

UVA DECARBONIZATION ACADEMY

FINAL REPORT, August 2024

PROJECT TOPIC: Forest Patches

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1. GOALS

Mission Statement: The Forest Patches team seeks to ensure sustainable and long-term development of forest infrastructure benefitting both the community and the climate. We will guide this work by empowering student-led and reciprocal community engagement and develop collaboration with institutions within the University of Virginia (UVA), Charlottesville, and across higher education.

In accordance with this mission and the three pillars of the University's 2030 Sustainability Plan, we pursue the following goals:

1. Steward:
 - a. Plant forest patches: Identify, plan, and build forest patches using the Miyawaki Method to sequester carbon and increase native biodiversity on Grounds.
 - b. Collaborate for sustained success: Develop a long-term plan for patch maintenance and growth in collaboration with UVA divisions and student groups.
2. Engage:
 - a. Model forest patches for higher education: Develop and communicate a procedure as a model for future UVA tree-planters and other schools/institutions.
 - b. Connect human and ecological communities: Through community dialogue, increase the visibility of the Forest Patches project and incorporate placemaking into patch design to facilitate nature connection in the UVA community.
3. Discover:
 - a. Quantify forest impact: Calculate and monitor the sequestered carbon impact and ecological benefits of forest patches.

2. INTRODUCTION and MOTIVATION

The Forest Patches project seeks to ensure the sustainable and long-term development of forest infrastructure at UVA to both sequester carbon on Grounds and improve community members' nature connectedness. Although tree planting has a limited carbon impact compared to other interventions, it serves as a compounding investment in carbon sequestration and other key benefits supporting UVA's Sustainability Goals.

By changing land use of sections of Grounds from manicured lawns to natural forests, UVA can reduce the water and energy intensive treatment of traditional landscaping. Through intentional placemaking in collaboration with UVA stakeholders, we can advance sustainability teaching and

Grounds-engaged learning by providing students and professors with places to learn and study with and in nature.

The Miyawaki Method, developed by Japanese botanist Akira Miyawaki, outlines the steps to quickly establish a mature forest patch in decades rather than centuries (Lewis, 2022). High biodiversity of native species mimicking the result of natural succession is central to the approach. Approximately 70-80% of species planted should be canopy and subcanopy species, 10% should be shrubs, and the remainder should be herbaceous plants (Lewis, 2022). After preparing the site and soil by removing weeds and invasives and turning over the topsoil, species are planted densely to drive growth from competition. The site is then mulched and lightly maintained for two to three years until reaching self-sufficiency. For its simplicity, efficacy, and many benefits, the Miyawaki Method offers a strong option for reforesting Grounds.

Some of these benefits include the following:

Wildlife

A primary benefit of forest patches is their impact on the ecological community. Forest patches provide shelter, habitat, and food to a variety of birds, insects, and mammals such as deer, groundhogs, rabbits, and foxes. Because of the fast-growing nature of Miyawaki patches, they provide the food, habitat, and ecological niches necessary to support numerous species and individuals. In addition to the insects currently present in the patch, berries and fruits from planted trees will attract birds who may nest in their branches. Overall, forest patches on Grounds provide the ecological foundation for increasing species biodiversity and supporting threatened populations in Charlottesville (“National Forest Foundation”).

Ecological Connectivity

In the urban environment of Charlottesville, habitat fragmentation due to human development provides a threat to ecological resilience. However, UVA’s close proximity to protected land and biodiversity cores in Shenandoah and Albemarle County provide the opportunity for the introduction of forest patches to improve connectivity. The most important factors in patch connectivity are patch area, distance between patches, and patch composition (Saura and Hortal 2007).

Carbon Sequestration

By densely planting a diverse mix of native species, Miyawaki forests can grow up to 10 times faster than conventional reforestation regimens (Largi, 2019). This accelerated growth results in a higher rate of carbon dioxide absorption, as young, fast-growing trees are particularly effective at sequestering carbon (Jana et al., 2009). The diversity of plant species in Miyawaki forests also enhances their productivity and resilience to pests and diseases, ensuring long-term carbon storage stability (Thompson et al., 2009). The multi-layered structure of these forests, with trees, shrubs, and herbaceous plants maximizes photosynthesis and carbon uptake (Ariluoma et al., 2023). As urban areas grapple with carbon emissions, Miyawaki forest patches offer a simple and viable nature-based solution for carbon sequestration.

Abiotic Factors: Temperature and Soil Quality

As a carbon sequestration tool, forests contribute to climate mitigation; but through the cooling they provide, trees and other plants serve as important climate adaptation measures in urban environments (Rahman et al., 2020). In addition to the shade trees provide, evapotranspiration contributes further to cooling. As plants absorb water through their roots and evaporate it through their leaves, the phase change from liquid to gas removes heat from the environment (Benefits of Trees and Vegetation, 2024). Through these mechanisms, increasing tree cover by 30% in urban environments could reduce 40% of heat-induced mortalities and significantly reduce the impacts of the urban heat island effect (Iungman et al., 2023,). Tree cooling's effects ripple to reduce energy demand for air conditioning, lowering greenhouse gas emissions and increasing air quality (Akbari, 2002).

Forest patches also play a key role in improving soil quality and reducing soil erosion. As plant roots grow, they break down rock material, which increases mineral diversity in the soil (Xiang et al., 2023). Roots also channel water, creating room for the soil to aerate and drain, and hold soil in place, reducing soil erosion (Clawson, 2023). In addition, as plant and leaf litter collect and decomposition occurs, organic matter increases in the soil, adding more nutrients and increasing soil quality (Giweta, 2020). Areas with plants also provide a habitat for more microorganisms, which add additional organic matter to the soil. Lastly, plants provide a defense for the soil against wind and rain, further decreasing soil erosion (Clawson, 2023).

Human Benefits

Forested areas have numerous quantifiable mental and physical health benefits. These effects are especially significant for those in an academic community, as stress is a common experience among students and faculty. Spending time in and around nature can reduce blood pressure and two stress-related hormones, adrenaline and cortisol, in addition to improving focus (*Immerse Yourself In A Forest For Better Health - NYSDEC*, n.d.). Although the surrounding area of Charlottesville is not without hikes and natureful experiences, it is crucial that the urban area of UVA provides ample green space to its residents.

3. METHODOLOGY

This summer's work began by researching background materials including books and articles to become familiar with the Miyawaki method, the relationship between humans and forests, and tree measurement and identification. Some of these resources included *Braiding Sweetgrass*, *Mini-Forest Revolution*, short documentaries on Miyawaki forests in Boston and Utrecht, and reviewing the past teams' work (see Appendix A). With direction from faculty mentor, Professor Tim Beatley, we developed a list of goals for the summer (see Goals section).

Exploring Grounds in search of open and unused areas, we identified 34 potential locations and scored them on patch viability and benefits as represented by the following criteria: visibility, usability, erosion control, size, water and sunlight availability, and connectivity (see Appendix B). Compiling these rankings and data on land area and carbon sequestration potential, we

presented our top choices to Associate Director of Grounds Rich Hopkins and UVA Senior Landscape Architect Helen Wilson. This initial proposal, using the Miyawaki standard of three trees per square meter, accounted for nearly 85,000 new trees which would sequester two-thirds of UVA's transportation emissions. After discussing concerns about the location of buried utilities and the University's commitment to Crime Prevention Through Environmental Design (CPTED), we received approval for 13 sites and prioritized the top five strongest sites for planting in 2024-25.

Once we determined the planting order of the patch sites, we researched the native plants best suited to each forest patch. Cross referencing the species available at Facilities Management's nursery partner and native plants to the Piedmont region, we compiled a list of plants for each patch according to their drought and flood tolerance, sun tolerance, and growth rate. Using the Miyawaki patch composition and density standards—70-80% trees, 10% shrubs, and the rest herbaceous plants planted at three per square meter—we determined the necessary quantities of each. Another important aspect of our species selection was consideration of a changing climate. It was recommended to us that certain native species, such as Yellow birch and Northern red oak, not be planted as these species have suffered losses from recent hot and dry conditions.

We also developed a wildlife and plant monitoring procedure for existing and future patches. We began with preliminary wildlife observations for each of the patches and set up a camera trap to augment these capabilities. We also mapped out each existing patch and measured height, diameter at breast height, and health of each individual plant to create a baseline of data so that future teams can monitor each patch's growth. These measurements were applied to the species-specific equations associated with the i-Tree My Tree tool to produce estimates of each patch's total carbon sequestration. We also took surface temperature measurements of each patch and created temperature maps to visualize the cooling effects of existing canopy cover. After completing this process, we streamlined the steps taken to create a successful forest patch for the purpose of replication by other institutions.

Steps to Plant a Forest Patch:

1. Conduct background research on the Miyawaki Method and forest patches.
2. Identify an initial list of patch sites. This may include visiting sites or using maps to determine potential opportunities for green space or ecological connectivity.
3. Upon deciding the purpose of the forest patches, create a list of weighted criteria to rank potential sites. Present ranked sites to stakeholders for approval.
 - a. Criteria included (weighting): visibility (1.5), usability (1), erosion control (0.5), size (1), connectivity (1), sun/shade (1), water availability (1).
4. Evaluate and measure current biotic and abiotic conditions for each proposed patch.
5. Create a species list of native, fast-growing species based on the specific conditions of each patch and planting timelines to meet goal patch composition: 70-80% trees, 10% shrubs, and 10-20% herbaceous plants.
 - a. Factors for consideration might include sun tolerance, drought tolerance, flood tolerance, growth rate, and a species' carbon sequestration capability.

- b. Determine quantities based on the Miyawaki standard planting density of 3 plants per square meter.
6. Engage community members and mobilize volunteers for forest patch planting days.
 - a. Potential partners include schools, student organizations, community groups, and local businesses with aligned sustainability goals.
7. Establish a plan for watering the patches and performing light maintenance for the first 2-3 years after planting, as stated in the Miyawaki method.
8. Monitor the health and growth of each patch and evaluate associated patch benefits.
 - a. Patch benefits to monitor include soil quality, temperature, species present, and stormwater management.

4. RESULTS TO DATE

Throughout the summer, we monitored patches planted at Carr’s Hill, the 4th Side, and Hereford during the 2023-24 academic year and documented the dbh, height, species, and condition of each plant (Appendix C). These measurements contribute to long term data on plant growth and carbon sequestration using Climate Positive Design’s Pathfinder tool and species-specific equations from the i-Tree MyTree tool. In the existing patches, carbon sequestration totals 73.9 kg of CO₂-equivalent (CO₂e). Once all trees in existing and planned patches reach one inch (2.54 cm) in diameter, this number grows to 376.9 kg CO₂e and 2,158.5 kg CO₂e, respectively. Twenty years after the plants reach one inch in diameter i-Tree predicts all patches to have sequestered 241.4 metric tonnes CO₂e.

Through observing the patches for hour-long increments on multiple days and setting up a camera trap in the Carr’s Hill Patch, we noted the animal species inhabiting the patch as a baseline. Species observed include several white-tailed deer, a red fox, a squirrel, a swallowtail butterfly, robins, paper wasps, and more. Surface temperature measurements at each of the current patches and two future patch sites yielded heat maps illustrating the difference in surface temperatures between areas unshaded and shaded by trees (Appendix E). On average, we measured differences of about 15°F between shaded and unshaded areas.

We subsequently identified potential forest patch sites and sought administrative approval. Stakeholders and experts including Fred Missel of the UVA Foundation, James Covert and Chris Gentry of Facilities Management, and Jill Trischman-Marks of the Botanical Garden of the Piedmont offered possible sites and important criteria for consideration. After receiving approval for 13 of the initial 34 sites, we prioritized five sites—Hancock, Monroe Hall, Carr’s Hill Field, Goodwin Bridge, and Old Dorms—for planting in the 2024-25 academic year based on the criteria previously mentioned in the “Methodology”.

Based on the factors outlined in the “Methodology”, we finalized planting lists tailored to each patch (Appendix F). The Hancock patch will have 80 tall trees, 30 short trees, 40 shrubs, and 40 ferns, totalling 190 plants from 28 species. Due to limitations on plant height from the CPTED principles, the Monroe patch will have two tall trees, two short trees, 250 shrubs, and 150 ferns, resulting in a total of 404 plants and 11 different species. The Carr’s Hill Field patch will have

228 tall trees, 108 short trees, 100 shrubs, and 50 ferns, resulting in a total of 486 plants and 37 different species. In total, these three patches will add 450 trees and 1080 total plants to Grounds and contribute to our goal of native biodiversity with 41 different species. A native wildflower and grass seed mix in all three patches will further increase biodiversity and provide habitats for pollinators.

To execute plantings, we set primary and backup dates for fall plantings and a plan for future outreach and engagement. This includes possible organizations for collaboration and provides a specific set of steps to raise awareness and mobilize volunteers for planting.

5. FUTURE DIRECTIONS, OUTCOMES, and SIGNIFICANCE

Shortly after the conclusion of the Decarbonization Academy program, we will present our plans to UVA's Arboretum and Landscaping Committee at their August meeting to request funding and receive feedback on the forest patches. In the fall semester, we will follow the outreach and engagement plan for each planting date. This includes reaching out to academic departments, student groups, and community members to recruit volunteers for fall planting days. Building on this momentum, we will use the fall to plan the remaining plantings in the spring.

On the day of patch plantings, we will organize the species with the help of Helen Wilson and instruct volunteers on how to plant properly. After planting, we will rely on the help of Facilities Management landscapers to water the plants and provide light weeding, mulching, and maintenance while the patches establish themselves and reach self-sufficiency. From conversations with Rich Hopkins, we learned that the more visible forest patches (such as the Carr's Hill, 4th Side, and Monroe patches) will receive more landscaping attention. For this reason, we plan to use volunteer support to weed the Hereford and Hancock patches and remove English ivy.

A more advanced monitoring plan to observe the wildlife present at each patch should be developed in the future. There should also be ongoing contributions to our database documenting plant growth and related carbon sequestration benefits. In addition to monitoring wildlife, a plan should be developed to track and quantify other benefits of forest patches, including soil quality, human health, and ecological connectivity.

Another priority is placemaking for existing and future patches to begin to shape the identity of the patch and encourage usability by the UVA community. Placemaking efforts this summer have focused on the Monroe Hall patch, which is scheduled for planting in mid-October this year. Because of its central location on Grounds and its visibility, a combination of shrubs, intentionally placed trees, seating, signage, and other elements will be utilized to create an edible park patch. Appendix F details the sketches submitted to Helen Wilson for approval. With demand for seating in this location, we will move forward with design A in the fall.

Additionally, we have begun a collaboration with [UVA Sawmilling](#), an organization dedicated to preservation, sustainability, and education and the usage of fallen trees. We have proposed ideas to upcycle this material into paths, fencing, seating, and other usable structures such as little

libraries. As the patches expand on Grounds, ideas for placemaking elements for use by the UVA community should continue to be developed and implemented.

To ensure ongoing plantings and stewardship of existing forest patches, we also hope to determine the future organization of the Forest Patches team. We are currently exploring options such as creating a Contracted Independent Organization (CIO) open to new members or establishing the group as a more formal organization working year-round outside of the summer Decarbonization Academy timeline. This is long-term work, and the success of the project relies on its longevity and the preservation of patches far into the future. As this group continues to grow and becomes more formalized, our hope is to expand our capacity for protecting forest patches and pre-existing mature forests on Grounds and increasing plantings.

As we continue to build upon this work, there are several other projects we hope will be developed. Olivia Vargo, a past member of the Forest Patches team, completed a capstone project outlining a tree nursery project at Morven. In the future, we hope there are continued conversations about this idea with Beth Meyer and other Morven organizers. Other opportunities for collaboration include the American Chestnut Foundation, passive regeneration efforts on Grounds, and reforestation efforts across the greater Charlottesville community.

Our methodology and future directions outline the process of forest patch development, from patch selection to planting and maintenance. Through this report and its associated resources, we hope to make the reforestation process easily reproducible and accessible to other college campuses and communities similar to ours. As the project relates to UVA's sustainability goals, the Forest Patches team will continue to prioritize UVA's target of carbon neutrality and no fossil fuel use while planting climate-resilient patches. The forest patch sites will also serve as a form of Grounds-engaged learning, as community members and visitors interact with the patches and learn about our project from programming, signage, and other materials. To quote Miyawaki himself, "Then what is the reason for living? It is to do something anyone can do anywhere for our tomorrow...I will plant trees for the next thirty years—for myself, my loved ones, for Japan, for the future of the seven billion people living on this planet. Let's plant trees together."

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Appendix A: Introductory Forest Patch Resources

“Natural Turned National Infrastructure: Urban Forest Patches in the 21st Century” (USFS):
https://research.fs.usda.gov/sites/default/files/2022-03/cross-pollinator_issue-1-summer-2020.pdf

“This Urban Forest becomes self-sufficient in three years” (Christian Science Monitor):
<https://www.youtube.com/watch?v=CKcy0YAzeYU>

“Tiny Forests” (Biophilic Cities): <https://vimeo.com/896317661>

Lewis, H. (2022). Mini-Forest Revolution: Using the Miyawaki Method to Rapidly Rewild the World. Chelsea Green Publishing.

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Appendix B: Forest Patch Selection Criteria

Table 1: Sample Scorecard

Criteria	Neutral (1)	Good (2)	Great (3)
<i>Visibility:</i> Qualitative measurement of human interaction potential.			
<i>Usability:</i> Qualitative measurement of placemaking potential.			
<i>Erosion Control:</i> Qualitative measurement based on slope and potential to support erosion mitigation efforts.			
<i>Size:</i> Quantitative measurement of area, proportional to the number of plantable trees.			
<i>Connectivity:</i> Quantitative measurement of distance to nearby patches as a proxy for ecological benefit.			
<i>Sun/Shade:</i> Quantitative measurement of sunlight during the day.			
<i>Water Availability:</i> Qualitative measurement based on proximity to water sources and drainage properties.			

Table 2: Patch Selection Scoresheet

Site Name	Visibility	Usability	Erosion Control	Size	Connectivity	Sun/Shade	Water Availability	Weighted	Rank		Criteria	Weighting
Nameless Field	3	3	1	3	2	3	3	19	1			
Monroe Hill	3	3	2	3	1	3	3	18.5	2		Visibility	1.5
Behind Old Dorms	2	3	2	3	3	2	3	18	3		Usability	1
IRC along Emmet	3	3	3	3	2	2	2	18	3		Erosion Co	0.5
AFC	3	3	1	2	2	3	3	18	3		Size	1
O-Hill Field	3	3	2	2	2	3	2	17.5	6		Connectivity	1
Clark Hall	3	3	2	3	1	2	3	17.5	6		Sun/Shade	1
Upper Alderman Rd Residence Area	2	3	2	2	3	2	3	17	8		Water Ava	1
Massie Rd Bike Path	3	3	1	2	3	2	2	17	8			
Astronomy Building	3	3	1	3	2	1	3	17	8			
	3	3	1	2	1	3	3	17	8			
Emmet - South of McCormick	3	1	3	3	1	3	3	17	8			
Behind NGRC	2	2	1	3	2	3	3	16.5	13			
Lambeth Creek - South of Goodwin Bridge	2	1	2	3	3	2	3	16	14			
Monroe Hall	3	3	1	2	1	2	3	16	14			
NCH West	3	2	2	2	1	3	2	15.5	16			
E-Way	3	2	2	1	2	2	3	15.5	16			
Health System South Garage Lake	2	3	2	2	2	1	3	15	18			
McLeod Hall	3	2	3	2	3	1	1	15	18			
Brown College Walkway	3	3	1	1	2	1	3	15	18			
Lacy Hall	2	2	1	1	2	3	3	14.5	21			
Scott Stadium West	3	1	2	2	2	1	3	14.5	21			
NGRC Parking Lot	1	1	1	2	3	3	3	14	23			
11th and Lee St	3	1	1	1	1	3	3	14	23			
Claude Moore Education Building	3	2	1	1	1	2	3	14	23			
Gilmer Hall	2	1	3	3	3	1	1	13.5	26			
Hancock Drive	2	1	1	1	3	2	3	13.5	26			
Darden Garage	2	1	1	2	3	3	1	13.5	26			
Corner of Stadium and Whitehead	3	1	2	1	1	3	2	13.5	26			
Upper Lambeth	1	1	3	2	2	2	2	12	30			
Slaughter Rec Center	2	1	2	1	1	3	2	12	30			
IRC Loop	2	1	3	1	1	2	1	10.5	32			

Table 3: Calculated Sun-Shade Values of Proposed Patches

Site	Hours of Sunlight on Equinox	Sun/Shade Value			
Monroe Hall	7.7	2			
Lambeth Creek - South of Goodwin Bridge	5	2	>8 hrs		3
McLeod Hall	0	1	5-8 hrs		2
Behind NGRC	10.7	3	<5		1
NGRC Parking Lot	8.7	3			
Massie Rd Bike Path	7.3	2			
Corner of Stadium and Whitehead	9.1	3			
IRC Loop	6.3	2			
IRC along Emmet	6.3	2			
Nameless Field	9.6	3			
Behind Old Dorms	5	2			
NCH West	12	3			
Monroe Hill	9.1	3			
Gilmer Hall	0	1			
Hancock Drive	5.9	2			
Upper Lambeth	5.4	2			
Darden Garage	9.6	3			
11th and Lee St	11	3			
Health System South Garage Lake	0	1			
Claude Moore Education Building	5.4	2			
Astronomy Building	3.6	1			
Upper Alderman Rd Residence Area	5.4	2			
AFC	8.7	3			
Lacy Hall	8.2	3			
Slaughter Rec Center	8.2	3			
O-Hill Field	8.7	3			
Scott Stadium West	0	1			
E-Way	5.9	2			
Carl Smith Center North	10.5	3			
Emmet - South of McCormick	9.6	3			
Clark Hall	6.3	2			
Brown College Walkway	0	1			

Table 4: Calculated Connectivity Values of Patches

Site	Distance to 100 m^2 patch (ft)	patch 1 (m)	Distance to second patch	patch 2 (m)	patch 1 weighted	patch 2 weighted	weighted total	Score
Monroe Hall	223	67.9704	841	256.3368	67.9704	384.5052	452.4756	1
Lambeth Creek - South of Goodwin Bridge	0	0	298	90.8304	0	136.2456	136.2456	3
McLeod Hall	0	0	203	61.8744	0	92.8116	92.8116	3
Behind NGRC	222	67.6656	416	126.7968	67.6656	190.1952	257.8608	2
NGRC Parking Lot	0	0	283	86.2584	0	129.3876	129.3876	3
Massie Rd Bike Path	0	0	229	69.7992	0	104.6988	104.6988	3
Corner of Stadium and Whitehead	53	16.1544	797	242.9256	16.1544	364.3884	380.5428	1
IRC Loop	0	0	657	200.2536	0	300.3804	300.3804	1
IRC along Emmet	241	73.4568	393	119.7864	73.4568	179.6796	253.1364	2
Nameless Field	211	64.3128	450	137.16	64.3128	205.74	270.0528	2
Behind Old Dorms	0	0	269	81.9912	0	122.9868	122.9868	3
NCH West	114	34.7472	953	290.4744	34.7472	435.7116	470.4588	1
Monroe Hill	247	75.2856	501	152.7048	75.2856	229.0572	304.3428	1
Gilmer Hall	0	0	293	89.3064	0	133.9596	133.9596	3
Hancock Drive	28	8.5344	123	37.4904	8.5344	56.2356	64.77	3
Upper Lambeth	0	0	603	183.7944	0	275.6916	275.6916	2
Darden Garage	121	36.8808	214	65.2272	36.8808	97.8408	134.7216	3
11th and Lee St	174	53.0352	874	266.3952	53.0352	399.5928	452.628	1
Health System South Garage Lake	0	0	301	91.7448	0	137.6172	137.6172	2
Claude Moore Education Building	308	93.8784	516	157.2768	93.8784	235.9152	329.7936	1
Astronomy Building	113	34.4424	304	92.6592	34.4424	138.9888	173.4312	2
Upper Alderman Rd Residence Area	54	16.4592	185	56.388	16.4592	84.582	101.0412	3
AFC	292	89.0016	331	100.8888	89.0016	151.3332	240.3348	2
Lacy Hall	124	37.7952	527	160.6296	37.7952	240.9444	278.7396	2
Slaughter Rec Center	245	74.676	570	173.736	74.676	260.604	335.28	1
O-Hill Field	124	37.7952	289	88.0872	37.7952	132.1308	169.926	2
Scott Stadium West	187	56.9976	297	90.5256	56.9976	135.7884	192.786	2
E-Way	370	112.776	390	118.872	112.776	178.308	291.084	2
Carl Smith Center North	485	147.828	677	206.3496	147.828	309.5244	457.3524	1
Emmet - South of McCormick	111	33.8328	118	35.9664	33.8328	53.9496	87.7824	1
Clark Hall	426	129.8448	429	130.7592	129.8448	196.1388	325.9836	1
Brown College Walkway	0	0	424	129.2352	0	193.8528	193.8528	2
Patch 1 weighting	patch 2 weighting							
1	1.5							
Bounds:	137.466324	292.106604						

Table 5: Calculated Size of Proposed Patches

Site	Number of trees	Score
Monroe Hall	1300	2
Lambeth Creek - South of Goodwin Bridge	10800	3
McLeod Hall	900	2
Behind NGRC	8400	3
NGRC Parking Lot	180	2
Massie Rd Bike Path	1200	2
Corner of Stadium and Whitehead	240	1
IRC Loop	540	1
IRC along Emmet	3200	3
Nameless Field	9200	3
Behind Old Dorms	14400	3
NCH West	2500	2
Monroe Hill	3800	3
Gilmer Hall	4000	3
Hancock Drive	150	1
Upper Lambeth	2100	2
Darden Garage	1300	2
11th and Lee St	375	1
Health System South Garage Lake	1000	2
Claude Moore Education Building	500	1
Astronomy Building	3050	3
Upper Alderman Rd Residence Area	1300	2
AFC	2600	2
Lacy Hall	440	1
Slaughter Rec Center	360	1
O-Hill Field	1450	2
Scott Stadium West	550	2
E-Way	500	1
Carl Smith Center North	1400	2
Emmet - South of McCormick	3000	3
Clark Hall	2850	3
Brown College Walkway	120	1
	83705	

Appendix C: Map of Tree Species and Diameter at Breast Height and Height for the 4th Side and Hereford Forest Patches

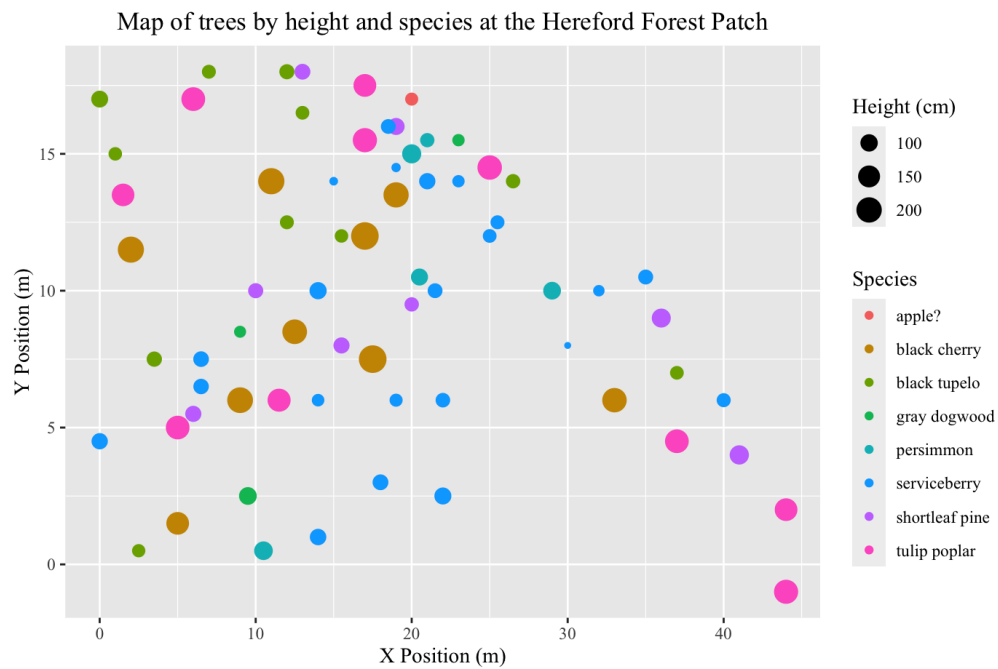


Figure 1: Map of trees by height and species at the Hereford Forest Patch.

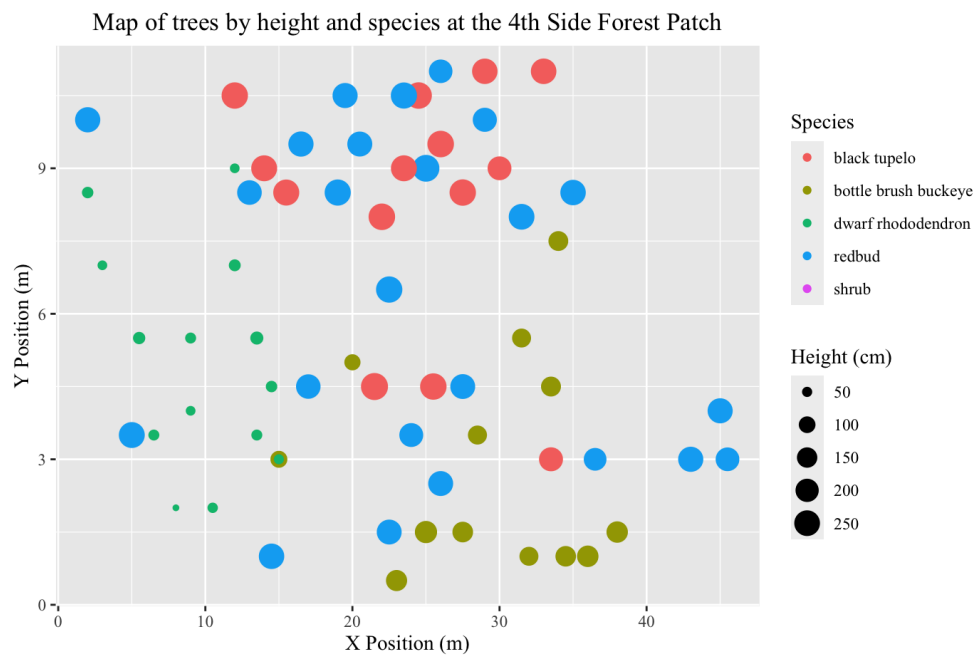


Figure 2: Map of trees by height and species at the 4th Side Forest Patch

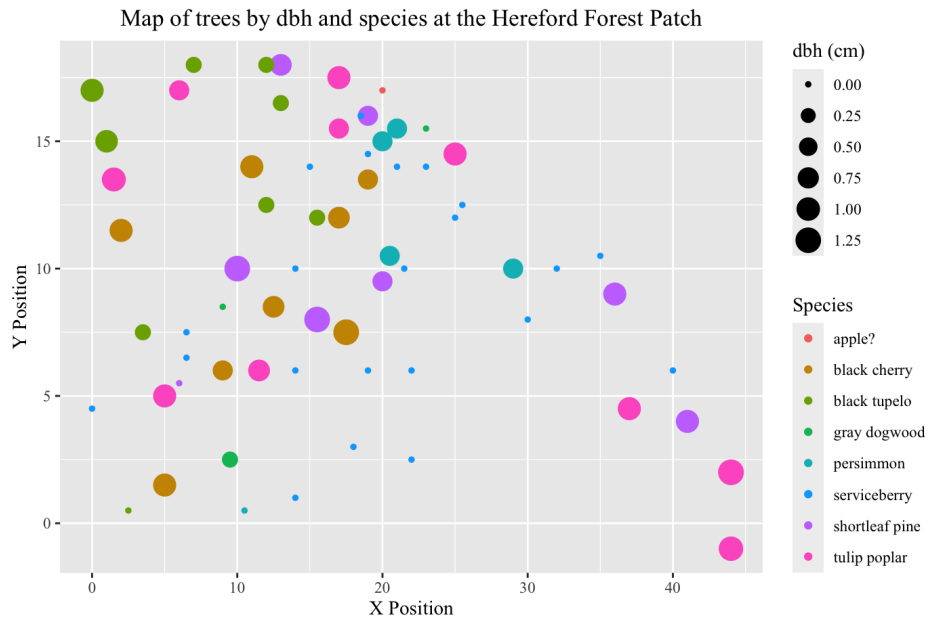


Figure 3: Map of trees by dbh and species at the Hereford Forest Patch

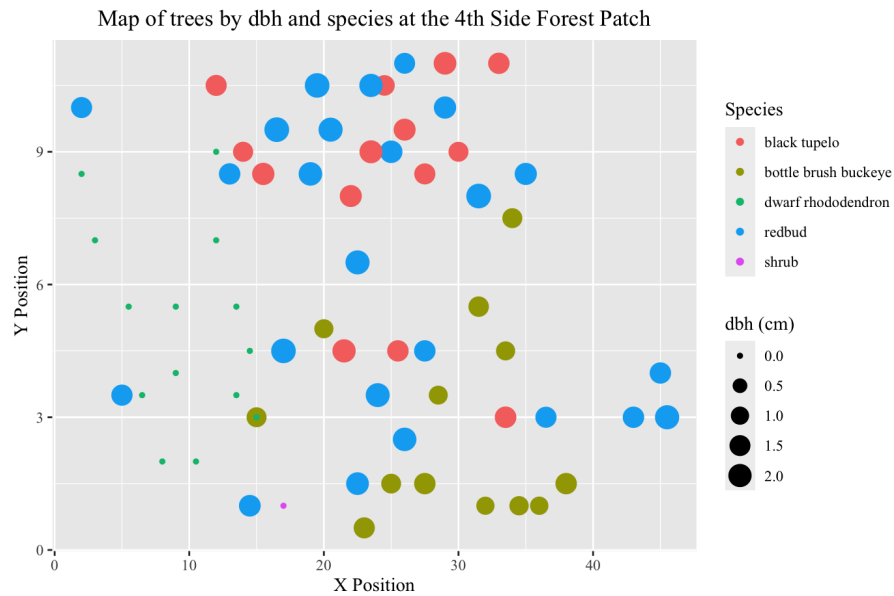


Figure 4: Map of trees by dbh and species at the 4th Side Forest Patch

Appendix D: Map of Forest Patch Sites

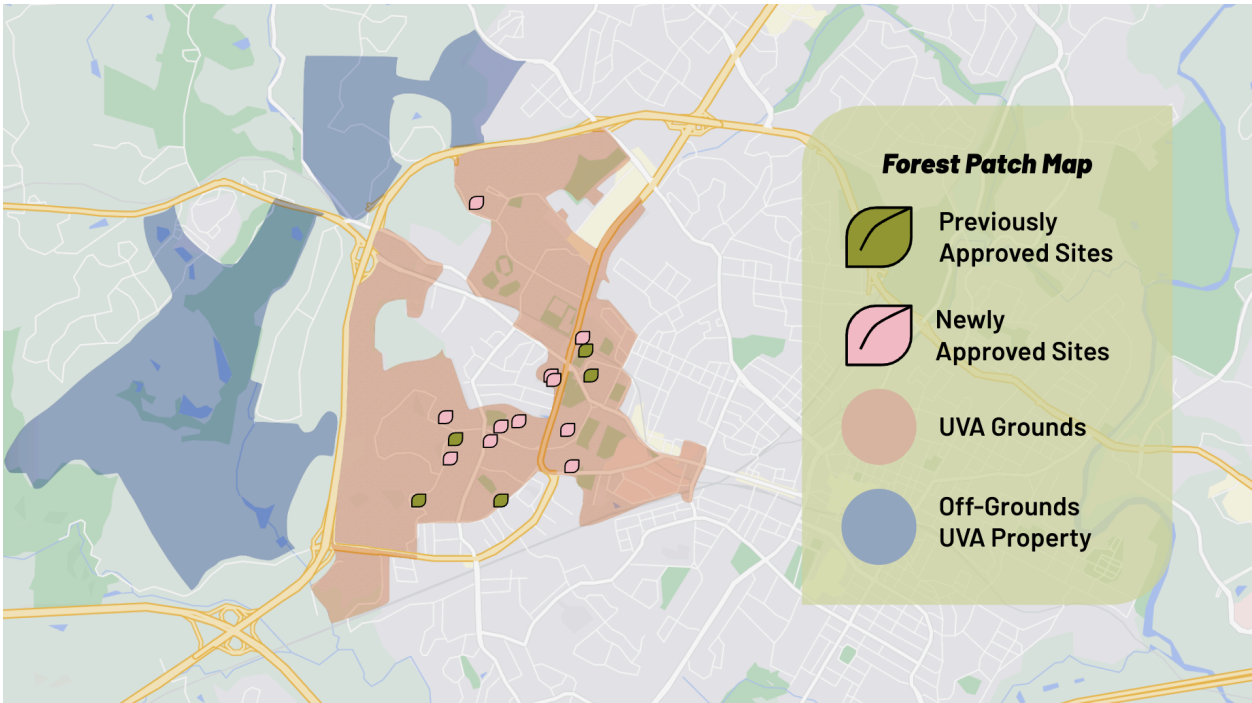


Figure 5: Map of previously approved and newly approved forest patch sites on grounds

Appendix E: Heat Maps



Figure 6: Hereford Forest Patch Heat Map

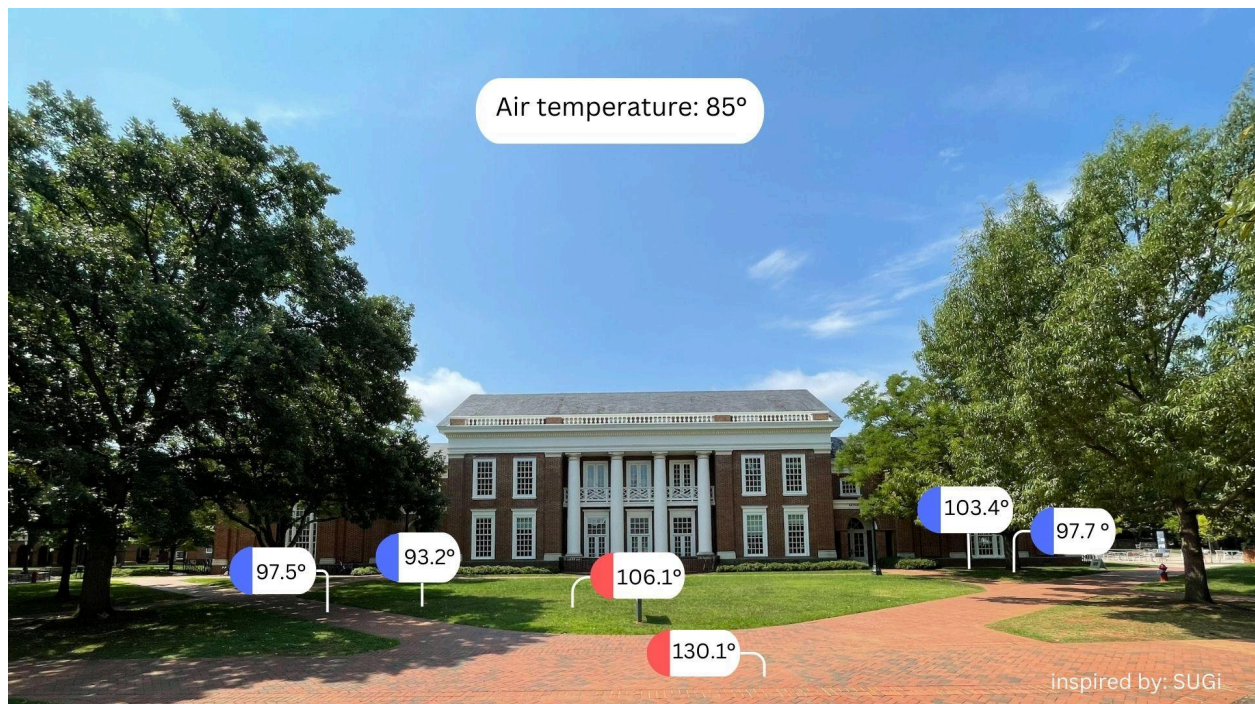


Figure 7: Monroe Hall Forest Patch Heat Map

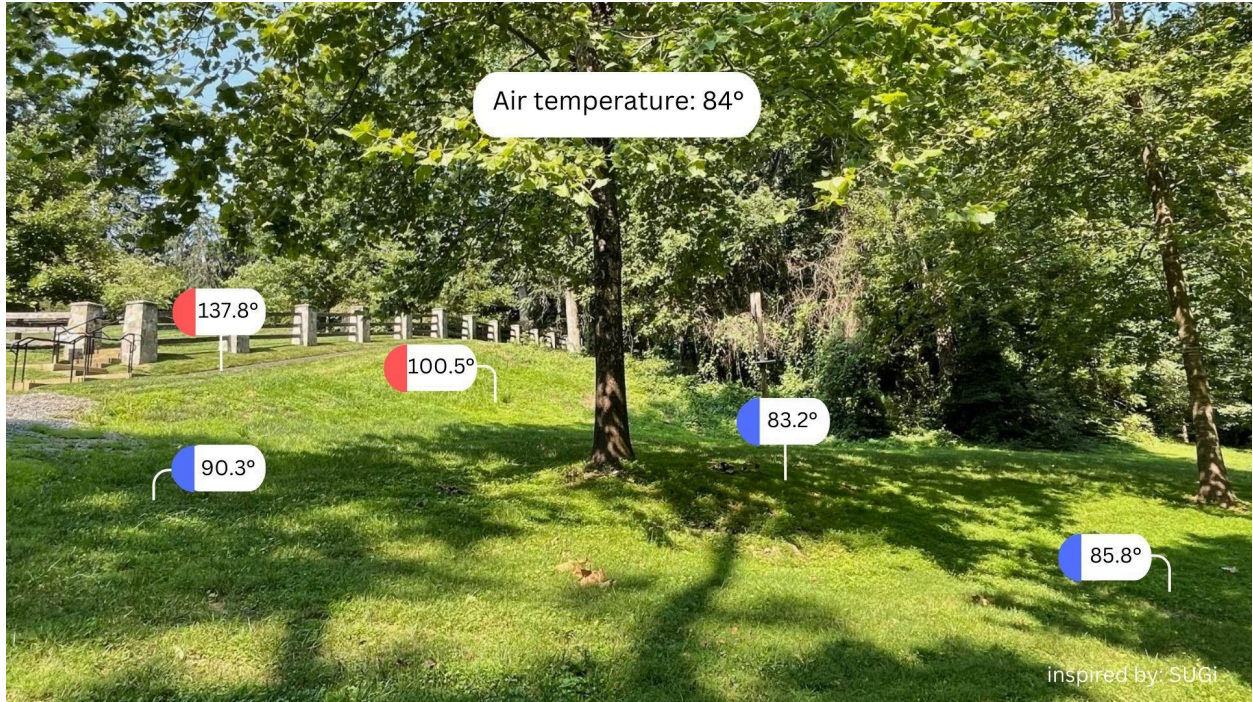


Figure 8: Old Dorms Future Forest Patch Heat Map

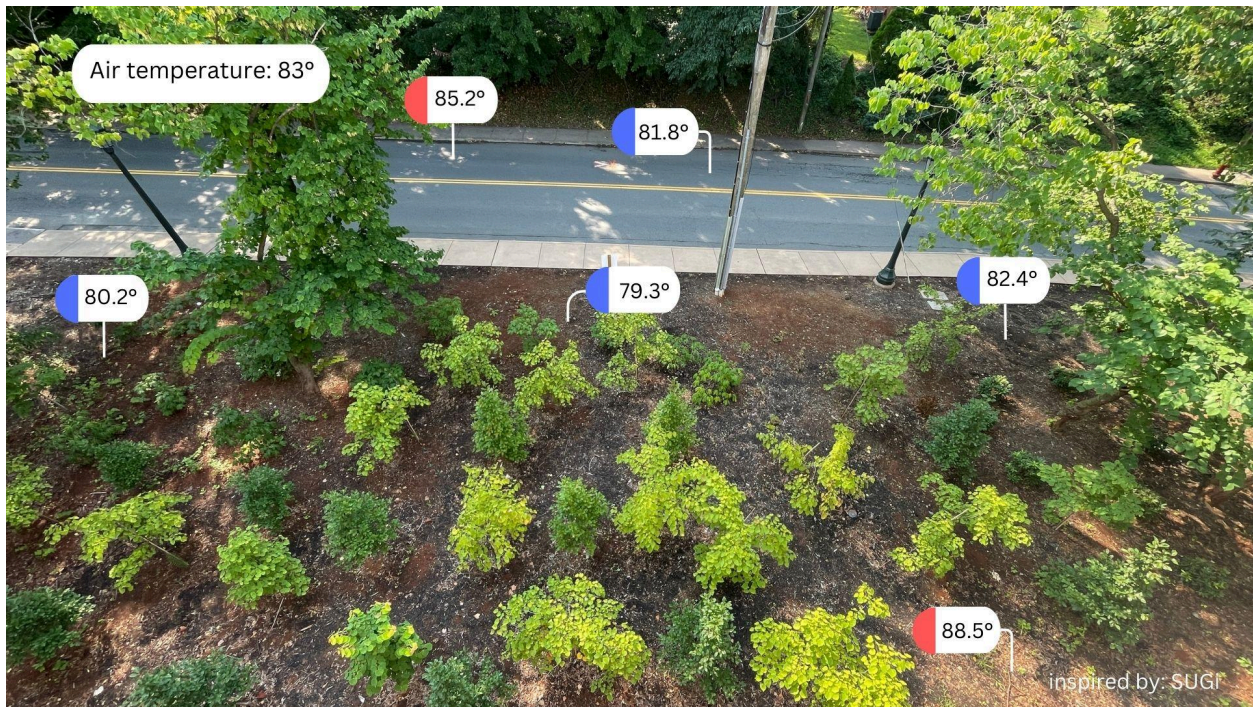


Figure 9: 4th Side Forest Patch Heat Map

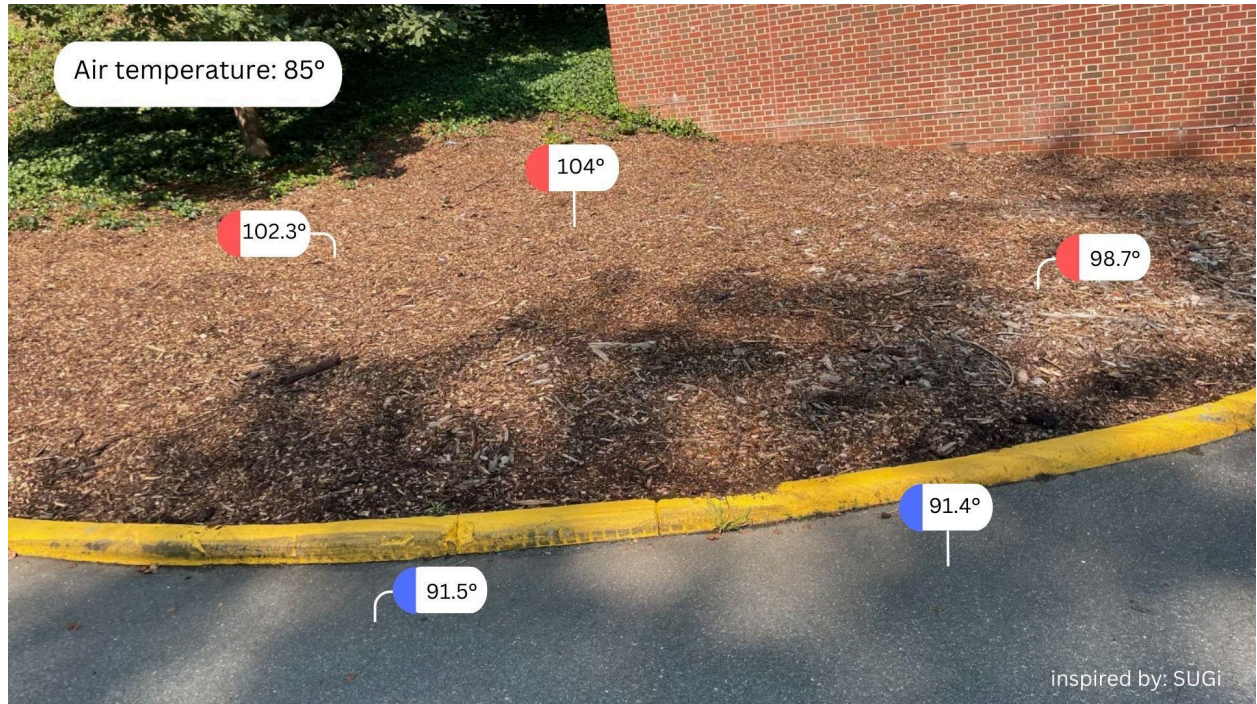


Figure 10: Hancock Proposed Forest Patch Heat Map

Appendix F: Species Planting Lists

Table 6: Requested Species List for Fall 2024 Plantings

Common Name	Scientific Name	Carr's Field	Hancock	Monroe	Total
Red maple	Acer rubrum	15	5	0	20
Yellow birch	Betula alleghaniensis	15	5	0	20
River birch	Betula nigra	15	5	0	20
Scarlet Oak	Quercus coccinea	15	5	0	20
Tulip poplar	Liriodendron tulipifera	15	5	0	20
Black gum	Nyssa sylvatica	15	5	0	20
Pin oak	Quercus palustris	15	5	0	20
Willow oak	Quercus phellos	10	0	0	10
Silver maple	Acer saccharinum	15	5	0	20
Swamp white oak	Quercus bicolor	15	5	0	20
Red oak	Quercus rubrum	13	5	2	20
Sycamore	Platanus occidentalis	10	10	0	20
Wild black cherry	Prunus serotina	10	0	0	10
Box elder	Acer negundo	10	10	0	20
Pitch pine	Pinus rigida	15	5	0	20
Virginia pine	Pinus virginiana	15	5	0	20
Sweet birch	Betula lenta	10	0	0	10
	Total Tall Trees	228	80	2	310
Paw paw	Asimina triloba	10	0	0	10
Eastern redbud	Cercis canadensis	13	5	2	20
American holly	Ilex opaca	15	5	0	20
Black willow	Salix nigra	15	5	0	20
Sweetbay magnolia	Magnolia virginiana	15	5	0	20
Downy serviceberry	Amelanchier arborea	15	5	0	20
Flowering dogwood	Cornus florida	15	5	0	20
American hornbeam	Carpinus caroliniana	10	0	0	10
	Total Small Trees	108	30	2	140

Lowbush blueberry	Vaccinium angustifolium	0	10	70	80
American black elderberry	Sambucus canadensis	15	5	0	20
Common alder	Alnus serrulata	15	5	0	20
Buttonbush	Cephalanthus occidentalis	15	5	0	20
Silky dogwood	Cornus amomum	15	5	0	20
Winterberry holly	Ilex verticillata	10	0	0	10
Spicebush	Lindera benzoin	10	0	0	10
Black chokeberry	Photinia melanocarpa	10	0	60	70
Swamp rose	Rosa palustris	10	0	0	10
Fragrant sumac	Rhus aromatica	0	10	60	70
New Jersey tea	Ceanothus americanus	0	0	60	60
	Total Shrubs	100	40	250	390
Marginal wood fern	Dryopteris marginalis	10	0	30	40
Christmas fern	Polystichum acrostichoides	10	20	30	60
Royal fern	Osmunda regalis	10	20	30	60
Cinnamon fern	Osmunda cinnamomea	10	0	30	40
Sensitive fern	Onoclea sensibilis	10	0	30	40
	Total Ferns	50	40	150	240
Native Wildflower Seed Mix	Could order from Pinelands Nursery or not	0	0	1 lb	1 lb.
Native Grass Seed Mix	Could order from Pinelands Nursery or not	0	0	1 lb	1 lb.
	Total Seeds	0	0	2 lb	2 lb
	Total Plants	486	190	404	1080

Appendix G: Placemaking Sketches for the Monroe Hall Patch

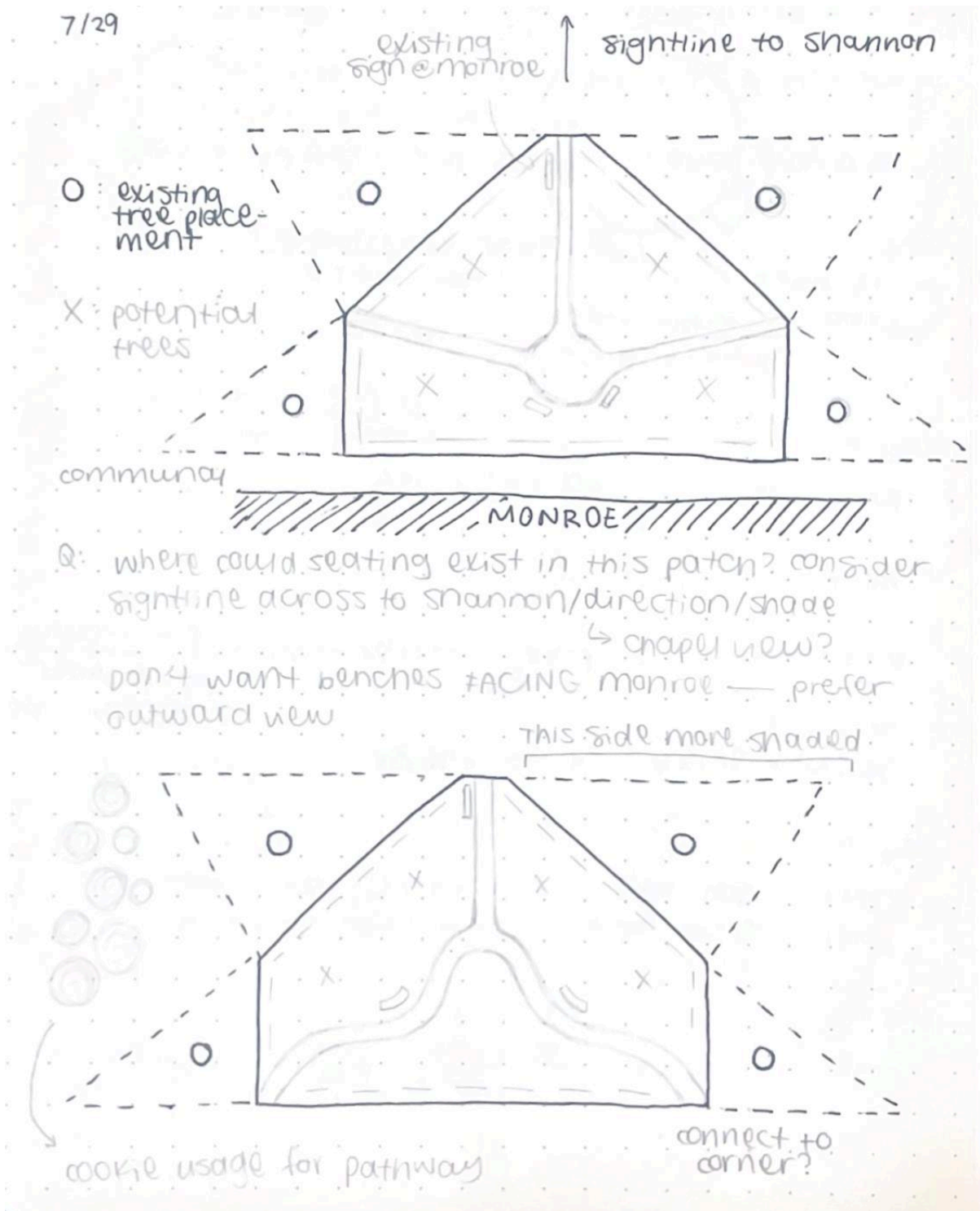


Figure 11: Monroe Hall Patch Designs A and B

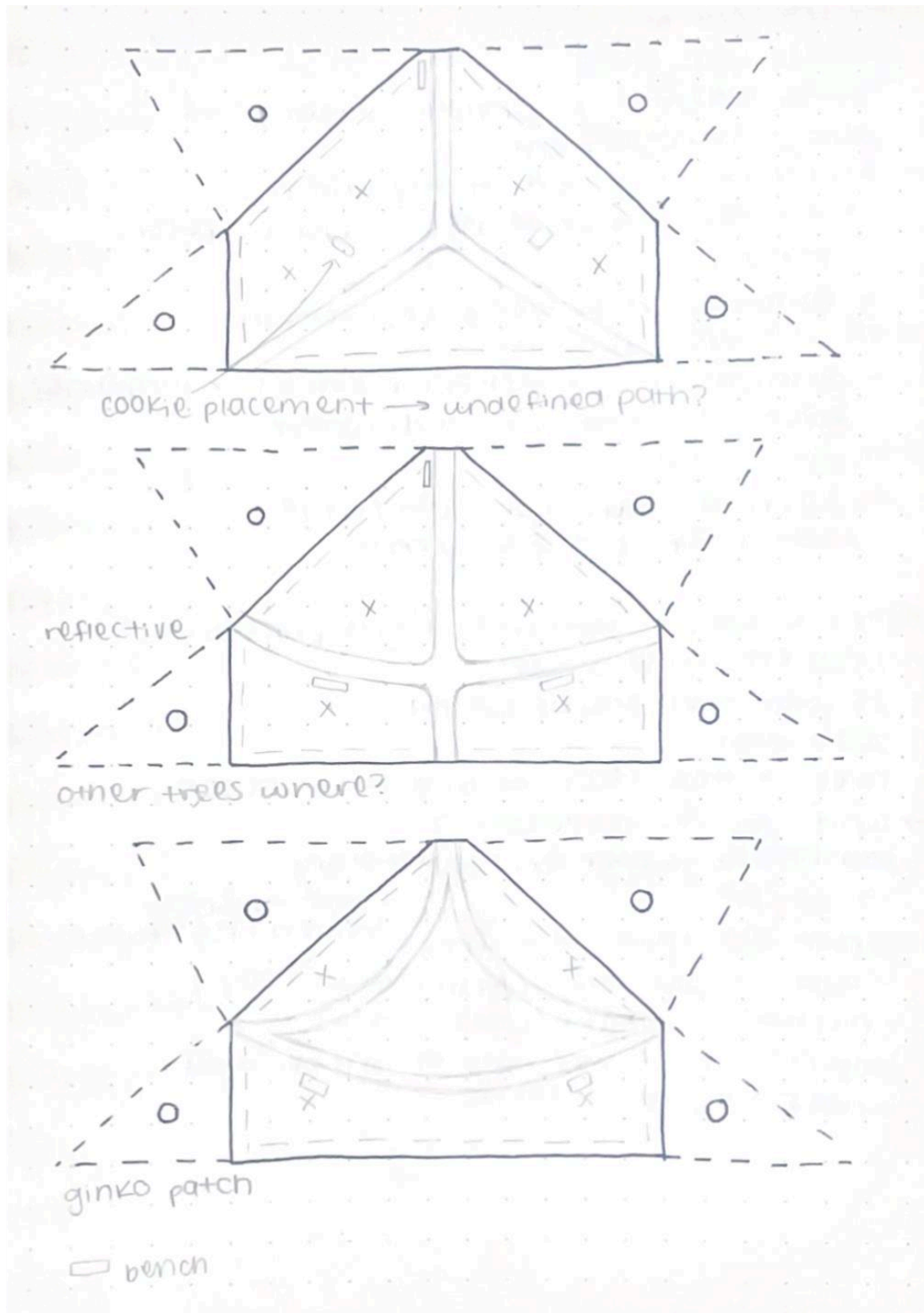


Figure 12: Monroe Hall Patch Designs C, D, and E

Appendix H: Calculated Carbon Sequestration of Forest Patches

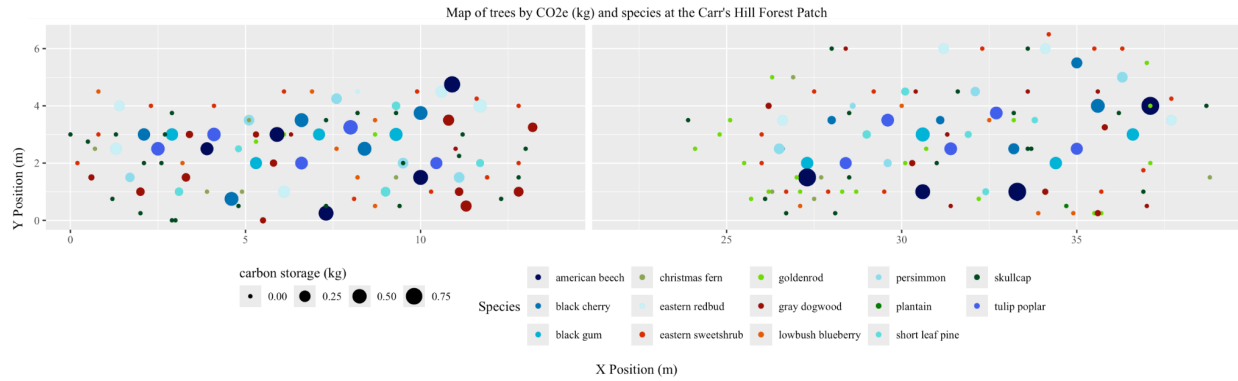


Figure 13: Map of trees by CO₂e (kg) and species at the Carr's Hill Forest Patch

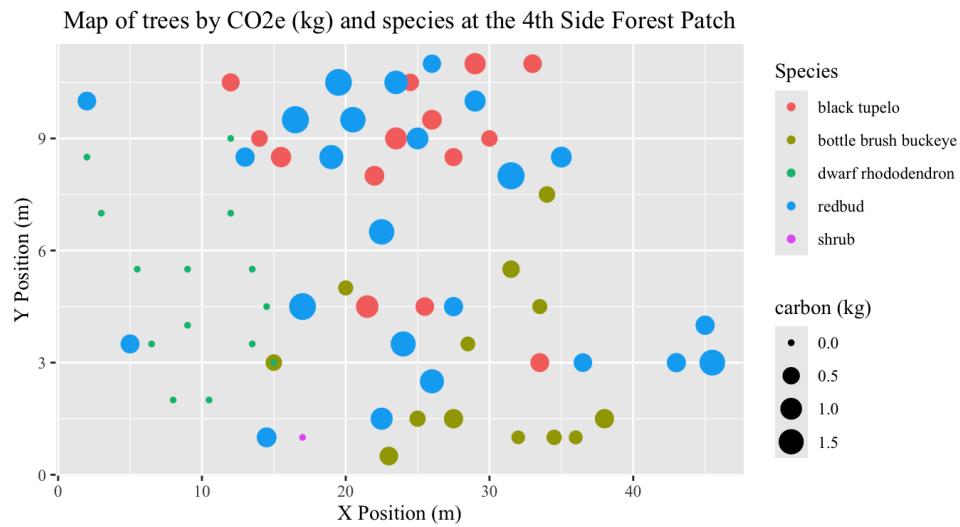


Figure 14: Map of trees by CO₂e (kg) and species at the 4th Side Forest Patch

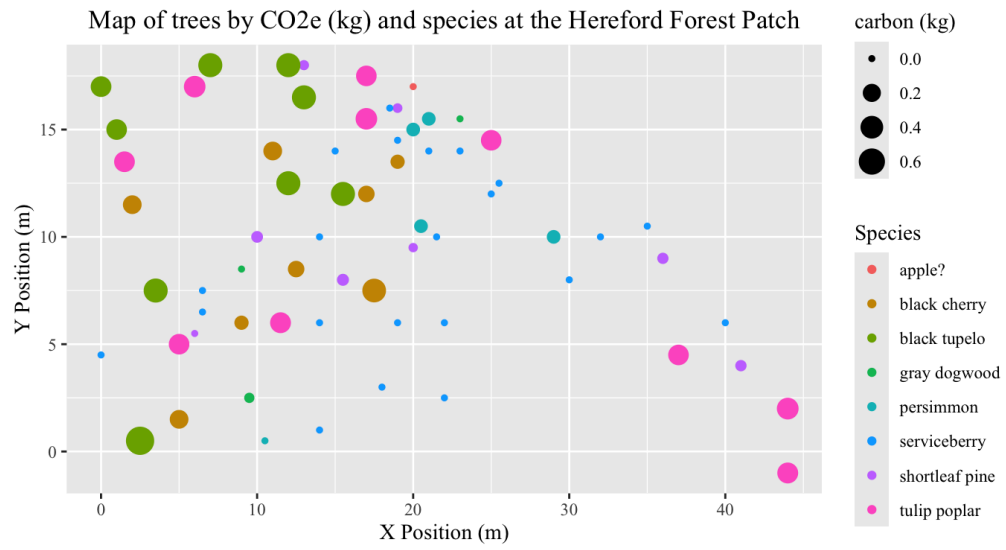


Figure 15: Map of trees by CO₂e (kg) and species at the Hereford Forest Patch