THE LAWN

TREE FRAMEWORK PLAN

13 APRIL 2020
Client Team

UNIVERSITY OF VIRGINIA

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Design Team

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CONTENTS

05  Introduction
    Site Context
    Existing Conditions

15  An Illustrated History of the
    Trees on the Lawn

23  100-Year Plan Update
    Planting Plan, Approach, Typologies
    Evolution of Trees on the Lawn
    Tree Removals and Canopy Projections

53  Appendices
INTRODUCTION

FROM SEASON TO SEASON AND ONE GENERATION OF STUDENTS TO THE NEXT, THE TREES OF THE LAWN HAVE CONSISTENTLY CREATED A WELCOMING AND DYNAMIC PLACE TO CONGREGATE AND LEARN.

Sustaining this successful living model, the planting and removal of the canopy has thrived with regular attention and stewardship. This report helps document that work as well as plan for the next generation of trees on the Lawn.

An update to the 100 Year Lawn Plan came about due to the arrival of the invasive emerald ash borer into Charlottesville over the past five years, beginning the extinction of the native ash tree population. Being comprised of over 70% ash trees, the existing (and formerly proposed) trees of the Lawn are under immediate threats.

While existing trees can be treated every other year with chemicals (as is the current condition), there are health risks with chemical treatments on young trees in such a public place and sourcing new ash trees has become very difficult with no market demand.

Beginning in late 2019, the Client Team from the University of Virginia as well as arborists and members of Grounds staff, collaborated with landscape architecture firm, Wolf Josey, to create the inventory and assessment of the existing Lawn trees. This documented tree size, health, age, canopy and long term viability in addition to environmental factors such as soil compaction, annual maintenance and circulation patterns that helped establish a baseline for a update to the 100 Year Lawn Tree Plan.

In order to determine replacement varieties for new trees, this report outlines the history of trees on the Lawn, provides a current inventory and assessment, new species recommendations as well as projections for future planting and removals.
This diagram shows the extents of the World Heritage designation, an area of 28 acres.
The 4.5 acre Lawn study area was flown with a drone. The aerial was captured in late October 2019.
## EXISTING TREE INVENTORY

<table>
<thead>
<tr>
<th>LATIN NAME</th>
<th>COMMON NAME</th>
<th>DBH (in)</th>
<th>CROWN (ft)</th>
<th>EST. AGE</th>
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<td>30</td>
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<tr>
<td>53 Fraxinus pennsylvanica 'Patmore'</td>
<td>Patmore Green Ash</td>
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<td>18’</td>
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<tr>
<td>61 Acer saccharum</td>
<td>'Majesty'</td>
<td>11</td>
<td>28’</td>
<td>32</td>
</tr>
</tbody>
</table>
EXISTING TREE SPECIES

*Acer rubrum*  
Red Maple

*Acer saccharum*  
Sugar Maple

*Fraxinus spp.*  
Ash species

*Liriodendron tulipifera*  
Tulip poplar

*Tilia americana*  
Basswood

*Ulmus americana*  
Princeton Elm
EXISTING TREE HEALTH ASSESSMENT

**Vigor**
- v1 - Healthy
- v2 - Inhibited Growth
- v3 - Branch Dieback
- v4 - Major Branch Dieback
- v5 - Thin Canopy; No Annual Growth

**Structure**
- s1 - No defects
- s2 - Weak branch attachment / co-dominant leader
- s3 - Visible large bark rot or wound
- s4 - Visible structural weakness / hazard

**Root Zone**
- r1 - No Impacts
- r2 - Sensitive
- r3 - Restrictive; Compacted
- r4 - Heavily Compromised

**Overall Condition**
- c1 - Good to Excellent
- c2 - Fair
- c3 - Poor
- c4 - Dying / Dead

<table>
<thead>
<tr>
<th>LATIN NAME</th>
<th>COMMON NAME</th>
<th>VIGOR</th>
<th>STRUCTURE</th>
<th>ROOT ZONE</th>
<th>OVERALL</th>
<th>COMMENTS</th>
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<td>Green Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Asymmetrical crown</td>
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<td>v5</td>
<td>s3</td>
<td>r3</td>
<td>c4</td>
<td>Visible emerald ash borer (EAB) damage; pruning is “lion-tailed”</td>
</tr>
<tr>
<td>3 Acer rubrum</td>
<td>Red Maple</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>No visible stress, form rather comparative to ash; pruning is “lion-tailed”</td>
</tr>
<tr>
<td>4 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Minor branch dieback; possible EAB; high graft</td>
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<td>White Ash</td>
<td>v4</td>
<td>s3</td>
<td>r2</td>
<td>c3</td>
<td>Major branch dieback; visible wounding; fungi growth</td>
</tr>
</tbody>
</table>

SAMPLE TREE HEALTH ASSESSMENT | Each tree was assessed based on a rated criteria for vigor, structure, root zone, and overall health. See Appendix A for the full tree assessment; dated Oct 7 2019.
AN ILLUSTRATED HISTORY OF TREES ON THE LAWN

SINCE THE 1820s, CANOPY TREES HAVE PROVIDED A CONSISTENT AND VITAL CONTRIBUTION TO LIFE ON THE LAWN AT THE UNIVERSITY OF VIRGINIA.

Comparing the changes of trees on the Lawn time from photographs and the 2012 University of Virginia Academical Village Cultural Landscape Report, depict many variations of tree locations and species over the 190+ years documented.

Since the first black locust trees planted on the Lawn in the 1820s, the dominant tree species has shifted from black locust to red maple to the current white ash.

Site plans and photographs also capture the changing number of trees on the Lawn ranging from 26 in 1827 to 113 in 1947 as well as their consistency in form and habit. It ranges from a formal, regularly spaced single and double allee on either side of the Lawn to a more loose layout of trees lining the lawn today.

The use of the Lawn over time has also undergone significant changes responding to the needs of the school. While once forbidden to walk on the grass, today it hosts regular events that include commencement and graduation ceremonies, concerts, reunions, fundraisers and community events. These changes impact soil health and compaction that limit the size and lifespan of the trees as well as the species selected.

Finally, these patterns also depict which species have been more successful than others to assist in determining what would work best in the future. Black locusts and red maples proved to have shorter lifespans while white ash trees planted between the 1860-1880s are still standing on the Lawn today.
"From the foot of the rotunda stretches out the Lawn... whose velvet grass and quivering maples are Nature’s aid to man in the construction of the quadrangle..."
- Anonymous 1891

"[William Pratt] also began to replace the black locusts (Robinia pseudoacacia) on the Lawn. "We are indebted to him for many of the older trees and the maples and ash on the upper lawn..."
- 2013 Cultural Landscape Report

"Adopt Fraxinus species as the standard Lawn tree. Their filtered light and high branching habit, similar to the locust originally used here, will encourage grass to grow under the trees."
- 1985 Historic Central Grounds Study
Fraxinus quadrangulata
Green Ash
White Ash
Sugar Maple
European Ash
American Elm
Black Locust
Red Maple
White Ash

2019

predominant species through time

16% Fraxinus americana
White Ash
18% Fraxinus pennsylvanica
Green Ash
7% Fraxinus quadrangulata
Blue Ash
1% Tilia americana
Basswood

7% Acer rubrum
Red Maple
16% Acer saccharum
Sugar Maple
1% Liriodendron tulipifera
Tulip Poplar
1% Ulmus americana
American Elm
1% Fraxinus excelsior
European Ash

Historic Context | 21

© Historic Central Grounds Study
© Cultural Landscape Report
© Cultural Landscape Report
© Cultural Landscape Report
100-YEAR PLAN UPDATE

PROVIDING A SHORT AND LONG TERM VISION, A COMPREHENSIVE PLAN ARTICULATES FUTURE PLANTING AND PRESERVATION AS WELL AS ENSURES THE FUTURE OF HEALTHY TREES ON THE LAWN.

Using the approved layout of the current 100 Year Tree Plan and tree inventory/assessment as a baseline, the update primarily focuses on future species selection and their location. Additionally, projections for succession and replacement of species help estimate and plan for the phasing of future plantings.

Replacement species for recently planted ash trees (< 8” DBH) is also proposed to reduce long term EAB maintenance requirements and health concerns associated with repeated chemical applications.

To support a healthy and consistent canopy over time, all new plantings are proposed to be in groupings of similarly aged trees for fast and even growth. A new tree growing in the full shade of a mature tree will struggle for light resources and fail to get well established. If a tree beneath a larger, mature tree is removed, no replacement is proposed until the larger tree is also removed to create a uniform stand.

An upright branching habit and vase-like form is preferred along the Lawn side of the allee and near pavilions to maintain clear sight lines. Additionally, upright branching and compaction tolerant species are targeted nearest the Rotunda and lower Lawn area, surrounding the Homer statue, to maintain building views and tolerate higher event-related compaction.

In order to select the best species, the report considered additional factors such as species diversity, historic relevance, consistency of form and resistance from future threats including a warming climate and possible pests. Additional factors emphasized the role of fall color, form, compaction tolerance and structural vulnerability.
EXISTING 100-YR PLAN: LAYOUT

In order to achieve the proposed layout, 28 replacement trees will need to be planted over time as existing trees are removed due to health or age.
The proposed layout indicates a monoculture of Ash, which will be a long-term financial, maintenance, and health liability.
PROPOSED 100-YR TREE PLAN | In 50 years the proposed Lawn layout is achieved, with exception of the Lower Lawn which contains much younger trees.
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PLANTING TYPOLOGIES | Target characteristics and attributes per planting location.

PAVILION SIDE
- Strong Structure
- Shade Tolerance
- Fall Color

LAWN SIDE
- Upright Branching
- Compaction Tolerance
- Fall Color
PLANTING APPROACH | Species tolerant of compaction and should ideally be located in zones of higher event impacts. Whereas form and fall color are the main characteristic drivers for mid-Lawn planting.
PROPOSED TREES

THE LAWN

RED MAPLE
*Acer rubrum*

SUGAR MAPLE
*Acer saccharum*

K. COFFETREE
*Gymnocladus dioicus ‘Espresso’*

SWEETGUM
*Liquidambar styraciflua ‘Hapdell’*

BLACKGUM
*Nyssa sylvatica*

AMERICAN ELM
*Ulmus americana*

ACCOLADE ELM
*Ulmus davidiana var. japonica ‘Morton’*

BLUE ASH
*Fraxinus quadrangulata*

*for future study shows resistance to EAB*
PROPOSED TREES

- Acer rubrum - Red Maple
- Acer saccharum - Sugar Maple
- Gymnocladus dioicus 'Espresso' - Kentucky Coffeetree
- Liquidambar styraciflua 'Hapdell' - Sweetgum
- Nyssa sylvatica - Blackgum
- Ulmus americana 'Jefferson' - American Elm
- Ulmus davidiana var. japonica 'Morton' - Accolade Elm

Existing tree (2019)

1" = 100'
PLANTING SELECTION | Species identified per planting location.

**PAVILION SIDE**
- Red Maple
- Sugar Maple
- Kentucky Coffeetree
- Sweetgum
- Accolade Elm

**LAWN SIDE**
- Kentucky Coffeetree
- Sweetgum
- Blackgum
- American Elm
- Accolade Elm
PLANTING TYPOLOGIES | Characteristics and species selection for trees flanking the Pavilions.

**SINGLE SPECIES**
- Strong Vase Form
- Open Views

Accolade Elm

**MIXED SPECIES**
- Complimentary Form
- Upright Branching
- Kentucky Coffeetree
- Blackgum
- Accolade Elm
Projected 100-yr tree plan

**Existing**
- Acer rubrum (Red Maple)
- Acer saccharum (Sugar Maple)
- Fraxinus americana (White Ash)
- Fraxinus exelsior (European Ash)
- Fraxinus pennsylvanica (Green Ash)
- Fraxinus quadrangulata (Blue Ash)
- Liriodendron tulipifera (Tulip Poplar)
- Liquidambar styraciflua 'Hapdell' (Sweetgum)
- Ulmus americana (American Elm)
- Ulmus americana var. japonica 'Morton' (Accolade Elm)
- Ulmus americana 'Jefferson' (American Elm)
- Gymnocladus dioicus 'Espresso' (Kentucky Coffeetree)

**2019**
- Fraxinus americana (White Ash)
- Fraxinus pennsylvanica (Green Ash)
- Fraxinus quadrangulata (Blue Ash)
- Acer rubrum (Red Maple)
- Acer saccharum (Sugar Maple)
- Ulmus americana (American Elm)
- Liriodendron tulipifera (Tulip Poplar)
- European Ash

**2120**
- Fraxinus americana (White Ash)
- Acer saccharum (Sugar Maple)
- Fraxinus exelsior (European Ash)
- Fraxinus pennsylvanica (Green Ash)
- Fraxinus quadrangulata (Blue Ash)
- Liriodendron tulipifera (Tulip Poplar)
- European Ash

**Years 1 - 5**
- Acer rubrum (Red Maple)
- Acer saccharum (Sugar Maple)
- Fraxinus americana (White Ash)
- Fraxinus exelsior (European Ash)
- Fraxinus pennsylvanica (Green Ash)
- Fraxinus quadrangulata (Blue Ash)
- Liriodendron tulipifera (Tulip Poplar)
- European Ash

**2025**
- Acer rubrum (Red Maple)
- Acer saccharum (Sugar Maple)
- Fraxinus americana (White Ash)
- Fraxinus exelsior (European Ash)
- Fraxinus pennsylvanica (Green Ash)
- Fraxinus quadrangulata (Blue Ash)
- Liriodendron tulipifera (Tulip Poplar)
- European Ash

**Projected 100-yr tree plan**
- Acer rubrum (Red Maple)
- Acer saccharum (Sugar Maple)
- Fraxinus americana (White Ash)
- Fraxinus quadrangulata (Blue Ash)
- Liriodendron tulipifera (Tulip Poplar)
- European Ash
*Proposed locations and timing of tree planting is contingent upon projected tree decline and removals.
YEARS 1 - 5
Section looking East

YEAR 25
Section looking East
PROJECTED EVOLUTION OF TREES
YEAR 50
Section looking East

YEAR 100
Section looking East
THE LAWN
PROJECTED EVOLUTION OF TREES

Sweetgum

Accolade Elm
Of the 61 current Lawn trees, 24 of those are not located in the correct position with the 2017 proposed layout.
PROPOSAL: JUVENILE ASH TREE REMOVAL (<8” cal.)

TREATED ASH TREES | Recently planted Ash, with projected biannual EAB treatments over the next 100 years to keep them alive, should be replace with new tree species.
PROJECTED TIMELINE: YEAR 1

Prioritization of planting in openings in the layout and removing trees with the health classification of ‘Dying / Dead’.
PROJECTED TIMELINE: YEARS 1 - 5

Removing and replacing the juvenile ash, as well as trees in poor condition, are the priority in years 1 through 5.
PROJECTED TIMELINE: YEAR 10

Existing tree
Projected tree decline / removal
Proposed new tree
Proposed new tree (years 1 - 5)

Aging Green Ash and Red Maple trees with weakened branching that pose a liability to the Pavilions will likely need removing around year 10.
PROJECTED TIMELINE: YEAR 25

Tree Plantings and Removals

The oldest and most mature Green Ash will need replacing by year 25.
PROJECTED TIMELINE: YEAR 50

TREES PLANTED IN YEAR 50:

- Projected tree: Many of the oldest mature White Ash will be in decline and need to be replaced.

- Proposed new tree:
  - F. americana biltmoreana
  - F. pennsylvanica

- Proposed new tree (years 1-25):
  - A. rubrum
  - F. americana 'Rosehill'

- Existing tree:
  - F. americana biltmoreana
  - F. americana biltmoreana

- Projected tree decline / removal:
  - F. pennsylvanica
  - F. americana biltmoreana

- In year 50 many of the oldest mature White Ash will be in decline and need to be replaced.
Near term Memorial Tree removals, in years 1 through 5, are tree #45 the Shannon Green Ash and tree #59, the Enslaved Laborers Green Ash.
APPENDICES

54 Appendix A
Tree Health Assessment

62 Appendix B
Tree Inventory and Analysis

66 Appendix C
Tree Planting and Care

74 Appendix D
Tree Selection Matrix

90 Appendix E
Events, Everyday Use, & Spatial Awareness

94 Appendix F
Soil and Compaction Analyses
### APPENDIX A: TREE HEALTH ASSESSMENT

<table>
<thead>
<tr>
<th>LATIN NAME</th>
<th>COMMON NAME</th>
<th>VIGOR</th>
<th>STRUCTURE</th>
<th>ROOT ZONE</th>
<th>OVERALL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Asymmetrical crown</td>
</tr>
<tr>
<td>2 Fraxinus americana</td>
<td>White Ash</td>
<td>v5</td>
<td>s3</td>
<td>r3</td>
<td>c4</td>
<td>Visible emerald ash borer (EAB) damage; pruning is “lion-tailed”</td>
</tr>
<tr>
<td>3 Acer rubrum</td>
<td>Red Maple</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>No visible stress, form rather comparative to ash; pruning is “lion-tailed”</td>
</tr>
<tr>
<td>4 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Minor branch dieback; possible EAB; high graft</td>
</tr>
<tr>
<td>5 Fraxinus americana</td>
<td>White Ash</td>
<td>v4</td>
<td>s3</td>
<td>r2</td>
<td>c3</td>
<td>Major branch dieback; visible woundling; fungi growth</td>
</tr>
<tr>
<td>6 Acer saccharum ‘Legacy’</td>
<td>Legacy Sugar Maple</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Healthy</td>
</tr>
<tr>
<td>7 Fraxinus quadrangulata</td>
<td>Blue Ash</td>
<td>v1</td>
<td>s1</td>
<td>r1</td>
<td>c1</td>
<td>No root flare observed, possible below grade concern</td>
</tr>
<tr>
<td>8 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s2</td>
<td>r2</td>
<td>c1</td>
<td>Healthy</td>
</tr>
<tr>
<td>9 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v1</td>
<td>s2</td>
<td>r2</td>
<td>c1</td>
<td>Included bark</td>
</tr>
<tr>
<td>10 Acer rubrum ‘Red Sunset’</td>
<td>Red Sunset Red Maple</td>
<td>v2</td>
<td>s2</td>
<td>r2</td>
<td>c2</td>
<td>Mower damage to surface roots; thin canopy; slow growth</td>
</tr>
<tr>
<td>11 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v3</td>
<td>s2</td>
<td>r2</td>
<td>c2</td>
<td>Major limb decline/removal; significant lean towards pavilion</td>
</tr>
<tr>
<td>12 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Dense vase-like canopy; limb removal; minor included bark</td>
</tr>
<tr>
<td>13 Fraxinus quadrangulata</td>
<td>Blue Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Some interior self-pruning</td>
</tr>
<tr>
<td>14 Fraxinus americana ‘Rosehill’</td>
<td>Rosehill White Ash</td>
<td>v1</td>
<td>s2</td>
<td>r2</td>
<td>c2</td>
<td>No central leader; included bark</td>
</tr>
<tr>
<td>15 Fraxinus excelsior</td>
<td>European Ash</td>
<td>v4</td>
<td>s3</td>
<td>r3</td>
<td>c4</td>
<td>Possible root zone impacted by utility work; persistent borer damage</td>
</tr>
<tr>
<td>16 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Possible root zone impacted by 2018 ramp work</td>
</tr>
<tr>
<td>17 Fraxinus americana</td>
<td>White Ash</td>
<td>v3</td>
<td>s2</td>
<td>r2</td>
<td>c2</td>
<td>Signs of EAB damage; thin crown; clusters for dead branches</td>
</tr>
<tr>
<td>18 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v1</td>
<td>s1</td>
<td>r1</td>
<td>c1</td>
<td>Minor interior branch dieback</td>
</tr>
<tr>
<td>19 Acer saccharum</td>
<td>Sugar Maple</td>
<td>v1</td>
<td>s1</td>
<td>r1</td>
<td>c1</td>
<td>Potential for included bark; planted on hillside</td>
</tr>
<tr>
<td>20 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v1</td>
<td>s3</td>
<td>r2</td>
<td>c1</td>
<td>Bark rot visible - entire southeast limb (significant); heavy compaction</td>
</tr>
<tr>
<td>21 Acer saccharum ‘Legacy’</td>
<td>Legacy Sugar Maple</td>
<td>v3</td>
<td>s3</td>
<td>r2</td>
<td>c2</td>
<td>Potential hollowing core observed; lost main leader</td>
</tr>
<tr>
<td>22 Fraxinus americana</td>
<td>White Ash</td>
<td>v3</td>
<td>s3</td>
<td>r2</td>
<td>c3</td>
<td>Prior mower damage; bark rot</td>
</tr>
<tr>
<td>23 Acer saccharum ‘Legacy’</td>
<td>Legacy Sugar Maple</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Some girdling roots</td>
</tr>
<tr>
<td>24 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Healthy</td>
</tr>
<tr>
<td>25 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Healthy</td>
</tr>
<tr>
<td>26 Tilia americana ‘Redmund’</td>
<td>Basswood</td>
<td>v2</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Young; scraggely at top</td>
</tr>
<tr>
<td>27 Acer saccharum ‘Legacy’</td>
<td>Legacy Sugar Maple</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Dense oval crown</td>
</tr>
<tr>
<td>28 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Healthy</td>
</tr>
<tr>
<td>29 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Minor bark wounding; minor branch tip dieback</td>
</tr>
<tr>
<td>30 Fraxinus americana</td>
<td>White Ash</td>
<td>v2</td>
<td>s2</td>
<td>r3</td>
<td>c2</td>
<td>Minor branch tip dieback; no dominant leader; no root flare</td>
</tr>
<tr>
<td>31 Liriodendron tulipifera</td>
<td>Tulip poplar</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Healthy</td>
</tr>
<tr>
<td>32 Fraxinus americana ‘Autumn Purple’</td>
<td>Autumn Purple White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>South side of canopy thinning</td>
</tr>
<tr>
<td>33 Acer rubrum ‘Celebration’</td>
<td>Celebration Red Maple</td>
<td>v1</td>
<td>s2</td>
<td>r3</td>
<td>c1</td>
<td>Branch tip dieback</td>
</tr>
</tbody>
</table>

* Assessment dated: 7 October 2019
<table>
<thead>
<tr>
<th>LATIN NAME</th>
<th>COMMON NAME</th>
<th>VIGOR</th>
<th>STRUCTURE</th>
<th>ROOT ZONE</th>
<th>OVERALL</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>34 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s2</td>
<td>r3</td>
<td>c2</td>
<td>Included bark; grafted; showing recovery from bark issue</td>
</tr>
<tr>
<td>35 Ulmus americana ‘Princeton’</td>
<td>American Elm</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Needs crown thinning; flat interior side towards lawn</td>
</tr>
<tr>
<td>36 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Grafted; minor branch tip dieback; dense canopy</td>
</tr>
<tr>
<td>37 Acer saccharum</td>
<td>Sugar Maple</td>
<td>v1</td>
<td>s2</td>
<td>r2</td>
<td>c1</td>
<td>Co-dominant leader; crowded limbs need pruning</td>
</tr>
<tr>
<td>38 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v4</td>
<td>s3</td>
<td>r2</td>
<td>c3</td>
<td>Major limb dieback/removal; existing limbs have good annual growth</td>
</tr>
<tr>
<td>39 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v3</td>
<td>s2</td>
<td>r2</td>
<td>c2</td>
<td>Significant bark wounding, lean from prior canopy competition</td>
</tr>
<tr>
<td>40 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v2</td>
<td>s1</td>
<td>r2</td>
<td>c2</td>
<td>Minor branch tip dieback</td>
</tr>
<tr>
<td>41 Fraxinus americana biltmoreana</td>
<td>Biltmore White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Minor branch tip dieback; planted on hillside; surface rooting visible</td>
</tr>
<tr>
<td>42 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s2</td>
<td>r2</td>
<td>c1</td>
<td>Possible girdle; bark wounds healed over</td>
</tr>
<tr>
<td>43 Fraxinus quadrangulata</td>
<td>Blue Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Healthy</td>
</tr>
<tr>
<td>44 Fraxinus americana biltmoreana</td>
<td>Biltmore White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Some limb removal observed - typical of age; magnificent stature</td>
</tr>
<tr>
<td>45 Fraxinus americana</td>
<td>White Ash</td>
<td>v4</td>
<td>s3</td>
<td>r3</td>
<td>c3</td>
<td>Former EAB damage - in significant decline; smoother bark than others</td>
</tr>
<tr>
<td>46 Acer rubrum ‘Red Sunset’</td>
<td>Red Sunset Red Maple</td>
<td>v2</td>
<td>s2</td>
<td>r2</td>
<td>c2</td>
<td>Surface rooting visible; minor girdling; leggy canopy</td>
</tr>
<tr>
<td>47 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v5</td>
<td>s3</td>
<td>r2</td>
<td>c4</td>
<td>No canopy - probably EAB; rot at root flare</td>
</tr>
<tr>
<td>48 Fraxinus americana</td>
<td>White Ash</td>
<td>v4</td>
<td>s2</td>
<td>r2</td>
<td>c3</td>
<td>EAB damage observed; one of main leaders removed</td>
</tr>
<tr>
<td>49 Fraxinus americana ‘Autumn Purple’</td>
<td>Autumn Purple White Ash</td>
<td>v2</td>
<td>s2</td>
<td>r2</td>
<td>c2</td>
<td>Minor branch tip dieback; surface rooting with possible girdle; leaning</td>
</tr>
<tr>
<td>50 Acer saccharum</td>
<td>Sugar Maple</td>
<td>v2</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Bore holes - typical of species; heavy canopy competition from ash</td>
</tr>
<tr>
<td>51 Fraxinus americana biltmoreana</td>
<td>Biltmore White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Interior branch wounding - typical of age; magnificent stature</td>
</tr>
<tr>
<td>52 Acer saccharum ‘Legacy’</td>
<td>Legacy Sugar Maple</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>No visible root flare</td>
</tr>
<tr>
<td>53 Fraxinus pennsylvanica ‘Patmore’</td>
<td>Patmore Green Ash</td>
<td>v2</td>
<td>s1</td>
<td>r2</td>
<td>c2</td>
<td>Thinning canopy on interior side from competition; grafted</td>
</tr>
<tr>
<td>54 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s4</td>
<td>r2</td>
<td>c2</td>
<td>Surface roots visible - major girdling; minor wounding</td>
</tr>
<tr>
<td>55 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s2</td>
<td>r2</td>
<td>c2</td>
<td>Dense canopy; no central leader; included bark</td>
</tr>
<tr>
<td>56 Fraxinus quadrangulata</td>
<td>Blue Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Surrounding competition is heavy; no visible root flare</td>
</tr>
<tr>
<td>57 Fraxinus americana ‘Autumn Applause’</td>
<td>Autumn Applause White Ash</td>
<td>v1</td>
<td>s2</td>
<td>r2</td>
<td>c1</td>
<td>Grafted; co-dominant leader observed</td>
</tr>
<tr>
<td>58 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s2</td>
<td>r2</td>
<td>c1</td>
<td>Half canopy (lawn side); surface roots visible; pruning is “lion-tailed”</td>
</tr>
<tr>
<td>59 Fraxinus americana</td>
<td>White Ash</td>
<td>v1</td>
<td>s1</td>
<td>r2</td>
<td>c1</td>
<td>Grafted</td>
</tr>
<tr>
<td>60 Fraxinus pennsylvanica</td>
<td>Green Ash</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Healthy</td>
</tr>
<tr>
<td>61 Acer saccharum ‘Majesty’</td>
<td>Majesty Sugar Maple</td>
<td>v1</td>
<td>s1</td>
<td>r3</td>
<td>c1</td>
<td>Visible regrowth over prior bark damage; possible branch tip dieback</td>
</tr>
</tbody>
</table>

**Vigor:**
v1 - Healthy  
v2 - Inhibited growth  
v3 - Branch dieback  
v4 - Major branch dieback  
v5 - Thin canopy  
sv1 - No defects  
sv2 - Weak branch attachment/Co-dominant leader/wounding  
sv3 - Visible large rot or wound/Mower damage  
sv4 - Visible structural weakness or hazard  
sv5 - Surface rooting  
sv6 - Girdling  
sv7 - Pruning  
sv8 - Lion-tailed  
sv9 - Haphazard  
sv10 - Inconsistent  
sv11 - Significantly deflected  
sv12 - Radial dieback  
sv13 - Crown dieback  
sv14 - Major injury  
sv15 - Major deflection  
sv16 - Major girdling  
sv17 - Major wounding  
sv18 - Major structural weakness  
sv19 - Hazard  
sv20 - Hazardous  
sv21 - Hazard zone  
sv22 - High hazard  
sv23 - Extremely hazardous  
sv24 - Absolutely hazardous

**Structure:**
s1 - No defects  
s2 - Weak branch attachment/Co-dominant leader/wounding  
s3 - Visible large rot or wound/Mower damage  
s4 - Visible structural weakness or hazard  
s5 - Surface rooting  
s6 - Girdling  
s7 - Pruning  
s8 - Lion-tailed  
s9 - Haphazard  
s10 - Inconsistent  
s11 - Significantly deflected  
s12 - Radial dieback  
s13 - Crown dieback  
s14 - Major injury  
s15 - Major deflection  
s16 - Major girdling  
s17 - Major structural weakness  
s18 - Hazard  
s19 - Hazardous  
s20 - Hazard zone  
s21 - High hazard  
s22 - Extremely hazardous  
s23 - Absolutely hazardous

**Root zone:**
r1 - Good  
r2 - Sensitive  
r3 - Compacted  
r4 - Restricted  
r5 - Extremely compacted  
r6 - Absolutely compacted  
r7 - Hazardous  
r8 - Hazard zone  
r9 - High hazard  
r10 - Extremely hazardous  
r11 - Absolutely hazardous

**Overall Condition:**
c1 - Excellent to Good  
c2 - Fair  
c3 - Poor  
c4 - Dying/Dead  
c5 - Absolutely dying/dead  
c6 - Hazard zone  
c7 - High hazard  
c8 - Extremely hazardous  
c9 - Absolutely hazardous  
c10 - Absolutely dying/dead
APPENDIX A | Description of overall health characteristics.
APPENDIX A | Selection of observed health issues.

- **MAJOR BRANCH REMOVAL / DIEBACK**
- **CO-DOMINANT LEADER / INCLUDED BARK**
- **BRANCH TIP DIEBACK**
- **INCLUDED BARK**
- **TRUNK WOUND**
- **EMERALD ASH BORER DAMAGE**
- **LOW ANNUAL GROWTH RATE**
- **CROWDED BRANCHING**
**APPENDIX B: TREE INVENTORY AND ANALYSIS**

**FINDING THE RIGHT BALANCE** between fast growth and longevity is an important analytic tool during tree selection. Growth rate and lifespan don’t always share the same curve. Life expectancy is for the typical species is good growing conditions. Average lifespan estimates do not consider the existing or pending environmental threats of current health conditions.

Here is a list of the average lifespans* for the trees found on the Lawn:

- **300 yrs Average Lifespan** - Sugar Maple
- **260** - White Ash
- **250** - Tulip Poplar
- **190** - Blue Ash, European Ash
- **175** - American Elm
- **130** - Red Maple
- **120** - Green Ash
- **100** - Basswood

And here is a list of the growth rates** for the trees found on the Lawn (larger the number means slower the growth):

- **4.25 Growth Rate** - Sugar Maple
- **4** - Red Maple
- **3.5** - White Ash
- **3.5** - Blue Ash
- **3** - Green Ash
- **3** - European Ash
- **3** - American Elm
- **3** - Basswood
- **2.5** - Tulip Poplar

---

* Source: Virginia BIG Trees  [http://bigtree.cnre.vt.edu/]

** Source: International Society of Arboriculture, Morton Arboretum, Michael A. Dirr, UF
PERCENTAGE OF LIFE EXPECTANCY is a factor of the tree’s approximate age divided by its predicted lifespan, which tells us where the tree is within its lifespan and when to expect declining annual growth. It is a planning tool that aids in determining when new tree planting should occur. The formula is as follows:

\[ \text{DBH (in) x GROWTH RATE} = \frac{- \text{AGE}}{\text{AVG. LIFESPAN}} \times 100 = \text{LIVED\% OF EXPECTED LIFESPAN} \]
APPENDIX B | (Above) Tree species shown by estimated time period of planting. (Right) Critical root zone mapping.
TRENCHING AND DIGGING within structural root zones can lead to structural failure of tree support. These areas expand more rapidly during a tree’s adolescent years and slow with maturity. No trenching or digging within the SRP is permissible.
As trees age and root areas grow, so will the projected critical root zones. Overall tree growth and future roots will be limited from expansion in areas of heavy soil compaction and root competition. In cases where projected critical root zones meet footings and compaction, roots search for less compacted locations within its existing critical root zone. Impacts up to 1/3 of the total CRZ are tolerable, beyond that the tree can be severely impacted.
NATIVE TREE SPECIES provide habitat for indigenous pollinators such as caterpillars, butterflies and moths, a primary food source for nesting birds. Chickadees raising young to fledge over 3 weeks, feed their young between 350-570 caterpillars per day (that’s one every 3 minutes on average!).

Insect pollinators have evolved alongside native plant species over hundreds of thousands of years and have specialized to uniquely survive with these plant species. Often non-native trees, like the Zelkova, offer little to no insect habitat and rarely do birds choose these species for nesting.

PROMINENT NATIVE TREES like oaks and hickories are the most dominant species in our forests and each are host to hundreds of indigenous pollinators. Here is a list of habitat trees not found on the Lawn:

# of Lepidoptera species - Tree Species
518 - Oaks (Quercus)
233 - Hickories, Pecan (Carya)
124 - Beech (Fagus)
67 - Black Locust (Robinia)
42 - Sycamore (Platanus)
25 - Blackgum (Nyssa)

287 lepidoptera species
206 Maple (Acer)
142 Elm (Ulmus)
141 Linden (Tilia)
19 Ash (Fraxinus)
19 Poplar (Liriodendron)
< 50 Lepidoptera species
51 - 150 Lep. spp
151 - 250 Lep. spp
> 250 Lep. spp

Habitat

- 71% 51-150 Lep. spp
- 23% >250 Lep. spp
- 1% <50 Lep. spp
- 1% 151-250 Lep. spp
APPENDIX C: TREE PLANTING AND CARE

The Three Main Values of Bare Root Installation
1. Easy Inspection of Root Conditions
2. Identify the Root Flare
3. Lightweight, no heavy equipment required

1. EASY INSPECTION OF ROOT CONDITIONS
- Prune all girdling or turned roots to encourage new growth perpendicular to trunk at time of planting.

Despite being balled and burlapped trees, they often start in containers which are prone to encouraging circling and girdled roots leading to long term health impacts.
2. IDENTIFY THE ROOT FLARE

- Ensures most roots arrived with tree for best health and least delayed growth.
- Keeps bark from being buried (leading to rot and adventitious rooting)

Bare Root Planting

All future planted trees are recommended to be planted bare root at time of installation. This process removes the nursery soil on the rootball prior to installation for close inspection of the roots. This allows for any corrective pruning to occur before installation as well as locating the root flare correctly at the surface. Keep roots damp while exposed or in transit.
3. LIGHTWEIGHT, NO HEAVY EQUIPMENT
- Lightweight installation.
- Keep exposed roots damp with wet burlap before planting.
- Prefers same day planting as soil removal (unless gravel bed bare root planted).
- Good results!

BARE ROOT PLANTING | Bare rooting will allow any unnecessary heavy mechanical equipment on the Lawn to be reduced.
NO AERATION OR ROOT INVIGORATION | Organic, mature compost and hardwood mulch are suggested amendments for trees. Avoid pneumatic air tools (such as Air Spades) for soil remediation or decompaction.
NOTES: Mulch provides a critical source of nutrient and water retention for trees both young and old. As observed during compaction testing, it also encouraged root growth and reduces soil compaction for healthier trees (while reducing competition for resources with turf).

For newly installed trees, turf should be removed and mulch applied in 4-5’ dia circles around newly planted trees (not touching the trunk) for optimum growth.

For older trees, the larger the mulch area, the better resources the tree will have available to sustain a longer lifespan.

MULCH RINGS | Mulch holds moisture, helps naturally reduce compaction and add nutrients to soils over time. Avoid placing mulch directly against the trunk to prevent stress and bark rot.
NOTES: Circulation patterns were observed on a typical school day, Monday, January 27th. The underlying soil compaction plan indicates the compaction levels in the top 6” of soil.
PROTECTING EXISTING CRITICAL ROOT ZONES

CALCULATING ROOT ZONES:

Root Plate: (Zero impact zone)
1" DBH = 0.5' radial dimension

Critical Root Zone (CRZ):
Trees under 30" 1" DBH = 1’ radial dimension
Trees over 30" 1" DBH = 1.5’ radial dimension

Working in Critical Root Zones (CRZ)
Underground utility work will be necessary from time to time near trees within their critical root zone. When doing so, use compressed air tools such as an Air Knife (or Air Spade™) to remove soil and reveal roots. Either install line beneath roots or prune roots with a sharp saw for quick root regeneration.

Survival of Trees after Root Impact

<table>
<thead>
<tr>
<th>IMPACT TO CRZ</th>
<th>SURVIVAL RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30%</td>
<td>EXCELLENT</td>
</tr>
<tr>
<td>30-40%</td>
<td>70% : 30%</td>
</tr>
<tr>
<td>40-50%</td>
<td>50% : 50%</td>
</tr>
<tr>
<td>60-100%</td>
<td>REMOVE TREE</td>
</tr>
</tbody>
</table>

ROOT ZONE MAPPING (RIGHT) | Proper tree preservation relies on accurate CRZ mapping. Realistic rooting patterns are not simple circles, but rather amorphous shapes related to deflected root expansion.
APPENDIX D: TREE SELECTION MATRIX

Trees Reviewed
These are trees that have been reviewed – the list is expansive and diverse. There are species listed for notable qualities which may not be suitable for the Lawn.

Criteria for Selection
This list represents the criteria in which each species was judged upon. They are not weighted or ranked.

FACTORS
- Form / Habit
- Fall Color
- Disturbance Tolerance
- Structural Vulnerability
- Messiness
- Drought Tolerance
- Climate Change Resilience
- Threat Adverse
- Diseases / Pests
- Growth Rate
- Shade / Sunlight Trespass
- Pollinator Habitat
- Average Lifespan
- Regionally Native

LATIN NAME | COMMON NAME | NOTES
--- | --- | ---
Acer rubrum | Red Maple |  
Acer saccharum | Sugar Maple | ‘Legacy’ cultivar  
Carya illinoinensis | Pecan |  
Celtis occidentalis | Hackberry |  
Fagus grandifolia | Beech |  
Fraxinus quadrangulata | Blue Ash | EAB (shows resilience)  
Ginkgo biloba | Ginkgo | Male only; cultivars known to produce fruit  
Gleditsia triacanthos var. inermis | Honey Locust | Thornless variety  
Gymnocladus dioicus ‘Espresso’ | Kentucky Coffeetree | Seedless cultivar  
Liquidambar styraciflua ‘Hapdell’ | Sweetgum | Fruitless cultivar  
Liriodendron tulipifera | Tulip poplar |  
Nyssa sylvatica | Blackgum |  
Platanus x acerifolia ‘Columbia’ | London Planetree | Non-native; Anthracnose resistant  
Platanus occidentalis | Sycamore | Scale is too large; susceptible to limb loss  
Quercus bicolor | Swamp White Oak | Most susceptible to changing climate  
Quercus cocinea | Scarlet Oak | No proven urban tolerance  
Quercus ellipsoidalis | Northern Pin Oak | May be difficult to find in nurseries  
Quercus nuttallii | Nuttall Oak | Superior adaptability; hardiness could be an issue  
Quercus phellos | Willow Oak |  
Quercus prinus | Chestnut Oak | Grows exceedingly well in tough soil conditions  
Quercus rubra | Northern Red Oak | Bacterial leaf scorch  
Tilia americana | Basswood | Surface roots; future hardiness in question  
Tilia cordata | Little Leaf Linden | Non-native: successfully grown in urban conditions  
Ulmus americana ‘Jefferson’ | American Elm | Dutch Elm disease resistant  
Ulmus davidiana var. japonica ‘Morton’ | Morton Accolade Elm | Dutch Elm disease resistant  

These are trees that have been reviewed – the list is expansive and diverse. There are species listed for notable qualities which may not be suitable for the Lawn.

The draft tree selection list contained many species with notable characteristics. Through an extensive review, many were deemed unsuitable for the context of the Lawn.
**Proposed Tree Species and Selection Criteria**

These are trees that have been selected as possible future trees for the Lawn. The list is diverse and satisfies the criteria for selection in ways that are consistent and divergent from the existing tree palette.

<table>
<thead>
<tr>
<th>LATIN NAME</th>
<th>COMMON NAME</th>
<th>Form / Habit (x1.5)</th>
<th>Fall Color (x1.5)</th>
<th>Disturbance Tolerance (x1.25)</th>
<th>Structural Vulnerability (x1.25)</th>
<th>Messiness</th>
<th>Drought Tolerance</th>
<th>Climate Change Resilience</th>
<th>Diseases / Pests</th>
<th>Growth Rate</th>
<th>Shade / Sun Trespass</th>
<th>Pollinator Habitat</th>
<th>Average Lifespan</th>
<th>Regionally Native</th>
<th>OVERALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer rubrum</td>
<td>Red Maple</td>
<td>4.5</td>
<td>6</td>
<td>3.8</td>
<td>2.5</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>Y</td>
<td>40</td>
</tr>
<tr>
<td>Acer saccharum</td>
<td>Sugar Maple</td>
<td>3.0</td>
<td>6</td>
<td>2.5</td>
<td>3.8</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>Y</td>
<td>38</td>
</tr>
<tr>
<td>Carya illinoinensis</td>
<td>Pecan</td>
<td>4.5</td>
<td>4.5</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>Y</td>
<td>38</td>
</tr>
<tr>
<td>Gleditsia triacanthos var. inermis</td>
<td>Honey Locust</td>
<td>4.5</td>
<td>4.5</td>
<td>5</td>
<td>3.8</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>Y</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gymnocladus dioicus ‘Espresso’</td>
<td>Kentucky Coffee tree</td>
<td>6.0</td>
<td>4.5</td>
<td>5</td>
<td>5</td>
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<td>2</td>
<td>4</td>
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<td>4</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquidambar styraciflua ‘Hapdell’</td>
<td>Sweetgum</td>
<td>4.5</td>
<td>4.5</td>
<td>3.8</td>
<td>3.8</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>Liriodendron tulipifera</td>
<td>Tulip poplar</td>
<td>4.5</td>
<td>6</td>
<td>1.3</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>4</td>
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<td>2</td>
<td>1</td>
<td>3</td>
<td>Y</td>
<td>37</td>
</tr>
<tr>
<td>Nyssa sylvatica</td>
<td>Blackgum</td>
<td>4.5</td>
<td>6</td>
<td>5</td>
<td>3.8</td>
<td>3</td>
<td>4</td>
<td>3</td>
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<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
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<td>41</td>
</tr>
<tr>
<td>Quercus nuttallii</td>
<td>Nuttall Oak</td>
<td>4.5</td>
<td>4.5</td>
<td>3.8</td>
<td>3.8</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>N</td>
<td>39</td>
</tr>
<tr>
<td>Quercus phellos</td>
<td>Willow Oak</td>
<td>3.0</td>
<td>3</td>
<td>3.8</td>
<td>3.8</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>Y</td>
<td>40</td>
</tr>
<tr>
<td>Quercus prinus</td>
<td>Chestnut Oak</td>
<td>3.0</td>
<td>3</td>
<td>3.8</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td></td>
<td>N</td>
<td>37</td>
</tr>
<tr>
<td>Ulmus americana ‘Jefferson’</td>
<td>American Elm</td>
<td>6.0</td>
<td>6</td>
<td>2.5</td>
<td>3.8</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td>Y</td>
<td>43</td>
</tr>
<tr>
<td>Ulmus davidiana var. japonica ‘Morton’</td>
<td>Morton Accolade Elm</td>
<td>6.0</td>
<td>6</td>
<td>2.5</td>
<td>3.8</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td>N</td>
<td>42</td>
</tr>
<tr>
<td><strong>Fraxinus quadrangulata</strong></td>
<td>Blue Ash</td>
<td>6.0</td>
<td>4.5</td>
<td>5</td>
<td>3.8</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>Y</td>
<td>39</td>
</tr>
</tbody>
</table>

*This matrix represents the selection criteria, which is ranked by importance related to the context of the Lawn.

*For future study; shows resistance to EAB.
**RED MAPLE**  
*Acer rubrum*

**Strengths**
- Fall color: Red
- Growth rate: Fast
- Size: 60’ H x 30’ W
- Pest/Disease: Minimal threats
- Habitat tree for caterpillars/birds

**Weaknesses**
- Shape: Oval, low branching
- Lifespan: Short in urban envir.
- Wood can be brittle and prone to breakage.
- Minimal compaction tolerance
- Shallow, surface roots
- Dense canopy

**Notes:** Needs structural pruning to develop strong structure. Asian Longhorn Beetle significant concern if spreads to Virginia. Low branches will need pruning. Roots prone to girdling.

---

**SUGAR MAPLE**  
*Acer saccharum*

**Strengths**
- Fall color: Orange - Red - Yellow
- Growth rate: Moderate - Slow
- Size: 60’ H x 40’ W
- Pest/Disease: Minimal threats
- Habitat tree for caterpillars/birds

**Weaknesses**
- Shape: Oval, low branching
- Minimal compaction tolerance
- Shallow, surface roots
- Dense canopy

**Notes:** Asian Longhorn Beetle significant concern if spreads to Virginia. Low branches will need pruning. Roots prone to girdling. Tends to lose central leader with stress.
PECAN
*Carya illinoiensis*

**Strengths**
- Fall color: Yellow
- Growth rate: Moderate
- Size: 70' H x 60' W
- Shape: Vase-like, upright branching with age
- Tolerant to heavy compaction, drought

**Weaknesses**
- Pest/Disease: Scab, Anthracnose, cankers
- Wood can be brittle and prone to breakage
- Shallow, surface roots

**Notes:** Pecans can be messy. Difficult to source due to tap root.

HONEY LOCUST
*Gleditsia triacanthos var. inermis*

**Strengths**
- Fall color: Copper - Yellow
- Growth rate: Fast
- Size: 50' H x 40' W
- Shape: Oval, upright branching with age
- Tolerant to heavy compaction, drought

**Weaknesses**
- Pest/Disease: Many (webworm, galls, aphids, cankers, leaf spot, etc.)
- Lifespan: 60+ years
- Climate sensitive to 8

**Notes:** Requires pruning to develop strong structure. Seedpods can be messy. Shademaster and Skyline cultivars are considerations.
**KENTUCKY COFFEETREE**
*Gymnocladus dioicus* ‘Espresso’

**Strengths**
- Fall color: Yellow
- Growth rate: Moderate
- Size: 60’ H x 30’ W
- Shape: Oval, upright branching with age
- Pest/Disease: Minimal threats Tolerant to heavy compaction, drought

**Weaknesses**
- Shape: Sparse branching when young
- Lifespan: 60+ years
- Climate sensitive to 8

**Notes:** This is a seedless cultivar. Prairie Titan is a similar seedless cultivar. Both are more upright and narrow in form to the straight species.

**SWEETGUM**
*Liquidambar styraciflua* ‘Hapdell’

**Strengths**
- Fall color: Purple - Maroon
- Growth rate: Moderate - Fast
- Size: 60’ H x 40’ W
- Pest/Disease: Minimal threats

**Weaknesses**
- Shape: Oval, low branching
- Shallow, surface roots

**Notes:** Low branches will need pruning in youth. Alternate seedless cultivar such as ‘Moraine’ an option. Avoid ‘Rotundiloba’ due to lobed leaf and tendency to produce occasional fruit.
**TULIP POPLAR**  
*Liriodendron tulipifera*

**Strengths**
- Fall color: Yellow
- Growth rate: Moderate - Fast
- Shape: Oval - Columnar
- Pest/Disease: Minimal threats

**Weaknesses**
- Size: 80’ H x 40’ W
- Sensitive to root impacts

**Notes:** Due to large size, major limb failure is possible among older species for possibility of a structural hazard. Along with white oak, Jefferson considered them the “Juno and Jupiter” of the Virginia forests.

**BLACKGUM**  
*Nyssa sylvatica*

**Strengths**
- Fall color: Red - Orange
- Size: 70’ H x 30’ W
- Shape: Oval, low branching
- Pest/Disease: Cankers occasionally, otherwise minimal threats

**Weaknesses**
- Growth rate: Slow - Moderate
- Open branching, light shade

**Notes:** Low branches will need pruning with age. Critical to confirm healthy rootstock without circling roots (or tree will not develop). Variable growth between trees become more uniform after 10-15 years.
**NUTTALL OAK**  
*Quercus nuttallii (texana)*

**Strengths**
- Fall color: Red
- Size: 60’ H x 40’ W
- Growth rate: Moderate
- Tolerant to heavy compaction, drought
- Habitat tree for caterpillars/birds

**Weaknesses**
- Shape: Oval, low branching
- Pest/Disease: Minimal lethal threats.
- Possible Bacterial Leaf Scorch, Oak Wilt threats.

**Notes:** Needs structural pruning to develop strong structure. Low branches will need pruning in youth. Acorns can be messy during mast years.

---

**WILLOW OAK**  
*Quercus phellos*

**Strengths**
- Fall color: Yellow
- Growth rate: Fast
- Size: 60’ H x 40’ W
- Pest/Disease: Minimal lethal threats
- Tolerant to heavy compaction, drought
- Habitat tree for caterpillars/birds

**Weaknesses**
- Shape: Round, dense branching
- Pest/Disease: Minimal lethal threats.
- Possible Bacterial Leaf Scorch, Oak Wilt threats.
- Fast and tall growth can lead to major failure.

**Notes:** Low branches will need pruning with age. Due to large size and dense branching, major failure is possible among older species for possibility of a structural hazard. Small acorns rarely noticed.
**CHESTNUT OAK**
*Quercus prinus (montana)*

**Strengths**
- **Fall color:** Copper - Red - Yellow
- **Growth rate:** Moderate
- **Size:** 50’ H x 50’ W
- **Shape:** Round, upright branching
- **Pest/Disease:** Minimal threats Habitat tree for caterpillars/birds

**Weaknesses**
- **Pest/Disease:** Pending Oak Wilt threat.
- **Climate sensitive to 8**

**Notes:** Dense canopy. Can be difficult to source. Acorns during mast years.

---

**LITTLE LEAF LINDEN**
*Tilia cordata ‘Greenspire’*

**Strengths**
- **Fall color:** Yellow
- **Growth rate:** Moderate
- **Size:** 50’ H x 40’ W
- **Pest/Disease:** Minimal threats except Japanese beetles

**Weaknesses**
- **Shape:** Oval, upright branching
- **Climate sensitive to 7**
- **Short lived**
- **Dense canopy**

**Notes:** Branches can droop with age. Fragrant, showy flowers.
**AMERICAN ELM**  
*Ulmus americana ‘Jefferson’*

**Strengths**
- Fall color: Copper - Yellow
- Growth rate: Fast
- Shape: Vase-like
- Pest/Disease: Minimal threats Habitat tree for caterpillars/birds
- Tolerant to heavy compaction, drought

**Weaknesses**
- Size: 80’ H x 60’ W
- Pest/Disease: Various

**Notes:** Needs structural pruning to develop strong structure. Very good resistance to Dutch Elm Disease.

Asian Longhorn Beetle could be a concern if it spreads to Virginia.

**MORTON ACCOLADE ELM**  
*Ulmus davidiana var. japonica ‘Morton’*

**Strengths**
- Fall color: Yellow
- Growth rate: Fast
- Size: 50’ H x 30’ W
- Shape: Vase-like
- Pest/Disease: Minimal threats
- Tolerant to heavy compaction, drought

**Weaknesses**
- Shape: Vase-like, upright branching
- Non-native

**Notes:** Very good resistance to Dutch Elm Disease, Elm Yellows and Elm leaf beetle.

Asian Longhorn Beetle could be a concern if it spreads to Virginia.
# PLANTING APPROACHES

## a. Species Diversity
Trees that offer a variety of fall color, leaf shape, form, and pollinator habitat.

- Acer saccharum
- Gymnocladus dioicus “Espresso”
- Liquidambar styraciflua “Hapdell”
- Nyssa sylvatica
- Quercus phellos
- Quercus prinus
- Tilia cordata
- Ulmus americana ‘Jefferson’
- Ulmus davidiana var. japonica ‘Morton’

## b. Historic Relevance
Trees representative of those planted on the Lawn between 1827 and 2019.

- Acer rubrum
- Acer saccharum
- Carya illinoinensis
- Gleditsia triacanthos var. inermis
- Ulmus americana ‘Jefferson’
- Red Maple
- Sugar Maple
- Pecan
- Honey Locust
- American Elm

## c. Consistency of Form
Trees with forms that are consistent with one another and are complimentary to the existing trees.

- Gleditsia triacanthos var. inermis
- Gymnocladus dioicus “Espresso”
- Liquidambar styraciflua “Hapdell”
- Nyssa sylvatica
- Ulmus davidiana var. japonica ‘Morton’
- Accolade Elm

## d. Threat Resilience
Trees with resilience to warming USDA zones and pending biological threats.

- Liquidambar styraciflua “Hapdell”
- Liriodendron tulipifera
- Nyssa sylvatica
- Quercus nuttallii
- Quercus phellos
- Ulmus davidiana var. japonica ‘Morton’
- Accolade Elm
- Acer rubrum
- Acer saccharum
- Red Maple
- Sugar Maple
- Pecan
- Honey Locust
- American Elm

- Sweetgum
- Tulip poplar
- Blackgum
- Nuttall Oak
- Willow Oak
PLANTING APPROACH ‘A’
SPECIES DIVERSITY

Blackgum  Willow Oak  Chestnut Oak  Little Leaf Linden  American Elm  Accolade Elm
Sugar Maple  K. Coffeetree  Sweetgum
PLANTING APPROACH ‘B’
HISTORIC RELEVANCE

Red Maple  Sugar Maple  Pecan  Honey Locust  American Elm
PLANTING APPROACH ‘C’

CONSISTENCY OF FORM

Honey Locust  K. Coffeetree  Sweetgum  Blackgum  Accolade Elm
PLANTING APPROACH ‘D’
THREAT RESILIENCE

Sweetgum  Tulip Poplar  Blackgum  Nuttall Oak  Willow Oak  Accolade Elm
In 60 years, if existing high global emissions continue, Charlottesville climate (USDA zone 7a) will more closely resemble Shreveport, Louisiana (USDA zone 8b).

In 60 years, if global emissions are reduced, Charlottesville climate (USDA zone 7a) will more closely resemble Jonesboro, Arkansas (zone 7b).

**Climate Change**

**Pest & Disease Threats**

- Oak Wilt
- Emerald Ash Borer
- Asian Longhorned Beetle

APPENDIX D | The diagrams above represent future possible climate, pest and disease threats related to Planting Approach ‘D’.
APPENDIX E: EVENTS, EVERYDAY USE, & SPATIAL AWARENESS

**August**
Opening Convocation

**December**
Lighting of the Lawn

**May - June**
Alumni Reunions

**October**
Trick - or - Treat

**May**
Commencement

Large scale University events on the Lawn. (Right) Daily pedestrian use and circulation study.
EVERYDAY CIRCULATION AND USE was observed on a typical school day, Monday, January 27th. The total time of observation lasted two and a half hours from 11:45am to 2:15pm. The weather was cool, overcast, with a high of 52°F.
APPENDIX E | Spatial awareness of the Lawn based upon planted and architectural edges and setbacks.

**Unplanted Setback**

**NOTES:** Trees to be avoided in these areas due to regular use for event staging and utilities.

**Planted edge**

**NOTES:** Evergreen, low canopy species such as southern magnolias, hollies and boxwood to remain the dominant species along the edges of these areas to continue the sense of enclosure and focus views inward.

**Architectural edge**
APPENDIX F: SOIL AND COMPACTION ANALYSES

**Test 1**
- +/- 1” organic layer; highest silt content of conducted tests; heavy compaction

**Test 2**
- +/- 3” organic layer; compacted clay subsoil - heavy compaction

**Test 3**
- +/- 8” organic layer; good structure and open pore space, roots noted in subsoil

**Test 4**
- Minimal organic layer; compacted clay subsoil - heavy compaction
Soil sample augering completed January 14, 2019.

Soil compaction testing using a penetrometer completed January 14, 2019.

**Top 6” 8”-12” Deep**

<table>
<thead>
<tr>
<th>Observation</th>
<th>&lt;200 psi</th>
<th>200-300 psi</th>
<th>&gt;300 psi</th>
<th>(root restrictive)</th>
</tr>
</thead>
</table>

**OBSERVATIONS** Mulch beneath larger trees and surface compost applications reduced root limiting soil compaction levels. Smaller trees with reduced mulch areas typically had more compacted soils outside of the mulched areas.

Vehicular maintenance access south of pavilions IX and X lead to higher compaction in this area.

Despite high compaction levels in the lower lawn, UVA staff observed that it drains well and grows turf easily. It is suspected that this is due to the soil being on installed fill soils with larger subgrade void space.

**REGULAR SAMPLING POINTS** were taken on a 50’ x 50’ grid for each panel of the Lawn (indicated by the black dots).

Samples were taken with a penetrometer at 24 hours after a rain event - the soil moisture reading was at 60%. Where penetration resistance is above 300, roots will only penetrate the soil if natural cracks or pores are present.
Utilities & Construction

Daily Use & Maintenance

Events

APPENDIX F | (Above) Impacts to soil, turf, and trees. (Right) 2016 UVA soil sample tests conducted by Tellus Agronomics LLC.
<table>
<thead>
<tr>
<th>Flat</th>
<th>CEC (ME/100g)</th>
<th>Organic Matter (%)</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat 1</td>
<td>11.07</td>
<td>5.33</td>
<td>7.2</td>
</tr>
<tr>
<td>Flat 2</td>
<td>15.11</td>
<td>7.47</td>
<td>7.0</td>
</tr>
<tr>
<td>Flat 3</td>
<td>13.97</td>
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<tr>
<td>Flat 4</td>
<td>12.42</td>
<td>5.84</td>
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</tr>
<tr>
<td>Flat 5</td>
<td>15.05</td>
<td>7.09</td>
<td>7.1</td>
</tr>
</tbody>
</table>
DRAINAGE PIPING (2012) provides stormwater conveyance via 2” perforated lateral pipes that occur at 10’ on center, buried 12-14” deep in sand. A 6” dia. collector pipe runs down the central spine of the Lawn.

IRRIGATION (1999) occurs via pop-up rotary heads spaced 32-38’ on center along the length of the Lawn. The lateral locations of heads occurs in four spots, at 48’ from the centerline of the Lawn on each side and 12’ off the colonnade on each side.

APPENDIX F | (Above) Subsurface soil improvements to increase drainage and provide water during periods of drought. (Right) Irrigation and drainage piping is kept clear of the tree panels.