THE LAWN
TREE FRAMEWORK PLAN

13 APRIL 2020

UNIVERSITY of VIRGINIA

Client Team

UNIVERSITY OF VIRGINIA

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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.

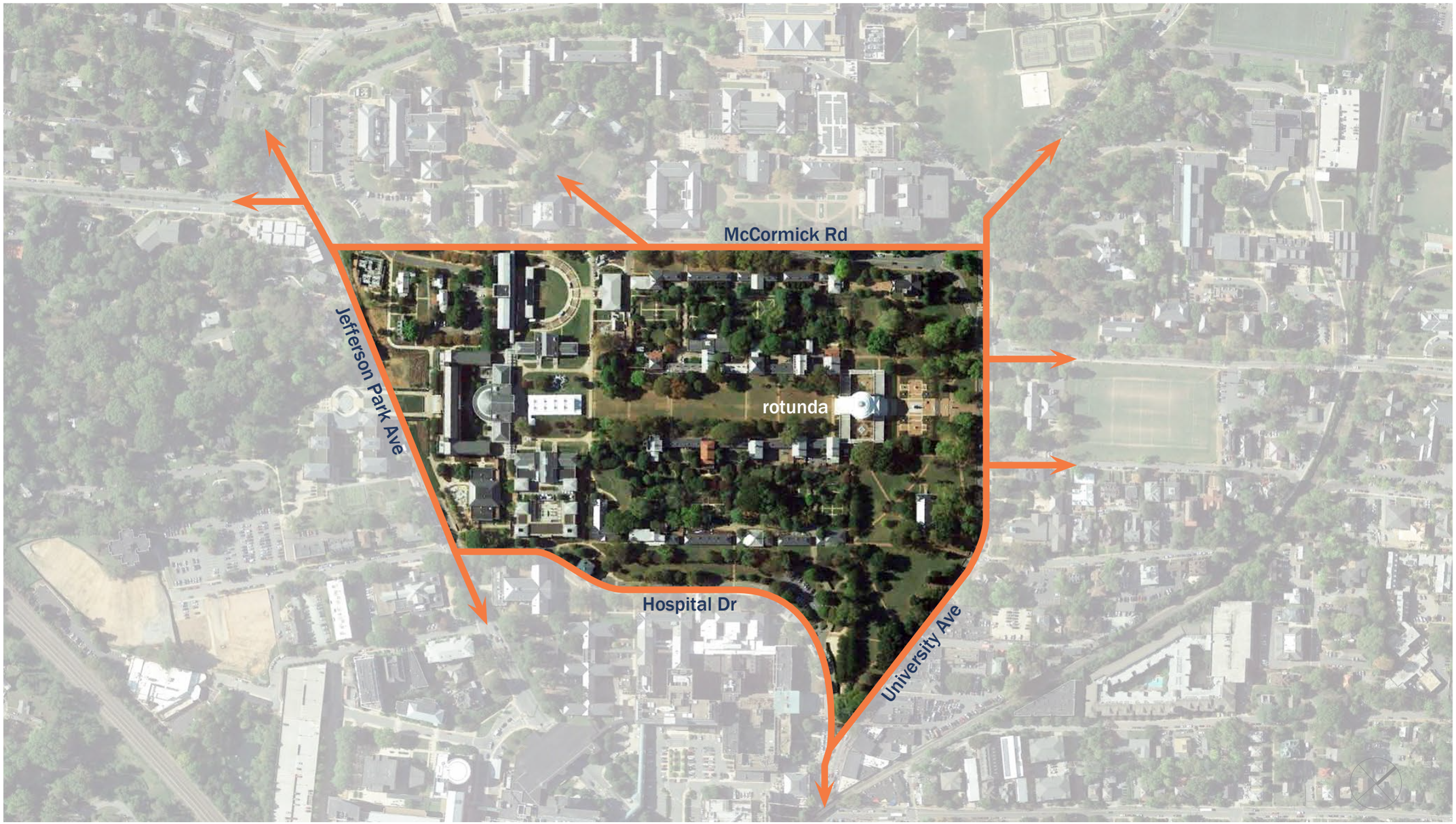
Sustaining this successful living model, the planting and removal of the canopy has thrived with regular attention and stewardship. This report helps document that work as well as plan for the next generation of trees on the Lawn.

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.

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.

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.



UNESCO WORLD HERITAGE SITE | This diagram shows the extents of the World Heritage designation, an area of 28 acres.

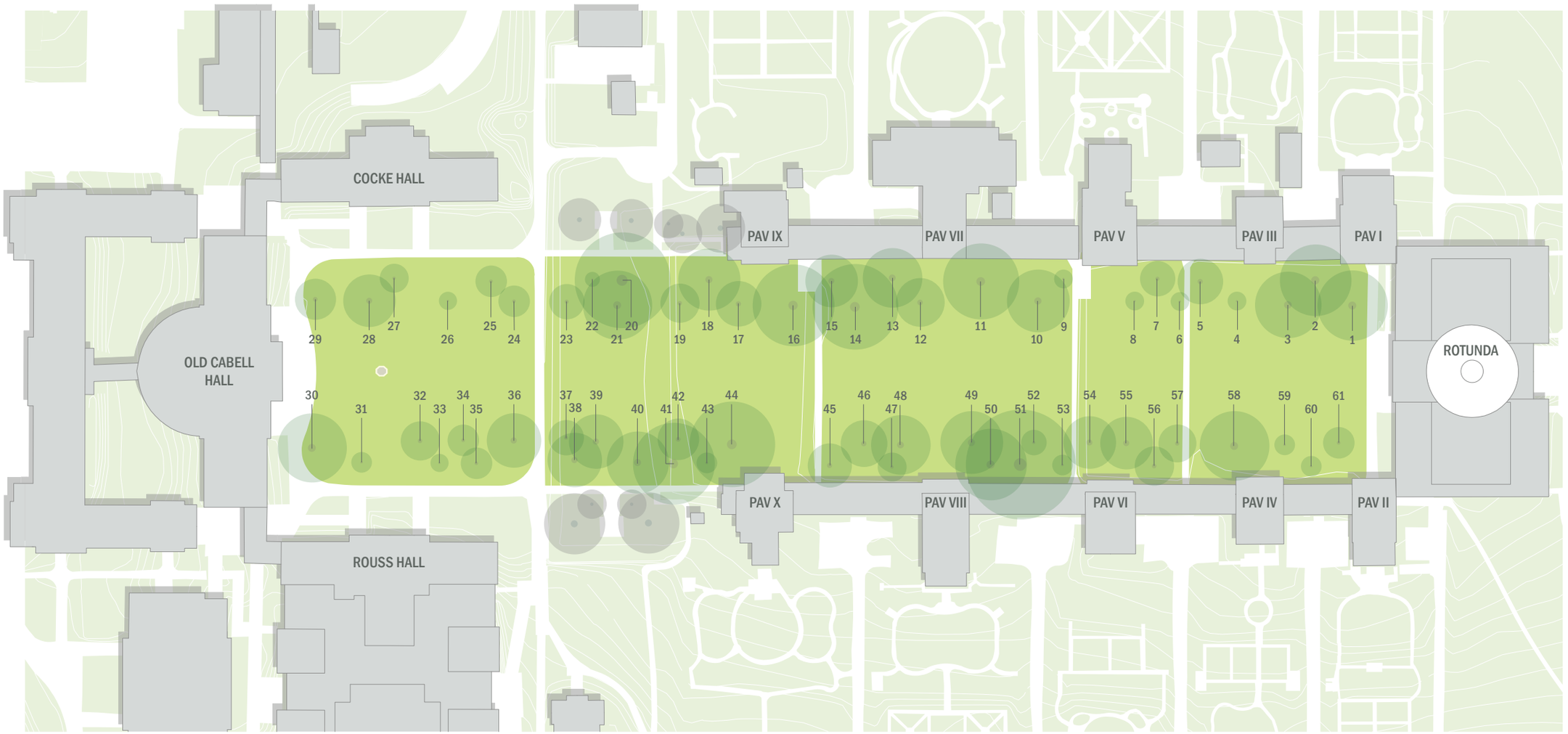
EXTENTS OF STUDY AREA | The 4.5 acre Lawn study area was flown with a drone. The aerial was captured in late October 2019.

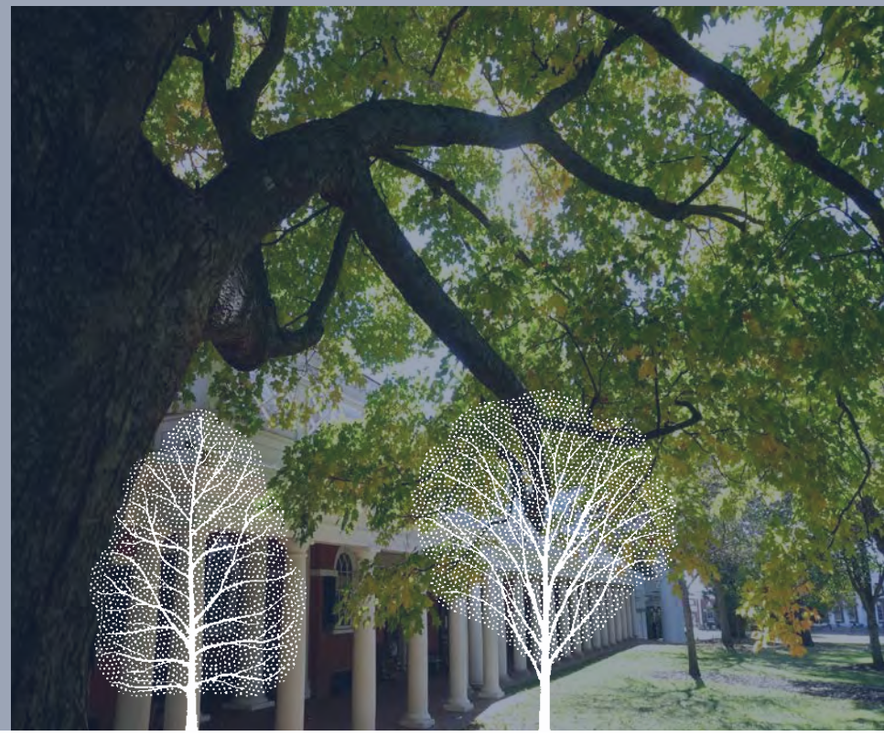
EXISTING TREE INVENTORY

	LATIN NAME	COMMON NAME	DBH (in)	CROWN (ft)	EST. AGE
1	*Fraxinus pennsylvanica*	Green Ash	28	60’	84
2	*Fraxinus americana*	White Ash	33.5	63’	117
3	*Acer rubrum*	Red Maple	29	57’	116
4	*Fraxinus americana*	White Ash	5	15’	18
5	*Fraxinus americana*	White Ash	35.5	39’	124
6	*Acer saccharum* ‘Legacy’	Legacy Sugar Maple	5	15’	16
7	*Fraxinus quadrangulata*	Blue Ash	8.5	30’	24
8	*Fraxinus americana*	White Ash	6	15’	21
9	*Fraxinus pennsylvanica*	Green Ash	6	15’	18
10	*Acer rubrum* ‘Red Sunset’	Red Sunset Red Maple	16	54’	32
11	*Fraxinus pennsylvanica*	Green Ash	30.5	66’	92
12	*Fraxinus americana*	White Ash	18.5	42’	65
13	*Fraxinus quadrangulata*	Blue Ash	23	51’	81
14	*Fraxinus americana* ‘Rosehill’	Rosehill White Ash	33	75’	48
15	*Fraxinus exelsior*	European Ash	27.5	45’	83
16	*Fraxinus americana*	White Ash	39	72’	137
17	*Fraxinus americana*	White Ash	15	39’	53
18	*Fraxinus pennsylvanica*	Green Ash	22	54’	66
19	*Acer saccharum* ‘Legacy’	Legacy Sugar Maple	12	33’	51
20	*Fraxinus pennsylvanica*	Green Ash	40.5	84’	122
21	*Acer saccharum* ‘Legacy’	Legacy Sugar Maple	28	60’	119
22	*Fraxinus americana*	White Ash	5.5	12’	19
23	*Acer saccharum* ‘Legacy’	Legacy Sugar Maple	10.5	30’	18
24	*Acer saccharum* ‘Legacy’	Legacy Sugar Maple	11	27’	18
25	*Fraxinus americana*	White Ash	9	27’	32
26	*Tilia americana* ‘Redmund’	Basswood	4	15’	12
27	*Acer saccharum* ‘Legacy’	Legacy Sugar Maple	9.5	24’	40
28	*Fraxinus americana*	White Ash	22	45’	77
29	*Fraxinus americana*	White Ash	10.5	36’	37
30	*Fraxinus americana*	White Ash	34.5	60’	121
31	*Liriodendron tulipifera*	Tulip poplar	7	18’	18
32	*Fraxinus americana* ‘Autumn Purple’	Autumn Purple White Ash	10.5	33’	37
33	*Acer rubrum* ‘Celebration’	Celebration Red Maple	7.5	15’	18

	LATIN NAME	COMMON NAME	DBH (in)	CROWN (ft)	EST. AGE
34	*Fraxinus americana*	White Ash	10	27’	35
35	*Ulmus americana* ‘Princeton’	American Elm	7	27’	21
36	*Fraxinus americana*	White Ash	28.5	48’	100
37	*Acer saccharum* ‘Legacy’	Legacy Sugar Maple	12	30’	51
38	*Fraxinus pennsylvanica*	Green Ash	43.5	48’	131
39	*Fraxinus pennsylvanica*	Green Ash	25	48’	75
40	*Fraxinus pennsylvanica*	Green Ash	18	54’	54
41	*Fraxinus americana biltmoreana*	Biltmore White Ash	52	78’	182
42	*Fraxinus americana*	White Ash	12.5	36’	44
43	*Fraxinus quadrangulata*	Blue Ash	5	18’	18
44	*Fraxinus americana biltmoreana*	Biltmore White Ash	53.5	75’	187
45	*Fraxinus pennsylvanica*	Green Ash	15.5	36’	34
46	*Acer rubrum* ‘Red Sunset’	Red Sunset Red Maple	13.5	39’	32
47	*Fraxinus pennsylvanica*	Green Ash	10	24’	30
48	*Fraxinus americana*	White Ash	27	51’	95
49	*Fraxinus americana* ‘Autumn Purple’	Autumn Purple White Ash	16.5	54’	46
50	*Acer saccharum*	Sugar Maple	25.5	63’	108
51	*Fraxinus americana biltmoreana*	Biltmore White Ash	58.5	96’	205
52	*Acer saccharum* ‘Legacy’	Legacy Sugar Maple	7	21’	30
53	*Fraxinus pennsylvanica* ‘Patmore’	Patmore Green Ash	8	18’	24
54	*Fraxinus americana*	White Ash	19.5	47’	68
55	*Fraxinus americana*	White Ash	20.5	45’	72
56	*Fraxinus quadrangulata*	Blue Ash	8	27’	28
57	*Fraxinus americana* ‘Autumn Applause’	Autumn Applause White Ash	12	33’	42
58	*Fraxinus americana*	White Ash	32.5	60’	114
59	*Fraxinus americana*	White Ash	6	18’	18
60	*Fraxinus pennsylvanica*	Green Ash	5	15’	15
61	*Acer saccharum* ‘Majesty’	Majesty Sugar Maple	11	28’	32

TREE INVENTORY | Each tree was surveyed for its species identification, physical location and size. The provided ages are estimated based on growth rate research per species.


COCKE HALL
OLD CABELL HALL
ROUSS HALL
PAV IX
PAV VII
PAV V
PAV III
PAV I
PAV X
PAV VIII
PAV VI
PAV IV
PAV II
ROTUNDA
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61
0’ 50’ 100’ 200’



Acer rubrum
Red Maple

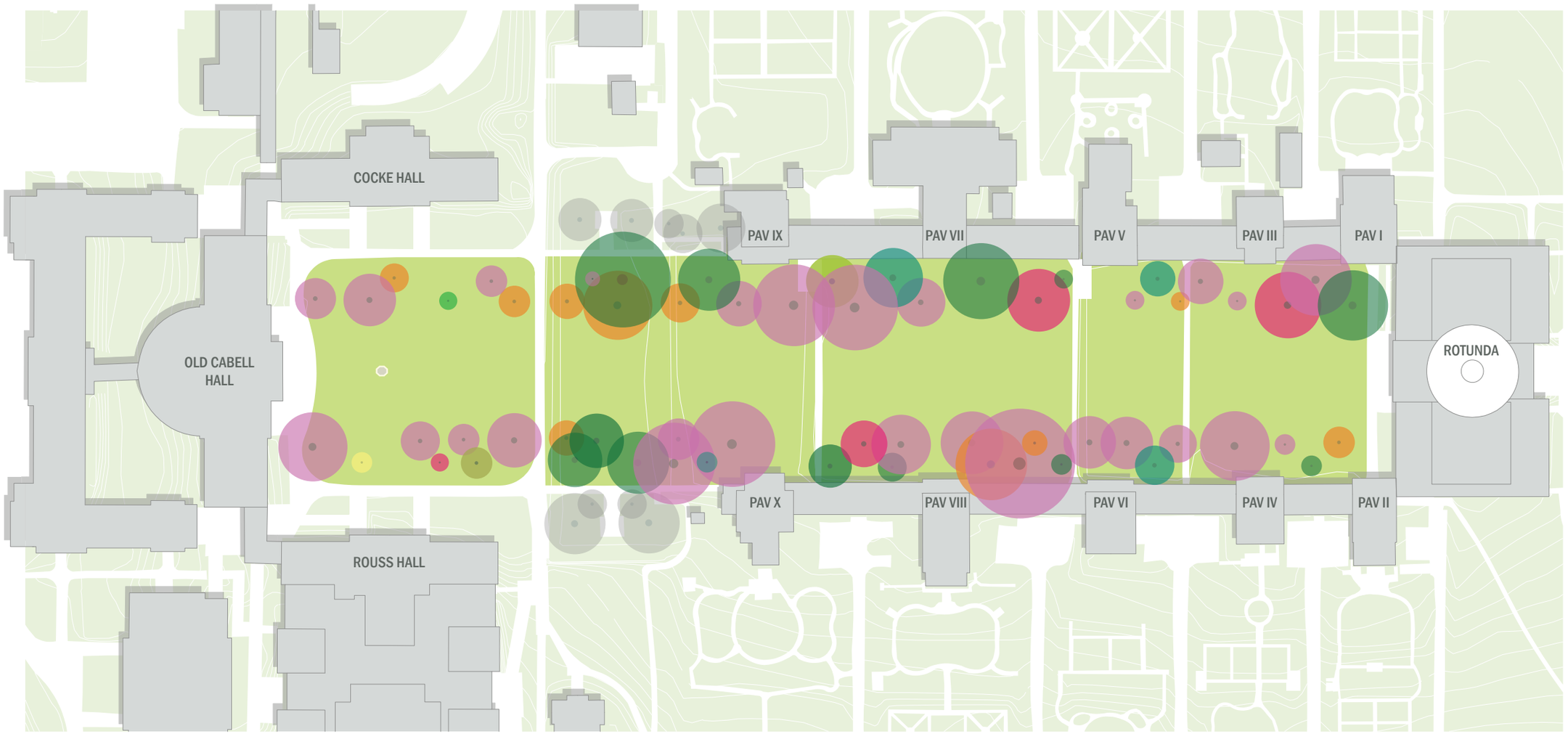
Acer saccharum
Sugar Maple

Fraxinus spp.
Ash species

Liriodendron tulipifera
Tulip poplar

Tilia americana
Basswood

Ulmus americana
Princeton Elm



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

Tilia americana - Basswood

Ulmus americana - American Elm

0’ 50’ 100’ 200’

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-dominate 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

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

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.


COCKE HALL
OLD CABELL HALL
ROUSS HALL
PAV IX
PAV VII
PAV V
PAV III
PAV I
PAV X
PAV VIII
PAV VI
PAV IV
PAV II
ROTUNDA
Excellent to Good
Fair
Poor
Dying or dead
0'
50'
100'
200'

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.

single allee

26 trees

1827

double allee

52 trees

1860

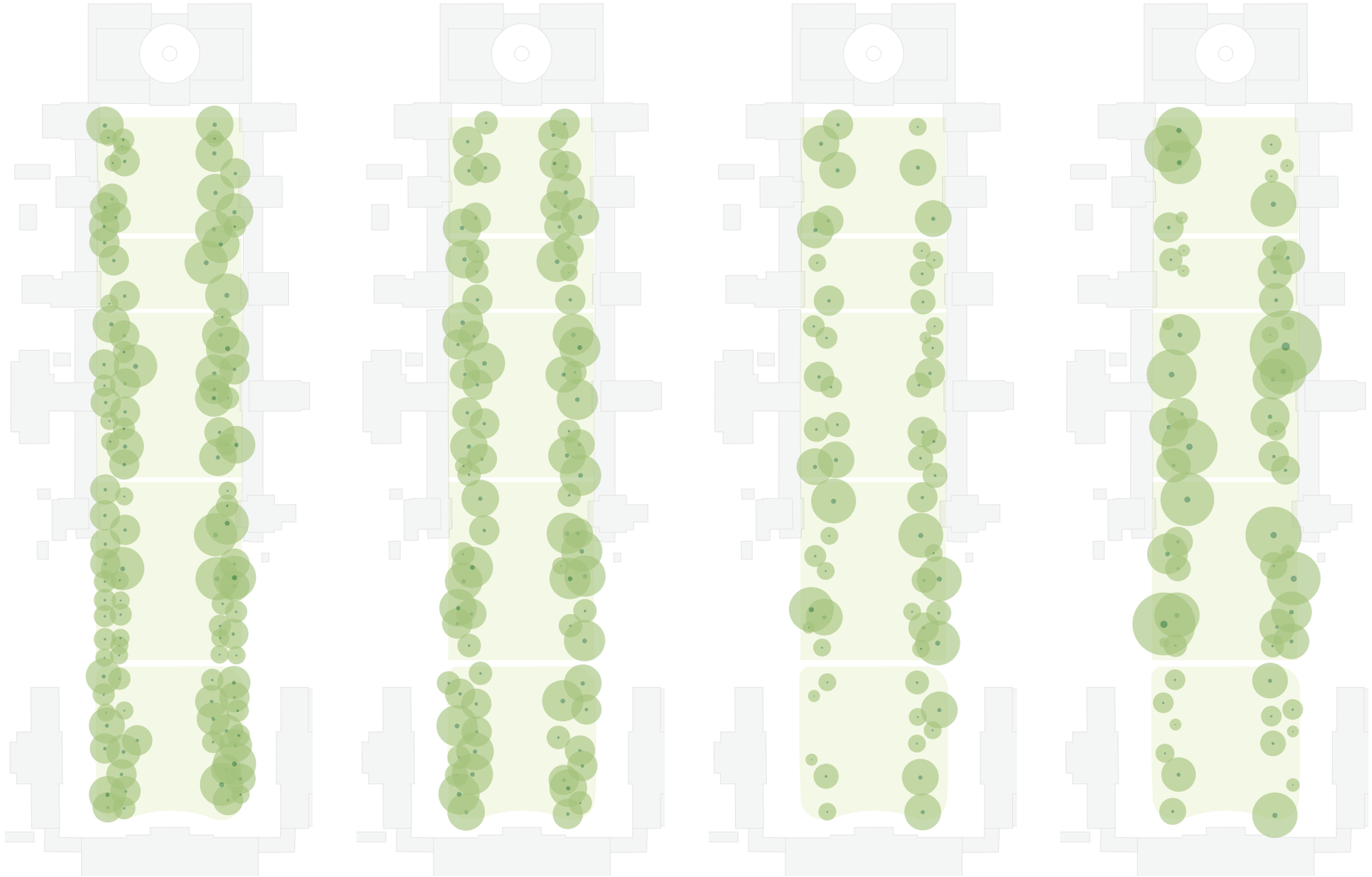
82 trees

1880

lower lawn added

101 trees

1914



peak canopy

113 trees

1947

tree decline

84 trees

1981

emerald ash borer

59 trees

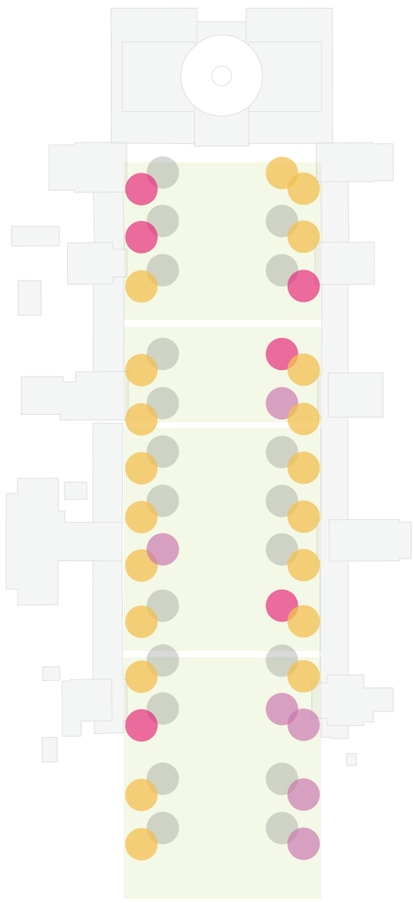
2013

61 trees

2019

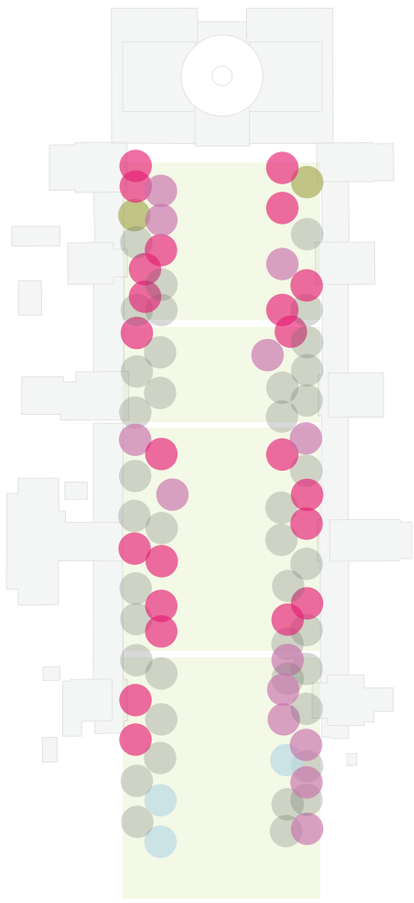
1 Black Locust

1827



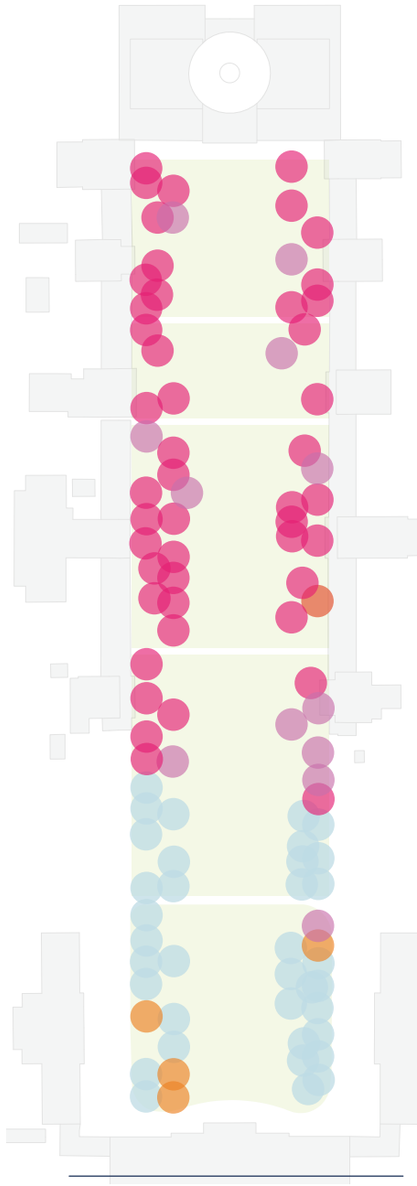
1 Red Maple
2 White Ash
3 Black Locust
4 *Unknown species*

1860



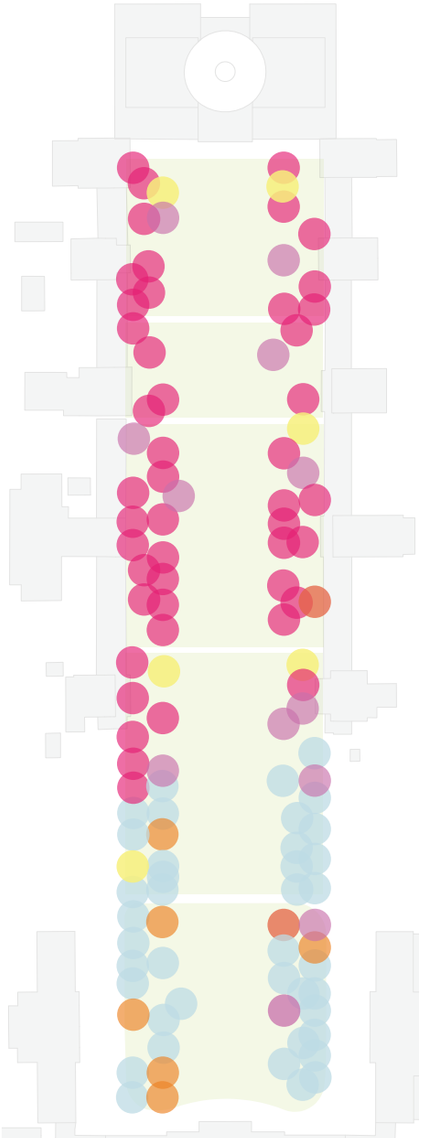
1 *Unidentified Maple spp.*
2 Red Maple
3 White Ash
4 American Elm
5 *Unknown species*

1880



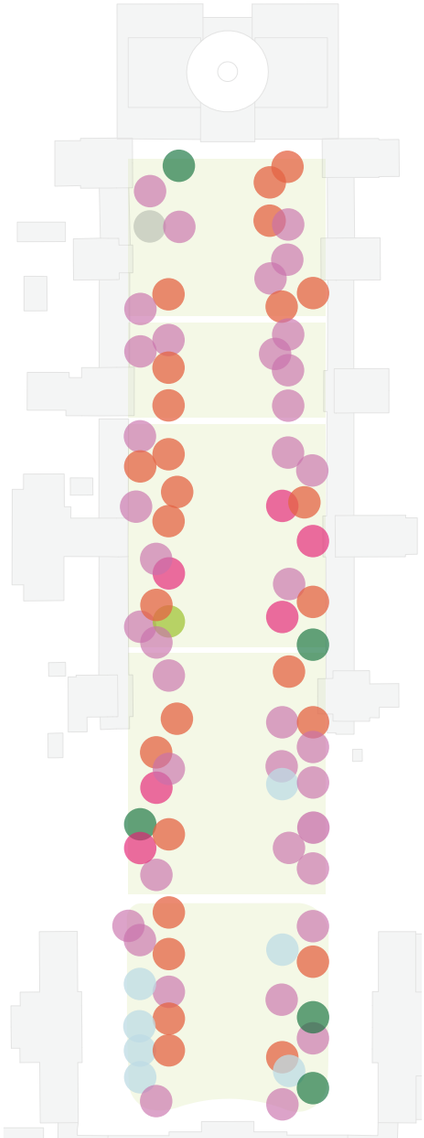
1 *Unidentified Maple spp.*
2 Red Maple
3 Silver Maple
4 Sugar Maple
5 White Ash

1914



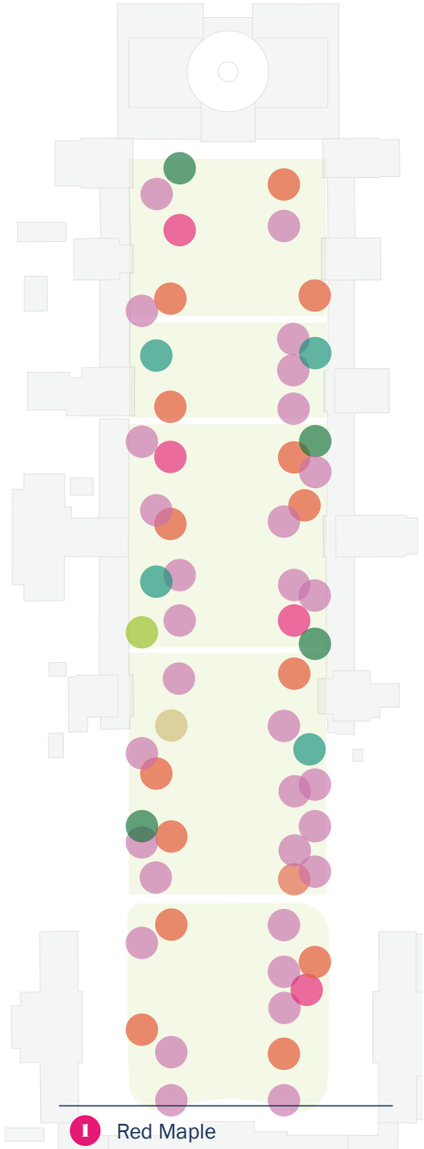
1. *Unidentified Maple spp.*
2. Red Maple
3. Silver Maple
4. Sugar Maple
5. Pecan
6. White Ash

1947



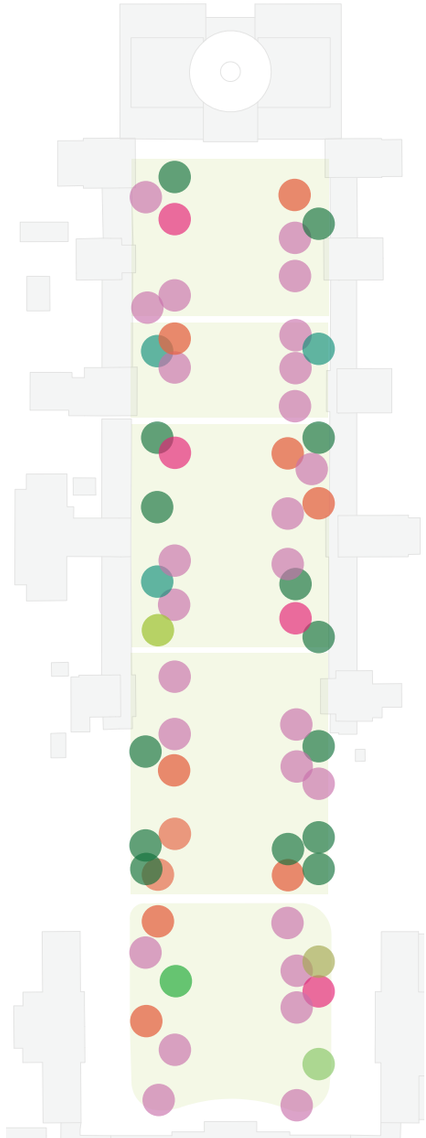
1. *Unidentified Maple spp.*
2. Red Maple
3. Sugar Maple
4. White Ash
5. European Ash
6. Green Ash

1981



1. Red Maple
2. Sugar Maple
3. White Ash
4. European Ash
5. Green Ash
6. Pumpkin Ash
7. Blue Ash

2013

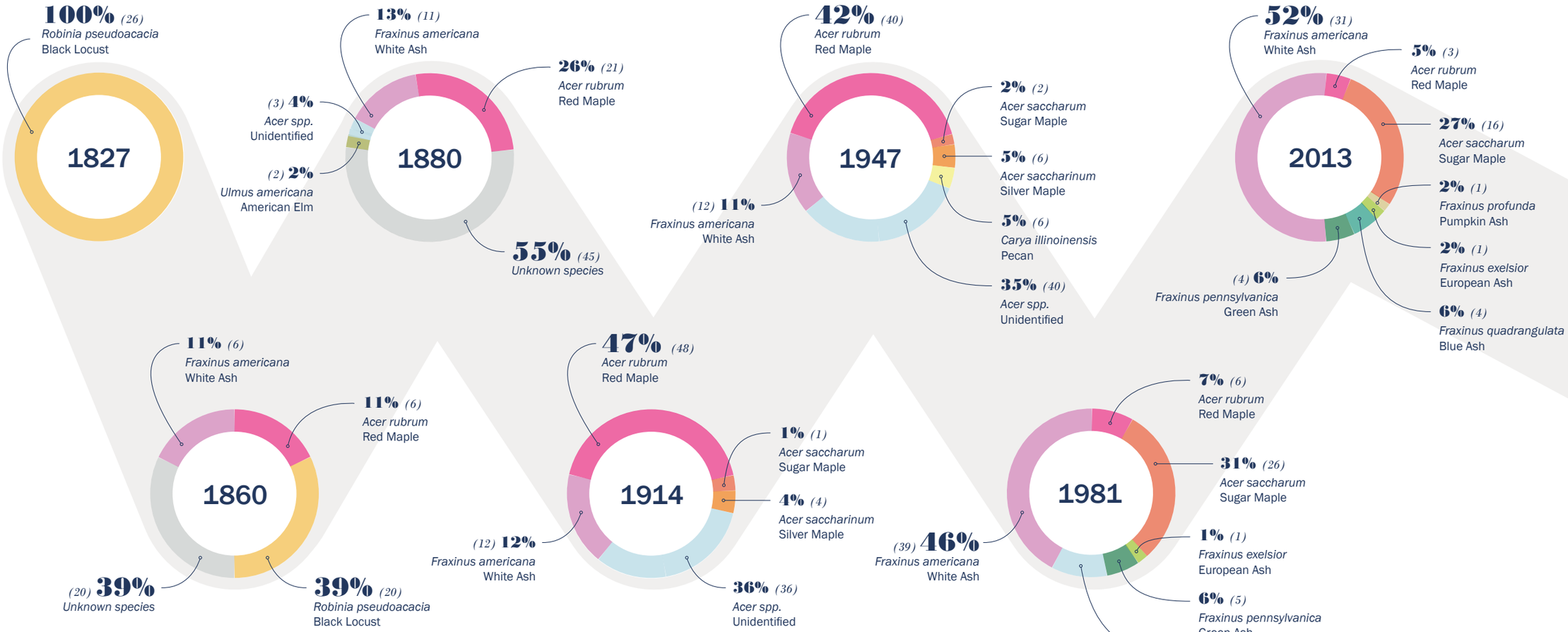


1. Red Maple
2. Sugar Maple
3. White Ash
4. European Ash
5. Green Ash
6. Blue Ash
7. Tulip Poplar
8. Basswood
9. Princeton Elm

2019

"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..."

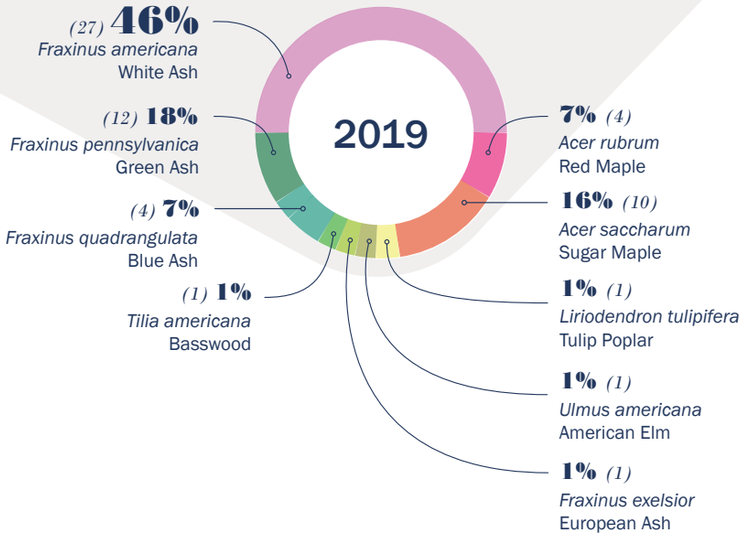
- 2013 Cultural Landscape Report

"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

Robinia pseudoacacia *Acer rubrum* *Fraxinus americana*

predominant species through time



BLACK LOCUST
Robinia pseudoacacia

© Cultural Landscape Report

RED MAPLE
Acer rubrum

© Cultural Landscape Report

WHITE ASH
Fraxinus americana

© Historic Central Grounds Study

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

EXISTING (2017) UVA 100-YR TREE PLAN | 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.

EXISTING 100-YR PLAN: SPECIES

EXISTING (2017) UVA 100-YR TREE PLAN | The proposed layout indicates a monoculture of Ash, which will be a long-term financial, maintenance, and health liability.

UPDATED 100-YR PLAN: YEAR 2070

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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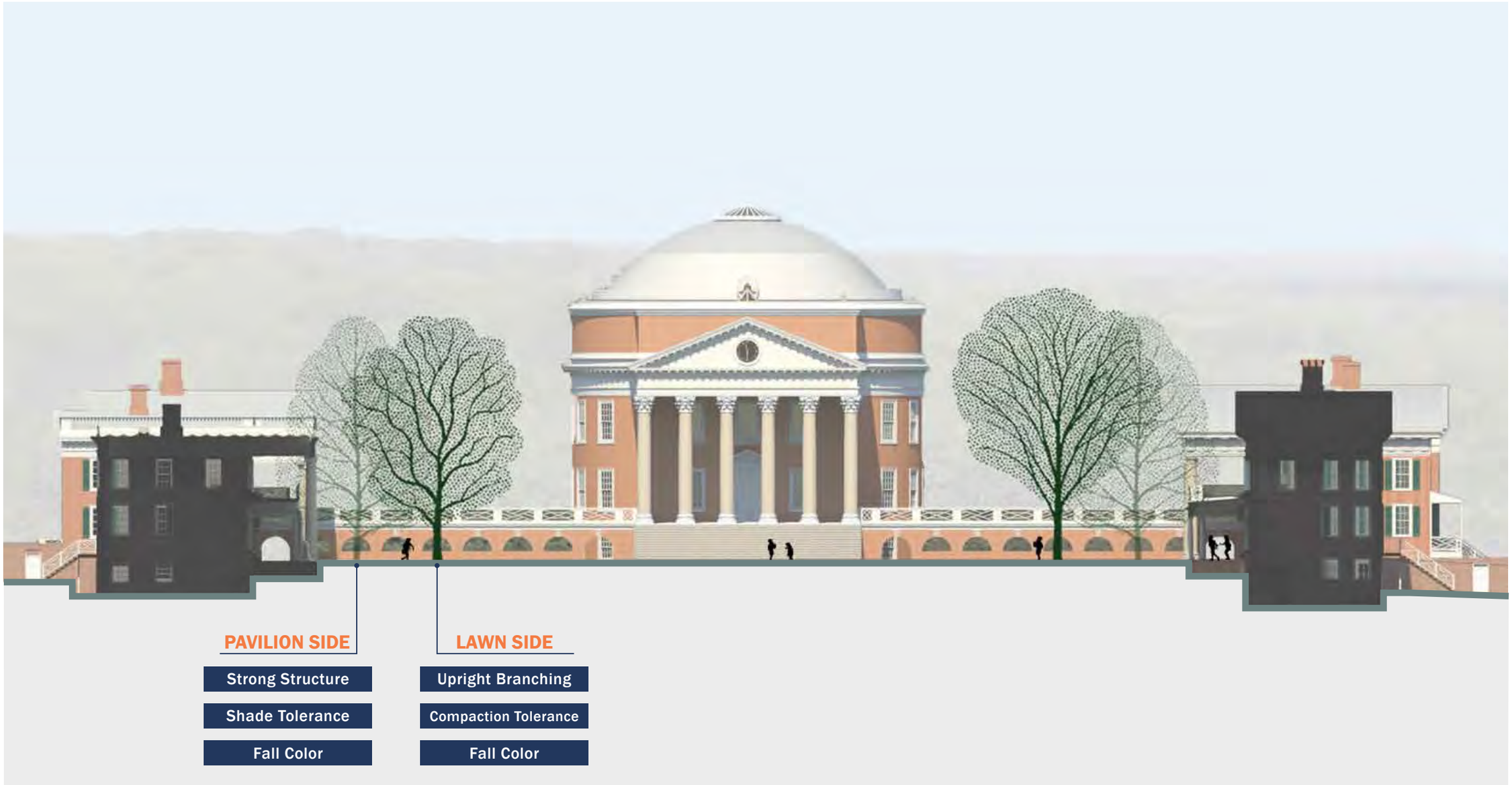
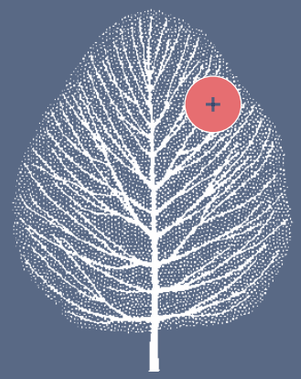


PLANTING TYPOLOGIES | Target characteristics and attributes per planting location.

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.

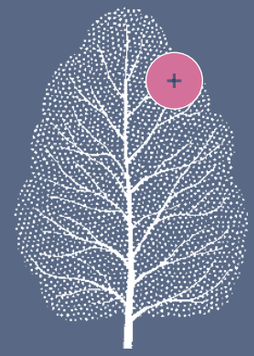
THE LAWN
PROPOSED TREES



RED MAPLE
Acer rubrum

SUGAR MAPLE
Acer saccharum

K. COFFEETREE
Gymnocladus dioicus ‘Espresso’

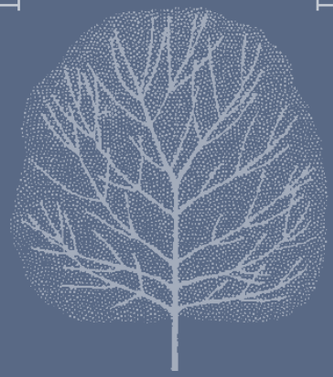


SWEETGUM
Liquidambar styraciflua ‘Hapdell’

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*

Existing tree (2019)

AR *Acer rubrum* - Red Maple

AS *Acer saccharum* - Sugar Maple

GD *Gymnocladus dioicus* 'Espresso' - Kentucky Coffeetree

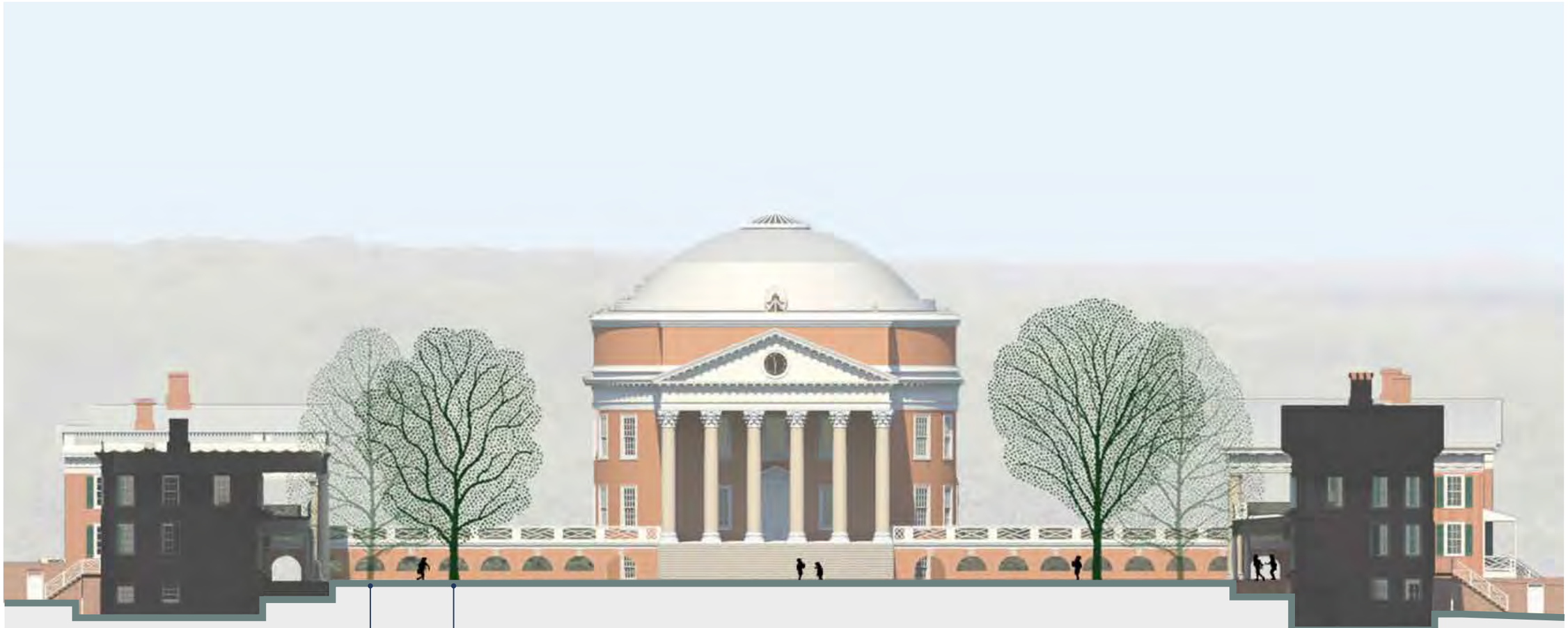
LS *Liquidambar styraciflua* 'Hapdell' - Sweetgum

NS *Nyssa sylvatica* - Blackgum

UA *Ulmus americana* 'Jefferson' - American Elm

UM *Ulmus davidiana var. japonica* 'Morton' - Accolade Elm

0' 50' 100' 200'



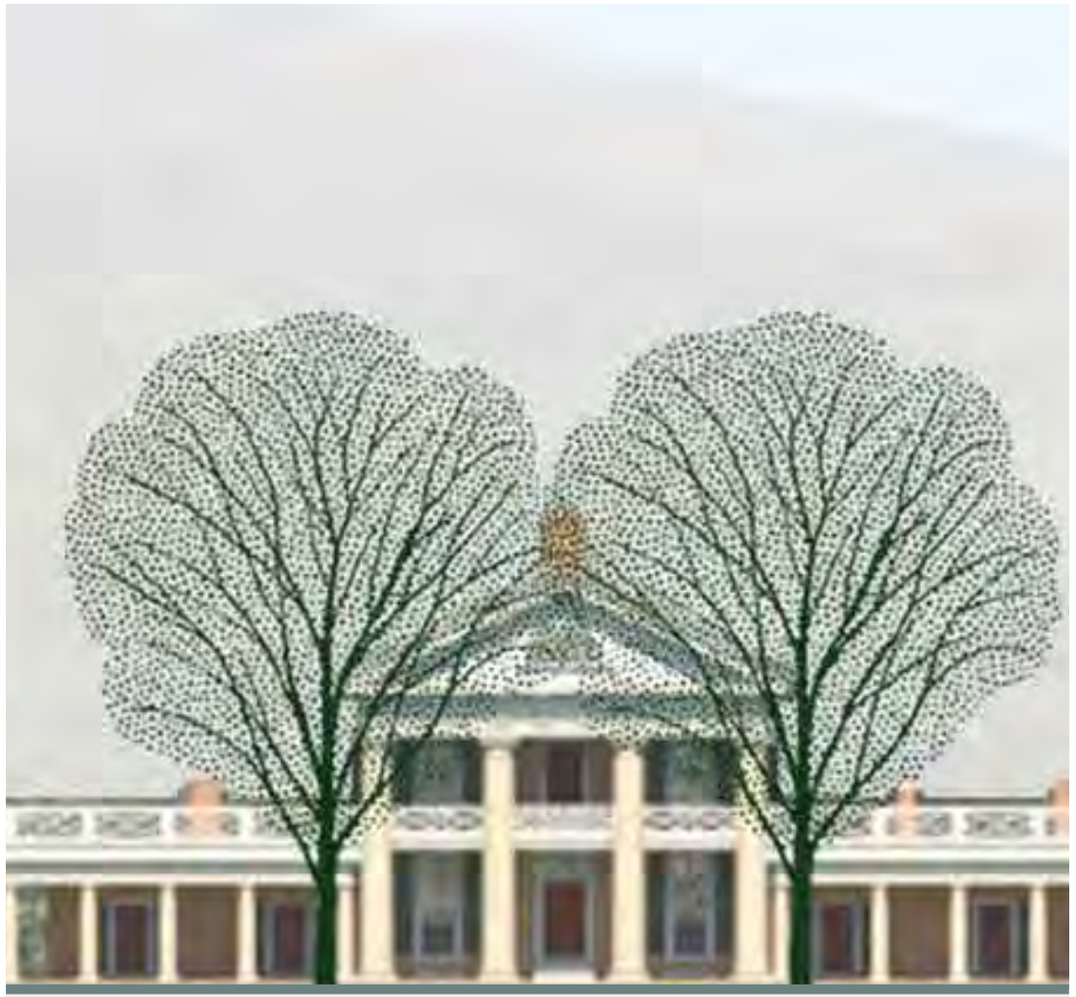
PAVILION SIDE

Red Maple
Sugar Maple
Kentucky Coffeetree
Sweetgum
Accolade Elm

LAWN SIDE

Kentucky Coffeetree
Sweetgum
Blackgum
American Elm
Accolade Elm

PLANTING SELECTION | Species identified per planting location.

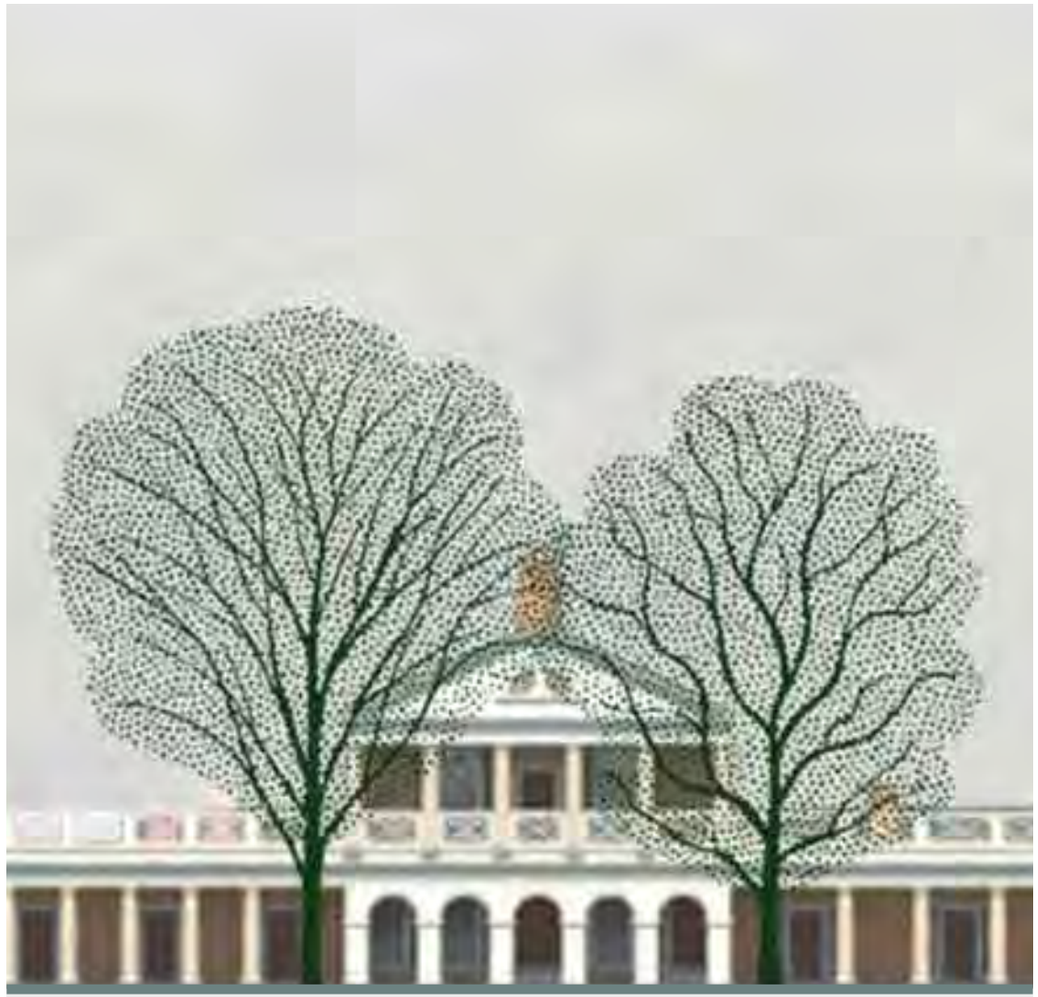


SINGLE SPECIES

Strong Vase Form

Open Views

} Accolade Elm



MIXED SPECIES

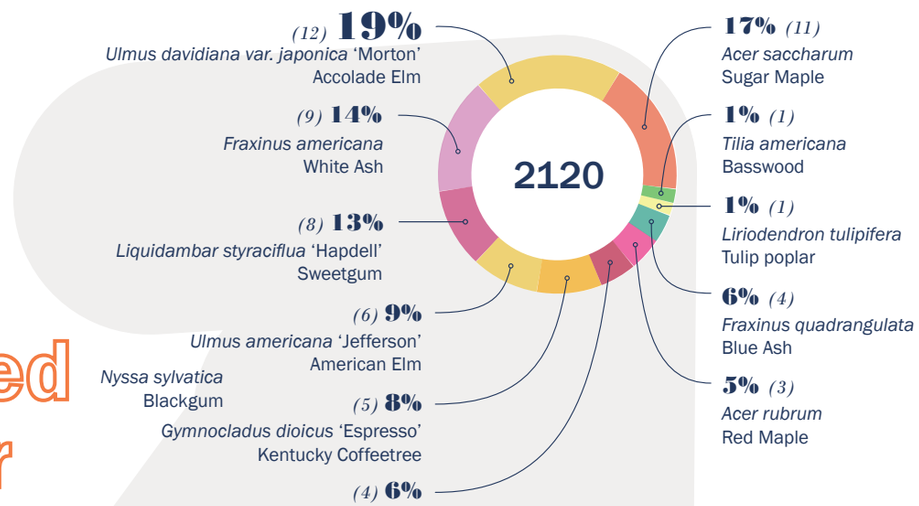
Complimentary Form

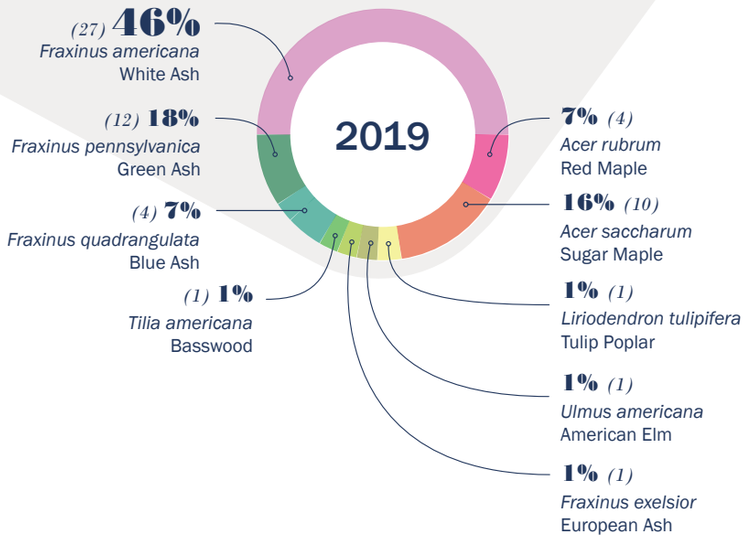
Upright Branching

} Kentucky Coffeetree
Blackgum
Accolade Elm

PLANTING TYPOLOGIES | Characteristics and species selection for trees flanking the Pavilions.

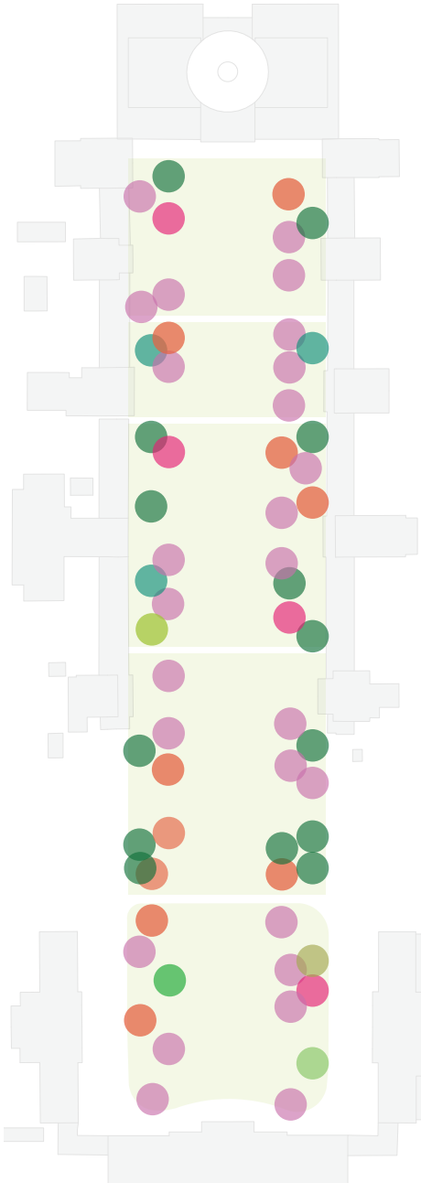
projected 100-yr tree plan*





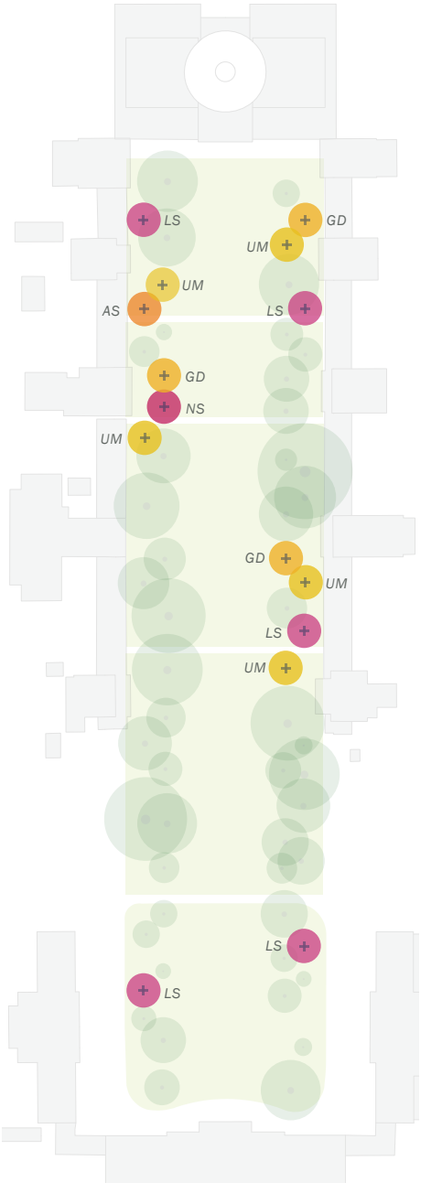
EXISTING

- *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
- *Tilia americana* Basswood
- *Ulmus americana* American Elm



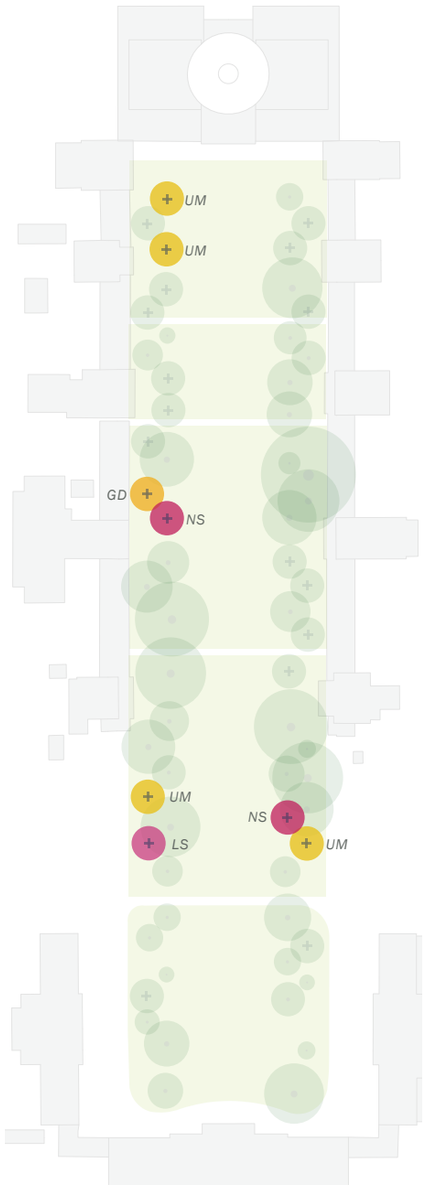
Existing

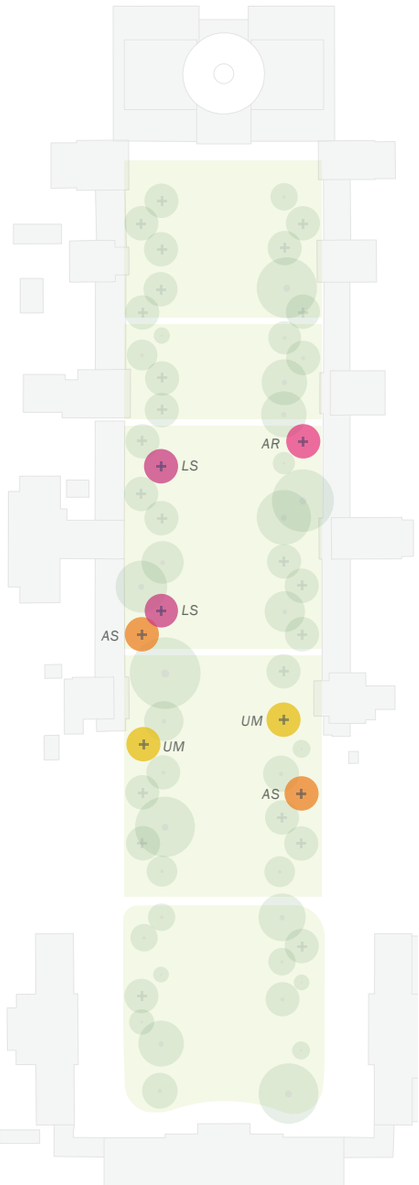
2019

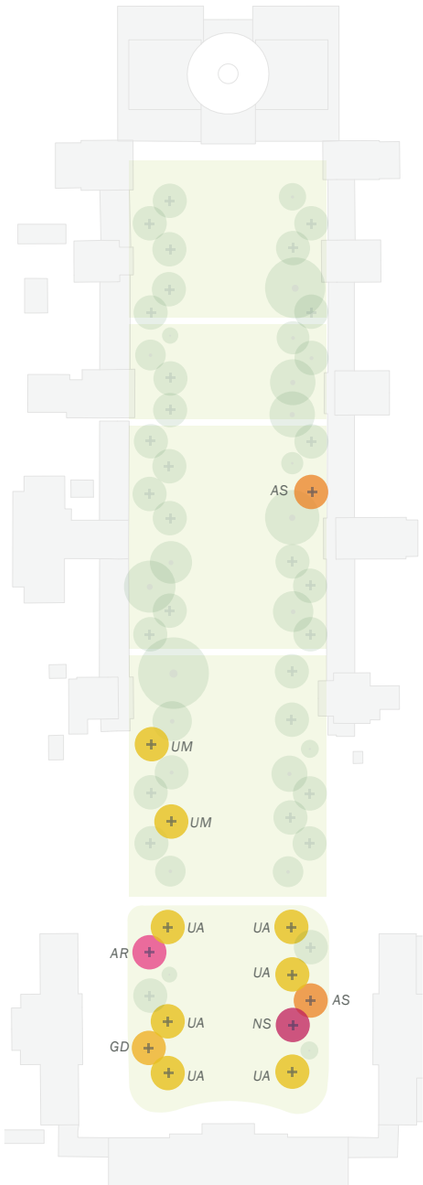


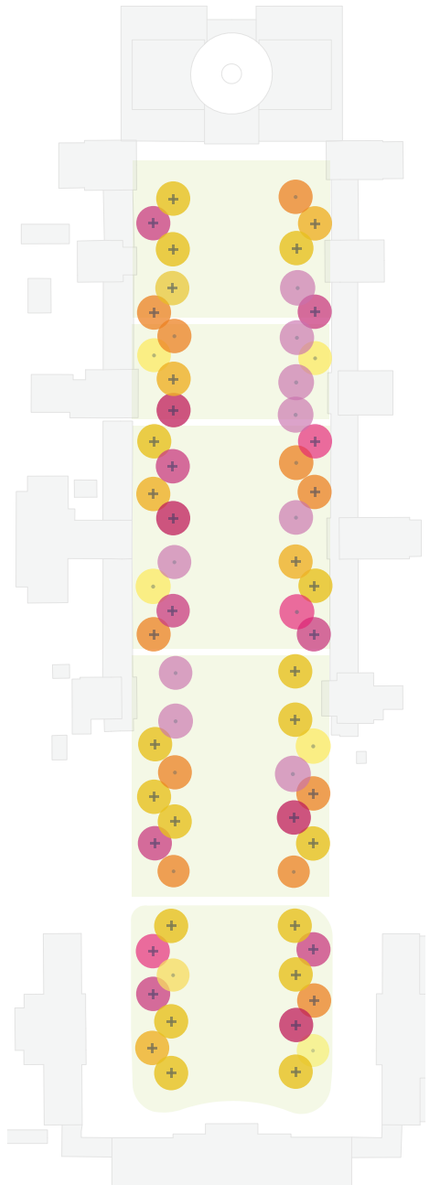
Years 1 - 5

2025









*Proposed locations and timing of tree planting is contingent upon projected tree decline and removals

EXISTING

- *Acer rubrum* Red Maple
- *Acer saccharum* Sugar Maple
- *Fraxinus americana* White Ash
- *Fraxinus quadrangulata* Blue Ash
- *Liriodendron tulipifera* Tulip Poplar
- *Tilia americana* Basswood

PROPOSED

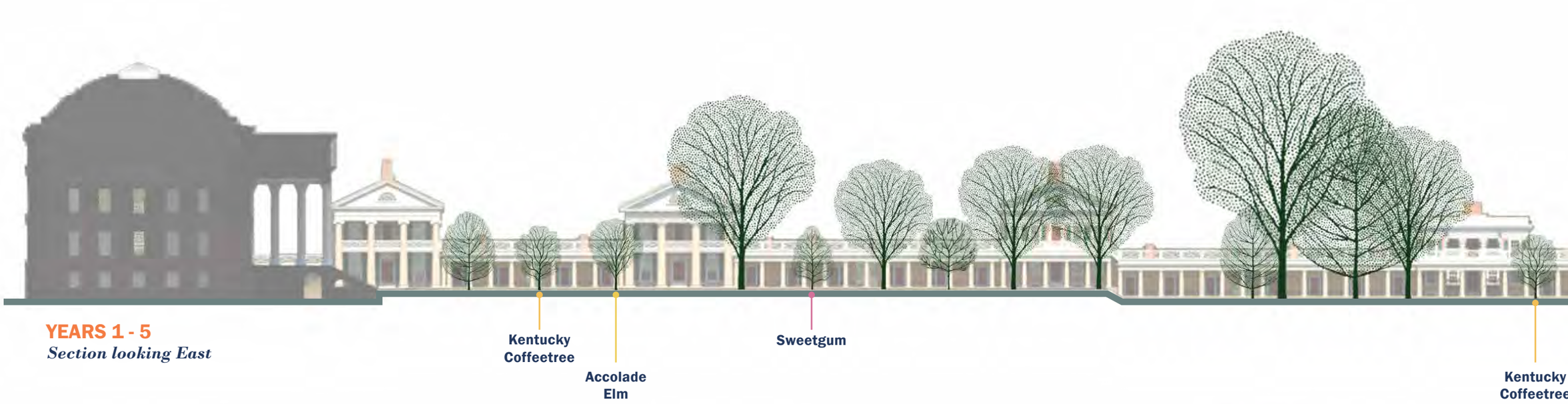
- AR + *Acer rubrum* Red Maple
- AS + *Acer saccharum* Sugar Maple
- GD + *Gymnocladus dioicus* 'Espresso' Kentucky Coffeetree
- LS + *Liquidambar styraciflua* 'Hapdell' Sweetgum
- NS + *Nyssa sylvatica* Blackgum
- UA + *Ulmus americana* 'Jefferson' American Elm
- UM + *Ulmus davidiana var. japonica* 'Morton' Accolade Elm

Years 10 - 25 — **2045**

Year 50 — **2070**

Year 100 — **2120**

Projected — **2120**



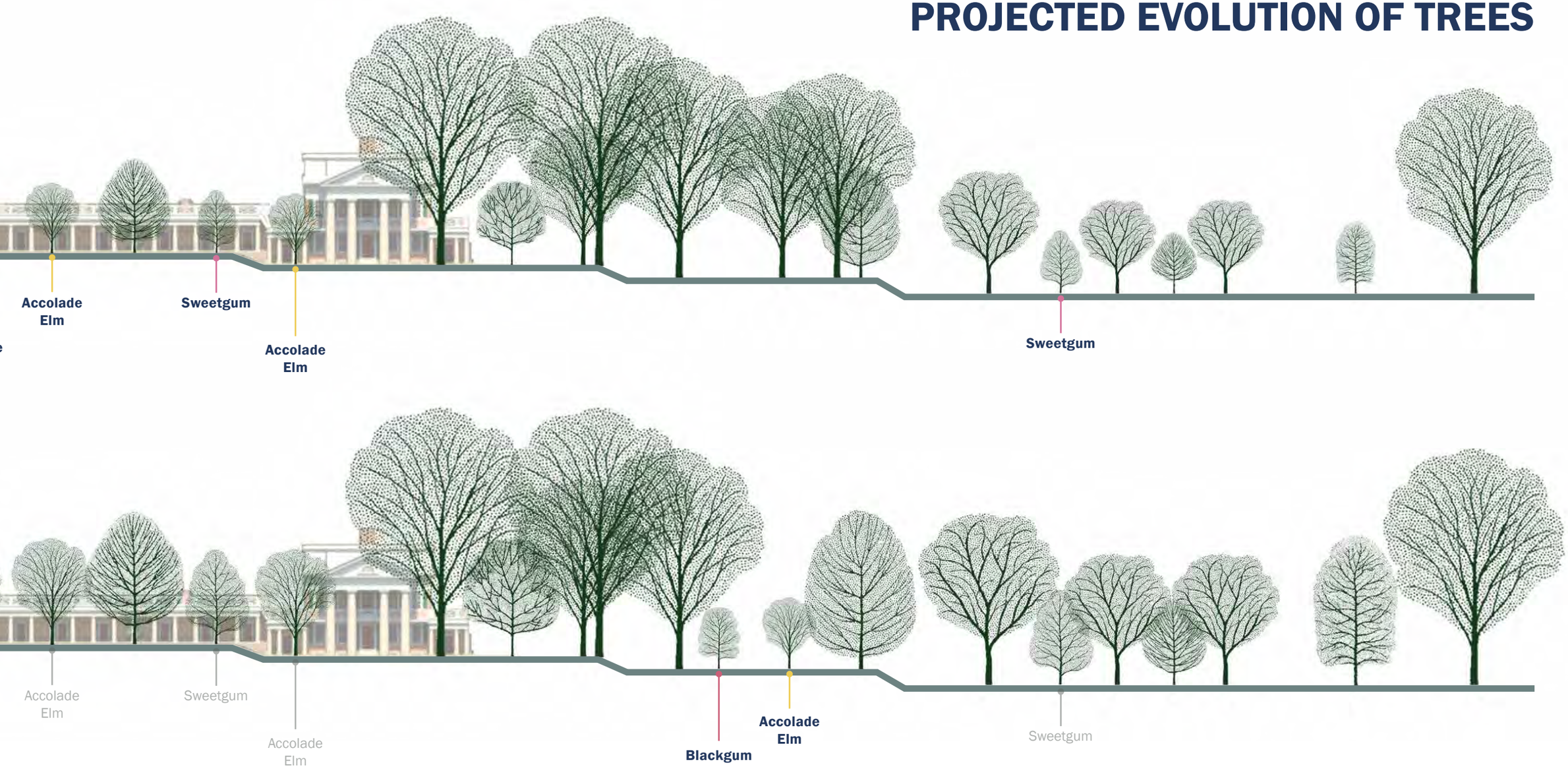
YEARS 1 - 5

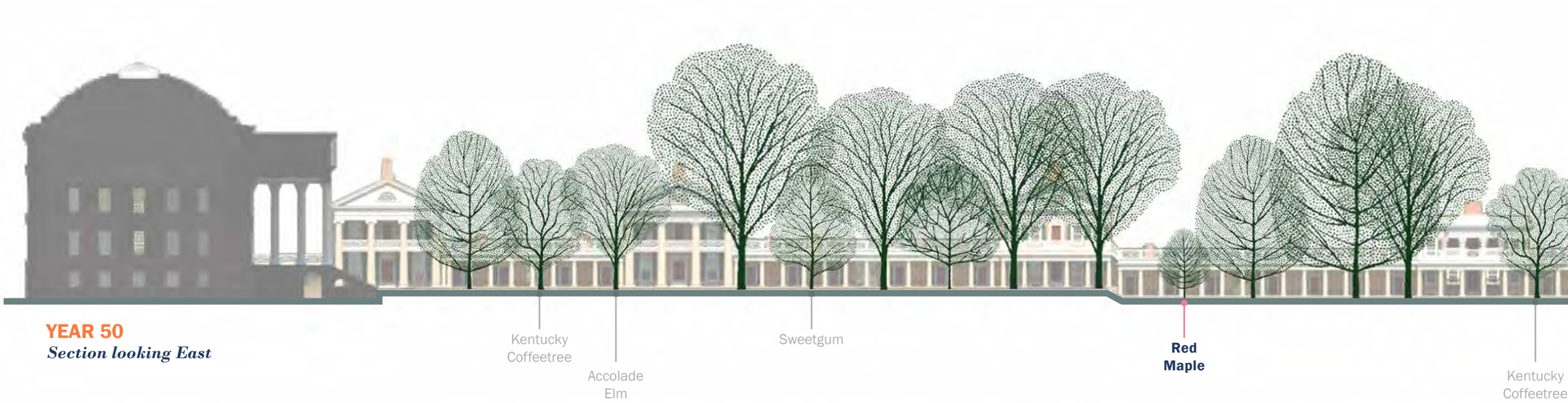
Section looking East

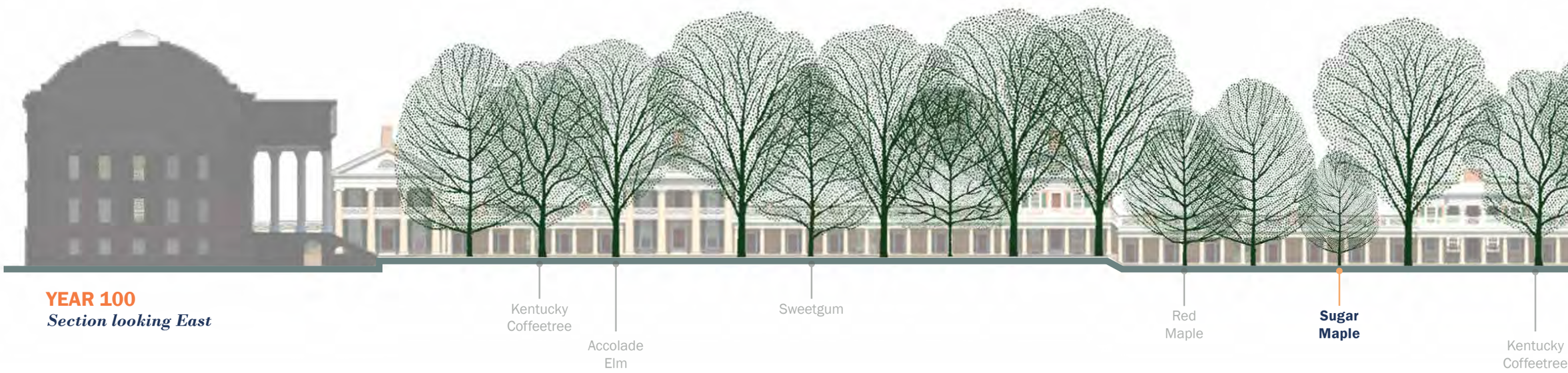
YEAR 25

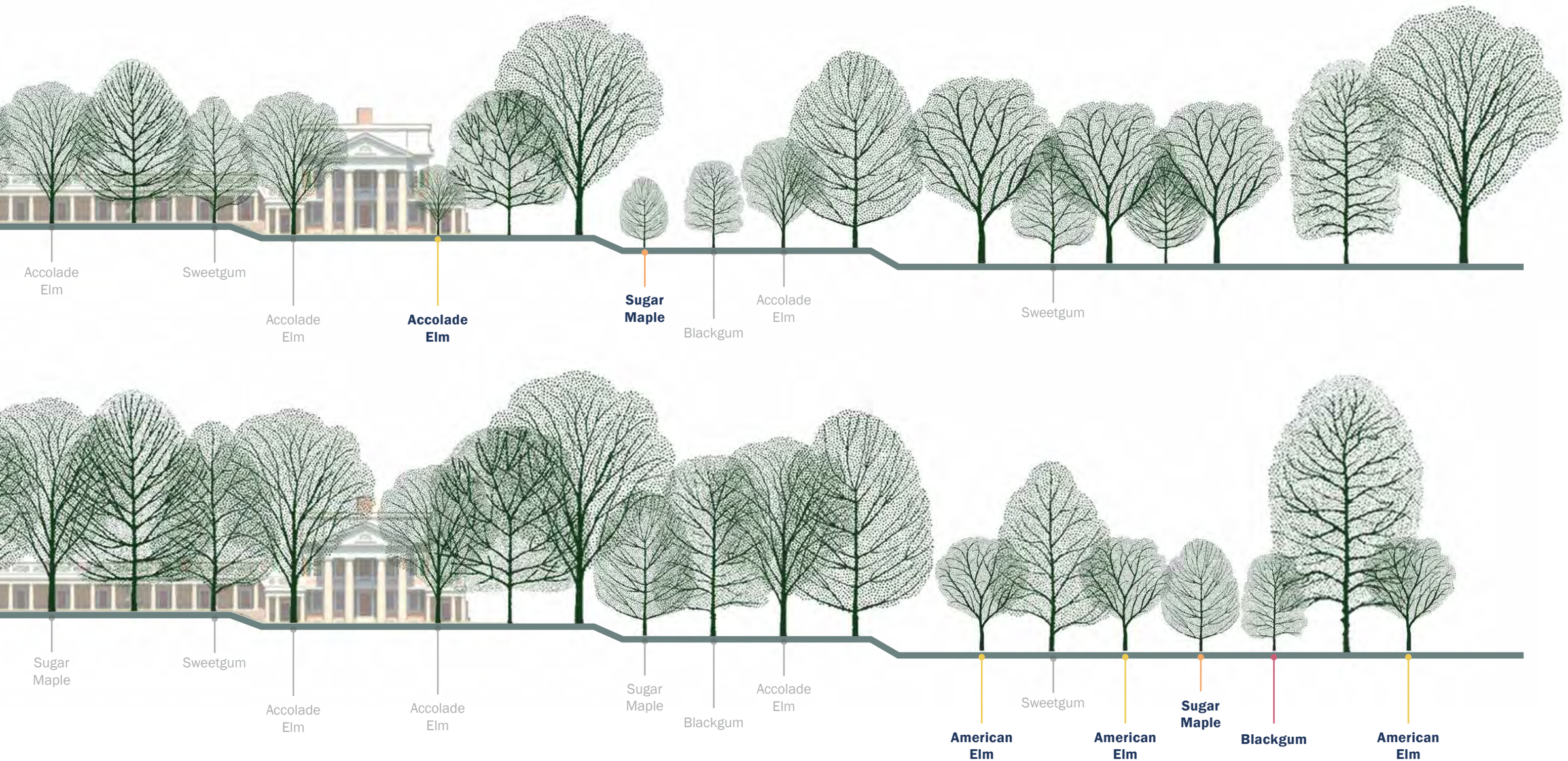
Section looking East

THE LAWN
PROJECTED EVOLUTION OF TREES

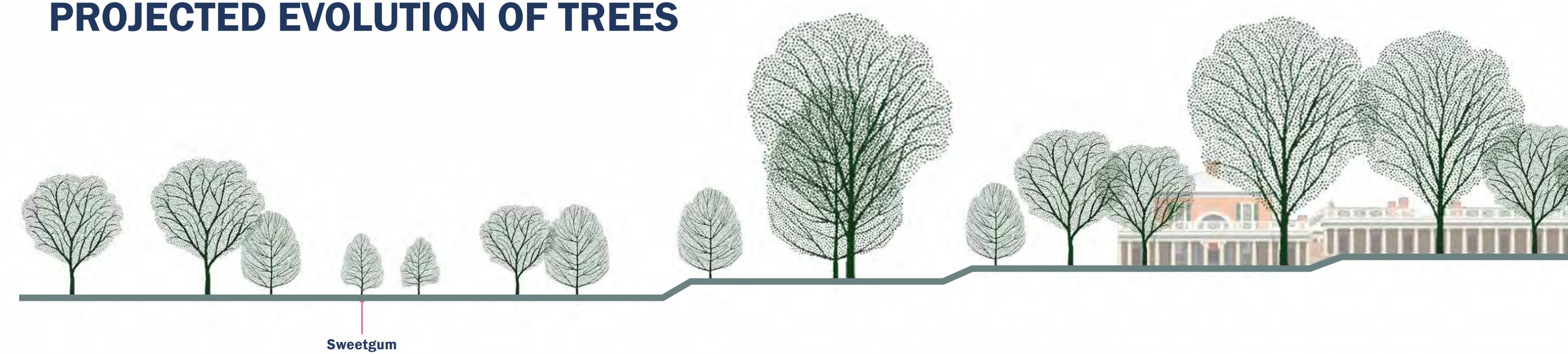


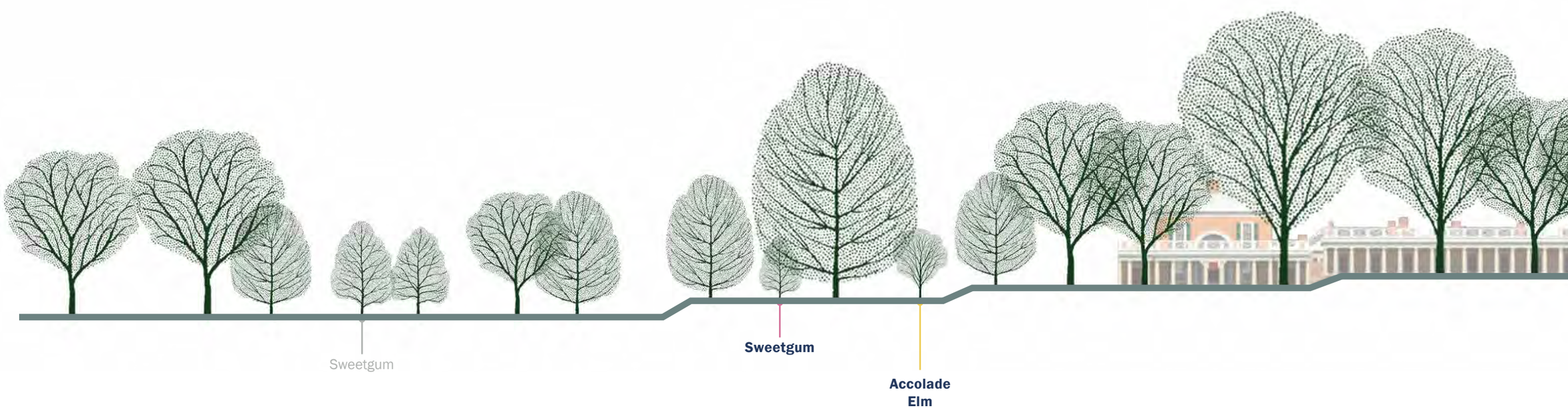

YEAR 50
Section looking East
Kentucky Coffeetree
Accolade Elm
Sweetgum
Red Maple
Kentucky Coffeetree

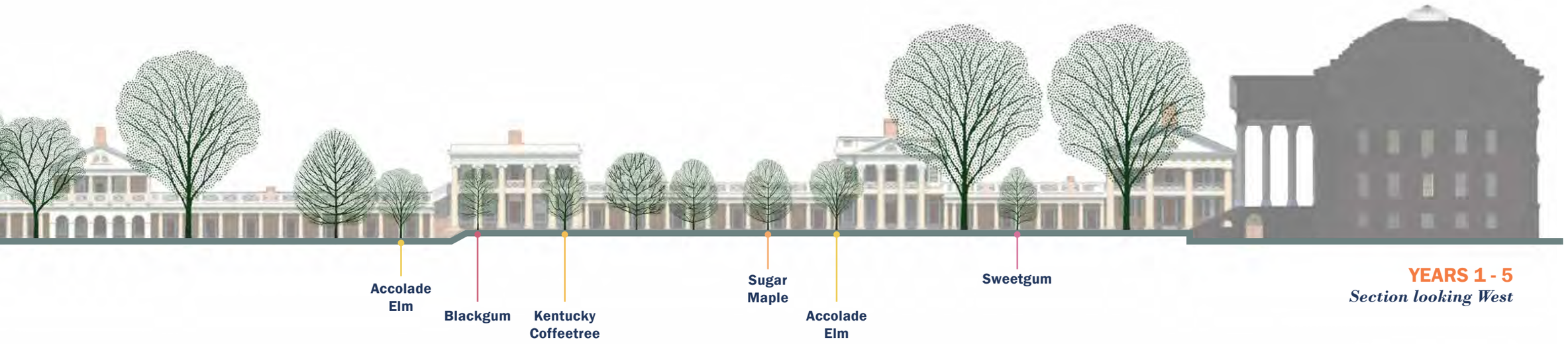

YEAR 100
Section looking East
Kentucky Coffeetree
Accolade Elm
Sweetgum
Red Maple
Sugar Maple
Kentucky Coffeetree


Accolade Elm
Sweetgum
Accolade Elm
Accolade Elm
Sugar Maple
Blackgum
Accolade Elm
Sweetgum
Sugar Maple
Sweetgum
Accolade Elm
Accolade Elm
Sugar Maple
Blackgum
Accolade Elm
Sweetgum
American Elm
American Elm
Sugar Maple
Blackgum
American Elm

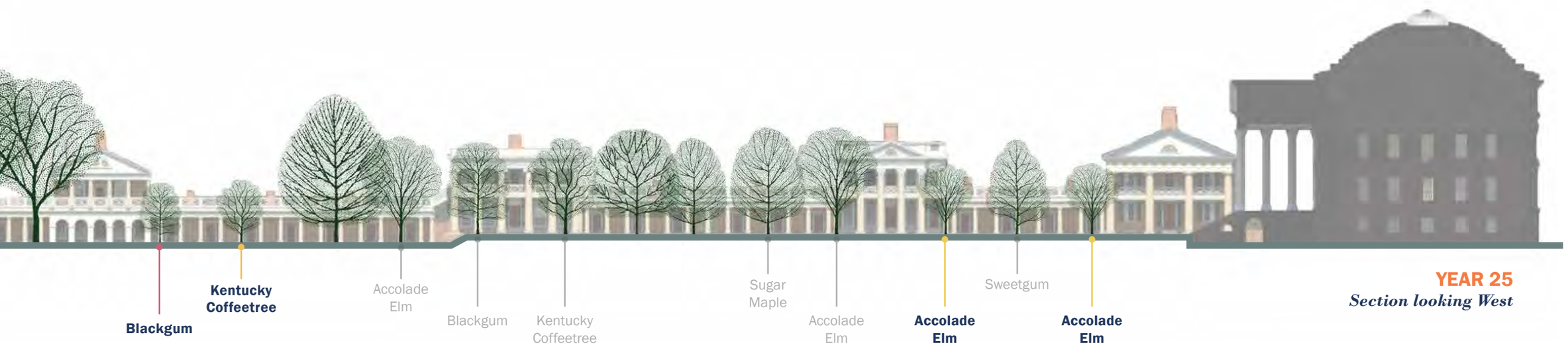
THE LAWN
PROJECTED EVOLUTION OF TREES



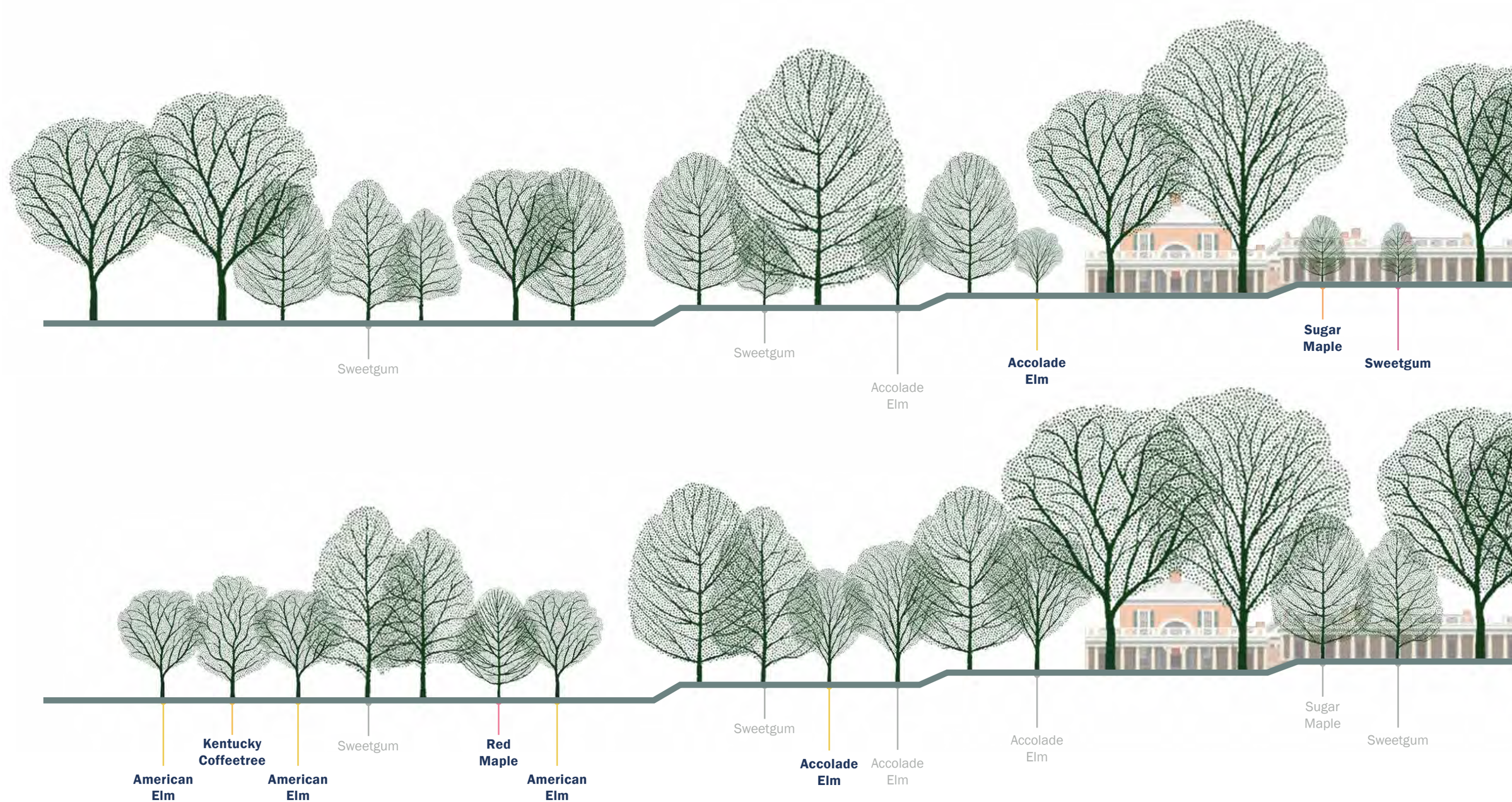


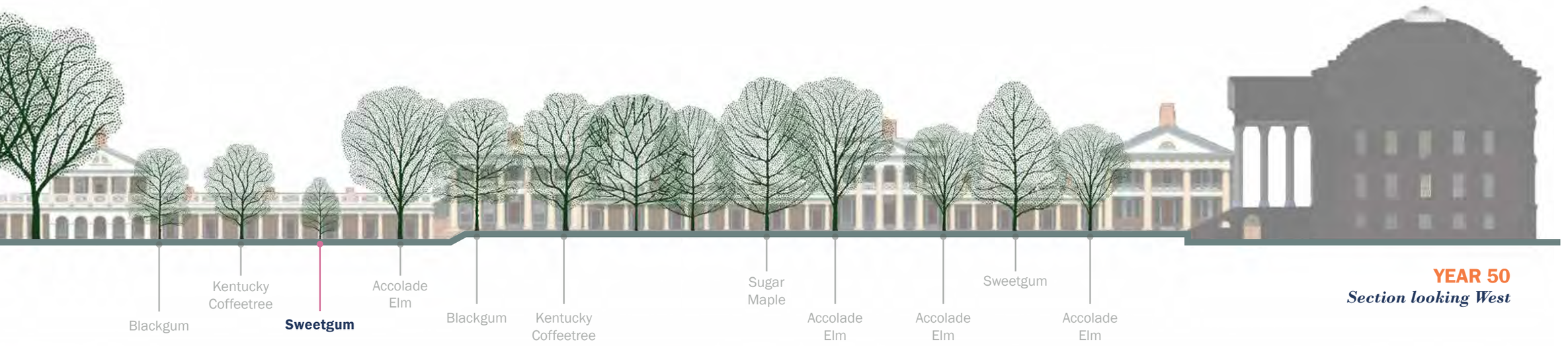


YEARS 1 - 5
Section looking West

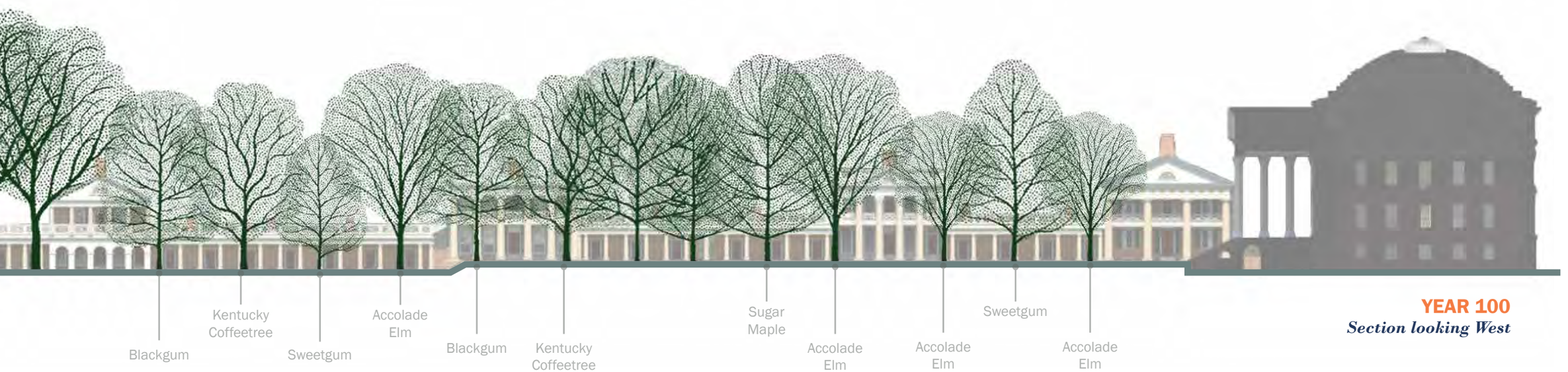


YEAR 25
Section looking West


Sweetgum
Sweetgum
Accolade Elm
Accolade Elm
Sugar Maple
Sweetgum
American Elm
Kentucky Coffeetree
American Elm
Sweetgum
Red Maple
American Elm
Sweetgum
Accolade Elm
Accolade Elm
Accolade Elm
Sugar Maple
Sweetgum



YEAR 50
Section looking West



YEAR 100
Section looking West

EXISTING 100-YR PLAN: NON-COMPLIANT TREES

EXISTING (2017) UVA 100-YR TREE FRAMEWORK PLAN | 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.)

Fraxinus americana - White Ash

Fraxinus pennsylvanica - Green Ash

Tree to be removed

0' 50' 100' 200'

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

TREE PLANTINGS AND REMOVALS | Prioritization of planting in openings in the layout and removing trees with the health classification of 'Dying / Dead'.

PROJECTED TIMELINE: YEARS 1 - 5

TREE PLANTINGS AND REMOVALS | 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

TREE PLANTINGS AND REMOVALS | 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

TREE PLANTINGS AND REMOVALS | In year 50 many of the oldest mature White Ash will be in decline and need to be replaced.

MEMORIAL TREES

MEMORIAL TREE REMOVALS | 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.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APPENDICES

APPENDIX A: TREE HEALTH ASSESSMENT

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

* Assessment dated: 7 October 2019

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

Vigor:
v1 - Healthy
v2 - Inhibited growth
v3 - Branch dieback
v4 - Major branch dieback
v5 - Thin canopy

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

Root zone:
r1 - Good
r2 - Sensitive
r3 - Compacted
r4 - Restricted

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

Excellent to Good

(39 TREES)

TYPICAL CONDITIONS:

- 100% LIVE CANOPY
- STRONG TO AVERAGE ANNUAL GROWTH
- OVERALL HEALTHY CONDITION

Fair

(14 TREES)

TYPICAL CONDITIONS:

- 75-100% LIVE CANOPY
- AVERAGE ANNUAL GROWTH
- SOME BRANCH DIEBACK, GIRDLED ROOTS

Poor

(5 TREES)

TYPICAL CONDITIONS:

- 50-75% LIVE CANOPY
- LOW ANNUAL GROWTH
- STRUCTURAL DEFECTS

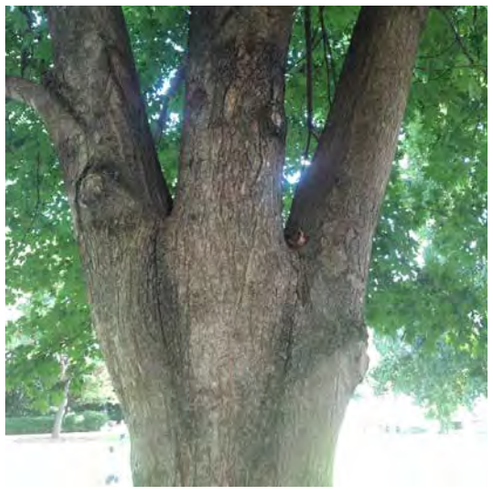
Dying / Dead

(3 TREES)

TYPICAL CONDITIONS:

- LESS THAN 50% LIVE CANOPY
- MINIMAL ANNUAL GROWTH
- CRACKS AND WOUNDS IN TRUNK
- IRREPARABLE DECLINE

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

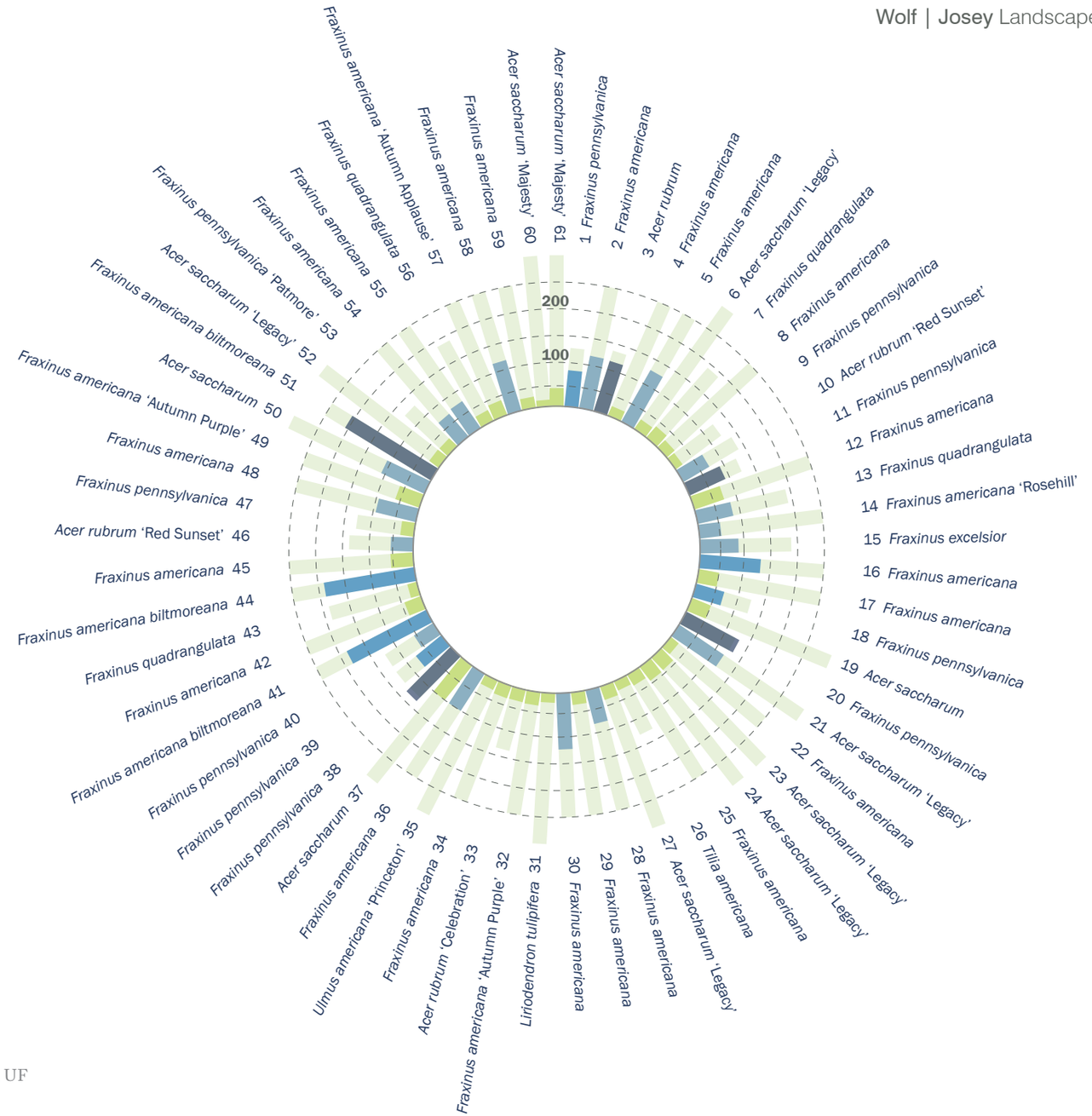
FINDING THE RIGHT BALANCE between fast growth and longevity is an important analytic tool during tree selection. Growth rate and lifespan don't always share the same curve. Life expectancy is for the typical species is good growing conditions. Average lifespan estimates do not consider the existing or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

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

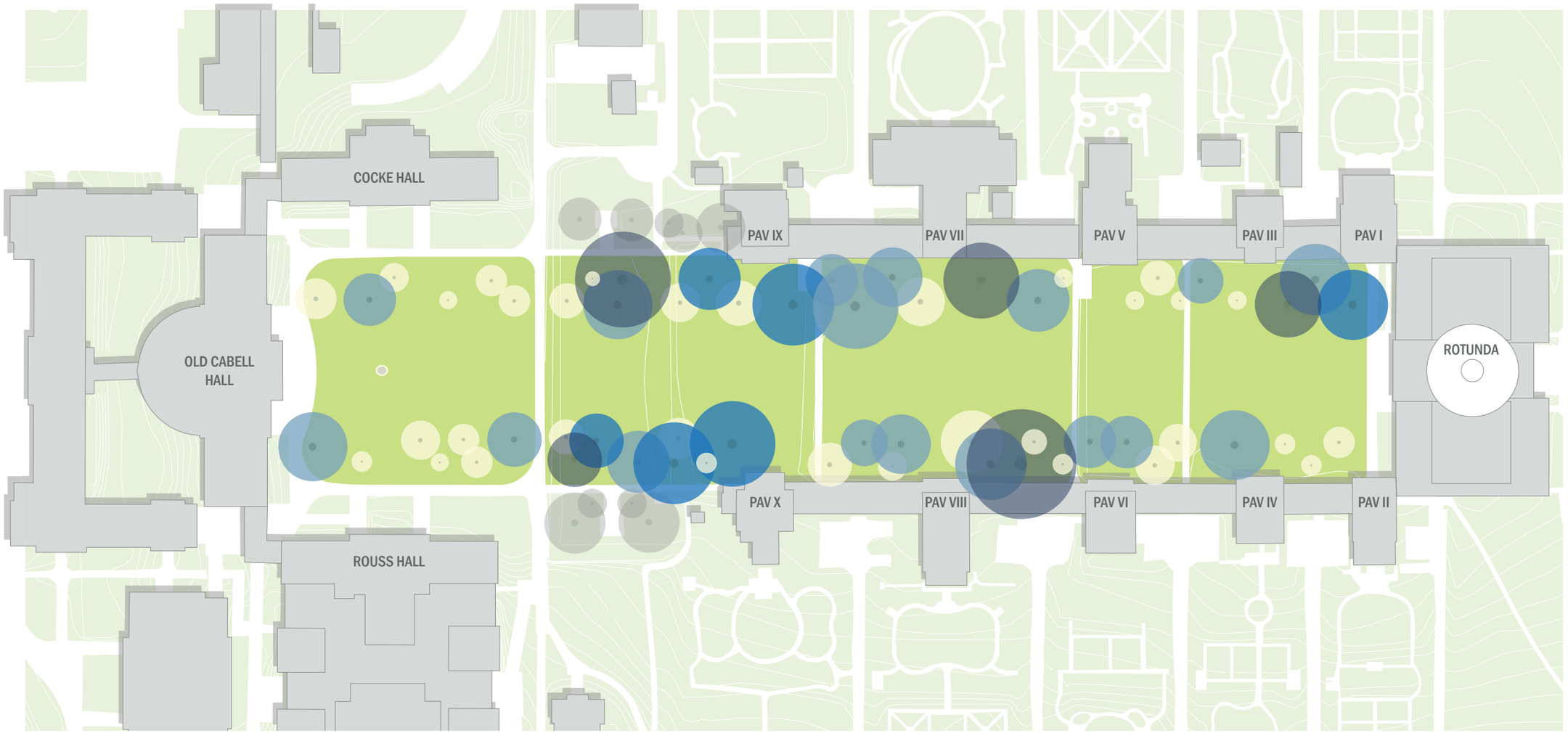
300 yrs Average Lifespan - Sugar Maple
260 - White Ash
250 - Tulip Poplar
190 - Blue Ash, European Ash
175 - American Elm
130 - Red Maple
120 - Green Ash
100 - Basswood

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

slow
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
fast
2.5 - Tulip Poplar



* Source: Virginia BIG Trees *http://bigtree.cnre.vt.edu/*
** Source: International Society of Arboriculture, Morton Arboretum, Michael A. Dirr, UF



< 25% Lived lifespan

26% - 50%

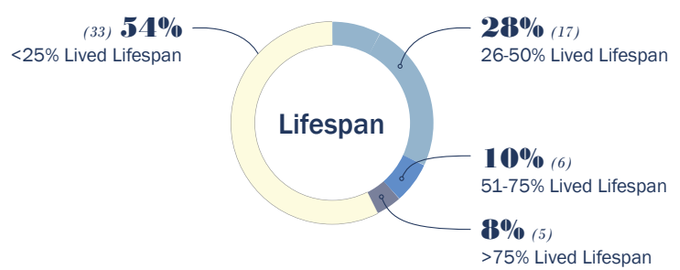
51% - 75%

> 75% Lived lifespan

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:

DBH *(in)* **x GROWTH RATE = ~AGE**

(~AGE / AVG. LIFESPAN) x 100 = LIVED% OF EXPECTED LIFESPAN



APPENDIX B | (**Above**) Tree species shown by estimated time period of planting. (**Right**) Critical root zone mapping.

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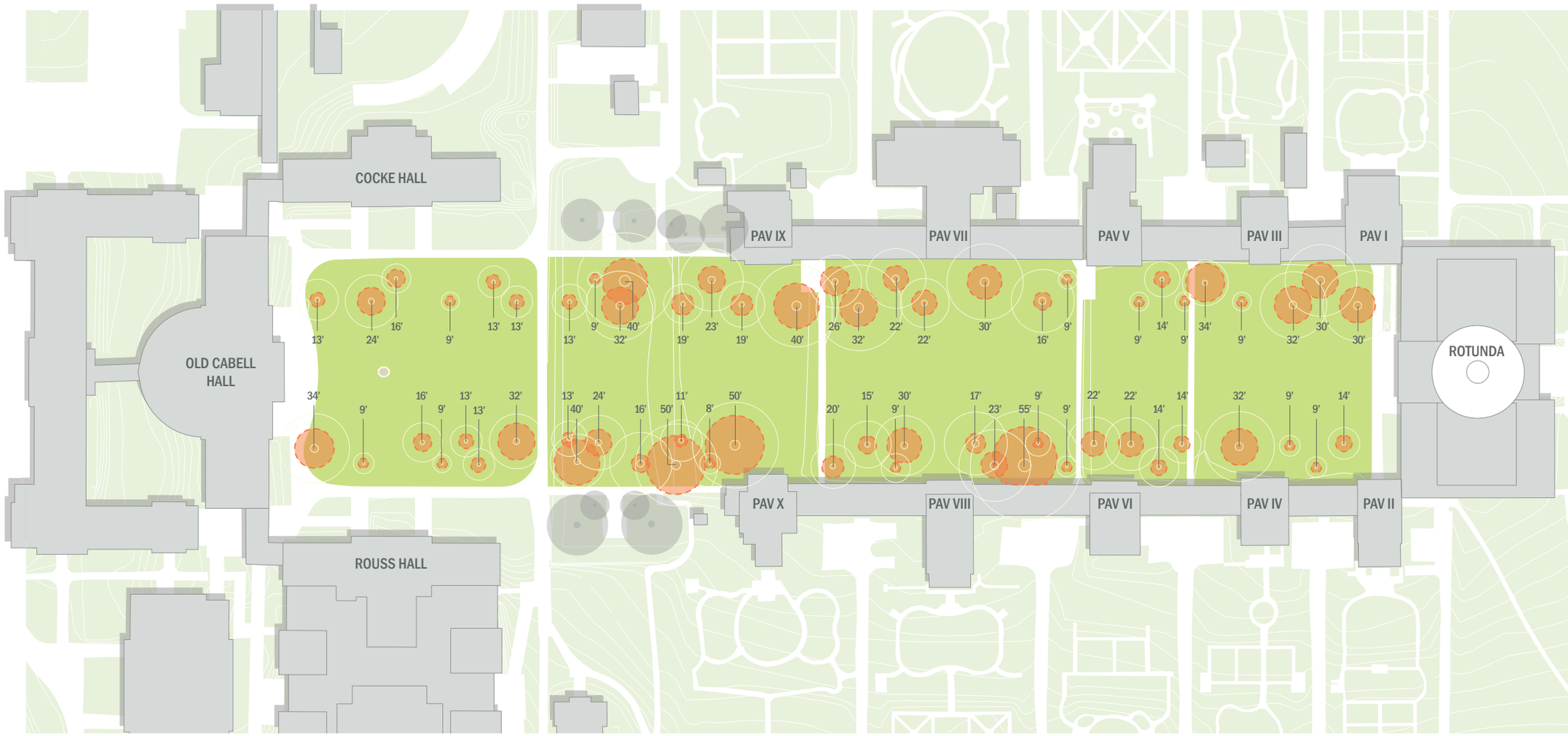
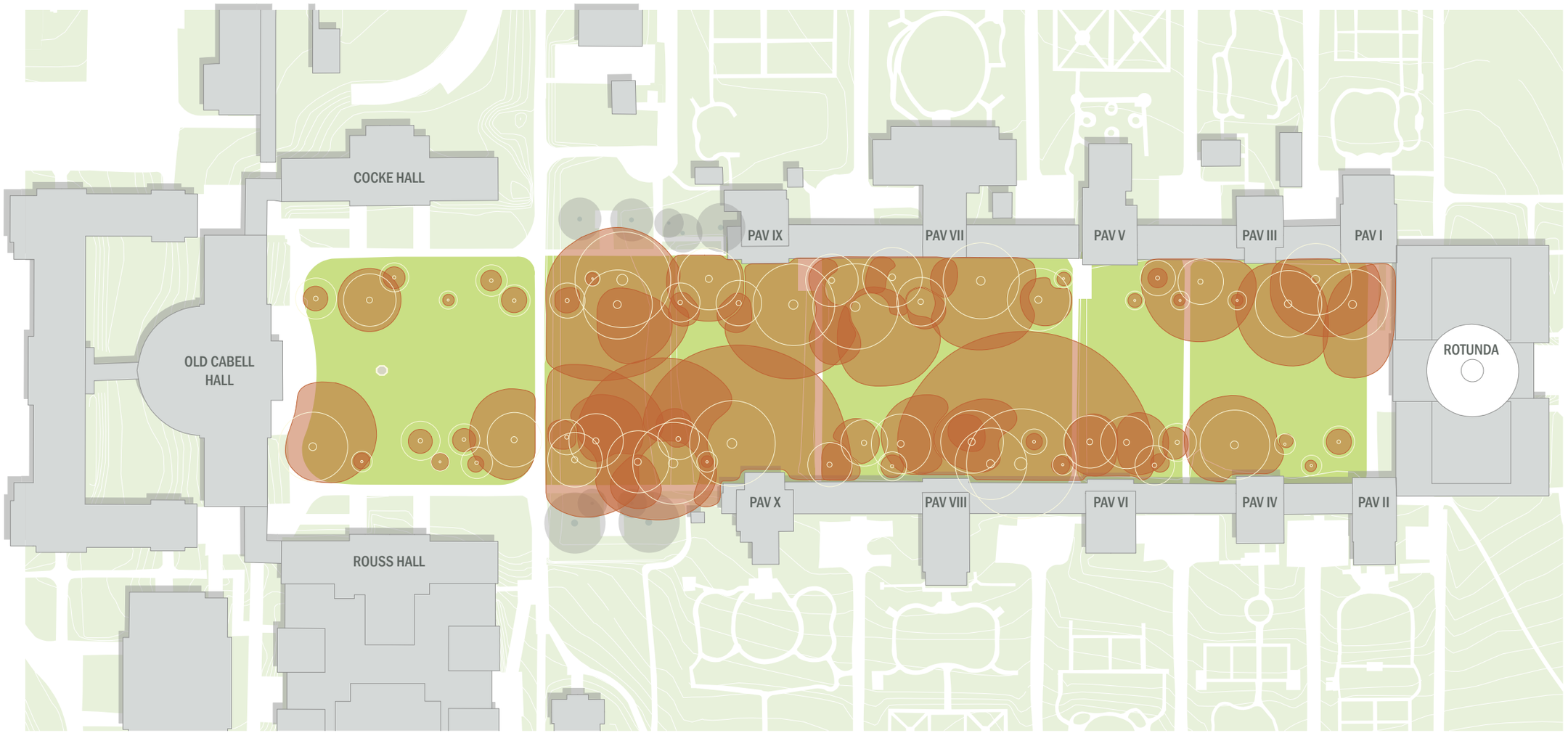


Structural root plate

24' Root plate diameter *(feet)*

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.

0' 50' 100' 200'



Critical root zone

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.

0’ 50’ 100’ 200’

Black Swallowtail caterpillar

Black Swallowtail butterfly

Blue bird feeding insects to its young

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

Maple *(Acer)*

206

Elm *(Ulmus)*

142

Linden *(Tilia)*

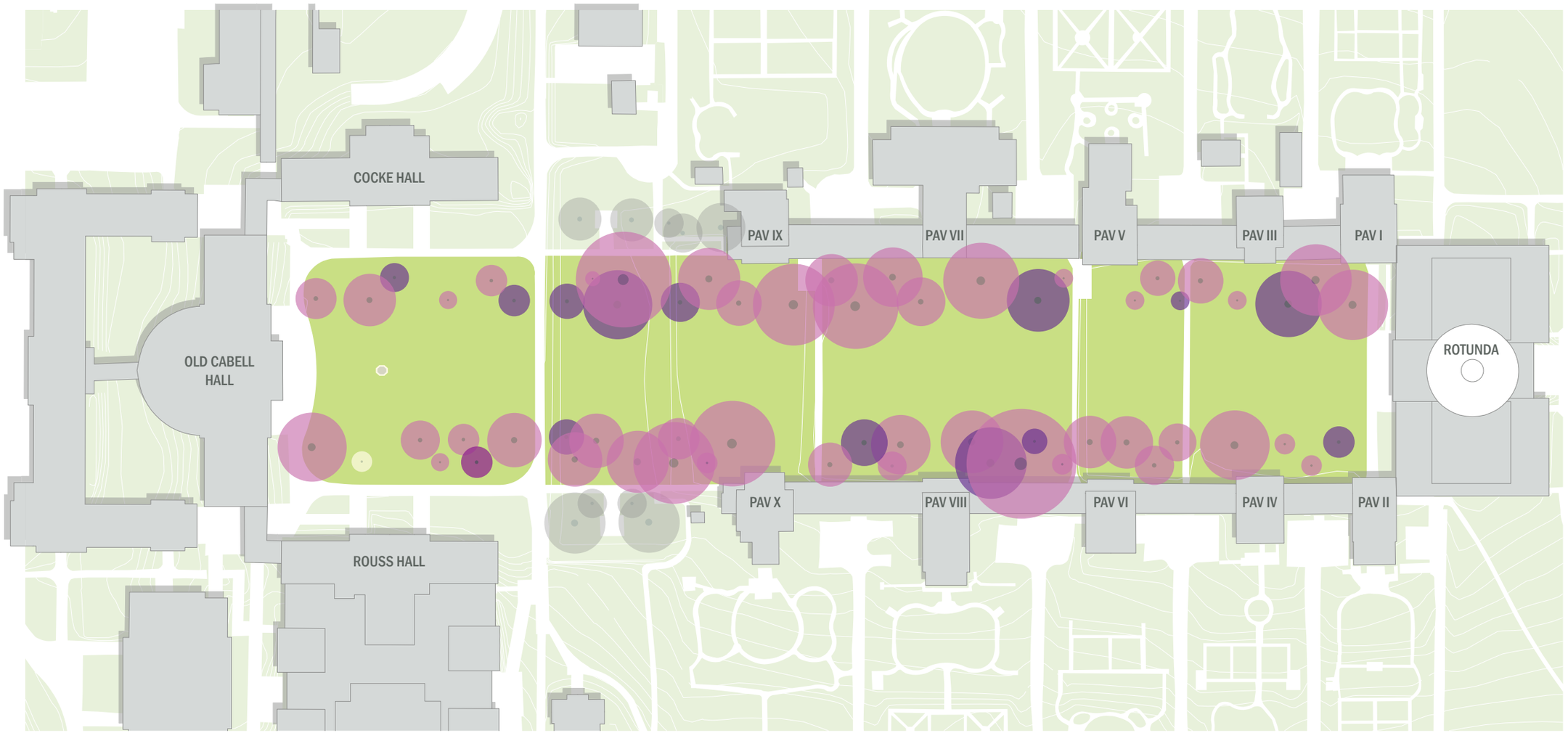
141

Ash *(Fraxinus)*

19

Poplar *(Liriodendron)*

APPENDIX B | Existing habitat support for current tree species on the Lawn.

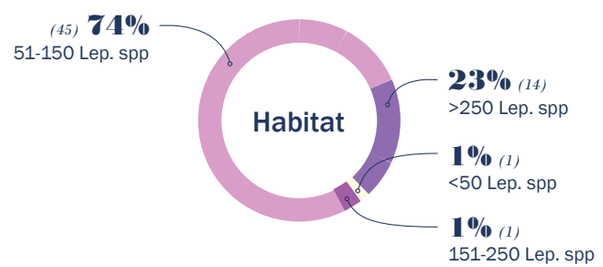


< 50 Lepidoptera species

51 - 150

151 - 250

> 250 Lepidoptera species



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

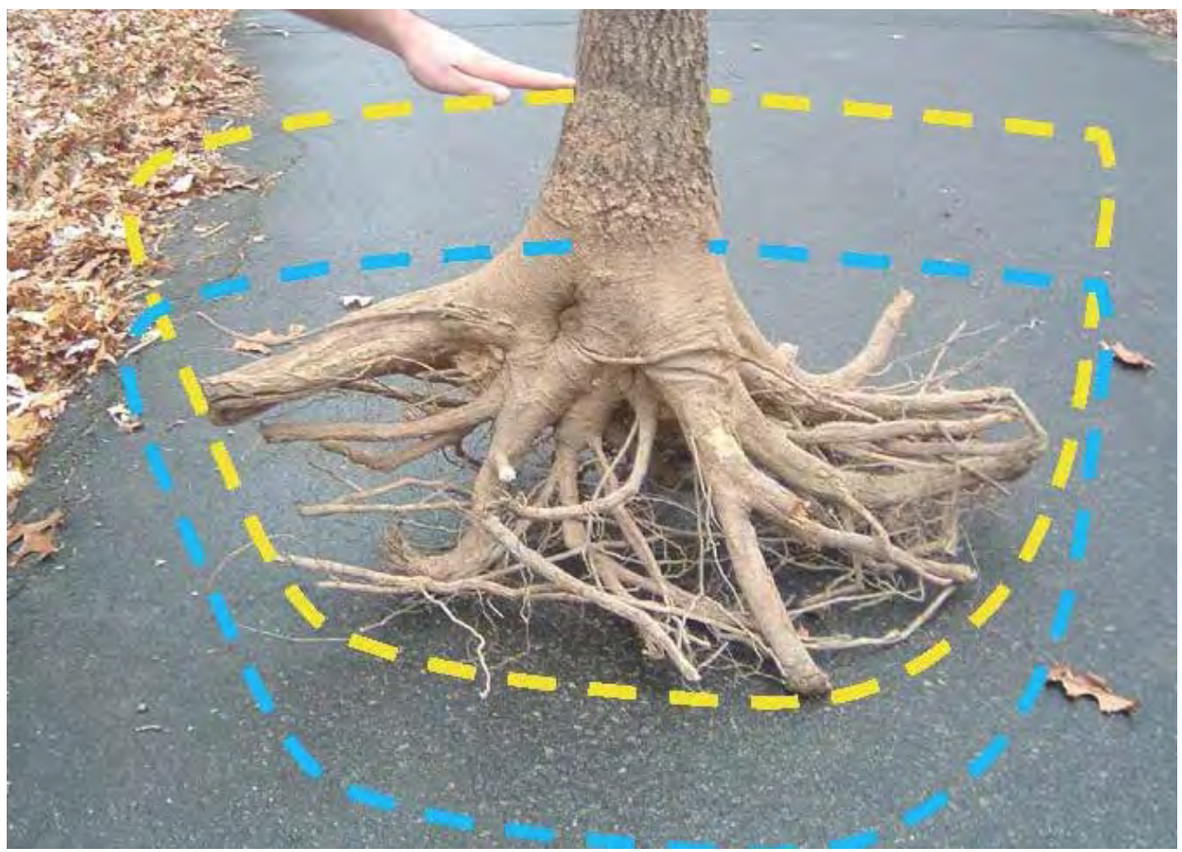
- Prune all girdling or turned roots to encourage new growth perpendicular to trunk at time of planting.

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.

BARE ROOT PLANTING | Bare root inspection allows for catching fatal rooting flaws before planting.

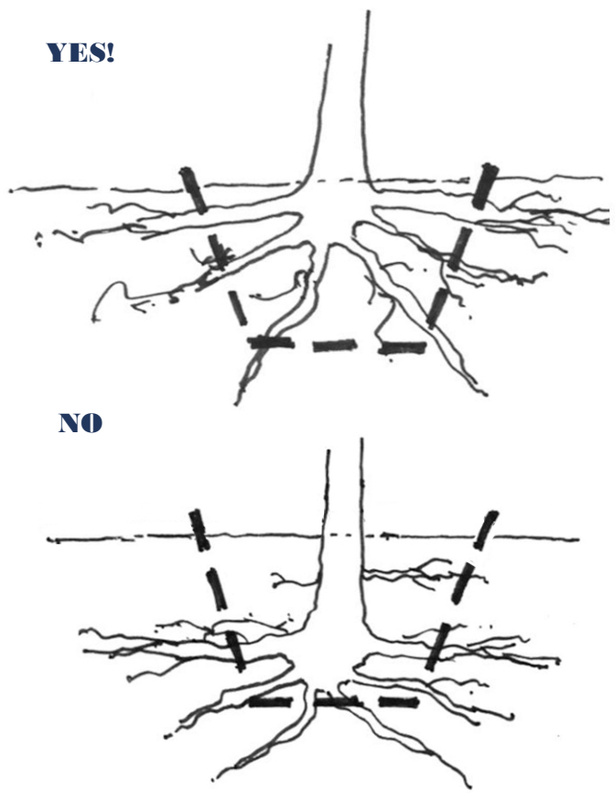
2. IDENTIFY THE ROOT FLARE

- 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.



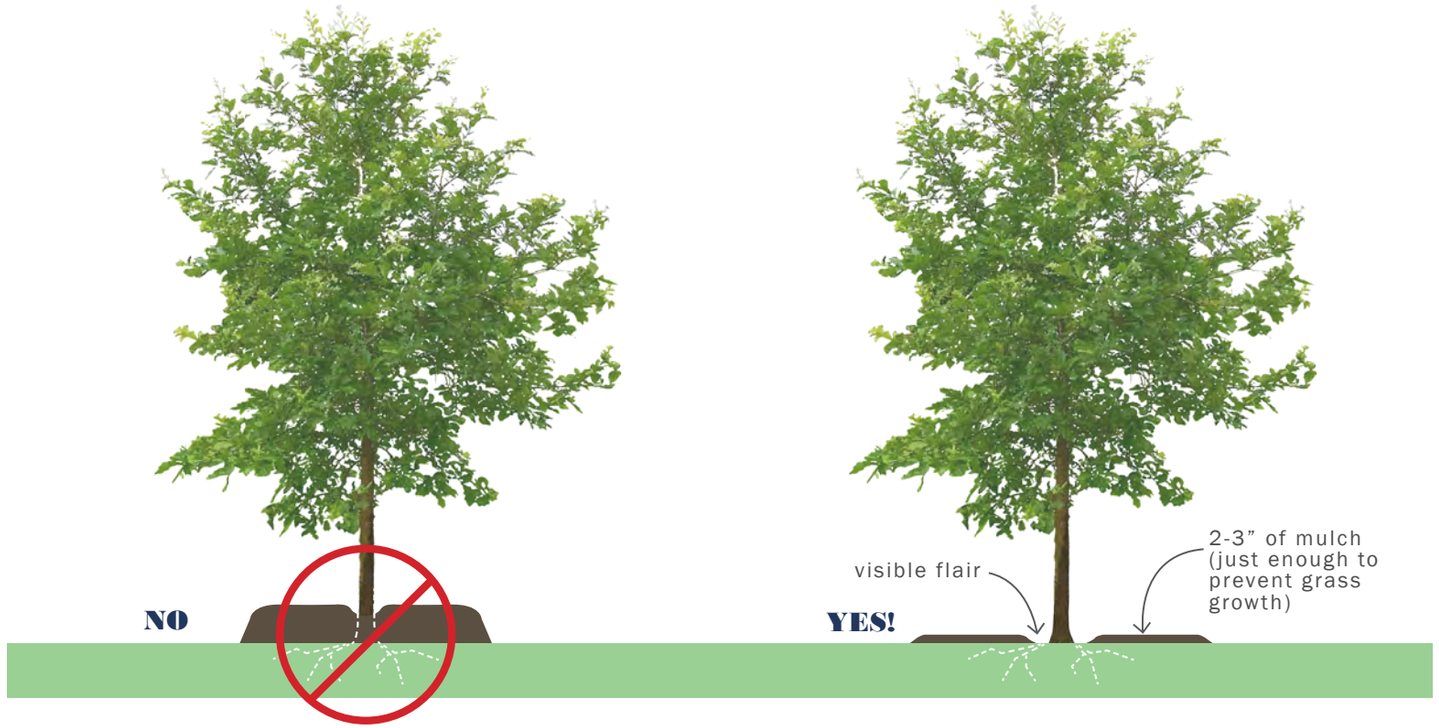
BARE ROOT PLANTING | Check condition of all nursery rootstock before planting on The Lawn to ensure good growth and long term success.

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.

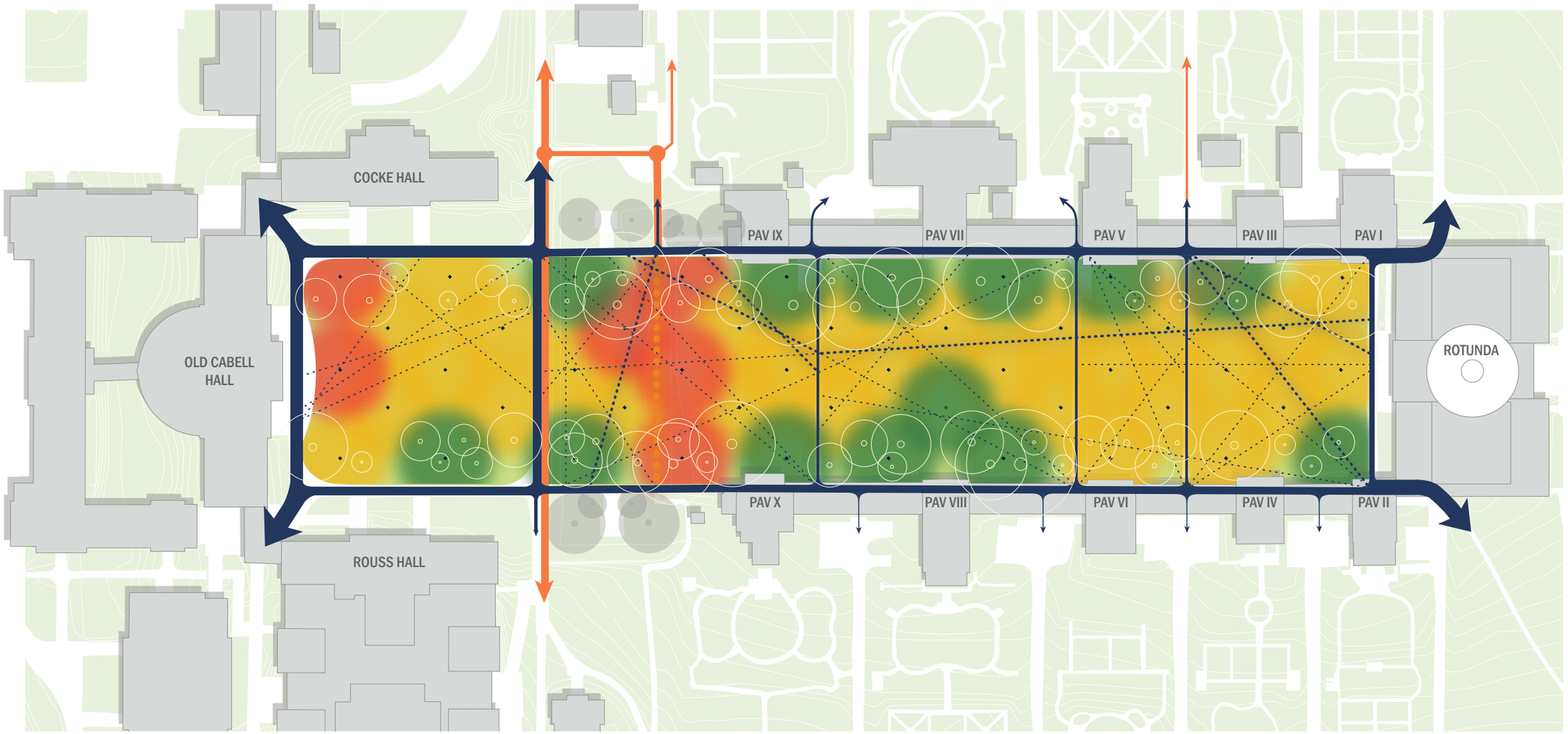


NOTES: Mulch provides a critical source of nutrient and water retention for trees both young and old. As observed during compaction testing, it also encouraged root growth and reduces soil compaction for healthier trees (while reducing competition for resources with turf).

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.



Pedestrian *(paved)*

Pedestrian *(turf)*

Maintenance *(paved)*

Maintenance *(turf)*

<200 psi

200-300 psi *(root limiting)*

>300 psi *(root restrictive)*

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.

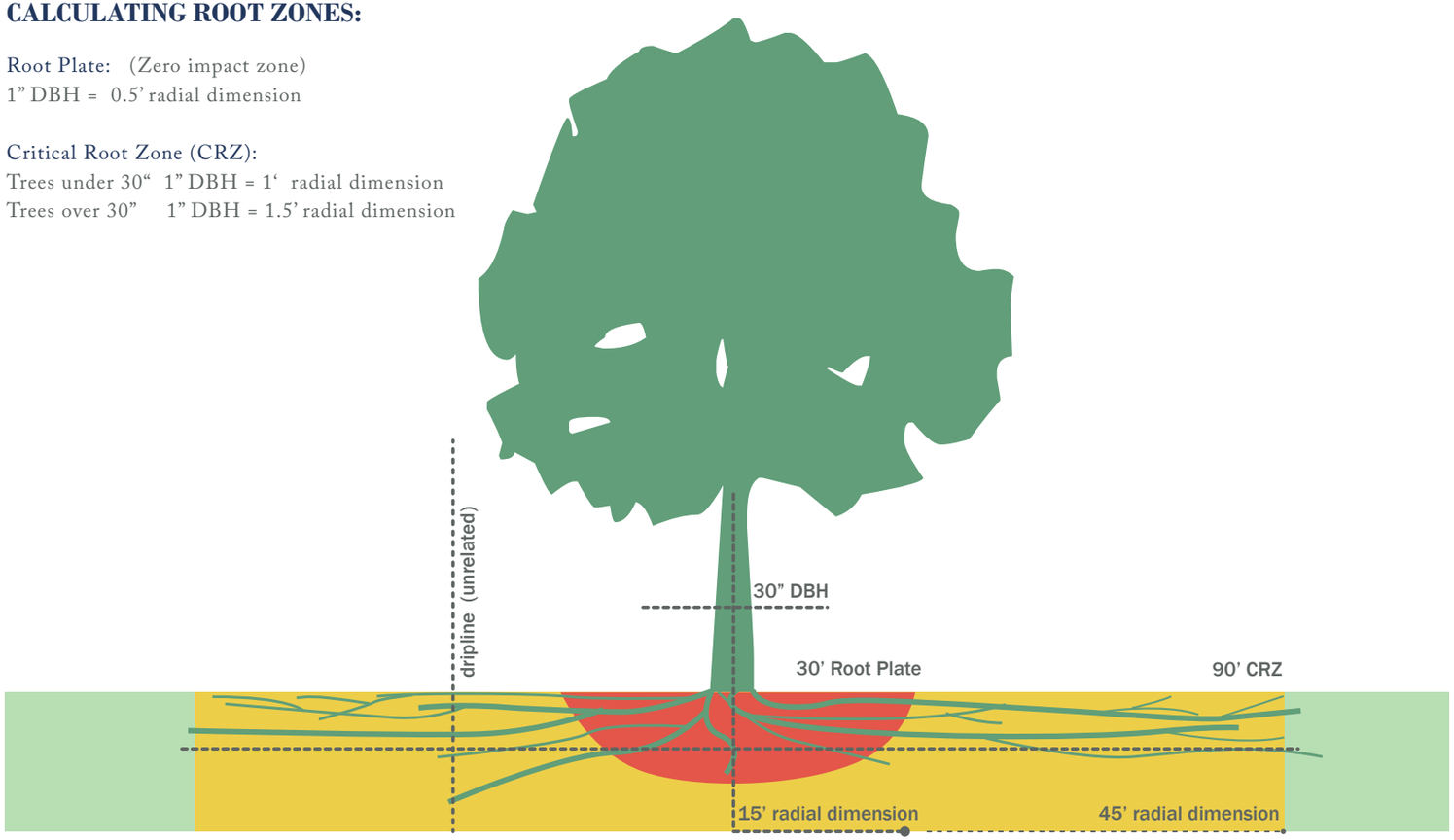
0' 50' 100' 200'

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

IMPACT TO CRZ	SURVIVAL RATE
0-30%	EXCELLENT
30-40%	70% : 30%
40-50%	50% : 50%
60-100%	REMOVE TREE

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.


COCKE HALL
OLD CABELL HALL
ROUSS HALL
PAV IX
PAV VII
PAV V
PAV III
PAV I
PAV X
PAV VIII
PAV VI
PAV IV
PAV II
ROTUNDA
Structural root plate
Critical root zone
Tree drip line
0'
50'
100'
200'

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	Difficult to transplant (deep taproot)
Celtis occidentalis	Hackberry	Weak wooded
Fagus grandifolia	Beech	Surface roots, compaction sensitive
Fraxinus quadrangulata	Blue Ash	EAB (shows resilience)
Ginkgo biloba	Ginkgo	Male only; cultivars known to produce fruit
Gleditsia triancanthos 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 coccinea	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

TREE SELECTION | 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.

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

**For future study; shows resistance to EAB.

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 divergant from the existing tree palette.

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

Excellent (4)
Good (3)
Fair (2)
Poor (1)

RED MAPLE
Acer rubrum

40

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 Virgina. Low branches will need pruning. Roots prone to girdling.

SUGAR MAPLE
Acer saccharum

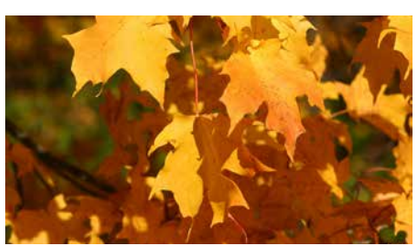
38

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 Virgina. Low branches will need pruning. Roots prone to girdling. Tends to lose central leader with stress.

PECAN
Carya illinoinensis

38

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 triancanthos var. inermis

37

Strengths

Fall color: Copper - Yellow

Growth rate: Fast

Size: 50' H x 40' W

Shape: Oval, upright branching with age

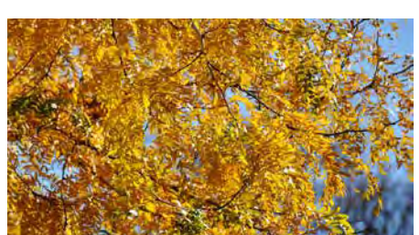
Tolerant to heavy compaction, drought

Weaknesses

Pest/Disease: Many (webworm, galls, aphids, cankers, leaf spot, etc.)

Lifespan: 60+ years

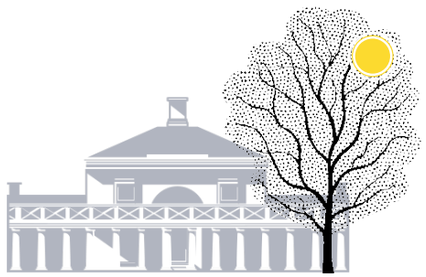
Climate sensitive to 8



Notes: Requires pruning to develop strong structure. Seedpods can be messy. Shademaster and Skyline cultivars are considerations.

KENTUCKY COFFEETREE
Gymnocladus dioicus 'Espresso'

43

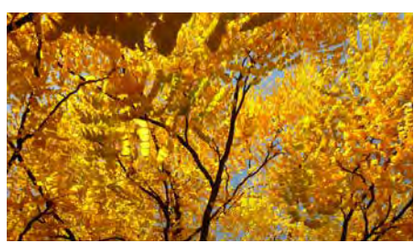


Strengths

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'

39

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

37

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

41

Strengths

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

Open branching, light shade

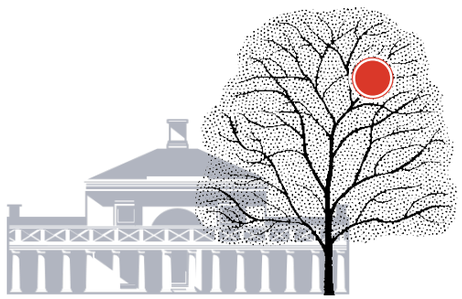
Weaknesses

Growth rate:	Slow - Moderate

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)

38

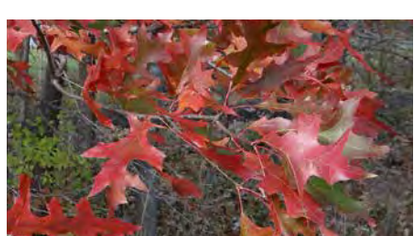


Strengths

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

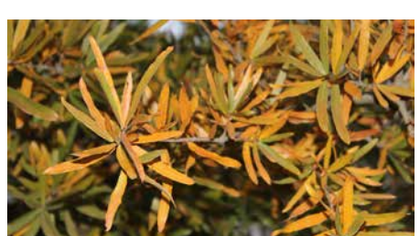
40

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)

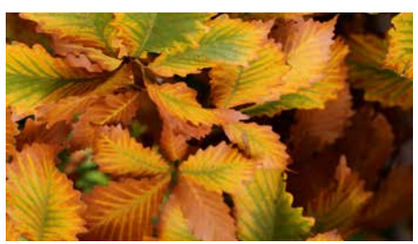
37

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'

34

Strengths

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

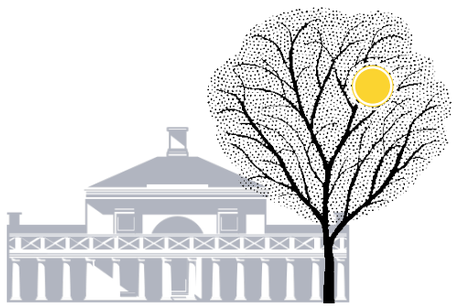
Weaknesses

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'**

43



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

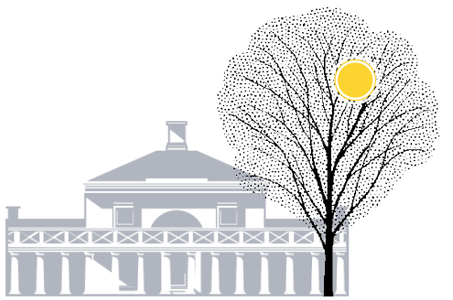
Size: 80' H x 60' W
Pest/Disease: Various

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'**

42

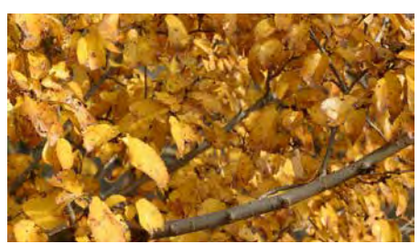


Strengths

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.

THE LAWN
PLANTING APPROACHES

a. Species Diversity

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

Acer saccharum	**Sugar Maple**
Gymnocladus dioicus 'Espresso'	**K. Coffeetree**
Liquidambar styraciflua 'Hapdell'	**Sweetgum**
Nyssa sylvatica	**Blackgum**
Quercus phellos	**Willow Oak**
Quercus prinus	**Chestnut Oak**
Tilia cordata	**L. leaf Linden**
Ulmus americana 'Jefferson'	**American Elm**
Ulmus davidiana var. japonica 'Morton'	**Accolade Elm**

b. Historic Relevance

Trees representative of those planted on the Lawn between 1827 and 2019.

Acer rubrum	**Red Maple**
Acer saccharum	**Sugar Maple**
Carya illinoinensis	**Pecan**
Gleditsia triancanthos var. inermis	**Honey Locust**
Ulmus americana 'Jefferson'	**American Elm**

c. Consistency of Form

Trees with forms that are consistent with one another and are complimentary to the existing trees.

Gleditsia triancanthos var. inermis	**Honey Locust**
Gymnocladus dioicus 'Espresso'	**K. Coffeetree**
Liquidambar styraciflua 'Hapdell'	**Sweetgum**
Nyssa sylvatica	**Blackgum**
Ulmus davidiana var. japonica 'Morton'	**Accolade Elm**

d. Threat Resilience

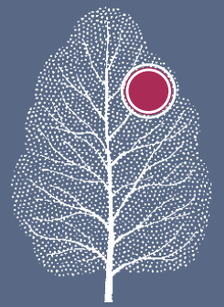
Trees with resilience to warming USDA zones and pending biological threats.

Liquidambar styraciflua 'Hapdell'	**Sweetgum**
Liriodendron tulipifera	**Tulip poplar**
Nyssa sylvatica	**Blackgum**
Quercus nuttallii	**Nuttall Oak**
Quercus phellos	**Willow Oak**
Ulmus davidiana var. japonica 'Morton'	**Accolade Elm**

PLANTING APPROACH 'A'
SPECIES DIVERSITY

Sugar Maple

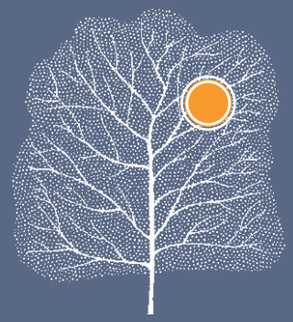
K. Coffeetree



Sweetgum

Blackgum

Willow Oak



Chestnut Oak

Little Leaf Linden

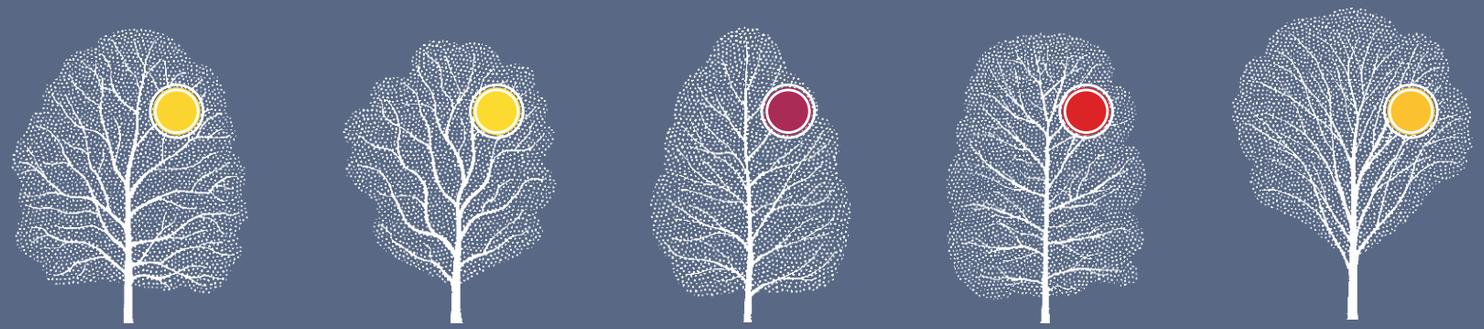
American Elm

Accolade Elm

PLANTING APPROACH ‘B’
HISTORIC RELEVANCE

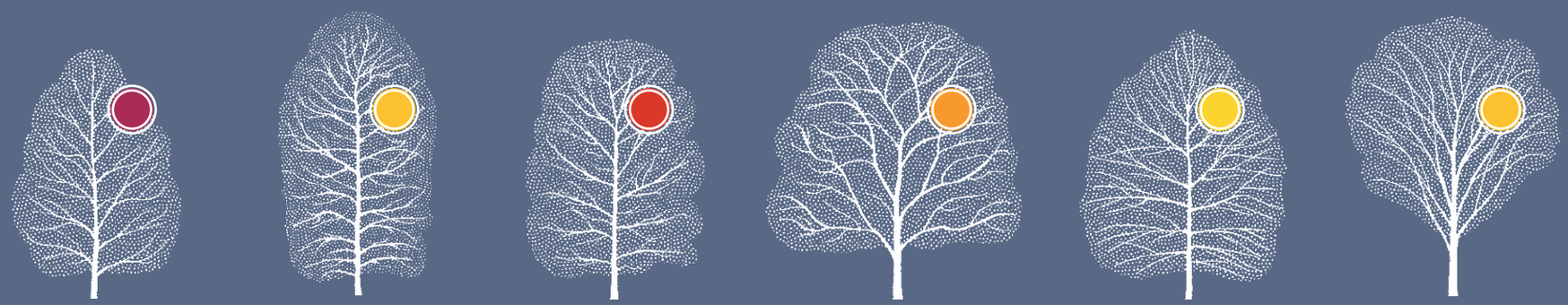
Red Maple Sugar Maple Pecan Honey Locust American Elm

PLANTING APPROACH ‘C’
CONSISTENCY OF FORM



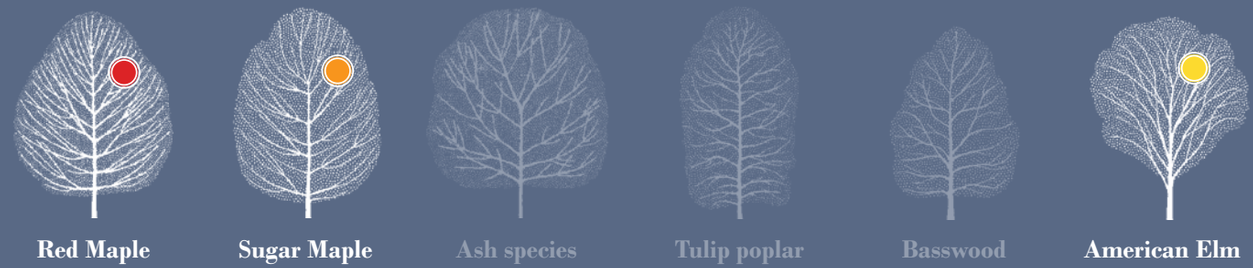
Honey Locust | K. Coffeetree | Sweetgum | Blackgum | Accolade Elm

PLANTING APPROACH ‘D’
THREAT RESILIENCE



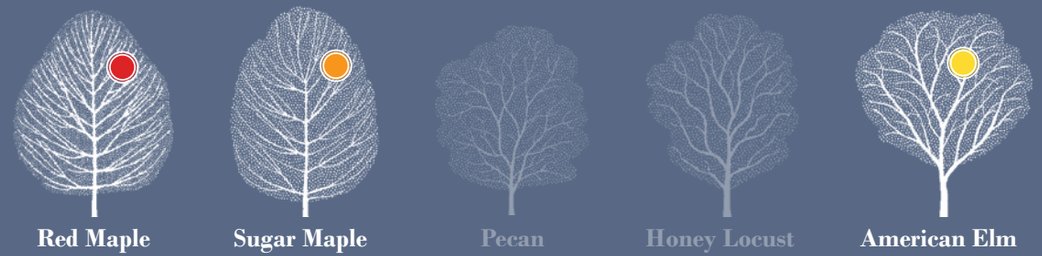
Sweetgum | Tulip Poplar | Blackgum | Nuttall Oak | Willow Oak | Accolade Elm

EXISTING SPECIES



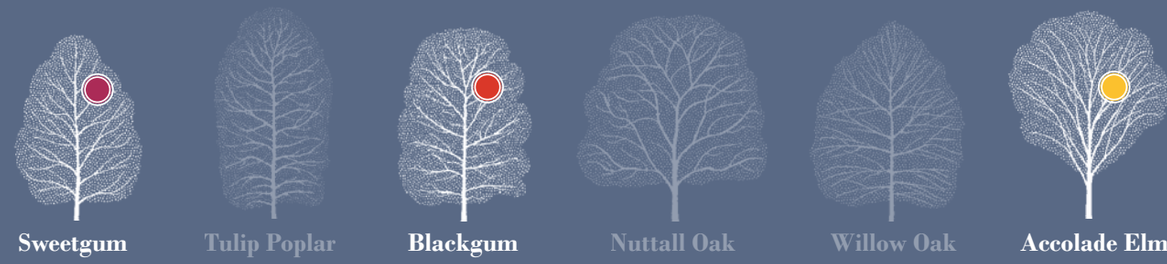
DIVERSITY OF SPECIES

HISTORIC RELEVANCE



CONSISTENCY OF FORM

THREAT RESILIENCE



Climate Change

In 60 years, if existing high global emissions continue, Charlottesville climate (USDA zone 7a) will more closely resemble Shreveport, Lousiana (USDA zone 8b).

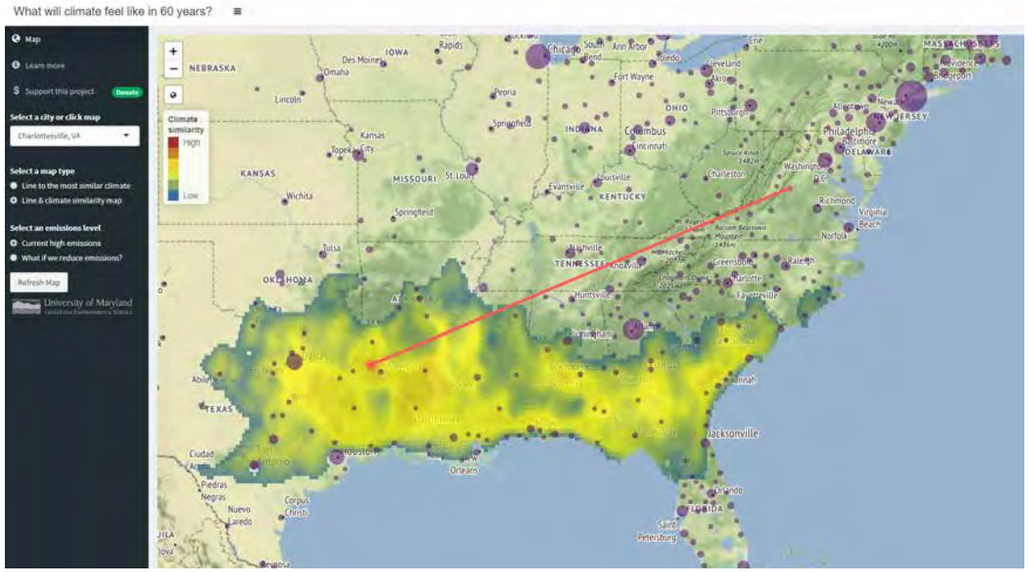


image credit: fitzlab.shinyapps. io/cityapp

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

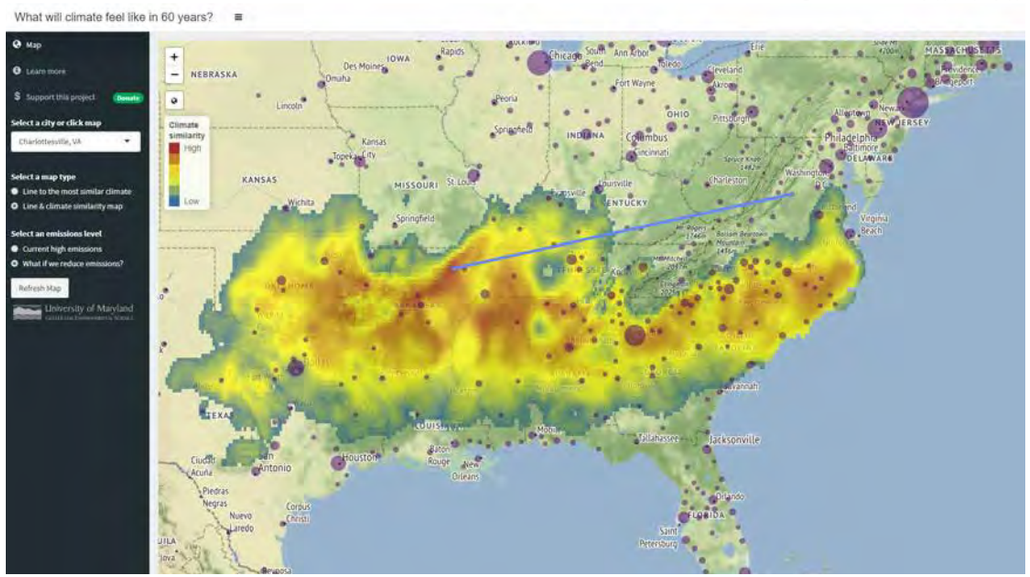
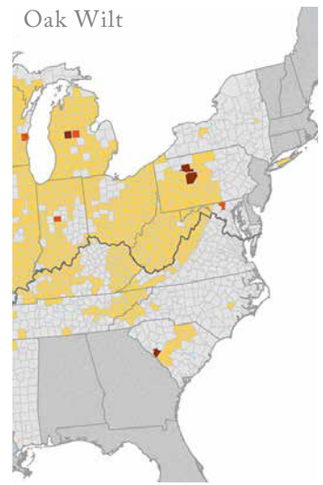


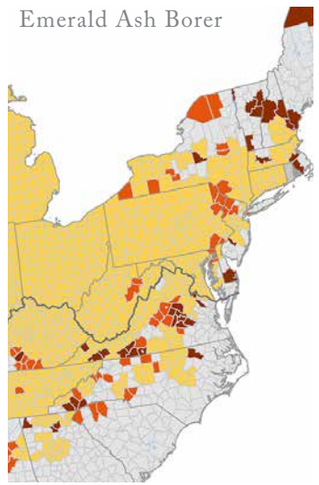
image credit: fitzlab.shinyapps. io/cityapp

Pest & Disease Threats

Oak Wilt



Emerald Ash Borer



Asian Longhorned Beetle

credit: USDA

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

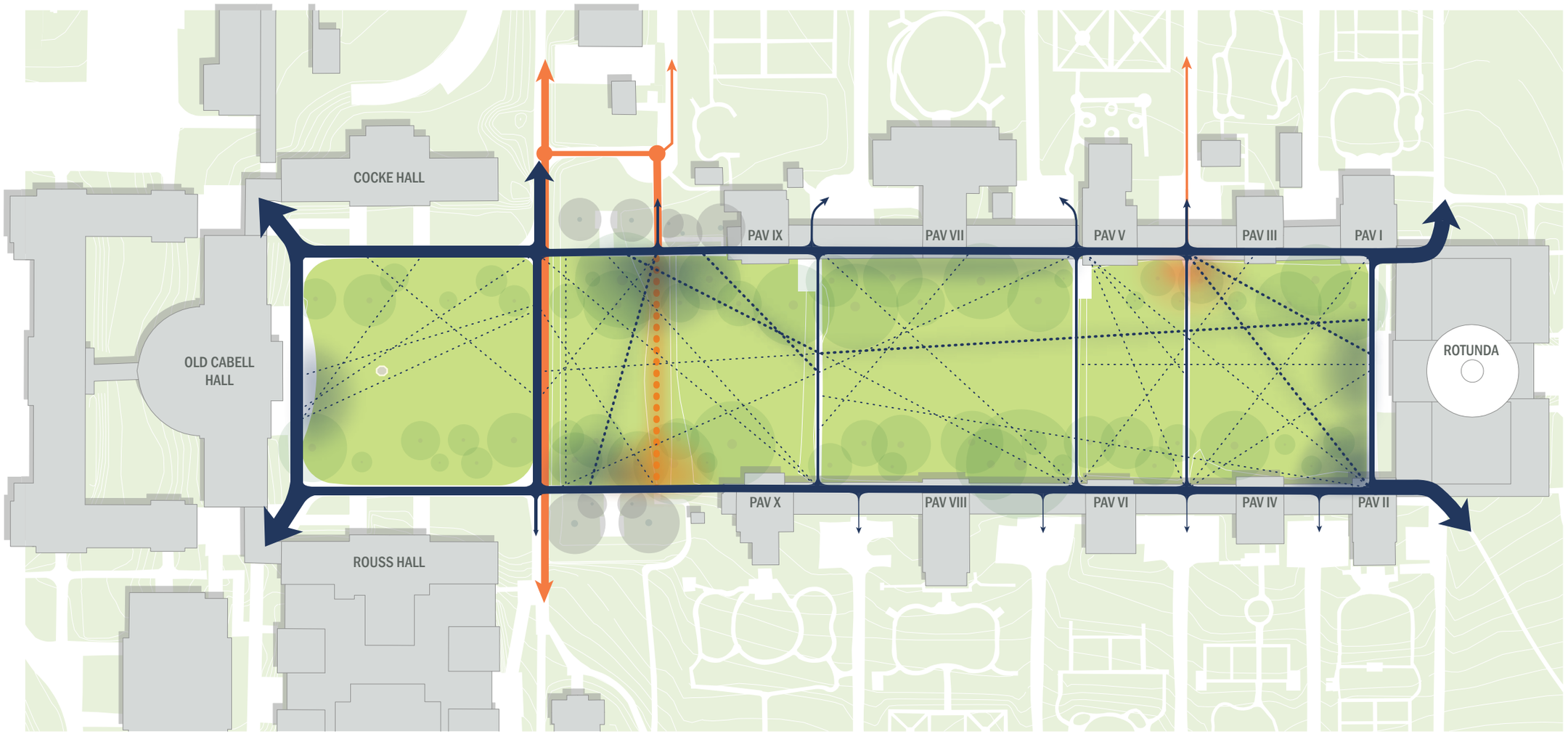
May - June
Alumni Reunions

fall winter spring summer

October
Trick - or - Treat

May
Commencement

APPENDIX E | (**Above**) Large scale University events on the Lawn. (**Right**) Daily pedestrian use and circulation study.



Pedestrian *(paved)*

Pedestrian *(turf)*

Maintenance *(paved)*

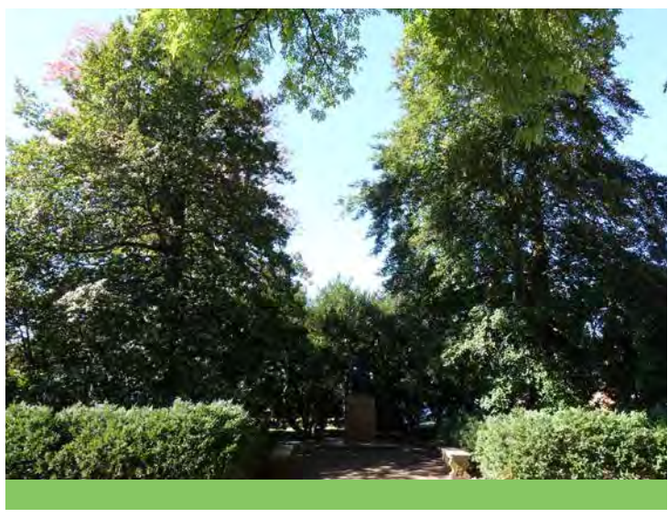
Maintenance *(turf)*

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.

0' 50' 100' 200'

Unplanted Setback

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

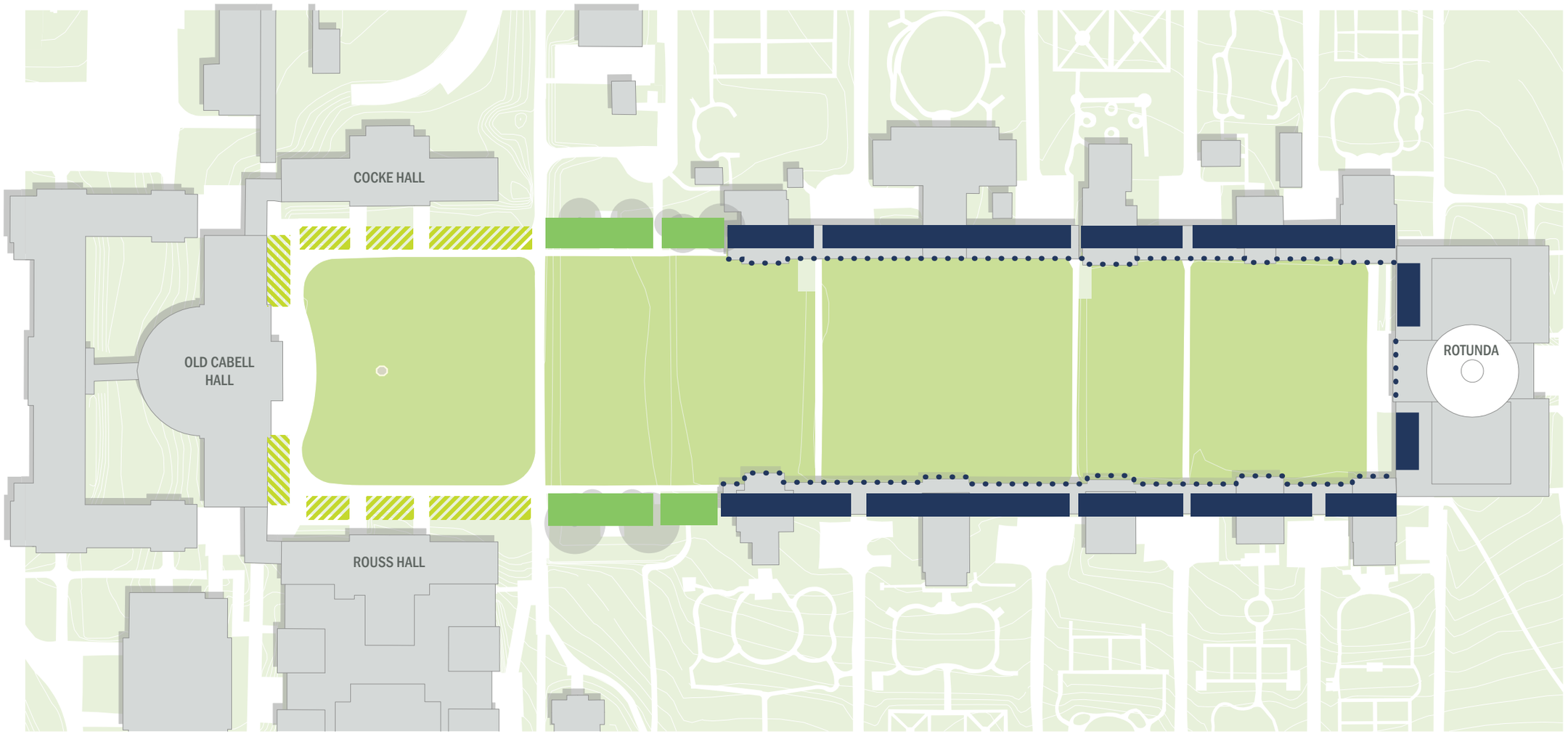


Planted edge

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 E | (Right) Spatial awareness of the Lawn based upon planted and architectural edges and setbacks.


COCKE HALL
OLD CABELL HALL
ROUSS HALL
ROTUNDA
0'
50'
100'
200'

APPENDIX F: SOIL AND COMPACTION ANALYSES

Test 1

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

Test 2

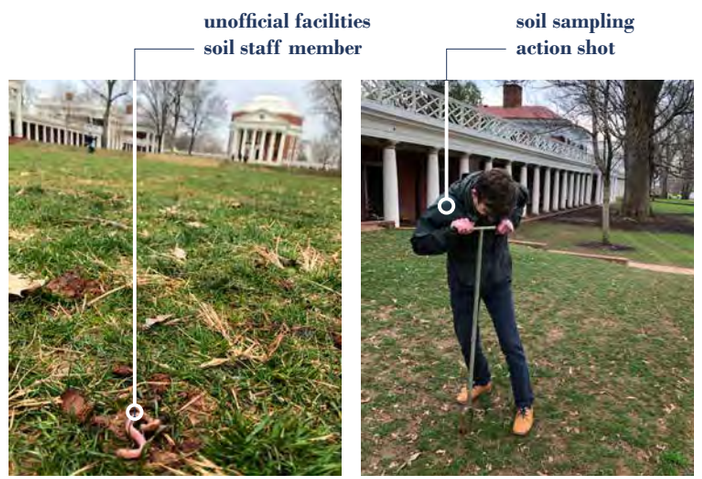
+/- 3” organic layer; compacted clay subsoil - heavy compaction

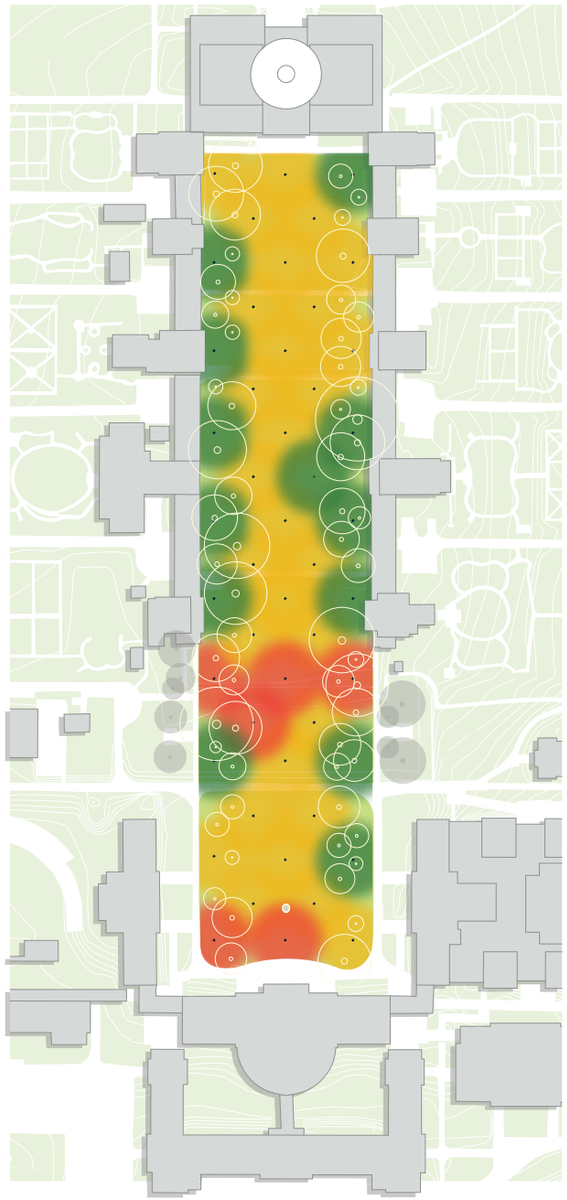
Test 3

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

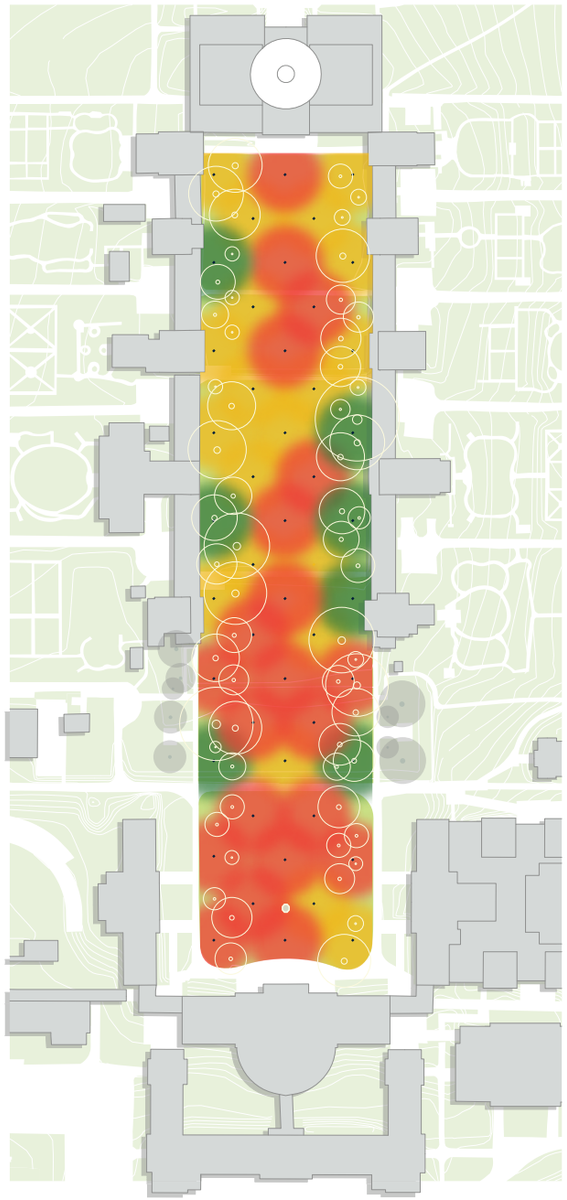
Test 4

Minimal organic layer; compacted clay subsoil - heavy compaction





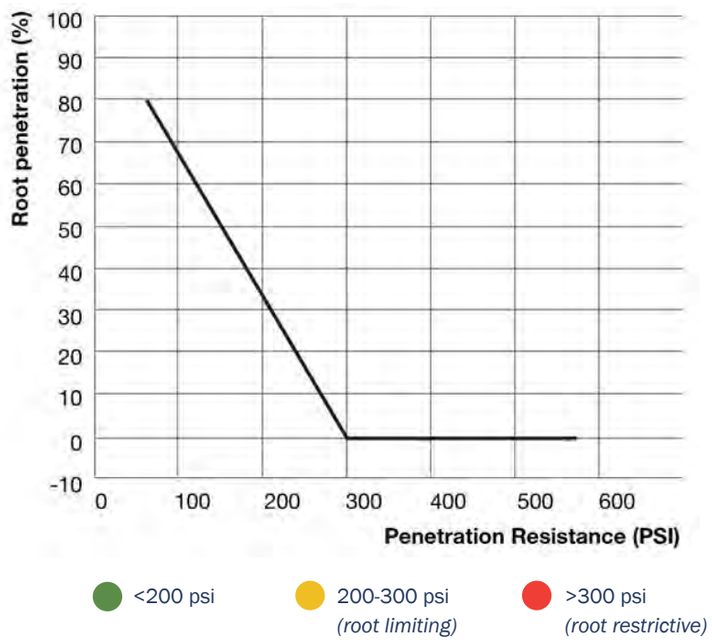
Top 6”



8”-12” Deep

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.



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.

APPENDIX F | **(Left)** Soil sample augering completed January 14, 2019. **(Above)** Soil compaction testing using a penetrometer completed January 14, 2019.

Utilities & Construction

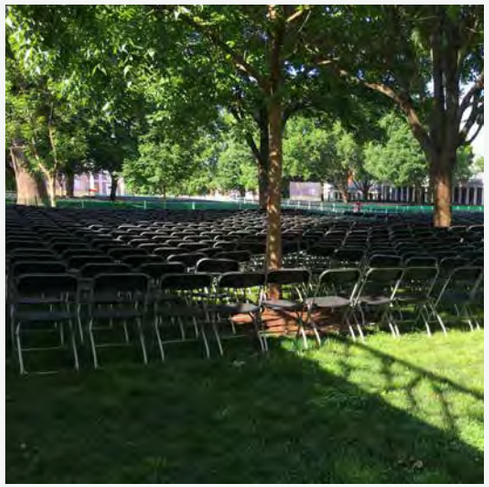
UTILITY DUCT BANK INSTALL

WORK AROUND BUILDINGS

TYPICAL MAINTENANCE

STUDENTS

Events



COMMENCEMENT

DONOR EVENTS

CONCERTS

LOWER LAWN EVENTS

Daily Use & Maintenance

APPENDIX F | (**Above**) Impacts to soil, turf, and trees. (**Right**) 2016 UVA soil sample tests conducted by Tellus Agronomics LLC.

Flat 1

CEC (ME/100g) = 11.07
Organic Matter (%) = 5.33
pH = 7.2

Flat 2

CEC (ME/100g) = 15.11
Organic Matter (%) = 7.47
pH = 7.0

Flat 3

CEC (ME/100g) = 13.97
Organic Matter (%) = 7.88
pH = 7.1

Flat 4

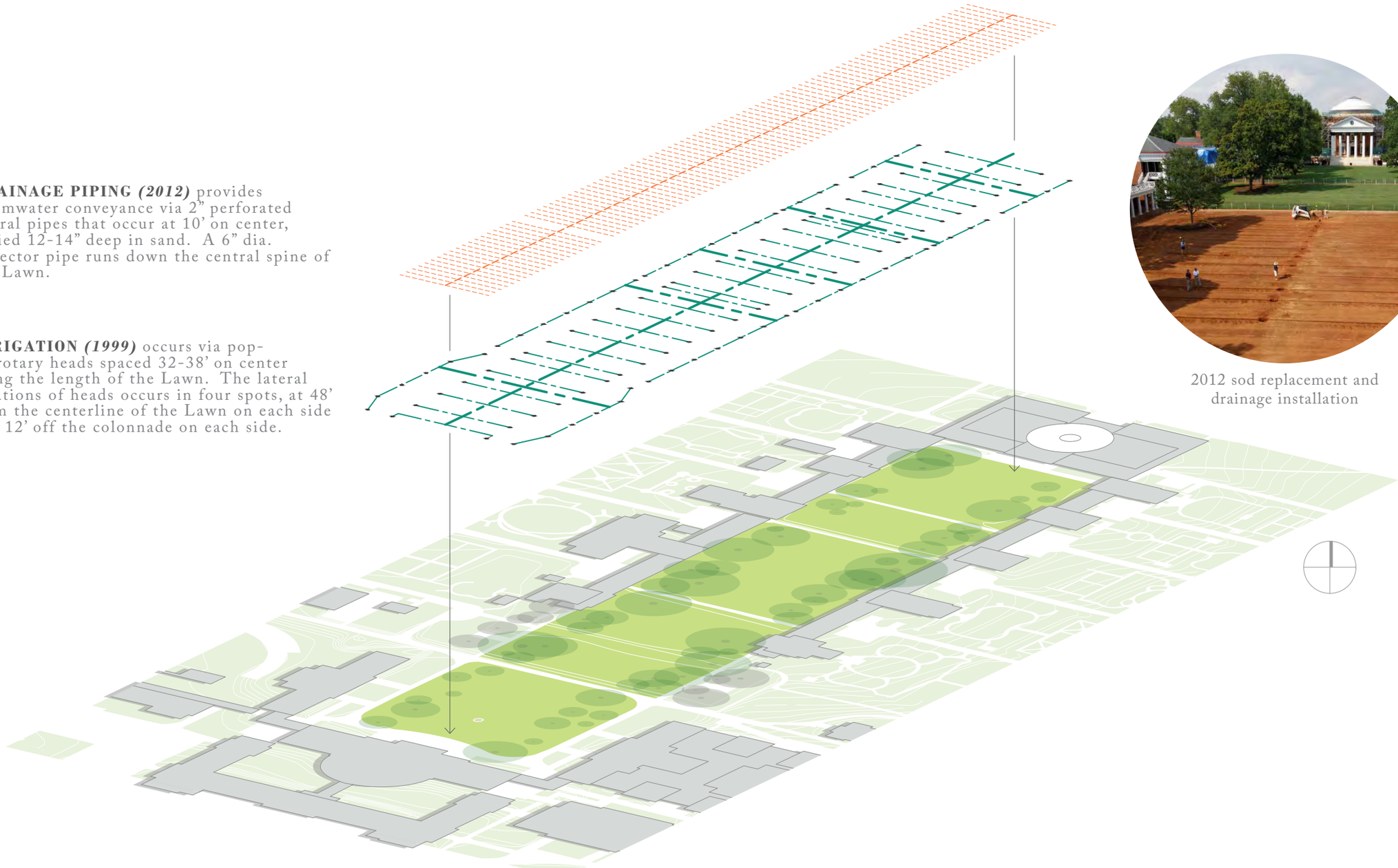
CEC (ME/100g) = 12.42
Organic Matter (%) = 5.84
pH = 7.1

Flat 5

CEC (ME/100g) = 15.05
Organic Matter (%) = 7.09
pH = 7.1

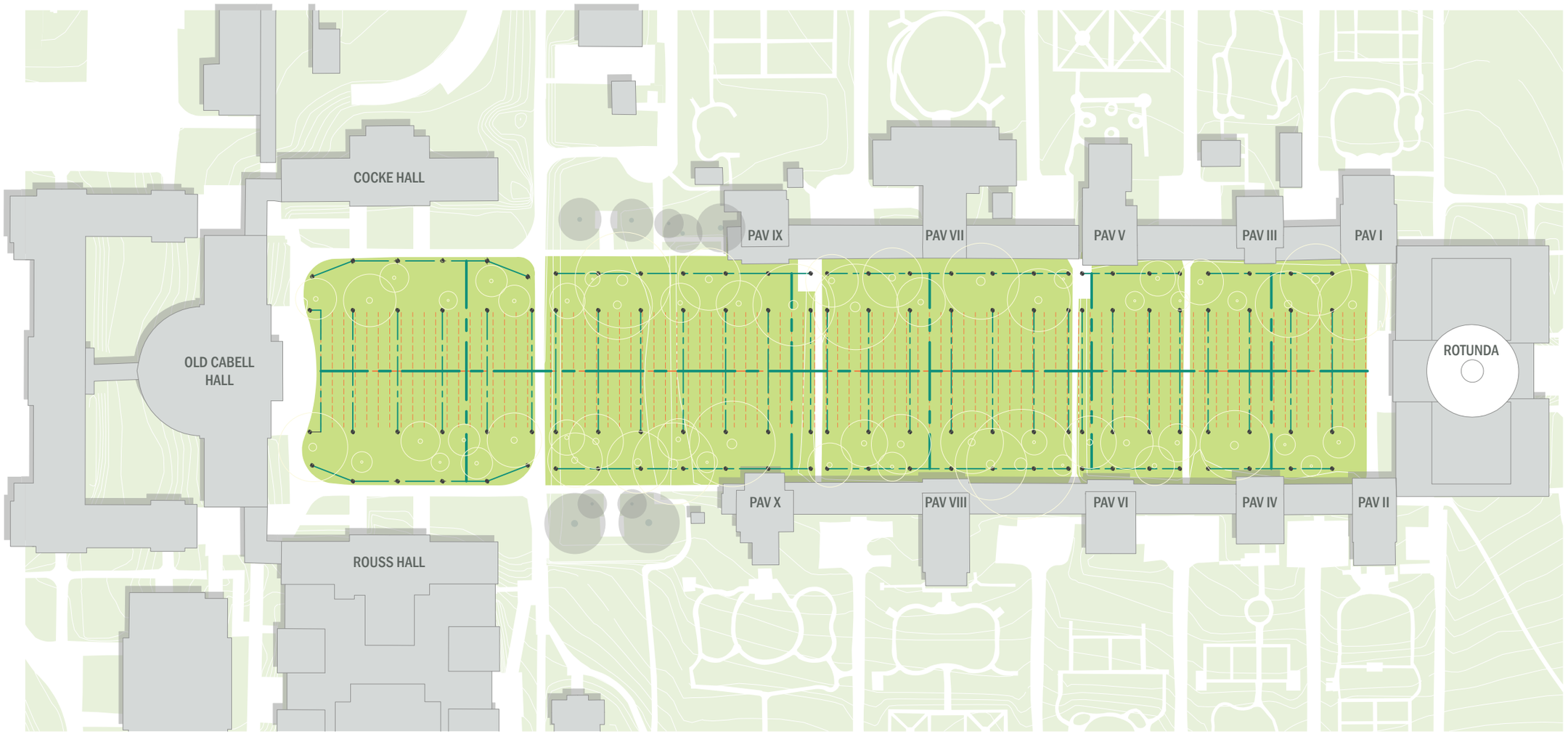
DRAINAGE PIPING *(2012)* provides stormwater conveyance via 2" perforated lateral pipes that occur at 10' on center, buried 12-14" deep in sand. A 6" dia. collector pipe runs down the central spine of the Lawn.

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.



2012 sod replacement and drainage installation

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.



Stormwater Infiltration Sytem (*installed 2012*)

Irrigation System (*installed 1999*)

0' 50' 100' 200'

UNIVERSITY of VIRGINIA

THE LAWN

TREE FRAMEWORK PLAN