

Understanding our Urban Forest Assets:

Methods of Tree Inventory and Urban Tree Canopy Analysis

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**Southern Regional Extension Forestry Webinar
July 9, 2014**



Virginia Cooperative Extension
Virginia Tech • Virginia State University

Learning Objectives

- 1. Define urban forest assessment and discuss key concepts**
- 2. Understand the basic applications and approaches of urban forest assessment**
- 3. Understand the capabilities and limitations of urban forest assessment approaches**
- 4. Identify tree inventory methods and tools for conducting them**
- 5. Identify UTC analysis methods and tools for conducting them**

OBJECTIVES

BACKGROUND

TREE
INVENTORY

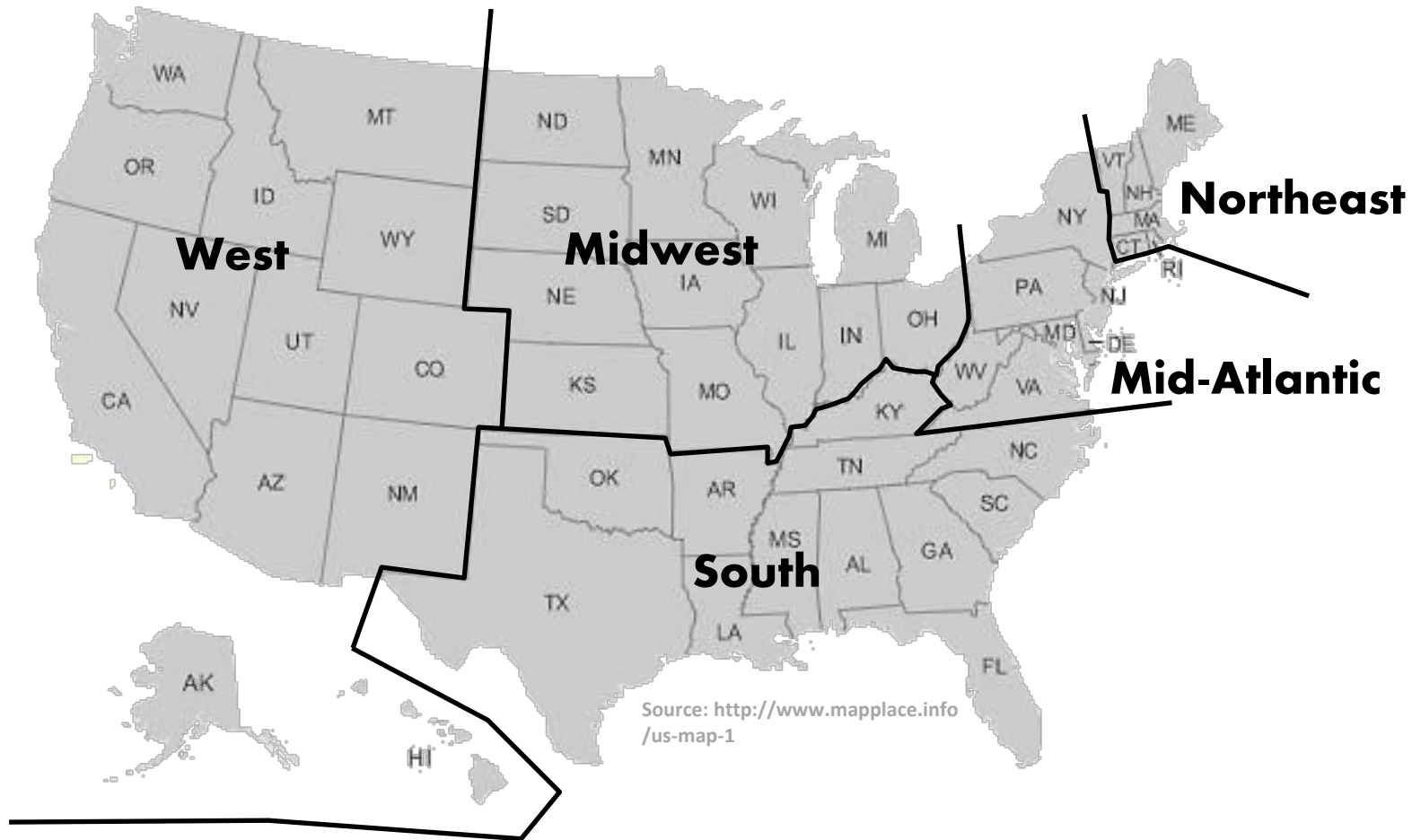
UTC
ANALYSIS

RESOURCES

SUMMARY

QUESTIONS

Where are you viewing from today?



A. West

C. South

E. Mid-Atlantic

B. Midwest

D. Northeast

OBJECTIVES

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What's your affiliation?

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A. Commercial arborist/consultant

B. Municipal arborist/urban forester

C. State/federal agency or university

D. Non-profit or civic group

E. Other



What's your urban forest assessment background?

OBJECTIVES

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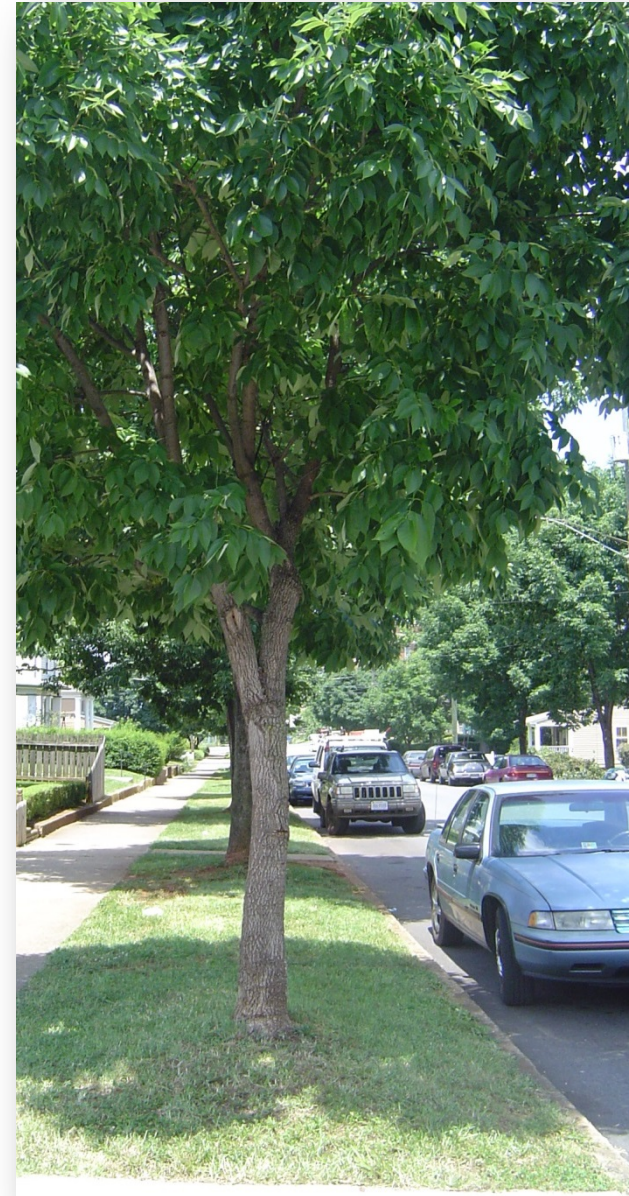
QUESTIONS

A. I'm a pro...I've done a bunch!

B. I've worked on a few, but I'm still figuring it all out.

C. I've read about them, but have never done one myself!

D. Uhh...what's an urban forest assessment?



What is Urban Forest Assessment?

OBJECTIVES

Urban Forest Assessment ~

BACKGROUND

Observation and evaluation of the quantity, quality, and distribution of urban forest resources within a defined geographic area of interest.

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What is Urban Forest Assessment?

OBJECTIVES

Urban Forest Assessment ~

Observation and evaluation of the quantity, quality, and distribution of urban forest resources within a defined geographic area of interest.

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Observation

Locating
Identifying
Measuring
Classifying
Rating



DATA



Evaluation

Existing & Potential UTC
Tree Population Metrics
Connectivity & Spatial Relations
Assets, Liabilities, & Risks
Hi-Value/Low-Value Resources
Threatened/Secure Resources
Management Opportunities
Ecosystem Function
Benefits and Costs

Applications of Urban Forest Assessment

OBJECTIVES

BACKGROUND

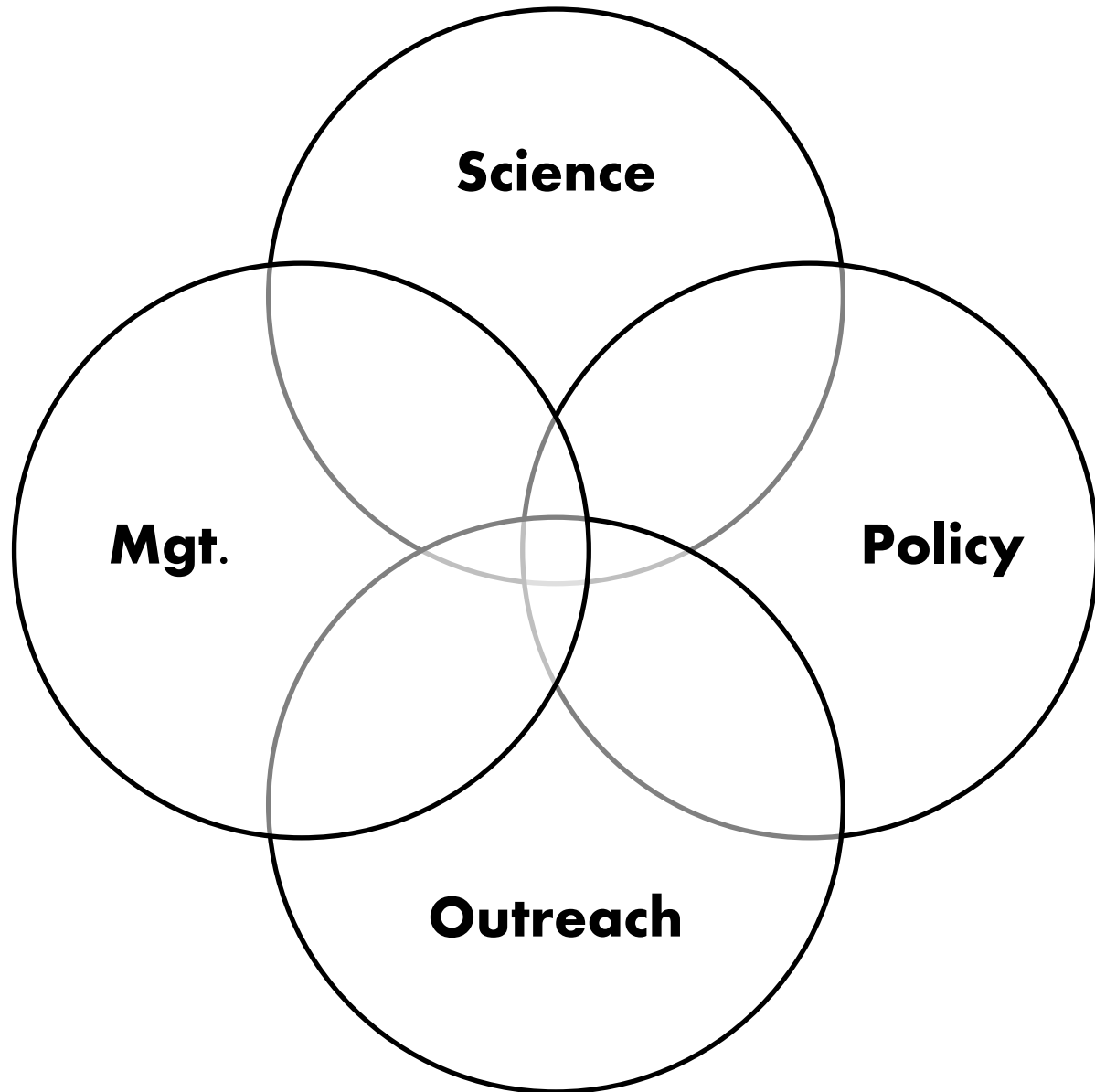
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Applications of Urban Forest Assessment

OBJECTIVES

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**What Do
We Have?**

Reassessment

**Resource
Assessment**

**Are We
There Yet?**



**What Do
We Want?**

**Management
Plans**

**Management
Objectives**

**How Do We
Get There?**

Approaches of Urban Forest Assessment

OBJECTIVES

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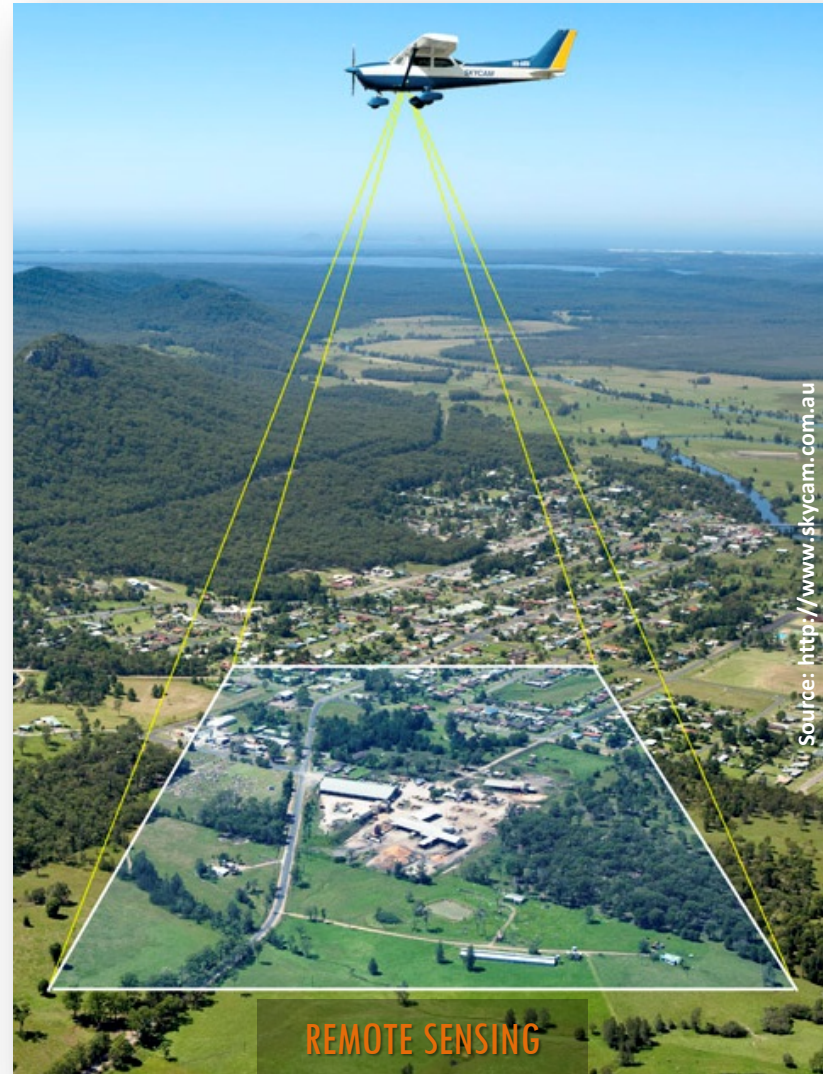
SUMMARY

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Bottom-Up Approach



Top-Down Approach



Capabilities of Assessment Approaches

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Data Acquisition and Application (Poor / Fair / Good / Excellent)	Bottom-Up	Top-Down
Cost – Time – Expertise	varies	varies
Tree Canopy Cover	P	E
Leaf Area and Biomass	G	F
Tree Abundance and Density	E	F
Tree Size/Age Distribution	E	F
Species Composition and Diversity	E	F
Tree Condition	E	F
Tree Disorders and Pests	E	F
Failure or Conflict Risks	E	P
Tree Maintenance Needs	E	P
Potential Planting Space	G	G
Site Quality	E	P
Ground Cover	E	F
Ecosystem Functions & Values	G	G

The Urban Forest Assessment Model

OBJECTIVES

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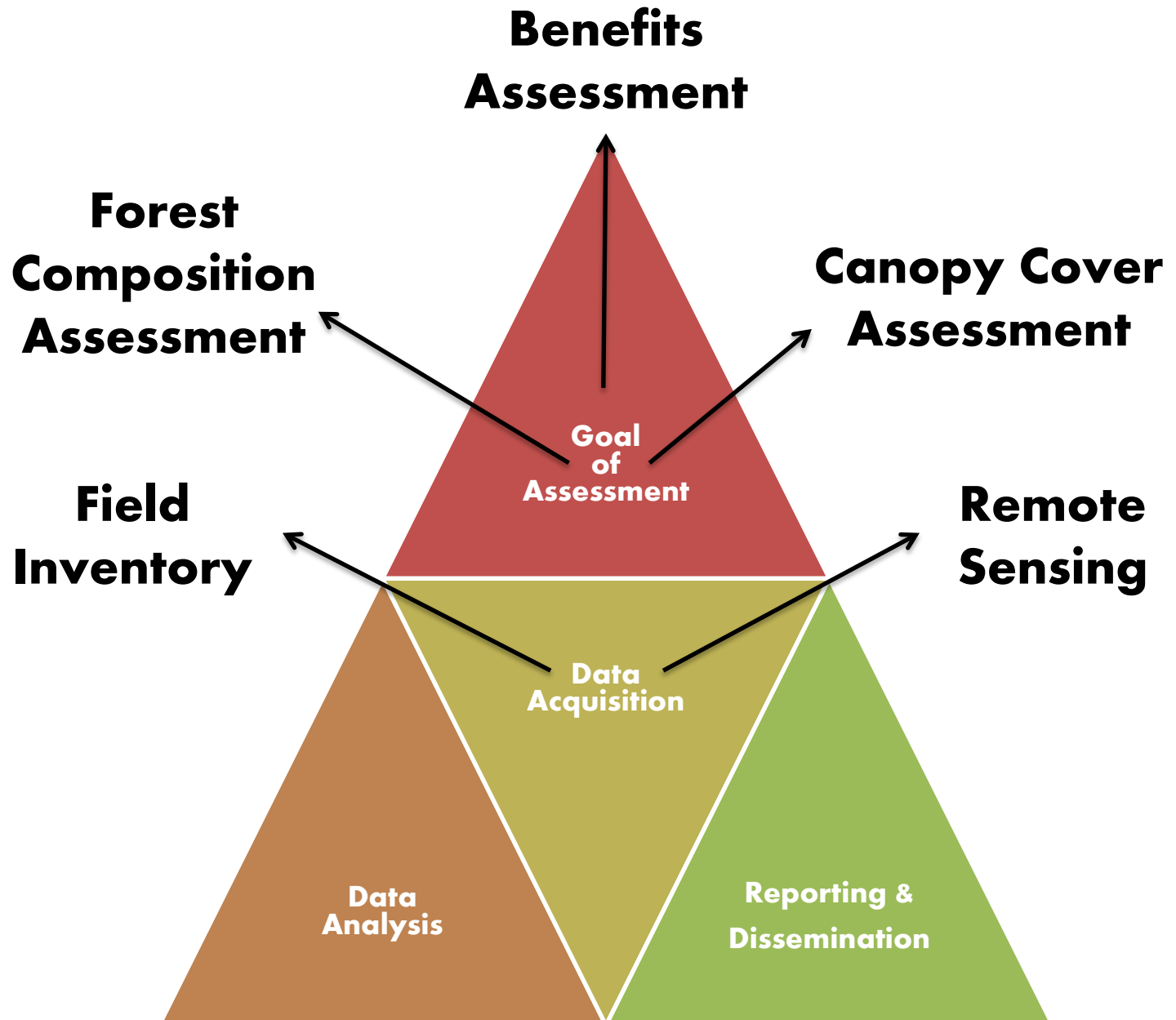
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Pop Quiz

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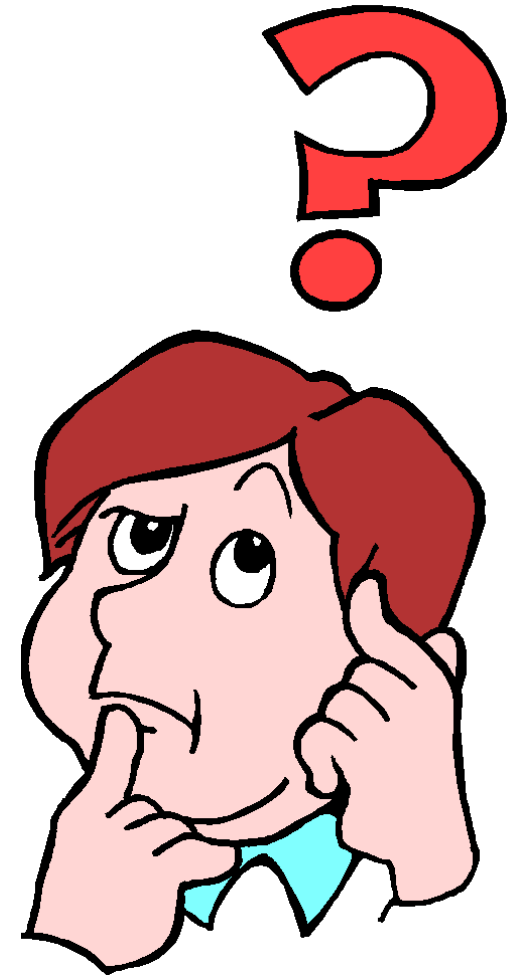
SUMMARY

QUESTIONS

Question 1:

The two basic approaches of urban forest assessment include:

- A. Bottom-Up Approach**
- B. Top-Down Approach**
- C. Right-Side-Up Approach**
- D. A & B only**
- E. B & C only**



Pop Quiz

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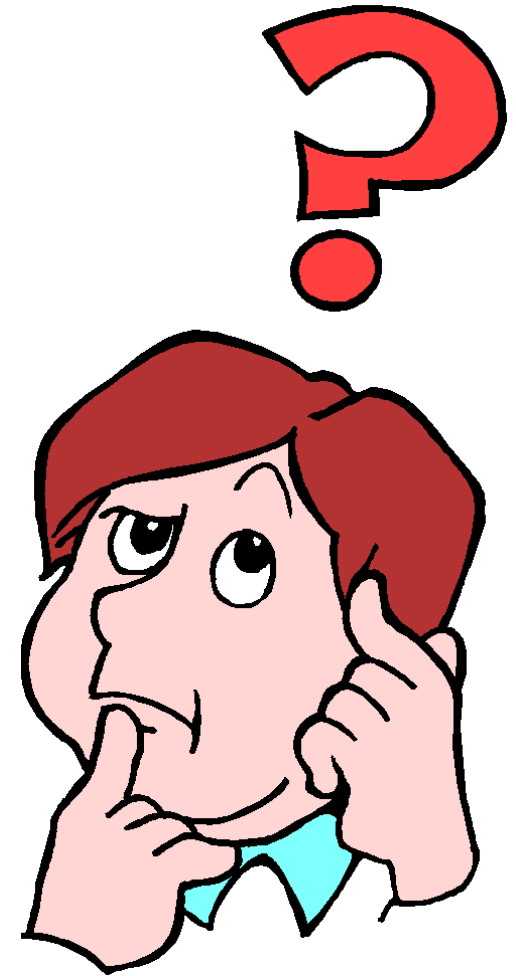
SUMMARY

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Question 2:

In choosing an urban forest assessment approach, one must consider

- A.** The assessment goal
- B.** Available resources & expertise
- C.** Capabilities of the assessment approach
- D.** All of the above
- E.** None of the above



Types of Tree Inventories

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Complete Inventory

- **"Census"**
- **Inventory of the entire tree population**

Sample Inventory

- **"Sample"**
- **Inventory of a representative portion of the tree population**

Partial Inventory

- **"Survey"**
- **Inventory of a critical portion of the tree population**

Tree Inventory Options

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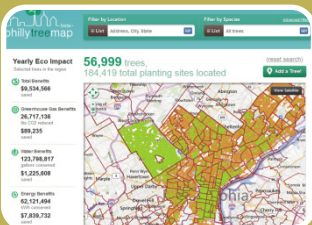
User-Customized

- Pencil-and -Paper
- Technology-Based



i-Tree Tools

- i-Tree Streets
- i-Tree Eco



Crowd-Sourced

- OpenTreeMap (Azavea)
- Tree Plotter LITE (Plan-It Geo)



Commercial

- Bartlett Inventory Solutions (Bartlett Tree Experts)
- TreeKeeper Suite (Davey Resource Group)

Tree Inventory Data Hierarchy

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Features

- **Live Trees**
- **Dead Trees**
- **Stumps**
- **Available Planting Spaces**

Attributes

- **Location**
- **Physical Dimensions**
- **Characteristics (Ownership, Spp. Name, Condition, Site Descriptors)**
- **Maintenance History/Needs/Priority**

Values

- **Qualitative (name; condition; yes/no)**
- **Quantitative**
 - Class (e.g., 0-8", 9-16", 17-24", >24")**
 - Unit (e.g., 25% UTC, 14" DBH, 45' Tall)**

Examples of Tree Inventory Uses

OBJECTIVES

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VT Urban Forestry Complet... x STREETS reports x +

urbanforestry.frec.vt.edu/STREETS/reports.html

Virginia Street Tree Assessment Project

An application of i-Tree Streets

HOME LOCALITY REPORTS RESOURCES ASSESS YOUR TREES COLLABORATORS ABOUT US

Locality Reports

The table below contains summary statistics for the street tree assessments conducted to date. Place the mouse pointer over each column header to see a description of the metric. For an overview of the methods used to conduct these street tree assessments, visit [Resources](#).

Locality	Inventory Type	Street Tree Population	Annual Benefits (\$)	Replacement Value (\$)	Links
Abingdon	Complete	1,193	65,171	2,829,814	report
Alexandria	Complete	7,565	1,047,157	22,171,857	report
Arlington CDP	Complete	20,355	2,145,911	35,615,750	report
Buchanan	Sample	771 (±112)	34,380 (±5,005)	1,467,544 (±213,639)	report
Charlottesville	Complete	5,988	603,290	28,892,459	report
Culpeper	Sample	1,733 (±219)	94,861 (±11,977)	3,545,449	report

Links

- [VT Urban Forestry Home](#)
- [i-Tree: Urban Forestry Assessment Tools](#)
- [Virginia Geospatial Extension Program](#)
- [Virginia Urban Forest Council](#)

Related Projects

- [Urban Tree Canopy Analysis of Virginia Localities](#)
- [Municipal Urban Forest Assessments](#)
 - [Town of Abingdon](#)
 - [City of Charlottesville](#)
 - [City of Falls Church](#)

Pop Quiz

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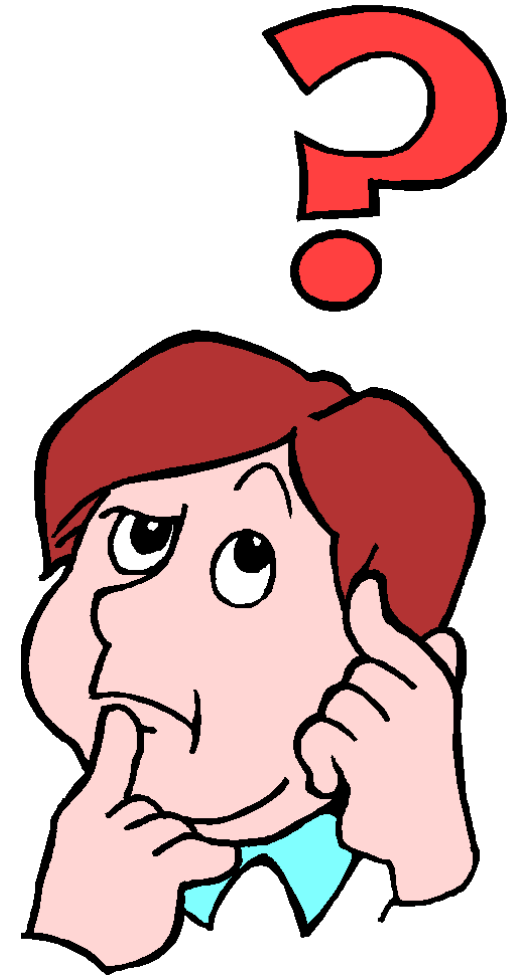
SUMMARY

QUESTIONS

Question 3:

A complete urban tree inventory:

- A.** Is also called a census
- B.** Is an inventory of the entire tree population in a defined area
- C.** Requires careful selection of data features, attributes, and values
- D.** All of the above
- E.** None of the above



Selecting a UTC Analysis Method

OBJECTIVES

Data Application Goal

BACKGROUND

Data Acquisition Method

TREE INVENTORY

UTC ANALYSIS

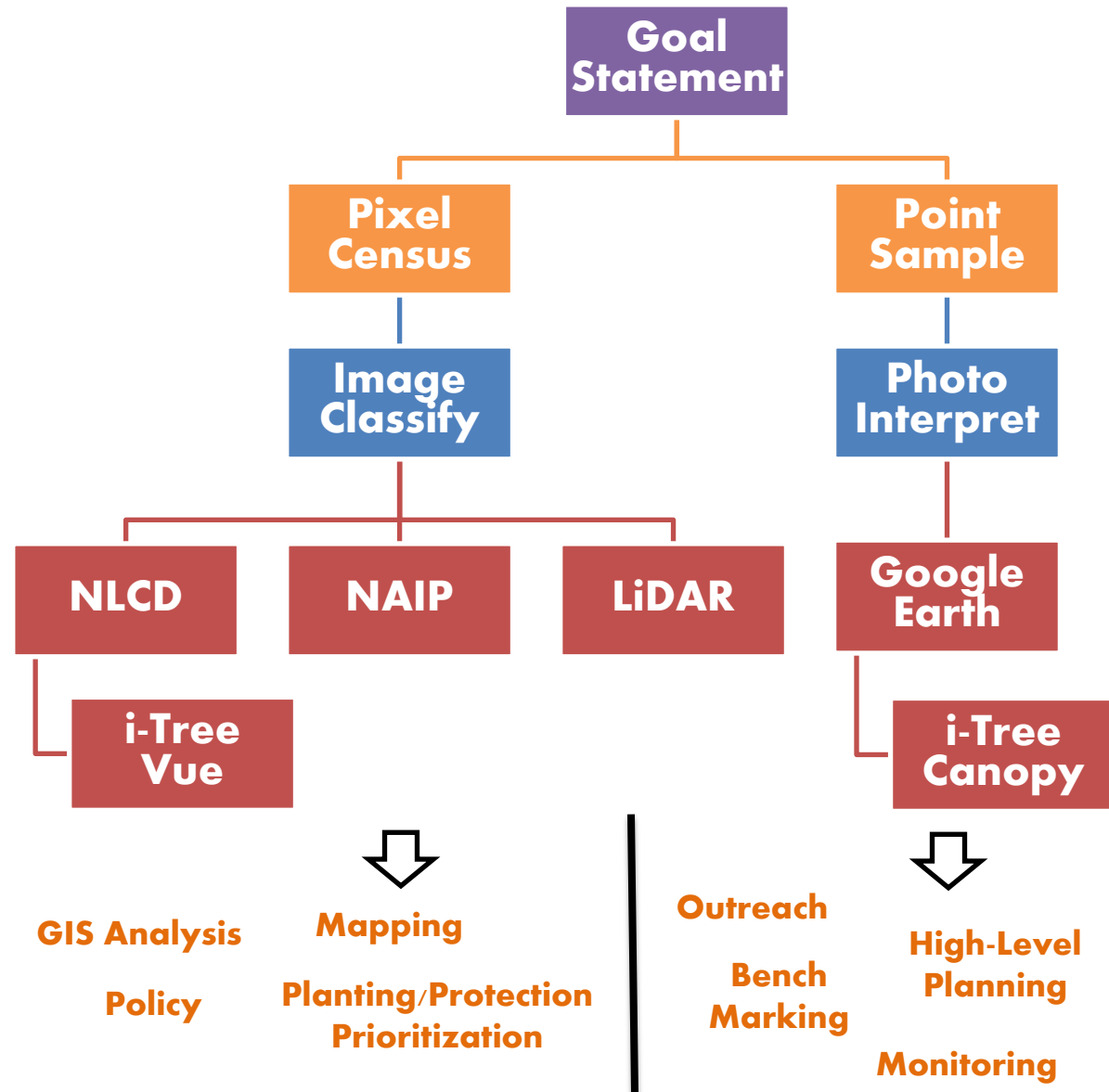
Data Resolution Need

RESOURCES

SUMMARY

Data Application Examples

QUESTIONS



UTC Analysis – Image Classification

OBJECTIVES

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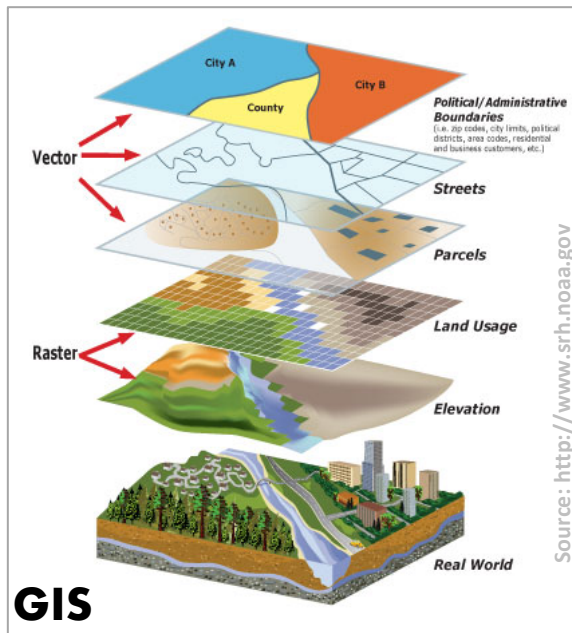
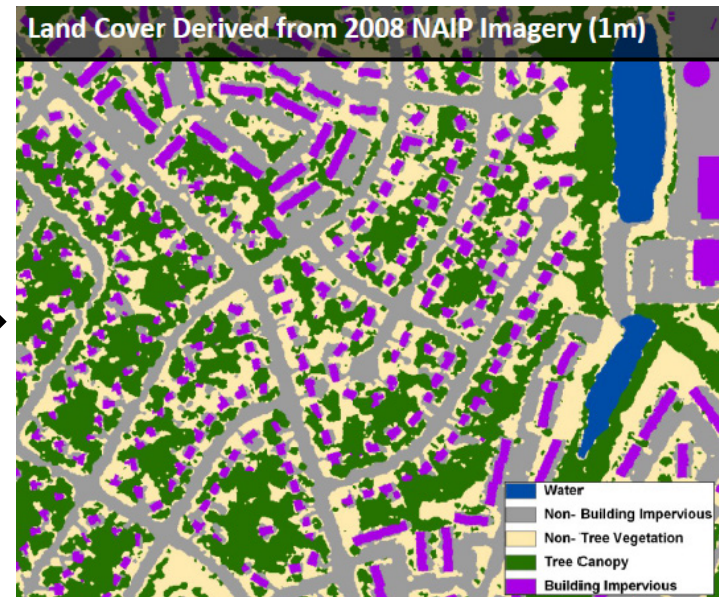
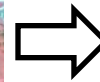
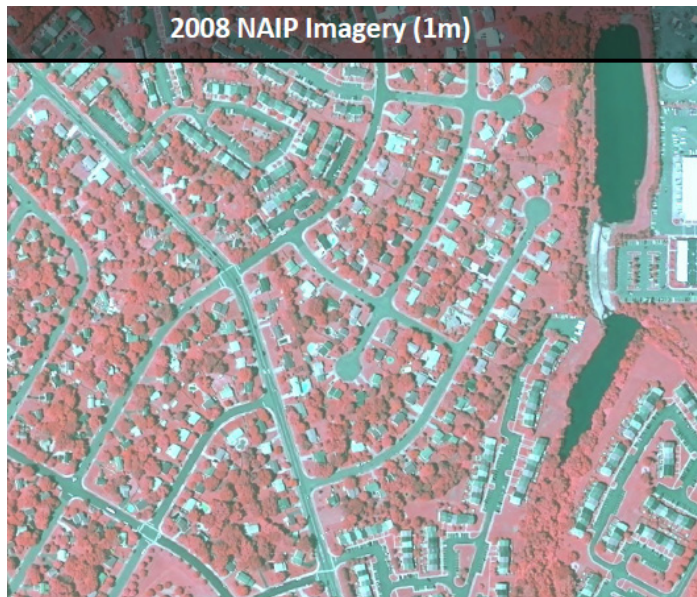
TREE INVENTORY

UTC ANALYSIS

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UTC Analysis – Photo Interpretation

OBJECTIVES

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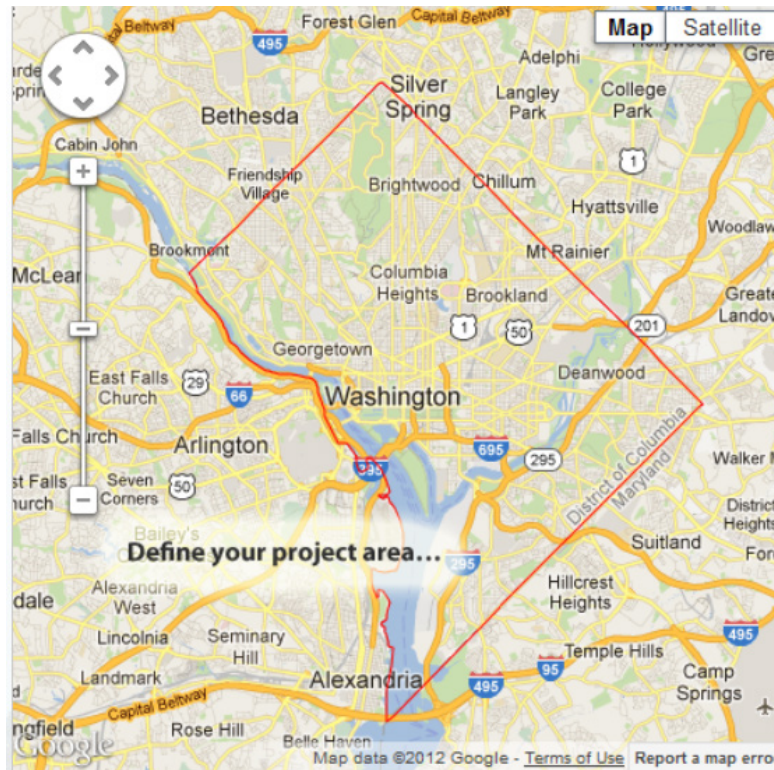
TREE INVENTORY

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UTC Analysis – Photo Interpretation



OBJECTIVES

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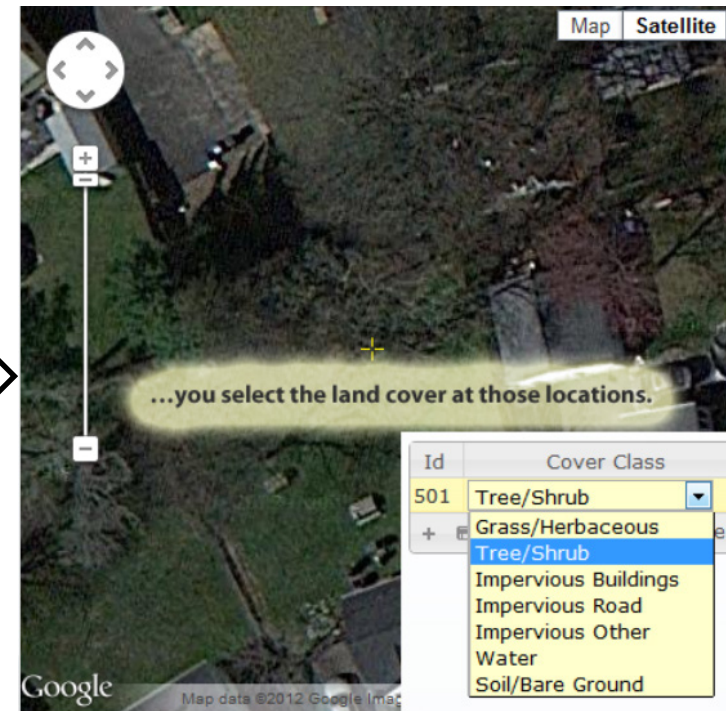
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UTC Analysis – Photo Interpretation

OBJECTIVES

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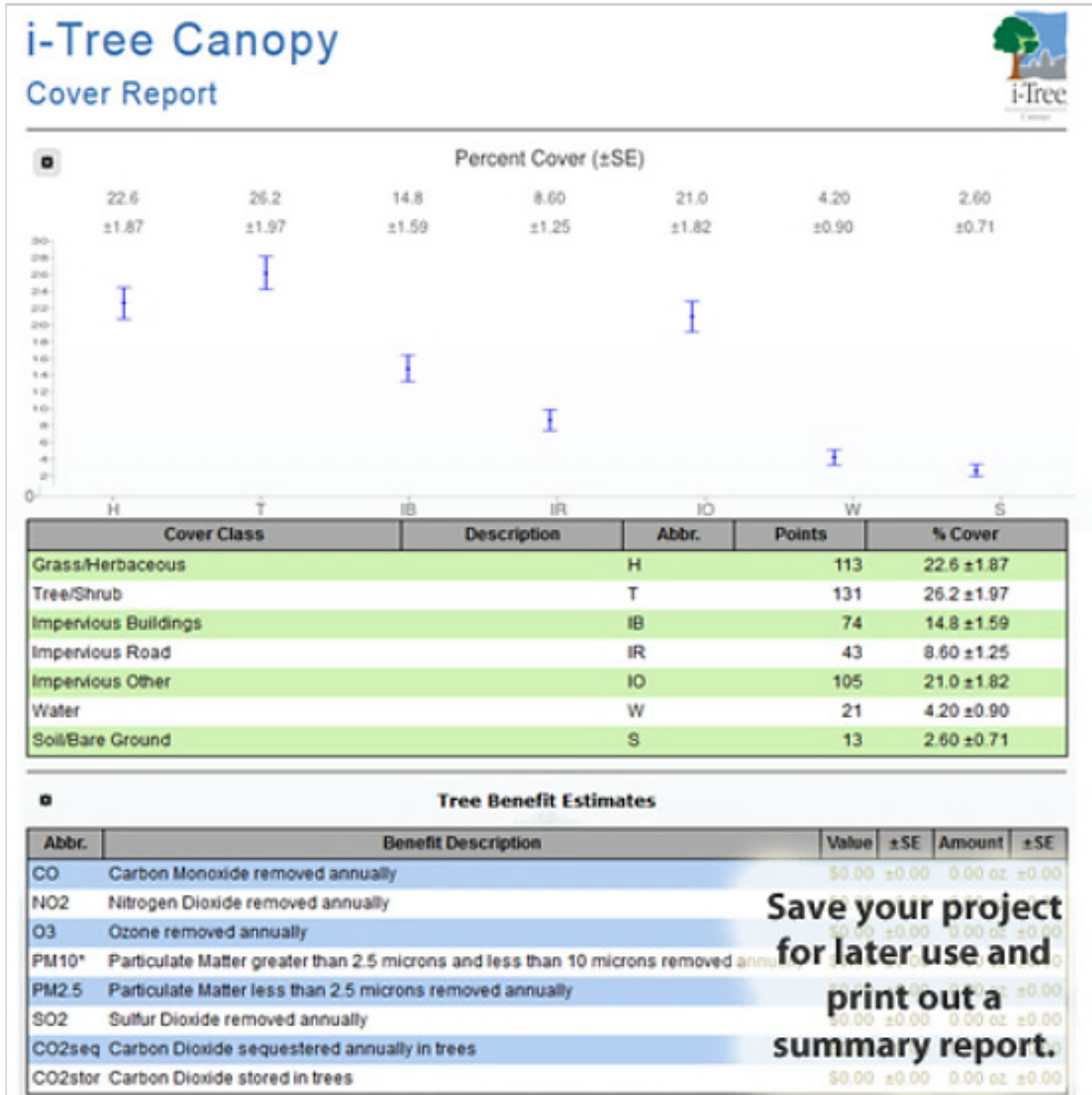
TREE INVENTORY

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Save your project for later use and print out a summary report.

Examples of UTC Analysis

OBJECTIVES

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Virginia Urban Tree Canopy Analysis

gcp.frec.vt.edu/va_utc.html

Spatial Analysis Laboratory (SAL) of the University of Vermont

Participating Localities

- Abingdon ([report](#))
- Arlington County ([report](#))
- Ashland ([report](#))
- Blacksburg ([report](#))
- Charlottesville ([report](#))
- Chesapeake ([report](#))
- Fairfax County ([Fairfax County 30 Year Tree Canopy Goal website](#))
- Fredericksburg ([report](#))
- Front Royal ([report](#))
- Leesburg ([Leesburg Tree Canopy website](#))
- Lexington ([report](#))
- Luray ([report](#))
- Manassas ([report](#))
- Newport News ([report](#))
- Norfolk ([report](#))
- Portsmouth ([report](#))
- Purcellville ([report](#))
- Radford ([report](#))
- Richmond ([report](#))
- Roanoke City ([report](#))
- Salem ([report](#))
- Vinton ([report](#))
- Virginia Beach ([report](#))
- Waynesboro ([report](#))
- Winchester ([report](#))
- Woodstock ([report](#))

Existing UTC Percent (% Land Area excluding Water Area)

Locality	Existing UTC Percent
Abingdon	26%
Arlington	44%
Ashland	52%
Blacksburg	30%
Charlottesville	47%
Chesapeake^	39%
Fairfax County**	41%
Fredericksburg	44%
Front Royal	41%
Leesburg*	27%
Lexington	44%
Luray	27%
Manassas	27%
Newport News	38%
Norfolk	33%
Portsmouth	30%
Purcellville*	20%
Radford	53%
Richmond City	42%
Roanoke City	48%
Salem	40%
Vinton	39%
Virginia Beach**^	36%
Waynesboro	43%
Winchester	27%
Woodstock	22%

www.uvm.edu/envnr/sal/

Examples of UTC Analysis

OBJECTIVES

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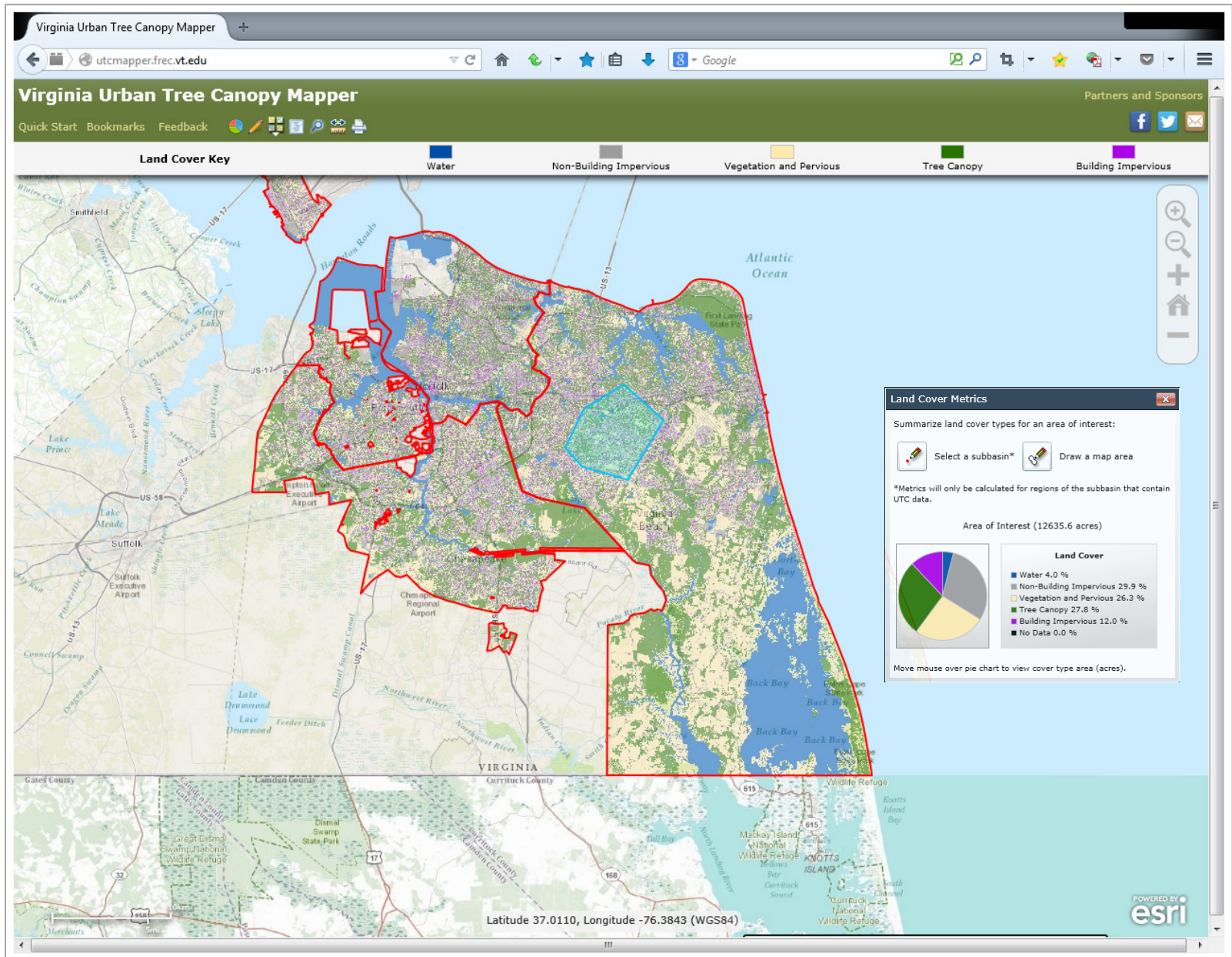
TREE INVENTORY

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Examples of UTC Analysis

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PG Online - Urban Forest Cloud - ...

pgonline.planitgeo.com/VA/JS_App/Sites/CanopyPlanner/index.aspx

Virginia Beach, VA : Urban Forest Cloud - Canopy Planner

Address, City, Point of Interest...

Map controls: +, -, Full Screen, Layers, Home, Print, Measure, Info, Help, Settings, Search, Close

Map Labels: Elizabeth River, Norfolk, Portsmouth, Portsmouth (City), Suffolk (City), Chesapeake (City), Chesapeake, Virginia Beach, Ocean NAS, First Landing State Park, North Bay, Back Bay, Fales Cape, North Landing River, Chesapeake (City), Virginia Beach (City), North Carolina, Moyock, Mackay Island National Wildlife Refuge, Knotts Island, Dismal Swamp State Park, NSGA Northwest Annex

Query:

Choose Layer: Virginia Beach Zoning

Query Type: AND OR

Existing Tree Canopy % \leq 20

Planting Area Veg. % \geq 20

Area (ac) $<$ 3

Apply Selection Apply Filter Remove Filter 1,814 / 11,756

Logos: Virginia Tech, plan-it GEO, DigitalGlobe, GeoEye, i-cubed, Earthstar, GeoGraphics, CNES/Airbus

User Guide

Examples of UTC Analysis

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
QUESTIONS

CITY OF VIRGINIA BEACH

URBAN FOREST MANAGEMENT PLAN


A COMPONENT OF THE COMPREHENSIVE PLAN





PREPARED BY
Land Studio, pc
PUBLISHED JANUARY 2014

VIRGINIA BEACH PARKS & RECREATION
PLANNING, DESIGN & DEVELOPMENT
AND LANDSCAPE MANAGEMENT DIVISIONS



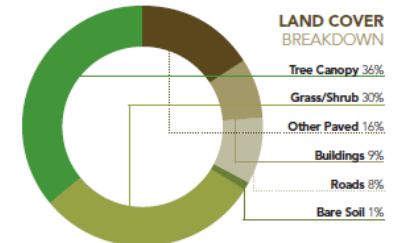
URBAN FOREST MANAGEMENT PLAN

CITY WIDE ANALYSIS

Land Area Type	Land Area Type (Acres)	Tree Canopy (Acres)	Tree Canopy Percentage	Possible UTC Vegetation/ Impervious	Factors Affecting UTC Percentages
State & Federal Property	29,005	13,219	46%	26% / 6*	
Entire City with State & Federal Property	155,314	58,291	38%	41* / 11*	State and federal property consisting of parks and military facilities add 2% to the city's overall UTC.
Without State & Federal Property	126,309	45,072	36%	41* / 11*	Residential tree cover and buffers along the city's waterways make up the majority of the city's UTC.

Note: Land area acreage identified does not include water or state and federal property.

The city's urban forest contains an estimated 3 million trees. Using the National Tree Benefit Calculator, which was developed based on the i-Tree street tree assessment tool, those trees provide over \$83 million in annual stormwater benefits to the city. As new software tools and more detailed tree inventory information becomes available, these numbers will be adjusted accordingly. The i-Tree software was developed from empirical models, based on observations in the field, and peer-reviewed studies over the last decade. Technical documents and information about the research behind the i-Tree application and utilities can be found at www.itreetools.org/resources/archives.php



Assessment of Urban Tree Canopy (UTC)

In 2008, the City received a Water Quality Improvement grant from the Virginia Department of Forestry and the Virginia Department of Conservation and Recreation to develop its first Urban Tree Canopy assessment. In 2013, the City received a Technical Assistance Grant from the Virginia Department of Forestry to develop a UTC Implementation Plan based on the 2008 UTC data assessment. The information provided on the following pages establishes the baseline for analysis of UTC percentages city-wide, as well as in many individual planning and land use categories. Tree canopy goals that are included in this Plan are also detailed. Another UTC data assessment is planned for 2014, and the changes in the city's UTC will be evaluated to determine trends in tree canopy expansion or loss. In addition, software is currently being developed as part of the Technical Assistance Grant which will assist the City in prioritizing tree preservation and planting sites.

Overall Characteristics

Based on the 2008 data, the city's overall tree canopy is 36%, not including state and federal properties. When state and federal property are included, the city's overall tree canopy is 38%. However, this assessment only includes areas within which the city has some level of planning control. Beyond the tree canopy, 31% of Virginia Beach's land area consists of pervious cover (grass/shrub and soil), and the remaining 33% is comprised of impervious cover including buildings, roads and other hard surfaces.

American Forests recommends a minimum of 40% UTC for cities in the mid-Atlantic region of the U.S. To meet this minimum, the city

would have to increase its overall UTC by 4%. As a point of reference, an estimated number of additional trees needed to increase the city's UTC by 1% is 80,000. This 1% increase would happen after a 15-20 year growth period and does not take into account tree removals or growth of existing trees. This example highlights the fact that although tree planting is an important element of increasing canopy cover, there are many other equally important elements that are essential to increasing UTC over time. Increasing the city's UTC is a multifaceted process that involves a wide variety of strategies such as:

- Actively maintaining the trees we have on public property to ensure that they increase in size
- Continuing to educate and encourage the planting of trees on private property
- Replacing dead or diseased trees on public property
- Working cooperatively with developers to preserve existing trees during development
- Educating the public to plant trees that contribute to species diversity, minimizing the chance of species 'meltdowns'
- Identifying and preserving publicly-owned open space that can be allowed to regenerate to forest
- Managing pests and diseases effectively

Using these and other new strategies outlined in this Plan, the city will be able to successfully increase its UTC. A citywide goal of reaching 45% canopy coverage over the next 20 years is achievable and will encourage other cities to adopt similar beneficial goals.

Pop Quiz

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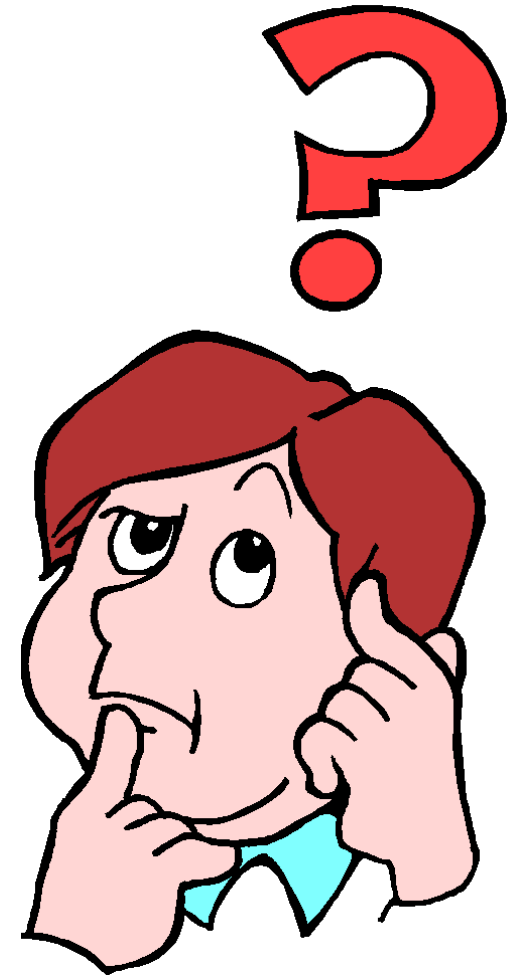
SUMMARY

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Question 4:

An urban tree canopy (UTC) analysis can be used for:

- A.** Quantifying tree canopy and other land cover types
- B.** Prioritizing areas for tree planting and forest protection
- C.** Educating the public and decision-makers about UTC
- D.** All of the above
- E.** None of the above



Pop Quiz

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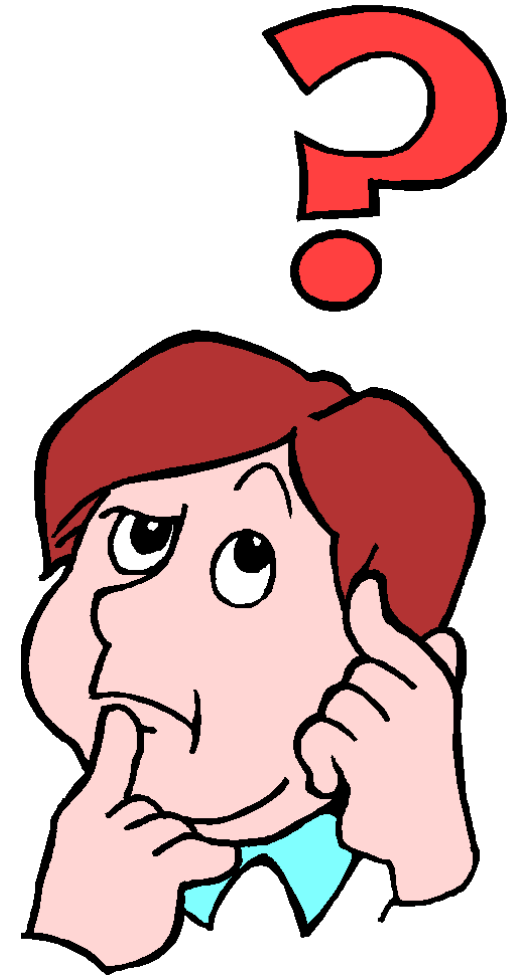
SUMMARY

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Question 5:

i-Tree Canopy is an example of an application used to perform a(n):

- A.** Sample tree inventory
- B.** Image classification UTC analysis
- C.** Photo interpretation UTC analysis
- D.** All of the above
- E.** None of the above



Urban Forest Assessment Resources

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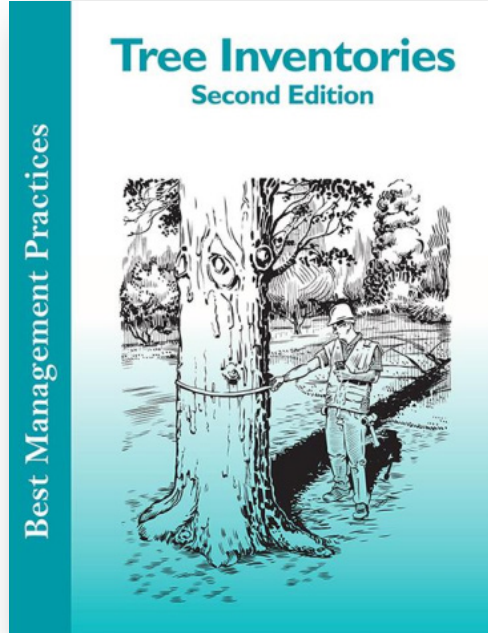
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Best Management Practices– Tree Inventories, 2nd Ed.

Jerry Bond (2013)

International Society of Arboriculture



Urban Forest Assessments Resource Guide

American Forests (2014)

[http://www.americanforests.org/
our-programs/urbanforests/
urban-forests-tools-resources](http://www.americanforests.org/our-programs/urbanforests/urban-forests-tools-resources)

Urban Forest Assessment Resources

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A Guide to Assessing Urban Forests

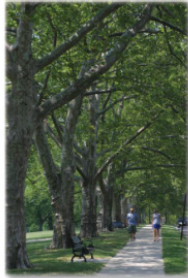
INTRODUCTION

Urban forests provide numerous ecosystem services. To quantify these services and guide management to sustain these services for future generations, the structure or composition of the forest must be assessed. There are two basic ways of assessing the structure or composition of the urban forest:

Bottom-up approach. Field-based assessments to measure the physical structure of the forest (e.g., species composition, number of trees)—typically used for strategic resource management or advocacy by connecting forest structure, functions and values with management costs, risks, and needs.

Top-down approach. Assessments of canopy cover using aerial or satellite images—used to determine amount and distribution of tree cover, potential planting space and other cover types.

These two approaches provide different types of urban forest information. The purpose of this guide is to outline the advantages, disadvantages and costs associated with various common assessment alternatives under these two approaches.



USDA United States
Department of Agriculture

US Forest
Service

Northern
Research Station

NRS-INF-24-13



A Guide to Assessing Urban Forests

David Nowak (2013)

**US Forest Service Northern Research
Station**

NRS-INF-24-13

i-Tree Tools 6.0.5

US Forest Service and Partners (2014)

<http://www.itreetools.org>

Urban Forest Assessment Resources

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Northern Research Station

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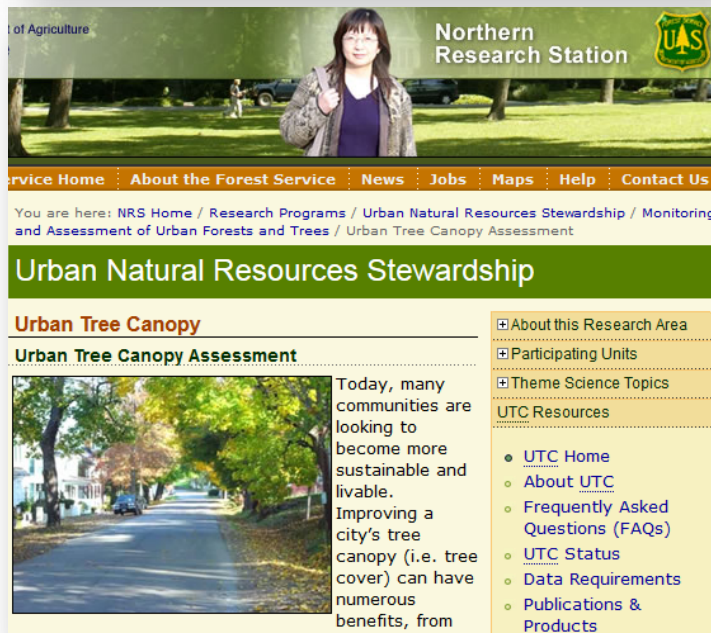
Publications & Data

Urban Forest Data

Urban forest data are being collected from across the United States based on top-down aerial approaches and bottom-up field data collection. This site links to various data sets and reports for urban forest data in the United States at the state level, county level, county subdivision level and local community or place level. Users are encouraged to explore states or communities of interest to see what data are available.

Data Toolbox

- GIS shapefiles | Metadata
- States (1.7 MB zip)
- Counties (9.5 MB zip)
- Places (20.5 MB zip)
Updated 11/8/2011
- County Sub-Divisions (36.1 MB zip)



Department of Agriculture
Northern Research Station


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Urban Natural Resources Stewardship

Urban Tree Canopy

Urban Tree Canopy Assessment



Today, many communities are looking to become more sustainable and livable. Improving a city's tree canopy (i.e. tree cover) can have numerous benefits, from

About this Research Area

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Urban Forest Publications & Data
US Forest Service
Northern Research Station

<http://www.nrs.fs.fed.us/data/urban>

Urban Tree Canopy Assessment
US Forest Service
Northern Research Station
Morgan Grove

<http://www.nrs.fs.fed.us/urban/utc>

Presentation Summary

OBJECTIVES

- **Urban forest assessment is the observation and evaluation of urban forest resources for applications in science, policy, management and outreach**
- **Urban forest assessment includes both bottom-up and top-down approaches, which have different capabilities and limitations depending on their application**
- **A tree inventory is powerful for understanding urban forest composition, tree maintenance needs, and ecosystem services**
- **A UTC analysis is powerful for understanding tree canopy amount, distribution, and spatial relationships with the human environment**
- **Numerous resources are available in the public and private sector for conducting an urban forest assessment**

BACKGROUND

TREE
INVENTORY

UTC
ANALYSIS

RESOURCES

SUMMARY

QUESTIONS

Thank you for participating!

Please type questions/comments
in the chat box

or

email to arborist@vt.edu for follow-up later!



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Virginia Cooperative Extension

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