Utilizing i-Tree to Assess the Urban Forest

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Outline

- Urban Tree Inventory
- Introduction to i-Tree
- Knoxville Urban Tree Canopy Assessment
- Future Directions

Why Inventory?

- Give a record of resources, track maintenance tasks, and make management decisions (Bassett, 1978)
- Describe the public tree resource (number and value) (Gerhold et al., 1987)
- Increase work efficiency and educate the public (Smiley and Baker, 1988)
- Maximize public benefits and minimize public expense (Miller, 2007)

Inventory Components

- Time and personnel
- Site descriptors
  - Location
  - Width of tree lawn
  - Overhead wires
  - etc.
- Tree descriptors
  - Species
  - Size
  - Condition
- Maintenance Records
- Updating


i-Tree
Streets
A STRATUM Analysis Tool


i-Tree


i-Tree
Eco


i-Tree
Design


Canopy Comparisons
i-Tree


i-Tree
Do you?

What is i-Tree?

- Initial release August 2006
- Developed by the USDA Forest Service
- Free public domain software
- Comprised of 6 individual urban ecosystem assessment tools

i-Tree Eco

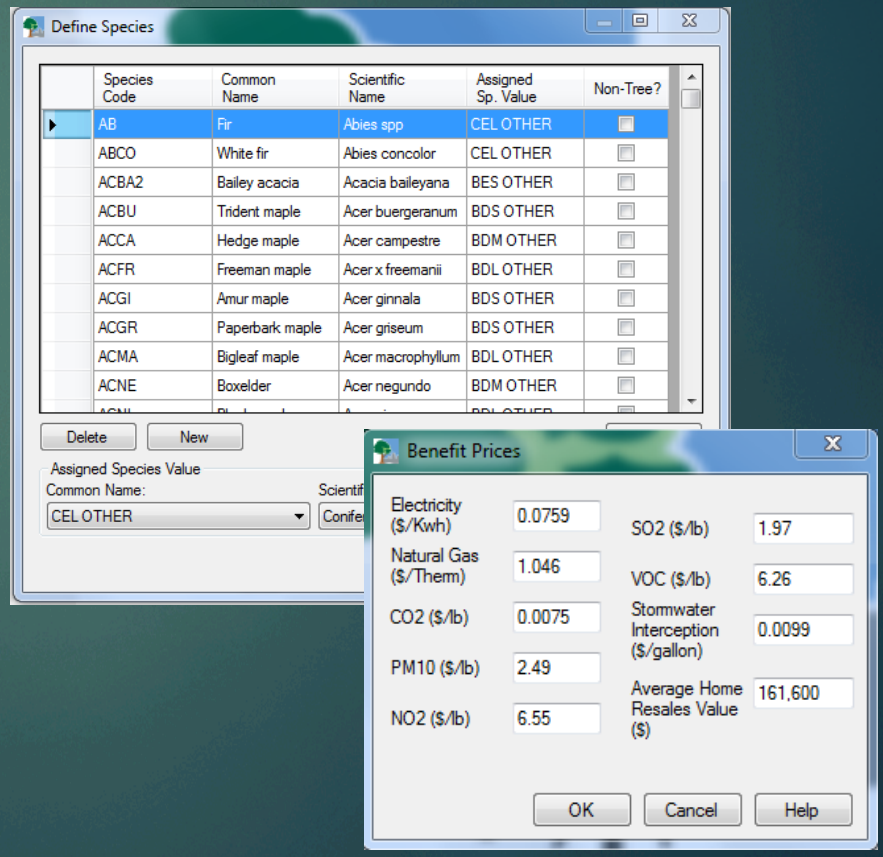
Quantifies urban forest structure, environmental effects, and value to communities

- Complete inventory or random sample
- Air pollution
- Other meteorological data

i-Tree Streets

Uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits

- Very easy to use
- Manage resources, develop policy, set priorities




i-Tree Streets Climate Zones
Reference Cities
Climate Zones
North
Interior West
Temperate Interior West
Pacific Northwest
Inland Valleys
Southwest Desert
Southern California Coast
Northern California Coast
Inland Empire
Tropical
Central Florida
Coastal Plain
South
Northeast
Lower Midwest
Midwest
Seattle
Tacoma
Spokane
Longview
Portland
Missoula
Bismarck
Fargo
Duluth
Boise
Cody
Minneapolis
Wall
Sioux Falls
Green Bay
Milwaukee
Madison
Grand Rapids
Flint
Lansing
Detroit
Cleveland
Buffalo
Rochester
Syracuse
Augusta
Berlin
Montpelier
Portland
Worcester
Springfield
Boston
Hartford
Providence
New Haven
Queens
New York
Philadelphia
Baltimore
DC
Reno
Berkeley
Salt Lake City
Fort Collins
Omaha
Des Moines
Rockford
Chicago
Toledo
Akron
Pittsburgh
Fort Wayne
Columbus
Indianapolis
Dayton
Lincoln
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Modesto
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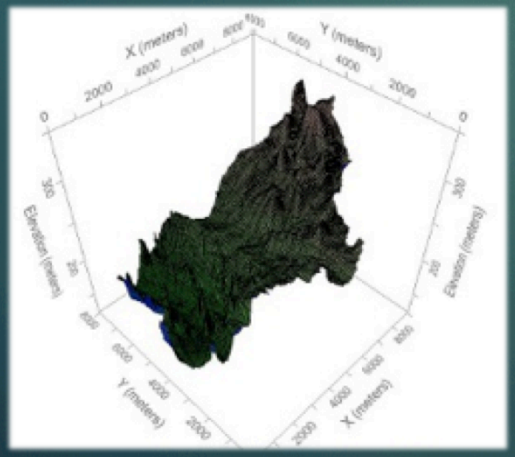
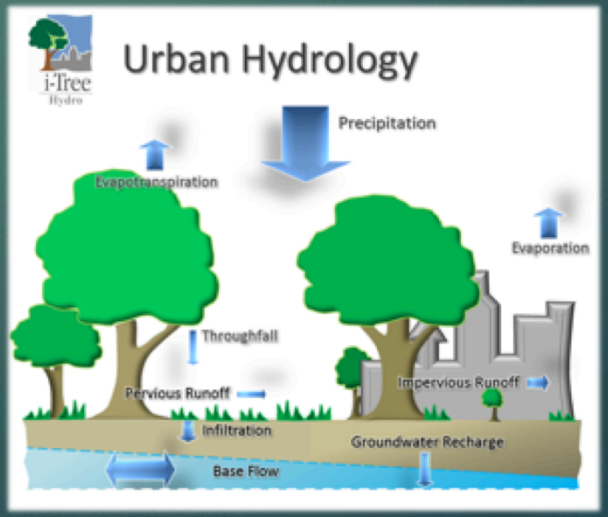
Richmond
Norfolk
Evansville
Lexington
Wichita
Springfield
Greensboro
Durham
Raleigh
Knoxville
Oxnard
Santa Monica
Claremont
Glendale
Albuquerque
Amarillo
Oklahoma City
Tulsa
Nashville
Chattanooga
Memphis
Charlotte
San Diego
Lubbock
Little Rock
Huntsville
Atlanta
Charleston
Birmingham
Dallas
Jackson
Columbus
Savannah
Tucson
El Paso
Shreveport
Montgomery
Mobile
Jacksonville
Tallahassee
Austin
Houston
Baton Rouge
New Orleans
Orlando
San Antonio
Tampa
Corpus Christi
Fort Lauderdale
Miami
Anchorage
Juneau
San Juan
Honolulu

i-Tree Hydro

Designed for users interested in watershed scale analyses of vegetation and impervious cover effects on hydrology

- Tree cover
- Impervious surface area
- City scale





i-Tree™
Hydro

i-Tree Vue

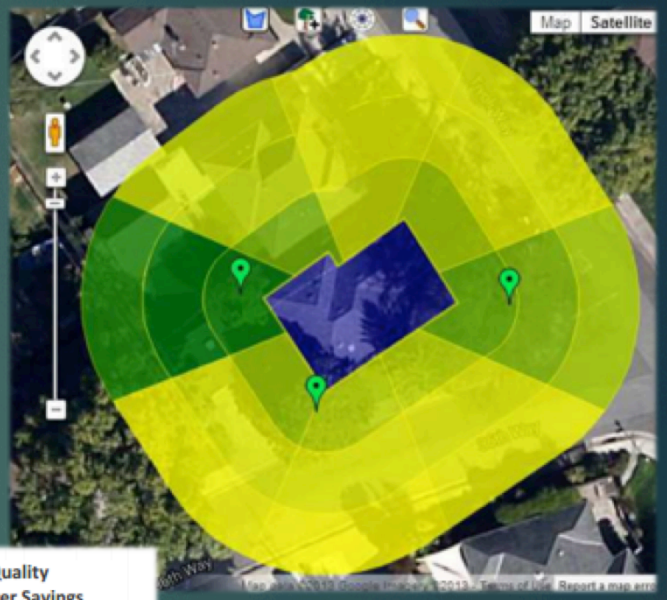
Utilizes the National Land Cover Database (NLCD) satellite-based imagery to assess a community's land cover

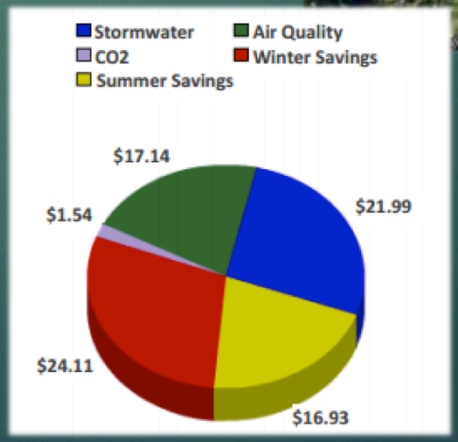
- Tree canopy
- Other ecosystem services
- Consists of 3 types of imagery:
  - 29 Land Cover classifications
  - Percent Impervious Cover
  - Percent Tree Canopy

i-Tree Design

Allows for simple estimation of the benefits provided by individual trees

- Inputs:
  - Location
  - Species
  - Size
  - Condition
- Benefit estimation includes:
  - Greenhouse gas mitigation
  - Air quality
  - Stormwater interception
  - Heating/Cooling costs



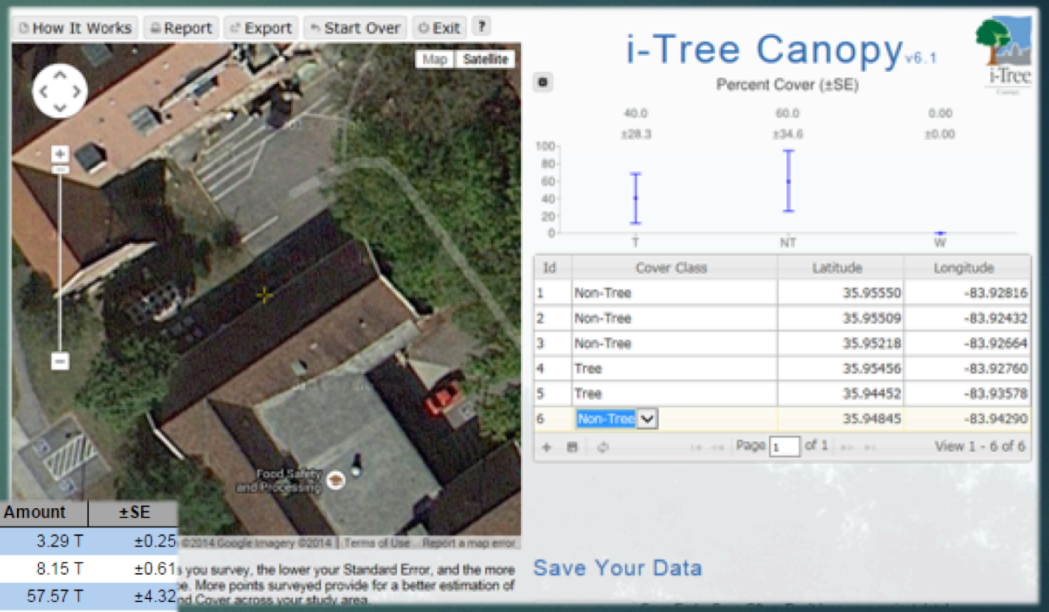


i-Tree
Design

i-Tree Canopy

Produce a statistically valid estimate of land cover types (e.g., tree cover) using aerial images available in Google Maps

- Define project area
- Define cover types
- Classify points
- Can estimate tree benefits



Abbr.	Benefit Description	Value	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	$2,042.42	±153.30	3.29 T	±0.25
NO2	Nitrogen Dioxide removed annually	$1,955.81	±146.80	8.15 T	±0.61
O3	Ozone removed annually	$77,039.58	±5,782.38	57.57 T	±4.32
PM2.5	Particulate Matter less than 2.5 microns removed annually	$156,116.15	±11,717.65	2.86 T	±0.21
SO2	Sulfur Dioxide removed annually	$120.28	±9.03	1.54 T	±0.12
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	$26,900.62	±2,019.09	7.99 T	±0.60
CO2seq	Carbon Dioxide sequestered annually in trees	$228,850.49	±17,176.88	11,818.75 T	±887.08
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$7,363,432.20	±552,678.82	380,277.02 T	±28,542.54


i-Tree in Action
KNOXVILLE, TN

Initial Assessment

- Davey Resource Group

- Total of 7,648 trees and 829 potential planting sites
- i-Tree Streets
  - Benefits of trees
  - Cost-benefit ratio of Urban Forestry Program

- Goal: To illustrate a business-case scenario for investing in the City's urban forest

i-Tree Streets Results

Eight representative Knoxville neighborhoods

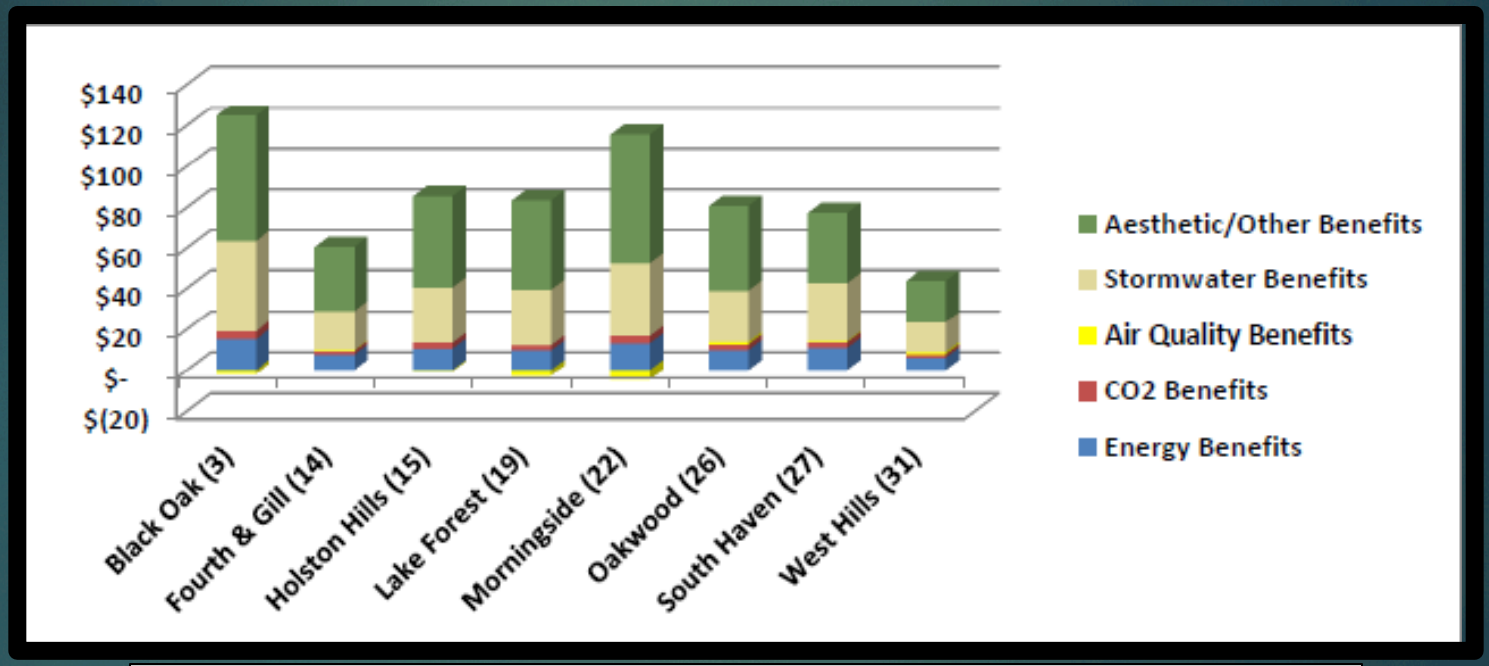


Figure 1. Annual benefits by category within each neighborhood

(Davey Resource Group, 2011)

i-Tree Streets Results

Table 5. Benefits and costs within each neighborhood

Neighborhood (Zone Number)	Estimated Total Trees	Costs (Dollars/Year)	Benefits (Dollars/Year)	Net Benefits (Dollars/Year)	Benefits per Tree (Dollars/Tree)	Benefit-Cost Ratio
Black Oak (3)	518	$15,893	$63,672	$47,779	$123	$4.01
Fourth & Gill (14)	610	$4,623	$36,847	$32,224	$60	$7.97
Holston Hills (15)	1,193	$44,760	$101,211	$56,451	$85	$2.26
Lake Forest (19)	879	$13,449	$70,934	$57,485	$81	$5.27
Morningside (22)	1,443	$16,417	$159,964	$143,547	$111	$9.74
Oakwood (26)	435	$10,954	$35,089	$24,135	$81	$3.20
South Haven (27)	1,138	$26,714	$87,932	$61,218	$77	$3.29
West Hills (31)	1,027	$41,529	$44,657	$3,128	$44	$1.08
Total	7,243	$174,339	$600,306	$425,967	$83	$3.44

(Davey Resource Group, 2011)

Report Recommendations

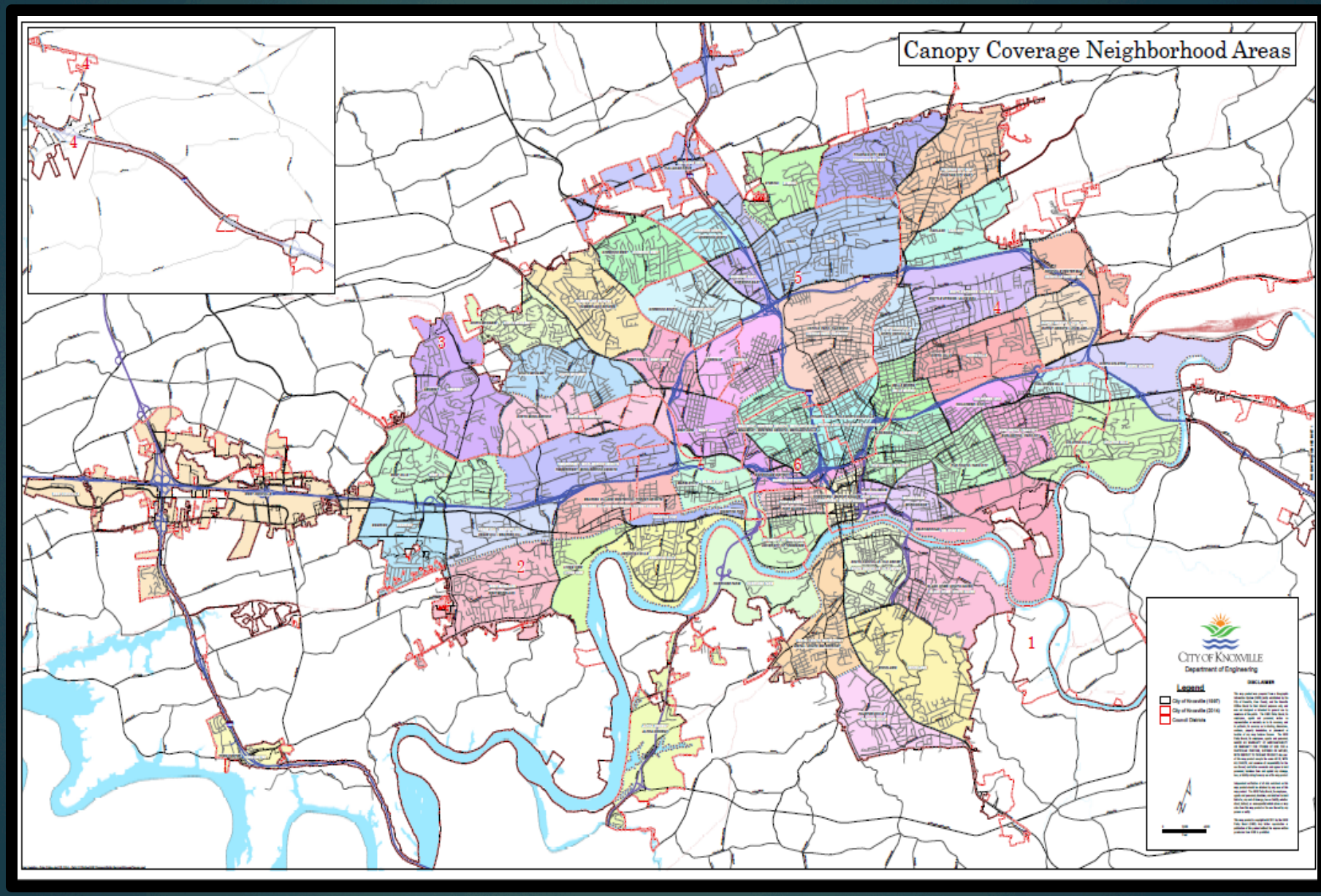
- "Create one new staff position – Urban Forester."
- Which led to…..

Kasey Krouse
Knoxville Urban Forester
Hired 2012

www.knoxnews.com

Knoxville's New Project

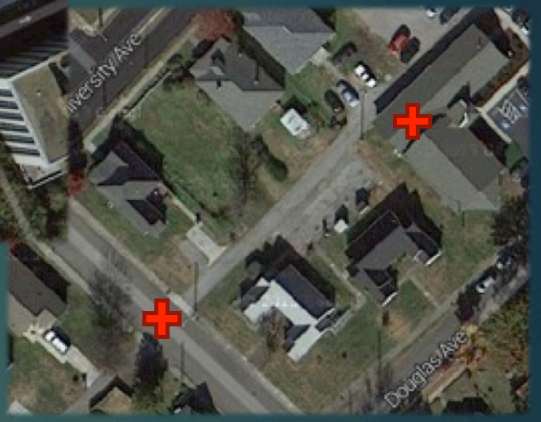
- Assessed canopy cover
- Delineated by neighborhoods
- Used i-Tree Canopy for a stratified random sample



(Urban Forestry – Trees in Knoxville, 2015)

Data Attributes

- Tree Canopy
- Impervious Surface
- Impervious Structure
- Other Green Space
- Other Pervious
- Other Impervious
- Water



Canopy Cover

City average canopy cover = 40%

Table 2. Neighborhoods above or below 40% canopy cover (city average).

Area	Tree (%)	Imp. Pavement (%)	Imp. Structure (%)	OGS (%)	OI (%)	OP (%)	Water (%)
Cherokee Farm	61.4	8.6	3	19.4	0.2	5.4	2
Kingston Pike	57	17.8	7.4	13.8	0.2	3.6	0.2
Sequoia Hills	55.2	11.8	6.6	22.6	1.4	2	0.4
Alcoa Hwy	45.6	4.4	1.95	41.8	0	1.05	5.2
Bearden	34	30.2	9	23.6	0	3.2	0
Downtown/ Market Square	14.8	43.5	24.6	11.2	0.4	4.41	1
University of Tennessee	13	39.4	19.8	17.6	0.8	9	0.4

(Urban Forestry – Trees in Knoxville, 2015)

Tree Benefits

Tree Benefit Estimates — **Downtown**

Abbr.	Benefit Description	Value	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	$36.01	±3.86	54.20 lb	±5.81
NO2	Nitrogen Dioxide removed annually	$65.18	±6.99	299.41 lb	±32.12
O3	Ozone removed annually	$2,993.63	±321.16	1.16 T	±0.12
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	$2,050.17	±219.95	656.44 lb	±70.42
PM2.5	Particulate Matter less than 2.5 microns removed annually	$6,267.19	±672.36	118.16 lb	±12.68
SO2	Sulfur Dioxide removed annually	$9.82	±1.05	147.19 lb	±15.79
CO2seq	Carbon Dioxide sequestered annually in trees	$4,555.15	±488.69	235.25 T	±25.24
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$138,172.44	±14,823.47	7,135.78 T	±765.54

Tree Benefit Estimates — **Island Home**

Abbr.	Benefit Description	Value	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	$305.74	±12.09	460.18 lb	±18.20
NO2	Nitrogen Dioxide removed annually	$66.43	±2.63	502.37 lb	±19.86
O3	Ozone removed annually	$37,688.43	±1,490.19	18.14 T	±0.72
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	$27,740.22	±1,096.84	4.44 T	±0.18
PM2.5	Particulate Matter less than 2.5 microns removed annually	$107,756.05	±4,260.65	1.33 T	±0.05
SO2	Sulfur Dioxide removed annually	$79.36	±3.14	1,603.93 lb	±63.42
CO2seq	Carbon Dioxide sequestered annually in trees	$73,291.98	±2,897.95	3,785.09 T	±149.66
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$2,223,184.81	±87,904.30	114,814.13 T	±4,539.73

Future Directions

- Oak Ridge, TN urban tree management plan
- Widely utilized by the public
  - www.itreetools.org
- Improve strengths and address weaknesses

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Photo Credits

- www.cityofknoxville.org/trees/canopy
- www.downtownknoxville.org
- www.itreetools.org
- www.knoxnews.com
- www.washingtondnr.wordpress.com
- www.wmky.org

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Questions?

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