



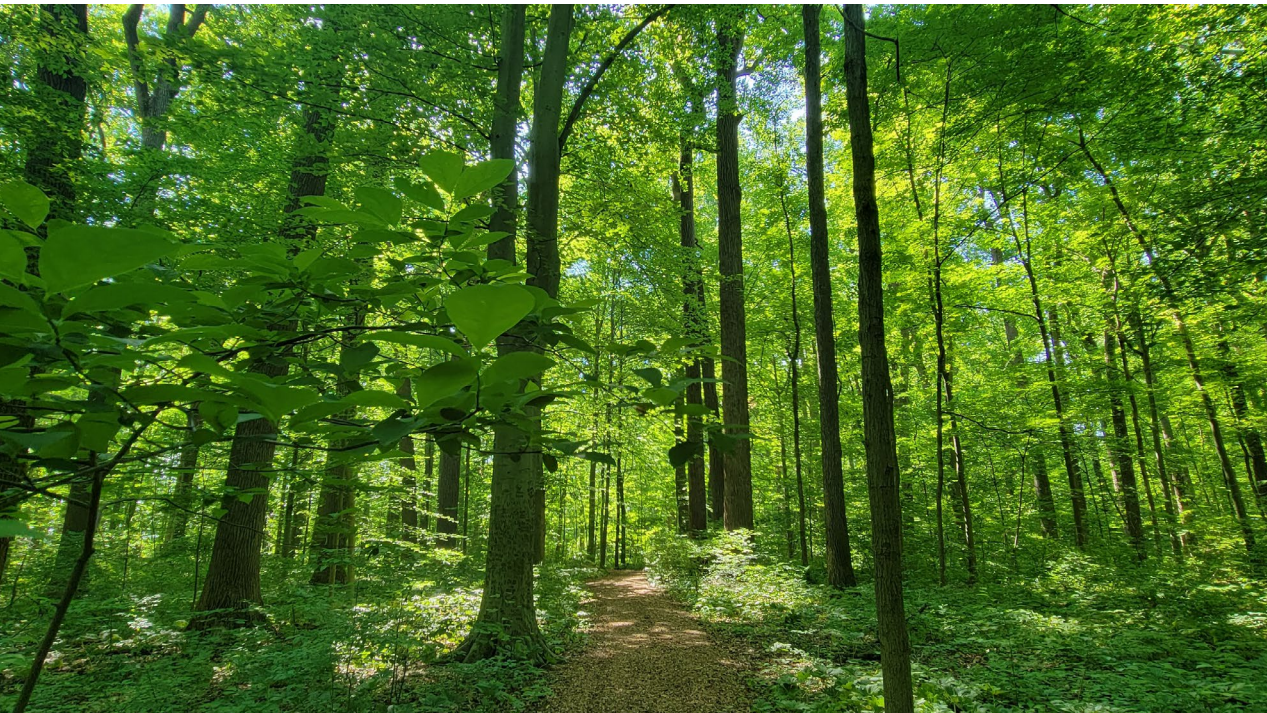
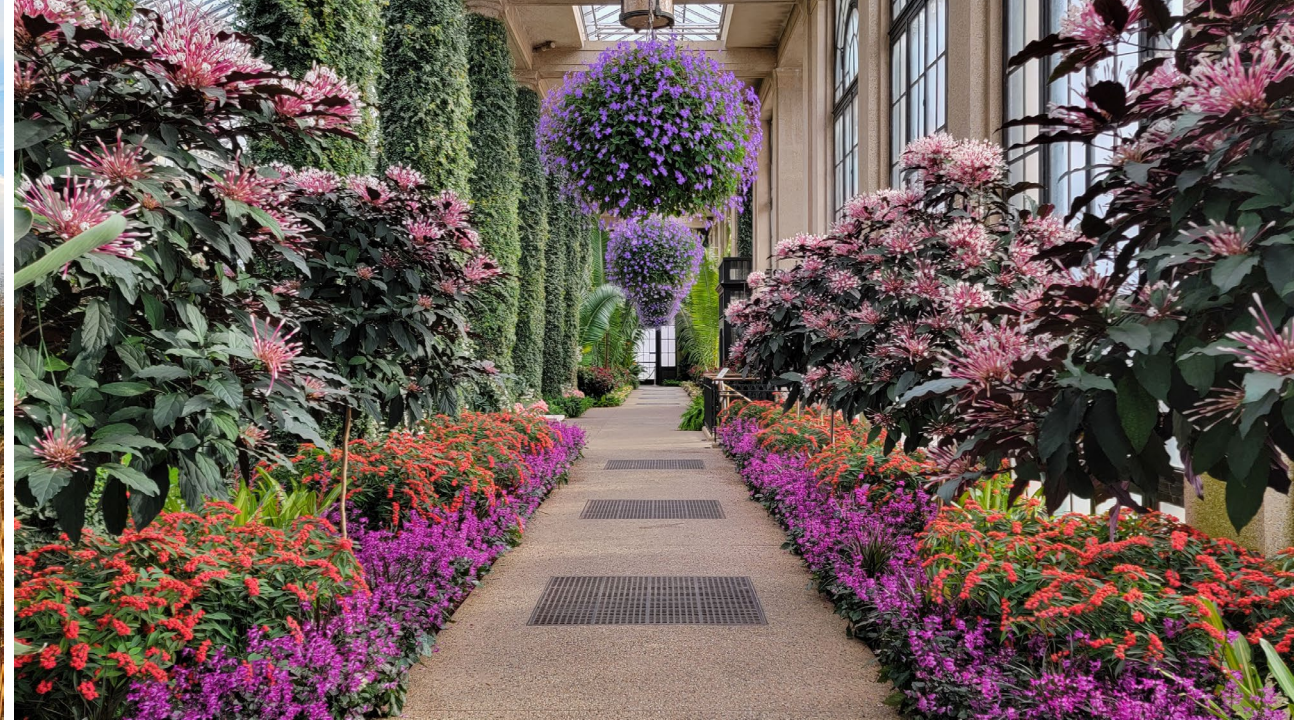
LONGWOOD  
GARDENS

Kate Santos, Ph.D; Associate Vice President, Science

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*Longwood Science*

Land Stewardship, Sustainability & Conservation





## LONGWOOD SCIENCE

Longwood Science inspires beauty through the lens of plant diversity, conservation, natural landscapes, extraordinary displays, and sustainable gardens.



# *Longwood Science Pillars*



## CONSERVE

Our plants, ecological systems, practices, and knowledge.



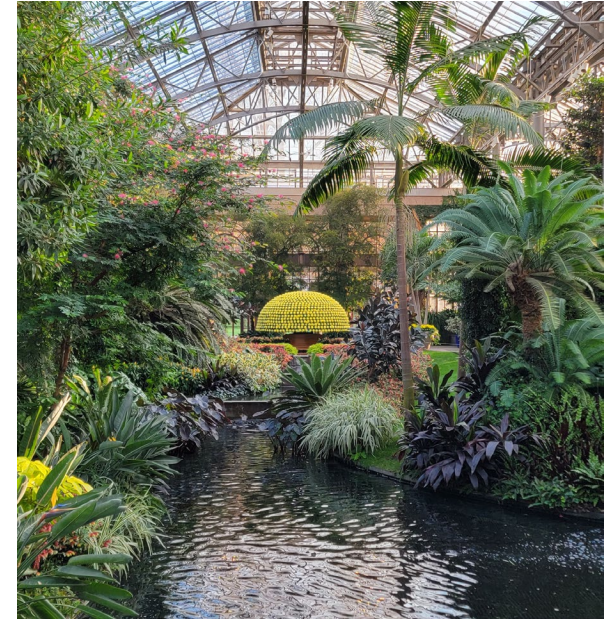
## GROW

Our collections and collaborations, improve the health of our soils and natural areas, and advance science with innovative research.



## SUSTAIN

Our practices for environmental impact and improved material circularity.



## INSPIRE

Through our plant collections and displays, conservation, stewardship, and sustainability.

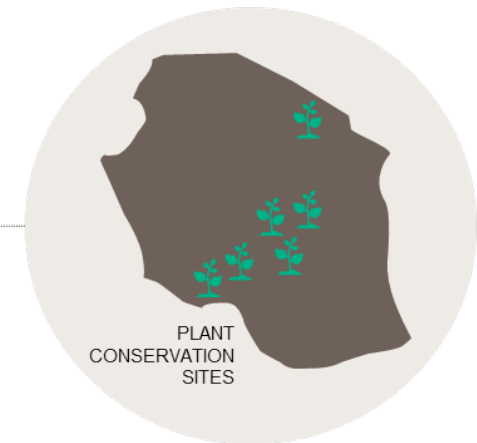
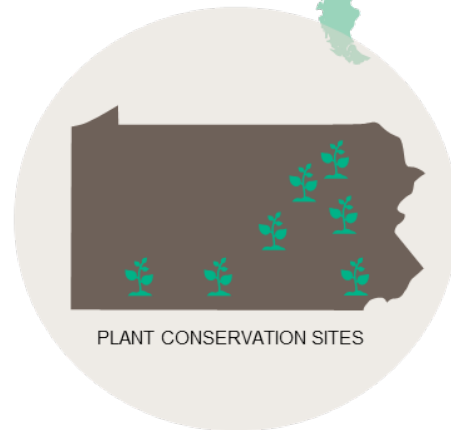


(Santos, YouTube Video, 2024)



# *Our Science starts at Longwood*

But our mission is for our impact to reach our global garden





Longwood Gardens: 1,100 acres



Longwood at Granogue: 505 acres

## *Conserving the Brandywine Valley Region*

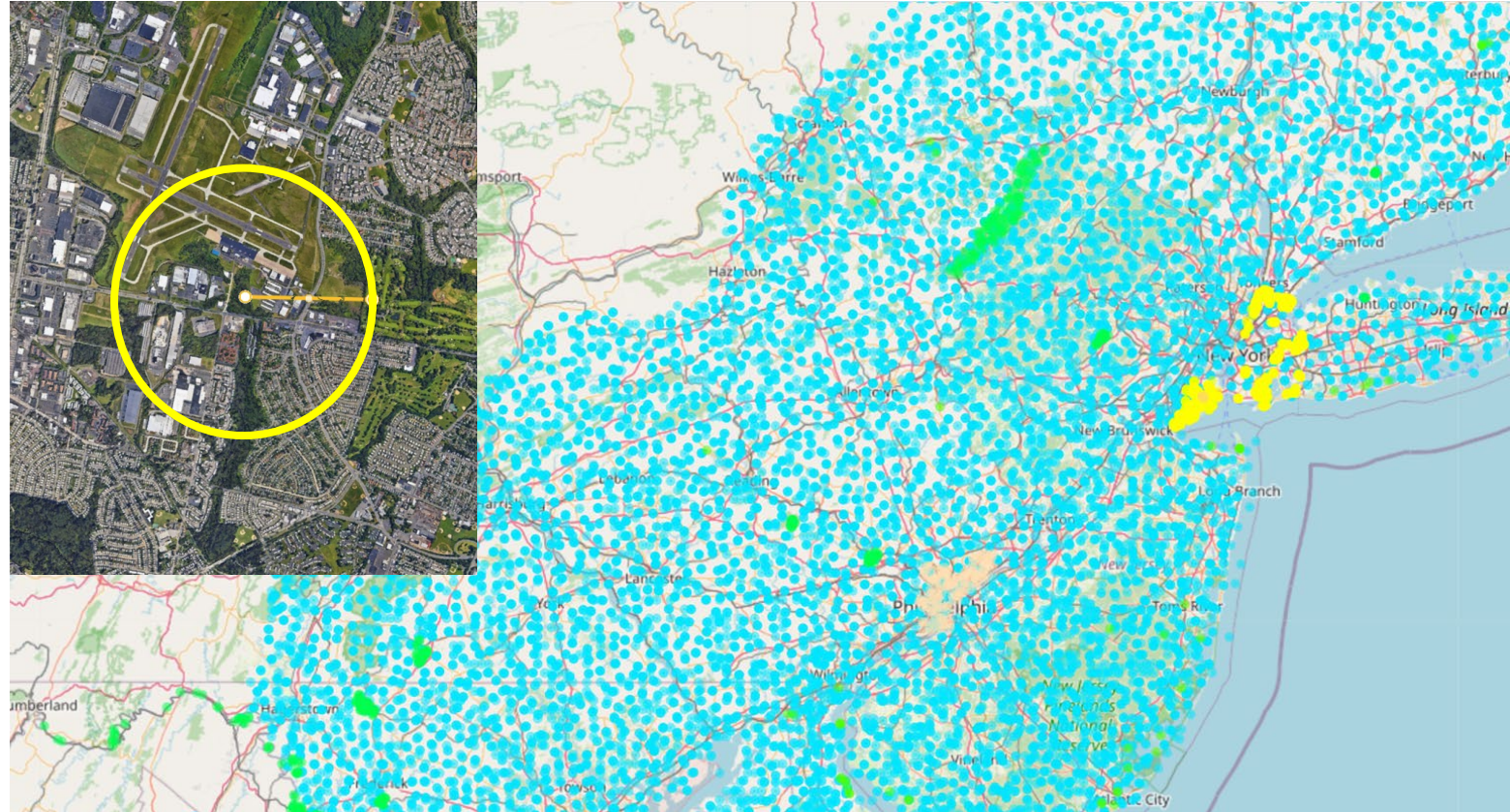
- Protecting and sustaining the area's natural beauty and ecological resilience for the future
- Collaborating with local partners, like the **Plant Conservation Alliance** and the **Pennsylvanian Natural Heritage Program**, to reintroduce rare and threatened plants locally
- Supporting and leading conservation and stewardship across the landscape gradient, including urban forest patches

# Regional Research Collaborations

## Multi-Institutional Research

### Highlights:

- **Regional biodiversity persists** in forests of highly urban and agricultural areas
- **Forests need care to preserve and restore biodiversity**
- **Urban forests are a seed source** for future forest restoration
- **Urbanization and agriculture have similar relationships** to indicators of forest health
- Managers of urban, peri-urban, and rural forests have **common challenges and opportunities**



Plot Data Synthesis | 19 field observation datasets, 4902 plots



(Morzillo et al., 2022)





LONGWOOD  
SCIENCE

LAND STEWARSHIP & ECOLOGY

# *ECOSYSTEMS*

*Integrating ecological science and adaptive land  
management for beauty and biodiversity*

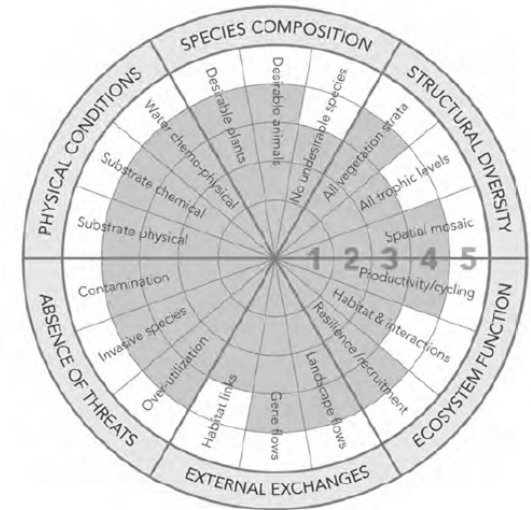
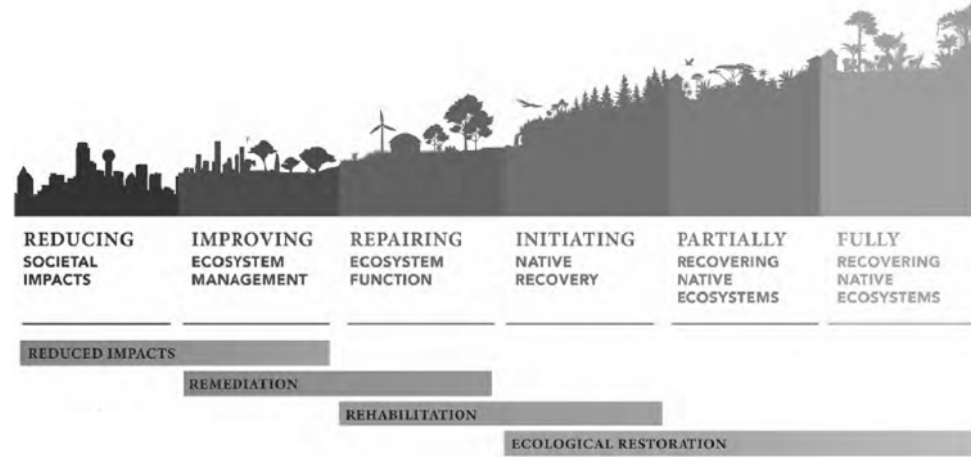
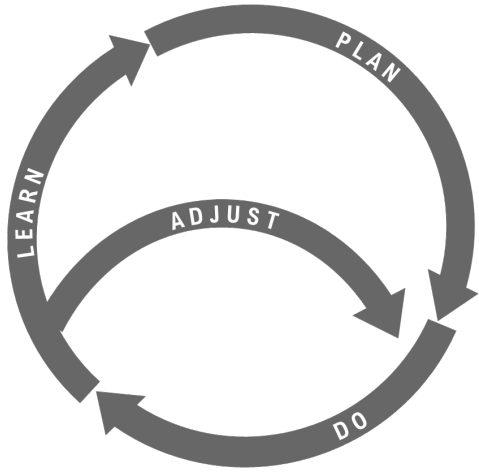


# *Stewardship Science*

- Testing innovative land stewardship practices relevant to many kinds of organizations
- Long-term scientific research
- Fueling adaptive management, planning, and decision-making



# A Science-based Approach



10 years later

**ADAPTIVE  
MANAGEMENT**

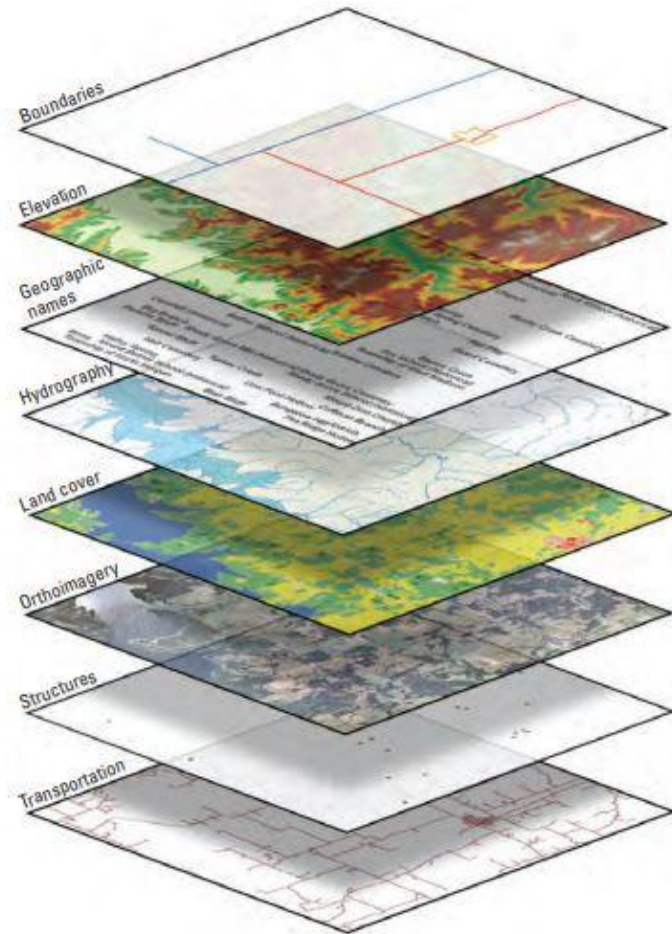
**RESTORATIVE  
CONTINUUM**

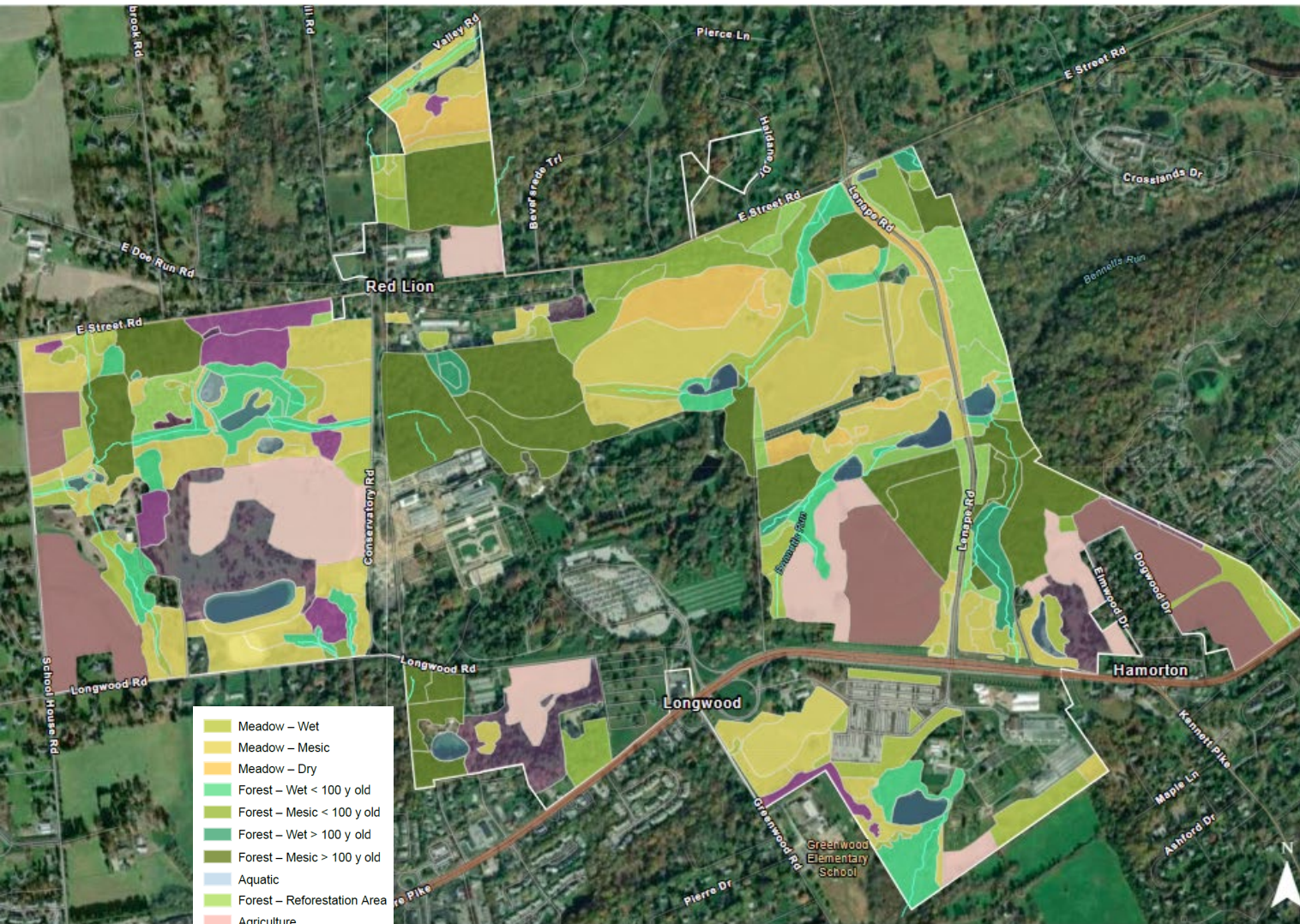
**MEASURING  
ECOLOGICAL  
INTEGRITY**



# *Applying Baseline Data*

**184 types of plants** were not previously recorded in Longwood's natural areas





# *Diverse Ecosystems and Communities*

**207 plant communities**

were identified, mapped, characterized, and established long-term ecological research plots in across our natural lands.





0 0.25 miles

(Johnson, YouTube Video, 2024)



# Reforestation Planning

 **Current Forest**

 **Potential Reforestation**

162 acres of new forest



# *Watershed Conservation Planning*



Total aquatic area:

**26 acres**

Total stream length:

**4.8 miles**



(Anderson, YouTube Video, 2024)



(Bennett's Run Watershed Conservation Plan, 2022)



# *Conserving Biodiversity*

## Botanical Surveys and Protection

**94** new species recorded

**37 | 599 species** observed in the Meadow Garden are endangered

**114** species of conservation concern recorded in Longwood's natural lands



*Salix eriocephala*



*Clematis fremontii*



*Euphorbia purpurea*



*Clematis addisonii*



*Clematis pitcheri*



# *Conserving Biodiversity*

## **Invasive Species Management**

**70** different species targeted

**295** consolidated acres of management

**1788** total person hours



(Johnson, YouTube Video, 2024)







# *Restoring Biodiversity*

**2,380** linear feet of riparian buffer reforested

**4,664** total plants planted in 2023

**64** new species planted in natural areas



(Johnson, YouTube Video, 2024)





# *Forest Restoration & Monitoring*

Our team is actively monitoring the health and growth of trees across our 289 acres of forest.

In addition to adding more than:

**430** trees in the forest gap study

**1,230** trees along Bennett's Run riparian corridor

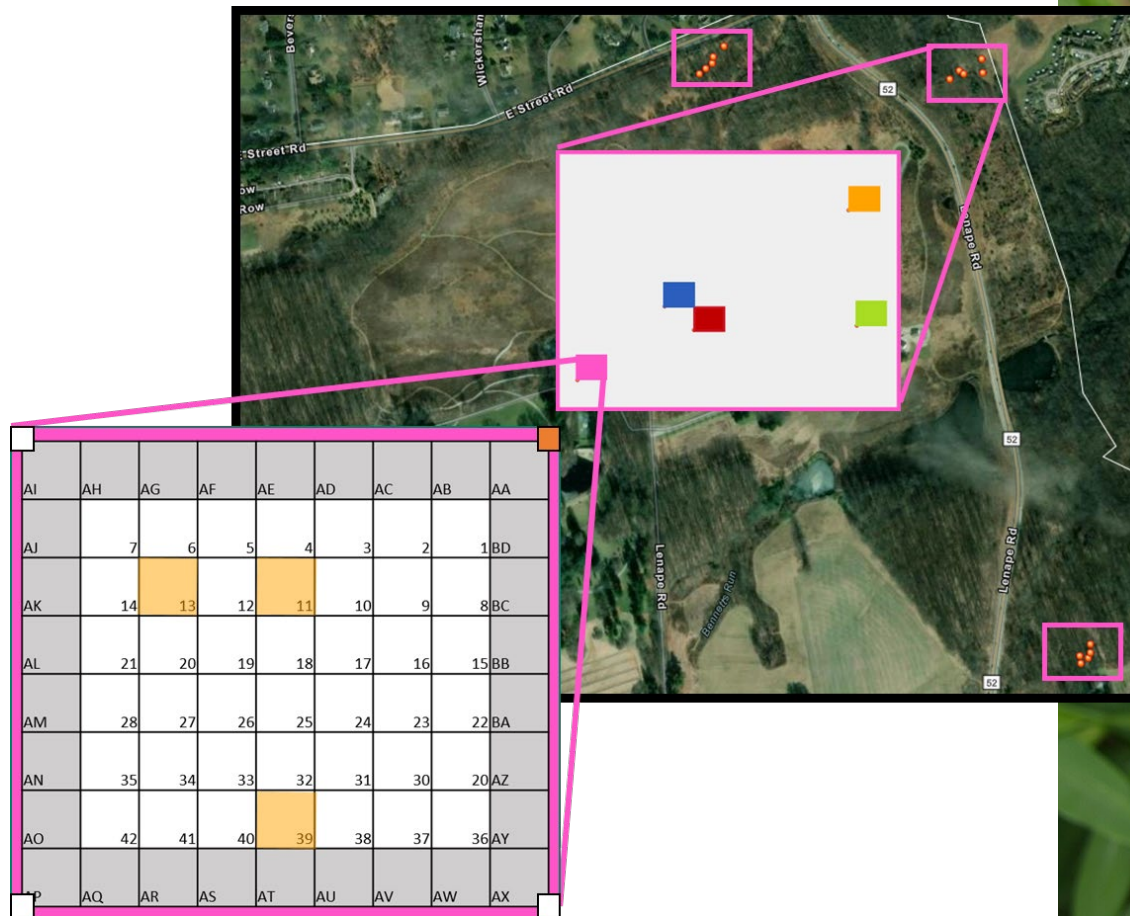
**1,360** trees pending planting along northern edge of Bennett's Run riparian corridor

(Johnson and Anderson, Blog Post, 2023)



Current Research | Conserving Biodiversity:

# *Evaluating Management Strategies for *Microstegium vimineum**

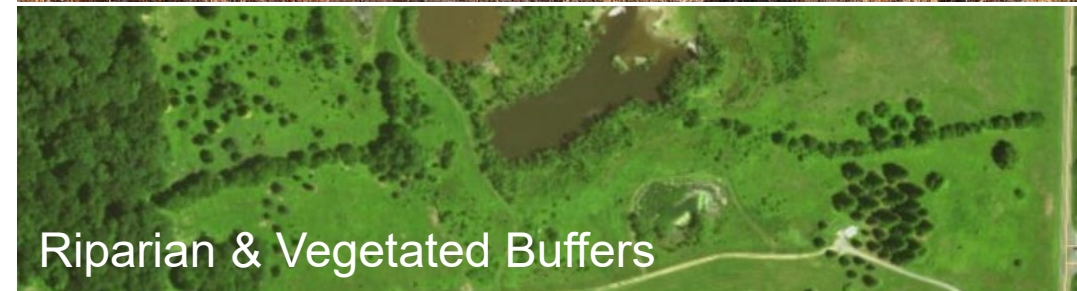


## Climate Resiliency Planning

# *Stormwater Management*

**Since 2003: >70 Million Gallons of Groundwater Saved**

- Slowing and absorbing stormwater through multiple ways
- Minimizing nutrient leaching through sustainable fertility practices
- Educating our local community on stormwater management



(Longwood Gardens, YouTube Video, 2024)



(Turner-Skoff et al., 2024)





LONGWOOD  
SCIENCE

CONSERVATION HORTICULTURE  
& COLLECTIONS

## *PLANTS*

*We are committed to the global preservation and celebration of plants. Our team of horticultural scientists is focused on conducting research projects that bridge gaps and contribute to solutions to conserve plant species.*



# *Bringing Horticultural Science to Conservation*

**1. SEED COLLECTION**



**3. DE-FLASKING**



**2. GERMINATION**



**4. GREENHOUSE ACCLIMITIZATION**



# Conservation Seed Banking

- Longwood has the only conservation seed bank in PA. A grant from the **Department of Conservation and Natural Resources (DCNR) Grant** supports this work
- **An opportunity to contribute to conservation research**
  - For some species, nothing is known about when to collect seeds or how to store and germinate them
- Examples:
  - **State Listed Rare Species:** *Polemonium vanbruntiae* (Appalachian Jacob's ladder), *Taenidia montana* (Mountain Parsley), *Trifolium virginicum* (Kate's Mountain Clover), *Calopogon tuberosus* (Tuberous Grass Pink)
  - **Orchids:** *Cypripedium parviflorum* var. *pubescens* (Yellow Lady's Slipper Orchid), *Galearis spectabilis* (Showy Orchid), *Platanthera pciliaris* (Orange Fringed Bog Orchid), *Platanthera peramoena* (Purple Fringeless Orchid)



(Zale and Turner-Skoff, Blog Post, 2024)



Capacity for **450**

4.5" × 3" seed packets per cubic foot

Capacity for **2,592**

orchid seed samples per cubic foot

Total capacity **18,900** seed packets or  
**108,864** vials of orchid seed.

**145** species native terrestrial orchids

**312** PA S1/S2 species

# *A Digital Catalog*

A complimentary visual catalog with high-magnification, high-resolution seed images to support research.



*Taenidia montana*

Mountain  
Pimpernel



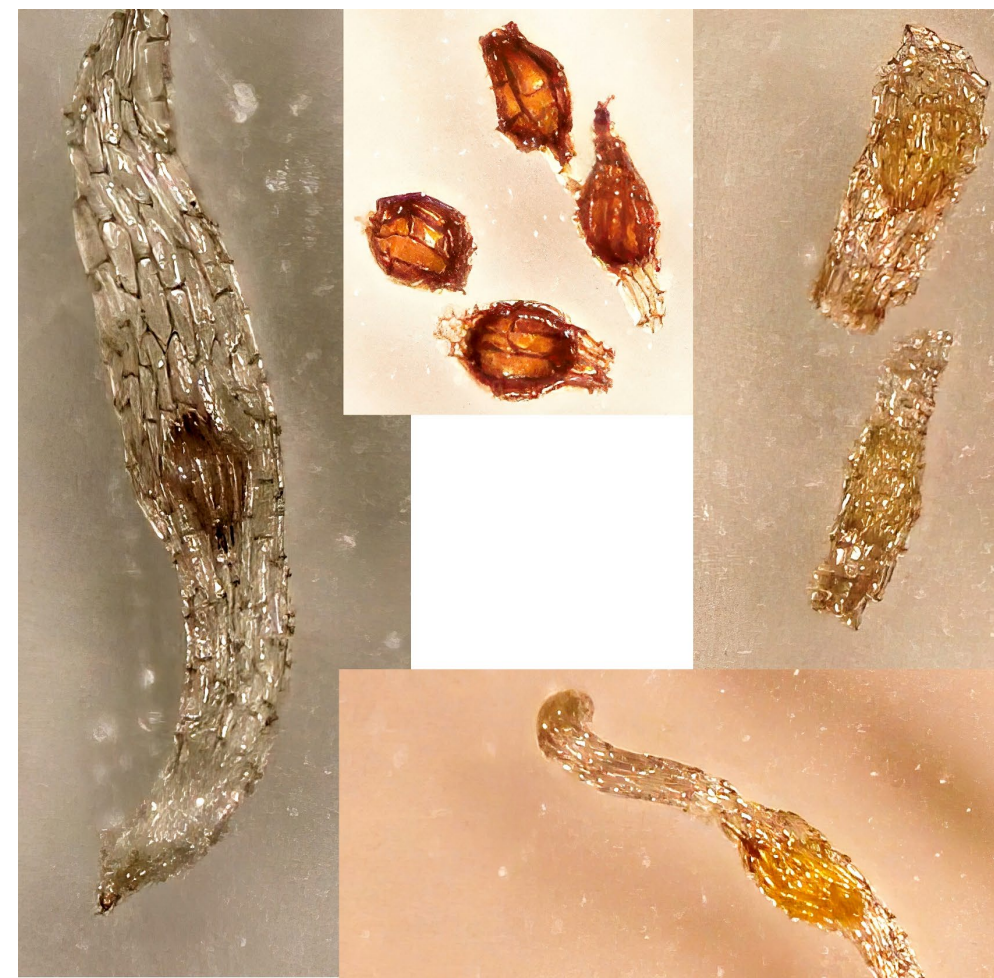
*Polemonium vanbruntiae*

Appalachian  
Jacob's Ladder

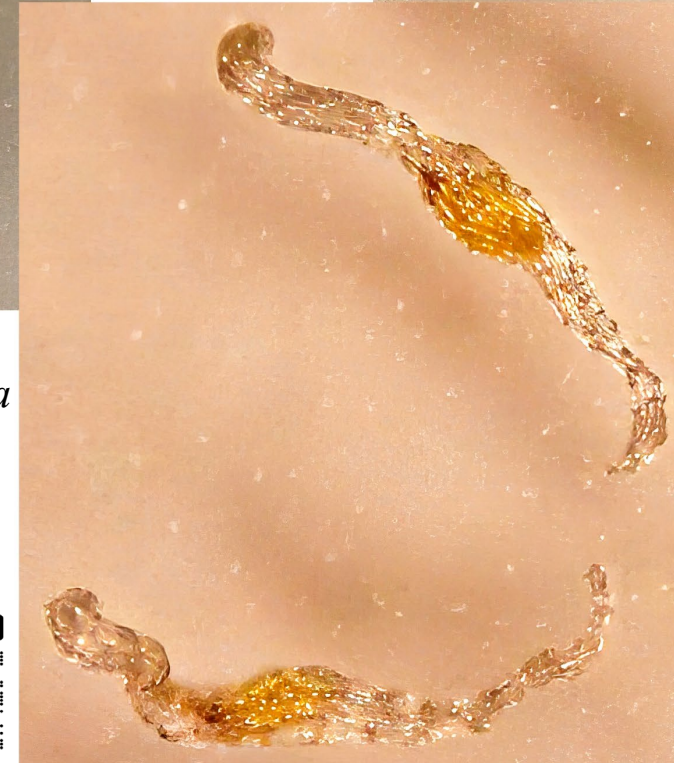


*Aconitum reclinatum*

Trailing White  
Monkshood



*Multiple orchid taxa*



(Zale, YouTube Video, 2024)





# Our Orchid Conservation Program

- Began in 1926, Formalized 2015
- Program Goals
  1. Restore orchid populations at their native sites (*in situ*)
  2. Develop collections of orchids off site (*ex situ*)
  3. Share techniques with other gardens and institutions
  4. Provide education opportunities for the public



# *Our Progress*

**62** Orchid protocols in process  
out of **145 / 43%** native terrestrial orchids

**2419** Orchids propagated for research and  
reintroduction this year, **15,000+** since start

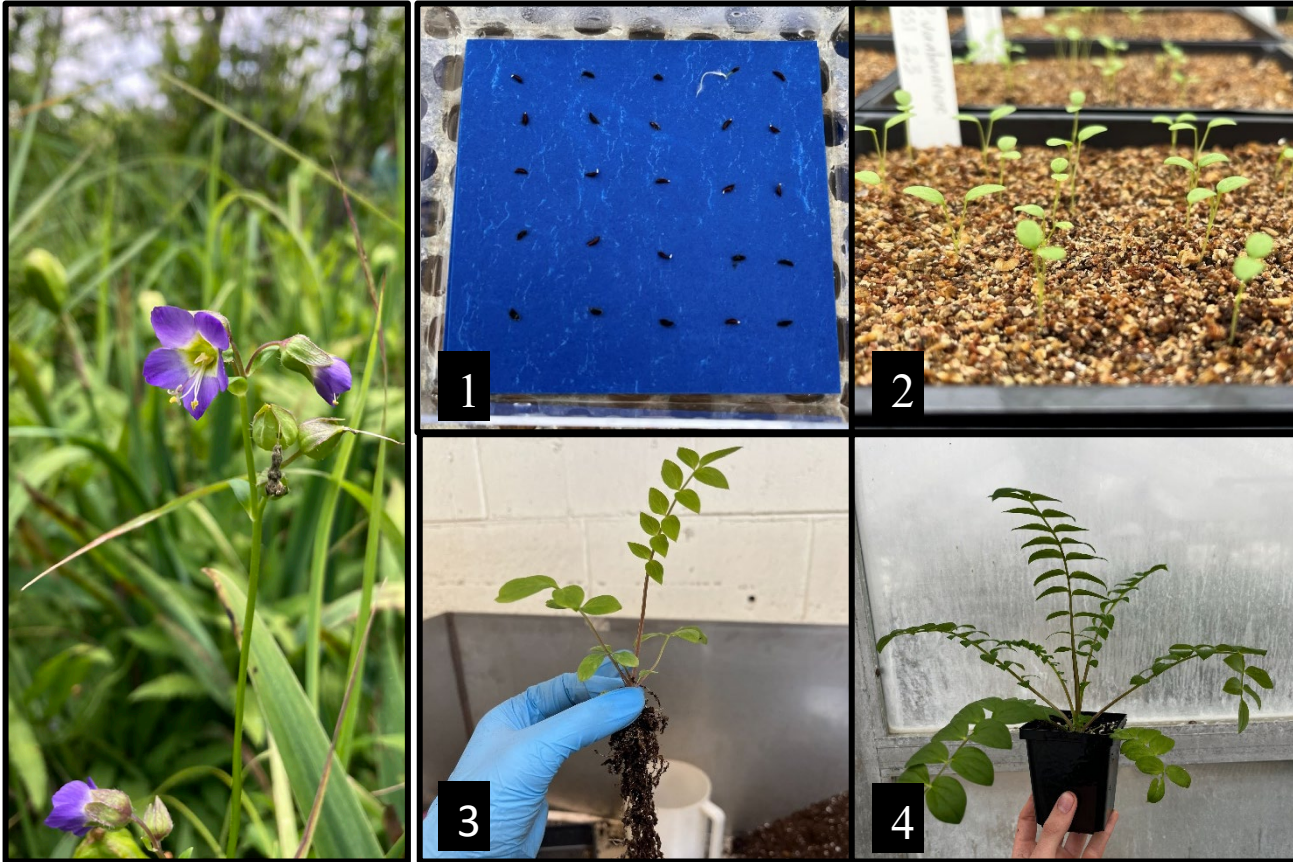
**50** Native orchids planted throughout Longwood



*Cypripedium reginae* is a PA native orchid with potential for display, conservation, and seed banking.

Student Science

# *Connecting to Conservation Horticulture*



# *What does success look like?*

## **Conservation**



## **Restoration**





LONGWOOD  
SCIENCE  
SOILS & COMPOST

## *SUSTAINABILITY*

*We sustain our practices with environmental impact in mind and improved material circularity.*

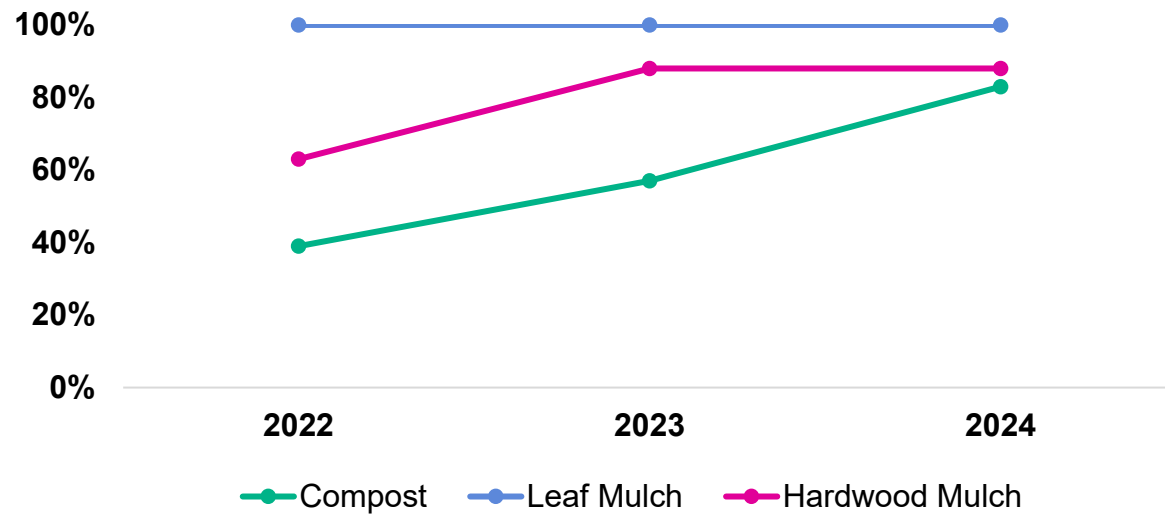


# Improving Soil Health

Annually: **10,000 yd<sup>3</sup>** of garden waste is diverted

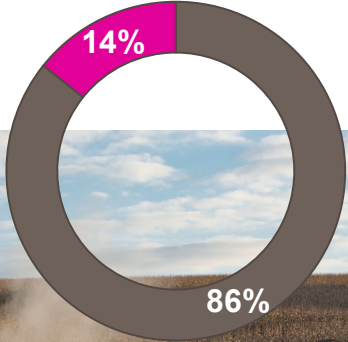
- Compost production recirculates materials from the Gardens and restaurants
- Mulches are used for reforestation, research, and to improve soil health

## Material Utilization Trends



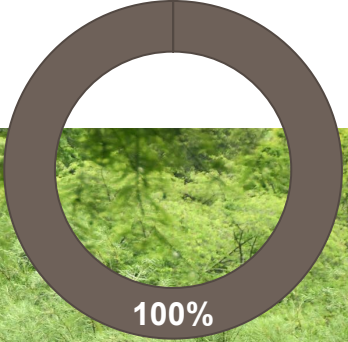
# Prioritizing Circularity of Materials

COMPOST



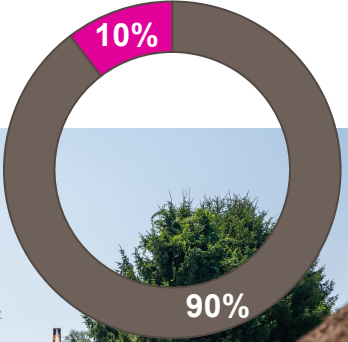
*Recirculating:* Food Waste, Green Debris, Brush, Manure

LEAF MULCH



*Recirculating:* Fallen Leaves

HARDWOOD MULCH



*Recirculating:* Trees, Fiber Pots, Brush & Woody Debris



# Longwood Compost Program

LONGWOOD  
GARDENS



## All-Purpose Compost Blend

This product was manufactured through the controlled aerobic biological decomposition of aged manure and discarded plant materials. It has undergone mesophilic and thermophilic temperatures which drastically reduce the viability of pathogens and weed seeds (in accordance with EPA 40 CFR503 standards) and stabilizes the carbon such that it is beneficial to plant growth. Finished compost was screened to reduce its particle size to improve soil incorporation.

**For turf, trees, shrubs, and planting beds.**

NET WT 3 LB

*The USCC makes no warranties regarding this product or its contents, quantity, or suitability for any particular use. Please refer to the individual producer's product label for specific use instructions.*







# LONGWOOD SCIENCE

CONSERVE | GROW | SUSTAIN | INSPIRE