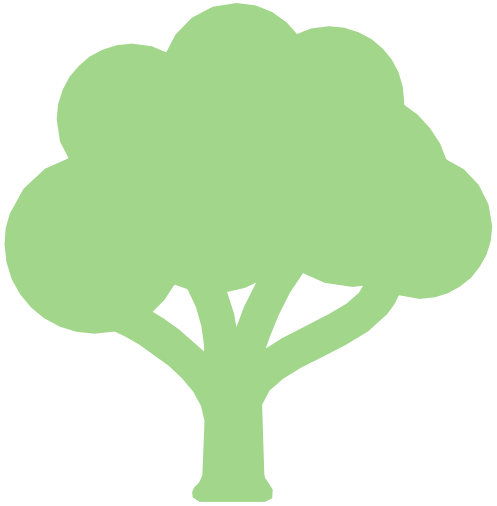


Report to NJ Community Forestry Council Guidelines Subcommittee

Respectfully submitted by Levon Bigelow and Pam Zipse, July 12, 2019

Initial recommendations for the use of *i-Tree* Applications in the update to the Community Forestry Management Plan Guidelines

The NJ Forest Service has a goal to encourage municipalities to utilize *i-Tree* to better understand the functions of the community forest. It is also considered important that the NJ Forest Service recommendations help to provide some standardization in the inventory structure that each participating municipality is utilizing in order to bring some level of uniformity to the program, and to enable meaningful comparisons of municipal tree resources throughout the State. This project represents the beginning steps toward refining a recommendation to include in the revision of the Community Forestry Management Plan Guidelines.

The first step of this project was to provide a brief training/demonstration of *i-Tree Landscape* and *i-Tree Eco* for the Guidelines Update Committee of the NJ Community Forestry Council, in order to provide the members of the committee with an understanding of the scope of these *i-Tree* applications, and to get feedback from the committee on the use of these applications. The applications *i-Tree Landscape* and *i-Tree Eco* were chosen to represent two different approaches to quantifying the urban/community forest and its functions.

The application *i-Tree Landscape* is a top down approach that uses canopy cover information from existing data sources already available within the program to estimate benefits and values of the tree resource. The application *i-Tree Eco* is a bottom up approach that uses inventory data collected and uploaded to the program by the user. It is our feeling that a combination of the information derived from these two applications will give our municipalities a fuller understanding of the functions carried out by their tree resource and the value of those functions.

There is, however, a significant learning curve in utilizing both *i-Tree* applications, and data collection for *i-Tree Eco* is time consuming and requires specialized knowledge and skill.

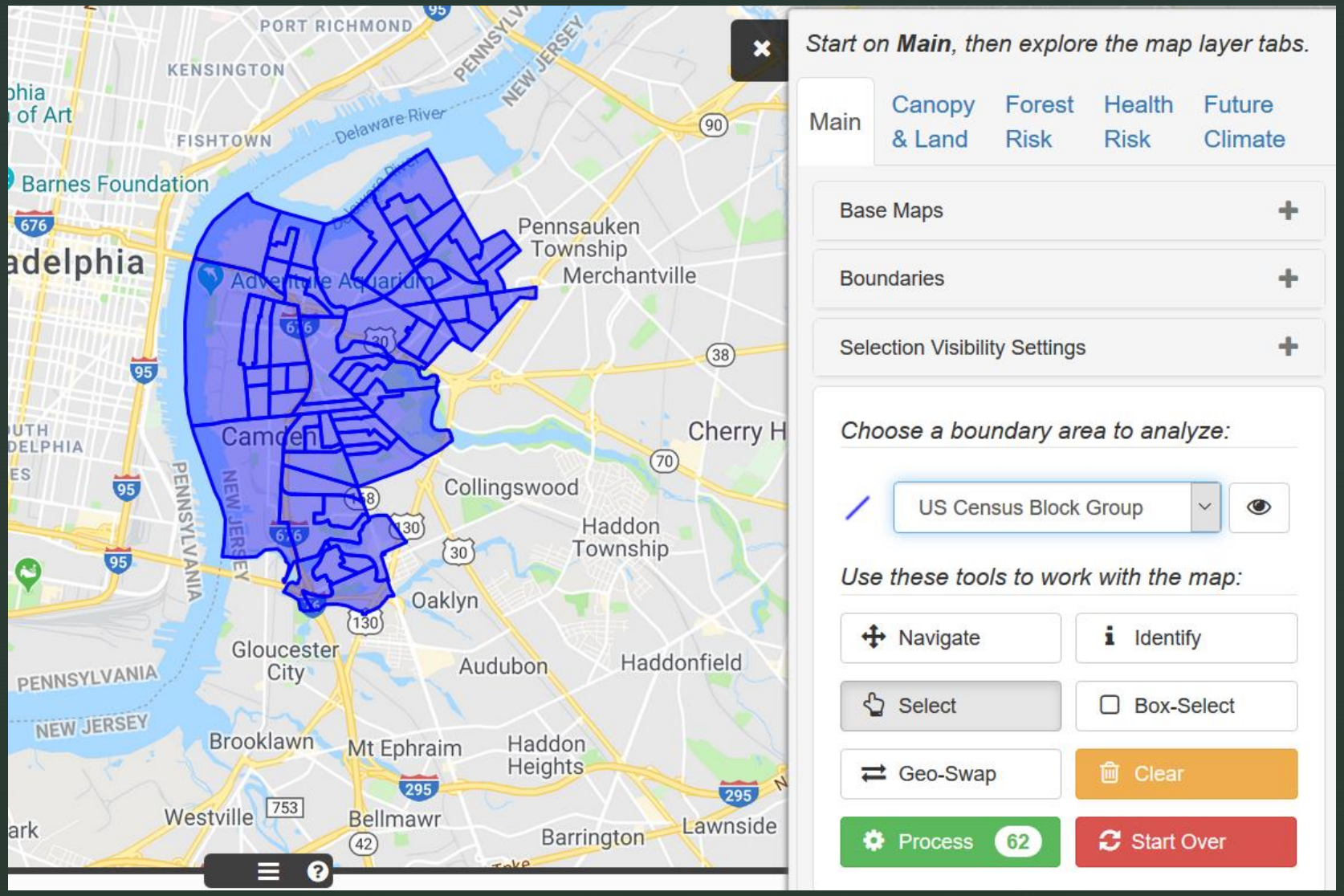
The second step was to complete an *i-Tree Eco* project as a small-scale representation of the environmental services information available in the *i-Tree Eco* reports. Working with the NJ Tree Foundation, we selected Judge Robert Johnson Park in Camden City for this representative *i-Tree Eco* project. We collected all the data that was “required” and “highly recommended” by the *i-Tree Eco* application, as well as additional information from the *i-Tree Eco* menu that we thought would be useful in making management decisions regarding trees in this park.

The goal in having municipalities utilize *i-Tree Landscape* as part of their tree inventory evaluation is to facilitate an improved understanding of the contributions of the entire tree resource in the municipality (not just the publicly owned trees), and to incorporate knowledge of tree functions with local demographic information and environmental needs to inform planting prioritization.

The goal in utilizing *i-Tree Eco* is to direct municipalities to collect their public tree inventory data in such a way that it can be easily and meaningfully run through the *i-Tree Eco* program to provide reports on the functions and value provided by municipally owned and controlled trees, in order to support a case for increased maintenance of existing trees and funding for urban forestry programs based on return on investment.

Findings & Recommendations: *i-Tree Landscape*

We initially looked at *i-Tree Landscape* projects for Camden City, Gloucester City, Trenton City, and Leonia Borough. Using Camden City as an example, one initial concern for ease of use is that the city contains 62 census block groups, and that these do not necessarily line up with municipal wards or neighborhoods.



Camden City is broken down into 62 US Census Block Groups each identified by a twelve-digit number

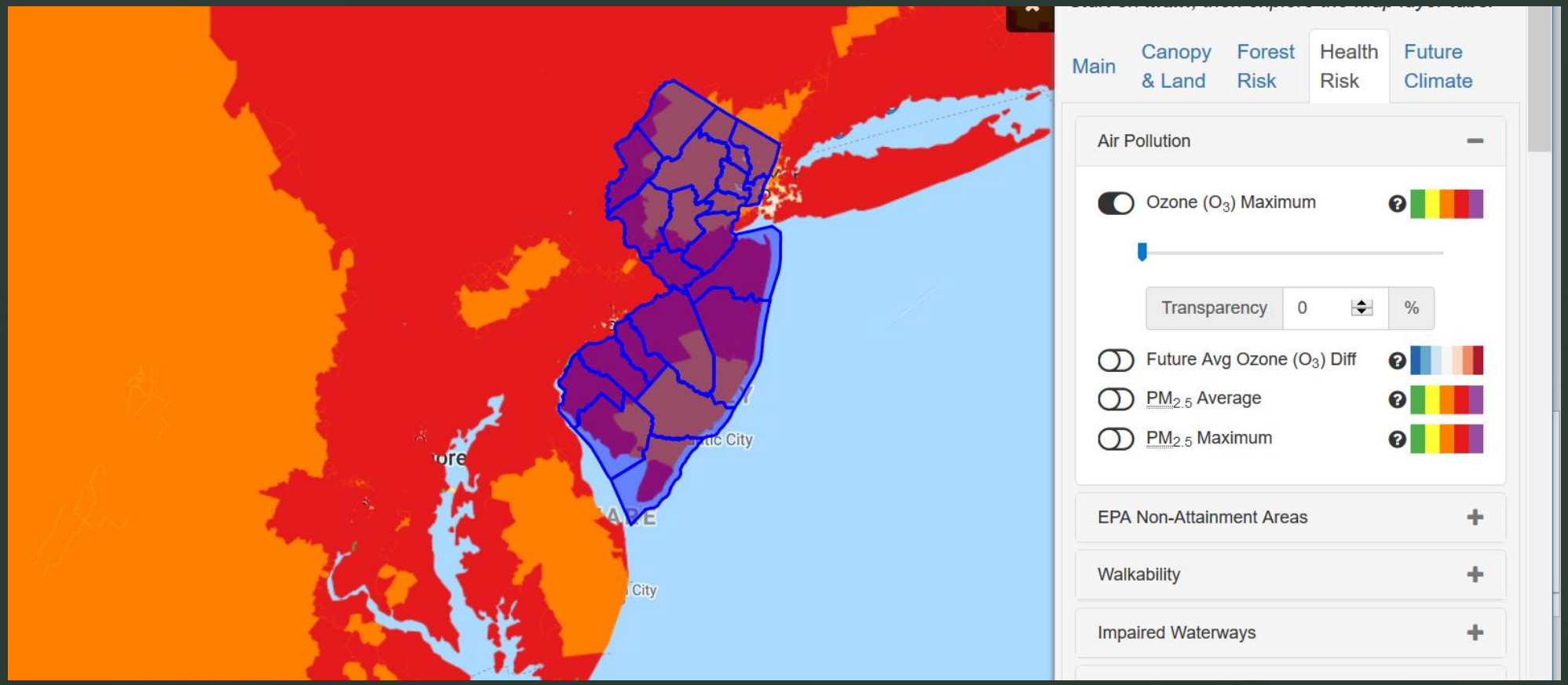
i-Tree Landscape

There are so many different report combinations that we wanted to narrow this down to a handful of minimum recommendations for municipal reports to be included in the development of the Community Forestry Management Plan. Working through this with the NJ Forest Service UCF Coordinator and the Guidelines Committee of the NJ Community Forestry Council was helpful in identifying what reports might be most meaningful.

i-Tree Landscape

We determined that the air quality reports available through i-Tree Landscape are too coarse to be meaningful at the municipal scale but are interesting to look at on the state and county level.

Regional Ozone (O3)

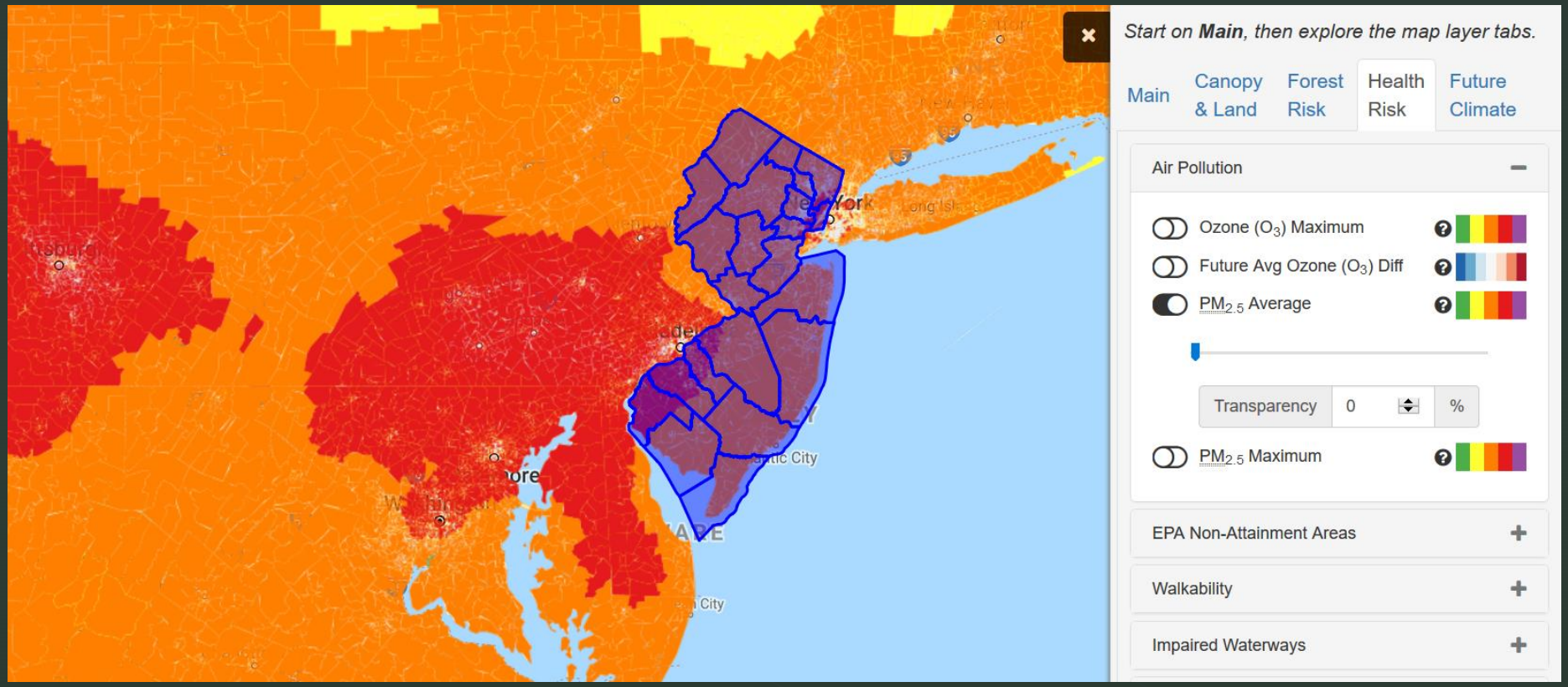


Ozone (O3) Maximum

- Good [50 thru 54 (ppb)]
- Moderate [55 thru 70 (ppb)]
- Unhealthy for Sensitive Groups [71 thru 85 (ppb)]
- Unhealthy [86 thru 105 (ppb)]
- Very Unhealthy [106+ (ppb)]

The maximum O3 (ppb) value for all days in 2008 from U.S. EPA Downscaler Modal - epa.gov.

Regional Particulate Matter (PM 2.5) Average

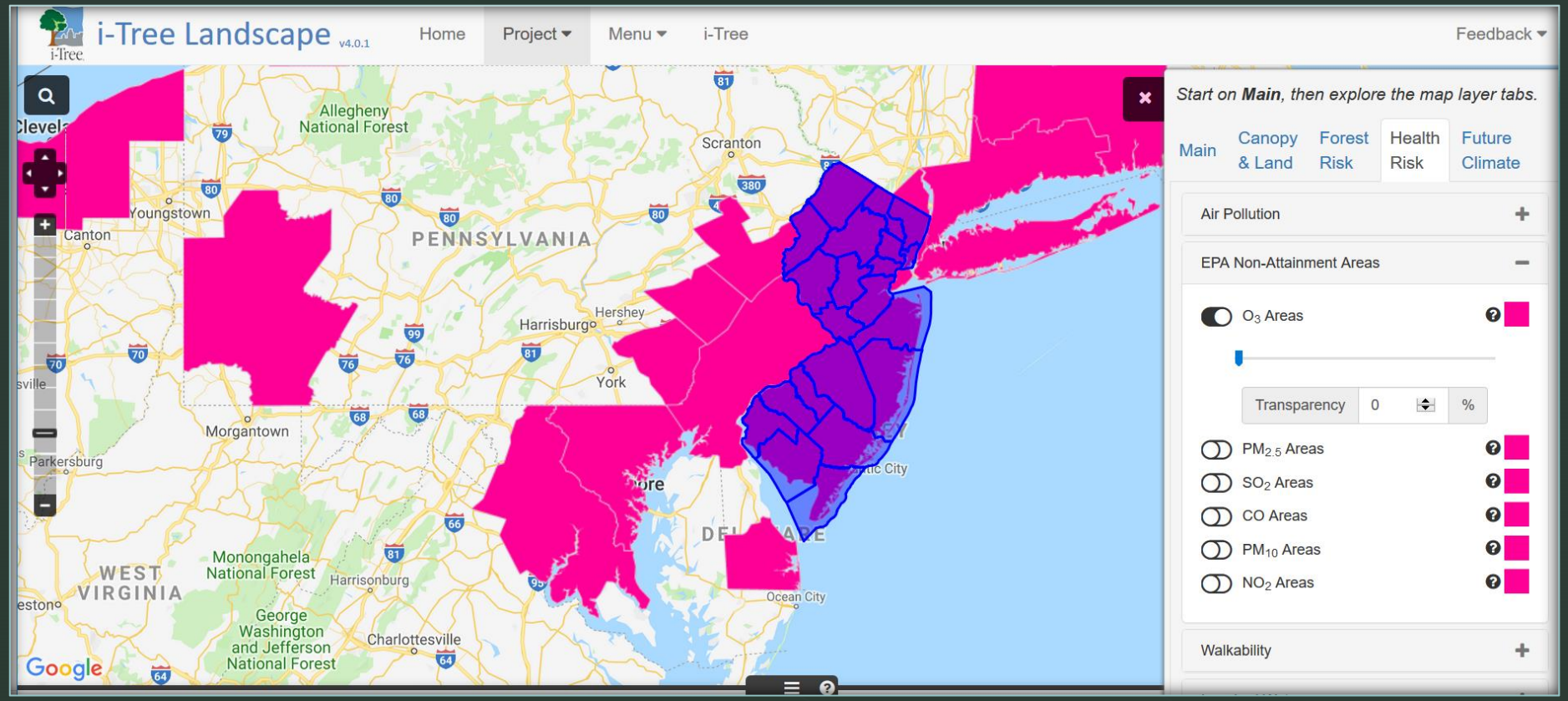


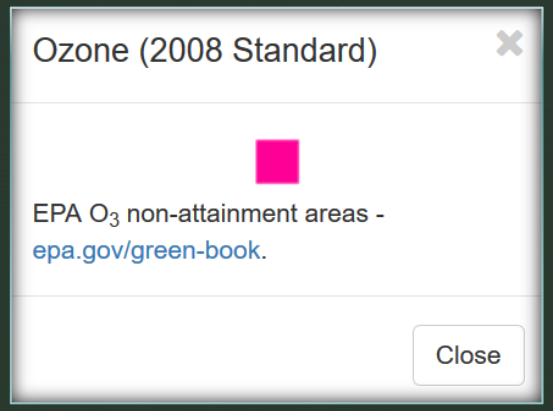
Particulate Matter (PM2.5) Average

- Good [4 thru 6 (µg/m³)]
- Moderate [7 thru 9 (µg/m³)]
- Unhealthy for Sensitive Groups [10 thru 12 (µg/m³)]
- Unhealthy [13 thru 15 (µg/m³)]
- Very Unhealthy [16+ (µg/m³)]

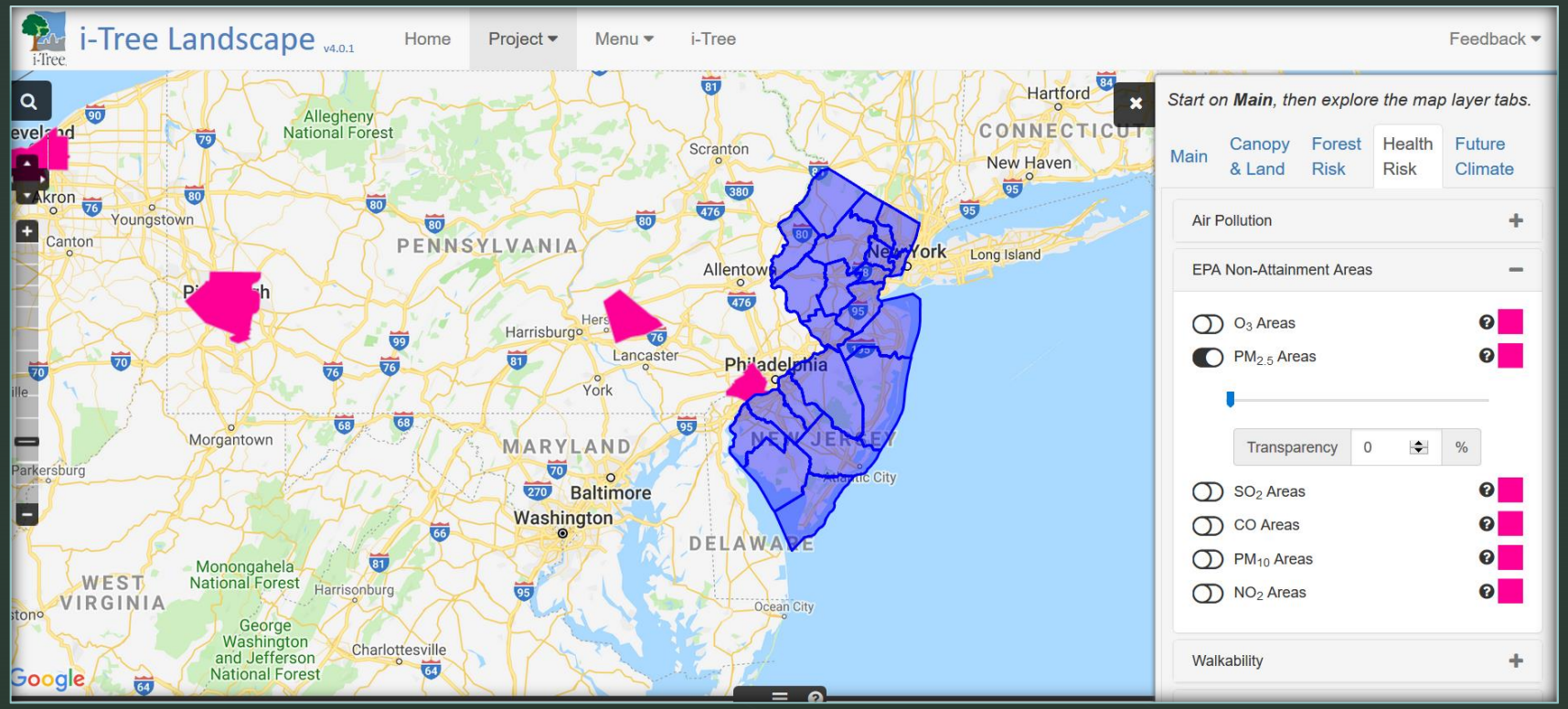
The average PM2.5 (µg/m3) value for all days in 2008 from U.S. EPA Downscaler Modal- epa.gov.

Regional EPA Ozone non-attainment areas





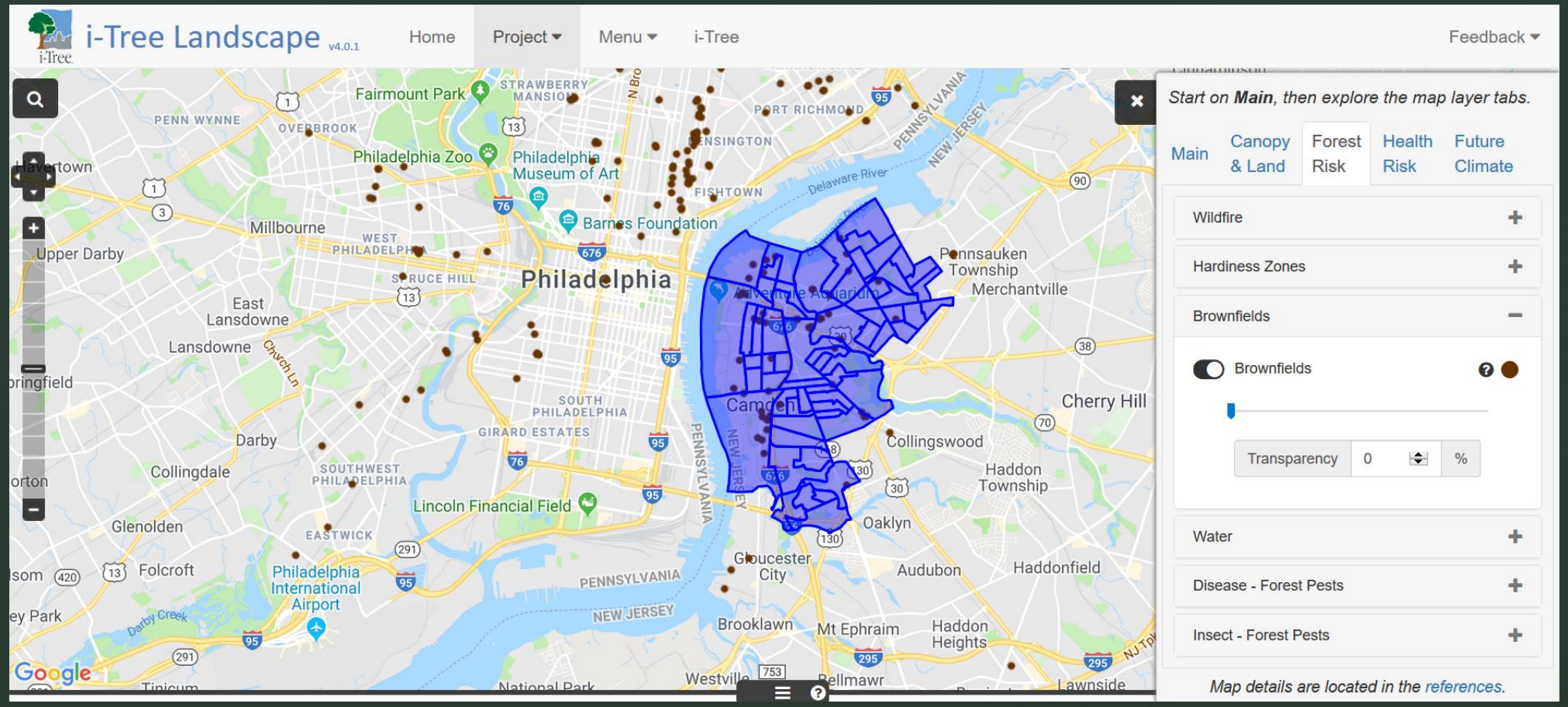
Regional EPA PM 2.5 non-attainment areas



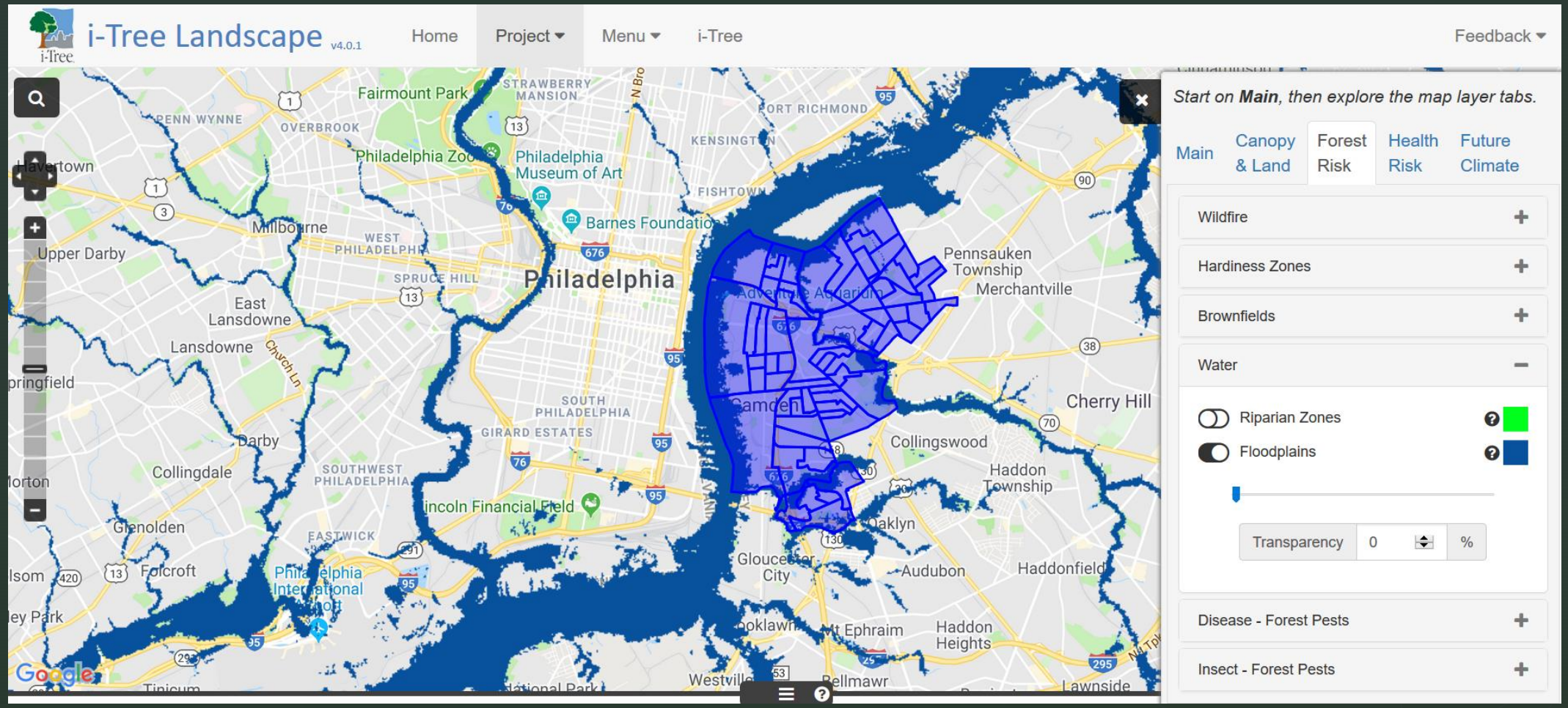
i-Tree Landscape

Other information is more meaningful on a municipal scale.

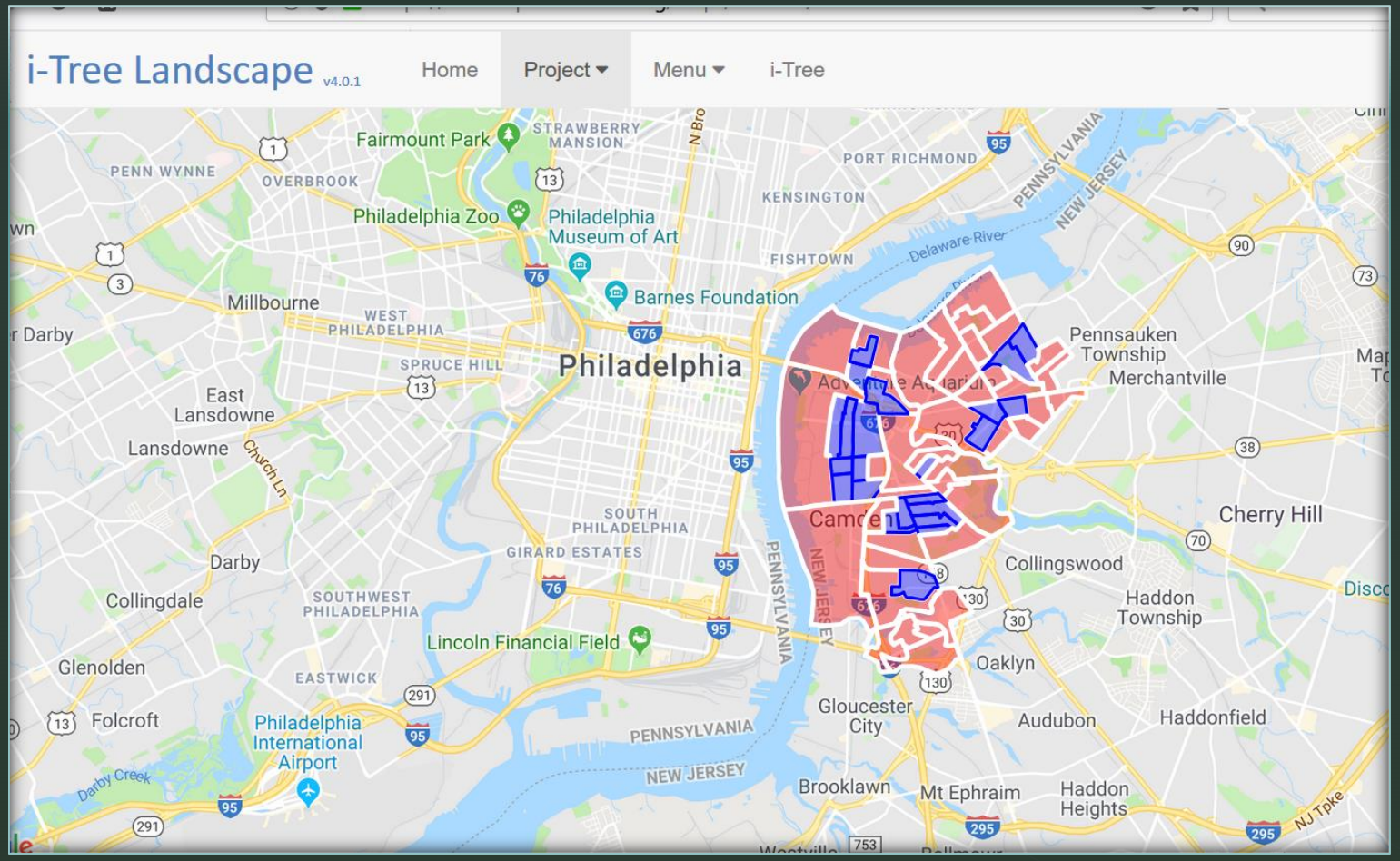
Brownfield sites in Camden City



Floodplain areas in Camden City

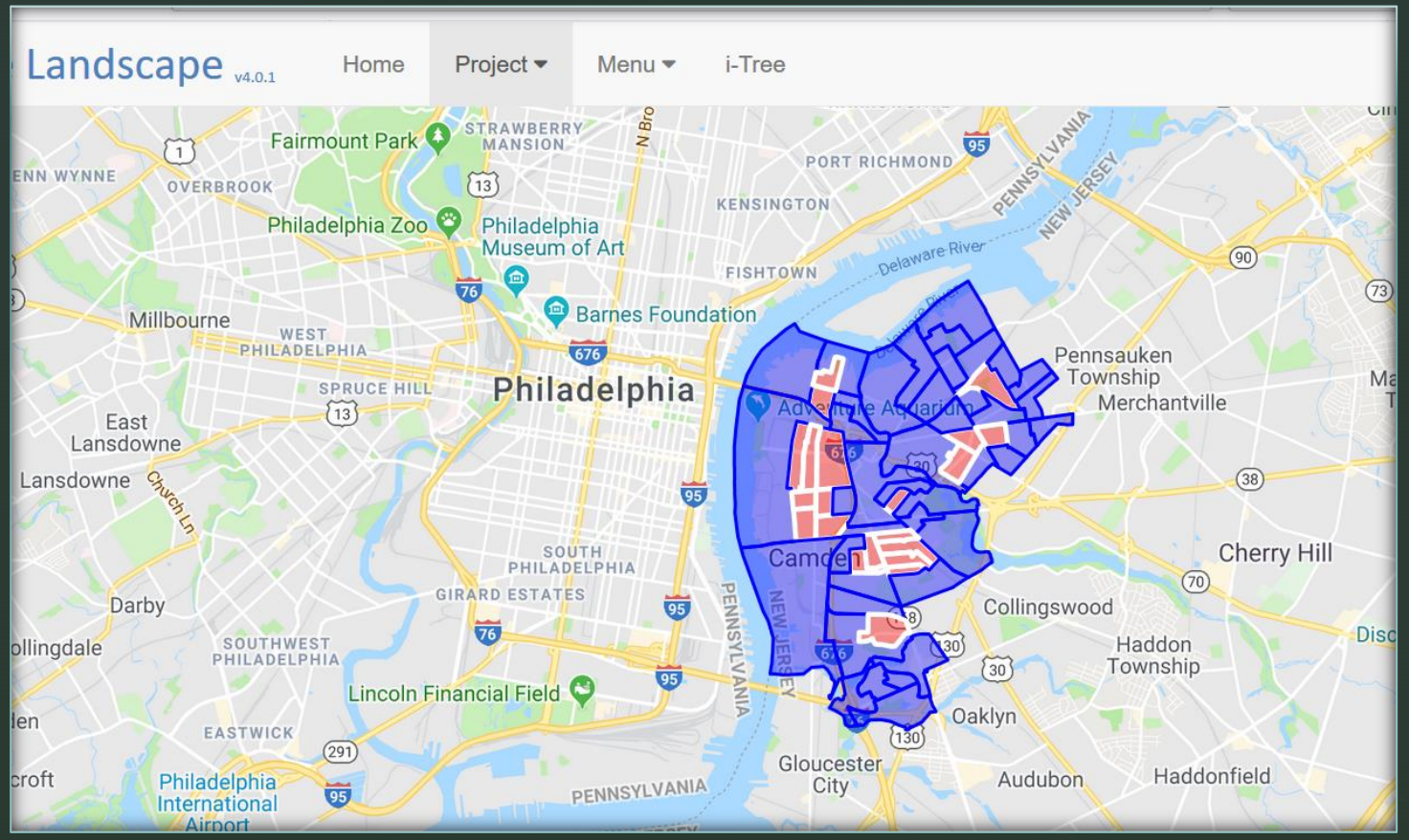


Carbon storage and sequestration



The block groups that are highlighted (pink) are those that each have over 100 short tons of carbon stored by the tree resource

Stormwater Management

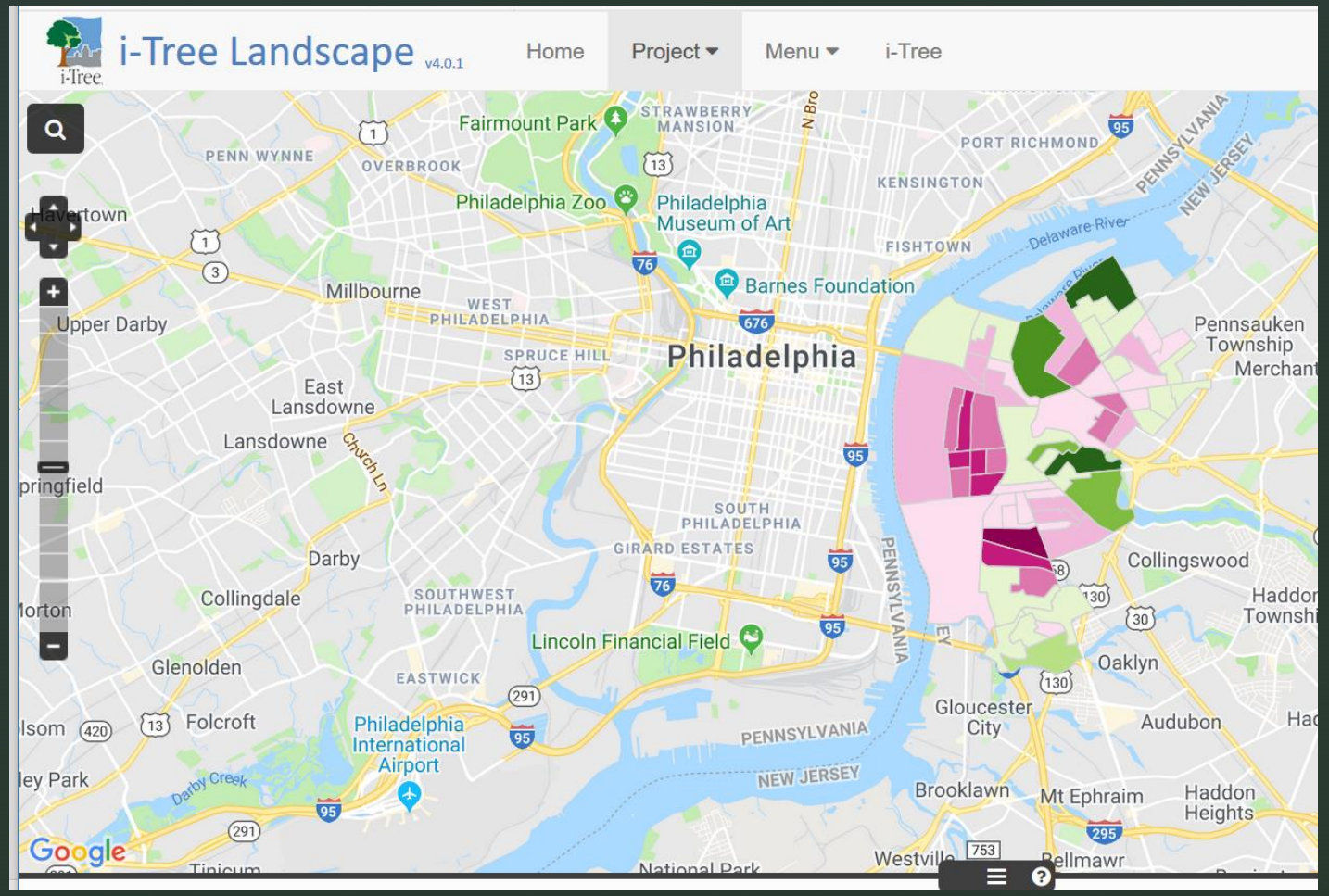


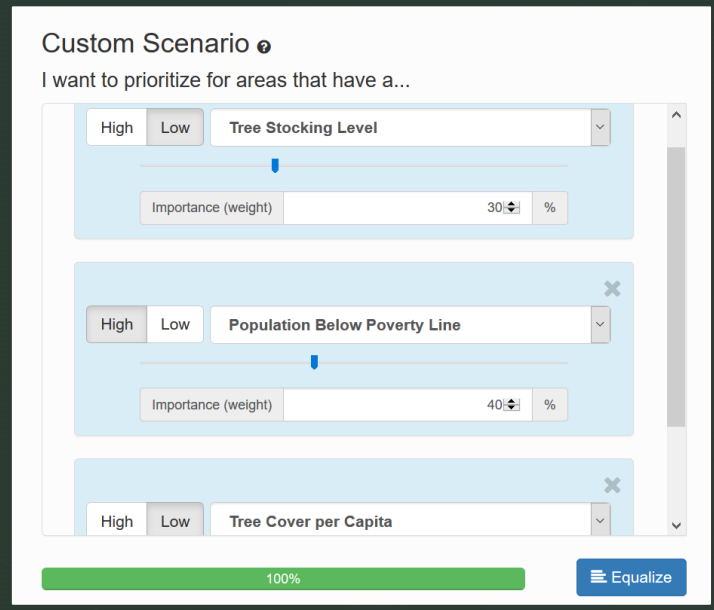
The block groups that are highlighted (pink) are those that provide transpiration of less that 0.5 MG/year of water through the tree resource

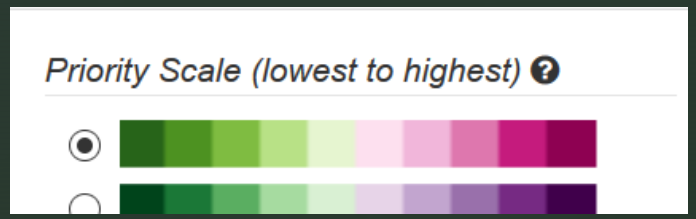
Tree Planting Priority

i-Tree Landscape allows the user to create tree planting prioritizations based on standard and custom scenarios. Standard components of the planting prioritization scenarios include areas (in our case US Census Block Groups) with low tree stocking level and low tree cover per capita. The NJ Forest Service wants to prioritize planting based on high percentage of residents below the poverty line as the third component of a standardized tree planting priority scenario.

Custom planting scenario - poverty



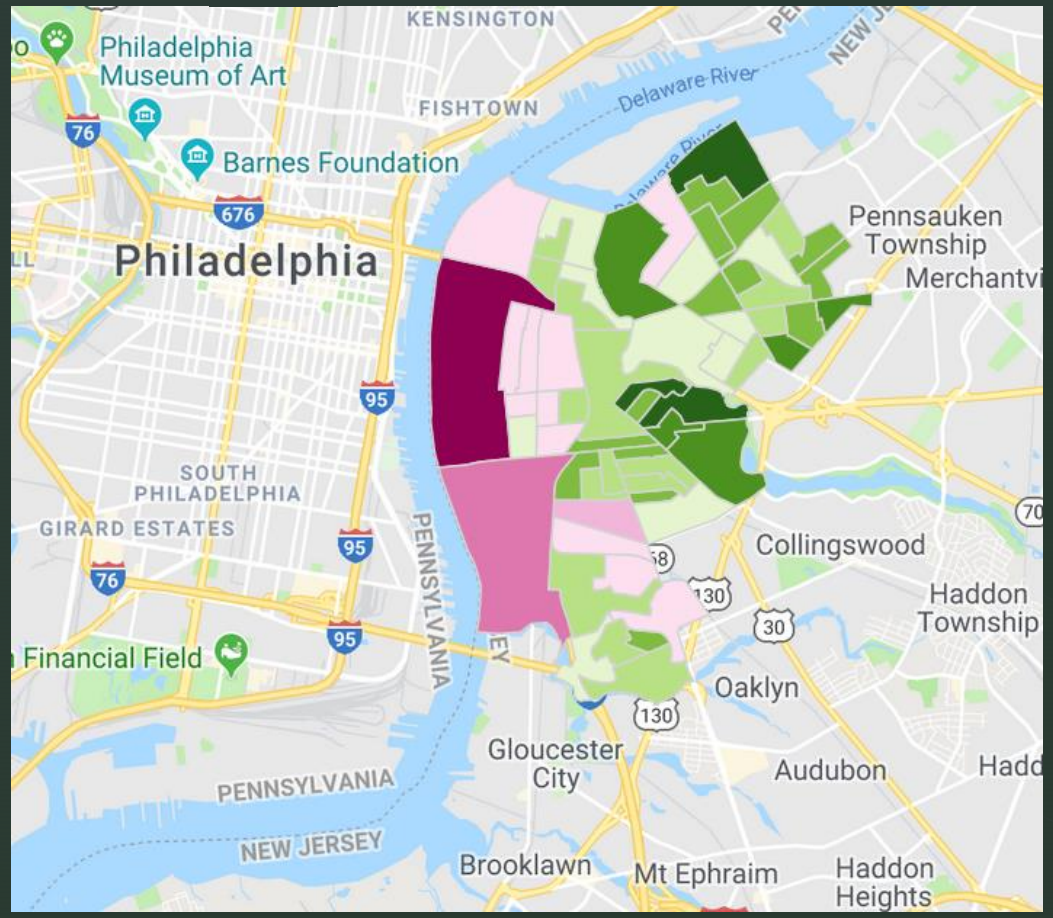


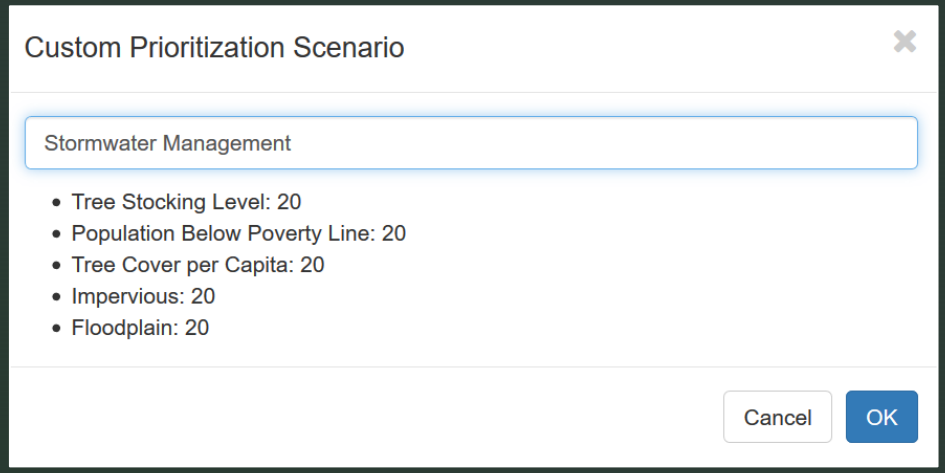


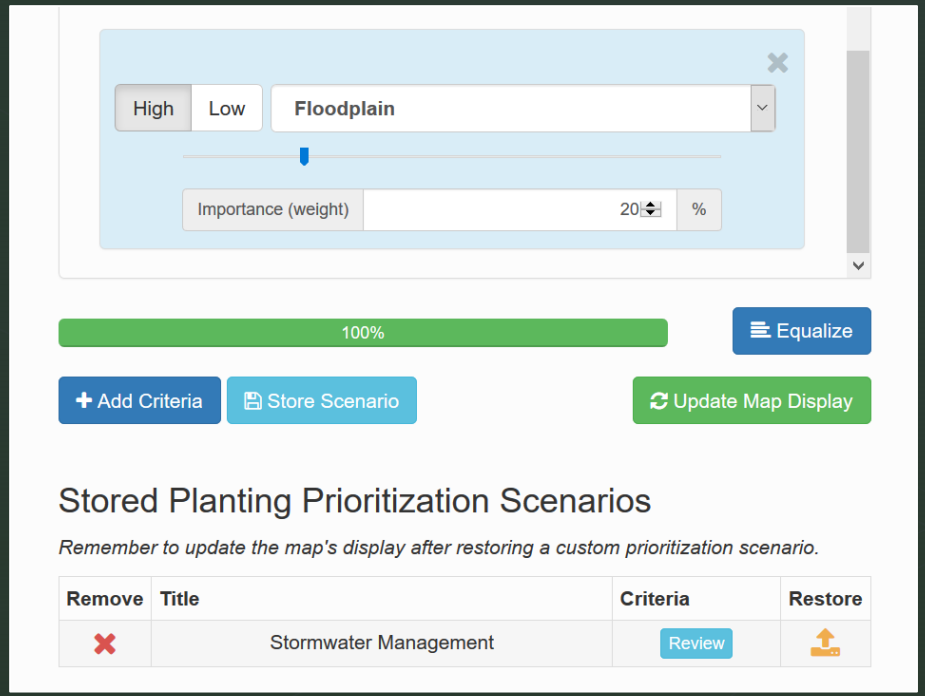
i-Tree Landscape

We can also create custom planting scenarios prioritizing for specific environmental services benefits in order to make the argument for utilizing tree planting as a tool to combat localized environmental problems, such as flooding…

Custom planting scenario – stormwater management

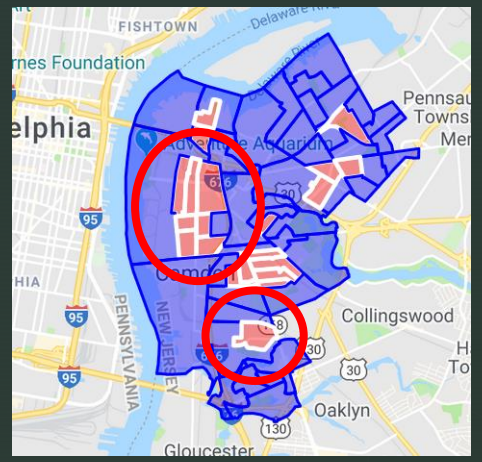




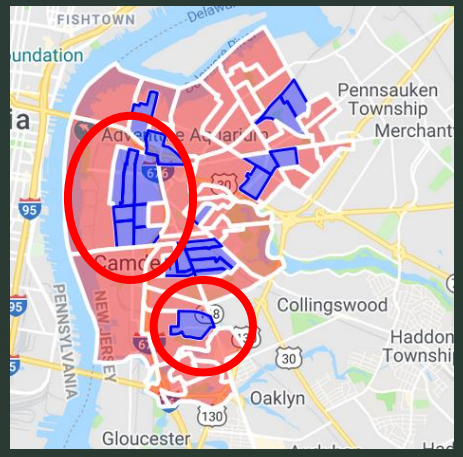


i-Tree Landscape

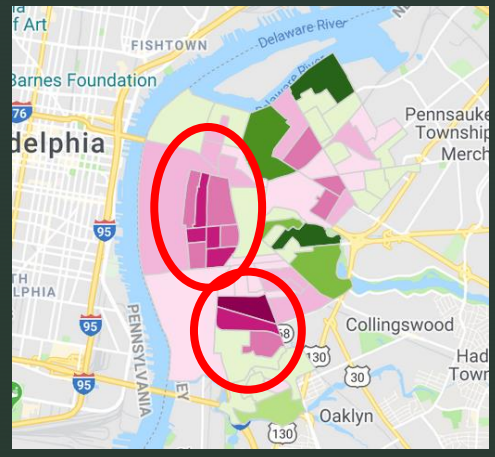
Comparing several scenarios can help to identify areas that consistently and for varied reasons are identified as priority areas to plant.



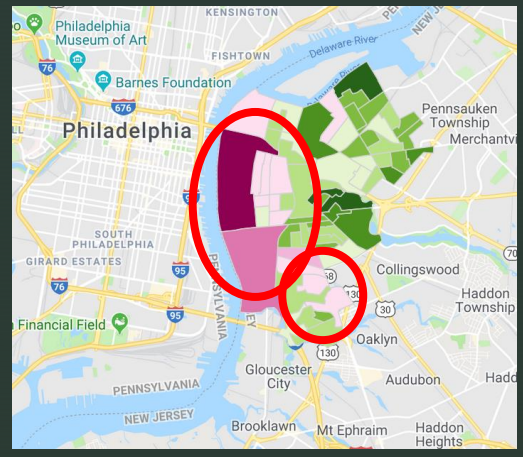
Low transpiration



Low carbon storage



High population below poverty line scenario



Stormwater management scenario

The circled areas are consistently identified for prioritized planting for a number of reasons.

Type	ID	Highlight	Priority Index
Block Group	340076002002	☐	23
Block Group	340076008005	☐	46
Block Group	340076008003	☐	35
Block Group	340076017001	☐	62
Block Group	340076017002	☐	56
Block Group	340076016002	☐	30
Block Group	340076104001	☐	52
Block Group	340076104002	☐	50
Block Group	340076103001	☐	100
Block Group	340076104003	☐	52
Block Group	340076009001	☐	7
Block Group	340076004002	☐	50
Block Group	340076008002	☐	42

Findings & Recommendations: *i-Tree Eco*

We conducted an inventory of trees in Judge Robert Johnson Park in Camden City, NJ as an initial example to show the wide array of tree structure, function, and value reports that *i-Tree Eco* can generate to model the use of i-Tree in inventory interpretation and utilization to inform management decisions and public outreach and education. This park was chosen because it could be easily stratified to contrast the section of the park where there were mature trees against the adjacent section of park where most of the trees had been planted over just the last two years.

Judge Robert Johnson Park, Camden, NJ

ed Qty dered	U.O.M. Item Number Description
0	ZLKSRGV30025
5	ZELKOVA SER. GREENVASE 30G
0	QRCPLXX30025
2	QUERCUS PALUSTRIS 20G
0	LGRXXXX30030
11	LAGERSTROEMIA IND. #30
0	QRCRRXX30030
8	QUERCUS RUBRA #30
0	LQDSTRT30025
4	LIQUADAMBAR STY ROTUNDILOBA 30G
0	ULMAMPR30020
16	ULMUS AMER. PRINCETON #20
0	ACRGNXX30025
20	ACER GINNALA #25
0	CLTOCXX11002
9	CELTIS OCCIDENTALIS 2"

Recently planted trees are not yet on the Google Earth image.

Judge Robert Johnson Park, Camden, NJ

Not all trees in the park were inventoried. Our goal was to stratify the inventory to contrast mature trees from newly planted trees. We did this by inventorying mature trees along the southern boarder of the park and newly planted trees around the ballfields.

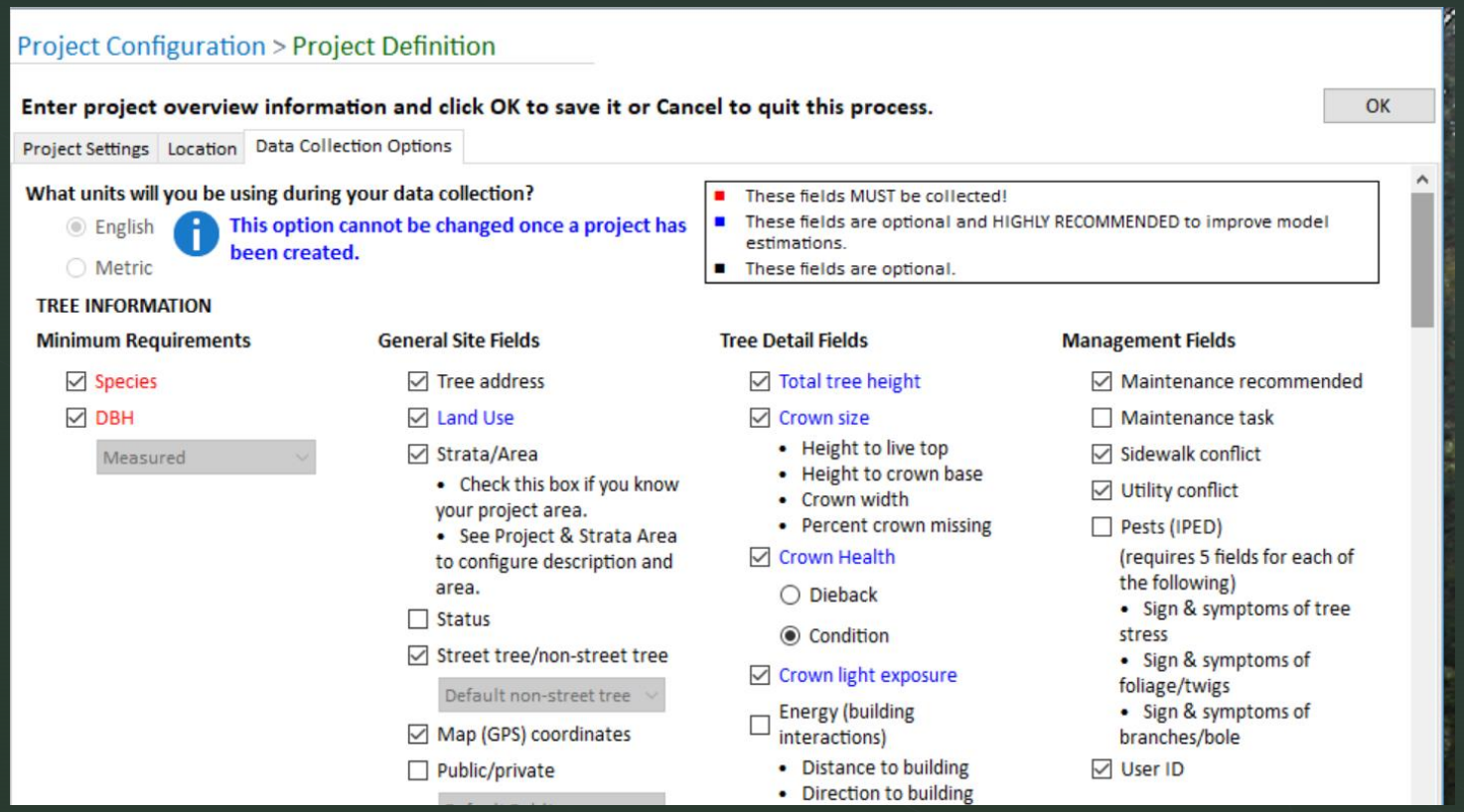
We wanted to identify menu items within *i-Tree Eco* that would help with tree management decisions and record keeping for the municipal tree managers, in addition to providing tree function values.

We also wanted to get a feel for the degree of difficulty and time necessary for collecting the “highly recommended” data fields in *i-Tree Eco*.

i-Tree Eco – Judge Robert Johnson Park

We collected data for all required and highly recommended options, as well as several additional optional data fields. The image to the right is the project definition screen in *i-Tree Eco*, there is a check mark next to the data fields we collected.

Data was collected following instructions in the *i-Tree Eco* field manual.



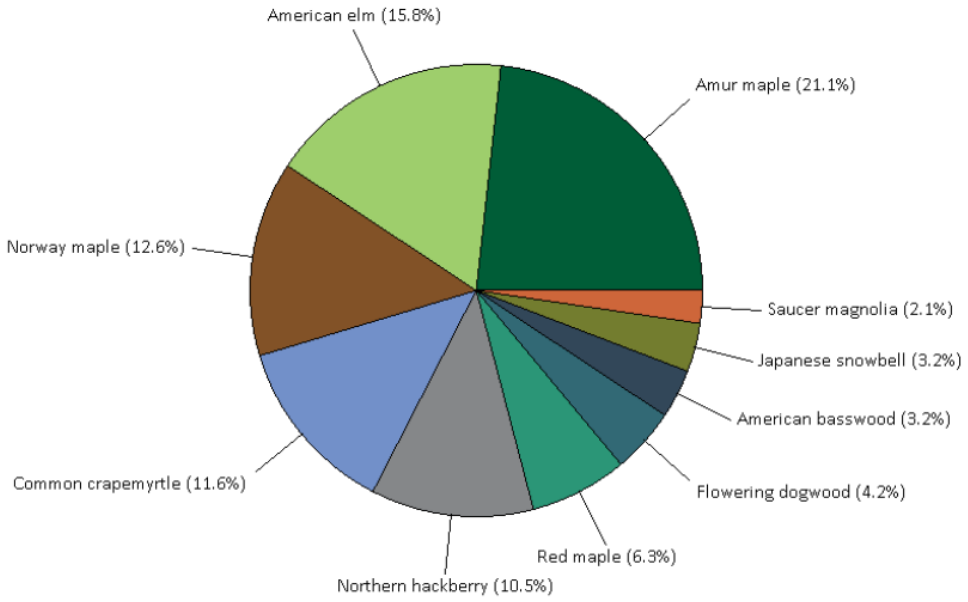
i-Tree Eco – Judge Robert Johnson Park

i-Tree Eco will generate standard composition and structure reports such as species composition and relative age distribution

i-Tree Eco – Judge Robert Johnson Park

Population Summary by Species

Location: Camden, Camden, New Jersey, United States of America
Project: Robert Johnson Park 1, Series: 1, Year: 2019
Generated: 7/10/2019

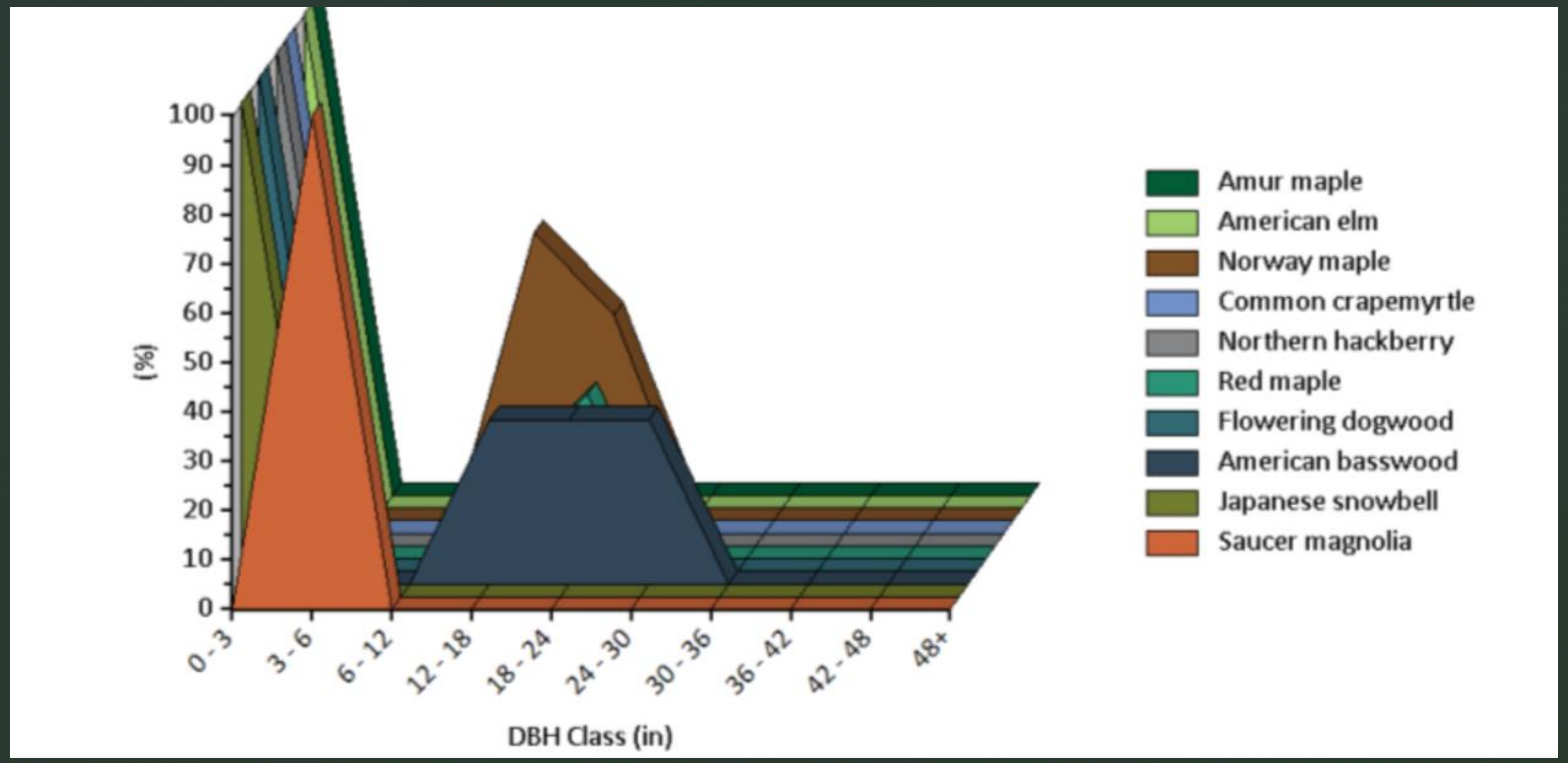


Species	Number of Trees	Percent of Population
Amur maple	20	21.1%
American elm	15	15.8%
Norway maple	12	12.6%
Common crapemyrtle	11	11.6%
Northern hackberry	10	10.5%
Red maple	6	6.3%
Flowering dogwood	4	4.2%
American basswood	3	3.2%
Japanese snowbell	3	3.2%
Saucer magnolia	2	2.1%
Sweetgum	2	2.1%
Northern red oak	1	1.1%
Ginkgo	1	1.1%
Black cherry	1	1.1%
Pin oak	1	1.1%
Japanese zelkova	1	1.1%
ash spp	1	1.1%
Green ash	1	1.1%
Total	**95**	**100%**

i-Tree Eco – Judge Robert Johnson Park

Species Distribution by DBH Class

Location: Camden, Camden, New Jersey, United States of America
Project: Robert Johnson Park 1, Series: 1, Year: 2019
Generated: 7/10/2019



Species composition and relative age distribution are standard metrics that should be utilized from any inventory to make management decisions. Knowledge of species composition can be used to help select tree species for planting projects to increase overall species diversity throughout the municipal tree resource, thereby improving resilience to insect and disease outbreaks. Knowledge of relative age distribution can be used to identify gaps in overall age structure, stagger plantings to improve consistency in annual plantings and removals over time and forecast budgetary needs. These analyses can and should be included in any inventory regardless of the method or software utilized.

Where i-Tree differs from other tree inventory software is in the ability to quantify the functions of the tree resource in terms of environmental services benefits and apply a value to those functions.

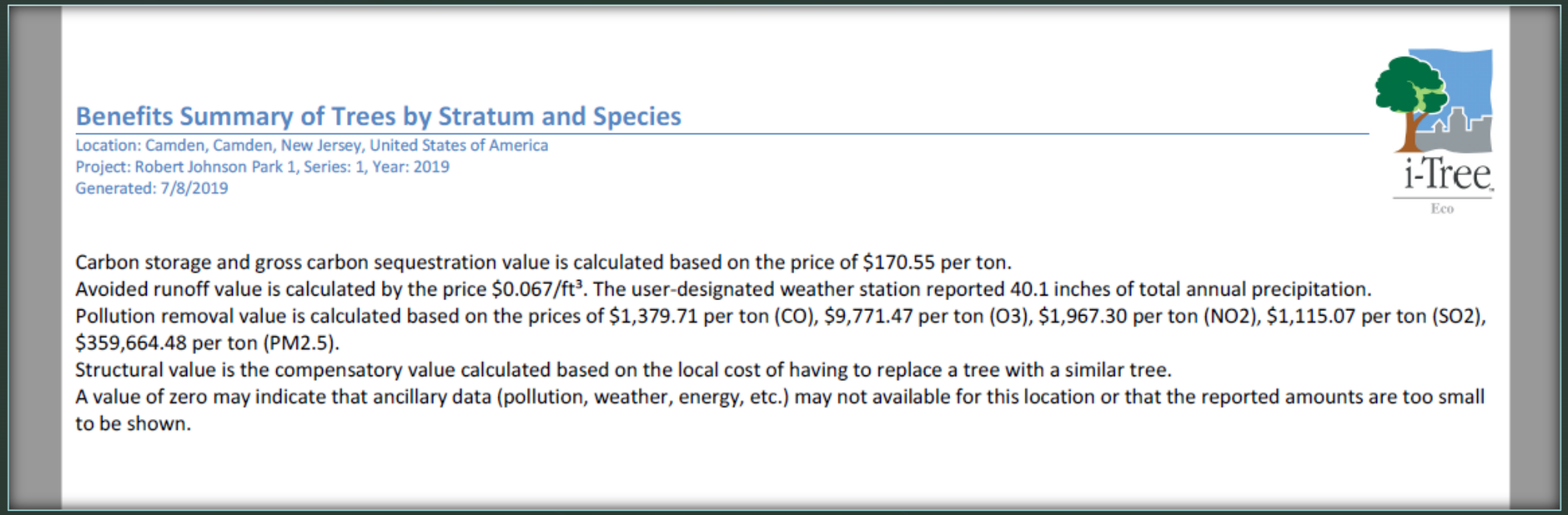
The following are just a few examples of the many environmental services reports that can be generated by *i-Tree Eco* once an inventory has been completed and uploaded to the program.

i-Tree Eco – Judge Robert Johnson Park

Benefits Summary of Trees by Stratum and Species

Location: Camden, Camden, New Jersey, United States of America
Project: Robert Johnson Park 1, Series: 1, Year: 2019
Generated: 7/8/2019

Stratum	Species	Trees	Carbon Storage		Gross Carbon Sequestration		Avoided Runoff		Pollution Removal		Structural Value
		Number	(ton)	($)	(ton/yr)	($/yr)	(ft^3/yr)	($/yr)	(ton/yr)	($/yr)	($)
MT	Norway maple	12	6.52	1,112.65	0.22	36.89	393.81	26.32	0.01	100.05	32,862.90
	Red maple	3	1.80	306.33	0.08	14.15	161.90	10.82	0.00	41.13	9,572.02
	ash spp	1	0.91	155.17	0.00	0.08	35.34	2.36	0.00	8.98	92.28
	Green ash	1	0.12	20.04	0.00	0.54	10.60	0.71	0.00	2.69	590.36
	Northern red oak	1	1.42	242.25	0.05	8.14	40.37	2.70	0.00	10.26	5,511.02
	American basswood	3	2.04	347.97	0.08	13.64	223.27	14.92	0.00	56.72	10,296.01
	Total	**21**	**12.81**	**2,184.42**	**0.43**	**73.44**	**865.29**	**57.84**	**0.01**	**219.83**	**58,924.58**
YT	Amur maple	20	0.07	12.77	0.03	5.80	33.25	2.22	0.00	8.45	1,367.11
	Red maple	3	0.00	0.77	0.00	0.24	0.70	0.05	0.00	0.18	66.29
	Northern hackberry	10	0.02	2.97	0.01	1.73	10.32	0.69	0.00	2.62	365.47
	Flowering dogwood	4	0.01	1.02	0.00	0.76	2.91	0.19	0.00	0.74	174.59
	Ginkgo	1	0.00	0.24	0.00	0.20	0.48	0.03	0.00	0.12	66.29
	Common crapemyrtle	11	0.04	6.36	0.02	2.91	7.42	0.50	0.00	1.89	993.07
	Sweetgum	2	0.00	0.50	0.00	0.18	1.23	0.08	0.00	0.31	127.95
	Saucer magnolia	2	0.08	14.16	0.01	1.52	5.23	0.35	0.00	1.33	1,289.19
	Black cherry	1	0.12	20.49	0.00	0.75	2.20	0.15	0.00	0.56	439.85
	Pin oak	1	0.00	0.45	0.00	0.29	0.98	0.07	0.00	0.25	94.50
	Japanese snowbell	3	0.01	0.95	0.00	0.61	2.36	0.16	0.00	0.60	169.35
	American elm	15	0.04	6.63	0.02	3.40	20.82	1.39	0.00	5.29	957.82
	Japanese zelkova	1	0.00	0.24	0.00	0.20	0.66	0.04	0.00	0.17	51.56
	Total	**74**	**0.40**	**67.56**	**0.11**	**18.58**	**88.57**	**5.92**	**0.00**	**22.50**	**6,163.06**
Study Area		**95**	**13.20**	**2,251.97**	**0.54**	**92.02**	**953.85**	**63.76**	**0.01**	**242.33**	**65,087.63**



Benefits Summary of Trees by Stratum and Species

Location: Camden, Camden, New Jersey, United States of America
Project: Robert Johnson Park 1, Series: 1, Year: 2019
Generated: 7/8/2019

i-Tree Eco

Carbon storage and gross carbon sequestration value is calculated based on the price of $170.55 per ton.
Avoided runoff value is calculated by the price $0.067/ft^3. The user-designated weather station reported 40.1 inches of total annual precipitation.
Pollution removal value is calculated based on the prices of $1,379.71 per ton (CO), $9,771.47 per ton (O3), $1,967.30 per ton (NO2), $1,115.07 per ton (SO2), $359,664.48 per ton (PM2.5).
Structural value is the compensatory value calculated based on the local cost of having to replace a tree with a similar tree.
A value of zero may indicate that ancillary data (pollution, weather, energy, etc.) may not available for this location or that the reported amounts are too small to be shown.

Methods used to derive these values are also included for each report generated, and additional details can be found on the i-Tree website.

These environmental services values are calculated based on tree species and size information collected and uploaded by the user. *i-Tree* uses allometry to relate the tree measurements collected to metrics such as leaf area and leaf biomass, which are used to estimate the environmental services benefits.

Structure Summary by Stratum and Species

Location: Camden, Camden, New Jersey, United States of America
Project: Robert Johnson Park 1, Series: 1, Year: 2019
Generated: 7/3/2019

Stratum	Species	Trees		Leaf Area		Leaf Biomass		Tree Dry Weight Biomass		Average Condition
		Number	SE	(ac)	SE	(ton)	SE	(ton)	SE	(%)
Lawn Area / Mature Trees	Norway maple	12	±0	0.993	±0.000	0.239	±0.000	13.048	±0.000	79.83
	Red maple	3	±0	0.408	±0.000	0.123	±0.000	3.592	±0.000	86.50
	ash spp	1	±0	0.089	±0.000	0.036	±0.000	1.820	±0.000	13.00
	Green ash	1	±0	0.027	±0.000	0.008	±0.000	0.235	±0.000	37.50
	Northern red oak	1	±0	0.102	±0.000	0.036	±0.000	2.841	±0.000	82.50
	American basswood	3	±0	0.563	±0.000	0.073	±0.000	4.081	±0.000	94.50
	Total	**21**	**±0**	**2.182**	**±0.000**	**0.515**	**±0.000**	**25.616**	**±0.000**	**77.81**
Ballfields / young trees	Amur maple	20	±0	0.084	±0.000	0.021	±0.000	0.150	±0.000	81.25
	Red maple	3	±0	0.002	±0.000	0.001	±0.000	0.009	±0.000	31.50
	Northern hackberry	10	±0	0.026	±0.000	0.006	±0.000	0.035	±0.000	82.80
	Flowering dogwood	4	±0	0.007	±0.000	0.002	±0.000	0.012	±0.000	85.50
	Ginkgo	1	±0	0.001	±0.000	0.000	±0.000	0.003	±0.000	94.50
	Common crapemyrtle	11	±0	0.019	±0.000	0.006	±0.000	0.075	±0.000	80.73
	Sweetgum	2	±0	0.003	±0.000	0.001	±0.000	0.006	±0.000	72.50
	Saucer magnolia	2	±0	0.013	±0.000	0.004	±0.000	0.166	±0.000	94.50
	Black cherry	1	±0	0.006	±0.000	0.002	±0.000	0.240	±0.000	37.50
	Pin oak	1	±0	0.002	±0.000	0.001	±0.000	0.005	±0.000	99.50
	Japanese snowbell	3	±0	0.006	±0.000	0.002	±0.000	0.011	±0.000	90.50
	American elm	15	±0	0.052	±0.000	0.017	±0.000	0.078	±0.000	93.70
	Japanese zelkova	1	±0	0.002	±0.000	0.001	±0.000	0.003	±0.000	94.50
	Total	**74**	**±0**	**0.223**	**±0.000**	**0.063**	**±0.000**	**0.792**	**±0.000**	**82.63**
Study Area		**95**	**±0**	**2.406**	**±0.000**	**0.578**	**±0.000**	**26.408**	**±0.000**	**81.56**

Many reports are available and can be selected and interpreted to inform management decisions and justify budget requests.

Hydrology Effects of Trees by Stratum

Location: Camden, Camden, New Jersey, United States of America
Project: Robert Johnson Park 1, Series: 1, Year: 2019
Generated: 7/12/2019

Stratum	Number of Trees	Leaf Area (ac)	Potential Evapotranspiration (ft^3/yr)	Evaporation (ft^3/yr)	Transpiration (ft^3/yr)	Water Intercepted (ft^3/yr)	Avoided Runoff (ft^3/yr)	Avoided Runoff Value ($/yr)
Lawn Area / Mature Trees	21	2.18	31,961.98	4,174.16	13,860.53	4,176.73	865.29	57.84
Ballfields / young trees	74	0.22	3,271.43	427.24	1,418.68	427.50	88.57	5.92
Total	**95**	**2.41**	**35,233.41**	**4,601.40**	**15,279.21**	**4,604.24**	**953.85**	**63.76**

Avoided runoff value is calculated by the price \$0.067/ft^3. The user-designated weather station reported 40.1 inches of total annual precipitation.

This report, for example, shows how much more effective large trees are at managing stormwater than small trees. This can be used to make a case for increasing a tree maintenance budget or for treating ash trees to protect against emerald ash borer, especially in areas where flooding is a concern.

Benefits and Costs Summary of Individual Trees

Location: Camden, Camden, New Jersey, United States of America
Project: Robert Johnson Park 1, Series: 1, Year: 2019
Generated: 7/3/2019

i-Tree Eco

						Annual benefits									
Tree ID	Species Name	DBH (in)	Structural Value ($)	Carbon Storage (lb)	Carbon Storage ($)	Gross Carbon Sequestration (lb/yr)	Gross Carbon Sequestration ($/yr)	Avoided Runoff (ft³/yr)	Avoided Runoff ($/yr)	Carbon Avoided (lb/yr)	Carbon Avoided ($/yr)	Pollution Removal (oz/yr)	Pollution Removal ($/yr)	Energy Savings ($/yr)	Total Annual Benefits ($/yr)
1	American basswood	28.7	5,138.77	2,182.5	186.12	79.1	6.74	91.0	6.09	N/A	N/A	43.5	23.13	N/A	35.96
2	Northern red oak	25.3	5,511.02	2,840.8	242.25	95.5	8.14	40.4	2.70	N/A	N/A	19.3	10.26	N/A	21.09
3	Green ash	12.0	590.36	235.0	20.04	6.3	0.54	10.6	0.71	N/A	N/A	5.1	2.69	N/A	3.94
4	Norway maple	18.0	3,501.24	1,060.3	90.41	56.4	4.81	53.8	3.60	N/A	N/A	25.7	13.67	N/A	22.07
5	Norway maple	14.6	447.18	651.5	55.56	7.8	0.66	4.9	0.33	N/A	N/A	2.3	1.24	N/A	2.23
6	Norway maple	15.0	2,673.33	742.6	63.32	49.2	4.19	34.6	2.31	N/A	N/A	16.5	8.79	N/A	15.29
7	Norway maple	19.2	3,936.69	1,592.4	135.79	43.9	3.74	34.6	2.32	N/A	N/A	16.5	8.80	N/A	14.86
8	Norway maple	18.1	3,728.65	1,399.2	119.32	43.1	3.67	34.4	2.30	N/A	N/A	16.4	8.74	N/A	14.71
9	Norway maple	15.3	0.00	925.9	78.95	0.0	0.00	0.0	0.00	N/A	N/A	0.0	0.00	N/A	0.00
10	Norway maple	15.5	2,684.28	997.0	85.02	33.8	2.88	14.5	0.97	N/A	N/A	6.9	3.68	N/A	7.53
11	Norway maple	19.0	3,862.16	1,556.2	132.71	43.3	3.69	42.6	2.85	N/A	N/A	20.3	10.81	N/A	17.35
12	Norway maple	15.0	2,535.53	886.4	75.58	24.7	2.10	21.4	1.43	N/A	N/A	10.2	5.43	N/A	8.97
13	Norway maple	18.7	3,955.74	1,502.9	128.16	44.8	3.82	59.9	4.01	N/A	N/A	28.6	15.22	N/A	23.05
14	Norway maple	12.5	1,966.25	577.9	49.28	26.0	2.22	33.6	2.25	N/A	N/A	16.1	8.55	N/A	13.01
15	ash spp	22.6	92.28	1,819.7	155.17	0.9	0.08	35.3	2.36	N/A	N/A	16.9	8.98	N/A	11.42
16	Red maple	18.5	3,679.26	1,264.6	107.84	68.0	5.79	54.6	3.65	N/A	N/A	26.1	13.86	N/A	23.30
17	Red maple	21.0	4,129.22	1,702.1	145.15	71.7	6.11	71.0	4.74	N/A	N/A	33.9	18.03	N/A	28.89
18	Red maple	12.5	1,763.54	625.5	53.34	26.3	2.25	36.4	2.43	N/A	N/A	17.4	9.24	N/A	13.92
19	American basswood	21.5	3,073.58	1,104.5	94.19	53.6	4.57	81.2	5.43	N/A	N/A	38.8	20.63	N/A	30.63
20	American basswood	17.0	2,083.66	793.5	67.67	27.3	2.32	51.0	3.41	N/A	N/A	24.4	12.96	N/A	18.69
21	Norway maple	18.2	3,571.86	1,155.5	98.54	59.7	5.09	59.4	3.97	N/A	N/A	28.4	15.10	N/A	24.17
22	Black cherry	8.0	439.85	240.3	20.49	8.8	0.75	2.2	0.15	N/A	N/A	1.1	0.56	N/A	1.46
23	Pin oak	2.0	94.50	5.3	0.45	3.4	0.29	1.0	0.07	N/A	N/A	0.5	0.25	N/A	0.61
24	Common crapemyrtle	1.7	64.89	3.8	0.32	2.7	0.23	0.9	0.06	N/A	N/A	0.4	0.22	N/A	0.51
25	Common crapemyrtle	2.3	118.96	7.8	0.66	3.9	0.34	0.9	0.06	N/A	N/A	0.4	0.22	N/A	0.61
26	Common crapemyrtle	2.3	113.55	7.5	0.64	3.9	0.33	0.9	0.06	N/A	N/A	0.5	0.24	N/A	0.63
27	Common crapemyrtle	2.3	118.96	7.8	0.66	3.9	0.33	0.7	0.05	N/A	N/A	0.3	0.17	N/A	0.55
28	Common crapemyrtle	2.5	140.59	9.5	0.81	4.4	0.37	0.8	0.05	N/A	N/A	0.4	0.20	N/A	0.62
29	Common crapemyrtle	1.7	64.89	3.8	0.32	2.7	0.23	0.8	0.05	N/A	N/A	0.4	0.21	N/A	0.49
30	Common crapemyrtle	2.3	113.55	7.3	0.63	3.8	0.33	0.6	0.04	N/A	N/A	0.3	0.16	N/A	0.52
31	Common crapemyrtle	2.3	113.55	7.4	0.63	3.8	0.33	0.8	0.06	N/A	N/A	0.4	0.21	N/A	0.59
32	Saucer magnolia	5.8	657.81	87.8	7.49	9.2	0.78	2.7	0.18	N/A	N/A	1.3	0.69	N/A	1.66

These reports can provide meaningful and exciting information, but this information must be carefully interpreted by individuals with knowledge of urban forestry and the local tree resource, as well as an understanding of how the *i-Tree* application works.

The more information collected for each individual tree, the more accurate the calculations of environmental services functions will be, provided that data is collected accurately. This requires that data collection teams be able to correctly identify tree species and be experienced at taking a variety of tree measurements.

	DERIVED VARIABLES		ECOSYSTEM SERVICES										
DIRECT MEASURES	Leaf Area	Leaf Biomass	Carbon Storage	Gross Carbon Sequestration	Net Carbon Sequestration	Energy Effects	Air Pollution Removal	Avoided Runoff	Transpiration	VOC Emissions	Compensatory Value	Wildlife Suitability	UV Effects
Species	D	D	D	D	D	D	I	I	I	D	D		
Diameter at breast height (DBH)			D	D	D						D	D	
Total height	D	D	D	D	D	D	I	I	I	I		D	
Crown base height	D	D	C				I	I	I	I			
Crown width	D	D	C				I	I	I	I			
Crown light exposure (CLE)				D	D								
Percent crown missing	D	D	C			D	I	I	I	I			
Crown health (condition/dieback)				D	D						D	D	
Field land use			D	D	D						D	D	
Distance to building						D							
Direction to building						D							
Percent tree cover						D	D	D				D	D
Percent shrub cover												D	
Percent building cover						D							
Ground cover composition												D	
Maintained Grass, Unmaintained Grass, and Herbaceous % cover							I						

D Directly used I Indirectly used C Conditionally used

We decided to run 3 different levels of data collection in *i-Tree Eco* so we are more informed when it comes to making data collection recommendations. Including more data metrics in your inventory will ensure the utmost accuracy from Eco's estimations, however, it can be very time consuming. Taking this into account, we chose these three different levels:

- Min: the minimum required by *i-Tree Eco* to run the model - species and DBH
- Med: our decision for a "medium" amount of information - Species, DBH, Crown Health (Condition), and Crown Light Exposure
- Max: the full inventory we collected, which included all the fields highly recommended by the *i-Tree* team for improved model estimations: Species, DBH, Land Use, Tree Height, Crown Size, Crown Health, and Crown Light Exposure.

Analysis

After we ran the 3 different scenarios, we decided to analyze the degree of difference between the 3, using the “max” as the reference and assuming it to be the most accurate. We do this to help inform the discussion toward providing recommendations for minimum data collection to be incorporated in the NJ Community Forestry Management Plan Guidelines Update.

To illustrate this, we have calculated the percentage difference between the “min” & “max” inventory results, and between the “med” and “max” inventory results.

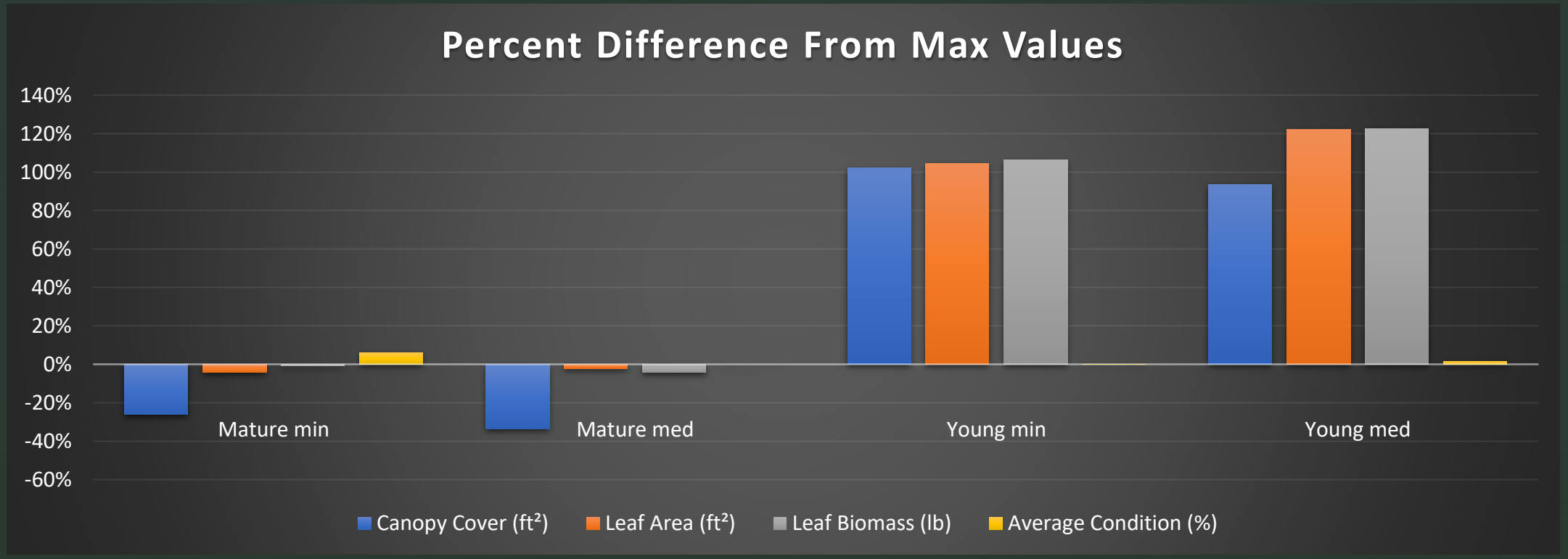
The data were plotted to represent the degree of difference between these three levels of data collection in *i-Tree Eco*, using “max” (the example with the most data collected) as the standard.

Composition & Structure Data

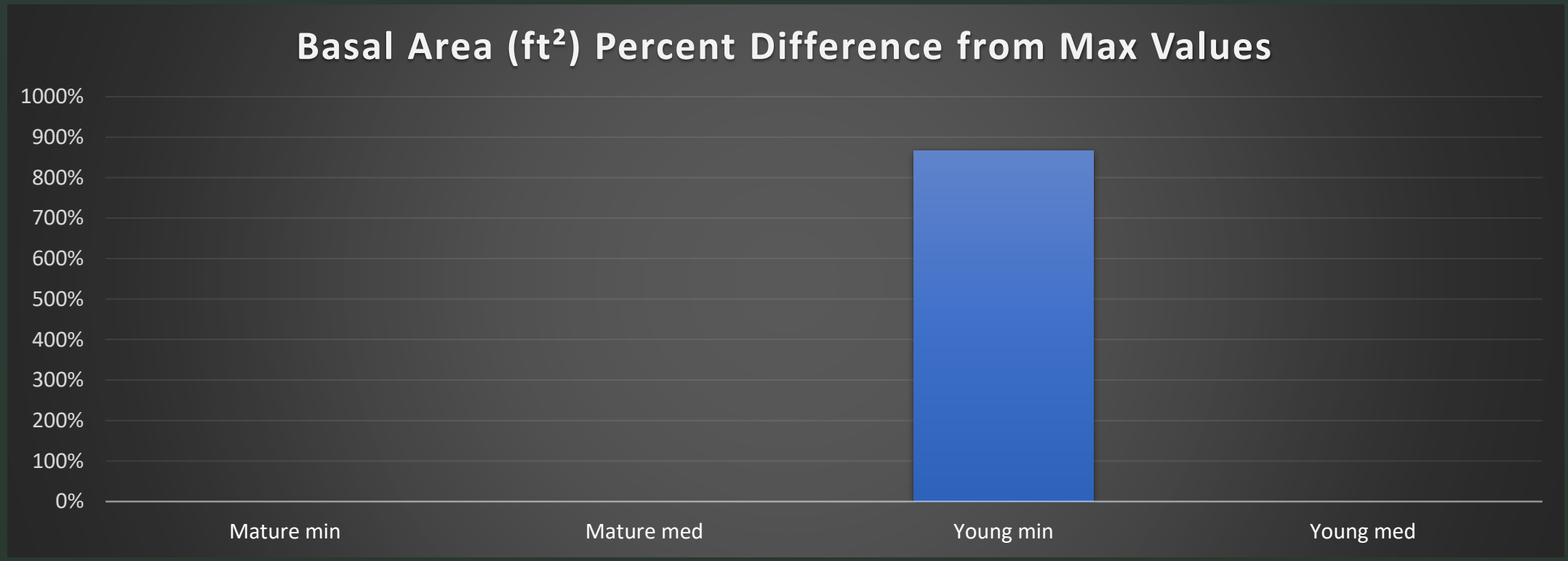
Stratum	Canopy Cover (ft²)	Leaf Area (ft²)	Leaf Biomass (lb)	Basal Area (ft²)	Average Condition (%)
Mature Min	17,492.20	91,109.60	1,021.20	39.10	82.50
Mature Med	15,750.80	93,052.80	986.20	39.10	77.81
Mature Max	23,695.10	95,055.50	1,029.80	39.10	77.81
Young Min	5,195.00	19,880.60	260.40	20.30	82.50
Young Med	4,974.50	21,617.40	281.00	2.10	83.76
Young Max	2,567.70	9,729.30	126.20	2.10	82.63

Percentage Difference From Max Values					
Stratum	Canopy Cover (ft²)	Leaf Area (ft²)	Leaf Biomass (lb)	Basal Area (ft²)	Average Condition (%)
Mature Min	-26%	-4%	-1%	0%	0.060275029
Mature Med	-34%	-2%	-4%	0%	0
Young Min	102%	104%	106%	867%	-0.001573278
Young Med	94%	122%	123%	0%	0.013675421

Composition & Structure Percent Difference



Composition & Structure Percent Difference Graph 2 Basal Area (Outlier)



Benefits Summary Data

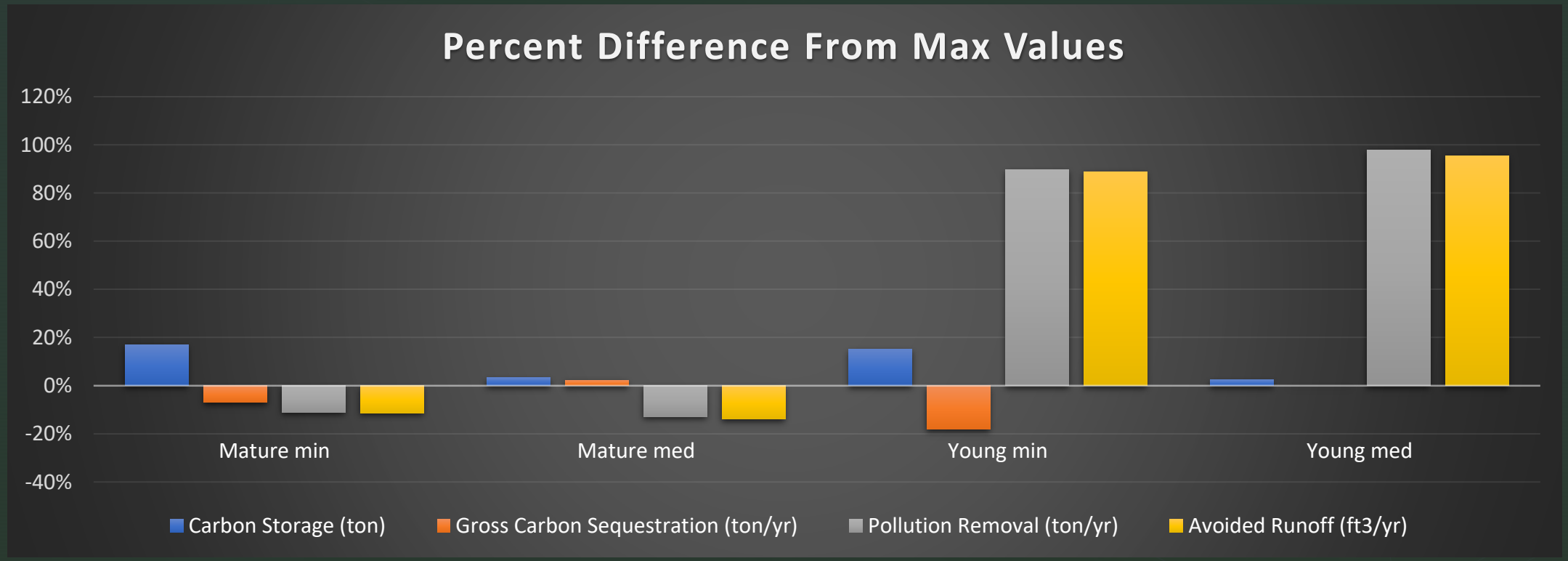
Stratum	Carbon Storage (ton)	Gross Carbon Sequestration (ton/yr)	Pollution Removal ($/yr)*	Avoided Runoff (ft3/yr)
Mature Min	14.99	0.4	195.47	766.77
Mature Med	13.22	0.44	191.74	744.81
Mature Max	12.81	0.43	219.83	865.29
Young Min	0.46	0.09	42.65	167.31
Young Med	0.41	0.11	44.54	173.03
Young Max	0.4	0.11	22.5	88.57

Percentage Difference From Max Values				
Stratum	Carbon Storage (ton)	Gross Carbon Sequestration (ton/yr)	Pollution Removal ($/yr)**	Avoided Runoff (ft3/yr)
Mature Min	17%	-7%	-11%	-11%
Mature Med	3%	2%	-13%	-14%
Young Min	15%	-18%	90%	89%
Young Med	2%	0%	98%	95%

*Pollution removal value is calculated based on the prices of $0.69 per pound (CO), $4.88 per pound (O3), $0.97 per pound (NO2), $0.56 per pound.

**Eco presents pollution removal data in tons. In tons, our data showed very little variation (.00 and .01), so we decided to use the dollar value associated with each stratum. We assume this dollar value is directly proportional to the pollution removal value estimated by Eco.

Benefits Summary Percent Difference

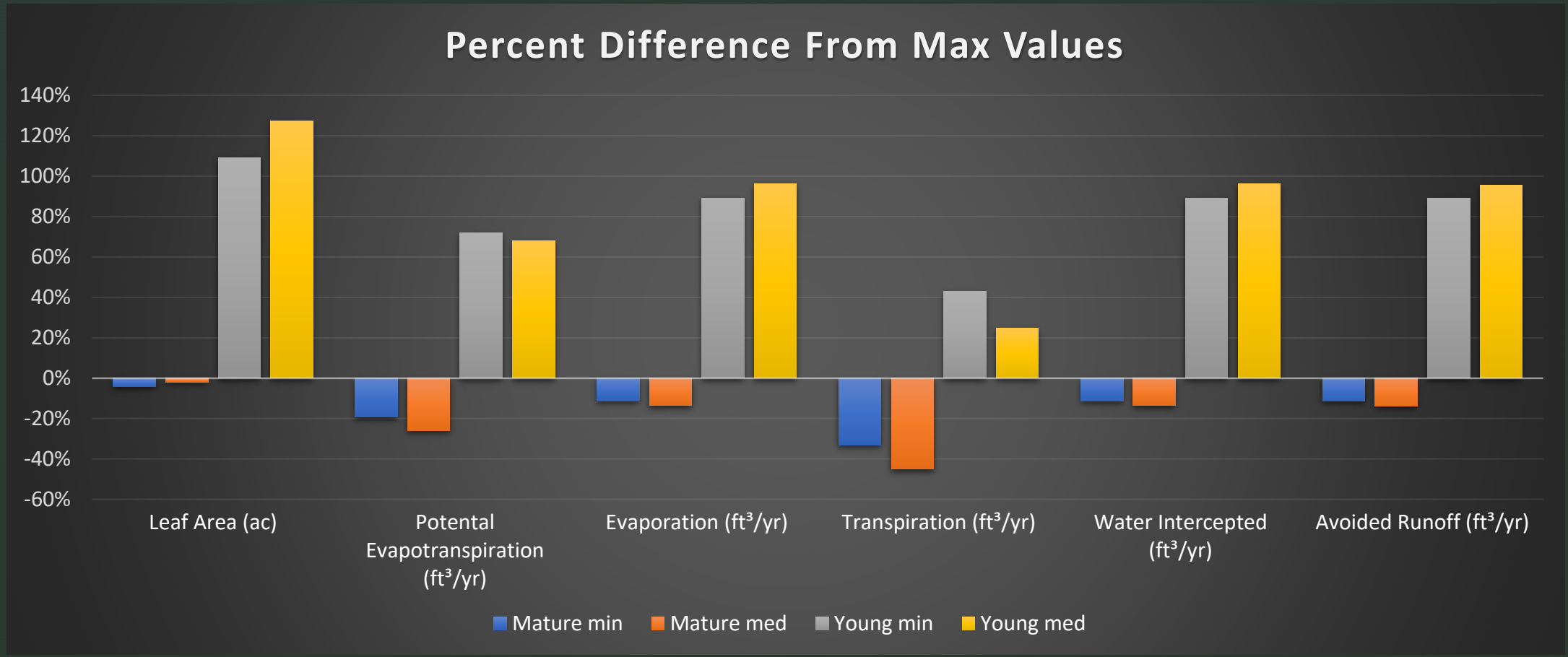


Hydrology Data

Stratum	Leaf Area (ac)	Potental Evapotranspiration (ft^3/yr)	Evaporation (ft^3/yr)	Transpiration (ft^3/yr)	Water Intercepted (ft^3/yr)	Avoided Runoff ($ft3^3$/yr)
Mature Min	2.09	25,754.05	3,705.41	9,290.90	3,707.97	766.77
Mature Med	2.14	23,640.82	3,609.08	7,619.75	3,611.75	744.81
Mature Max	2.18	31,961.98	4,174.16	13,860.53	4,176.73	865.29
Young Min	0.46	5,619.69	808.54	2,027.33	809.10	167.31
Young Med	0.5	5,492.06	838.44	1,770.16	839.05	173.03
Young Max	0.22	3,271.43	427.24	1,418.68	427.50	88.57

Percentage Difference From Max Values						
Stratum	Leaf Area (ac)	Potental Evapotranspiration (ft^3/yr)	Evaporation (ft^3/yr)	Transpiration (ft^3/yr)	Water Intercepted (ft^3/yr)	Avoided Runoff (ft^3/yr)
Mature Min	-4%	-19%	-11%	-33%	-11%	-11%
Mature Med	-2%	-26%	-14%	-45%	-14%	-14%
Young Min	109%	72%	89%	43%	89%	89%
Young Med	127%	68%	96%	25%	96%	95%

Hydrology Percent Difference



Results & Interpretation

Generally, in this example, the data show that canopy & leaf measurements, benefits, and hydrology estimates in young trees are moderately to greatly overestimated for both minimum and medium levels of data collection.

Also, we see that these metrics are generally slightly underestimated in mature trees for both minimum and medium levels of data collection.

Results & Interpretation

These results do make sense, based on our observations in the field during data collection and the warning generated by *i-Tree Eco* when minimal data fields are used.

For example, tree condition will be rated at a default of 87% (healthy) if no condition information is recorded in the inventory. In conducting our inventory of the young trees, we rated many as lower than 87% condition, while we rated many of the mature trees as greater than 87% condition.

Results & Interpretation

We had hoped that the “medium” level of detail, in which we included crown condition and crown light exposure but not tree height and crown measurements, would bring the estimates a little closer to those found in our more complete “max” inventory, which did include height and crown measurements. In some cases, we found this effect. However, in other cases, the opposite happened.

This is just one example and obviously will need to be repeated in subsequent example projects in other representative municipalities, but we hope that these comparisons will help to inform the discussion on minimum inventory requirements for the Guidelines update.

Recommendations & Next Steps

Based on our time spent reviewing several i-Tree applications and in attending several meetings of the NJ Community Forestry Management Plan Guidelines Update Committee, we have a few recommendations that we would like to put forth:

- We feel strongly that *i-Tree* should be utilized as a tool to help municipalities understand and describe the functions and related value of the municipal tree resource. In addition, we still feel that *i-Tree Landscape* and *i-Tree Eco* are the most reasonable applications to utilize in order to provide some level of standardization across municipalities statewide.

Recommendations & Next Steps

- Based on the level of difficulty involved in utilizing and interpreting these applications, and the skill required for data collection, we feel strongly that a forester should be involved at some level in the development, collection, and interpretation of the tree inventory in every municipality.
- In this way, we can use the NJ Community Forestry Management Plan Guidelines Update as a means toward creating a culture in NJ whereby every municipality has a forester on staff, either through contract or in house, as common practice.

Recommendations & Next Steps

- The NJ Forest Service Urban & Community Forestry Program, in cooperation with partners including Rutgers Urban Forestry Program and the NJ Tree Foundation, can provide training and technical support in the use and interpretation of these *i-Tree* applications for consulting and municipal foresters working with municipal volunteers and in-house staff to develop Community Forestry Management Plans under the new Guidelines. It would then be the forester's responsibility to bring these skills to the municipality, helping to build relationships and strengthen the connections of local knowledge of the tree resource in interpreting inventory results.

Recommendations & Next Steps

This project and subsequent report is intended as only a first step toward defining minimum requirements for a municipal tree inventory.

We look forward to further discussion with the Guidelines Update Committee, and to continuing to work toward the update.