Using iTree VUE with GIS to Quantify the Carbon Storage by Urban Trees

"Results in about an hour for free"

Peggy Minnis

Pace University

Register a username & password

Download the free tools

i-Tree

Vue

User's Manual

v. 4.0

Version 4.x due in the summer

i-Tree Vue offers the following advantages:

- It provides a broad estimate of tree canopy, carbon storage and annual carbon sequestration and air pollution removal, for the contiguous United States.

- It allows you to explore National Land Cover Data information and provides a broad estimate of land cover classes.

- No field data are required.

- Canopy cover and ecosystem services are presented in spatial terms, so you can visualize how they vary across your community.

- User friendly tools within the VUE application allow you to refine an area of interest for analysis.

- Integration of regional correction factors allow you to adjust and improve upon NLCD estimates based on recent research.

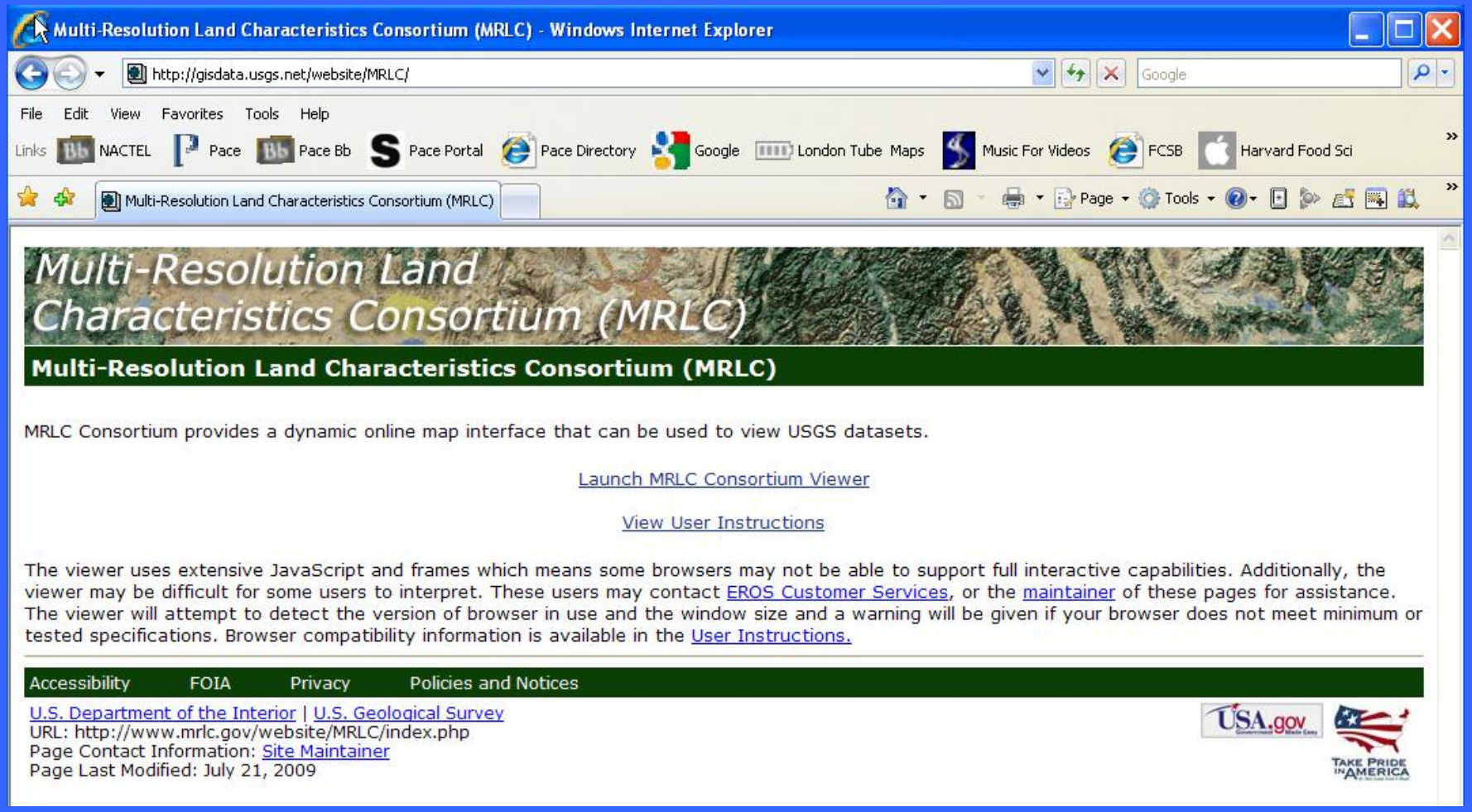
The land cover is being classified from satellite imagery captured by an orbiting platform 400+ miles up. Then the pixels are classified based on ground truthing in selected areas. The classification is automated. Each pixel represents 30 meters.

The current data available is from 2001 and 2006.

So, while VUE does have several limitations, for a quick and dirty estimate of carbon storage, annual sequestration, certain pollution removal and a monetary estimate of the value of the standing forest, it gets you going while you are waiting for the money for a more in-depth study.

http://gisdata.usgs.net/website/MRLC/

(allow pop ups)



MRLC Consortium Viewer (Return to start page)

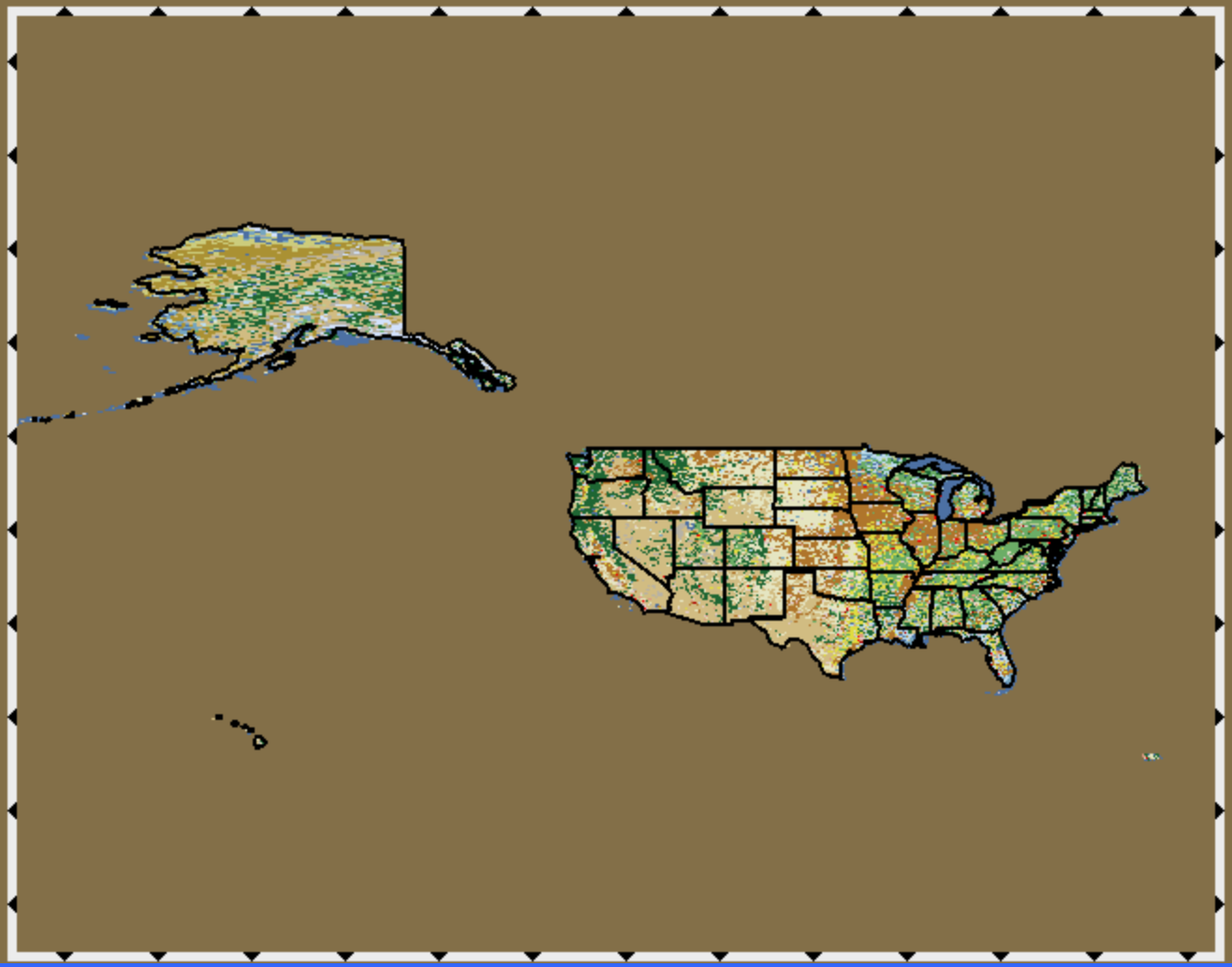
Zoom

Query

Tools

Downloads

Documents



Scale Information

Out In

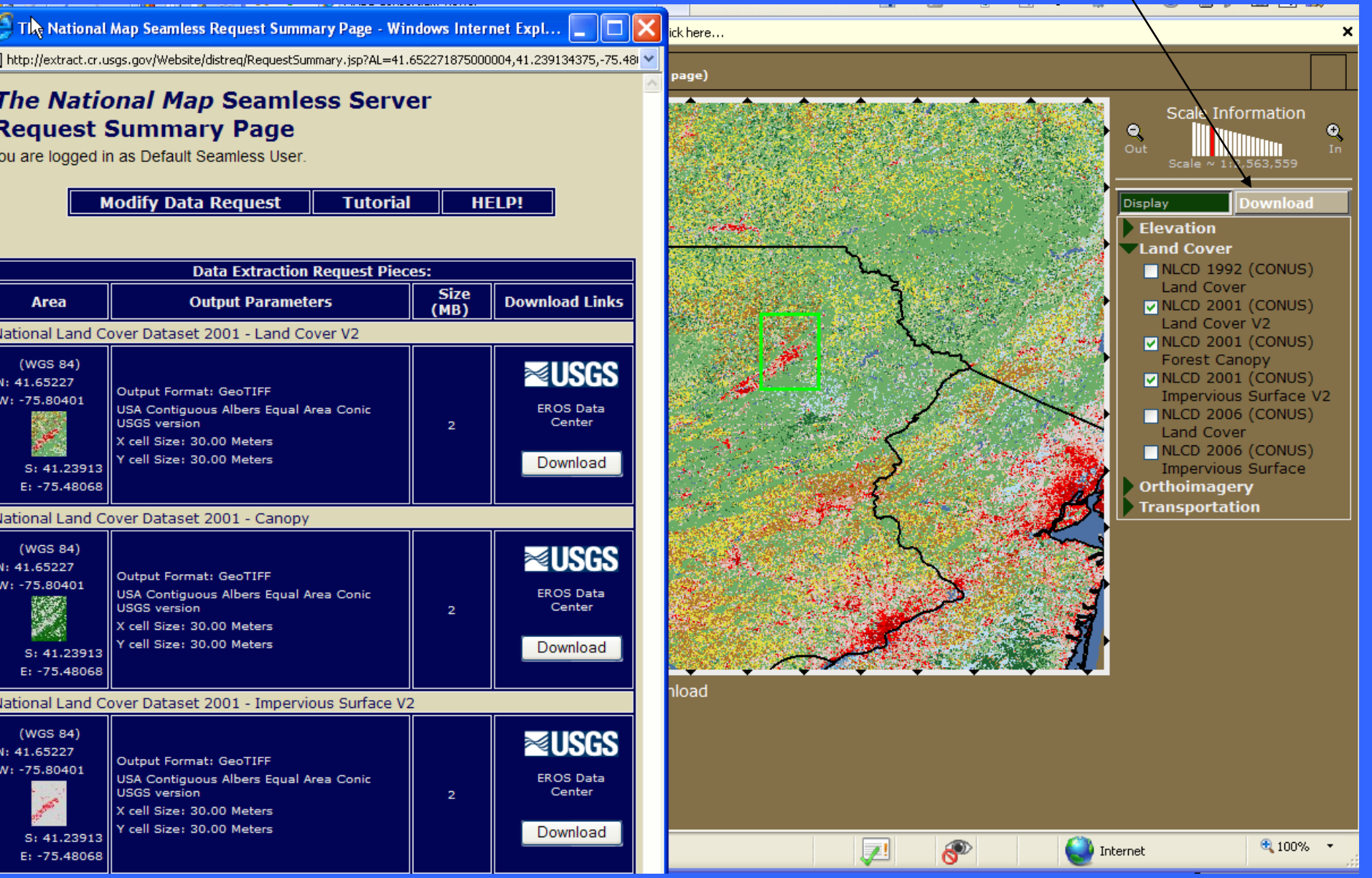
Scale ~ 1:80,111,232

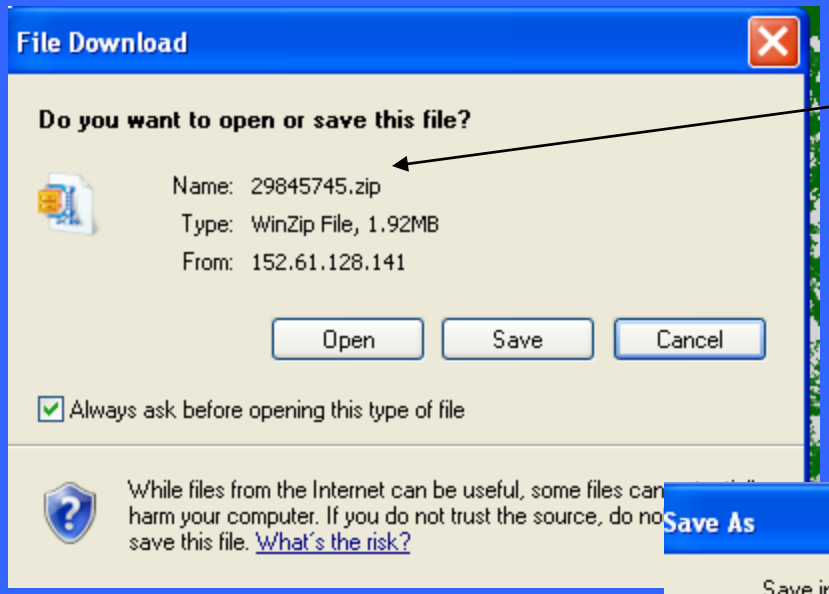
Display | Download

- Places (Names)
- Transportation
- Boundaries
- Layer Extent
- Hydrography
- Land Cover
- Elevation

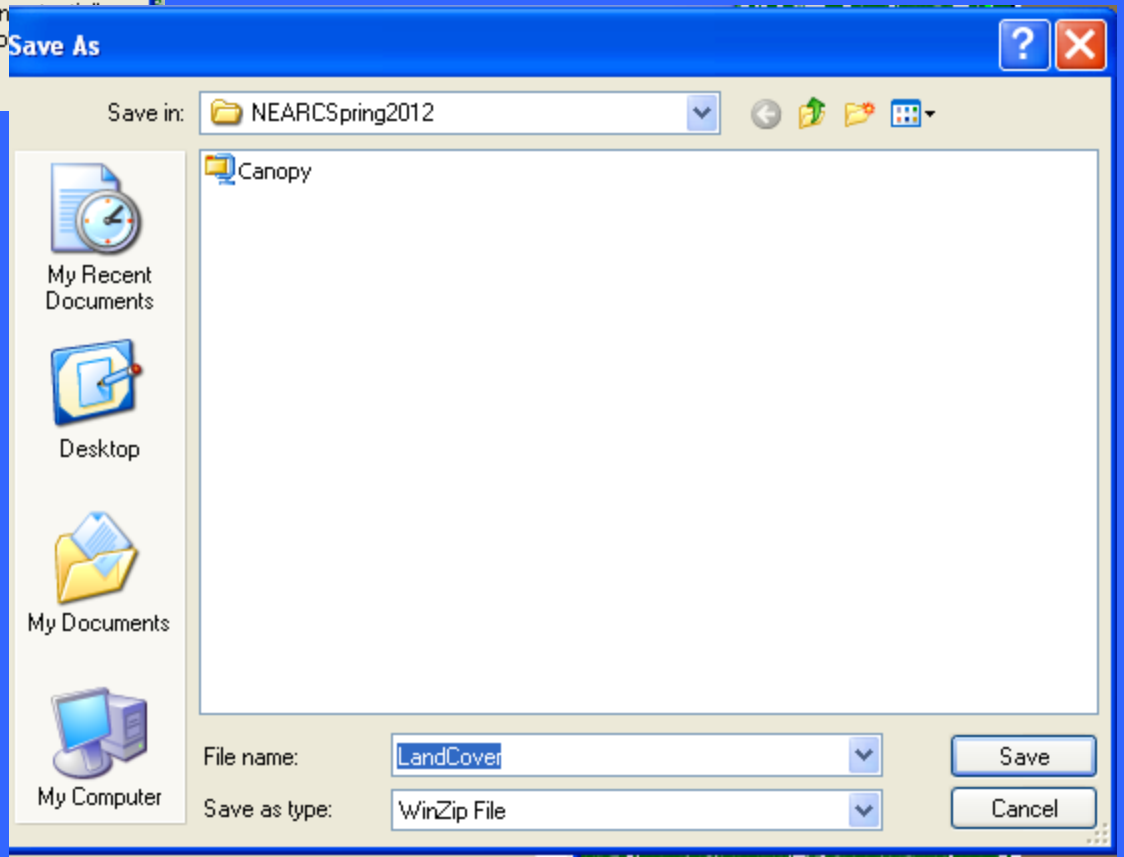
NLCD Land Classes

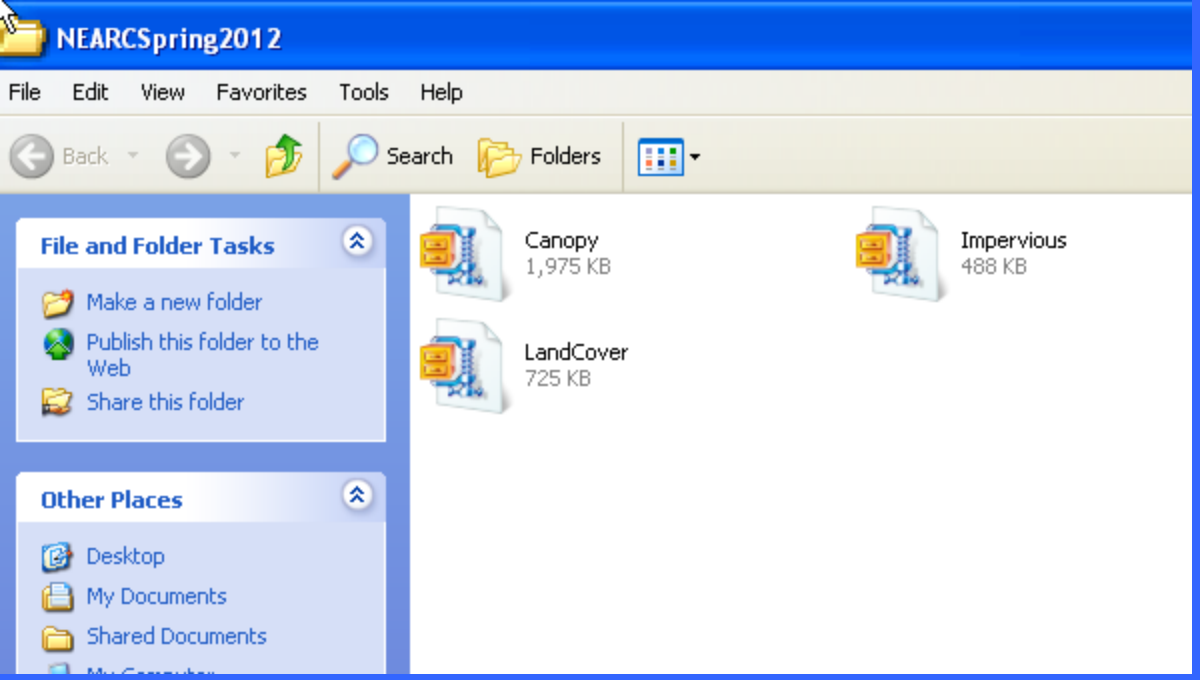
Download button



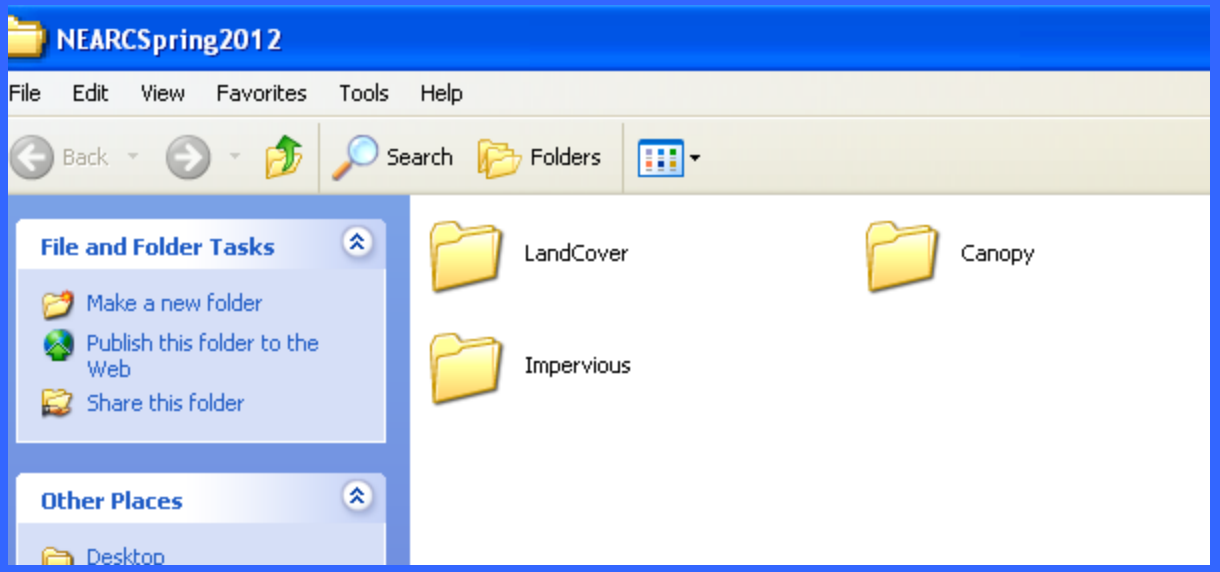


Keeping track of the individual data sets might be the hardest part, so writing down the numbers that correspond to the three maps is important.

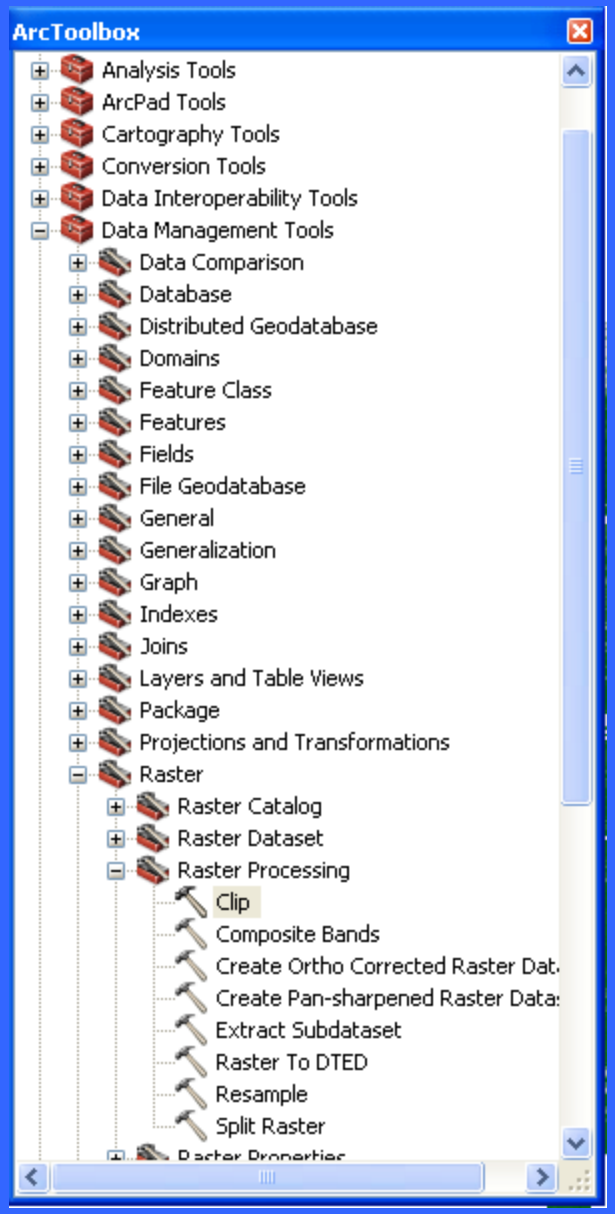




It helps to create a folder for each shapefile that is extracted.

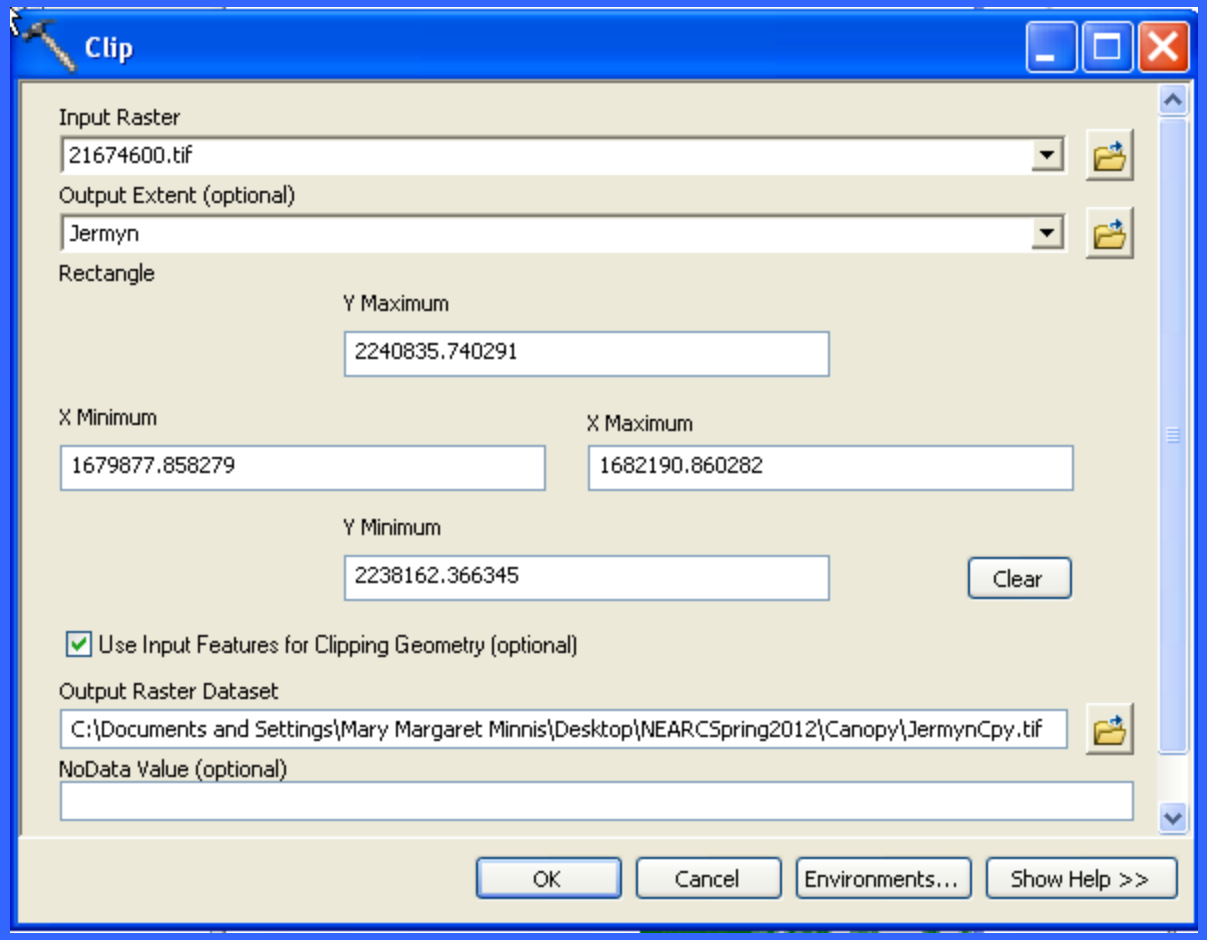


In ArcGIS 10, clip all three datasets to the area of interest.

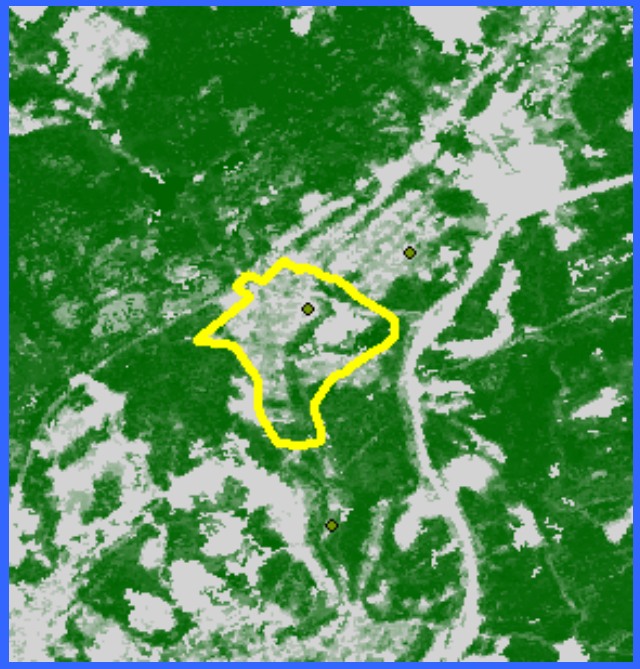


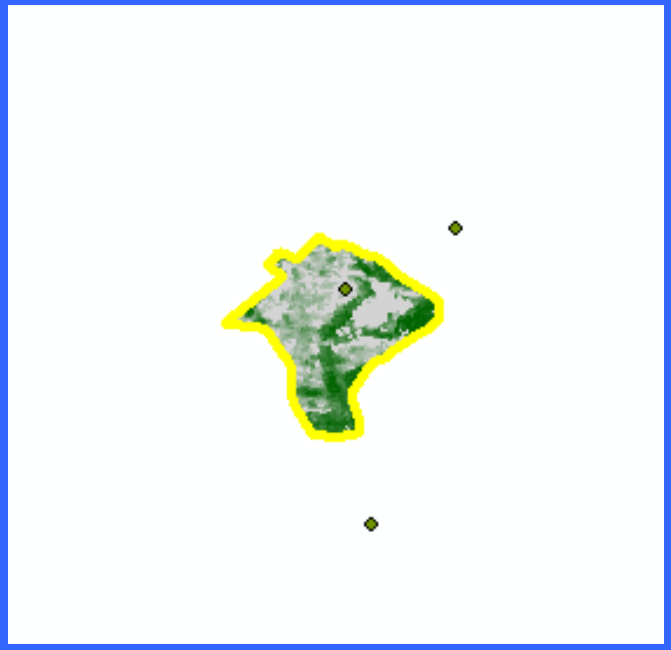
If a user does not have GIS capability, they can use tools within Vue to isolate the area of interest.

If you love using Spatial Analyst, that works. There are instructions on how to use Spatial Analyst in the manual.

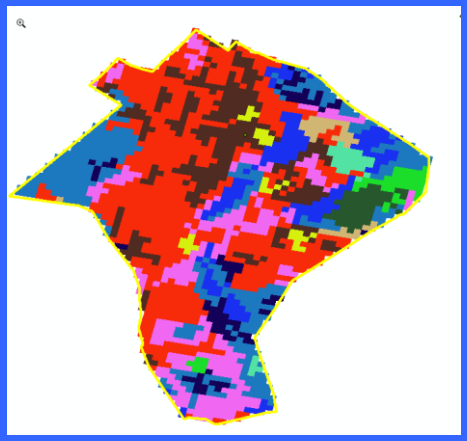


Make sure to name the output data with a tif extension. A TFW world file will be created at the same time.

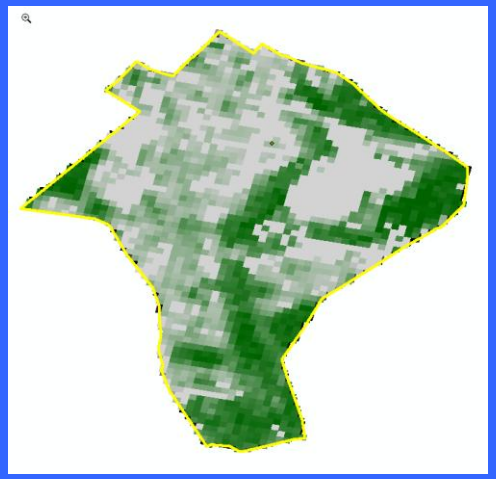




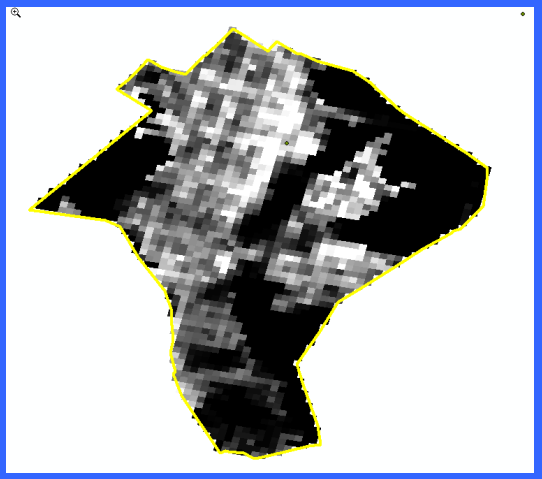
Why not work with Jermyn, PA, my home town?



Land Cover



Canopy



Impervious Cover

Browse for NLCD Imagery

Browse for an NLCD LAND COVER image

Example of NLCD 2001 LAND COVER

note: imagery clipped in GIS software may exhibit a grayscale palette

Browse for an NLCD TREE CANOPY image

Example of NLCD 2001 TREE CANOPY

note: imagery clipped in GIS software may exhibit a grayscale palette

Browse for an NLCD IMPERVIOUS COVER image

Example of NLCD 2001 IMPERVIOUS COVER

note: imagery clipped in GIS software may exhibit a grayscale palette

Choose a State for Default Pollution Removal Values or use values from an existing i-Tree Eco project:

Check to manually define an AREA OF INTEREST on UNCLIPPED NLCD imagery.

note: feature should not be used on previously clipped imagery.

Help for this Form:

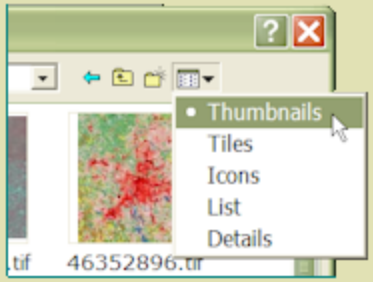
Use this form to load all three of the downloaded and uncompressed (unzipped) NLCD images from www.mrlc.gov. All three images MUST have been downloaded at the same time for exact alignment. Otherwise, calculations in this application will be incorrect. Vue CANNOT correct for image alignment problems.

(For Help downloading imagery, click the NLCD Download Help button below.)

If one is working with CLIPPED versions of the three images, the color palettes may have changed.Vue will attempt to apply the standard NLCD colors to each image.

»OK starts the image statistics calculations and launches i-Tree Vue.
»Cancel exits i-Tree Vue.

TIP: In the File Open Dialog window, switch to Thumbnail View in order to help discern each of the three NLCD images:



NLCD Download Help

i-Tree Vue Manual

Explore Sample Imagery

Cancel

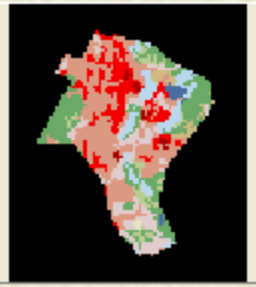
OK

Browse for NLCD Imagery

Browse for an NLCD LAND COVER image

Example of NLCD 2001 LAND COVER

note: imagery clipped in GIS software may exhibit a grayscale palette



C:\Documents and Settings\Mary Margaret Minnis\Desktop\NEARCSpring2012\LandCover\LandCvrJmn.tif

Browse for an NLCD TREE CANOPY image

Example of NLCD 2001 TREE CANOPY

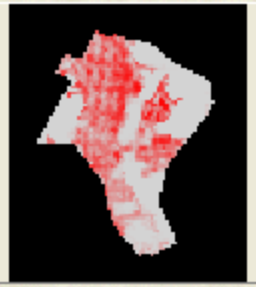
note: imagery clipped in GIS software may exhibit a grayscale palette

C:\Documents and Settings\Mary Margaret Minnis\Desktop\NEARCSpring2012\Canopy\LndCvrJ.tif

Browse for an NLCD IMPERVIOUS COVER image

Example of NLCD 2001 IMPERVIOUS COVER

note: imagery clipped in GIS software may exhibit a grayscale palette



C:\Documents and Settings\Mary Margaret Minnis\Desktop\NEARCSpring2012\Impervious\ImpJer.tif

Choose a State for Default Pollution Removal Values or use values from an existing i-Tree Eco project: PA - PENNSYLVANIA

☐ **Check to manually define an AREA OF INTEREST on UNCLIPPED NLCD imagery.**

note: feature should not be used on previously clipped imagery.

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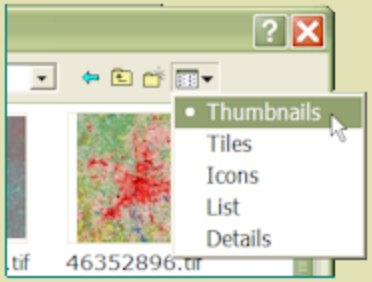


NLCD Download Help

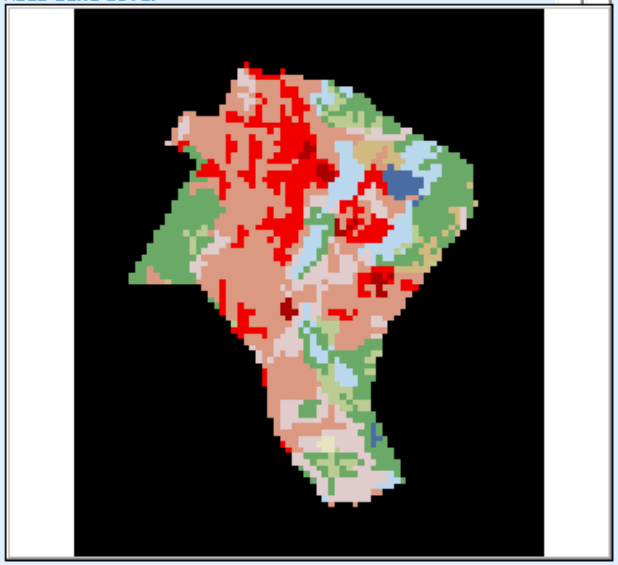
i-Tree Vue Manual

Explore Sample Imagery

Cancel OK

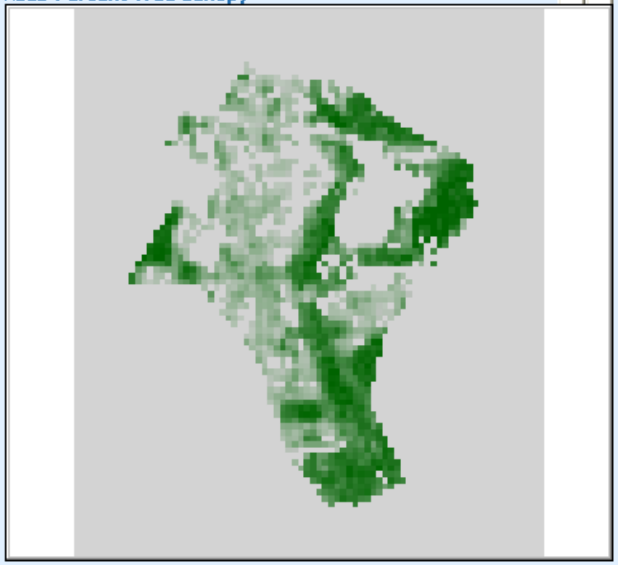
i-Tree Vue

NLCD Land Cover



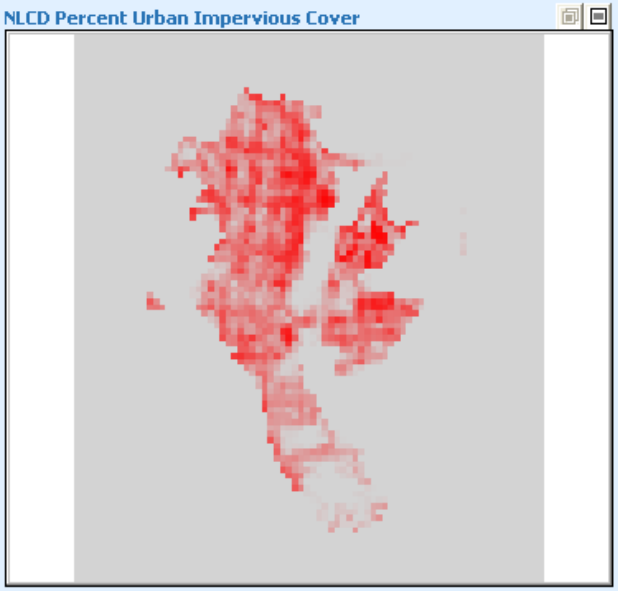
C:\Documents and Settings\Mary Margaret Minnis\Desktop\NEARCSpring201...

NLCD Percent Tree Canopy



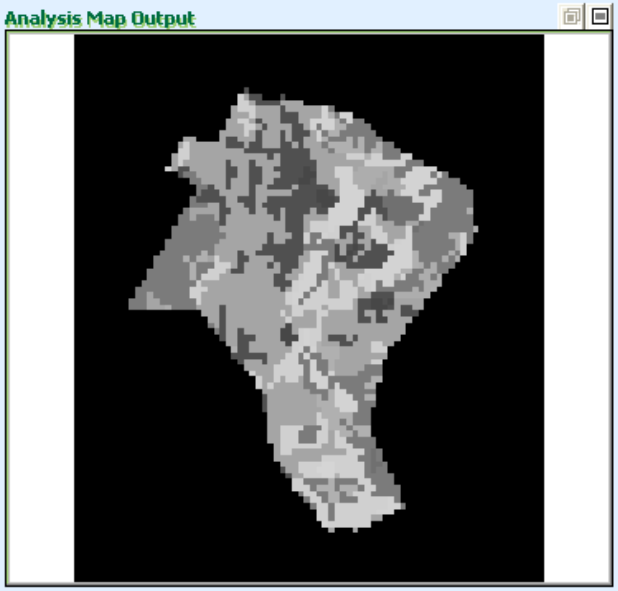
C:\Documents and Settings\Mary Margaret Minnis\Desktop\NEARCSpring201...

NLCD Percent Urban Impervious Cover



C:\Documents and Settings\Mary Margaret Minnis\Desktop\NEARCSpring201...

Analysis Map Output



Output Not Saved Yet.

NLCD Statistics

General | Developed | Forest | Wet 1 | Wet 2 | Agri | Misc | Pixel Info | Classes | About

NLCD Image Area:
493.3 acres

Tree Canopy (TC):
185.3 acres
38.1 %

Impervious Cover (IC):
114.0 acres
23.5%

Developed (all):
309.4 acres
62.7 %
TC: 25.1% IC: 36.9%

Forest (all):
135.0 acres
27.4 %
TC: 63.4% IC: 0%

Wetlands (all - wet1 & 2 tabs):
40.0 acres
8.1 %
TC: 54.3% IC: 0%

Agriculture (all):
0.0 acres
0 %
TC: 0% IC: 0%

Miscellaneous (all):
1.6 acres
0.3 %
TC: 15.3% IC: 0%

Water:
7.3 acres
1.5 %

NLCD Adjustment: Tree Canopy
NLCD Adjustment: Impervious Cover
Carbon Storage
Carbon Sequestration
CO Removal
NO_2 Pollution Removal
O_3 Pollution Removal
SO2 Pollution Removal
PM_{10} Pollution Removal
Tree Available Green Space
Tree Canopy Green Space
Tree Canopy % Change: Region
Tree Canopy % Change: Developed, All
Tree Canopy % Change: Developed Classes
Tree Canopy % Change: General Classes

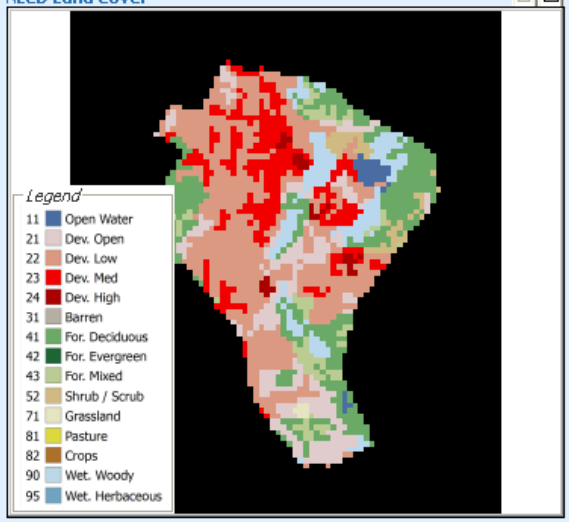
GoogleFind | GoogleVue | Metric Units

Analysis Options

Save Output | Reset Output

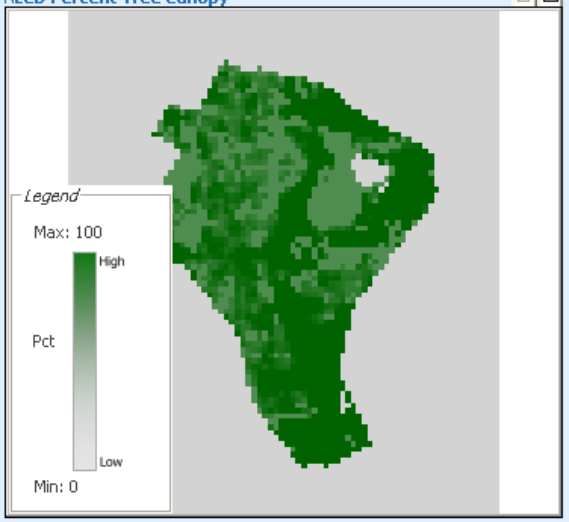
i-Tree Vue

NLCD Land Cover



C:\Documents and Settings\Mary Margaret Minnis\Desktop\NEARCSpring201.

NLCD Percent Tree Canopy



C:\Documents and Settings\Mary Margaret Minnis\Desktop\NEARCSpring2012\

NLCD Statistics

NLCD Image Area:
493.3 acres

Tree Canopy (TC):
417.6 acres
85.9 %

Impervious Cover (IC):
114.0 acres
23.5%

Developed (all):
309.4 acres
62.7 %
TC: 81.8% IC: 36.9%

Forest (all):
135.0 acres
27.4 %
TC: 93.4% IC: 0%

Wetlands (all - wet1 & 2 tabs):
40.0 acres
8.1 %
TC: 93% IC: 0%

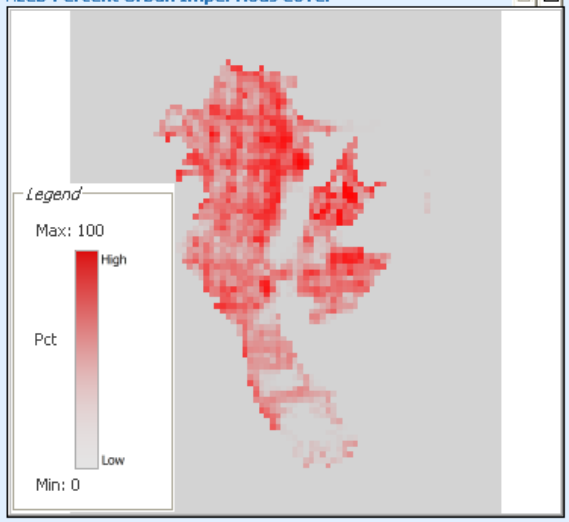
Agriculture (all):
0.0 acres
0 %
TC: 0% IC: 0%

Miscellaneous (all):
1.6 acres
0.3 %
TC: 77.4% IC: 0%

Water:
7.3 acres
1.5 %

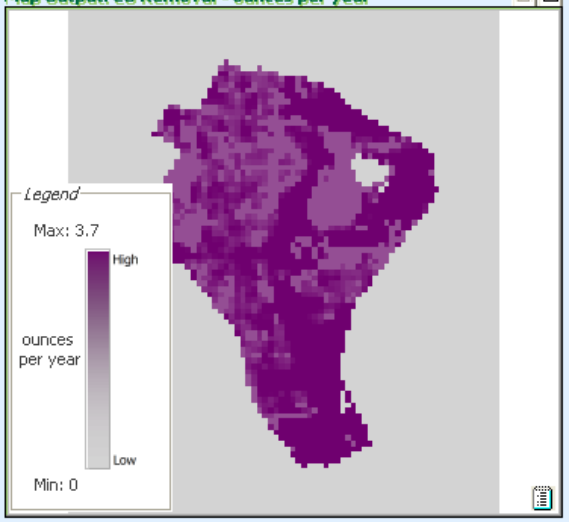
General | Developed | Forest | Wet 1 | Wet 2 | Agri | Misc | Pixel Info | Classes | About | Help

NLCD Percent Urban Impervious Cover



C:\Documents and Settings\Mary Margaret Minnis\Desktop\NEARCSpring201.

Map Output: CO Removal - ounces per year



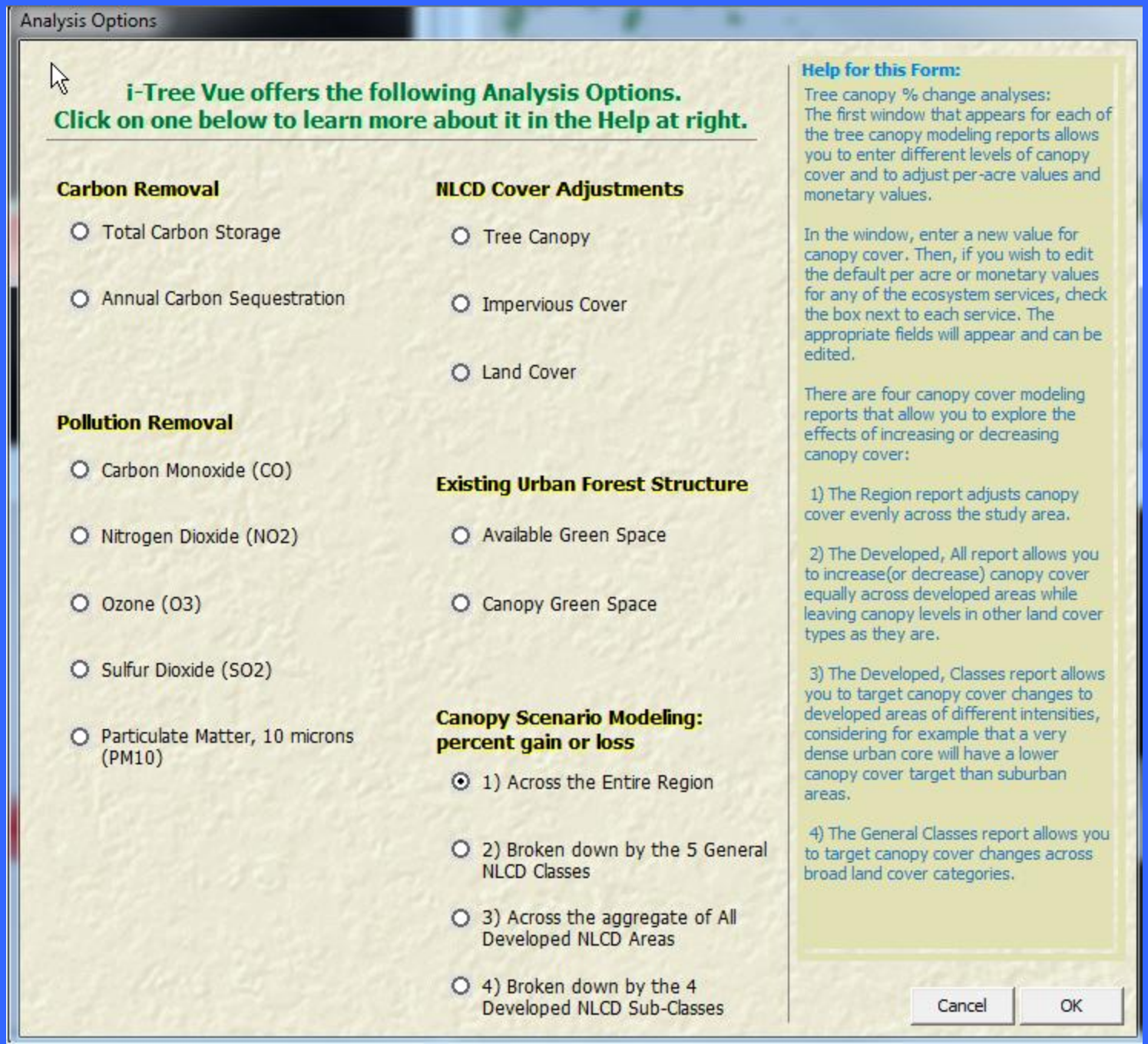
CO Removal - ounces per year: Output Not Saved Yet.

GoogleFind | GoogleVue | US Units

Analysis Options

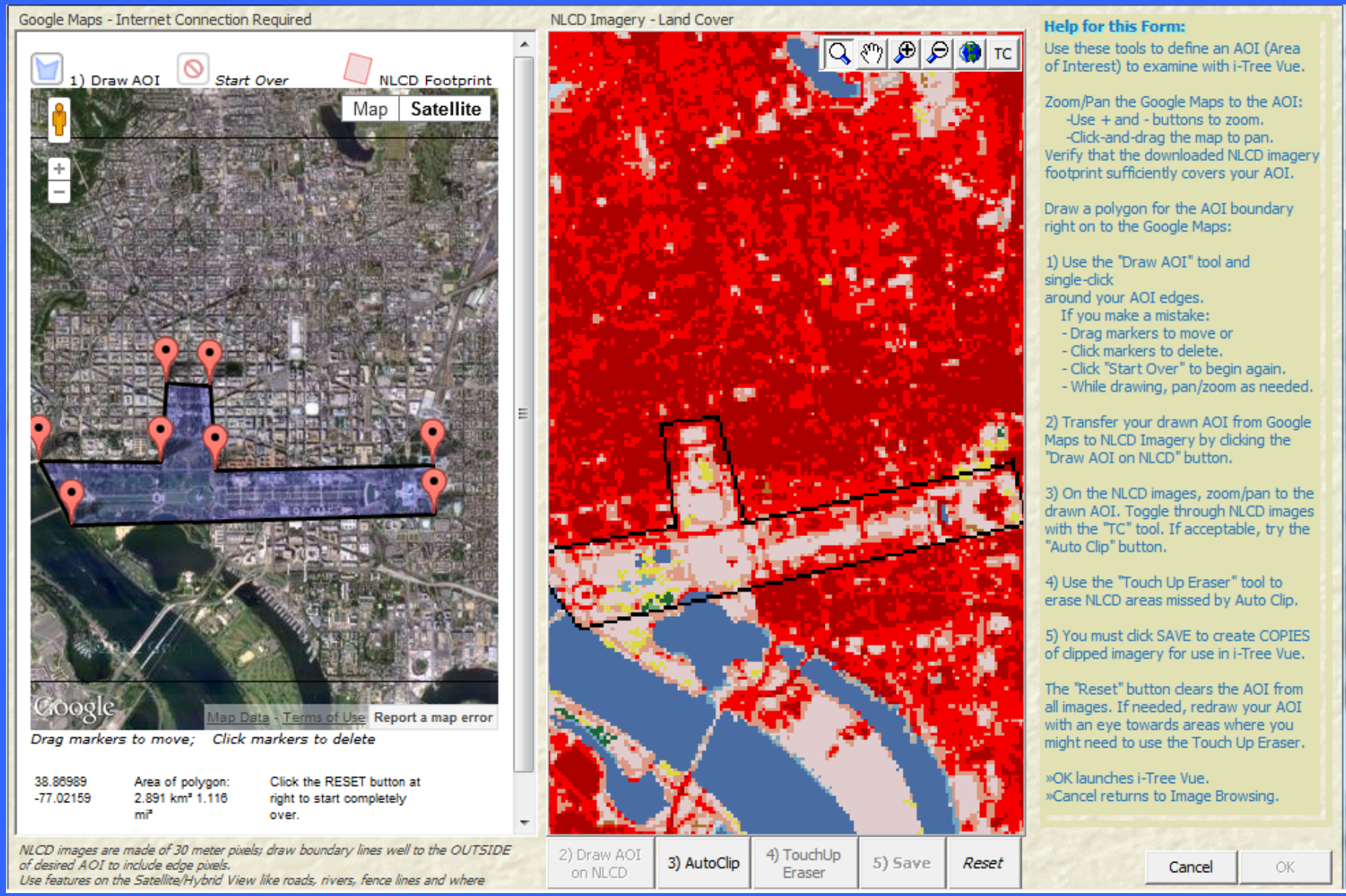
Save Output | Reset Output | CO Pollution Removal

Vue 5.0 will be out this summer and this is the new options page:



Even now, you can “Manually define an Area of Interest” on the image load screen to use Google to clip your AOI. Good for non-GIS users.

This is Washington, DC mall area:



The Reports

Carbon storage: estimates the total carbon (and carbon dioxide equivalents) stored in the total urban forest.

Carbon sequestration: estimates the annual carbon (and carbon dioxide equivalents) sequestered each year by the urban forest.

CO pollution removal: estimates the amount of carbon monoxide removed by the urban forest annually.

NO_2 pollution removal: estimates the amount of nitrogen dioxide removed by the urban forest annually.

O_3 pollution removal: estimates the amount of ozone (smog) removed by the urban forest annually.

SO_2 pollution removal: estimates the amount of sulfur dioxide removed by the urban forest annually.

PM_{10} pollution removal: estimates the amount of small particulate matter removed by the urban forest annually.

i-Tree Vue - Analysis Report

Carbon Storage

Entire region.

*(Carbon Storage * Tree Canopy) note: all estimates are rounded*

Date: 5/21/2012 10:54:12 AM

⊞ Image Area

⊞ Impervious Cover

⊟ Tree Canopy

185.3 acres

38.1 %

Carbon Storage: 7,523.2 short tons ; $155,609.4 @ $20.68 per short tons

CO2 Equivalent Storage: 27,580.2 short tons ; $155,609.4 @ $5.64 per short tons

⊞ NLCD Developed

⊞ NLCD Forest

⊞ NLCD Wetlands

⊞ NLCD Miscellaneous

⊞ NLCD Water

i-Tree Vue - Analysis Report

Carbon Sequestration

Entire region.

*(Carbon Sequestration * Tree Canopy) note: all estimates are rounded*

Date: 5/21/2012 10:53:23 AM

Image Area

Impervious Cover

Tree Canopy

185.3 acres

38.1 %

Carbon Sequestration: 248.0 short tons per year ; $5,130.0 @ $20.68 per short tons per year

CO2 Equivalent Sequestration: 909.2 short tons per year ; $5,130.0 @ $5.64 per short tons per year

NLCD Developed

NLCD Forest

NLCD Wetlands

NLCD Miscellaneous

NLCD Water

i-Tree Vue - Analysis Report

Available Green Space

Across the entire region.

(100 - %Existing Tree Canopy - %Impervious Cover) note: all estimates are rounded

Date: 5/21/2012 11:29:44 AM

Image Area

Impervious Cover

Existing Tree Canopy

185.3 acres

38.1 %

Pollution Removal - SO2: 0.9 short tons per year ; $1,915.5 @ $2199.92 per short tons per year

Available Green Space

186.6 acres

Difference: 1.3 acres

38.4 %

Pollution Removal - SO2: 0.9 short tons per year ; $1,928.5 @ $2199.92 per short tons per year

Difference: 0.0 short tons per year ; $13

NLCD Developed

NLCD Forest

NLCD Wetlands

NLCD Miscellaneous

Tree Canopy Ecosytem Services Benefits

Executive Summary of Estimates

More than just beauty and shade, trees work for us all every day to clean the air we breathe.

Date: 5/21/2012 1:45:19 PM

Executive Summary

Full Report

LAND COVER

	Area		Impervious		Tree Canopy	
	acres	%	acres	%	acres	%
Entire Area	**691.6**	**100**	**281.7**	**40.7**	**87.0**	**12.6**
Developed, All Classes	571.1	82.6	278.1	48.7	27.2	4.8
Forested, All Classes	63.8	9.2	1.9	3.0	45.8	71.8
Wetlands, All Classes	8.9	1.3	0.3	3.0	6.5	73.2
Agriculture, All Classes	23.4	3.4	0.7	3.0	2.7	11.5
Miscellaneous, All Classes	24.5	3.5	0.7	3.0	4.8	19.5
Water	0.0	0	n/a	n/a	n/a	n/a

CARBON DIOXIDE

	Annual Sequestration *carbon stored each year*		Total Storage *total accumulated carbon*	
	short tons	$	short tons	$
Entire Area	**426.7**	**2,407.4**	**12,943.0**	**73,025.3**
Developed, All Classes	133.4	752.6	4,046.0	22,828.0
Forested, All Classes	224.7	1,268.0	6,816.9	38,461.2
Wetlands, All Classes	31.9	180.2	968.7	5,465.6
Agriculture, All Classes	13.2	74.5	400.5	2,259.5
Miscellaneous, All Classes	23.4	132.2	710.9	4,011.0

AIR POLLUTION

	TOTAL *all pollutants*		CO *Carbon Monoxide*		NO2 *Nitrogen Dioxide*		O3 *Ozone*		SO2 *Sulfur Dioxide*		PM10 *Particulate Matter 10 microns*	
	total pounds	total $	pounds	$	pounds	$	pounds	$	pounds	$	pounds	$
Entire Area	**6,076.8**	**22,384.4**	**86.3**	**55.1**	**1,062.1**	**4,772.3**	**2,537.7**	**11,402.6**	**535.8**	**589.4**	**1,854.9**	**5,565.0**
Developed, All Classes	1,899.7	6,997.4	27.0	17.2	332.0	1,491.8	793.3	3,564.5	167.5	184.3	579.9	1,739.6
Forested, All Classes	3,200.6	11,789.5	45.4	29.0	559.4	2,513.5	1,336.6	6,005.6	282.2	310.4	977.0	2,931.0
Wetlands, All Classes	454.8	1,675.3	6.5	4.1	79.5	357.2	189.9	853.4	40.1	44.1	138.8	416.5
Agriculture, All Classes	188.1	692.6	2.7	1.7	32.9	147.7	78.5	352.8	16.6	18.2	57.4	172.2
Miscellaneous, All Classes	333.7	1,229.5	4.7	3.0	58.3	262.1	139.4	626.3	29.4	32.4	101.9	305.7

Estimates generated with i-Tree Vue for Trees only. For more information, visit www.itreetools.org.

What is this good for?

- Serves as a foot in the door to evaluating the urban forest value
- Fills the need of groups that will never have the time money for the higher-end analyses
- Gets results on little to no budget, with or without GIS software.
- Does not replace the more accurate LiDAR analyses
- Can help justify a more expensive analysis if the benefit can be shown.

i-Tree software suite v 4.0 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 (Beta)** 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 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 (beta)** 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 beta tool is the first stage in development of more sophisticated options that 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.

Canopy updates due this summer:

In Canopy, you create your own classification scheme for your area of study. Then, the program generates random points in that area for you to classify according to your system. Real-time statistics and error bars are generated, so if volunteers are doing the analyses, they can see the error bars get smaller as they classify more spots (incentive!).

Users will be able to draw in their own area if they don't have a shapefile.

Users will be able to save their classification schemas for re-use if they want to classify repeated areas like city council districts

Users can load a previously completed i-Tree Canopy survey, export it to KMZ, and then open GE side-by-side with their web browser, bring in the KMZ to GE, use GE's image date slider and go back to each survey point and assess what the canopy was on those older photos. See how the urban forest has or is changing.

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www.itreetools.org for the programs and the manuals.