

FORESTS IN CITIES

COOLING STUDY

Methods document for study question 1:

Do cooling benefits vary across land cover types?



Concept: Clara Pregitzer & Crystal Crown
Design & Documentation: Crystal Crown
Review: Helen Forgione, Grace Muset & Brittany Wienke
Finalized: 4/5/2022

Table of Contents

Click section name to jump to section

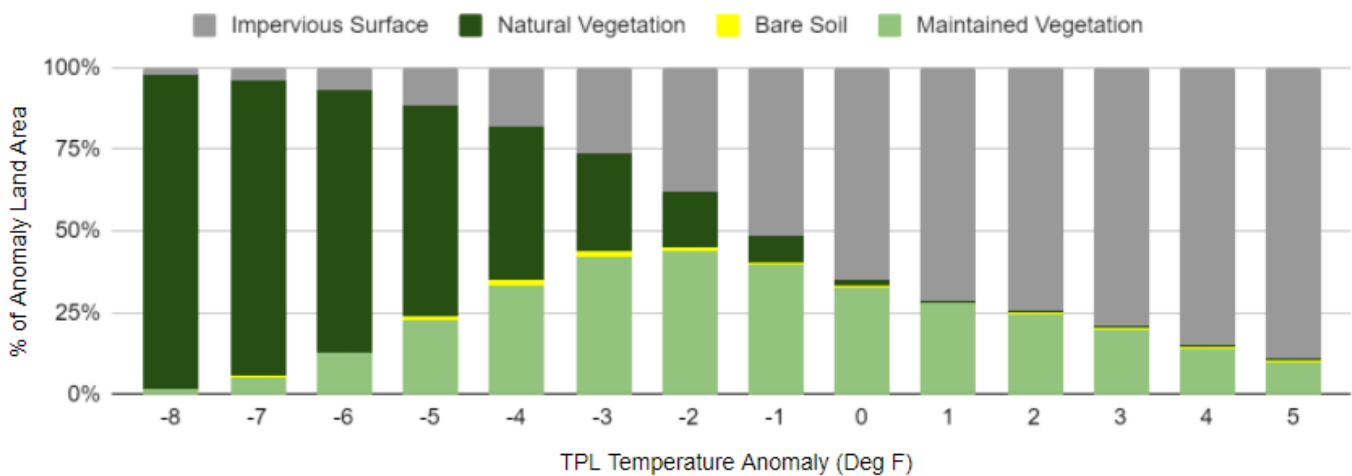
Project background	2
Section 1: General site guidelines	3
Section 2: Cover type definitions	4
Section 3: How to access the digitization web app	5
<i>Web app home screen contents</i>	6
Section 4a: How to digitize sites	7
Section 4b: How to alter existing sites	8
Appendix 1: AGOL account specifics	9
Appendix 2: Data dictionary	10

Project background

The summer of 2021 was the hottest on record in the contiguous U.S. Cities across the country faced heatwaves, and the impacts of extreme heat and urban heat islands on social well-being became more clear. Extreme heat is now the leading cause of weather-related deaths in the United States, with urban areas documented as 2-10 degrees (F) warmer than rural locations. Increasing urban tree canopy cover and planting trees within municipal boundaries are associated with multiple positive outcomes including reducing urban heat islands. However, the magnitude of these benefits have not been well-documented or described across different types of urban tree canopy, such as between natural areas or street trees.

In winter 2021-22, the Natural Areas Conservancy conducted preliminary analysis utilizing existing datasets to explore the cooling benefits of natural areas across New York City. One portion of this analysis compared land cover classifications from the NYC Ecological Coverture Map to the Trust for Public Land’s (TPL) land surface temperature anomaly data to quantify differences in surface temperature anomaly across land cover types. The results showed a statistically significant difference in land surface temperature anomaly across land cover types.

Visualization of the temperature anomaly data by the proportion of broad land cover types (below) demonstrates as overall vegetation presence decreases the temperature anomaly increases, and further, larger proportions of natural area cover are associated with the coolest land cover temperatures.



To expand on this research, we are asking FiC member cities to provide site shape data for a range of cover types across their city.

Section 1: General site guidelines

The way we will quantify differences in the cooling potential between urban cover types is by comparing the temperature anomaly across locations digitized and categorized by participating teams. This section describes the criteria for selecting locations for inclusion.

1. Each site should be a single continuous area and not overlap any other site.
2. Quantity and Stratification: A minimum of 30+ sites across three main cover type categories (natural/maintained/built), with a minimum of 10 per cover type. See section 2 for the full list of cover types, their categorization, and definitions. No maximum, more sites are preferable.
 - *Under this configuration, the minimum site submission would be 10 built, 10 of one of the maintained vegetation cover types (e.g. maintained lawn/ trees), and 10 of one of the natural vegetation cover types (e.g. upland forest). Each additional cover type requires a minimum of 10 additional sites within a city.*
The more sites the better!
3. Site Size and Dimensions: Minimum size of 1 acre, no maximum. All sites should have a minimum width of 60m, no maximum.
4. Determining the cover type and site extent: Seek out areas that you know for certain are a specific cover type. Sites are not required to be areas managed by the city team, but the cover type should be known.
 - For Vegetated Areas (both natural and landscaped): Draw full patches of a cover type when possible rather than cutting off a cover type in the middle. Each polygon should represent the full, contiguous area of a cover type, with edges representing the area of transition between cover types. By this definition, trails going through natural areas would not demarcate edges unless the trail itself was the dividing line between cover types. Additionally, transitions in jurisdiction also do not represent edges.
 - For Built Areas: Unlike areas of vegetation, built areas may be difficult to demarcate as sites, since in most cities built areas make up the majority of area. In this case, we recommend utilizing individual properties. For example, a college or hospital campus, an airport, a stadium, group of apartment buildings, or a parking lot could all be eligible as long as they are $\geq 75\%$ built.
5. Site Submission: Sites may be submitted by:
 - Digitizing them in a Web App (Sections 3 & 4a).
 - Multiple users can digitize sites per team.
 - Submitting a shapefile for loading into the main dataset, and then editing the attributes for several variables (Sections 3 & 4b). If you would like to submit a shapefile of previously created sites, please ensure they fit the above criteria, then email the zipped shapefile to Crystal and she will let you know once they're loaded, after which you can update the attribute table.
 - There is also an in-field site creation method if required - if this interests you please reach out to Clara and Crystal.

Section 2: Cover type definitions

Categories and definitions of the cover types to be assigned to polygons delineated for temperature anomaly analysis:

1. NATURAL VEGETATION (*native or invasive*)

- Upland Forest: Tree dominated, closed canopy communities on soils that are well-drained and never regularly flooded; or on soils that are usually well-drained and not hydric, and lack predominantly wetland vegetation. Site is usually not within or adjacent to a wetland. Canopy cover >75%. Contains structural understory layers that can include herbaceous and shrub species.

Subtypes:

- Coniferous Dominated
- Deciduous Dominated

- Upland Woodland: Tree dominated communities on soils that are well-drained and never regularly flooded; or on soils that are usually well-drained and not hydric, and lack predominantly wetland vegetation. Site is usually not within or adjacent to a wetland. Canopy cover 51-75%. Contains structural understory layers that can include herbaceous and shrub species. Canopy.

Subtypes:

- Coniferous Dominated
- Deciduous Dominated

- Savanna¹: Plant communities co-dominated by woody and herbaceous species, where the woody canopy is open enough to support herbaceous species requiring high light levels. The woody stems that form the canopy may be isolated or clustered. The herbaceous component may occur as a matrix, as patches in a woody matrix, or an intermediate state. Canopy covers 10-50%².

Subtypes:

- Tree Dominated
- Shrub Dominated

- Upland Shrubland: Shrubs are dominant in the overstory and/or midstory and/or understory. Site dominated by shrubs (>50% cover). Trees are absent from the site OR cover <25%.
- Forested Wetland: A forested wetland (PFO) or swamp is a closed-canopy tree-dominated vegetation type adapted to tolerate flooded conditions, where the soil is saturated or flooded for some or all of the growing season.
- Freshwater Wetland: Palustrine sites dominated by shrubs or herbaceous plants (PSS & PEM). Wetland communities that are permanently saturated by seepage, permanently flooded wetlands, and wetlands that are seasonally or intermittently flooded (these may be seasonally dry). Sites can be within or adjacent to a mapped or unmapped wetland.
- Tidal Wetland: Saltmarshes and other estuarine wetlands of the intertidal zone, located between the highest tide level and the lowest tide level where the substrate is periodically exposed and flooded by semidiurnal tides (two high tides and two low tides per tidal day). Habitat is dominated by a mixture of native and invasive grasses and graminoids.

¹ Definition modified from https://www.uvm.edu/~bbeckage/Manuscripts/savanna_Book_Ch%205.pdf

² Canopy range from https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_010804.pdf

- Open Upland: Open uplands dominated by grasses, graminoids, forbs, or vines, with occasional scattered shrubs. Trees are absent from the site OR trees cover <10% of the site.
- Mangrove Swamp: Brackish to saline coastal wetlands dominated by mangrove trees and other halophytic vegetation. Found in tropical and subtropical regions.

2. LANDSCAPED VEGETATION

- Maintained Lawn w/ Trees: Highly-manipulated, landscaped areas dominated by cultivated (usually cool season) turf grasses. Cemeteries could be included in this cover type. No canopy cover constraints.
- Mowed Lawn: Open canopy, highly-manipulated, landscaped areas dominated by cultivated (usually cool season) turf grasses. Trees are absent from the site.

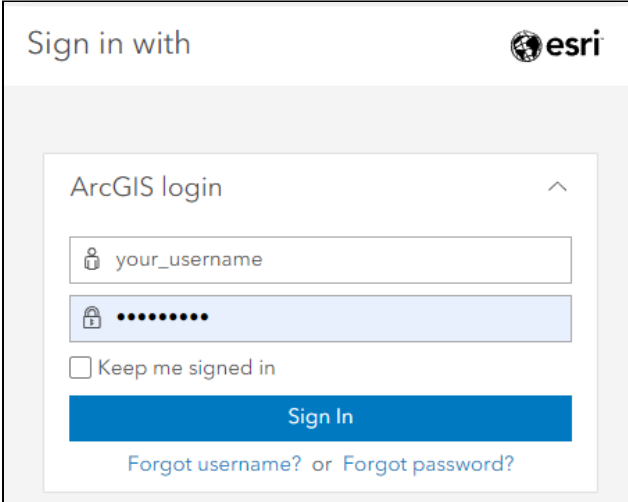
3. BUILT

- Paved/Built: Areas dominated ($\geq 75\%$) by built/impermeable surfaces such as pavement and buildings.

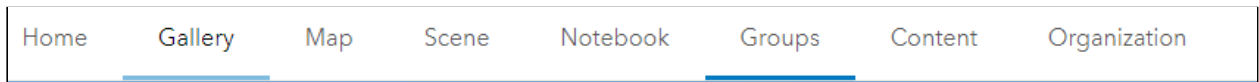
Section 3: How to access the digitization web app

Site creation and editing of attributes will happen via the Web App, which is accessible in ArcGIS Online (AGOL). To access the Web App:

- Login to AGOL by navigating to www.arcgis.com and entering your username and password:



- Click on the *Groups* heading:



- Click on the *FiC Cooling Study* group icon:



Username entered into the Google form will be given access if they meet the username criteria – see [Appendix 1](#). If there are usernames that need access that were not submitted via the Google form please email them directly to Crystal.

- Click on the *Cooling Study Web Application* icon:



Web app home screen contents



Section 4a: How to digitize sites


To create new sites in the web app, following these steps:

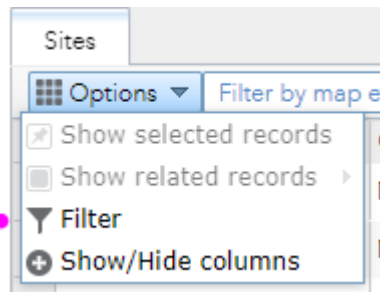
1. **Navigate** to the location where you'd like to draw your site - you can do this by panning, zooming, and/or using the search bar.
2. **Assess** eligibility for temperature anomaly analysis by clicking the Layers icon  and turning on the Full Range Heat Anomalies layer by clicking the check box  next to it.
 - If your site overlaps with the heat anomaly dataset extent proceed to the next step
 - If your site does not overlap with the heat anomaly dataset, please select a new location that overlaps with this dataset.
3. **Declutter** your view to begin drawing your site by toggling off the Full Range Heat Anomalies layer  then closing the layer window.
4. **Measure** the dimensions of the proposed site by clicking the Measure icon  and measuring the area in acres  | Acres ▾ and the width of the site in meters  | Meters ▾ .
 - If the area is smaller than one acre or the width is narrower than 60m, please find a new location.
 - If the area is ≥ 1 acre and wider than 60m proceed to step 5.
 - *Note: that if one portion of a large area is narrower than 60m that is okay as long as the average width is ≥ 60 m. The goal of this constraint is to ensure that the sites can be accurately analyzed for temperature anomaly, as the temperature anomaly dataset has a gridcell size of 30m.*
5. **Close** the Measure window.
6. **Open the edit window** by clicking the Edit icon .
7. **Digitize** your site by selecting the appropriate template (Cover type) from the window that pops up, and clicking the map at one portion of the site boundary to start drawing. Continue clicking around the site boundary to digitize the site extent. Once you're done double click to complete the polygon.
 - If the resultant polygon is inaccurate you can click the Delete button  to delete the polygon and start over.
8. **Fill in the attribute data** for the site in the fields that are presented in the pop-up window.
 - See **Appendix 2** for the data dictionary and instructions.
9. Click 'Close'  to save information.



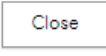
Section 4b: How to alter existing sites

To alter the attributes of previously created sites (including sites that were loaded from a shapefile) follow the steps below:

Option 1: Identifying sites by name

1. **Click** the attribute table icon  to open the attribute table.
2. **Scroll** the table to find your site name.
 - You can also filter the table for your city or other attributes by clicking the 'Options' dropdown, selecting 'Filter' and entering the filter attributes:



3. **Double click** the row to zoom to the polygon on the map.
4. **Click** the shape on the map
5. **Click** the overflow menu  on the attribute pop-up
6. **Select 'Edit'**  Edit
7. Fill in fields
8. **Click 'Close'**  to save.

Option 2: Locating sites spatially

1. **Pan/zoom** the map to find your site
2. Follow **steps 4-8 above**.

Appendix 1: AGOL account specifics

To be added to the FiC Cooling Study ArcGIS Online group, the AGOL username -must:

- ... have [privileges](#) to join groups.
- ...be part of an organizational account.
- ...have a [profile](#) *not* set to private.

If you have any questions about accessing AGOL content, please contact Crystal:
crystal.crown@naturalareasnyc.org

Appendix 2: Data dictionary

Site Variables	
City: The city the site is in.	
App Instructions: Select from dropdown.	
Site ID: The unique ID of the site, to be assigned by the team. Should be 10 characters max, no spaces.	
App Instructions: Free text - type in.	
Cover type: The cover type that best describes the site. See Section 2 for the full list and criteria.	
App Instructions: Select from dropdown list,	
Plant Community: <u>Optional</u> field for users to enter the specific plant community for <i>natural vegetation types</i> .	
App Instructions: Write-in. LANDSAT TM could be a source for this.	
Edge Type: The best descriptor for the edge of the site. Most relevant for vegetated cover types.	
App instructions: Select from dropdown list.	
Value	Description
Hard	Edge is to a hard/built area (>=75%).
Soft	Edge is to a permeable or vegetated area (>=75%).
Mixed	Edge is to mixed permeable-impervious areas.
Canopy Cover: Percent of site that is covered by tree canopy.	
App instructions: Select from dropdown.	
Value	Description
0%	Site has no canopy cover.
1-10%	1 - 10% of the site is covered by canopy.
11-25%	11 - 25% of the site is covered by canopy.
26-50%	26 - 50% of the site is covered by canopy.
51-75%	51 - 75% of the site is covered by canopy.
76-100%	76 - 100% of the site is covered by canopy.
Canopy Cover Source: The source of the canopy cover range entered.	
App instructions: Select from dropdown.	
Value	Description
Measured	Canopy cover value is the result of measurement using LiDAR or other precise method.
Estimated	Canopy cover estimate is based on visual estimate on aerial imagery or in-field.

Notes: Important notes that pertain to the site.

App instructions: Free text. Write in.

Invasive Groundcover: Percent of site covered (2D) by invasive groundcover. *Optional*, and only relevant to natural cover types.

App instructions: Select from dropdown.

Value	Description
0%	Site has no invasive groundcover.
1-10%	1 - 10% of the site is covered by invasive groundcover.
11-25%	11 - 25% of the site is covered by invasive groundcover.
26-50%	26 - 50% of the site is covered by invasive groundcover.
51-75%	51 - 75% of the site is covered by invasive groundcover.
76-100%	76 - 100% of the site is covered by invasive groundcover.

Invasive Groundcover Source: The source of invasive groundcover value provided.

App instructions: Select from dropdown.

Value	Description
Measured	Invasive groundcover value is the result of field measurements.
Estimated	Invasive groundcover value is the result of rough visual estimate.

Example:

