i-Tree

Streets

User's Manual

i-Tree is a cooperative initiative

About i-Tree

i-Tree is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban and community forestry analysis and benefits assessment tools. The i-Tree tools help communities of all sizes to strengthen their urban forest management and advocacy efforts by quantifying the environmental services that trees provide and assessing the structure of the urban forest.

i-Tree has been used by communities, non-profit organizations, consultants, volunteers, and students to report on the urban forest at all scales from individual trees to parcels, neighborhoods, cities, and entire states. By understanding the local, tangible ecosystem services that trees provide, i-Tree users can link urban forest management activities with environmental quality and community livability. Whether your interest is a single tree or an entire forest, i-Tree provides baseline data that you can use to demonstrate value and set priorities for more effective decision-making.

Developed by USDA Forest Service and numerous cooperators, i-Tree is in the public domain and available by request through the i-Tree website (www.itreetools.org). The Forest Service, Davey Tree Expert Company, the Arbor Day Foundation, Society of Municipal Arborists, the International Society of Arboriculture, and Casey Trees have entered into a cooperative partnership to further develop, disseminate, and provide technical support for the suite.

i-Tree Products

The i-Tree software suite v 5.0 includes the following urban forest analysis tools and utility programs.

i-Tree Eco provides a broad picture of the entire urban forest. It is designed to use field data from randomly located plots throughout a community along with local hourly air pollution and meteorological data to quantify urban forest structure, environmental effects, and value to communities.

i**-Tree Streets** focuses on the ecosystem services and structure of a municipality's street tree population. It makes use of a sample or complete inventory to quantify and put a dollar value on the trees' annual environmental and aesthetic benefits, including energy conservation, air quality improvement, carbon dioxide reduction, stormwater control, and property value increases.

i-Tree Hydro is the first vegetation-specific urban hydrology model. It is designed to model the effects of changes in urban tree cover and impervious surfaces on hourly stream flows and water quality at the watershed level.

i-Tree Vue allows you to make use of the freely available National Land Cover Database (NLCD) satellite-based imagery to assess your community's land cover, including tree canopy, and some of the ecosystem services provided by your current urban forest. The effects of planting scenarios on future benefits can also be modeled.

i-Tree Species Selector is a free-standing utility designed to help urban foresters select the most appropriate tree species based on environmental function and geographic area.

i-Tree Storm helps you to assess widespread community damage in a simple, credible, and efficient manner immediately after a severe storm. It is adaptable to various community types and sizes and provides information on the time and funds needed to mitigate storm damage.

i-Tree Design is a simple online tool that provides a platform for assessments of individual trees at the parcel level. This tool links to Google Maps and allows you to see how tree selection, tree size, and placement around your home effects energy use and other benefits. This tool is in the early stages of development; more sophisticated options will be available in future versions.

i-Tree Canopy offers a quick and easy way to produce a statistically valid estimate of land cover types (e.g., tree cover) using aerial images available in Google Maps. The data can be used by urban forest managers to estimate tree canopy cover, set canopy goals, and track success; and to estimate inputs for use in i-Tree Hydro and elsewhere where land cover data are needed.

Disclaimer

The use of trade, firm, or corporation names in this publication is solely for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable. The software distributed under the label "i-Tree Software Suite v. 5.0" is provided without warranty of any kind. Its use is governed by the End User License Agreement (EULA) to which the user agrees before installation.

Feedback

The i-Tree Development Team actively seeks feedback on any component of the project: the software suite itself, the manuals, or the process of development, dissemination, support, and refinement. Please send comments through any of the means listed on the i-Tree support page: http://www.itreetools.org/support/.

Acknowledgments

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Introduction

Streets (an adaptation of the Street Tree Resource Analysis Tool for Urban Forest Managers [STRATUM]) is an easy-to-use software tool with a focus on a municipality's street trees that enables any community to inventory and assess the benefits its urban forest is providing. The analysis provides baseline data to improve management of the urban forest and assist communities to garner support and funding for their programs. Streets assesses the following aspects of a street tree population:

Structure: Streets describes the species composition, age distribution, species importance values, and canopy cover of the urban forest, helping managers anticipate future planting needs and the potential impact of pest threats.

Function: The core of Streets is its capacity to analyze the ecosystem services, i.e., the function, the urban forest is providing. These services include energy conservation, air quality improvement, stormwater management, and carbon dioxide reduction. Increased property values due to aesthetic and other benefits are also calculated.

Value: Streets quantifies the environmental and other benefits that the urban forest is providing, both in unit terms (e.g., kilowatt hours of electricity conserved) and in dollar terms. Management costs can be included in the analysis to determine the return on investment the trees are providing.

Management needs: If you choose to collect inventory data related to tree condition, maintenance requirements, infrastructure conflicts, or pest threats, Streets produces reports that will help make use of this information for management and budget planning.

Using the reports and information provided by Streets will help you:

Improve the return on your investment dollar by determining which tree species maximize canopy cover and provide the benefits that are important to your community.

Determine the management needs of your urban forest to maintain and improve the health of the trees.

Encourage investment from partners for such things as carbon credits or energy conservation.

Gain public support by demonstrating the value of trees to enhancing the quality of life in your community.

Conduct economic evaluations of tree performance using annual budget and expenditure data.

Assess costs of management—rather than benefits alone—to provide a platform for strategic planning.

Designed to be flexible and adaptive, Streets is not GIS-based and requires only basic inventory data. The Streets inventory protocol and PDA application or web-based smartphone functionality can be used for communities interested in conducting a sample or complete street tree inventory. In addition, Streets can make use of any existing street tree inventory as long as species and DBH data are present. The inventory must be formatted according to Streets protocols.

Reports can be produced for the entire city, for management zones, or by species. Streets uses regional tree growth models and regional default costs and benefits, which can be customized for local conditions. Streets will provide you with quantifiable justification for your tree program, whether you want to preserve existing trees or increase your budget. You will be able to answer the most important question related to your tree program: Do the accrued benefits of street trees outweigh their management costs?

State-of-the-art research provides the scientific foundation for Streets' benefits reports. Data on the benefits and costs of maintaining street trees come from extensive field research and laboratory modeling for 16 national climate regions. For more information on the methods used, see the published series of Tree Guides (available at www.itreetools. org under Resources), which correspond to the Streets climate regions.

About This Manual

This manual provides all the information needed to conduct a Streets project. We begin with installing the software and continue with the four project phases:

Phase I: Getting Started. In this section, we talk about decisions that need to be made right at the outset, such as whether you will use an existing inventory or conduct a new one and whether a new inventory will be a random sample of street segments or a complete inventory of all trees. Phase I also includes gathering general data that you'll need to consider or have ready, such as city budget information, local benefit prices, and a list of street names for inventories. During this phase, you will also plan your inventory, either determining the fields you will collect and defining the categories within them or organizing your existing inventory to fit the Streets requirements. The final step in getting started is creating a sample inventory, if necessary.

Phase II: Getting Started with the Software. In this section, we use the Streets software to enter the data we collected during Phase I, configure our inventory, and set-up the PDA application or smartphone/tablet functionality for those who will be using these tools to collect data.

Phase III: Out in the Field. This phase is where all the hard work gets done, as you send your inventory crews out into the field to collect data. This section of the manual focuses on using your web-enabled mobile device, such as a smartphone or tablet, or PDA.

Phase IV: Back at Your Desk: Running Streets. In this section, we describe how to run the software to get results. We start with transferring data from the paper forms, your smartphone or tablet, or a PDA to the desktop or uploading your existing inventory, and discuss how to make changes to your inventory and how to recheck data in the field. Lastly, this section covers all of the available reports and describes how to save, export, and print your results.

Appendix I: Random Sample Workbook. If you are conducting a sample inventory, Appendix I gives step-by-step instructions for one method of generating random street segments using ArcGIS.

Appendix II: Troubleshooting. There are a few common mistakes we've noticed over the years that happen to Streets users. In this appendix, we describe what they look like and how to fix them.

Appendix III: Formatting Pest Protocol Data for Import. Tables presenting the data fields and categories associated with the IPED pest detection protocol are given here.

Installation

System Requirements

Requirements for desktop/laptop computers

Minimum hardware:

- 1600 MHz or faster processor
- 512 MB of available RAM
- Hard drive with at least 500 MB free space

Software:

- Windows operating system: XP service pack 2 or higher, including Windows 7
- Microsoft Excel
- Microsoft Data Access Component (MDAC) 2.8 or higher (included in installation)
- .NET 2.0 framework (included in i-Tree installation)
- Adobe Reader 9.0
- For PDA users, ActiveSync 4.5 or higher for Windows XP, or Mobile Device Center 6.0 or above for Vista and Windows 7 (included in i-Tree installation)
- Crystal Report 2008 Runtime (included in i-Tree installation)

Requirements for field data collection devices

Smartphones, tablets, and other web-enabled mobile devices:

- A web browser with HTML-5 compatibility (most recent versions of Chrome, Firefox, and Safari; IE 9 and 10 have limitations)

For an updated list of compatible devices, see the i-Tree forum at http://forum.itreetools.org.

PDAs:

- Windows Mobile 5.0–6.5 operating system
- 240 × 320 screen resolution

Requirements for GPS devices

Collecting GPS coordinates during an i-Tree Streets project is entirely optional. For those who are interested, GPS-enabled devices running the Windows Mobile 5.0–6.5 operating

system or compatible devices paired with NMEA Bluetooth or serial GPS devices may be used.

i-Tree Streets users have successfully used the Trimble Juno SB, Trimble Nomad, Pharos Traveler 525 and MWg Zinc II, among others. Functionality of GPS devices can differ, however, and some devices may not operate as well as others. For example, the Pharos m619 GPS does not work properly with Streets and is currently not recommended.

The GPS functionality of your smartphone or tablet can also be used.

Installation

To install Streets on your desktop:

1   Visit www.itreetools.org to download the software or insert the i-Tree Installation CD into your CD/DVD drive.

2   Follow the on-screen instructions to run the itree_setup.exe file. This may take several minutes depending on which files need to be installed.

3   Follow the Installation Wizard instructions to complete the installation (default location recommended).

You can check for the latest updates at any time by clicking **Help** > **Check for Updates**.

Exploring Streets with the Sample Project

Now that you've installed Streets, you would probably like to see a little of what the software can do. To allow you to explore the program, we've included a sample project based on a random sample inventory of the street trees of Davis, California. In addition, for those interested in the reporting features of the Pest Detection module, an IPED Sample Project has been included.

1   You can begin by opening Streets using your computer's **Start** menu > **(All) Programs** > **i-Tree** > **i-Tree Streets**.

2   You will find the project under **File** > **Open** > **Sample Project**.

Under the **Input** menu, you can see the many customizable fields for your inventory, your city's basic data, and budget costs and benefit prices. In the **View** menu, you can switch between English and metric units and between scientific and common names. Under **Reports**, you can explore the benefits, structural, replacement cost, and pest reports. We will, of course, explain all of these steps in more detail, but for now feel free to explore and see what options and functions are available.

Phase I: Getting Started

Early Decisions to Be Made

Before you get started with Streets there are several decisions that must be made. In this section, we'll describe some of the pluses and minuses of each option to help you choose.

Do you have an existing inventory or will you need to conduct one?

If your community already has a tree inventory that was conducted recently and that includes at minimum tree species and DBH, you can use it for Streets. It will simply need to be formatted to match the Streets minimum requirements and saved as a Microsoft Access database. The Inventory Planning section below describes the required structure. A supplementary guidebook, *Formatting Existing Inventories into Streets*, is available at www.itreetools.org > **Resources** > **Archives** along with other resources for importing an existing inventory into Streets

Two additional factors should be kept in mind for communities with existing inventories. First, if you only have a sample inventory (i.e., you measured some, but not all, of your city's trees), it must be a simple random sample or it will not function properly with the underlying models. Second, Streets provides a snapshot-in-time picture of the benefits and structure of your urban forest. If your inventory is not recent, the results you receive will not reflect existing conditions and you should consider conducting a new inventory.

If you need to conduct an inventory, will you measure every street tree in your study area or carry out a random sample?

If you do not have an inventory, you will need to conduct one. It can either be a complete inventory in which you determine at least the species and DBH of every street tree within your community or it can be a sample inventory. In a sample inventory, street segments (or linear plots) are selected according to the statistical principles of random sampling, and all the trees along the selected segments are inventoried. Sample inventories generally include 3–6% of all street segments, depending on community size and variation from segment to segment. This sampling rate has been shown to produce about a 10% standard error for the total number of trees citywide.

A complete inventory provides a much more comprehensive picture of your urban forest and a great foundation for daily work activities as well as future planning. A sample inventory, on the other hand, is quicker, less expensive, and can provide baseline data for decision making, but typically cannot be used for day-to-day management activities. You should balance the needs and resources of your community to decide which inventory method is appropriate.

If a new inventory is needed, will you collect data using (a) the Streets webform on a smartphone, tablet, or other web-enabled mobile device, (b) the Streets PDA tool, or (c) paper forms for manual data entry?

iTree Streets v.5.0 includes a very important update: inventories can now be conducted using web-enabled smartphones or tablets (hereafter mobile devices). The Streets mobile device functionality isn't an app that you have to download from a store; it's a web-based inventory data collection form. This means that the only requirement is a device with a web browser that is HTML5 compatible. Compatible browsers include most recent versions of Chrome and Firefox (for Android phones and tablets), Safari (for iPhones and iPads), and to a lesser extent, Internet Explorer 9 and 10 (for Windows phones and tablets). IE is limited by its ability to cache data offline—users must remain "connected" while collecting field data. For this reason, if you are using IE, you should be prepared to transfer your data from your mobile device to the server frequently and recognize that a lost data connection means all data since last submission will be lost.

For a running list of compatible devices, see the i-Tree forum at http://forum.itreetools.org.

In addition to the mobile webform, Streets v. 5.0 continues to support the use of a PDA in conducting inventories. The PDA application works seamlessly from within Streets. It is fully customizable for your city's inventory needs, easy to use, and results in a one-click data transfer process to your Streets project. The PDA application will work with several handheld devices running Window's Mobile 5.0–6.5. For an updated list of compatible devices, see the *System Requirements and Installation Document* at www.itreetools.org > Resources > Manuals and Workbooks.

If your community lacks funding to support the use of mobile devices or PDAs or you simply prefer to use an alternate method, that's no problem. Inventories can be conducted using paper forms, proprietary inventory tools, spreadsheets, etc. With paper forms, tree records can be entered directly into Streets using the user-friendly data entry form. For all other methods of inventory, the end result must simply be a Microsoft Access database in a specific format. You should review the Inventory Planning section below to get an idea of what data are necessary to help with planning.

Gathering General Data

A great deal of information in Streets can be customized for your city, including benefit prices (e.g., the price of one kilowatt-hour of electricity or a ton of carbon dioxide), budget information, and data on city infrastructure. In some cases, such as benefit prices, default information for the region comes pre-loaded into Streets and can be edited to suit your community. In other cases, entering the data is optional, but will result in more valuable output. In this section, we describe the customizable inputs and provide worksheets to help you gather the information. Each worksheet below represents a data-entry window within Streets where the information will eventually be entered.

Define City information

Streets will report per capita values for benefits and costs and calculate several values related to canopy cover. If you are interested in this information, use the Define City Info worksheet to gather the necessary information.

Define City worksheet

Field	Your data
Total municipal budget	
Population	
Total land area (sq. miles)	
Average sidewalk width (ft)	
Total linear miles of streets (miles)	
Average street width (ft)	

Define Costs information

Using basic inventory information, Streets will calculate the benefits your urban forest is providing. To calculate the benefit-cost ratio of those benefits (a valuable public-policy tool), however, requires data on citywide costs associated with street tree management. If you are interested in comparing the benefits and costs of your urban forest, use the Define Public Costs worksheet to gather the necessary information. Because benefits are reported as annual sums, citywide costs associated with street tree management should also be annual values. Do not forget to include tree-related costs that may come from other departments' budgets, such as sidewalk repair costs or litigation fees.

Some communities wish to separate out costs for public versus private trees. This allows the benefit-cost ratio to be calculated separately, for instance, for trees in the public right-of-way whose maintenance is paid for by the adjacent property owner and for trees in the public right-of-way that are maintained using public funds. If you will distinguish between public and private trees in your inventory, complete the column for private costs in the Define Costs worksheet to estimate costs associated with private trees.

Define Costs worksheet

Field	Public costs	Private costs
Annual planting		
Annual pruning		

Define Costs worksheet, continued.

Field	Public costs	Private costs
Annual tree and stump removal and disposal		
Annual pest and disease control		
Annual establishment/irrigation		
Annual price of repair/mitigation of infrastructure damage		
Annual cost of litter/storm clean-up		
Average annual litigation and settlements due to tree-related claims		
Annual expenditure for program administration		
Annual expenditures for inspection/ answer service requests		
Other annual expenditures		

Define Benefit Prices info

Streets comes preloaded with unit prices for calculating urban forest benefits based on prices that are typical for your region. You are encouraged to update some or all of the benefit prices to match local market conditions. Use the Define Benefit Prices worksheet to gather the information.

Define Benefit Prices worksheet

Field	Your data
Electricity ($/kWh)	
Natural gas ($/therm)	
CO_2 ($/lb)	
PM_{10} ($/lb)	
NO_2 ($/lb)	

Field	Your data
SO_2 ($/lb)	
VOC ($/lb)	
Stormwater interception ($/gallon)	
Median home resale value ($)	

Inventory Planning

The first step in inventory planning, whether you have an existing inventory or are planning to conduct one, is to determine what information you will incorporate. Streets has some very flexible options and some very rigid rules for inventories. In this section, we describe the inventory fields that are available for use and the customizable and default categories within each field. If you intend to conduct a new inventory, this section will help you plan for data collection. If you are using an existing inventory, this section describes the framework you must use to organize your data.

To perform a Streets analysis, your inventory must include the species and DBH for each tree. All other inventory information is optional. The benefits of collecting more data on each tree include the ability to report on condition and maintenance needs, replacement value, location, species performance, and pest detection. Additionally, inventory details (i.e., street address, GPS coordinates, survey date) can be collected to aid in record management. Decide, based on the list below, which fields you will include.

Reportable data

Species: Required. Streets uses codes to identify species rather than scientific or common names. To greatly reduce the time and effort involved in working with Streets, you should plan from the start to use Streets species codes to identify your trees. A complete list of codes with scientific and common names can be found at www. itreetools.org > **Resources** > **Archives** > *i-Tree Streets & STRATUM Species Codes by Climate Region*. Streets recognizes the most prevalent species in each region. However, many other species may be included in your city's street tree inventory. Give these species a code that does not match any of those on the species code list; you will be able to enter these later directly into Streets. Non-tree codes can also be used to keep track of empty planting sites, stumps, etc.

DBH: Required. Diameter ranges or actual values can be used.

Tree ID: Required. Each tree must have a unique identifying number. Streets will generate these automatically.

Management zone: Optional. You have the option of dividing your city into

management zones or neighborhoods to provide more information on how the urban forest structure and benefits differ in different areas.

Street Segment: Required for sample inventories. This is a unique number that identifies the street segment the inventoried tree is located in. If you are using the method in Appendix 1 to create an inventory, this field would be the Tiger Line ID.

City managed (public vs private): Optional. Streets will calculate benefits and costs separately for public and private trees if you choose to distinguish between them during your inventory.

Condition: Optional. The condition category relates to the health and structure of the trees (e.g., poor condition, good, dead/dying). Assessing the condition of the trees will help with planning for future management needs and can help identify trends across different neighborhoods.

Maintenance: Optional. The maintenance category includes two fields: **recommended maintenance** (e.g., routine maintenance for small tree, immediate maintenance for large tree) and **priority task** (e.g., clean crown, treat pests). Determining the maintenance needs of the trees will help with prioritizing, planning and budgeting for future tree care activities.

Land use: Optional. The land use category describes the broad land use of the area where the tree is planted (e.g., residential, commercial, industrial). Assessing land use can help you to better understand the distribution of canopy and identify underserved areas where future plantings can be emphasized.

Site type: Optional. The site type category identifies the kind of planting site (e.g., planting strip, cutout). Determining the site type is useful for comparisons with tree conflicts and maintenance recommendations and tasks for understanding problem planting sites for specific species

Conflicts: Optional. The conflicts category includes two fields: sidewalk damage and wire conflicts. The sidewalk damage category measures the extent of damage to sidewalks from nearby trees (e.g., heaved 3/4 to 1 1/2 inches). The wire conflicts category addresses potential or existing conflicts between tree branches and overhead utility lines. Assessing these conflicts allows maintenance costs for sidewalk repair or pruning to be anticipated and allows the species associated with the most conflicts to be identified.

Pest signs and symptoms: Optional. The pest detection fields make use of a uniform and systematic protocol, developed by the US Forest Service, for assessing signs and symptoms to help with early detection of pests and diseases. Following the protocol requires completing approximately 15 data fields for each tree, including checking the trunk, branches, and foliage for signs of stress, damage, or abnormal growth. Because of the nature of the protocol, these fields are not customizable within Streets. For detailed information, refer to the Pest Detection Protocol webpage (www.itreetools.org/iped/index.php) or the online Wiki IPED resources site (http://wiki.bugwood.org/IPED).

Other 1, 2, 3: Optional. Streets allows up to three additional data fields to be collected. Note that the data fields can not be open-ended but must be divisible into 10 or fewer categories. For example, a field called "General remarks" can not be created, but a field called "Landmark tree" with categories "yes" and "no" could be.

Inventory details

Location and surveyor information, as well as notes and comments, can be incorporated into Streets records. Although this information will not appear in the reports, you can view this information at the record level and use it to sort the data, locate and re-inventory individual trees, or conduct analyses outside of Streets.

Street address: House number and street name can be collected.

GPS latitude/longitude: GPS coordinates for the tree location can be recorded.

Surveyor: The name of the person or team who inventoried the tree can be recorded.

Survey date: The date of the inventory can be recorded.

Location site: The location of the planting site in relation to the building address can be recorded (e.g., front, rear, side-right, side-left).

Location number: The position of a tree can be recorded as a way to distinguish between multiple trees at one address, e.g., by numbering trees consecutively in the direction of traffic flow.

Defining categories for each field

For each inventory field described above, Streets includes default category options. For all categories except pest detection, these defaults can be customized to suit your needs. In the following worksheets, the default options for each field are presented along with blank spaces to fill in your customized choices for the fields you decided to collect.

Define DBH Categories worksheet

If you decided to measure DBH in classes instead of exact measurements, enter the range you will use for each class.

Code	Streets default value	Your value
1	0–3 in (0–7.6 cm)	
2	3–6 in (7.6–15.2 cm)	
3	6–12 in (15.2–30.5 cm)	
4	12–18 in (30.5–45.7 cm)	
5	18–24 in (45.7–61 cm)	
6	24–30 in (61–76.2 cm)	
7	30–36 in (76.2–91.4 cm)	
8	36–42 in (91.4–106.7 cm)	
9	42+ in (106.7+ cm)	
10	—	

Define Management Zones worksheet

If you will be dividing your city into management zones or neighborhoods, enter their names if desired (use additional sheets if more zones are needed).

Zone	Name
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Define Conditions worksheet

If you decided to collect inventory information related to tree condition and you wish to change the default options, define your codes here. Replacement factor percent (RFP) values are used in calculating the replacement values of the trees using the CTLA method and reflect the relative structural integrity and health of a typical tree in the given condition. Provide an appropriate RFP for each of your conditions.

	Streets defaults			Your condition values		
Code	Description	Woody RFP (%)	Foliage RFP (%)	Description	Woody RFP (%)	Foliage RFP (%)
1	Dead or dying	10	10			
2	Poor	35	35			
3	Fair	60	60			
4	Good	85	85			
5						
6						
7						
8						
9						
10						

Define Maintenance worksheet

If you decided to collect information related to tree maintenance recommendations and/or priority tasks and you wish to change the default options, define your codes below.

Code	Streets defaults	Your maintenance recommendations
1	None	
2	Small tree (routine)	
3	Small tree (immediate)	
4	Large tree (routine)	
5	Large tree (immediate)	
6	Critical concern (public safety)	
7		
8		
9		
10		

Code	Streets default	Your priority tasks
1	None	
2	Stake/train	
3	Crown clearing	
4	Crown raising	
5	Crown reduction/thinning	
6	Remove	
7	Treat pests/disease	
8		
9		
10		

Define Land Use worksheet

If you decided to collect information related to land use and you wish to change the default options, define your codes below.

Code	Streets defaults	Your land use categories
1	Single family residential	
2	Multi-family residential	
3	Small commercial	
4	Industrial/large commercial	
5	Park/vacant/other	
6		
7		
8		
9		
10		

Define Site Type worksheet

If you decided to collect information related to site type and you wish to change the default options, define your codes below.

Code	Streets defaults	Your site type categories
1	Front yard	
2	Planting strip	
3	Cutout	
4	Median	
5	Other maintained locations	
6	Other unmaintained locations	
7	Backyard	
8		
9		
10		

Define Conflicts worksheet

If you decided to collect information related to sidewalk damage or utility line conflicts and you wish to change the default options, define your codes below.

Code	Streets defaults	Your sidewalk heave categories
1	0–3/4 in	
2	3/4–1 1/2 in	
3	> 1 1/2 in	
4		

Code	Streets defaults	Your wire conflict categories
1	No lines	
2	Present and no potential conflict	
3	Present and conflicting	
4		
5		

Define Other 1 worksheet

If you decided to customize the Other 1 category, define your codes below.

Code	Title of category:
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Define Other 2 worksheet

If you decided to customize the Other 2 category, define your codes below.

Code	Title of category:
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Define Other 3 worksheet

If you decided to customize the Other 3 category, define your codes below.

Code	Title of category:
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Creating a Sample

If you do not have an existing inventory and you have decided to conduct a sample inventory rather than a complete one, the next step in planning is creating a random sample of street segments. This can be done in several ways, one of which is outlined in Appendix 1. What is critical for all sampling methods is that they must follow simple random sampling conventions based on linear street segments to be compatible with the underlying Streets models.

Sample inventories are generally a 3–6% sample of total street segments, depending on community size and variation from segment to segment. This level will produce about a 10% standard error for the total number of trees citywide. The following general guidelines can be used as a starting point for determining sample sizes:

- For communities with human populations under 50,000, sample size is 6% of total street miles or segments

- For populations between 50,000 and 150,000, sample size is 5%

- For populations between 150,000 to 250,000, sample size is 4%

- For populations over 250,000, sample size is 3%

All communities differ in their tree density, street miles, and population characteristics. Therefore, no single sampling intensity will work uniformly for all communities of a similar size. Ultimately, it is up to you to determine sampling size and an acceptable level of error based on how the results will be used.

Regardless of the method you use to create your sample, the end result should be a simple random sample of street segments. In addition, you must know the total number of street segments in your study area. If you will be dividing your study area into management zones or neighborhoods, you must also know the total number of street segments in each zone. Enter the total number for each zone or for the city on the worksheet on the next page.

> NOTE: There are a few things to keep in mind when you're collecting data for a sample inventory. They are discussed in Phase III.

Sample worksheet

If you have divided your city into management zones or neighborhoods and are completing a sample inventory, fill in the *total* number of segments (not the number to be sampled) in each zone (use additional sheets if more zones are necessary). If you are not using management zones, enter the total number of segments in the entire community under Zone 1.

Zone	Total no. of segments	Zone	Total no. of segments
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

Creating a List of Streets

If you decided to conduct a new complete inventory, it will simplify data collection if you have a list of all streets in your project area. The proper format is a *.csv file with one street name per row (created in Excel) or a *.txt file with one street name on each line (created in Word, Notepad, or Wordpad).

Formatting Existing Inventories

If you are working with an existing inventory, you must format your data to conform to the Streets requirements. The end result will be a Microsoft Access database that includes at least Species and DBH fields, but can additionally include any of the 28 fields in Table 1 and/or all of the fields used in the Pest protocol (see Appendix 3). The Access file can have any name, but the table within it containing the inventory must be called STRATUM_Inventory.

The requirements for formatting are as follows:

You are only required to include fields for which you have data. If, for example, you only have species and DBH data, your database will only need two columns.

The field names must appear exactly as they are shown in Table 1. Spelling is critical.

Your data must match the format shown in Table 1. For example, the SpCode field must be formatted as text and the DBH field must be formatted as a number.

Entries without data should be left blank or filled with zeros. Streets data fields that are not used in your inventory can be omitted from the import process.

A supplementary guidebook, *Formatting Existing Inventories into Streets*, is available at www.itreetools.org > **Resources** > **Archives** along with templates and other resources for importing an existing inventory into Streets .

Existing STRATUM or MCTI projects

If you have an older STRATUM-formatted database (*.mdb) or i-Tree Grand Database (*.mdb), these do not need to be reformatted; they can be imported in their existing form. In fact, if you have an older STRATUM project (with the *.proj file extension), the project itself can simply be opened as it is from the Streets File menu.

Existing MCTI projects

If you have an existing MCTI project and choose to import that inventory data into Streets, the MCTI.mdb database will need to be reformatted to conform to the Streets requirements as described above. Once this has been completed, the procedures for importing an existing inventory can be followed. It is suggested that you work with a copy rather than the original MCTI database.

Table 1. Required field names and formats as well as category options for final Streets Access database. It is only necessary to include the fields for which you have data. Remember to be extra careful with the spelling of the field names as they must be exact.

Field name	Format	Possible values
ID	Number	0-4,000,000,000
StreetSeg	Number	0-4,000,000,000 if sampling or 0 for complete inventory
Zone	Number or text	1-4,000,000,000 if number; up to 20 characters if text; or blank if not recorded
SpCode	Text	Up to 10 characters; see www.itreetools.org > Resources for species codes
CityManaged	Number	1 if yes, 0 if private; 1 or blank if not recorded (assumes public tree)
DBH	Number	1-10 for categories or actual value
LandUse	Number	1-10; blank or 0 if not recorded
SiteType	Number	1-10; blank or 0 if not recorded
LocSite	Number	1-10; blank or 0 if not recorded
LocNo	Number	1-10; blank or 0 if not recorded
MtncRec	Number	1-10; blank or 0 if not recorded
MtncTask	Number	1-10; blank or 0 if not recorded
SwDamg	Number	1-10; blank or 0 if not recorded
WireConflict	Number	1-10; blank or 0 if not recorded
CondWood	Number	1-10; blank or 0 if not recorded
CondLvs	Number	1-10; blank or 0 if not recorded
OtherOne	Number	1-10; blank or 0 if not recorded
OtherTwo	Number	1-10; blank or 0 if not recorded
OtherThree	Number	1-10; blank or 0 if not recorded
GPS_Lat	Text	Decimal degrees (0-90) with direction (35.34642345N)
GPS_Lon	Text	Decimal degrees (0-180) with direction (98.34642345W)
StreetName	Text	Up to 50 characters
StreetNumber	Text	Up to 50 characters
SurveyorId	Text	Up to 10 characters
SurveyDate	Date/Time	Any allowable date/time format
NoteThisTree	Yes/No	Yes or No
Comments	Text	Up to 255 characters

Phase II: Getting Started with Streets

Once you've collected your general data, decided which fields to collect during your inventory and how you will customize the categories within each field, and created a random sample, if appropriate, it's time to get started with the software.

1   To begin working with Streets, click your computer's **Start** menu > **(All) Programs** > **i-Tree** > **Streets**.

2   To start a new project, click **File** > **Open** > **New project**. The **New Project** window will appear.

  a   The first entry in the **New Project** window asks you to name and locate where the project database will be stored. Next to the **Database** field, click the **Specify** button and choose **Create New**. Browse to the location where the file should be saved. Enter a name in the **File Name** field and click **Save**.

      Note: The **Specify** > **Select Existing** option allows you to add a new project to an existing Streets project database .

  b   Enter a name in the **Project Name** field.

  c   In the **Inventory Type** field, choose between complete or sample inventory from the drop-down menu.

  d   Enter the year in which the inventory was done in the **Year** field.

  e   In the **Climate Region** field, select your city's climate region from the drop-down list. If you aren't sure which climate region to use, click **View Map** (Fig. 1).

  f   Click **Finish** to move to the next window.

3   In the **Define City** window, select your country, state, county and city from the drop-down menus.

  a   If you collected your city's information using the Define City worksheet, you can enter the data now or return to this window later by clicking **Input** > **City Information**. Click **OK** to move to the next window.

4   In the **Define Cost** window, enter the budget information you collected using the Define Costs worksheet for Public trees and Private trees. You can also return to this window later to add or edit data by clicking **Input** > **Annual Costs**. Click **OK** to move to the next window.

Fig. 1. Streets climate zones.

5   In the **Benefit Prices** window, enter the benefit prices you collected using the Define Benefit Prices worksheet or accept the regional default options by clicking **OK**. You can also return to this window later to add or edit data by clicking **Input** > **Benefit Prices**. Click **OK** to move to the next window.

6   The **User Defined Fields** menu appears next. In the **Record** tab, check the boxes next to the inventory fields you decided to collect or that are present in your existing inventory. If you will be working with the PDA or intend to use the manual data entry form, keep in mind that only the fields you check here will be available later. You can return to this window and any of the subsequent ones later to edit the project data fields by clicking **Input** > **Data Fields**.

    a   Click the **DBH** tab and choose whether you are measuring DBH by class or exact measurements. Choose whether measurements are in inches or centimeters. If you elected to create your own DBH classes, enter the appropriate ranges for each class to the left based on the Define DBH Categories worksheet. Click **Defaults** to reset to the Streets default options.

    b   The **Zone/Sample** tab has two functions: stratifying an inventory into zones and indicating the number of street segments in each zone or in the city. If you decided during Phase I: Getting Started: Inventory Planning that you would divide your city into management zones or neighborhoods and you specified names for them in the Define Management Zones worksheet, you should enter the zone names here. To add new zones, click **New** and enter a name directly into the grid if desired.

       For sample inventories, enter the number of street segments per Zone from the Sample worksheet directly into the grid under **Number of Segments**. If you haven't stratified your inventory into zones, enter the total number of street segments in the entire city under Zone 1.

       [Note: This is the total number available, not the total number sampled. The total number sampled will be tallied automatically from the inventory.]

7   If you created a list of streets to use during your inventory, click on the **Streets** tab and then **Import List** and navigate to the location where it is stored. Click **Open**. Alternatively, you can simply type the street names into the grid; ID numbers will be generated automatically.

8   For the remaining tabs, enter your customized categories for each field from the worksheets or leave the default options as they are. Clicking **Defaults** will restore all categories for that field to the Streets defaults.

9   When you are finished editing all of your inventory fields, click **OK**. You can return to the User Defined Fields window to make changes at any time by clicking on the **Input** menu > **Data Fields**.

Once you have completed these windows, your project will be saved automatically. When you make changes in the future, be sure to save your work frequently under **File** > **Save Project**, by clicking the **disk icon**, or by pressing **Ctrl-S**.

NOTE: If you have decided to conduct your inventory on paper or with a method other than a PDA or mobile device, you can head out to the field.

Preparing for Data Collection with Smartphones and Tablets

 Once you have defined the fields and categories for your inventory, the information can be transferred to the Web for data collection on your mobile device.

NOTE: If you are using the Pest Detection Protocol, be sure to update the module before beginning the PDA configuration. This will ensure that you can load the latest information from US Forest Service forest health experts. To do so, select Update IPED under the Help option in the menu bar.

Send project configuration to the Web (i-Tree online server)

To send your customized data fields and other project information to the Web where they can be accessed from your mobile device:

1 Select the **Tools** menu > **Work with Mobile**. The **Streets Mobile Manager** window will appear.

2   Click **Submit Project Configuration** and click **Next**.

3 If this is a new project, the next window will be blank.

NOTE: For existing projects, in this window, you would select any trees whose data you would like to have available out in the field. This is helpful for quality control checks, for example.

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4 Click **Next**.

5 In the final window, you'll be asked to enter an email address and password. (Please note that these are unrelated to your i-Tree log-in credentials.) These will be the email and password associated with this project for the duration of your work, so be sure to write them down. A special link customized for the project will

be sent to the email address and can be shared with all users to access online data collection sheets for the project via the Internet.

Project email address: _____

Project password: _____

> NOTE: For best project management techniques, each project should have one data manager who is using one computer to run the Streets project. This person will be responsible for downloading all data submitted to the server so that it can be properly incorporated into Streets.

Preparing for Data Collection with PDA

Once you have defined the fields and categories for your inventory, the information can be uploaded to the PDA if that is your inventory method of choice.

> NOTE:If you are using the Pest Detection Protocol, be sure to update the module before beginning the PDA configuration. This will ensure that you can load the latest information from US Forest Service forest health experts. To do so, select Update IPED under the Help option in the menu bar.

Check status and install necessary components

When you are ready to transfer data to the PDA:

1   Connect the PDA to your computer and ensure that it is recognized.

    [Note: Check the manual that came your PDA if you have trouble getting your computer to "see" it.]

2   With Streets open on your computer, select the **Tools** menu > **Work with PDA**. The **Streets PDA Transfer** window will appear.

3   Click **Check Status**. Streets will determine if ActiveSync or Windows Mobile Device Center is installed on your PC, if you have the proper PDA OS and the proper .NET version, and whether the Streets PDA Application is installed. If not, the incorrect versions or missing software will appear in red and the Install button will be highlighted.

4 Click **Install** to begin installation of necessary software. Click **Yes** to install the i-Tree Streets PDA application and follow the remaining instructions on the desktop and, as directed, on the PDA screen. After installation, click **Check Status** again to ensure that all installations were successful. If any versions still appear in red, click **Install** again and proceed as before.

Send project configuration to PDA

To send your customized data fields and other project information to the PDA:

1 Click **Tools** > **Work with PDA** on your desktop.

2 With the PDA connected to your computer and actively communicating, click **Send Project Configuration to the PDA**.

You can only make changes to the PDA configuration (e.g., add new fields, edit category definitions) through the desktop application. If you find that you need to make changes:

1 From within the Streets desktop interface, click on the **Input** menu > **Data Fields** and make your changes.

2 Follow the steps above for sending the project configuration to the PDA. This will overwrite your previous choices.

NOTE: For best project management techniques, each project should have one data manager who is using one computer to run the Streets project. This person will be responsible for downloading all data submitted to the server so that it can be properly incorporated into Streets.

Phase III: Out in the Field

Sample Inventories

There are a few things to keep in mind when conducting a sample inventory that are different from a full inventory. First, of course, is that you'll only be collecting data on trees that are within the segments on your list. Second, if a segment has NO trees, it is very important to capture this information so that the total number of trees in your city can still be estimated.

For the treeless segment, create one record in the database and enter the following data:

- Tree ID: give it a number even though it is not really a tree.
- Management zone: if, during project configuration, you decided to track management zones, record the zone the segment is in.
- Street segment: record the street segment.
- Species: enter a species code specially designated for this circumstance, such as NOTREE.

Since there are no trees, no other data are necessary.

> NOTE: If you are collecting data on available planting spaces and a treeless segment includes available planting spaces, it is not necessary to create this NOTREE record.

If you are conducting an inventory using paper forms or another non-i-Tree platform, you can head out into the field and get started with data collection. If you'll be using the PDA or mobile device, instructions follow.

Using Your Smartphone or Tablet

Some important things to know about using a mobile device with Streets

To allow access to Streets across the greatest number of devices, we have chosen to build the mobile device functionality as a webform accessed from your Internet browser rather than as an app. This has several consequences for use:

- As you collect data, it is stored temporarily within your Internet browser's cache. The amount of storage available there varies significantly based on the device, browser, and setting. You can increase the amount of storage available by clearing your browser history and data. If your storage is full from browsing history or other

data, your tree data may be limited to relatively few records. With cleared history and data, you will likely be able to store hundreds, if not thousands, of records. Regardless, data should be submitted to the server frequently (see below)!

- For Chrome, Firefox, and Safari users, although you will be working via a Web page, you are not limited to working only when you have Internet access (via wireless or a 3G, 4G, or Edge network). The browser's cache as described above will allow you to work temporarily without an Internet connection. So although you need not worry about short-term losses in connectivity, eventually you must connect and submit your data.

- For Internet Explorer users this is unfortunately not true. IE is limited in its ability to cache data offline—users must remain "connected" while collecting field data. For this reason, if you are using IE, you should be prepared to submit data from your mobile device to the server frequently and recognize that a lost data connection means all data collected since your last submission will be lost.

- When your cache's memory is getting full, you will receive a warning message, suggesting that you clear your browser's cache and history. *You must submit your data before doing so or it will be lost!*

Getting started

Remember, the data collection functionality for Streets isn't an app—it's an internet-accessible webform, one designed specifically for your project. To access this webform and begin collecting data:

1 Open your smartphone or tablet's email application.

2 Open the email with the link to your project's custom webform.

3 A new window will open in your device's Web browser. To begin, enter the user's name in the Surveyor box and click **Login**.

Options menu

The **gear wheel** in the top left allows you to access the **Options** menu, where higher level operations such as submitting data and reloading the project configuration can be done as well as adjusting the number of entries viewed per page.

Number of trees/page: As you begin to collect data or if you are rechecking existing data entries, the number of trees you must scroll through can become unwieldy. If you wish to change the number of trees shown per page, adjust the slide bar to set the number of trees; if you wish to view all trees on one page, set the value to 0.

Reload project: At times your project manager might indicate that some aspects of the project configuration have changed and ask you to reload the project to incorporate

those changes. *After you have submitted any new data*, simply click the **Reload Project** button and you will be up to date.

Submitting data: It is critical to submit your data to the web server often! To do so simply click the **Submit data button**.You will be shown a tally of the number of trees you have modified and added since the last time you submitted data. Click **Submit**.

Adding trees

To begin adding trees to your inventory, click the **plus sign** in the top right of the main screen. You will work your way through several pages, which are described in detail below. When you have completed entering data on a page, click the **right arrow** at the top of the screen to move forward.

Location

ID: This number is automatically generated to avoid duplicates.

Zone: If you decided to divide your city into management zones or neighborhoods, select the management zone from the drop-down menu.

Street Segment: For sample inventories, enter the street segment ID here. If you used the random sampling method in Appendix 1, this would be the Tiger Line ID.

Street Name : If you uploaded a street list during setup, select the street from the drop-down list. Otherwise, street names can be manually entered by clicking the **plus sign** to the right of the field name.

Street Number: Enter the house number or parcel number.

Location Number: If there is more than one tree at a given address and location site, enter a number here to distinguish them.

Location Site: The location of the planting site in relation to the building address can be recorded here, e.g., front, rear, side-right, side-left, or your user-defined options.

Land Use: Select the most appropriate land use type from the drop-down menu.

Site Type: Select the most appropriate site type from the drop-down menu.

City Managed: Check this box if the tree is city managed. Leave unchecked for private street trees.

Hold Location: Checking the Hold box will "hold" the address data from one tree to the next so that, for properties with many trees, the address information does not need to be re-entered.

Clear Location: When you have collected all the trees at one address and are ready to move on, you can use the Clear Location button to remove all location data and start fresh.

GPS

Start: Click **Start** to begin satellite acquisition. A rough latitude and longitude will appear, together with an estimated accuracy. It can take up to several minutes for a sufficient number of satellites to be acquired to reach acceptable accuracy.

Capture: Once the data meet your acceptable level of accuracy, click **Capture** to save those values.

Coordinates can also be manually entered.

[Note: GPS accuracy depends on the device, its connectivity, and environmental factors. Consult with the device manufacturer for more information.]

Species

Species: Use the drop-down menu to select the tree species. Clicking the button just below the drop-down menu will toggle the list between scientific and common names.

If you find a species that isn't on the list, click the **plus sign** next to the field name and the **Add Species** window will appear. To avoid species duplications, you are asked to enter a four-letter species code here. (These species codes are the underlying foundation of much of Streets' functionality, but are usually invisible to users using web-based mobile devices).

The easiest way to create a species code is to combine the first two letters of the genus and the first two letters of the species, for example, Juglans nigra becomes JUNI. If you receive an error message indicating your species code has already been used, you can append a number to the end, e.g., JUNI_2. The species code will now appear on both the common and scientific name lists. (The project manager will be able to enter the correct scientific and common names on the desktop version of Streets. Then, after a new configuration is pushed, your mobile device will show the names instead of the codes.)

DBH: If you elected to measure DBH exactly, type in the DBH value. If you are measuring DBH by category, select the category from the drop-down menu.

Condition of Wood/Leaves: Select the condition for each from the drop-down menu.

Note/comment: Enter any notes you wish to make in this box.

Note this tree: Check this box if you wish to identify the tree as significant, e.g., if you are unsure of the species or for other reasons defined by the project manager.

Management

Maintenance Recommendation: Select the most important maintenance recommendation from the drop-down menu.

Priority Task: Select the priority task from the drop-down menu.

Sidewalk Damage: Select the level of sidewalk damage from the drop-down menu.

Wire Conflict: Select the appropriate wire conflict from the drop-down menu.

Other 1, 2, 3: Select the appropriate options from the drop-down menu.

Pest

The initial pest detection window asks you to evaluate whether the overall tree, foliage/twigs, and branches/bole show indications of pest or disease. If you answer "yes" to any of these, an additional window appears asking you to further characterize the damage. Once you've answered these questions, the final entry on the Pest window asks you to identify the primary pest if known. If you are unsure, select **Unknown**.

For detailed field data collection protocol, refer to the Inventory Pest Early Detection (IPED) manual under Resources > Manuals and Workbooks at www.itreetools.org or the online Wiki IPED Resources site (wiki.bugwood.org/IPED).

> NOTE: Remember, your data isn't sent to the server automatically! To save your data to the server, you MUST submit it as described above. Access the Submit Data functionality under the gear wheel in the top left corner of the main windows. Submit often!

You're ready to move on to the next tree.

Using the PDA

To access the PDA program, select **i-Tree Streets** from your PDA's **Programs** menu.

Overview

The **Log In** button allows you to enter the survey date and surveyor/team name, if you elected to do so during project configuration. The **Add New Tree** button gives you access to five tabbed screen options: **Location**, **GPS**, **Species**, **Mgt**, and **Pest**. These are described in more detail below. The **Edit Tree** button links to the list of inventoried trees and allows you to select one and edit its entry using the same screen options as the **Add New Tree** option. The **Clear ALL Data** button does just that: removes all inventoried trees from the PDA. The **Backup Data to SD Card** offers an additional layer of data security by allowing you to save your data during the course of the inventory to an SD card if your PDA has that capability (highly recommended). The **Settings** button offers a summary of the options that you chose when you set up the PDA configuration on the desktop and allows you to configure your GPS system if you are working with a GPS-capable device and you chose to collect GPS information during project setup.

Configuring GPS

If you have a GPS-compatible PDA and wish to collect GPS data, click **Settings** from the main menu of the PDA to configure the GPS. Click **Scan Ports** to populate the COM Port, Baud Rate, Parity, Data and Stop Bits fields. When scanning is completed, click **Test GPS**. If unsuccessful, refer to the PDA's user manual for proper settings.

Add New Tree

The **Add New Tree** function is the core of the PDA application. After you've clicked the **Add New Tree** button on the home screen, you have access to five windows that appear as tabs along the bottom: **Location**, **GPS**, **Species**, **Mgt**, and **Pest**. Within each of these windows you will only be able to enter information you elected to collect when you set up the PDA configuration on the desktop. Unwanted fields are either grayed out or marked Not Required.

Location

Tree ID: This number is automatically generated to avoid duplicates.

Street Seg: For sample inventories, enter the street segment ID here. If you used the random sampling method in Appendix 1, this would be the Tiger Line ID.

Address #: Enter the house number or parcel number.

Zone: If you decided to divide your city into management zones or neighborhoods, select the management zone from the drop-down menu.

Street: If you uploaded a street list during PDA setup, select the street from the drop-down list. Otherwise, street names can be manually entered.

Location Site: The location of the planting site in relation to the building address can be recorded here, e.g., front, rear, side-right, side-left, or your user-defined options.

City Managed: Check this box if the tree is city managed. Leave unchecked for private street trees.

Location No.: If there is more than one tree at a given address and location site, enter a number here to distinguish them.

Land Use: Select the most appropriate land use type from the drop-down menu.

Site Type: Select the most appropriate site type from the drop-down menu.

Hold: Checking the Hold box will "hold" the address data from one tree to the next so that, for properties with many trees, the address information does not need to be re-entered.

GPS

Start: Click Start to begin satellite acquisition; this may take several minutes and can be left activated to avoid reacquisition for every tree record (note that this will drain the battery more quickly).

Capture: The Capture function begins averaging sequential latitude and longitude coordinates; ideally, three or more satellites should be tracked before capturing data.

Accept: Once the coordinates begin to settle, click Accept to record latitude and longitude coordinates to the inventory.

Stop: The Stop button stops satellite data acquisition; use this feature between trees to conserve battery power.

Direct entry: Coordinates can manually be entered by selecting this option.

[Note: GPS accuracy depends on the device and on environmental factors. Consult with the device manufacturer for more information.]

Species

Species: Enter the species code or use the drop-down menu to select the tree species. Clicking the blue button just below will toggle the list between scientific and common names. New species codes can be entered for trees not available on the drop down list. This will require species matching to be done once you're back at your desk. This is further described in Phase IV. For a complete list of species codes, refer to *i-Tree Streets & STRATUM Species Codes* by Climate Region under Resources > Archives at www.itreetools.org.

DBH: If you elected to measure DBH exactly, type in the DBH value. If you are measuring DBH by category, select the category from the drop-down menu.

Condition of Wood and Leaves: Select the condition for each from the drop-down menu.

Note/comment: Enter any notes you wish to make in this box.

Note this tree: Check this box if you wish to identify the tree as significant, e.g., if you are unsure of the species or for other reasons defined by the project manager.

Mgt

Maintenance Recommendation: Select the most important maintenance recommendation from the drop-down menu.

Priority Task: Select the priority task from the drop-down menu.

Sidewalk Damage: Select the level of sidewalk damage from the drop-down menu.

Wire Conflict: Select the appropriate wire conflict from the drop-down menu.

Other 1, 2, 3: Select the appropriate options from the drop-down menu.

Pest

The initial pest detection window asks you to evaluate whether the overall tree, foliage/twigs, and branches/bole show indications of pest or disease. If you answer "yes" to any of these, an additional window appears asking you to further characterize the damage.

The final box on the Pest window asks you to identify the primary pest if known. If you are unsure, select **Unknown**. If no signs of stress or signs and symptoms of pest or disease presence were indicated, select **None**.

For detailed field data collection protocol, refer to the Inventory Pest Early Detection (IPED) manual under Resources > Manuals and Workbooks at www.itreetools.org or the online Wiki IPED Resources site (wiki.bugwood.org/IPED).

Save

Once you've entered all data for a tree, click **Save** to save the entry to the database. If you

> NOTE: If the Pest Detection option is selected, some data will have to be entered under the primary pest for every tree before the tree record can be saved.

need to make changes to a tree once it's been saved, return to the home screen and click **Edit Tree**. Select the tree to be edited and click **Edit**. Make your changes using the same windows described above and click **Save**.

You're ready to move on to the next tree!

Phase IV: Back at Your Desk: Running Streets

Transferring Data to Streets

New inventories conducted with a smartphone or tablet

To access the data you collected with your mobile device, open the Streets program on your desktop computer. From the **Tools** menu, select **Work with Mobile**. Choose **Retrieve Project Data** and enter the password you chose earlier.

You'll be presented with a list of trees entered. Check those you wish to retrieve and click **Finish**.

New inventories conducted with the PDA application

To transfer inventory data collected on your PDA to your desktop, connect the PDA to the computer. From within the Streets program on your desktop, from the **Tools** menu, select **Work with PDA**. In the Field Data Transfer section, click **Retrieve Data from PDA**. Click **OK** to close window. Your inventory data have now been uploaded to Streets and your PDA has been cleaned of data.

The **Clean PDA of Collected Data** function can also be used to delete the PDA entries.

Manual data entry

Data can also be manually entered in Streets using the data entry form under **Input** > **Records**. Click **New** to add a new entry and a form that mimics the PDA will appear. Move from tab to tab (General, Location, Tree Info, Management, Other, Pest) and complete the entries, keeping in mind that only the options you selected during set-up will be available.

Importing Access database inventories

If you have an existing inventory or you conducted your inventory in a digital format other than with the PDA, your correctly formatted Microsoft Access database with your tree inventory saved in a table called STRATUM_Inventory can be uploaded to Streets using the **File** menu > **Import** > **Inventory Data**.

> NOTE: Refer back to Phase I: Getting Started: Formatting Existing Inventories for more information.

Existing STRATUM projects

Older STRATUM projects (with the *.proj file extension) can simply be opened as

projects under **File** > **Open** > **Existing Project**. If you do not have an existing STRATUM project but have an inventory formatted according to i-Tree version 1.x or 2.x formatting conventions and stored in a STRATUM-formatted database (*.mdb) or i-Tree Grand Database (*.mdb), you can make use of it by using the **File** menu > **Import** > **Inventory Data**. Be sure to define project parameters following the instructions under Phase I: Getting Started: Inventory Planning.

Checking for errors

Once you've imported an inventory, it's important to check it to be sure that all the data have been entered correctly. You'll find the inventory list under **Input** > **Records**. Scroll through the list looking for red exclamation marks indicating incorrect codes or unmatched species. To make corrections, click on the incorrect entry and the manual data entry form will appear, allowing you to make changes.

> NOTE: In some cases, the error will need to be corrected under **Input** > **Data Fields**, if for example, your inventory includes five data fields under **Condition**, but only four are enabled under **Data Fields**.

Combining projects

You can combine inventories within Streets, if for example, you want to group cities to get a picture of the regional urban forest or even your state's urban forest. To combine inventories, create a new project and simply add one inventory at a time using the **File** menu > **Import** > **Inventory Data**. Remember to use the Tree Inventory window under **Input** > **Records** to check for exclamation marks indicating errors.

> NOTE: The ability to combine inventories requires that they have similar underlying structures, including sample/full inventory, climate zone, and data fields.

Species Matching

Your inventory will most likely include species or species codes that were not included in the Streets default list. In this case, the first window you will see after uploading your data is the Define Species window. (This window can also be accessed under **Input** > **Species**.) Unmatched species codes will be marked with a red exclamation point. To match each marked species:

1   Click inside the row and enter the appropriate common and scientific names.

2   In the fourth column, Assigned Sp. Value, you must select the most closely matched species from the lists below. Click within the empty **Assigned Sp. Value**

box to highlight it. Then, from the lists at the bottom of the window, select the most closely related species from either the common or scientific name drop-down menus. Take into consideration mature size, tree type, form, and family and genus relationships. Where direct matching is difficult, you can opt to select from the tree types (e.g., Broadleaf Deciduous Large, Conifer Evergreen Small).

3 If you conducted a sample inventory that included treeless street segments, ignore any species code you used to identify these segments (e.g., NOTREE). Simply leave these as unmatched.

Editing default species

You should also review the default assignments for the listed species. For example, in your region, a crape myrtle might generally be considered a Broadleaf Deciduous Small tree, but local conditions might make Broadleaf Deciduous Medium a more appropriate choice. Species values can be changed for any listed species as follows:

1 Highlight the row and using the Assigned Species Value drop-down menus to make changes.

2 You can also use the Define Species window to edit the default common names of the species to match those of your community. Simply click on the common name directly in the grid that you want to edit and type over the current entry.

Non-tree species codes

In many inventories, non-tree information is collected using a species code to define the data. For example, the code EPSTL might denote an empty planting site for a large tree or STUMP could indicate a potential planting site where a tree stump exists. These are non-tree species codes and must be defined in Streets if reports on their numbers are desired.

1 In the Define Species window, check the **box** in the **Non-Tree? column** for each non-tree species.

2 Then, click the **Stocking** button.

3 In the Stocking Codes window that appears, select each non-tree code from the drop-down menu and enter a brief description.

4 If the code refers to a specific-sized site, such as the EPSTL above, select the size from the drop-down menu in the **Tree Size** column. If no size is indicated, such as for STUMP above, select **Undefined**.

5 Click **OK** when you are finished.

Making Changes

Your inventory data have been uploaded to the desktop, but you've noticed some mistakes. Maybe one of your data collection teams just realized they had been using the wrong side of the DBH tape or what they thought was an ash tree was really *Acer negundo*. It's not too late to make changes or even to add completely new entries from within Streets.

Additions to the inventory or changes to any record can be made under **Input** > **Records**.

1 To add a record, click **New**.

2 To edit a record, highlight the record you want to change and click **Edit**. A window will appear that looks very similar to the PDA windows, with tabs for General data, Location, Tree Info, Management, Other, and Pest. Make any additions or changes necessary and click **OK** to close the window.

   Note that if mistakes exist, or you make any changes that aren't consistent with your field definitions, a small red exclamation point will appear to call your attention.

Duplicating records

One exciting new feature of Streets is the Duplicate Records function found under **Input** > **Records**. This feature allows you to quickly add identical records to your inventory to avoid tedious data entry where all trees have the same attributes. Additionally, it allows you to add hypothetical trees quickly to see how changes to your urban forest are reflected in benefits and structural diversity.

Because it's easy to get carried away adding hypothetical trees, the best way to begin is by saving your project under a new name so you have something to play with safely.

3 Select **File** > **Save Project As** and give the project a new name, such as MyTown_ WithALotMoreTrees.istreets. Then select **Input** > **Records**, highlight a record you would like to copy and click **Duplicate**.

4 A pop-up window will ask you how many copies you wish to add. Enter the desired number and click **OK**.

5 Return to the Reports to see how the benefits and urban forest structure have been affected.

Rechecking Data in the Field

On some occasions, you may find that you need to return to the field to recheck inventory entries (for example, if you find trees with DBHs of 303 inches. You know this is incorrect, but should it be 30, 3, 33 inches?).

Rechecking data with a smartphone or tablet

1 Select **Tools** > **Work with Mobile** and click the button labeled **Submit Project Configuration**.

2 On the next screen, check the box next to any trees that you want to revisit in the field and click **Next**.

3 Enter the email address and password you created for the project earlier.

4 Click **Finish**.

5 Open your mobile device's email application and click on the link within the email you received from iTree.

6 After logging in, the trees you selected should be visible. To edit the data for a tree, simply click on it and make your way through the screens.

7 Remember to submit your data frequently!

Rechecking data with the PDA

1 Select **Tools** > **Work with PDA** and click the button labeled **Select Records to Transfer to the PDA**. The inventory list will appear.

2 Check the box next to the appropriate records and click **OK**. WIth the PDA connected to your computer and ActiveSync running, click **Send Project Configuration to PDA** button. Your records should now appear in the PDA.

Reporting Results

Once your inventory has been uploaded and edited to your satisfaction, you are ready to view the many reports that are available within Streets. They can be broken down into four main categories: Benefit-Cost Analysis, Resource Structural Analysis, Replacement Value, and Pest Analysis.

NOTE: Reports will only be available if you collected the relevant data. For example, if you did not inventory maintenance recommendations, then the Recommended Maintenance reports will be empty. Similarly, if you did not enter Annual Cost information for your tree program, a benefit-cost ratio will not be computed.

Within each report, there are a number of options for viewing. Each report can be broken down for Public, Private, or All (public and private) trees by selecting the appropriate

tab. Additionally, some reports can be organized by species or zone by choosing the respective radio buttons. When selected, the Summary report type lists the most prevalent species (species that represent >1% of the entire population); remaining trees are grouped as Other Street Trees. The Complete report type lists all trees inventoried in descending order of prevalence and grouped by tree type.

Reports can be displayed by the scientific or common name of the species and using metric or English units. If scientific names are desired, select **View** > **Scientific Name** and a check mark will appear next to the option. To return to common names, choose the option again and the check mark will be removed. Similarly, choose **View** > **Metric Units** to switch from English to metric. After making these changes, click **Refresh** to show the new format.

Benefit-cost analysis reports

Streets calculates the environmental and other benefits provided by the urban forest. It is not intended to account to the penny for every benefit that trees produce. Reported benefits and costs are initial approximations as some benefits and costs are intangible or difficult to quantify (e.g., impacts on psychological health, crime, and violence). Also, limited knowledge about the physical processes at work and their interactions makes estimates imprecise (e.g., fate of air pollutants trapped by trees and then washed to the ground by rainfall). Tree growth and mortality rates are highly variable, and benefits and costs depend on the specific conditions at the site (e.g., tree species, growing conditions, maintenance practices). Therefore, Streets provides a general accounting of the benefits street trees produce given limited knowledge of site-specific conditions—an accounting with an accepted degree of uncertainty that can nonetheless provide a foundation on which decisions can be made. Methods used to quantify and price these benefits are described in the published series of Tree Guides (available at www.itreetools.org under Resources), which correspond to the Streets climate regions. There are three kinds of Benefit-Cost Reports: Annual Benefits, Management Costs, and Net Annual Benefits. They are found under **Reports** > **Benefit-Cost Analysis**.

Annual Benefits: Seven reports are available from the drop-down menu on the left. Benefits are quantified on an annual basis and presented in terms of resource units and dollars. For sample inventories, reports show a standard error function that describes the uncertainty. Complete inventories will show NA under standard error.

> **Energy**: The Energy report presents the contribution of the urban forest toward conserving energy in terms of reduced natural gas use in winter (measured in therms or gigajoules) and reduced electricity use for air conditioning in summer (measured in kilowatt-hours or gigajoules).

> **Stormwater**: The Stormwater report presents the reductions in annual stormwater runoff due to rainfall interception by trees (measured in gallons or cubic meters).

> **Air quality**: The Air Quality report quantifies the air pollutants (O_3, NO_2, SO_2, PM_{10})

deposited on tree surfaces and reduced emissions from power plants (NO_2, PM_{10}, VOCs, SO_2) due to reduced electricity use (measured in pounds or kilograms). Also reported are the potential negative effects of trees on air quality due to BVOC emissions.

Carbon dioxide: The Carbon Dioxide report presents annual reductions in atmospheric CO_2 due to sequestration by trees and reduced emissions from power plants due to reduced energy use (in pounds or kilograms). The model accounts for CO_2 released as trees die and decompose and CO_2 released during the care and maintenance of trees.

Carbon stored: Whereas the above report quantifies *annual* CO_2 reductions, the Carbon Stored report tallies all of the carbon dioxide stored in the urban forest *over the life of the trees* as a result of sequestration (in pounds or kilograms). It should not be added to the Carbon Dioxide value or double-counting will occur.

Aesthetic/other: The Aesthetic/Other report presents the tangible and intangible benefits of trees reflected in increases in property values (in dollars).

Summary: The Summary report presents the annual total of energy, stormwater, air quality, carbon dioxide, and aesthetic/other benefits. Values are dollars per tree or total dollars.

Management Costs: Expenditures associated with street tree management are presented according to category and summed. Results are presented in total dollars, dollars per tree, and dollars per capita.

Net Annual Benefits: Citywide benefits and costs are presented according to category and summed. Net benefits are calculated as benefits minus costs, and the benefit-cost ratio (benefits divided by costs) is shown.

Resource structural analysis

The Resource Structural reports present a snapshot in time of the urban forest and provide information necessary for management planning. Using the Resource Structural reports along with the Benefit-Cost Analysis reports provides information for short- and long-term resource management. The data reported will help you anticipate future trends and management challenges that will need to be met to achieve urban forest sustainability.

Fourteen basic reports are available under **Reports** > **Resource Structural Analyses**.

Population Summary: The Population Summary reports include summary tables and complete lists of inventoried species, their total numbers, numbers by tree type, and numbers by default DBH size classes. These reports provide a basic understanding of species frequencies citywide, by management zone and by DBH size class. Note that trees whose species codes have not been matched will appear at the bottom of the reports in the Unmatched category.

Species Distribution: The Species Distribution reports present data on species composition in the form of pie charts and tables for the 10 most common species, displayed in percentage of total numbers. These reports are helpful for understanding species dominance.

Relative Age Distribution: Tree age data, presented in terms of DBH size class, is given in chart and table form for the 10 most common species, displayed in percentage of total numbers. These reports are important for determining current management needs as well as anticipating how needs will change based on total numbers and aging of individual species. The distribution of ages within a tree population influences present and future costs as well as the flow of benefits. An uneven-aged population allows managers to allocate annual maintenance costs uniformly over many years and assure continuity in overall tree canopy cover. An ideal distribution has a high proportion of new transplants to offset establishment-related mortality, while the percentage of older trees declines with age.

Importance Values (IV): IVs are displayed in table form for all species that make up more than 1% of the population. The Streets IV is the mean of three relative values (percentage of total trees, percentage of total leaf area, and percentage of canopy cover) and can range from 0 to 100 with an IV of 100 suggesting total reliance on one species. IVs offer valuable information about a community's reliance on certain species to provide functional benefits. For example, a species might represent 10% of a population, but have an IV of 25% because of its great size, indicating that the loss of those trees due to pests or disease would be more significant than their numbers suggest.

Condition: Condition of the wood and foliage of the trees is presented in pie chart and table form for the most prevalent species, displayed in percent of total numbers. Tree condition indicates both how well trees are managed and their relative performance given site-specific conditions.

Relative Performance Index (RPI): The RPI relates the overall condition of each species in comparison to all the others; the information is presented in table form. Any value higher than 1 indicates species that have proportionately better condition ratings. Likewise, index values lower than 1 are species with below-average condition ratings when compared with other inventoried street trees. The RPI of each species provides an indication of its suitability to local growing conditions, as well as its performance. Species with more trees in good or better condition are likely to provide greater benefits at less cost than species with more trees in fair or poor condition. Keep in mind, however, that RPI values should be compared with species age data to provide a more complete picture. If, for example, one species is represented by a large proportion of very old trees that have served your city well for many years but are now nearing the end of their life spans, the RPI of that species will appear low.

Stocking Level: These reports present data on stocking levels and available planting sites based on your inputs in the Stocking Codes window. Stocking level reports are useful for

identifying high-priority planting areas and enabling strategic plant purchasing and cost planning.

Maintenance Recommendation: Maintenance recommendations are displayed in table form. A table is available for each individual recommendation with a summary of all recommendations below. The results can be displayed according to DBH class or for the top five species receiving a particular recommendation. These reports help managers understand the actual pruning and maintenance needs of the street trees. This provides clues to whether or not the pruning is adequate and suggests the level of risk and liability that is associated with the city's street tree population. Problematic species are identified, and cost planning is facilitated.

Priority Task: The most urgent maintenance tasks are displayed based on the user-defined categories. Each priority task is presented individually with a summary of all tasks below. The reports present data for each maintenance category according to zone and DBH class; the five species showing the greatest maintenance needs in each zone can also be displayed. These reports help managers understand the actual pruning and maintenance needs of the street trees. Problematic species are identified, and cost planning is facilitated.

Land Use: Tree distribution by land use is presented in chart and table form, displayed by zone as percentage of total numbers. These reports are useful for understanding how your urban forest is distributed across land uses and for comparisons with reports on tree conflicts, maintenance recommendations, and tasks for understanding problem planting sites for specific species.

Location: Tree location information is presented in chart and table form, displayed by zone as percentage of total numbers. These reports are useful for comparisons with tree conflicts, maintenance recommendations, and tasks for understanding problem planting sites for specific species.

Conflicts: Sidewalk damage and wire conflict information are presented in table form. Data can be viewed by species or by zone. These reports are useful for understanding the current and potential infrastructure-related conflicts by species and management zone location.

Canopy cover: Data about the level of canopy cover over the city and over streets are presented in chart and table form, displayed in acres per zone and for the entire city, if you entered the relevant information in the City Information window. These reports are useful for understanding the current versus desired levels of canopy cover in the city.

Other: If you collected "other" data during your inventory, it is presented in table form by species, displayed as percent of total numbers.

Replacement values

Replacement values are estimates of the full cost of replacing trees in their current condition, should they be removed for some reason. Replacement values are based on the Council of Tree and Landscape Appraisers (CTLA) Guide for Plant Appraisal, which uses a trunk formula methodology. The CTLA is a widely accepted methodology used by arborists for determining landscape tree replacement value based on regional species ratings, condition, location in the landscape, cross-sectional area of the trunk and regional replacement costs. Species ratings, replacement costs, and basic prices were obtained for each species in each reference city from regional appraisal guides. Because of the approximations used in these calculations, replacement values are first-order estimates for the population and are not intended to be definitive on a tree-by-tree basis.

Replacement values reports can be displayed by DBH class for every species in the inventory or by DBH class for each zone. They are available under **Reports** > **Replacement Value**.

Pest analysis

Pest analysis reports make use of the data collected using the IPED protocol to assess the existing and potential pest threats in your urban forest. They are available under **Reports** > **Pest Analysis**. Reporting features include multiple options for analyzing tree records based on pests, signs and symptoms. The **Pest Review** and **Sign and Symptom Review** options allow you to query records for more detailed analysis

Summary: The Summary report presents data on the number and percentage of trees affected by pests in table form.

Exporting Data

Exporting reports

There are two options for exporting reports. The **Export** button on the main window allows you to export individual reports in three formats: Adobe Acrobat (*.pdf), Microsoft Word (*.doc), and Rich Text Format (*.rtf). Alternatively, you can export reports in Excel (*.xls) format by using the Export Reports dialogue.

To export single PDF, Word, or RTF reports from the active report view:

1 In the active report view, click the **Export** button.

2 Select the desired file type (*.pdf, *.doc, or *.rtf) from the **Save as type** pull-down menu.

3 Browse to the location where you would like to save the file and enter a file name that represents the active report.

4   Click **Save** to finish.

To export single or multiple reports as Excel files using the Export Reports dialogue:

1   From the **File** menu, select **Export > Reports**; the Export Reports Selection for Excel dialogue box appears.

2   Select **Browse** to locate the folder where you would like to save the reports. The dialogue box that appears allows you to create a new folder if necessary.

3   Check the Public, Private, or All box to indicate the population subset. You may select any or all of the subsets; for multiple selections, each will be exported as a separate file.

4   The reports are available in three categories: Benefit-Cost Reports, Population Summary, and Resource Structural Analysis. For each category, you can choose either **All Reports** or you can select from among the individual reports. Individual reports from each category will be grouped together and saved in one file.

Exporting inventory data

You can also export existing tree records from the Streets program in spreadsheet format (*.csv) or in an xml format (*.xml).

1   Click **File** > **Export** > **Inventory Data**.

2   Select the desired file type (*.csv or *.xml) from the **Save as type** pull-down menu.

3   Browse to the location where you would like to save the file and enter a file name that represents the records.

4   Click **Save** to finish.

Printing reports

The **Print** button allows users to print any report in the active view. Alternatively, you can select **File** > **Print**.

Appendix 1: Random Street Segments Workbook

These instructions are designed to help users of all skill levels create random i-Tree Streets (STRATUM) sample street segments for use in field data collection. ESRI ArcGIS software is used; the instructions will need modification depending on the version of ArcGIS employed. For purposes of example, US Census TIGER map data are utilized for an entire city. If zones within a city will be used, follow the basic directions for EACH zone.

These instructions are composed of two basic steps:

1 Prepare project area data.

2 Generate sample street segments

When you are finished, you will have created the following:

- Area-of-interest *polygon* map layer.

- Random street segments *line* map layer

Tips

- These instructions require use of basic ArcGIS functions at the ArcView level. No extensions are necessary.

- Advanced GIS users can primarily follow the bulleted overviews with attention given to the detailed instructions in areas such as field names and types.

- For advanced GIS users: For a zones-based analysis, after creating a random sample segments layer, intersect it with a zones polygon layer to split the segments by zone borders.

- If desired, obtain projection/coordinate system and map unit information from the map data provider.

- AOI examples are large polygons such as city boundary, park areas, or individual management zone(s).

- ESRI shapefiles, coverages, or geodatabases can be used. Shapefiles are easiest.

- Practice good file management using folders to hold copies of original data, folders to hold output, employ logical file naming, etc.

- Save your work in an ArcGIS *.mxd project periodically through all steps.

- You may need to turn off any pop-up blockers in your web browser when downloading data.

Common tools

 Open Project   Select   Add Data

Project Area Data Preparation

Overview

- Obtain a GIS map layer representing the area-of-interest (AOI) polygon(s) for your project area.

- Obtain a GIS map layer representing the street centerlines for your project area.

- Launch the ArcMap application of ArcGIS at the ArcView, ArcEditor, or ArcInfo level.

- Save an *.mxd project file with a name and location of your choice.

- Load the AOI and streets map layers into the view.

- If needed, select the specific AOI polygon(s) from any others present that best represent your project area.

- Export the selected AOI polygon(s).

- If needed, select (or clip) only the street lines that lay within your AOI.

- Export selected street lines.

Results

- AOI map layer composed of one or more polygons

- Associated street lines map layer.

Detailed instructions

1 To begin, you'll need to obtain a shapefile that outlines your area-of-interest (AOI). Possible sources include a local government or school GIS Department or an online resource such as ESRI's Free Data (http://www.esri.com/data/free-data):For

example, you can use the US Census TIGER map data to obtain shapefiles of counties:

   a To obtain US Census TIGER map data for counties, scroll to "Downloadable Data" on the web page.

   b Click the **Census 2010 TIGER/Line Data** link.

   c On the Census web page, click **Web interface** under Download by Type.

   d Under "Select a layer type" choose County Subdivisions.

   e Choose the appropriate state under "County Subdivision 2010".

   f Select the appropriate county. Click **Download**.

   g Save the resulting file when prompted and unzip into your working directory, or another location that you can easily find again.

2 You'll also need a shapefile of road centerlines. To obtain these from the US Census TIGER map data, scroll to "Downloadable Data" on the web page.

   a Click the **Census 2010 TIGER/Line Data** link.

   b On the Census web page, click the **Web interface** link under Download by Type.

   c Under "Select a layer type" choose **Roads**.

   d Under "All Roads" choose the appropriate state and then the appropriate county.

   e Save the resulting file when prompted and unzip into your working directory, or another location that you can easily find again.

3 Launch ESRI's ArcMap application.

4 Use the **Add Data** button to browse to and load the TIGER **County Subdivisions** and **Line Features – Roads** map layers to the current view. If an "Unknown Spatial Reference" message appears, click **OK** to move past it.

5 TIGER County Subdivisions data are typically organized by county and often include multiple place polygons. Use the **Select** tool to select your specific AOI polygon from those on the screen. Peruse the attribute table or use the feature labeling functions to help identify your AOI polygon if necessary.
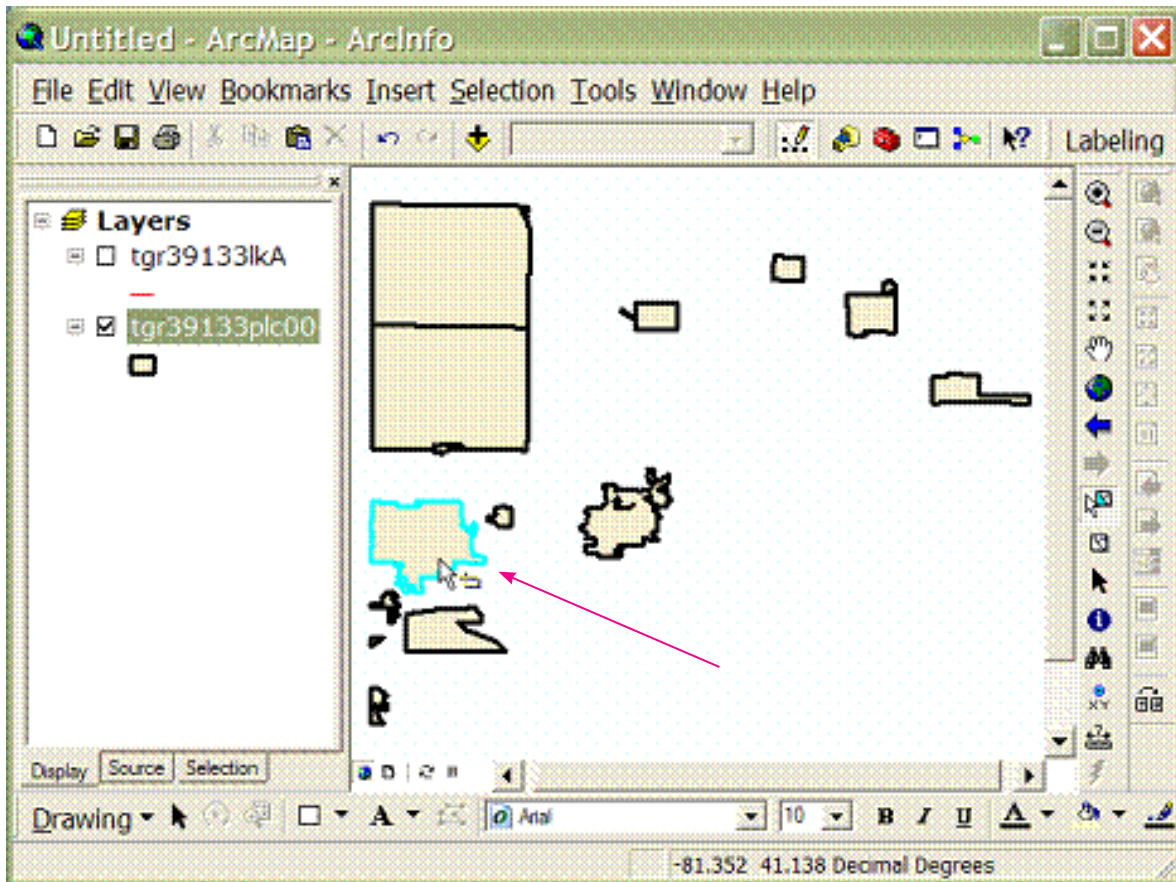
6 Export the selected AOI polygon(s) to a separate map layer and add the exported
   layer to the view:

   a Right-click on the **TIGER County Subdivisions** map layer and select **Data**
      > **Export Data**.

   b Verify that the **Export** drop-down list is set to **Selected features**.

   c Choose an appropriate name for the AOI polygon map layer and save it.

   d When prompted, click **Yes** to add the exported data as a map layer to the
      view.

7 Query the TIGER Road Lines map layer to select street segments suitable for
   sampling:

   a In the **Table of Contents (TOC)** map layer list, click the **Road Lines** map
      layer to select it (verify the map layer is also checked in the TOC and thus
      visible in the map view).

   b From the main menu, choose **Selection** > **Select by Attributes.**

c In the resulting dialog window:

Verify that the **Road Lines** map layer is selected from the drop-down list.

Verify the chosen method is set to **Create new selection**.

Copy and paste this query below into the query box at the bottom of the window:

"MTFCC" = 'S1200' OR "MTFCC" = 'S1400' OR "MTFCC" ='C3061' OR "MTFCC" = 'C3062'

NOTE: These are updated codes for the 2010 Census and differ from pervious Census codes. In addition, this query selects for local, county, and state roads but does NOT include Interstates or Interstate ramps, or private roads, alleys, 4WD tracks, etc. Users may of course choose any set of codes they wish to sample.

8 Export the subset of selected TIGER Road Lines to a separate map layer and add the layer to the view:

a Right-click on the **TIGER Road Lines** map layer and select **Data** > **Export Data**.

b Verify that the **Export** drop-down list is set to **Selected features**.

c Choose a name for the selected streets line map layer and save it.

d When prompted, click **Yes** to add the exported data as a map layer to the view.

9 Clip the Street Segments suitable for sampling to fall within only the AOI boundary.

a Launch the Clip tool via **ArcToolbox** > **Analysis Tools** > **Extract** > **Clip**.

b Under Input Features, choose your exported Street Segments map layer suitable for sampling.

c Under Clip Features, choose your exported AOI map layer.

d Under Output Feature Class, browse to your working folder, enter a name for the clipped roads layer with the extension .SHP (example: myStreets_ Clip.shp).

e Leave the XY Tolerance box empty.

f The clipped roads layer should add automatically to the ArcGIS Table of Contents.

10 From the main menu, choose **Selection** > **Clear Feature** to unselect the AOI polygon and Streets features.

Results

Area-of-interest (AOI) *polygon* **map layer and associated AOI Streets in a** *line* **layer that are suitable for sampling.**

- Verify AOI polygon and Streets map layers are loaded into the map view. It may be necessary to **right-click** the new AOI layer and select **Zoom to Layer**.

- Right-click the new AOI layer name in the map layers list, and choose **Open Attribute Table** to verify you have the correct AOI polygon using an attribute field such as "name".

- Verify the street lines are clipped within the AOI polygon.
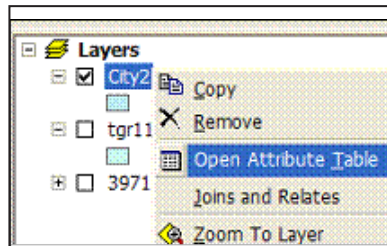
The street lines are now ready to be sampled.

Overview

- Add a field to the Streets data.

- Calculate random number values for the Streets data.

- Select the desired number of street segment samples from the attribute table.

- Export the street sample data and map.

Results

- Random street segments for field sampling

Detailed instructions

1 On the clipped **Streets** map layer, open the table by right-clicking on the **layer name** in the **TOC**.

2 Using the **Table Options** button in the upper left of the table window, add a field named **RandomSeg** of type **Double** to the clipped Streets table. Leave the Precision and Scale entries blank.
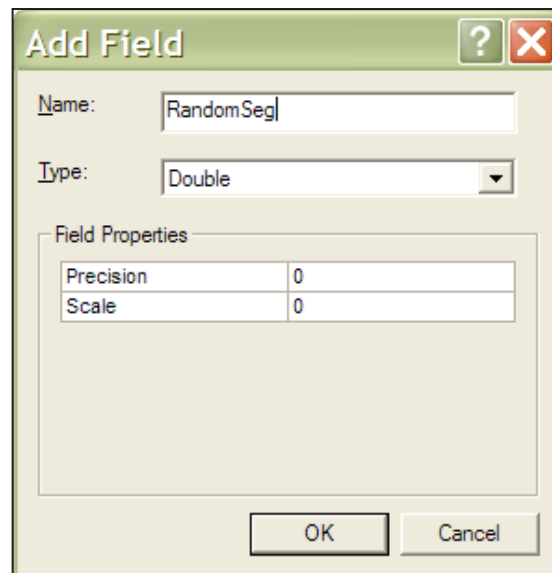
3 Right-click the newly created **RandomSeg** field title and use the **Field Calculator** to populate the field using the **rnd** function:
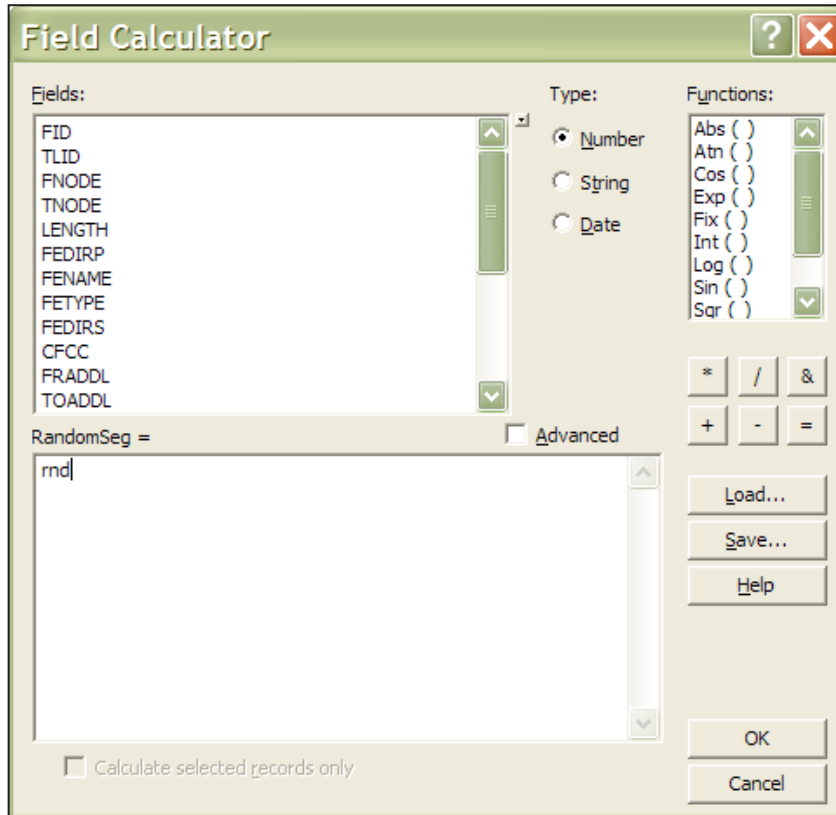
4 Once the field is populated, right-click the **RandomSeg** field title to sort the field in ascending order.

5 Scroll down the attribute table to reach the desired number of street segments and select them:

> **a** Click one of the cells in the table to see which record number it is in the **Record count box.**

> **b** When the desired number of records is found, hold down **Shift** while selecting the records using the gray buttons to the left of the records.

6 Close the table window and return to the map view to export the selected Streets map layer samples and add them to the view:

> **a** Right-click on the clipped **Streets** map layer and select **Data** > **Export Data**.

> **b** Verify that the **Export** drop-down list is set to **Selected features**.

> **c** Choose an appropriate name for the selected street samples map layer and save it.

d When prompted, click **Yes** to add the exported data as a map layer to the view.

7 From the main toolbar, choose **Selection** > **Clear Selected Features** to unselect deisgnatthe Streets features.

8 If desired, open the newly created street samples attribute table and export the records for use in Microsoft Excel (for printing, etc.):

a From the **Attribute** table > **Options** button > **Export** > **All records**

b Choose to export as a dBase file, which can be read by MS Excel

1335	1352	0.06106	N	Mantua	St		A31	
2448	2457	0.04195		Summit	Rd		A41	
2104	2082	0.07055		Petrarca	Dr		A41	
1023	986	0.09051		Delores	Ave		A41	
2104	2190	0.14685		Petrarca	Dr		A41	

9 If desired, print a map of the segments for planning and field use:
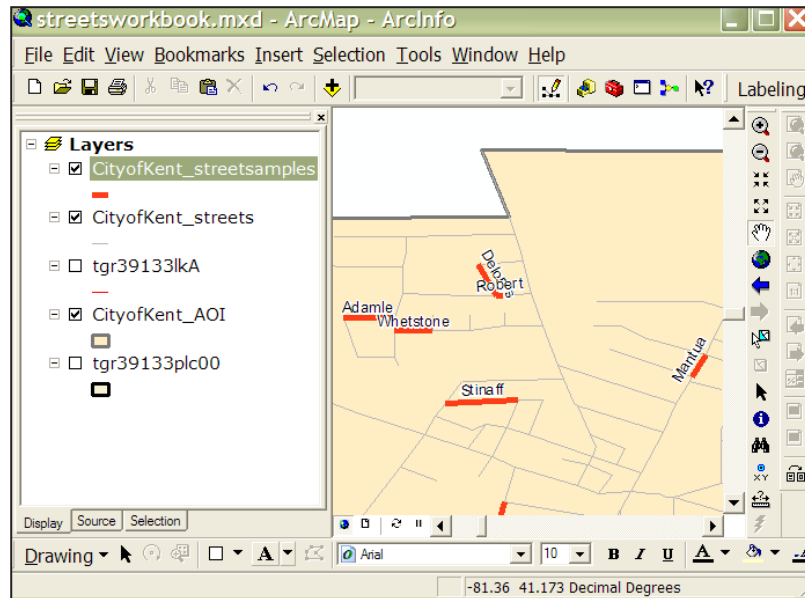
a Label the street segments with a name field in the map view.

b Recolor the map layers for better visibility by right-clicking on their symbology in the TOC.

c Switch to the Layout view and add map elements such as north arrow and scale bar via the **Insert** menu at top.

d From the main toolbar, choose **File** > **Print** and select appropriate printer and paper.

e Optional: choose **File** > **Export Map** to save an electronic copy of the map.

10 Optional: For zones within an AOI, add in a zones polygon layer. Intersect the zone polygons with the street sample segments in order to "break" them across zones and to assign appropriate zone attributes to the segments.

a Use the Intersect tool via **ArcToolbox** > **Analysis Tools** > **Overlay** > **Intersect**.

b The output Intersect street segment layer will have zone attributes assigned to the street segments.

c Use the **Select by location** function for each zone in order to tally street sample counts within each zone.

Results

Desired number of random Street Segment Samples in a LINE map layer.

MS Excel file of Street Segment Samples attribute data.

Hardcopy or electronic maps of Sample Segments.

Appendix 2: Troubleshooting

The Population Summary Report shows the incorrect number of trees (or no trees at all), but other reports such as Conflicts show the correct number of trees:

In the **New Project** dialogue box, you incorrectly selected that your DBH was recorded By Class. From the **Input** menu, select **Data Fields** and click on the **DBH** tab. Change the **Recorded By** selection to **Measurement**.

The Population Summary Report shows the correct number of trees, but they aren't broken down into the correct DBH classes:

From the **Input** menu, select **Data Fields** and click on the **DBH** tab. Change the **Measured In** selection to the correct units (inches vs. centimeters).

Some reports show species codes instead of common or scientific names:

You have not matched all species codes in the Define Species dialogue box. Select **Input** > **Species** and follow the directions for matching species codes.

Species that I know are included in my inventory are not appearing in the Population Summary Report:

Be sure that you have matched all species codes. Select **Input** > **Species** and follow the directions for matching species codes. Note also that there are two types of Population Summary reports: one shows only species that represent more than 1% of the population with other species grouped together (Summary), the second shows all species (Complete).

When selecting Stocking Level Report, I receive a message that says "You don't have stocking information in your inventory":

You haven't designated species codes to be reported in Stocking Level Reports. Under the **Input** menu, select **Species** and follow the directions for matching non-tree species codes.

The Population Summary Report has two entries with the same name:

You have assigned the same species name to two different species codes. Select **Input** > **Species** and scroll through the Species Code list until you find the two species codes that have been given the same name.

If the two different species codes are in fact the same species, you can correct the records to have the same species code from within Streets, by selecting **Input** > **Records** and making changes to the individual records in the Tree Inventory window.

Alternatively, if two species codes have the same common name (for example, QUWI = *Quercus wislizeni* = live oak and QUAG = *Quercus agrifolia* = live oak), you can change the common names under **Input** > **Species** to be more specific (QUWI = interior live oak and QUAG = California live oak).

Appendix 3: Pest Protocol

If you conducted the IPED protocol, but did not use the PDA application, you can use the following tables to format your data to take advantage of the advanced reporting opportunities in Streets. You can find more information on the protocol at www.itreetools. org under Resources, on the IPED webpage at www.itreetools.org/iped/index.php, and the online Wiki PED resources site (wiki.bugwood.org/IPED).

Table 1. The pest fields, their categories, and the respective values.

Field name	Category	Value
PestBBAbnGrowth	None	0
	Loose bark only	5
	Rhizomorphs present	7
	Mycelial fans or pads present	8
	Insect boring or galleries causing loose bark	9
	Other	6
PestBBDiseaseSigns	None	0
	Decay	9
	Conks	1
	Fleshy mushrooms	2
	Cankers	3
	Bleeding/slime flux	4
	Resinosis/gummosis	7
	Woody galls or burls	10
	Other	8
PestBBInsectPres	None	0
	Caterpillars	1
	Beetles	2
	Aphids	3
	Scale	4
	Carpenter ants	5
	Other insects	6

Table 1, continued.

Field name	Category	Value
PestBBInsectSigns	None	0
	Frass only	1
	Sawdust	2
	Pitch/resin exudation	3
	D-shaped exit holes	4
	Pencil round or oval exit holes (>=2mm)	5
	Shot holes (<2mm)	6
	Other holes	7
PestBBProbLoc	None	0
	Branches	1
	Bole and/or root collar	2
	Both	3
PestBBNotes	Text; up to 255 characters	
PestFTAbnFoli	None	0
	Foliage/twigs distorted (including galls)	2
	Witches' brooms present	6
	Other	5
PestFTChewFoli	None	0
	Defoliation, >10% of foliage but not pervasive	1
	Defoliation, pervasive throughout the crown	4
	Leaf mining, >10% but not pervasive	2
	Leaf mining, pervasive throughout the crown	5
	Chewing of the mid-rib only (any level)	3

Table 1, continued.

Field name	Category	Value
PestFTDiscFoli	None	0
	Mottling, spots, or blotches (any color)	1
	Marginal scorching (browning) of leaves	2
	Interveinal scorching (browning) of leaves	3
	White coating	4
	Black coating often sticky	10
	Complete browning/bronzing of leaves or needles	5
	Complete yellowing of leaves or needles	6
	Stippling	7
	Yellow/orange pustules	8
	Other	9
PestFTFoliAffect	None	0
	>10%; <30%	2
	>30% but not the whole crown	3
	Whole crown affected	4
PestFTInsectSigns	None	0
	Caterpillars/sawflies feeding throughout the crown	1
	Beetles feeding throughout the crown	3
	Aphids/white cotton pervasive throughout the crown	4
	Bags pervasive throughout the crown	5
	Scales pervasive throughout the crown	6
	Tents/webbing on more than one branch	7
	Other	8
PestFTNotes	Text; up to 255 characters	
PestTSDieback	None	0
	Twig dieback upper/outer crown (>10%), but not pervasive	2
	Pervasive twig dieback throughout the crown	3

Table 1, continued.

Field name	Category	Value
PestTSEnvStress	None	0
	Frost cracks	8
	Lightning strike	1
	Hail injury	2
	Sunscald	3
	Broken branches	4
	Flooding	5
	Drought/poor soil	6
	Other	7
PestTSEpiSprout	No	0
	Yes	1
PestTSHumStress	None	0
	Topping/Poor pruning	1
	Poor or restricted planting/mulching	2
	Wounding of woody tissues	3
	Salt/Chemicals	4
	Other	5
PestTSWiltFoli	None	0
	Wilt, whole crown	1
	Wilt, partial crown	2
PestNTNotes	Text; up to 255 characters	
PestPest	See Table 3.	

Table 2. Pest IDs to be entered under field PestPest in the database. The pest list is dynamic and is frequently updated by forest health pest experts. IPED users should frequently select the **Update IPED** option under the **Help** menu to ensure that they are using the most current pest list available.

Common name	Scientific name	Value
- Unknown -	- Unknown -	-1
- None -	- None -	0
Ash yellows phytoplasma	*Candidatus Phytoplasma fraxini*	906
Asian gypsy moth	*Lymantria dispar*	10911
Asian longhorned beetle	*Anoplophora glabripennis*	2178
Bacterial leaf scorch	*Xylella fastidiosa*	647
Balsam woolly adelgid	*Adelges piceae*	288
Bark beetle	*Hylurgops palliatus*	9357
Beach bark disease	*Nectria coccinea*	569
Blue stain	*Ophiostoma piceae*	4065
Bronze birch borer	*Agrilus anxius*	352
Brown root rot	*Phellinus noxius*	525
Brown spruce longhorn beetle	*Tetropium fuscum*	4117
Butternut canker	*Sirococcus clavigignenti-juglandacearum*	578
Citrus greening	*Candidatus Liberibacter asiaticus*	4695
City longhorned beetle	*Aeolesthes sarta*	4013
Dogwood anthraconose	*Discula destructiva*	670
Dutch elm disease	*Ophiostoma ulmi*	643
Dutch elm disease	*Ophiostoma novo-ulmi*	19386
Eastern larch beetle	*Dendroctonus simplex*	31
Egyptian cotton leafworm	*Spodoptera littoralia*	5010
Elm phloem necrosis phytoplasma	*Phytoplasma*	11269
Emerald ash borer	*Agrilus planipennis*	7171
European oak bark beetle	*Scolytus intricatus*	4086

Table 2, continued.

Common name	Scientific name	Value
European oak leaf roller	*TOrtrix viridana*	9319
False coddling moth	*Thaumatotibia leucotreta*	4989
Forest tent caterpillar	*Malacosoma disstria*	172
Giant woodwasp	*Urocerus gigas*	4097
Goldenhaired bark beetle	*Hylurgus ligniperda*	885
Goldspotted oak borer	*Agrilus coxalis*	56246
Great spruce bark beetle	*Dendroctonus micans*	4038
Gymnopus fungus	*Gymnopus fusipes*	22250
Gypsy moth	*Lymantria dispar*	165
Hemlock woolly adelgid	*Adelges tsugae*	289
Jack pine budworm	*Choristoneura pinus*	117
Japanese pine sawyer beetle	*Monochamus alternatus*	4532
Larch engraver beetle	*Ips subelongatus*	4140
Large brown trunk beetle	*Hylobius abietis*	4119
Laurel wilt	*Raffaelea lauricola*	20929
Leptographium root rot	*Leptographium truncatum*	4057
Light brown apple moth	*Epiphyas postvittana*	4954
Mediterranean pine engraver beetle	*Orthotomicus erosus*	4071
Oak ambrosia beetle	*Platypus quercivorus*	10989
Oak splendour beetle	*Agrilus biguttatus*	4101
Oak wilt	*Ceratocystis fagacearum*	642
Phytophthora root rot	*Phytophthora quercina*	10986
Pine shoot beetle	*Tomicus destruens*	10996
Pine-tree lappet	*Dendrolimus pini*	7053
Raffaela fungus	*Raffaelea quercivora*	22299
Rosy gypsy moth	*Lymantria mathura*	4601

Table 2, continued.

Common name	Scientific name	Value
Sakhalin pine sawyer	*Monochamus saltuarius*	4060
Siberian silk moth	*Dendrolimus superans*	12200
Sirex woodwasp	*Sirex noctilio*	4093
Small white-marmorated long-horned	*Monochamus sutor*	4113
Southern pine beetle	*Dendroctonus frontalis*	24
Spruce budworm	*Choristoneura fumiferana*	114
Sudden oak death	*Phytophthora ramorum*	4603
Summer fruit tortrix	*Adoxophyes orana*	4937
Thousand cankers disease	*Geosmithia morbida*	56599
Tremex wasp	*Tremex fuscicornis*	10997
White pine blister	*Cronartium ribicola*	722
White satin moth	*Leucoma salicis*	162