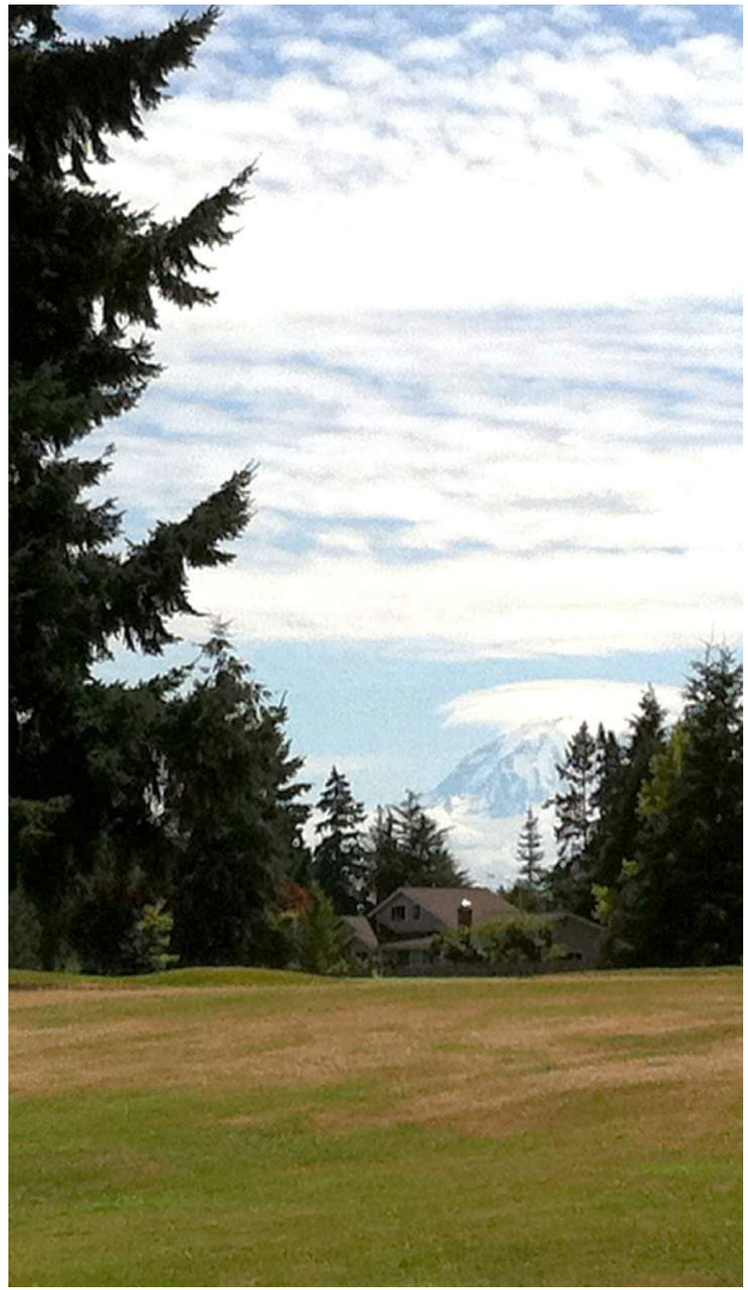
“To educate students for lives of thoughtful inquiry, service, leadership and care – for other persons, for their communities and for the earth.”

Pacific Lutheran University South Campus Open Space Master Plan 2013

MITHŪN



Credit: Mithun

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PACIFIC LUTHERAN UNIVERSITY MITHŪN

Prairie classroom and Mima mound walk

Executive Summary

The closure of the PLU golf course in October 2011 provided Pacific Lutheran University with a new opportunity to advance its mission—“to educate students for lives of thoughtful inquiry, service, leadership, and care—for other persons, their communities, and the earth”—by transforming the site into a multi-functional academic resource, and ecologically rich open space. PLU programs in biology, hydrology, botany, and geology have been using this site over the years to support curriculum. The opportunities to expand the site’s use by faculty and students are widely anticipated and great enthusiasm exists to develop the open space into a place that is beautiful and ecologically healthy.

The former golf course has an extremely unique history, with evidence of ancient prairie burns in the soil makeup, Mima mounds, and rare prairie vegetation. This interesting juxtaposition of cultural uses and ecological history has set the stage for the restoration of a declining native habitat. To have such a wonderful resource on-campus is a major asset for the University, and this master plan helps to understand and define the potential of this new space.

Some of the project goals for this site include the following:
- Promote experiential education & academic research
- Create a space for recreational activities in a natural environment
- Improve habitat through prairie & garry oak woodland restoration

In the state of Washington, native prairie habitat has shrunk to less than 3% of its original extent, yet the 24 acre site at PLU has indirectly protected some of this habitat within the roughs of the former golf course. The site therefore presents an opportunity to support an on-site prairie restoration, incorporated into a flexible open space with a richly layered program. Furthermore, the open space is located within a larger network of regional habitat corridors, and can potentially have a meaningful impact on habitat connectivity and biodiversity in the area. The leadership, faculty, students, and stakeholders at PLU are highly supportive of native prairie and Garry Oak woodland restoration as a key component of the overall open space plan. Plans for the remaining areas of the original golf course include athletic facilities and potential inter-generational housing.

The design weaves restored prairie and Garry Oak woodland, mown eco-lawn, and ribbons of native vegetation into an experiential sequence of spaces within the site. It will provide areas that will directly support PLU curriculum, from the arts to the sciences, while building a crucial habitat corridor connection within the Parkland region. The loop trail, at one-mile long, will be a great path for walking, jogging, and training, meandering through a number of habitat types, and capturing incredible views of Mt. Rainier that are already framed by existing Douglas Firs. Visitors will be able to move freely into areas of mown eco-lawn along the northern and eastern edges, which creates a gentle transition from the adjacent athletic fields and housing. The “Mima Walk” along the northern edges features constructed mounds that will provide opportunities to take in more expansive views of the prairie, and to sit, study, or picnic. These mounds will call attention to the subtle yet dynamic geologic history of the landscape. Existing natural Mima mounds will be revealed by intentionally planting them with taller native vegetation, creating a pattern that will be more easily perceptible within the larger field of prairie or mown lawn. The open space will be accessed from the north and east through allees of Garry Oak and Ponderosa Pine which will enhance visitor orientation and safety.

The existing Douglas Firs on the site are important wind breaks which can support the movement and protection of native butterflies and the Western Grey Squirrel as they travel from one habitat patch to another. New plants, such as Pacific Madrone and Sword Fern, will highlight and expand upon these existing Firs, and dissolve their linear arrangement. New native woodlands, consisting primarily of Garry Oak and Ponderosa Pine, will be introduced along the northwest and western edges, and will help to buffer the adjacent athletic fields, increase biodiversity, and provide woodland habitat sanctuaries.

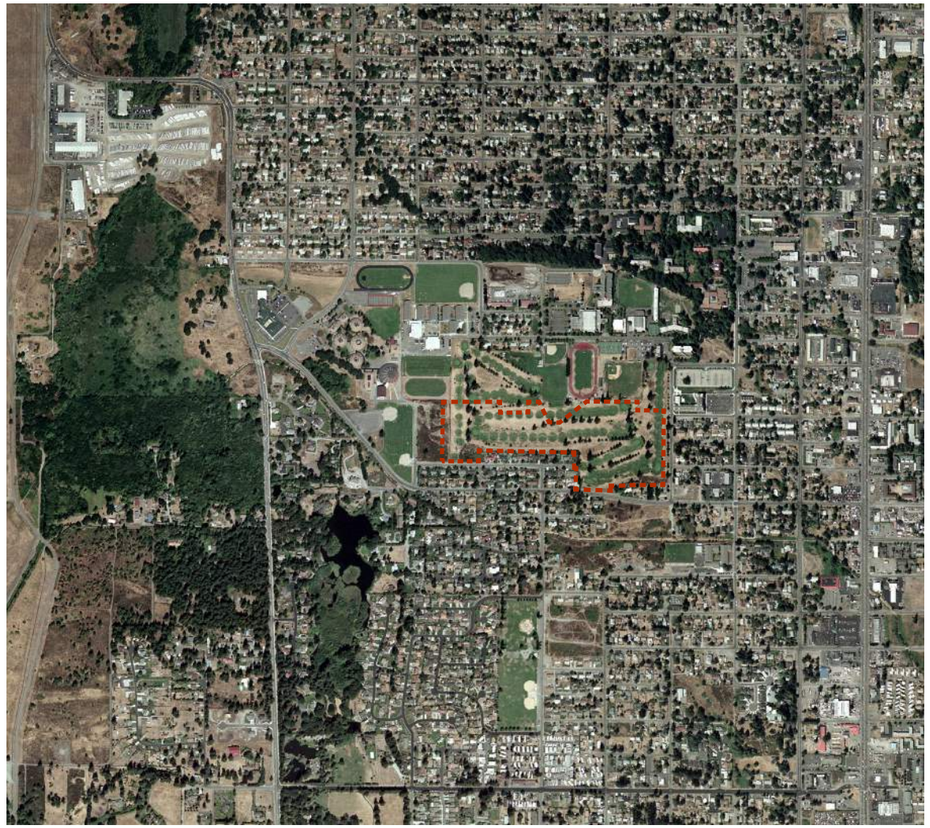
Views into and out of the site are a critical part of the design. There are stunning views of Mt. Rainier that the design preserves and highlights by providing viewing spots that frame the mountain with strategic tree planting. The neighboring homes along the southern edge will continue to have open views. Taller plants will weave within the existing prairie, loop trail, and mown edge, but will not press up against their fence line. Vegetation will be selected to provide open views for safety and an “open woodland” experience. The loop trail meanders along the southern edge, but at a distance from existing homes in order to preserve their privacy.

The golf course has been closed since Fall 2011, therefore immediate and long term maintenance of the site is critical. The management plan within this document contains information about prairie restoration including: Site preparation strategies, native plant installation, and long term maintenance. The management plan also includes a prairie restoration schedule that includes first steps, interim management, and a general restoration time line. Management plans will include the future inter-generational housing area to insure that no area of the site is overrun by invasive species before restoration or construction can begin.

This report documents the process that PLU Steering Committee, PLU staff, PLU students and faculty, Mithun, and the team of consultants has used over the last year to generate a South Campus open space master plan. This process included three public meetings and four steering committee meetings that discussed the following:

- Analysis: Site history, existing site conditions, existing site ecology, invasive plants, case studies of similar sites
- Programming, Visions and Goals: Dreams for the site, expected users, curriculum support, sustainability goals, potential partnerships, precedents
- Alternatives Concepts: Eco-charette to discuss sustainable strategies and opportunities, development of concepts based on all feedback, review and refinement
- Final Concept Design: Final refinements of preferred plan, and management strategies
- An initial cost estimate was provided by Robinson & Company for the university to use in establishing priorities.

Next Steps:
- Further develop management plan and design of important gathering spaces.
- Determine areas for native tree planting.
- Define the path layout, dimensions, and programmatic requirements to host official regional/national cross country meets, protect resources, and capture views important views.
- The university has been in discussions with the county fire department about conducting controlled burns to manage the site. However, the fire department has concerns about air quality permits.
- Define the programmatic needs of the geology faculty.
- Conduct discussions with the Perry Keithley Middle School regarding access from the east.



Context | PLU South Campus Open Space and surrounding neighborhood

© Google Earth

The project is located within the greater Parkland area, part of the PLU Campus, the former site of the golf course. It acts as a critical open space within the surrounding heavily developed area.

Project Area | PLU South Campus aerial photo

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PLU South Campus Open Space

Context

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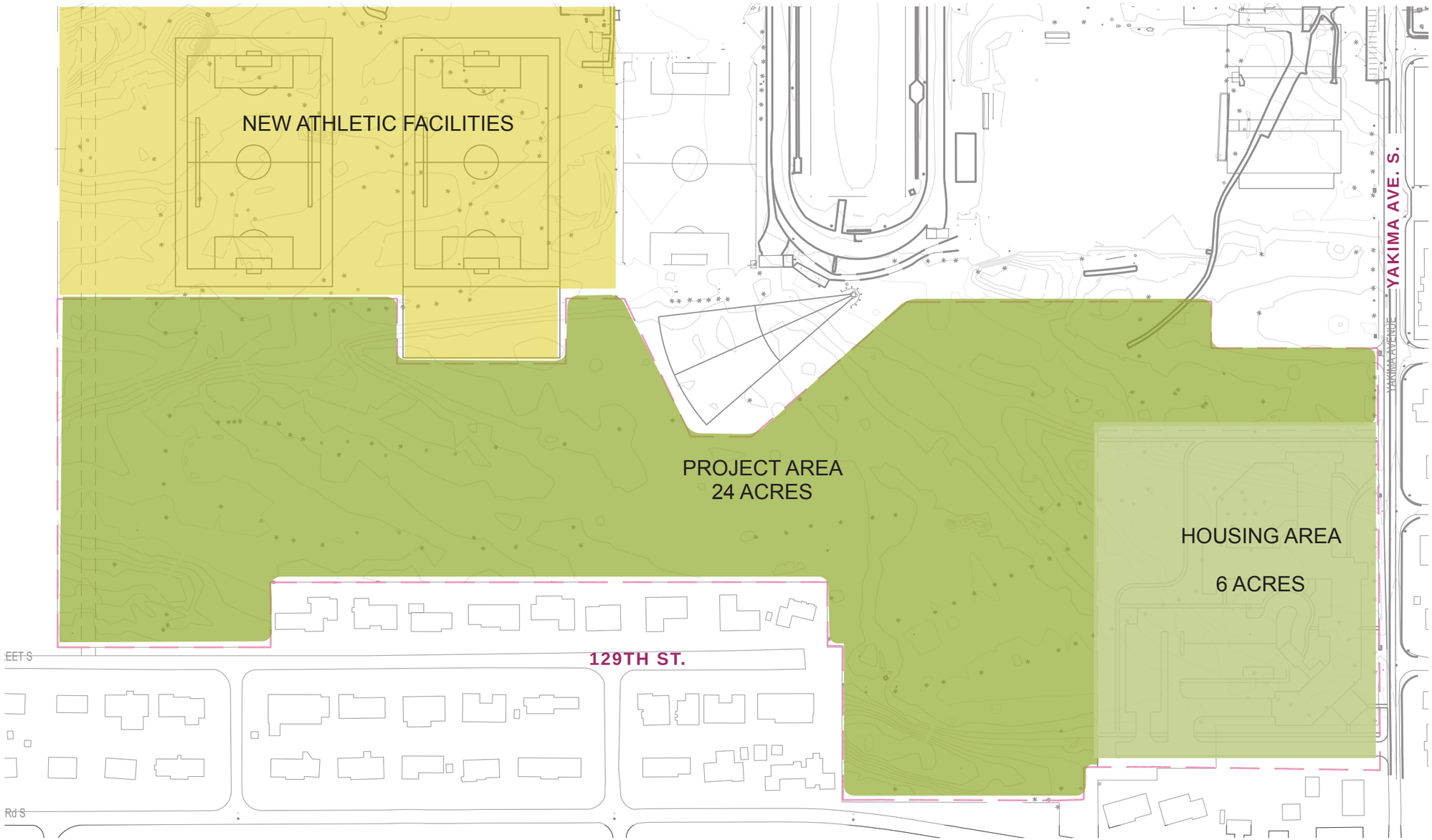

Overall Site: Limits & Size

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Analysis

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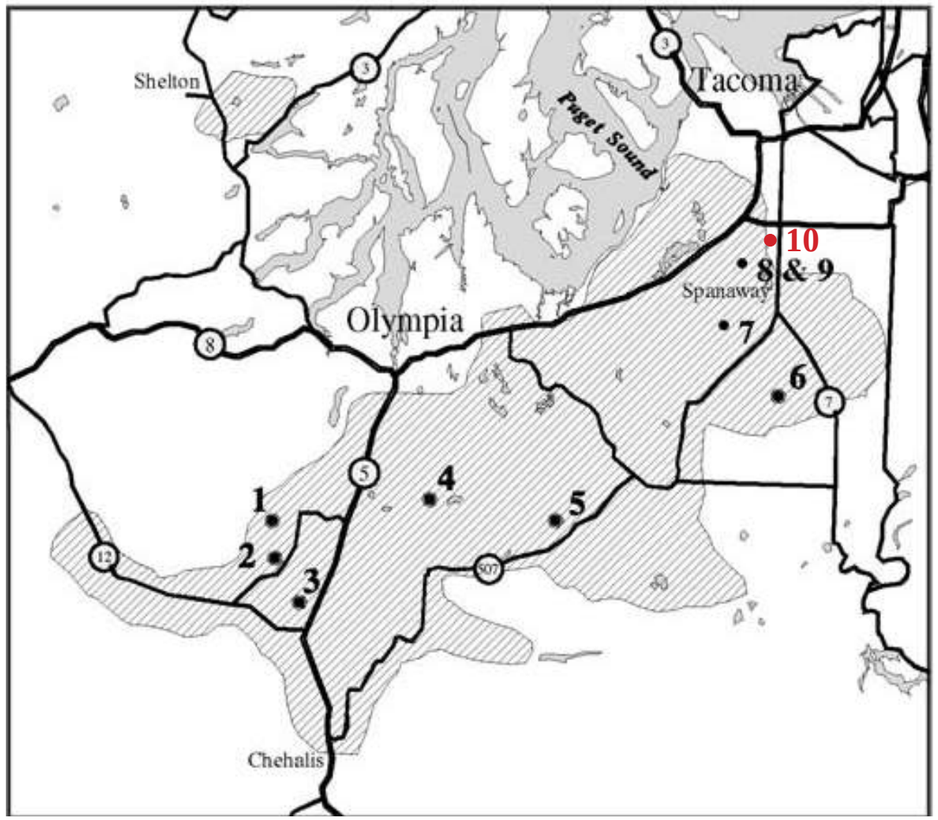
Many organizations are working to protect and restore prairies in the Puget Sound.

South Puget Sound prairie region including major protected prairies

- 1 - Mima Mounds Natural Area Preserve
- 2 - Black River-Mima Prairie-Glacial Heritage Park
- 3 - Scatter Creek Wildlife Area
- 4 - Rocky Prairie Natural Area Preserve
- 5 - Weir Prairie Research Natural Area
- 6 - Thirteenth Division Prairie RNA
- 7 - Bower Woods Ponderosa Pine Forest RNA
- 8 - Bensten Candidate RNA
- 9 - Talbot Candidate RNA
- **10 - PLU South Campus Open Space**

Potential partnerships

- Institute for Applied Ecology
  (Already researching at the regional restoration sites.)
- Audubon Society
- Evergreen State College
- The Nature Conservancy
- Rare Species Recovery Project: Department of Defense
- Natural Resource Conservation Service (NRCS)
- USDA
- WA Native Plant Society
- Sound Native Plants (Susan Buis)
- Society for Ecological Restoration
- Wash DOT
- Tree Campus USA
- Sustainable Prisons
- Chambers-Clover Creek Watershed Council
- South Puget Sound Salmon Enhancement Group
- Pierce Conservation District Stream Team
- Pierce County Public Works & Utilities Water Programs
- Cascadia Prairie Oak Partnership
  (Listserve connects prairie-oak practitioners.)



Prairie Habitat Restoration and Maintenance on Fort Lewis and within the South Puget Sound Prairie Landscape - Final Report and Summary of Findings. http://www.southsoundprairies.org/documents/FtLewisFinalReport.pdf

Regional Prairie Sites

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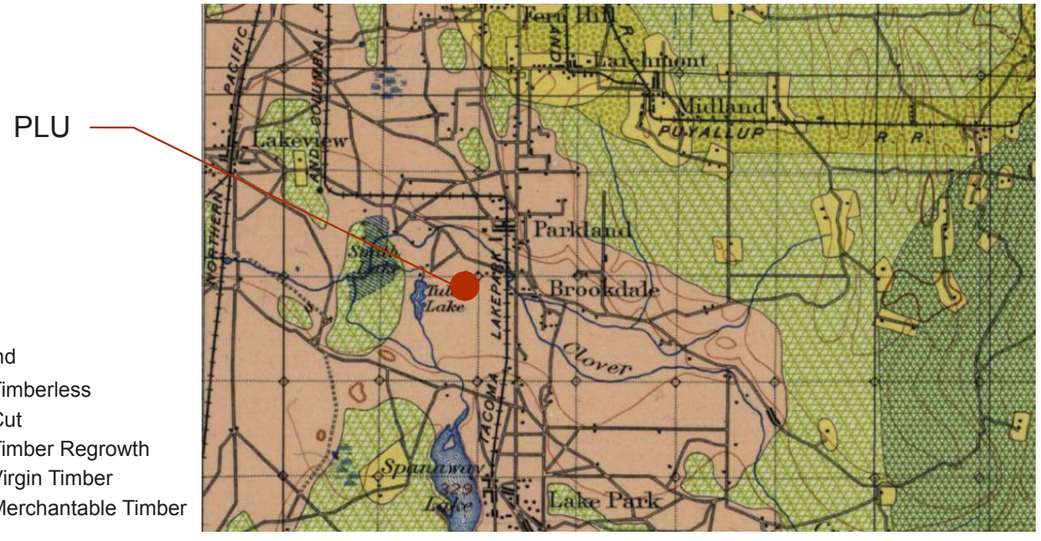
The PLU campus and the golf course were built in a treeless area called the Parkland Prairie. Very little remains of this unique native habitat.

- Prairies are among the least protected and most threatened habitat types on earth.
- Washington prairies were concentrated between the Oregon border and Vancouver, WA with scattered areas on Whidbey Island, the Olympia Peninsula & the San Juan Islands. The Nisqually plains was the large center of these prairies and PLU makes up a portion of these
- South Puget Sound prairie ecosystems have been reduced to 3% of its historic extent due to:
  - Conversion to farming, development and recreational use
  - Cessation of regular burning
  - Invasion by weedy & invasive species and Douglas fir forests
- USDA Natural Resources Conservation Service Wildlife Habitat Incentives Program (WHIP) provides financial assistance through cost-share agreements to improve habitat for important wildlife populations.
  - Western Washington prairies and Garry Oak woodlands ARE on their top priority habitat list.



1897 | Land Classification Map (Rankine and Plummer)

1938 | View of South Campus's open prairie (Nordquist 1990)

Historic Plant Communities

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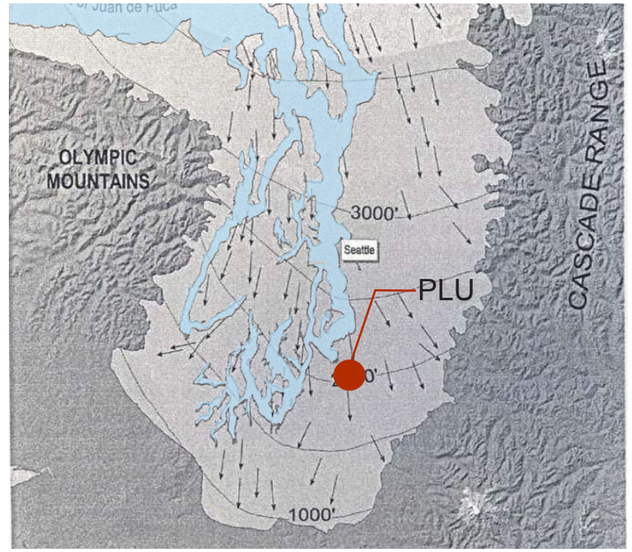
PLU South Campus: Site Analysis

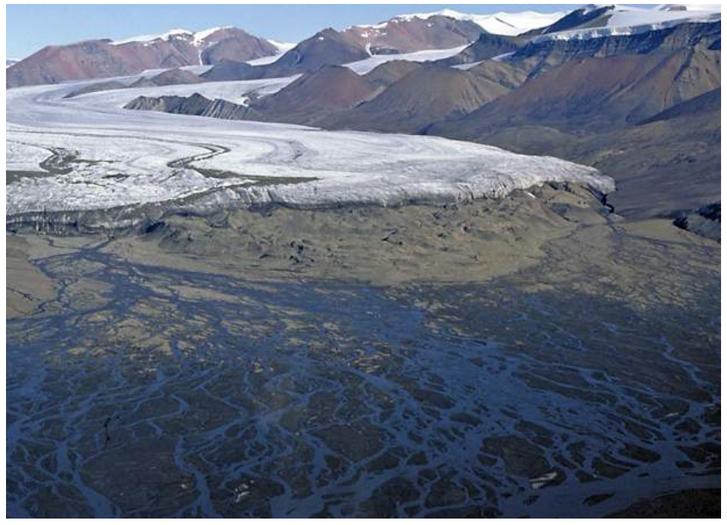
The geological history of the site is visible at many scales: from the form of Mt Rainier, to the “Parkland Potato” gravels and volcanic ash present in the soil.

- Uplift of Cascade Range, 5-7 millions years ago
- Formation of current volcanos, 2 million years ago
- Separate Glacial “Ice Ages”, over the past 2 million years
- Vashon Ice Advance south of Olympia, 15,000 years ago - ice sheet estimated at ~2,000 feet thick at PLU
- Melting of ice and deposition of outwash sands, gravels, stones, 14,000 years ago
- Eruptions and lahars from Mt. Rainier infill valleys and seawater channels
- Volcanic eruptions deposit tephra (ash), (I.E.-Mount Mazama & mount St. Helens), 6850 & 31 years ago
- Ongoing Earthquakes

1980 | Ash Plume, Mount St. Helens (USGS, Robert Krimmel)



2002 | Vashon Puget Lobe of the Cordilleran Ice Sheet (Kovanen & Easterbrook)



1977 | Outwash plain in front of Thompson Glacier, Axel Heiberg Island, Canadian Arctic. (J. Alean)

2011| Mount Rainier from site (Mithun)

Geological Influences

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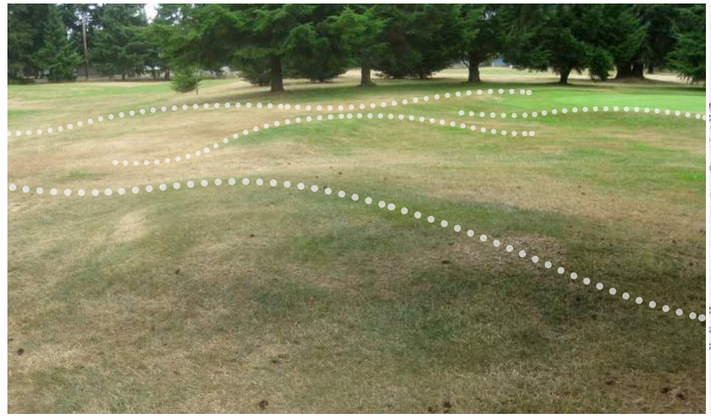
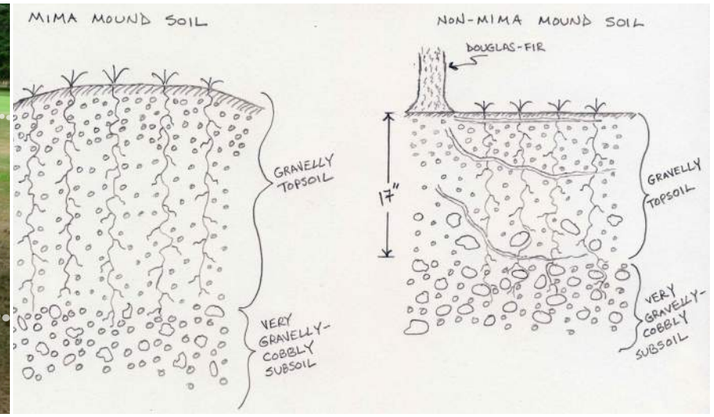
There are Mima Mounds scattered across the site, and evidence of microchar, a vestige of Native American burning practices.

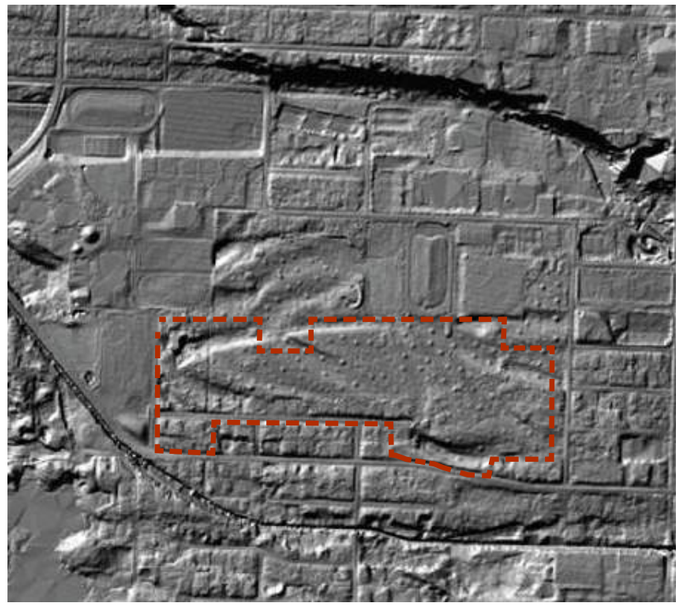
- Spanaway gravelly sandy loam is found across the site, which is indicative of historic native prairie habitat.
- Very high organic matter content in topsoil.
- 15-30% gravels in topsoil.
- Glacial outwash + volcanic ash content + Evidence of microchar.
- Evidence of Mima Mounds across the site.



On-site Mima Mounds | more subtle than Thurston County Mima Mounds, contour highlighted | Credit: Rozewood



Soil profile comparison: Mima and non-Mima areas, hand sketch NTS | Credit: Rozewood



LIDAR: Mima Mound formations on South Campus | credit: DNR

On-site Mima Mound with Douglas Fir | found across the site | Credit: Rozewood

Site Soils

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PLU South Campus: Site Analysis

The former golf course is located in the Clover/Chambers Creek Aquifer recharge area, which supplies drinking water to the nearby communites. Therefore, maintaining watershed, and stream health is of great importance.

Clover / Chambers Watershed

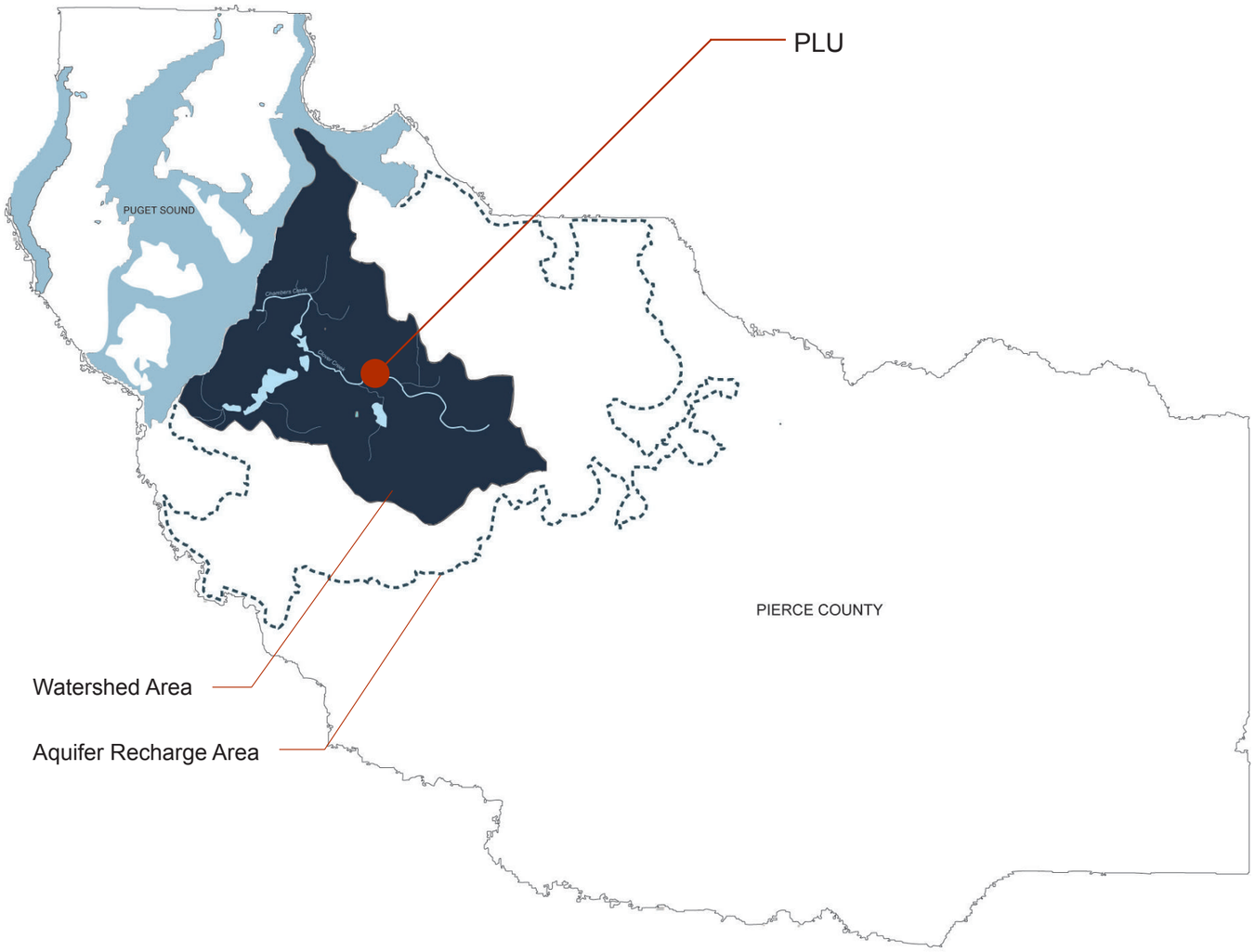
- Annual rainfall = 38-40 in. per year.
- Main tributaries include North Fork of Clover Creek, Spanaway Creek, & Morey Creek.
- 14 mile long, 74 sq. mile drainage area.
- Flows to Puget Sound via Lake Steilacoom & Chambers Creek.

Major Challenges & Opportunities

- Land cover changes.
- Non-point pollution (polluted runoff & septic tanks) .
- Alteration of stream channel.
- By increasing tree and prairie land cover, as well as reducing irrigation in the summer, this project is expected to have a positive long-term impact on Clover Creek, and the aquifer below, by reducing stormwater runoff (infiltration) in the winter and reducing groundwater withdrawal in the summer.

Watershed & Stream Health:

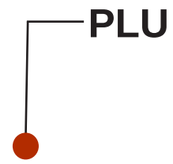
- The Pacific Lutheran University South Campus Open Space Master Plan study area is tributary to Clover Creek, and is located within the Central Pierce County Sole Source Aquifer, in the Clover/ Chambers Creek Groundwater Management Area. According to the July 3, 2003, Aquifer Recharge Area map, prepared by the Pierce County Department of Planning and Land Services, the study area is also located in the recharge area of this critical aquifer.
- Well-drained, gravelly soils infiltrate large volumes of stormwater but do not
- Sufficiently treat pollutants.
- Clover Creek is urbanized and generally not healthy. Department of Ecology measurements show pollutants & conditions beyond acceptable levels, including high levels of fecal coliforms, low dissolved oxygen levels, and high temperatures.
- Stormwater runoff is an identified source of pollution.
- Clover Creek currently floods in the winter and may run dry in the summer. The project is not within the FEMA flood plain area and no known critical areas exist on the site.

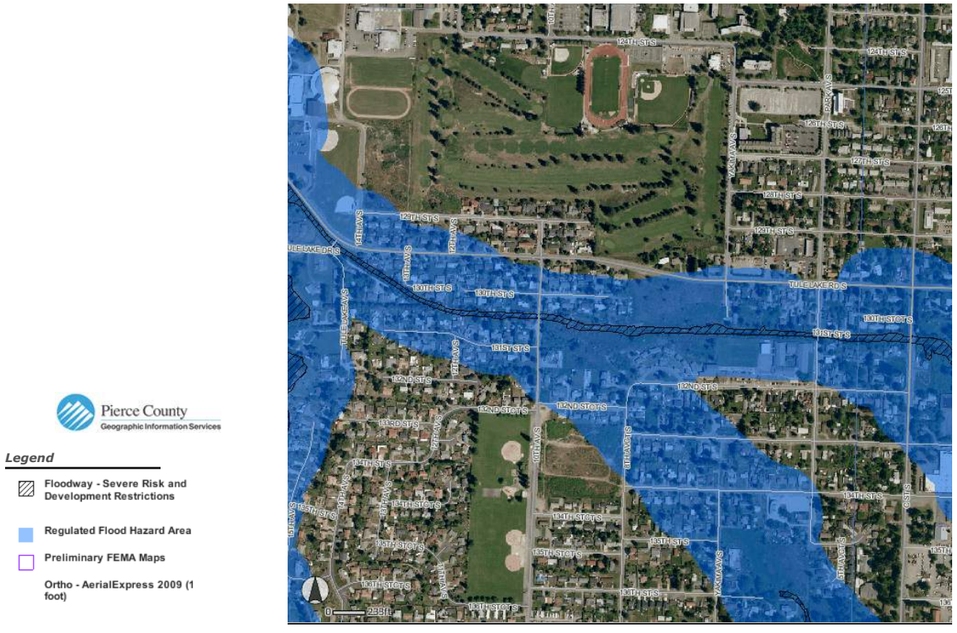


Clover / Chambers Creek Aquifer Recharge and Watershed Areas

There are various issues of concern in the Clover / Chambers watershed.

- Developed watershed with many non-point sources of pollution
- Position above sole-source aquifer makes pollution and water use very important
- 16 documented Total Daily Maximum Load (TMDL) water quality problems
- Channelized creek with some relocated and/or culvert sections and other fish passage barriers
- Characterized by flooding in winter and low flow/dry segments





Clover / Chambers Creek Watershed

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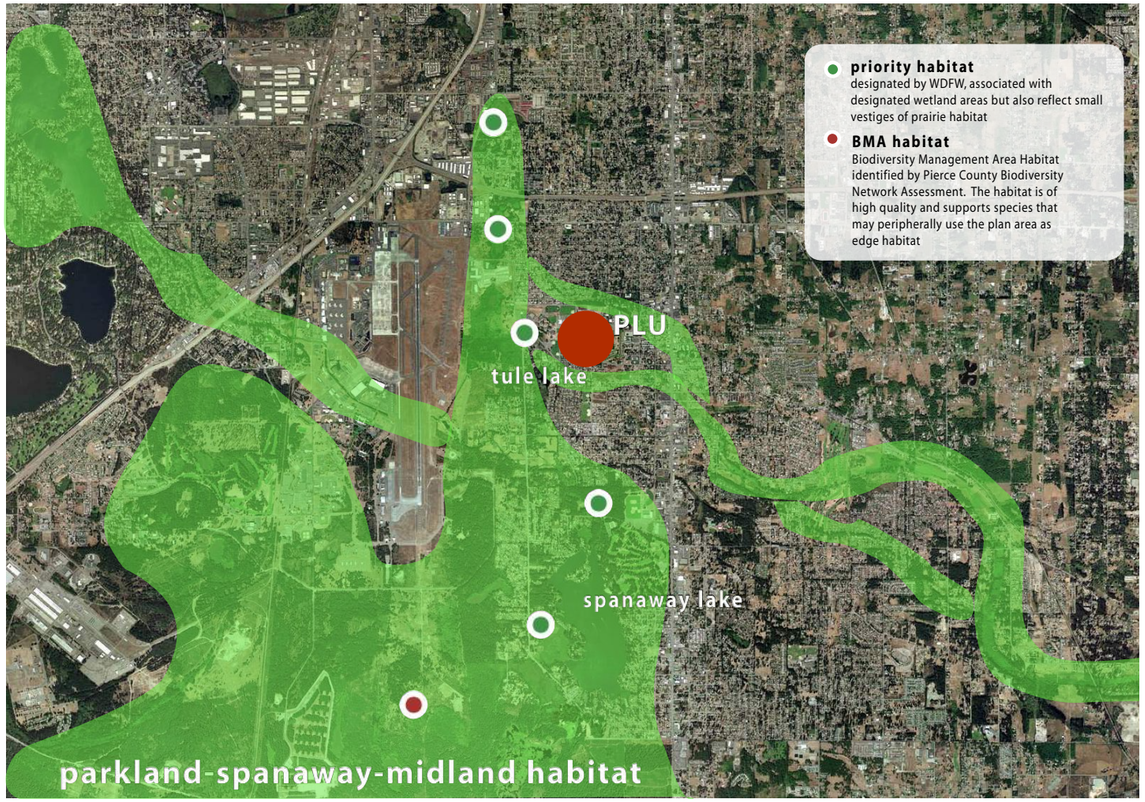
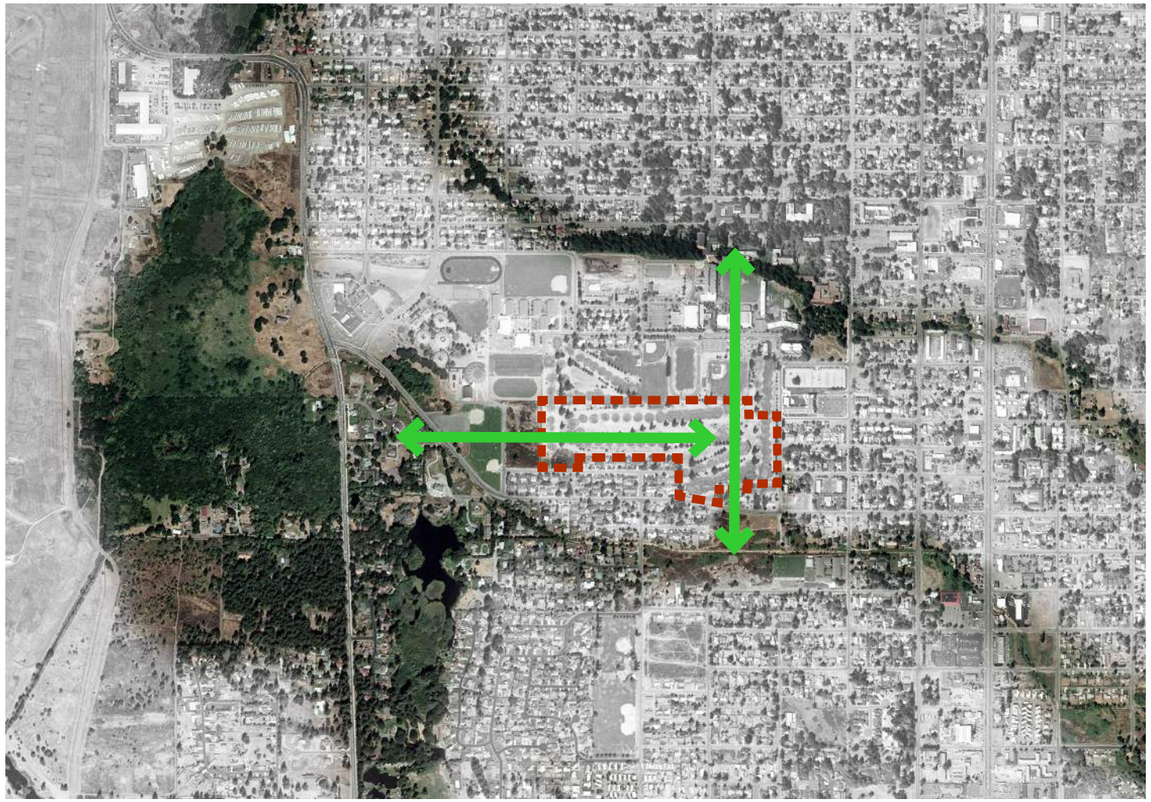
PLU South Campus: Site Analysis

The site has an important role as a connection in the larger open space corridor system. This connection supports healthy habitats for greater diversity of species.

Pierce County Open Space Corridors



Open Space Corridor | Parkland-Spanaway-Midland habitat



Open Space Corridor | South Campus Open Space in context

The project site is located within a larger regional system of habitat corridors, and has the opportunity to fill the gap that currently exists between two threads of green space that reach through Parkland, as shown above. This site could begin to act as a major hub of increased biodiversity and habitat restoration.

Legend

- PLU Campus
- PLU South Campus Open Space

Ecological Habitat

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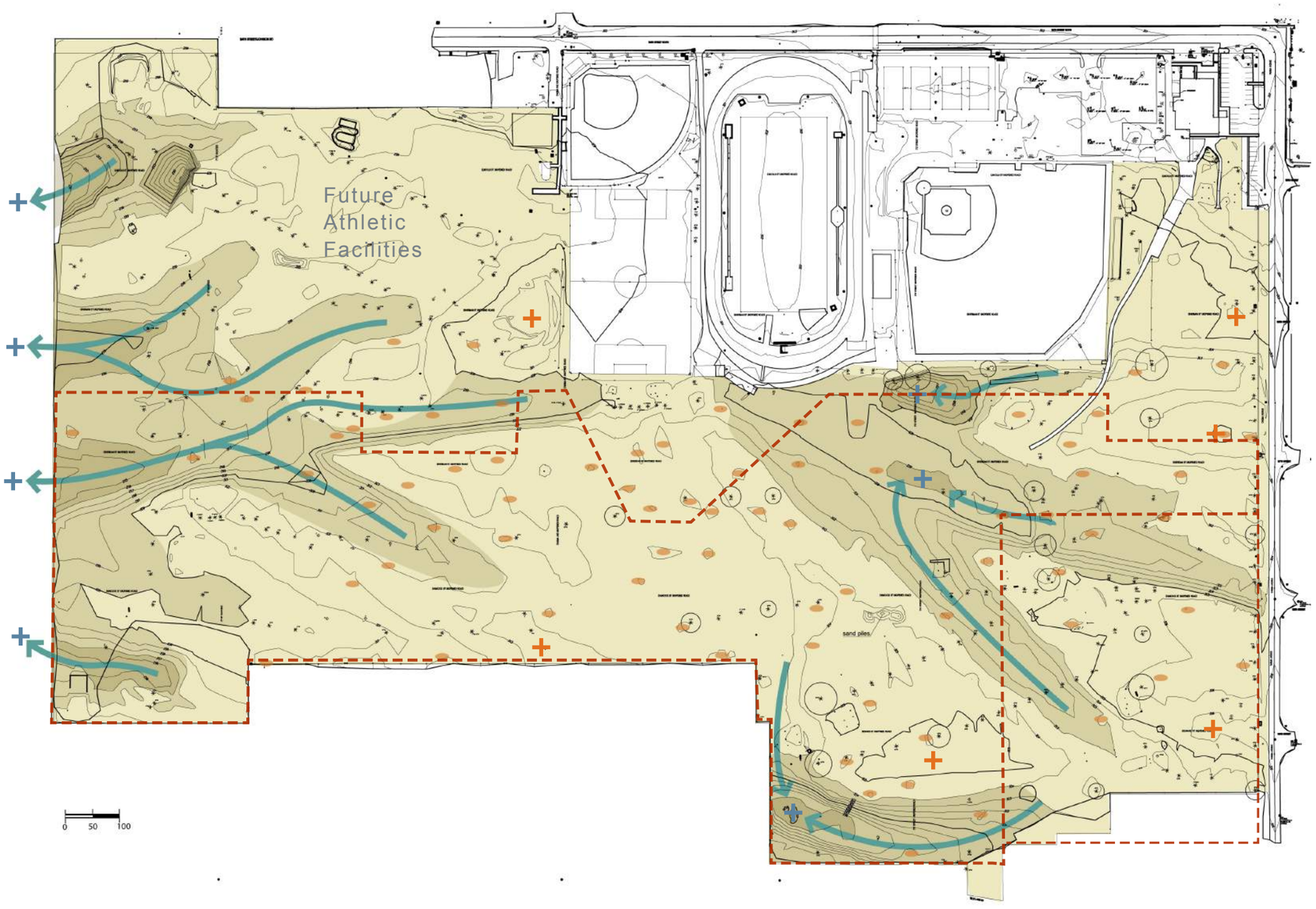

The site generally drains from east-to-west, with a few major drainage swales ending in low points within the center.

The western edge of the site generally drains towards the adjacent high school property, with a much lower point at the southwestern corner.

Existing Site Drainage and Mima Mounds

The golf greens were a primary vegetation type over the course's history, with the unmown spaces in-between offering higher habitat value and richer biodiversity.

Site Conditions at Golf Course Closing

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PLU South Campus: Site Analysis

A number of rare or endangered species rely upon the Prairie-Oak-Conifer ecosystem that once existed in the Parkland area.

Plants and wildlife are inextricably linked in South Puget Sound Prairie ecosystems with their loss resulting in a steep decline of wildlife that depends on this habitat; including some butterflies, western grey squirrel, streaked horned lark and Mazama pocket gopher, to name a few. The Washington State Department of Natural Resources found that even in areas where prairies had been affected by development, prairie vegetation - even rare species- still persisted. Given the remnant prairie discovered on-site, an exciting opportunity presents itself in the potential for a significant prairie restoration on-site.

Critical links between plants and wildlife

© M. Weiland | www.orcawatcher.org

© Flickr | William Leonard

Early Blue Violet provides nectar for the Mardon Skipper
(Washington State endangered species & federal candidate species)

© Flickr | wackybadger

© www.bentler.us

Prairie Lupine is a Key species for the Puget Blue butterfly
(Washington State candidate species)

Other rare wildlife species of the prairie:

© www.southsoundprairies.org

Mazama Pocket Gopher
(State threatened & federal candidate species)

© Flickr | Just chaos

Western Gray Squirrel
(State threatened & federal species of concern)

© 2008 Christopher Christie

Streaked Horned Lark
(State endangered & federal candidate species)

© Flickr | Franco Folini

Zerene Fritillary
(Federal species of concern)

© Flickr | USFWS Endangered Species

Taylor's Checkerspot
(State endangered & federal candidate species)

These rely upon the following:

- Prairie-oak-Conifer mosaic
- Protected open space
- Native vegetation for food & nesting
- Education & Outreach
- Invasives management strategy

Rare Vegetation and Wildlife

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Remnant Prairie species found on-site:

© **Flickr** | Born 1945
Camas Lily

Credit: Touchstone EcoServices
Camas Lily Seeds (collected on-site)

© **Flickr** | Thomas Hilton
Harvest Brodiaea

© **www.orww.org**
Roemer's Fescue

© **www.stockseed.com**
Red Fescue

Wildlife habitat found on-site

Douglas Fir provide beneficial habitat for butterflies and other wildlife | Credit: Mithun

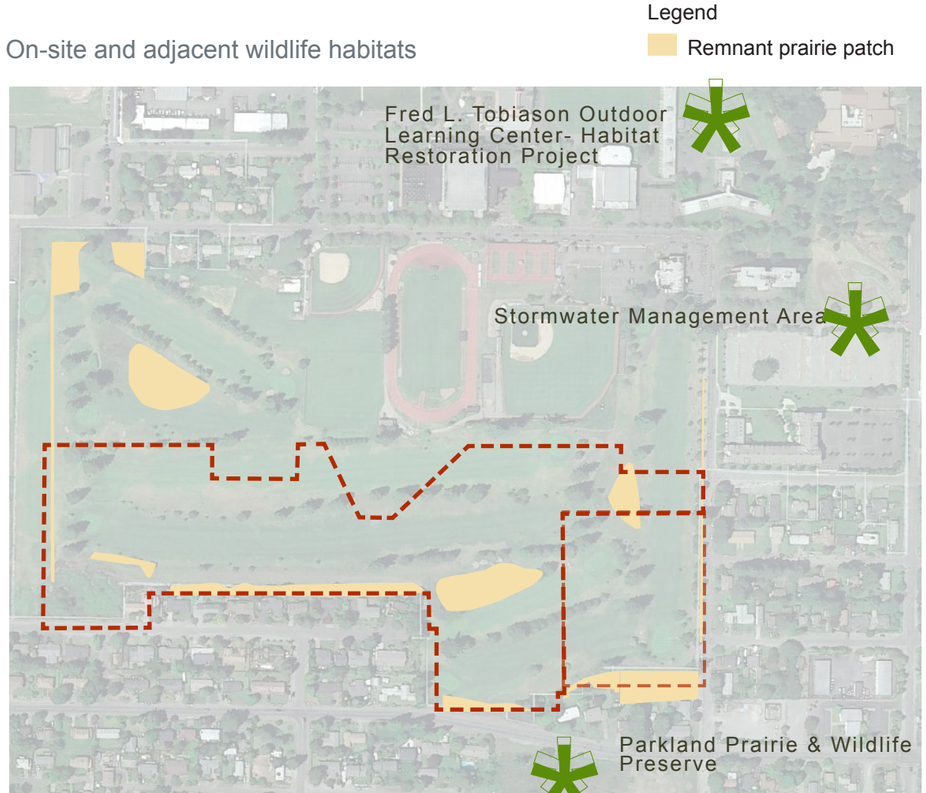
Adjacent wetland area provides critical habitat for butterflies and other wildlife | Credit: Touchstone EcoServices

Bluebird nesting boxes found on-site | Credit: Touchstone EcoServices

Thatching Ants, nests along fence line | Credit: Rozewood

Background research for the South Campus Open Space Master Plan area at Pacific Lutheran University indicates the golf course was likely created on prairie habitat. This is based on the prevalence of Camas Lily (*Camas quamash*) throughout the golf course, LIDAR (Light Detection And Ranging) imagery of the area showing remnant Mima mounds and the on-site soil investigation verifying the presence of Mima mounds and relatively intact prairie soils (Rozewood Environmental Services 2012). Also found within the golf course were species typical of prairies, but atypical of urban environments such as Harvest Brodiaea (*Brodiaea coronaria*) and Roemer's fescue (*Festuca roemeri)*.

On-site and adjacent wildlife habitats



Restoration projects & existing wildlife habitat around PLU South Campus

Existing Vegetation and Wildlife

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PLU South Campus: Site Analysis

Plants Associated with South Puget Sound Prairies:


© Flickr | gmayfield10


© Flickr | mahalie


© www.dkcnynps.org


© Flickr | Pacific Rim Institute


© www.geocaching.com

Common name	Scientific name
Common yarrow	*Achillea millefolium*
Narrowleaf onion	*Allium amplectens*
Tapertip onion	*Allium acuminatum*
Nodding onion	*Allium cernuum*
Menzies' fiddleneck	*Amsinckia menziesii*
Pearly everlasting	*Anaphalis margaritacea*
Rosy pussy-toes	*Antennaria microphylla*
Red columbine	*Aquilegia formosa*
Puget balsamroot	*Balsamorhiza deltoidea*
Harvest Brodiaea	*Brodiaea coronaria*
Long-stoloned sedge	*Carex inops*
Common camas	*Camassia quamash*
Large camas	*Camassia leichtlinii*
Common harebell	*Campanula rotundifolia*
Harsh paintbrush	*Castelleja hispida*
Field chickweed	*Cerastium arvense*
Small-flowered blue-eyed mary	*Collinsia parviflora var parviflora*
California oatgrass	*Danthonia californica*
Poverty oatgrass	*Danthonia spicata*
Menzie's larkspur	*Delphinium nutalli*
Heller's rosette grass	*Dichanthelium oligosnathes*
Broad-leaf shooting star	*Dodecatheon hendersonii*
Few-flowered shooting star	*Dodecatheon pulchellum*
Oregon sunshine	*Eriophyllum lanatum*
Giant white fawnlily	*Erythronium oreganum*
Roemer's fescue	*Festuca idahoensis var. roemeri*
Red fescue	*Festuca rubra var. rubra*
Woodland strawberry	*Fragaria vesca*
Wild strawberry	*Fragaria virginiana*
Chocolate lily	*Fritilleria affinis*
Blanket flower	*Gaillardia aristata*
Hounds-tongue hawkweed	*Heuchera chlorantha*
Prairie junegrass	*Koelaria macrantha*
Small-flowered woodland-star	*Lithophragma parviflora*
Spring gold	*Lomatium utriculatum*
Sicklekeel lupine	*Lupinus albicaulis*
Miniature lupine	*Lupinus bicolor ssp. bicolor*
Wyeth's lupine	*Lupinus wyethii*
Garry oak	*Quercus garryana*
Western buttercup	*Ranunculus occidentalis*
Meadow goldenrod	*Solidago canadensis*
White brodiaea (Fool's onion)	*Triteleia hyacinthina*
Meadow death camas	*Zigadenus venenosus*

Wildlife Associated with South Puget Sound Prairies:


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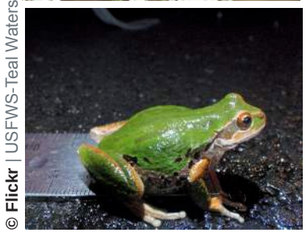
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Common name	Scientific name
Birds	
Western bluebird	*Sialia mexicana*
Red-tailed hawk	*Buteo jamaicensis*
Northern Harrier	*Circus cuaneus*
Band-tailed pigeon	*Columba fasciata*
Stellar's jay	*Cyanocitta stelleri*
Pileated woodpecker	*Dryocopus pileatus*
American kestrel	*Falco sparverius*
Lewis' woodpecker	*Melanerpes lewis*
Rufus hummingbird	*Selasphorus rufus*
Tree swallow	*Tachycineta bicolor*
Violet-green swallow	*Tachycineta thalassina*
American robin	*Turdus migratorius*
Butterflies	
Anise swallowtail	*Papilio zelicaon zelicaon*
Puget fritillary	*Argunnis (Speyeria) cybele*
Western meadow fritillary	*Bolobira epithore chermocki*
Ochre ringlet	*Coenonympha tulia eumomia*
Common ringlet	*Coenonympha tulia*
Orange sulphur	*Colias eurytheme*
Mylitta crescent	*Phycoides mylitta mylitta*
Echo blue	*Echo echo*
Silver blue	*Glaucopsyche lygdamus columbia*
Woodland skipper	*Ochlodes sylvanoides*
Margined white	*Pieris marginalis marginalis*
European cabbage white	*Pieris rapae*
Two-banded skipper	*Pyrgus ruralis ruralis*
Puget Sound silverspot	*Speyeria cybele pugetensis*
Reptiles and Amphibians	
Pacific chorus frog	*Pseudacris regilla*
Rubber boa	*Charina bottae*
Sharp-tail snake	*Contia tenuis*
Northwestern garter snake	*Thamnophis ordinoides*
Mammals	
Coyote	*Camis latrans*
Raccoon	*Procyon lotor*
Northwestern garter snake	*Thamnophis ordinoides*
Red fox	*Vulpes vulpes*

Note: Species lists are not exhaustive, but intended to convey the potential for increased biodiversity on-site See appendix 1 for references.

Vegetation and Wildlife Potential

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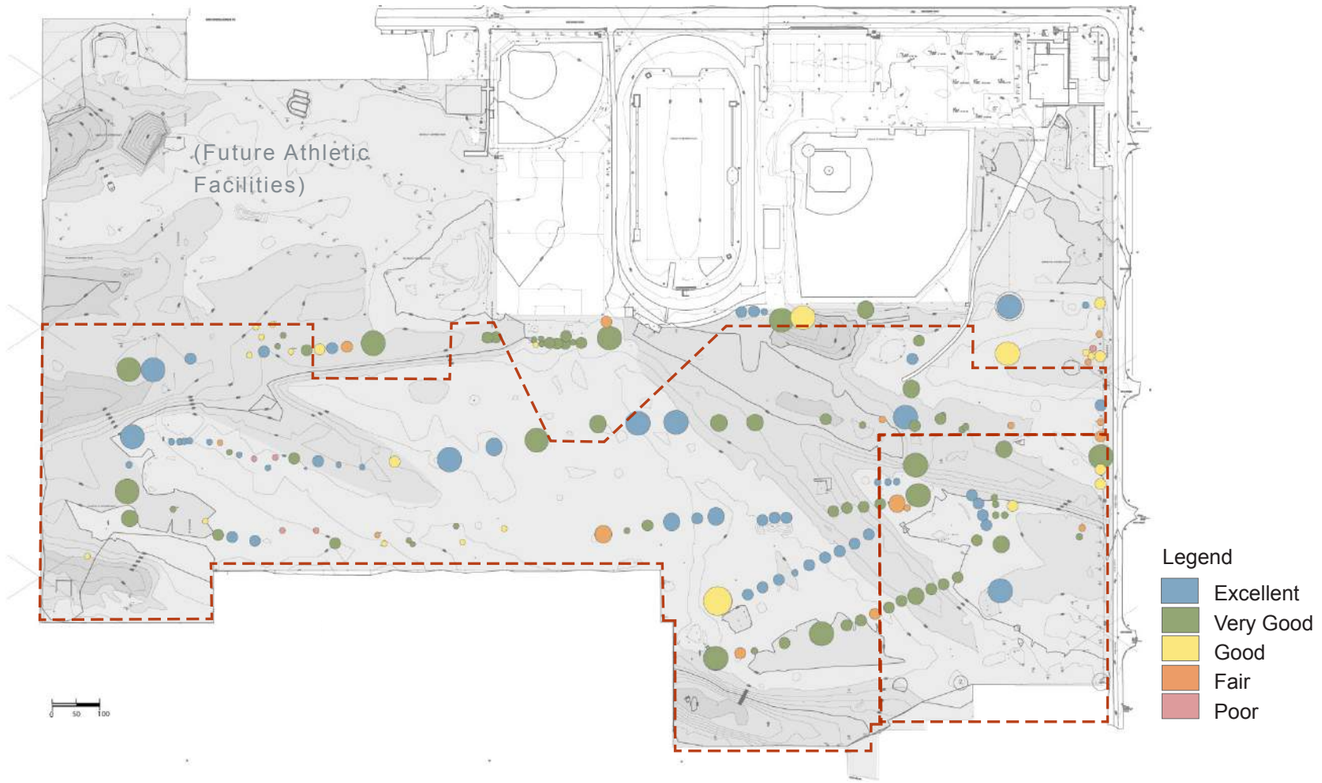
A large majority of the existing trees on site are in excellent or very good condition. However, species diversity is very low, and typical native understory is uncommon.

Existing site trees:

- Exceptionally good condition and age diversity
- Douglas fir dominated population
- Free of risk related structural damage and defects.. Some co-dominant and damaged trunks. Trunk wounds from limbing-up trees.
- Witches Broom and Bud Twig Miner were evident in single trees. The former should be addressed promptly.
- Western Red Cedars along fairways show drought and sun stress. Excessively well drained soil provides inadequate soil moisture necessary for Cedars in full sun.
- Low species diversity makes it crucial to control pest and disease problems promptly and pro-actively.
- Stand lack understory woody species associated with natural Douglas Fir settings and would benefit from there presence.
- A less heavily used and managed condition will alleviate compaction, over watering (root disease), and risk exposure.



Douglas Firs in very good condition | Credit: Mithun

Co-dominant trunks | Credit: Arbutus Design

Mining Beetle damage | Credit: Arbutus Design

Witch's broom invasion | Credit: Arbutus Design

Stressed Cedar | Credit: Arbutus Design

Site Tree Assessment

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Species	Botanical Name	Site Distribution	Significance	Pierce Weed Control	Noxious Weed
PRIMARY:					
Himalayan Blackberry	Rubus procerus	Widespread - roughs / fenceline	Aggressive spread by copious seed & runners	NA	No
Scot's Broom	Cytisus scoparius	Widespread - roughs / fenceline	Aggressive colonizer with profuse, long-lived seed	Recommended	WA Class B
Canada Thistle	Cirsium arvense	Discontinuous infestations - edges & SW waste area	Persistent rhizomatous colonizer, also seed spread	Recommended	WA Class C
Hedge Bindweed	Convolvulus sepium	Discontinuous infestations - edges & SW waste area	Smothering vine also grows from root fragments	Recommended	WA Class C
Fruiting Cherry	Prunus avium cv.	Single area - SW of Green #2 near fence	Escaped from mother tree via seed and suckers	NA	No
Aspen*	Populus tremuloides	Single area - SW of Green #2 near fence	Suckering widely from mother trees into grove	NA	No
SECONDARY:					
St. John's Wort	Hypericum perforatum	Isolated patches in roughs	Major noxious weed spread by seed and rhizome	Not listed	WA Class C
Common Hawkweed	Hieracium lachenalii?	Discontinuous - fenceline / roughs	Perennial, profuse seeder	Required	WA Class C
Nightshade	Solanum spp.	Isolated	Bittersweet=perennial, hairy=annual; poisonous	NA	No
Tansy Ragwort	Senecio jacobaea	Adjacent offsite patch to W only	Major noxious weed endures dry habitats	Mandatory	WA Class B
Poison Hemlock	Conium maculatum	Adjacent moist area offsite to W only	Deadly noxious weed in moist habitats	Mandatory	WA Class B
Reed Canary Grass	Phalaris arundinacea	Adjacent moist area offsite to W only	Aggressive rhizomatous noxious wetland weed	Recommended	WA Class C
TERTIARY:					
Foxglove	Digitalis purpurea	SW waste area	Naturalized, spread by seed, poisonous	NA	No
Dandelion	Taraxacum officinale	Fairways & roughs	Naturalized, thrives in lawns and rough areas	NA	No
English Daisy	Bellis perennis	Fairways	Naturalized where moist or in irrigated lawn	NA	No
White Clover	Trifolium repens	Fairways	Rhizomatous spread primarily lawn weed	NA	No

NOTE:
List is not comprehensive for herbaceous weeds.
Significant invasive species may not be classified as Noxious Weeds.
Class B weeds have uneven distribution in state; containment to prevent further spread recommended.
Class C weeds are widespread statewide; containment/local control recommended.
Tertiary weeds are commonplace in cultivated landscapes; control desirable.

* Aspen is native in some areas of Washington State, but in some conditions can form extensive groves that might adversely effect prairie species.

Legend
- Pierce County recommended eradication
- Pierce County required eradication
- Washington State mandatory eradication

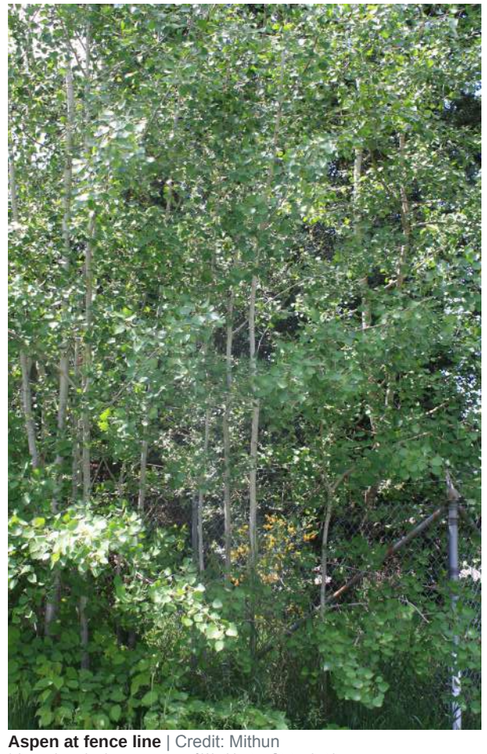
Invasive Plant Assessment

Common on-site invasives that out-compete native prairie species:

Canada Thistle | Credit: Arbutus Design

Green waste area with invasives (Morning Glory, Blackberry, etc.) | Credit: Mithun

Introduced species (Cherry Trees) | Credit: Touchstone EcoServices



Aspen at fence line | Credit: Mithun

* Aspen is native in some areas of Washington State, but in some conditions can form extensive groves that might adversely effect prairie species.

Eastern Cottontail | Credit: Touchstone EcoServices

Scot's Broom | Credit: Mithun

Eastern Gray Squirrel | © Flickr | kjarret

Bamboo at fence line | Credit: Touchstone EcoServices

Common Invasive Species Found On Site

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Program

Credit | Arbutus Design

PLU's Mission statement:

- "To educate students for lives of thoughtful inquiry, service, leadership and care –for other persons, for their communities and for the earth."

PLU Project Principles:

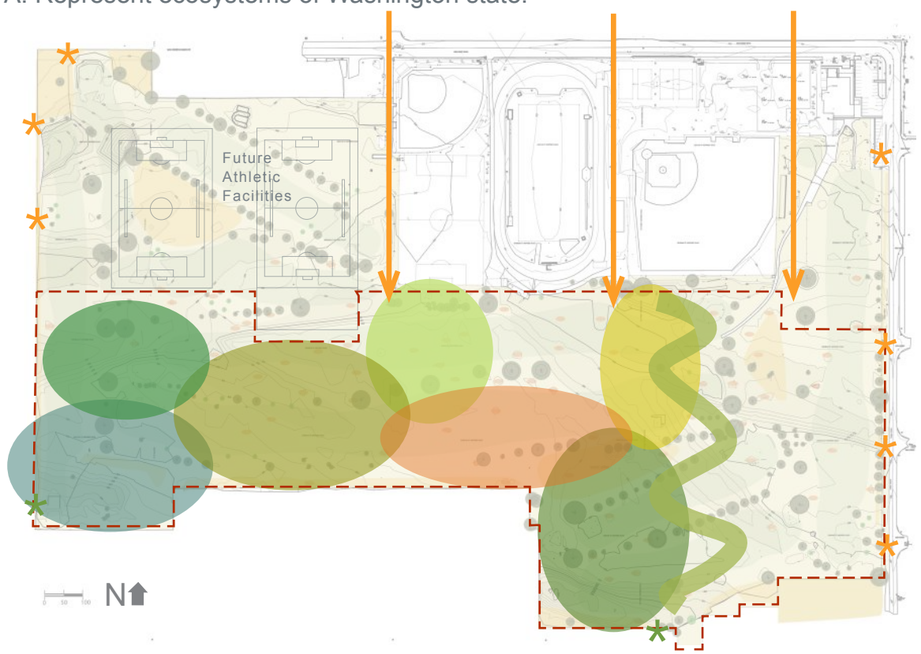
- Create a national model of the south campus open space that supports interdisciplinary research and curriculum; a place that is an outdoor classroom and laboratory.
- Create a place dedicated to the preservation and restoration of a unique habitat and the display of native species.
- Support authenticity and health by creating a place dedicated to a flexible integration of uses that support the ecological functions and potential biodiversity of the site.
- Create a place to continue and enhance PLU's leadership role in the community
- Create a place for community outreach, education, and recreation.
- Revisit and incorporate the campus sustainability goals during the course of the project development

Anticipated Users:

- Students
- Faculty
- Researchers
- Athletes
- Senior Citizens
- School children
- Families/Community/Neighbors
- Birders, Native Plants & Habitat Restoration Enthusiasts

Project Mission, Principles and Anticipated Users

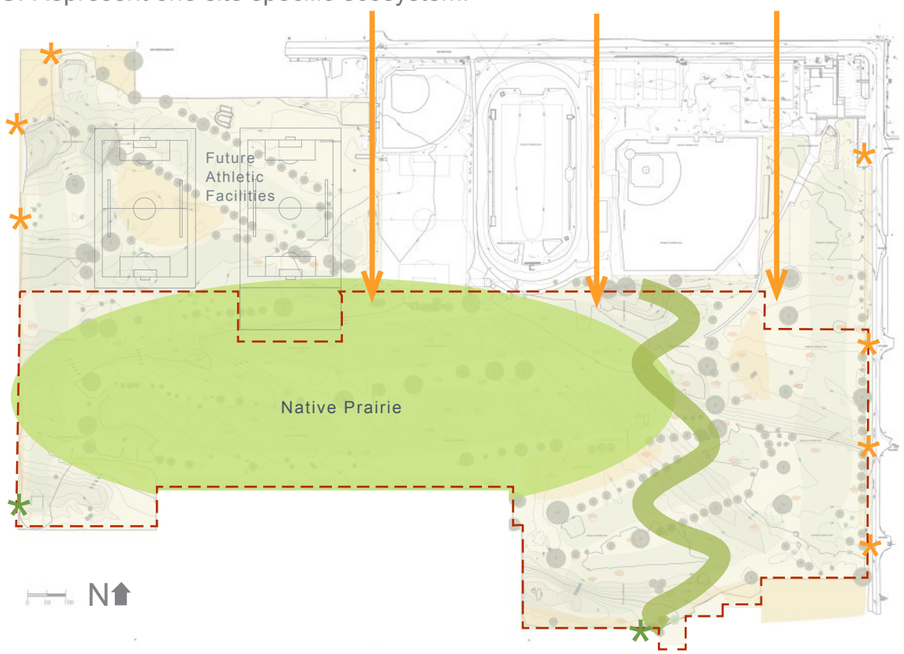
A. Represent ecosystems of Washington state.



Demonstration zones could include:

- Alpine
- Montane
- Ponderosa
- Shrubsteppe
- San Juan & Olympic rainshadow
- West lowland forest
- Rainforest
  - Old growth forest
  - Garry oak
  - Woodland prairie

C. Represent one site specific ecosystem.



B. Represent several ecosystems relevant to local area and site.

Demonstration zones could include:

- Wetland prairie
- Upland prairie
- Garry oak woodland prairie

Program: Habitat Options

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Habitat Sizes

Butterflies and Streaked Horned Meadowlarks:

At least three patches of prairie grassland that are at least 2.5 acres

The patches should be within 328 feet of each other and connected by a corridor of prairie grassland.

Western Grey Squirrels:

Squirrels rely on Garry oak/pine forests. Typically, an individual squirrel would need a forest that was at least 5 acres in size. It would be useful to create Garry oak forest in the golf course as there are other nearby Garry oak restoration projects. Together, these areas could potentially provide habitat for a species that is experiencing ever-dwindling habitat.

All Wildlife:

The off-site wetland to the west would be an important feature, once invasive plants are removed.

The existing conifers on the golf course could be incorporated into habitat restoration plans, to serve as a wind break for butterflies during large storms, to provide shade during hot summer days, and habitat for squirrels.

* A wetland is likely to exist in this general vicinity and is shown only schematically*

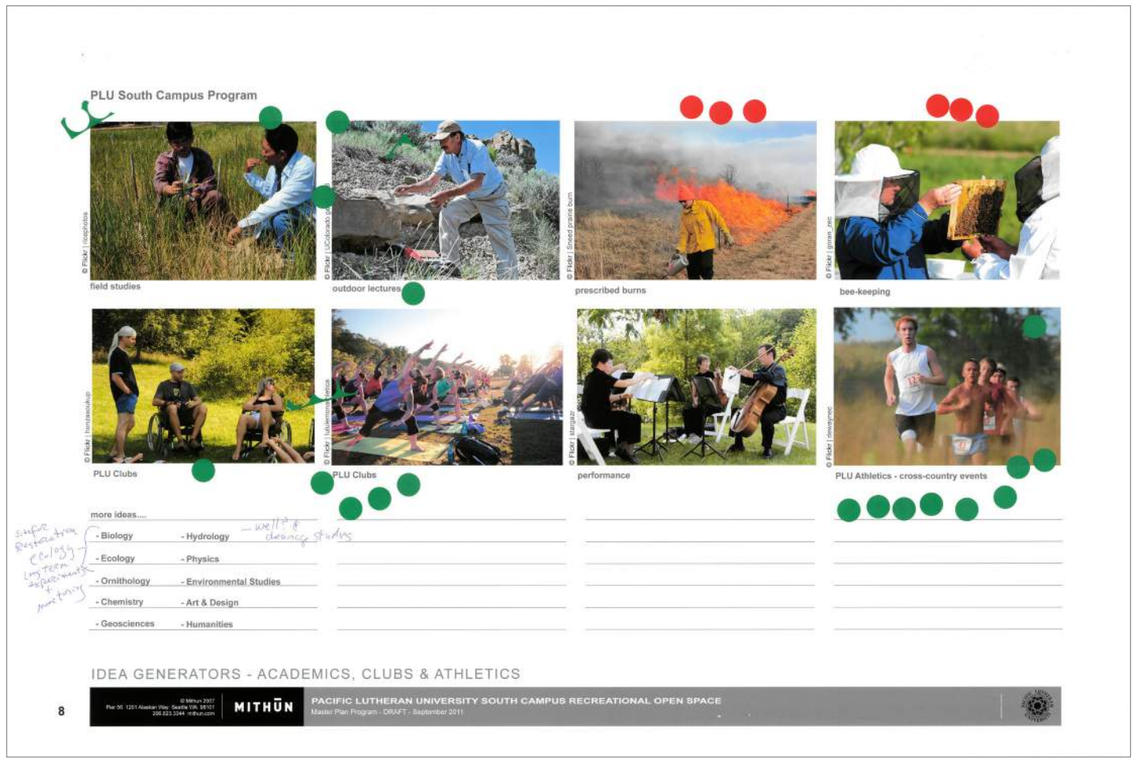
Program: Minimum Meaningful Habitat Sizes

Dot Exercise:

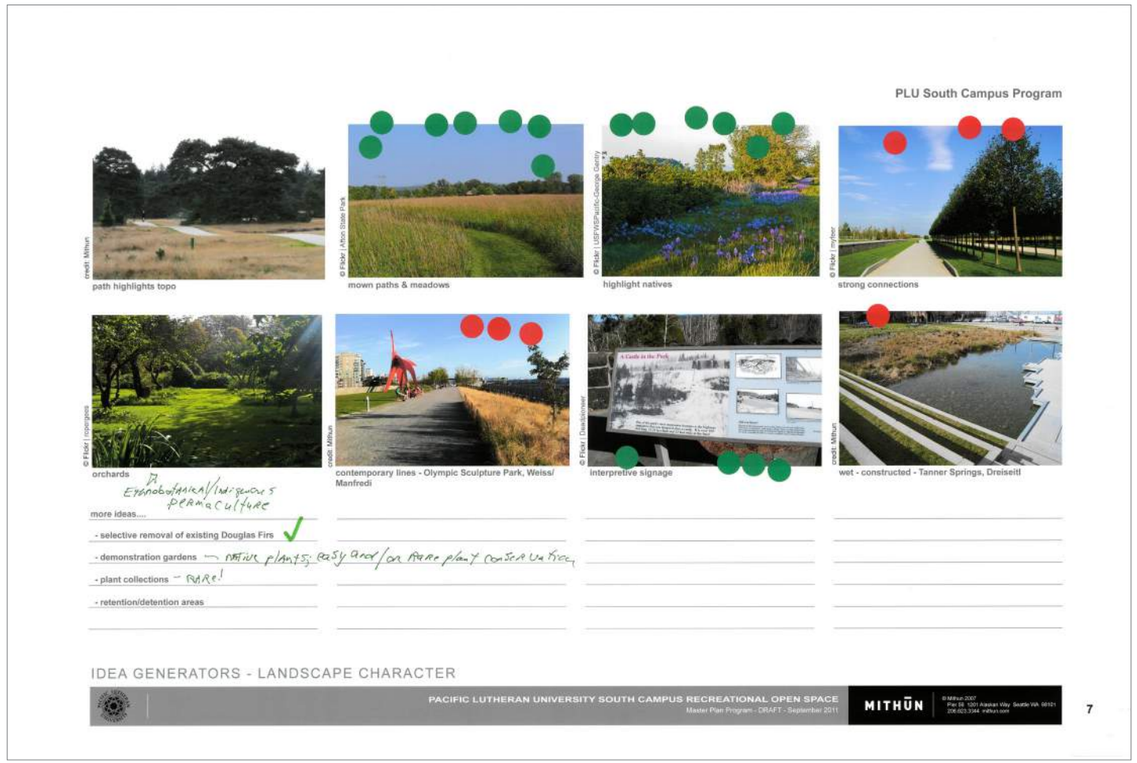
Over the course of a number of meetings and workshops, both with the Steering Committee and the Community, we used a series of participatory exercises to get immediate feedback on the visions and goals for the site.

- **Landscape character:** 'Feel' of the landscape-hardscape, softscape, lines, curves, etc.
- **Elements:** Lighting, site furnishings,shelters, pea-patch gardens, etc.
- **Academics clubs and athletics**: Features that support curriculum.
- **Flexible uses:** Bicycle paths, open mown lawn areas, picnic areas, etc.
- **Sustainable site strategies and technologies**: Invasive plant management, composting toilets, renewable energy use, building healthy soils, etc.)
- **Art and outreach:** Permanent or temporary art installations, high school outreach, community field ecology classes, etc.)

Participants were asked to stick colored dots on those images and ideas that most reflected their preferences for future uses of the site. Red indicated that they were NOT interested/supportive of that program element, and green indicated that they were.



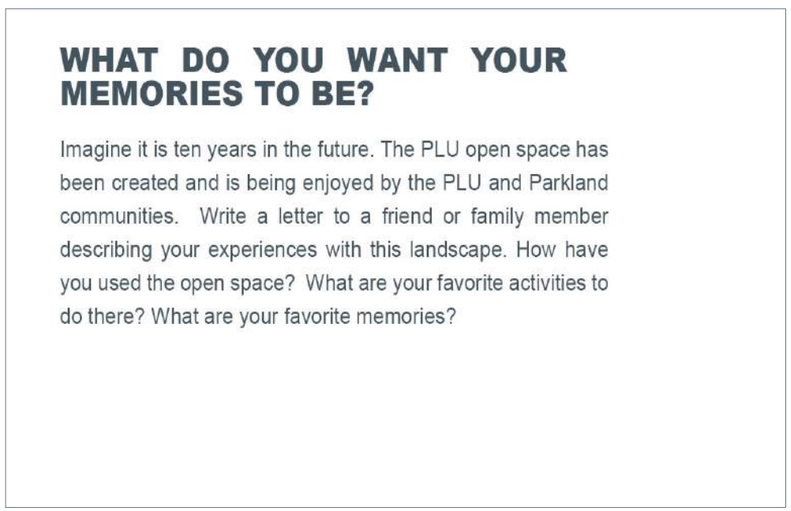
Sample result from dot exercise: Academics, clubs and athletics board- showing a clear preference for a site that supports academic curriculum (ie. Field study area, outdoor classrooms), clubs, and athletics (ie- cross country running, training on loop trail) .



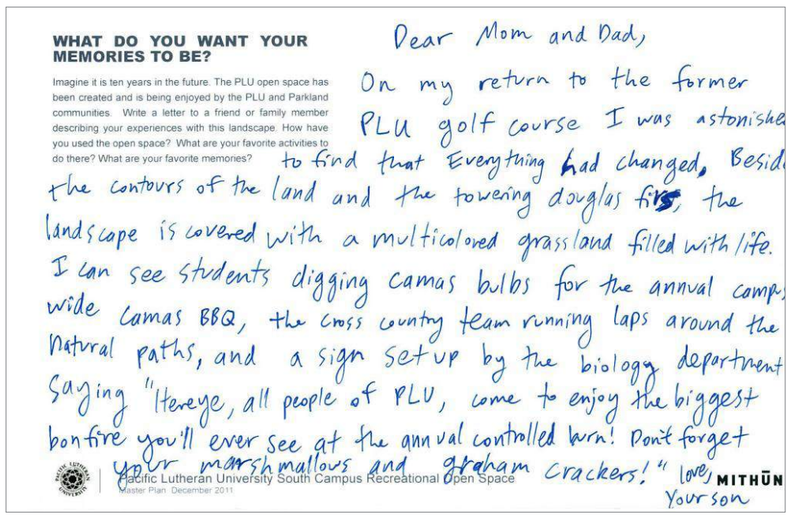
Sample result from dot exercise: Landscape character board - showing a clear preference for a softer landscape approach, with opportunities for interpretive signage.

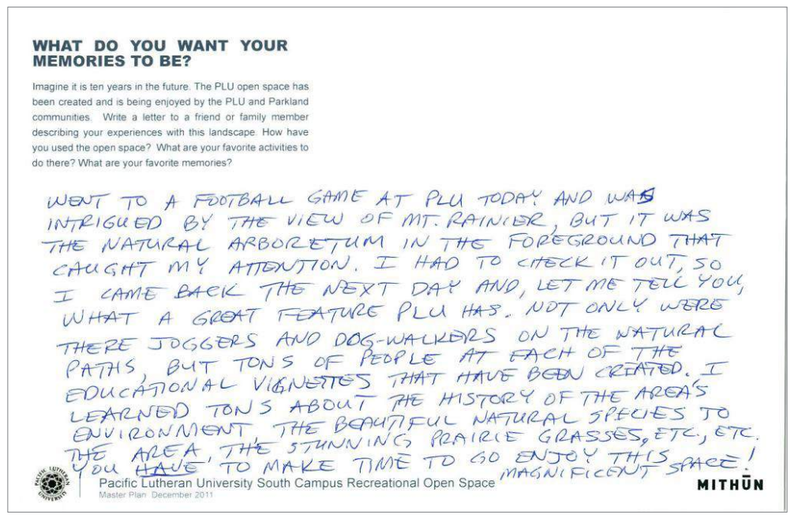
Program: Stakeholder Input

The Postcard Exercise: Participants were given a postcard asking them to write about their future ideal memories of the site.



Sample results from postcard exercise: Describing clear visions of a beautiful, native, open space that supports curriculum and community.





Program Confirmation

- One to two outdoor classroom gathering spaces: 30 people each
- Outdoor classroom support (i.e. geology samples, water well, Camas fields)
- Variety of walking path surfaces (permeable concrete, accessible gravel, mulch, mown)
- Pedestrian connections to university, streets and neighborhood
- Cross country running paths and space to host related events: 200 people
- Garry oak prairie restoration
- Mima mounds highlighted
- Invasives management
- Fir groves and lowland native plantings, Madrone and Ponderosa pine
- Aquifer recharge
- Full cutoff lighting, during certain hours
- Interpretive signs
- Art: durable or temporary
- Access for dogs
- No bike trails
- Restroom near north edge of site
- Emergency access
- Emergency blue phones (to be confirmed)

Program: Visioning Exercises and Confirmation

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Summary of feedback from steering committee, faculty, students, and public meetings

There is a strong desire to continue academic activities and an enthusiasm for the many ways the site can support the curriculum in the future.

Current academic activities on the site include:

- Topographic mapping
- Hydrology studies (requires low spot or swale for infiltration, and proximity to water supply)
- Rock type studies
- Prairie restoration survey areas
- Botanical surveys of remnant prairie areas (golf course roughs)
- Sustainable landscape research

Sustainability

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Major topics discussed during the eco-charette:

Environmental Context
- Climate Change
- Impacts to Regional Ecosystems
- Sequestration
- Mitigation/Adaptive Planning

Site Strategies
- Energy
- Water
- Soils
- Habitat
- Materials
- Human health & well-being
- District Strategies

Goal Setting
- Existing (Master Plan 2006)
- Aspirational (relevant rating systems/ guidelines)

Eco-Charette: An interactive brainstorming exercise that generates and targets sustainability goals for site design.

Premise: The South Campus Open Space is a unique opportunity to combine the mission with the site and community goals of the PLU community. This project weaves native landscapes, connects the campus, athletic facilities, and neighborhood and creates a model of sustainable, and potentially regenerative design, in the region.

For the future of PLU and the citizens of the 21st century, finding ways to wisely use water and energy resources while protecting and enhancing human health and habitat, creates a positive connection with nature and the community. The South Campus Open Space embeds these key lessons and experiences into its fabric. The lessons need to be meaningful, tied to curriculum, and fun in order to reach the widest audience over time who will support and help develop the site.

Sustainability is a multi-layered goal, requiring an understanding of many features on site and the broader context: the history, the climate, the bioregion, watershed, local economy, and more. The project will show a man-made landscape transformed into a restored native landscape.

To establish and confirm sustainability goals for the site, the next step in the masterplanning process was an eco-charette with the Steering Committee.

Eco-Charette

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Credit: Mithun

Site

Goals:

- Restore native habitat and enhance ecological function.
- Promote biodiversity.
- Protect stormwater functions and recharge aquifer.
- Minimize toxic materials such as pesticides
- Cultural benefits.
- Use best management practices for maintenance.

Strategies:

The project could utilize the ‘Sustainable Sites Initiative’ to target and track these strategies:

Improve Biomass. This enhances ecological function by maintaining or establishing regionally appropriate vegetative biomass to support the ecosystem service benefits provided by site vegetation such as; pollutant interception, water absorption, greenhouse gas regulation and microclimate regulation.

Preserve or improve floodwater storage capacity as necessary to achieve the SITES prerequisite to protect floodplain functions. This prerequisite is particularly important for the health of the Clover Creek Watershed.

Provide outdoor spaces for supporting curriculum and social interaction: This builds community and improves social ties as required by SITES.

Develop an interim and long term management plan prior to construction to remove invasive species, limit disturbance, assist soil restoration efforts, and define the location and boundaries of all vegetation and soil protection zones.

Water

Goals:

- Achieve a regenerative watershed site for water and hydrological systems.
- Reduce potable water used for irrigation
- Increase water quality.
- Recharge aquifer.

Strategies:

Reduce use of on-site wells for irrigation. Past use of wells to irrigate golf course during summer may be contributing to a low water table and dry sections of creek in summer.

Restoration of native prairie or addition of trees would increase interception and reduce the rate and volume of water infiltrated in the winter, and could have a positive effect on downstream flooding.

Potential aquifer recharge.

If existing clubhouse and parking lots are to remain, retrofit with water quality treatment or green stormwater infrastructure. This could help reduce downstream pollution.

Connect to Nature

Goals:

- Connect community to natural systems.
- Employ emerging study of ‘Biophilia’: the instinctive affinity of humans to connect with living systems.

Strategies:

Provide a variety of spaces for the student’s and the neighbor’s experience to be influenced by the nature.

Field studies occur at the exterior classrooms and overlook the prairie.

The viewpoint/overlook areas provide moments of pause and views of majestic Mt. Rainier, connecting visitors to the larger regional landscape.

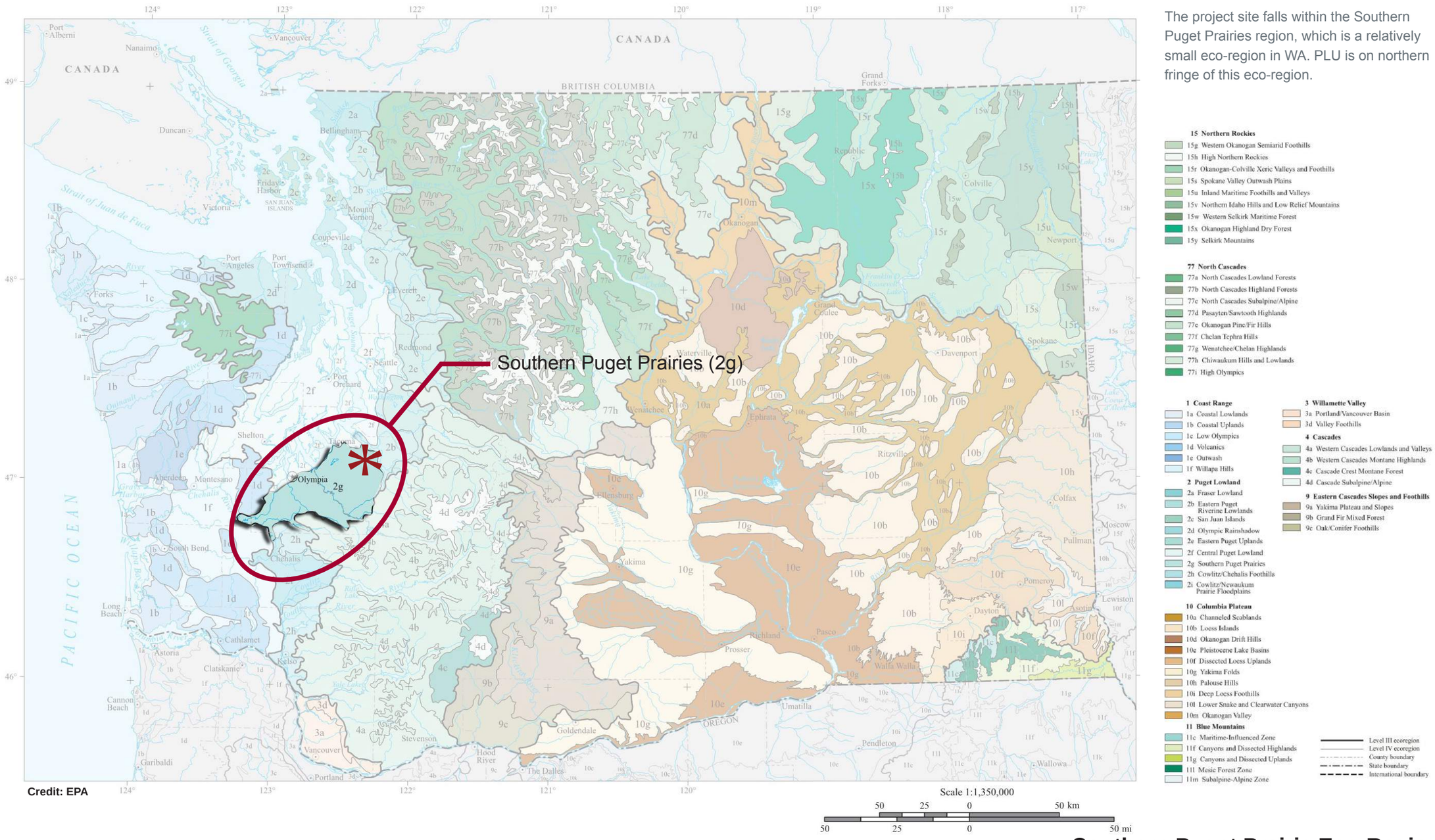
Highlight existing unique site features (Mima mounds and remnant prairie habitat) through strategic planting and topographical moves.

Provide a path system that moves through various landscape types, enriching the experience through variety and increased biodiversity.

All of these experiences help create a safe and positive connection to nature within examples of vanishing Garry Oak Prairie landscapes.

Goals and Strategies

The project site falls within the Southern Puget Prairies region, which is a relatively small eco-region in WA. PLU is on northern fringe of this eco-region.



Credit: EPA

Southern Puget Prairie Eco-Regions

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Carbon Sequestration in Prairies

Prairies have been found to sequester the second largest amount of carbon of all ecosystem types. This is mostly due to carbon being sequestered underground in the deep roots of the prairie plants.

PLU's prairie restoration areas can therefore have a positive impact on regional and local carbon sequestration goals.

Climate Change Response Strategies

Anticipate and allow for new plant types that are climate refugees. Historic plant assemblages may no longer be the appropriate baseline.

Preserve ecosystem processes and constraints. Preserving physical and biological interactions in situ is the key to successful long-term conservation, and differentiates natural lands conservation from species preservation in zoos or botanical gardens.

Use habitat heterogeneity of site to sustain populations and functions in place. In several South Puget Sound prairies, conservation practitioners have begun to increase the amount of annual forbs and non-native plant species that can fill the need for early season food, especially in cool wet springs, for larvae of the Taylor's Checkerspot butterfly.

Monitor climate response and change of biological communities.

Integrating native prairie restoration within a regional climate adaptation strategy.

Storm Drainage Requirements

Construction activities that disturb more than 6,000 square feet, create more than 2,000 square feet of new impervious area, move more than 50 cubic yards of soil, spread more than 50 cubic yards of topsoil per year, perform trenching, or perform work within a sensitive

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Climate Change, Water Standards, Water Requirements

area must following the requirements of the Pierce County 2008 Stormwater Management and Site Development Manual (Pierce County SWM Manual), and must obtain a site development permit.

Due to the relatively high permeability of site soils on-site dispersion and infiltration facilities including low impact development facilities are expected to be feasible for on-site stormwater management. The need for runoff treatment facilities is not anticipated as the project does not propose to construct roads, parking lots, or other impervious surfaces that would generate polluted runoff.

If permanent building structures are proposed, their locations and elevations, relative to on-site closed depressions and the Clover Creek flood plain to the south, should be analyzed for compliance with Pierce County SWM Manual requirements. There are currently no existing sanitary sewer or potable water facilities, and no existing storm drain facilities or conveyance elements. Construction stormwater controls are required for all land-disturbing projects.

Note that a new version of the Pierce County Manual is expected to be approved in summer of 2012. Future phases of the project should review the updated Manual for any pertinent revisions.

Irrigation

While existing irrigation mains should be acceptable for use during the plant establishment period, existing pipes may require replacement in areas where existing grade will be lowered.

Potable Water

If new potable water connections are desired for drinking fountains or hand washing in restroom facilities, water availability should be discussed with Parkland Light & Water Co (PL&WCo).

Sanitary Sewer Requirements

Restroom facilities, if added, are currently proposed to be composting toilets.

Composting toilets are intended to use aerobic microbial digestion to transform human waste into compost. These facilities would eliminate the need for a new sanitary sewer connection to the Pierce County system, and may also eliminate the need for a new potable water connection to the PL&WCo system. Composting toilets come in many different types and configurations, and can be purchased commercially or built on site.

Composting toilets installed in Pierce County must meet Washington State Department of Health (DOH) requirements, and must be maintained according to DOH guidelines. Note that finished compost must be removed from the toilet unit and properly disposed of. Proper use, operation, monitoring, and maintenance of composting toilets are critical to their successful function.

If composting toilets are proposed in the future, the potential to use these as an educational facility and the availability of staff for monitoring and maintenance should be discussed with PLU at that time.

Permit Requirements

Pierce County requirements for drainage control plans and associated permits increase incrementally with the quantity of soil moved, amount of new impervious surface constructed, and total area disturbed. Land disturbance over 7,000 square feet, construction of new impervious surface over 2,000 square feet, or earthwork exceeding 50 cubic yards will require a site development permit from Pierce County Planning and Land Services Department, and may require SEPA (State Environmental Policy Act) review.

Land disturbance over one acre will require a construction stormwater Notice of Intent (NOI) to Washington State Department of Ecology if surface runoff may leave the site.

Composting toilets would require approval by the Tacoma-Pierce County Health Department.

Other Topics Requiring Further Discussion

Pierce County Assessor tax parcel maps show public right-of-way within the project area, generally following the adjacent street grid. Future projects should verify that all work proposed is on PLU property, or discuss any additional requirements with Pierce County if work is in fact proposed within County right-of-way.

Climate Change, Water Standards, Water Requirements

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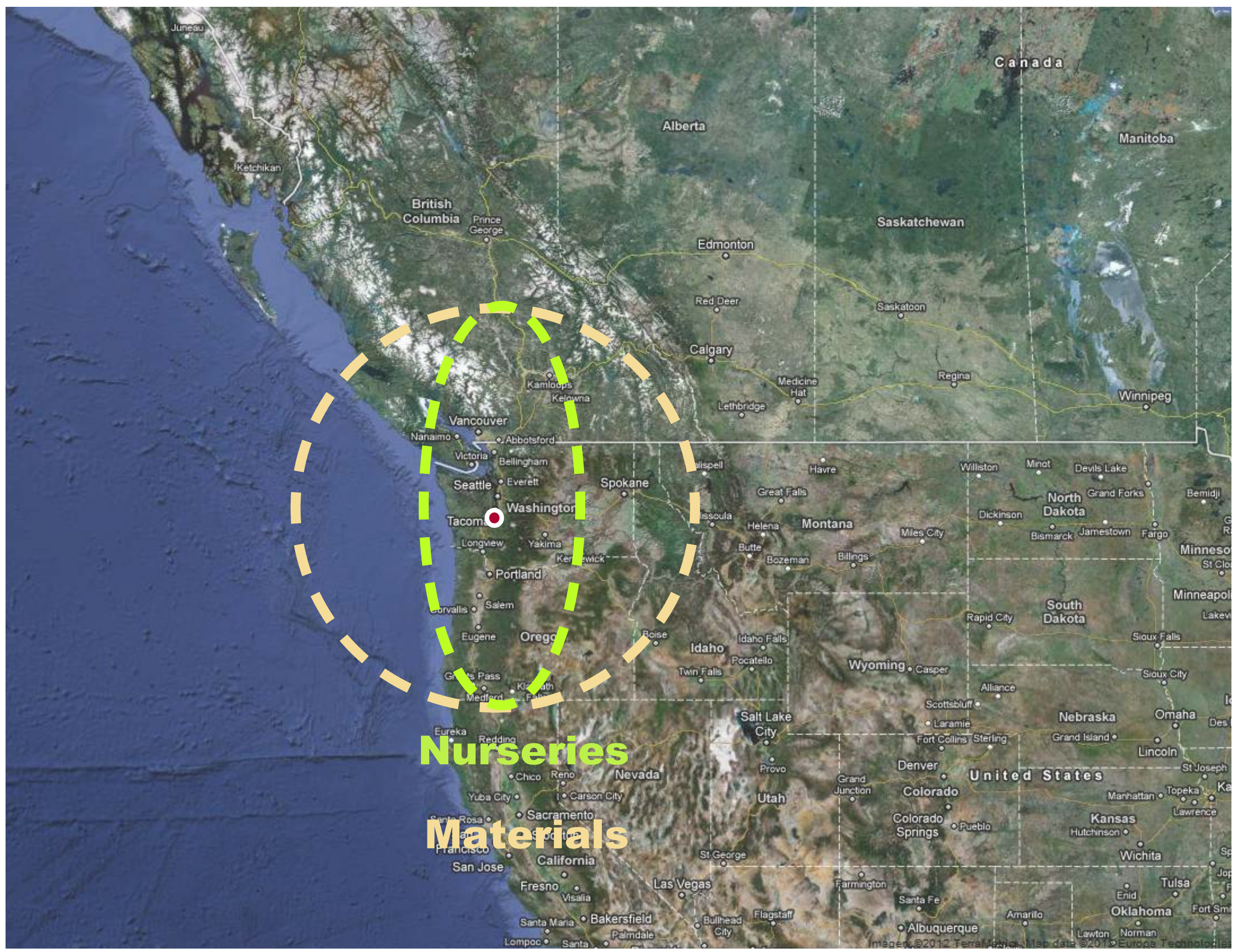

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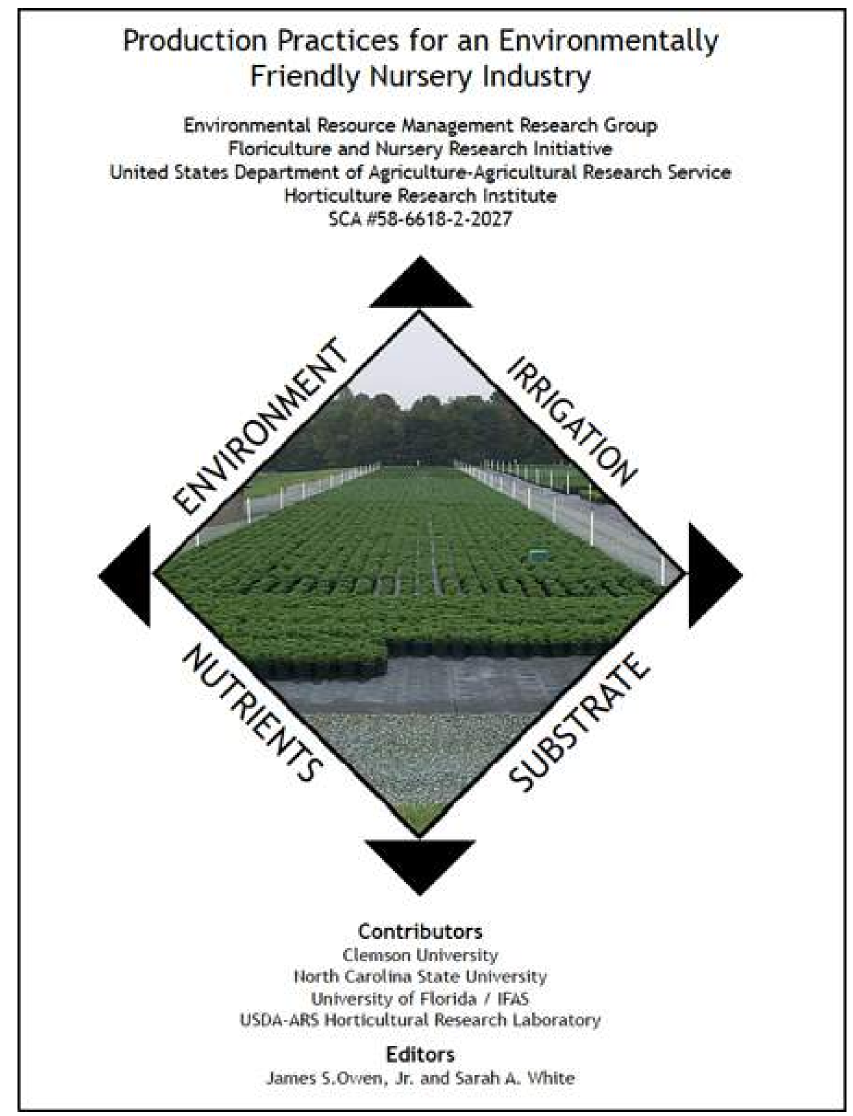
Production Practices for an Environmentally Friendly Nursery Industry

Environmental Resource Management Research Group
Floriculture and Nursery Research Initiative
United States Department of Agriculture-Agricultural Research Service
Horticulture Research Institute
SCA #58-6618-2-2027

Contributors
Clemson University
North Carolina State University
University of Florida / IFAS
USDA-ARS Horticultural Research Laboratory

Editors
James S. Owen, Jr. and Sarah A. White

Materials Sourcing

- Utilize materials that have been extracted, harvested or recovered, and manufactured within 300 miles of the project site.
- Source planting material from local nurseries.
- Preference for nurseries that use sustainable practices.

Sustainable Nursery Practices

- Plant provenance.
- Soil health.
- Improving water and nutrient use efficiency.
- Capturing and recycling runoff.
- Remediation of runoff.
- Containing excess nutrients and residual pesticides prior to offsite discharge.
- Non-monetary benefits or costs.

Material Sourcing

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Materials Considerations

- Initial Costs—Purchase, Acquisition, Construction Costs, Incentives.
- Fuel Costs.
- Operation, Maintenance, and Repair Costs.
- Replacement Costs.
- Residual Values—Resale or Salvage Values or Disposal Costs.

Materials Standards

- Low Emitting
- Durable
- Recyclable
- Recycled
- Local
- Non-toxic
- Low Embodied Energy
- Tactile / Educational

Material Consideration and Standards

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Motion

Resilience

Prospect & Refuge

Sensory Richness

Biophilia

Biophilia

The goals at the South Campus Open Space include employing the emerging study of 'Biophilia': the instinctive affinity of humans to connect with living systems.

The site will provide a diversity of experiences and opportunities for connection to and learning from the natural environment.

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Sustainability Goals

Mithun authored the 2006 PLU Campus Masterplan, the tenets upon which the current project has built, including reviewing the previous overall sustainability goals. The South Campus Open Space has the opportunity to expand those goals, achieving even higher sustainable practice.

Existing Campus Goals (2006 Master Plan)

Water

- Reduce water consumption by 25% over 5 year period.

Energy

- Reduce overall energy consumption by 20% over 5 year period.
- Carbon neutral by 2020.
- Consider renewable energy generation.

Habitat

- Increase habitat quality and quantity.
- Increase tree canopy by 22% within 5-10 years.

Vegetation

- Specify plant species that will thrive without special care and are disease resistant.
- Develop planting palettes that support habitat connectivity.

Aspirational Goals for South Campus Open Space

- Net zero water - eliminate aquifer withdrawal.
- Net zero energy.
- Sustainable ecosystems that increase native diversity.
- Ethnobotany, working landscapes, food production.
- Living laboratory / outdoor classroom.
- Health and safety.

Sustainable Sites Initiative:

The Sustainable Sites Initiative was created to promote sustainable land development and management practices that can apply to sites with and without buildings. SITES will provide tools for those who influence land development and management practices and can address increasingly urgent global concerns such as climate change, loss of biodiversity, and resource depletion. They can be used by those who design, construct, operate and maintain landscapes, including but not limited to planners, landscape architects, engineers, developers, builders, maintenance crews, horticulturists, governments, land stewards and organizations offering building standards. http://www.sustainablesites.org

Criteria	Prerequisites and Credits		Achievement: yes	maybe	no
1 SITE SELECTION — Select locations to preserve existing resources and repair damaged systems		21 Possible Points			
1.1 Prerequisite	**Limit disturbance of soils designated as prime farmland, unique farmland, and farmland of statewide importance**	Required	x		
1.2 Prerequisite	**Protect floodplain functions**	Required	x		
1.3 Prerequisite	**Preserve wetlands**	Required	x		
1.4 Prerequisite	**Preserve threatened or endangered species and their habitats**	Required	x		
1.5 Credit	Select brownfields or greyfields for redevelopment	5-10 Points			x
1.6 Credit	Select sites within existing communities	6 Points	x		
1.7 Credit	Select sites that encourage non-motorized transportation and use of public transit	5 Points		x	
2 PRE-DESIGN ASSESSMENT AND PLANNING — Plan for sustainability from the onset of the project		4 Possible Points			
2.1 Prerequisite	**Conduct a pre-design site assessment and explore opportunities for site sustainability**	Required	x		
2.2 Prerequisite	**Use an integrated site development process**	Required		x	
2.3 Credit	Engage users and other stakeholders in site design	4 Points	x		
3 SITE DESIGN—WATER — Protect and restore processes and systems associated with a site's hydrology		44 Possible Points			
3.1 Prerequisite	**Reduce potable water use for landscape irrigation by 50 percent from established baselines**	Required	x		
3.2 Credit	Reduce potable water use for landscape irrigation by 75 percent or more from established baseline	2-5 Points		x	
3.3 Credit	Protect and restore riparian, wetland, and shoreline buffers	3-8 Points			x
3.4 Credit	Rehabilitate lost streams, wetlands, and shorelines	2-5 Points			x
3.5 Credit	Manage stormwater on site	5-10 Points	x		
3.6 Credit	Protect and enhance on-site water resources and receiving water quality	3-9 Points		x	
3.7 Credit	Design rainwater/stormwater features to provide a landscape amenity	1-3 Points		x	
3.8 Credit	Maintain water features to conserve water and other resources	1-4 Points			x
4 SITE DESIGN—SOIL AND VEGETATION — Protect and restore processes and systems associated with a site's soil and vegetation		51 Possible points			
4.1 Prerequisite	**Control and manage known invasive plants found on site**	Required	x		
4.2 Prerequisite	**Use appropriate, non-invasive plants**	Required	x		
4.3 Prerequisite	**Create a soil management plan**	Required	x		
4.4 Credit	Minimize soil disturbance in design and construction	6 Points	x		
4.5 Credit	Preserve all vegetation designated as special status	5 Points		x	
4.6 Credit	Preserve or restore appropriate plant biomass on site	3-8 Points	x		
4.7 Credit	Use native plants	1-4 Points	x		
4.8 Credit	Preserve plant communities native to the ecoregion	2-6 Points	x		
4.9 Credit	Restore plant communities native to the ecoregion	1-5 Points	x		
4.10 Credit	Use vegetation to minimize building heating requirements	2-4 Points			x
4.11 Credit	Use vegetation to minimize building cooling requirements	2-5 Points			x
4.12 Credit	Reduce urban heat island effects	3-5 Points		x	
5 SITE DESIGN—MATERIALS SELECTION — Reuse/recycle existing materials and support sustainable production practices		36 Possible points			
5.1 Prerequisite	**Eliminate the use of wood from threatened tree species**	Required	x	x	
5.2 Credit	Maintain on-site structures, hardscape, and landscape amenities	1-4 Points		x	
5.3 Credit	Design for deconstruction and disassembly	1-3 Points		x	
5.4 Credit	Reuse salvaged materials and plants	2-4 Points		x	
5.5 Credit	Use recycled content materials	2-4 Points		x	
5.6 Credit	Use certified wood	1-4 Points		x	
5.7 Credit	Use regional materials	2-6 Points		x	
5.8 Credit	Use adhesives, sealants, paints, and coatings with reduced VOC emissions	2 Points		x	
5.9 Credit	Support sustainable practices in plant production	3 Points		x	
5.10 Credit	Support sustainable practices in materials manufacturing	3-6 Points		x	
6 SITE DESIGN—HUMAN HEALTH AND WELL-BEING — Build strong communities and a sense of stewardship		32 Possible Points			
6.1 Credit	Promote equitable site development	1-3 Points	x		
6.2 Credit	Promote equitable site use	1-4 Points		x	
6.3 Credit	Promote sustainability awareness and education	2-4 Points		x	
6.4 Credit	Protect and maintain unique cultural and historical places	2-4 Points	x		
6.5 Credit	Provide for optimum site accessibility, safety, and wayfinding	3 Points	x		
6.6 Credit	Provide opportunities for outdoor physical activity	4-5 Points	x		
6.7 Credit	Provide views of vegetation and quiet outdoor spaces for mental restoration	3-4 Points	x		
6.8 Credit	Provide outdoor spaces for social interaction	3 Points	x		
6.9 Credit	Reduce light pollution			x	
7 CONSTRUCTION — Minimize effects of construction-related activities		21 Possible Points			
7.1 Prerequisite	**Control and retain construction pollutants**	Required	x		
7.2 Prerequisite	**Restore soils disturbed during construction**	Required	x		
7.3 Credit	Restore soils disturbed by previous development	2-8 Points		x	
7.4 Credit	Divert construction and demolition materials from disposal	3-5 Points		x	
7.5 Credit	Reuse or recycle vegetation, rocks, and soil generated during construction	3-5 Points		x	
7.6 Credit	Minimize generation of greenhouse gas emissions and exposure to localized air pollutants during construction	1-3 Points		x	
8 OPERATIONS AND MAINTENANCE — Maintain the site for long-term sustainability		23 Possible Points			
8.1 Prerequisite	**Plan for sustainable site maintenance**	Required	x		
8.2 Prerequisite	**Provide for storage and collection of recyclables**	Required	x		
8.3 Credit	Recycle organic matter generated during site operations and maintenance	2-6 Points		x	
8.4 Credit	Reduce outdoor energy consumption for all landscape and exterior operations	1-4 Points		x	
8.5 Credit	Use renewable sources for landscape electricity needs	2-3 Points		x	
8.6 Credit	Minimize exposure to environmental tobacco smoke	1-2 Points		x	
8.7 Credit	Minimize generation of greenhouse gases and exposure to localized air pollutants during landscape maintenance activities	1-4 Points		x	
8.8 Credit	Reduce emissions and promote the use of fuel-efficient vehicles	4 Points		x	
9 MONITORING AND INNOVATION — Reward exceptional performance and improve the body of knowledge on long-term sustainability		18 Possible Points			
9.1 Credit	Monitor performance of sustainable design practices	10 Points	x		
9.2 Credit	Innovation in site design	8 Points		x	

© Sustainable Sites Initiative

Rating systems:

Multiple rating systems offer certifications for varying sustainability achievements. These certifications are opportunities to document environmental stewardship by third party verification. Nationally recognized systems include:

- Sustainable Sites Initiative (SITES) for site and landscape
- Living Building Challenge
- Salmon Safe
- 2030 Challenge for Carbon reduction and Greenhouse Gas Emissions

There is some overlap between the different rating systems; These rating systems provide a recognized goal for donors, agencies and stakeholders. We would recommend that the PLU South Campus Open Space Project register for the Sustainable Sites Initiative program to achieve a documented, nationally recognized certification.

Rating Goals:

We recommend setting high goals for sustainability, with the understanding that certain key elements will be dependent upon funding and support.

Green Rating Tools

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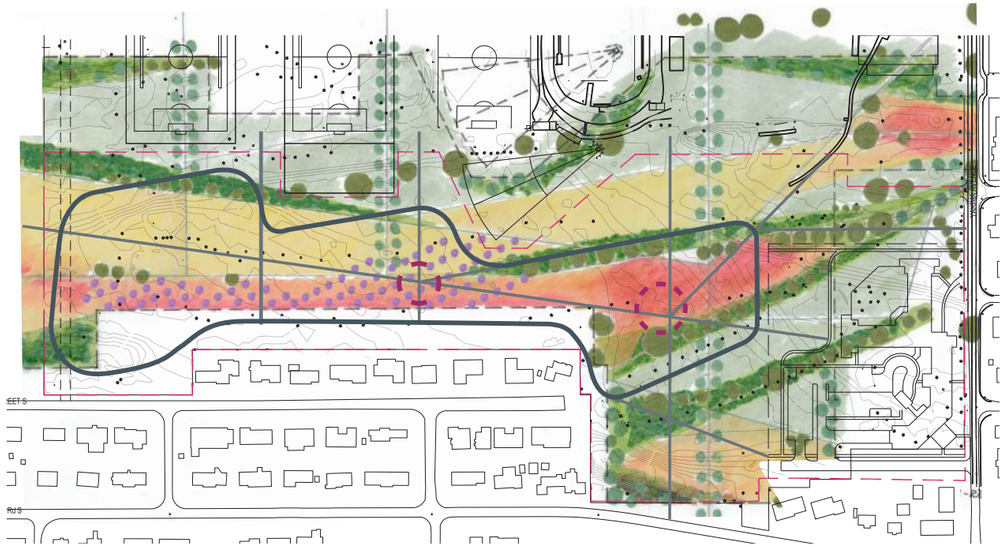
Alternatives &
Final Concept Design

Credit | Arbutus Design

1

Alternative 1: Open Prairie and Mima Walk

Highlight Mima mounds (existing and new) on north edge, buffering athletics.
Open prairie mostly within curvilinear loop trail.
Open views from south edge.
Axial paths connecting to campus.



2

Alternative 2: Transects and Orchards

Existing Firs provide framework for planting and paths.
Create habitat corridors by expanding Fir lines with rich planting.
Develop allees along axial north-south campus connections.
Buffer views with orchard along south and west edges.

3

Alternative 3: Fir Groves and Lowlands

Mixed canopy and low groundcover planting on north edge buffering athletics.
Open prairie mostly within the loop trail with ribbons extending out.
Partial views from south edge with ribbons of enriched Fir groves.
Loop trail passes through multiple habitats and plantings.

Alternative Plans

1 Summary of Feedback on Alternative 1:

- Positive response to Mima mound walk.
- The plan has too much open prairie.
- Positive response to loop trail.

2 Summary of Feedback on Alternative 2:

- The orchard is good idea but may need to reconsider location and size.
- Too many linear paths, although good to build off of existing lines of Douglas firs.
- The north/south Axis paths could be good for safety/security.

3 Summary of Feedback on Alternative 3:

- Positive response to bands of woodland/habitat within prairie .
- Strong preference for treatment of southern edges.
- Positive response to loop trail and curving paths.

Preferred Draft Alternative

- Incorporates Mima mound walk from Alt 1.
- Incorporates North South Axis paths from Alt 2.
- Incorporates orchard from Alt 2, reducing size and moving the path closer to inter-generational housing.
- Incorporates the loop trail habitat bands and southern border treatment from Alt 3.
- Designs a 1 mile trail alignment that fits within the site, habitat, and program requirements.

Alternatives: Feedback

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Final Concept Design: Organizational Site Diagram

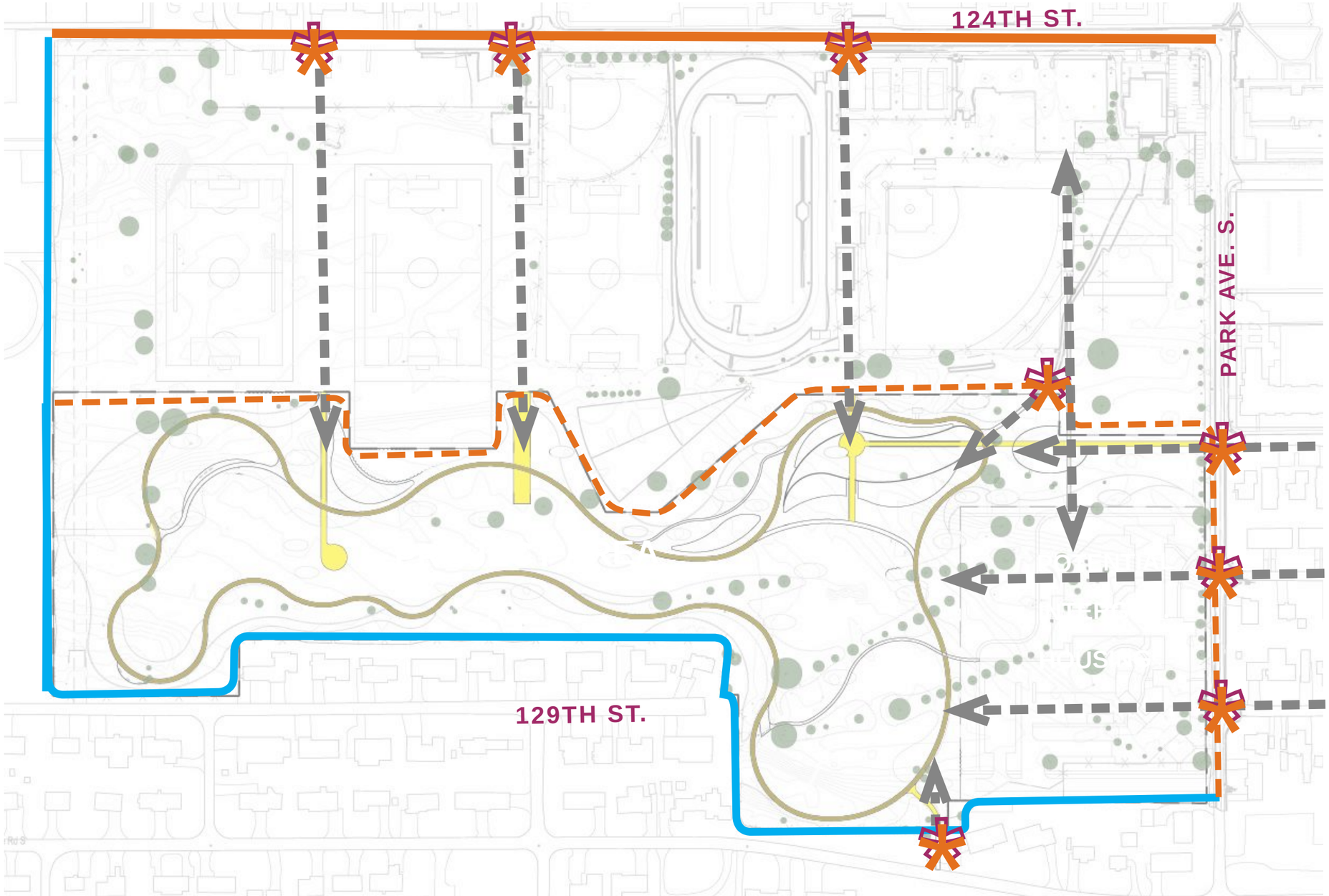
Trees & Trail System

Prairie Restoration Area

Key Points

- Main paths should define edges of habitat zones
- Establish areas specifically for habitat restoration, where entry is not encouraged
- Protect mounds when possible
- Concentrate active use/recreational areas
- The site is a living laboratory that will evolve over time
- In order to best protect site resources, development should evolve within the framework of the master plan
- Successful habitat restoration requires stewardship by the campus and parkland community.
- The more thorough the initial control of weeds is prior to planting, the less weed control will be needed later.
- University to assess dog access and management strategies with goal of continuing access and protecting natural resources

Final Concept Design: Key Site Elements



A key consideration in creating a successful master plan includes ensuring that all connections and edges are taken into account. This diagram was created to test the potential for all access points and adjacencies.

Important connections and edges:

- North/south connections through athletic facilities to Upper Campus, as per 2006 Master Plan.
- East/west connections to adjacent neighborhood.
- Permeable edge along inter-generational housing property, so as to blur the edge, creating a holistic site and connections to the Upper Campus.
- Formal, fenced edge along 124th Street, acting as a threshold to the athletic facilities and the open space
- Potential southern connection to restoration area .
- Due to concerns about added foot traffic and parking, no entry at the east end of 129th Street.

Legend
- Existing Fence
- Proposed Fence
- Project Limit Line
- Potential Entry

N

Fencing Diagram: Potential Connections and Edges

credit: Mithun

Mulch

© Flickr | Afton State Park

Mown

credit: Mithun

Crushed Gravel (future, needs further study)

Path Surface Types

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Proposed Final Concept Design: Illustrative

Woodland
Sanctuary

Oak
Bosque

Woodland
Edge

Prairie
Reserve

Proposed Final Concept Design: Ecosystem Overlay

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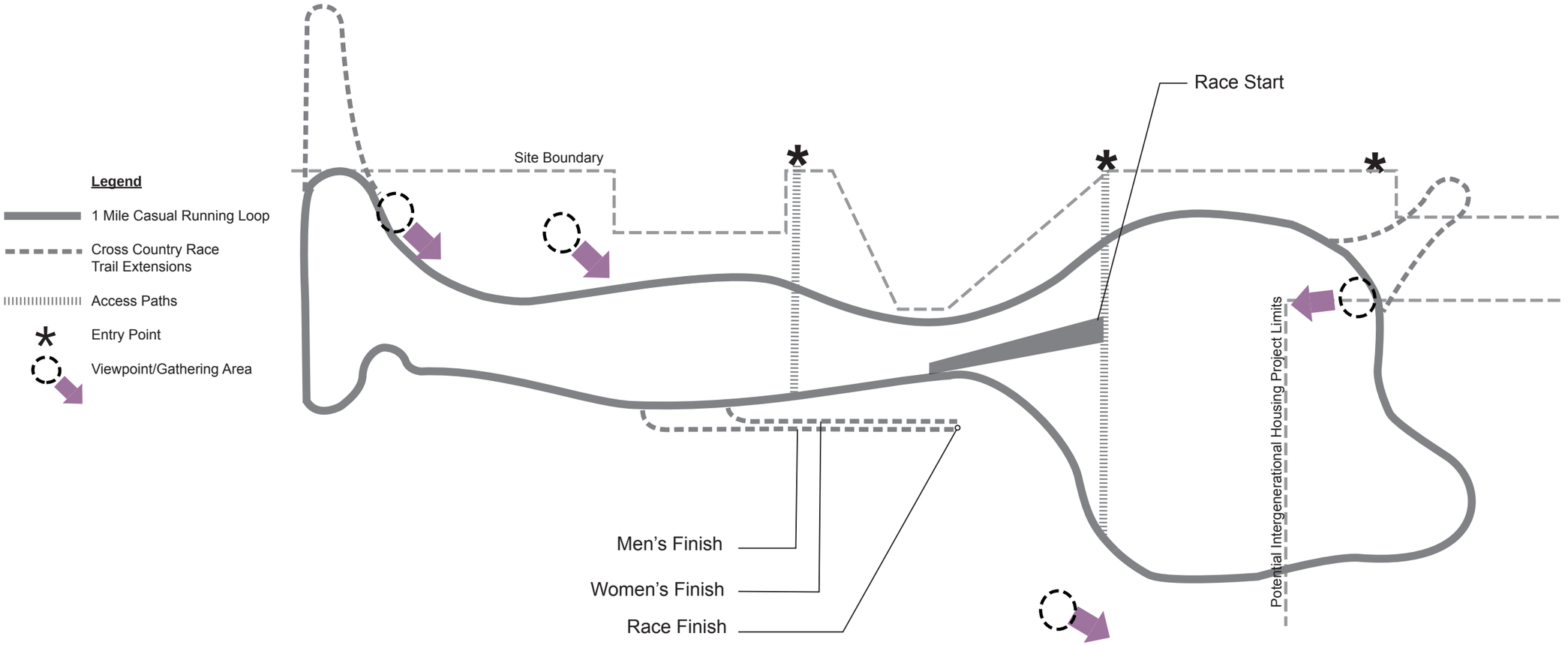

Current Trail Layout - July 2013

N

Current Trail Layout: Ecosystem Overlay - July 2013

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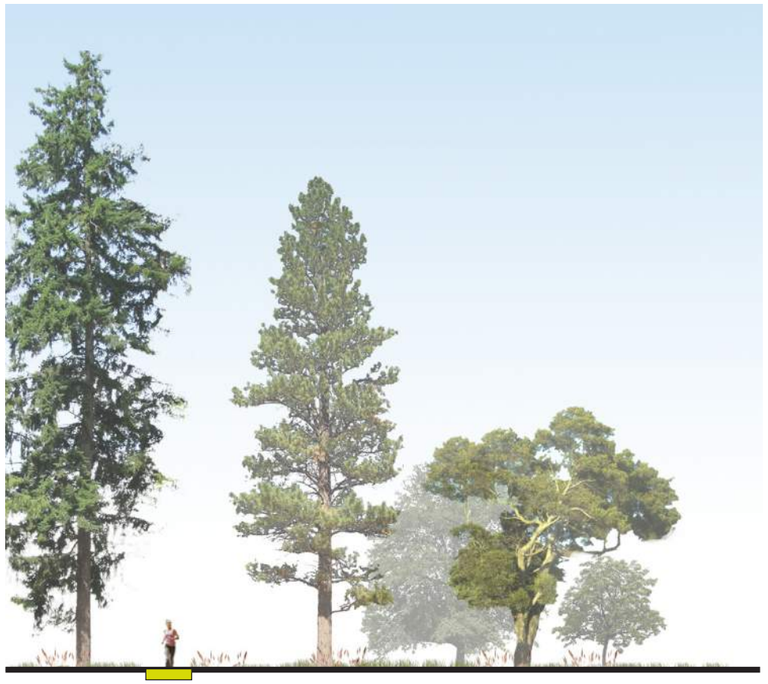
Detailed sections describe the potential species mixes, vertical structure, and spacing of the major landscape types intended for the site. Keeping the openness of the site while increasing habitat, maintaining sight lines for views and safety, and incorporating the existing Douglas Firs into the future design are all important aspects of the design.

Douglas Fir: Dense Understory

Douglas Fir
Madrone
Sword Fern
Salal
Serviceberry
Vine Maple

Credit | Mithun



Mixed Canopy: Low Groundcover

Ponderosa Pine
Garry Oak
Snowberry
Fescue
Beaked Hazelnut

© Flickr | ecstaticist

Garry Oak: Prairie

Garry Oak
Snowberry
Fescue
Camas Lily
Western Buttercup

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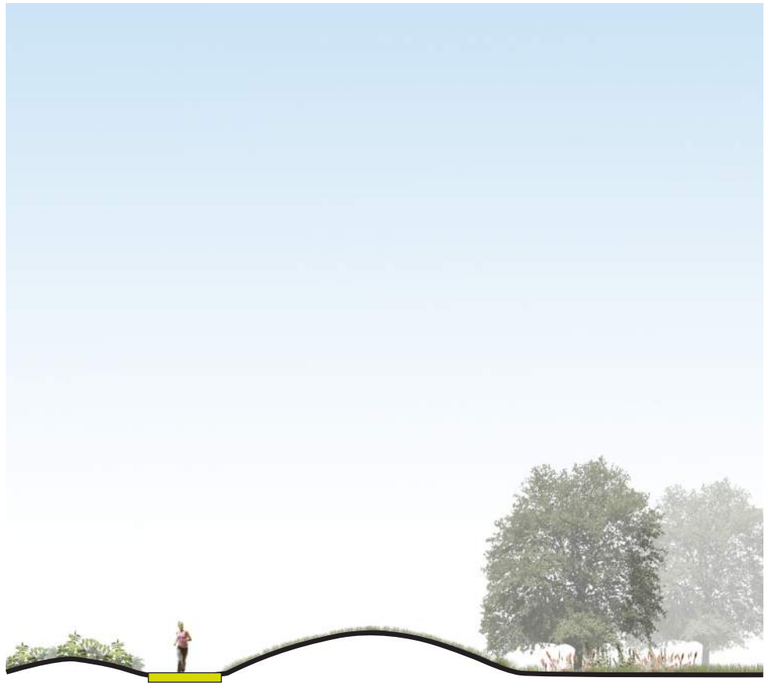
Final Concept: Habitat and Landscape Types

Open Prairie

Garry Oak <10%
Fescue
Camas Lily
Prairie Lupine
Harvest Brodiaea

Credit | Mithun

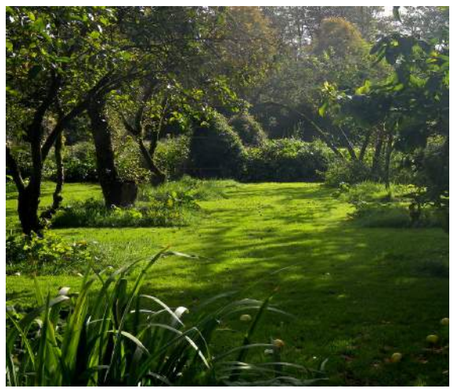


Mima Mound: Mima Walk

Fescue
Eco-lawn
Woody Shrubs
Camas Lily
Common Yarrow

Credit | Mithun

Heirloom Orchard



Fruit Trees
Fescue
Eco-lawn

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PLU South Campus: Alternatives and Final Concept Design

Study of potential treatments to highlight existing Mima mounds.

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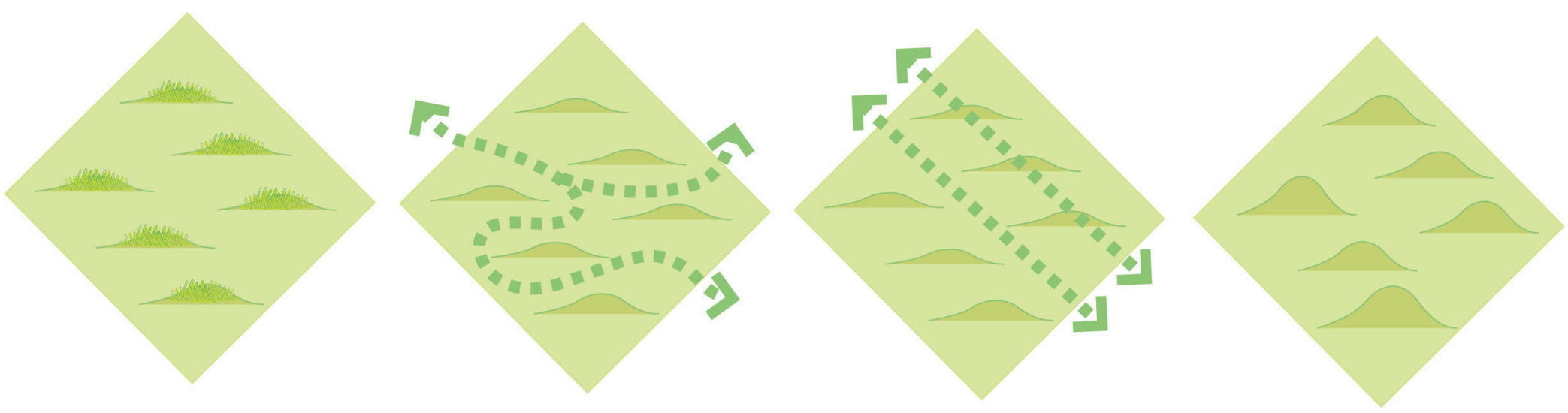
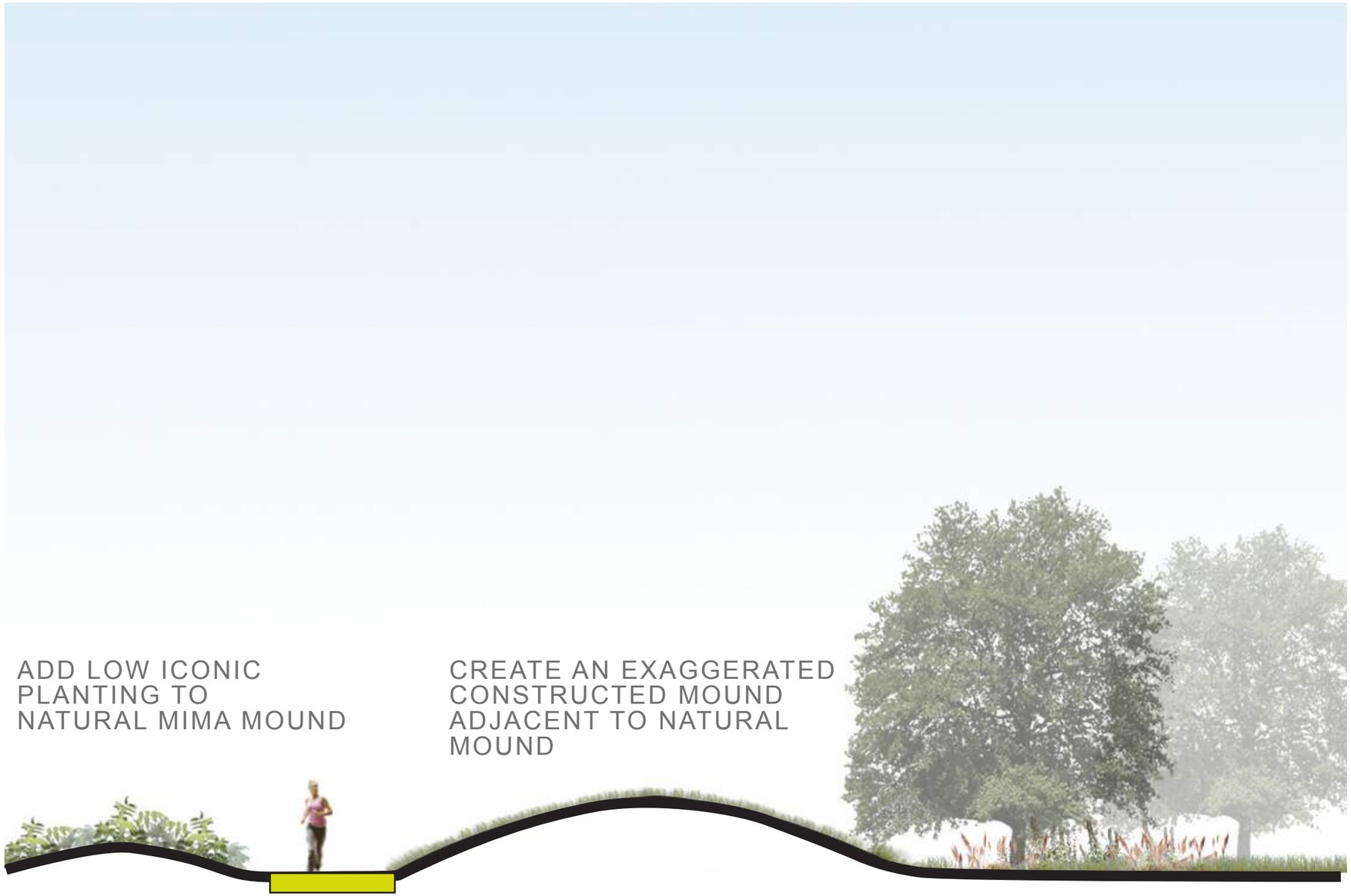
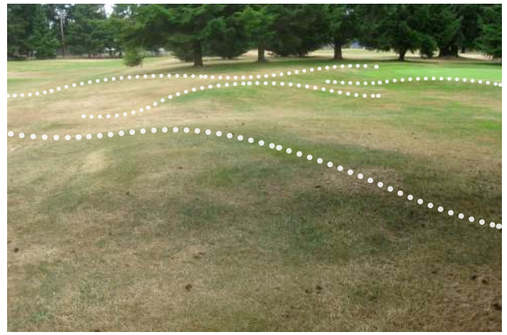


Final Concept: Mounds / Experience and Texture

New mounds will be sculpted as distinctly different from Mimas, allowing places for rest and play, planted with eco-lawn and specific vegetation will be planted on existing mounds to make them ‘pop’ within the larger landscape.





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Final Concept: Mima Walk

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Final Concept Perspective: Open Prairie in Spring

Final Concept Perspective: Open Prairie in Late Summer

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Final Concept Perspective: Outdoor Classroom and Mima Walk

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Final Concept Perspective: Orchard View

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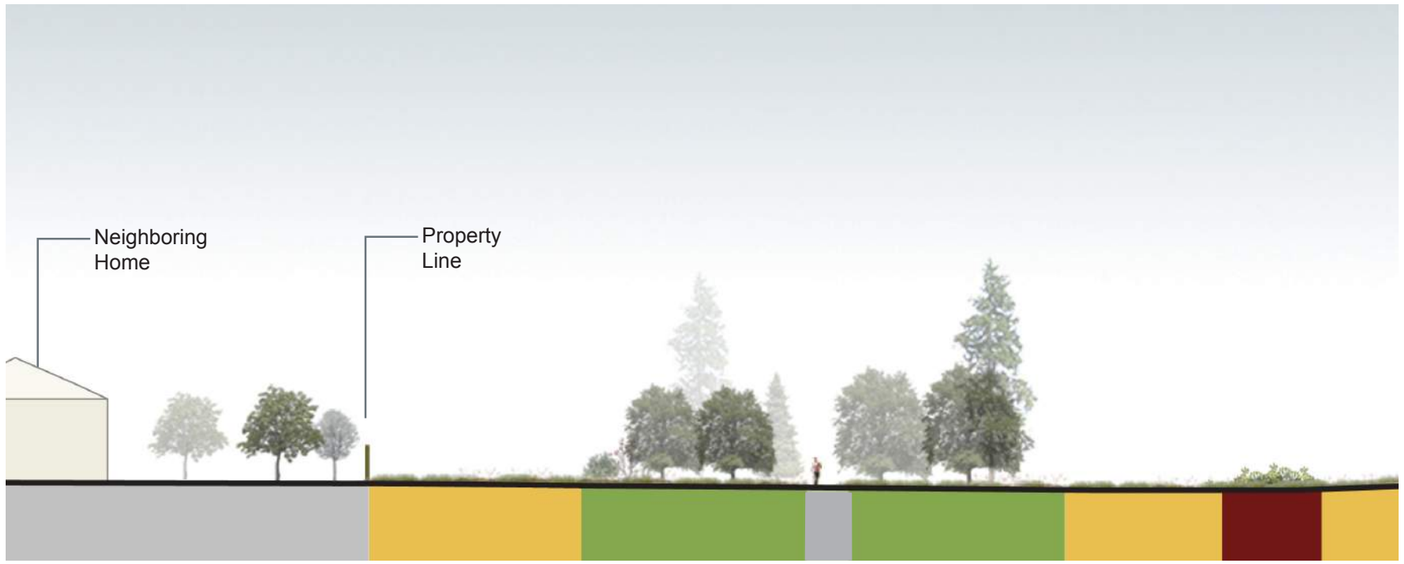
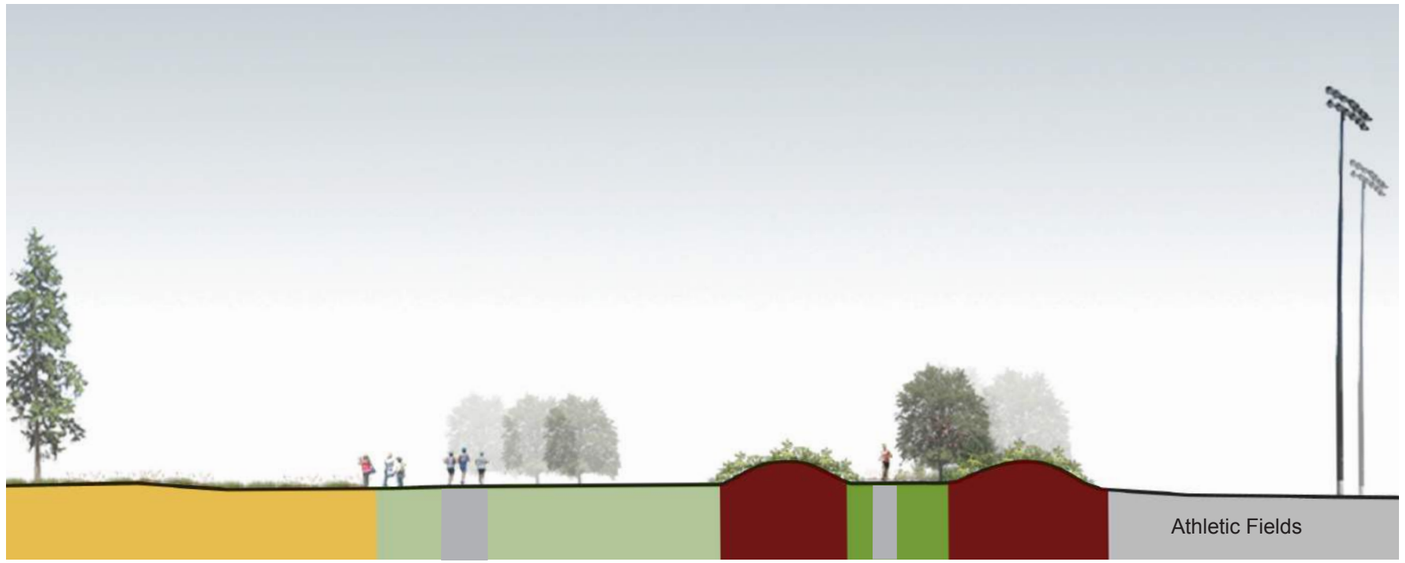


1. South Oak Prairie: Residences



2. North Mima Walk: Athletic Fields

Key plan

Legend

- Pine/Oak Woodland: High Understory
- Oak Woodland: Lower Understory/Grass
- Prairie
- Path
- Mima Mound

N

Final Concept Sections: Edge Conditions

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credit: Mithun

No management

credit: Mithun

Mixed non-native & native grasses w/ removal of scotch broom, blackberry, bindweed

credit: Southsoundprairies.org

Mixed grasses & perennial meadow

credit: Southsoundprairies.org

Native short grass meadow

credit: Mithun

Eco-lawn

Meadow Character

Prairie Restoration & Management Plan

Prepared by Diane Brewster, Touchstone EcoServices

Mima Mounds | © DNR, Birdie Davenport, washingtondnr.wordpress.com

Prairie Restoration & Management

Introduction

Restoring prairie and oak habitats is a high priority issue for numerous agencies. It may be advantageous to contact the local U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) office to find out more about the Wildlife Habitat Incentive Program (WHIP). Washington Department of Fish and Wildlife (WDFW) also administers Landowner Incentive Programs (LIP) that offer support to habitat restoration on private lands.

Prairie restoration requires planning and site preparation. As with all restoration projects, restoring prairie habitat is a process that is as educational as it is rewarding. Photographic monitoring of the site, from site preparation through planting and follow-up monitoring, is a good way to document changes to the golf course and is a useful tool for future activities and successes in the restoration process.

Three Main Steps:

- Site preparation
- Native plant installation
- Long-term maintenance

Step #1: Site Preparation

Key Points

- Controlling weeds, preparing the soil, and helping native plants establish are critical components of prairie and oak woodland restoration.
- The more thorough the initial control of weeds is prior to planting, the less weed control will be needed later.
- Prairie restoration can be completed in phases, but weed control should occur over the whole site.
- Removal strategies require more than one year to reduce weed cover .

Summary

Site preparation is critical to the success of prairie and oak woodland restoration. This involves controlling weeds that would compete with native plantings, preparing the soil and helping native plants become established the first few years after seeding/planting. Typically, woody plants within native habitat restoration projects require irrigation during the first two growing seasons after planting while the new vegetation becomes established; potentially less for prairie establishment.

The more thorough the initial control of weeds prior to planting, the less weed control will be needed later. However, there will always be a need for some level of weed maintenance through the long term. Species to be controlled at the golf course site include Scotch broom and ornamental shrubs that have escaped from surrounding areas. There are also non-native forbs such as common dandelion, St. John's wort, hairy cat's-ear, plantains, clovers, thistle; and non-native grasses. Douglas fir thinning may also be warranted based on the plant community design to allow enough sunlight for the prairie and oak woodland community and to remove diseased trees.

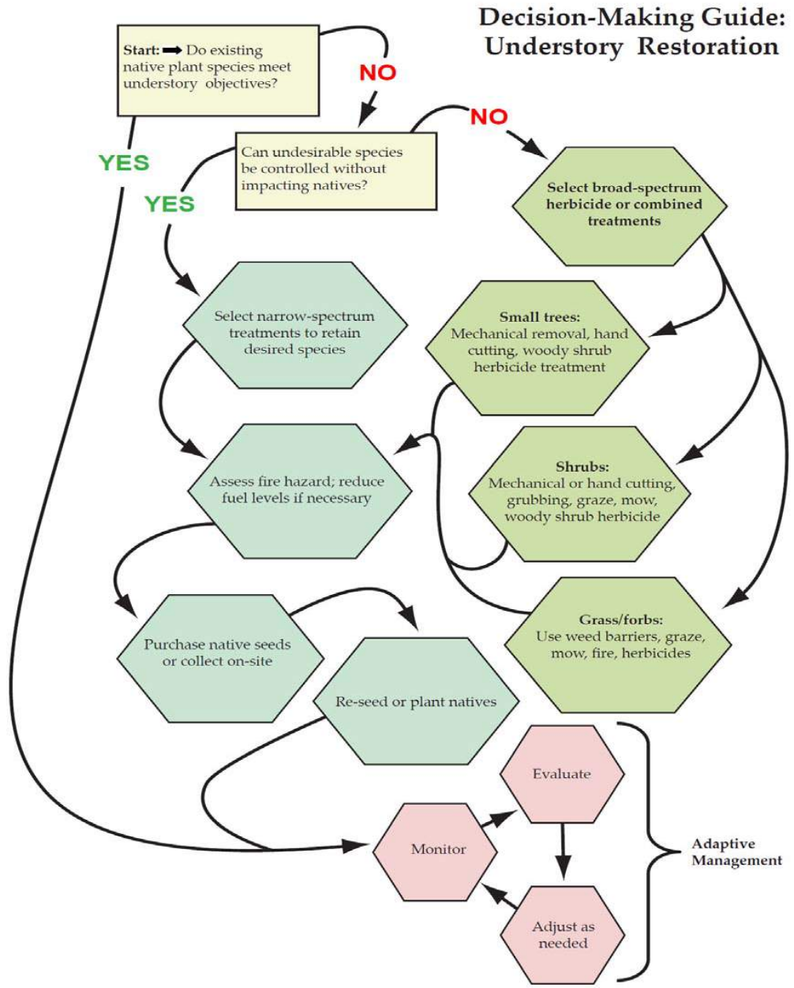
While the prairie restoration will likely be completed in phases, weed control over the entire open space area will provide the best results over the long term. If possible, full-site weed control will reduce the re-introduction of weed seed into areas that have already received control efforts. Control methods that can be readily used over large areas would be best in the initial stages of weed control; including mowing, which can control annual species, and herbicide used in tandem and prescribed burns. These strategies may require more than one year to sufficiently reduce weed cover. The site will need to be evaluated as the control methods are used to determine if additional applications of the methods are necessary.

Following large-scale weed control and achieving less than 25 percent non-native cover, hand-pulling and herbicide spot spraying can be used for long-term maintenance. Hand-pulling is the preferred method; however, herbicide spot spraying may be necessary in the first 5 years to control any areas of aggressive non-native regrowth. Figure 1 provides a decision-making guideline for Garry oak site preparation methods. This guideline is also applicable for prairie preparation.

Drill seeding with native grasses can be used after the mowing-herbicide effort in order to begin to establish native prairie vegetation and to discourage germination of any remaining non-native seedbank. Any herbicide used to remove non-native grasses will also affect native grasses. After drill seeding, any herbicide used should be done only as spot-spray to target specific species.

Specific Site Preparation Techniques

Scotch Broom is best removed by cutting the stems. This method has been used successfully in western Canada and Washington and has the best results when stems greater than one-quarter inch in diameter are lopped or sawn less than two inches from the soil surface. Doing this in the dry summer of July or August results in a very low re-sprout rate (approximately 1.5 to 5%). If this method is used at other times of year, care should be taken to cut the Scotch



Source:
Vesely, Dave and Gabe Tucker. 2004. *Landowner's Guide to Restoring and Managing Oregon White Oak Habitats.* Funded by USDI Bureau of Land Management, Salem District; Oregon Department of Forestry, The Nature Conservancy, and USDA Forest Service.

broom before any flowers go to seed. This can be accomplished quickly with minimal impacts to desired vegetation. In addition, there is less disturbance to the soil than if the broom is removed (roots and stems) via a weed wrench tool; thus minimizing germination of the existing broom seedbank in the soil. Some believe that pulling plants out of the ground or burning is the best approach, but opponents claim this raises new seeds to the surface. Perhaps a test area that compares different approaches could be supported by academic study at PLU.

Hand pulling is one option for control of non-native grasses and forbs; the use of which will depend on site conditions. This method is not practicable as the first-order control method given the size of the site. This option may be reasonable to remove straggler weeds that remain after a large-scale weed control method has been used. Many non-native species will re-root if left on the ground so removed plants will need to be bagged and removed from the site.

Sheet mulching or smothering is useful for smaller areas and could be used if the restoration is completed in phases. It should be used only where there is little to no existing prairie vegetation. Mima mounds should not be mulched. This method entails laying down a layer of cardboard and then a 4 to 8 inch layer of mulch over the cardboard. This should be left in place for a full growing season. It is best when applied in late winter before plants start growing. Although this method will kill vegetation, it will not kill the seedbank in the soil. This ensures that desired native seedbank and bulbs will survive, however, so will the weed seeds. Focused and ongoing monitoring and control will be needed to remove unwanted non-native vegetation that re-sprouts in these areas.

Solarization and cultivation are two methods that are not recommended on most of this site. Solarization, anchoring clear plastic over the restoration, will kill vegetation and the seedbank. However, it is will also overheat and kill the desired native seeds and soil microbes that are necessary for healthy plants in the gravelly soils at the site. That said, the area underneath the large pile of discarded weeds may be a good candidate for this method as the weed seedbank in this area will be enormous compared to the desired seedbank. Cultivation consists of tilling, discing or plowing to prepare soil for seeding. However, it should not be used in areas where Mima mounds are to be protected.

Herbicide can be effective when used properly. For prairie restoration, herbicide is typically used as a spot-spray method. Herbicides specific to the target weed species will need to be used and all label instructions followed. Timing is important to avoid affecting the desired native forbs and grasses. This method requires careful use of toxic chemicals and, in some cases, will require repeated applications.

Mowing weakens but does not remove weed root systems. It can reduce the future weed seed bank if it is timed prior to weed seed set (and after the desired native species seed set). Repeated mowing will weaken weed roots over time. This method alone will take a long time to sufficiently reduce the weed population at

© **Flickr** | Sneed prairie burn **Prescribed Burns**

the site and would be most successful when used in conjunction with the other weed control methods described above.

Establishing micro topography is important in addition to weed control. Preserving existing swales and Mima mounds and adding more topography on level ground will provide habitat diversity that is imperative for healthy butterfly populations. Low-lying swales and rolling topography provide a variety of sun and moisture conditions for both butterflies and plants. It also adds to the visual aesthetic of the area.

Prescribed Burning is used for specific management objectives under a narrowly defined set of environmental conditions to minimize wildfire risk. This method was used by native peoples to remove weeds and shrubs from the prairies and has been a critical part of ecosystem processes that sustain the South Puget Sound prairies. It is an effective weed control method for large areas.

Burning small areas at a time, hand-carried drip torches are typically used to apply fire across the site preparation area. However, due to the consequences of an out-of-control fire, landowners should not consider the use

© **Flickr** | ecstaticist **Natural Oak Woodlands**

of broadcast burning without professional supervision and a trained crew at the site. The use of fire for restoration is regulated by local fire ordinances and under state forest practice rules. This method requires a permit and the local fire department, local extension forester or state agency staff that regulates prescribed burn should be contacted to plan for this method.

Prescribed burning is usually done during the summer and fall after desired prairie vegetation has died back. It is best to conduct the burn in phases, rotating burns in small portions of the prairie each year. In areas with a dense population of weeds, the weeds may re-colonize the burned area. In this case, herbicide can be spot-sprayed after weeds have re-sprouted.

Oak Woodland planting will include Garry oak as the primary tree species. While it is typically more slow growing than other woody species found in oak woodlands, it has been found to establish more readily and grow more rapidly when mycorrhizae is added to the planting hole. In general, Garry oak will achieve the fastest height growth on open sites where there is little competition from other trees and shrubs. Inclusion of Douglas fir, Ponderosa pine and Bigleaf maple as part of the oak woodlands planting is important to support a wide range of wildlife species. However, the conifers should be spaced far enough from the Garry oak so they won't grow into the oak canopy as each tree matures. Woodland understory species such as Snowberry, Oregon grape, western Serviceberry, and western hazelnut provide food, hiding cover, and nesting sites for wildlife and increase biodiversity on the site. Initial plant spacing should be done in such as way as to accommodate the oaks need for an open understory. Patches of shrubs can be planted in between the oaks, but their growth directly underneath oaks should be controlled to avoid competition. In addition, tree shelters and weed-barriers placed around newly planted oak saplings can protect them from deer, mice and voles that can cause severe mortality.

Soils

Onsite soil observations and laboratory analysis concluded that most locations contain intact or

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partially intact prairie topsoil, containing notable natural additions of volcanic ash and soil organic matter. These soils are sufficient in nutrients and organic matter to provide a suitable rooting environment for prairie and oak savannah plant species (Rozewood Environmental Services 2012).

PLU golf course greens contained thin layers of imported lifts (layers or lenses) of topsoil,

credit: Southsoundprairies.org

credit: Southsoundprairies.org

credit: Southsoundprairies.org

Puget Sound Prairie Management: Controlled Burning

sand, and peat moss overlying buried gravelly topsoil. These artificially enhanced greens are somewhat compacted, however there was evidence of earthworm activity along the immediate edges of the greens, and these worms could be expected to continue to naturally aerate and loosen the soil with time. The greens could be left intact and planted, or they could be roto-tilled and planted to help break up the compacted surface layer.

Small localized areas within the former golf course may have had their original topsoil stripped for development reasons (foundations for cart pathways, former building or shed locations, or for re-sculpting purposes of the golf course fairways, greens, or rough areas). In locations where evidence of truncated subsoils occur (areas with excessive pale-colored sands and gravels with no apparent dark-colored organic-enriched matrix), previously excavated and stockpiled topsoils from the golf course should be spread and top-dressed over such areas to a minimum depth of 8 to 10 inches. If stockpiled topsoil is used up and further disrupted locations remain, then 4 to 5 inches of fine compost should be spread and roto-tilled into the top 6 to 8 inches of soil (use a roto-tiller design that can accommodate gravels and cobbles).

Soil microbial foodweb analysis had indicated that microbial populations were out of balance, with high populations of bacteria and/or fungi, and low populations of beneficial protozoa and nematodes. This imbalance can be augmented with use of actively aerated compost teas (AACT), which is not the same as standard manure teas or other compost leachate teas that are often discussed by organic farmers or gardeners. AACT is a short-term aeration process that starts with non-chlorinated water and a nylon bag full of good quality compost, soaked in a bucket or tub of water under a constant supply of air-injected bubblers or air stones. The result is a brown colored tea that is heavily concentrated with bacteria, fungi, protozoa, and nematodes, that can be applied as an inoculant directly to soils, or sprinkled around the base of newly installed plantings. It is likely a single application is all that would be necessary to rebalance the microbial population. Over time, as the former golf course lies untreated with artificial fertilizers and pesticides, and as additional natural mulches are established and used, prairie and woodland will evolve over the long-term with balanced soil microbial populations as they re-establish and maintain themselves.

credit: Southsoundprairies.org

Step #2: Native Plant Installation

Key Points

- Native plants can be installed using: seeds, plugs, bare root, stakes, or container plants.
- Container plants are most appropriate option for Garry oak.
- Camas Lily can be propagated using seed and/or bulbs collected from the golf course.

General Installation

This step needs to be coordinated with weed control efforts. Weeds do not need to be 100 percent eradicated prior to planting. However, percent cover of non-natives should be around less than 25 percent to ensure that the newly planted native species are not out-competed. Drilling in native grass seed the first fall after beginning weed control can help to control weed re-establishment, but should be done only if large-scale full-spectrum herbicide use is not planned at the site.

Initial decisions for native plant installation will require deciding whether to use seeds, plugs, bare root, stakes or container plants. Seed can be the most economical choice depending on the species. Grass seed is the least expensive with costs increasing for species that have large seed with a lower germination rate. Seed also has high predation by birds and rodents. Plugs are still economical and are a viable way to install forbs and grasses. Live stakes are a low-cost way to establish native understory, but this option is limited to the species that will grow using this medium. Bare root is generally used for woody species and can be a more economical option than container plants. However, container plants are the most appropriate option for species that are difficult to establish such as Garry oak.

credit: Southsoundprairies.org

Attachment B provides a list of native plant nurseries that provide prairie species.

Camas

PLU also has the option of propagating common Camas using seed and/or bulbs collected from golf course areas that are planned for development. While seed is a viable alternative, the requirement for a greenhouse makes the use of bulbs a more feasible alternative at this time. Common Camas is readily established by transplanting the bulbs (USDA 2006). Individual plants have been known to live for 15 to 20 years. The best time to excavate bulbs is from early summer through mid-fall following seed maturation, die-back of the leaves and development of the 'daughter' bulbs. The window for bulb removal is generally narrow; when soils are moist after flowering in the spring. The next time to harvest is in the fall after the rains begin.

Given the large area of available land at the golf course, the bulbs can be transplanted or heeled in immediately and planted at the same depth as at their original location. Generally, that is 0.5 to 1 inch deep for small bulblets and up to 4 to 6 inches for mature bulbs. Mature bulbs will produce 3 to 4 leaves.

Native Americans harvested Camas bulbs by lifting out the turf in small sections and replacing the turf after removing the large bulbs for food. This method may work well for collecting the bulbs at PLU by lifting the turf in sections and placing them, with bulbs intact, in raised beds (using native soils in the beds under the collected turf). This way, both mature and young bulbs are collected with a minimum of disturbance. This keeps each bulb at the original depth; however, care will need to be taken to ensure that the bulbs are kept moist through their flowering season.

When transplanting the Camas into the restoration area, it is best to plant them in fall or early winter when soils are moist enough to dig and soils temperatures are cool (less than 60 degrees F). Fall planting allows for better root development and chilling needed for flowering. Bulbs can be placed in groupings of 6 to 8 bulbs per square foot with a mix of both mature and young bulbs. The mature bulbs will typically flower each year. Young bulbs with only 2 leaves do not flower until they mature. If seed is also used, broadcasting at a rate of 20 live seeds per square ft. will, on average, result in 10 seedlings per square ft. Seedlings will produce flowers after 3 to 5 years.

Step #3: Long Term Maintenance

Key Points

- The PLU open space will require regular maintenance in perpetuity.
- The most intensive maintenance will occur in the first five years.
- Controlling Scotch Broom, non-native grasses, and forbs will be long term maintenance challenges .
- Hand-pulling, prescribed burning, and selective herbicide use are common non-native plant eradication techniques.
- Prairie stewardship provides volunteer opportunities for students, faculty, and the neighboring community.
- Monitoring is critical.

Throughout history, the South Sound prairies have been in existence only because of the regular, long-term maintenance by native peoples. The PLU prairie will also require regular maintenance in perpetuity. Most important will be control for Scotch broom and non-native grasses and forbs. This can be done

using primarily the hand-pulling and prescribed burns methods; with herbicide used judiciously.

Invasive control maintenance of most native habitat restorations require more intensive efforts in the first 5 years after installation, with less frequent maintenance needed in the following years. Monitoring should occur every 10-14 days with control executed as often as necessary to prevent seed set and spread. Typically, hand pulling in the first 5 years should begin in early spring and be repeated every 2 to

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4 weeks until August when most plants in this area have started to go dormant. This task is often carried out by students and community members interested in learning more about and supporting prairie restoration. Prescribed burns can be implemented once a year over a small portion of the prairie habitat (see specific information in the Site Preparation section). Herbicide should only be used when other methods have not been successful and only applied as spot-spraying. Once prairie habitat is established, mowing is not recommended at any time of year.

Maintenance Guidelines for Specific Plant and Wildlife Species:

While it will take a few years for the prairie restoration to mature into habitat that will support the target wildlife species, once functional habitat appropriate to western grey squirrels, streaked horned lark, and/or butterflies has established WDFW can be contacted for feasibility of a passive reintroduction program. As of 2012, some prairie wildlife species are being propagated through the Sustainable Prisons Project (South Puget Sound Prairie Landscape Working Group 2012).

Common Camas:

Late summer burning can improve this species vigor, reduce competition from weeds and aid in regeneration.

Mowing should be avoided even after the leaves have died back. (USDA 2006).

© www.geocaching.com

Oak Woodlands:

Rapid growth of native conifers, shrubs and grasses make them a serious threat to the survival of young oaks. Controlling competing vegetation is an essential step to ensure the fastest possible growth of oak seedlings and saplings. Above ground, conifers and shrubs can overtop oak seedlings and limit the availability of sunlight to the trees. Below ground, shrubs and grass compete against oaks for water and soil nutrients. Native shrubs and grasses are an important component of natural woodlands, but any plant that is growing up into the oak canopy should be controlled. Conifers that crowd oaks can be made into snags rather than removing completely.

Maintain natural oak regeneration using acorns, oak seedlings, and stump sprouts in the existing stand. Ripe acorns can be collected from the ground starting early September through November. Direct seeding of Garry oak acorns is a simple, low-cost method of regeneration and should be done in the fall soon after the start of the rainy season when the upper layer of soil has been moistened. Germination of acorns can be enhanced by following instructions provided in the Landowners Guide to Restoring and Managing Oregon White Oak Habitats (Vesely and Tucker 2004).

Western Grey Squirrels:

Western grey squirrels travel nearly exclusively along aerial pathways where tree canopies touch. If thinning trees is necessary, retain contiguous aerial pathways (Larsen and Morgan 1998).

Burns should be planned in the late summer and fall to minimize impact on western gray squirrels. For example, prescribed burns conducted in the spring could reduce food availability when females are pregnant or lactating and smoke could affect juveniles still in the nest. (Linders and Stinson 2007)

Keeping dogs leashed is important for attracting and maintaining a grey squirrel population.

Ideal habitat for western gray squirrels may reflect a balance between open conditions that encourage acorn and conifer seed production, and the clumping of trees that allows arboreal travel by squirrels, secure nesting sites, and patches of high canopy closure.

Maintain a fairly open understory of 35- to 50-percent cover of food species: Snowberry, Hazelnut, Indian Plum, Salal, Serviceberry, Rose species, Red huckleberry, Currant species, and Vine maple (Ryan & Casey 1995) under the canopy of Garry oak, Douglas-fir, Bigleaf maple, Pacific yew, Grand fir, and Pacific dogwood.

© Flickr | USFWS Endangered Species

Butterflies:

Ideal butterfly habitat will maintain at least 5 acres of open prairie and allow for tree islands or edge habitat with oaks and conifers. Pockets of prairie can extend into the woodlands to provide butterfly refuge from wind, hot sunny weather, cold weather and heavy rains, and changes in humidity during extreme weather conditions.

Control scotch broom and non-native grasses.

Augment the native grasses and forbs that larval and adult butterflies depend on for food (See Appendix A).

© 2008 Christopher Christie

Incorporate a butterfly-sensitive fire regime that emphasizes regular burning of small portions of the prairie habitat in the late summer or fall. Only a small portion of the prairie should be burned each year.

Streaked Horned Lark:

Control scotch broom and non-native grasses.

Reinstate late summer fire.

Reduce disturbance to breeding larks by seasonally restricting off-leash dogs, kite flying, fireworks and vegetation trampling from mid April through early July. (Pearson and Altman 2005)

Soils:

Soils should not need any form of supplements, additions, or special maintenance over time. Soil organic matter will build and be maintained with natural additions through decomposing leaves, needles, roots, and humus, other life form by-products (dead microbes and animals, animal droppings, worm castings, etc.) and the sporadic, infrequent additions of micro-char (microscopic charcoal) from low-intensity ground fires.

Legend

- 1 Mile Path
- Remove Invasive Plants
- New Tree
- Temporary Restoration Signage

N

Issues of Immediate Concern

- Mow per management recommendations to control invasives
- Update path layout to preserve plant and geologic resources and capture views.
- Define the path layout, dimensions, and programmatic requirements to host official regional/national cross country meets.
- Define the immediate programmatic needs of the geology faculty.

Restoration First Steps

- Plant Garry Oaks (~75) and other slow growing trees (Note: Special maintenance required).
- Manually remove invasive plants from entire site
- After manual plant removal, mow entire site per management recommendations.
- Install temporary restoration signs at main entrances.

Minimum Interim Management

- Monitor/remove non-native plants.
- Mow entire site per management recommendations and for weed control.
- Mow flexible-use/eco-lawn spaces.
- Remove specified trees from prairie, per management plan.

First Steps & Interim Management

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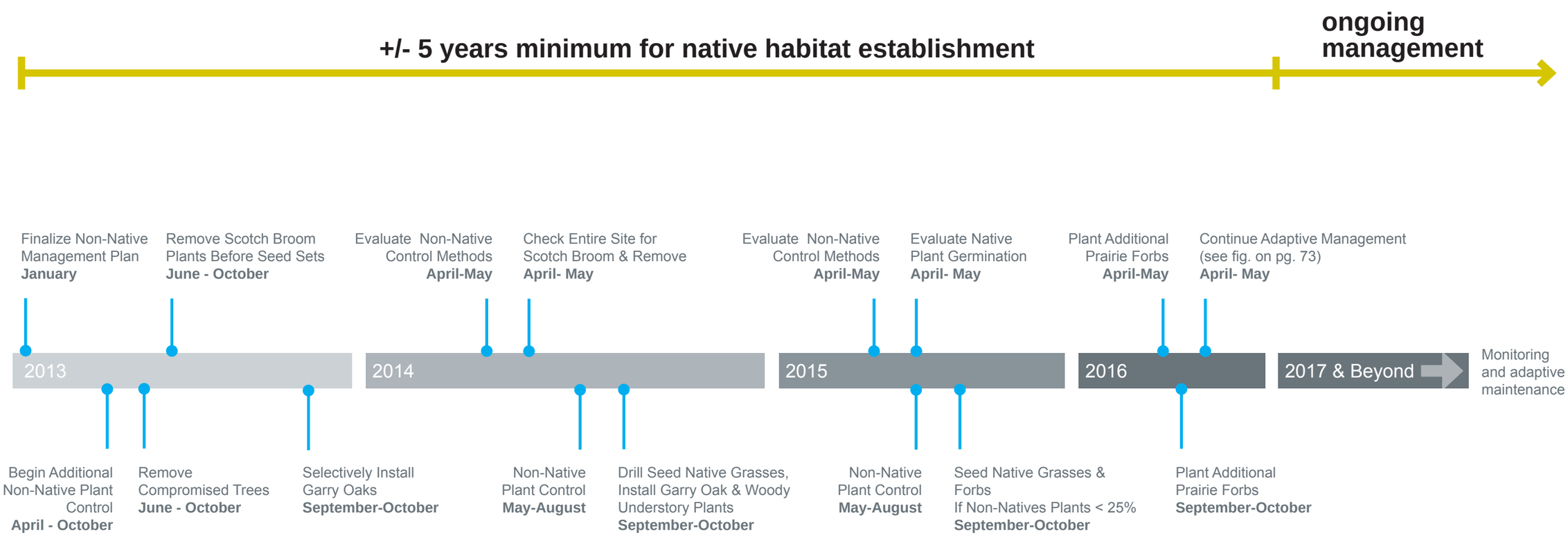
PLU South Campus: Restoration Schedule



Restoration Milestones / Timeline

Establishing a schedule for native habitat restoration is an iterative process given uncontrollable elements that can affect the project. The planned schedule can be changed by weather conditions, vegetation damage by animals, incidental impacts from humans and pets, and the available volunteer base. It is important to have a schedule for restoration projects, knowing that adaptive management will be needed to respond to actual site conditions as the project progresses. With this in mind, the following schedule is recommended:

2013

January

Make decisions regarding non-native control. Will it be done site-wide or will portions be done in phases. Choose the non-native control method(s) appropriate for phased or whole site preparation.

April-October

Remove Scotch broom plants before they go to seed. Given the tight timeline for this, initial removal efforts can focus on flowering plants. Younger plants that have not flowered can be removed following the first effort. All Scotch broom should be removed from the site and disposed of in a manner that will not spread seed to other parts of the campus.

Collect Camas. Once flowering is done and leaves have started to dry out, collect and heel in Camas bulbs. This can be conducted by students overseen by teaching staff.

Begin implementation of non-native control method(s). If using herbicide, it must be applied before plants go into summer dormancy.

Remove dead, diseased, and dying trees. Thin as part of the prairie restoration plan. This can be done anytime this year.

Evaluate the need for soil restoration in greens. Identify areas within the restoration site that have disrupted or truncated soils. This can be conducted by students overseen by teaching staff. Conduct transects through the proposed restoration area to identify any coarse sand and gravel subsoil evident directly at the surface. Digging into such areas will confirm if the pale sands and gravels are merely a thin layer on top of intact dark-colored, humus-rich topsoil. Estimate sizes of any encountered areas and map them onto a general site map. These spots will receive topsoil additions at a later date. Examine former golf course greens and check soils for compaction. If earthworm castings are evident on the surface, one can assume earthworm burrows will slowly reverse past human compaction. Evaluate whether greens need to be roto-tilled, or if natural processes can suffice.

Stockpile any topsoil stripped from new development of expanded sport playfields. Stockpiled soils should be overseeded with crimson clover and/or annual rye grass if moist conditions will allow for germination. If stockpiling is being done during dry summer conditions, the piles should be covered over with burlap or another semi-aerated tarp material to allow some air exchange and prevent soils from being over-heated (as would occur if plastic sheeting was used). If practical, any identified areas in the restoration area that previously had their topsoil removed or stripped, could be topdressed with 8 to 10 inches of this stockpiled topsoil. Overseeding with short-term cover crops or desired prairie grass species would be necessary if this action step was enacted this year.

Selectively Install Garry Oaks. Trees can be planted if the following conditions are met: grass is mown regularly around young trees to prevent vole damage; trees are irrigated regularly (potentially using “Tree Gator”); trees are not planted where there is currently a high density of scotch broom; planting holes are inoculated with mycorrhizae.

2014

April-May

Evaluate the non-native control effort. Plan for control method(s) to use this year.

Check the entire site for Scotch broom plants and remove all plants.

Apply compost tea around new or existing plantings. For areas that have achieved a satisfactory level of exotic vegetation control, applications of AACT (actively aerated compost tea) inoculant can be sprayed on the ground surface or sprinkled around any newly installed plantings or existing plantings. This inoculant should only be applied when soils are moist and temperatures are above 45 degrees.

May – August

Implement chosen non-native control methods.

September – October

Evaluate the non-native control effort. If less than 25 percent non-native vegetation is achieved, native grasses can be drill seeded in the chosen planting area after rains have started and before temperatures turn cold.

Install Garry Oak and woody understory plants. If percent cover of non-native plants is low enough, Garry oak and woody understory vegetation (container plants) can be installed if regular irrigation will also be implemented. The AACT inoculant can be used in each planting hole to assist with the vitality and vigor of the plantings. Plants should be installed after the winter rains have started and before day time temperatures dip below freezing; typically from mid-October to the end of November.

A test plot of Camas bulbs can be transplanted in late fall or early winter

2015

April-May

Evaluate the efficacy of last year’s non-native control methods and plan for control method(s) to use this year.

Evaluate success of native plantings. Evaluate the germination of native grasses, and the success and vigor of transplanted Camas bulbs and planted woody vegetation. If the spring evaluation shows an unacceptable success rate from the fall 2014 plantings, the cause needs to be investigated and a new method or approach planned for future transplanting/planting efforts.

Check the entire site for Scotch broom plants

and remove all plants.

May – August
Implement chosen non-native control methods.

Conduct long-term maintenance efforts in planted areas using the spring evaluation as a basis for maintenance actions.

Provide necessary irrigation where needed. Irrigation needs to be provided for at least the first two years after installation for all plantings. If plantings are installed in phases, irrigation will need to be provided for two years in each area.

September – October
Continue native plant installation. If percent cover of non-native plants is low enough, additional native grass can be drill seeded in the next planting area if the project is to be phased.

Additional Camas can be transplanted in late fall or early winter using the transplanting method chosen following the spring evaluation.

Plant prairie forbs. If percent cover of non-native plants is low enough, prairie forbs can be seeded in the fall after the rains have started and before temperatures turn cold.

2016
February - March
Additional prairie forbs can be planted after the last frost using plugs.

Apply compost tea around new or existing plantings. For areas that have achieved a satisfactory level of non-native vegetation control, applications of AACT (actively aerated compost tea) inoculant can be sprayed on the ground surface or sprinkled around any newly installed plantings or existing plantings. This inoculant should only be applied when soils are moist and temperatures are above 45 degrees.

April – October
The same schedule for evaluation of restoration areas, adaptive management (See fig. on pg. 78), and maintenance as outlined for this period in 2015 can be used. This schedule can be followed for each successive year using adaptive management to plan for and carry out on-going maintenance and, if necessary, additional plantings.

If questions about maintenance and/or to find out about updated methods for non-native vegetation control, contact the Washington State Department of Fish and Wildlife (WDFW) that administers Landowner Incentive Programs (LIP) to offer support to habitat restoration on private lands.

2017 and beyond
Ongoing monitoring and adaptive maintenance.

Restoration Milestones / Timeline

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Appendix

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PLU South Campus: Appendix

This campus has a rich natural and cultural history.

Prairie Burn | Mithun

Camas lilies | © Flickr - Forestbloom

Date unknown | ES Glover lithograph

1936 | King Salmon caught at Clover Creek
(Tom Cambern family photo)

PRAIRIE BEGINS

Nisqually Plains inhabited and maintained by Native Americans.

DISAPPEARANCE OF

European contact

Donation Land Claim Act: Settlers arrive in large numbers with the promise of free land.
The Plains were surveyed and mapped into 1 mile square grids, and 320 acres of free land were given to any citizen who lived there for 5 years. With new agricultural methods, fire suppression, invasion of non-native species, livestock grazing, and land use conversion, the transformation of the open landscape begins.

Puget Sound War: War over land rights between the United States Military, local militias and members of the Native American tribes of the Nisqually, Muckleshoot, Puyallup, and Klickitat. Conflict catalyzed by the Treaty of Medicine Creek of 1854, which preserved Native American fishing rights but took away prime farm lands.

A major migration of Scandinavian settlers into Puget Sound area occurs, drawn in by open land, proximity to Tacoma as the end of the Northern Pacific Railroad. Clover Creek advertised as a good water supply with plentiful fish.

PLU FORMED

Pacific Lutheran University Association organized and land agreed upon.

350 apple, pear, cherry, & Plum trees planted by Clover Creek

First channeling of Clover Creek for farming irrigation.

~10,000 | Late 1700's | 1850 | 1855-1856 | 1888+ | 1890 | 1892 | 1895

Site History

Parkland Light & Water Co. formed, attracting more people to the area

Golf Club being formed on site. Art Swindland, founder of the College Golf Course, begins playing. Professors come to join in and a course was formed, mostly by buying land from Lutheran owners in CA, NJ, and the Midwest. *"The land was almost a natural golf course, and the Parkland men hit golf balls across it's expanses, rigging cans for holes."*

Parkland Golf Association created.

Course remodeled to an 18 hole course.

Fort Lewis develops.

College acquires the course. Existing course was converted to a 9 hole course, football field, baseball diamond, and tennis courts.

McChord Field is built. Sections of Clover Creek were relocated and rechanneled through two huge culverts, built not to obstruct fish passage or water. Other sections of Creek are excessively channeled, diked, and dredged.

Post-war boom begins, with GIs returning home to Parkland, building houses and attending the University. *"Suburbia replaced the existing rural condition." (R.O. Osness)*

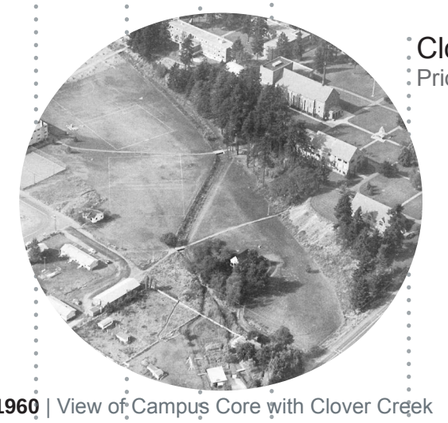
Clover Creek rerouted into a new channel lined with asphalt to stem water loss.
Prior to this, the Creek flowed across the PLU campus.

Golf course popular today. Prairie restoration efforts on PLU campus and Fort Lewis. The golf course has essentially protected the open space, and the remnant prairies within.

1969 | Mt. Rainier from Campus

PLU Archives | Clover Creek

1951 | 12' culvert for Clover Creek



1960 | View of Campus Core with Clover Creek

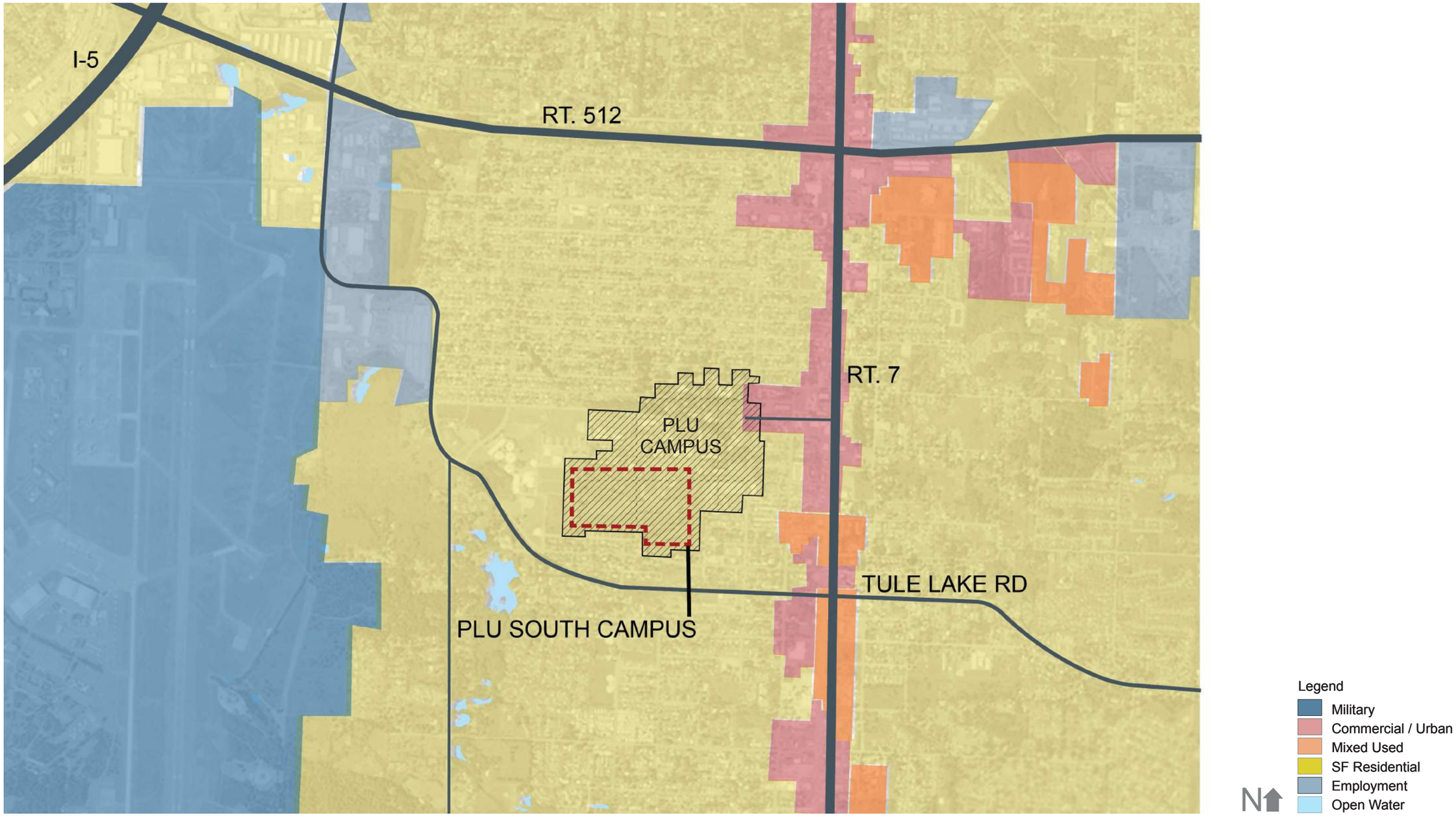
PLU.edu | Golf

GOLF CLUB FORMED

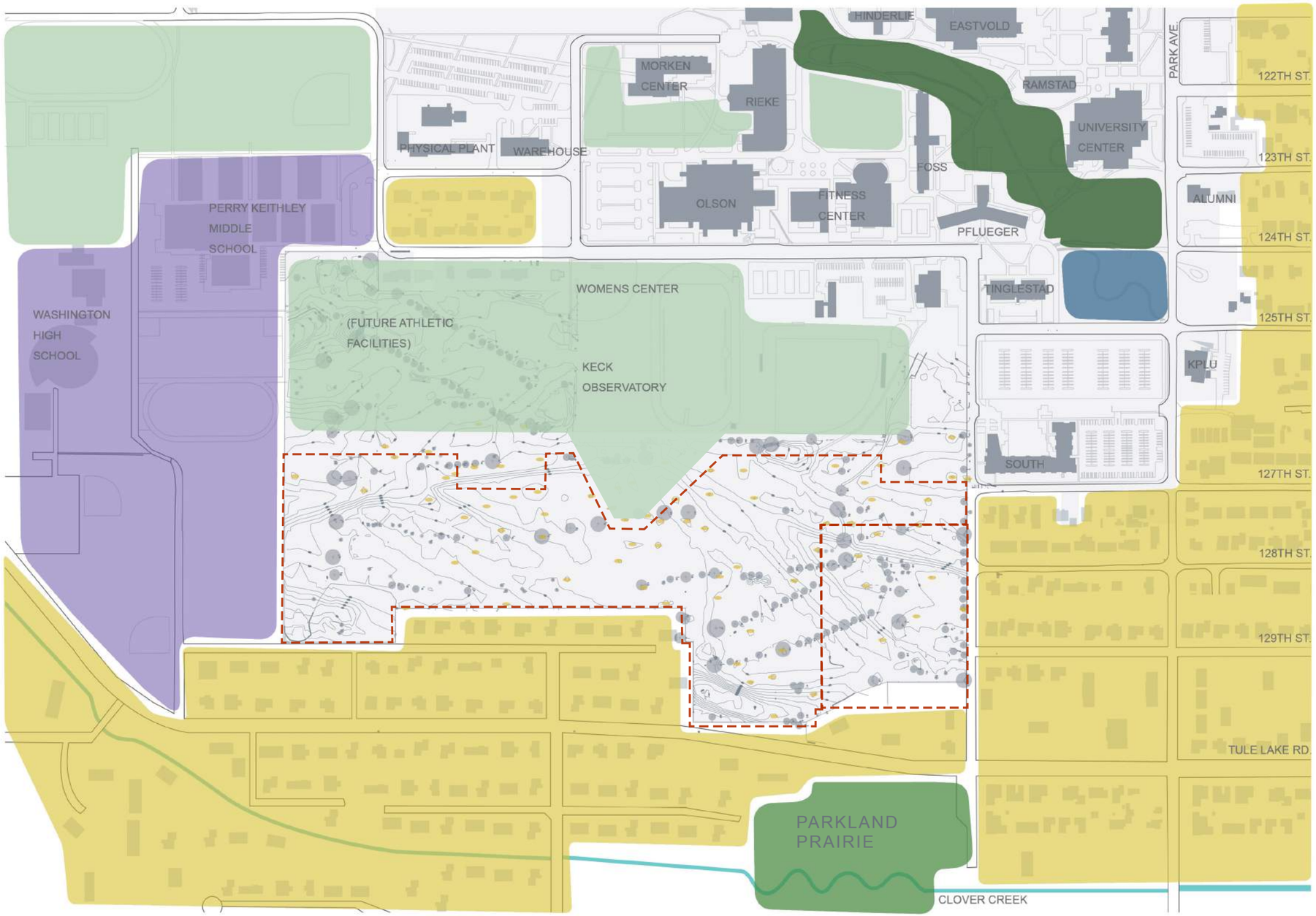
1914 | 1920-1924 | 1928 | 1929 | 1927-1937 | 1937 | 1938 | 1945+ | 1967 | Present day

Source: From Wilderness to Suburbia, An Illustrated History of Parkland Washington, Richard D. Osness

Site History



Zoning



Legend

- Forest
- Restoration Area
- Lawn Turf
- Residences
- Schools
- Stormwater Management

N

Adjacent Conditions

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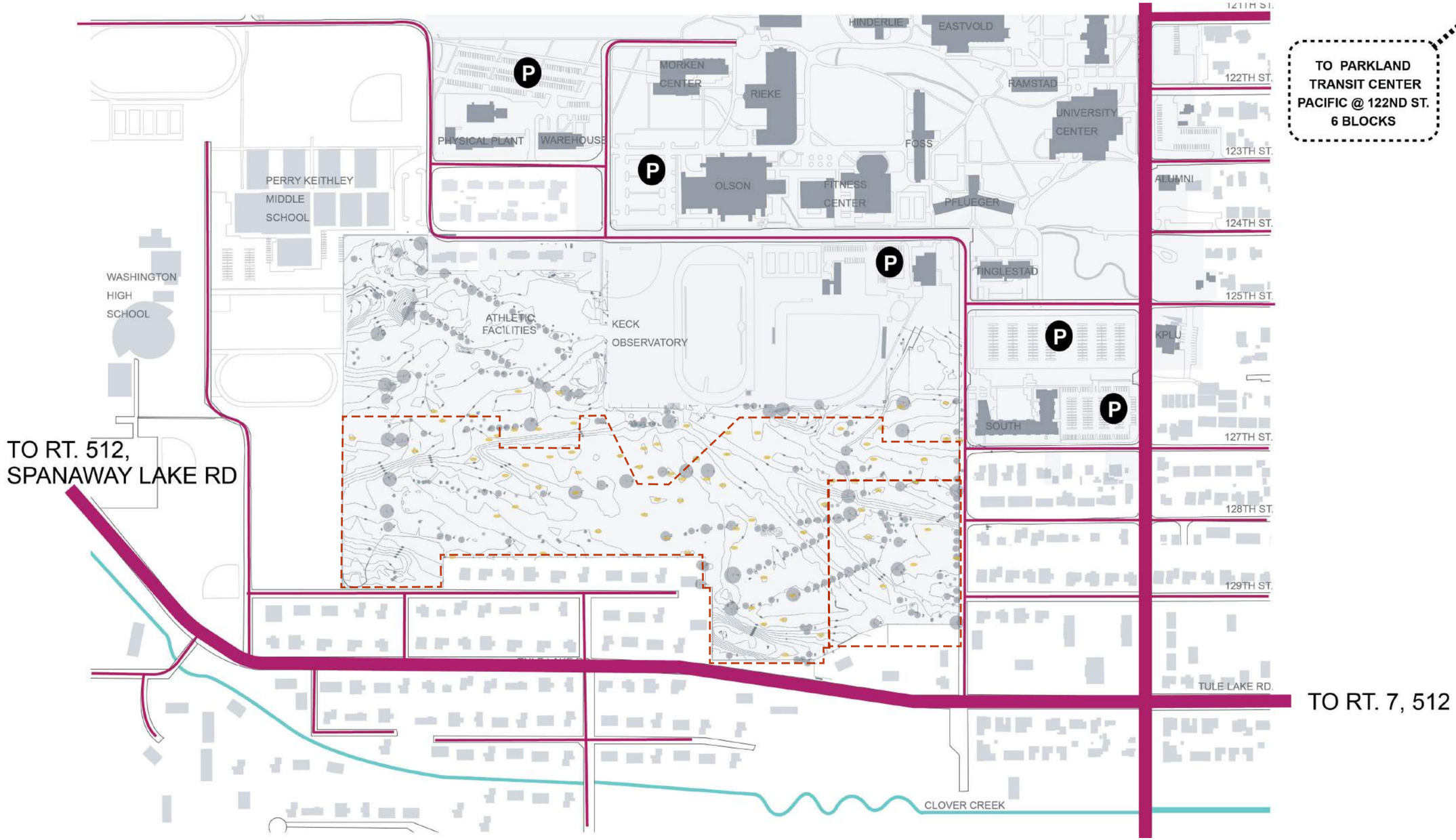

Vehicular Circulation

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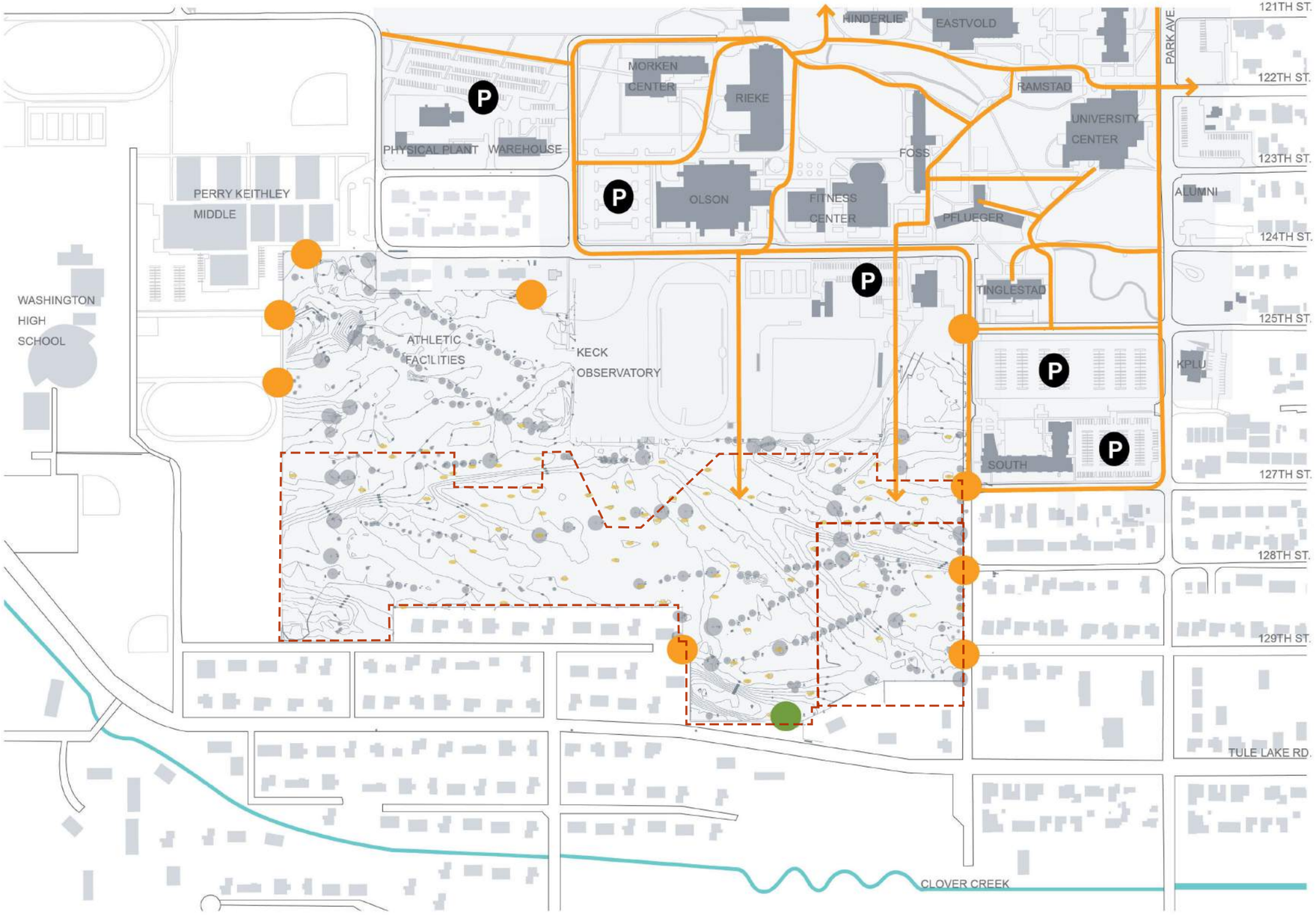

Legend

- Potential Street Entry
- Potential Greenway Entry

Pedestrian Circulation

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There are majestic views looking southeast across the site towards Mt. Rainier. The existing Douglas Firs are often framing these views.

There are also a few important views looking north, towards upper campus.

The final design will work to make these moments of prospect and overlook important features, connecting to the larger landscape.

Legend

- Significant View
- 36"+ Coniferous Tree
- 24-35" Coniferous Tree
- 12-23" Coniferous Tree
- 0-11" Coniferous tree
- 12-23" Deciduous tree
- 0-11" Deciduous tree
- Remnant Prairie
- Mima Mound
- Low Area
- Swale Area
- Higher Area / Plateau

N

Existing Significant Views

Prairie Restoration Report
Pacific Lutheran University - South Campus Open Space
Tacoma, Washington

June 4, 2012

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INTRODUCTION

Background research for the South Campus Open Space Master Plan area at Pacific Lutheran University indicates the golf course was likely created on prairie habitat. This is based on the prevalence of camas lily (*Camas quamash*) throughout the golf course, LiDAR (Light Detection And Ranging) imagery of the area showing remnant mima mounds and the on-site soil investigation verifing the presence of mima mounds and relatively intact prairie soils (Rozewood Environmental Services 2012). Also found within the golf course were species typical of prairies, but atypical of urban environments such as Harvest Brodiaea (*Brodiaea coronaria*) and Roemer's fescue (*Festuca roemeri*).

Prairies are one of the rarest and most endangered ecosystems in the nation. A key characteristic of Washington prairies is the well-drained, gravelly and nutrient-poor soils, such as found at the PLU golf course. Prairies occur on flat-to-rolling terrain; some with mima mounds. They offer ecologic functions that support rare and threatened species and provide cultural values as a reminder of the glacial past and indigenous populations. Today, they give residents the opportunity to observe a unique landscape.

Typically, open prairie is intermixed with patches of Garry Oak (*Quercus garryana*) woodland. Although the exact history of prairie habitat in Washington is unknown, this unique system exists due to intensive management by Native peoples. By regularly burning the open prairie and oak woodlands that they used for hunting and growing food and medicines, Native tribes created a rare ecosystem supporting wildlife species and plant communities that occur no where else in the world. Attachment A provides a listing of vegetative and wildlife species known to occur in Washington prairies and oak woodlands.

Once covering approximately 150,000 acres, today prairies have been reduced to 3 percent of their historic extent due to conversion to agriculture, over grazing, development, recreational use, and lack of periodic fires that suppress invasion of weedy/exotic species such as Scotch broom (*Cytisus scoparius*) and Douglas fir (*Pseudotsuga menziesii*).

Plants and wildlife are inextricably linked in South Puget Sound Prairie ecosystems with their loss resulting in a steep decline of wildlife that depends on this habitat; including some butterflies, western grey squirrel, streaked horned lark and Mazama pocket gopher, to name a few.

At PLU campus, prairie habitat impacts are due to the golf course and its associated uses. Compacted soils occur from foot traffic, golf carts and maintenance equipment. While regular mowing at the golf course has limited invasive plant establishment, it also limited the extent of healthy prairie vegetation. Non-native vegetation, observed August 2011 just prior to closure of the golf course, includes Himalayan blackberry (*Rubus armeniacus*), Scotch broom, morning glory (*Convolvulus arvense*), Canada thistle (*Cirsium arvense*), common dandelion (*Taraxicum officinale*), bentgrass species (*Agrostis* sp.), common velvetgrass (*Holcus lanatus*), orchardgrass (*Dactylis glomerata*), sheep sorrel (*Rumex acetosella*), white clover (*Trifolium repens*), common St. John's wort (*Hypericum perforatum*), and various ornamental plants that have spread or escaped from neighboring properties.

With planning and maintenance, historic prairie at the university can be restored through re-establishment of the forbs, grasses, and oak woodland patches that are typical of this habitat. Even with portions of the golf course dedicated for expanded sport fields and senior housing development, the remaining 24 acres is sufficient to restore self-sustaining prairie vegetation community that can provide habitat for native prairie wildlife and serve as community education.

PRAIRIE HABITAT RESTORATION

Restoring prairie and oak habitats has become a high priority issue for numerous agencies. It may be advantageous to contact the local U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) office to find out more about the Wildlife Habitat Incentive Program (WHIP). Washington Department of Fish and Wildlife (WDFW) also administers Landowner Incentive Programs (LIP) that offer support to habitat restoration on private lands.

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Prairie restoration requires planning and site preparation. As with all restoration projects, restoring prairie habitat is a process that is as educational as it is rewarding. Photographic monitoring of the site, from site preparation through planting and follow-up monitoring, is a good way to document changes to the golf course and is a useful tool for future activities and successes in the restoration process. Three main steps are involved: 1) preparing the site, 2) installing native plants and 3) long-term maintenance. Each is described in more detail below.

Site Preparation is critical to the success of prairie and oak woodland restoration. This involves controlling weeds that would compete with native plantings, preparing the soil and helping native plants become established the first few years after seeding/planting. Typically, native habitat restoration projects require irrigation during the first two growing seasons after planting while the new vegetation becomes established.

The more thorough the initial control of weeds prior to planting, the less weed control will be needed later. However, there will always be a need for some level of weed maintenance through the long term. Species to be controlled at the golf course site include Scotch broom and ornamental shrubs that have escaped from surrounding areas. There are also non-native forbs such as common dandelion, St. John's wort, hairy cat's-ear, plantains, clovers, thistle; and non-native grasses. Douglas fir thinning may also be warranted based on the plant community design to allow enough sunlight for the prairie and oak woodland community; and to remove diseased trees.

While the prairie restoration will likely be completed in phases, weed control over the entire open space area will provide the best results over the long term. If possible, full-site weed control will reduce the re-introduction of weed seed into areas that have already received control efforts. Control methods that can be readily used over large areas would be best in the initial stages of weed control; including mowing and herbicide used in tandem and prescribed burns. These strategies may require more than one year to sufficiently reduce weed cover. The site will need to be evaluated as the control methods are used to determine if additional applications of the methods are necessary.

Following large-scale weed control and achieving less than 25 percent non-native cover, hand-pulling and herbicide spot spraying can be used for long-term maintenance. Hand-pulling is the preferred method; however, herbicide spot spraying may be necessary in the first 5 years to control any areas of aggressive non-native regrowth. Figure 1 provides a decision-making guideline for Garry oak site preparation methods. This guideline is also applicable for prairie preparation.

Drill seeding with native grasses can be used after the mowing-herbicide effort in order to begin to establish native prairie vegetation and to discourage germination of any remaining non-native seedbank. Any herbicide used to remove non-native grasses will also affect native grasses. After drill seeding, any herbicide used should be done only as spot-spray to target specific species.

Scotch broom is best removed by cutting the stems. This method has been used successfully in western Canada and Washington and has the best results when stems greater than one-quarter inch in diameter are lopped or sawn less than two inches from the soil surface. Doing this in the dry summer of July or August results in a very low re-sprout rate (approximately 1.5 to 5%). If this method is used at other times of year, care should be taken to cut the Scotch broom before any flowers go to seed. This can be accomplished quickly with minimal impacts to desired vegetation. In addition, there is less disturbance to the soil than if the broom is removed (roots and stems) via a weed wrench tool; thus minimizing germination of the existing broom seedbank in the soil.

Hand Pulling is one option for control of non- native grasses and forbs; the use of which will depend on site conditions. This method is not practicable as the first-order control method given the size of the site. This option may be reasonable to remove straggler weeds that remain after a large-scale weed control method has been used. Many non-native species will re-root if left on the ground so removed plants will need to be bagged and removed from the site.

Sheet Mulching or Smothering is useful for smaller areas and could be used if the restoration is completed in phases. It should be used only where there is little to no existing prairie vegetation. Mima mounds should not be mulched. This method entails laying down a layer of cardboard and then a 3- to 4-inch

layer of mulch over the cardboard. This should be left in place for a full growing season. It is best when applied in late winter before plants start growing. Although this method will kill vegetation, it will not kill the seedbank in the soil. This ensures that desired native seedbank and bulbs will survive, however, so will the weed seeds. Focused and ongoing monitoring and control will be needed to remove unwanted non-native vegetation that re-sprouts in these areas.

Solarization and Cultivation are two methods that are not recommended on most of this site. Solarization, anchoring clear plastic over the restoration, will kill vegetation and the seedbank. However, it is will also overheat and kill the desired native seeds and soil microbes that are necessary for healthy plants in the gravelly soils at the site. That said, the area underneath the large pile of discarded weeds may be a good candidate for this method as the weed seedbank in this area will be enormous compared to the desired seedbank. Cultivation consists of tilling, disking or plowing to prepare soil for seeding. However, it should not be used in areas where mima mounds are to be protected.

Prescribed Burning is used for specific management objectives under a narrowly defined set of environmental conditions to minimize wildfire risk. This method was used by native peoples to remove weeds and shrubs from the prairies and has been a critical part of ecosystem processes that sustain the South Puget Sound prairies. It is an effective weed control method for large areas.

Burning small areas at a time, hand-carried drip torches are typically used to apply fire across the site preparation area. However, due to the consequences of an out-of-control fire, landowners should not consider the use of broadcast burning without professional supervision and a trained crew at the site. The use of fire for restoration is regulated by local fire ordinances and under state forest practice rules. This method requires a permit and the local fire department, local extension forester or state agency staff that regulates prescribed burn should be contacted to plan for this method.

Prescribed burning is usually done during the summer and fall after desired prairie vegetation has died back. It is best to conduct the burn in phases, rotating burns in small portions of the prairie each year. In areas with a dense population of weeds, the weeds may re-colonize the burned area. In this case, herbicide can be spot-sprayed after weeds have re-sprouted.

Herbicide can be effective when used properly. For prairie restoration, herbicide is typically used as a spot-spray method. Herbicides specific to the target weed species will need to be used and all label instructions followed. Timing is important to avoid affecting the desired native forbs and grasses. This method requires careful use of toxic chemicals and, in some cases, will require repeated applications.

Mowing weakens but does not remove weed root systems. It can reduce the future weed seed bank if it is timed prior to weed seed set (and after the desired native species seed set). Repeated mowing will weaken weed roots over time. This method alone will take a long time to sufficiently reduce the weed population at the site and would be most successful when used in conjunction with the other weed control methods described above.

Establishing Microtopography is important in addition to weed control. Preserving existing swales and mima mounds and adding more topography on level ground will provide habitat diversity that is imperative for healthy butterfly populations. Low-lying swales and rolling topography provide a variety of sun and moisture conditions for both butterflies and plants. It also adds to the visual aesthetic of the area.

Soil Amendments are typically not needed for native habitat restoration because low soil fertility favors native plants over non-native weeds. Adding nitrogen-rich soil amendments may prevent the establishment of desired native forbs and grasses due to competition from non-native weeds. Chemical fertilizers and nitrogen-based fertilizers should never be used.

Onsite soil observations and laboratory analysis concluded that most locations contain intact or partially intact prairie topsoil, containing notable natural additions of volcanic ash and soil organic matter. These soils are sufficient in nutrients and organic matter to provide a suitable rooting environment for prairie and oak savannah plant species (Rozewood Environmental Services 2012).

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PLU golf course greens contained thin layers of imported lifts (layers or lenses) of topsoil, sand, and peat moss overlying buried gravelly topsoil. These artificially enhanced greens are somewhat compacted, however there was evidence of earthworm activity along the immediate edges of the greens, and these worms could be expected to continue to naturally aerate and loosen the soil with time. The greens could be left intact and planted, or they could be roto-tilled and planted to help break up the compacted surface layer.

Small localized areas within the former golf course may have had their original topsoil stripped for development reasons (foundations for cart pathways, former building or shed locations, or for re-sculpting purposes of the golf course fairways, greens, or rough areas). In locations where evidence of truncated subsoils occur (areas with excessive pale-colored sands and gravels with no apparent dark-colored organic-enriched matrix), previously excavated and stockpiled topsoils from the golf course should be spread and top-dressed over such areas to a minimum depth of 8 to 10 inches. If stockpiled topsoil is used up and further disrupted locations remain, then 4 to 5 inches of fine compost should be spread and roto-tilled into the top 6 to 8 inches of soil (use a roto-tiller design that can accommodate gravels and cobbles).

Soil microbial foodweb analysis had indicated that microbial populations were out of balance, with high populations of bacteria and/or fungi, and low populations of beneficial protozoa and nematodes. This imbalance can be augmented with use of actively aerated compost teas (AACT), which is not the same as standard manure teas or other compost leachate teas that are often discussed by organic farmers or gardeners. AACT is a short-term aeration process that starts with non-chlorinated water and a nylon bag full of good quality compost, soaked in a bucket or tub of water under a constant supply of air-injected bubblers or air stones. The result is a brown colored tea that is heavily concentrated with bacteria, fungi, protozoa, and nematodes, that can be applied as an inoculant directly to soils, or sprinkled around the base of newly installed plantings. It is likely a single application is all that would be necessary to rebalance the microbial population. Over time, as the former golf course lies untreated with artificial fertilizers and pesticides, and as additional natural mulches are established and used, prairie and woodland will evolve over the long-term with balanced soil microbial populations as they re-establish and maintain themselves.

Installing Native Plants needs to be coordinated with weed control efforts. Weeds do not need to be 100 percent eradicated prior to planting. However, percent cover of non-natives should be around less than 25 percent to ensure that the newly planted native species are not outcompeted. Drilling in native grass seed the first fall after instigating weed control can help to control weed re-establishment, but should be done only if large-scale herbicide use is not planned at the site.

Initial decisions for native plant installation will require deciding whether to use seeds, plugs, bare root, stakes or container plants. Seed can be the most economical choice depending on the species. Grass seed is the least expensive with costs increasing for species that have large seed with a lower germination rate. Seed also has high predation by birds and rodents. Plugs are still economical and are a viable way to install forbs and grasses. Live stakes are a low-cost way to establish native understory, but this option is limited to the species that will grow using this medium. Snowberry, as an understory to the oak woodlands, is likely to be the only species where live stakes are appropriate. Bare root is generally used for woody species and can be a more economical option than container plants. However, container plants are the most appropriate option for species that are difficult to establish such as Garry oak. Attachment B provides a list of native plant nurseries that provide prairie species.

PLU also has the option of propagating common camas using seed and/or bulbs collected from golf course areas that are planned for development. While seed is a viable alternative, the requirement for a greenhouse makes the use of bulbs a more feasible alternative at this time. Common camas is readily established by transplanting the bulbs (USDA 2006). Individual plants have been known to live for 15 to 20 years. The best time to excavate bulbs is from early summer through mid-fall following seed maturation, die-back of the leaves and development of the 'daughter' bulbs. The window for bulb removal is generally narrow; when soils are moist after flowering in the spring. The next time to harvest is in the fall after the rains begin.

Given the large area of available land at the golf course, the bulbs can be transplanted or heeled in immediately and planted at the same depth as at their original location. Generally, that is 0.5 to 1 inch deep for small bulblets and up to 4 to 6 inches for mature bulbs. Mature bulbs will produce 3 to 4 leaves.

Native Americans harvested camas bulbs by lifting out the turf in small sections and replacing the turf after removing the large bulbs for food. This method may work well for collecting the bulbs at PLU by lifting the turf in sections and placing them, with bulbs intact, in raised beds (using native soils in the beds under the collected turf). This way, both mature and young bulbs are collected with a minimum of disturbance. This keeps each bulb at the original depth; however, care will need to be taken to ensure that the bulbs are kept moist through their flowering season.

When transplanting the camas into the restoration area, it is best to plant them in fall or early winter when soils are moist enough to dig and soils temperatures are cool (less than 60 degrees F). Fall planting allows for better root development and chilling needed for flowering. Bulbs can be placed in groupings of 6 to 8 bulbs per square foot with a mix of both mature and young bulbs. The mature bulbs will typically flower each year. Young bulbs with only 2 leaves do not flower until they mature. If seed is also used, broadcasting at a rate of 20 live seeds per square ft. will, on average, result in 10 seedlings per square ft. Seedlings will produce flowers after 3 to 5 years.

Oak woodland planting will include Garry oak as the primary tree species. While it is typically more slow growing than other woody species found in oak woodlands, it has been found to establish more readily and grow more rapidly when mycorrhizae is added to the planting hole. In general, Garry oak will achieve the fastest height growth on open sites where there is little competition from other trees and shrubs. Inclusion of Douglas fir, Ponderosa pine and bigleaf maple as part of the oak woodlands planting is important to support a wide range of wildlife species. However, the conifers should be spaced far enough from the Garry oak so they won't grow into the oak canopy as each tree matures. Woodland understory species such as snowberry, Oregon grape, western serviceberry, and western hazelnut provide food, hiding cover, and nesting sites for wildlife and increase biodiversity on the site. Initial plant spacing should be done in such as way as to accommodate the oaks need for an open understory. Patches of shrubs can be planted in between the oaks, but their growth directly underneath oaks should be controlled to avoid competition. In addition, tree shelters and weed-barriers placed around newly planted oak saplings can protect them from deer, mice and voles that can cause severe mortality.

Wildlife Habitat Features can also be included as part of the restoration. This could include bluebird houses, bat boxes, water sources, butterfly basking rocks, logs and snags. In addition, trees continue to fulfill important ecological functions even after they die. Dead wood is important in soil development and is essential for maintaining fungi and other microorganisms that are the foundation for woodland food webs. Snags, stumps, and large-diameter logs are used by a variety of woodland and prairie wildlife species. For instance, twelve oak woodland species, including western grey squirrels, benefit from snags that are at least 17 inches in diameter and at least 20 ft. long. (Vesely and Tucker 2004).

LONG TERM MAINTENANCE

Throughout history, the South Sound prairies have been in existence only because of the regular, long-term maintenance by native peoples. The PLU prairie will also require regular maintenance in perpetuity. Most important will be control for Scotch broom and non-native grasses and forbs. This can be done using primarily the hand-pulling and prescribed burns methods; with herbicide used judiciously.

Invasive control maintenance of most native habitat restorations require more intensive efforts in the first 5 years after installation, with less frequent maintenance needed in the following years. Typically, hand pulling in the first 5 years should begin in early spring and be repeated every 3 to 4 weeks until August when most plants in this area have started to go dormant. This task is often carried out by students and community members interested in learning more about and supporting prairied restoration. Prescribed burns can be implemented once a year over a small portion of the prairie habitat (see specific information in the Site Preparation section). Herbicide should only be used when other methods have not been

successful and only applied as spot-spraying. Once prairie habitat is established, mowing is not recommended at any time of year.

Maintenance guidelines for specific plant and wildlife species is listed below:

For common camas:

- late summer burning can improve this species vigor, reduce competition from weeds and aid in regeneration.
- Mowing should be avoided even after the leaves have died back. (USDA 2006).

For oak woodlands:

- Rapid growth of native conifers, shrubs and grasses make them a serious threat to the survival of young oaks. Controlling competing vegetation is an essential step to ensure the fastest possible growth of oak seedlings and saplings. Above ground, conifers and shrubs can overtop oak seedlings and limit the availability of sunlight to the trees. Below ground, shrubs and grass compete against oaks for water and soil nutrients. Native shrubs and grasses are an important component of natural woodlands, but any plant that is growing up into the oak canopy should be controlled. Conifers that crowd oaks can be made into snags rather than removing completely.
- Maintain natural oak regeneration using acorns, oak seedlings, and stump sprouts in the existing stand. Ripe acorns can be collected from the ground starting early September through November. Direct seeding of Garry oak acorns is a simple, low-cost method of regeneration and should be done in the fall soon after the start of the rainy season when the upper layer of soil has been moistened. Germination of acorns can be enhanced by following instructions provided in the *Landowners Guide to Restoring and Managing Oregon White Oak Habitats* (Vesely and Tucker 2004).

For western grey squirrels:

- Western grey squirrels travel nearly exclusively along aerial pathways where tree canopies touch. If thinning trees is necessary, retain contiguous aerial pathways (Larsen and Morgan 1998).
- Burns should be planned in the late summer and fall to minimize impact on western gray squirrels. For example, prescribed burns conducted in the spring could reduce food availability when females are pregnant or lactating and smoke could affect juveniles still in the nest. (Linders and Stinson 2007)
- Keeping dogs leashed is important for attracting and maintaining a grey squirrel population.
- Ideal habitat for western gray squirrels may reflect a balance between open conditions that encourage acorn and conifer seed production, and the clumping of trees that allows arboreal travel by squirrels, secure nesting sites, and patches of high canopy closure.
- Maintain a fairly open understory of 35- to 50-percent cover of food species: snowberry, hazelnut, Indian plum, salal, serviceberry, rose species, red huckleberry, currant species, and vine maple (Ryan & Casey 1995) under the canopy of Garry oak, Douglas-fir, bigleaf maple, Pacific yew, grand fir, and Pacific dogwood.

For butterflies:

- Ideal butterfly habitat will maintain at least 5 acres of open prairie and allow for tree islands or edge habitat with oaks and conifers. Pockets of prairie can extend into the woodlands to provide butterfly refuge from wind, hot sunny weather, cold weather and heavy rains, and changes in humidity during extreme weather conditions.

- Control scotch broom and non-native grasses.
- Augment the native grasses and forbs that larval and adult butterflies depend on for food (see Appendix A).
- Incorporate a butterfly-sensitive fire regime that emphasizes regular burning of small portions of the prairie habitat in the late summer or fall. Only a small portion of the prairie should be burned each year.

For streaked horned lark:

- control scotch broom and non-native grasses.
- Reinstate late summer fire.
- Reduce disturbance to breeding larks by seasonally restricting off-leash dogs, kite flying, fireworks and vegetation trampling from mid April through early July. (Pearson and Altman 2005)

While it will take a few years for the prairie restoration to mature into habitat that will support the target wildlife species, once functional habitat appropriate to western grey squirrels, streaked horned lark, and/or butterflies has established WDFW can be contacted for feasibility of a passive reintroduction program. As of 2012, some prairie wildlife species are being propagated through the Sustainable Prisons Project (South Puget Sound Prairie Landscape Working Group 2012).

For soils:

Soils should not need any form of supplements, additions, or special maintenance over time. Soil organic matter will build and be maintained with natural additions through decomposing leaves, needles, roots, and humus, other life form deaths and byproducts (dead microbes and animals, animal droppings, worm castings, etc.) and the sporadic, infrequent additions of micro-char (microscopic charcoal) from low-intensity ground fires.

RESTORATION IMPLEMENTATION SCHEDULE

Establishing a schedule for native habitat restoration is an iterative process given uncontrollable elements that can affect the project. The planned schedule can be changed by weather conditions, vegetation damage by animals, incidental impacts from humans and pets, and the available volunteer base. It is important to have a schedule for restoration projects, knowing that adaptive management will be needed to respond to actual site conditions as the project progresses. With this in mind, the following schedule is recommended:

June 2012

- Make decisions regarding non-native control; will it be done site-wide or will portions be done in phases. Choose the non-native control method(s) appropriate for phased or whole site preparation.

June-October 2012

- Remove Scotch broom plants before they go to seed. Given the tight timeline for this, initial removal efforts can focus on flowering plants. Younger plants that have not flowered can be removed following the first effort. All Scotch broom should be removed from the site and disposed of in a manner that will not spread seed to other parts of the campus.
- Once flowering is done and leaves have started to dry out, collect and heel in camas bulbs. This can be conducted by students overseen by teaching staff.
- Begin implementation of non-native control method(s). If using herbicide, it must be applied before plants go into summer dormancy.

- Removal of dead, diseased, dying trees and trees to be thinned as part of the prairie restoration plan. This can be done anytime this year.
- Identify areas within the restoration site that have disrupted or truncated soils. This can be conducted by students overseen by teaching staff. Conduct transects through the proposed restoration area to identify any coarse sand and gravel subsoil evident directly at the surface. Digging into such areas will confirm if the pale sands and gravels are merely a thin layer on top of intact dark-colored, humus-rich topsoil. Estimate sizes of any encountered areas and map them onto a general site map. These spots will receive topsoil additions at a later date.
- Examine former golf course greens and check soils for compaction. If earthworm castings are evident on the surface, one can assume earthworm burrows will slowly reverse past human compaction. Evaluate whether greens need to be roto-tilled, or if natural processes can suffice.
- Stockpile any topsoil stripped from new development of expanded sport playfields. Stockpiled soils should be overseeded with crimson clover and/or annual ryegrass if moist conditions will allow for germination. If stockpiling is being done during dry summer conditions, the piles should be covered over with burlap or another semi-aerated tarp material to allow some air exchange and prevent soils from being over-heated (as would occur if plastic sheeting was used). If practical, any identified areas in the restoration area that previously had their topsoil removed or stripped, could be topdressed with 8 to 10 inches of this stockpiled topsoil. Overseeding with short-term cover crops or desired prairie grass species would be necessary if this action step was enacted this year.

April-May 2013

- Evaluate the efficacy of last year's non-native control methods and plan for control method(s) to use this year.
- Check the entire site for Scotch broom plants and remove all plants.
- For areas that have achieved a satisfactory level of exotic vegetation control, applications of AACT (actively aerated compost tea) inoculant can be sprayed on the ground surface or sprinkled around any newly installed plantings or existing plantings. This inoculant should only be applied when soils are moist and temperatures are above 45 degrees.

May – August 2013

- Implement chosen non-native control methods.

September – October 2013

- Evaluate the non-native control effort. If less than 25 percent non-native vegetation is achieved, native grasses can be drill seeded in the chosen planting area after rains have started and before temperatures turn cold.
- If percent cover of non-native plants is low enough, Garry oak and woody understory vegetation (container plants) can be installed if regular irrigation will also be implemented. The AACT inoculant can be used in each planting hole to assist with the vitality and vigor of the plantings. Plants should be installed after the winter rains have started and before day time temperatures dip below freezing; typically from mid-October to the end of November.
- A test plot of camas bulbs can be transplanted in late fall or early winter.

April-May 2014

- Evaluate the efficacy of last year's non-native control methods and plan for control method(s) to use this year.

- Evaluate the germination of native grasses, and the success and vigor of transplanted camas bulbs and planted woody vegetation. If the spring evaluation shows an unacceptable success rate from the fall 2013 plantings, the cause needs to be investigated and a new method or approach planned for future transplanting/planting efforts.
- Check the entire site for Scotch broom plants and remove all plants.

May – August 2014

- Implement chosen non-native control methods.
- Conduct long-term maintenance efforts in planted areas using the spring evaluation as a basis for maintenance actions.
- Irrigation needs to be provided for at least the first two years after installation for all plantings. If plantings are installed in phases, irrigation will need to be provided for two years in each area.

September – October 2014

- If percent cover of non-native plants is low enough, additional native grass can be drill seeded in the next planting area if the project is to be phased.
- Additional camas can be transplanted in late fall or early winter using the transplanting method chosen following the spring evaluation.
- If percent cover of non-native plants is low enough, prairie forbs can be seeded in the fall after the rains have started and before temperatures turn cold.

February - March 2015

- Additional prairie forbs can be planted after the last frost using plugs.
- For areas that have achieved a satisfactory level of non-native vegetation control, applications of AACT (actively aerated compost tea) inoculant can be sprayed on the ground surface or sprinkled around any newly installed plantings or existing plantings. This inoculant should only be applied when soils are moist and temperatures are above 45 degrees.

April – October

- The same schedule for evaluation of restoration areas, adaptive management, and maintenance as outlined for this period in 2014 can be used. This schedule can be followed for each successive year using adaptive management to plan for and carry out on-going maintenance and, if necessary, additional plantings.

If questions about maintenance and/or to find out about updated methods for non-native vegetation control, contact the Washington State Department of Fish and Wildlife (WDFW) that administers Landowner Incentive Programs (LIP) to offer support to habitat restoration on private lands.

USE OF THIS REPORT

This report was prepared for the exclusive use of Pacific Lutheran University and Mithun, and their specific application to the prairie restoration plans at the golf course. The use by others, or for purposes other than intended, is at the user's sole risk. The findings presented herein are based on Touchstone EcoServices' understanding of current prairie restoration practices as developed by Washington Department of Fish and Wildlife, USDA Forest Service and The Nature Conservancy. Within the limitations of scope, schedule, and budget, the findings presented in this report were prepared in accordance with generally accepted native habitat restoration methods, principles and practices in this locality at the time the report was prepared. Touchstone EcoServices makes no other warranty, either express or implied.

Signed:

Diane Brewster
Touchstone EcoServices

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Attachment A
Vegetation and Wildlife of South Sound Prairies

Wildlife

Several species of wildlife associated with Washington prairies that are similar to the Pacific Lutheran University (PLU) golf course area have become extinct, such as several subspecies of Mazama pocket gopher (*Thomomys mazama*), Pacific gopher snake (*Pituophis melanoleucus*) and racer (*Coluber constrictor*). Other species are rare or declining such as the streaked horned lark (*Eremophila alpestris spp. strigata*); Oregon vesper sparrow (*Pooecetes gramineus affinis*); western meadowlark (*Sturnella neglecta*); northern harrier (*Circus cyaneus*); slender-billed white-breasted nuthatch (*Sitta carolinensis aculeata*); western gray squirrel (*Sciurus griseus*), western fence lizard (*Sceloporus occidentalis*) and several butterflies that include Taylor's checkerspot (*Euphydryas editha taylorii*), and Mardon Skipper (*Polites mardon*). One species, the western bluebird (*Sialia mexicana*), is increasing due to a successful bluebird box program started on Joint Base Lewis-McChord and managed by the Washington Department of Fish and Wildlife.

A list of wildlife associated with Washington prairies and/or Garry Oak woodlands is shown below:

Birds:

Scientific Name	**Common Name**
Buteo jamaicensis	Red-tailed hawk
Circus cuaneus	Northern Harrier
Columba fasciata	Band-tailed pigeon
Cyanocitta stelleri	Stellar's jay
Dryocopus pileatus	Pileated woodpecker
Eremophila alpestris spp. strigata	Streaked horned lark [P]
Falco sparverius	American kestrel
Melanerpes lewis	Lewis' woodpecker
Selasphorus rufus	Rufus hummingbird
Sialia mexicana	Western bluebird
Sturnella neglecta	Western meadowlark
Tachycineta bicolor	Tree swallow
Tachycineta thalassina	Violet-green swallow
Turdus migratorius	American robin

P – a species that is rare and protected by Washington State and/or Federally

Butterflies

Scientific Name	**Common Name**
Argunnis (Speyeria) cybele	Puget Fritillary
Bolobira epithore chermocki	Western meadow fritillary
Coenonympha tulia eumomia	Ochre ringlet
Coenonympha tulia	Common ringlet
Colias eurytheme	Orange sulphur
Echo Echo	Echo Blue (or Spring azure)

Butterflies, continued:	
Euphydryas editha taylorii	Taylor's checkerspot [P]
Icaricia icaroides blackmorel	Puget blue [P]
Glaucopsyche lygdamus columbia	Silver blue
Ochlodes sylvanoides	Woodland skipper
Papilio zelicaon zelicaon	Anis swallowtail
Phycoides mylitta mylitta	Mylitta crescent
Pieris marginalis marginalis	Margined white
Pieris rapae	European cabbage white
Polites mardon	Mardon skipper [P]
Pyrgus ruralis ruralis	Two-banded skipper
Speyeria Cybele pugetensis	Puget Sound silverspot (or Great spangled silverspot)
Speyeria zerene bremnerii	Zerene Fritillary [P]

P - a species that is rare and protected by Washington State and/or Federally

Mammals

Scientific Name	**Common Name**
Camis latrans	Coyote
Microtus pennsylvanicus	Meadow vole [F]
Procyon lotor	Raccoon
Scapanus townsendii	Townsend's mole [F]
Sciurus griseus	Western gray squirrel [P]
Thamnophis ordinoides	Northwestern garter snake
Thomomys mazama	Mazama pocket gopher [P]
Vulpes vulpes	Red fox

F – an important food source in the prairie ecosystem for larger mammals and raptors
P - a species that is rare and protected by Washington State and/or Federally

Reptiles and Amphibians

Scientific Name	**Common Name**
Elgaria coerulea	Northern alligator lizard
Charina bottae	Rubber boa
Contia tenuis	Sharp-tail snake
Pseudacris regilla	Pacific chorus frog
Sceloporus occidentalis	Western fence lizard
Thamnophis ordinoides	Northwestern garter snake

Vegetation

A number of Washington prairie plant species are declining and/or rare due to loss and impacts to prairie habitat. These include golden paintbrush *(Castilleja levisecta),* white-topped aster *(Sericocarpus rigidus),* rose checker-mallow *(Sidalcea malviflora ssp. virgata),* Small-flowered Trillium *(Trillium parviflorum),* Torrey's Peavine *(Lathyrus torreyi),* Tall Agoseris *(Agoseris elata), and* Common Blue-Cup *(Githopsis speculariodes).*

Native prairie plants that are associated with soil and hydrologic conditions similar to those at PLU golf course:

Scientific Name	**Common Name**
Achillea millefolium	Common yarrow
Allium amplectens	Narrowleaf onion
Allium acuminatum	Tapertip onion
Allium cernuum	Nodding onion
Amsinckia menziesii	Menzies' fiddleneck
Anaphalis mafgaritacea	Pearly everlasting
Antennaria microphylla	Rosy pussy-toes
Aquilegia formosa	Red columbine
Aster chilensis var hallii	Hall's aster
Balsamorhiza deltoidea	Puget balsamroot [B]
Brodiaea coronaria	Harvest Brodiaea
Carex inops	Long-stoloned sedge
Camassia quamash	Common camas [B,F]
Camassia leichtlinii	Large camas
Campanula rotundifolia	Common harebell
Castelleja hispida	Harsh paintbrush [B]
Castelleja levisecta	Golden paintbrush [B,P]
Cerastium arvense	Field chickweed
Collinsia parviflora var parviflora	Small-flowered blue-eyed mary
Danthonia californica	California oatgrass
Danthonia spicata	Poverty oatgrass
Delphinium nutalli	Menzie's larkspur
Deschampsia cespitosa	Tufted hairgrass
Dichanthelium oligosnathes	Heller's rosette grass
Dodecatheon hendersonii	Broad-leaf shooting star
Dodecatheon pulchellum	Few-flowered shooting star
Eriophyllum lanatum	Oregon sunshine
Erythronium oreganum	Giant white fawnlily
Festuca indahoensis var. *roemeri*	Roemer's fescue [B]
Festuca rubra var. *rubra*	Red fescue
Frageria vesca	Woodland strawberry [B]
Frageria virginiana	Wild strawberry [B]
Fritilleria affinis	Chocolate Lily
Gaillardia aristata	Blanket flower
Heuchera chlorantha	Hounds-tongue hawkweed
Koelaria macrantha	Prairie junegrass
Lithophragma parviflora	Small-flowered woodland-star
Lomatium utriculatum	Spring gold
Lupinus albicaulis	Sicklekeel lupine
Lupinus bicolor ssp. bicolor	Miniature lupine
Lupinus lepidus	Prairie lupine [B,K,P]
Lupinus wyethii	Wyeth's lupine
Quercus garryana	Garry oak
Ranunculus occidentalis	Western buttercup

Prairie Vegetation, continued	
Sericocarpus rigidus	White-topped aster [P]
Solidago canadensis	Meadow goldenrod [B,M]
Triteleia hyacinthina	White brodiaea (Fool's onion)
Viola adunca	Early blue violet [B,K]
Zigadenus venenosus	Meadow death camas [B]

B = important food source for butterflies and/or their larvae
F – native people's food source
K – key species for butterfly habitat
M – traditional medical uses
P – a species that is rare and protected by Washington State and/or Federally

Native Garry oak woodland plants that are associated with soil and hydrologic conditions similar to those at PLU golf course:

Scientific Name	**Common Name**
Acer macrophyllum	Bigleaf maple [K,S]
Amelanchier alnifolia	Serviceberry [S]
Berberis aquifolium	Tall Oregon grape [S]
Cornus nutalli	Pacific Dogwood [S]
Corylus cornuta	Western hazelnut [S]
Holodiscus discolor	Oceanspray
Oemlaria cerasiformis	Indian plum [S]
Pinus ponderosa	Ponderosa pine [K,S]
Pseudotsuga heterophylla	Douglas fir [K]
Quercus garryana	Garry oak [K,S]
Rosa gymnocarpa	Baldhip rose [S]
Rubus ursinus	Trailing blackberry
Symphoricarpos albus	Common snowberry [S]
Taxus brevifolia	Pacific yew [S]

Note: Grasses and Forbs in Garry Oak woodlands are the same as those listed for prairie habitat.
K – key species for western grey squirrel habitat
S = important food source for western grey squirrel

References:

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Attachment B
South Sound Nurseries - Native Prairie Vegetation

Shotwell's Nursery
Operated by the Center for Natural Lands Management
Propagates over 100 native plant species, including 30-50 rare prairie species; collects and cleans seed from regional prairies, cultivates plant plugs, conduct research into plant collection and propagation methods, and supplies native seeds and plugs to conservation partners* throughout the region.

Webster's Nursery
Operated by the Center for Natural Lands Management for.
Focuses on seed production; specifically, species that are host and larval sources for imperiled butterfly species.

The Sustainable Prisons Project
Partnered with the Evergreen State College and Center for Natural Lands Management
Produces around 400,000 plugs for use in regional prairie sites.

For more information on native plant propagation, contact Angela Winter at:
awinter@cnlm .org, 360-464-0540.

* Conservation Partners include public agencies, non-profit organizations and private landowners that are working together with The Center for Natural Lands Management (www.cnlm.org) to restore South Sound prairies and oak woodlands. The CLNM promotes conservation provides services to assist with pest plant control, native habitat enhancements and prescribed fire of prairies and oak woodlands throughout the Northwest.
For more information, contact Hannah Anderson
South Sound Prairies Working Group Administrator
Phone/Fax : 360.283.5449
handerson@cnlm.org

Other nurseries/sources that may carry prairie plants:

Fourth Corner Nurseries
Bellingham, WA
http://fourthcornernurseries.com/

Sound Native Plants
Olympia, WA
www.soundnativeplants.com

Pacifica Restoration
Olympia, WA
gonetoseed@gmail.com

Washington Native Plant Society
List of nurseries
www.wnps.org/landscaping/nurserylist.html

PLU Prairie Restoration 1 Touchstone EcoServices

South Sound Nurseries

Goals:

To maintain the landscape in a manner that prevents vegetation degradation through neglect and promotes its transition to native prairie and Garry oak woodland.

Objectives:

To preserve existing vegetation that contributes to the intended future native ecosystem.
To arrest and prevent new degradation by undesirable plant species.
To encourage native plant salvage and baseline vegetation data collection.
To address tree-related risk.
To enhance user security.
To optimize investment of natural and financial resources.

Actions:

Trees

1. Identify valuable trees

In consultation with Mithun team, sort trees by current and future ecological value:

- High quality mature Douglas firs to retain.
- Juvenile Douglas firs with good habitat potential, based on condition and location.
- Young or small non-native trees worth salvaging, for use elsewhere on campus or for sale or donation.
- Trees not providing significant ecological or aesthetic value, for removal or minimum levels of maintenance.

2. Risk reduction

Review tree risk status after storm events and at least annually by a certified arborist.
Update records in Table of Trees as conditions change and mitigation is completed.
Establish risk abatement priorities and professionally address in order of urgency.
Complete all tasks that grounds staff can execute without outside contractor help.

3.Tree management

Deal with Tree 1104 dwarf mistletoe to prevent spread to uninfected fir population.
Install and maintain 3-4” deep wood chip mulch to dripline under all “keeper” trees.
Plan for and provide supplemental summer water to fairway trees that formerly received irrigation, tapering to none after three seasons. Water can be delivered by soaker hose on timers at a slow rate over several hours, in preference to inefficient, manually-controlled sprinklers.
Complete one-time tree management actions recommended in Table of Trees.

- Give priority to Exceptional status tree needs.
- Give priority to tasks that grounds staff can handle in-house.

Table of Trees Action Key:

M	Monitor
I	Inspect roots, trunk or crown
D	Diagnose insect / disease
MU	Mulch / protect root zone
SP	Structural prune
CC	Crown clean prune
EW	End-weight reduction prune
TX	Remove risk targets
R	Remove
S	Convert to snag
O	Other (see Remarks)

Identify opportunities and recruit volunteers for special projects or ongoing maintenance assistance (such as mulching or removing aspen & cherry suckers).
Identify any locations posing security concerns and as a secondary, not primary, remedy evaluate trees for judicious pruning to improve sight lines.

Understory

1. Turf Management

Stop watering former greens and fairways (except spot irrigation of trees discussed above).
Based on monitoring, mow former turf just often enough to prevent ripe seed dispersion, approximately 3-4 times a year in spring, early summer and fall.
Cease applying lime, fertilizer, peat or any other amendments to former turf areas.
In existing roughs, mow based on plant ecologist’s evaluation of species present and relative value of controlling exotic grass infestations vs. native species seed production.

2. Native Plant Protection

Protect the few existing native woody plants on site and encourage vegetative spread (mahonia, Redtwig dogwood).
Salvage existing Camas, Brodaea and other native bulbs and herbaceous plants in path of development; prepare convenient receiving site by removing or sheet mulching abandoned turf and replanting as much in soil taken from salvage removal site as possible.
Preserve existing colonies of native herbaceous plants in place; if possible weed 2-3 times per season to remove competing non-natives, especially noxious weeds before they set seed (thistle, St John’s wort).
Establish baseline vegetation monitoring plots or transects under leadership of botany faculty or restoration ecologist. Recruit, train and provide oversight for student or community volunteers to conduct field work and electronic data entry at least annually basis, but preferably in spring, (midsummer) and fall.

3. Invasive Plant Control

Develop a monitoring program to begin in Spring 2012, to identify invasive and weed species for containment or preferably, elimination. Program should include clear metrics, a schedule, documentation forms, methodology training for those doing field investigation, provision for electronic data entry, and responsibility to act on findings.
Establish and fund a mechanism by which to respond promptly and appropriately to identified “hot spots” and document methods used.
Use IPM strategies to minimize use of herbicides to control invasives & weeds, including pulling, cutting and sheet mulching.
Give top priority to removing flowering plant parts before they mature and disperse seed; some species may require repeat treatments over a single season.
Eradicate infestations as feasible, especially mandated noxious weeds and small patches that have not yet spread.
Identify external sources of potential or current infestations and contact adjacent property owners about control; if necessary, offer assistance to reduce invasive pressure on PLU site.
Engage University community in monitoring and control activities, and adaptive management based on results achieved. Invasive plant control is a first step in native habitat restoration.
Continuity of above efforts is essential to prevent invasive plant encroachment to and from the PLU site. In an urban context, native habitat does not equate with wild and uncontrolled; active management will be an on-going need.

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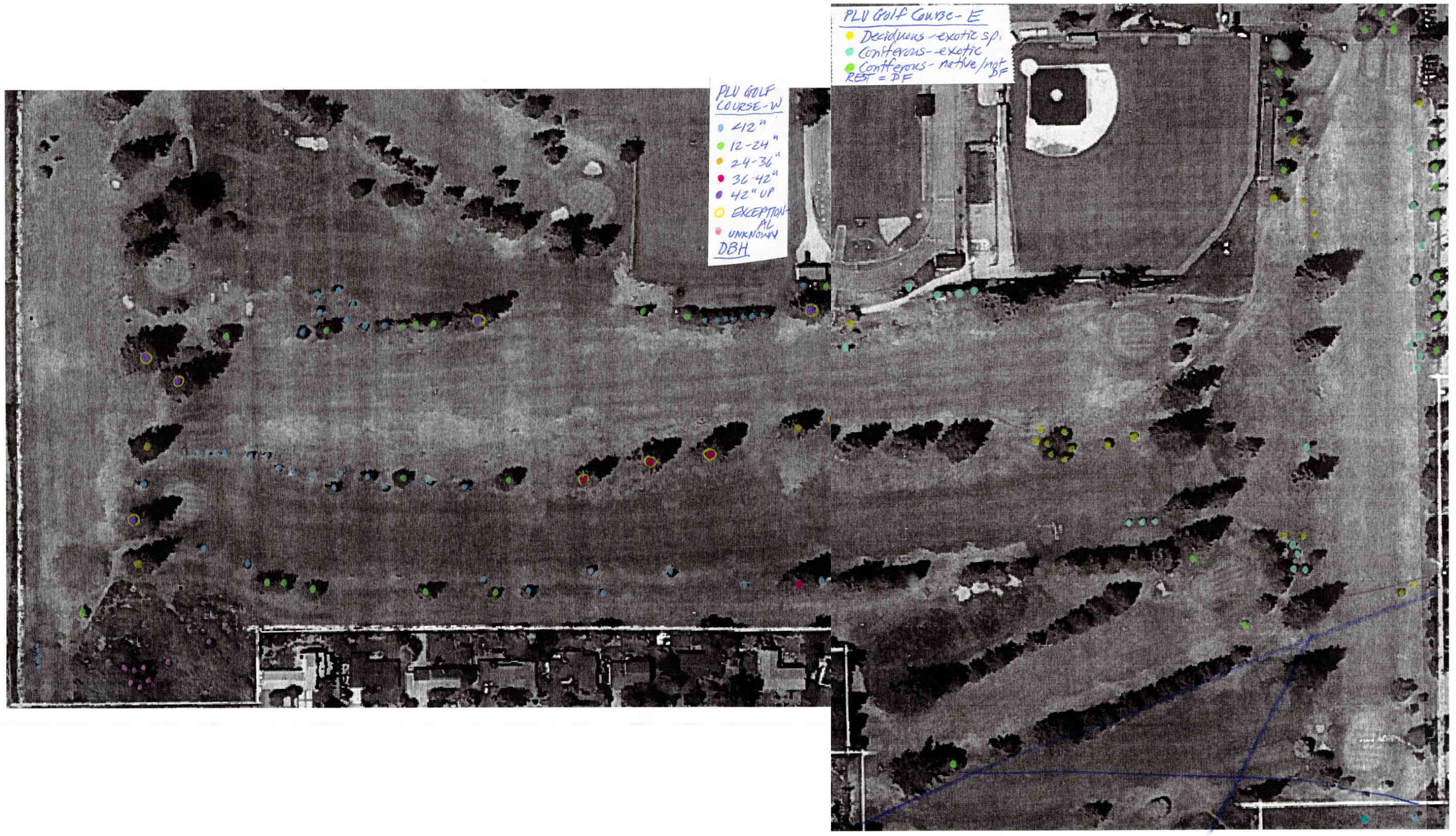

Tree Management Report: Size Class

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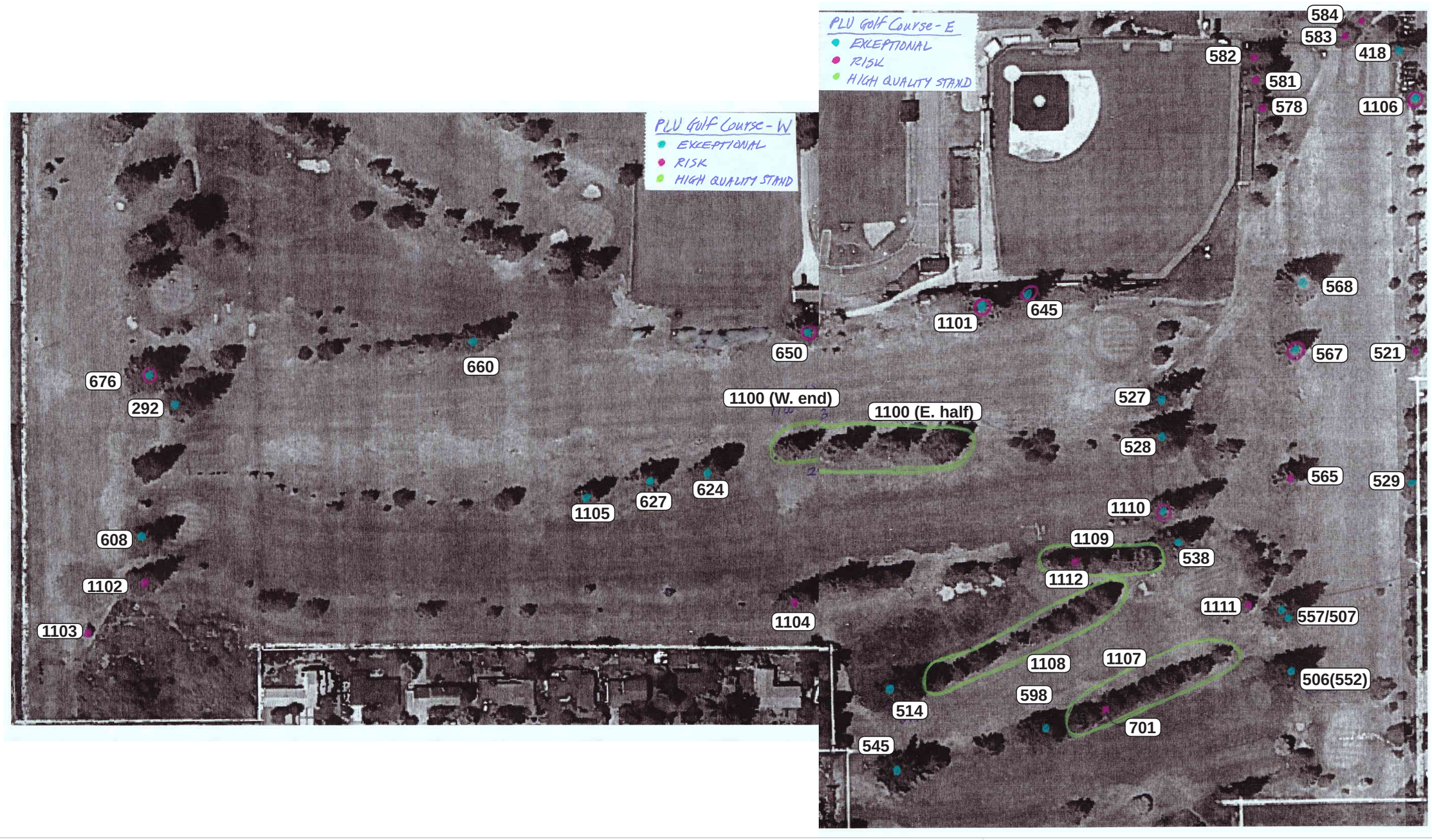


Tree Management Report: Table of Trees

PLU - Table of Trees

Abbreviation Key

DBH	Diameter at Breast Height (4'-6")

Condition:

E	Excellent
VG	Very Good
G	Good
F	Fair
P	Poor

Risk Status:

-	No / low risk
(+)	Potential / future risk
+	Current risk
++	High risk

Defects / Health Issues:

SR	Surface structural roots
RZ	Root disturbance / damage
C	Compaction
L	Lean
CO	Co-dominant trunks
TD	Trunk defect / damage
DW	Dead wood / stubs
P	Pitch flow
OC	Off-color foliage
TH	Thinning foliage
ID	Insect +/or disease

Management:

M	Monitor
I	Inspect roots, trunk or crown
D	Diagnose insect / disease
MU	Mulch / protect root zone
SP	Structural prune
CC	Crown clean prune
EW	End-weight reduction prune
TX	Remove risk targets
R	Remove
S	Convert to snag
O	Other (see Remarks)

Pacific Lutheran University **TABLE OF TREES** **Golf Course Study Site**

Tree ID	Fairway Location	Common Name	DBH inches	Condition	Risk Status	Exceptional	Defects / Health Issues	Management Action(s)	Remarks
292	9	Douglas fir	53	E	-	yes	TD, P	MU	On Mima mound (+ immed SW); pitch 15' down, limb removal scars
293	9/4	Douglas fir	37	E	-	yes	SR, RZ, C	MU	
418	1	Douglas fir	34	VG	-	yes	RZ, C, TD, DW	MU, CC, TX	Exceptional due to location; mound, limbed to 40', scars; remove prominent lower dead limbs, eliminate parking on W half of root zone if possible.
506	1/2	Douglas fir	48	E	-	yes	SR, RZ	MU, O	Also tagged 556; tee immediately W; reduce/redirect irrigation.
507	1	Douglas fir	31	VG	-	yes	(DW)	MU	Mound, ants, copious frass @ base (raccoon?); grows as #557 twin.
521	1	Douglas fir	6, 15	G	(+)	no	CO, TH	SP	Codominant @ 4'; remove suppressed leader while small.
527	9	Douglas fir	36	VG	-	yes	SR, RZ, C, P	M, MU	Mound; major scalping, asphalt path 14' NW root disturbance?; old pitch flow 20' down NE & SW sides, branch removal scars.
528	4	Douglas fir	45	E	-	yes	SR, RZ	MU	Minor root damage
529	1	Douglas fir	41	VG	+	yes	RZ, C, P, TH	M, (I)	Mound, tight to fence, ants; street over E half of root zone; extensive old pitch flow - decay? Consider trunk resistograph.
538	4	Douglas fir	44	VG	-	yes	SR, RZ, C, DW, TH	CC	Roots scalped, slight thinning
545	2/3	Douglas fir	44	VG	-	yes	SR, DW	CC	Beyond site; large rocky mound, canopy asymmetrical to NE
557	1	Douglas fir	39	VG	-	yes	(DW)	MU	Mound, ants, copious frass @ base (raccoon?); grows as #507 twin.
565	1	Douglas fir	33	VG	+	no	TD, DW	M, MU	Trunk defect @ 10', slight bend @ 50', downgrade condition.

Pacific Lutheran University **TABLE OF TREES** **Golf Course Study Site**

Tree ID	Fairway Location	Common Name	DBH inches	Condition	Risk Status	Exceptional	Defects / Health Issues	Management Action(s)	Remarks
567	1	Douglas fir	36+	G	+	yes	SR, RZ, TD, P	MU, M, (I)	DBH per survey. Pitch flow heavy 25' down, lacks root flare N side; trunk/flare resistograph?
568	1	Douglas fir	60+	E	-	yes	SR	MU	DBH per survey.
574	3	Douglas fir	52	G	-	yes	DW, TH	M, (CC)	Beyond site; mound, thatch ants
578	1	Sitka? spruce	16	G	++	no	C, L, DW	M, TX, R?	Uncorrected 30º lean S over pedestrians, shed - monitor; consider removal if targets remain.
581	1	Sitka? spruce	21	F	++	no	C, TD, DW	M, MU, TX, EW, CC	Topped @ 20', dense multi-leader above; parking, sportfield targets stay but eliminate pedestrians.
582	1	Douglas fir	30	VG	+	no	C, TD, DW	M, MU, TX, EW	Suppressed secondary 10" leader @ 8' with included bark; monitor for separation, reduce endweight, exclude pedestrians underneath.
583	1	Shore pine	28	F/G	++	no	RZ, CO, L, TD, DW	M, EW	Confirm species; leans 5-30º W toward parking & pedestrians, canopy asymmetrical; asphalt path immediately south, probable past root removal; limbed to 20', scars.
584	1	Shore pine	23	F/G	++	no	RZ, L, TD	M, EW	Confirm species; leans 10º+ N over bldg & pedestrians, canopy asymmetrical; raised bed, probable past root removal; limbed to 35', scars.
598	2/3	Douglas fir	39	VG	(+)	yes	SR, TH, ID	M, MU	Rocky mound, ants; slight thinning; non-pathogenic boletus fungi on ground on S-SW sides 5-14' out
608	4/5	Douglas fir	42	VG	-	yes	SR, P	M	Mound; old pitch on N, SE sides
627	9/4	Douglas fir	36	E	-	yes	DW	MU, CC	Mound; remove stubs

Tree Management Report: Table of Trees

Pacific Lutheran University **TABLE OF TREES** **Golf Course Study Site**

Tree ID	Fairway Location	Common Name	DBH inches	Condition	Risk Status	Exceptional	Defects / Health Issues	Management Action(s)	Remarks
629	4/9	Douglas fir	40	VG	-	yes	SR, C, DW, TH	MU	Large mound; slightly sparse
645	9/4	Douglas fir	50	G	+	yes	RZ, TD, DW, TH	M, MU, O	Fill over N half of root zone from ballfield construction, pull soil back from trunk & re-slope
650	9	Douglas fir	44	VG	++	yes	RZ, C, CO	M, TX, O	Storage in root zone; codominant @ 12': monitor for separation, remove targets or consider bolting
660	8/9	Douglas fir	44	VG	-	yes	SR, TD, P, DW	MU	Mound; old pitch from branch removal scars
676	5	Douglas fir	45	VG	(+)	yes	SR, CO, DW, TH	M, MU, TX	Mound, gravel; huge surface root S side - protect; keep targets away in future
701	2/3	Douglas fir	19	F	+	no	SR, TH, OC, ID?	D, R?	Mound, 5" + basal conk - diagnose if pathogenic, consider removal.
1101	9	Douglas fir	42	VG	+	yes	RZ, DW	M, O, (CC)	Fill covers 40% of root zone from ballfield construction; pull soil back from trunk & re-slope
1102	4/5	Douglas fir	34	VG	+	no	DW	MU, SP	Remove large 6" hanger W side.
1103	5	Blue Atlas cedar	12	G	+	no	TD	SP, R	6 stems union @ 5', included bark; reduce to 2-3 stems, consider future safety removal when larger.
1104	4	Douglas fir	39	VG?	-	no	SR, DW, ID	I, D, R?	Large witch's broom @ 40'; confirm dwarf mistletoe infection; remove tree if found, inspect/monitor all firs w/in 50' radius to prevent spread.
1105	4/9	Douglas fir	36	E	-	yes	SR, RZ, DW, P	M, MU, CC	Remove large dead wood
1106	1	Douglas fir	41	VG	+	yes	RZ, C, TD	M, MU TX	Outside fence; limbed to 30', root disturbance 3 sides by asphalt/gravel parking; eliminate parking in root zone if possible.

Pacific Lutheran University **TABLE OF TREES** **Golf Course Study Site**

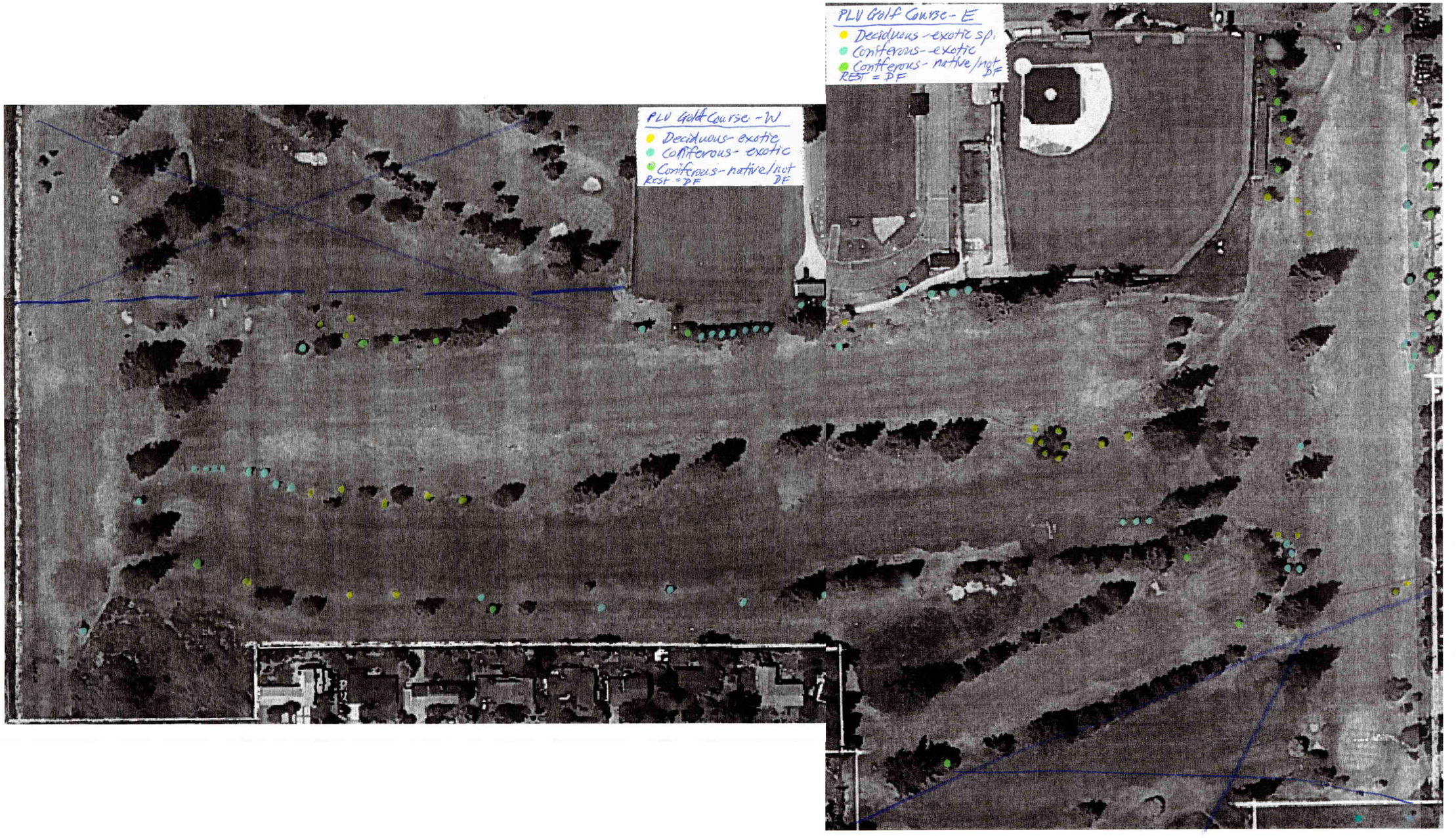
Tree ID	Fairway Location	Common Name	DBH inches	Condition	Risk Status	Exceptional	Defects / Health Issues	Management Action(s)	Remarks
1110	4	Douglas fir	42	VG	(+)	yes	TD, DW	M, MU	Handsome glaucous foliage; trunk bends @ base & 60', downgrade for defects.
1111	3	Douglas fir	13	VG	+	no	CO, TD	M, R?	Mound; trunk splits @ 6', included bark: remove in future if targets are present.
1112	3/4	Douglas fir	24	G	+	no	SR, C, TD	M, MU, (I), S?	Hooked leader @ 30'; consider aerial soundness inspection; if weak reduce to snag below hook or exclude access in target range.

NOTE:
All 1100 series ID #'s are newly-assigned and mapped but not field-tagged.
Remaining #'s refer to ID tags found on trees.
For trees having multiple tags, most recent-looking was selected as ID.
For abbreviations refer to key provided as separate sheet.

Pacific Lutheran University **TABLE OF TREE STANDS** **Golf Course Study Site**

Stand ID	Fairway Location	Common Name	Tree Count	DBH Range inches	Condition Range	Risk Status	Defects / Health Issues	Management Action(s)	Remarks
1100	4/9	Douglas fir	5	31 - 37	VG - E	-	SR, C, DW	MU	#293 also individually exceptional.
1107	2/3	Douglas fir	7	10 - 28	VG	-	SR, C	MU	#701 @ west end of row excluded because of condition & risk issues.
1108	3	Douglas fir	8	9-23	G - E	-	SR, C, DW	MU	3 @ E end are best quality trees to retain.
1109	3/4	Douglas fir	5	24 - 27	F/G - VG	(+)	SR, RZ, C, DW, (TH	M, MU, (R or S)	#1112 @ 2nd from W end is risk tree, see TOT; 27" tree @ E end is stressed, thinning, has much DW - consider removing

Tree Management Report: Table of Trees & Tree Stands



Tree Management Report: Species Type

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