<i>Spiraea douglasii</i>	Moist, well drained	Shrub
Elderberry	<i>Sambucus racemosa/cerulea</i>	Very moist	Shrub (tall)
Ninebark	<i>Physocarpus capitatus</i>	Range of soils	Shrub
Ocean Spray	<i>Holodiscus discolor</i>	Range of soils	Shrub
Oregon Ash	<i>Fraxinus latifolia</i>	Wet	Tree
Oregon white oak	<i>Quercus garryana</i>	Variable	Tree
Pacific Willow	<i>Salix lucida</i>	Variable	Shrub
Red Alder	<i>Alnus rubra</i>	Variable	Tree
Scouler willow	<i>Salix scouleriana</i>	Variable	Shrub
Sitka willow	<i>Salix sitchensis</i>	Wet	Shrub
Snowberry	<i>Symphoricarpos albus</i>	Very wet to dry	Shrub
White alder	<i>Alnus rhombifolia</i>	Wet	Tree

2.3.1 Option B

Option B contains only upland forest/shrubland and riparian forest. Work will restore and enhance current conditions to the habitat types described below, which are identified in Table 8 and mapped in Figure 17.

Table 8. Proposed areas (acres) of restored habitat at three restoration areas at Zena Forest (Option B)

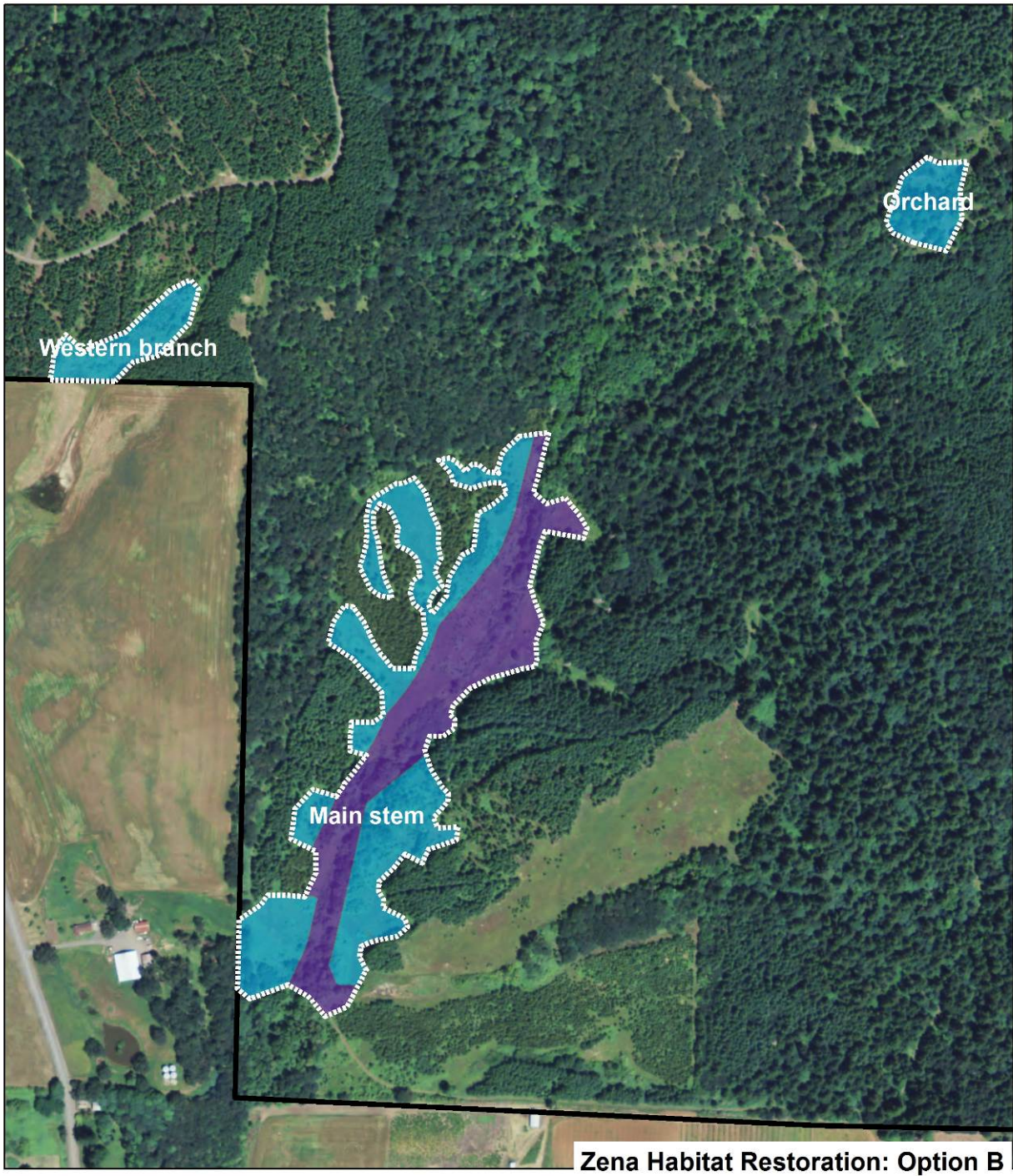
Habitat	Main Stem (acres)	NW Branch (acres)	Orchard (acres)	Total
Upland forest/shrubland	11	1.9	1.6	14.5
Riparian forest	9.1	0	0	9.1
Total	20.1	1.9	1.6	23.6

2.3.1.0 Riparian forest

See description of this habitat type in Option A and Table 7.

2.3.1.1 Upland forest/shrubland

This habitat type will contain an overstory of native trees, with an understory of native shrubs. Tree species could include but are not limited to those listed in Table 7. More wet-condition tolerant species are likely to be successful closer to the riparian area, while species tolerant of drier or more variable soil conditions will be more appropriate in upper areas.



0 75 150 300 Meters



Future Conditions

- Riparian
- Upland forest/shrubland

Figure 17. Proposed restored habitats within the main stem Richards Creek riparian restoration area at Zena Forest (Option B).

3 Restoration Strategy

The goal of restoration work is to restore fish passage and restore and enhance riparian forest, 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 Richards Creek watershed.

The restored habitats along Richards Creek will support a diversity of native trees, shrubs and forbs that will provide shade over creeks and minimize erosion. Habitat will benefit many species of birds, reptiles and amphibians and fish, including the current resident sensitive wildlife species, such as slender-billed nuthatch, Western bluebird, Western gray squirrel, willow flycatcher and yellow-breasted chat. 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.

3.1 *Planting Strategy*

Work in this area will focus on removing non-native vegetation (blackberry and teasel), and replacing it with native vegetation in a variety of habitats, including prairies and savannas, depending on whether Option A or B is selected. Where possible, the mowed and treated grass understory and meadows will be restored to a mix of native grasses and forbs.

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

- **High density planting strategy:** When using this method, bare root riparian trees and shrubs are planted in restoration areas at extremely high densities, ranging from 2,000 to 2,500 stems per acre. Tree to shrub ratios are often 1:3. The rationale of this strategy is that the more closely spaced trees and shrubs will rapidly produce a closed canopy, which will shade out and limit weed growth. This strategy has a higher initial cost, but will potentially have a lower maintenance cost after 7 years.
- **Low density planting strategy:** With this method, bare root riparian trees and occasionally shrubs are planted at low densities into restoration areas, ranging from 200-300 stems per acre. A 3:1 tree to shrub ratio is typically applied. The lower density has a much lower initial planting material and labor cost. The more widely spaced rows allow access for mowing and weed control, which may occur for an extended period of time until the canopy closes.

This plan proposes using a combination of high (2000 stems per acre), medium (750) and low density (250). High density plantings will occur in new riparian forest near Richards Creek and medium or variable density of interplanting will occur within the existing riparian forest. Low density planting will occur in the shrubland (or Option B's upland forest/shrubland).

3.2 *Work Schedule*

The projected project schedule is included in Table 9. Precise timings may vary with site access for equipment, weather conditions, and adaptive management.

Table 9. Overall project schedule over a 7 year period for restoration at Zena Forest.

	Year 1	Year 2	Year 3	Year 4	Year 5-7
	2014	2015	2016	2017	2018-20
Replace culverts	Design culverts and obtain permits	Replace culverts			
Monitoring	Survey and mark trees for removal				
	Survey weeds & establish vegetation plots				Survey weeds and plant establishment
Thinning	Thin trees and shrubs				
	Treat stumps				
Brush removal	Skid steer mow of brush & blackberries				
	Hand removal	Hand removal brush & weeds			
Mowing	Mow meadows	Mow all areas	Mow between tree rows	Mow between tree rows	Mow low density zones, savanna & prairie
			Mow savanna & prairie	Mow savanna & prairie	
Herbicide treatments	Spot spray teasels & thistles	Spot spray teasels & thistles	Ring spray around trees	Ring spray around trees	
	Spot spray blackberry regrowth after mow	Spot spray blackberry regrowth	Spot spray weeds	Spot spray weeds	Spot spray weeds
Plant materials		Broadcast seed or drill native grasses & forbs in prairies and all disturbed areas			
	Order trees & shrubs		Plant trees & shrubs	Re-plant trees & shrubs as needed	

3.3 Work Elements

The work elements designed to achieve the restoration strategy are briefly outlined below. A relatively conservative approach has been adopted to keep costs down and minimize the use of herbicides. Details of areas treated and estimated costs are provided in Appendix 1. A more intensive approach might include broadcast spraying of meadows and prairies to remove all non-native ground cover, and more frequent spot-spraying during tree and shrub establishment.

3.3.0 Replace culverts

Replace two culverts to restore fish passage to the main stem of Richards Creek. In order to achieve this task it is advisable to engage an environmental consultant to design the culverts, liaise with ODFW and watershed councils, arrange permits and construct the replacements. Costs have not been estimated in Appendix 1.

- Obtain a native migratory fish determination from ODFW.
- Design new culverts.
- Create a fish passage plan using ODFW criteria <http://www.dfw.state.or.us/fish/passage/>
 - e.g., new culvert must provide an opening equivalent to the active channel width, match the stream slope and surrounding creek bottom substrate.
- Apply for any required permits, exemptions or waivers (Department of State Lands, Army Corps of Engineers).

3.3.1 Monitor and weed survey

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.

- Option A and B
- Timing:
 - Year 1 – Spring
 - Year 7 – Spring

3.3.2 Survey and mark trees for removal

Mark trees and shrubs at edge of savanna meadows, where they have encroached from the plantation forest, and non-native and invasive tree and shrubs.

- Option A and B
- Timing:
 - Year 1 – Spring

Remove trees and shrubs at edge of savanna meadows where they have encroached from the plantation forest.

- 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 for wildlife habitat, burning or removal. Leaving piles intact provides many habitat benefits to a range of invertebrates, amphibians, birds and mammals.
- Hand-cut with chain saws any trees >10" in diameter and in places that are inaccessible to the skid steer.
- Option A (Option B would leave these trees intact).

- Timing:
 - Year 1 – Summer

Remove non-native and invasive tree and shrub species.

- Methods as above.
- Option A and B
- Timing:
 - Year 1 – Summer

3.3.3 Brush and invasive species removal

Mow/cut invasive blackberries and teasels in all habitats *before* herbicide control. An alternative approach is to spray before mowing, however this requires a greater amount of herbicide.

- A tracked skid steer with a rotary mower attachment can be used to mow blackberries and teasels in a variety of difficult terrain. Some native vegetation may need to be mowed where it is intermixed with blackberry.
- Hand-cut blackberries and teasels with chain saws and weed-eaters in areas that are inaccessible to the skid steer.
- Area: up to 12 acres
- Option A and B
- timing:
 - Year 1 – Summer
 - Year 2 – Summer (hand removal only)

3.3.4 Mowing

Mow grassland in meadows and cleared brush areas.

- A tracked skid steer with a rotary mower attachment can be used to mow grassland to reduce thatch and seeding of weeds in preparation for plantings in Year 1.
- Continue to mow all open areas and cleared zones in Year 2
- Mow between rows of new plantings in Years 3-4.
- Mow the lower density plantings and savanna and prairies in Years 5-7.
- Option A and B
- timing:
 - Years 5-7 – Summer

3.3.5 Herbicide Treatments

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

- Following tree and shrub removal, species, such as Oregon ash, hawthorn, holly and Scotch broom, which have a tendency to re-sprout and coppice should have their stumps treated
- Suggested herbicide: triclopyr (e.g. Garlon 3A).
- Option A and B (invasive species only)
- timing:
 - Year 1 – Summer

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).
- Option A & B
- timing:
 - Year 1 – Fall
 - Years 2-7 – Spring to early summer

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).
- Area: up to 10 acres
- Option A & B
- timing:
 - Year 1 – fall

Ring spray around new trees and shrubs.

- Following planting 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: glyphosate (e.g. Aquamaster).
- Option A & B
- timing:
 - Years 3-4 – early spring (March-April)

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.

3.3.6 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 forest/shrubland in the fall of Year 2 (Table 11, Appendix 2).
- Sow seeds by broadcast from an ATV.
- Option A & B
- timing:
 - Year 2 – fall

Install native trees and shrubs

- Following two years of ground preparation, plant trees and shrubs at the desired densities for particular habitats in the winter of Year 3 (Table 10, Appendix 1).
- Plant in sinuous rows to facilitate mowing (and create a more natural appearance) in the initial establishment years until sufficient canopy closure is attained.
- Plant up to 25% replacement trees and shrubs in Year 4 in order to maintain planting densities in the initial establishment period.

- Option A & B
- timing:
 - Year 3 – winter
 - Year 4 – winter (2nd planting of replacement trees/shrubs)

Table 10. Estimated costs for native tree and shrub plant materials by option and habitat, based on average 2012 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.

Native Tree/Shrub Plant Materials						
Option	Habitat	Stems/acre	Acres	Cost/Stem	# Stems Needed	Total Cost
A,B	Riparian forest-Enhanced	750	3.8	\$ 0.60	2850	\$1,710.00
A,B	Riparian forest-Restored	2000	5.3	\$ 0.60	10600	\$6,360.00
A	Upland Shrubland	250	5.6	\$ 0.60	1400	\$840.00
A	Mixed Savanna	15	7.2	\$ 0.60	108	\$64.80
B	Upland forest/Shrubland	250	14.5	\$ 0.60	3625	\$2,175.00
Total for Option A			21.9		14958	\$8,974.80
Total for Option B			23.6		17075	\$10,245.00

Table 11. Estimated costs for native grass and forb seed, by option and habitat, based on average 2012 prices at Willamette Valley native seed producers. Actual costs may vary with source.

Native Grass & Forb Seed					
Option	Habitat	Acres	Grass Seed \$/Acre	Grass-Forb Mix \$/acre	Total Cost
A,B	Riparian forest-Enhanced	1.0	\$ 70.00		\$ 70.00
A,B	Riparian forest-Restored	4.0	\$ 70.00		\$ 280.00
A	Upland shrubland	3.0		\$ 394.00	\$ 1,182.00
A	Mixed Savanna	3.0		\$ 394.00	\$ 1,182.00
A	Upland Prairie	1.4		\$ 394.00	\$ 551.60
A	Wet Prairie	0.3		\$ 430.00	\$ 129.00
B	Upland forest/shrubland	7.0		\$ 394.00	\$ 2,758.00
Total for Option A		12.7			\$ 3,394.60
Total for Option B		12.0			\$ 3,108.00

Total estimated native tree/shrub plant material costs plantings are included in Table 10 and Appendix 1. Native grass and forb seed costs are included in Table 11. Specific seed mixes/costs are included in Appendix 2.

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.

4 Monitoring and Adaptive Management

The Willamette Wildlife Mitigation Program will be developing standard monitoring and reporting protocols during 2013 and these will be adopted for the restoration project as appropriate.

Monitoring will occur to:

- Locate and map invasive species and assess success of invasive species control efforts.
- Evaluate the establishment rates of riparian plantings, the intensity of wildlife browse to plantings, and effectiveness of vegetation control (invasive and otherwise) in riparian planting areas.

Informal monitoring to assess weed control issues, chemical treatment effectiveness and seeding establishment should occur on a regular basis in Years 1-5. Formal monitoring methods will vary between habitat types.

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 may be required and heavier application of a native cover crop.
- 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 1 for both Options A and B. This does not include costs for project management, often 10-20 % of project expenses, which will vary with who implements the plan and when the work takes place.

The plan also does not include costs required for culvert replacement, to restore fish access to Richards Creek.

The estimated costs include:

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

Costs were estimated from 2013 labor and contract rates from commonly used restoration contractors, and plant material costs from nursery catalogs.

Total estimated costs over a 7 year period for Option A and B are similar (\$92,700 and \$89,400 respectively).

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 that is funded by the ODFW program. Separate 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 References

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Appendix 1: Task chronology and estimated costs for restoration at Zena Forest.

OPTION A Task Table

Year	Timing	Task	Acres	Hours	Description	Cost/Acre or Cost per hour	Cost
Year 1	spring	Survey & mark trees		40	Mark for thinning and removal	\$40/hr	\$ 1,600.00
Year 1	spring	Monitoring weed survey		16	Weed survey whole site.	\$60/hr	\$ 960.00
Year 1	spring	Monitoring vegetation plots		40	Establish veg plots	\$60/hr	\$ 2,400.00
Year 1	spring	Order trees & shrubs			Order trees and shrubs and pay 25% deposit to nursery		
Year 1	summer	Thin trees & shrubs		40	Skid steer sheering & removal to habitat piles	\$120/hr + \$160 mobilize	\$ 4,960.00
Year 1	summer	Thin trees & shrubs		80	Hand removal of trees and shrubs with chain saw	\$35.5/hr	\$ 2,840.00
Year 1	summer	Treat stumps		16	Treat stumps with herbicide	\$67/hr + \$200 chemical	\$ 1,432.00
Year 1	summer	Brush removal and mowing	18	32	Skid steer mowing of blackberry/brush and meadows c. 18 acres.	\$94/hr + \$160 mobilize	\$ 3,168.00
Year 1	summer	Hand brush removal	5		Chainsaw or weed whacking in riparian zone where inaccessible to skid steer. 5 acres.	\$500/acre	\$ 2,500.00
Year 1	Fall	Herbicide spot spray	6		Spot spray teasels & thistles.	\$250/acre + \$160 mobilize + \$250 chemical	\$ 1,750.00
Year 1	Fall	Herbicide spot spray	10		Spot spray blackberry regrowth.	\$250/acre + \$350 chemical	\$ 2,850.00
Year 2	summer	Mow	18	18	Skid steer mowing all except riparian.	\$94/hr + \$160 mobilize	\$ 1,852.00
Year 2	summer	Hand brush removal	2		Chainsaw or weed whacking in riparian zone. 5 acres.	\$500/acre	\$ 1,000.00
Year 2	Spring/Summer	Herbicide spot spray	6		Spot spray teasels & thistles.	\$250/acre + \$250 chemical	\$ 1,750.00
Year 2	fall	Herbicide spot spray	10		Spot spray blackberry regrowth.	\$250/acre + \$350 chemical	\$ 2,850.00
Year 2	fall	Buy seed			Prairie and grassland seed mix		\$ 3,393.56
Year 2	fall	Seed native grasses & forbs	13		Broadcast seed or drill native grasses and forbs in prairies and disturbed areas of other habitats	\$50/acre	\$ 650.00
Year 3	winter	Buy trees & shrubs			Purchase 14,958 trees & shrubs	\$0.60 per plant	\$ 8,974.80
Year 3	winter	Plant trees & shrubs	21.9		Labor to plant about 14,958 trees and shrubs in riparian, shrubland and savanna	\$0.30 per plant	\$ 4,487.40

		Task	Acres	Hours	Description	Cost/Acre or Cost per hour	Cost
Year 3	early spring	Herbicide ring spray	21.9		Ring spray around planted trees and shrubs.	\$250/acre + chemical	\$ 6,075.00
Year 3	spring	Mow high density riparian rows.	5.3		Push mower.	\$250/acre	\$ 1,325.00
Year 3	spring	Mow shrubland, savanna and prairies.	14.5		Skid steer or tractor mower.	\$150/acre + \$160 mobilize	\$ 2,335.00
Year 3	fall	Herbicide spot spray	17.5		Spot spray.	\$250/acre + \$250 chemical	\$ 4,625.00
Year 4	winter	Buy trees & shrubs			Purchase trees & shrubs for 25% replacements		\$ 2,243.70
Year 4	winter	Plant trees & shrubs			Labor to plant replacement plants.	\$0.30 per plant	\$ 1,121.85
Year 4	early spring	Herbicide ring spray	17.5		Ring spray ~ 17.5 acres riparian plantings and shrubland.	\$250/acre + chemical	\$ 4,975.00
Year 4	spring	Mow high density riparian rows.	5.3		Push mower (if feasible).	\$250/acre	\$ 1,325.00
Year 4	spring	Mow shrubland, savanna and prairies.	14.5		Skid steer or tractor mower.	\$150/acre + \$160 mobilize	\$ 2,335.00
Year 4	spring-fall	Herbicide spot spray	17.5		Spot spray.	\$250/acre + \$250 chemical	\$ 4,625.00
Year 5-7	spring-summer	Mow savanna and prairies.	8.9		Skid steer or tractor mower.	3 x \$150/acre + \$160 mobilize	\$ 4,485.00
Year 5-7	spring-summer	Herbicide spot spray		16	Spot spray 1 x per year for 3 years.	3 x \$67/hr + \$160 mobilize + \$250 chemical	\$ 4,446.00
Year 7	spring	Monitoring weed survey		16	Weed survey whole site.	\$60/hr	\$ 960.00
Year 7	spring	Monitoring vegetation plots		40	Post treatment monitor of veg plots to compare change from pre-treatment	\$60/hr	\$ 2,400.00
						Year 1	\$ 24,460.00
						Year 2	\$ 11,495.56
					Subtotal Cost	Year 3	\$ 27,822.20
						Year 4	\$ 16,625.55
						Years 5-7 (sum)	\$ 12,291.00
					Grand Total	Project costs over 7 year period	\$ 92,694.31

Option B: Task Table

Year	Timing	Task	Acres	Hours	Description	Cost/Acre or Cost per hour	Cost
Year 1	spring	Survey & mark trees		16	Mark for thinning and removal	\$40/hr	\$ 640.00
Year 1	spring	Monitoring weed survey		16	Weed survey whole site.	\$60/hr	\$ 960.00
Year 1	spring	Monitoring vegetation plots		32	Establish veg plots	\$60/hr	\$ 1,920.00
Year 1	spring	Order trees & shrubs			Order trees and shrubs and pay 25% deposit to nursery		
Year 1	summer	Thin invasive trees & shrubs		16	Skid steer sheering & removal to habitat piles	\$120/hr + \$160 mobilize	\$ 2,080.00
Year 1	summer	Thin trees & shrubs		40	Hand removal of trees and shrubs with chain saw	\$35.5/hr	\$ 1,420.00
Year 1	summer	Treat stumps		8	Treat stumps with herbicide	\$67/hr + \$200 chemical	\$ 896.00
Year 1	summer	Brush removal and mowing	18	32	Skid steer mowing of blackberry/brush and meadows c. 18 acres.	\$94/hr + \$160 mobilize	\$ 3,168.00
Year 1	summer	Hand brush removal	5		Chainsaw or weed whacking in riparian zone where inaccessible to skid steer. 5 acres.	\$500/acre	\$ 2,500.00
Year 1	Fall	Herbicide spot spray	6		Spot spray teasels & thistles.	\$250/acre + \$160 mobilize + \$250 chemical	\$ 1,750.00
Year 1	Fall	Herbicide spot spray	10		Spot spray blackberry regrowth.	\$250/acre + \$350 chemical	\$ 2,850.00
Year 2	summer	Mow	18	18	Skid steer mowing all except riparian.	\$94/hr + \$160 mobilize	\$ 1,852.00
Year 2	summer	Hand brush removal	2		Chainsaw or weed whacking in riparian zone. 5 acres.	\$500/acre	\$ 1,000.00
Year 2	Spring/Summer	Herbicide spot spray	6		Spot spray teasels & thistles.	\$250/acre + \$250 chemical	\$ 1,750.00
Year 2	fall	Herbicide spot spray	10		Spot spray blackberry regrowth.	\$250/acre + \$350 chemical	\$ 2,850.00

		Task	Acres	Hours	Description	Cost/Acre or Cost /hour	Cost
Year 2	fall	Buy seed			Prairie and grassland seed mix		\$ 3,107.02
Year 2	fall	Seed native grasses & forbs	12		Broadcast seed or drill native grasses and forbs in prairies and disturbed areas of other habitats	\$50/acre	\$ 600.00
Year 3	winter	Buy trees & shrubs			Purchase 17,075 trees & shrubs	\$0.60 per plant	\$ 10,245.00
Year 3	winter	Plant trees & shrubs	17.5		Labor to plant about 17,075 trees and shrubs on riparian and upland forest/shrubland.	\$0.30 per plant	\$ 5,122.50
Year 3	early spring	Herbicide ring spray	17.5		Ring spray around trees and shrubs.	\$250/acre + chemical	\$ 4,975.00
Year 3	spring	Mow high density riparian rows.	5.3		Push mower.	\$250/acre	\$ 1,325.00
Year 3	spring	Mow low density rows in forest and shrubland.	14.5		Skid steer or tractor mow.	\$150/acre + \$160 mobilize	\$ 2,335.00
Year 3	fall	Herbicide spot spray	17.5		Spot spray.	\$250/acre + \$250 chemical	\$ 4,625.00
Year 4	winter	Buy trees & shrubs			Purchase trees & shrubs for 25% replacements		\$ 2,561.25
Year 4	winter	Plant trees & shrubs			Labor to plant replacement plants.	\$0.30 per plant	\$ 1,280.63
Year 4	early spring	Herbicide ring spray	17.5		Ring spray ~ 17.5 acres riparian plantings and shrubland.	\$250/acre + chemical	\$ 4,975.00
Year 4	spring	Mow high density riparian rows.	5.3		Push mower (if feasible).	\$250/acre	\$ 1,325.00
Year 4	spring	Mow low density rows in forest and shrubland.	14.5		Skid steer or tractor mow.	\$150/acre + \$160 mobilize	\$ 2,335.00
Year 4	spring-fall	Herbicide spot spray	17.5		Spot spray.	\$250/acre + \$250 chemical	\$ 4,625.00
Year 5-7	spring-summer	Mow low density rows in forest and shrubland.	14.5		Skid steer or tractor mow.	3 x \$150/acre + \$160 mobilize	\$ 7,005.00
Year 5-7	spring-summer	Herbicide spot spray		16	Spot spray 1 x per year for 3 years.	3 x \$67/hr + \$160 mobilize + \$250 chemical	\$ 4,446.00
Year 7	spring	Monitoring weed survey		16	Weed survey whole site.	\$60/hr	\$ 960.00
Year 7	spring	Monitoring vegetation plots		32	Post treatment monitor of veg plots to compare change from pre-treatment	\$60/hr	\$ 1,920.00
					Subtotal Cost	Year 1	\$ 18,184.00
						Year 2	\$ 11,159.02
						Year 3	\$ 28,627.50
						Year 4	\$ 17,101.88
						Years 5-7 (sum)	\$ 14,331.00
					Grand Total	Project costs over 7 year period	\$ 89,403.40

Appendix 2: Suggested seed mixes for restoration at Zena Forest.

Table A. Upland seed mix.

Scientific Name	Species	Growth Form	Lbs./ acre	Pounds needed for 14.5 acres	Cost/ Pound	Cost	Cost/acre
<i>Achillea millefolium</i>	yarrow	Perennial Forb	2	30	\$ 23.52	\$ 705.60	
<i>Clarkia amoena</i>	farewell to spring	Annual Forb	1	13	\$ 81.00	\$ 1,053.00	
<i>Prunella vulgaris</i>	all heal	Perennial Forb	2	26	\$ 40.00	\$ 1,040.00	
<i>Ranunculus occidentalis</i>	western buttercup	Perennial Forb	1	13	\$ 87.50	\$ 1,137.50	
Subtotal Forbs			6	82		\$ 3,936.10	\$ 271.46
<i>Bromus carinatus</i>	California brome	Perennial Grass	1	14.5	\$ 6.40	\$ 92.80	
<i>Danthonia californica</i>	California oatgrass	Perennial Grass	2	29	\$ 43.00	\$ 1,247.00	
<i>Elymus glaucus</i>	Blue wildrye	Perennial Grass	3	43.5	\$ 10.00	\$ 435.00	
Subtotal Grasses			6	87		\$ 1,774.80	\$ 122.40
Grand Totals:			12	169		\$ 5,710.90	\$ 393.86

Table B. Wet prairie seed mix

Scientific Name	Species	Growth Form	Lbs. / acre	Lbs. for 0.3 acres	Cost/lb.	Cost	Cost/acre
<i>Achillea millefolium</i>	yarrow	Perennia l forb	1	0.3	\$ 23.52	\$ 7.06	
<i>Epilobium densiflorum</i>	dense flower willow herb	Annual Forb	1.5	0.45	\$ 57.00	\$ 25.65	
<i>Lotus unifoliolatus</i>	Oregon bird's foot trefoil	Perennia l forb	1	0.3	\$ 72.00	\$ 21.60	
<i>Prunella vulgaris var. lanceolata</i>	common all heal	Perennia l Forb	3	0.9	\$ 57.00	\$ 51.30	
Subtotal Forbs			6.5	1.95		\$ 105.61	\$ 352.02
<i>Deschampsia cespitosa</i>	tufted hairgrass	Perennia l Grass	2	0.6	\$ 10.70	\$ 6.42	
<i>Hordeum brachyantherum</i>	meadow barley	Perennia l Grass	4	1.2	\$ 14.25	\$ 17.10	
Subtotal Grasses			6	1.8		\$ 23.52	\$ 78.40
Grand Totals:			12.5	3.75		\$ 129.13	\$ 430.42