# Greening the Gateway Cities

Human-Environment Regional Observatory (HERO)

July 13th 2017

Eli Baldwin, Meyru Bhanti, Hannah Corney, Joe Mogel, Miles Weule & Gemma Wilkens

# Our Research Team

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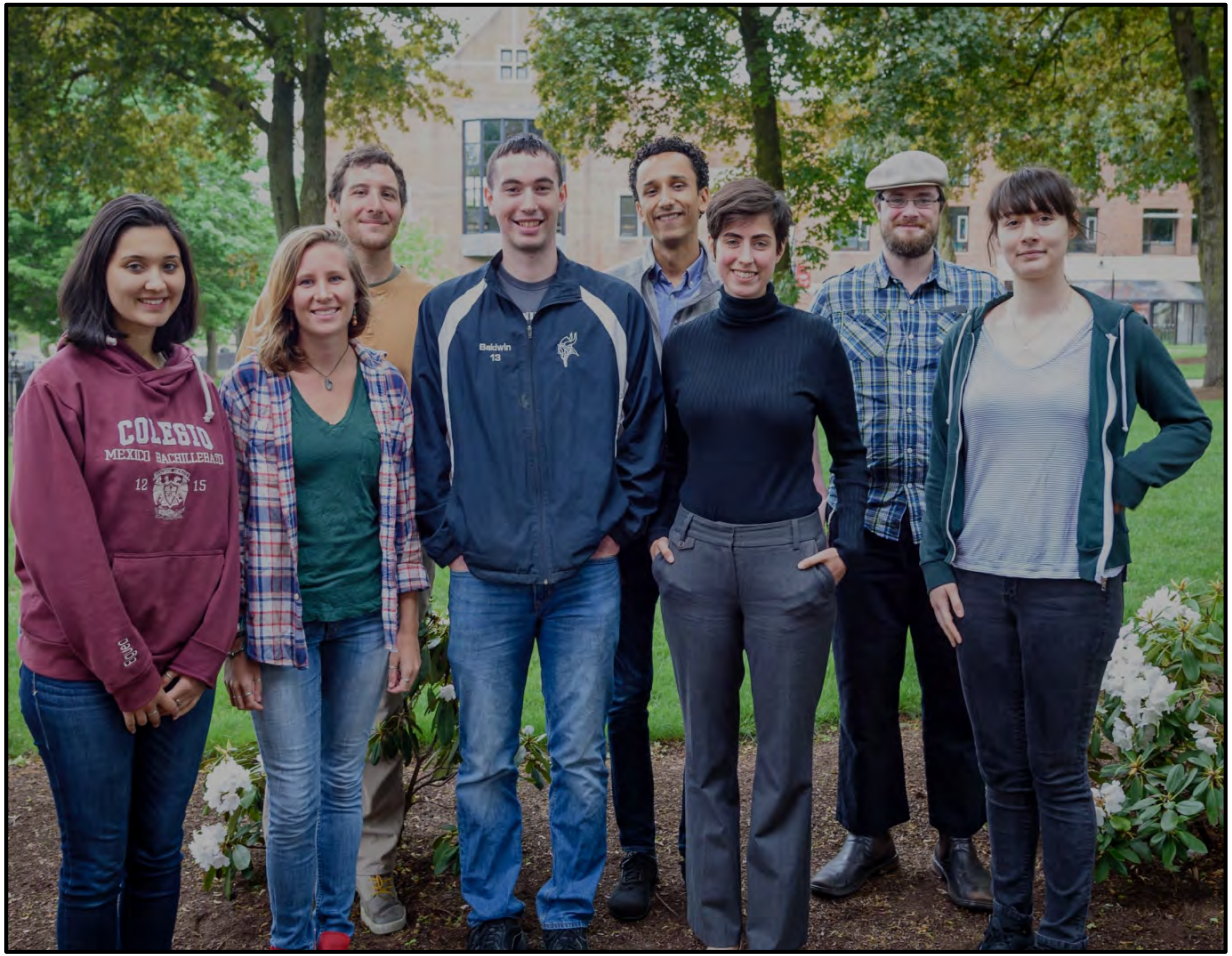



Front Row: Meyru, Hannah, Eli, Sonny & Gemma
Back Row: Ben, Miles & Joe

# Undergraduate Human-Environment Research

1999

2005

2012

GREENING THE GATEWAY CITIES

2017

HERO Human-Environment Regional Observatory

# Greening the Gateway Cities (GGC) Program

**Goal:** To reduce energy costs by expanding tree canopy to cover 10% of the gateway cities.

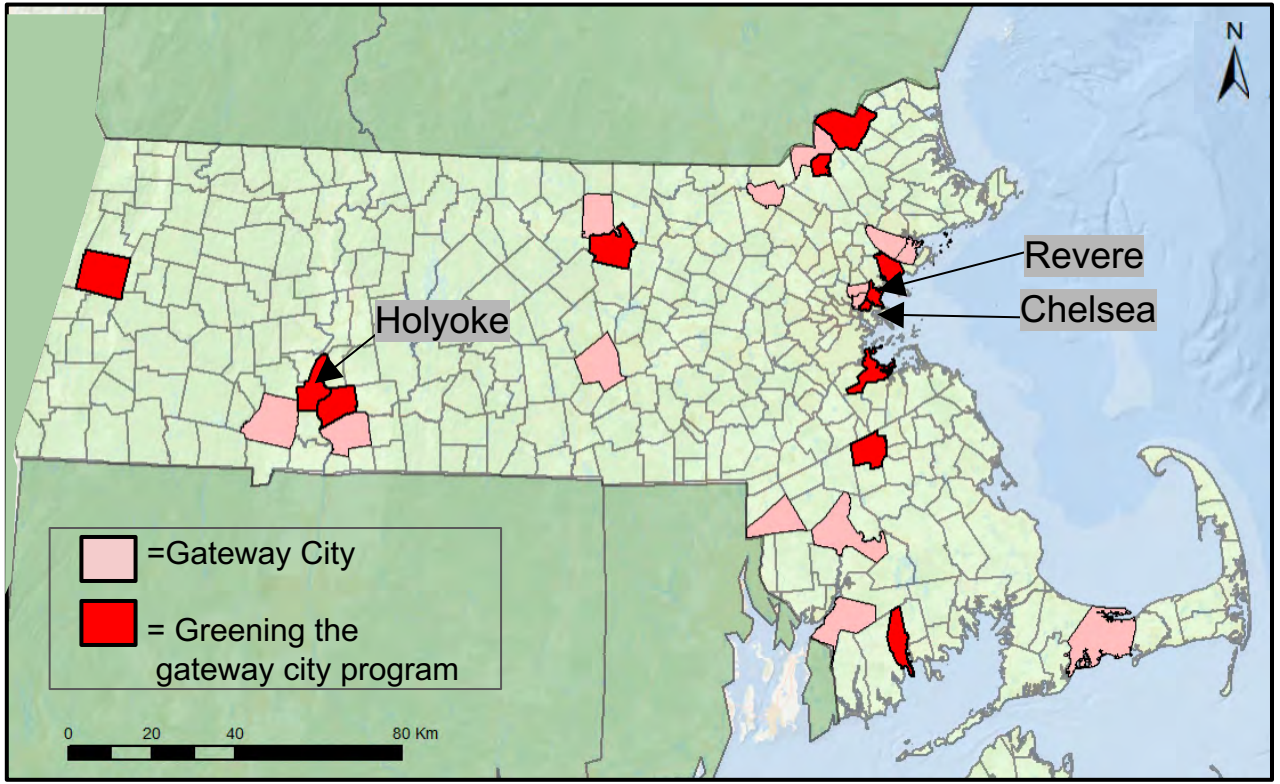
**Planting zone criteria:**

Low tree canopy

Older housing stock

High wind speeds

Large renter population



# Why Plant Trees?

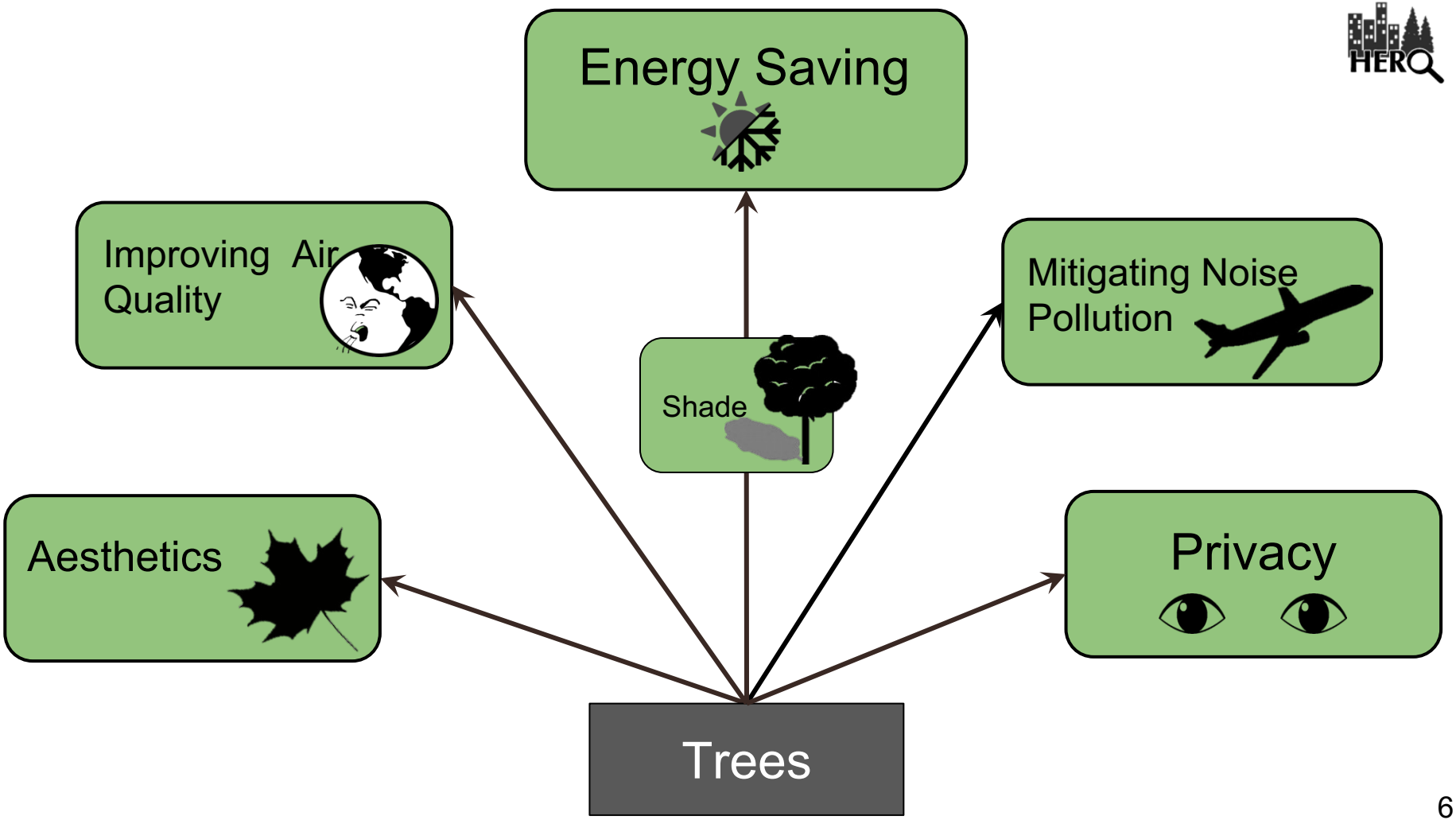

**Urban Heat Islands**: Metropolitan areas in which the temperature is significantly higher than surrounding vegetated areas due to human activities

Temperature 20-50°F higher in urban heat islands.

For every 1°F of increase over 68°F energy demands increase by up to 2%

Increase peak demand

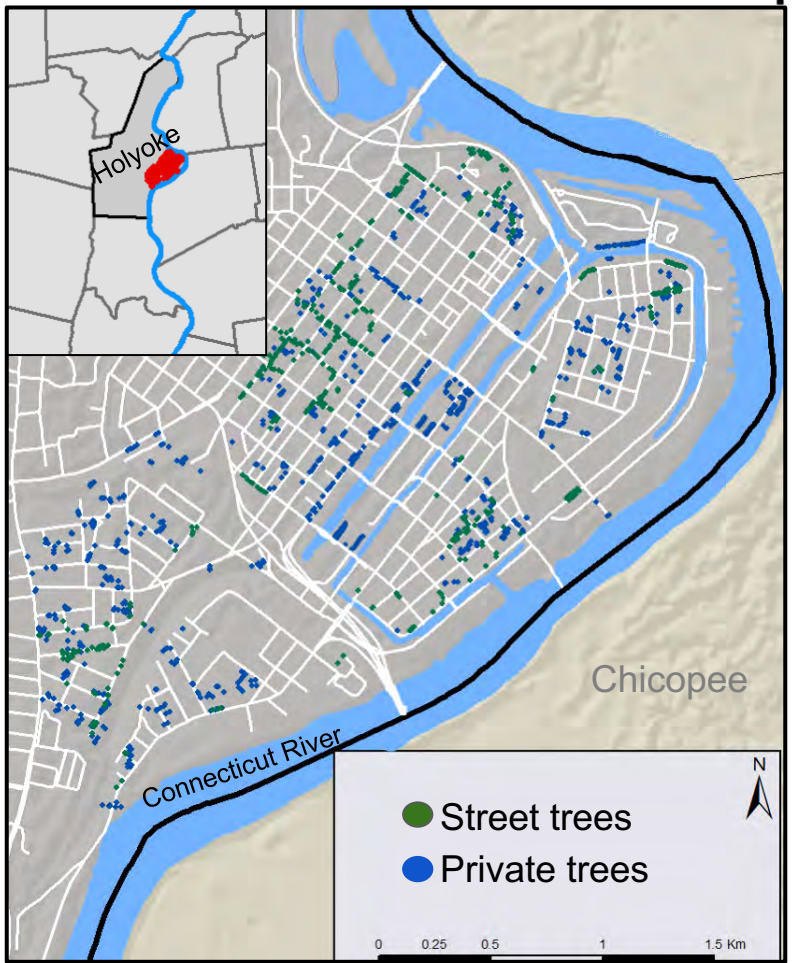
http://www.wbur.org/commonhealth/2017/07/05/greater-boston-heat-islands


Energy Saving
Improving Air Quality
Mitigating Noise Pollution
Shade
Aesthetics
Privacy
Trees

# Holyoke (Fall 2014-Present)

Population: 40,280
Median Household Income: $37,372
Education: 23.4%

842 trees surveyed
- 515 street trees
- 327 private trees



# Chelsea (Spring 2014-Present)

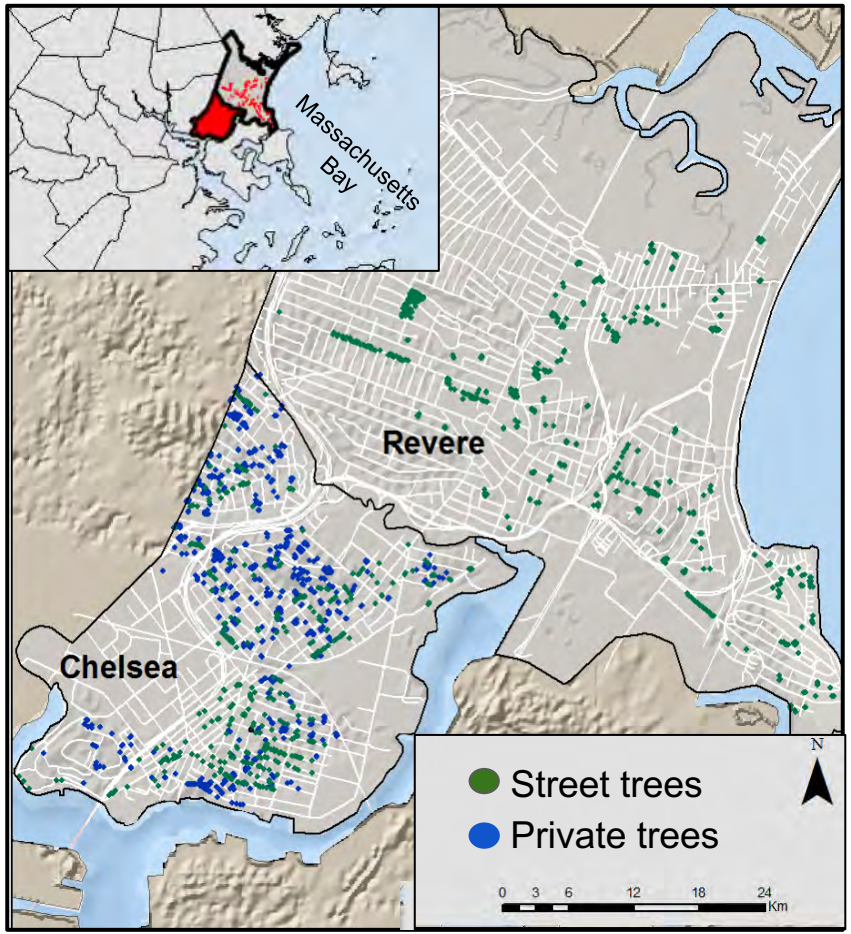
Population: 38,861
Median Household Income: $49,231
Education: 65.4%

429 trees surveyed
373 street trees
56 private trees

# Revere (Fall 2015-Present)

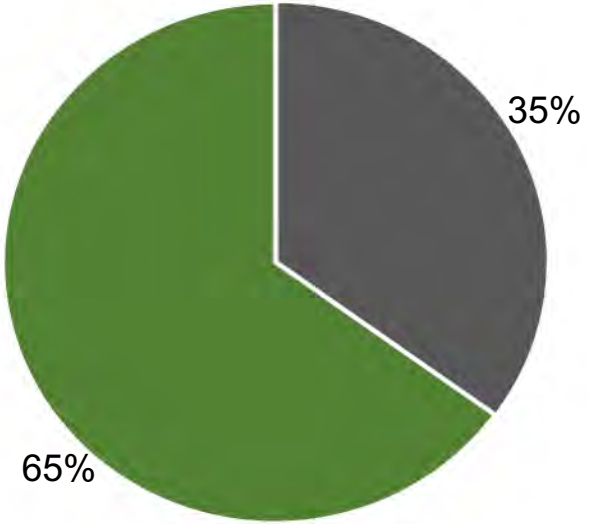
Population: 54,157
Median Household Income: $52,483
Education: 19.5%

117 trees surveyed
117 street trees
0 private trees



# Impervious Surface Composition

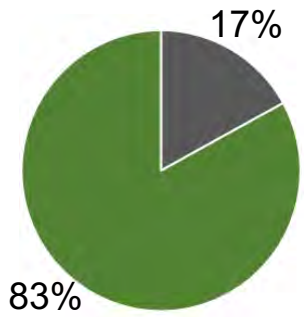
**Average for all Greening the Gateway Cities (12 cities)**
Area 56.3 km²



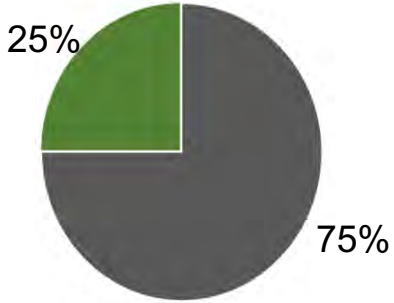

Impervious

Non-impervious

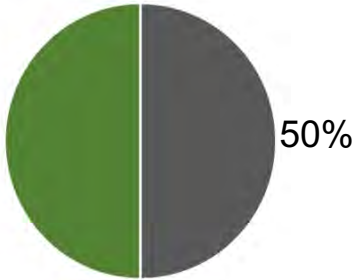
**Holyoke**
Area 59.1 km²




**Chelsea**
Area 6.4 km²




**Revere**
Area 26 km²



# Research Questions

1. **Understand factors related to tree health and survivorship**

   **How does tree health compare across the three cities?**

   **…by species?**

   **…by land use?**

   **…by site type?**

2. **Understand the contribution and experience of residents and stakeholders**

   **What attitudes contribute to successful tree stewardship?**

   **What are the experiences of residence in caring for trees?**

   **How have the new trees affected residents' perception of their property? of their neighborhood? of their city?**

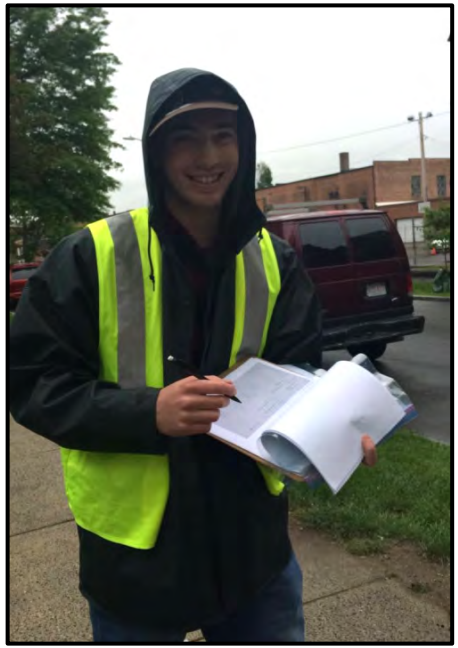
# Tree Survey and Interviews

**Tree Survey - 4 weeks**

Assess tree characteristics that indicate tree health and canopy cover

Record environmental factors that could affect tree health

**Interviews - 1 week**



Interview residents and stakeholders

Assess resident interaction with the Department of Conservation and Recreation

# Tree Assessment Characteristics: Survivorship


Alive


Standing Dead


Removed

| | | | |
|---|---|---|---|
| 0 | | U | |
| 0 | | U | |
| 0 | | U | |
| 3 | 26-Apr-16 | U | N |
| 2.125 | 26-Apr-16 | U | N |
| 70833333 | | U | |
| 4.625 | 26-Apr-16 | U | N |
| 0 | | U | |
| 0 | 11/12/2014 | U | |
| 0 | 28-Apr-16 | U | N |
| 0 | | U | N |
| 0 | 01-Jun-16 | U | N |

Unknown

# Tree Assessment Characteristics: Vigor


1 - Healthy


2 - Slightly unhealthy


3 - Moderately unhealthy


4 - Severely unhealthy


5 - Dead

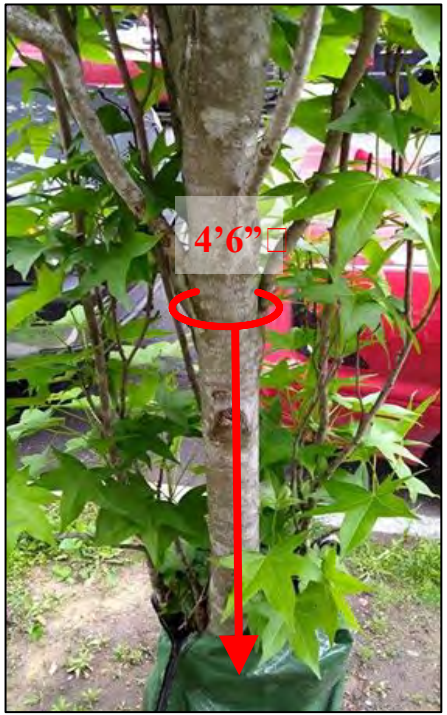
# Tree Health: Other Indicators

Basal Sprouting

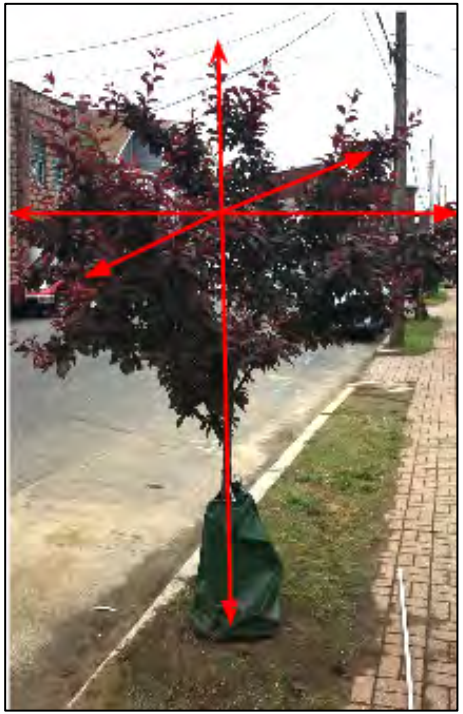
Insect & Fungus Damage

Trunk Damage

# Tree Assessment Characteristics: Size Metrics


Diameter at Breast Height (DBH)



Height and Canopy Width

Distance to Impervious


HERO Eli measuring **DBH**

HERO's Meyru, Miles and Hannah measuring **height**

HERO's Gemma, Eli and Miles measuring **width**

HERO’s Hannah and Miles measuring distance to impervious

# Tree Assessment Characteristics: Site Type

Planting Strip

Sidewalk Cutout


Maintained Park


Other Maintained

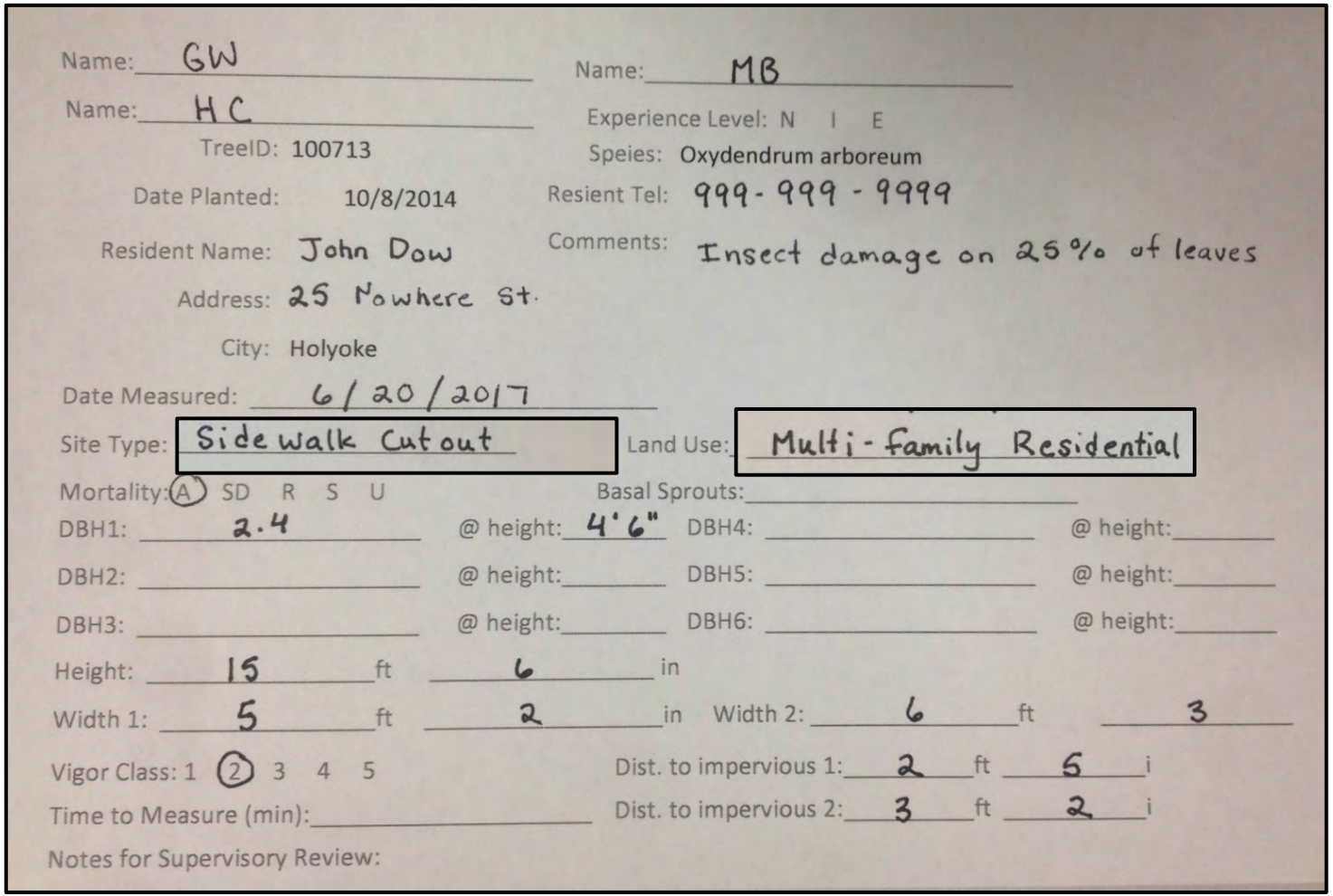
# Tree Assessment Characteristics: Area Land Use


Commercial land use


Industrial land use

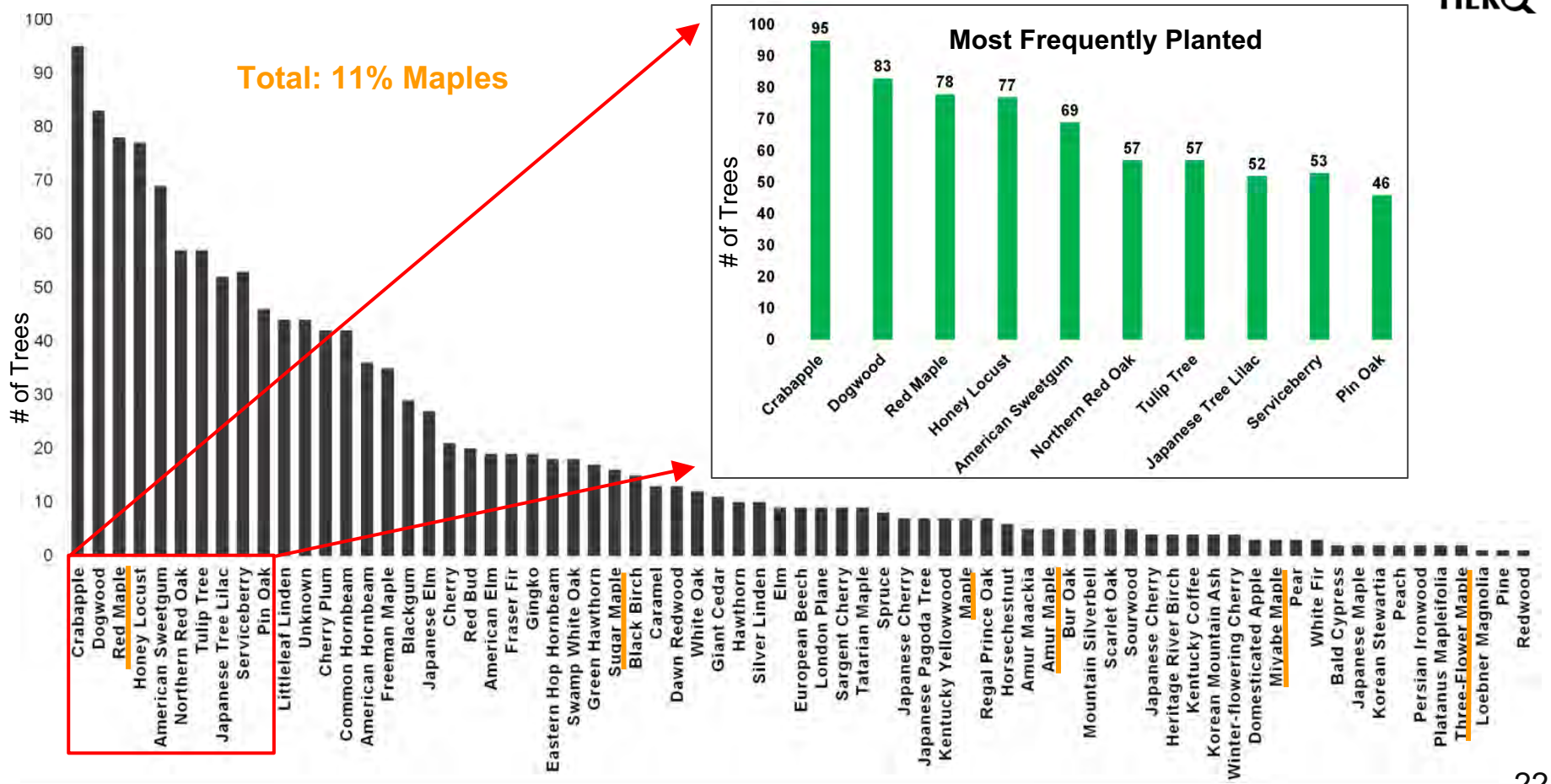

Multi-family residential


Single-family residential

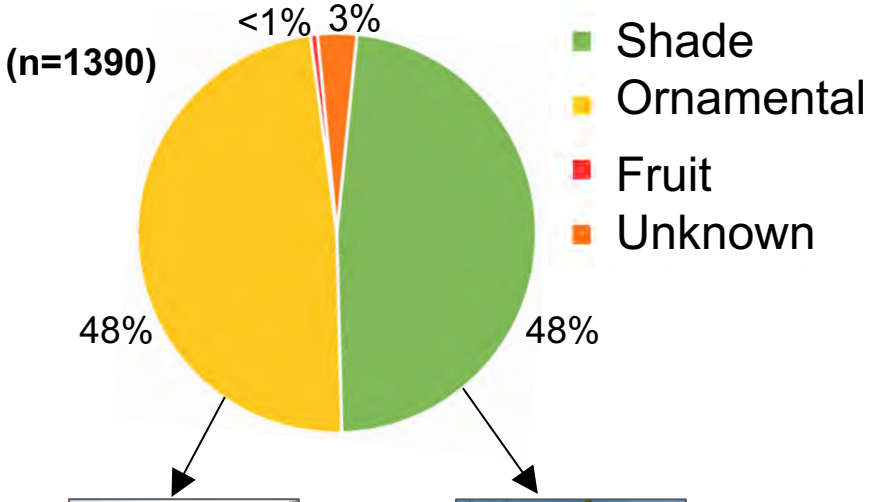


Name: GW
Name: HC
TreeID: 100713
Date Planted: 10/8/2014
Resident Name: John Dow
Address: 25 Nowhere St.
City: Holyoke
Name: MB
Experience Level: N I E
Speies: Oxydendrum arboreum
Resient Tel: 999-999-9999
Comments: Insect damage on 25% of leaves
Date Measured: 6/20/2017
Site Type: Sidewalk Cutout
Land Use: Multi-family Residential
Mortality: (A) SD R S U
Basal Sprouts:
DBH1: 2.4 @ height: 4'6"
DBH2: @ height:
DBH3: @ height:
DBH4: @ height:
DBH5: @ height:
DBH6: @ height:
Height: 15 ft 6 in
Width 1: 5 ft 2 in
Width 2: 6 ft 3
Vigor Class: 1 (2) 3 4 5
Time to Measure (min):
Dist. to impervious 1: 2 ft 5 i
Dist. to impervious 2: 3 ft 2 i
Notes for Supervisory Review:

# Species Composition of All Trees (n=1390)

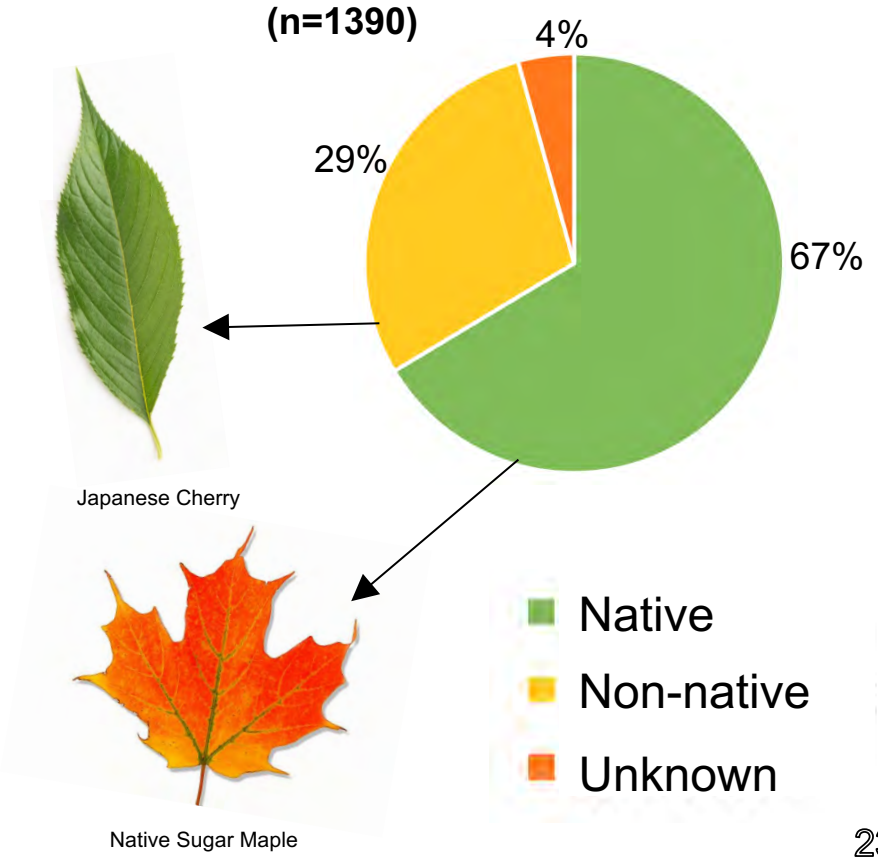


# Species Attribute Composition of All Trees




Fraser Fir


Maple



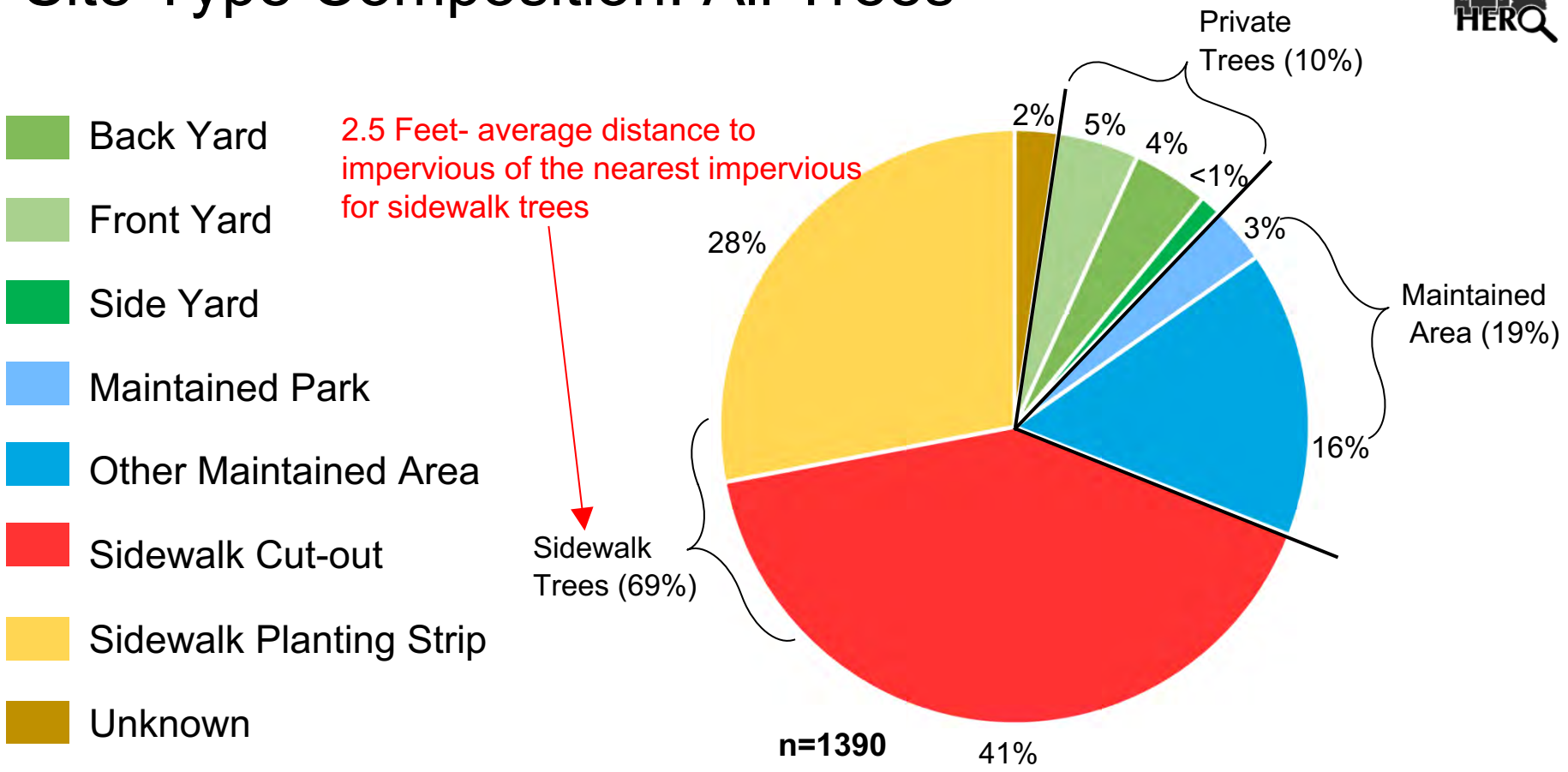



Japanese Cherry

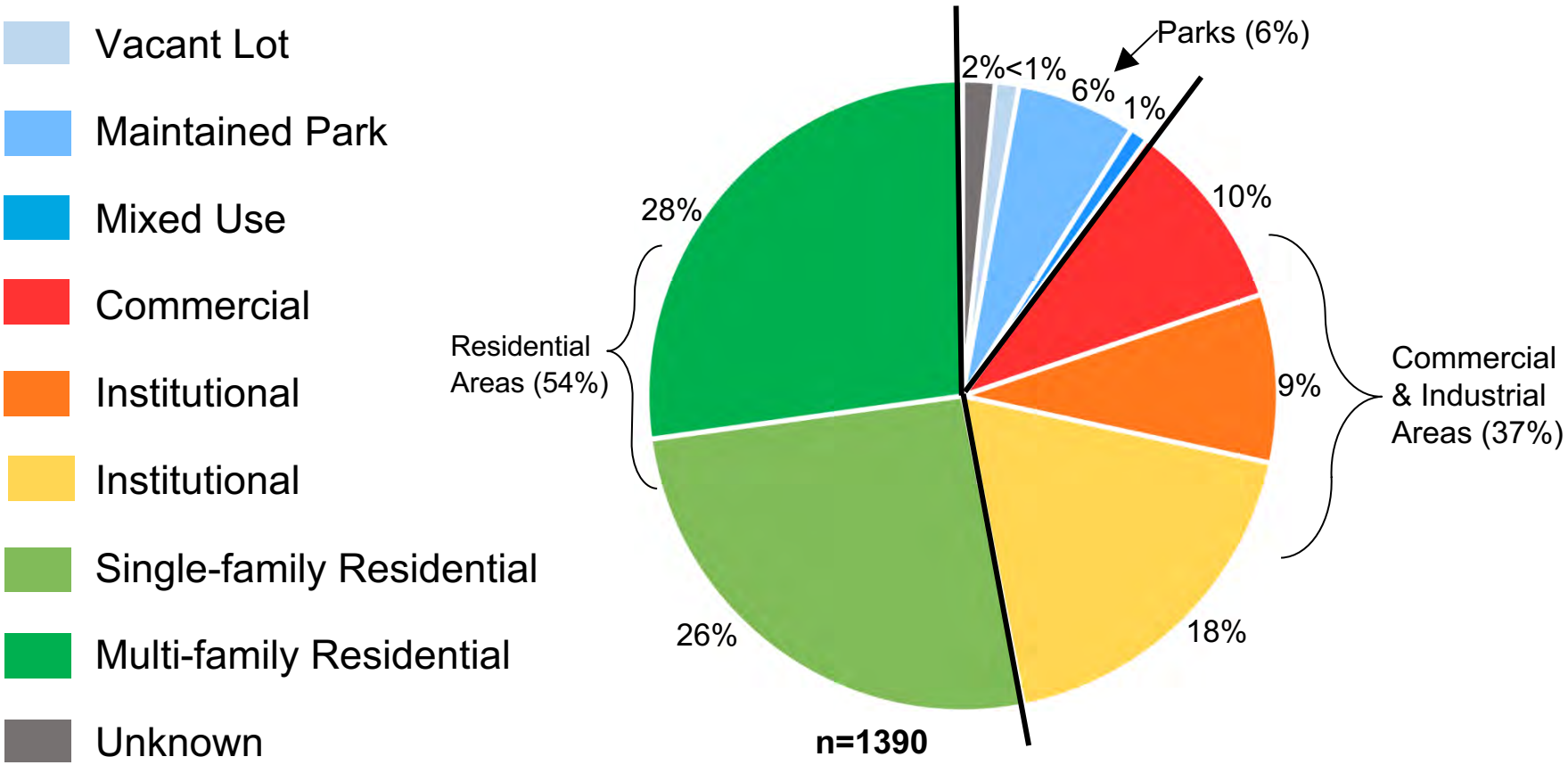


Native Sugar Maple

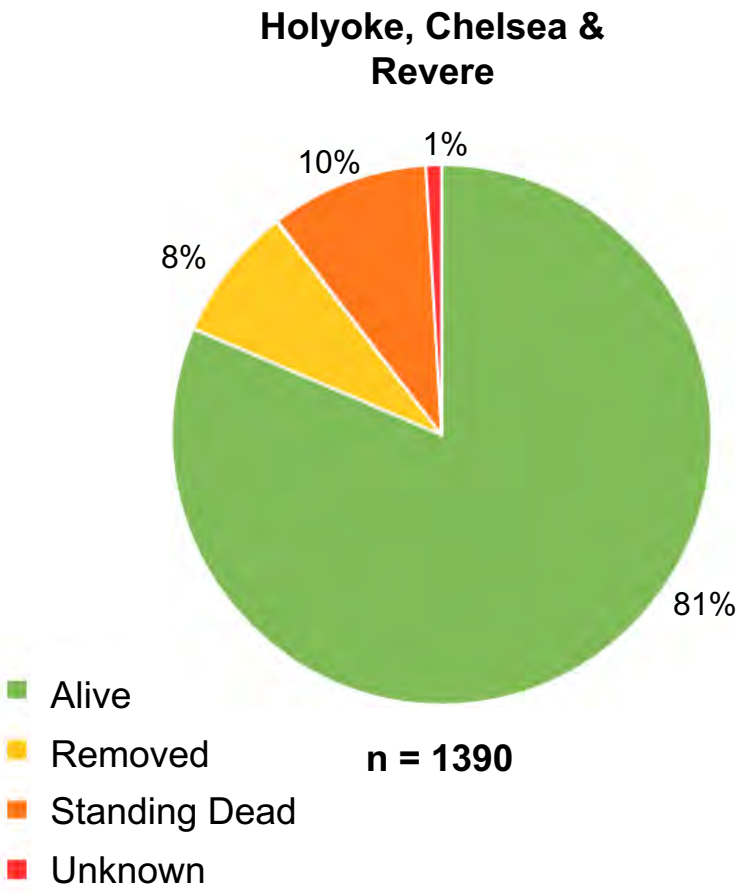
# Site Type Composition: All Trees

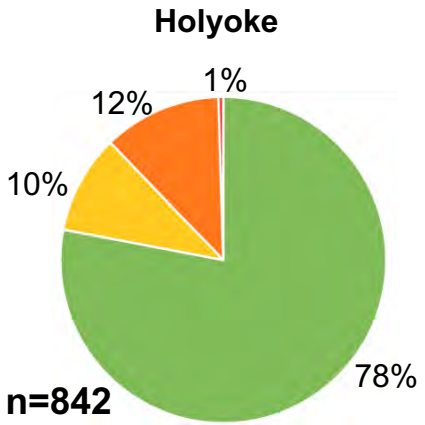


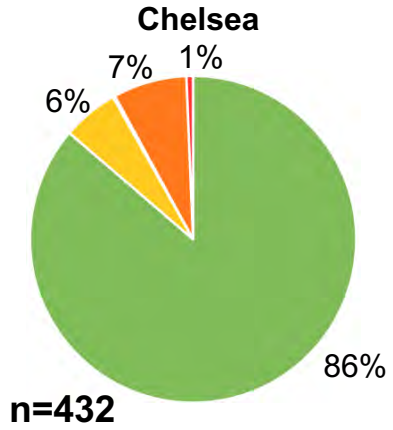
# Land Use Composition: All Trees

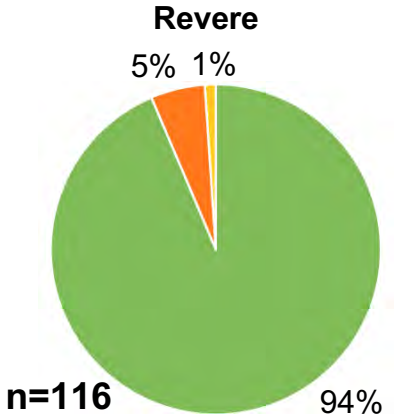


# Survivorship: All Trees



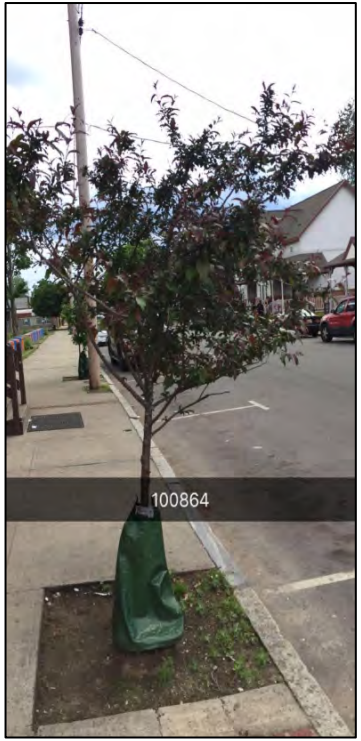



# Top Five Species for Survivorship

Cherry Plum


Eastern Redbud

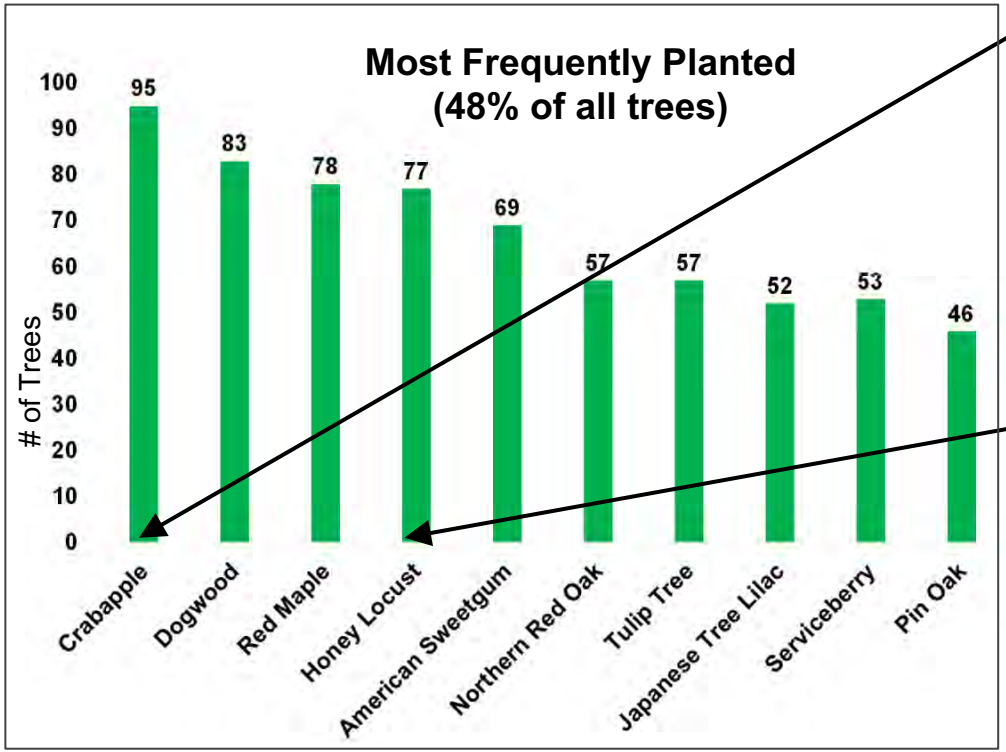


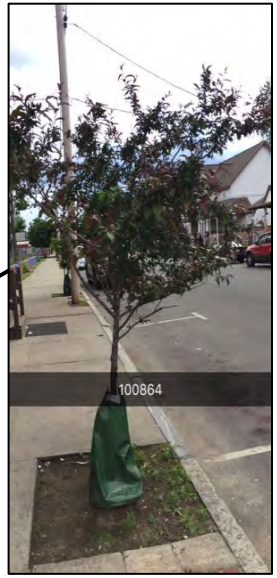

Crabapple


White Oak

Honey locust

# Species Composition of All Trees



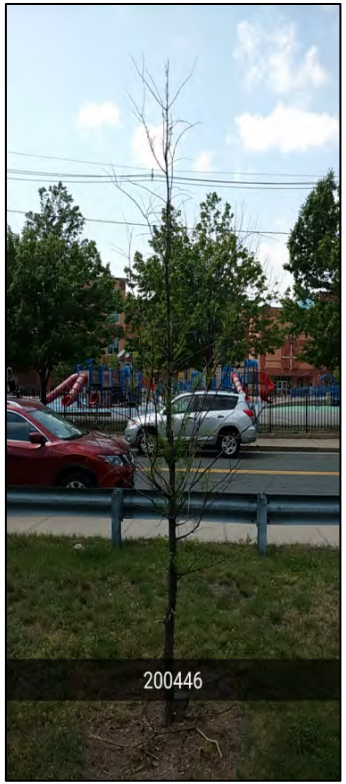

Crabapple

Honey Locust

# Bottom Five Species For Survivorship

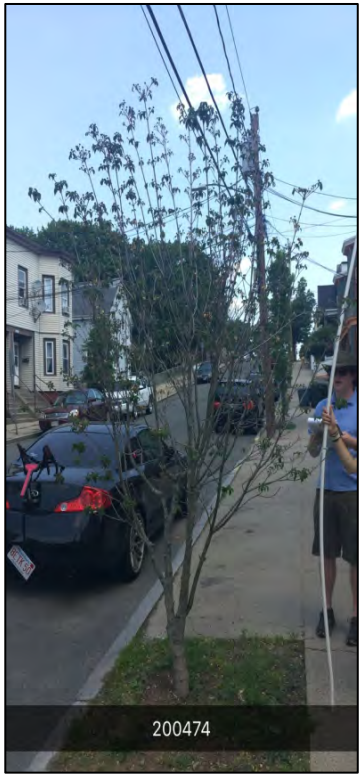

Black Gum


Tulip Tree



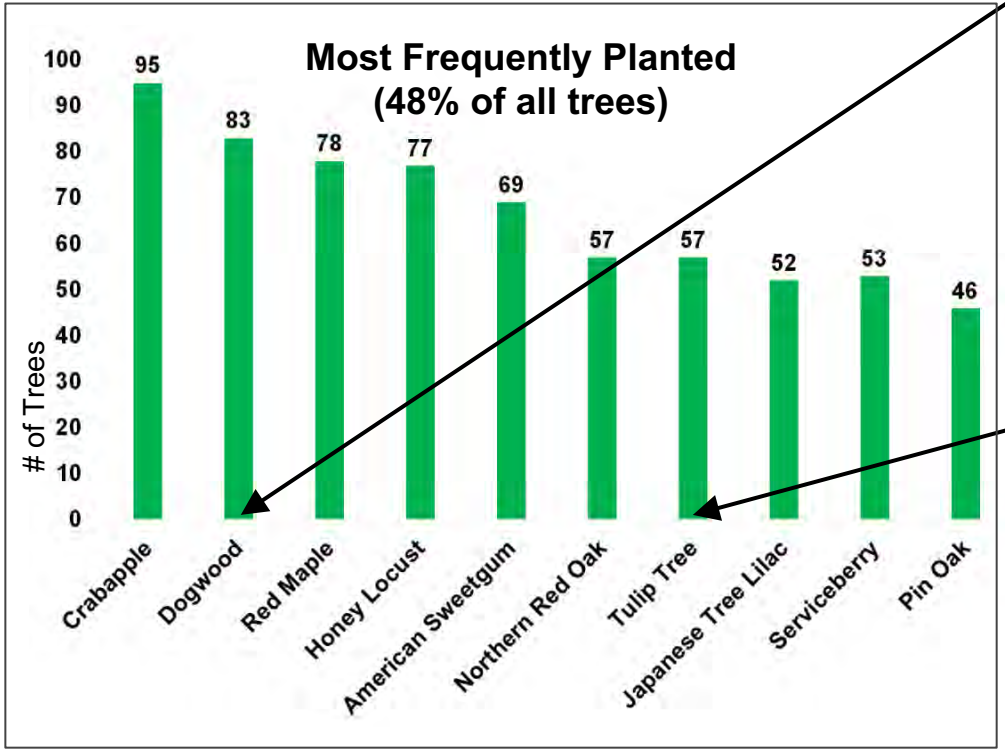

Dawn Redwood

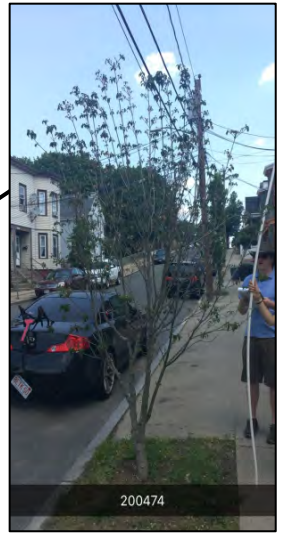

Cherry Dogwood




Dogwood

# Species Composition of All Trees




Dogwood

Tulip Tree

## Street Trees

**Census of tree health**
Nearly all street trees were surveyed based on DCR geodatabase

**Stewardship responsibility**
Maintained by the DCR and/or Department of Public Works

**Size**
Generally a larger caliper stem at planting (2.0-2.5 in)

**Stresses**
Include traffic,vandalism & lower quality soil

## Private Trees

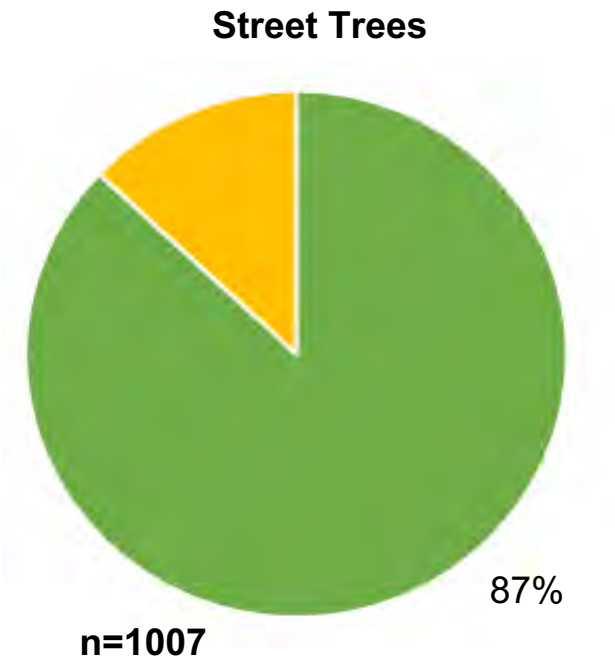
**Convenience sample of tree health**
Private residential/non-residential trees were surveyed based on individuals' willingness to participate

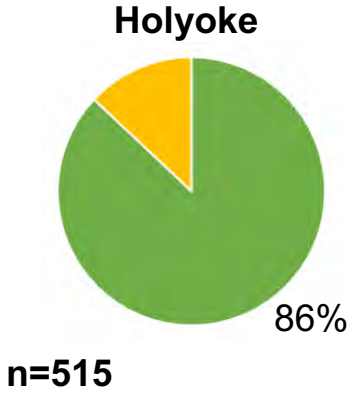
**Stewardship responsibility**
Maintained by private residents or institutions

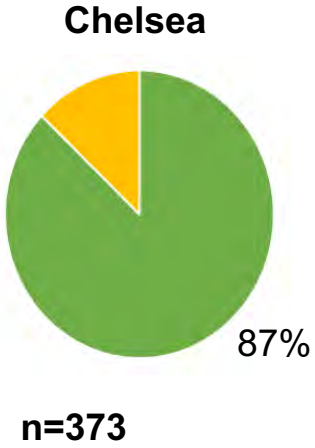
**Size**
Generally a smaller caliper stem at planting (1.5-2.0 in)

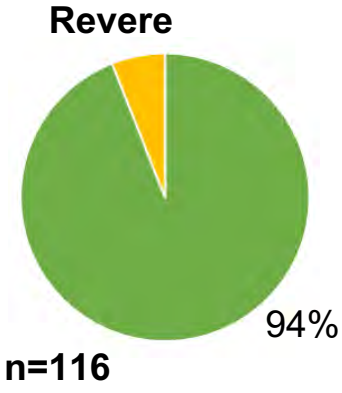
**Stresses**
Include damage from landscaping & infrequent watering

# Survivorship for Street Trees



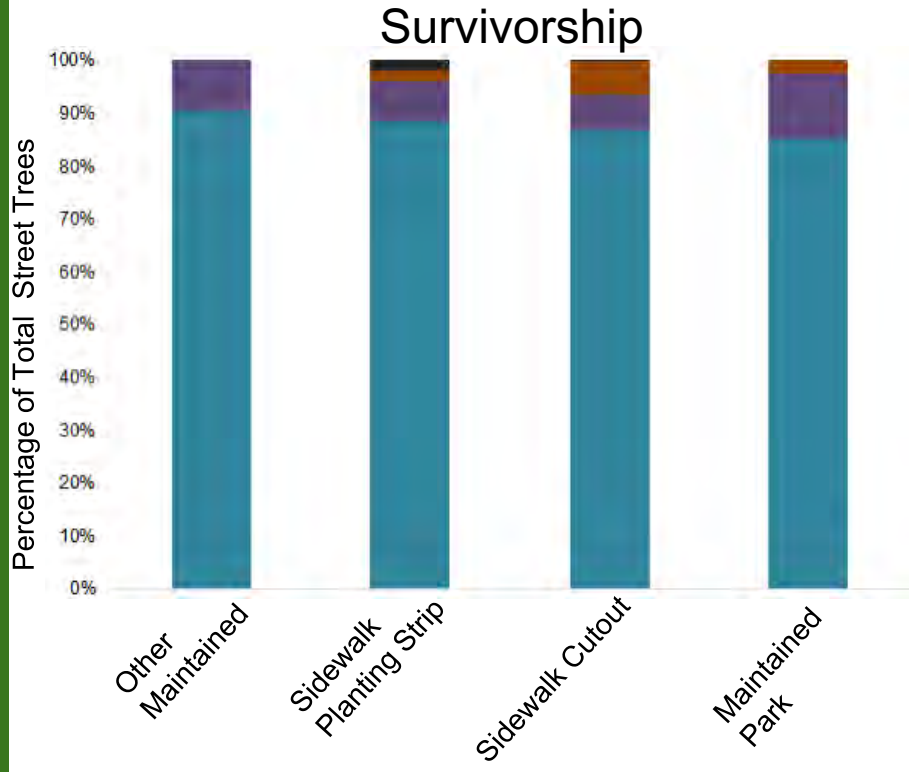



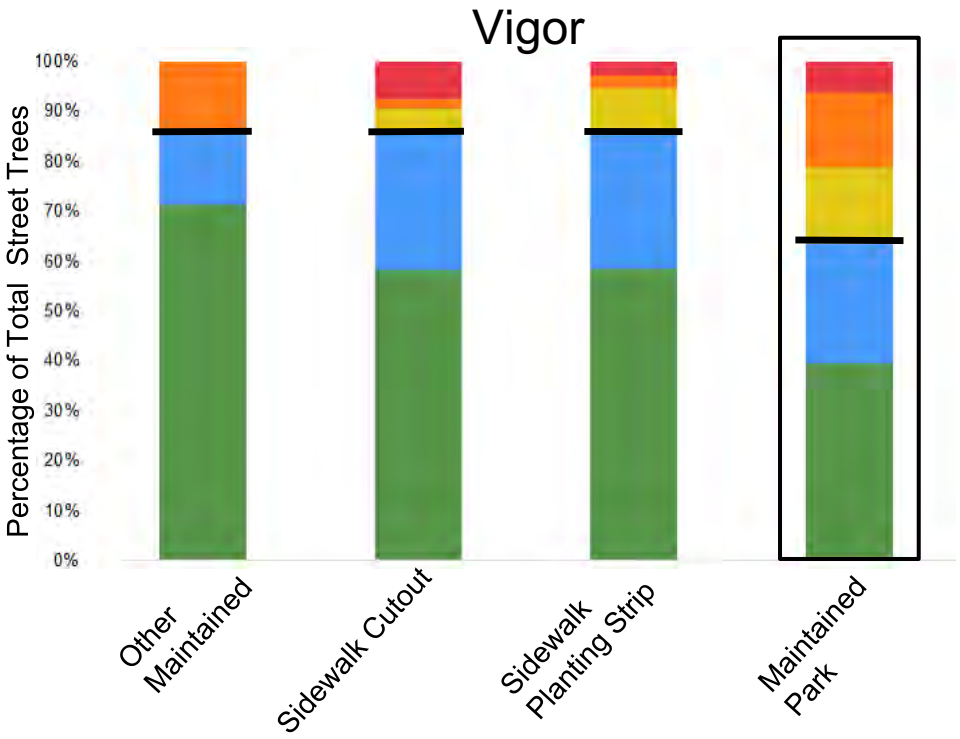




Alive

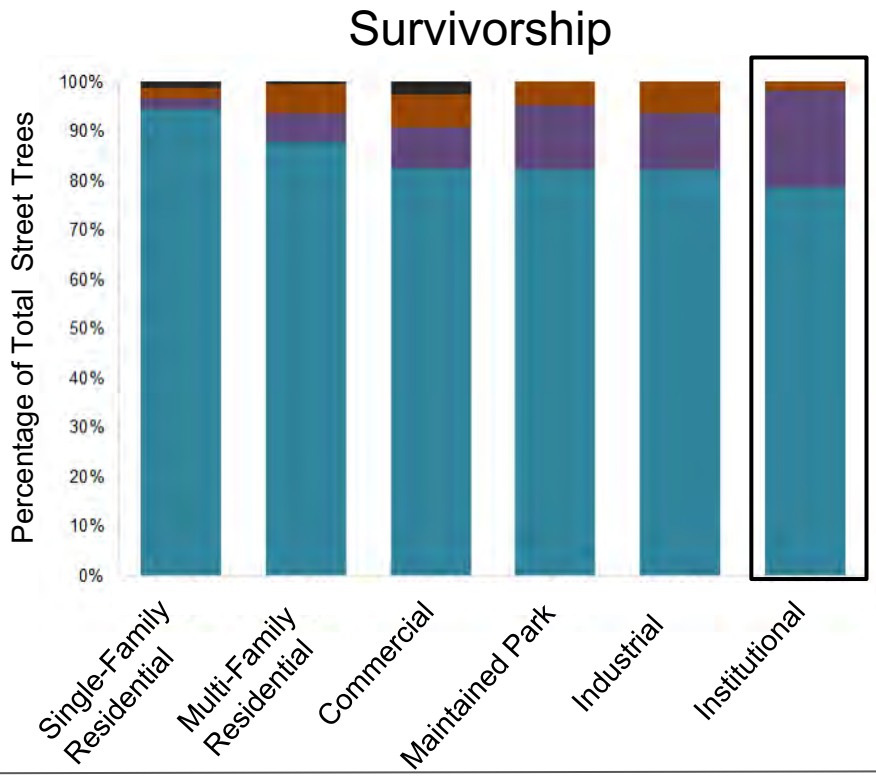
Dead or Removed

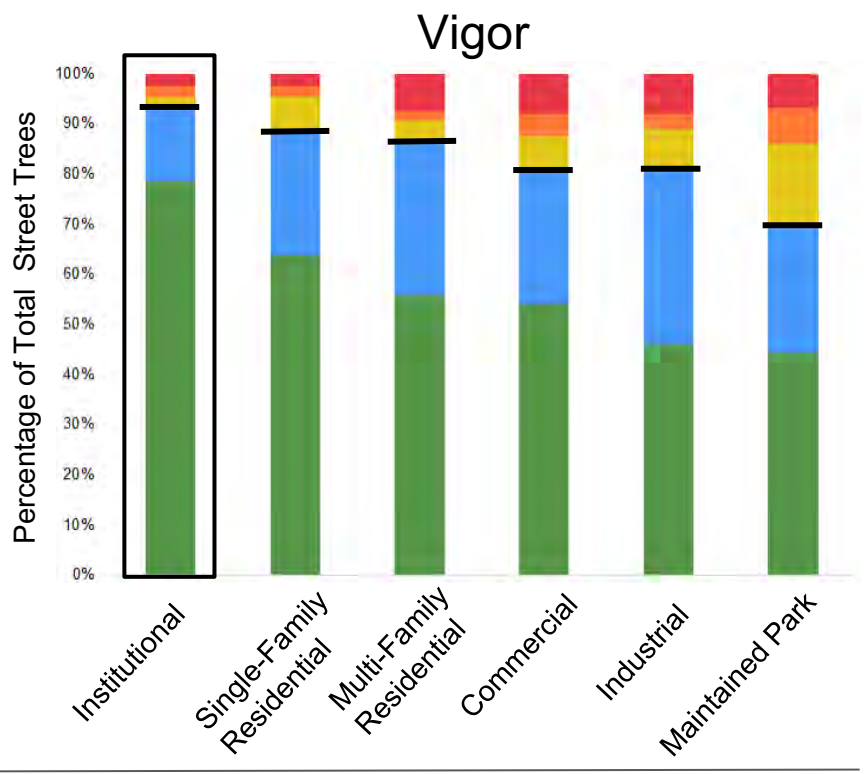
# All Street Trees: Site Type



# All Street Trees: Land Use



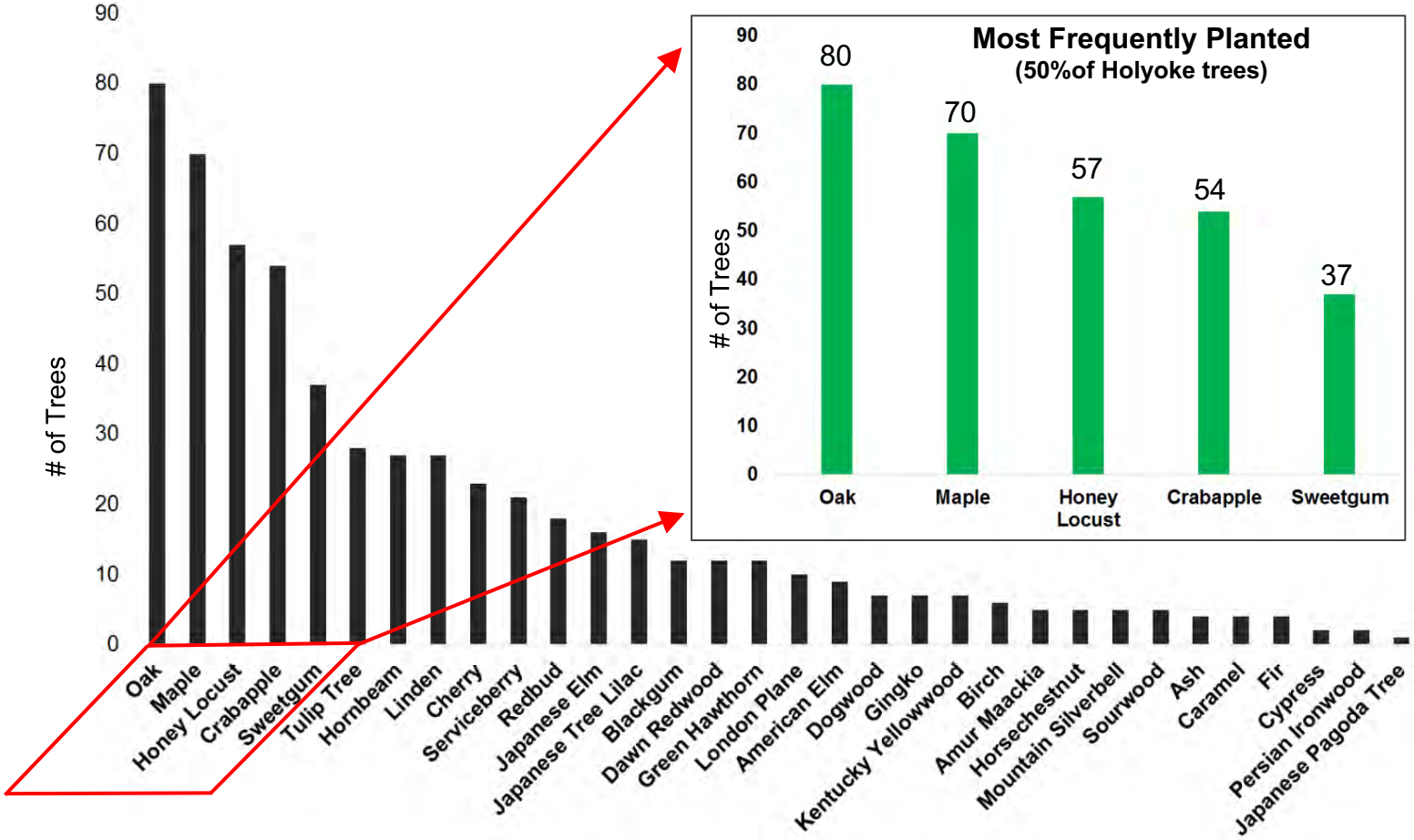

Alive
Removed
Standing Dead
Unknown

Healthy
Moderately Unhealthy
Dead
Slightly Unhealthy
Severely Unhealthy

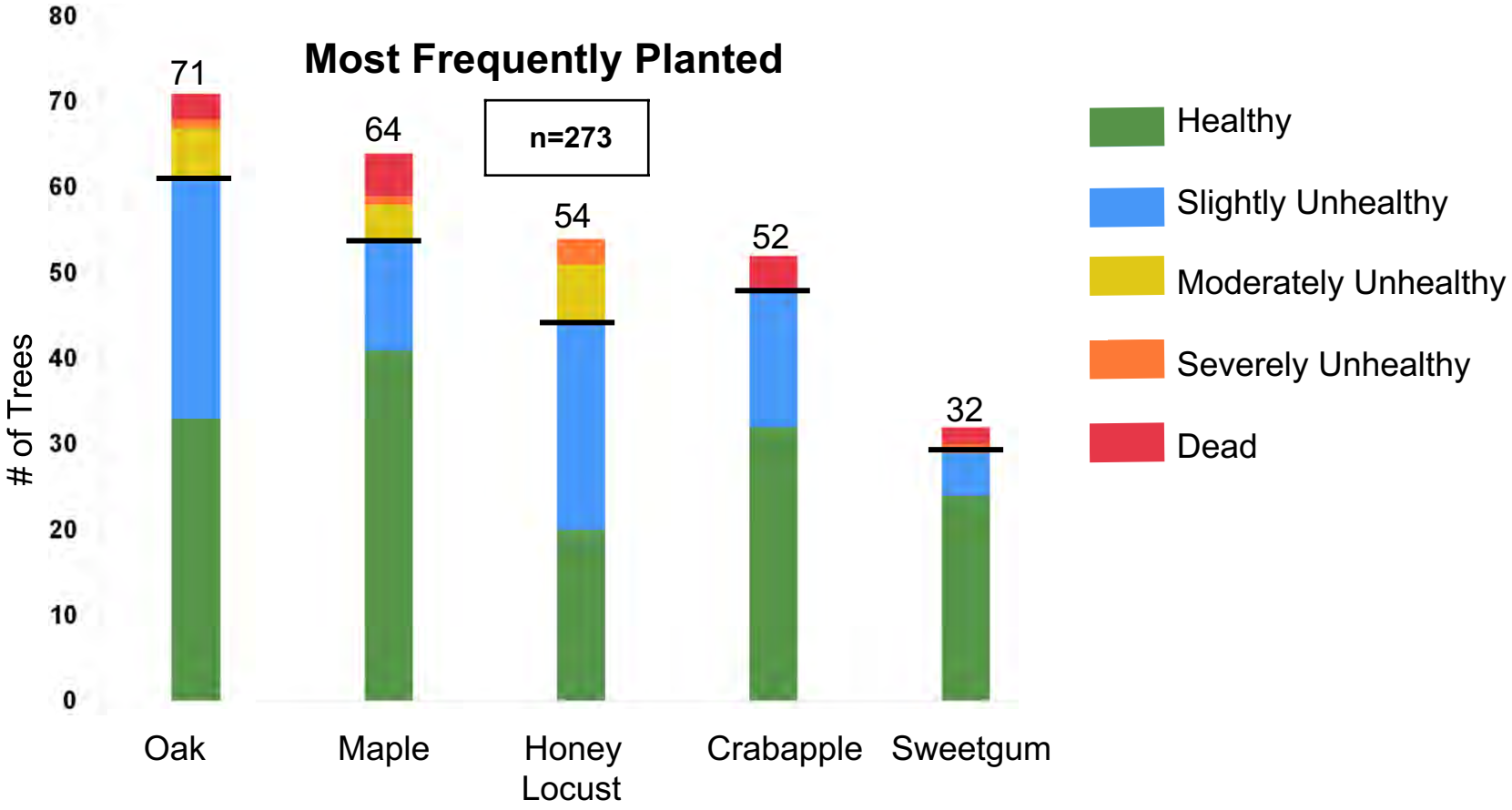
# Comparison Of All Street Trees

| | % Alive | Mean DBH (In.) | Mean Height (Ft.) | Mean Vigor | Mean Crown Width (Ft.) | Number of Trees |
|---|---|---|---|---|---|---|
| All | 87 | 2.14 | 12.3 | 1.72 | 6.28 | 1005 |
| Holyoke | 86 | 2.25 | 11.8 | 1.72 | 6.04 | 515 |
| Chelsea | 87 | 2.17 | 13.4 | 1.78 | 6.87 | 374 |
| Revere | 94 | 1.68 | 11.5 | 1.51 | 5.48 | 116 |

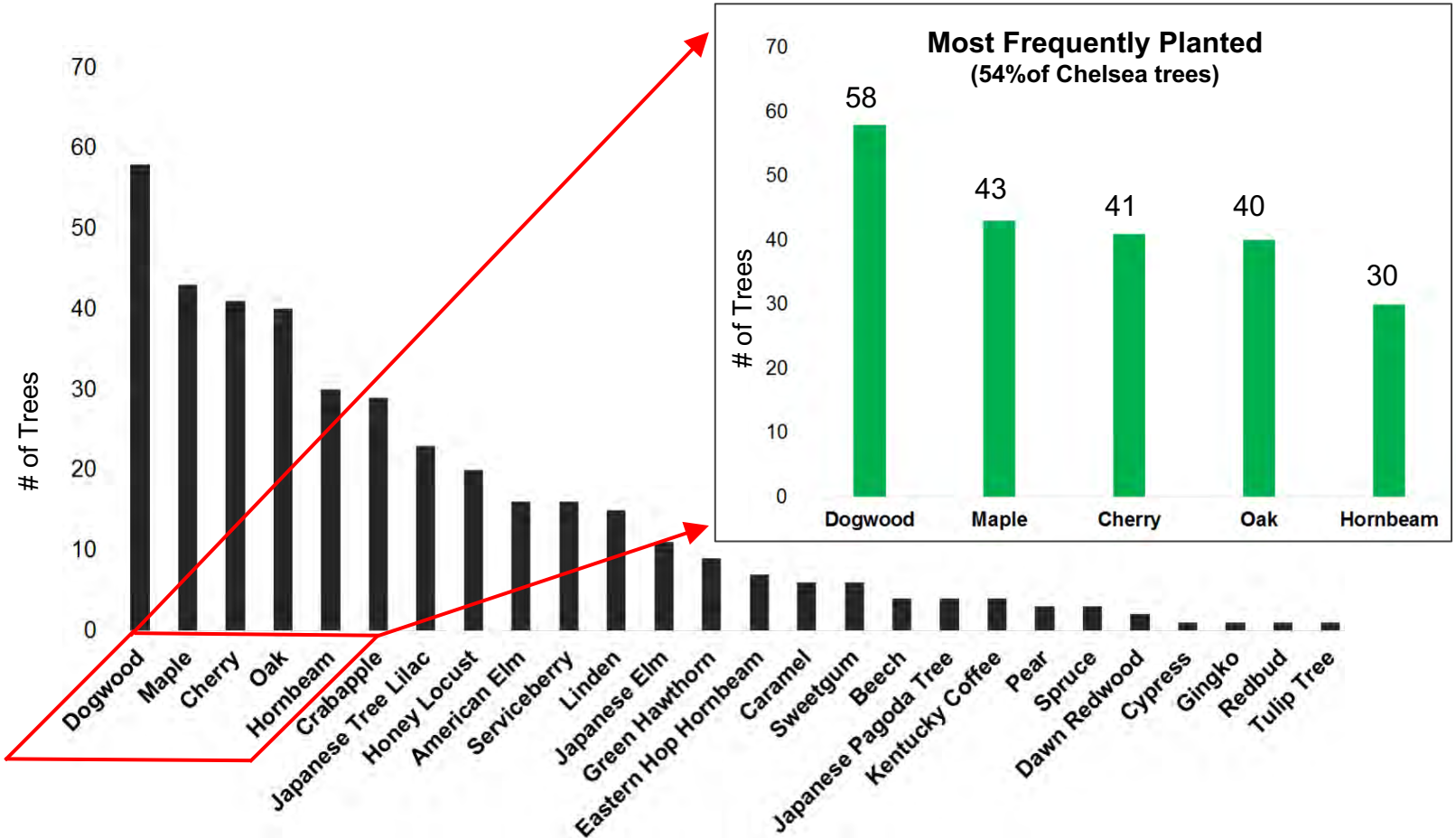
# Holyoke: Street Tree Species Composition



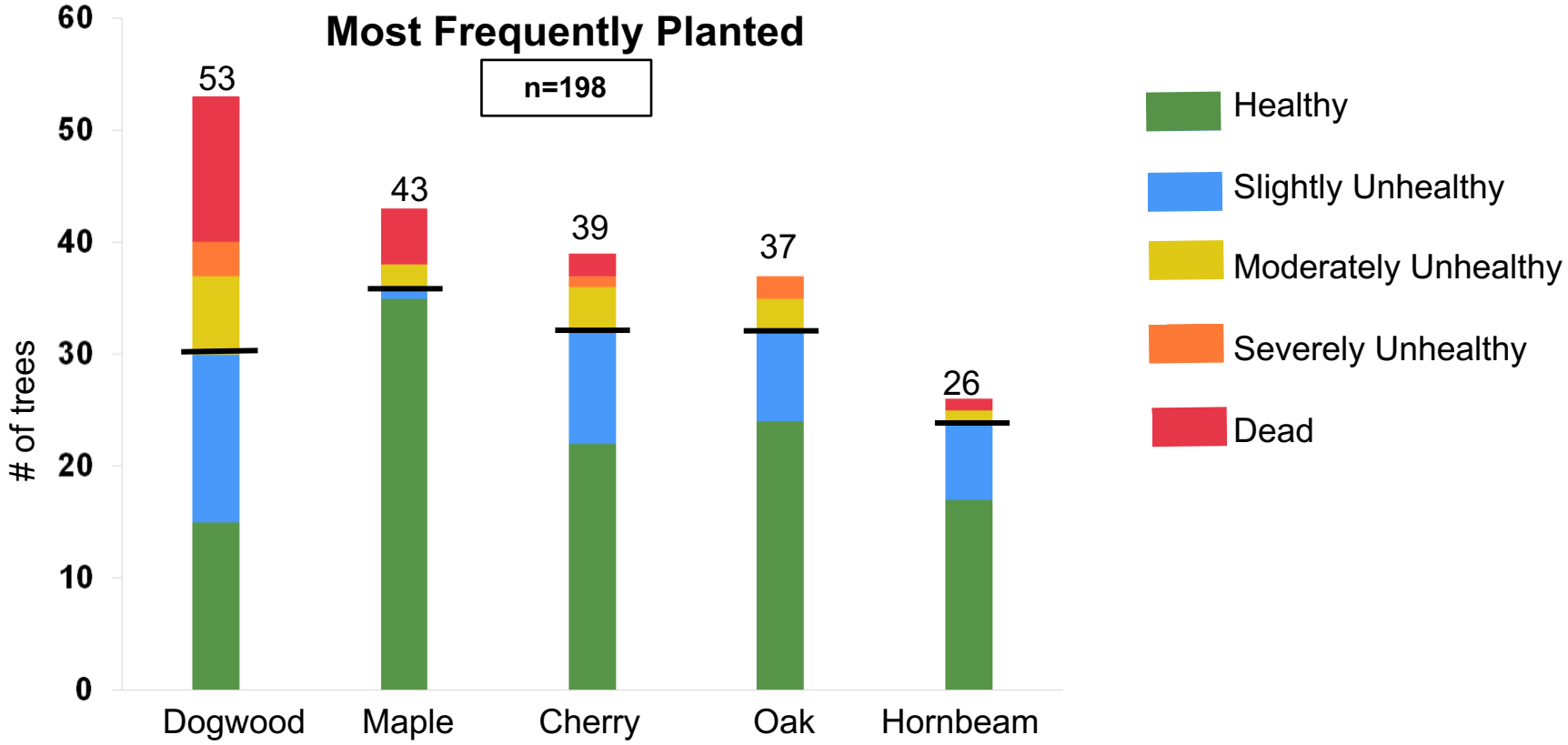
# Vigor of the Most Frequent Street Trees in Holyoke



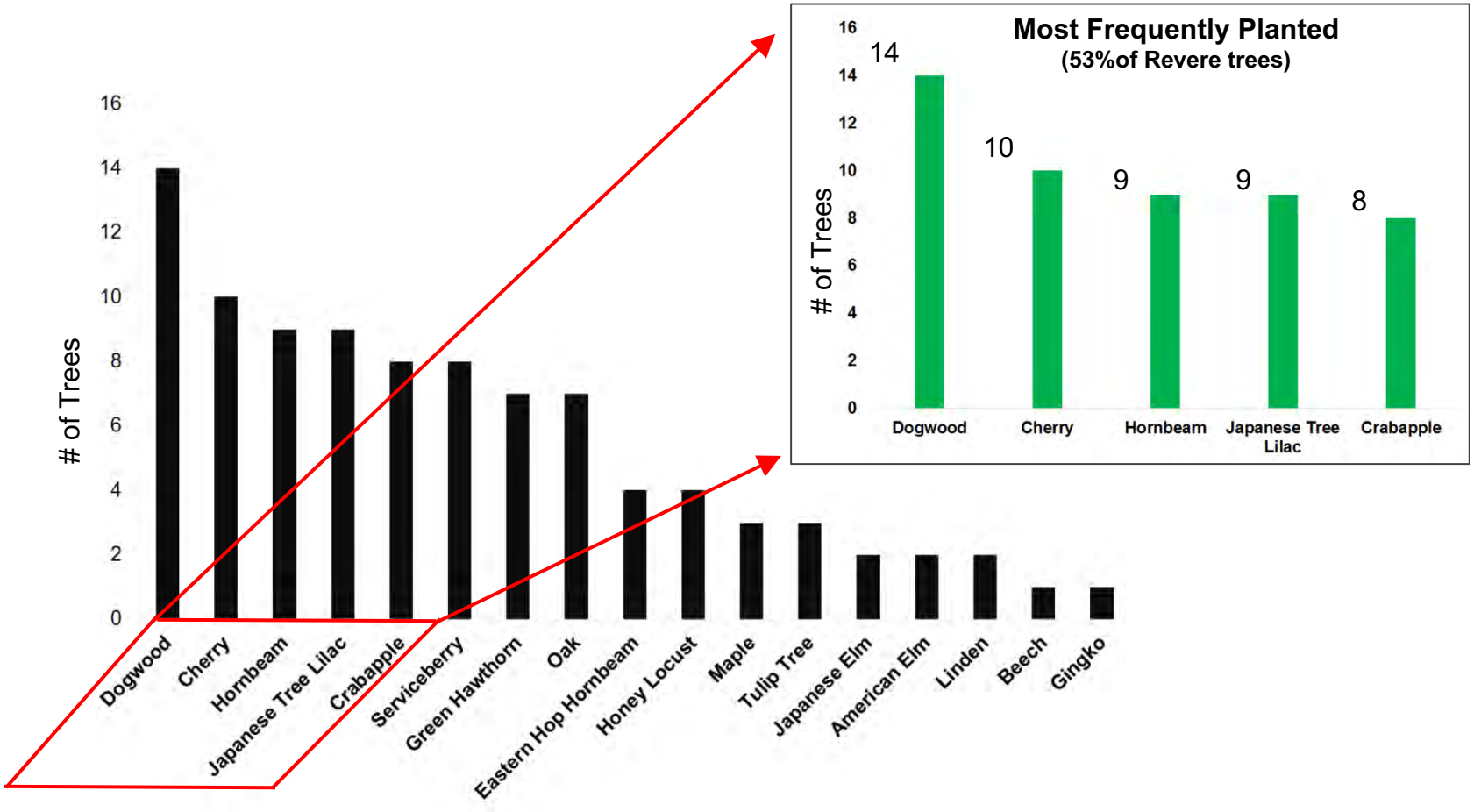
# Chelsea: Street Tree Species Composition



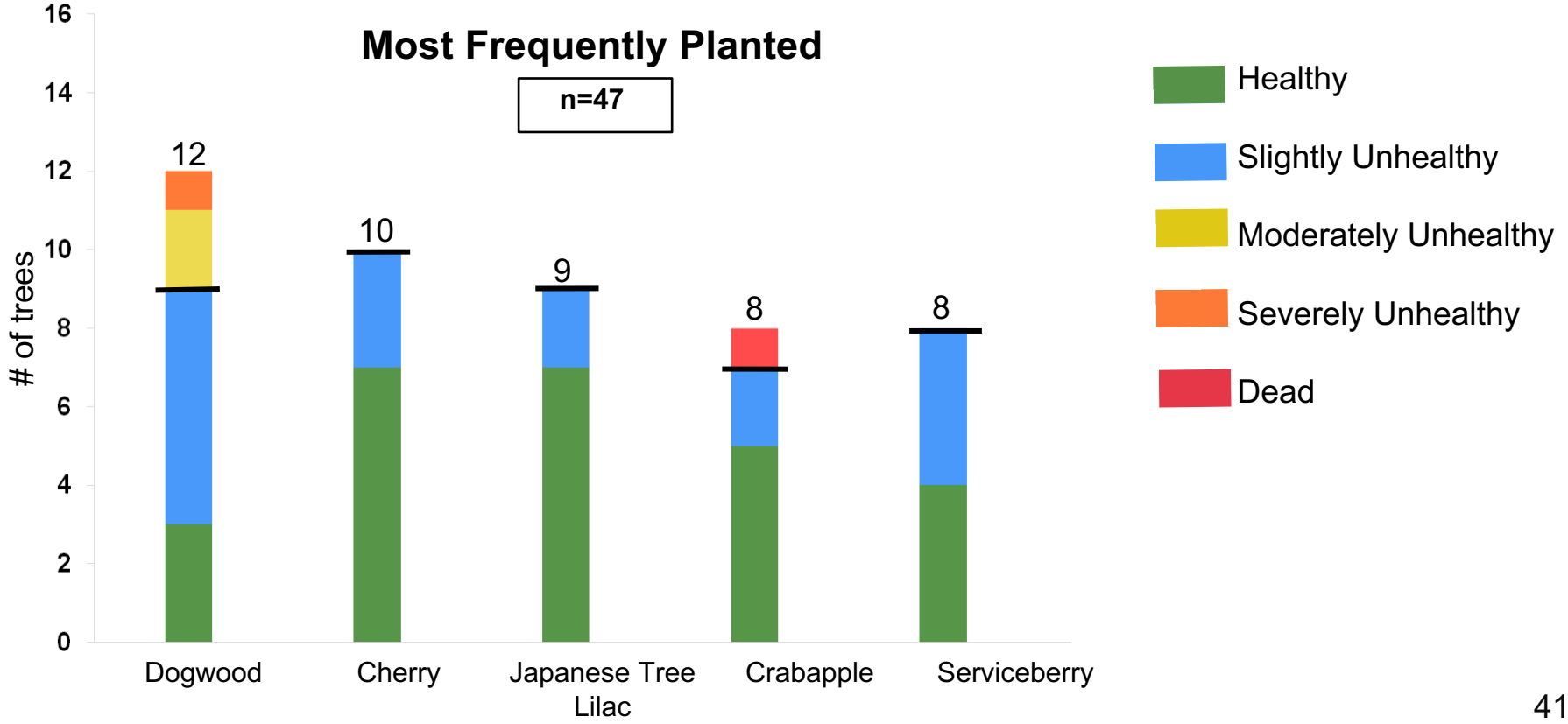
# Vigor of the Most Frequent Street Trees in Chelsea



# Revere: Street Tree Species Composition



# Vigor of the Most Frequent Street Trees in Revere



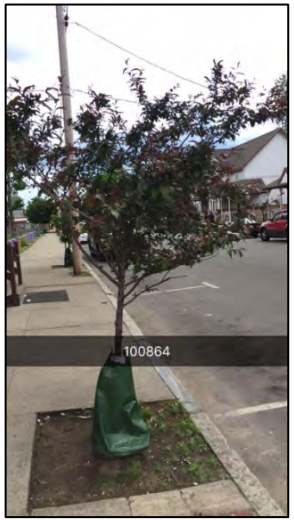
# Best Performing Street Tree Species

**Honey Locust**

Excellent performance in all three cities

**Cherry Plum**

Excellent performance in Holyoke and Revere




**Crabapple**

Excellent performance in Chelsea and did well in Revere

**Pin Oak**

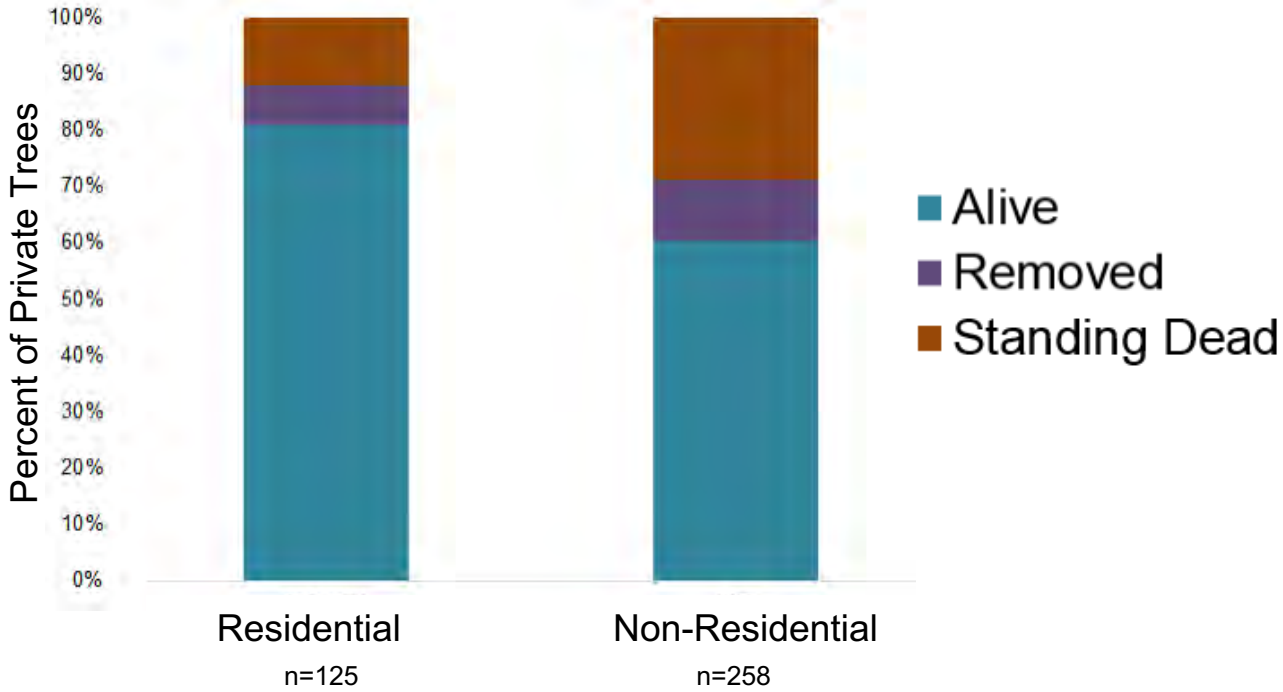
Excellent performance in Holyoke and did well in Revere

**Japanese Tree Lilac**

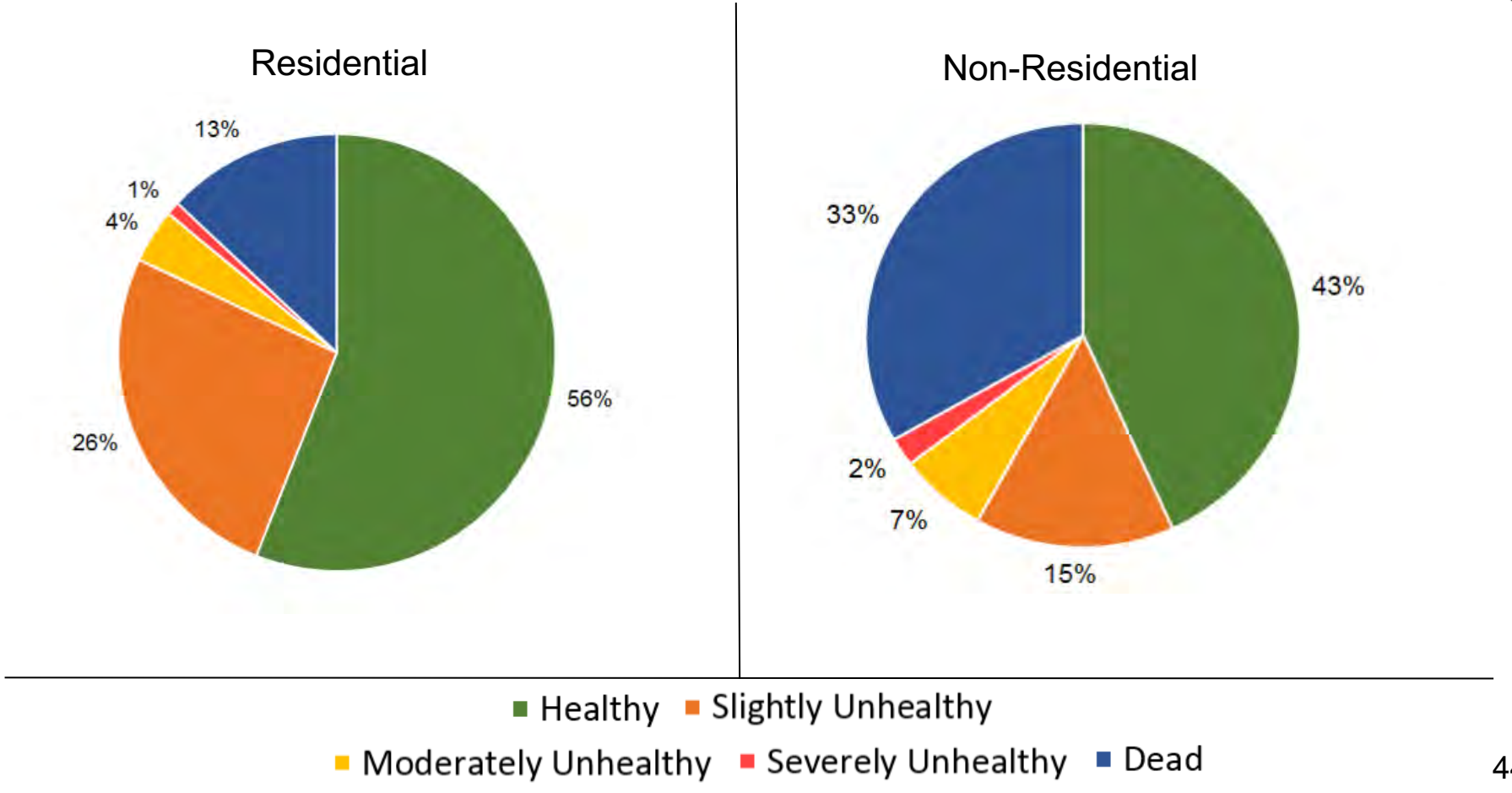
Excellent performance in Holyoke and Revere, did well in Chelsea

# Private Tree Sample

| % Alive | Vigor | DBH | Height | Width | n |
|---|---|---|---|---|---|
| 67 | 2.41 | 1.08 in | 8.0 ft | 3.21 ft | 383 |



# Vigor Distribution of Private Trees

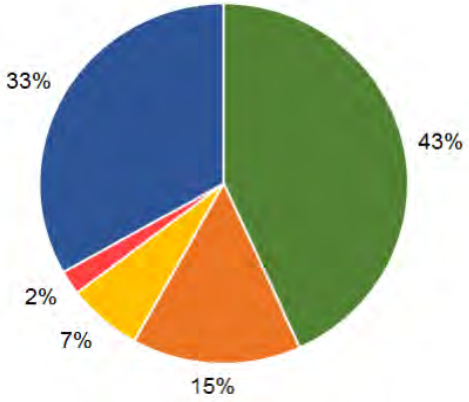


# Private Residential Trees

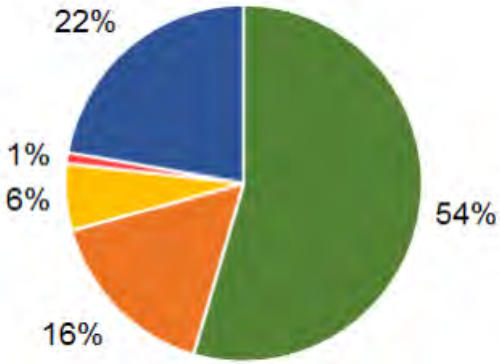

There is no significant difference between Single and Multi-family properties

# Private Non-Residential Trees

| All (n=258) | | Subsample Controlling for Bias |
|---|---|---|
| 60% Alive | Vigor | 67% Alive |




- Healthy
- Slightly Unhealthy
- Moderately Unhealthy
- Severely Unhealthy
- Dead




No significant difference in DBH

# Private Trees Holyoke

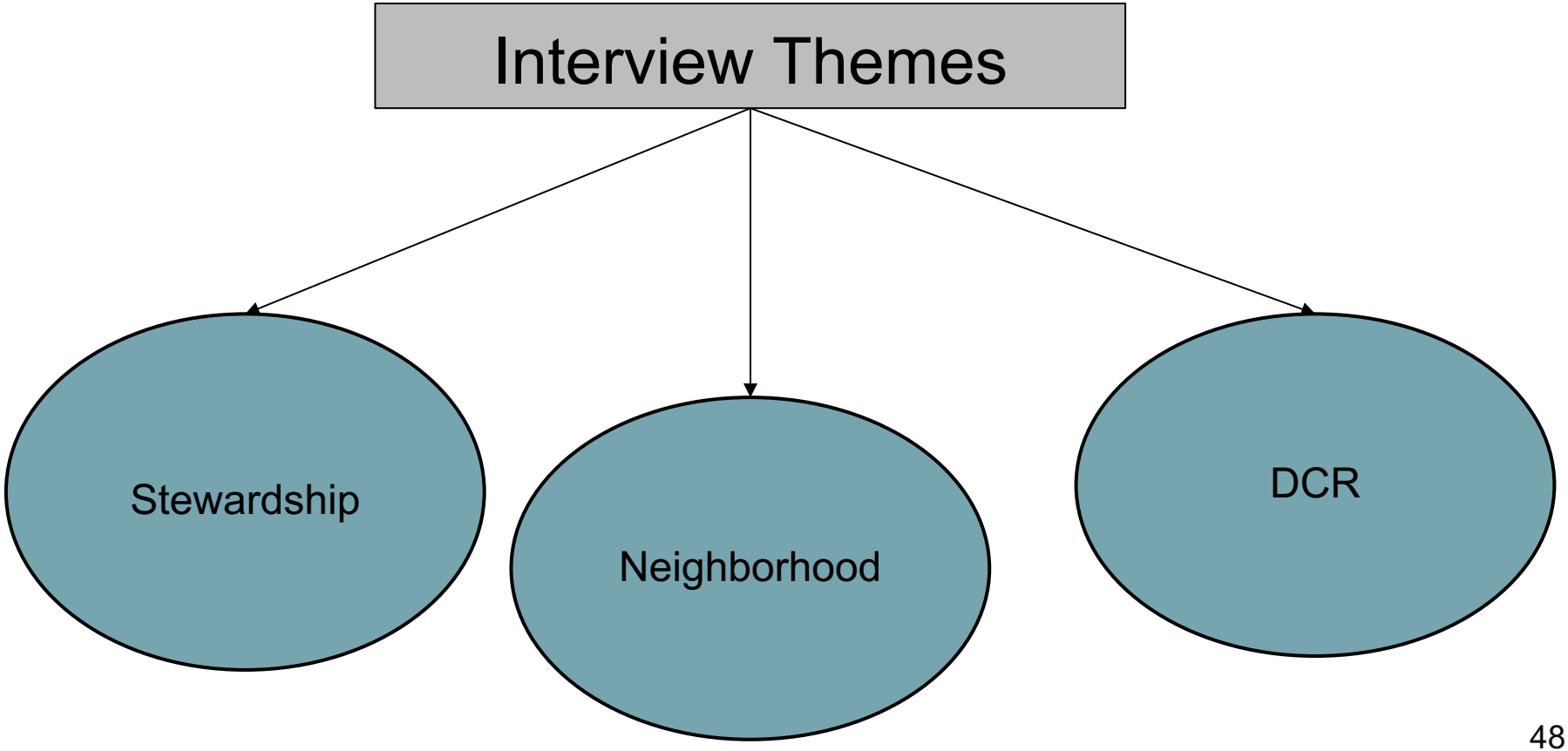
| %Alive | Vigor | DBH | Width | Height | N |
|---|---|---|---|---|---|
| 64 | 2.53 | 0.99 in | 2.84 ft | 7.7 ft | 327 |

- One third of Holyoke's private trees are on just two properties
- Without them: 75% Alive, Vigor 1.98, DBH is the same

# Private Trees Chelsea

| %Alive | Vigor | DBH | Width | Height | N |
|---|---|---|---|---|---|
| 82 | 1.72 | 1.57 in | 5.8 ft | 10.2 ft | 57 |

There is no significant difference between cities within residential trees

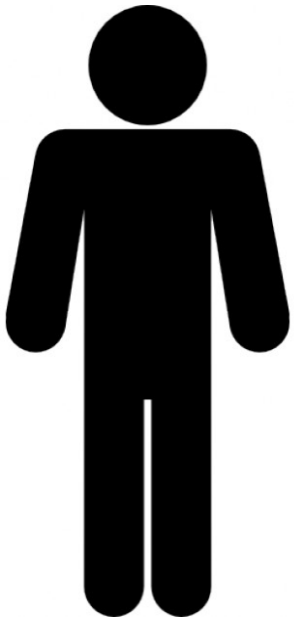

Interview Themes
Stewardship
Neighborhood
DCR

# Demographics

50% female

**Ethnicity/Race:**
67% white
16.5% American Indian/Alaska Native 16.5% Hispanic/Latino
**Language(s):**
English
**Age**
>45 years old
**Educational Attainment:**
33% Trade/Technical Schooling
16.6% Some College
16.6% Associate Degree
16.6% Bachelor's Degree
16.6% Master's Degree

50% male



**Total Participants: 8**
(6 responded to demographic survey)

# How did residents find out about the program?

## Flyers & Mailings (6)

"They came around with flyers, I believe it was about the Chelsea planting program. I said sure, I'll have a couple."

"I received a notice in the mail, it came with my water bill I believe."

## Neighbor Networking (3)

"I called my neighbors and they got some too."

"When they put the trees here, my neighbors requested some as well."

HERO Eli Baldwin in the field.

# What motivates residents to participate?

## Aesthetics (4)

"I figured it was a nice way to make the yard and everything more beautiful."

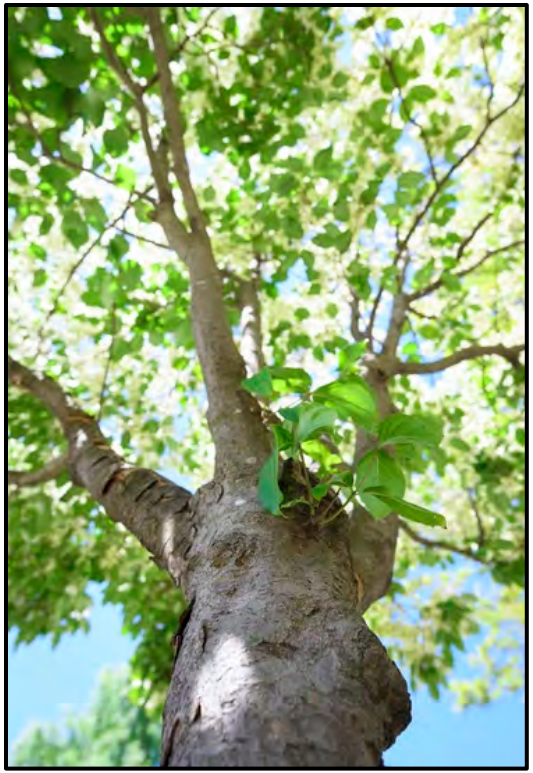
"It makes the property look so much nicer with the greenery around."

## Ecosystem services (4)

"We get fresh air and it's nice and cool here. Over there it's really hot and you never see anyone in the yard because there aren't trees."

"To add to the yard, and the shade in the future."

"I like to make my yard as close to nature as I can, I like the birds and the habitat and they're good for the environment."



# How was their experience with the DCR?

DCR foresters in the field

## Receiving Information (5)

"They told me how to take care of them, give them so much water a week and stuff like that."

"I did not even think to call them."

"If I had a question about a tree, I would go on the internet."

## General Comments (4)

"You people work hard and are very dedicated, everybody was very positive."

"You don't think about it that much until you're actually sitting down talking with someone about it. That's what I think helps a lot- **someone** coming down and talking to you about it."

# How does it help their community?

"I hope it cleans the air."

"It's really pretty, it makes a big difference in the city, going down the street and seeing all the trees."

"I've lived in Chelsea my whole life and I can say there are a lot more trees."

"It's good, but it (the planting program) needs more attention and awareness."

DCR & DPW tree planting in Chelsea

# How did the residents care for their trees?

"I was watering the tree every other day."

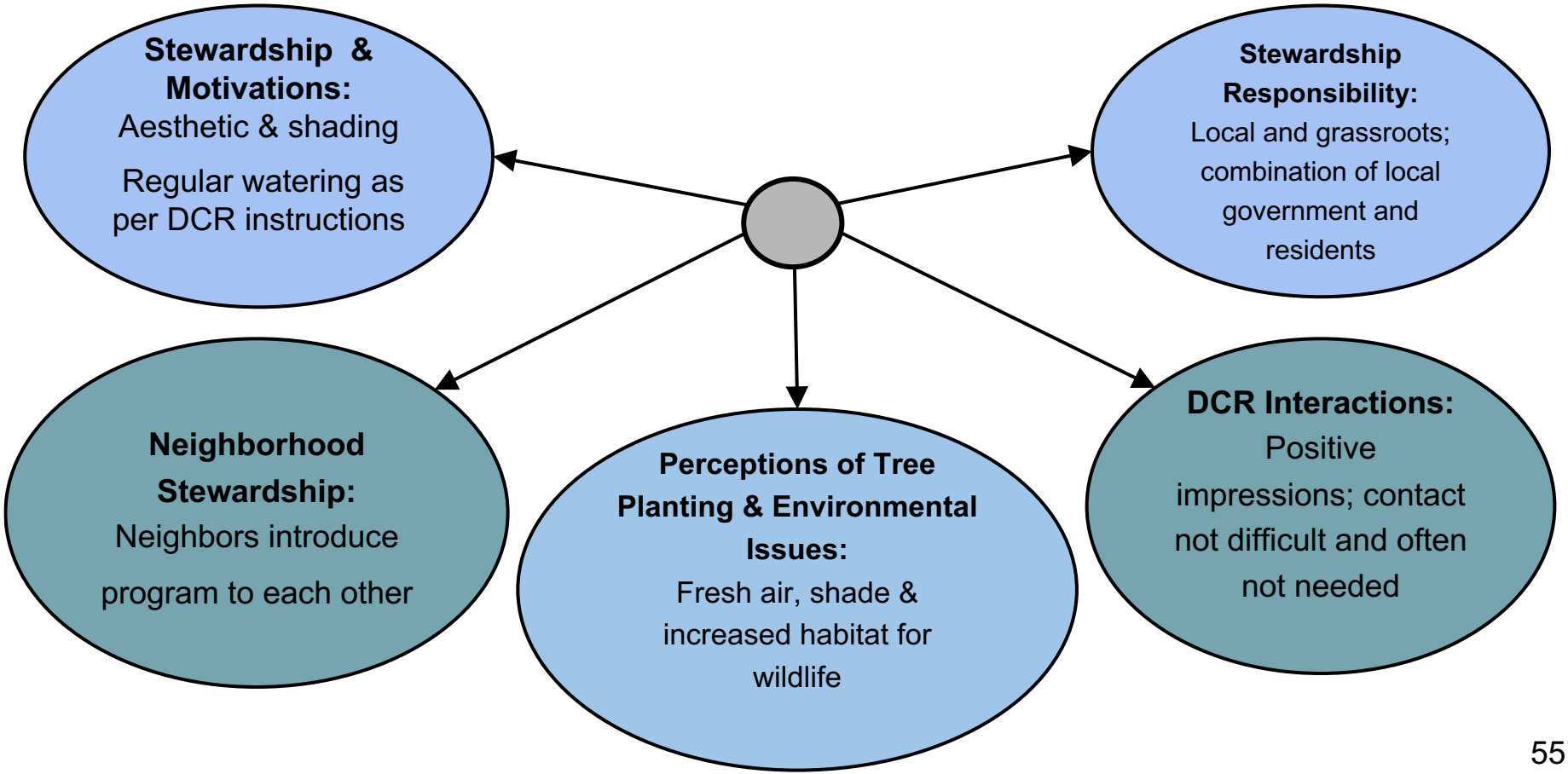
"In fact, I'm watering the ones they planted outside on the sidewalk also."

"My brother was the one who watered them and everything."

"If it's in the yard, it should be the owner."

Examples of Resident Tree Care

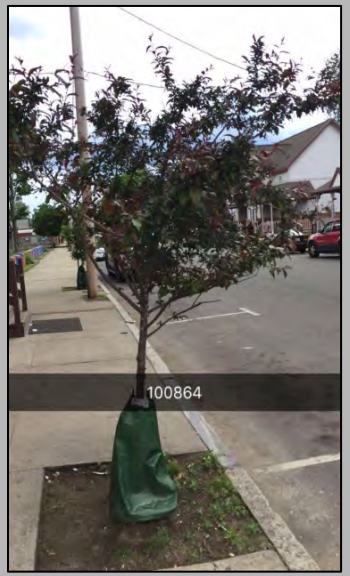
# Interview Themes



# Take-Aways: Species Performance

## Frequently Planted ✓

**Crabapples** & **Honey Locusts** performed well




## Frequently Planted ✗

**Dogwoods** & **Tulip Trees** performed poorly

## Canopy Coverage

Of the top performing trees **Cherry**, **Honey Locust** & **Crabapple** provide the largest canopy cover

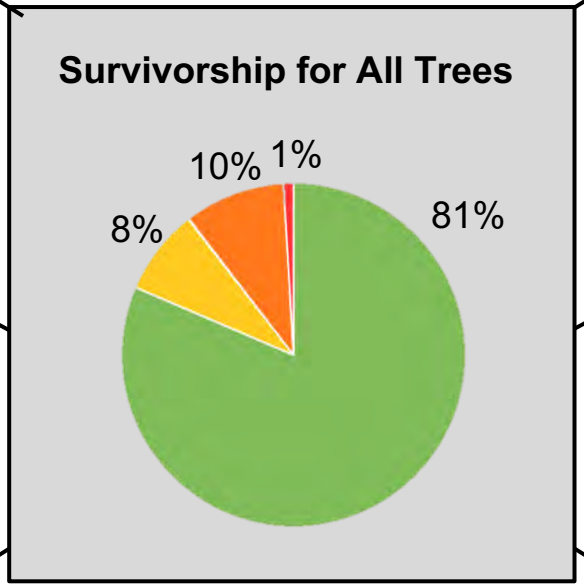
## Across All Cities

**Honey Locust** performed the best across all three cities and provides the most canopy cover

# Take-Aways: Other Trends

Housing type was not significant in survivorship of private trees.

Front yard trees perform better than backyard trees.




Street trees performed better than private trees.

Maintained parks and other maintained areas performed poorly compared to other land uses.

Private, non-residential trees had lower survivorship than private residential and street trees.

Street trees on institutional land use had high mortality though surviving trees had higher vigor than trees on other land uses.

# Future Research and Policy Suggestions

## 1. Understand factors related to tree health and survivorship

- Continue surveying trees to monitor growth patterns and stewardship
- Model the ecosystem services that the future canopies will provide
- Investigate the effects of soil composition & shading on tree health


## 2. Understand the contribution and experience of residents and stakeholders

- Conduct more interviews to get a more demographically representative sample
- Identify communication gaps in tree stewardship with maintainers & landscape companies
- Understand why people choose not to participate in the program and how to strengthen partnerships with local grassroots organizations

# Acknowledgements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CLARK UNIVERSITY

The HERO Team at Dodge Park

Thank you.