

# Socio-Environmental Science Investigations that Support NGSS Teaching and Learning

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# Socio-Environmental Science Investigations (SESI)

- Inquiry-based investigations
- Map-based mobile data collection
- Analysis with Web-based mapping software
- Pedagogical frameworks of place-based education and socio-scientific investigations
- Local issues
- Field work in the local setting

# Context

- 9<sup>th</sup> grade students (and teachers) - urban public school
- All economically disadvantaged
- 2/3 Hispanic or Latino
- 21% ELL, 19% IEPs
- Many (~10-20%) are reluctant learners
  - Unmotivated to learn
  - Do not complete tasks
  - Avoid challenging work

## GEOSPATIAL THINKING AND REASONING

Investigative  
Questions



Geospatial  
Data  
Visualizations



Geospatial  
Data  
Analysis



Constructing  
Explanations



Arguments  
and  
Claims

### **Geospatial Science Technological Pedagogical Content Knowledge**

- Interactions between geospatial technology and pedagogical content knowledge to produce effective environmental science teaching and student learning.
- Modeling geospatial data exploration and analysis techniques.
- Scaffolding students' geospatial thinking and analysis skills.

### **Earth and Environmental Science Content**

- Human-Environment Interactions: Know and apply geographic information about relationships between nature and society.
- Physical Geography: Know and apply geographic information about processes shaping the structure of the Earth's surface, physical landscapes, natural hazards, weather, climate, and atmospheric processes.

### **Social Studies Content**

- Human-Environment Interaction: Place, Regions, and Culture
- Human Population: Spatial Patterns and Movements

### **Geospatial Science and Analysis Skills**

- Use GIS to manage, display, query, and analyze geospatial data.
- Use geospatial analysis to process geospatial data for the purpose of making calculations and inferences about space, geospatial patterns, and geospatial relationships.
- Use geospatial data analysis in which geospatial relationships such as distance, direction, and topologic relationships (e.g. adjacency, connectivity, and overlap) are particularly relevant.
- Use inductive and deductive reasoning to analyze, synthesize, compare, and interpret information.
- Use logic and reasoning to identify strengths and weaknesses of alternative solutions, conclusions, or approaches to problems.

# Prototype SESI Investigations (Spring 2017)

- **Urban Heat Islands**  
Students investigate the school property to identify different types of ground surface heat radiation.
- **Trees and Ecological Services**  
Students identify trees and explore the environmental and societal benefits that trees provide in their city. They also investigate the relationship among trees and crime in their city.
- **Zoning and Me**  
Identify land use zones and compare to the official city zoning map





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Collect a new feature


Filter


Temperature Observation

8B Urban Heat Island Observations







**Location**  
No valid Location

**Temperature Observation: grass**

Surface Type  
grass

Surface Shade  
no shade

Surface Condition  
dry

Surface Temperature Degree C

Weather Condition  
clear

Air Temperature Degree C

Notes



# Urban Heat Islands: How do surface properties affect heat?

Home ▾ All UHI Classroom Map

New Map ▾ Alec ▾

Details Add Basemap Analysis

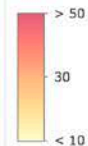
Save Share Print Directions Measure Bookmarks Find address or place

About Content Legend

Legend

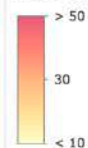
8B Urban Heat Island Observations

Surface Temperature Degree C



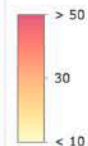
8A Urban Heat Island Observations

Surface Temperature Degree C



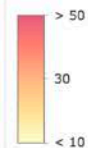
3B Urban Heat Island Observations

Surface Temperature Degree C



3A Urban Heat Island Observations

Surface Temperature Degree C



2B Urban Heat Island Observations







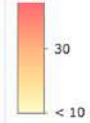
### Temperature Observation: grass

Surface Type	grass
Surface Shade	no shade
Surface Condition	dry
Surface Temperature Degree C	34.30
Weather Condition	
Air Temperature Degree C	
Notes	A bunch of leaf litter
created_user	115231_B21
created_date	April 11, 2017
last_edited_user	115231_B21

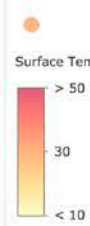
[Zoom to](#) [Get Directions](#)



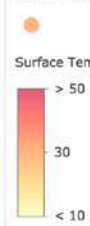
### Legend



### 2B Urban Heat Island Observations



### 2A Urban Heat Island Observations



### UHI\_Classroom\_Areas



### Land Cover

#### Allentown Land Cover

- Water
- Wetlands
- Tree Canopy
- Scrub Shrub
- Low Vegetation
- Barren
- Structure
- Other Impervious Surface
- Roads
- Tree Canopy over Structure
- Tree Canopy over Other Impervious Surface
- Tree Canopy over Roads

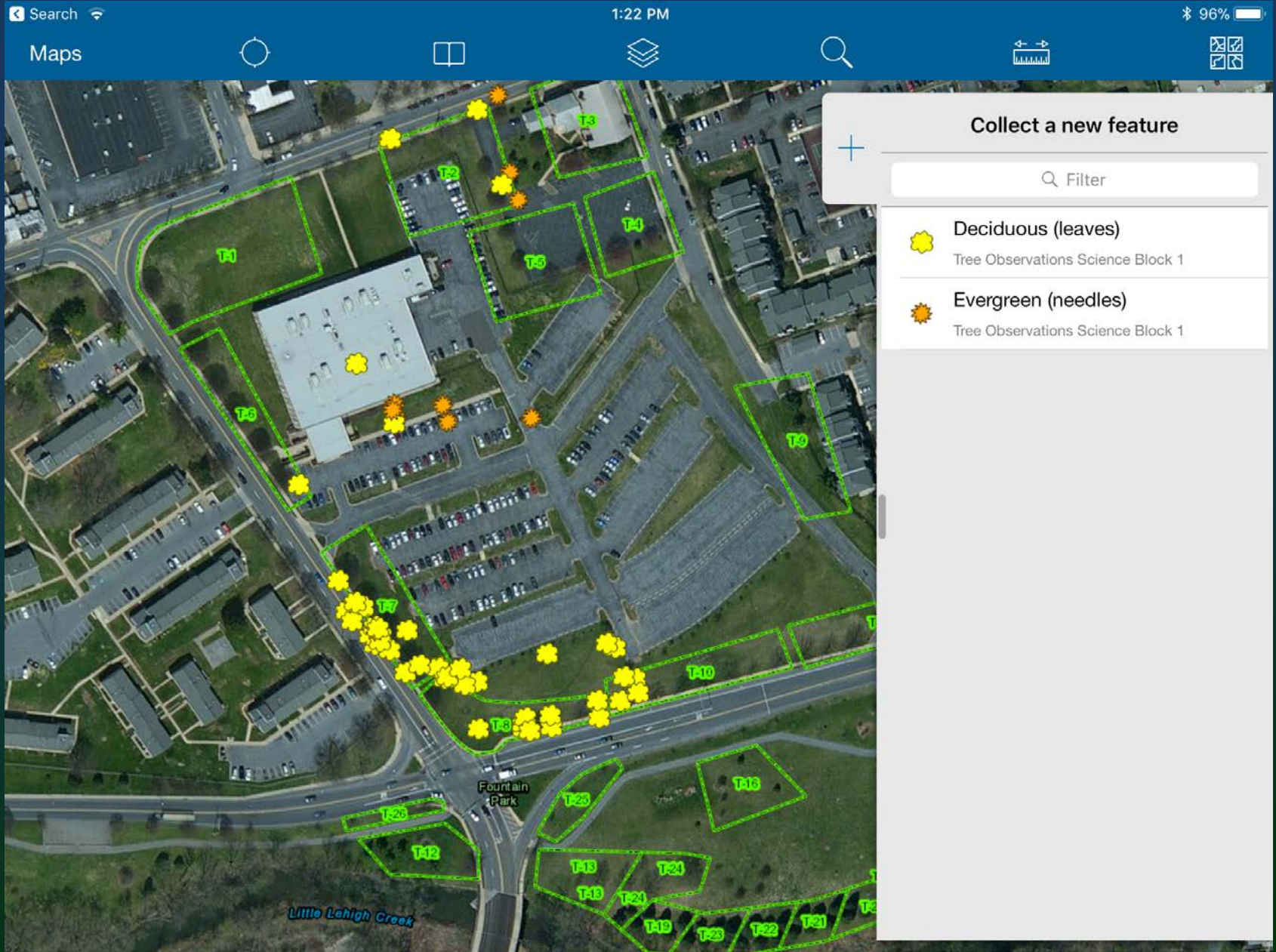




# Artifact – Assigned City Area

- Estimate the amount of each land cover type
- Map drawing - reduce the urban heat island effect
- Articulate changes to reduce the urban heat island effect


# Trees and Ecological Services







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Location

No valid Location

Tree Observations:

Tree Type

1

Genus and Species

Common Name

Origin

native

Height meters

Circumference cm

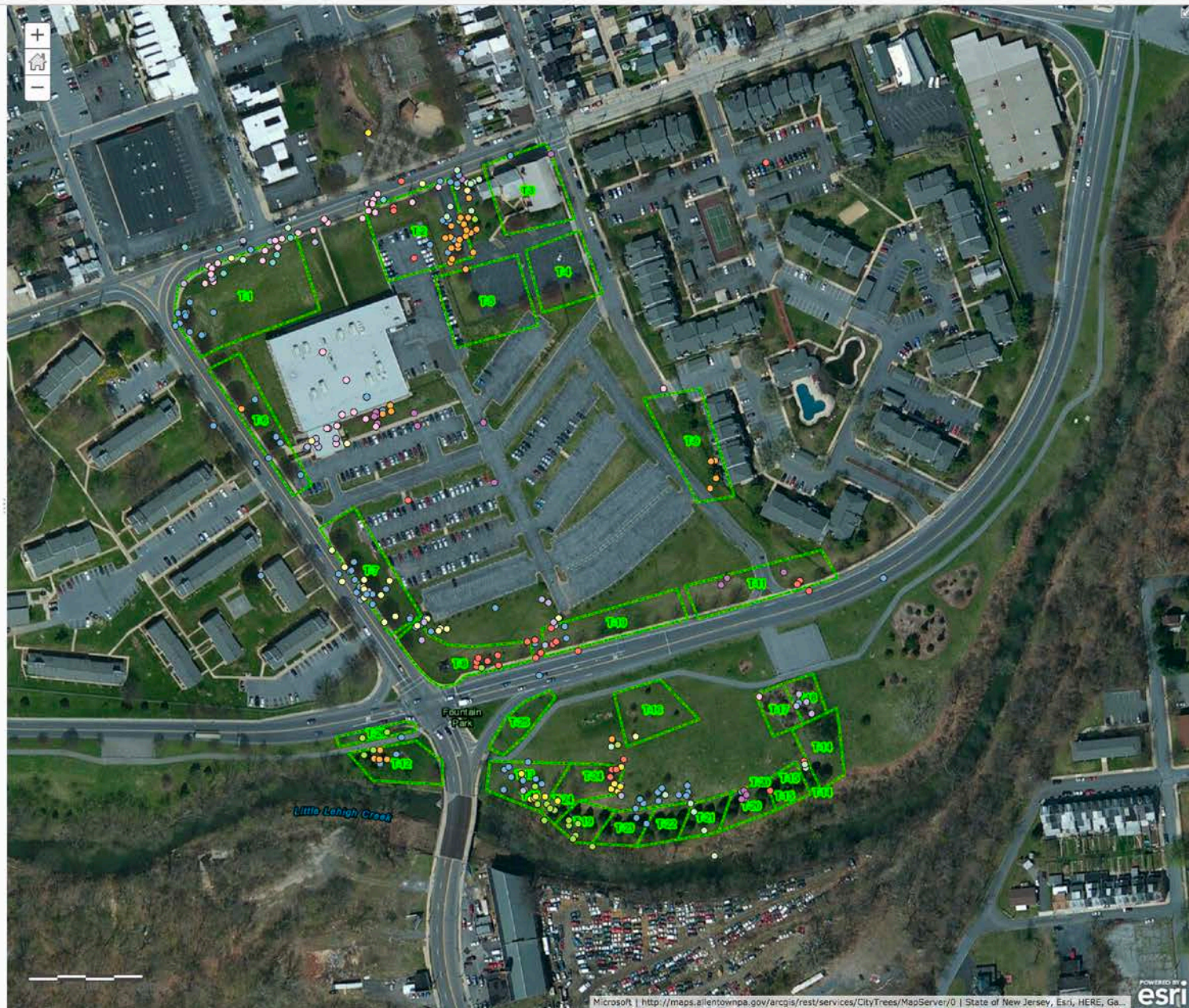
Notes or Observations



[Details](#) [Add ▾](#) [Basemap](#) [Analysis](#)[Save ▾](#) [Share](#) [Print ▾](#) [Directions](#) [Measure](#) [Bookmarks](#) [About](#) [Content](#) [Legend](#)

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- ☒ Ecological Services Areas
  -
- ☐ Allentown City Trees
- ☐ Allentown City Tree Density
- ☐ Allentown Percent Canopy Cover
- ☐ Allentown Property Crime
- ☐ Allentown Personal Crime
- ☒ Tree Observation Areas
- ☐ Tree Canopy
- ☐ 2016 USA Population Density
- ☒ Imagery with Labels







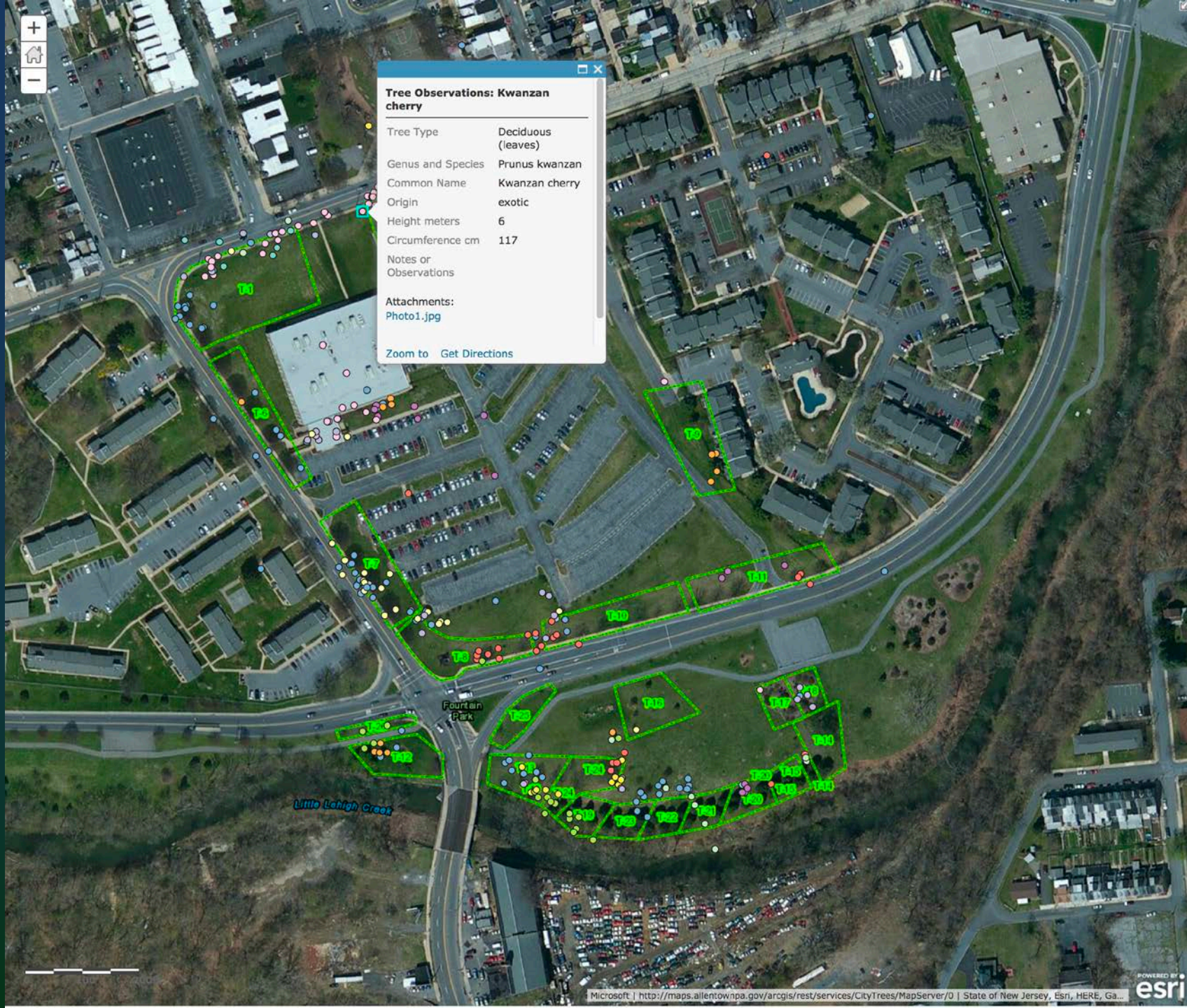
**Tree Observations: Kwanzan cherry**

Tree Type	Deciduous (leaves)
Genus and Species	Prunus kwanzan
Common Name	Kwanzan cherry
Origin	exotic
Height meters	6
Circumference cm	117
Notes or Observations	

**Attachments:**

Photo1.jpg

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# Percent Canopy

Home ▾ Prototype Eco Services Classroom Map

New Map ▾  Alec

Details Add Basemap Analysis

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Legend

Prototype Eco Services Observations











- Deciduous (leaves)
- Evergreen (needles)

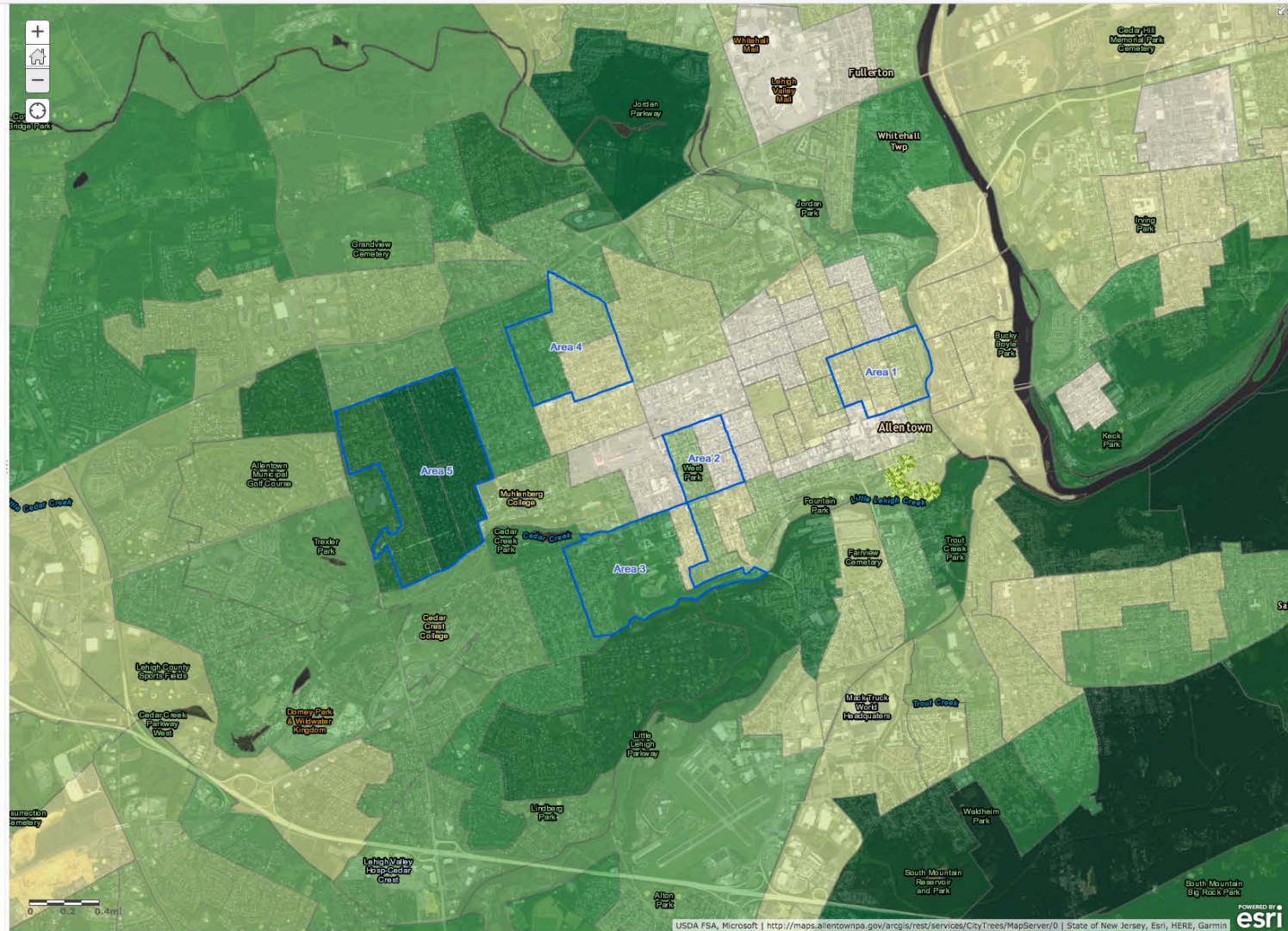
### Ecological Services Areas



### Allentown Percent Canopy Cover

Percent Canopy Cover

 > 71.8 to 88  
 > 59.9 to 71.8  
 > 49.5 to 59.9  
 > 42 to 49.5  
 > 35.5 to 42  
 > 29.6 to 35.5  
 > 24.2 to 29.6  
 > 18.6 to 24.2  
 > 12.6 to 18.6  
 4.8 to 12.6





# Personal and Property Crime

Home ▾ Prototype Eco Services Classroom Map

New Map ▾ Alec ▾

Details Add ▾ Basemap Analysis

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☒ Prototype Eco Services Observations

☒ Ecological Services Areas

☐ Allentown City Trees

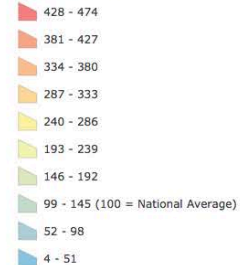
☐ Allentown City Tree Density

☐ Allentown Percent Canopy Cover

☐ Allentown Property Crime

☒ Allentown Personal Crime

### Personal Crime Index



☐ Tree Canopy

☐ 2016 USA Population Density

☐ Imagery with Labels

Total Crime Index	14
Personal Crime Index	19
Murder Index	33
Rape Index	82
Robbery Index	31
Assault Index	3
Property Crime Index	14
Burglary Index	17
Larceny Index	14
Motor Vehicle Theft Index	4
Total Canopy	455,573
Percent Canopy Cover	54.30

Zoom to Get Directions



# Personal and Property crime and % tree canopy

Home ▾ Prototype Eco Services Classroom Map

New Map ▾ Alec ▾

Details Add ▾ Basemap Analysis

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## Legend

### Prototype Eco Services Observations

- Deciduous (leaves)
- Evergreen (needles)

### Ecological Services Areas



### Allentown Percent Canopy Cover

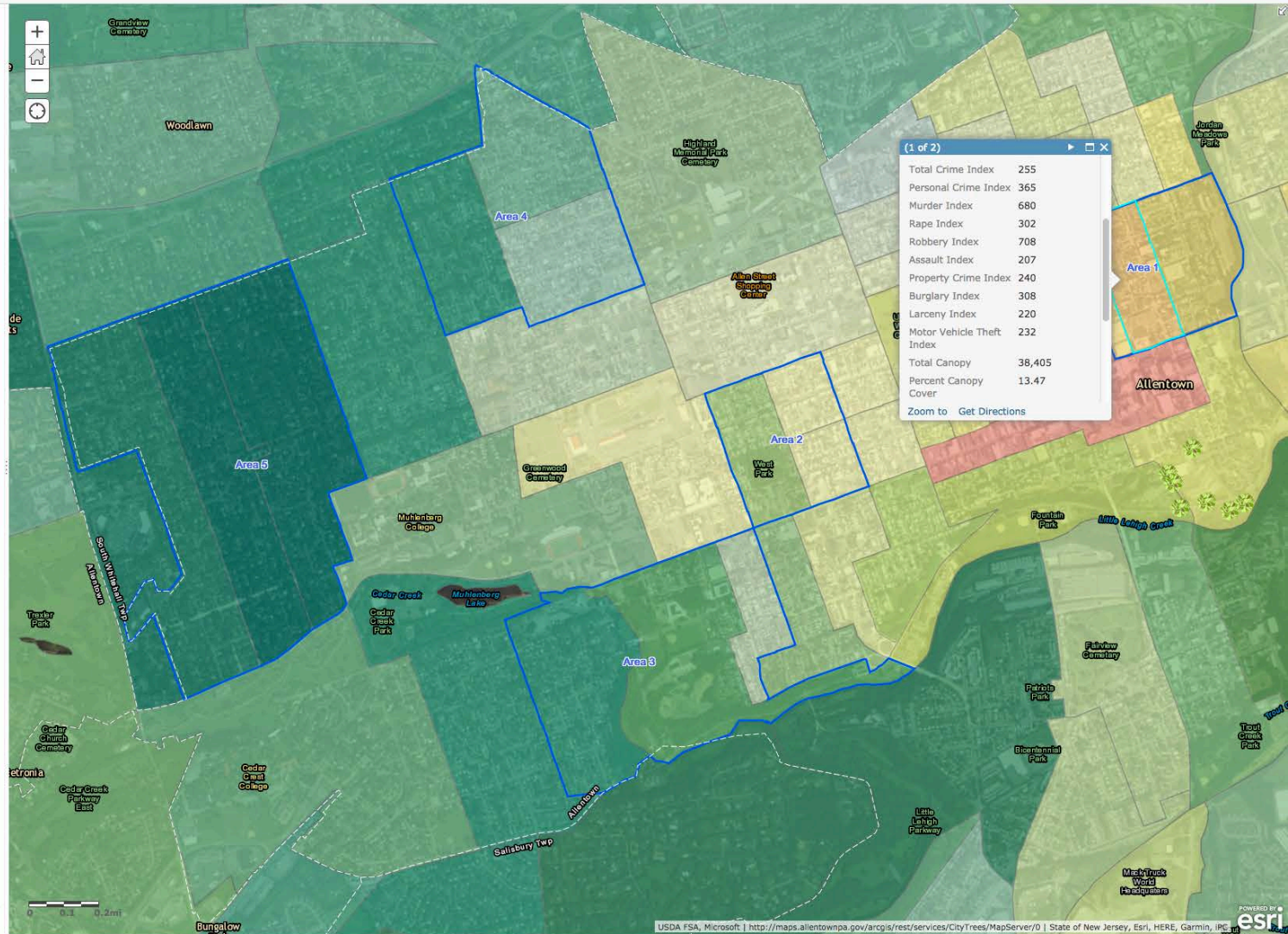
#### Percent Canopy Cover

- > 71.8 to 88
- > 59.9 to 71.8
- > 49.5 to 59.9
- > 42 to 49.5
- > 35.5 to 42
- > 29.6 to 35.5
- > 24.2 to 29.6
- > 18.6 to 24.2
- > 12.6 to 18.6
- 4.8 to 12.6

### Allentown Personal Crime

#### Personal Crime Index

- 428 - 474
- 381 - 427
- 334 - 380
- 287 - 333
- 240 - 286
- 193 - 239
- 146 - 192
- 99 - 145 (100 = National Average)
- 52 - 98
- 4 - 51





# Analysis – Local Neighborhood

- Estimate the amount of trees
- Compare tree canopy to other city areas
- How would you improve your neighborhood to get more value out of trees? What benefit would be most important to your neighborhood?

# Some Findings

- Strong growth in teacher's G-TPACK (see poster T124)
- Effective modeling to guide students' GIS analysis
- Additional skill building activities needed – 2 scavenger hunts during first weeks of school
- Interfaces, visualizations, and scaffolding are effective with all students