i-Tree for funding opportunities
i-Tree Eco for Monitoring, Forecasting, and Strategic Management

Jason Henning
Krista Heinlin
Phillip Rodbell
Dave Bloniarz
Jay Heppler
Scott Maco
Plan for today

• Intro to i-Tree Eco
• The Philadelphia Story
• 3 example ways to employ i-Tree Eco
  1. i-Tree Eco can be easy
  2. Small and targeted
  3. Expand your view
• Q/A
i-Tree Eco

Convert inventory data (sample or census) to a wealth of tree ecosystem service estimates.

- Educate
- Advocate
- Manage
i-Tree Tool Relationships

**Eco**: Tree/Population Ecosystem Services Calculator

**i-Tree Engine/API**: Individual tree benefits and projections

- MyTree
- Planting
- Design
- Canopy
- Landscape
- OurTrees

**Cover multipliers**: Structure and benefits per unit area of tree cover

i-Tree is a Cooperative Initiative among these partners.
i-Tree model basics: Inventory data → tree benefits?

- City Data
- Pollution Data
- Weather Data
- Species Data (8000+)
- Location Data

- Carbon
- Air Quality
- Hydrology
- Energy
- Volatile Organic Compounds
- Structure
- Value

Field Data

Forecast
The i-Tree Eco Framework

Structure

• Summary of field measurements
• Leaf area
• Condition
• Species distribution
• Diameter distribution

Function

• Air quality improvement
• Energy effects
• Carbon storage & sequestration
• Hydrology effects
• Shade ultraviolet effects (UV)
• Foodscape characteristics - limited species info
• Wildlife suitability – avian focus
• Volatile organic compound VOC
• Leaf nutrients

Value

• Monetary value
• Equivalent values
• Health outcomes
• Cost Benefit analysis
• Summaries for management
Eligible funding activities

<table>
<thead>
<tr>
<th>Eligible Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Foster individuals, groups, and organizations in the communities served to become engaged participants in urban forest planning and management, especially those in disadvantaged communities that do not have adequate resources or are underrepresented.</td>
</tr>
<tr>
<td>• Protect, enhance, and expand equitable urban tree canopy cover to maximize community access to human health, social, ecological, and economic benefits particularly in disadvantaged and nature-deprived communities experiencing low tree canopy, extreme heat, frequent flooding, and poor access to parks and nature.</td>
</tr>
<tr>
<td>• Encourage long-term urban forest planning, assessment, and management.</td>
</tr>
<tr>
<td>• Encourage proactive and systematic maintenance and monitoring of urban trees to improve forest health; assess risk to forest pests, disease, and adverse climate impacts; and formulate adaptive management strategies to improve forest resilience.</td>
</tr>
<tr>
<td>• Advance the use of tree and forest inventories, monitoring, and assessment tools in priority areas.</td>
</tr>
<tr>
<td>• Improve preparation for severe storms and the recovery of damaged or deteriorated landscapes to more healthy and resilient conditions.</td>
</tr>
<tr>
<td>• Protect and enhance watersheds in urban and developing areas with a focus on conserving and managing forest patches, and green stormwater infrastructure.</td>
</tr>
<tr>
<td>• Support the creation and maintenance of green jobs and economic opportunities for planning and sustainably maintaining trees and forests, and producing and using urban forest products.</td>
</tr>
<tr>
<td>• Address exotic invasive pest species that adversely impact urban forests.</td>
</tr>
<tr>
<td>• Work across jurisdictional boundaries, leveraging ideas and resources to increase capacity to provide equitable access to benefits across the larger landscape and at a greater geographic scale.</td>
</tr>
<tr>
<td>• Aid in planning, goal setting, and skill sharing with other professions such as urban planners, engineers, and public health officials.</td>
</tr>
</tbody>
</table>

https://www.fs.usda.gov/managing-land/urban-forests

100% fundable activities in Climate and Economic Justice focus communities
i-Tree Eco: The Philly Story
i-Tree Eco: Citywide results

Table 1.—Summary of city-wide urban forest features, Philadelphia, 2012

<table>
<thead>
<tr>
<th>Feature</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trees*</td>
<td>2,918,000</td>
</tr>
<tr>
<td>Tree cover</td>
<td>20%b</td>
</tr>
<tr>
<td>Most dominant species by:</td>
<td></td>
</tr>
<tr>
<td>Number of trees</td>
<td>spicebush, black cherry, ash species, tree-of-heaven, boxelder</td>
</tr>
<tr>
<td>Leaf area</td>
<td>sycamore species, northern red oak, black walnut, red maple, Norway maple</td>
</tr>
<tr>
<td>Trees 1 to 6 inches d.b.h.</td>
<td>62.2%</td>
</tr>
<tr>
<td>Air temperature reduction&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.3 °F</td>
</tr>
<tr>
<td>Pollution removal</td>
<td>513 tons/year ($19.0 million/year)</td>
</tr>
<tr>
<td>VOC emissions</td>
<td>228 tons/year</td>
</tr>
<tr>
<td>Carbon storage</td>
<td>702,000 tons ($50.0 million)</td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td>27,000 tons/year ($1.9 million/year)</td>
</tr>
<tr>
<td>Value of reduced building energy use</td>
<td>$6.9 million/year</td>
</tr>
<tr>
<td>Value of reduced carbon emissions</td>
<td>$764,000/year</td>
</tr>
<tr>
<td>Compensatory value&lt;sup&gt;d&lt;/sup&gt;</td>
<td>$1.7 billion</td>
</tr>
<tr>
<td>Rainfall interception</td>
<td>81.0 million cubic feet</td>
</tr>
</tbody>
</table>
City owned parkland is **9%** of the city

Trees on city owned parkland account for **40%** of carbon storage and sequestration

<table>
<thead>
<tr>
<th>Feature</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trees</td>
<td>1,100,000</td>
</tr>
<tr>
<td>Tree Cover</td>
<td>64%</td>
</tr>
<tr>
<td>Carbon Storage</td>
<td>273,000 tons ($19.4 million)</td>
</tr>
<tr>
<td>Pollution Removal</td>
<td>179 tons/yr ($6.6 million/yr)</td>
</tr>
</tbody>
</table>
## Ash Trees:
City stands to lose 7.1% of its forest and millions in benefits to emerald ash borer

This table shows the impact of emerald ash borer on the city's ash trees:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Units</th>
<th>% of Total City</th>
<th>Species Group Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>206,996</td>
<td>number</td>
<td>7.1</td>
<td>3</td>
</tr>
<tr>
<td>Density</td>
<td>2.3</td>
<td>trees/acre</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Carbon stored</td>
<td>35,742</td>
<td>tons</td>
<td>5.1</td>
<td>7</td>
</tr>
<tr>
<td>Carbon sequestered</td>
<td>1,025</td>
<td>tons/year</td>
<td>3.8</td>
<td>11</td>
</tr>
<tr>
<td>Net carbon sequestered</td>
<td>935</td>
<td>tons/year</td>
<td>4.0</td>
<td>10</td>
</tr>
<tr>
<td>Leaf area</td>
<td>4,818</td>
<td>acres</td>
<td>5.2</td>
<td>7</td>
</tr>
<tr>
<td>Leaf biomass</td>
<td>1,936</td>
<td>tons</td>
<td>6.3</td>
<td>3</td>
</tr>
<tr>
<td>Trees, diameter 1-3 in.</td>
<td>111,777</td>
<td>number</td>
<td>54.0(^a)</td>
<td>2</td>
</tr>
<tr>
<td>Trees, diameter &gt;18 in.</td>
<td>10,557</td>
<td>number</td>
<td>5.1(^a)</td>
<td>12</td>
</tr>
</tbody>
</table>

\(^a\) Percent of all ash trees
From inventory to strategic planning

### 2030 Canopy Projection

<table>
<thead>
<tr>
<th>Management Unit</th>
<th>2018 Canopy Cover (%)</th>
<th>2030 Canopy Cover Target (%)</th>
<th># Trees to Reach Canopy 2030 Target</th>
<th>Estimated Complete Cost/Tree</th>
<th>Cost to Reach 2030 Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street Trees</td>
<td>10%</td>
<td>17%</td>
<td>142,241</td>
<td>$900</td>
<td>$128,017,000</td>
</tr>
<tr>
<td>Residential Yards</td>
<td>19%</td>
<td>23%</td>
<td>136,162</td>
<td>$100</td>
<td>$13,616,000</td>
</tr>
<tr>
<td>Commercial Industrial</td>
<td>10%</td>
<td>17%</td>
<td>134,251</td>
<td>$500</td>
<td>$67,125,000</td>
</tr>
<tr>
<td>Campuses &amp; Schools</td>
<td>17%</td>
<td>21%</td>
<td>21,675</td>
<td>$800</td>
<td>$17,340,000</td>
</tr>
<tr>
<td>City Facilities</td>
<td>11%</td>
<td>18%</td>
<td>30,863</td>
<td>$800</td>
<td>$24,690,000</td>
</tr>
<tr>
<td>Public Facilities</td>
<td>10%</td>
<td>17%</td>
<td>37,820</td>
<td>$800</td>
<td>$30,256,000</td>
</tr>
</tbody>
</table>

**Total Cost to Reach 2030 Target**

- Tree planting cost subtotal: $281,044,000
- Private development contribution*: $34,902,000
- **Total cost to reach 2030 target**: $246,142,000

### Calculated Benefits

- **400 premature deaths avoided per year** based on the combined health impacts of a tree canopy cover of 30% in Philadelphia.
- **+ 1,000 full time jobs** over the course of 30 years.
- **+$20 million/year in combined environmental benefits** including reduced air pollution, carbon sequestration, reduction in residential energy consumption, and stormwater management.
- **+$50 million/year in captured value from reduced robbery and theft** based on a projected 12% reduction in crime associated with increased tree canopy cover.

### Philly Tree Plan

**Growing Our Urban Forest**

This 30-year investment in trees could have the following benefits:
Impactful and realistic goals

Priority area analysis - SOUTHWEST

This area is characterized by two- or three-story row homes, commercial corridors with surface parking, and large industrial areas.

To achieve the 30% tree canopy goal, strategies must be identified for new tree planting along the streets, in residential yards, and in collaboration with landlords and other commercial or industrial land owners. Opportunities for green corridors that connect the neighborhood to Cobb Creek Park, Bartram's Garden, or other green spaces should be considered.

TOTAL CANOPY

- 2018 tree canopy cover
- 2018 burden tree canopy
- New tree canopy potential
- ≥ 2,500 new trees*

*Does not include all trees missed or under-counted by avg. canopy tool (see cost projection)
Evaluating relative to Climate and Economic Justice

- Non-CEJ has 3 times the species richness
- Non-CEJ has 3.5 times the leaf area per acre
- Trees decrease UV radiation by 45% in non-CEJ, only 16% in CEJ areas
- CEJ 5 most important species Boxelder, Tree of heaven, red maple, arborvitae, mulberry

<table>
<thead>
<tr>
<th></th>
<th>Non-CEJ</th>
<th>CEJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
<td>58,000 ac</td>
<td>32,600 ac</td>
</tr>
<tr>
<td>Trees</td>
<td>88%</td>
<td>12%</td>
</tr>
<tr>
<td>Tree per acre</td>
<td>86</td>
<td>21</td>
</tr>
<tr>
<td>Carbon</td>
<td>86 tons/ac (96%)</td>
<td>6 tons/ac (4%)</td>
</tr>
<tr>
<td>Air pollution</td>
<td>$39.9 million (83%)</td>
<td>$8.15 million (17%)</td>
</tr>
<tr>
<td>Energy</td>
<td>$1.71 million (38%)</td>
<td>$2.83 million (62%)</td>
</tr>
</tbody>
</table>
There is more than one way to i-Tree Eco

1. i-Tree Eco can be easy
2. Small and targeted
3. Expand your view

...and many more
Eco flexible tree data variables

Minimum Required Tree Data

1. Tree species
2. Diameter at breast height (DBH)

Optional but Recommended Tree Data

3. Total tree height
4. Height to live top
5. Height to crown base
6. Crown width (N-S)
7. Crown width (E-W)
8. % Crown missing
9. % dieback (condition)
10. Crown light exposure (CLE)
11. Land use
### Table 2

Summary of which directly field-measured characteristics are used to estimate derived variables and ecosystem services. **D** = directly used; **I** = indirectly used; **C** = conditionally used.

<table>
<thead>
<tr>
<th>DIRECT MEASURES</th>
<th>DERIVED VARIABLES</th>
<th>ECOSYSTEM SERVICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Leaf Area</td>
<td>Leaf Biomass</td>
</tr>
<tr>
<td>Diameter at breast height (d.b.h.)</td>
<td>Carbon Storage</td>
<td>Gross Carbon Sequestration</td>
</tr>
<tr>
<td>Total height</td>
<td>Gross Carbon Sequestration</td>
<td>Net Carbon Sequestration</td>
</tr>
<tr>
<td>Crown base height</td>
<td>Energy Effects</td>
<td>Air Pollution Removal</td>
</tr>
<tr>
<td>Crown width</td>
<td>Avoided Runoff</td>
<td>Transpiration</td>
</tr>
<tr>
<td>Crown light exposure</td>
<td>VOC Emissions</td>
<td>Compensatory Value</td>
</tr>
<tr>
<td>Percent crown missing</td>
<td>Wildlife Suitability</td>
<td>UV Effects</td>
</tr>
<tr>
<td>Crown health (condition/dieback)</td>
<td>Field land use</td>
<td>Distance to building</td>
</tr>
<tr>
<td>Field land use</td>
<td>Direction to building</td>
<td>D</td>
</tr>
<tr>
<td>Distance to building</td>
<td>Percent tree cover</td>
<td>D</td>
</tr>
<tr>
<td>Direction to building</td>
<td>Percent shrub cover</td>
<td>D</td>
</tr>
<tr>
<td>Percent tree cover</td>
<td>Percent building cover</td>
<td>D</td>
</tr>
<tr>
<td>Percent shrub cover</td>
<td>Ground cover composition</td>
<td>D</td>
</tr>
<tr>
<td>Percent building cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground cover composition</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sample or complete inventory

Sample plots
• Regional or watershed
• County
• City
• Where measuring every tree is impractical

Complete inventory
• Residential properties
• Neighborhoods/blocks
• Street tree inventory
• Parks
• Campuses
• Existing data
Example 1: i-Tree Eco can be easy

Mobile data entry

https://bit.ly/3KMHVSr
Example 1: i-Tree Eco can be easy

• Citizen science
• Engagement/Outreach
• Monitoring
• Diverse audiences
• Connect people to their trees
Example 2: Small and targeted

Tree Size Matters. The neighborhood’s large, mature shade trees have the most leaf area and provide the greatest benefits. While trees 30” or greater in diameter make up only 8% of the population - their canopies make up 27% of the neighborhood’s leaf area. A comparison of the benefits of an 11” diameter Dogwood tree and a 30” diameter Maple tree growing in the neighborhood shows that the Maple provides nearly 8 times the ecosystem benefits as the Dogwood.

To maximize the benefits Abington’s tree canopy provides - we should focus our private property efforts on preserving our existing large trees and planting species that will grow to be large shade trees to replace those we have lost or will lose in the future.

https://storymaps.arcgis.com/stories/ed7e547aeaed454ea5dd44c4b1be08c0
“These six trees store 14,291 lbs of carbon and continue to sequester 470 lbs of carbon each year. For comparison, the 1,316 small trees between 1-4 inches DBH in this study store a combined total of 16,567 lbs of carbon”

From Corey Bassett, https://www.itreetools.org/documents/352/UPenn_iTreeEcoInventory.pdf
Example 2: Small and Targeted

- Focus on only the trees and places of interest
- Neighborhood, block, park, ... inventories
- High development/high turnover
- All the i-Tree Eco results
- Impact policy
- Benchmark
- Monitor
Example 3: Expand your view

City of Tempe's canopy

Different species and varieties

<table>
<thead>
<tr>
<th>Total trees</th>
<th>205</th>
</tr>
</thead>
</table>

City of Tempe Tree Canopy Cover

11.4%

Carbon Storage:

$1,088,375.48

Pollution Removal:

$31,080.25 per year

Avoided Runoff:

$8,830.15 per year

Gross Carbon Sequestration:

$43,106.58 per year

https://tempe-urban-forest-tempegov.hub.arcgis.com/
Example 3: Expand your view

Planning your i-Tree Eco project

- Timeline
- Cost/budgeting
- Templates
- Learn from others
  - i-Tree Reports
- State Urban Forestry Coordinators
- Contractors

### Project Planning and Management

Documents and resources to help plan and manage an i-Tree Eco project such as examples of notification letters, plot maps, equipment lists and project timelines. Most planning resources were developed and provided as a courtesy by past Eco project managers to help future project managers.

#### Which i-Tree Tool Should I Use?

- **Which i-Tree Tool Should I Use?** - A decision making matrix developed by the Urban Forest Assessment Subcommittee of the Urban & Community Forestry Committee of the Northeast-Midwest Alliance of State Foresters with input from the Davey Institute and support from the USDA Forest Service.

#### Project Creation Guides

- **Idaho Treasure Valley Dot Grid Reference Sheet** - This document provided courtesy of David Stephenson, Idaho Department of Lands Community Forestry Program, provides instructions for using an English dot grid for aiding in determining land use cover percentages. Refer to the Idaho Eco Management Guide above for more details.
- **City of Milwaukee - Eco Plot Map** - This is an example of Eco plot maps utilized by the City of Milwaukee.

#### Project Management

- **Idaho Treasure Valley i-Tree Eco Project Management Report** - This document developed by David Stephenson, Idaho Department of Lands Community Forestry Program, provides suggestions, methods, tips and tools to help future Eco project managers.
- **Eco Project Cost Estimation** - This document, developed by Eric Kuehler from Urban Forestry South, offers a cost estimate for an Eco project. Note - Numerous factors can affect project cost and this is provided only as a general guideline.
- **Eco Project Time Estimation** - This document, developed by Eric Kuehler from Urban Forestry South, provides time estimations for planning and conducting an Eco project.
- **Eco Project Time Line** - This document, developed by Eric Kuehler from Urban Forestry South, is an example of a Eco project time line for a county assessment.

[https://www.itreetools.org/support/resources-overview/project-planning-and-management-2](https://www.itreetools.org/support/resources-overview/project-planning-and-management-2)
Example 3: Expand your view

- Import your existing data in an hour or less
- Majority of trees are on private property
- Your existing data makes the case for larger projects
- Broader data and more results support better management and future funding

**HOW MUCH DO DC’S TREES HELP FILTER STORMWATER?**

Each year DC’s trees filter 44,274,580 cubic feet of water equating to about $779 million per year. That is equal to about 500 Olympic size swimming pools.

Not all trees filter water the same way. Larger tree species filter more water than smaller trees do, so even though there may be fewer of them, they put in much more work.

- **47,844** American Elm Trees = **41 Olympic Swimming Pools**
- **104,387** Common Crapemyrtle Trees = **25 Olympic Swimming Pools**
i-Tree Eco – Toward strategic management

Fundable projects

• Tree Inventories are fundable activities
• Support strategic management
• Make the case for current and future funding and its targeted use

Why i-Tree Eco?

• Science backed
• Wealth of results and uses
• All lands (rural to urban, public parks to private back yards)
Want to learn more?

- Start at the Funding Opportunities [page]
- i-Tree Academy [page]
- Video learning [page]
- Support [page]
- Office hours – 5/8 and 5/10 1:00-2:00 pm ET

info@itreetools.org
Thanks from the team

Supported by:
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Urban and Community Forestry Program

Jason Henning   Phillip Rodbell
Krista Heinlin  Dave Bloniarz
Jay Heppler      Scott Maco

Success stories?
Questions?
Suggestions?
info@itreetools.org