Office of the University Architect / 2016

URBAN FOREST MANAGEMENT PLAN

Purpose of Plan

VISUALIZING | ANALYSIS | VISIONING | PLANNING

The University of Washington takes pride in the quality of the natural environment of this region and on campus, illustrated by the landscape's complex and diverse character. To preserve its beauty and function, the University actively plans and develops strategies for protecting it in the face of new development. The Urban Forest Management Plan helps align various planning studies with the conservation and enhancement of the University's Urban Forest. The following goals provide the framework that becomes the lense by which strategies are developed through a thoughtful analysis of the tree canopy and resources.

Effectively **communicate the value** of UW's urban forest canopy relative to diversity of species, air quality, storm water, and well-being for humans and wildlife. Identify benefits/deficits associated with increasing/decreasing our urban forest on campus balanced with open space needs and access to daylight. Establish metrics for measuring and monitoring this over time.

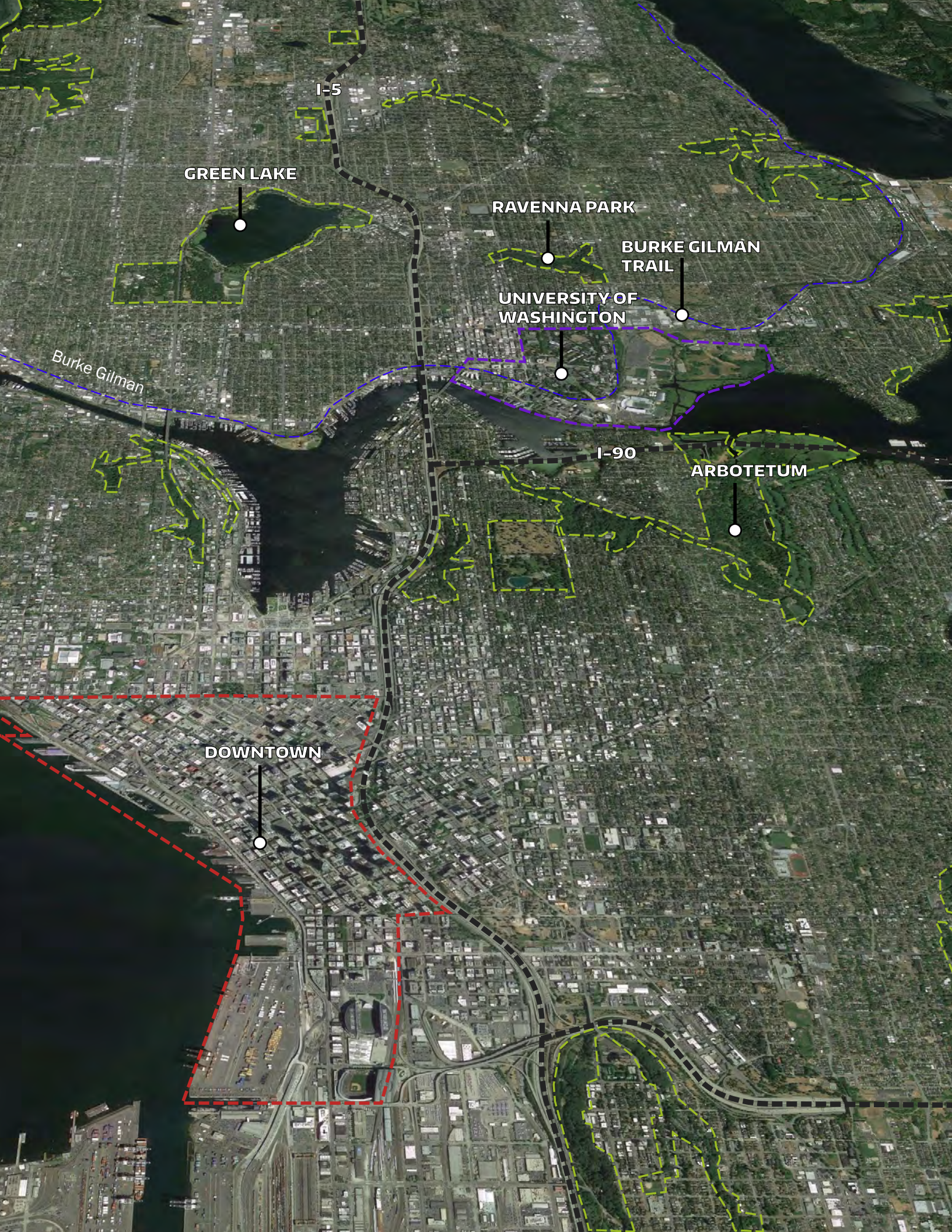
Identify **canopy coverage goals** to include percent cover per campus district and species selection criteria. Establish tree planting locations for large and small scale plantings; formal and informal plantings; memorial tree locations; naturalized and habitat enhancing locations; replacement plantings; and general guidelines for selecting plantings locations.

Identify opportunities to **become better stewards** of the urban forest through best management practices for protecting, planting, transplanting, wood reuse, and maintaining the trees on campus during establishment and long-term care. Provide policy recommendations for the protection of trees to include definitions for designation, replacement standards, approval process for removal, development of a replacement fund, and recreational use of trees (slack lines, hammocks, etc.). Identify dedicated and potential funding sources for the ongoing management of the urban forest and upkeep of this document.

Increase general knowledge and awareness of the urban forest through the development of campus tree tours, walking maps, informative posters, and a campus tree calendar; access to an online campus tree database; establishing annual tree planting work parties including Tree Campus USA and Arbor Day celebrations; and working with students to develop capstone projects and faculty to identify resources to enhance teaching.

Maintain a **current and dynamic tree database** for all trees on campus with information related to tree species, size, health, value, maintenance records, etc. Increase safety on campus by identifying and removing high risk trees and tree parts. Identify concerns related to trees with a high level of wind or disease susceptibility, high risk areas based on adjacent use, and risk relative to past maintenance activities.

Implement management strategies that are acknowledged, understood, and accepted by relevant municipal departments as regulated under the 2018 Campus Master Plan. Coordinate with the City of Seattle to identify exceptions to the codes administered by DPD regarding regulations around tree protection, removal, replacement and permitting to separate tree removal from building permit applications.


I-5
GREEN LAKE
RAVENNA PARK
BURKE GILMAN TRAIL
UNIVERSITY OF WASHINGTON
Burke Gilman
I-90
ARBOTETUM
DOWNTOWN

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Intro to Urban Forestry

The clearest way into the Universe is through a forest wilderness

John Muir

The majestic views of mountains and trees in both the foreground and background gives Western Washington its iconic landscape vistas. The landscape's historic condition has been substantially disturbed by man-made and natural forces, leaving us with relics of its old-growth character. The history of the Northwest forest is built on narratives of different management strategies, each signifying changes in development, man's vision and our understanding of the forest. Today, we are required to develop policies and management strategies that support the reestablishment, enhacement, and protection of the urban forests that remain. As the pressure of development continues in Seattle and on campus, balancing open space with buildings is pivotal for maintaining the natural experience in the city and on campus. The city of Seattle has established a standard for properly managing the Urban Forest through a sustainable framework that considers ecological, management, and stewardship goals as overlapping pillars for maintaining a healthy and vibrant urban forest. The University shares the same values as the city and is working towards addressing the challenges and opportunities associated with improving the installation, maintaince, and monitoring of the urban forest.

Washington's Forestry Past

LOGGING | MILLING | SKIDROW | HOUSING

The dense stands of Douglas fir, hemlock, spruce and cedar have been a symbol of the Puget Sound region since it was first inhabited. Historically, the dense canopy of trees were actively managed by local Native American tribes for food, clothing, ceremonies, and housing. Since then, the vision for our forests has shifted towards increase harvesting and manipulation. The history of this resource can be divided into four periods of significance, each representing a different ideology of how to sustain their production into the future.

PRE-SETTLERS : before 1848

Prior to European settlement, local Native Americans harvested and managed the forest in-line with the natural ecology. Some archaeologist believe that this region was one of the first populated areas in North American. They used the forest sustainably for weapons, baskets, and mats, with red cedar being specifically used to construct homes and canoes. As a management tool, they conducted annual burns to increase berry production and to encourage the growth of food crops. There are accounts of explorers writing about first arriving to an "impenetrable wilderness of lofty trees." In 1828, the Hudson's Bay Company (HBC) expanded their economic efforts beyond the fur trade by building a lumber mill at Fort Vancouver, dramatically transforming how we used and valued the forest of the Northwest; from hunter-gathers to manufacturers.

THE RISE OF THE LUMBER INDUSTRY : 1848 - 1883

The gold rush of 1848 sparked a growing demand for lumber used for steam powered engines and as structural supports within mining tunnels. In addition, lumber was increasingly being harvested to build housing and shops in burgeoning mining towns and lumber camps. By the mid-1850's there were over 100 mills in the Puget Sound region, run by lumber barons who saw this region's forests as an inexhaustible resource. This period also saw an increase in illegal logging and timber theft along with high levels of corruption within the industry.

TECHNOLOGY, RAILROADS, AND CAPITAL : 1883 - 1940

The expansion of the railroad throughout this region and beyond provided greater access to harvestable land along with expanding timber markets across the country. This paired with advancements in logging technology resulted in dramatic increases in lumber production. This period also marked the beginning of government intervention through policy developed to limit loggings' negative impact on watersheds. As part of this thinking, the first head of the Forest Service, Gifford Pinchot felt that old-growth forests were wasteful because they grew very slowly. This encouraged the harvesting of old growth forests to be replaced by a younger faster growing stands for production purposes. Wars along with the Great Depression caused the lumber industry to be in constant flux during this period. From 1905 to 1930, Washington was the nation's leader in timber production until Oregon took over the title in 1931.

INTENSIVE LOGGING, ENVIRONMENTALISM, AND OWLS : after 1940

The lumber industry lost its dominance in Washington's economy during WWII. Most of the harvested lumber after the war went towards pulp and paper due to a change in demand. The lumber Industry continued to grow steadily, while other industries like airplanes, atomic weapons, and other goods grew much faster. Timber prices rose substantially as the private supply of trees declined. The Forest Service emphasized rapid logging and intensive management. They were optimistic that the high levels of production could be sustained as technology and scientific expertise would circumvent depletion.

source: National Archives and Records Administration

FORESTRY TODAY: 2015

Today, the Washington State Department of Natural Resources (DNR) and the Forest Service help manage the forest through policy and oversight of both private and public forests. One thing to note is that Western and Eastern Washington manage their forest differently due to variations in climate and forest stand species. In Western Washington, foresters practice clear-cut harvesting which allows for new seedlings to grow by reducing the competition for light. The Forest Practices Rules governed by the DNR establish laws that defines what proper management of forests look and feel like in Washington. These laws do not impact urban forestry, which is managed and governed by local municipalities.

WASHINGTON FORESTRY TODAY

- **18 million acres of Timberland in Washington**
- **Washington harvested 3,179,846,000 bf in 2013**
- **King County harvested 109,653,000 bf in 2013**

↑ The US Army Corps of Engineers built the Lake Washington Ship Canal and the Hiram Chittenden Locks to allow passage between fresh water Lake Union and salt water Puget Sound. Photo taken November 25, 1917

↓ Urban Forestry has become a prominent research focus of cities due to their relationship with public health, ecological processes, economic development, and livability.

Seattle's Urban Forest

SUSTAINABLE | RESEARCH | MANAGEMENT | COMMUNITY

The city of Seattle has had a long history of supporting urban forestry in the region because of their awareness to the value trees provide in creating a livable and healthy city. Sited properly, trees can help reduce the need for hard infrastructural improvements by leveraging natural systems as soft or green infrastructure for stormwater management, cooling, and air quality that can help extend the life of existing infrastructural systems while increasing the ecological health of an area.

The management of an urban forest differs from that of a natural setting due to increased complexity related to development, public safety, infrastructure, and transportation. In addressing these concerns, the city has adopted a sustainable model for managing its urban forest. The sustainable model places a higher value on the services of the forest rather than on the production of goods. The city's model identifies three primary management strategies for monitoring and improving the existing urban forest:

Tree Resources: an understanding of the trees themselves, as individuals or in forest stands.

Management Framework: assignment of responsibility, resources, and best practices for the care of trees.

Community Framework: the way residents are engaged in planning and caring for trees.

The management of Seattle's trees occur through multiple departments of city government: Seattle Department of Transportation manages street trees, Seattle Parks and Recreation Department manages park trees, City Light maintains trees around utilities, and Public Utilities manages trees along creeks. The diverse nature of the urban environment and multiple managing bodies makes a comprehensive plan important for aligning efforts across landscape types amongst different stakeholders. To establish realistic urban forestry goals the city established unique goals based on different land use types (single family, multi-family, institutional, industrial, etc.) with a citywide goal of 30% and a institutional canopy goal of 20% by 2037. The University will follow a similar model by defining unique canopy goals for each campus neighborhood based on their specific land uses and available open space to meet and potentially exceed the city's institutional goal.

SEATTLE'S FORESTRY STRATEGIES

- **Optimize Forest Health & Environmental Benefits**
- **Increase Canopy Understanding**
- **Support Interdepartmental Efforts**
- **Proactive Management & Preservation**
- **Increase Public Awareness & Support**
- **Model Good Stewardship**

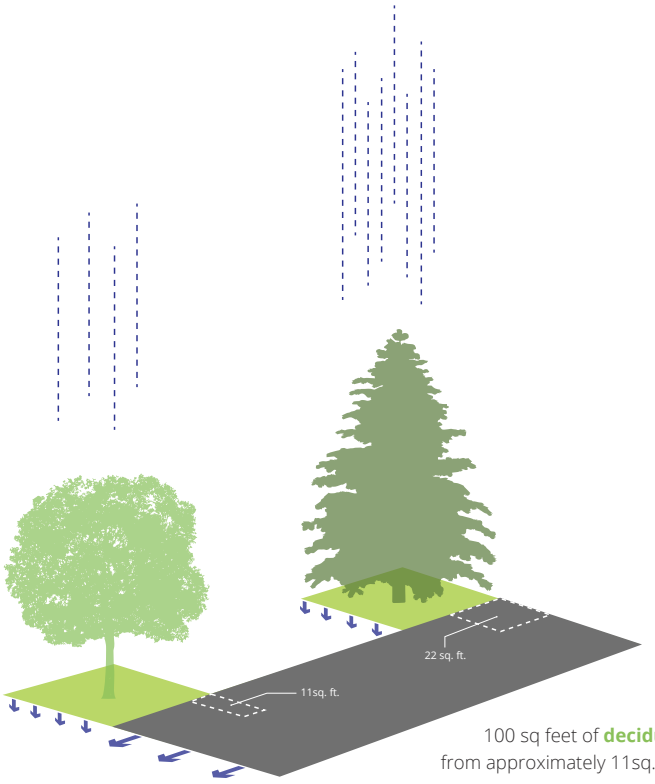
The Value of Urban Trees

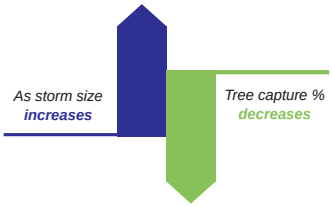
ECOLOGICAL | SOCIAL | CULTURAL | VISUAL | PHYSIOLOGICAL

The value trees provide to cities is hardly tangible to the human eye, but is significant in terms of their positive impacts to human health, the ecology, wildlife and campus aesthetics. Overall, trees help make urban environments more livable through softening edges, cleaning the air, water, and soil, and providing color and shade to an otherwise harsh environment. As trees age, their benefits grow with their trunk size while also becoming more prominent in the landscape. Recently, there has become a surge in research validating the experienced relationship between the presence of trees, human health, safety, creativity, social values, decision making, crime and consumerism. In order to maximize their value, trees should be properly planted and maintained by residents and the local municipality based on their specific requirements. The following diagrams elucidate the multi-faceted benefits trees provide towards improving the living conditions for all creatures within cities.

STORMWATER MANAGEMENT

Trees help reduce the volume of stormwater that enter into municipal infrastructure and public waterways through interception, absorption, transpiration, and infiltration. These processes result in improved water quality and water quantity volumes. To fully manage stormwater on-site, trees need to be paired with other green stormwater infrastructure systems due to only being able to manage stormwater from an area 10 - 20% the size of their canopy area. In the Northwest, deciduous trees are dormant during the "wet" season, which reduces their stormwater management value in comparison to evergreen trees.





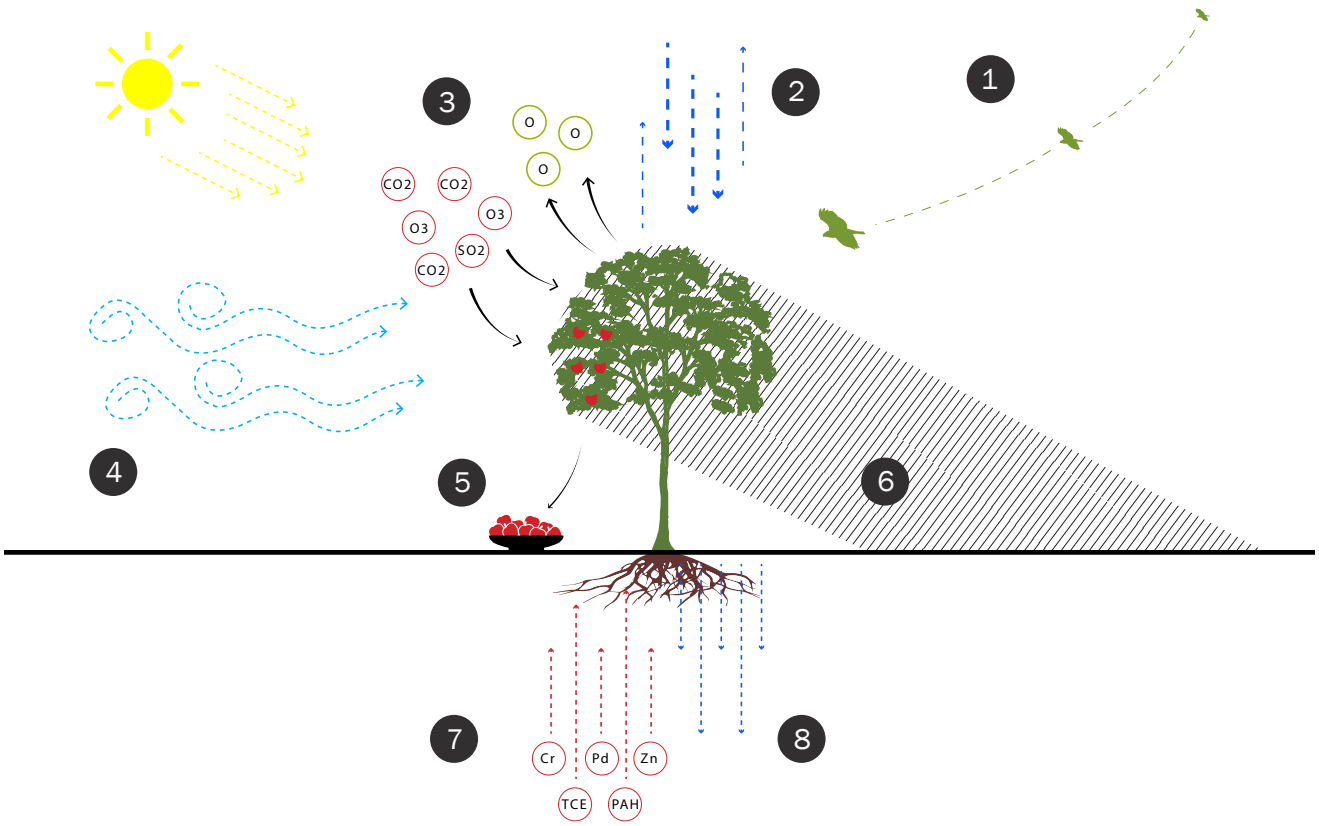
Deciduous Trees capture
1/2 the stormwater
volume as **Evergreen Trees**

100 sq feet of **evergreen tree canopy manages** runoff from approximately 22sq. feet of nearby impervious surface

100 sq feet of **deciduous tree canopy manages** runoff from approximately 11sq. feet of nearby impervious surface

The Effects of Trees on Stormwater Runoff; Herrera Environmental Consultants, Inc., February 2008

Green Stormwater Infrastructure in Seattle, 2025 Implementation Strategy; Seattle Public Utilities



ECOLOGICAL BENEFITS

1 *Habitat*

Trees are able to provide food, shelter, and water for wildlife habitat. Habitat benefits vary based on tree density, health, and specie varieties.

2 *Stormwater*

The size of a tree and its foliage dictates how much stormwater it can absorb, intercept and evapotranspirate, which are important aspects of the water-cycle.

3 *Air Quality*

Trees aid in improving air quality by absorbing greenhouse gases and other toxins while releasing oxygen back into the environment.

4 *Wind*

Siting trees perpendicular to prevailing winds helps dissipate their power and can make harsh urban environments more pleasant.

5 *Food*

Trees can provide food for both human and wildlife consumption. Tree selection defines the types of food produced and their potential habitat benefit.

6 *Microclimate*

The shade produced by trees creates microclimates in the city by reducing the ambient air temperature within their shaded up to 23 degrees.

7 *Phytoremediation*

A select group of trees have the ability to uptake or stabilize contaminates within soil. Tree selection needs to be correlated with the existing soil toxin.

8 *Ground Water*

Trees promote the natural infiltration of stormwater, with their roots helping clean the water prior to it entering a ground water aquifer.

VISUAL BENEFITS

The visual presence of trees has been found to help reduce common ailments associated with the fast pace life of living in cities. Their presence can also help stimulate the mind resulting in increased creative inspiration and improved health.

PLANT TREES FOR SAFETY

Trees have been shown to make a place safer when they do not obstruct views at eye-level. Research has found that their is a relationship between obstructed views from first-floor windows and an increase in crime. In residential buildings, the top of first floor windows is on average 8.7 feet above grade. Recognizing this relationship can aid designers and managers in creating safe and pleasant environments across campus.

62%

of students say, "appearance of **GROUNDS** and **BUILDINGS** is the most influential factor during a campus visit"

INFLUENCE OF CAMPUS LANDSCAPES

Research has shown that prospective students are greatly influenced by the appearance of the landscape during a campus visit making maintenance integral to a university's success.

What Students Notice During a Campus Visit

http://www.olemiss.edu/depts/landscape/iowa.html

How clean, well-kept or orderly the campus is	*24%*
How pretty, beautiful or nicely landscaped	*24%*
Largeness of campus	*24%*
Architecture of buildings	*20%*
Friendly or happy place	*15%*
Traffic	*14%*
Smallness of Campus	*14%*
Campus Layout	*11%*
Town/city atmosphere	*6%*
Dorms/living arrangements	*5%*

Environmental Context

SOIL | TEMPERATURE | RAINFALL | SUN | WIND

Seattle's climate is described as temperate marine or Mediterranean, characterized by cool, wet winters and warm, dry summers. On average, Seattle receives only 4 - 6 inches of rain from May - September compared to 30 inches from October - March. This condition requires plants and trees to be irrigated during summer months, especially for establishment. This condition makes rainwater harvesting for summer irrigation challenging because of the lack of rain and the scale of system required to provide significant water for the dry months.

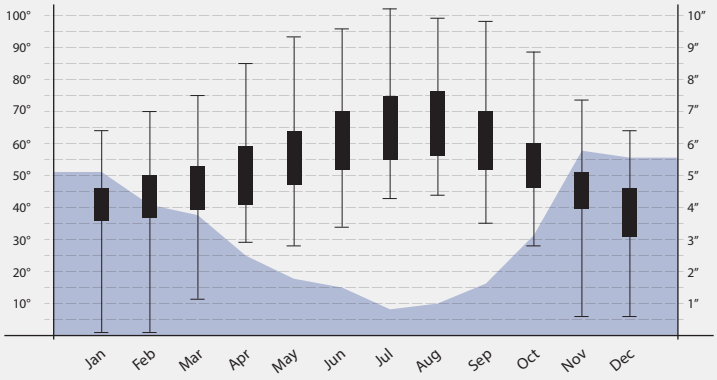
Seattle's Hardiness Zone is 30°- 35°/ 24"- 48", meaning this area has a low temperature of 30-35 degrees Fahrenheit with 24 - 48 inches of rain annually. Climate change has the potential to shift hardiness zones to the north making our climate warmer and drier which may alter the types of trees and vegetation that may thrive here in the future. Local cities are beginning to experiment by planting new varieties of trees from warmer hardiness zones to tests species for the impacts .

The sun path of this region encourages planting deciduous trees on the south and west sides of structures to reduce the amount of solar gain during the summer that reverses in the winter after they have lost their leaves. While, evergreens provide year around shade and wind protection.

One of the most challenging aspects of this region's ecology is the soil. Large deposits of a thick clay layer called Vashon Till was created during the ice age as the Vashon Glacier repeatedly advanced and receded thousands of years ago. The Vashon Till layer underlies most of the city, making drainage poor, establishing vegetation difficult and installing low-impact design strategies complex. Existing environmental conditions need to be evaluated prior to tree selection to identified a species best suited for the site.

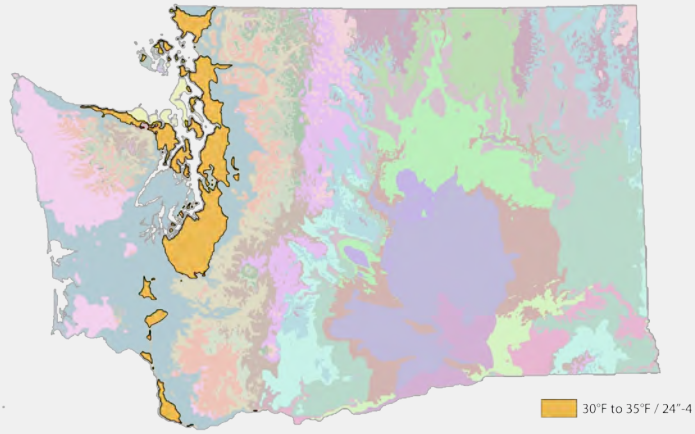
Average Annual Temperature and Rainfall

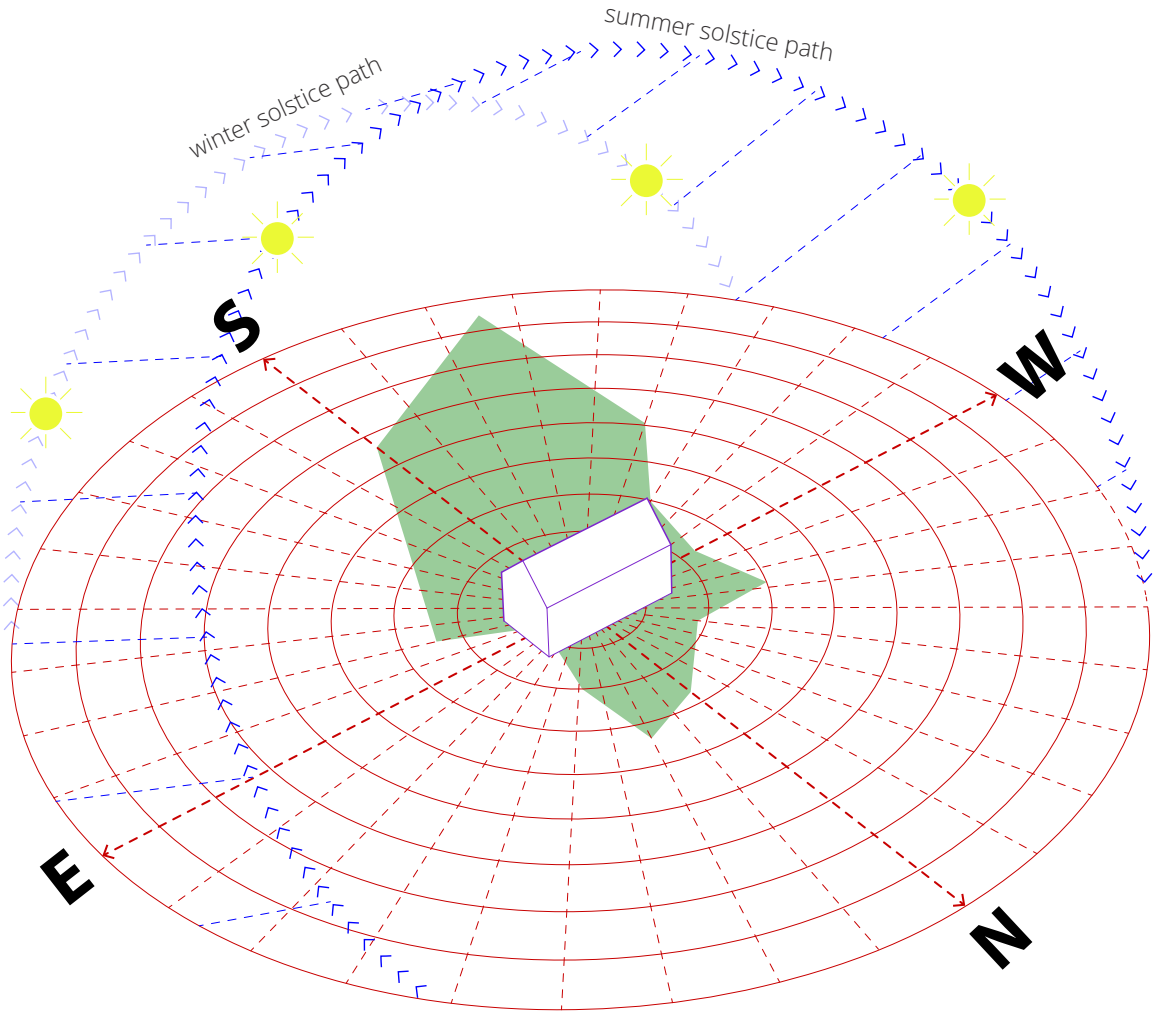
The Mediterranean climate of Seattle has warm dry summers with wet cold winters.



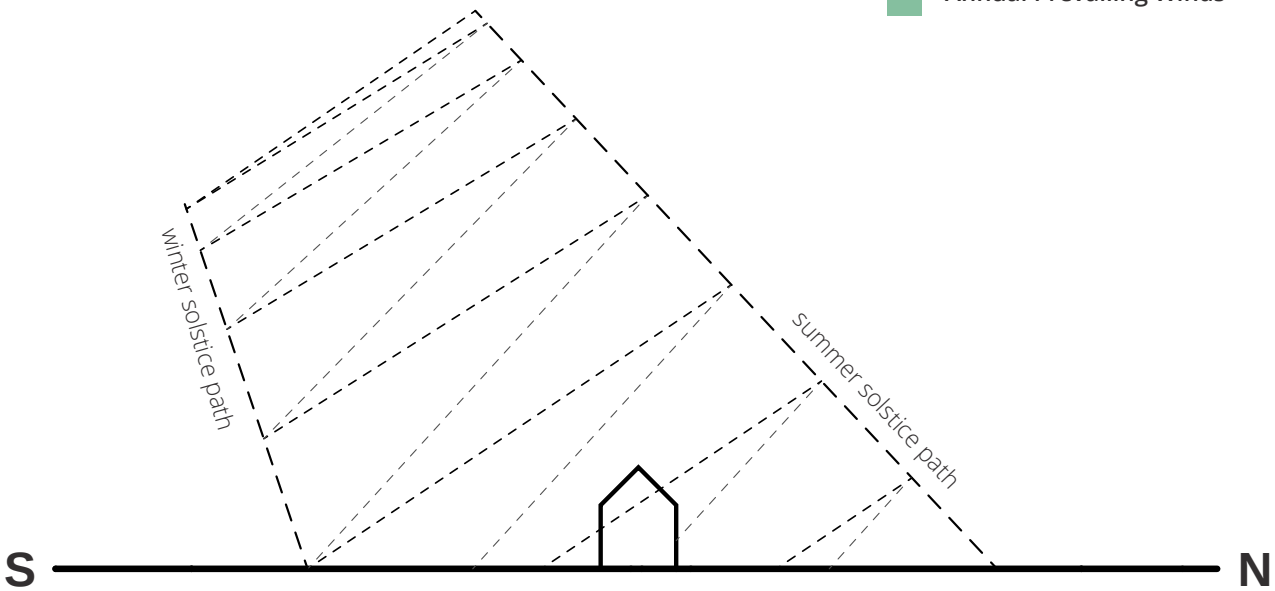
Hardiness Zone

Seattle is located in the 8b zone which promotes plants that are hardy down to 15 to 20 degrees.





Annual Prevailing Winds



Development & Forest Ecology

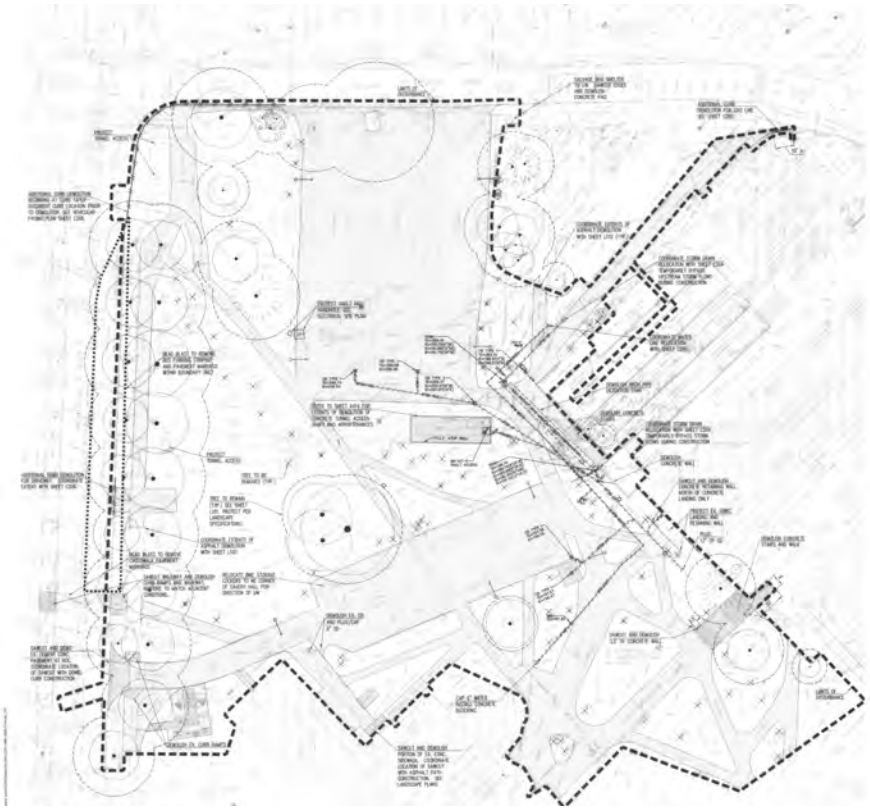
BIOTIC | ABIOTIC | PERTURBATION | CATASTROPHE

Urban Forests, like natural forest are constantly being impacted by biotic (living) and abiotic (non-living) factors within an ecosystem. The constantly evolving human occupation of Seattle and UW's campus poses the greatest threat to the city's urban forest. Construction of building and roads, infestations of disease and insects, and physical damage caused by the public and weather reshape the urban forest daily. The intensity and scale of each impact shifts a forest's state of "equilibrium". Research shows that a state of non-equilibrium is favored over a static state, though a continuous reduction in canopy size, diversity, and number of trees is not prefered. Natural disturbances allow a stand to become diverse in age, type, and resiliency as the interaction between impact and recovery results in a healthier forest. The University recognizes the need for the landscape to change and evolve to meet the growing demand for new spaces where students and faculty can learn, live, work, play, and create; while also trying to maintain the integrity and grandeur of the campus's natural environment.

Improvements and new construction has been constant across campus resulting in new buildings, enhanced landscape features, increased accessibility, and expanded building footprints. With more development on the way and much more planned, a strategy for maintaining and managing one of the University's greatest asset, its natural environment is critical. The volume of projected growth makes establishing and achieving a static canopy goal difficult because with each new project comes new impacts that will alter the existing ecology of a site and potentially the University as a whole. Instead, the primary goal becomes developing a monitoring and management strategy that strengthens the presence of nature and its function while allowing for the expansion of land uses on campus. A balance between nature and edifice is required in the design, planning, and vision of the University of Washington Seattle campus.

PACCAR Hall

The site prior to construction of PACCAR Hall was a parking lot surrounded by a large canopy of evergreen and deciduous trees. The parking lot provide an area for the building to be sited without major impacts to the existing canopy.



Preserving the dense natural edge of the site was an important goal from the onset of the design. This was accomplished through strategically locating the building and developing the site logistics plan. This project highlights a process for building in Central Campus that accomadates the increase of academic space with the improvement and preservation of the site's natural ecology.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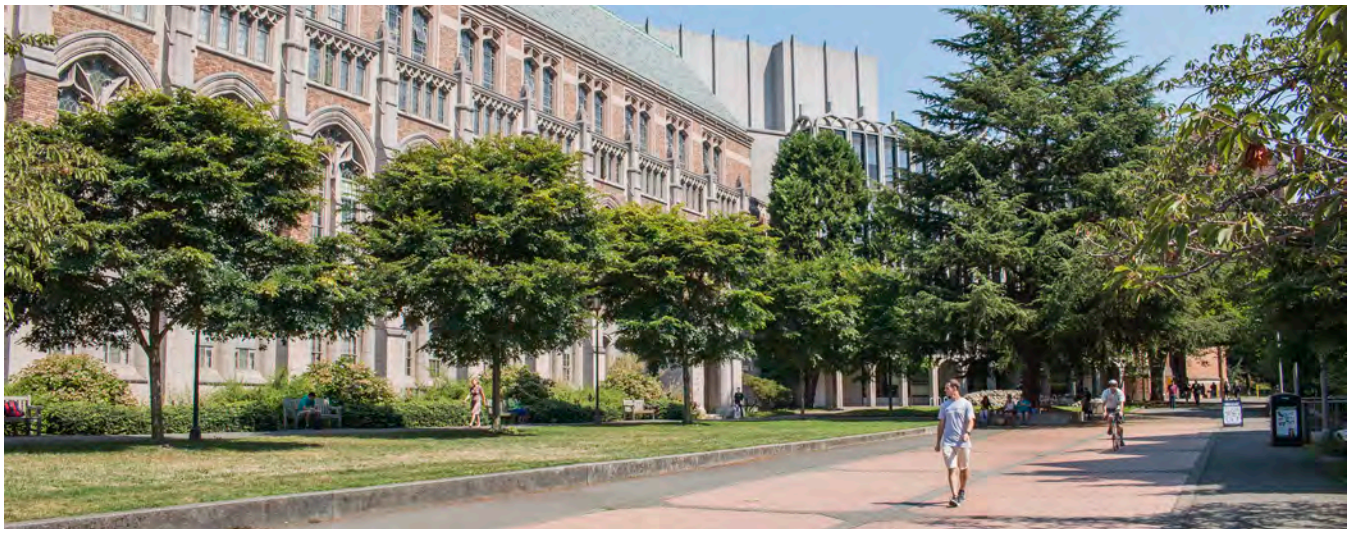


UW's Urban Forest

Man is nature as much as the trees

Daniel Urban Kiley

The University of Washington was carved out of a forest of trees, where reminisce of its grandeur still exist today at the campus edges. Framed by water and hills, the University consists of a mosaic of landscape types, each providing important environmental services that as a whole comprise a robust example of a range of northwest ecotones: conifer forest, deciduous forests, wetlands, steep and shallow slopes, and grasslands. The urban forest on campus is not only comprised of trees, but is experienced as the harmonious combination of vegtation and architect that leads to the iconic nature on the campus. Preserving and enhacing these attributes has the ability to benefit all life on campus for the better. In order to establish goals and strategies related to the Urban Forest, a baseline needs to be defined for which all future changes will be compared with to understand the progress and value of subsequent efforts. As part of this analysis, the campus is evaluated as a whole and as four distinct neighorhoods to identify multi-scalar aspect of the system that can be improved to acheive our Urban Forestry goals.

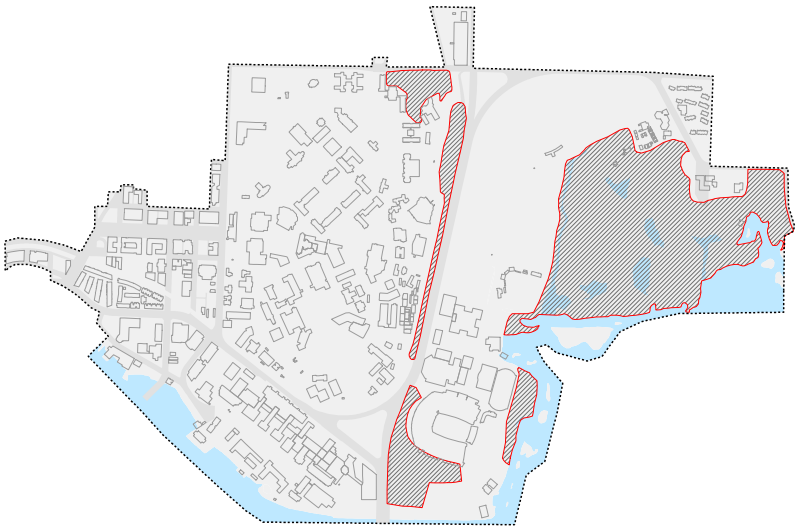
Land Cover

665.5 ACRES | LAND | WATER | BUILDINGS | INFRASTRUCTURE

The focus area for the tree inventory is within the surveyed areas of the University's Major Institution Overlay or MIO. The MIO defines the area that the University is required to manage to standards set by the university and city; this includes all hardscape, softscape, buildings, vegetation, utilities, and water that falls within the boundary. One thing to note is that some areas of campus (see map below) have not been inventoried and are thus not inlcuded in this analysis. However, they do provide significant value to the campus's urban forest and are included as part of the University's tree canopy analysis. To establish a baseline for analyzing the urban forest, the existing ground conditions have been quantified by thee primary land use types found on campus: architecture, infrastructures, water, and land. The 665.5 acreas of land within the MIO is greater than UW's ownership due to the inclusion of the public right-of-way.

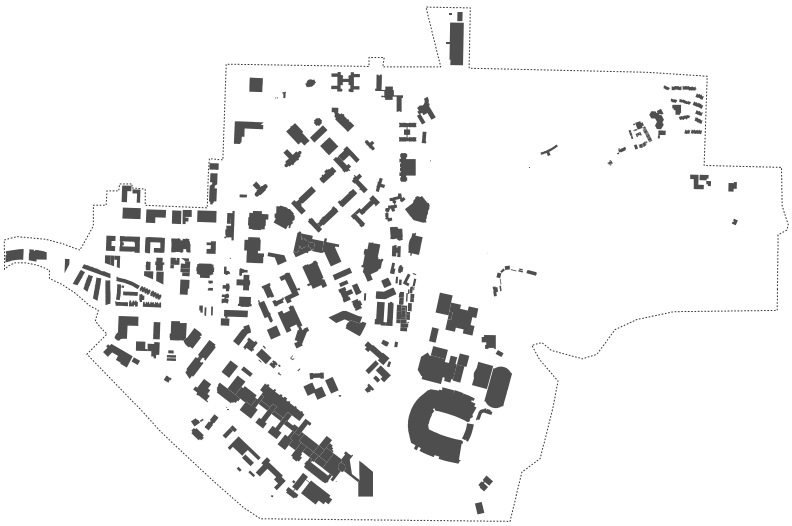
Land Cover

Total Area:	**665.5 acres** 100%
Land :	**538.41 acres** 80.9%
Water :	**64.84 acres** 9.7%
Public ROW :	**62.25 acres** 9.4%



Future Areas to be Surveyed

Total Area :	**111.62 acres** 16.8%
Land :	**103.68 acres** 15.6%
Water :	**7.94 acres** 1.2%



Building Coverage

# Buildings :	**343**
Total Area :	**100.83 acres** 15.2%

Tree Database

GIS | GPS | ASSETMAPPER | FIELD SOLUTIONS

The following analysis of the University of Washington Seattle campus's urban forest was completed using ArcGIS 10.2, Microsoft Access, Illustrator, InDesign, AutoCAD, and Microsoft Excel. The tree database was acquired in August of 2014 from the campus arborist who regularly updates the database when trees are planted or removed. With the campus in constant flux, this analysis represents a snapshot in time that establishes a baseline for moving forward in enhancing the UW's Urban Forest.

The creation of a GIS Tree Database began in September 2005 when UW Seattle's Grounds Management started to develop a tree inventory with the goal of qualifing and quantifing every tree on campus. The initial effort mapped approximately 9,500 of an estimated 11,000 trees on the Seattle Campus with information relative to height, caliper and their type. The initial analysis needed to be expanded upon, so a Campus Sustainability Fund grant was acquired to hire a consultant and students to conduct a comprehensive forest resource assessment. The result of the data collection was a robust database and an-house GIS interface that allowed University Grounds' personal to access and update tree data in the field using a cell phone or tablet device.

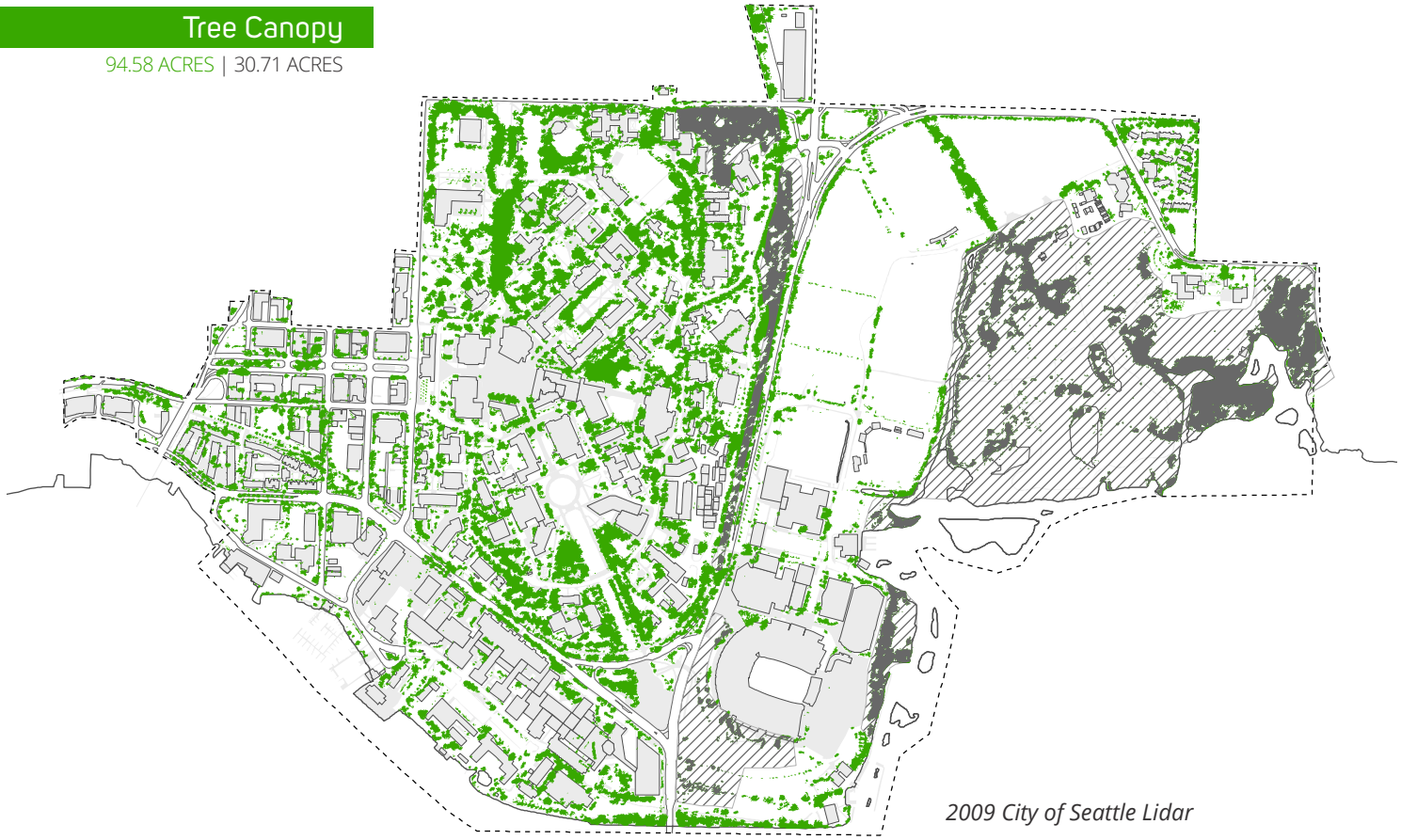
The GIS mapping tools also allows the campus arborist to monitor all trees on campus, while being able to preserve historic data, providing a historical narrative for the trees on campus. Notes and additional data can also be time stamped within the database making the information more robust. A publicly accessible dataset of the campus trees dataset is available through WAGDA 2.0; a university specific data portal giving students and researchers access to the information for data analysis.

The data used for the canopy cover analysis was derived from a lidar scan completed by the City of Seattle in 2009. Since then, the campus has gone through substantial change, making the canopy analysis less accurate than the tree inventory. The University is working with the city and other stakeholders to define a process for having the campus scanned more frequently to gain a better understanding of the relationship between development and the urban forest.

The other data used to create all of the maps that follow were acquired from the WAGDA 2.0 database and the University of Washington internal GIS databases. This includes building outlines, landscape feature outlines, pavement edges, shoreline, MIO boundary, and right-of-way. All additional map data is approximated by georeferencing hardcopy maps using known points and then tracing the features into a new feature class.

Tree Canopy

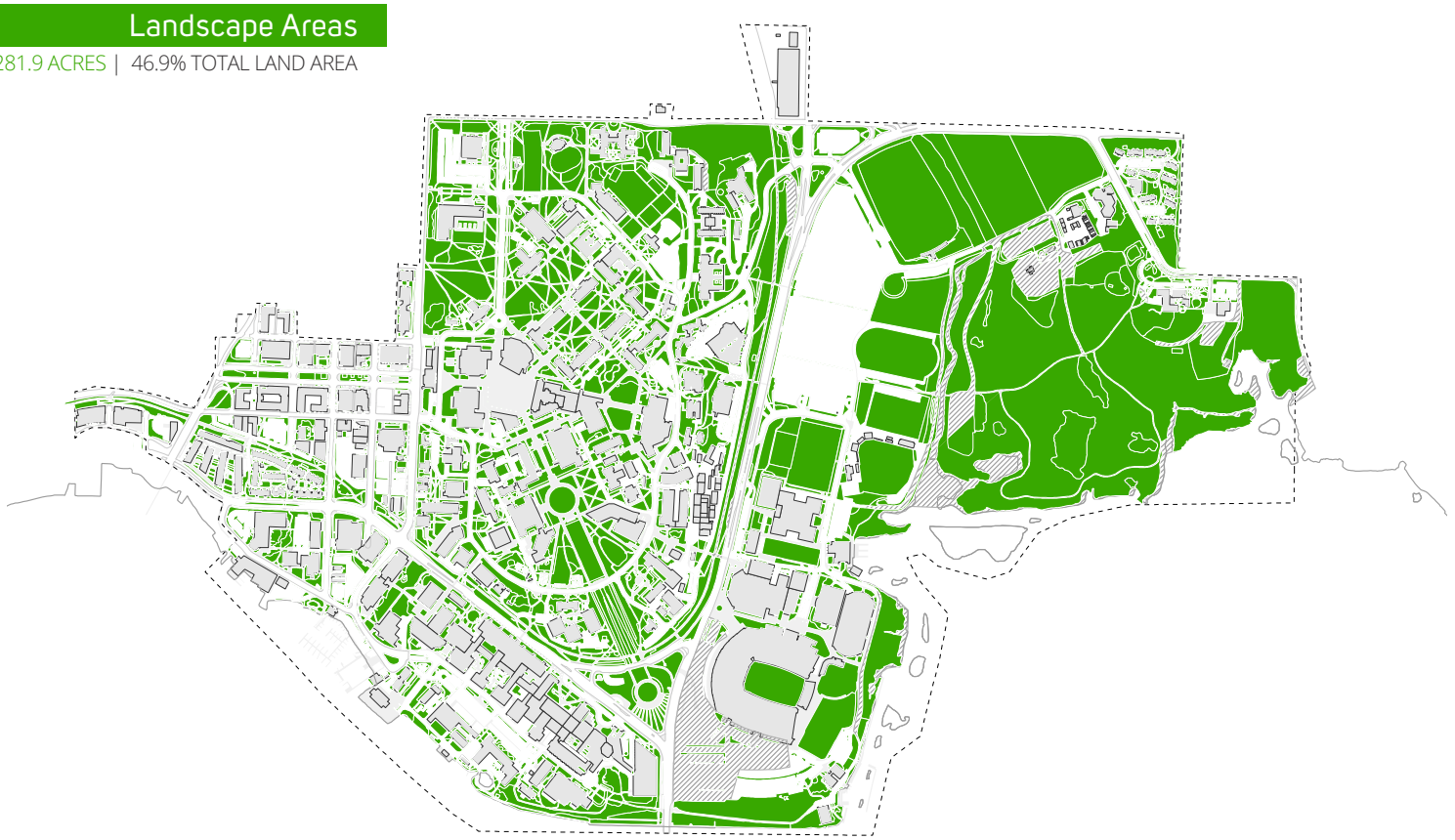
94.58 ACRES | 30.71 ACRES



2009 City of Seattle Lidar

Landscape Areas

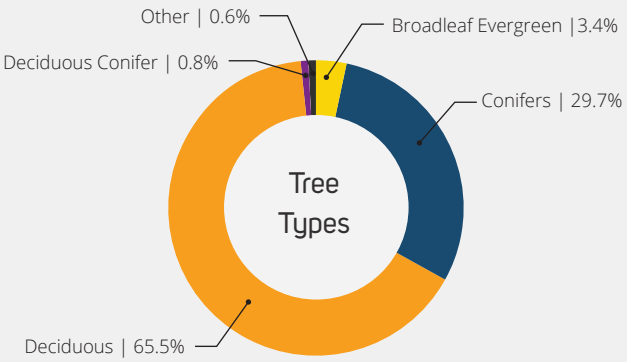
281.9 ACRES | 46.9% TOTAL LAND AREA

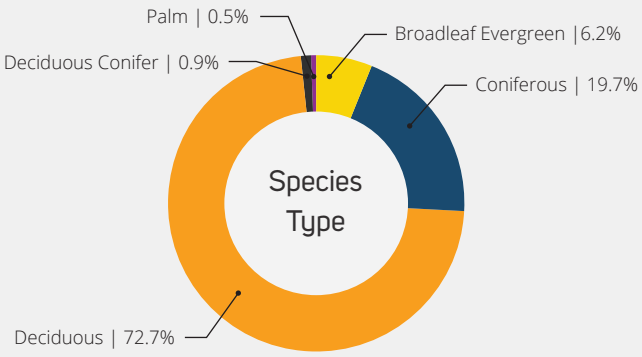


All Trees

8,274 TREES | 417 SPECIES

The Seattle campus has 8,274 trees, ranging 417 different species with each providing value to the character and quality of the landscape experience. The health and diversity of the University's forest speaks to the Husky spirit of stewardship to the campus and the local environment. Through strategic care and management the University strives to provide a diversity of trees and distinct landscapes that emphasizes the variety of ecological zones that are native to the Pacific Northwest; from herbaceous wetland to Lowland Conifer-Hardwood Forest. Continuing to enhance the campus's biodiversity while improving the overall health of the urban forest is paramount for minimizing potential tree loss due to pests and severe weather. The trees paired with the landscape act as an educational resource that pushes the classroom outside of buildings to encourage hands-on, experiential learning techniques that help realize the vision of the landscape being a living laboratory for students, faculty, and staff. Growing this campus resource by increasing the number of species and trees on campus will help build upon the University of Washington's legacy of being good .

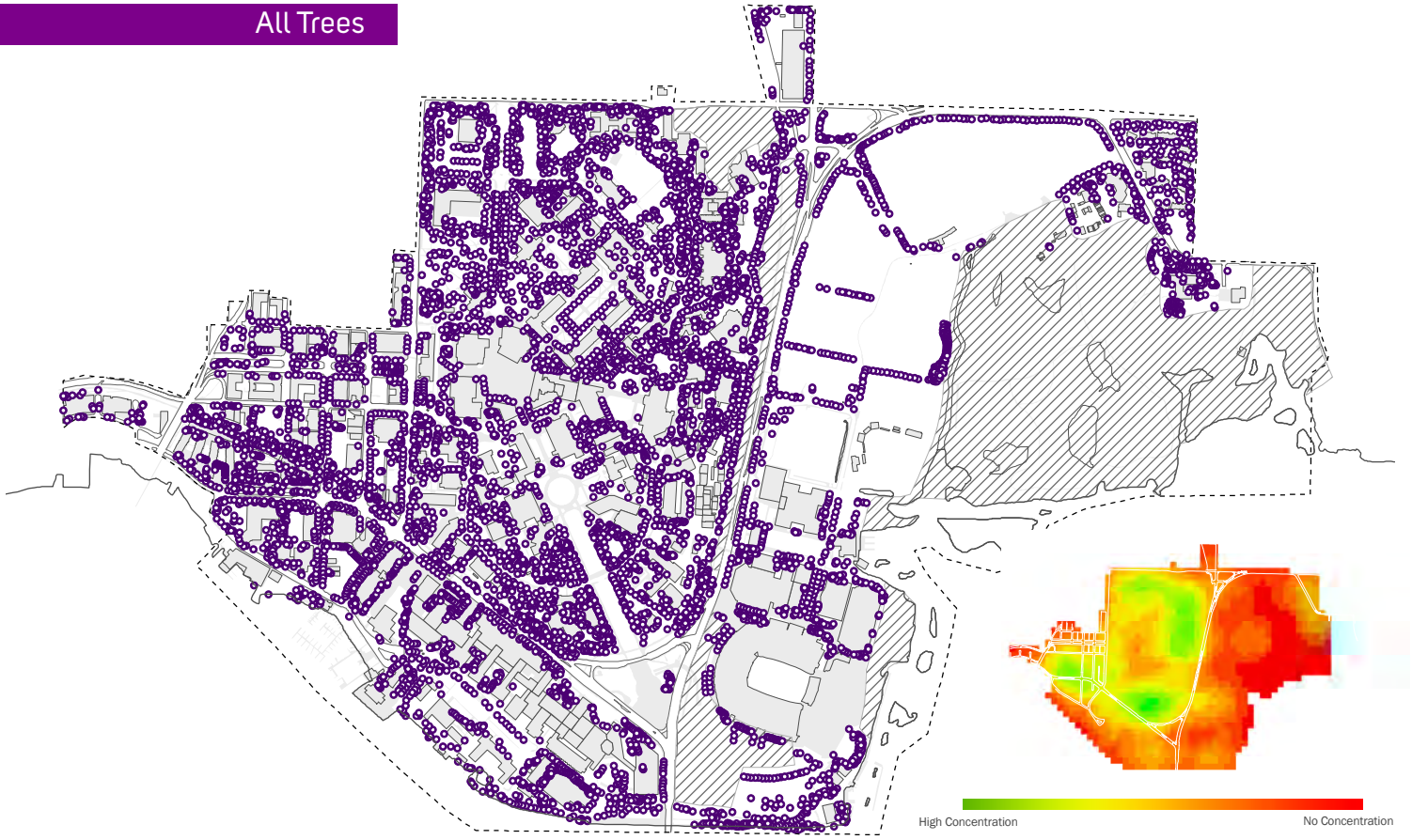




Most Common Species

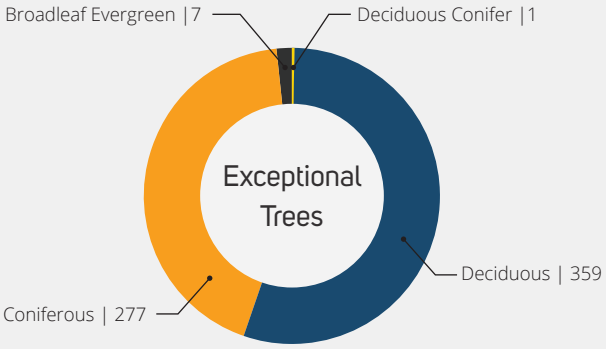
Tree Species	# of Trees	Condition Rating
Pseudotsuga menziesii	*448*	*78.72%*
Acer macrophyllum	*396*	*70.69%*
Acer circinatum	*305*	*79.88%*
Chamaecyparis lawsoniana	*264*	*74.52%*
Pinus sylvestris	*199*	*73.34%*
Thuja plicata	*199*	*78.56%*
Quercus rubra	*195*	*75.54%*
Acer rubrum	*162*	*73.13%*
Calocedrus decurrens	*156*	*77.81%*
Platanus x acerifolia	*152*	*69.52%*

All Trees

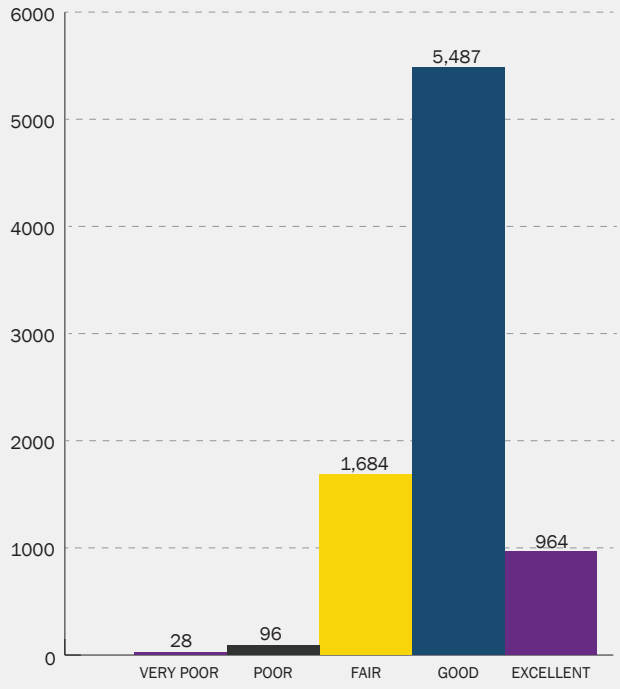


75.5%
AVERAGE CONDITION RATING

$35,106,400
TOTAL TREE VALUE



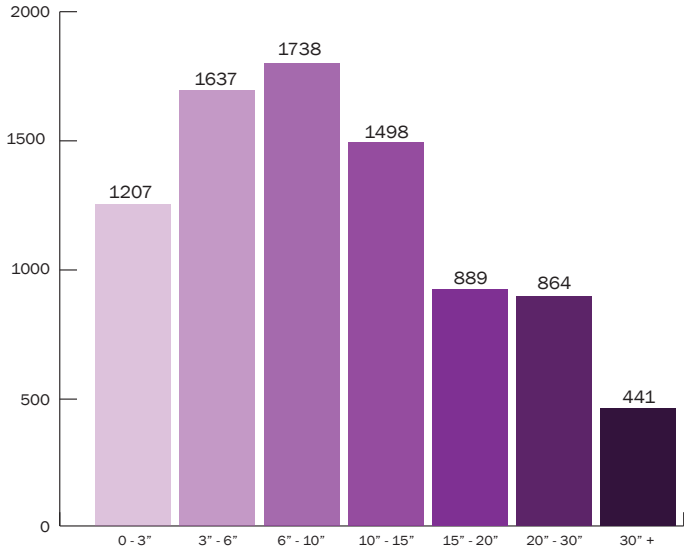
TREE CONDITION



Diameter at Breast Height

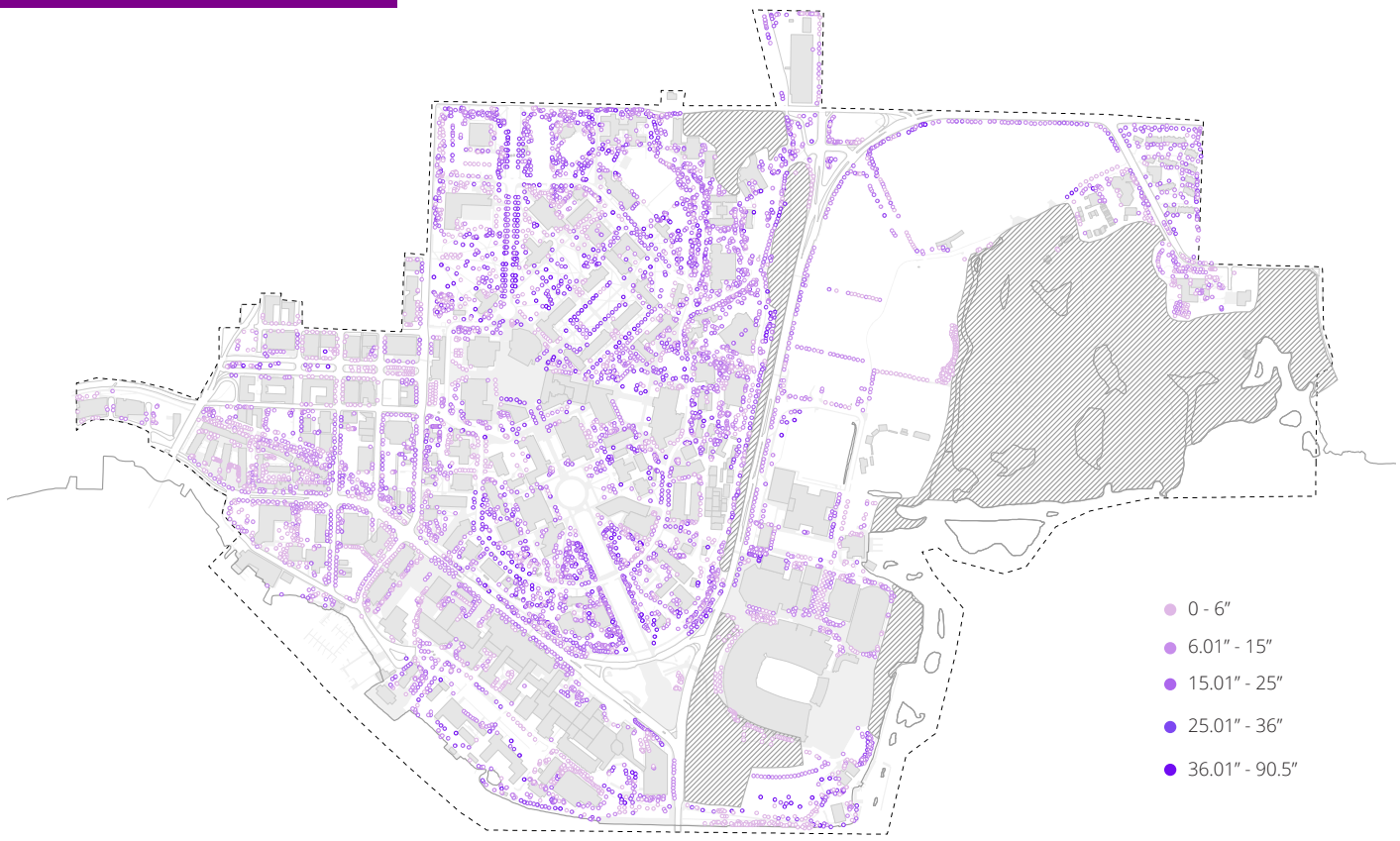
EXCEPTIONAL | CALIPER | DBH

The Diameter at Breast Height measurement or DBH is a standard dimension taken at 1.4 meters above the base of the tree. The DBH measurement can be used to extrapolate other dimensions of a tree; tree height, crown volume, and age. The city of Seattle uses this measurement to define which trees are and are not exceptional. The majority of trees on campus have a DBH less than 15 inches with only 441 above 30". It is important for the University to have a range of trees with varying DBH's to provide a diverse urban forest that consists of a range of species at different sizes and ages.



Quantity per DBH Range

DBH Measurement

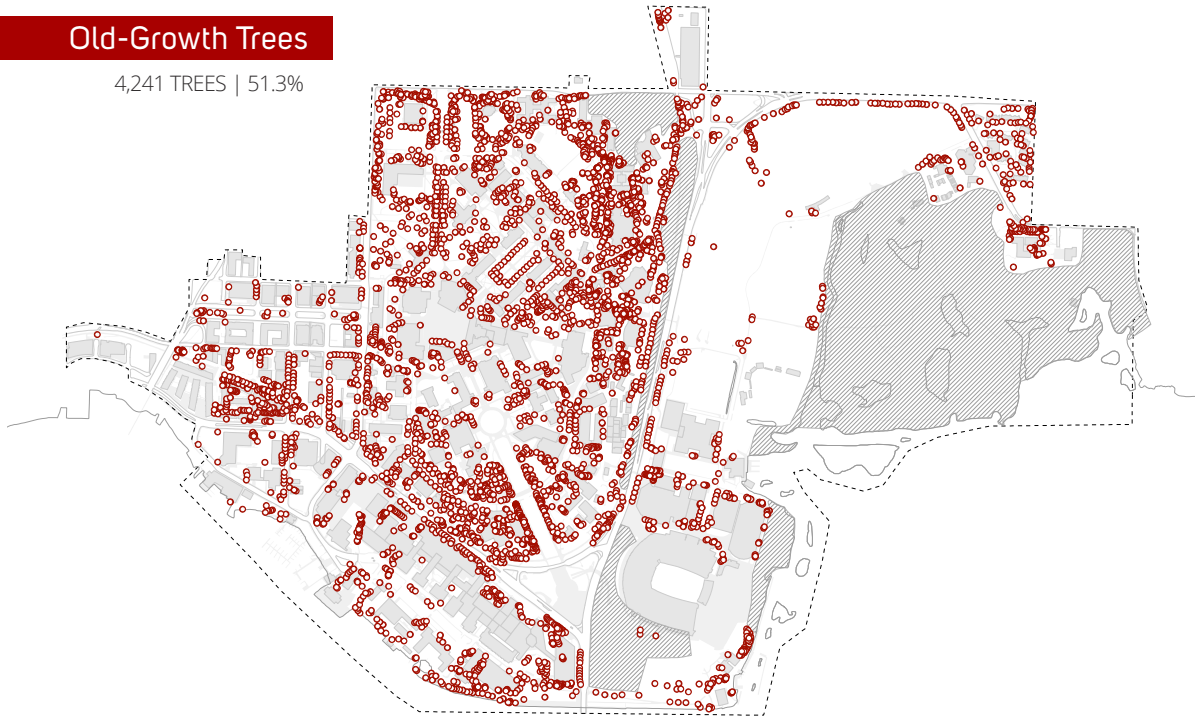


Tree Age

A healthy forest is comprised of trees with varying ages to help reduce the possibility of simultaneous large volumes of tree loss. The age of trees has been derived from comparing their existing height to their potential max height and then dividing them into three categories: young, middle, old. This revealed that a little over half of the existing trees on campus are at the end of their life; which means there is a need to diversify the ages of trees on campus by strategically adding new trees annually with new construction projects, systematic tree replacement, and planting events.

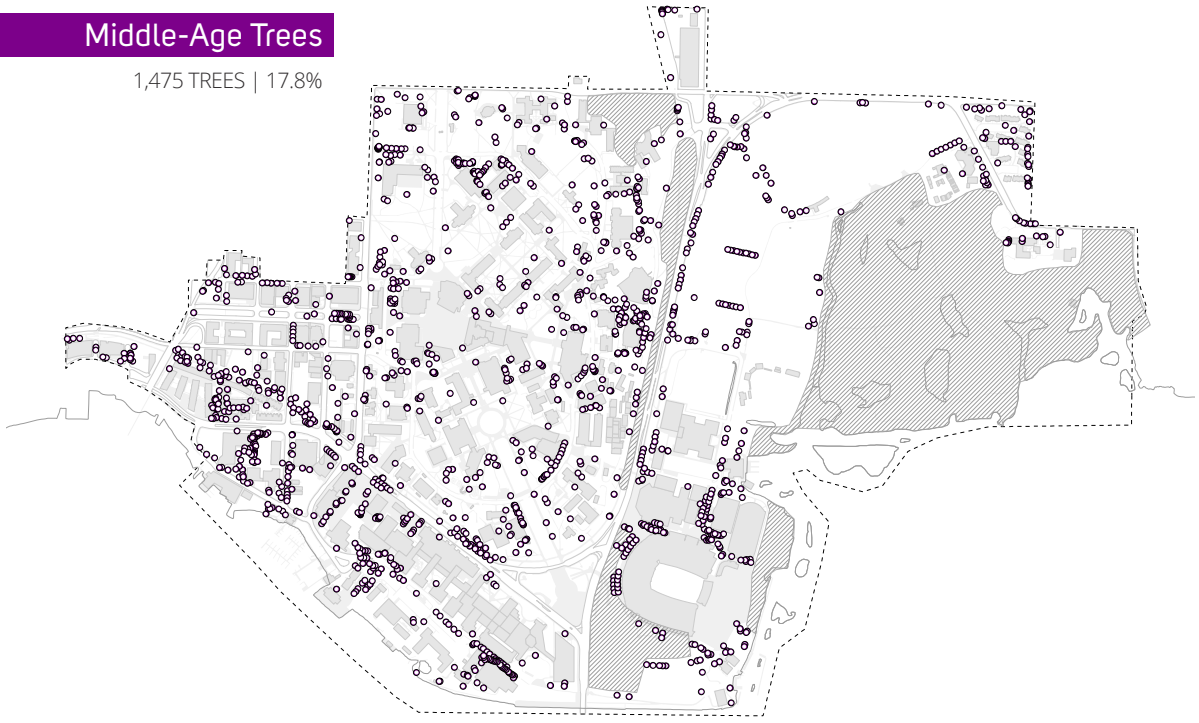
Old-Growth Trees

4,241 TREES | 51.3%



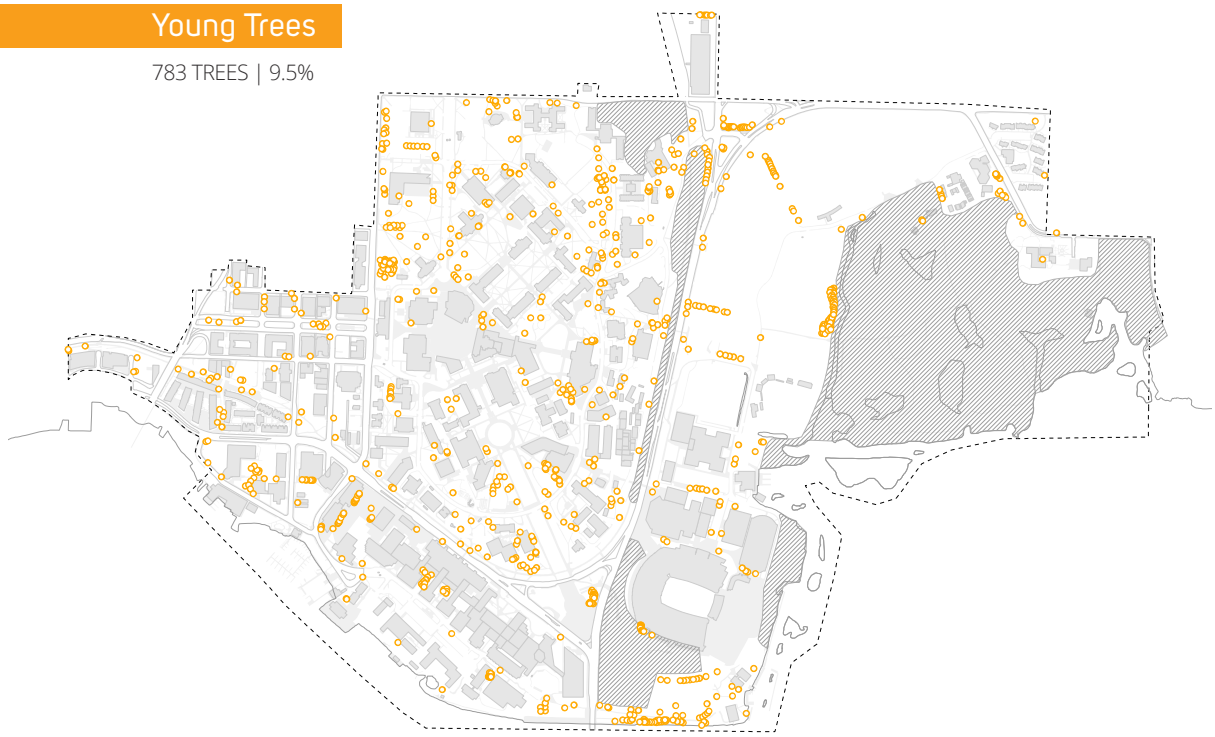
Middle-Age Trees

1,475 TREES | 17.8%



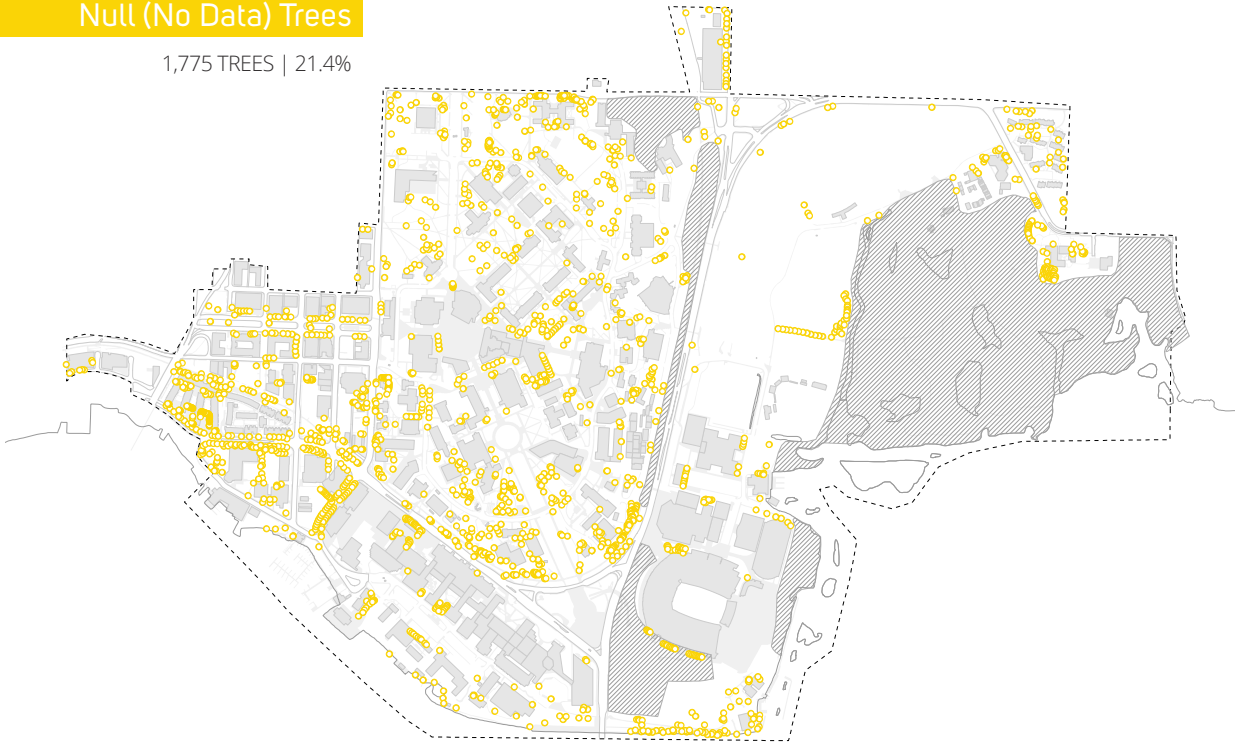
Young Trees

783 TREES | 9.5%



Null (No Data) Trees

1,775 TREES | 21.4%

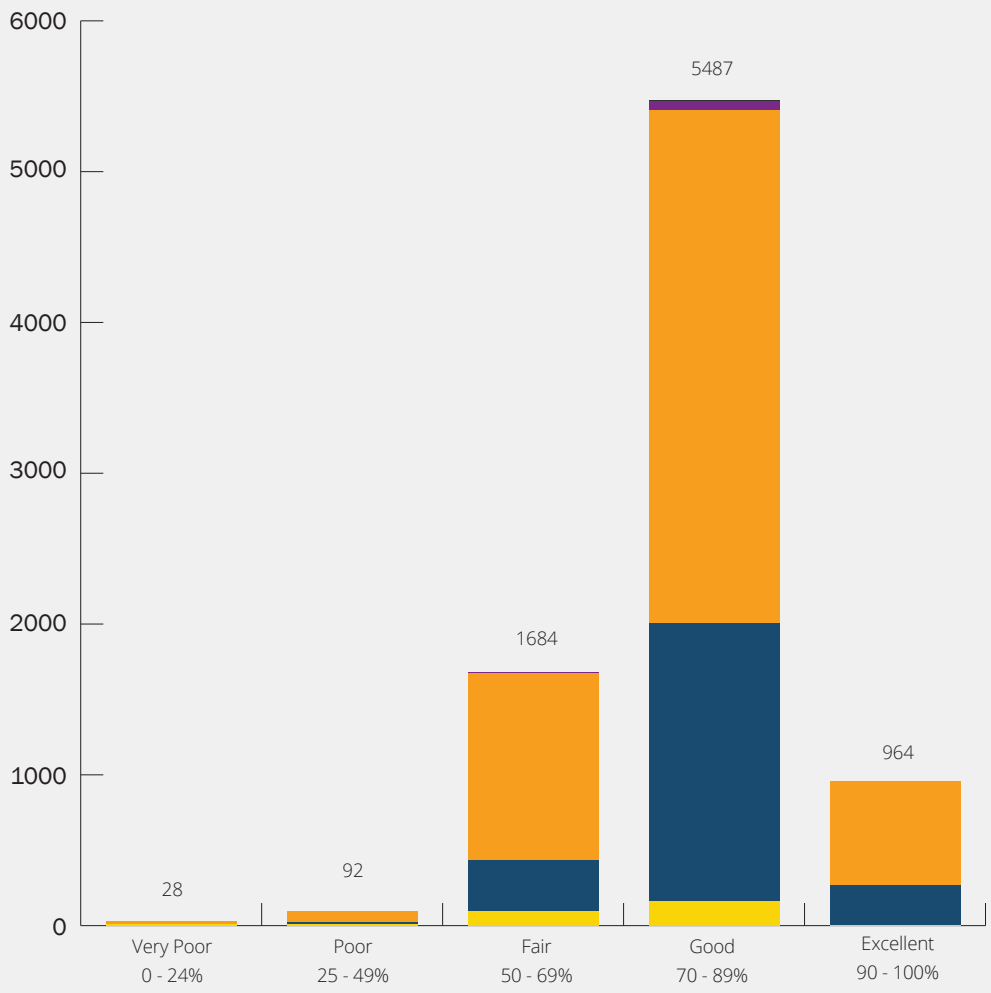


Tree Condition

EXCELLENT | GOOD | FAIR | POOR | VERY POOR

The University has implemented a robust management strategy to keep its urban forestry healthy and thriving for generations to come. With approximately 78% of the trees on campus being in Good or Excellent Condition, students and visitors are exposed to an amazing example of a healthy Northwest Forest that consists of both common and rare specimens to the Puget Sound Region. The University has an arborist on staff who establishes and implements best management practices for keeping the campus's forest at its optimal performance. The level of maintenance that each landscape area receives varies based on their historic significance, visibility, and aesthetic quality. The goal of management is to continue to increase the diversity and scale of its urban forest by promoting the health, safety, and economic value of each tree. The formula used to quantify the condition of each trees is as follows:

(crown + trunk + branch structure + twig growth + foliage + insect & disease + roots) / 35 = Condition Rating %



75.58%
Average Tree Condition

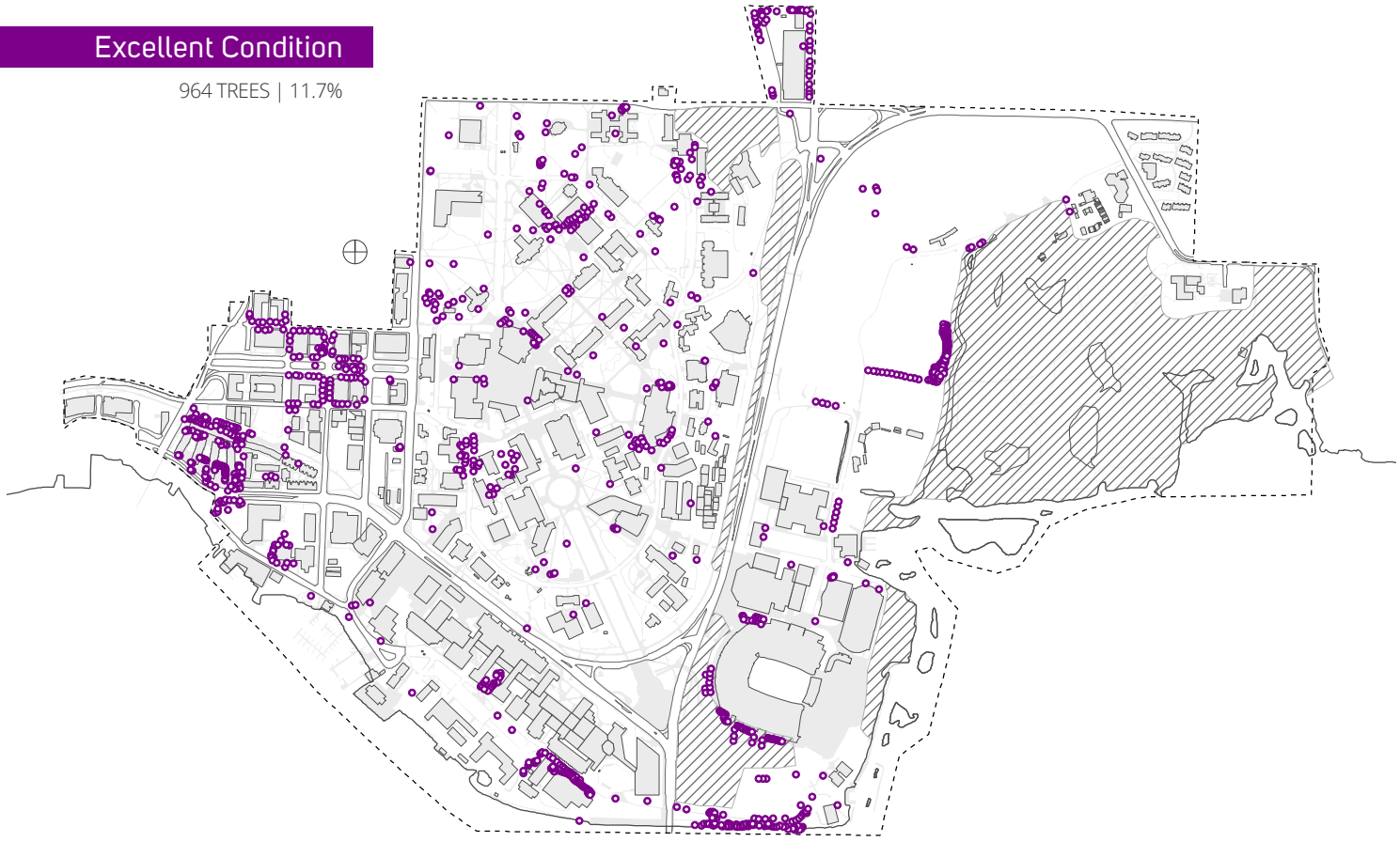
11.7%
Excellent Condition

Overall Tree Condition

- Palm
- Deciduous Conifer
- Deciduous
- Coniferous
- Broadleaf Evergreen

Excellent Condition

964 TREES | 11.7%



THE BEST* AND WORST

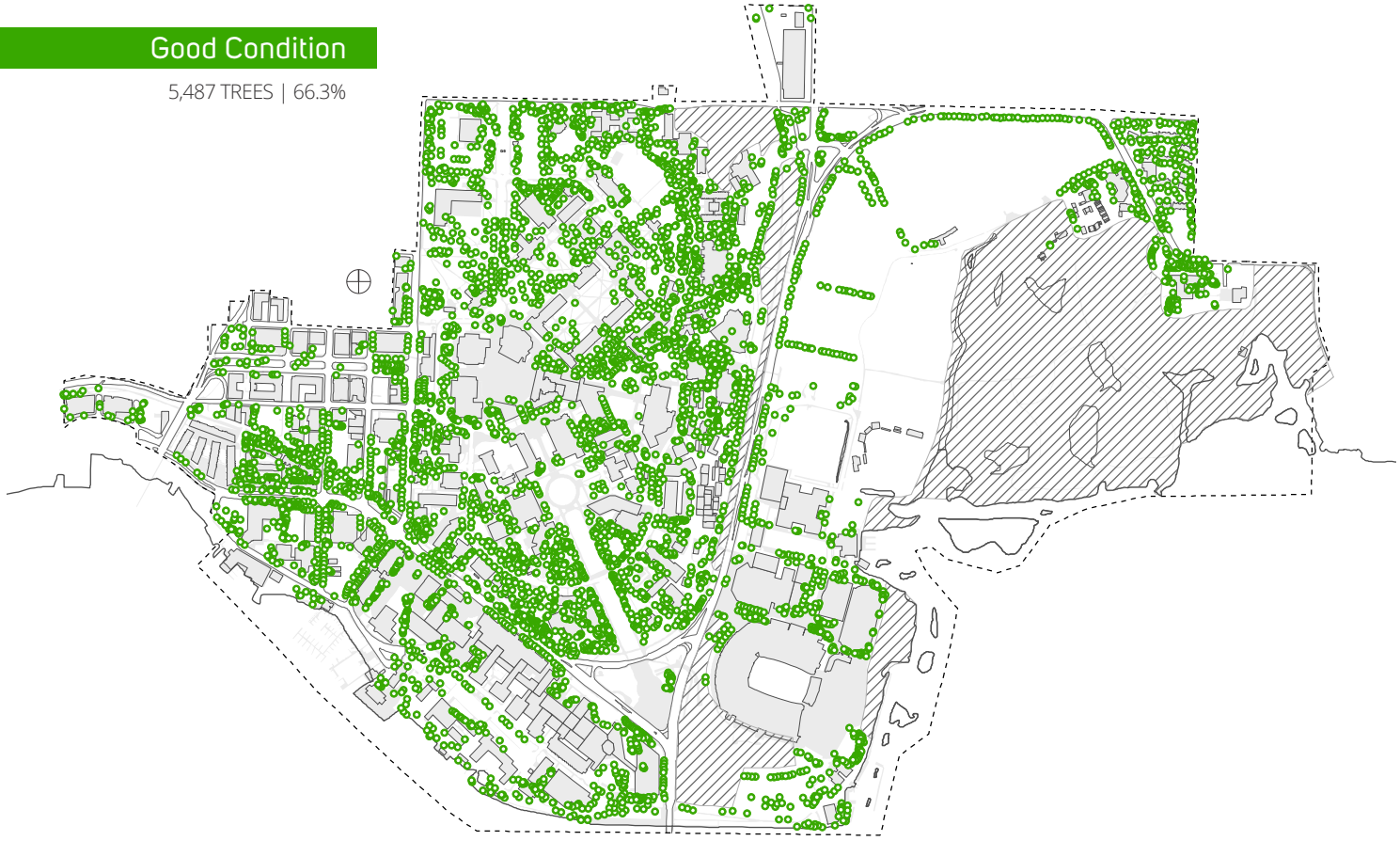
Tree Species	# of Trees	Average Condition Rating
Magnolia x soulangeana	2	90.00%
Fagus grandifolia	7	85.14%
Tilia spp	8	84.88%
Trachycarpus fortunei	2	84.50%
Quercus macrocarpa	2	84.00%
Davidia involucrata	2	83.00%
Zelkova sp	26	82.88%
Viburnum sp	2	82.50%
Tsuga canadensis	2	81.50%
Sequoiadendron giganteum	14	81.43%

Tree Species	# of Trees	Average Condition Rating
Pterostyrax psilophylla	1	57.00%
Elaeagnus angustifolia	1	57.00%
Acer grosseri	1	57.00%
Catalpa speciosa	3	55.00%
Prunus subhirtella 'Whitecomb'	4	53.00%
Picea rubens	1	51.00%
Acer tegmentosum	1	46.00%
Eucalyptus gunnii	1	40.00%
Prunus subhirtella 'Pendula'	1	40.00%
Acacia melanoxylon	8	32.88%

* *DBH > 8 & # > 1*

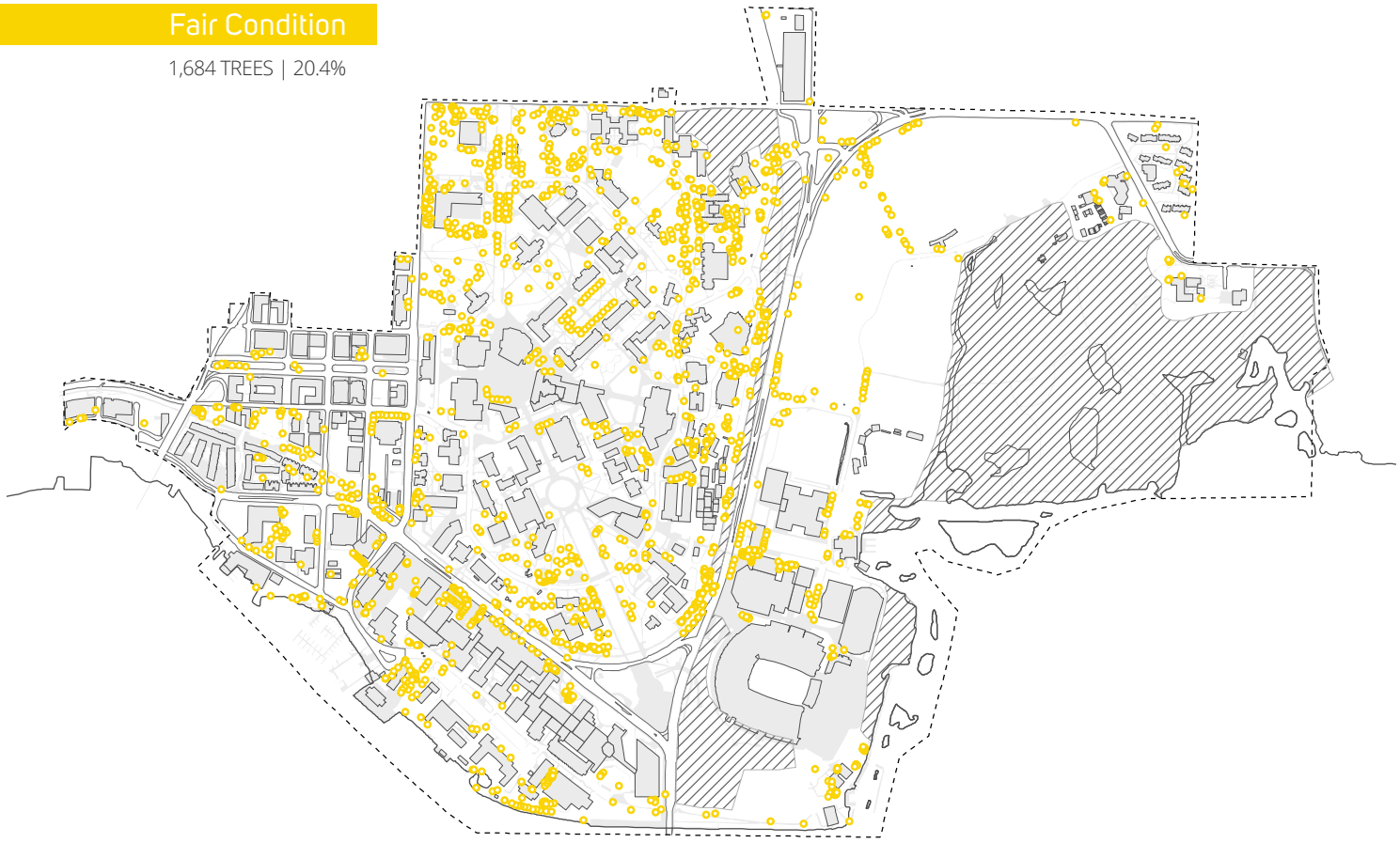
Good Condition

5,487 TREES | 66.3%



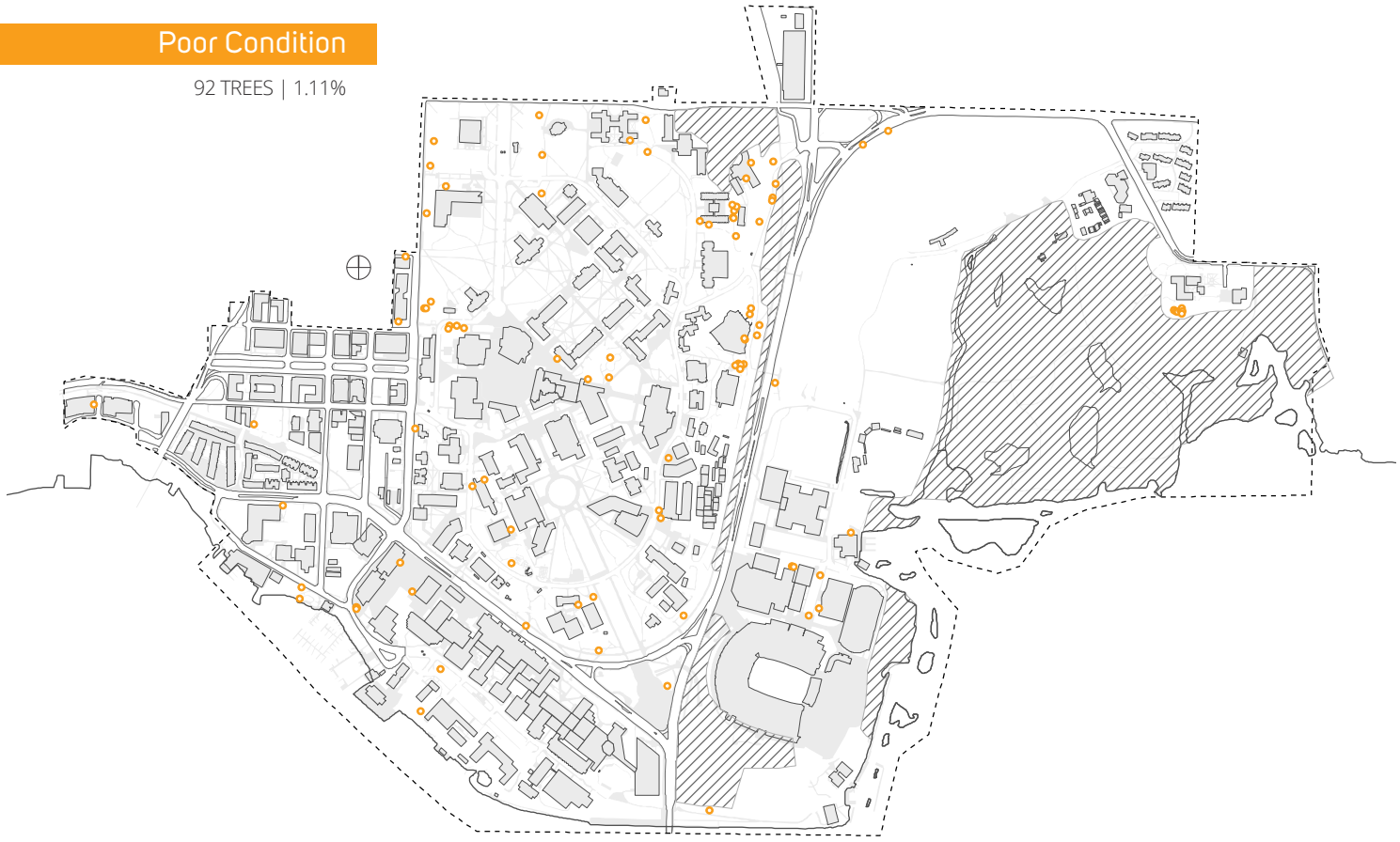
Fair Condition

1,684 TREES | 20.4%



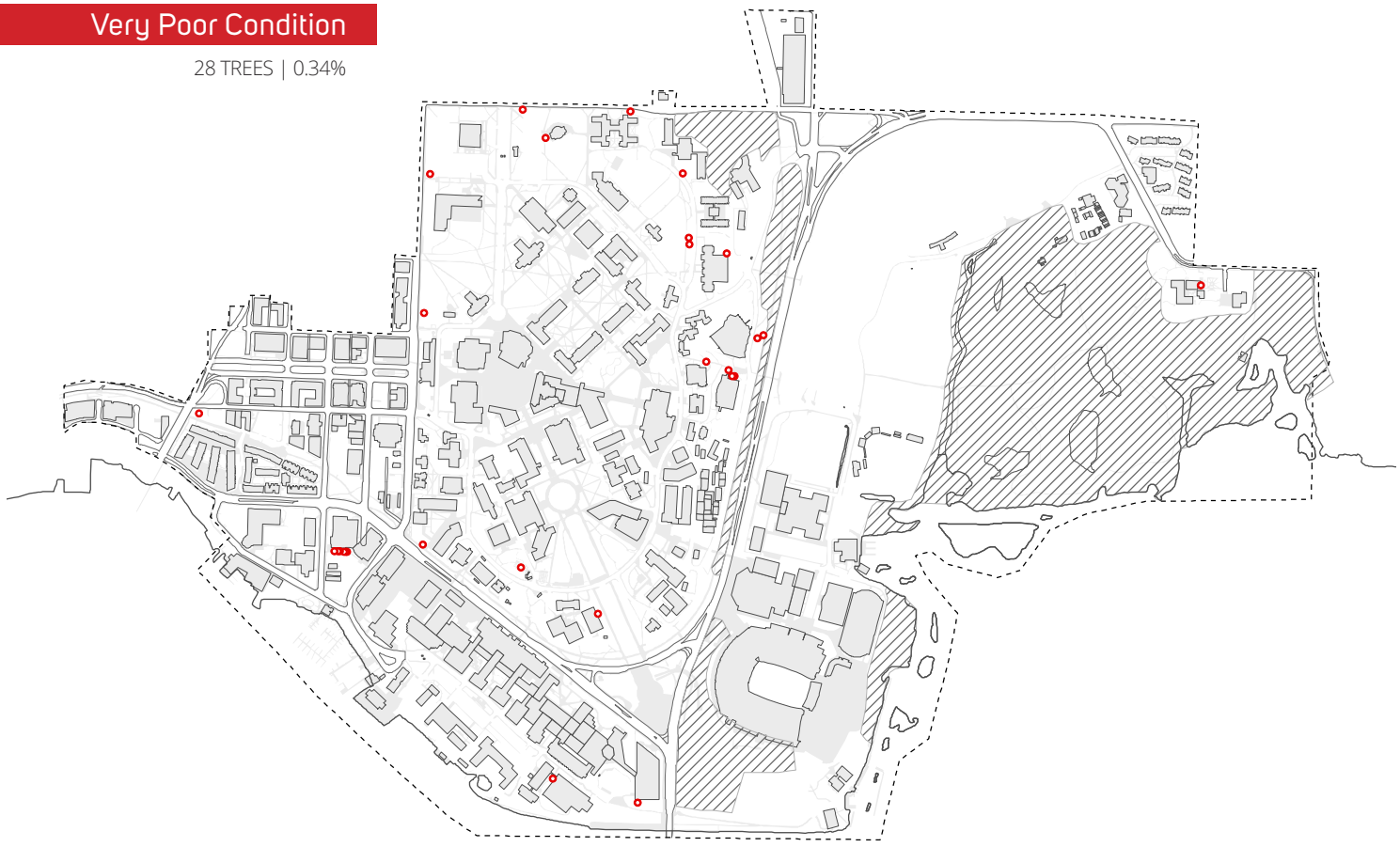
Poor Condition

92 TREES | 1.11%



Very Poor Condition

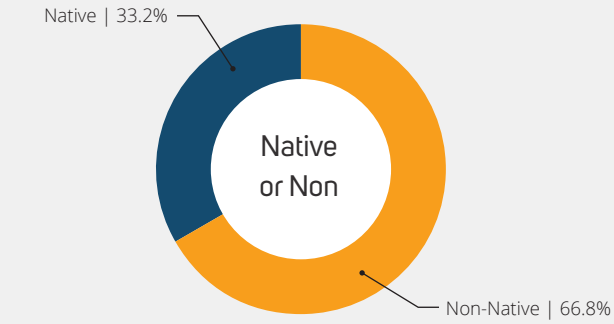
28 TREES | 0.34%

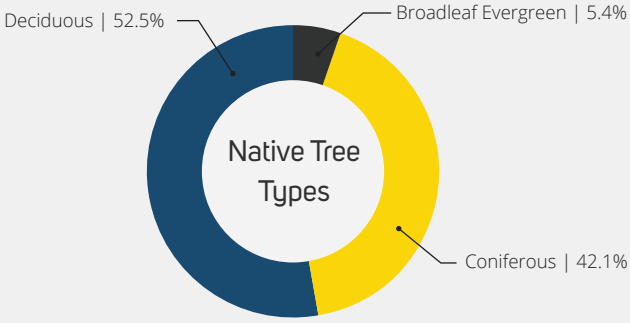


Native Trees

2,704 TREES | 49 SPECIES

Native Trees are valuable assets to the campus because of their natural acclimation to the Northwest climate and their benefit to wildlife habitat. Native trees have naturally aligned their watering and nutrient needs with the local climate which reduces irrigation requirements, reduces disease risk, enhances the local ecology, and helps limit the introduction of potential invasive species into the landscape. The University has slightly less number of native conifers compared to native deciduous trees. With only 49 native tree species on campus, the university has the opportunity to enhance the biodiversity and improve wildlife habitat by introducing more native species into the landscape. The University recognizes the benefits of native trees but also feels that a healthy Urban Forest needs to respond to the existing conditions which are greatly altered from what was present historically, making natives not always the most ideal choice. Without fully being aware of the impact climate change will have on the region, exploring non-natives species could be a means towards identifying which tree species may thrive here in the future.



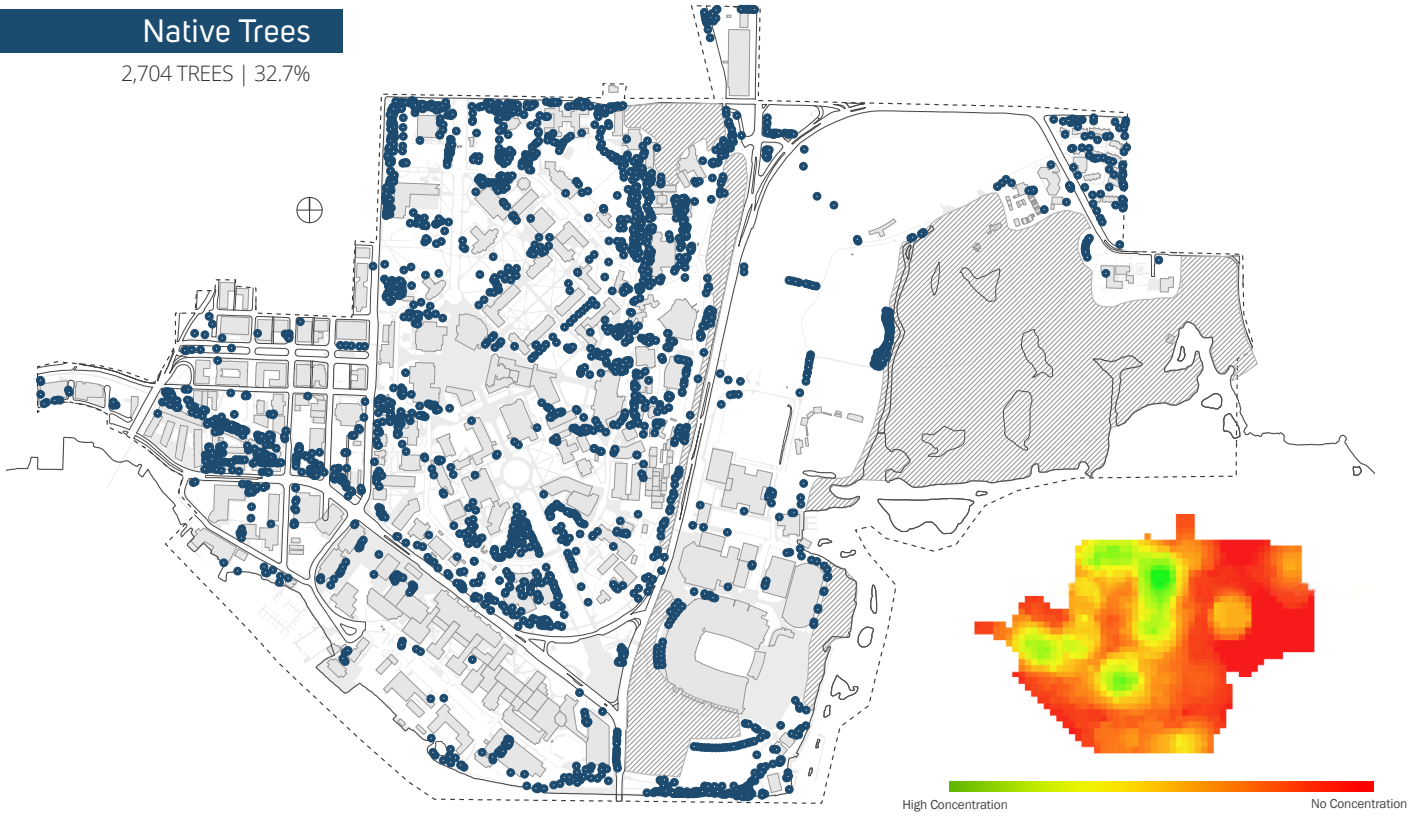


Most Common Native Species

Tree Species	# of Trees	Average Condition Rating
Pseudotsuga menziesii	*448*	*78.72%*
Acer macrophyllum	*396*	*70.69%*
Acer circinatum	*305*	*79.88%*
Thuja plicata	*199*	*78.56%*
Calocedrus decurrens	*156*	*77.81%*
Betula pendula	*129*	*73.66%*
Pinus contorta	*120*	*72.42%*
Arbutus menziesii	*103*	*65.50%*
Acer platanoides	*88*	*77.65%*
Thuja plicata 'Zebrina'	*76*	*75.16%*

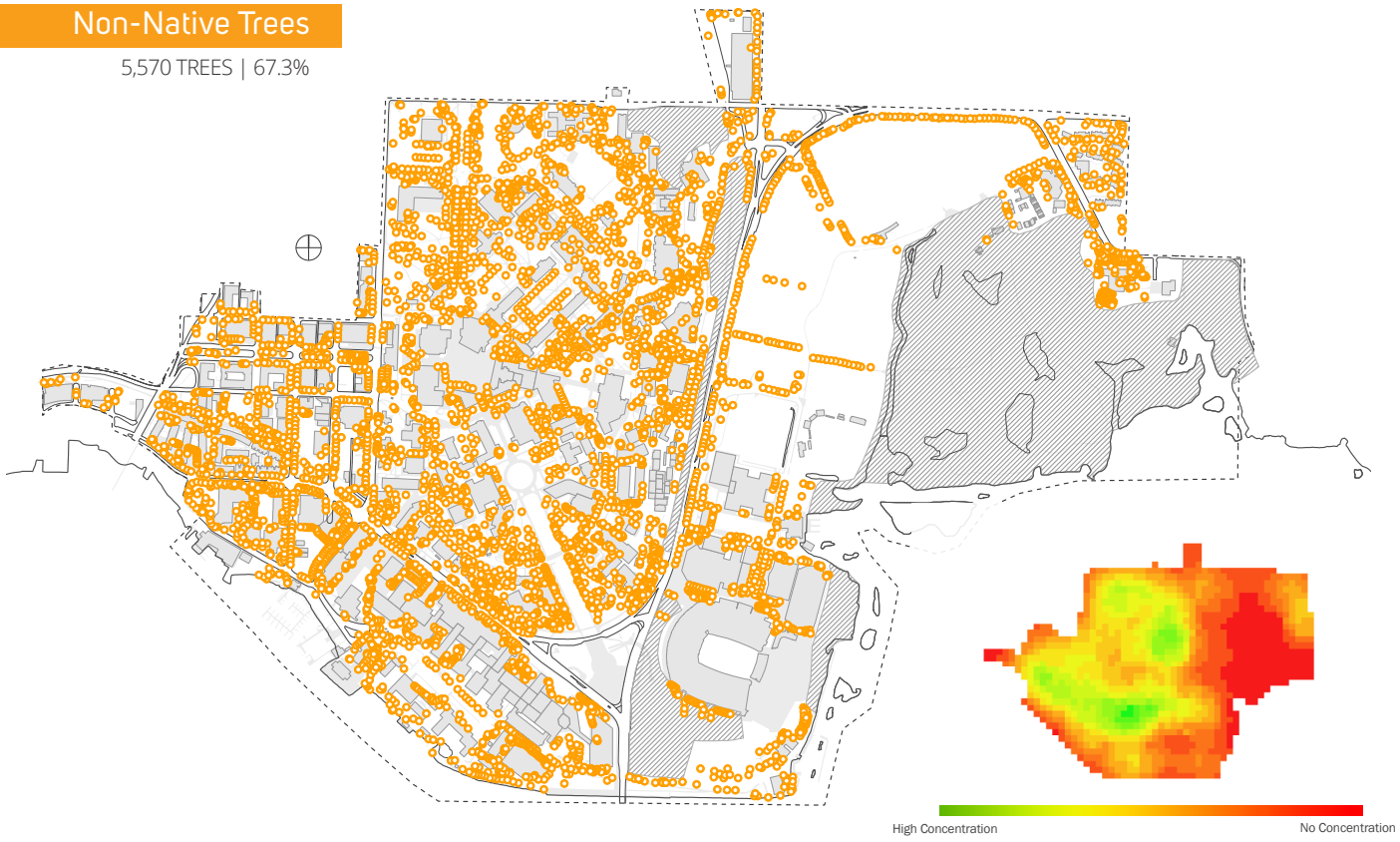
Native Trees

2,704 TREES | 32.7%



Non-Native Trees

5,570 TREES | 67.3%



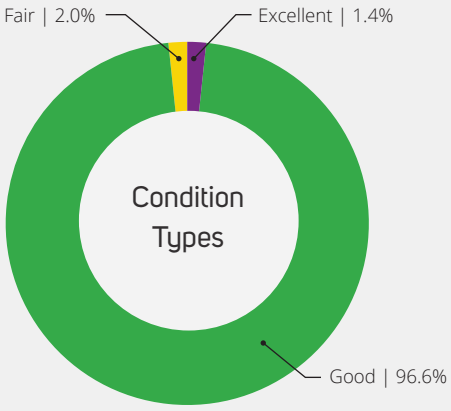
Coniferous Trees

2,458 TREES | 82 SPECIES

Historically, Washington was dominated by conifer forests that were logged extensively and what remains are scattered patches of old-growth forests across Western Washington. This has impacted the natural succession of Washington's forest that are now dominated by deciduous trees. Currently, Seattle has only 11% of its urban forest as coniferous while the University's urban forest consist of almost 20% conifers. Five of the top ten most prevalent species on campus are conifers with the highest densities of conifers being along the edges of central campus. Conifers are unique in that they provide environmental services all year long; improve air quality, provide wind & noise barriers, provide shade, and help retain stormwater runoff caused by impervious surfaces. Leveraging the environmental services offered by conifers could help the university protect areas from prevailing winds, shade buildings to reduce energy costs, and help manage stormwater on-site. One thing to note is that native varieties of conifers on campus are of a higher value than non-natives which could be the result of them being healthier due to their natural acclimation to the local ecology.

76.4%
Average Condition Rating

19.7%
of Total Trees on Campus

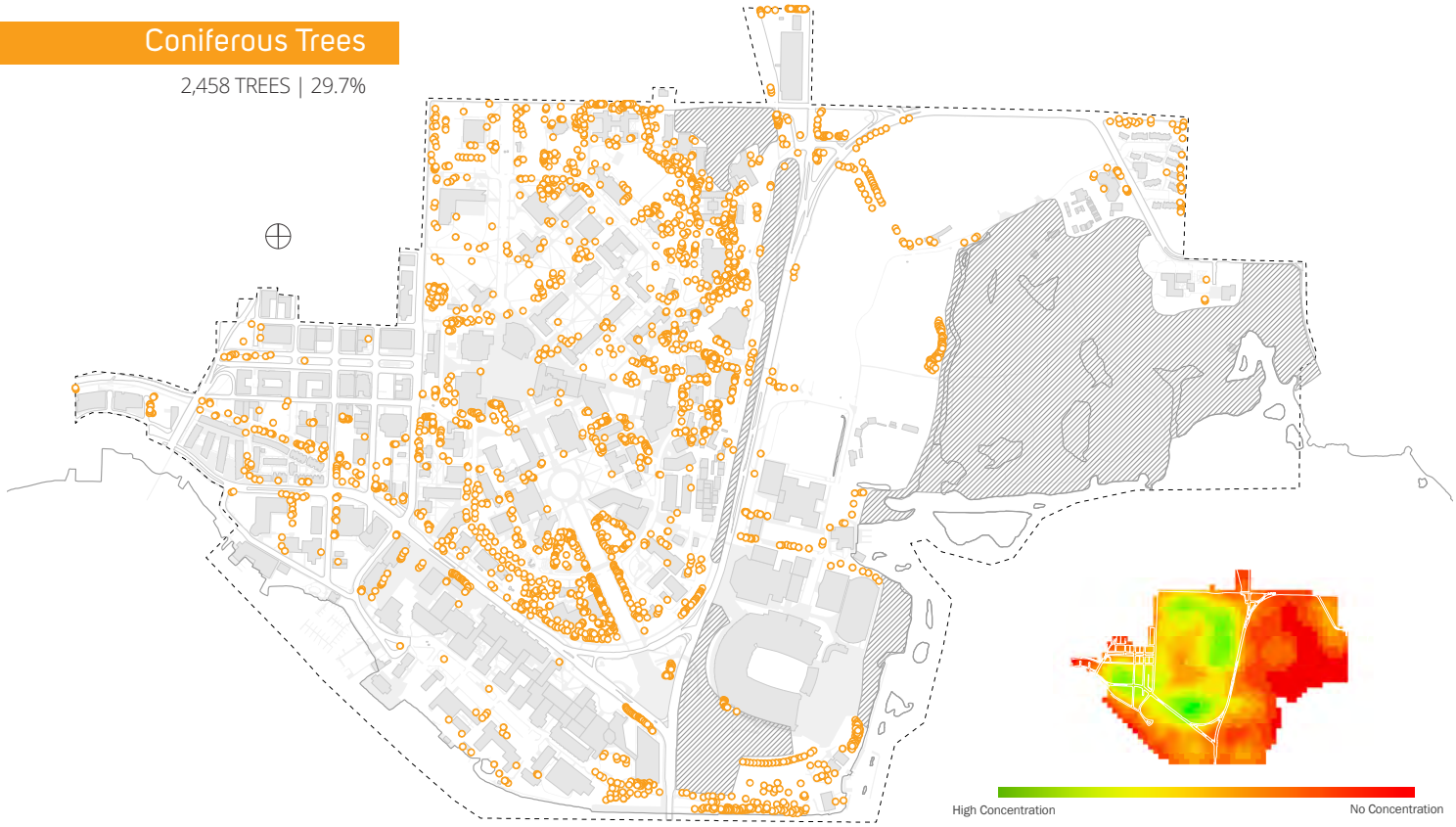


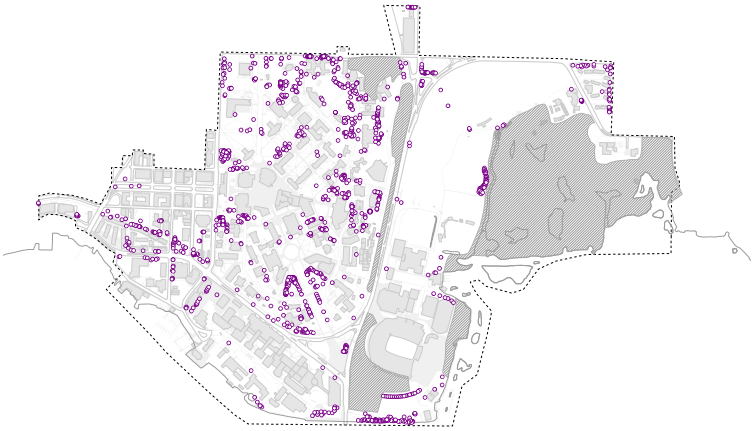
Most Common Coniferous Species

Tree Species	# of Trees	Average Condition Rating
Pseudotsuga menziesii	*448*	*78.72%*
Chamaecyparis lawsoniana	*264*	*74.52%*
Pinus sylvestris	*199*	*73.34%*
Thuja plicata	*199*	*78.56%*
Calocedrus decurrens	*156*	*77.81%*
Cedrus deodara	*142*	*76.78%*
Pinus contorta	*120*	*72.42%*
Thuja plicata 'Zebrina'	*76*	*75.16%*
Pinus nigra	*75*	*72.84%*
Tsuga heterophylla	*69*	*88.28%*

Coniferous Trees

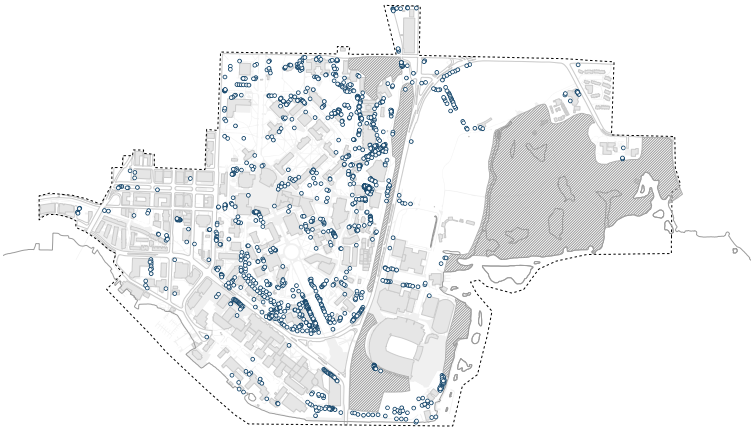
2,458 TREES | 29.7%





Native Conifers

1,137 TREES | $8,051,700



Non-Native Conifers

1,321 TREES | $5,706,440

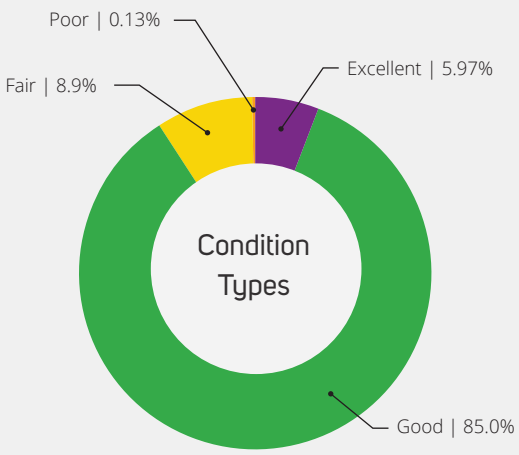
Deciduous Trees

5,420 TREES | 303 SPECIES

The amazing Fall color that is offered by Northwest deciduous trees is a cultural legacy that is celebrated by residents and visitors with trips to Northwest forested landscapes throughout the year. The majority of this region's old-growth forest has been replaced with deciduous trees that vary in their ability to produce food, flowers, and other resources. Strategically locating deciduous trees on the south and west side of buildings, around open space, and along critical areas can help create micro-climates to reduce energy costs, stabilize slopes, and provide shade. With 303 different species planted on campus, the University has a vast living resource that reflects the robust and diverse community that work, live, play, and study within the campus. A limitation of deciduous trees is that they provide half the stormwater management value that conifers offers because they are dormant during Seattle's wet/cold months. Populus tremuloides (Quacking Aspen) is a unique deciduous tree species because it has the ability to photosynthesize during the winter when other deciduous trees are dormant.

75.47%
Average Condition Rating

65.5%
of Total Trees on Campus

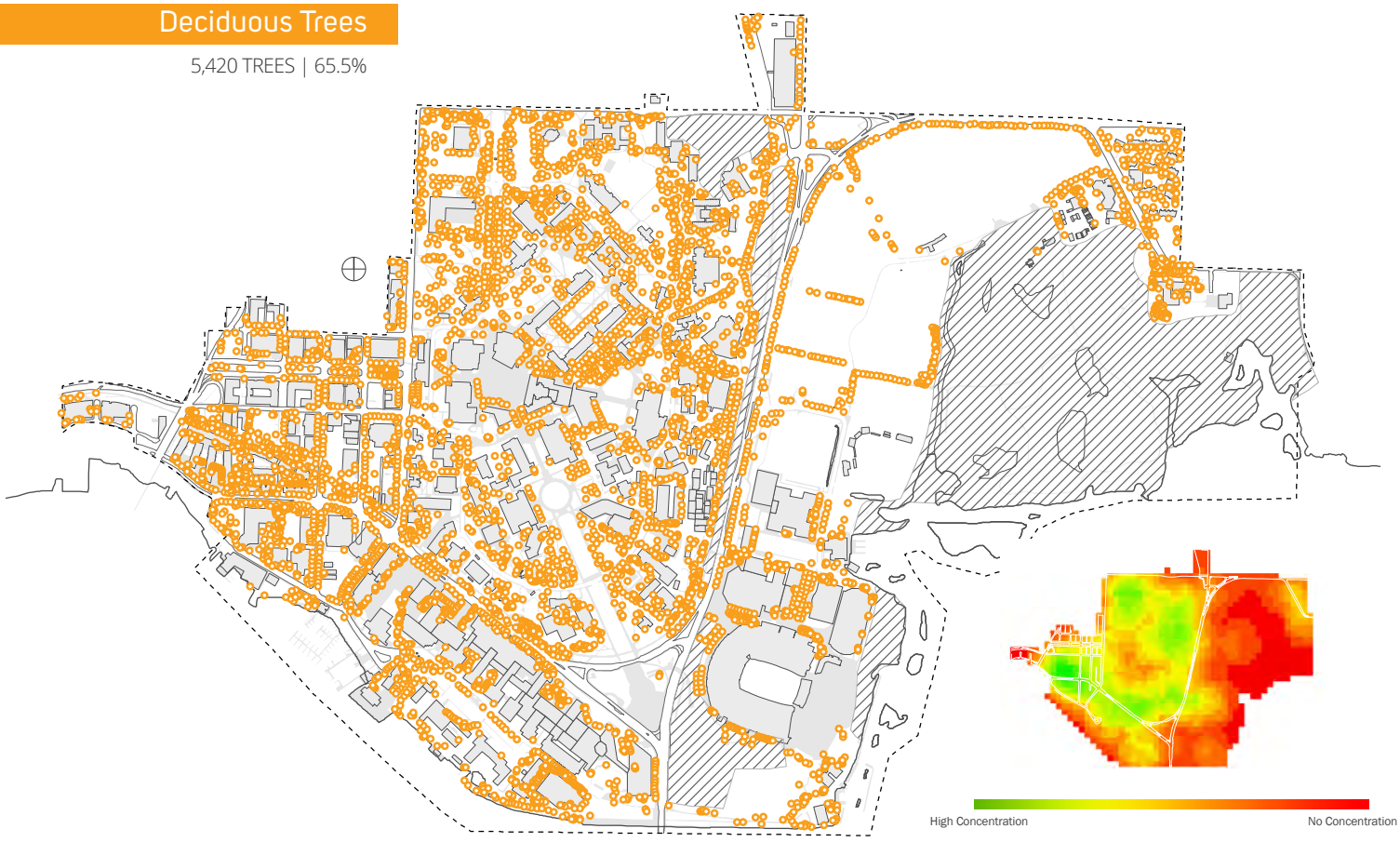


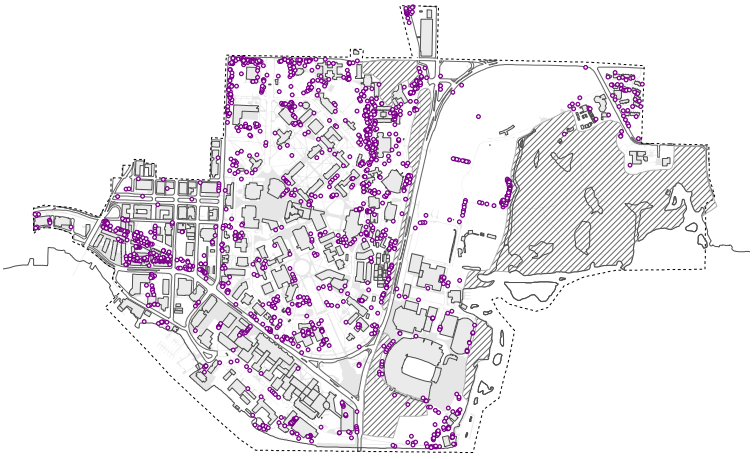
Most Common Deciduous Species

Tree Species	# of Trees	Average Condition Rating
Acer macrophyllum	396	70.69%
Acer circinatum	305	79.88%
Quercus rubra	195	75.54%
Acer rubrum	162	73.13%
Platanus x acerifolia	152	69.52%
Quercus palustris	139	75.47%
Carpinus betulus 'Fastigiata'	131	78.80%
Betula pendula	129	73.66%
Liriodendron tulipifera	122	74.55%
Acer palmatum	94	75.34%

Deciduous Trees

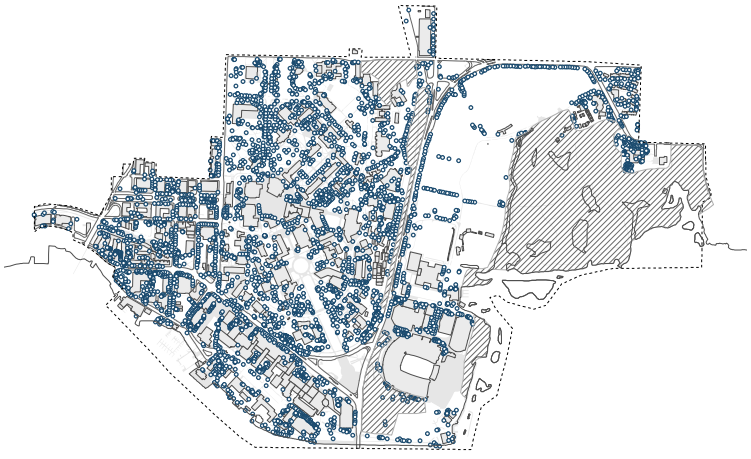
5,420 TREES | 65.5%





Native Deciduous

1,420 TREES | $5,498,930



Non-Native Deciduous

4,000 TREES | $14,906,485

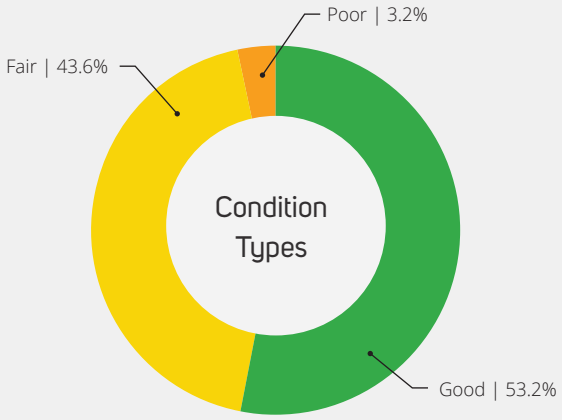
Broadleaf Evergreens

282 TREES | 26 SPECIES

Broadleaf Evergreens are trees or shrubs that have broad rather than needle like scaled leaves and maintain their leaves through out the year. They offer the color and fruit production of a deciduous tree while providing shade and canopy cover year-around. Shrubs can also be classified as a broadleaf evergreen with the state flower the Rhododendron being one example. One thing to note is that the most prevalent trees of this classification, Arbutus menziesii or the Pacific Madrona also have one of the lowest condition ratings. Both broadleaf evergreen trees and shrubs are susceptible to winter burn or desiccation caused by freezing temperatures which causes the plant to be unable to draw moisture from the frozen soil. With only 282 tree specimens and Madrona or "Arbutus mensiesii" representing almost 50% of the total, the University can grow this resource by increasing the number of types and specimens on campus. A challenge to increasing the diversity of Broadleaf Evergreens, like other tree varieities are favorable site conditions along with availability at local nurseries.

69.42%
AVERAGE CONDITION RATING

3.4%
of Total Trees on Campus

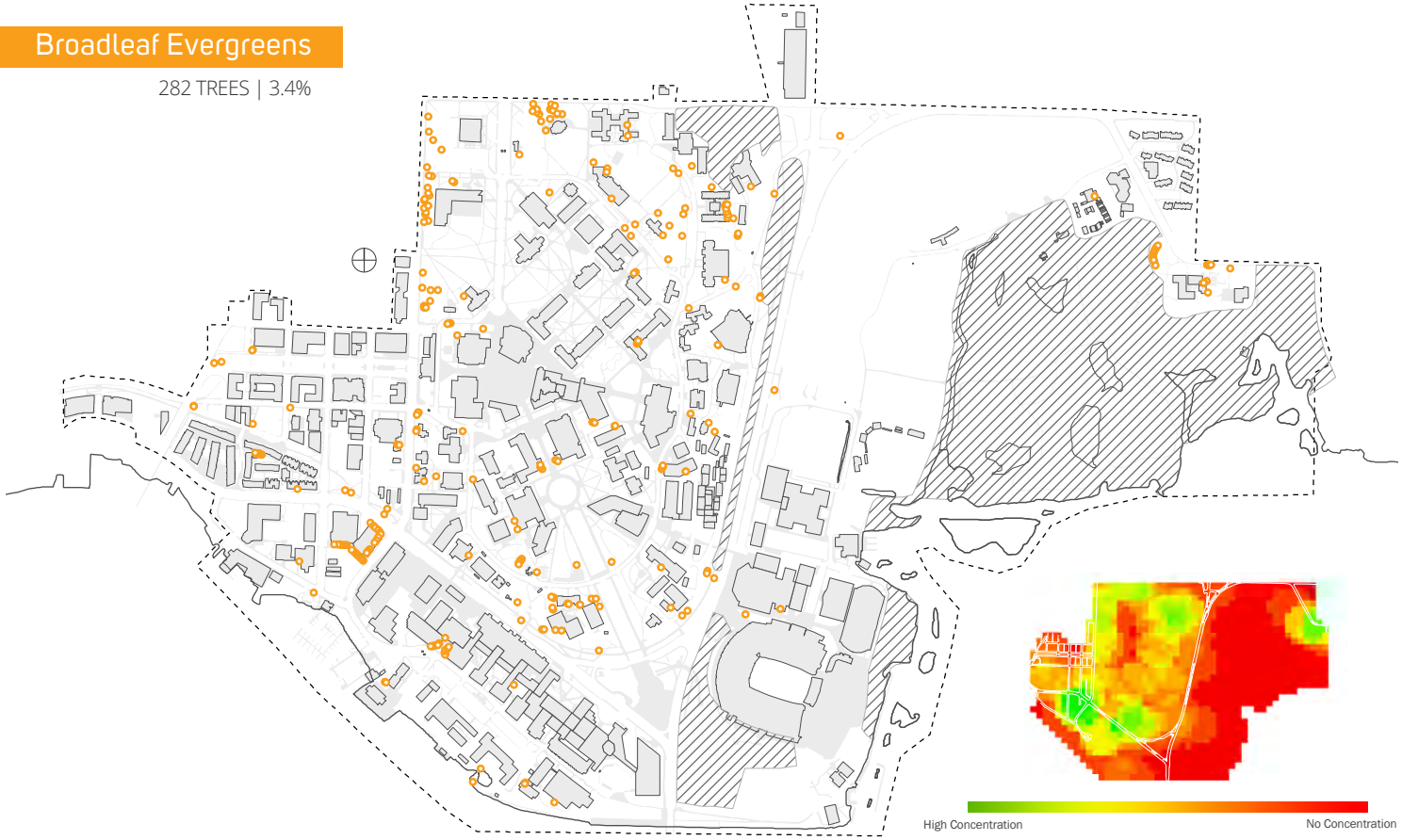


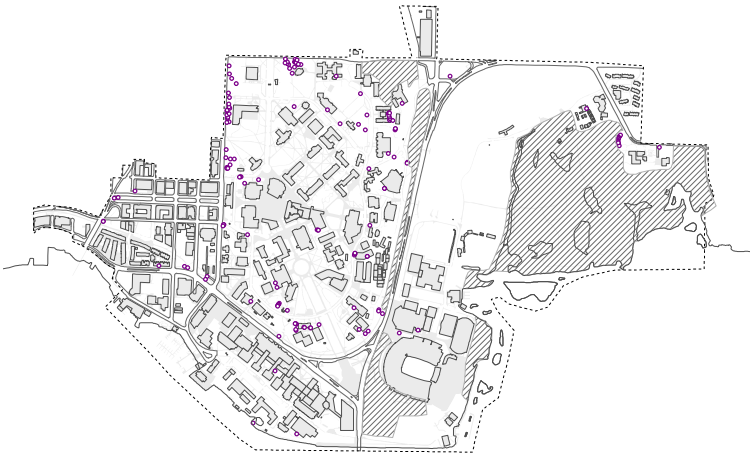
Most Common Broadleaf Evergreen Species

Tree Species	# of Trees	Average Condition Rating
Arbutus menziesii	103	65.50%
Arbutus unedo	22	78.77%
Laurus nobilis	21	73.62%
Eucalyptus sp	20	69.35%
Ilex aquifolium	19	75.11%
Umbellularia californica	14	74.21%
Ilex 'September Gem'	11	77.00%
Nothofagus antarctica	8	72.38%
Podocarpus macrophyllus	8	68.88%
Acacia melanoxylon	8	32.88%

Broadleaf Evergreens

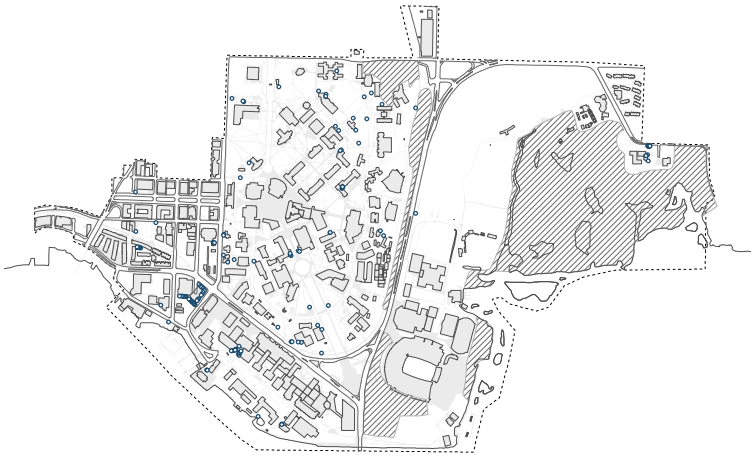
282 TREES | 3.4%





Native Broadleaf Evergreens

147 TREES | $510,670



Non-Native Broadleaf Evergreens

135 TREES | $183,660

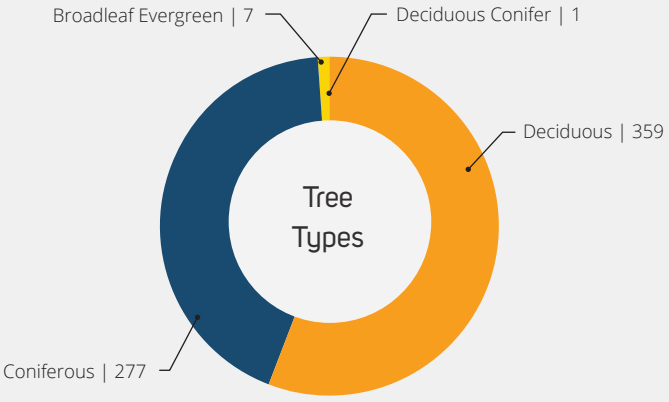
Exceptional Trees

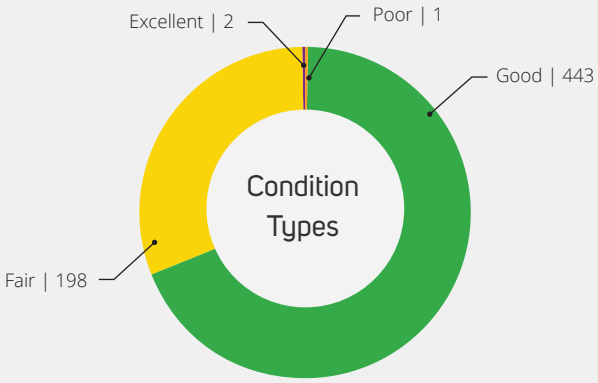
644 TREES | 70 SPECIES

Exceptional Trees provide the University with culturally significant specimens that offer educational opportunities, habitat benefits, and enhance the overall quality of the University. These trees have been identified based on the City of Seattle's Director Rule 16-2008 that defines an exceptional tree as one that:

"because of its unique historical, ecological, or aesthetic value constitutes an important community resource"

There are two primary thresholds that the university uses in defining which trees on campus are considered exceptional or not. A DBH of 30" or greater, or meets and/or exceeds the threshold diameters specified by the Director's rule for specific tree species with a threshold below 30". There is an additional threshold associated with grooves of trees that the University does not use because it would classify the majority of trees on campus as exceptional.



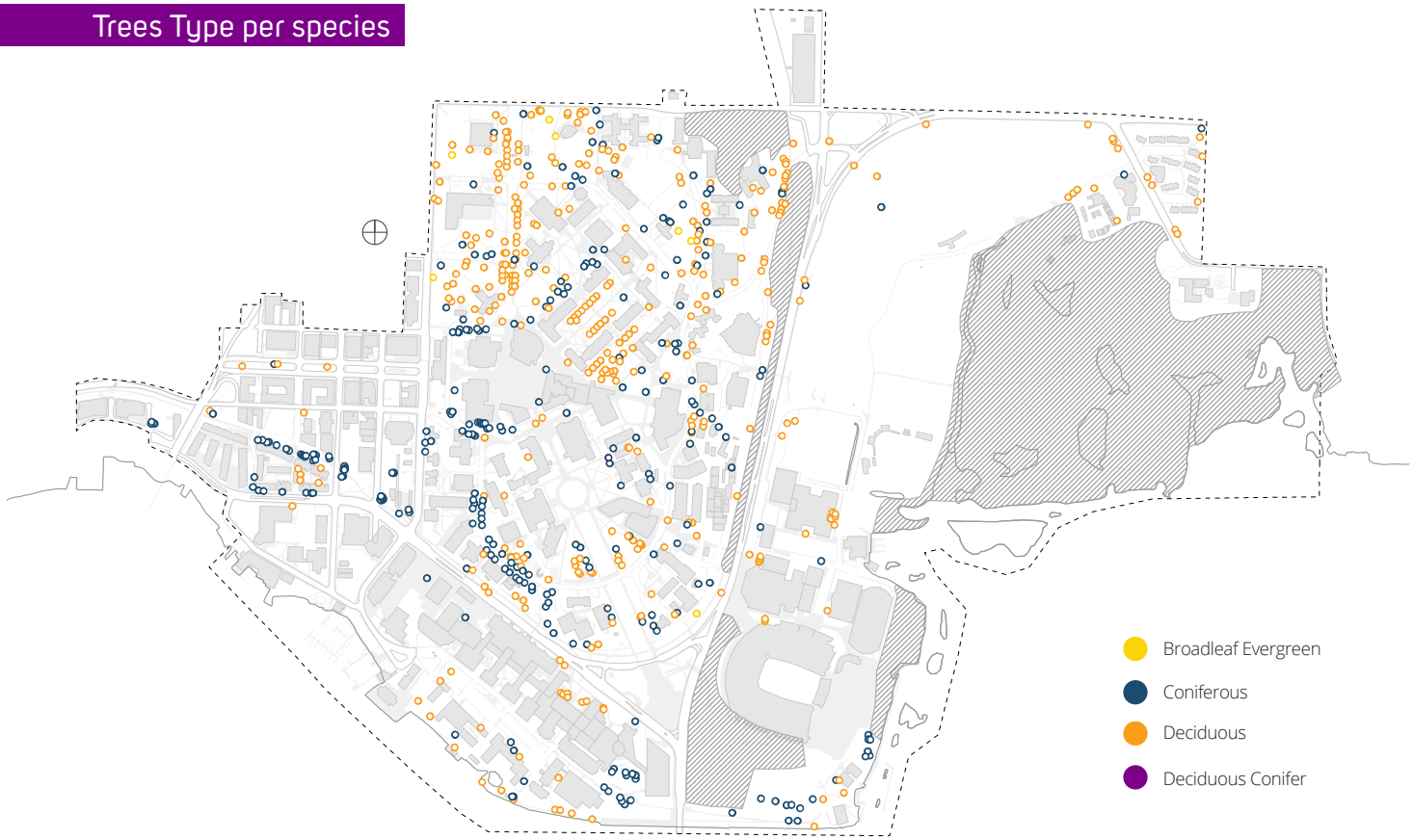


Most Common Exceptional Trees

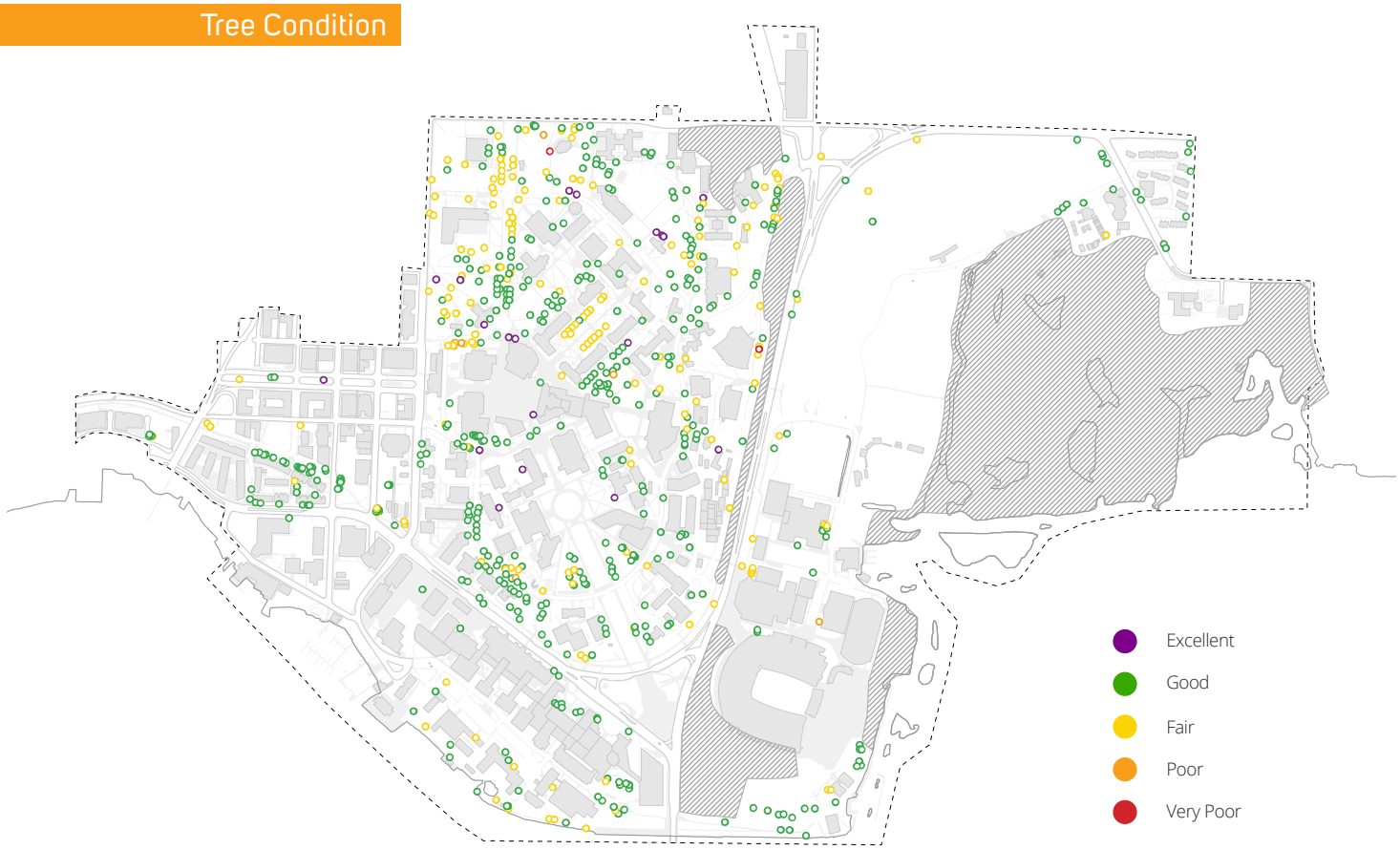
Tree Species	# of Trees	Average Condition Rating
Pinus contorta	106	71.72%
Acer macrophyllum	60	67.30%
Cedrus deodara	57	77.16%
Pseudotsuga menziesii	50	75.40%
Platanus x acerifolia	44	69.91%
Cornus nuttallii	30	69.40%
Acer circinatum	24	70.13%
Aesculus hippocastanum	22	77.18%
Prunus x yedoensis	17	66.65%
Carpinus betulus 'Fastigiata'	17	80.06%

** This does not include Exceptional trees as part of grooves and trees 75% the size of the largest documented trees*

Trees Type per species



Tree Condition



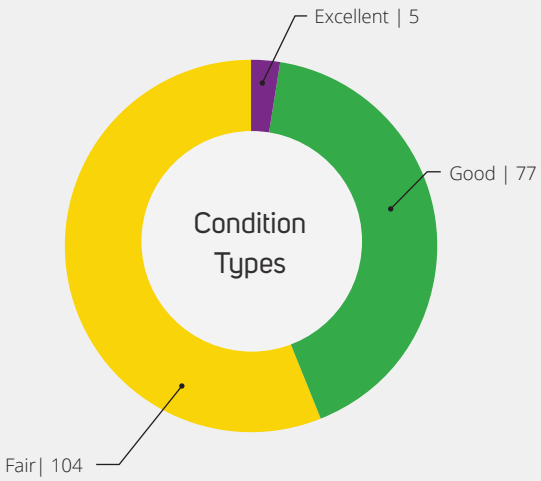
Memorial Trees

186 TREES | 30 SPECIES

Following major events in history, the University has completed multiple tree plantings on campus to honor students, veterans, professors, and faculty associated with these events. In addition, individuals are able to purchase a memorial tree for a loved one or colleague that is maintained in perpetuity by UW Grounds Management and showcased on a Memorial Tree map that can be found online. A short list of memorial plantings of interest are the allee of London Plane (Platanus x acerifolia) trees that line Memorial Way to honor the 58 students that died in World War I, Douglas Firs (Pseudotsugo menzieseii) for Jewish Arbor Day, and the Giant Dogwoods (Cornus controversa) that honor 911 victims. The trees on campus not only represent the amazing ecology of the northwest but also provide moments to reflect and honor veterans, and influential faculty that have left a cultural or social impact on the UW community and society. The continued promotion and expansion of this resource can help increase the awareness of the multiple layers of value and significance that many campus trees possess.

72.59%
Average Condition Rating

44
Exceptional Trees

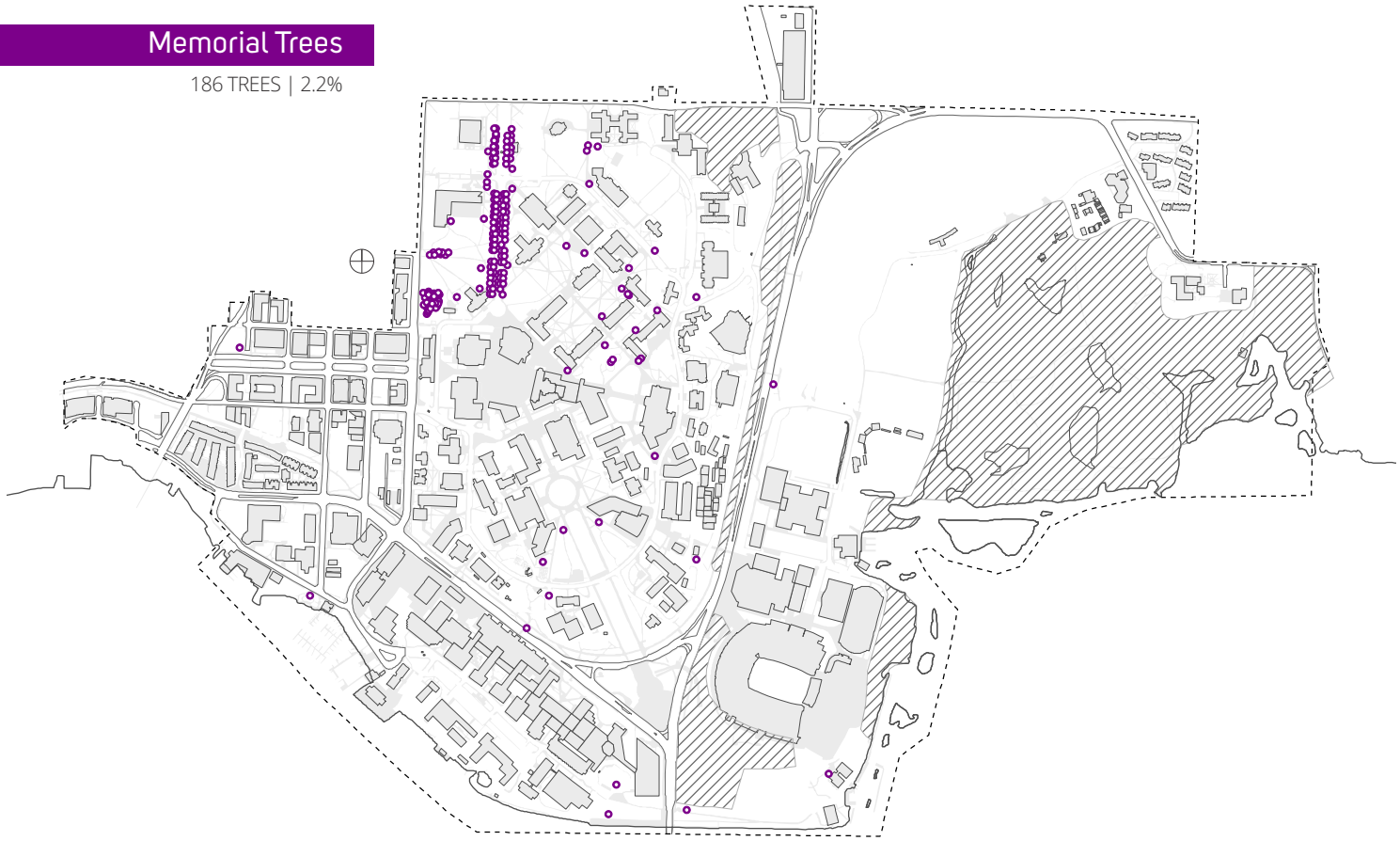


Most Common Memorial Trees

Tree Species	# of Trees	Average Condition Rating
Platanus x acerifolia	99	69.17%
Pseudotsuga menziesii	36	83.61%
Quercus coccinea	9	82.22%
Thuja plicata	5	82.80%
Cornus controversa	3	80.00%
Davidia involucrata	3	81.00%
Malus sp	3	83.67%
Prunus subhirtella	2	55.50%
Sequoiadendron giganteum	2	78.50%
Cornus kousa	2	77.00%

Memorial Trees

186 TREES | 2.2%



TREE DEDICATIONS

Major Events

911 Victims
Armistice day, 1920
58 students who died WW1
Jewish Arbor Day

In Honor of.....

Annie Knight
Ben Athay, 2007
Bill Talley, 2007
Bob Anderson Memorial Tree
Charles "Griz" Graves
Chris Holmer and the Holmer family
Class of 2007
David Ogrodnik, 2013
Eugene G. Goforth, MD 1975
Holly Turner
Honor of Staff member Baby
In memory of an employee by fellows
Jill M Nakawatase
Laurence Walters Family
Lynn Guggenheim 1997
Lynns Tree
Mark Nelson
Martin Elder
Phil Johnson "UW Gardener"
Sigma Kappa Centennial Memorial Tree
UW Graduate John Messier
Walt Gordon
William Bergsma, UW School of Music Director, 1963-1971

Unique Trees

"Meany Sequoia" planted by Edmond S. Meany
"The Miller Elm" for Francis G. Miller
Meany Oak
"Washington Elm" - George & Martha Holly
Centenneal Cedar by Mary Gates Hall

Special Trees

PINACEAE | SAPINDACEAE | CUPRESSACEAE | ROSACEAE

The University of Washington adds to the value of its urban forest by planting rare Northwest trees on campus that are curated as a campus tree tour in honor of Professor Frank Brockman, an influential professor in Forestry who created the first university tree tour in 1980. The University takes pride in utilizing the landscape as an educational resource by designing it as an extension of the classroom. Rare trees on campus have been identified using the book, "Trees of Seattle" by Arthur Lee Jacobsen, a local tree guide that identifies mature healthy examples of each unique tree specie in the city. The Brockman Memorial Tree Tour currently consists of 66 trees that highlights the beauty and diversity of trees on campus through an online available tour with a printable map for those who would like to experience the trees on site. One thing to note is the below average condition of rare trees compared to the memorial trees. This shows that rare trees might require additional maintenance to be kept at excellent health compared to other, more common Northwest species.

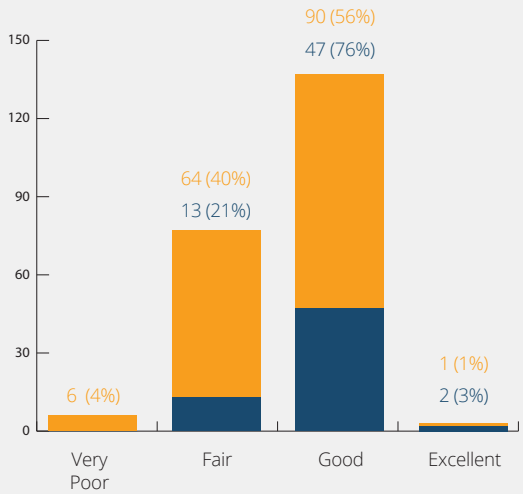
68.69%

Average Rare Tree Condition

73.79%

Average Memorial Tree Condition

SPECIAL TREE CONDITION

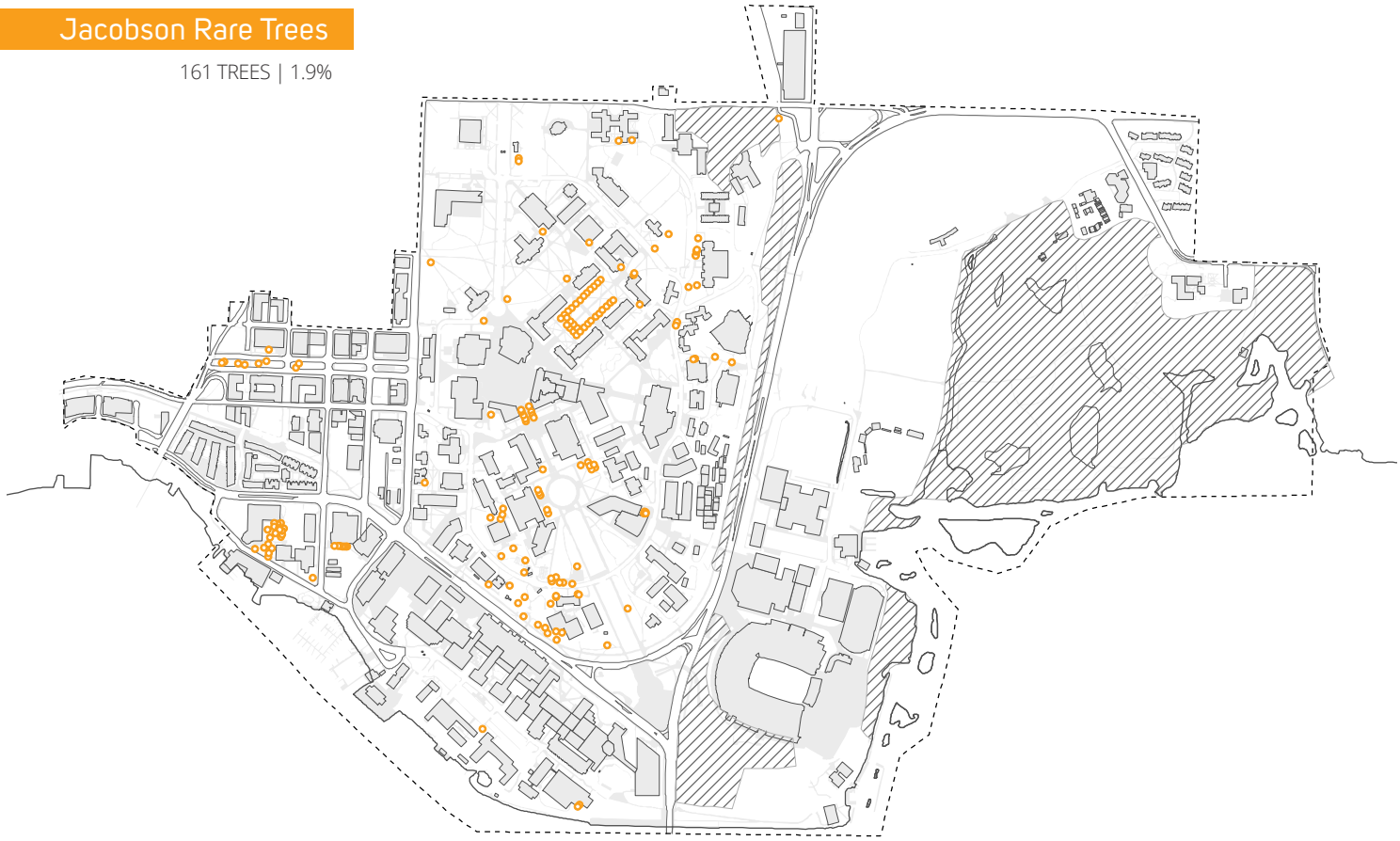


Most Common Jacobson Rare Trees

Tree Species	# of Trees	Condition Rating
Prunus x yedoensis	30	66.97%
Idesia polycarpa	19	64.89%
Prunus serrulata 'Hisakura'	9	71.00%
Pinus coulteri	8	70.50%
Malus baccata	7	74.14%
Acacia melanoxylon	7	29.43%
Carpinus japonica	5	67.00%
Crataegus pruinosa	5	72.20%
Tilia cordata	5	70.40%
Chamaecyparis pisifera	4	77.00%

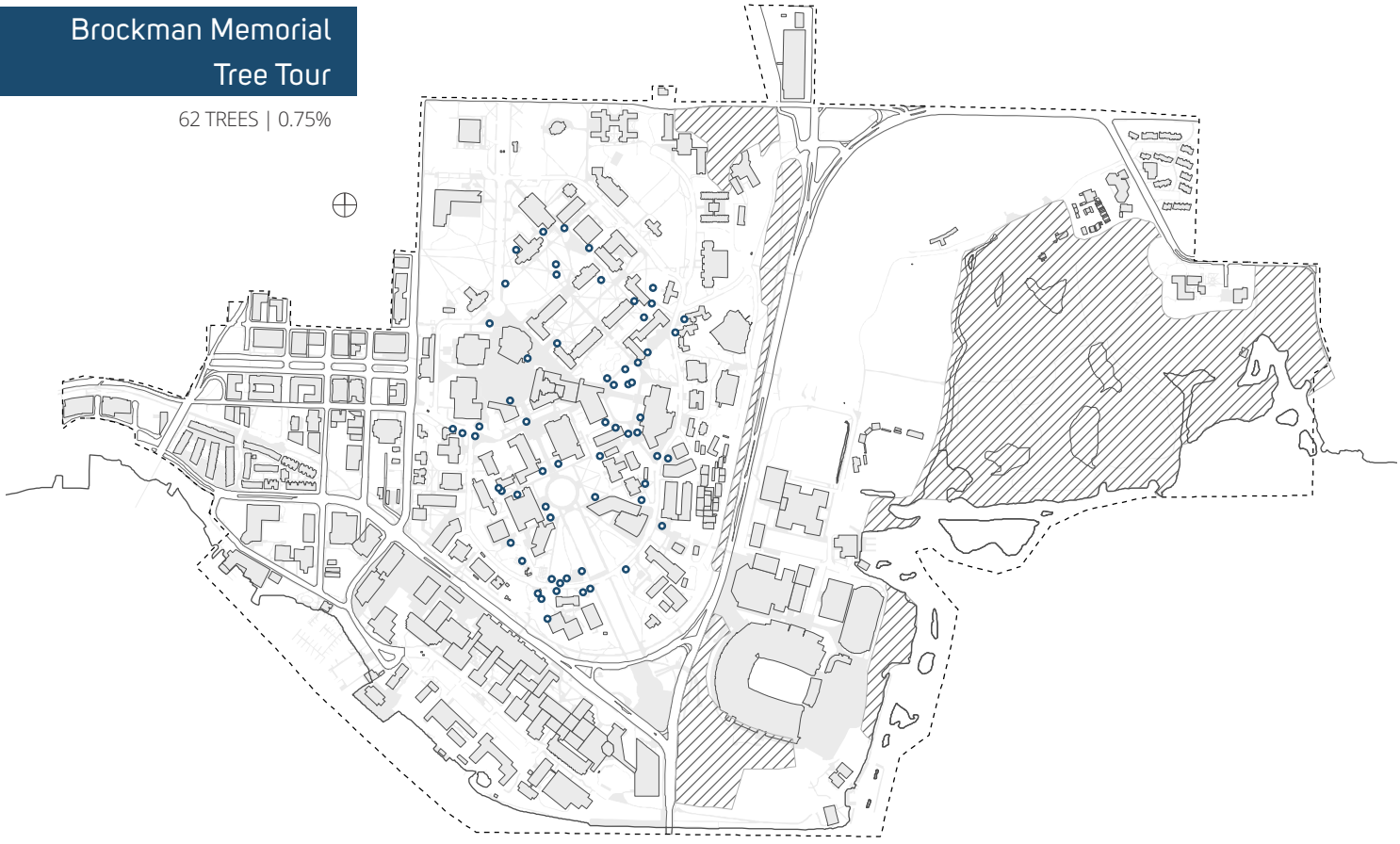
Jacobson Rare Trees

161 TREES | 1.9%



Brockman Memorial Tree Tour

62 TREES | 0.75%



Disease Susceptibility

INTEGRATED PEST MANAGEMENT | INOCULATION

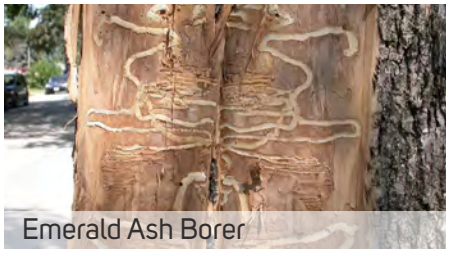
All trees are susceptible to disease or insects, it's the fatal nature of their susceptibility that varies. The best way to protect a tree from harmful agents is to plant them in an ideal condition and maintain them to optimal health. Though not all disease or insects only attack unhealthy trees. Emerald Ash Borer, Dutch Elm, and Chestnut Blight attack trees of all conditions. Planting a diverse stand that is not limited to natives is ideal because many diseases and insects affect native plants. A ratio of no more than 10% of one species or 20% of one genus or 30% of one family is recommended to minimize the risk of massive disease infestation resulting in large volumes of tree death. Currently, the University is below these thresholds.

With the number of outbreaks growing, a diversity of trees need to be maintained in the urban environment to better protect the forest from a single vector destroying the canopy. Urban areas that have a concentration of individual species are more susceptible to a massive infestation. When establishing a tree palette for an area, it is not recommended to limit tree types to ones that are not associated with a major disease or insect risk, unless there have been high volumes of outbreaks. Overly restricting tree choices will put areas at risk of potential outbreaks caused by future unknown pests.

When a tree has been identified as potentially infected or diseased the University's Arborist conducts an evaluation of the tree using the University of Washington Tree Hazard Evaluation Form. This form helps the University determine the necessary means for resolving the hazard. A tree is removed when pruning, cabling, spraying, or injecting are not viable options for resolving the concern. The University takes advantage of integrated pest management to minimize its use of insecticides, fungicides, and pesticides because of their potential negative effects on soil biology, pollinators, water quality, and human health.


Dutch Elm Disease


Horse Chestnut Blight


Emerald Ash Borer


Bronze Birch Borer


Aphids


Spider Mite

Dutch Elm Disease

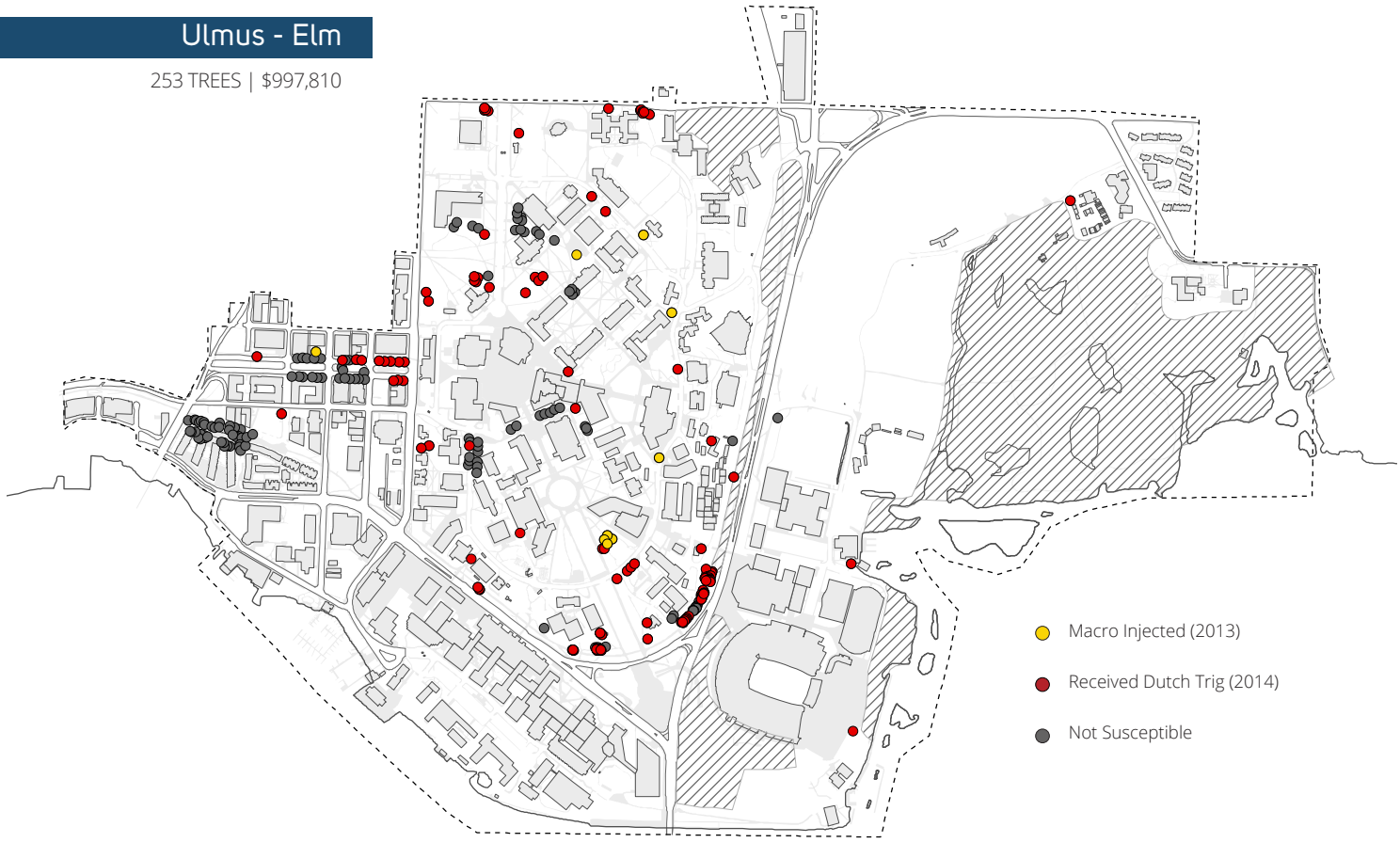
ULMUS | TREATMENT ON-GOING

Dutch Elm Disease is currently a problem on the University of Washington Seattle Campus with a number of trees having already died as a result of being infected by the Elm Bark beetle. The battle to save other Elms on campus is an on-going and difficult effort because of the beetle's mobility and the existence of a large number of suceptible elm varieties on campus and in the surrounding communities. Even if the University manages their trees to a high standard, neighboring properties can become infected which can spread onto campus. The Elm Bark Beetle has the ability to travel up-to 1,000 feet per flight and is prolific having four reproduction cycles per year.

Grounds Management staff has been trained to identify the pest along with signs of infestation to assist in early detection and eradication. As part of the university's management strategy, roughly 100 susecptible elms are innoculated with the "Dutch Trig" vaccine each year while the more significant Elm trees on campus are treated with a Arbotech Macroinjection every two years. The University will continue using early detection and rapid response paired with injections to minimize future tree loss while also specifing elm varieties that are less susceptible to the Dutch Elm for new plantings.

Ulmus - Elm

253 TREES | $997,810



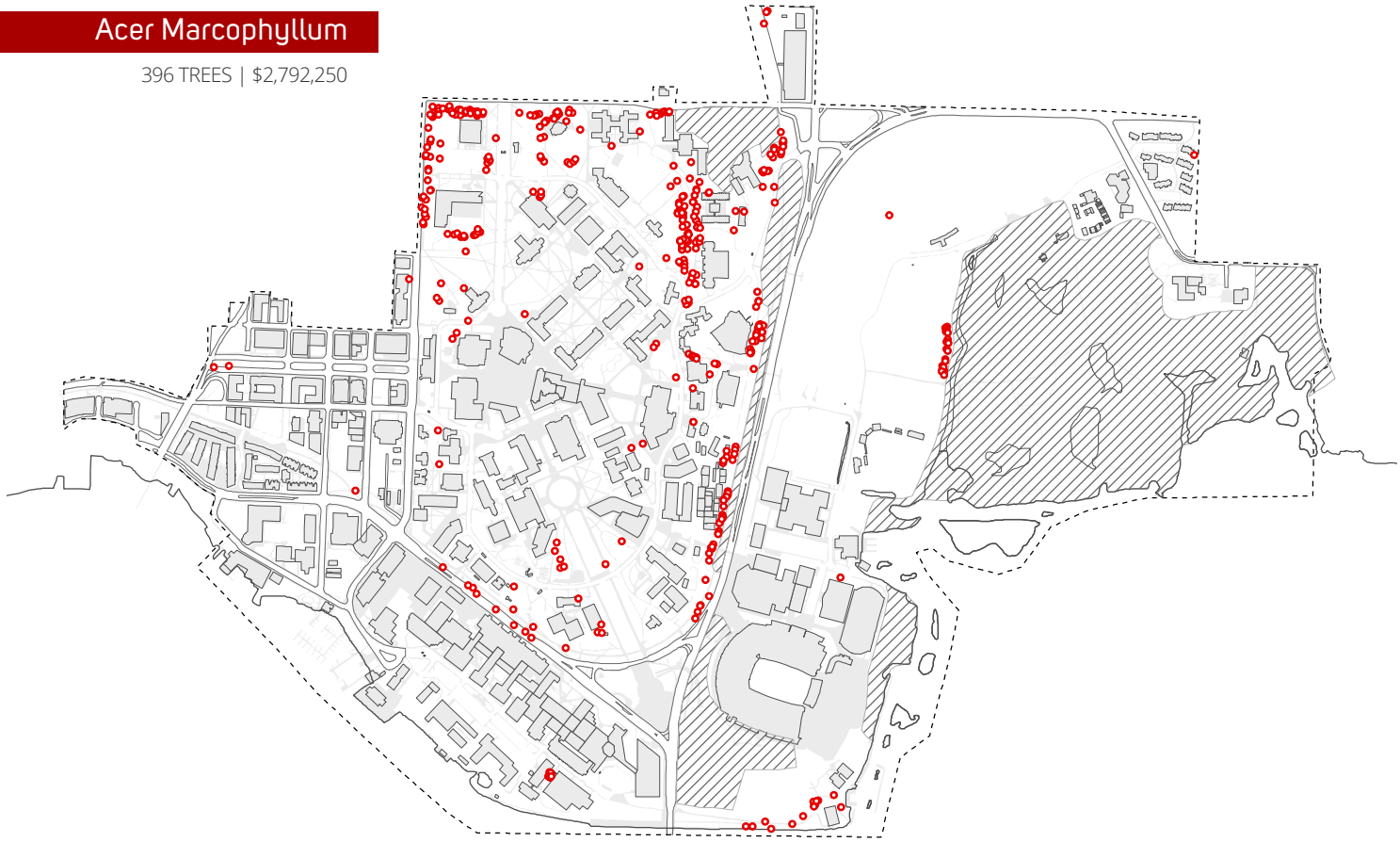
Verticillium Wilt

ACER | CURRENT PROBLEM

Verticillium is a soil-borne fungi that attacks woody ornamental trees in the United States. Verticillium slowly spreads inside the tree causing a slow and long death. Many times this infection is confused with other tree impacts: herbicide damage, adverse environmental conditions or mechanical damage. Nurseries using land that was previously growing infected plants are more susceptible to this disease. Certain trees are more susceptible to this disease while others are immune to Verticillium, like Beech, Birch, Pine and Polar. Currently, this disease has been infecting trees on campus, with the response being to immediately remove the tree and replace it with a different species. The map below shows the breath of Big Leaf Maples on campus which are highly susceptible to this disease.

Acer Marcophyllum

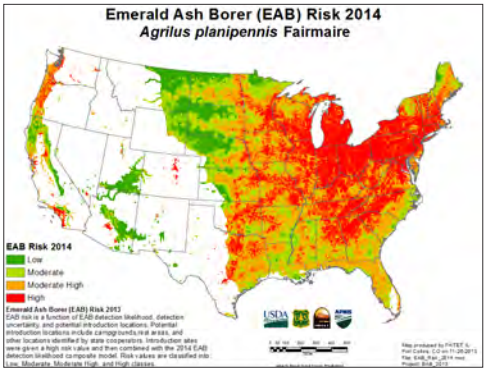
396 TREES | $2,792,250



Emerald Ash Borer

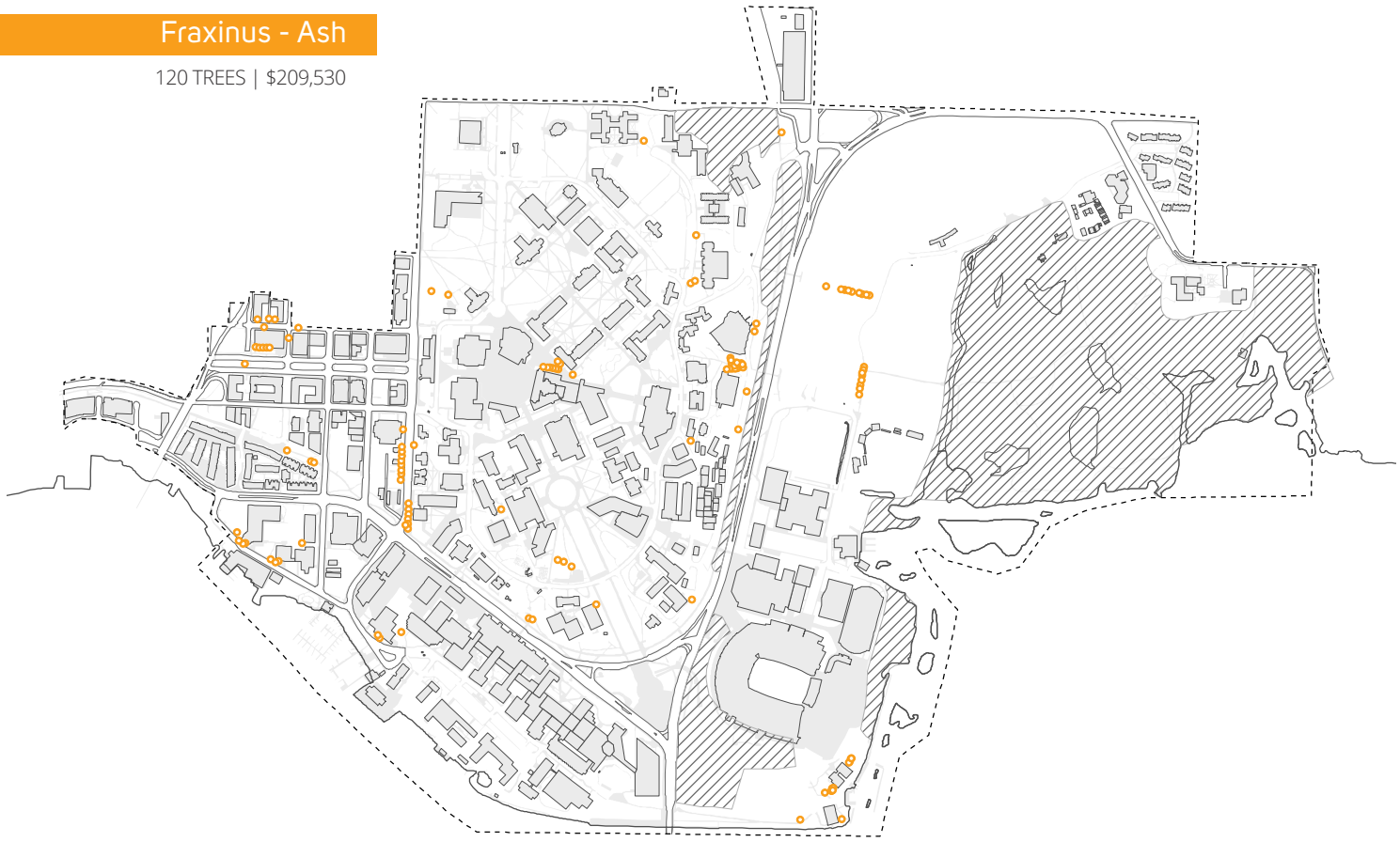
FRAXINUS | NO REPORTED CASES

Emerald Ash Borer is an invasive beetle that has yet to make its way into Washington State. The beetle feeds on the inner bark of ash trees negatively impacting the tree's ability to transport water and nutrients. The beetle is native to Asia and is assumed to have arrived to the US on solid wood packing materials. The areas where this beetle is being reported have implemented quarantines in an effort to restrict its movement. The Puget Sound Region has been identified by the USDA and US Forest Service as a high risk area for potential outbreaks because of the robust forest and associated industries that are in this region. Establishing an early detection rapid response strategy to help educate staff on properly identifying this diseases will aid in reducing any outbreaks that may occur.



Fraxinus - Ash

120 TREES | $209,530



Bronze Birch Borer

BETULA | NO CASES YET

The Bronze Birch Borer has yet to be found on campus, but has been established in the Portland area since 2000. The UW gardeners and arborist are on the watch for the black beetle because once infestation has started in a tree it is difficult to eradicate without the use of pesticides. The beetles are most attracted to unhealthy trees so by planting new Birch trees in their ideal habitat; cool areas with moist soil and partial sun exposure with minimal foot traffic will help minimize the risk of infestation. Also, selecting varieties that have greater resistance is also a good strategy for minimizing risk. It has been said that it is not a matter of if, but when this becomes an issue on campus so the University is taking the appropriate steps for establishing a early detection and rapid response strategy.

High Susceptibility

Betula pendula

Betula pendula 'Youngii'

Betula utilis var jacquemontii

Moderate Susceptibility

Betula papyrifera

Betula populifolia

Betula alleghaniensis

Minimal Susceptibility

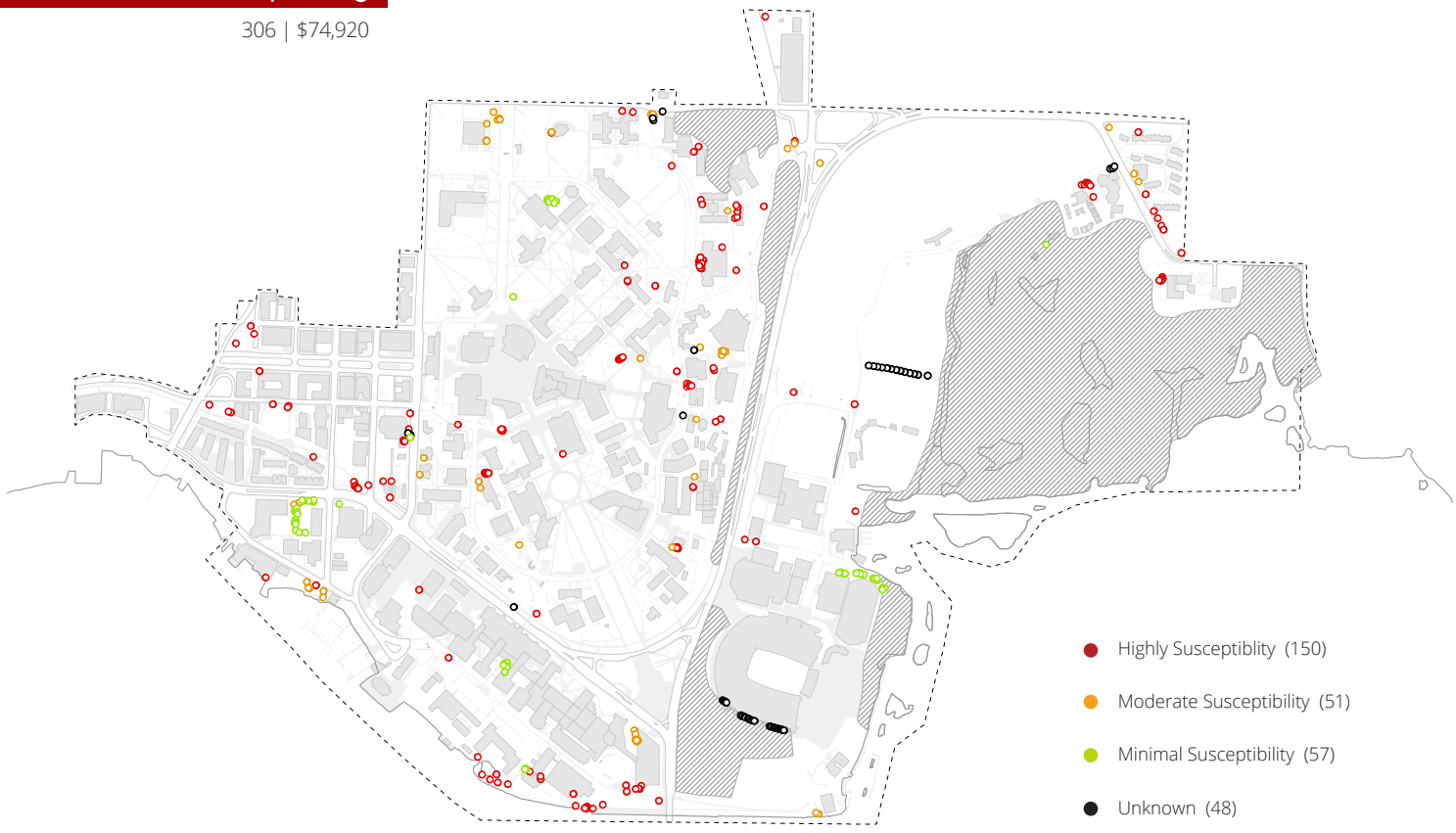
Betula nigra

Betula nigra 'Heritage'

Betula lenta

Betula Susceptibility

306 | $74,920

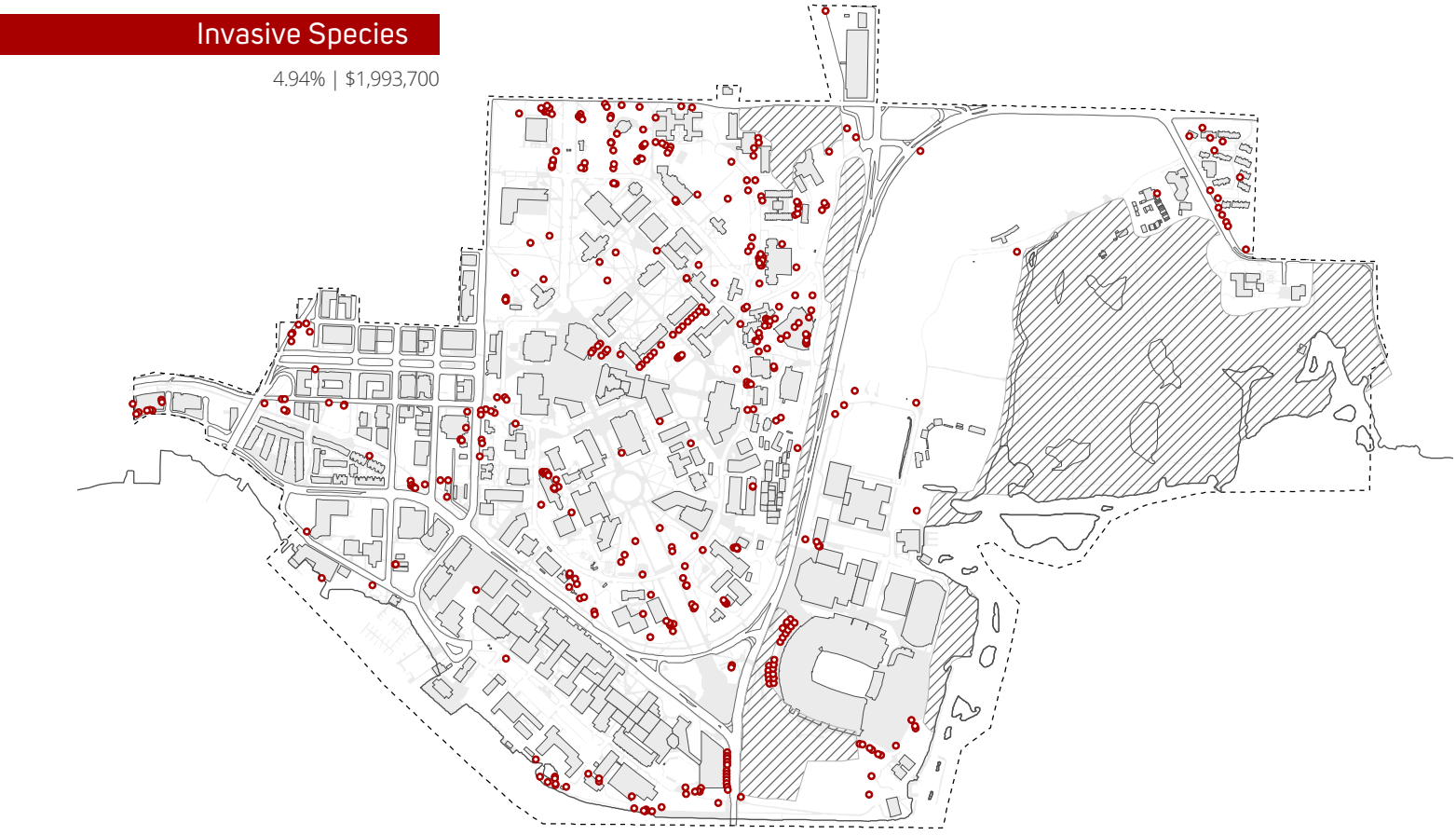


Invasive Species

409 TREES | 12 SPECIES

The University has approximately 409 trees on campus that have been identified by the King County Noxious Weed Division as being invasive. These species have the potential to out compete diverse grooves of plants turning areas into a mono-culture of unwanted vegetation. A form of quarantine management is an potential strategy for minimizing their ability to out compete adjacent vegetation to preserve their presence on campus as an academic resource. The following species have been identified as invasive and are scattered across campus:

Norway maple – *Acer platanoides*
Horse chestnut – *Aesculus hippocastanum*
Tree-of-heaven – *Ailanthus altissima*
European birch – *Betula pendula*
One-seed hawthorn – *Crataegus monogyna*
English holly – *Ilex aquifolium*
Goldenrain tree – *Koelreuteria paniculata*
Sweet cherry – *Prunus avium*
Cherry laurel – *Prunus laurocerasus*
Portugal laurel – *Prunus lusitanica*
Black locust – *Robinia pseudoacacia*
European Mt. Ash – *Sorbus aucuparia*

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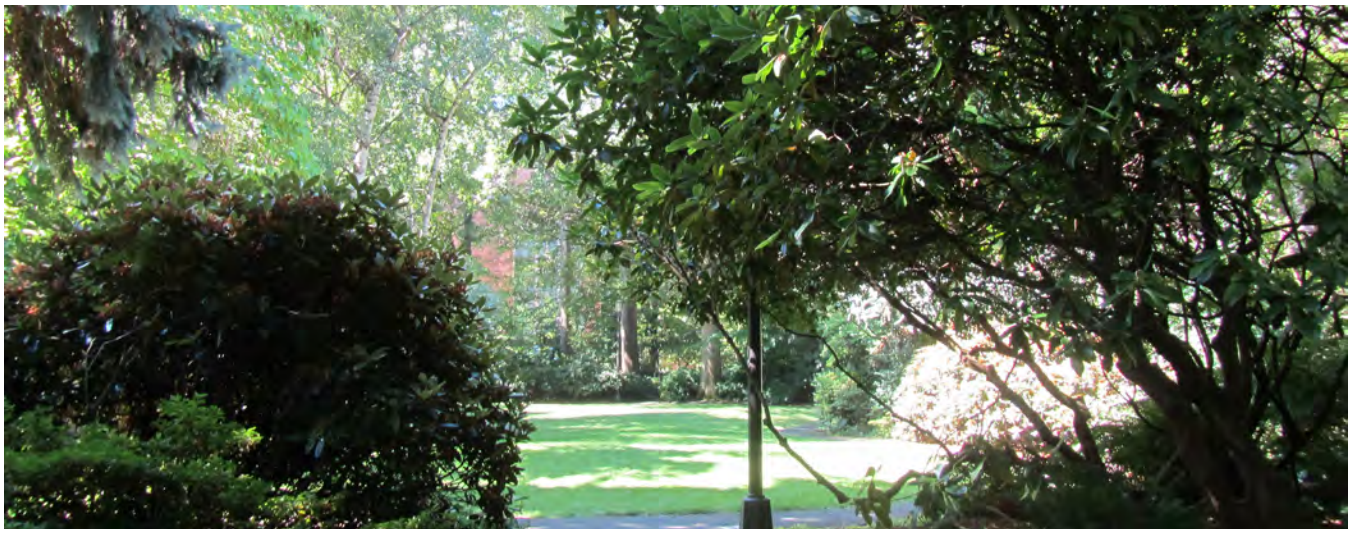


Urban Forest Strategy

From little seeds grow mighty trees

Aeschylus

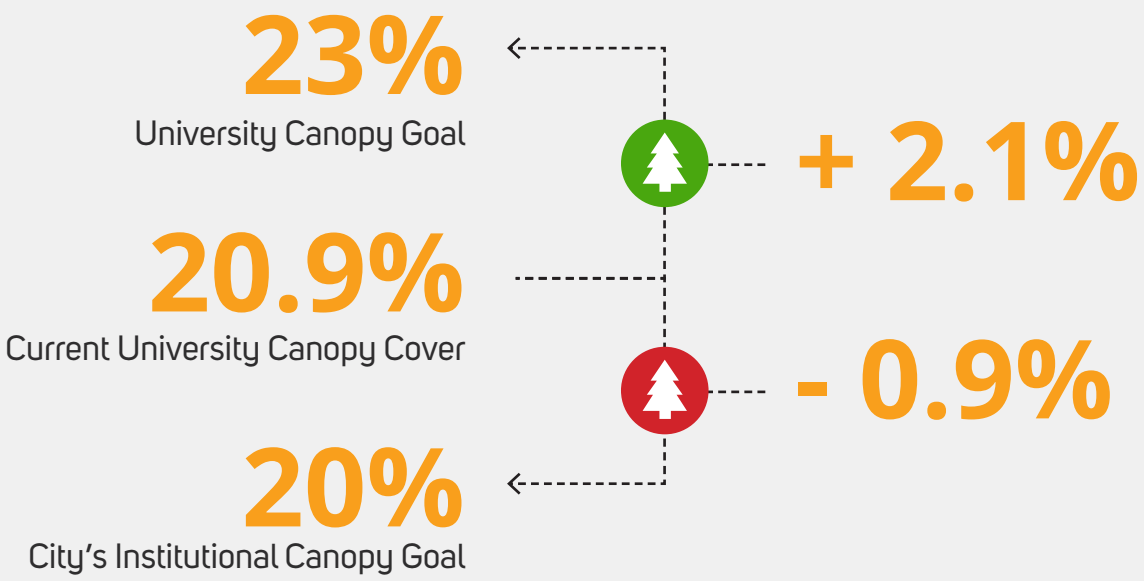
The multi-scalar analysis of the University's landscape results in a range of recommendations and insights that address both short-term and long-term strategies for improving the urban forest and its derivative resources. As the campus evolves, data collection and tracking will be important for evaluating the University's progress towards the identified Urban Forest goals. The strategy also explores the different roles trees can play in shaping the campus environment through their scale, agglomeration, alignment, and context. The use and function of trees on campus should be considered based on the landscape mosaic in which they are located to create a mutually beneficial relationship between site, nature, and architecture. These relationships will be important to consider as the University works towards increasing the canopy cover by 10 percent in each of the neighborhoods by 2037, resulting in a campus wide increase of 2.l percent.

Tree Canopy Goals

UPPER CANOPY | LOWER CANOPY | UNDERSTORY | GROUND COVER

The city of Seattle has defined a tree canopy goal of 20% for all Institutional properties by 2037. This percentage is derived by dividing the total canopy area by the total area of land including buildings and the public right-of-way. Based on the canopy coverage derived from the 2009 Seattle lidar scan, the University has exceeded the city's goal by almost one percent. When only looking at the area of campus that has been surveyed, the campus is one percent away from reaching the city's goal, while the areas of campus that have yet to be surveyed have some of the densest grooves of trees on campus. Having already met the city's institutional canopy goal, the university has defined a goal of 23% canopy coverage by 2037 which equates to an additional 10.3 acres of canopy cover. The strategies and policies to achieve this goal are outline in the following pages through identifying missed opportunities and promoting well established practices. The Campus's urban forest has and will continue to be a part of the University of Washington's legacy and there by needs to be a major topic of discussion when considering the future evolution of campus.

Tree Canopy Coverage



Non-Surveyed Canopy Cover

29.6%
Canopy Cover

Surveyed Canopy Cover

19%
Canopy Cover

Landscape Mosaic

The landscape of the Seattle campus is a diverse mosaic of landscape types. Each type, or piece of the mosaic, has a distinct character and function, ranging from the highly figured "Campus Green" spaces of Denny Yard and Rainier Vista, to the "interstitial or buffer spaces" that are often forgotten, but are found in key locations throughout the campus. By identifying, and describing each element of the mosaic, the urban forest management framework can establish goals that work together with the different spatial functions of campus to create an integrated whole. The reading of the campus as a mosaic celebrates the richness and diversity of landscape types, and resists the temptation to find campus-wide solutions to issues that demand more nuance. Each mosaic element should be addressed on its own terms, taking into account adjacent relationships, but making sure they are treated as having their own integrity. Strategic urban forestry practices can help emphasize the character of each tile within the mosaic while enhancing ecological and social function campus-wide.

WOODLAND GROVE

Character

The woodland grove is the immediately recognizable Pacific Northwest frame for the university, with a mixture of tall evergreens and deciduous trees, and a robust canopy. The continuity of the woodland grove around three sides of central campus is key to the campus character.

INTERSTITIAL / BUFFER SPACE

Character

These spaces are largely defined by adjacent uses, though, in many cases, this does not prevent them from being beautiful or interesting. Interstitial spaces sometimes provide important connections between destinations. Interstitial spaces are typically small in size, fragmented, and scattered across all parts of campus.

THRESHOLD

Character

Thresholds are landscapes whose primary purpose is to provide a transition into or between important moments on campus and as such have a significant role to play in the experience of those more iconic spaces.

URBAN FRONTAGE

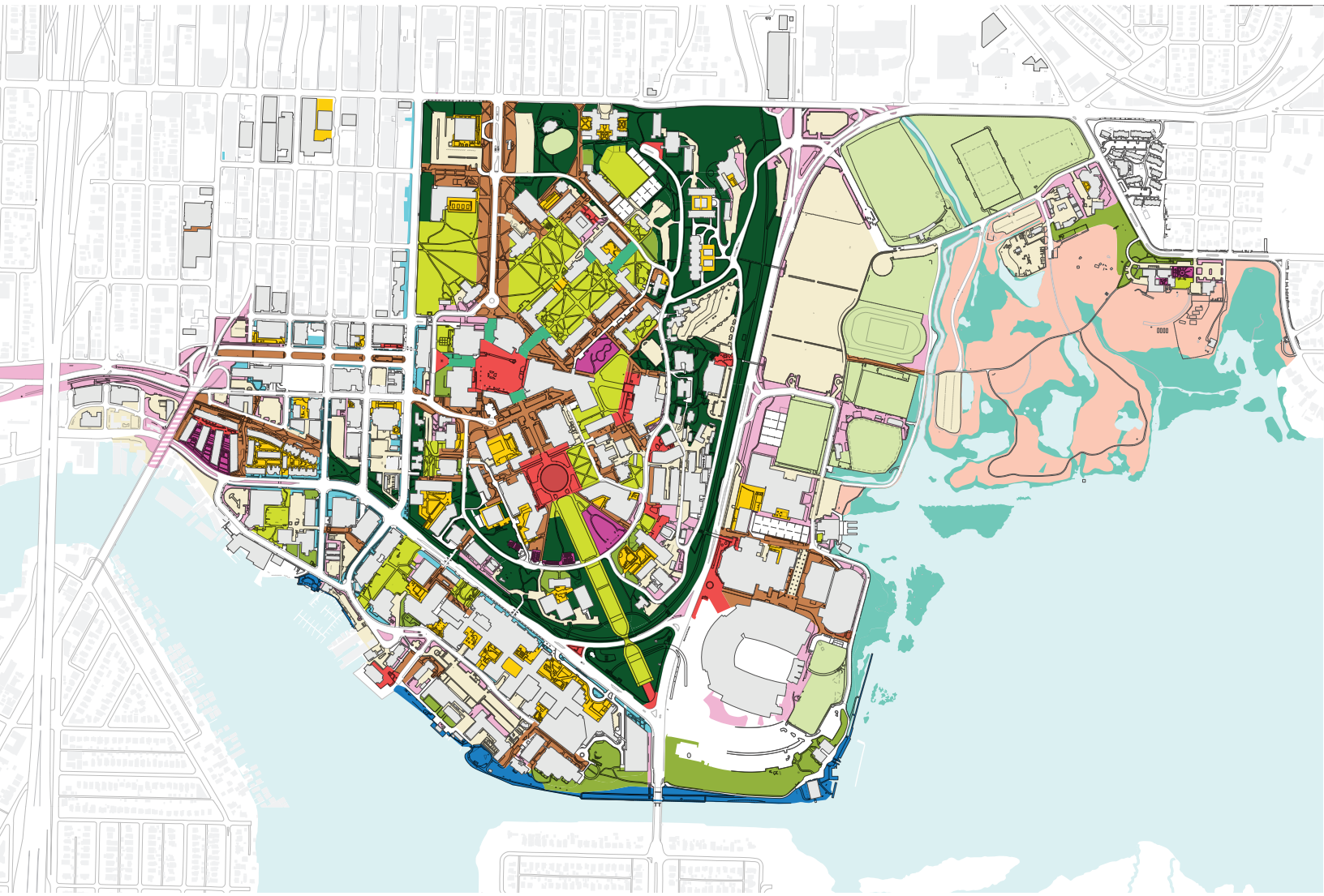
Character

Urban frontage is a varied condition on the UW Camups. In some cases, it can be a vibrant and exciting territory between campus architecture and adjacent urban street, or it can be a relatively banal and inhospitable sidewalk between a roadway and a campus building.

LAKE EDGE WETLAND

Character

These landscapes are UW lands that are too wet to be occupiable, but support rich environments and habitat. The sole example of this mosaic type is the generally unstructured shoreline of the Union Bay Natural Area.



GARDEN

Character

The UW is lucky to have a handful of small-scaled, comfortable, inward-looking, lushly planted gardens. For the amount of space they occupy, gardens give back many fold in psychological refreshment.

SERVICE AND PARKING

Character

Service spaces have been designed to accommodate the needs of cars and trucks for service and loading, as well as places to leave cars and continue on foot.

CAMPUS GREEN

Character

Campus greens are clearly figured landscapes, and amongst the most well known parts of the campus. They are often bounded by architecture or by woodland plantings, as in the case of Rainier Vista, and have either open lawns, or lawn beneath a shading canopy, providing space for studying, casual sports, and informal gatherings. The primary spatial relationship of a campus green is between the ground level and the canopy level so these spaces do not usually have beds or shrubs, except at building edges.

MEADOW

Character

The UW's meadows are large swaths of unmown grasses and plants that allow for circulation. The vast expanse of this system makes it a very visible part of the University's natural habitat.

INFORMAL GREEN

Character

Informal Greens are open, unfigured lawn areas, usually found at the campus periphery, and feel less planned and welcoming, even though they share many spatial characteristics with Campus Greens. These spaces are vulnerable to change because they are unresolved with respect to program and use.

RECREATIONAL FIELDS

Character

Either taking advantage of a relatively flat area, or building one from existing topography, recreational fields are large landscape spaces with very high recreational and social value but little to no ecological value.

COURTYARD / TERRACES

Character

Courtyards and Terraces are relatively small, intimate spaces associated with individual buildings. These are frequently, but not always, part of the entry sequence into a building, and are designed to feel slightly separate from campus circulation, with a gardenesque individuality and intricacy.

PASSAGES

Character

Passages are spaces whose primary purpose is to provide a direct route between destinations. At minimum, these spaces should be accessible, but it is preferable if they are also memorable and enjoyable. spaces.

PLAZA

Character

Plazas are large scale figured spaces, usually defined by surrounding buildings. Typically plazas are mostly paved, and allow free circulation across them rather than through defined pathways. Most of the uses that take place in a plaza do not preclude trees, but they are generally open to the sky, with relatively little shade.

CONSTRUCTED WATERFRONT

Character

The Constructed Waterfront includes structured waterfront access, frequently with concrete edges. This type of landscape is usually low in ecological diversity, but high in other types of value such as recreation, passage, research, and moorings.

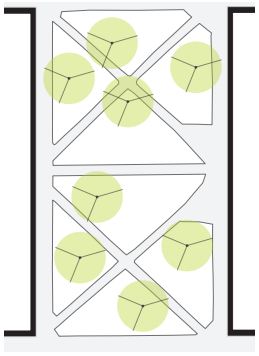
Design Considerations

Trees are used in the landscape to provide a variety of experiences for students, staff, visitors, and faculty as they navigate the campus. Each of the tree design strategies below highlight the experiential quality trees are currently performing from enclosing a space to acting as a landmark in the landscape. These conditions are not limited to a single mosaic, but range a breath of contexts which makes the campus experientially exciting when moving within and between the different neighborhoods. By using these strategies in areas where trees do not exist, it can help connect disparate areas of campus into a seamless and dynamic whole.

Informal

Within many of the lawns of campus, trees are placed into the landscape with no immediate visual order. Denny Lawn and Parrington Lawn are examples of this condition.

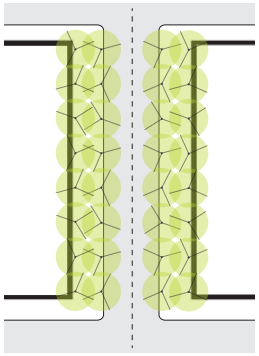
Campus Green, Informal Green



Formal

Allees are used on campus to define ceremonial paths of travel through the campus. They support way finding by helping guide the public into the campus along major vehicle and pedestrian corridors.

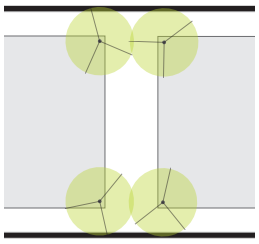
Passage



Frame

Trees can mark the transition between spaces on campus by framing a threshold or vista. Placing two trees at an intersection can help frame important landmarks or mixing zones.

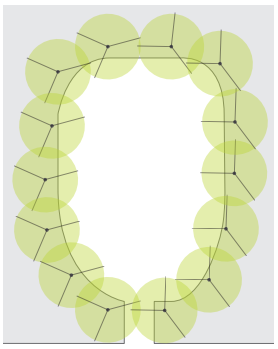
Campus Green, Plaza, Threshold, Garden



Enclosure

Some of the most memorable places on campus like Grieg Garden and Sylvan Grove are enclosed by trees that removes the space from the surrounding context.

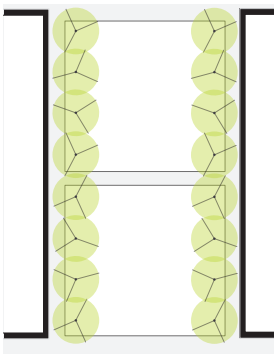
Garden, Courtyard/Terraces



Edge

Trees are commonly used on campus to define the edge of a path, landscape, and open space along with buffering pedestrians from auto infrastructure.

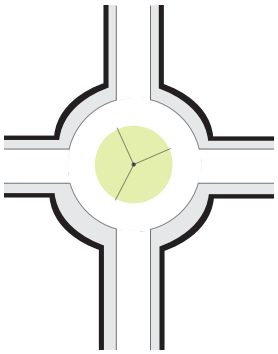
Urban Frontage, Passage, Service and Parking, Campus Green



Landmark

To highlight specific exceptional trees on campus, they have been isolated in the landscape to emphasize their grandeur. These trees require additional management to maintain their vigor.

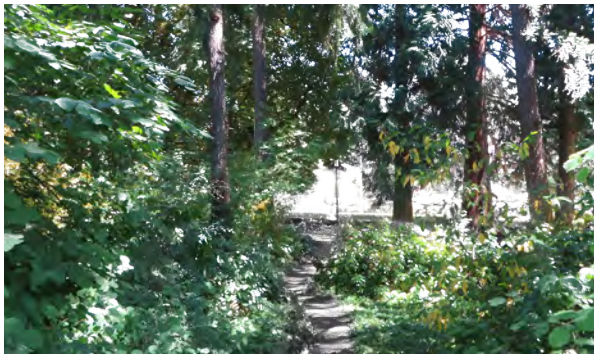
Plaza, Informal Green, Campus Green



Native

Along the edges of campus and within corridors exists dense groves of trees with a robust under-story that have been preserved and maintained to provide examples of native northwest forests.

Woodland Grove, Meadow, Lake Edge Wetland



NEIGHBORHOOD SNAPSHOT

West Campus

Total Area : 70.6 acres (13.7%)
Landscape Area : 14.9 acres (21.1%)
Tree Canopy : 10.7 acres (15.2%)
# of Trees : 1,276 (15.4%)

Central Campus

Total Area : 217.3 acres (42.3%)
Landscape Area : 91.8 acres (42.2%)
Tree Canopy : 68.3 acres (31.4%)
# of Trees : 4,727 (57.2%)

East Campus

Total Area : 161.2 acres (33.9%)
Landscape Area : 27.6 acres (17.1%)
Tree Canopy : 16.3 acres (10.1%)
# of Trees : 1,468 (17.8%)

South Campus

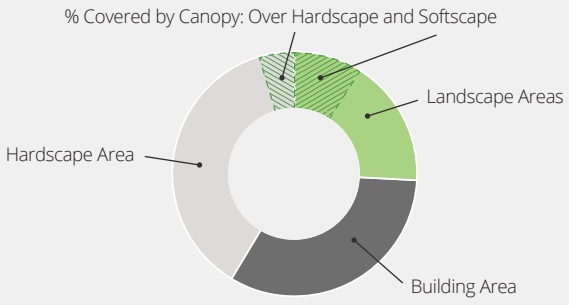
Total Area : 52 acres (10.1%)
Landscape Area : 14 acres (26.9%)
Tree Canopy : 7.4 acres (14.2%)
# of Trees : 798 (9.7%)

Campus Neighborhoods

WEST | SOUTH | CENTRAL | EAST

The University of Washington Seattle campus is made up of four distinct neighborhoods, each comprised of unique functions and aesthetic qualities grounded in their academic relevancy and context. Each zone has clearly defined boundaries that are delineated by steep slopes and major roadways creating strong edges between each neighborhood. This has lead to a campus that has a tremendous range of experiences while also suffering from being disconnected. Central Campus is the quintessential University experience, consisting of the iconic landscapes and architecture. South Campus is predominately covered by the Medical Center and Health Science facilities with valuable waterfront access. West Campus also has access to the waters' edge and is home to student housing and academic facilities. East Campus consists of collegiate athletic uses paired with large parking lots. As unique pieces of the whole, each neighborhood should be integrated into a seamless mesh that is variable yet cohesive.

With each neighborhood having their own unique condition, they require specific goals and strategies based on their nuanced character, function and land use. Analyzing each neighborhood as a whole and then zooming into specific conditions will facilitate the establishment of a strategy that works to identify opportunities and challenges for increasing the canopy cover that emphasizes each neighborhoods primary function. By understanding the relationship between canopy cover, landscaped and hardscaped areas, a canopy goal can be proposed based on the available areas. The neighborhood goals paried with campus wide goals will provide a multi-grain understanding of the campus's urban forest condition along with opportunities for enhancing the experience of the campus by improving its urban forest resource.



LEGEND

Each campus neighborhood has been stratified into their primary land cover types. The tree canopy cover has been evaluated based on the percentage of hardscape and landscape area that is covered by canopy. This provides a snapshot of what exsits while also showing the potential for increased canopy cover in each neighborhood.

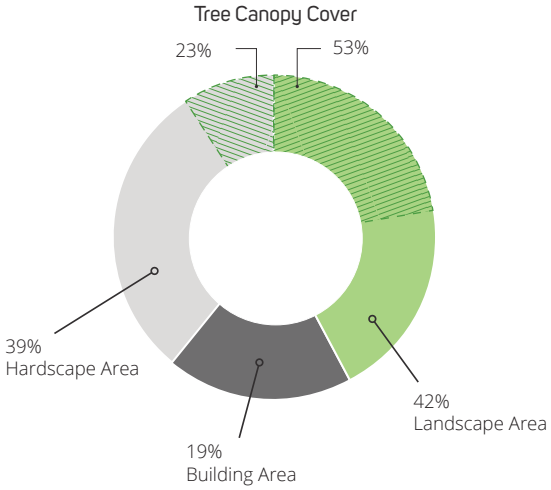
Tree Condition

- Excellent : 89 - 100
- Good : 70 - 89
- Fair : 50 - 69
- Poor : 25 - 49
- Very Poor : 0 - 24

Central Campus

4,727 TREES (57.2%) | 217.3 ACRES (42.3%) | 341 SPECIES

Central Campus is the point of origin for most people visiting the University of Washington Seattle Campus. It has clearly defined landscapes, ranging in size and importance from the Rainier Vista to Memorial Way. This neighborhood is the most vibrant with the highest levels of social life, activities, and diversity of students, staff, and faculty. Central Campus is highly developed with limited space for future development that highlights a need to preserve and enhance the urban forest for its environmental, social, and educational values. The balancing of vegetation and building has been well established in this neighborhood with 42% of the ground plane dedicated to landscaped areas. It is recommended to maintain this condition as central campus evolves to meet the demand for new academic facilities.



Central Campus makes up a little over 40% of the University's total land area with more than half of the total number of trees. The canopy consists of 59% deciduous and 41% conifer trees with approximately 37% of the total being native. With a canopy cover of 31.4% and a tree density of 22.27 per acre, Central Campus has the fullest canopy with the highest density of trees on campus.

Tree Canopy
68.3 acres | 31 %

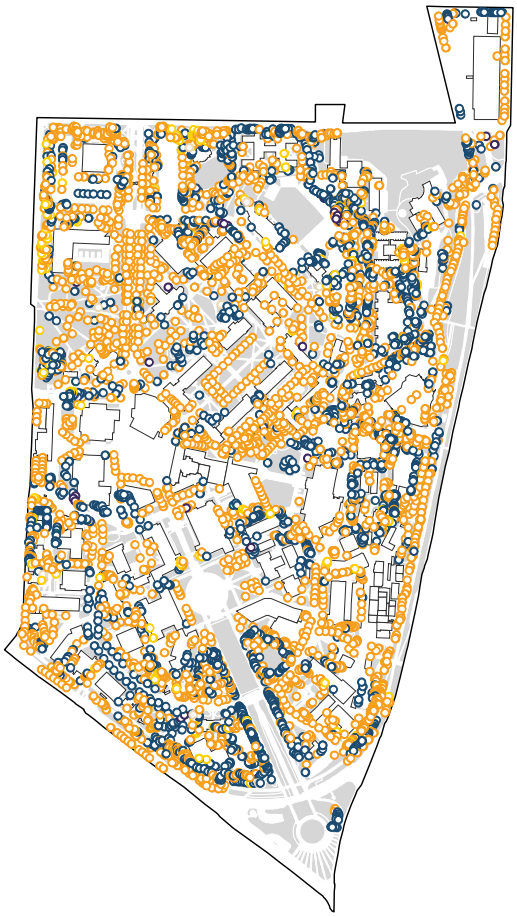
Landscape Area
91.8 acres | 42 %

Building Area
40.7 acres | 19 %

Hardscape Area
84.8 acres | 39 %

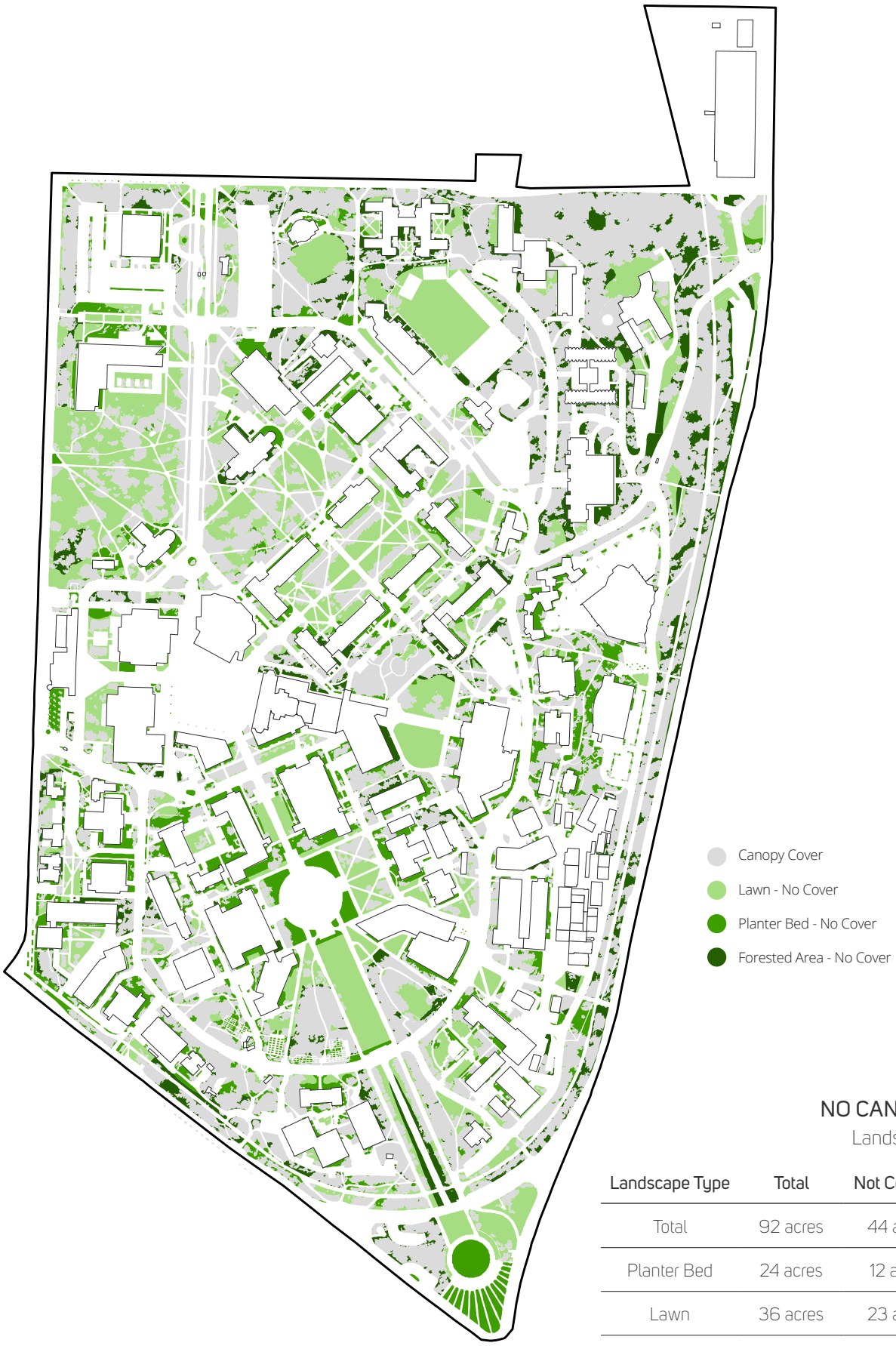
TREE TYPE AND TREE CONDITION

The diversity and density of tree species in Central Campus transforms areas of this neighborhood into nature walks, providing respite from the hectic urban condition, and frames open lawns. The greatest diversity of tree types occurs at the edges of campus where a large volume of future development is planned. Central campus also consists of memorial and iconic landscapes like Memorial Way and the Quad that need to be protected and preserved yet they currently consist of trees that are in fair condition. Fair conditioned trees are scattered across Central Campus while trees in excellent condition are clustered around new development: the HUB, PACCAR, Architecture Hall, and Plant Services. Increasing the diversity of trees while protecting existing trees during construction can help maintain and grow the living lab of trees in Central Campus.



Tree Type	Total	% of Total
Deciduous	2,761	58.4%
Coniferous	1,753	37.1%
Broadleaf Evergreen	171	3.6%
Deciduous Conifer	28	0.6%
Unknown	14	0.3%

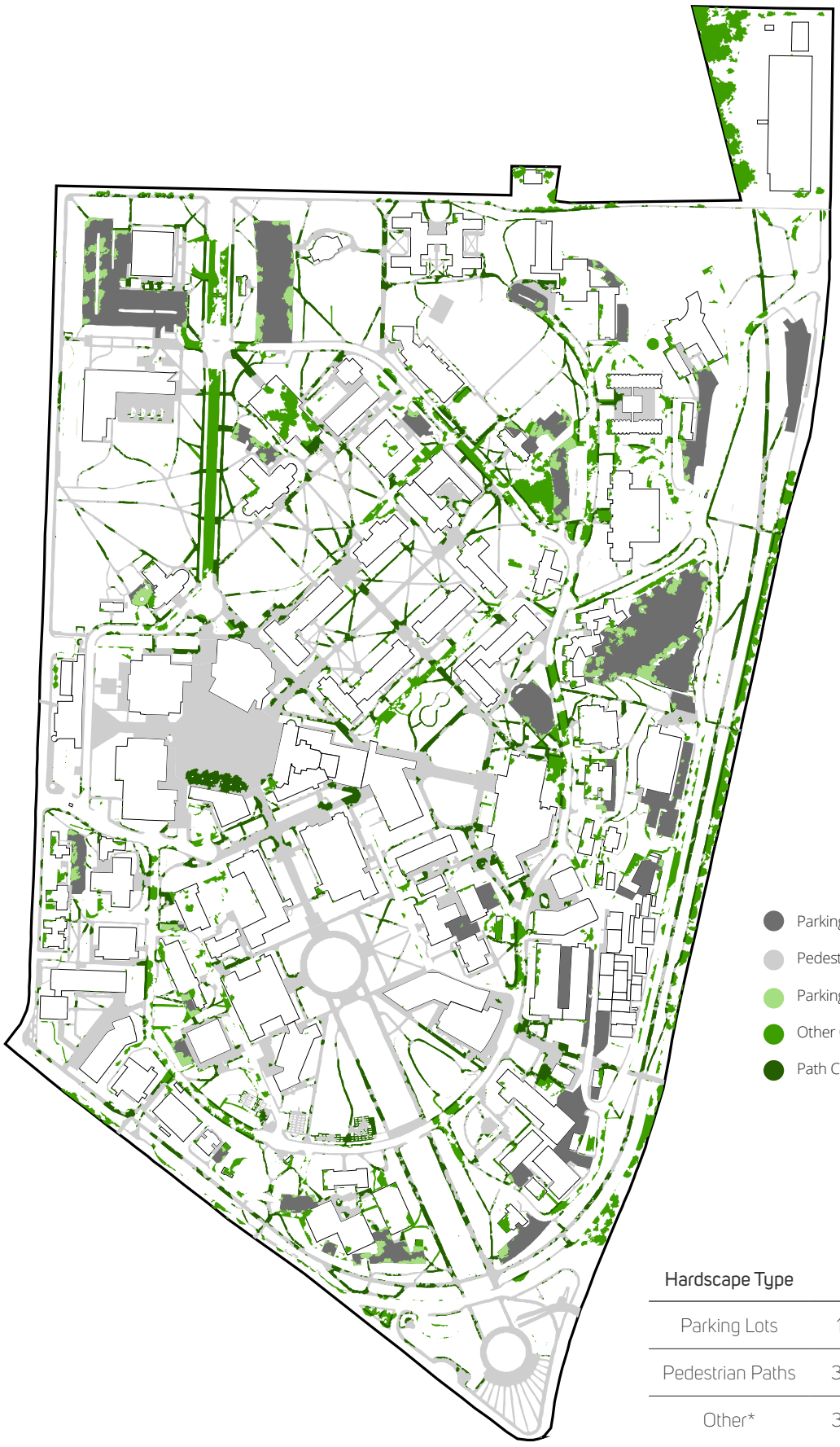
Condition	Total	% of Total
Excellent	296	6.3%
Good	3,311	70%
Fair	1,038	22%
Poor	61	1.3%
Very Poor	21	0.4%



NO CANOPY COVER

Landscape Features

Landscape Type	Total	Not Covered	%
Total	92 acres	44 acres	47%
Planter Bed	24 acres	12 acres	50%
Lawn	36 acres	23 acres	65%
Forested Area	31 acres	8 acres	26%



NO CANOPY COVER

Hardscape Features

Hardscape Type	Total	Not Covered	%
Parking Lots	12 acres	10 acres	83%
Pedestrian Paths	38 acres	29 acres	76%
Other*	35 acres	25 acres	71%

** Does not include buildings*

LAWNS

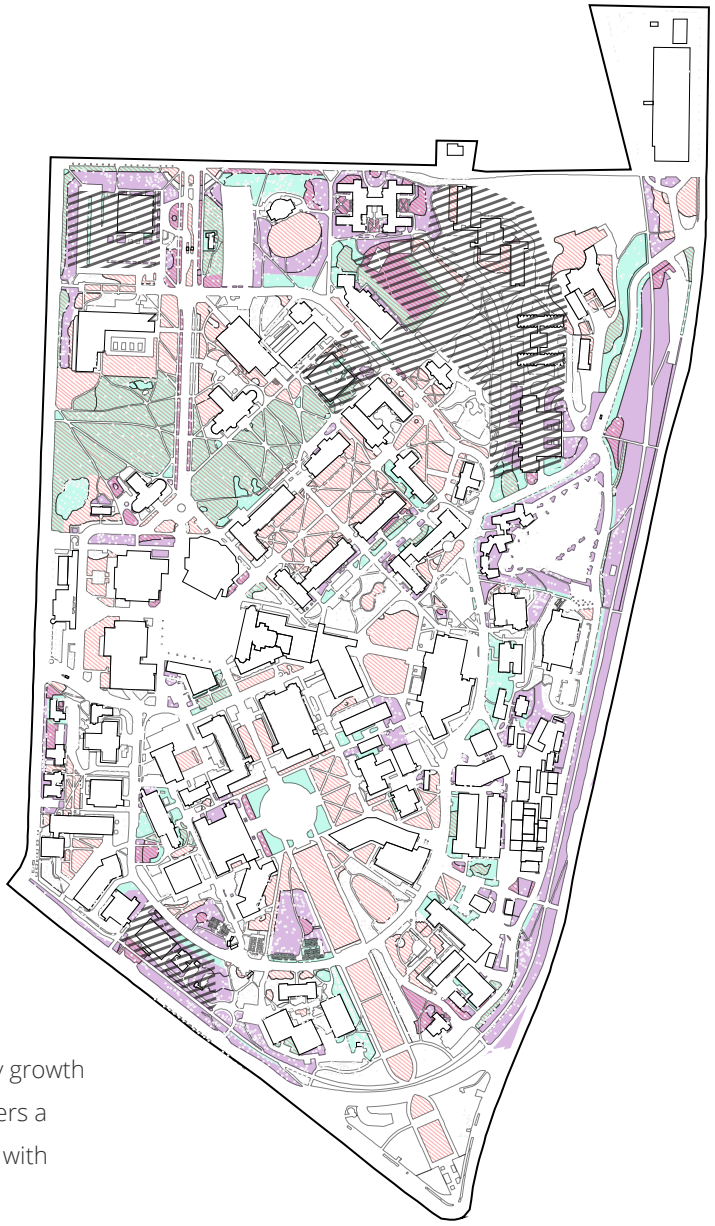
The University has a number of large open lawns with cross-axial paths that speak to the history and evolution of the campus. In some cases, existing trees are aligned along historic paths that no-longer exist giving the trees a random order. Trees play a role as edges, enclosing space, and landmarks. Maintaining the function of the space while providing substantial canopy cover could help organize the lawns into smaller defined spaces with varying micro-climates. Increasing canopy cover needs to be balanced with preserving open lawn for large group events.

DEVELOPMENT

The landscaped areas adjacent to existing surface parking lots and along the edges of Central Campus consist of the densest and maturest grooves on campus. These areas are also the most ideal for development because of their current under-utilization and the lack of developable land. Creative site planning and architectural form making can help protect the mature trees in these areas. Along with protecting existing trees, projects have the opportunity to add to the canopy by adding more trees than the number removed.

IRRIGATION

Irrigation is a critical component for establishing new trees on campus. Not all landscaped areas in Central Campus have automatic irrigation system which limits the University's ability to add new vegetation. Integrating new irrigation systems into the landscape with new development can help expand the areas where additional canopy can be added. Mapping the landscapes that currently lack irrigation on campus will help focus efforts to these areas.



ISSUES AND OPPORTUNITIES

The greatest challenges for adding additional trees in Central Campus are the lack of irrigation and the lack of staff time for manually irrigating. Development is also of concern with there being minimal unoccupied area other than parking lots, lawn, and mature forested areas. Many of the remaining landscapes are iconic to the University and deserve to be maintained as grand open spaces with the potential for adding additional trees. With 44 acres of landscape without canopy cover, there is significant room for canopy growth in Central Campus. The complexity of Central Campus offers a great opportunity for Urban Forestry research associated with development and wildlife habitat to name a few.

ACTION ITEMS

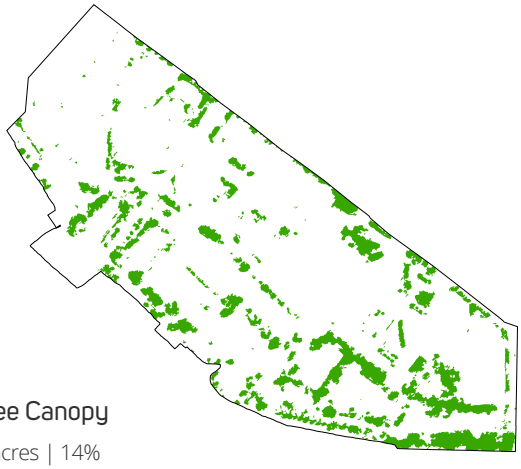
- As development occurs strategically improve adjacent irrigation systems.
- Prioritize landscapes for improvement and characterize aspects that should be preserved.
- Identify areas within central campus where additional trees can be planted.
- Develop a phasing strategy for new tree plantings that leverage unique and established partnerships.
- Work with professors to emphasize the use of the landscape as an education resource.
- Develop outreach materials to showcase restoration projects happening ie. Kincaid Ravine and behind Lewis Hall.
- Create a tree replacement policy for Central Campus that will achieve no net tree canopy loss.
- Explore opportunities associated with adding trees within Red Square.
- Finish surveying trees within Kincaid Ravine and along the Burke Gilman trail.

South Campus

798 TREES (13.5%) | 52 ACRES (10.2%) | 101 SPECIES

The South Campus of UW is dominated by health sciences, with the Medical Center being the major landmark in this neighborhood. The large footprint of the hospital and parking lots, limits the available area where new trees can be planted. With plans to establish new landscapes along the Portage Bay Vista and the waterfront there is an opportunity to significantly increase the health and size of canopy cover in South Campus. Recognizing the limited amount of ground floor space and the visual benefits associated with trees, the University has installed both intensive and extensive green roofs atop existing facilities in this neighorhood. The dense, diverse mosaic of land uses from the water's edge to Central Campus makes establishing a robust, continuous tree canopy challenging.

South Campus currently has the second lowest percentage of canopy cover on campus at 13.4%. This could be due to South Campus having the largest percentage of land area dedicated to buildings on campus . The canopy consists of 1,119 trees (13.52%) covering 67.94 acres (13.4%) of land with 101 unique species. The trees in South Campus are predominately deciduous (80%) with a overall tree density of 16.47 per acre.

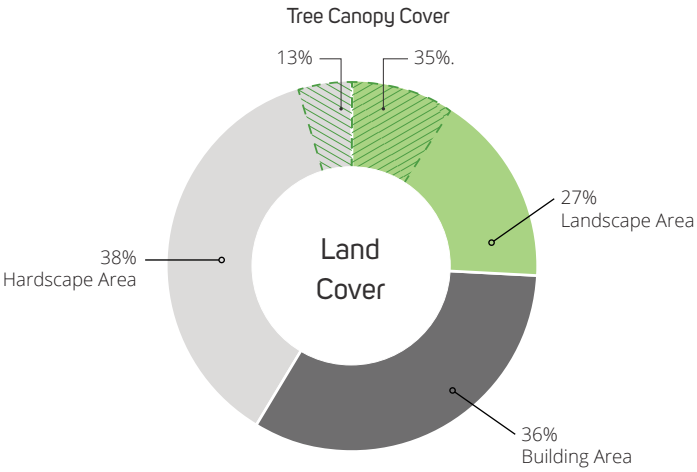


Tree Canopy

7 acres | 14%

Landscape Area

14 acres | 27%



Building Area

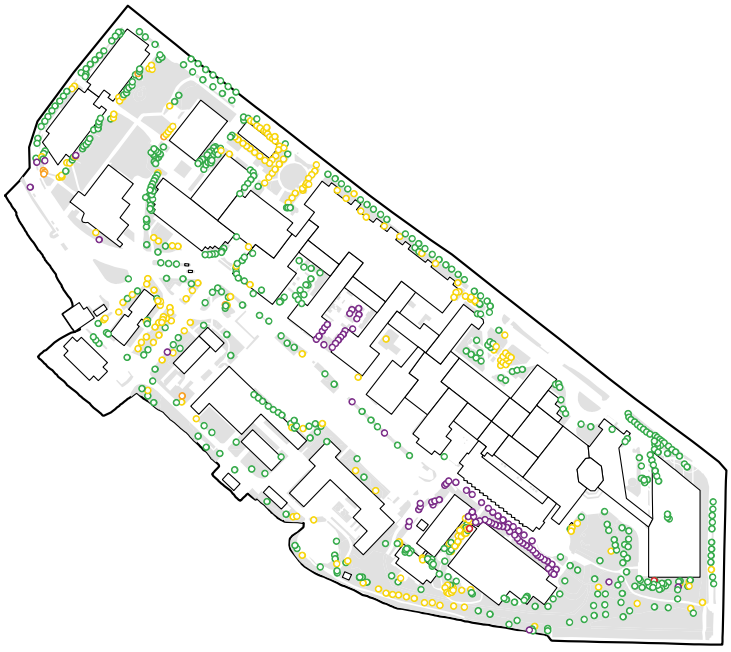
19 acres | 36%

Hardscape Area

20 acres | 38%

TREE TYPE AND TREE CONDITION

With almost a 1:5 ration between coniferous and deciduous trees, South Campus has the least diversity in terms of tree species. The majority of coniferous trees are located around the entrance to the medical center with others sprinkled along building facades and the waterfront. With over 25% of trees being in Fair Condition and clustered togethered, there is a need to better understand the conditions that exist within these areas to develop strategies for improving tree health. The distribution of poor and very poor trees do not follow any pattern, thus may be the result of improper species selection, specimen choice, or installation/maintenance.



Condition	Total	% of Total
Excellent	85	11%
Good	489	61%
Fair	215	27%
Poor	7	1%
Very Poor	2	0.5%

Tree Type	Total	% of Total
Deciduous	633	79%
Coniferous	132	17%
Broadleaf Evergreen	23	3%
Deciduous Conifer	5	0.5%
Unknown	5	0.5%

NO CANOPY COVER

Landscape Features

Landscape Type	Total	Not Covered	%
Total	14 acres	9 acres	65%
Planter Bed	7 acres	4 acres	59%
Lawn	6 acres	4.5 acres	79%
Forested Area	1 acres	.4 acres	37%

NO CANOPY COVER

Hardscape Features

Hardscape Type	Total	Not Covered	%
Parking Lots	2.5 acres	2.4 acres	96%
Pedestrian Paths	7.4 acres	6.3 acres	85%
Other*	10.1 acres	8.9 acres	88%

** Does not include buildings*

UW HOSPITAL / HEALTH SCIENCES

Health Sciences and the University Hospital occupies the majority of land in south campus, limiting the amount of space for surface level landscapes. The hospital has utilized some of its roof surface for landscaping which could be expanded to more areas. Providing a view of nature from patients' rooms and offering vegetated spaces for reflection and respite could aid with patient recover while enhancing the canopy cover in South Campus.

WATERFRONT

The waterfront in south campus has two primary conditions; remnants of the historic UW golf course and an industrial edge, all of which provides an abrupt transition from the land to the water. The industrial edge has little to no vegetation and does not offer opportunities for the public to omce in contact with the water. The vegetated areas consist of large open lawns with allees of trees that once framed the fairways of the University Golf Course until 1947 when it was replaced by the UW School of Medicine.

COURTYARDS & VISTA

In order to provide public exterior open space in South Campus, on structure courtyards have been designed into the architecture to provide needed outdoor vegetated spaces. The function and use of courtyards varies between primary entrances, places for refuge, and visual beauty. Each condition requires different design considerations, but can all benefit from having additional trees planted of varying species to increase the volume, color, and shade within an environment dominated by concrete, steel, asphalt, and brick.

ISSUES & OPPORTUNITIES

South Campus makes up 10% of the campus's total land area, while having 13.5% of the total trees. With a large percentage of trees in Fair condition, there needs to be a strategy for improving them that also begins to create institutional knowledge for tree conditions in this neighborhood and across campus. There is some private ownership along the waterfront in South Campus which limits the university's ability to fully improve its ecological and social condition. With approximately 65% of the total landscape and 96% of parking lots not having any tree canopy, it provides over 11 acres of land that could be planted with trees in the future.

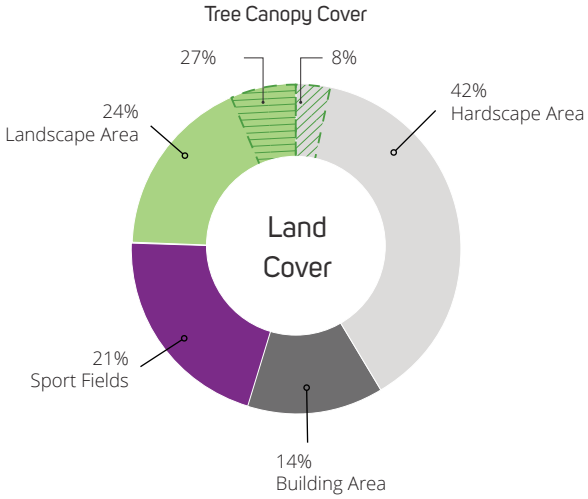
ACTION ITEMS

- Develop green infrastructure standards that emphasizes green roofs across campus with an emphasis on the medical center.
- Create a shoreline restoration plan that protects the shoreline and enhances aquatic habitat for endangered salmon species.
- Celebrate the historic conditions that exist along the waterfront with enhanced open space and strategic water access.
- Strategically use trees to help connect South Campus to other neighborhoods on campus.
- Establish a focused management plan for improving the 26.9% of trees currently in fair condition.
- Emphasize landscaped courtyard development within large buildings to create healing and therapeutic spaces and views.
- Maximize trees within Portage Bay Vista while preserving view.

East Campus

1,468 TREES (17.8%) | 174.3 ACRES (33.9%) | 148 SPECIES

East Campus emphasis is collegiate athletics; sports fields, gyms and stadiums. Accompanying these land uses is a sea of surface parking lots that are designed for the capacity of major sporting and ceremonial events. But as development and transportation systems evolve with the opening of a new light rail station along with improvements to the Burke Gilman Trail, a reduction in parking spaces may be needed in the future. East campus also consists of family-student housing and additional campus facilities along its Eastern edge, making a pedestrian friendly environment between Central Campus and these areas of value to those communities. Between the stadiums and family-student housing is the Union Bay Natural Area which is not included in this analysis because it has yet to be surveyed and is not managed by the University of Washington's Grounds staff, but does provide significant ecological, educational, and cultural value to the University.



East Campus has the lowest canopy cover percentage out of the four neighborhoods due of hardscape, buildings, and sports fields dominating the environment. With only 8% of the hardscape covered by canopy, additional plantings would be welcomed in these areas. The parking area behind HEC Edmundson Pavilion provides a good example to how trees can be integrated into parking lots.

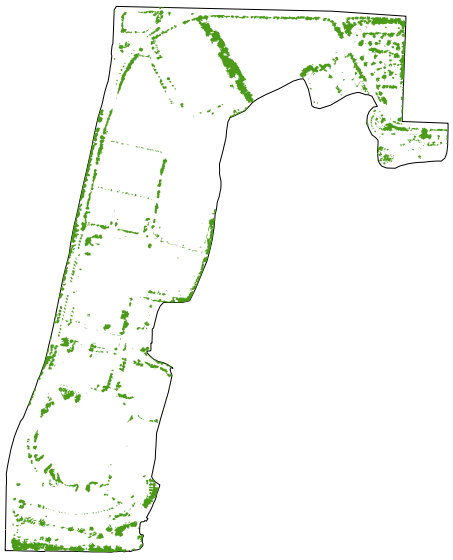
Tree Canopy
17.2 acres | 10%

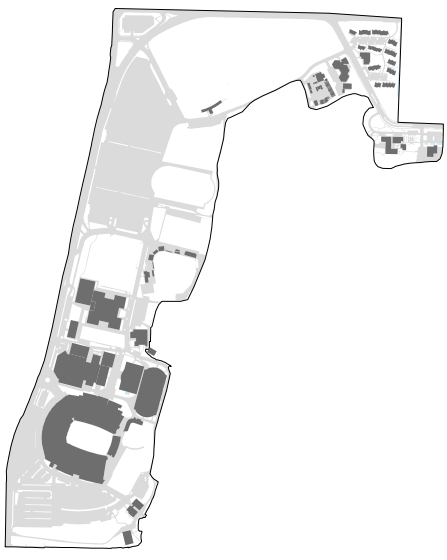
Landscape Area
42.3 acres | 24%

Sport Fields
36 acres | 21%

Building Area
23.2 acres | 13%

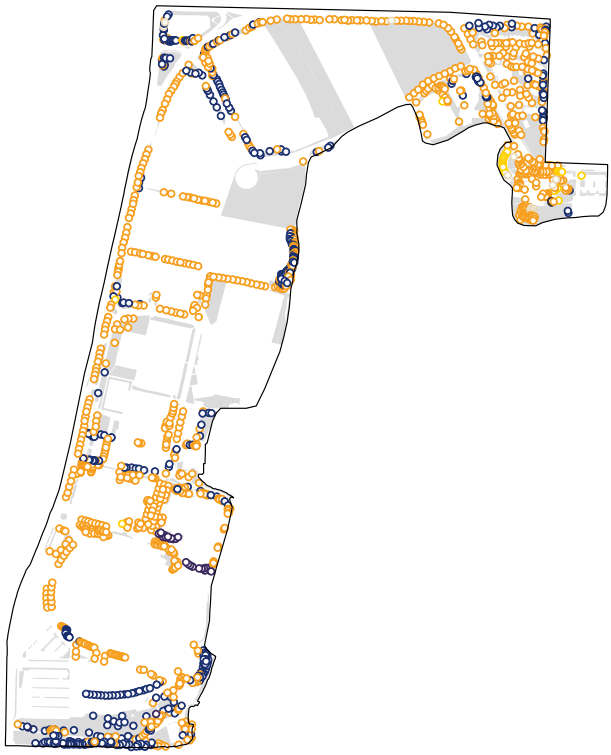
Hardscape Area
72.5 acres | 42%

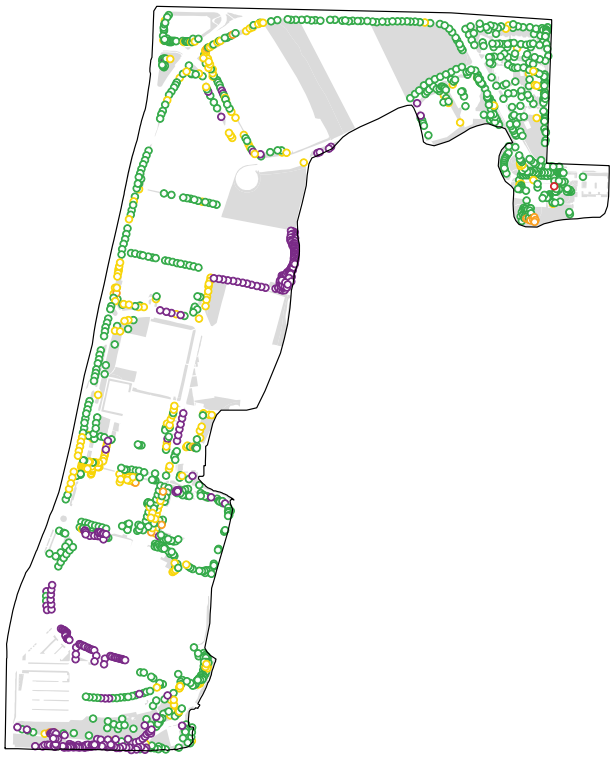




TREE TYPE & TREE CONDITION

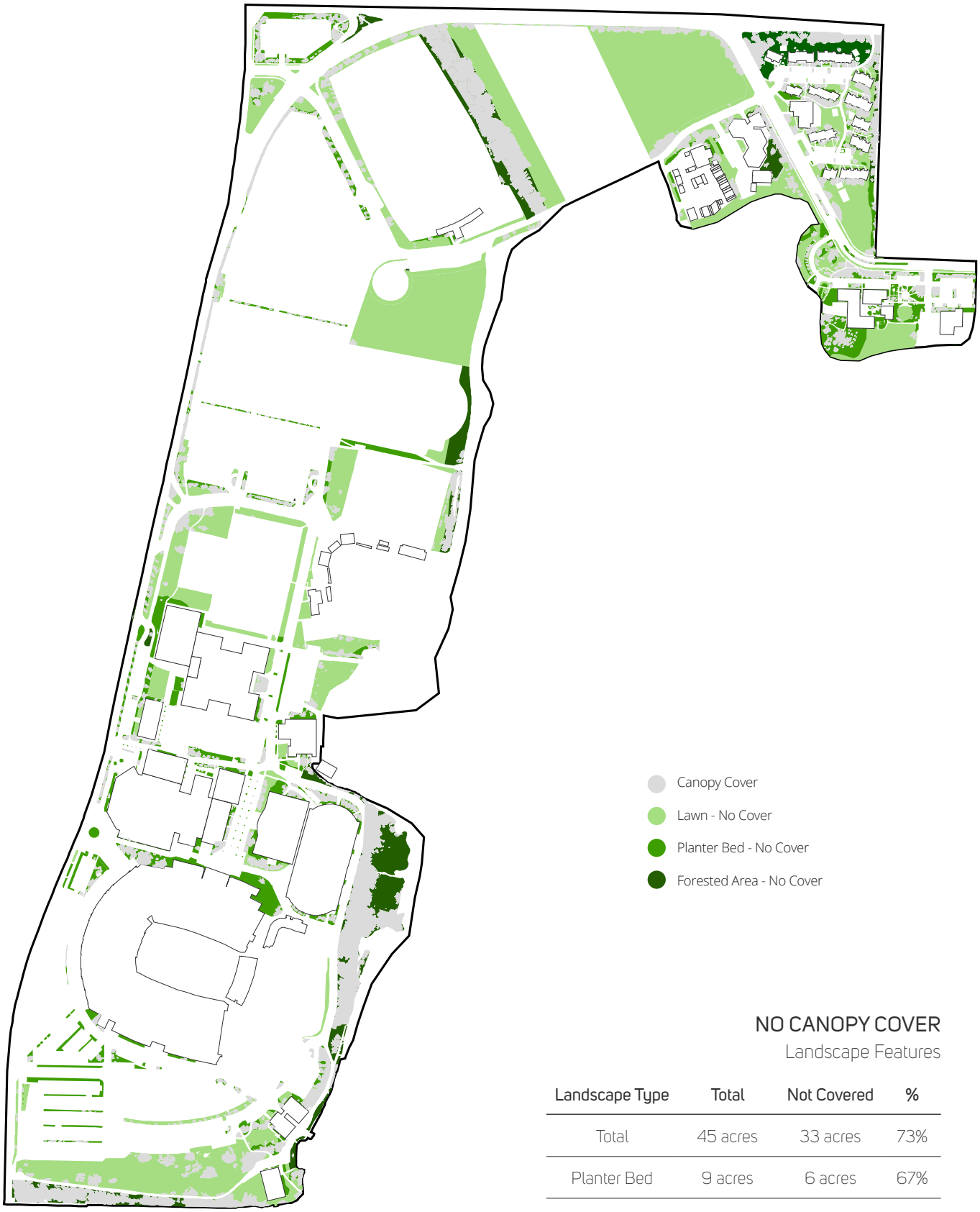
East Campus's canopy consist of 69% deciduous trees with 35% of the total trees being native at a density of 8.16 trees per acre. Within the existing landscaped areas there are large open areas where trees could be easily added. One challenge to increasing canopy cover in this zone is the conflict between trees, sport fields, parking stalls, and vehicular circulation which are paramount to the function of East Campus. The condition and density of trees vary between the urban edge, new development, and student housing. The urban edge has a significant number of trees in fair condition while a large percentage of trees in good condition are located around the student housing, student farm, and Center for Urban Horticulture. Like other neighborhoods, the majority of excellent trees are associated with recent development projects. With this neighborhood also having access to the water, its edges could be greatly improved by softening them with additional plantings.





Tree Type	Total	% of Total
Deciduous	992	67.6%
Coniferous	398	27.1%
Broadleaf Evergreen	34	2.3%
Deciduous Conifer	26	1.8%
Unknown	14	1.0%
Palm	4	0.3%

Condition	Total	% of Total
Excellent	295	20.3%
Good	910	62.6%
Fair	231	15.9%
Poor	17	1.2%
Very Poor	1	0.1%



NO CANOPY COVER

Landscape Features

Landscape Type	Total	Not Covered	%
Total	45 acres	33 acres	73%
Planter Bed	9 acres	6 acres	67%
Lawn	28 acres	24 acres	86%
Forested Area	8 acres	3 acres	38%

NO CANOPY COVER

Hardscape Features

Hardscape Type	Total	Not Covered	%
Parking Lots	30.4 acres	29.8 acres	98%
Pedestrian Paths	12.4 acres	10.8 acres	87%
Other*	29.7 acres	25.2 acres	85%

** Does not include buildings*

HARDSCAPE

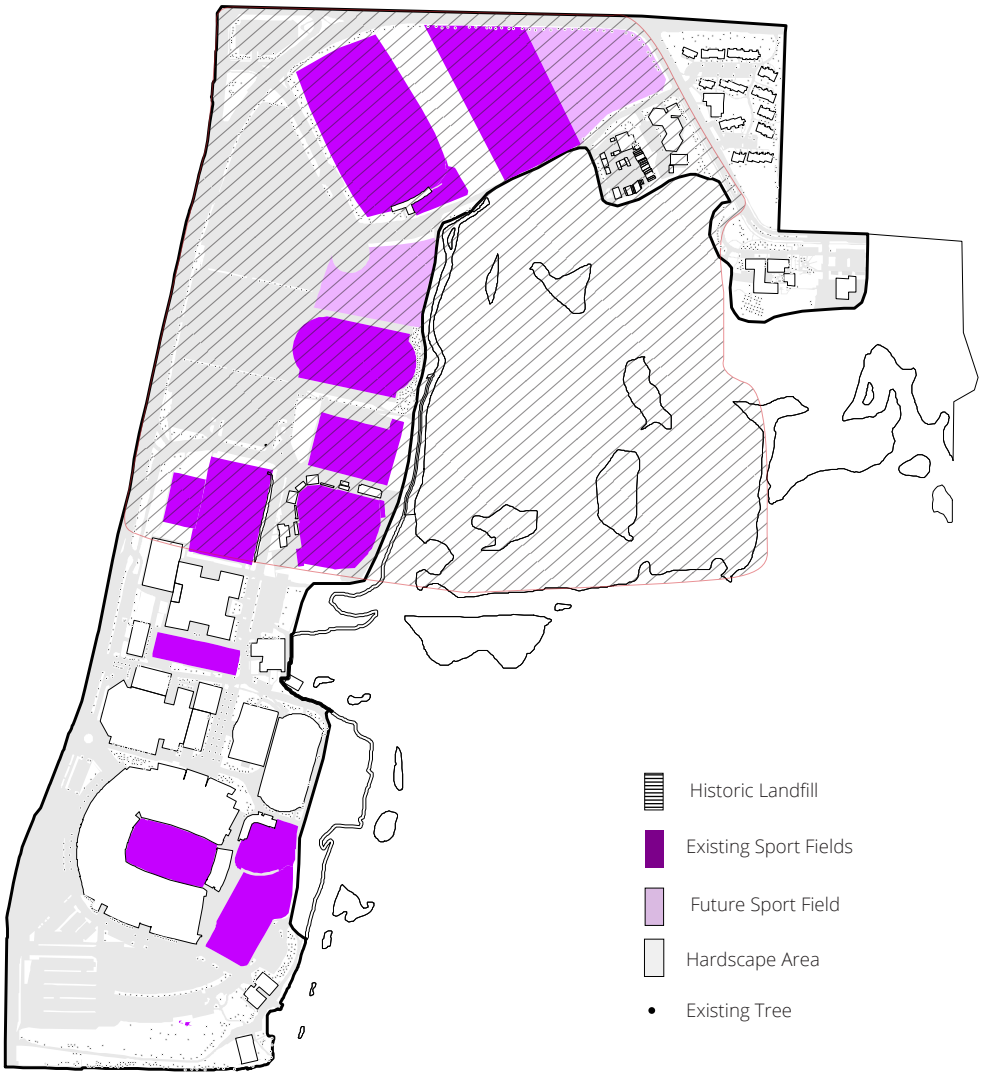
The amount of terrain covered in hardscape creates an exposed and harsh environment throughout the year making it an unenjoyable place to be and move through. With the addition of the new light Stadium Station, there will be significantly more people walking through this area on their way to U. Village and campus, so providing circulation that is buffered from cars will need to be improved. Placing trees within this landscape provides a strong contrast to the asphalt that could aid with wayfinding.

SPORT FIELDS

Collegiate athletics are a critical part of the University of Washington's identity. They require a broad open space for each sporting activity, seating, and operational needs. The requirements of these facilities limits the siting of trees within stadiums, courts, or fields, but could be utilized around each facility to help block the wind and sun providing a more pleasant environment for viewers and participants.

HISTORIC LANDFILL

Historically this area was used as a municipal landfill that was closed and capped in 1971. Drainage and settlement issues can be seen while walking through East Campus, making the addition of trees complex. Today, a Montlake Landfill Project Guide has been developed to define what is possible in the landfill area by defining allowable maintenance and construction activities. Despite this challenge, E-1 parking lot, the driving range, and undeveloped sports offer open space for new tree plantings.



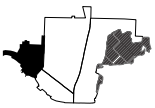
ISSUES & OPPORTUNITIES

Integrating trees into the parking lots, stadiums, and sport fields provides the best opportunity for increasing canopy cover in East Campus considering that 98% of the hardscape has no canopy cover. Strategic tree plantings could help connect East Campus to adjacent neighborhoods by highlighting points of access and street crossings. Montlake Boulevard is a strong barrier to campus that could also benefit from additional tree plantings along with the widening of the sidewalk. The presence of the historic landfill makes it challenging and expensive for adding new features at any scale. With the predominate use being athletics and sport fields, there needs to be strategies developed for how to maximize canopy cover associated with these land uses.

ACTION ITEMS

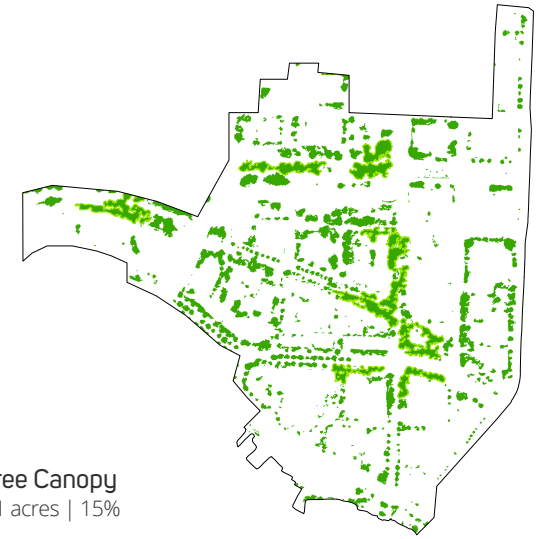
- Explore creative strategies for increasing tree canopy cover in and around stadiums and parking lots.
- Work with the Center for Urban Horticulture on establishing a research focus in Urban Forestry practices.
- Use trees as a wayfinding tool to promote a stronger connection between UBNA, U. Village, lightrail station, CUH, and the stadiums.
- Utilize the historic dump condition as an opportunity for research associated with adding and maintaining landscape in this unique environment,
- Extend the UBNA's natural condition into adjacent areas to expand and leverage environmental services.
- Complete a tree survey of the Union Bay Natural Area (UBNA).

West Campus

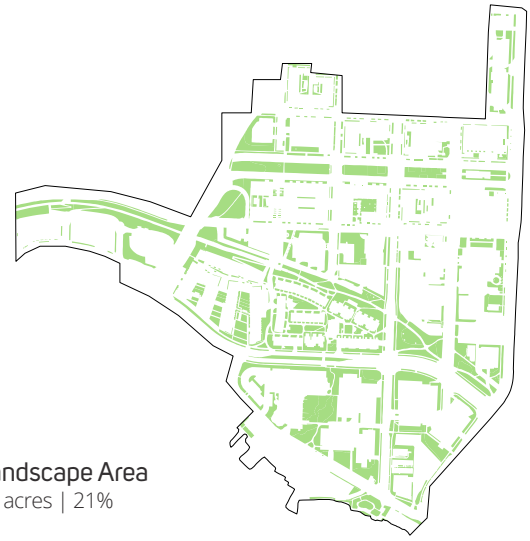


1276 TREES (%) | 70.6 ACRES (13.9%) | 155 SPECIES

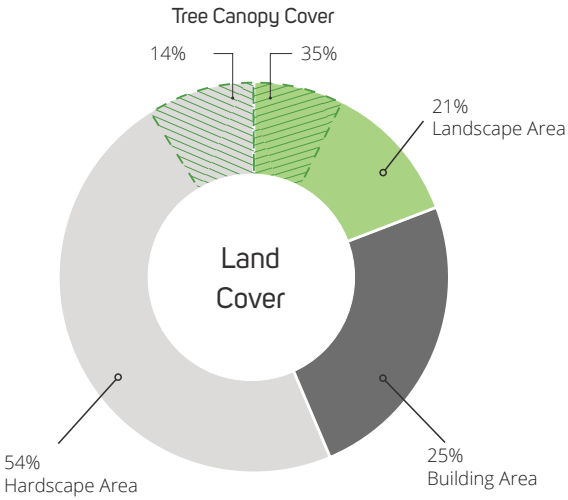
West Campus is characterized by its integration into the urban fabric of the University District with the primary land uses being shared between student housing and educational facilities. The scale of buildings range from one to 6 stories, each possessing few landscape moments. Instead, West Campus is spotted with small semi-public courtyards and terraces that are part of the architecture. Trees are being used in West Campus to line streets, buffer buildings from the sidewalk, and as path edges. Landscapes moments of note are the plaza in-front of Elm Hall, Mercer Court Garden Terraces, Burke Gilman Trail, Fishery Sciences wetland garden, and Sakuma Park. Each space showcases the diversity of environments that are accessible to students, staff and visitors. The streetscape and design of buildings plays the biggest role in establishing a complex forest canopy in this zone, but is challenging due to existing conditions that are not ideal for new plantings. While the Campus Parkway median offers a great opportunity for additional tree plantings.



Tree Canopy
11 acres | 15%



Landscape Area
15 acres | 21%



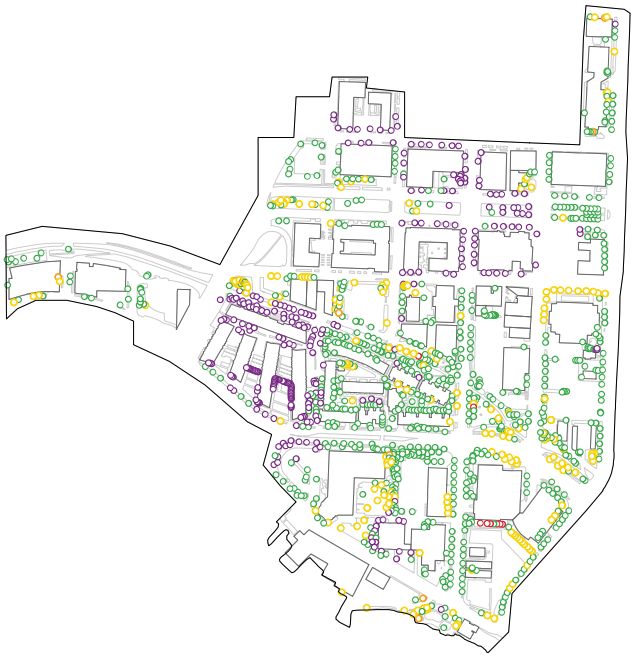
Building Area
18 acres | 25%

Hardscape Area
38 acres | 54%

TREE TYPE & TREE CONDITION

The diversity of tree species in West Campus is high with 155 unique varieties that are mostly in fair to excellent condition. With the large amount of recent development in West Campus, many of the trees within this neighborhood are young and have been given an initial condition rating of excellent. The few trees that have a poor or very poor condition rating are predominately broadleaf evergreens (Acacia melanoxylon) located on the south side of the west campus parking garage. Coniferous trees are scattered across west campus in low densities with the majority being along the Burke Gilman Trail. Conifers are most commonly sited directly in front of building facades or within a grove of similar aged trees.

Tree Type	Total	% of Total
Deciduous	1,031	80.8%
Coniferous	173	13.6%
Broadleaf Evergreen	54	4.2%
Deciduous Conifer	9	0.7%
Unknown	7	0.6%
Palm	2	0.2%



Condition	Total	% of Total
Excellent	286	22.4%
Good	774	60.7%
Fair	200	15.6%
Poor	7	0.6%
Very Poor	9	0.7%

NO CANOPY COVER

Landscape Features

Landscape Type	Total	Not Covered	%
Total	15 acres	10 acres	65%
Planter Bed	8 acres	5 acres	63%
Lawn	4 acres	3 acres	75%
Forested Area	3 acres	1.5 acres	50%

NO CANOPY COVER

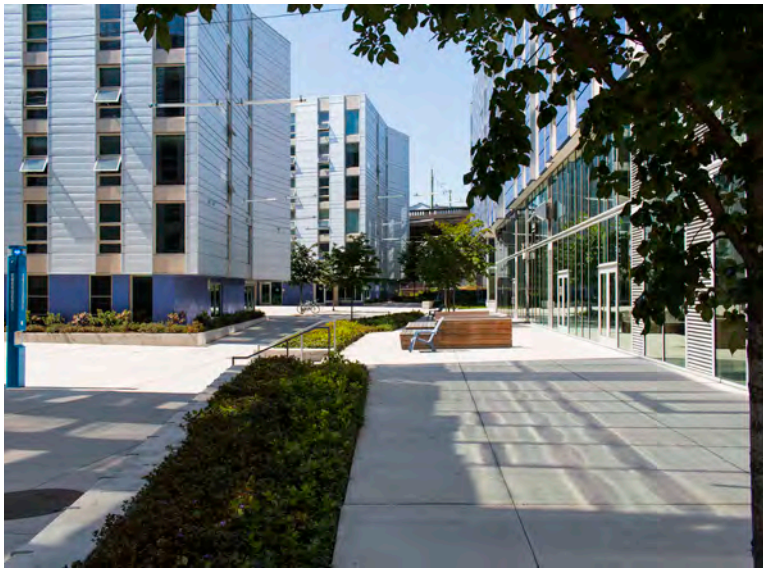
Hardscape Features

Hardscape Type	Total	Not Covered	%
Parking Lots	5.4 acres	5.2 acres	96%
Pedestrian Paths	9.3 acres	7.5 acres	76%
Other*	23.3 acres	19.9 acres	85%

** Does not include buildings*

STREET CANOPY

West Campus has a diverse urban edge, with varing sidewalk and road widths. A full range of canopy cover volumes can be experienced walking in West Campus from complete cover to fully exposed. The challenge of not having enough space along the sidewalk for street trees is one issue that is componded by the careful negotiation that is required with below and above-grade utility infrastructure.



WEST CAMPUS HOUSING / FUTURE DEVELOPMENT

A large percentage of West Campus is dedicated to student housing. With each new dorm, new semi-public courtyard spaces are integrated into the architecture. Within these courtyard spaces, trees should be leveraged to provide pleasing environments that blur the boundary between the exterior and interior. The proper placement and density of trees within these environments should be a major topic of discussion during the design process.

WATERFRONT

The West Campus waterfront is evolving to provide greater public access and improve the environmental quality of the shoreline. As new development occurs along and near the waterfront, protecting the shoreline with trees while providing access to the waters edge needs to be balanced. The strategic use of trees throughout West Campus could help guide the public to the water and aid with integrating the waterfront into adjacent Campus neighborhoods.

ISSUES & OPPORTUNITIES

The density of buildings within the existing urban grid makes finding places to add trees challenging. As new development occurs building footprints should be designed to preserve existing trees while providing additional space for new landscapes. Identifying gaps within the existing urban forest along street edges can be areas of focus for increasing the diversity of trees in West Campus. With a new park under development along the waterfront, it offers the chance to enhance the waters edge for salmon and other wildlife while growing the forest canopy cover into West Campus from the waters edge. With 10 acres of landscape and 5.2 acres of parking without canopy cover, there is an significant opportunity for increasing tree canopy cover.

ACTION ITEMS

- Conduct a more detailed analysis of existing sidewalk conditions to identify specific issues and opportunities for tree plantings along the street edge.
- Prioritize Campus Parkway's median as a future design project that adds both public space and canopy cover to the space.
- Work with the city on enhancing the environmental performance of the streetscape.
- Use trees along proposed green streets to connect West, Central and South Campus to the waterfront and to one another.
- Build upon the implementation of a Waterfront Park and the West Campus Development Proposals to enhance the shoreline into a high functioning ecological zone.

Neighborhood Canopy Goals

Proper and strategic tree selection is vital when working towards a specific canopy goal. Each tree has its own dimensions that reflect the overall shape of the tree from pyramidal to columnar. Choosing trees that have a wide mature canopy width can greatly reduce the number of trees needed to achieve canopy goals for each campus neighborhood and the campus overall. Canopy Goals for each of the campus neighborhoods were derived by comparing the results of the analysis below with the available land in each campus neighborhood for new plantings. Integrating this type of quantitative thinking during the planting design phase of a project could help with projecting potential canopy volumes over time.

Canopy Diameter (ft)	Area per tree (sq ft)	# of trees per acre
5	*20*	*2,218*
10	*79*	*555*
15	*177*	*246*
20	*314*	*139*
25	*491*	*89*
30	*707*	*62*
35	*962*	*45*
40	*1,257*	*35*
45	*1,590*	*27*
50	*1,963*	*22*
55	*2,376*	*18*
60	*2,827*	*15*
65	*3,318*	*13*
70	*3,848*	*11*
75	*4,418*	*10*
80	*5,027*	*9*
90	*6,362*	*7*
100	*7,854*	*6*

Metasequoia glyptostrobodies **20'**

Circidiphyllum japonicum **40'**

Juglans nigra **70'**

10 ACRE INCREASE IN CANOPY COVER BY **2037**

NEIGHBORHOOD	CANOPY GOALS		ADDITIONAL TREES PER YEAR	
CENTRAL CAMPUS	Existing Canopy Cover :	31% (68.3 acres)	30' DBH :	20 trees per year
	Addition Canopy Cover :	6.8 acres	45' DBH :	9 trees per year
	Canopy Cover Goal :	**34% (75.1 acres)**	60' DBH :	5 trees per year
SOUTH CAMPUS	Existing Canopy Cover :	14% (7 acres)	30' DBH :	2 trees per year
	Addition Canopy Cover :	0.7 acres	45' DBH :	0.9 trees per year
	Canopy Cover Goal :	**15.4% (7.7 acres)**	60' DBH :	0.5 trees per year
WEST CAMPUS	Existing Canopy Cover :	15% (11 acres)	30' DBH :	3 trees per year
	Addition Canopy Cover :	1.1 acres	45' DBH :	1.4 trees per year
	Canopy Cover Goal :	**16.5% (12.1 acres)**	60' DBH :	0.8 trees per year
EAST CAMPUS	Existing Canopy Cover :	10% (17.2 acres)	30' DBH :	5 trees per year
	Addition Canopy Cover :	1.7 acres	45' DBH :	2.2 trees per year
	Canopy Cover Goal :	**11% (18.9 acres)**	60' DBH :	1.2 trees per year
TOTAL	Existing Canopy Cover :	20.9% (103.5 acres)	30' DBH :	30 trees per year
	Addition Canopy Cover :	10.3 acres	45' DBH :	13 trees per year
	Canopy Cover Goal :	**23% (113.8 acres)**	60' DBH :	7.5 trees per year

The University of Washington's Seattle Campus is a dynamic landscape constantly changing as structures and landscapes are added, removed, and upgraded. Weather also plays an important role; wind, lightening, and extreme hot and cold are also causing the landscape to evolve in both a positive and negative direction. These conditions make achieving a static goal difficult, so in order to maintain and go beyond the city's Institution Canopy Goal of 20% the university has established a goal of 2.1% (10 acre) increase in canopy cover by 2037. In order to achieve this goal, the type and sizes of trees being removed and added need to be considered. Achieving increases in each neighborhood can be accomplished by having a net increase of 8 - 30 trees per year depending on the mature canopy volume of the trees planted. In addition to adding new trees where none currently exists, there also needs to be a tree replacement policy established that requires new projects to match or add to the tree canopy that previously existed on the site. In order to monitor the progress of this goal, the University will need to maintain an up-to-date GIS tree database with an updated campus lidar scan to track and better align management and operations processes with changes to the University's Urban Forest.

Campus Wide Strategy

The urban forest is constantly changing and evolving making accurate monitoring critical for understanding how the urban forest is changing. In addition to monitoring, strategic outreach and partnerships can help create a greater awareness of the resource that the University has along with growing the educational knowledge within the profession.

Standardize Lidar Scan Schedule

If the university wants to accurately tract the evolution of its tree canopy, having periodic lidar scans is of utmost importance. As development continues to occur on campus it will be of value to monitor how it is impacting the Urban Forest and to see how the canopy is changing over time.

TASKS

1. Contact in-house staff and professors who have Lidar Scanning equipment and are experienced with conducting large surveys.
2. Identify the cost for having it completed by a consultant.
3. Develop a time-line for campus wide scanning frequency.
4. Explore different opportunities for scanning at different scales.
5. Establish a methodology for conducting Lidar Scans of Campus.

BENEFITS

1. Track tree canopy goals
2. Provides an updated 3d point cloud of campus that can be translated into accurate 3d models
3. Supports cross disciplinary and interdepartmental partnerships.
4. Can be used for campus development needs.

Maintain an up-to-date GIS Tree Database

The University began a process to survey all of the trees on campus resulting in approximately 85% of the trees being documented in a database. Since then substantial construction has taken place on campus changing the forest's structure on campus. Completing the survey and having a methodology to keep the database up-to-date will allow the University to monitor how the urban forest is changing on a tree-by-tree basis.

TASKS

1. Identify the cost for completing tree surveying in non-surveyed areas.
2. Work with the campus arborist and campus landscape architect on identifying the needs of the existing tree database.
3. Define a methodology for updating the tree database when projects on campus occur.
4. Identify different funding sources for completing these tasks.
5. Complete a comprehensive update to the tree database.
6. Explore the value of aligning UW's tree database with iTrees standard.

BENEFITS

1. Used to identify existing trees located within the limit of work of construction sites.
2. Allows the university to track the changing diversity, age, and health of trees on campus.
3. Can be provided to the city to be used with their online tree maps.
4. With iTree formatted data, environmental value can be quantified.

Increase the diversity of trees on campus

In establishing a resilient urban forest, a diversity of trees in age, type, and size should be intermixed throughout campus. This will help protect the University's urban forest from large infestations and massive tree death. Having greater diversity on campus will emphasize the forest as a learning resource for students, staff, guest, and professors.

TASKS

1. Develop standards for planting new trees on campus.
2. Work with grounds staff to identify locations on campus where new trees can be planted.
3. Create a planting palette for campus.
4. Create a Replacement Plan for aging and unhealthy trees on campus.
5. Strengthen the discussion related to tree plantings during the design process of projects.
6. Identify funding sources to plant additional trees on campus.
7. Build upon the successes of student lead restoration projects to increase their occurance on campus.
8. Develop a tree replacement policy for trees removed due to construction.

BENEFITS

1. Helps build a resilient urban landscape
2. Builds upon the University's goal of turning the landscape into a "Living Laboratory"
3. Strengthens the cultural value that the forest adds to the University.
4. Enhances wildlife habitat on campus
5. Different tree types can be leveraged for their environmental services resulting in cost savings.

Improve the health of trees on campus

The university's forest could benefit from management that improves the health of each tree. Having a strategy for improving the health of existing trees can help minimize costs associated with tree removal, damage caused by unmaintained trees, and maintenance.

TASKS

1. Identify all the trees on campus that are currently in fair, poor and very poor health.
2. Conduct an evaluation of the different site conditions and management associated with trees in poor health.
3. Create a series of BMP's that define steps towards improving tree condition.
4. Define lightning protection standards for high value trees on campus.
5. Develop a means for conducting additional tree maintenance on unhealthy trees.
6. Monitor new tree plantings on campus to identify issues with specific sites and conditions.
7. Develop a weed removal plan to enhance the environmental quality where trees can thrive.
8. Prescribe a strategy for protecting trees from deadly bugs and disease.
9. Explore project opportunities with the Green Seattle Partnership, Campus Sustainability Fund, and EarthCorps.

BENEFITS

1. Provides the public with Northwest specimen trees.
2. Helps protect the cultural value of trees on campus.
3. Helps to minimize maintenance and operation costs.

Align University tree policies with the city's

Working with city of Seattle to align goals and policies could benefit both parties through information sharing and support. The city of Seattle has a history of promoting urban forestry so by working closely with them the university can benefit from their insight into challenges and opportunities associated with Urban Forestry.

TASKS

1. Establish a partnership with the city to share information and tools.
2. Coordinate with the city for the university to be part of existing urban forestry meetings or establish a new group focused on this effort.
3. Work with the city on testing innovative permitting processes associated with "Exceptional Tree" policy.
4. Develop opportunities for joint educational events in the classroom and/or to the public.
5. Collaborate to define Urban Forestry research topics of interest that are of value to both parties.

BENEFITS

1. Builds upon the strong relationship between the city and the University.
2. Has the potential to expedite permitting processes related to "exceptional trees."
3. Grows institutional knowledge associated with urban forestry.
4. Standardizes University's urban forestry language to match the city's

Establish an academic focus in Urban Forestry

In order to grow the knowledge base of urban forestry there needs to be an academic focus in the field to support research. The University has an academic program in Forestry and a Center for Urban Horticulture yet does not have a focus in urban forestry.

TASKS

1. Identify professors that have an interest in the topic Urban Forestry.
2. Talk with local urban forestry managers about educational needs and opportunities.
3. Meet with academic departments that focus on the natural environment about administering the program.
4. Work with the Center of Urban Horticulture on establishing an urban forestry focus.
5. Collect support from the academic and professional community.
6. Identify opportunities for funding the creation of a new program.
7. Research the of the profession and identify gaps in current course work.

BENEFITS

1. Grows the academic options available to students.
2. Promotes additional job opportunities for students during and post school.
3. Builds upon literature relavent to urban forestry.
4. Establishes an in-house resource for urban forestry researchers.
5. Has the potential to provide support to the campus arborist.

Increase awareness of UW's urban forestry activities & resources

The urban forestry program has implemented numerous activities to strengthen the value of the Urban Forest to the public that could benefit from greater awareness. Information associated with the Brockman Tree Tour, wood salvage program, memorial tree program, and student lead restoration projects could be centrally showcased online to promote greater recognition and support.

TASKS

1. Identify all of the on-campus activities happening associated with the Urban Forest.
2. Update the web content for the Brockman Memorial Tree Tour.
3. Develop online content associated with the wood salvage program.
4. Promote the university's memorial tree program.
5. Develop signage to promote student lead restoration projects.
6. Implement a campaign around Arbor Day (last Friday of April) to promote recent activities.
7. Provide other online tree mapping groups with the University's tree database to be added to their map.

BENEFITS

1. Increases the value of activities on campus.
2. Eases access to Urban Forestry Information.
3. Standardize outreach materials for forestry activities.
4. Facilitates grant writing information needs.
5. Expands the locations where information can be acquired from.

Support the campus as a "Living Laboratory"

A goal of the University of Washington is to utilize its landscape as an extension of the classroom, turning it into a "Living Laboratory. This goal can benefit both students and professors who are learning by doing that produces information of value to academics and university staff.

TASKS

1. Develop a list of potential student projects that would be of benefit to the campus landscape management staff.
2. Identify professors, courses, and staff that could take a leadership role for each project.
3. Pair each project with a potential funding source.
4. Explore project opportunities associated with the Green Seattle Partnership and EarthCorps.
5. Consider using the campus to plant unique trees from southern hardiness zones to test climate change impacts.

BENEFITS

1. Promotes experiential learning on campus.
2. Gives students the opportunity to gain greater ownership of the campus landscape through projects.
3. Supports an academic goal of the campus.
4. Can provide valuable data to the University for planning and management.

Metrics and Reporting

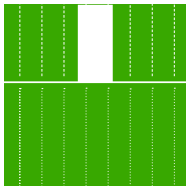
To track the overall quality of the urban forest and to gauge the progress of the University's Urban Forest goals, metrics have been defined to aid the university in identifing where things are going well, when goals are achieved, and making management and development decisions. The University has defined a range of metrics to evaluate the forest that touch upon the health and density of trees at both the site and campus scale. The University has the means and methods in place to track tree health and diversity but will need to establish a standardized method for collecting tree canopy and ecological value data. The data collection process provides the opportunity for cross-discipline and inter-departmental partnerships with students, staff, and faculty.

TOOLS + METRIC

CANOPY COVER

In order to track canopy goals the university will need to have regular lidar scans of campus completed and analyzed. As a less accurate method, canopy cover could be estimated using a formula based on a tree's age and its maximum dimension.

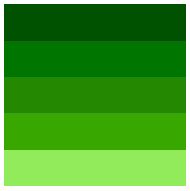
Aerial Lidar
Formula
% Canopy Cover



ECOLOGICAL VALUE

With the use of open-source software it is possible to evaluate an urban forest ecological value in terms of dollars and environmental services. To produce this data the University's existing tree database would need to be formatted to align with I-Trees or a similar software.

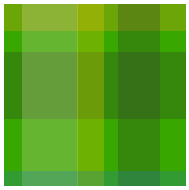
I-Trees
Tree Database
Air Quality
Water Quality
Water Quantity
Habitat



TREE HEALTH

Evaluating the urban forest based on tree health will continue to help the university identify trees and areas that need additional maintenance. Currently this is done on a tree-by-tree basis, but could also include a macro scale analysis using infra-red photography.

Visual Survey
Trunk Formula
Infra-Red Photography
Condition Rating
Level of Photosynthesis



DIVERSITY

Continuing to update the tree database will support tree diversity evaluations. The University will continue to manage and grow the Urban Forest to not exceed 10% of one species or 20% of one genus or 30% of one family.

Tree Database
Species
Tree Types
Age


4
NATIONAL

Stewardship & Guidelines

The death of the forest is
the end of our life

Dorothy Stang

The University of Washington takes great pride in their ability to maintain and enhance the urban forest. With oversight from the University Landscape Architect and Manager of Grounds Operations management of each tree is being conducted by the University Arborist with assistance from grounds management crews. Having acquired the title of Tree Campus USA in 2010 the University has continually added to their urban forestry program by establishing an Urban Tree Committee and partnering with students and faculty in tree plantings events and restoration projects. In addition, the University has established a tree salvage program that has grown in stature since its inception with the purchase of a kiln, sawmill and other lumber processing equipment. This management structure is paired with a multi-layered design review process that works with architects, engineers, landscape architects, and construction managers to preserve trees on campus when possible and to promote tree replacement. These processes along with management guidelines are outlined in this chapter to provide designers and builders with the University's tree planting standards and processes.

Tree Campus USA

Since 2010, the University of Washington has held the proud distinction of Tree Campus USA. Tree Campus USA recognizes excellence in campus tree management that also engages both the student body and the wider community in the establishment and maintenance of community forests.

Tree Campus USA is a national program created in 2008 to honor colleges and universities for effective campus forest management and for engaging staff and students in conservation goals. The University of Washington achieved the title by meeting Tree Campus USA's five standards, which include:

- **Maintaining a tree advisory committee,**
- **Having a campus tree-care plan,**
- **Dedicated annual expenditures toward trees**
- **Arbor Day observance**
- **Annual Student service-learning projects**

Each year the University of Washington holds an annual planting event that engages students and staff in enhancing an area of campus that could use some additional care. Each events is designed to empower participants by allowing them to gain ownership of the landscape through their active engagement in maintaining and enhancing its legacy.

Design Process

CONCEPT | SCHEMATIC | DETAILS | CONSTRUCTION

The University has established a robust design review process from a projects inception to completion that promotes an open dialogue between designers, the UW community, and project stakeholders. The goal of this process is to align every project with University goals for preserving significant vegetated conditions, maximizing a building's function and capacity while enhancing the overall experience of the University. Every major project must go through this process, so the campus is developed and designed with buy-in from all stakeholders and considered part of a integrated whole.

PRE-CONSTRUCTION

At the start of every project, trees potentially impacted by the project are assessed. All capital projects require the university to hire an third-party Arborist to assess all trees within the construction area. An assessment of current conditions and an appraisal of each tree using the Trunk Formula Method is prepared. Tree protection is a high priority with the University using every measure to protect the root system and canopy of existing trees. For more details into the University's standards, see the "Design Guideline" section at the end of this chapter.

DESIGN REVIEW

All major projects are required to present at both ULAC and UWAC for review and comment during all phases of the design process.

University Landscape Advisory Committee (ULAC)

The University Landscape Advisory Committee plays a key role in helping to preserve and enhance the unique character of the University's outdoor spaces and attain high quality campus environments through reviewing and providing feedback to project teams. The committee is made up of a diverse mix of stakeholders that have specific interest and expertise in topics directly related to landscape architecture, botany, urban design, campus planning, and public health.

University of Washington Architectural Commision (UWAC)

UWAC was established in 1957 to advise the University President and Board on issues related to design, function, performance, and environmental integrity associated with new construction and planning on campus. The commission provides project review for all development that affects the aesthetic character and composition of the university's three campuses.

DURING CONSTRUCTION

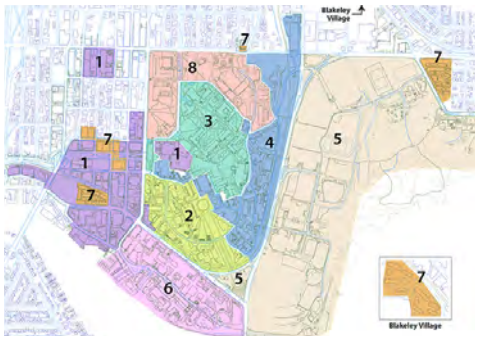
Once construction begins, the University Arborist, University Landscape Architect, and consulting Landscape Architect conduct site visits, nursery visits, and observes the installation of vegetation for each project. The collaboration within this group makes sure that the design intent is being fully realized while taking into consideration the maintenance requirements and the long-term vision of the landscape. Outside arborist may be brought in for unique circumstances.

POST CONSTRUCTION

After construction has been completed, the campus Arborist conducts all tree management work during and after the warranty period of the contract.

UW Grounds Management

The character of the landscape is a product of the careful management done by UW Grounds Management. Unlike the city, who has multiple departments managing different aspects of the urban forest, UW Grounds Management conducts all maintenance of trees, native areas, lawns, beds, and hardscape along sidewalks, vegetated areas, and parking lots within the Major Institutional Overlay. Grounds Management is a division of Facility Services that consist of an Arborist, mow, irrigation, and landscape crews. The campus is divided into eight maintenance zones for different crews to individually manage. All trees on campus are managed as a whole by the University Arborist with support from third-party arborist for unique projects.



GROUNDS CREWS

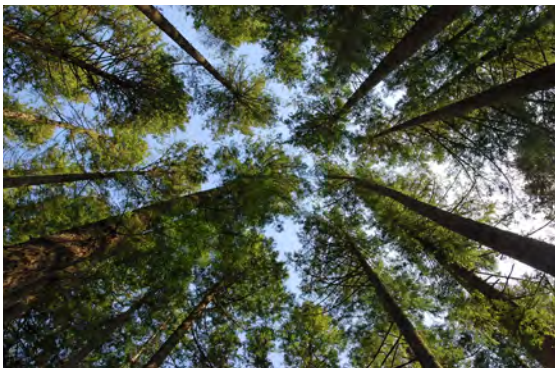
As manager of all property within the Major Institutional Overlay the University has a highly trained staff of landscape managers, arborists, and irrigation crews that maintain the campus to a high standard of care. Each maintenance zones consist of one lead with the support of 2 - 4 gardeners.

URBAN FOREST SPECIALIST

The University has a full time ISA certified Arborist on staff that manages all trees on campus with the assistance of an aid. The Arborist conducts all tree pruning, removal, tagging, inoculations, mulching, and staking. During construction projects the University uses a third-party Arborist to conduct a tree analysis for each site to provide recommendations with regards to existing trees on the site. The Office of University Architect works closely with the Arborist in maintaining the vibrancy of the Urban Forest.

CAMPUS TREE ADVISORY COMMITTEE

To provide additional oversight and as a requirement of being a Tree Campus USA, a tree advisory committee has been established to facilitate an open dialogue amongst the various stakeholders of the urban forest: Facility Services Manager, University Arborist, Arboretum Manager, Integrated Pest Management Lead, Center for Urban Horitculture Staff and University Landscape Architect. They meet once a year to discuss concerns related to protecting and replanting trees that are impacted by construction activities and natural disturbances. This committee offered valuable guidance in the creation of this document through content recommendations and oversight.



Design Guidelines

The preservation and enhancement of a healthy University landscape and urban forest begins with defining project goals through project delivery. In order to establish a standard for landscape implementation, the University of Washington has defined critical design guidelines for consultants to use for creating successful, thriving landscapes on campus. These guidelines range the breath of design implementation from initial site planning to final acceptance. Within the guidelines, construction details are provided to support specific guidelines and to be used by designers in the creation of construction documents. For a complete list of University Design Guidelines, see the Facility Services Design Guidelines (FSDG).

GUIDELINE TOPICS

SITE PLANNING

SITE CONDITIONS

OBSERVATION OF WORK

SUBMITTALS

DELIVERY, STORAGE, AND HANDLING

WORK CHANGES AND CORRECTIONS

SITE PREPARATION

TREE PROTECTION PRODUCTS

TREE AND PLANT PROTECTION

TREE REMOVAL

WEED REMOVAL

TREE REPLACEMENT

COMPACTED SOIL

PLANTING SOIL

SOIL INSTALLATION

SOIL MOISTURE

FINISH GRADES

PLANT SELECTION

PLANT WARRANTY

PLANT QUALITY

PLANTING SEASON

PLANTING LAYOUT

TREE AND SHRUB EXCAVATION

TREE AND SHRUB INSTALLATION

PLANTING OVER STRUCTURE

STAKING AND GUYING

MULCH

COMPOSTED MULCH

WATER

WATERING BAGS

TREE PRUNING

PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION

CLEAN-UP AND DISPOSAL

SUBSTANTIAL COMPLETION

MAINTENANCE DURING WARRANTY PERIOD

END OF WARRANTY - FINAL ACCEPTANCE

SITE PLANNING

- Meetings with the University Landscape Architect and University Architect are encouraged prior to starting the design process.
- An evaluation of the existing trees on a site is required prior to design. This evaluation will be conducted by a third-party Arborist for projects costing greater than 10 million. Otherwise the University Arborist can conduct this analysis.
- All exceptional trees, trees to remain on site and trees for removal will be denoted on the site plan, demolition plan, and tree protection plan.
- A site survey is required for all new projects on campus, conducted by a licensed surveyor. An electronic AutoCAD version of the survey is to be provided to Campus Engineering when completed.

SITE CONDITION

- It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to notify the University Landscape Architect, in writing, of any circumstances that would negatively impact the health of plantings. Do not proceed with work until unsatisfactory conditions have been corrected.
    - Should subsurface drainage or soil conditions be encountered which would be detrimental to growth or survival of plant material, the Contractor shall notify the University Landscape Architect in writing, stating the conditions and submit a proposal covering cost of corrections. If the Contractor fails to notify the University Landscape Architect of such conditions, he/she shall remain responsible for plant material under the "Warranty" section of these guidelines.
    - This specification requires that all Planting Soil and Irrigation (if applicable) work be completed and accepted prior to the installation of any plants.
- It is the responsibility of the Contractor to be familiar with the local growing conditions, and if any specified plants will be in conflict with these conditions. Report any potential conflicts, in writing, to the University Landscape Architect.
- Planting operations shall not begin until such time that the irrigation system is completely operational for the area(s) to be planted, and the irrigation system for that area has been preliminarily observed and approved by the University Landscape Architect.
- Actual planting shall be performed during those periods when weather and soil conditions are suitable in accordance with locally accepted horticultural practices.
    - No planting shall take place during extremely hot, dry, windy or freezing weather without the approval of the University Landscape Architect.

OBSERVATION OF WORK

- Schedule a pre-construction meeting with the University Landscape Architect at least seven (7) days before beginning work to review any questions the Contractor may have regarding the work, administrative procedures during construction and project work schedule.

- The University Landscape Architect may observe the work at any time. They may remove samples of materials for conformity to specifications. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications shall be paid by the Contractor.
- The Campus Landscape Architect shall be informed of the progress of the work so the work may be observed at key times in the construction process. The University Landscape Architect shall be afforded sufficient time to schedule visit to the site. Failure of the University Landscape Architect to make field observations shall not relieve the Contractor from meeting all the requirements of this specification.

SUBMITTALS

- Product submittals are required at least 8 weeks prior to the installation of plants and the start of soil work.
- Submit plant growers certificates for all plants indicating that each meets the requirements of the specification, including the requirements of tree quality, to the University Landscape Architect for approval.
- Product Data:
    - Plant Material: Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
    - Product Samples: Submit samples of each product and material where required by the specification to the University Landscape Architect for approval. Label samples to indicate product, characteristics, and locations in the work.
    - Soil Material: Provide a particle size analysis (% dry weight) and USDA soil texture analysis. Soil testing of Planting Soil Mixes shall also include USDA gradation (percentage) of gravel, coarse sand, medium sand, and fine sand in addition to silt and clay.
    - Provide the following other soil properties:
        - pH and buffer pH.
        - Percent organic content by oven dried weight.
        - Nutrient levels by parts per million including: phosphorus, potassium, magnesium, manganese, iron, zinc and calcium. Nutrient test shall include the testing laboratory recommendations for supplemental additions to the soil for optimum growth of the plantings specified.
        - Soluble salt by electrical conductivity of a 1:2 soil water sample measured in Milliohm per cm.
        - Cation Exchange Capacity (CEC).
    - Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the project.

DELIVERY, STORAGE, & HANDLING

- Packaged Materials shall be delivered in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal law if applicable.
- Bulk Materials:
    - Do not dump or store materials near structures, utilities, walkways, and pavements, or on existing turf areas or plants.
    - Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
- Deliver bare-root stock plants freshly dug. After digging up, immediately pack root system in a suitable material to keep root system moist until planting.
- Do not prune trees or shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery.
- All plant material shall be transported to planting locations with care to prevent damage. Branches shall be tied back, as necessary, and bark protected with burlap from chafing by ropes at all times.
- No plant material shall be dragged along the ground without proper protection of the root and branches. All planting stock shall be handled by the root ball.
- Protect materials from deterioration during delivery and storage. Adequately protect plants from drying out, exposure of roots to sun, wind or extremes of heat and cold temperatures. If planting is delayed more than 6 hours after delivery, set plants in a location protected from sun and wind. Provide adequate water to the root ball package during the shipping and storage period.
- Topsoil: The contractor is responsible for coordinating blending, shipping, delivery and installation of soils so that the following conditions are met:
    - Components of stockpiled mixes do not segregate or become contaminated
    - Placement and compaction of the soils shall be coordinated to avoid damage to toter installed work, such as roof waterproofing systems, sub-drainage, or irrigation systems.
- Do not deliver more plants to the site than there is space with adequate storage conditions. Provide a suitable remote staging area for plants and other supplies.
    - The University Landscape Architect or Contractor shall approve the duration, method and location of storage of plants.

WORK CHANGES AND CORRECTIONS

- The University Landscape Architect may order changes in the work, and the contract sum adjusted accordingly. All such orders and adjustments plus claims by the Contractor for extra compensation must be made and approved in writing before executing the work involved.

- All changes in the work, notifications and contractor's request for information (RFI) shall conform to the contract general condition requirements.

- The Contractor shall re-execute any work that fails to conform to the requirements of the contract and shall remedy defects due to faulty materials or workmanship upon written notice from the University Landscape Architect, at the soonest possible time that can be coordinated with other work and seasonal weather demands but not more than 180 (one hundred and eighty) days after notification.

SITE PREPARATION

- Protect structures utilities, pavements, other facilities and existing exterior plants from damage caused by planting operations.

- Provide erosion controls measures to prevent erosions or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkaways.

- Lay out tree, shrub, ground cover, and vine areas as shown in Drawings. Stake locations, outline areas, adjust locates when requested and obtain University Landscape Architect approval of layout before individual plant placement.

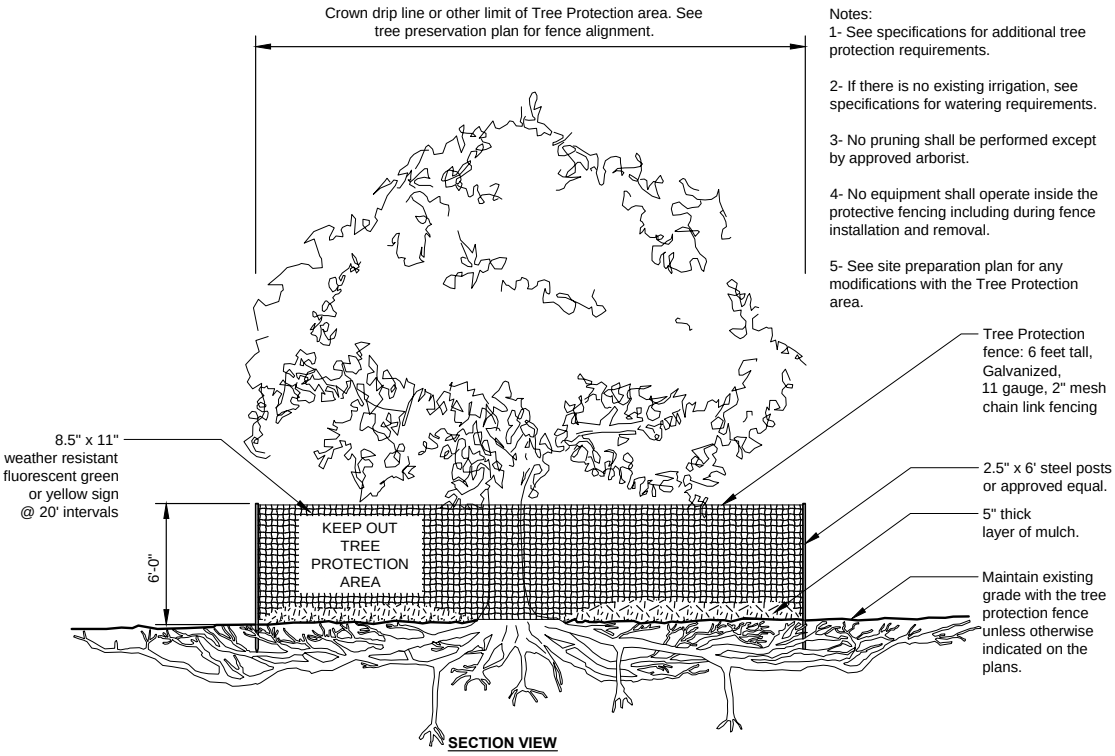
- Place individual trees, shrubs, ground covers, and vines in approved planting areas. University Landscape Architect shall review placement and direct adjustments, as needed. Obtain University Landscape Architect acceptance prior to final installation.

TREE PROTECTION PRODUCTS

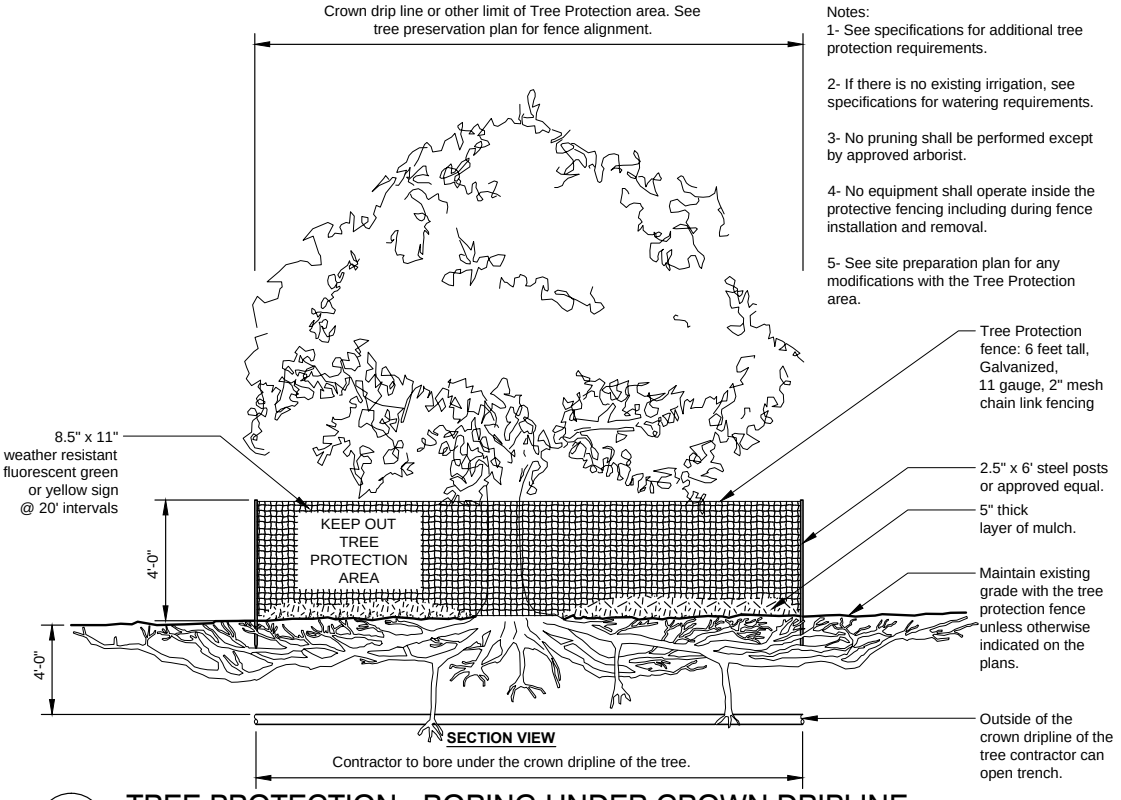
- Tree Protection shall be reviewed and approved by the project Arborist or the University Landscape Architect prior to installation.
    - PROTECTION FENCING shall be equal to the following:
        - CHAIN LINK FENCE: 6 feet tall Galvanized, 11 gauge, 2 inch mesh chain link fencing with nominal 2 1/2 inch diameter galvanized steel posts set in metal frame panels on movable core drilled concrete blocks of sufficient size to hold the fence erect in areas of existing paving to remain.
        - GATES: For each fence type and in each separate fenced area, provide a minimum of one 3 foot wide gate. Gates shall be lockable. The location of the gates shall be approved by the University Landscape Architect.
        - Submit suppliers product data that product meets the requirements for approval.
    - MATTING shall be equal to the following:
        - Matting for vehicle and work protection shall be heavy duty matting designed for vehicle loading over tree roots.
        - Submit suppliers product data that product meets the requirements for approval.
    - GEOGRID shall be equal to the following:
        - Geogrid shall be woven polyester fabric with PVC coating, Uni-axial or biaxial geogrid, inert to biological degradation, resistant to naturally occurring chemicals, alkalis, acids.
        - Submit suppliers product data that product meets the requirements for approval.
    - FILTER FABRIC shall be equal to the following:
        - Filter Fabric shall be non-woven polypropylene fibers, inert to biological degradation and resistant of naturally occurring chemicals, alkalis and acids.
        - Submit suppliers product data that product meets the requirements for approval.
    - PROTECTIVE SIGNAGE shall be equal to the following:
        - Contractor shall post weather-resistant 8.5″x11″ fluorescent green or yellow signage on protection fencing at 20 foot intervals warning construction personnel to keep out of tree protection zones.

TREE AND PLANT PROTECTION AREA

- The Tree and Plant Protection Area is defined as all areas indicated on the tree protection plan. Where no limit of the Tree and Plant Protection area is defined on the drawings, the limit shall be the drip line (outer edge of the branch crown) of each tree.
- The Contractor shall not engage in any construction activity, traverse the area to access adjacent areas of the project, or use the Tree Protection area for lunch or any other work breaks without the approval of the University Landscape Architect.
- All tree management activities within the Tree Protection Area will be performed or observed by a Certified Arborist.
- Potentially harmful materials to tree roots can not be stored within twenty (20) feet of protection fencing. Potentially harmful materials include, but are not limited to, petroleum products, cement and concrete materials, cement additives, lime, paints and coatings, waterproofing products, concrete forms coatings, detergents, acids, and cleaning agents.
- Flag all trees and shrubs to be removed by wrapping orange plastic ribbon around the trunk and obtain the University Landscape Architect's approval of all trees and shrubs to be removed prior to the start of tree and shrub removal. After approval, mark all trees and shrubs to be removed with orange paint in a band completely around the base of the tree or shrub 4.5 feet above the ground.
- Flag all trees and shrubs to remain with white plastic ribbon tied completely around the trunk or each tree and on a prominent branch for each shrub. Obtain the University Landscape Architect's approval of all trees and shrubs to be remain prior to the start of tree and shrub removal.
- Prior to any construction activity at the site including utility work, grading, storage of materials, or installation of temporary construction facilities, install all tree protection fencing, Filter Fabric, silt fence, tree protection signs, Geogrid, Mulch and or Wood Chip.
- All trees and landscape requiring protection shall be fertilized and watered by the Contractor until Substantial Completion.
- In the event that construction activity is unavoidable within the Tree and Plant Protection Area, notify the University Landscape Architect and submit a detailed written plan of action for approval. The plan shall include: a statement detailing the reason for the activity including why other areas are not suited; a description of the proposed activity; the time period for the activity, and a list of remedial actions that will reduce the impact on the Tree and Plant Protection Area from the activity. Remedial actions shall include but shall not be limited to the following:
    - When excavation for new construction is required within the Tree Protection Area, hand clear and excavate in a matter that will not cause damage to the tree, roots or soil.
    - Tree branches that interfere with the construction may be tied back or pruned to clear only to the point necessary to complete the work. Other branches shall only be removed when specifically indicated by the University Landscape Architect.



D-1 TREE PROTECTION



D-2 TREE PROTECTION - BORING UNDER CROWN DRIPLINE

TREE REMOVAL

- Trees are to not be dropped with a single cut unless the tree will fall in an area not included in the Tree and Plant Protection Area. No tree to be removed within 50 feet of the Tree and Plant Protection Area shall be pushed over or up-rooted using a piece of grading equipment.
- Protect adjacent paving, soil, trees, shrubs, ground cover plantings and understory plants to remain from damage during all tree removal operations, and from construction operations. Protection shall include the root system, trunk, limbs, and crown from breakage or scarring, and the soil from compaction.
- Grind stumps to ground level, unless there are roots from other trees or vegetation that may be negatively impacted by the practice. Otherwise, (what should be done)
- Prior to tree removal, work with the University Landscape Architect and University Arborist on potentially salvaging the lumber produced from the removed tree.

WEED REMOVAL

- During the construction period, Contractor is required to control any plants that seed in and around the fenced Tree and Plant Protection area at least three times a year.
    - All plants that are not shown on the planting plan or on the Tree and Plant Protection Plan to remain shall be considered as weeds.
- At the end of the construction period provide one final weeding of the Tree and Plant Protection Area.

TREE REPLACEMENT

- The requirement for tree replacement is a 1:1 ratio of trees lost to trees required. New trees shall be 2" in caliper minimum.
- When the project cannot replace all trees on-site, the equivalent value of these trees will be charged to the project. The cost to the contractor is based upon the square inches of cross sectional area of trunk measured at 4 ft. above grade, in accordance with the following criteria:
    - $75.00/square inch for trees less than or equal to 6 inch diameter
    - $50.00/square inch for trees greater than 6 inch and less than 18 inch diameter
    - $40.00/square inch for trees greater than or equal to 18 inch diameter

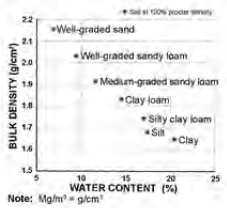
COMPACTED SOIL

- Compacted Soil is defined as soil where the density of the soil is greater that the threshold for root limiting, and further defined in this specification.
- Maintain at the site at all times a soil penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.
- The following are threshold levels for compaction as determined by different testing methods:

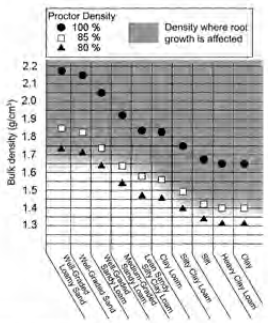
    - Acceptable Compaction: Good rooting anticipated, but increasing settlement expected as compaction is reduced and/or in soil with a high organic matter content.
        - Bulk Density Method – Varies by soil type see Chart Below.
        - Standard Proctor Method – 75-85%; soil below 75% is unstable and will settle excessively.
        - Penetration Resistance Method – about 75-250 psi, below 75 psi soil becomes increasingly unstable and will settle excessively.
    - Root limiting Compaction: Root growth is limited with fewer, shorter and slower growing roots.
        - Bulk Density Method – Varies by soil type see Chart Below
        - Standard Proctor Method – above approximately 85%.
        - Penetration Resistance Method – about 300 psi.
    - Excessive Compaction: Roots not likely to grow but can penetrate soil when soil is above field capacity.
        - Bulk Density Method – Varies by soil type see Chart Below.
        - Standard Proctor Method – Above 90%.
        - Penetration Resistance Method – Approximately above 400 psi

- Planting Soil compaction shall be tested at each lift using a penetrometer calibrated to the mock-up soil and its moisture level. The same penetrometer and moisture meter used for the testing of the mock-up shall be used to test installed soil throughout the work.

Table 1.2.3. The relationships of soil types to bulk density and Proctor values.



a. Various soils compacted to 100 percent of maximum dry density (Proctor). Note that as sand content increases, less water is needed to obtain the maximum density and the soil reaches maximum dry density at a higher bulk density. *(Source: Abramson et al. 1995)*



b. Bulk density and levels affecting rooting compared to several Proctor densities. Note that soils to be used for most trees and shrubs should always be compacted to less than 85 percent of maximum dry density. There is limited research comparing bulk density to Proctor value, but a reasonable specification for compacting planting soil would be between 75 and 80 percent, with some settlement expected at that range. Sandier soils can be compacted up to 85 percent, with the exception of well-graded sandy soils. *(Source: Data adapted from Daddow and Warrington 1983, Lichter and Lindsey 1994, and Brady et al. 1999)*

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PLANTING SOIL

- Lawn Planting Soil
    - Lawn planting soil shall consist of 60% Sand and 40% organic amendment by volume, and shall meet or exceed the following specifications:
        - The Sand component shall meet the following specifications with reasonable variations:

          Screen Size Percent (%) Passing
          3/8" 100
          1/4" 95-100
          #10 85-95
          #30 60-75
          #60 50-60
          #100 20-30
          #200 <5
        - pH range between 6.5 and 7.0
        - The Compost (Organic Amendment) Component shall consist of 100% recycled yard waste material or other organic waste material that have been sorted ground up, aerate and aged and shall be fully composted, stable and mature (non-aerobic). The composting process shall be for at least six months time and the organic amendment shall have a uniform dark, soil-like appearance. In addition, the compost shall have the following physical characteristics:
            - Shall have a Carbon to Nitrogen ration of between 20:1 and 40:1
            - Shall be certified by the Process to Further Reduce Pathogens (PFRP) guideline for hot composting as established by the United States Environmental Protection Agency.
            - Shall be fully mature and stable before usage.
            - Shall be screened using a sieve no finer than 1/4" and no greater than 1/2"
            - Based on dry weight of total organic amendment sample: Must comply with the following percent by weight passing:

              Sieve Size Percent (%) Passing
              1/2" (12.7mm) 100
              1/4" (6.35mm) 95-100
              4.76mm 90-95
              2.38mm 75-90
              1.00mm 45-70
              500 micron 0-30
            - Shall have heavy metal concentrations below the WSDA limits as follows:

Metal Type WA State (Max. lb./ac..)
ARSENIC 0.297
CADMIUM 0.079
COBALT 0.594
LEAD 1.981
MERCURY 0.019
MOLYBDENUM 0.079
NICKEL 0.713
SELENIUM 0.055
ZONC 7.32

- Trees, Shrubs, and Ground cover Planting Soil
    - Planting soil shall consist of 67% sandy loam and 33% composted organic material
        - The Sandy Loam or Loamy Sand component shall consist largely of sand, but with enough silt and clay present to give it a small amount of stability and shall meet the following screen analysis:

          Screen Size Percent (%) Passing
          3/8" 100
          1/4" 95-100
          #10 85-95
          #30 60-75
          #60 50-60
          #100 10-20
          #200 0-10

        - Individual sand grains can be seen and felt readily. On squeezing in the hand when dry, it shall form a cast that will not only hold its shape when the pressure is released, but shall withstand careful handling with breaking. The mixed loam shall meet the following:
            - Shall have a pH range of 6.5 - 7.0 with dolomite lime, sulfur, or other amendments, added prior to delivery, as necessary to attain this range, The decomposed organic amendment component shall consist of composed organic materials as described above Lawn Planting Soil.

SOIL INSTALLATION

- As plants are installed, soil shall be evenly spread, cultivated, and lightly compacted to prevent future settlement.
- Planting soil components must be mixed prior to placement in the planting bed or tree pit
- Loosen and scarify sub-grade to a minimum depth of 8 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off University of Washington property.

- Apply fertilizer directly to sub-grade before loosening.
- Thoroughly blend planting soil mix off-site before spreading.
- Delay mixing fertilizer with planting soil if planting will not process within a few days
- Mix lime with dry soil before mixing fertilizer
- Spread first lift of planting soil mix to depth of 9 inches over loosened sub-grade. Mix thoroughly into top 4 inches of sub-grade.
- Do not spread if planting soil or sub-grade is frozen, muddy or excessively wet.

SOIL MOISTURE

- Volumetric soil moisture level, in both the planting soil and the root balls of all plants, prior to, during and after planting shall be above permanent wilting point and below field capacity for each type of soil texture within the following ranges.

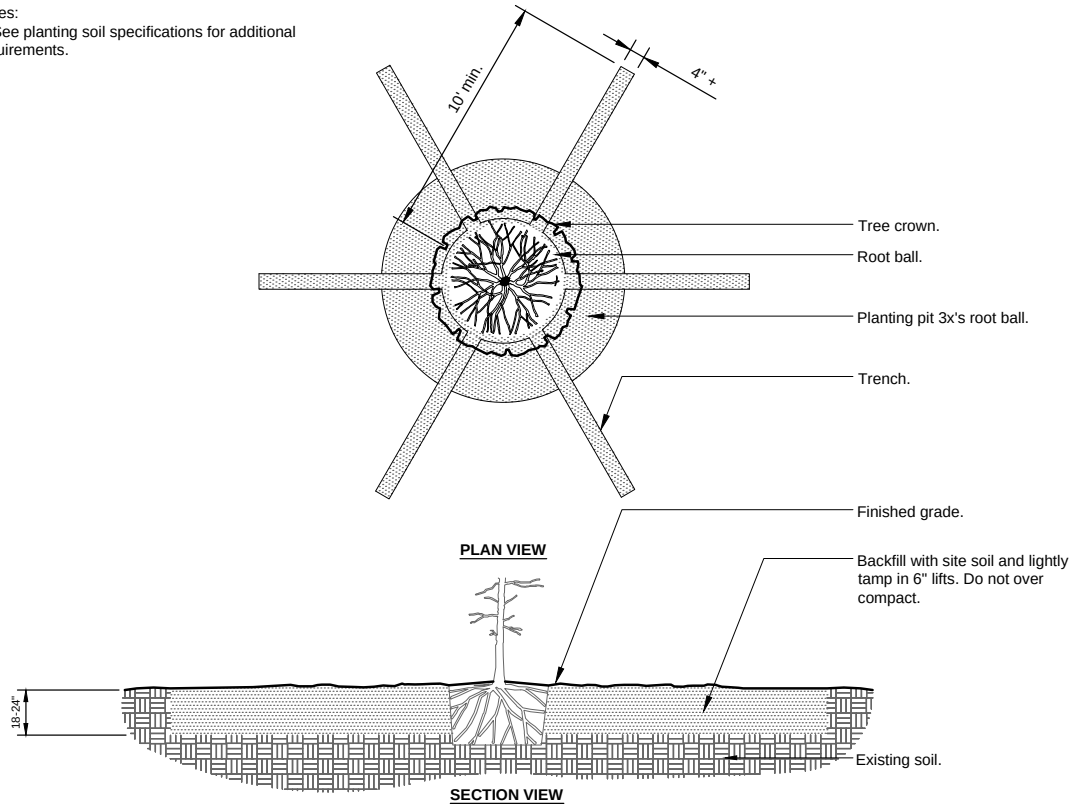
Soil Type	Permanent Wilting Point	Field Capacity
Sand, Loamy sand, sandy loam	*5% - 8%*	*12% - 18%*
Loam, sandy clay, sandy clay loam	*14% - 25%*	*27% - 36%*
Clay loam, silt loam	*11% - 22%*	*31% - 36%*
- 41%Silty clay, silty clay loam	*22% - 27%*	*38% - 41%*

- Maintain at the site at all times a soil penetrometer with pressure dial and a soil moisture meter to check soil compaction and soil moisture.
- The Contractor shall confirm the soil moisture levels with a moisture meter. If the moisture is too high, suspend planting operations until the soil moisture drains to below field capacity.

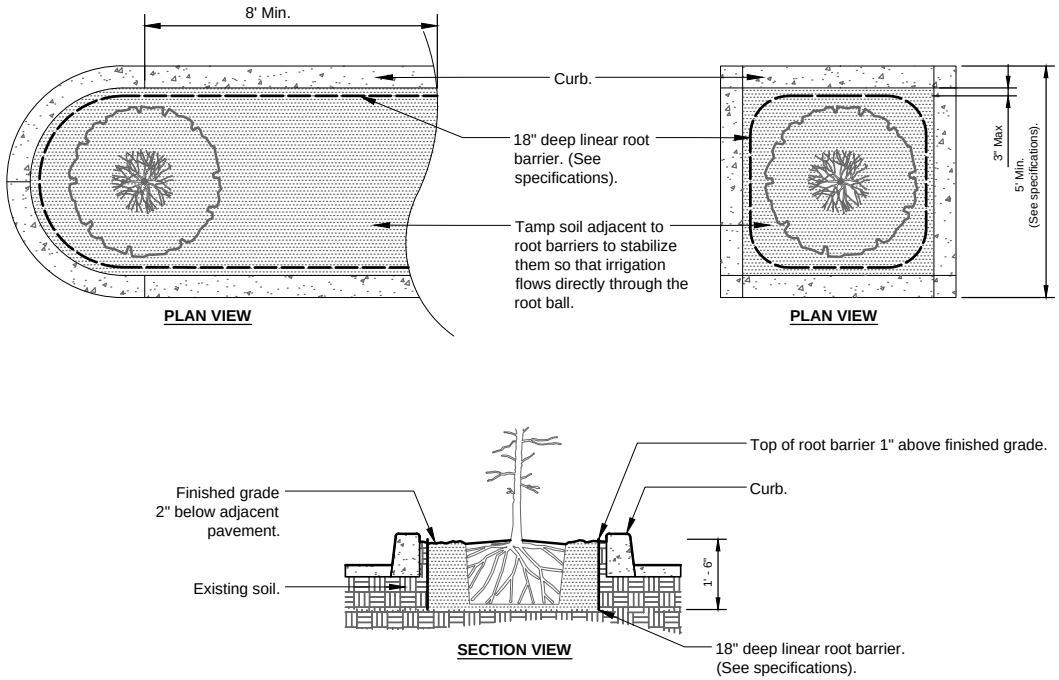
FINISH GRADES

- Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, ensuring the all debris is removed as specified and that the surface is smooth, free draining, contains no low or high spots, and meets specified finish grades. Limit fine grading to areas that can be planted in the immediate future.
    - Grades will not be less than required to meet the finish grades after light rolling and natural settlement.
    - Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.
    - Coordinate finish grading with installation of irrigation system.
    - Before planting, obtain University Landscape Architect acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

Notes:
1- See planting soil specifications for additional requirements.



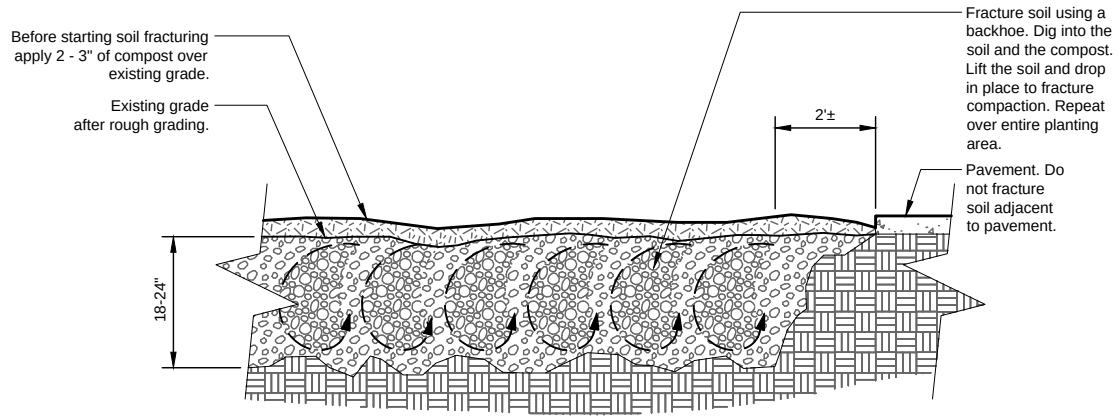
S-X RADIAL TRENCHING



Notes:
1- Root barriers shall be installed per manufacturer's specifications and recommendations.

2- Root barriers shall be installed when root ball is located within 8' of pavement.

S-X ROOT BARRIERS - PARKING LOT ISLANDS

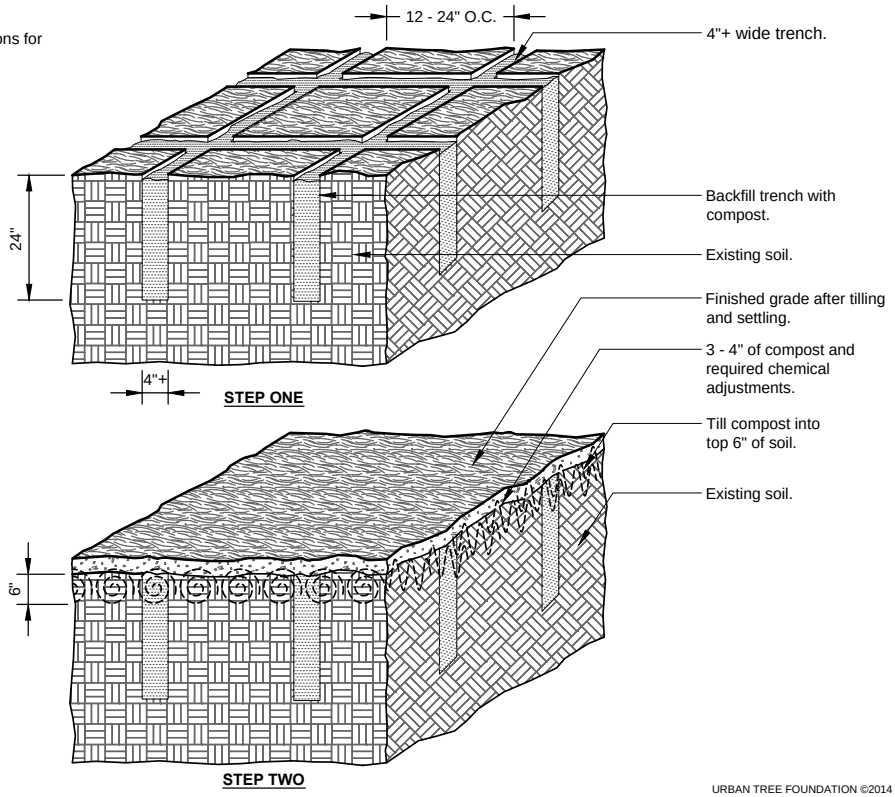


Notes:
1- For planting areas narrower than 8' reduce the distance between paving and soil fracturing from 2' to 1'.

2- See planting soil specification for additional requirements.

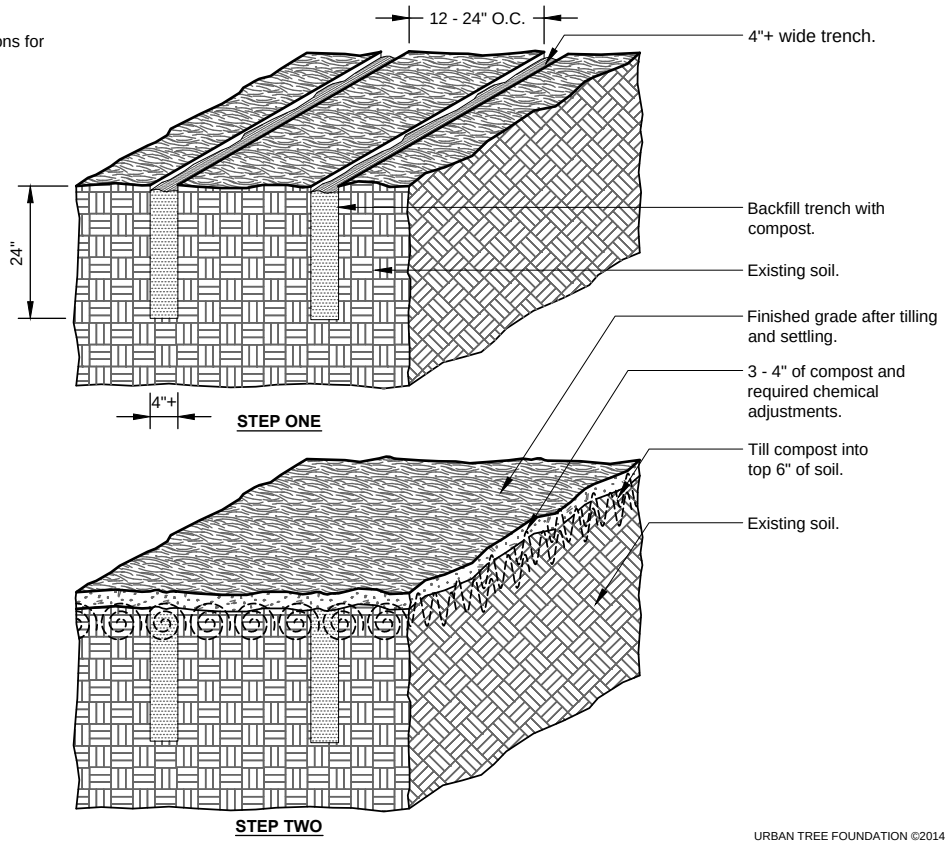
S-X MODIFIED EXISTING SOIL - COMPACTED SUB SOIL (FRACTURING)

Notes:
1- See planting soil specifications for additional requirements.

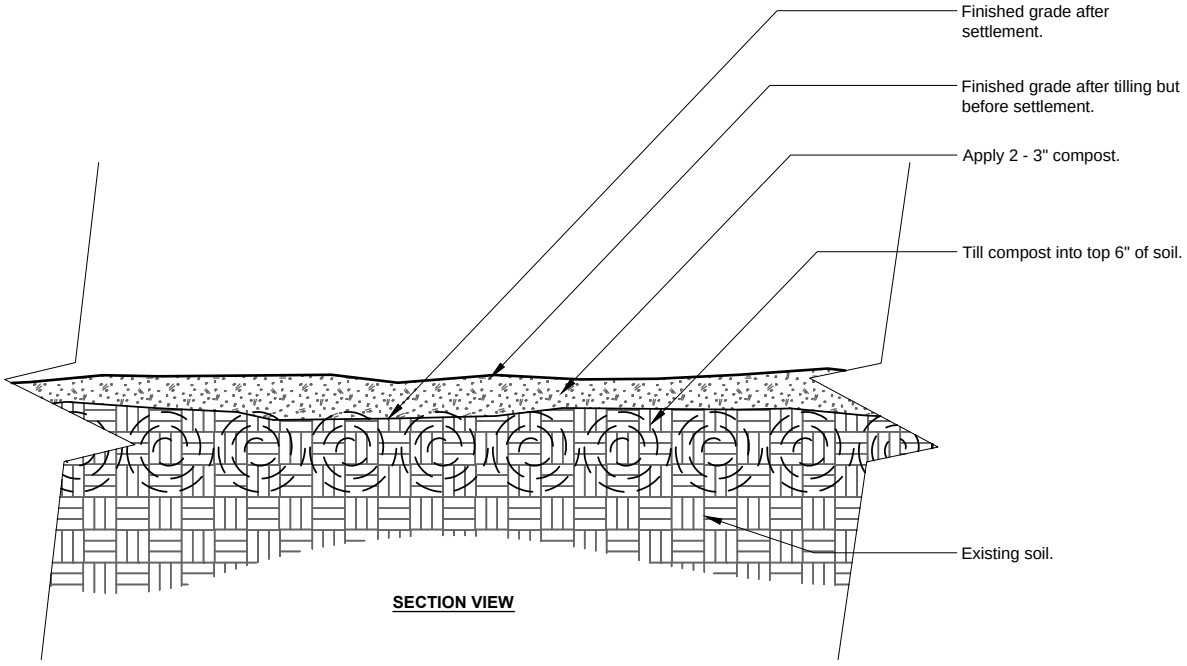


S-X MODIFIED EXISTING SOIL - COMPACTED SUBSOIL (RIPPING)

Notes:
1- See planting soil specifications for additional requirements.

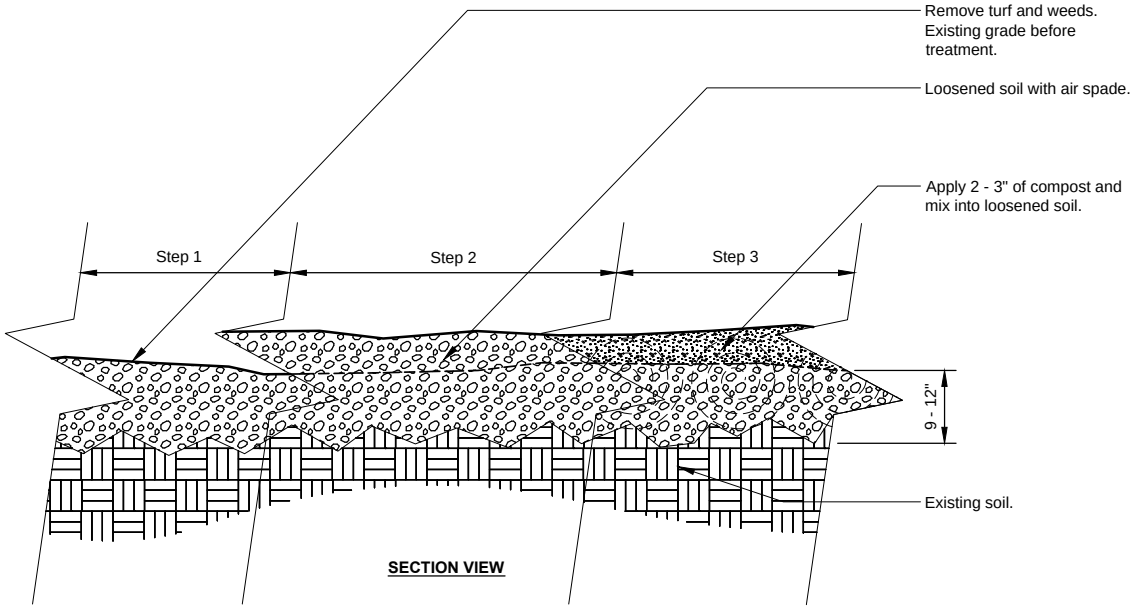


S-x MODIFIED EXISTING SOIL - COMPACTED SUBSOIL (TRENCHING)



Notes:
1- See planting soil specifications for additional requirements.

S-X MODIFIED EXISTING SOIL - COMPACTED SURFACE SOIL



Notes:
1- Prior to the start of work remove all thatch, sod, and/or weeds.

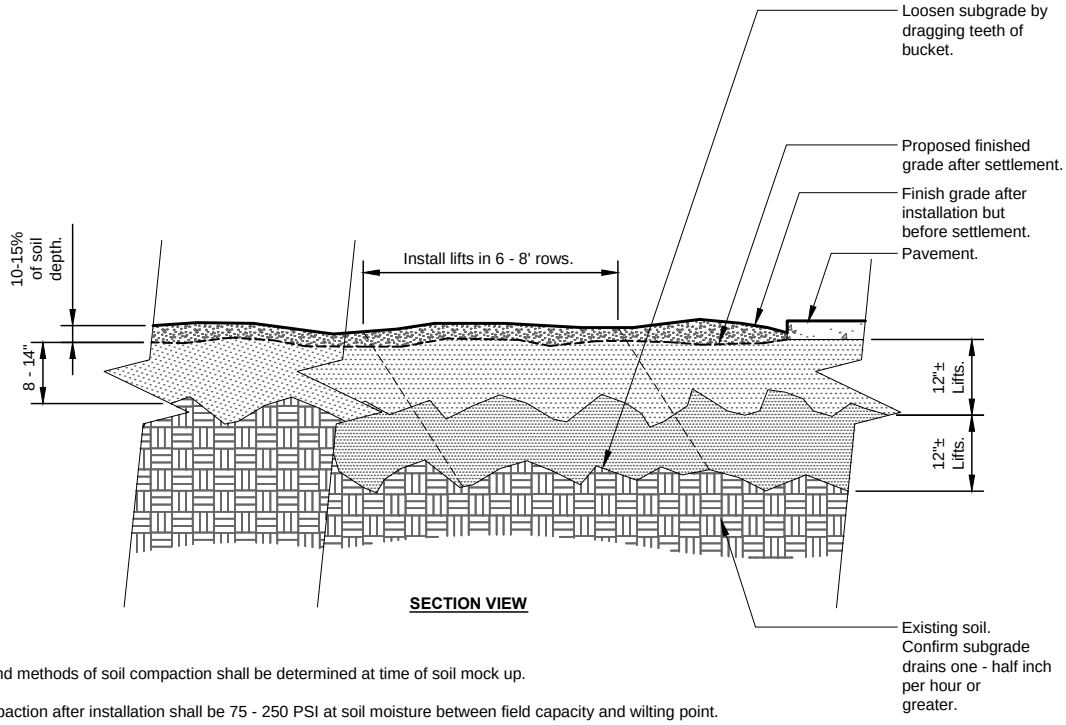
2- Loosen soil with Air Spade or approved equal to a depth of 9 - 12" and work around encountered roots.

3- Apply 2 - 3" of compost over loosened soil. Using an air space mix compost into loosened soil.

4- Water entire root zone at end of each work day.

5- See planting soil specifications for additional requirements.

D-X MODIFIED EXISTING SOIL - COMPACTED SOIL IN TREE DRIPLINE



Notes:
1- Means and methods of soil compaction shall be determined at time of soil mock up.

2- Soil compaction after installation shall be 75 - 250 PSI at soil moisture between field capacity and wilting point.

3- For soil depths see planting soil specifications.

4- See planting soil specification for additional requirements.

S-x MODIFIED EXISTING SOIL - INSTALLED PLANTING MIX

PLANT SELECTION

- The University follows the motto, "Right Tree, Right Place" strategy for planting new trees on University Property.
- Designers are required to work closely with the University Landscape Architect to identify ideal tree species for projects.
- The University Landscape Architect may review all plants subject to approval of size, health, quality, character, etc. Review or approval of any plant during the process of selection, delivery, installation and establishment period shall not prevent that plant from later rejection in the event that the plant quality changes or previously existing defects become apparent that were not observed.
- All plants that are rejected shall be immediately removed from the site and acceptable replacement plants provided at no cost to the Owner.
- When requested by the University Landscape Architect, submit photographs of plants or representative samples of plants. Photographs shall be legible and clearly depict the plant specimen. Each submitted image shall contain a height reference, such as a measuring stick. The approval of plants by the University Landscape Architect via photograph does not preclude the University Landscape Architect right to reject material while on site.
- University Landscape Architect may inspect plant material at nursery or off-site holding area prior to arrival on site. Plant materials shall be inspected by the University Landscape Architect after arrival on site. Notify the University Landscape Architect four business days prior to the proposed arrival of plant materials on site. Arrange for adequate manpower and equipment on site at the time of plant material inspection and installation to unload and handle material and provide a complete staked layout during inspection. Plants not meeting the requirements herein specified or matching approved representative photographs shall be immediately removed from the project and replaced by the Contractor at no additional cost to the University of Washington.
- All trees shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by genus, species, variety and cultivar.
- All plant species substitution request, or size needs to be submitted to the University Landscape Architect, for approval, prior to purchasing the proposed substitution. Requests shall also include sources of plants found that may be of a smaller or larger size, or a different shape or habit than specified, or plants of the same genus and species but different cultivar origin, or which may otherwise not meet the requirements of the specifications, but which may be available for substitution.

PLANT WARRANTY

- Contractor shall furnish imported plants materials, move and/or remove on-site plants specified, and install all plant materials indicated on the drawings, provide maintenance and care of plant material, cleanup, and provide warranty as defined in this section.
- Contractor is required to replace defective work and defective plants. The University Landscape Architect shall make the final determination if plants meet these specifications or that plants are defective.

- Defective includes, but is not limited to, the following:
    - Death or unsatisfactory growth, except for defects resulting from incidents that are beyonds contractors control.
    - Structural failures including planting falling or blowing over.
    - Faulty performance of tree stabilization or edging.
    - Deterioration of metals, metal finishes and other materials beyond normal weathering.
- Warranty period is 1 year from the data of substantial completion.
- When the work is accepted in parts, the warranty periods shall extend from each of the partial Substantial Completion Acceptances to the terminal date of the last warranty period. Thus, all warranty periods for each class of plant warranty, shall terminate at one time.
- All plants shall be warrantied to meet all the requirements for plant quality at installation in this specification. Defective plants shall be defined as plants not meeting these requirements. The University Landscape Architect shall make the final determination that plants are defective.
- The warranty of all replacement plants shall extend for an additional one-year period from the date of their acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended warranty period, the Owner's Representative may elect one more replacement items or credit for each item. These tertiary replacement items are not protected under a warranty period.
- At the end of the warranty period, the University Landscape Architect shall observe all warranted work, upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date for final observation.
- All plants that are rejected shall be immediately removed from the site and acceptable replacement plants provided at no cost to the Owner.

PLANT QUALITY

- Plants are to possess normal well-developed branch systems; sound crotches; vigorous fibrous root systems; trees with straight trunks and leader intact; densely foliated free from defects, disfiguring knots, suncald or windburn injuries, disfigurement and abrasion of the bark, disease, pests, eggs and larvae. Freshly dug at time of delivery.

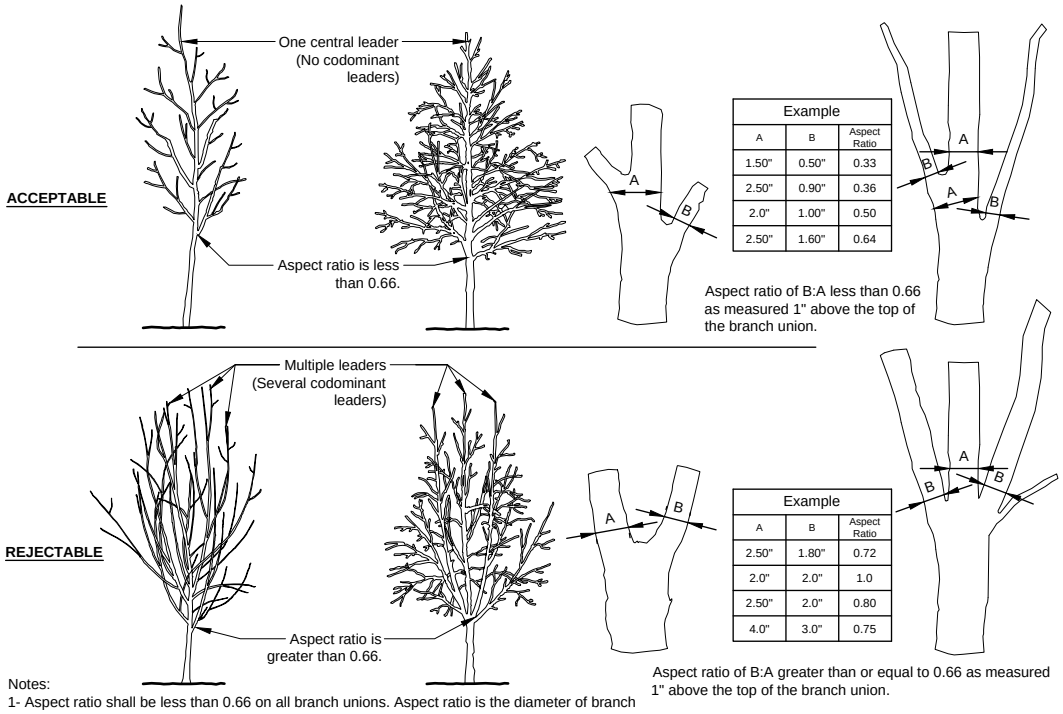
- Do not use plants harvested from the wild, from native stands, from established landscape planting or not grown in a nursery unless otherwise approved by the University Landscape Architect.
- All trees to be field grown. No potted or bagged plants will be accepted. The University recommends using plant stock that is balled and burlapped over or container plants instead of bare-root.
- Provide plant material grown within 1 hardiness zone of the project for a minimum of 3 years prior to the date of planting unless approved otherwise by the University Landscape Architect.

above soil line

- Plants shall be healthy with the color, shape, size and distribution of trunk, stems, branches, buds and leaves normal to the plant type specified. Tree quality above the soil line shall comply with the project Crown Acceptance details and the following:
    - Crown: The form and density of the crown shall be typical for a young specimen of the species or cultivar pruned to a central and dominant leader.
    - Crown specifications do not apply to plants that have been specifically trained in the nursery as topiary, espalier, multi-stem, clump, or unique selections such as contorted or weeping cultivars.
    - Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress or over watering as indicated by wilted, shriveled, or dead leaves.
    - Branches: Shoot growth (length and diameter) throughout the crown should be appropriate for the age and size of the species or cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.
    - Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds that penetrate to the wood (properly made pruning cuts, closed or not, are acceptable and are not considered wounds), sunburned areas, conks (fungal fruiting bodies), wood cracks, sap leakage, signs of boring insects, galls, cankers, girdling ties, or lesions (mechanical injury).
    - Temporary branches, unless otherwise specified, can be present along the lower trunk below the lowest main (scaffold) branch, particularly for trees less than 1 inch in caliper. These branches should be no greater than 3/8-inch diameter. Clear trunk should be no more than 40% of the total height of the tree.
    - Trees shall have one central leader, unless a different form is specified. If the leader was headed, a new leader (with a live terminal bud) at least one-half the diameter of the pruning cut shall be present.
- All graft unions, where applicable, shall be completely closed without visible sign of graft rejection. All grafts shall be visible above the soil line.
- Trunk caliper and taper shall be sufficient so that the lower five feet of the trunk remains vertical without a stake. Auxiliary stake may be used to maintain a straight leader in the upper half of the tree.
- Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

at or below soil line

- Plant roots shall be normal to the plant type specified. Root observations shall take place without impacting tree health. Root quality at or below the soil line shall comply with the project Root Acceptance details and the following:
    - The roots shall be reasonably free of scrapes, broken or split wood.
    - The root system shall be reasonably free of injury from biotic (e.g., insects and pathogens) and abiotic (e.g., herbicide toxicity and salt injury) agents. Wounds resulting from root pruning used to produce a high quality root system are not considered injuries.
    - A minimum of three structural roots reasonably distributed around the trunk (not clustered on one side) shall be found in each plant. Root distribution shall be uniform throughout the root ball, and growth shall be appropriate for the species.
    - The root collar shall be within the upper 2 inches of the substrate/soil. Two structural roots shall reach the side of the root ball near the top surface of the root ball. The grower may request a modification to this requirement for species with roots that rapidly descend, provided that the grower removes all stem girdling roots above the structural roots across the top of the root ball.
    - The root system shall be reasonably free of stem girdling roots over the root collar or kinked roots from nursery production practices.
    - At time of observations and delivery, the root ball shall be moist throughout. Roots shall not show signs of excess soil moisture conditions as indicated by stunted, discolored, distorted, or dead roots.

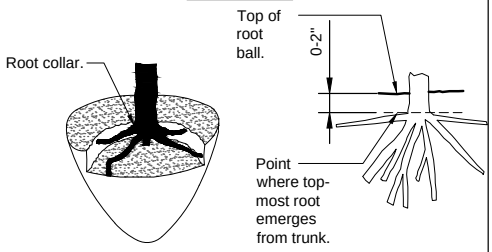


Notes:
1- Aspect ratio shall be less than 0.66 on all branch unions. Aspect ratio is the diameter of branch (B) divided by the diameter of the trunk (A) as measured 1" above the top of the branch union.

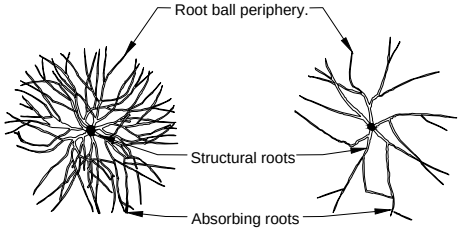
2- Any tree not meeting the crown observations detail may be rejected.

P-X CROWN OBSERVATIONS - HIGH BRANCHED

ACCEPTABLE

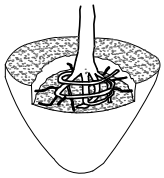


The point where top-most root(s) emerges from the trunk (root collar) should be within the top 2" of substrate. The root collar and the root ball interior should be free of defects including circling, kinked, ascending, and stem girdling roots. Structural roots shall reach the periphery near the top of the root ball.

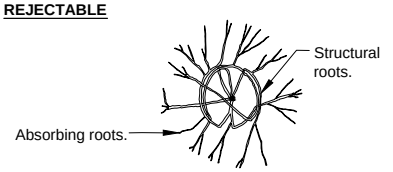


Roots radiate from trunk and reach side of root ball without defecting down or around.

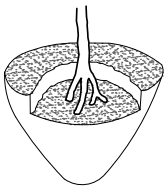
REJECTABLE



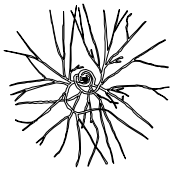
Structural roots circle interior of root ball. No structural roots are horizontal and reach the root ball periphery near the top of the root ball.



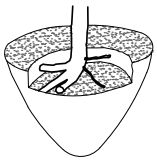
Only absorbing roots reach the periphery near the top of the root ball. Structural roots mostly wrap or are deflected on the root ball interior.



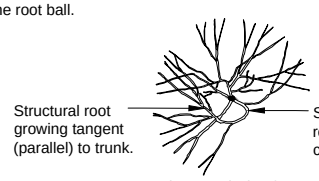
Structural roots descend into root ball interior. No structural roots are horizontal and reach the root ball periphery near the top of the root ball.



Structural roots circle and do not radiate from the trunk.



Structural roots primarily grow to one side.



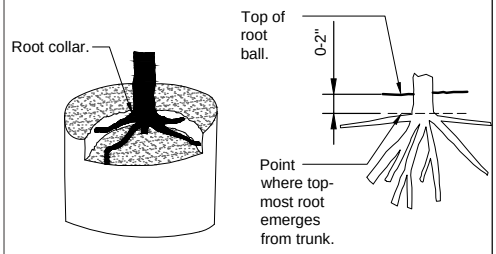
Structural roots missing from one side, and/or grow tangent to trunk.

Notes:
1- Observations of roots shall occur prior to acceptance. Roots and soil may be removed during the observation process; substrate/soil shall be replaced after the observations have been completed.

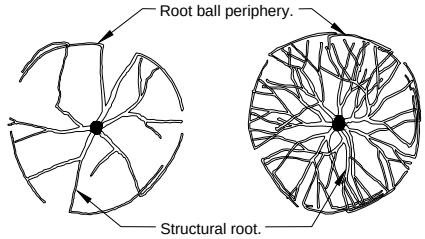
2- See specifications for observation process and requirements.

P-X ROOT OBSERVATIONS DETAIL - BALLED AND BURLAPPED

ACCEPTABLE

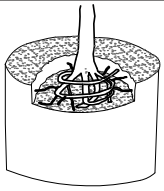


The point where top-most root(s) emerges from the trunk (root collar) should be within the top 2" of substrate. The root collar and the root ball interior should be free of defects including circling, kinked, ascending, and stem girdling roots. Structural roots shall reach the periphery near the top of the root ball.

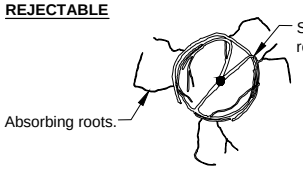


Roots radiate from trunk and reach side of root ball without deflecting down or around.

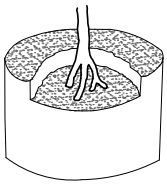
REJECTABLE



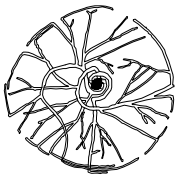
Structural roots circle interior of root ball. No structural roots are horizontal and reach the root ball periphery near the top of the root ball.



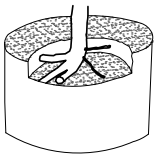
Only absorbing roots reach the periphery near the top of the root ball. Structural roots mostly wrap or are deflected on the root ball interior.



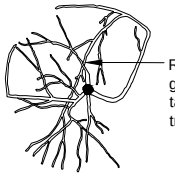
Structural roots descend into root ball interior. No structural roots are horizontal and reach the root ball periphery near the top of the root ball.



Structural roots circle and do not radiate from the trunk.



Structural roots primarily grow to one side.



Structural roots missing from one side, and/or grow tangent to trunk.

Notes:
1- Observations of roots shall occur prior to acceptance. Roots and substrate may be removed during the observation process; substrate/soil shall be replaced after observation has been completed.

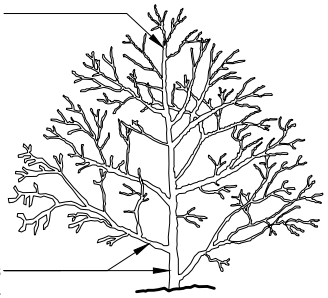
2- Small roots (¼" or less) that grow around, up, or down the root ball periphery are considered a normal condition in container production and are acceptable however they should be eliminated at the time of planting. Roots on the periperhy can be removed at the time of planting. (See root ball shaving container detail).

3- See specifications for observation process and requirements.

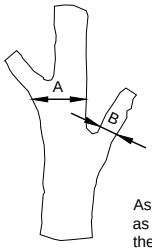
P-X ROOT OBSERVATIONS DETAIL - CONTAINER

One central leader
(No codominant
leaders)

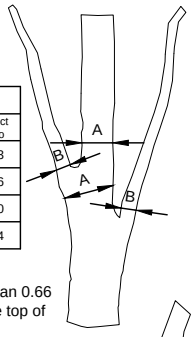
ACCEPTABLE



Aspect ratio is less
than 0.66.



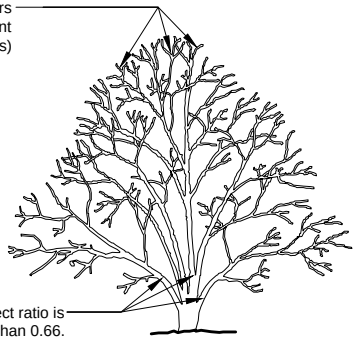
Example		
A	B	Aspect Ratio
1.50"	0.50"	0.33
2.50"	0.90"	0.36
2.0"	1.00"	0.50
2.50"	1.60"	0.64



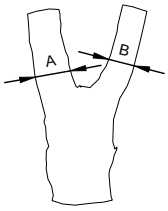
Aspect ratio of B:A less than 0.66
as measured 1" above the top of
the branch union.

Multiple leaders
(Several codominant
leaders)

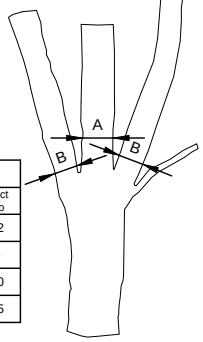
REJECTABLE



Aspect ratio is
greater than 0.66.



Example		
A	B	Aspect Ratio
2.50"	1.80"	0.72
2.0"	2.0"	1.0
2.50"	2.0"	0.80
4.0"	3.0"	0.75



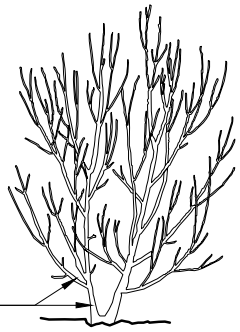
Aspect ratio of B:A greater than or equal to 0.66

Notes:
1- Aspect ratio shall be less than 0.66 on all branch unions. Aspect ratio is the diameter of branch (B) divided by the diameter of the trunk (A) as measured 1" above the top of the branch union.

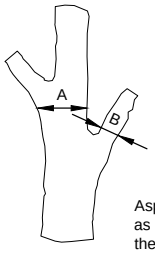
2- Any tree not meeting the crown observations detail may be rejected.

P-X CROWN OBSERVATIONS - LOW BRANCHED

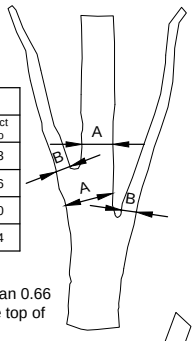
ACCEPTABLE



Aspect ratio is less
than 0.66.



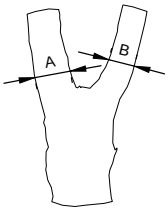
Example		
A	B	Aspect Ratio
1.50"	0.50"	0.33
2.50"	0.90"	0.36
2.0"	1.00"	0.50
2.50"	1.60"	0.64



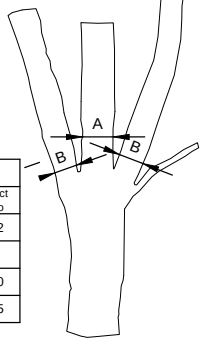
Aspect ratio of B:A less than 0.66
as measured 1" above the top of
the branch union.

REJECTABLE

Aspect ratio is
greater than 0.66.



Example		
A	B	Aspect Ratio
2.50"	1.80"	0.72
2.0"	2.0"	1.0
2.50"	2.0"	0.80
4.0"	3.0"	0.75



Aspect ratio of B:A greater than or equal to 0.66 as measured
1" above the top of the branch union.

Notes:
1- Aspect ratio shall be less than 0.66 on all branch unions. Aspect ratio is the diameter of branch (B) divided by the diameter of the trunk (A) as measured 1" above the top of the branch union.

2- Any tree not meeting the crown observations detail may be rejected.

P-X CROWN OBSERVATION DETAIL - MULTI

PLANTING SEASON

- Planting shall only be performed when weather and soil conditions are suitable for planting the materials specified. Install plants during the planting time as described below unless otherwise approved in writing by the University Landscape Architect. In the event that the Contractor request planting outside the dates of the planting season, approval of the request does not change the requirements of the warranty
    - Spring Planting: March 15 - June 1
    - Fall Planting: September 15 to November 1
- Weather Limitations: No planting shall take place during extremely hot, dry, windy or freezing weather without the approval of the University Landscape Architect. Plant when existing and forecasted weather conditions permit planting to be performed when beneficial and optimal results may be obtained.
- Plant trees, shrubs and other plants after finish grades are established and before planting sod areas unless otherwise approved by the University Landscape Architect.

PLANTING LAYOUT

- Notify the University Landscape Architect, one (1) week prior to layout. Layout all individual tree and shrub locations. Place plants above surface at planting location or place a labeled stake at planting location. Layout bed lines with paint for the Owner's Representative's approval. Secure the Owner's Representative's acceptance before digging and start of planting work.
- When applicable, plant trees before other plants are installed.
- Plants are not precise objects and minor adjustments in the layout will be required as the planting plan is constructed. These adjustments may not be apparent until some or all of the plants are installed. Make adjustments as required by the University Landscape Architect including relocating previously installed plants.

TREE AND SHRUB EXCAVATION

- Excavate circular pits with side sloped inward. Leave center area raised slightly to support root ball and assist in drainage. Scarify sides of plant pit smeared or smoother during excavation.
    - Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown stock.
    - Excavate 36" depth for trees prior to planting and 24" depth for shrubs as a baseline or deeper if needed to accommodate rootball depth and raised center area for planting pedestal.

- Fill excavation with water and allow to percolate away before positioning trees and shrubs. Notify University Landscape Architect, in writing, immediately of any subsurface drainage, ponding, or other soil conditions which the Contractor or Arborist consider detrimental to growth and survival of plant materials.
- Unsatisfactory Condition: Examine sub-grade, verify elevation, observe conditions under which work is to be performed and notify University Landscape Architect of any unsatisfactory or adverse conditions such as but not limited to:
    - Unexpected rock, utilities, or other obstructions detrimental to plant material are encountered in excavation.
    - Subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- Do not proceed until unsatisfactory conditions have been corrected.

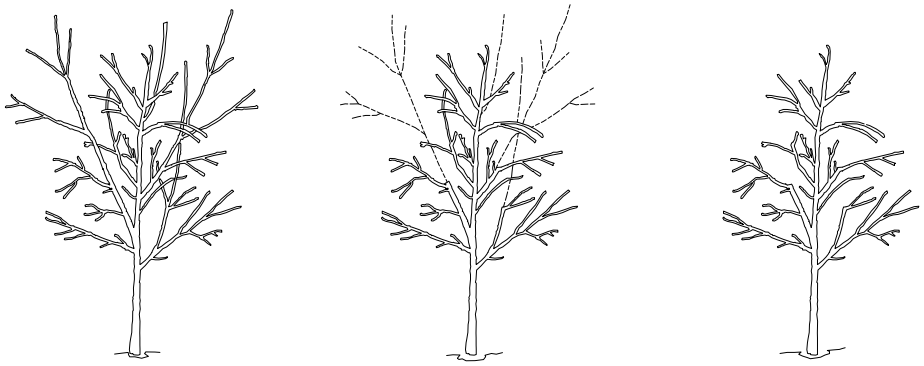
TREE AND SHRUB INSTALLATION: GENERAL

- Plant trees, shrubs and other plants after finish grades are established and before planting sod areas unless otherwise approved by the University Landscape Architect.
- Due to digging techniques or improper transplanting, plants may arrive from the nursery with the root flare buried. The Landscape Contractor must take care to make sure that the original root flare is planted at the proper grade.
- The root system of each plant, regardless of root ball package type, shall be observed by the Contractor, at the time of planting to confirm that the roots meet the requirements for plant root quality under the Plant Quality section. The Contractor shall undertake at the time of planting, all modifications to the root system required by the University Landscape Architect to meet these quality standards.
    - Modifications, at the time of planting, to meet the specifications for the depth of the root collar and removal of stem girdling roots and circling roots may make the plant unstable or stress the plant to the point that the Owner's Representative may choose to reject the plant rather than permitting the modification.
    - Any modifications required by the University Landscape Architect to make the root system conform to the plant quality standards outlined in the Plant Quality section.
    - The University Landscape Architect may reject the plant if the root modification process makes the tree unstable or if the tree is not healthy at the end of the warranty period. Such plants shall still be covered under the warranty.
    - The Contractor remains responsible to confirm that the grower has made all required root modifications noted during any nursery observations.

- Container and Boxed Root Ball Shaving: The outer surfaces of ALL plants in containers and boxes, including the top, sides and bottom of the root ball shall be shaved to remove all circling, descending, and matted roots. Shaving shall be performed by a certified arborist using suitable equipment that is capable of making clean cuts on the roots. Shaving shall remove a minimum of one inch of root mat or up to 2 inches as required to remove all root segments that are not growing reasonably radial to the trunk.
- Exposed Stem Tissue after Modification: The required root ball modifications may result in stem tissue that has not formed trunk bark being exposed above the soil line. If such condition occurs, wrap the exposed portion of the stem in a protective wrapping with a white filter fabric. Secure the fabric with biodegradable masking tape. DO NOT USE string, twine, green nursery ties or any other material that may girdle the trunk if not removed.
- Excavation of the Planting Space: Using hand tools or tracked mini-excavator, excavate the planting hole into the Planting Soil to the depth of the root ball measured after any root ball modification to correct root problems, and wide enough for working room around the root ball or to the size indicated on the drawing or as noted below.
    - For trees and shrubs planted in soil areas that are NOT tilled or otherwise modified to a depth of at least 12 inches over a distance of more than 10 feet radius from each tree, or 5 feet radius from each shrub, the soil around the root ball shall be loosened as defined below or as indicated on the drawings.
        - The area of loosening shall be a minimum of 3 times the diameter of the root ball at the surface sloping to 2 times the diameter of the root ball at the depth of the root ball.
        - Loosening is defined as digging into the soil and turning the soil to reduce the compaction. The soil does not have to be removed from the hole, just dug, lifted and turned. Lifting and turning may be accomplished with a tracked mini excavator, or hand shovels.
    - If an auger is used to dig the initial planting hole, the soil around the auger hole shall be loosened as defined above for trees and shrubs planted in soil areas that are NOT tilled or otherwise modified.
    - The measuring point for root ball depth shall be the average height of the outer edge of the root ball after any required root ball modification.
    - If motorized equipment is used to deliver plants to the planting area over exposed planting beds, or used to loosen the soil or dig the planting holes, all soil that has been driven over shall be tilled to a depth of 6 inches.
    - Mulch: Apply 2-inch average thickness of organic mulch to planting bed. Feather mulch to zero inches at root collar, beginning at 4 inches from trunks and stems. In no circumstances should mulch contact exposed portions of trunk flare.

PLANTING OVER STRUCTURE

- Verify prior to plant installation:
  - Verify that all protection board and membranes are in place
  - Verify that roof waterproofing membrane has been tested to ensure that there are no leaks, and continually protected after this testing.
  - If areas of membrane have been left exposed, waterproofing must be retested prior to installation of overburden.
- Do not proceed until unsatisfactory conditions have been corrected.



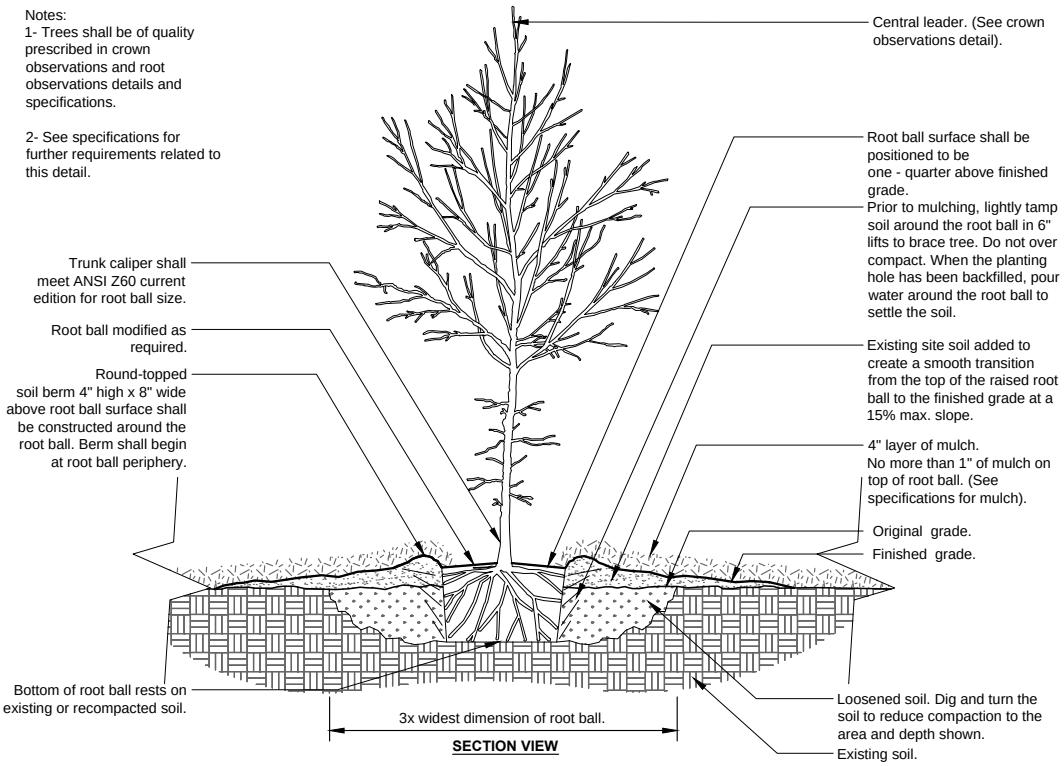
Before planting, tree has three codominant stems. The two that compete with the one in the center should be pruned to supress their growth.

Two competing stems were reduced substantially, in this case remvoing about 70% of their foilage using reduction cuts.

After pruning, tree has only one dominant stem.

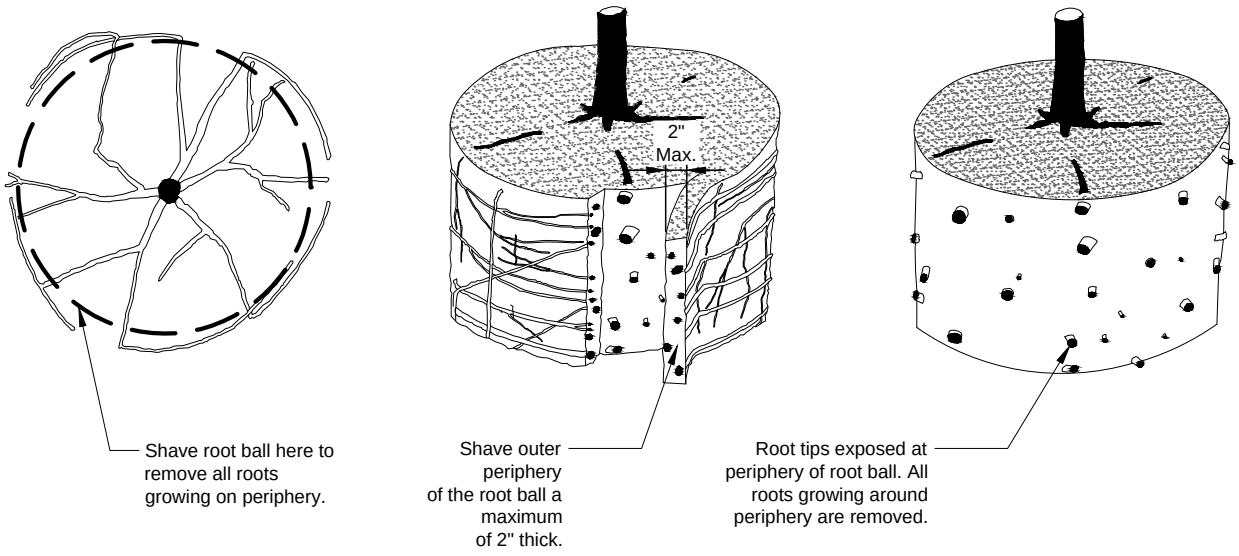
Notes:
1- All trees shown are rejectable unless they undergo recommended treatment.
2- Tree shall meet crown observation detail following correction.

S-X CROWN CORRECTION DETAIL



P-X TREE IN POORLY DRAINED SOIL

BEFORE SHAVING **SHAVING PROCESS** **SHAVING COMPLETE**



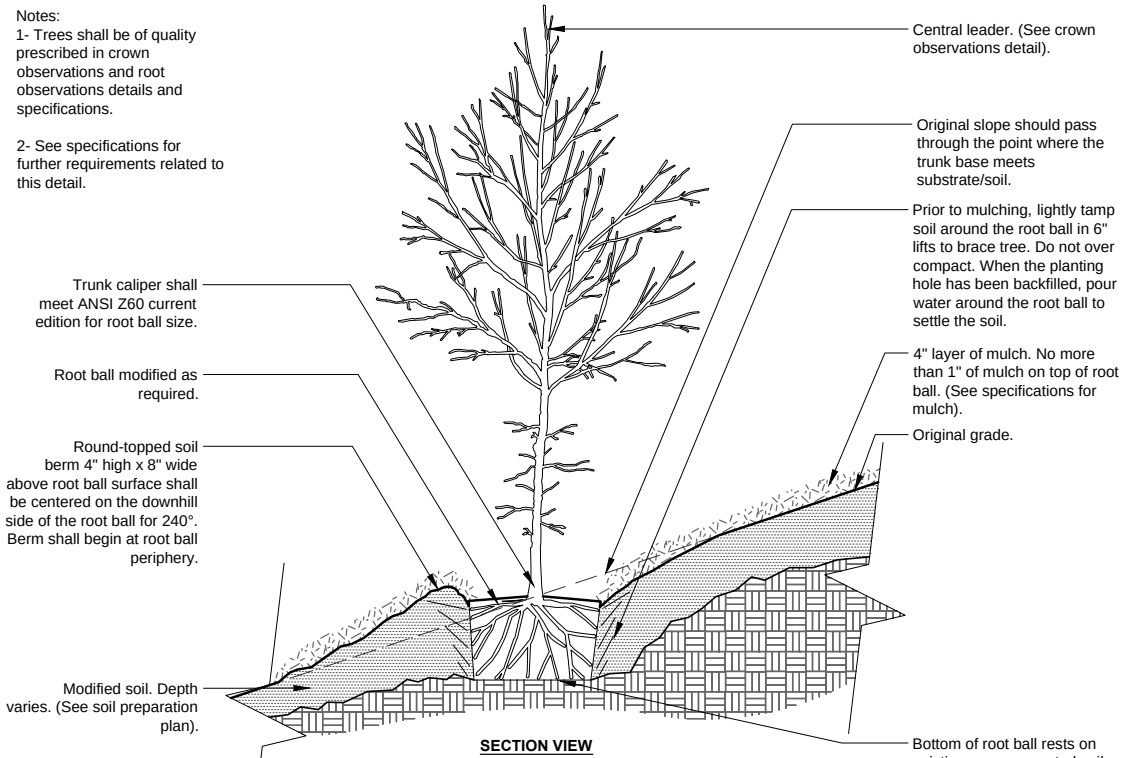
Notes:
1- Shaving to be conducted using a sharp blade or hand saw eliminating no more than needed to remove all roots on the periphery of root ball.

2- Shaving can be performed just prior to planting or after placing in the hole.

P-X ROOT BALL SHAVING CONTAINER DETAIL

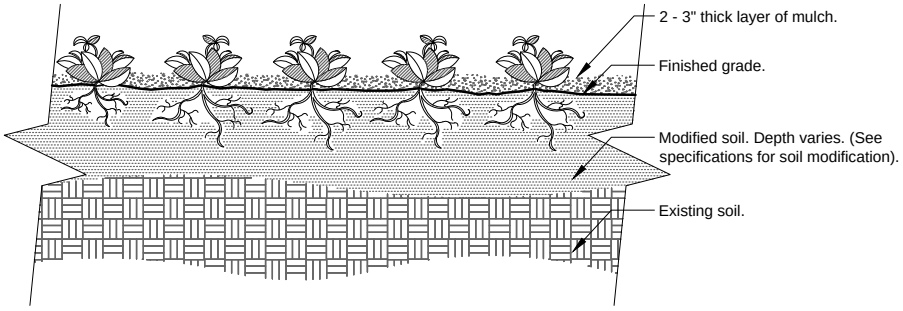
Notes:
1- Trees shall be of quality prescribed in crown observations and root observations details and specifications.

2- See specifications for further requirements related to this detail.

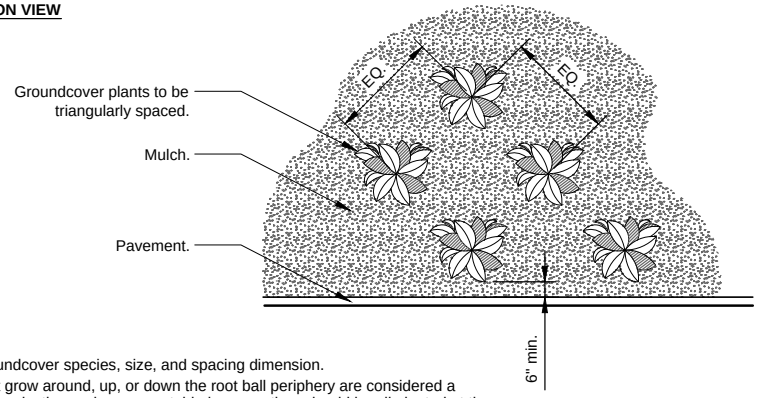


SECTION VIEW

P-X TREE ON SLOPE 5% (20:1) TO 50% (2:1) (EXISTING SOIL MODIFIED)



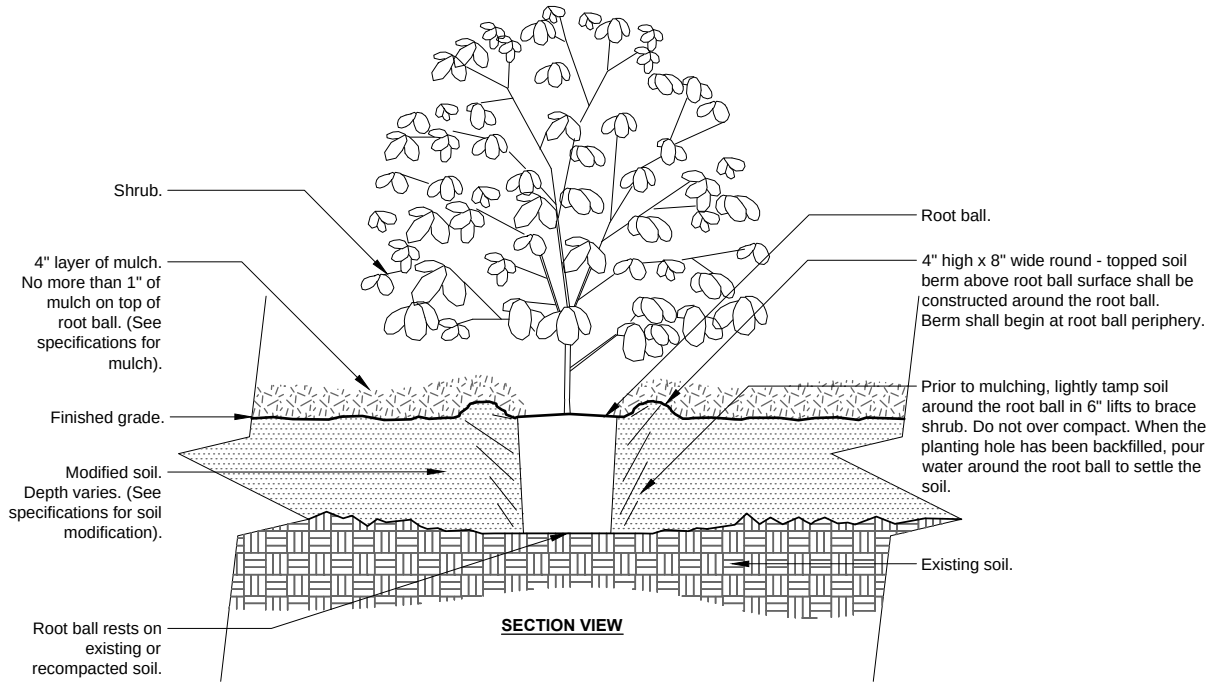
SECTION VIEW



PLAN

Notes:
1- See planting legend for groundcover species, size, and spacing dimension.
2- Small roots (¼" or less) that grow around, up, or down the root ball periphery are considered a normal condition in container production and are acceptable however they should be eliminated at the time of planting. Roots on the periperhy can be removed at the time of planting. (See root ball shaving container detail).
3- Settle soil around root ball of each groundcover prior to mulching.

P-X GROUNDCOVER



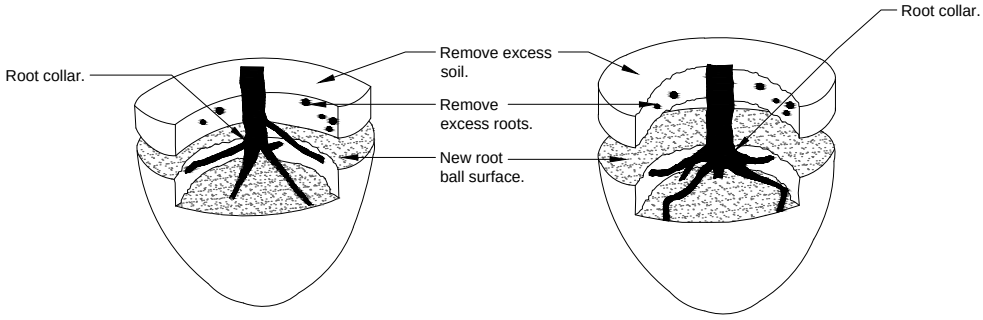
SECTION VIEW

Notes:
1- Shrubs shall be of quality prescribed in the root observations detail and specifications.

2- See specifications for further requirements related to this detail.

P-X SHRUB - MODIFIED SOIL

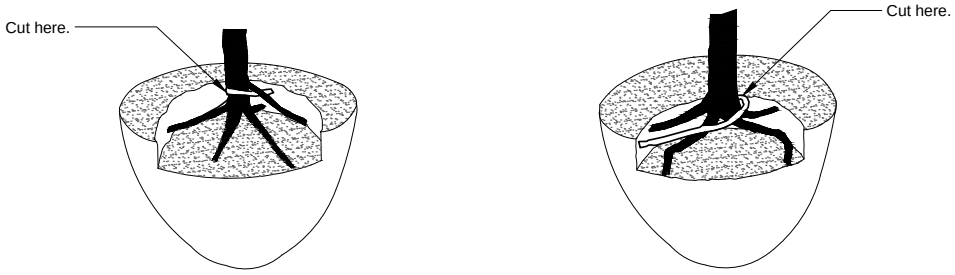
Step 1 - Remove soil and roots over the root collar.



Tree planted too deeply in root ball. Remove excess soil and roots to meet root inspection detail.

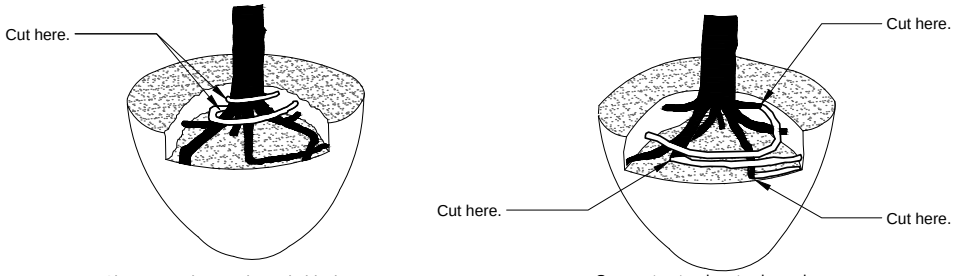
Tree planted too deeply in root ball. Remove excess soil and roots to meet root inspection detail.

Step 2 - Remove defects.



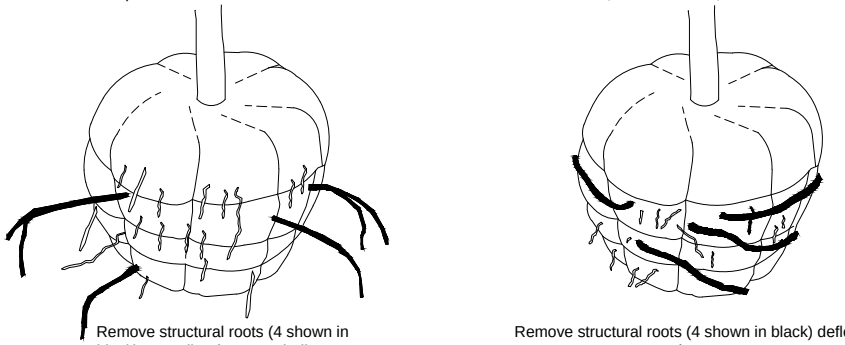
Five structural (large) roots shown in black. Remove structural (white) root wrapping root collar.

Four structural roots shown in black. Remove root (white) growing over structural roots.



Six structural roots shown in black. Remove structural roots (white) growing over root collar by cutting them just before they make an abrupt turn.

Seven structural roots shown in black. Remove structural roots (white) growing around or over root collar by cutting them just before they make an abrupt turn.



Remove structural roots (4 shown in black) extending from root ball.

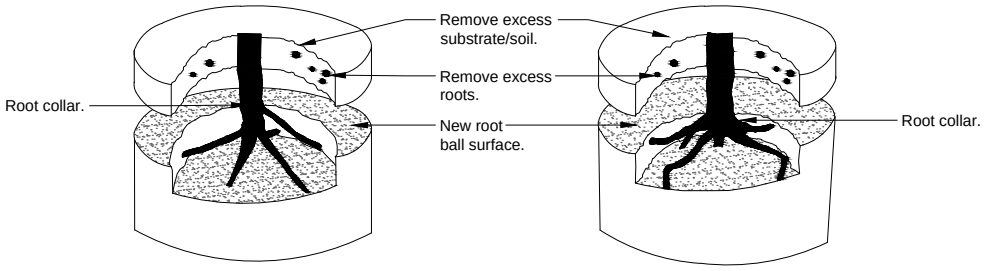
Remove structural roots (4 shown in black) deflected on root ball periphery. Small roots (¼" or less) at the periphery of the root ball are not defined as defects and do not need to be removed.

Notes:
1- All trees shown are rejectable unless they undergo recommended correction.
2- First step 1, then step 2. Adjust hole depth to allow for the removal of excess soil and roots over the root collar.
3- Roots and soil may be removed during the correction process; substrate/soil shall be replaced after the correction has been completed.
4- Trees shall pass root observations detail following correction.

P-X

ROOT CORRECTION DETAIL - BALLED AND BURLAPPED

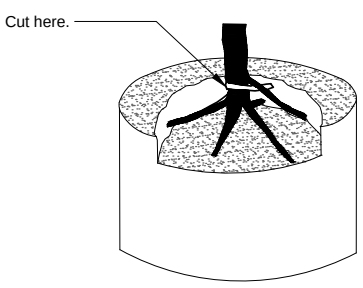
Step 1 - Remove substrate over root collar.



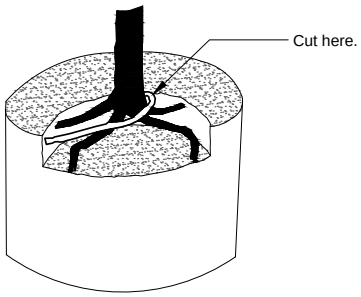
Tree planted too deeply in root ball. Remove excess substrate and roots to meet root inspection detail.

Tree planted too deeply in root ball. Remove excess substrate and roots to meet root inspection detail.

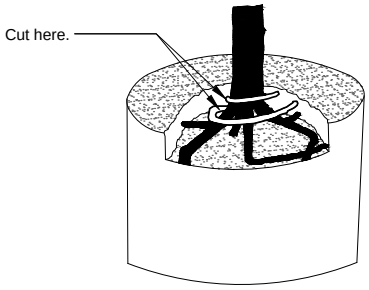
Step 2 - Remove defects.



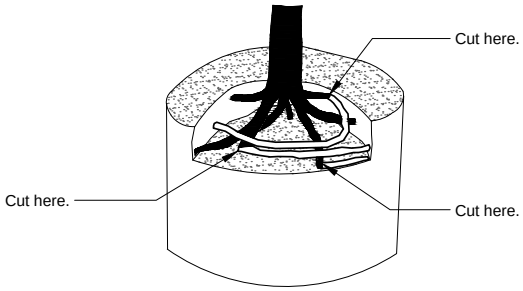
Five structural (large) roots shown in black. Remove structural root (white) wrapping root collar.



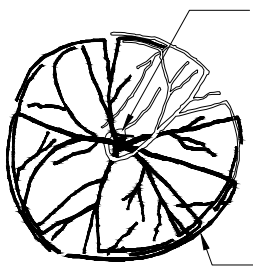
Four structural roots shown in black. Remove root (white) growing over structural roots.



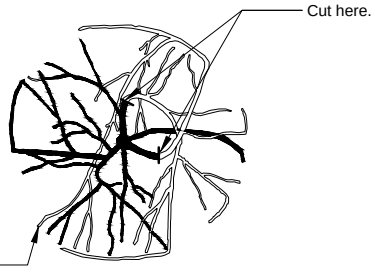
Six structural roots shown in black. Remove roots (white) growing over root collar by cutting them just before they make an abrupt turn.



Seven structural roots shown in black. Remove structural roots (white) growing around or over root collar by cutting them just before they make an abrupt turn.



Cut structural root just before it makes abrupt turn. Pruning cut should be made tangent (parallel) to the trunk.



Cut structural roots just before they make abrupt turn by cutting tangent (parallel) to the trunk (two cuts shown).

Notes:
1- All trees shown are rejectable unless they undergo recommended correction.
2- First Step 1, then Step 2. Roots and soil may be removed during the correction process; substrate/soil shall be replaced after correction has been completed.
3- Trees shall meet root observations detail following correction.
4- Small roots (1/4" or less) on the periphery of the root ball are common with container plant production. These small roots are not defined as "defects" and can be addressed at the time of installation (See root ball shaving container detail).

P-X

ROOT CORRECTION DETAIL - CONTAINER

STAKING AND GUYING

- Tree guying to be flat woven polypropylene material, 3/4 inch wide, and 900 lb. break strength. Product to be approved by the University Landscape Architect.

- Stakes shall be lodge pole stakes free of knots, holes, cross grain, and other defects at diameters and lengths appropriate to the size of plant as required to adequately support the plant.

- Below ground anchorage systems to be constructed of 2 x 2 dimensional untreated wood securing (using 3 inch long screws) horizontal portions to 4 feet long vertical stakes driven straight into the ground outside the root ball.

- Stake or guy trees as detailed immediately after planting. Trees shall stand plumb after staking or guying.

- Do not stake or guy trees unless specifically required by the Contract Documents, or in the event that the Contractor feels that staking is the only alternative way to keep particular trees plumb.

    - The University Landscape Architect shall have the authority to require that trees are staked or to reject staking as an alternative way to stabilize the tree.

    - Trees that required heavily modified root balls to meet the root quality standards may become unstable. The University Landscape Architect may choose to reject these trees rather than utilize staking to temporarily support the tree.

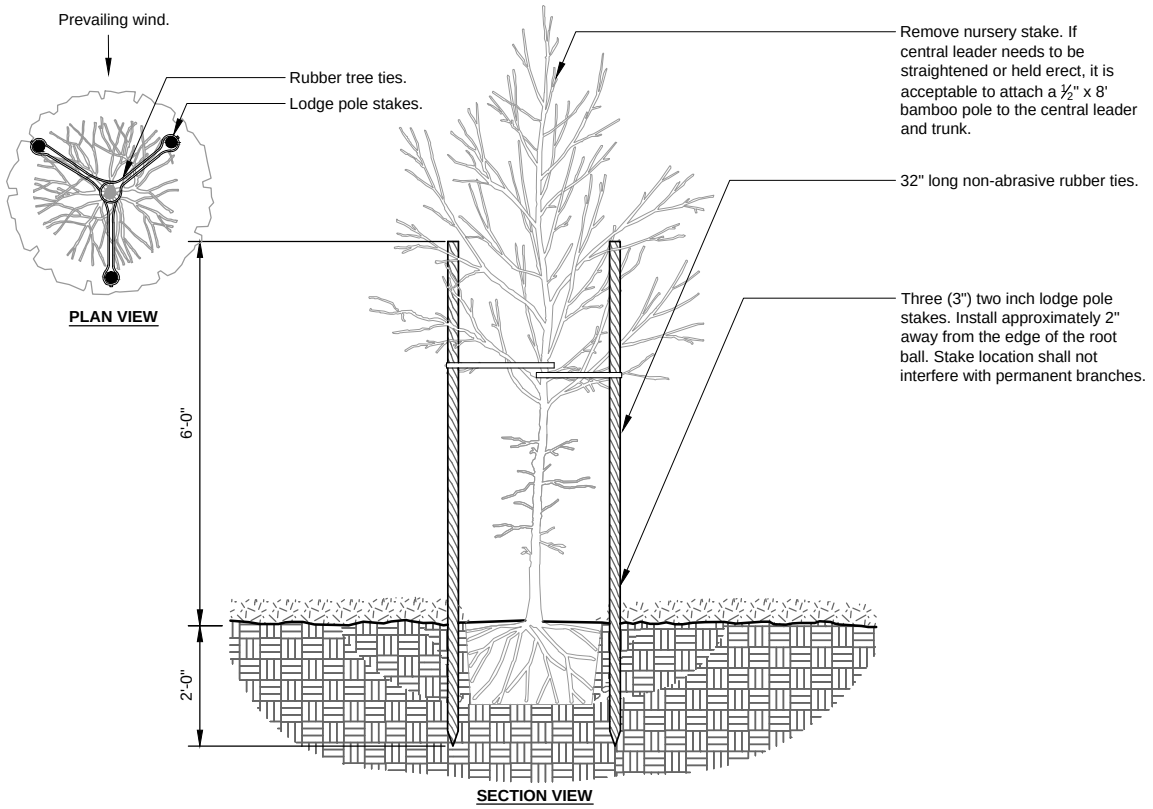
- Trees that are guyed shall have their guys and stakes removed after one full growing season or at other times as required by the University Landscape Architect.

- Tree guying shall utilize the tree staking and guying materials specified. Guying to be tied in such a manner as to create a minimum 12-inch loop to prevent girdling. Refer to manufacturer's recommendations and the planting detail for installation.

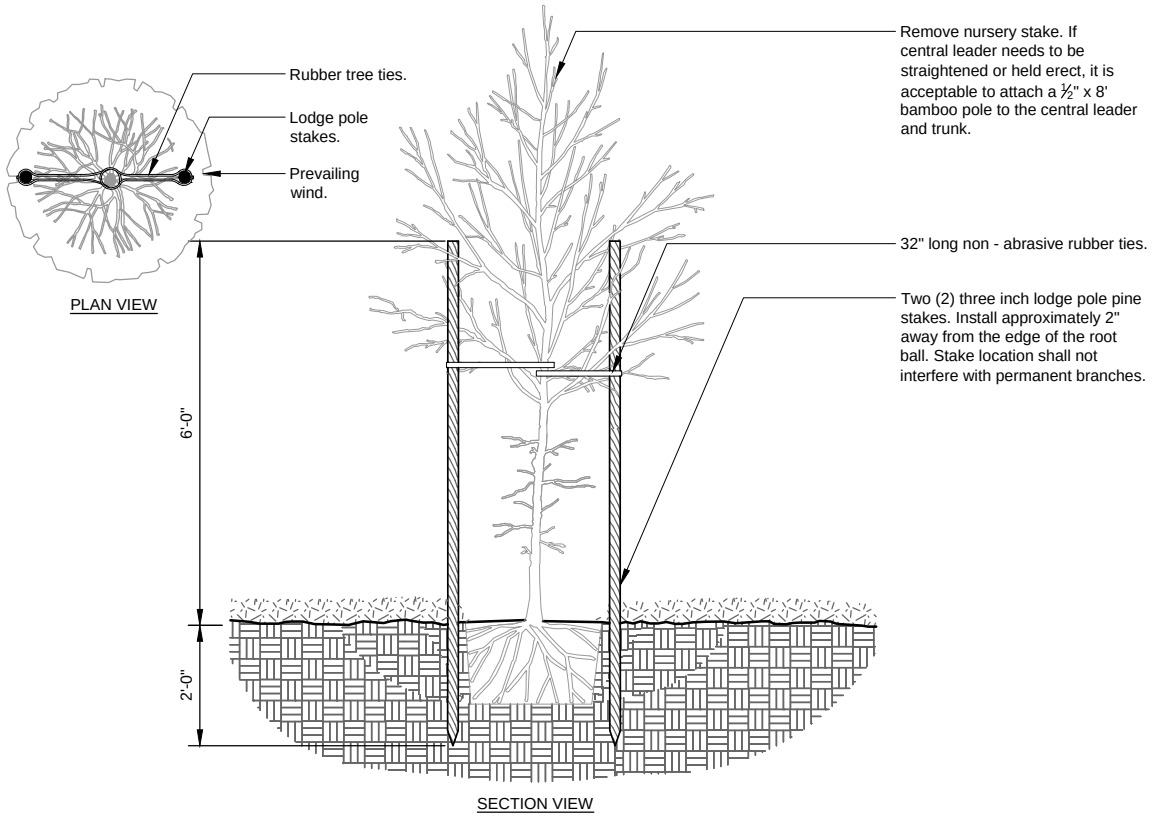
    - Plants shall stand plumb after staking or guying.

    - Stakes shall be driven to sufficient depth to hold the tree rigid.

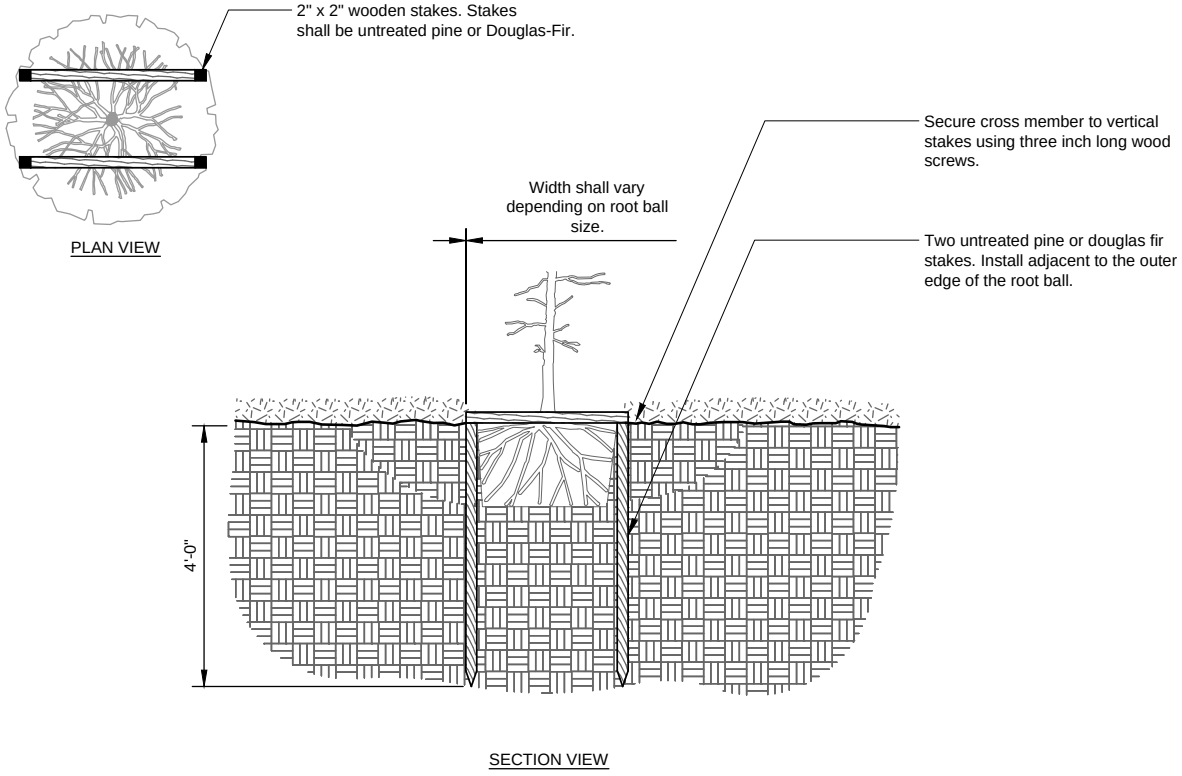
- For trees planted in planting mix over waterproofed membrane, use dead men buried 24 inches to the top of the dead man, in the soil. Tie the guy to the dead man with a double wrap of line around the dead man followed by a double half hitch. When guys are removed, leave the dead men in place and cut the guy tape 12 inches above the ground, leaving the tape end covered in mulch.



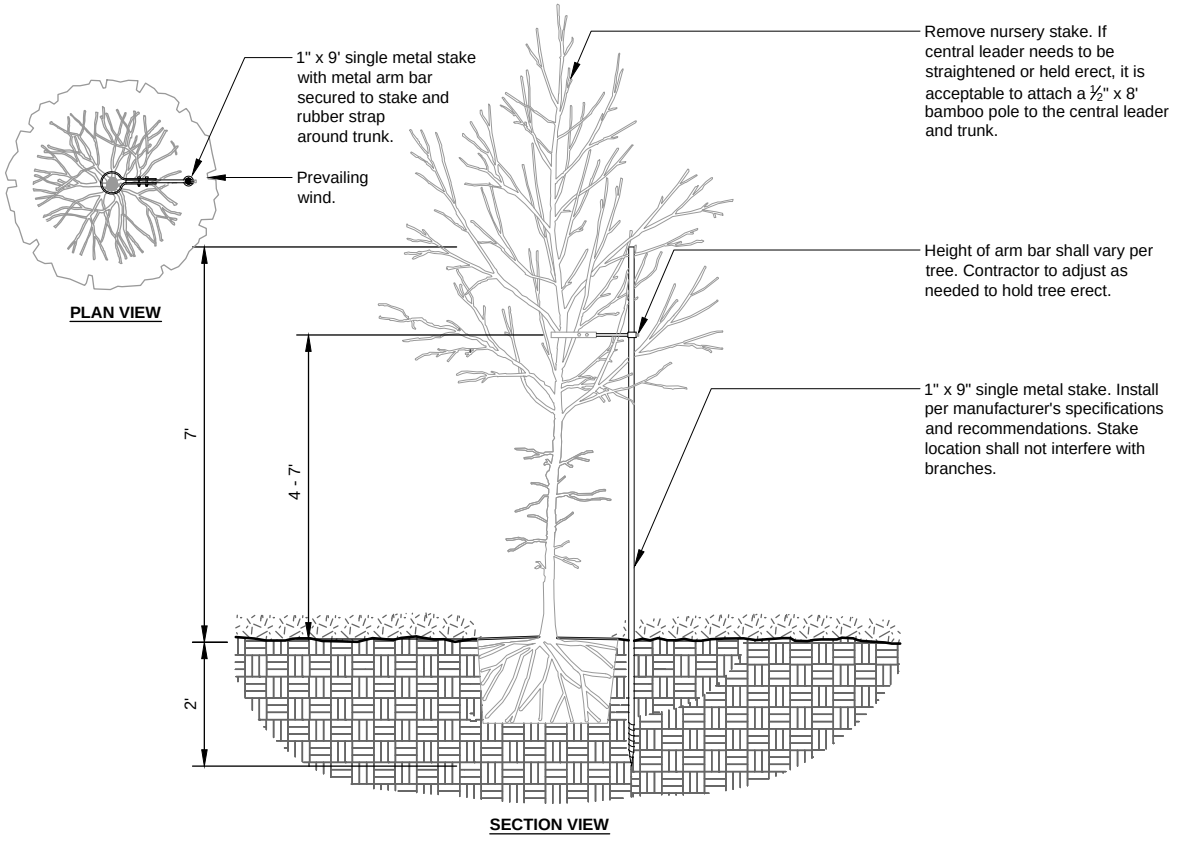
P-X TREE STAKING - LODGE POLES (3)



P-X TREE STAKING - LODGE POLES (2)



P-X TREE STAKING - STAPLE



P-X TREE STAKING - SINGLE METAL STAKE

MULCH

- Apply 2-inches of organic mulch before settlement, covering the entire planting bed area. Feather mulch to zero inches at root collar, beginning at 4 inches from trucks or stems. In no circumstances should mulch contact exposed portions of trunk flare.
- For trees planted in lawn areas the mulch shall extend to a 5 foot radius around the tree or to the extent indicated on the plans.
- Lift all leaves, low hanging stems and other green portions of small plants out of the mulch if covered.
- Mulch shall be "Walk on" grade, coarse, ground, from tree and woody brush sources. The size range shall be a minimum (less than 25% or less of volume) fine particles 3/8 inch or less in size, and a maximum size of individual pieces (largest 20% or less of volume) shall be approximately 1 to 1-1/2 inch in diameter and maximum length approximately 4 to 8". Pieces larger than 8 inch long that are visible on the surface of the mulch after installation shall be removed.
    - It is understood that mulch quality will vary significantly from supplier to supplier and region to region. The above requirements may be modified to conform to the source material from locally reliable suppliers as approved by the Owner's Representative.
- Submit supplier's product specification data sheet and a one gallon sample for approval.
- Apply mulch within 2 days after planting and maintain at specified depth during maintenance period. Maintain mulch at uniform thickness. Do not allow mulch to wash and cover branches and foliage plants. Water thoroughly immediately after mulching and hose down planting area with fine spray to wash leave of plants. Remove any mulch spilled on pavements.

COMPOSTED MULCH

- Composted mulch shall be a well decomposed, humus-like material derived from the decomposition of organic matter. The compost shall have an earthy odor, shall be free of viable weed seeds and other plant propagules (weed seed test sample to be taken from 2" to 8" below surface of the pile), shall have a moisture content such that there is no visible free water or dust produced when handling the material, and shall be free of contaminants. In addition, compost shall have the following physical characteristics:
    - Shall have minimal weed seed or weed propagules present based on germination testing of a representative sample.
    - Shall have less than 100 plant parasitic nematodes per 100 CC of organic matter
    - Shall be free of soil borne pathogens.

- Shall have a pH from 6.5 to 7.0
- Shall have a maximum carbon to nitrogen ration of 20:1 to 40:1 for native plantings.
- Shall have heavy metal concentrations below the WSDA per year load limit
- Shall be certified by the Process to Further Reduce Pathogens guideline for hot composting as established by the United States Environmental Protection agency.
- Shall be produced at a permitted solid waste composting facility

WATERING

- The Contractor is fully responsible to ensure that adequate water is provided to all plants from the point of installation until the date of Substantial Completion Acceptance. The Contractor shall adjust the automatic irrigation system, if available, and apply additional or adjust for less water using hoses as required.
- Hand water root balls of all plants to assure that the root balls have moisture above wilt point and below field capacity. Test the moisture content in each root ball and the soil outside the root ball to determine the water content.
- The Contractor shall install 25 gallon watering bag for each tree to be maintained and used for tree watering during the warranty period.

WATERING BAGS

- Plastic tree watering bags holding a minimum of 15 gallons of water and with a slow drip hole(s) water release system, specifically designed to water establishing trees. Water should release over a several day period, not within a few hours
- Watering bags shall be:
  - Treegator Irrigation Bags sized to the appropriate model for the requirements of the plant, manufactured by Spectrum Products, Inc., Youngsville, NC 27596.
  - Ooze Tube sized to the appropriate model for the requirements of the plant, manufactured by Engineered Water Solutions, Atlanta, GA.
  - Or approved equal.

TREE PRUNING

- After substantial completion, the University Arborist performs preventative maintenance pruning based on the Pacific Northwest Chapter - ISA ANSI A300 Tree Care Standards.

- Prune plants as directed by the University Landscape Architect or University Arborist. Pruning trees shall be limited to addressing structural defects as shown in details; follow recommendations in "Structural Pruning: A Guide For The Green Industry" published by Urban Tree Foundation, Visalia CA.

- All pruning shall be performed by a person experienced in structural tree pruning.

- Except for plants specified as multi-stemmed or as otherwise instructed by the University Landscape Architect, preserve or create a central leader.

- Pruning of large trees shall be done using pole pruners or if needed, from a ladder or hydraulic lift to gain access to the top of the tree. Do not climb in newly planted trees. Small trees can be structurally pruned by laying them over before planting. Pruning may also be performed at the nursery prior to shipping.

- Remove and replace excessively pruned or malformed stock resulting from improper pruning that occurred in the nursery or after.

- Pruning shall be done with clean, sharp tools. No tree paint or sealants shall be used.

- Remove only dead, dying, or broken branches. Do not prune for shape.

- Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character.

PLANT MAINTENANCE PRIOR TO SUBSTANTIAL COMPLETION

- During the project work period and prior to Substantial Completion Acceptance, the Contractor shall maintain all plants.

- Maintenance during the period prior to Substantial Completion Acceptance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, repairing and replacing of damaged tree wrap material, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings reasonably free of damaging insects and disease, and in healthy condition. The threshold for applying insecticides and herbicide shall follow established Integrated Pest Management (IPM) procedures. Mulch areas shall be kept reasonably free of weeds, grass.

CLEAN-UP AND DISPOSAL

- During installation, keep the site free of trash, pavements reasonably clean and work area in an orderly condition at the end of each day. Remove trash and debris in containers from the site no less than once a week.
    - Immediately clean up any spilled or tracked soil, fuel, oil, trash or debris deposited by the Contractor from all surfaces within the project or on public right of ways and neighboring property.
- Once installation is complete, wash all soil from pavements and other structures. Ensure that mulch is confined to planting beds and that all tags and flagging tape are removed from the site. The University Landscape Architect seals are to remain on the trees and removed at the end of the warranty period.
- Make all repairs to grades, ruts, and damage by the plant installer to the work or other work at the site.
- Removal and disposal of all excess planting soil, subsoil, mulch, plants, packaging, and other material brought to the site is the responsibility of the Contractor.

SUBSTANTIAL COMPLETION

- Acceptance of the work prior to the start of the warranty period is defined as:
    - Once the Contractor completes the installation of all items in this section, the University Landscape Architect will observe all work for Substantial Completion Acceptance upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of the observation.
    - Substantial Completion Acceptance by the University Landscape Architect shall be for general conformance to specified size, character and quality and not relieve the Contractor of responsibility for full conformance to the contract documents, including correct species.
    - Any plants that are deemed defective as defined under the provisions below shall not be accepted.
- The University Landscape Architect will provide the Contractor with written acknowledgment of the date of Substantial Completion Acceptance and the beginning of the warranty period and plant maintenance period (if plant maintenance is included).

MAINTENANCE DURING WARRANTY PERIOD

- After Substantial Completion Acceptance, the Contractor shall make sufficient site visits to observe the Owner's maintenance and become aware of problems with the maintenance in time to request changes, until the date of End of Warranty Final Acceptance.
    - Notify the University Landscape Architect in writing if maintenance, including watering, is not sufficient to maintain plants in a healthy condition. Such notification must be made in a timely period so that the University Landscape Architect may take corrective action.
        - Notification must define the maintenance needs and describe any corrective action required.
    - In the event that the Contractor fails to visit the site and or notify, in writing, the University Landscape Architect of maintenance needs, lack of maintenance shall not be used as grounds for voiding or modifying the provisions of the warranty.

END OF WARRANTY FINAL ACCEPTANCE

- At the end of the Warranty and Maintenance period the University Landscape Architect shall observe the work and establish that all provisions of the contract are complete and the work is satisfactory.
    - If the work is satisfactory, the maintenance period will end on the date of the final observation.
    - If the work is deemed unsatisfactory, the maintenance period will continue at no additional expense to the University of Washington until the work has been completed, observed, and approved by the University Landscape Architect
- If the work fails to pass final observation, any subsequent observations must be rescheduled as per above. The cost to the University of Washington for additional observations will be charged to the Contractor at the prevailing hourly rate of the University Landscape Architect.

List of Resources

The following resources were used in the creation of this document.

Antoine, J. (2015). Case Study: Stormwater Funding for Urban Forestry in Vancouver, WA. City of Vancouver Public Works. Retrieved from www.cityofvancouver.us/urbanforestry

Aspinall, P., Mavros, P., Coyne, R., & Roe, J. (n.d.). The urban brain: analysing outdoor physical activity with mobile EEG. http://doi.org/10.1136/bjsports-2012-091877

Dillard, C. (2015). Making the Urban Forest Matter: Persuasive Tools and Techniques. Seattle.

Dilley, J. (2015). The Role of Trees in Seattle's Stormwater Management. Seattle.

Donovan, G. H., & Butry, D. T. (2009). The value of shade: Estimating the effect of urban trees on summertime electricity use. Energy and Buildings. http://doi.org/10.1016/j.enbuild.2009.01.002

Donovan, G. H., Butry, D. T., Michael, Y. L., Prestemon, J. P., Liebhold, A. M., Gatziolis, D., & Mao, M. Y. (2013). The relationship between trees and human health: Evidence from the spread of the emerald ash borer. American Journal of Preventive Medicine. http://doi.org/10.1016/j.amepre.2012.09.066

Donovan, G. H., & Prestemon, J. P. (n.d.). The Effect of Trees on Crime in Portland, Oregon. Environment and Behavior, 44(1), 3–30. http://doi.org/10.1177/0013916510383238

Dwyer, J. F., Schroeder, H. W., & Gobster, P. H. (1991). The Significance of Urban Trees and Forests: Towards a Deeper Understanding of Values. Journal of Arboriculture, 17, 276–284.

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Kardan, O., Gozdyra, P., Misic, B., Moola, F., Palmer, L. J., Paus, T., & Berman, M. G. (2015). Neighborhood greenspace and health in a large urban center. Scientific Reports, 1–14. http://doi.org/10.1038/srep11610

Matsuoka, R. H. (2010). Student performance and high school landscapes: Examining the links. Landscape and Urban Planning. http://doi.org/10.1016/j.landurbplan.2010.06.011

Nowak, D. J., Stein, S. M., Randler, P. B., Greenfi eld, E. J., Comas, S. J., Carr, M. A., … eld, G. (2010). Sustaining America's Sustaining America's Urban Trees and Forests Urban Trees and Forests A Forests on the Edge Report ABSTRACT.

State University Extension, O. (2009). Tree Protection on Construction and Development Sites A Best Management Practices Guidebook for the Pacific Northwest, 1–18.

Wolf, K. (2015). Co-Benefits of the Urban Forest with a mental health focus. Seattle: University of Washington.

Wyse, S. V., Beggs, J. R., Burns, B. R., & Stanley, M. C. (2015). Protecting trees at an individual level provides insufficient safeguard for urban forests. Landscape and Urban Planning. http://doi.org/10.1016/j.landurbplan.2015.05.006

Yadrick, M. (2015). City of Seattle Parks and Recreation Subject: Alder and Maple Thinning in the Forested Parklands. Seattle Parks and Recreation, (206), 615–1046.

ADDITIONAL RESOURCES

UW Urban Forest Symposium May 20, 2015

UW Urban Forest Committee

University Landscape Advisory Committee

UW Precision Forestry Group

Patrick Pirtle

Sara Shores

Kristine Kenney

Sarah Reichard

Google Maps

UW Visual Asset Collection