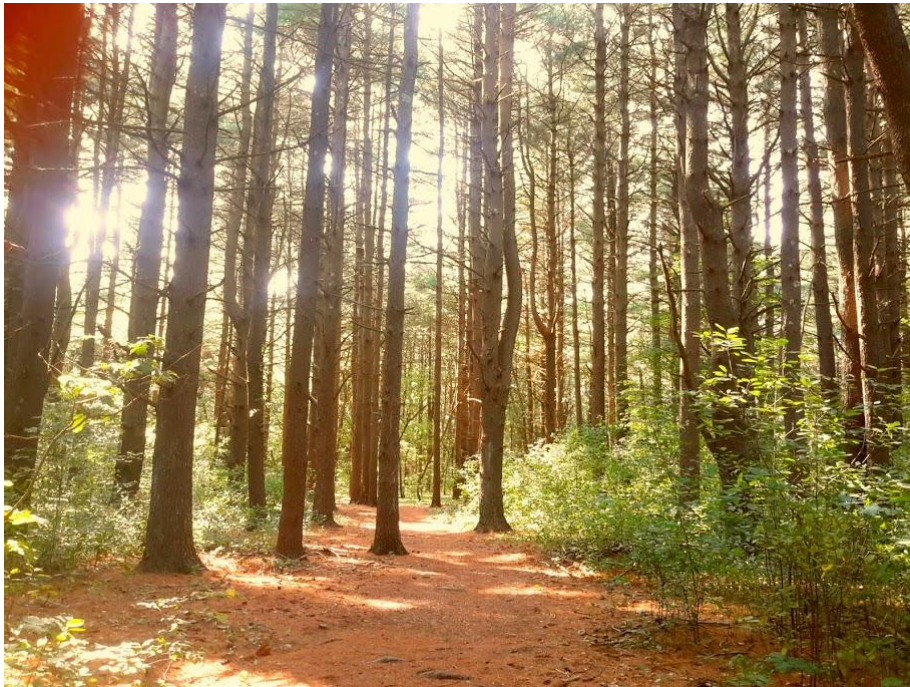# iTree Applications for the Town of Wellesley

Prepared by Brandon Schmitt, Director

Wellesley Natural Resources Commission

The following report summarizes a few of the key iTree tools available to the community to assess Wellesley's tree canopy, quantify the environmental and economic benefits of the urban forest and help prioritize the Town's planting initiatives.

The Wellesley Unified Plan recommends that the Town create a baseline estimate of total tree cover (public and private) in Wellesley, and the clean air, stormwater and habitat benefits to the town. Understanding of the town's overall tree canopy and the contribution of trees on private property can help create a powerful data-driven public campaign on the importance of Wellesley's trees. This report represents a glimpse into the potential of iTree to meet that action step.

Contents	Page

1. iTree Design: Prioritization and Environmental Benefits on specific parcel

The Town of Wellesley has a long-standing Public Shade Tree Planting Program, which enables the Town to plant trees within 20' of the Right of Way on Private Property.   Use of iTree Design allows homeowners in partnership with the Town to optimize planting locations, maximizing environmental benefits.   The following example from 59 Bernard shows proposed planting of 3 Sugar Maples. The interface allows the user to also model the crown growth over time of each proposed tree, as well as calculate benefits, as shown on the pages 3-5.

i-Tree Design v7.0   19 Bernard Rd, Wellesley, MA 02481, USA

Start Over
Save Progress
About

Get started with these easy steps:

1. Draw Structures   ?
2. Place Trees   ?

While we work to improve i-Tree Design, please break your projects into groups of no more than 25 trees at a time.

Describe your tree:
- Tree species: (Northeast region)
  Maple, Red ▾
- Tree species:
- Tree diameter: 3 Inches ▾
  or circumference: 9.4
- Tree condition: Excellent ▾
- Tree exposure to sunlight: Full sun ▾

Tree benefit zones:
- The colored zones surrounding the structure, which appear as you describe your tree, illustrate the relative monetary value of energy savings that the tree would provide in each zone.
- Hover over each zone to see that energy benefit information displayed below the map.

To place a tree:
- Drag this icon 🌳 to the location on the map where you would like to place your tree.
- Repeat to place additional trees.
- Hover over any tree you have placed on the map to display its benefits.

Model the tree(s) future crown growth over time:

Model Crown Growth

Map   Satellite

Alba Rd
Bernard Rd
Bernard Rd
Bernard Rd

YOUR TREES YOUR STRUCTURES

Map data ©2020 Imagery ©2020 , MassGIS, Commonwealth of Massachusetts EOEA, Maxar Technologies   Terms of Use

Lat: 42.30619   Bearing: 77.5   Tree: Maple, Red (3 Inches)   Energy Savings: $0.00
Lng: -71.28744   Distance: 44.4m (145.7ft)   Total Savings: $1.09   kWh: 0.0 Therm: 0.0

⏮ ◀ ▶ ⏩ ⏭   Year 60

based on tree and building characteristics and tree placement.

Crown Growth Modeler

Total Projected Benefits (2020-2050) - Over the next 30 years, based on forecasted tree growth, i-Tree Design projects total benefits worth $2,570:

- $129 of storm runoff savings by avoiding 14,439 gallons of stormwater runoff (intercepting 79,386 gallons of rainfall)
- $76 of air quality improvement savings by absorbing and intercepting pollutants such as ozone, sulfur dioxide, nitrogen dioxide, and particulate matter; reducing energy production needs; and lowering air temperature
- $427 of savings by reducing 18,375 lbs. of atmospheric carbon dioxide through CO_2 sequestration and decreased energy production needs and emissions
- $2,145 of summer energy savings by direct shading and air cooling effect through evapotranspiration
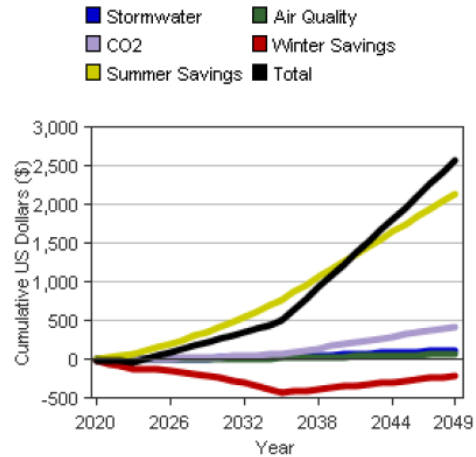- $-208 of winter energy savings by slowing down winds and reducing home heat loss

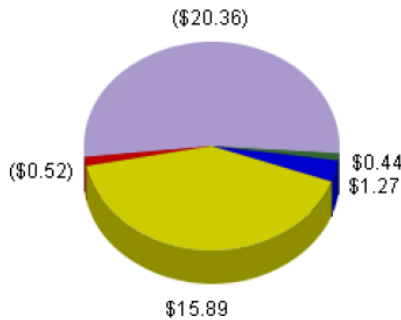
Figure 1. Tree benefit forecast for 30 years

Figure 2. Annual tree benefits for 2020

Current Year - For 2020, i-Tree Design estimates annual tree benefits of $-3.28:

- $1.27 of stormwater runoff savings by avoiding 142 gallons of stormwater runoff (intercepting 781 gallons of rainfall)
- $0.44 of air quality improvement savings
- $-0.52 of carbon dioxide reduction savings
- $15.89 of summer energy savings
- $-20.36 of winter energy savings

A cooperative initiative between:

Future Year - In the year 2050, based on forecasted tree growth, i-Tree Design projects annual benefits of $149.89:

- $7.59 of stormwater runoff savings by avoiding 850 gallons of stormwater runoff (intercepting 4,671 gallons of rainfall)
- $4.39 of air quality improvement savings
- $24.93 of carbon dioxide reduction savings
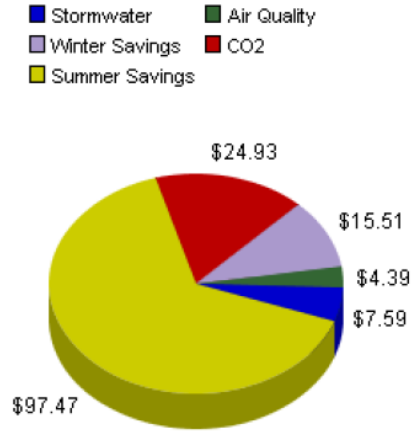- $97.47 of summer energy savings
- $15.51 of winter energy savings

Figure 3. Annual tree benefits for the year 2050
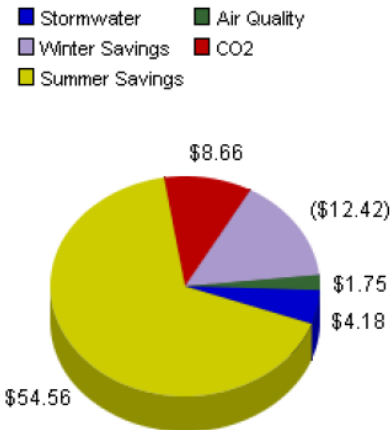
Figure 4. Total benefits to date

Total Benefits to Date - Over the life of the tree(s) so far, i-Tree Design calculates total benefits worth $57:

- $4 of stormwater runoff savings by avoiding 468 gallons of stormwater runoff (intercepting 2,573 gallons of rainfall)
- $2 of air quality improvement savings
- $9 of carbon dioxide reduction savings
- $55 of summer energy savings
- $-12 of winter energy savings

A cooperative initiative between:

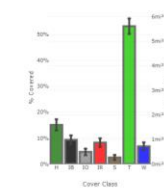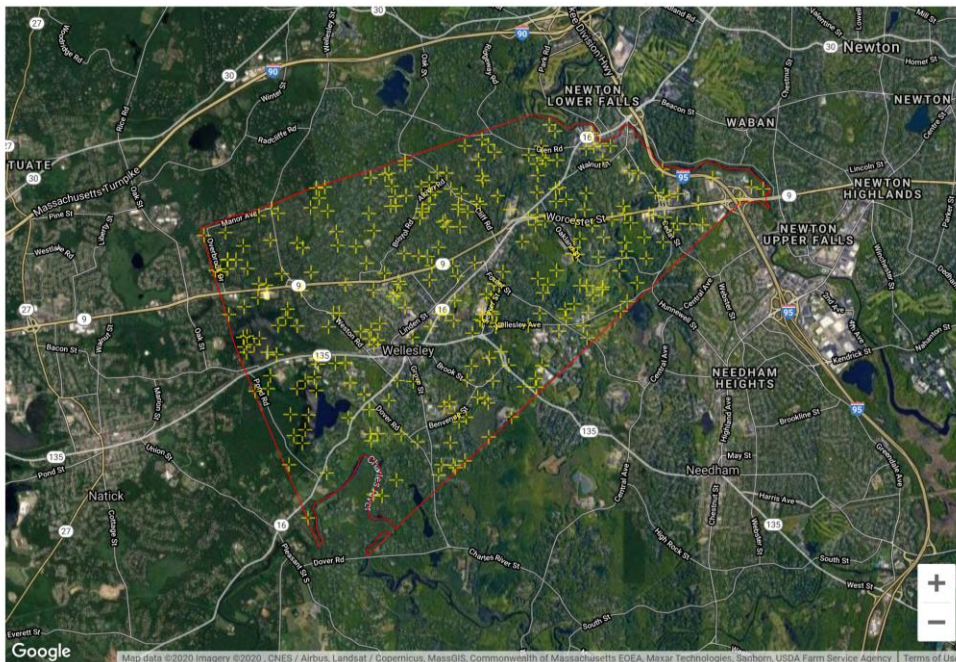|				Benefits			
Tree	DBH (in)	Condition	Location to Structure	Current Year (2020)	Future Year (2050)	Projected Total (2020-2050)	Total to Date
1. Maple, Red	3	Excellent	West (26 ft)	$11.67	$76.97	$1,578	$55
2. Maple, Red	3	Excellent	Southwest (24 ft)	$0.78	$42.52	$708	$24
3. Maple, Red	3	Excellent	South (20 ft)	$-15.74	$30.41	$284	$-22
Total				$-3.28	$149.89	$2,570	$57

Individual Tree Benefits

DBH: "diameter at breast height" is the standard measurement of tree trunk width at 4.5 feet (1.5 meters) above the ground.

2. iTtree Canopy: Community Canopy Analysis

While the Town of Wellesley has a complete inventory of all the public shade trees along the right of way and in much of the parkland, there has not been a formal canopy assessment. Using iTree Canopy allows the user to quickly develop a land use analysis that is statistically significant and trustworthy. The application then provides benefits of the dataset.

The following analysis invovled random selection of 230 points that were then identified as 1 of 7 land classes. The results estimate the percentage of the Community that has tree cover. In this analysis, an estimated 55% of the commuinity has tree cover which provides annual benefits of over 23 million dollars each year. This can serve as a benchmark to maintain or build on over time.

i-Tree Canopy v6.1
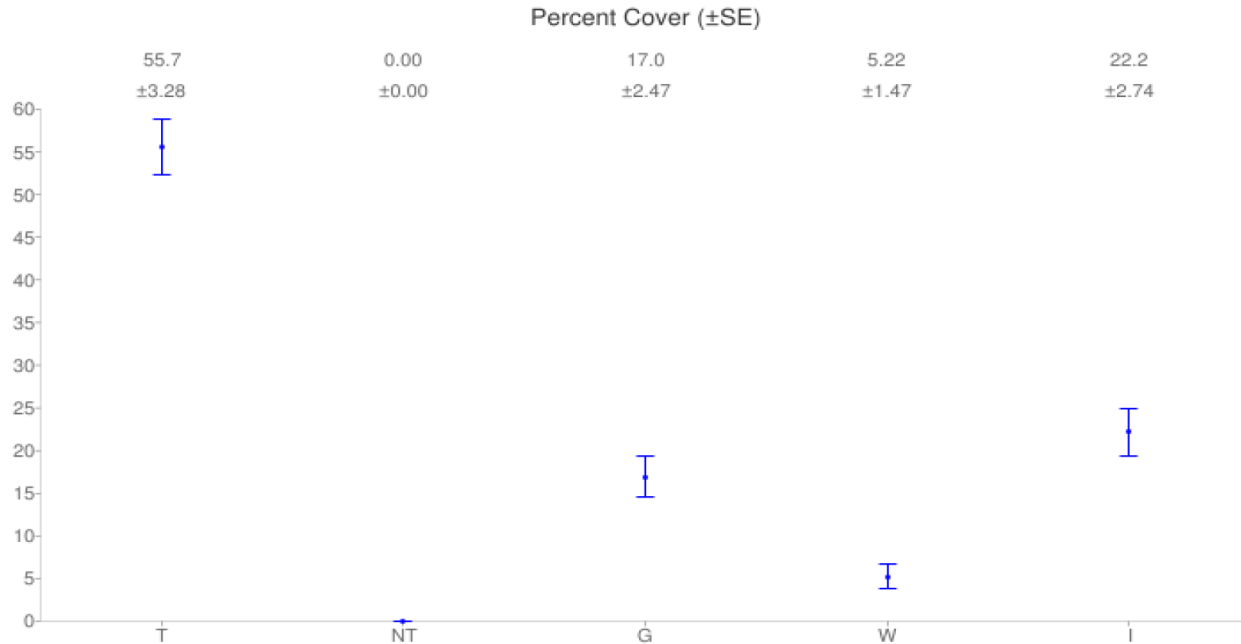## Cover Assessment and Tree Benefits Report
Estimated using random sampling statistics on 3/04/20

Percent Cover (±SE)

Cover Class	Description	Abbr.	Points	% Cover
Tree	Tree, non-shrub	T	128	55.7 ±3.28
Non-Tree	All other surfaces	NT	0	0.00 ±0.00
Grass	grass/lawn	G	39	17.0 ±2.47
Water	Open water	W	12	5.22 ±1.47
Impervious	Buildings/Pavement	I	51	22.2 ±2.74

Tree Benefit Estimates

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	545.09 USD	±32.08	1.21 T	±0.07
NO2	Nitrogen Dioxide removed annually	1,527.19 USD	±89.89	10.93 T	±0.64
O3	Ozone removed annually	81,274.73 USD	±4,783.95	86.74 T	±5.11
PM2.5	Particulate Matter less than 2.5 microns removed annually	186,834.47 USD	±10,997.35	4.19 T	±0.25
SO2	Sulfur Dioxide removed annually	245.15 USD	±14.43	5.10 T	±0.30
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	31,755.92 USD	±1,869.20	14.46 T	±0.85
CO2seq	Carbon Dioxide squestered annually in trees	872,848.44 USD	±51,377.15	18,832.80 T	±1,108.53
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	21,920,499.54 USD	±1,290,273.06	472,962.15 T	±27,839.25

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and USD/T/yr: CO 0.643 @ 452.37 USD | NO2 5.812 @ 140.16 USD | O3 46.105 @ 940.32 USD | PM2.5 2.225 @ 44,785.21 USD | SO2 2.711 @ 48.24 USD | PM10* 7.688 @ 2,203.38 USD | CO2seq 10,010.267 @ 46.51 USD | CO2stor is a total biomass amount of 251,395.359 @ 46.51 USD
Note: Currency is in USD
Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

About i-Tree Canopy

The concept and prototype of this program were developed by David J. Nowak, Jeffery T. Walton and Eric J. Greenfield (USDA Forest Service). The current version of this program was developed and adapted to i-Tree by David Ellingsworth, Mike Binkley, and Scott Maco (The Davey Tree Expert Company).

Limitations of i-Tree Canopy

The accuracy of the analysis depends upon the ability of the user to correctly classify each point into its correct class. As the number of points increase, the precision of the estimate will increase as the standard error of the estimate will decrease. If too few points are classified, the standard error will be too high to have any real certainty of the estimate.

A Cooperative Initiative Between:
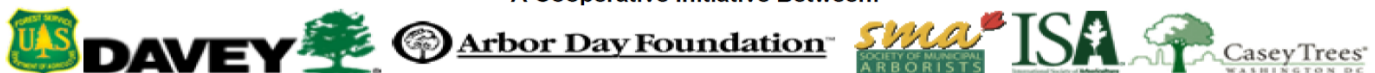
www.itreetools.org

3. iTree Canopy: North40

In a variation to the previous Town-wide analysis, the following analysis involved manually drawing the boundary of the study area. In this case, the boundary was the limit of the North 40, a nearly fully forested parcel of much interest to various stakeholders.   By using the same methodology of randomly selecting locations, the results demonstrate that the North 40 is 88% forest, and provides the benefits outlined in the following page.
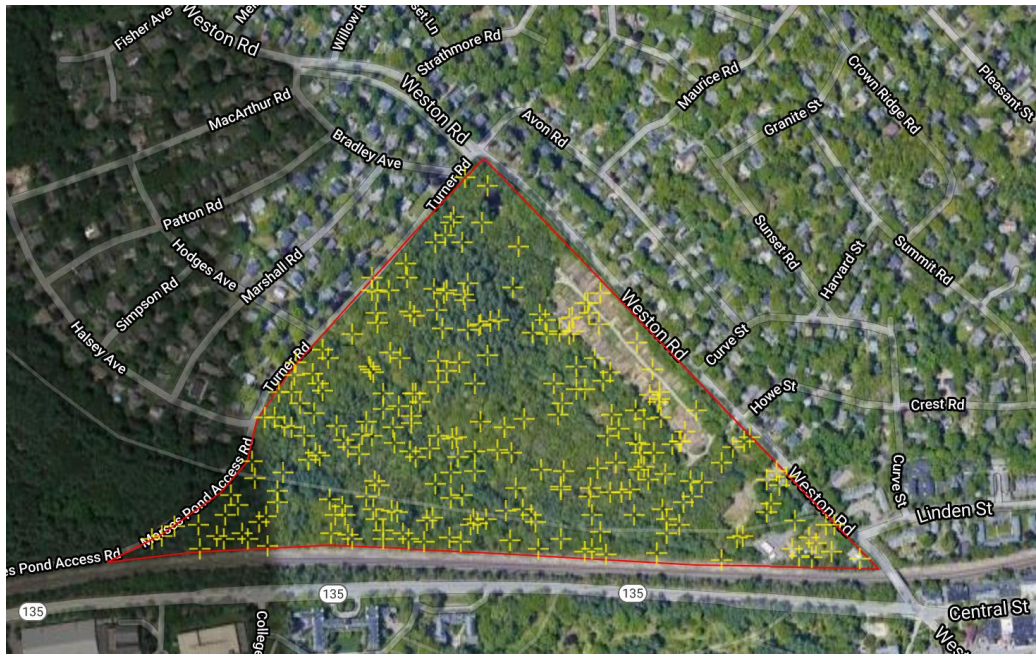
i-Tree Canopy v7.0

Cover Assessment and Tree Benefits Report
Estimated using random sampling statistics on 4/27/2020

Land Cover

Legend:
- Grass/Herbaceous
- Impervious Buildings
- Impervious Other
- Impervious Road
- Soil/Bare Ground
- Tree/Shrub
- Water

X-axis (Cover Class): H, IB, IO, IR, S, T, W

Abbr.	Cover Class	Description	Points	% Cover ± SE	Area (ac) ± SE
H	Grass/Herbaceous		6	2.42 ± 0.99	1.36 ± 0.55
IB	Impervious Buildings		3	1.21 ± 0.70	0.68 ± 0.39
IO	Impervious Other		0	0.00 ± 0.00	0.00 ± 0.00
IR	Impervious Road		6	2.42 ± 0.99	1.36 ± 0.55
S	Soil/Bare Ground		14	5.65 ± 1.47	3.16 ± 0.82
T	Tree/Shrub		219	88.31 ± 2.04	49.50 ± 1.14
W	Water		0	0.00 ± 0.00	0.00 ± 0.00
Total			**248**	**100.00**	**56.06**

Tree Benefit Estimates: Carbon (English units)

Description	Carbon (T)	±SE	CO₂ Equiv. (T)	±SE	Value (USD)	±SE
Sequestered annually in trees	67.57	±1.56	247.77	±5.73	$5,762	±133
Stored in trees (Note: this benefit is not an annual rate)	1,697.02	±39.21	6,222.42	±143.78	$144,714	±3,344

Currency is in USD. Standard errors of removal and benefit amounts are based on standard errors of sampled and classified points. Carbon sequestered is based on 1.365 T/ac/yr. Carbon stored is based on 34.281 T/ac. Carbon is valued at $23.26/T. (English units: T = tons (2,000 pounds), ac = acres)

Tree Benefit Estimates: Air Pollution (English units)

Abbr.	Description	Amount (lb)	±SE	Value (USD)	±SE
CO	Carbon Monoxide removed annually	31.82	±0.74	$7	±0
NO2	Nitrogen Dioxide removed annually	287.71	±6.65	$20	±0
O3	Ozone removed annually	2,282.33	±52.74	$1,073	±25
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	380.57	±8.79	$419	±10
PM2.5	Particulate Matter less than 2.5 microns removed annually	110.16	±2.55	$2,467	±57
SO2	Sulfur Dioxide removed annually	134.20	±3.10	$3	±0
Total		**3,226.78**	**±74.56**	**$3,990**	**±92**

Currency is in USD. Standard errors of removal and benefit amounts are based on standard errors of sampled and classified points. Air Pollution Estimates are based on these values in lb/ac/yr @ $/lb/yr:
CO 0.643 @ $0.23 | NO2 5.812 @ $0.07 | O3 46.105 @ $0.47 | PM10* 7.688 @ $1.10 | PM2.5 2.225 @ $22.39 | SO2 2.711 @ $0.02 (English units: lb = pounds, ac = acres)

Tree Benefit Estimates: Hydrological (English units)

Abbr.	Benefit	Amount (Kgal)	±SE	Value (USD)	±SE
AVRO	Avoided Runoff	19.58	±0.45	$175	±4
E	Evaporation	299.78	±6.93	N/A	N/A
I	Interception	300.42	±6.94	N/A	N/A
T	Transpiration	374.26	±8.65	N/A	N/A
PE	Potential Evaporation	1,976.07	±45.66	N/A	N/A
PET	Potential Evapotranspiration	1,487.74	±34.38	N/A	N/A

Currency is in USD. Standard errors of removal and benefit amounts are based on standard errors of sampled and classified points. Hydrological Estimates are based on these values in Kgal/ac/yr @ $/Kgal/yr:
AVRO 0.395 @ $8.94 | E 6.056 @ N/A | I 6.069 @ N/A | T 7.560 @ N/A | PE 39.918 @ N/A | PET 30.053 @ N/A (English units: Kgal = thousands of gallons, ac = acres)

About i-Tree Canopy

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Limitations of i-Tree Canopy

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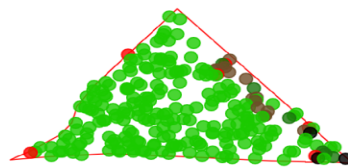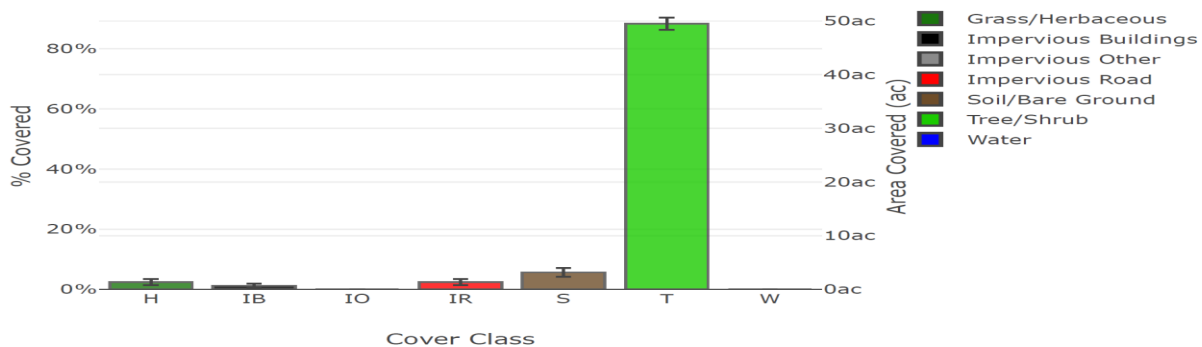

Use of this tool indicates acceptance of the EULA.

4. iTree Landscape: Community Tree Planting Prioritization

iTree Landscape allows the user to explore tree canopy, land cover, and basic demographic information in a defined location. The program then provides information about the benefits of trees within the study location, outlines how planting trees will increase the benefits provided, and maps areas to help prioritize tree planting efforts. The following analysis shows relative benefits provided by the Tree canopy within each census block group and provides weights for planting opportunities based on impervious surfaces and available planting space within each block group. 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 following scenario also includes a priority to increase Carbon Sequestration as well as a consideration of available planting space.   As outlined in the iTree Landscape report, the highest priority planting locations (those in darker purple) for the given the parameters are the Linden Square area and the census block between Grove St and Rt. 16 South of Wellesley square. Using a similar methodology, iTree landscape may also be useful in identifying those areas in the community that are vulnerable to tree loss as well.

Visit the i-Tree Tools (https://www.itreetools.org/) website to learn more about the benefits that trees provide.

Town Of Wellesley Tree Planting Prioritization

Date: 04/19/2020

landscape.itreetools.org

Version: 4.2

Share

Location Information

Canopy & Impervious (High Resolution UTC)

Dataset	Type	Name	ID	Area		Canopy		Impervious		Plantable Space	
				acre	%	acre	%	acre	%	acre	%
NLCD 2011	Block Group	N/A	250214043014	155.0	100.00	86.7	55.98	37.1	23.97	31.0	20.02
NLCD 2011	Block Group	N/A	250214043015	130.6	100.00	67.5	51.80	37.2	28.56	26.1	19.99
NLCD 2011	Block Group	N/A	250214043023	397.9	100.00	161.0	56.00	70.2	24.43	55.1	19.16
NLCD 2011	Block Group	N/A	250214044005	1,073.4	100.00	534.8	57.63	126.2	13.60	265.6	28.62
NLCD 2011	Block Group	N/A	250214044004	86.5	100.00	38.5	44.49	31.4	36.31	16.8	19.39
NLCD 2011	Block Group	N/A	250214044003	171.2	100.00	100.7	58.83	32.9	19.24	37.4	21.86
NLCD 2011	Block Group	N/A	250214044002	292.6	100.00	174.8	60.12	53.0	18.21	62.7	21.57
NLCD 2011	Block Group	N/A	250214044001	219.9	100.00	106.6	48.50	61.1	27.81	52.3	23.81
NLCD 2011	Block Group	N/A	250214043021	256.1	100.00	98.8	38.57	104.1	40.64	53.1	20.73
NLCD 2011	Block Group	N/A	250214043022	94.2	100.00	42.0	44.54	33.1	35.12	19.0	20.18
NLCD 2011	Block Group	N/A	250214043012	121.4	100.00	69.9	57.60	32.4	26.68	19.6	16.11
NLCD 2011	Block Group	N/A	250214043013	230.3	100.00	131.3	57.08	42.2	18.37	56.7	24.64
NLCD 2011	Block Group	N/A	250214043011	339.9	100.00	212.5	62.60	75.9	22.36	51.6	15.21
NLCD 2011	Block Group	N/A	250214042012	288.6	100.00	187.4	65.42	48.1	16.81	51.3	17.91
NLCD 2011	Block Group	N/A	250214042011	225.2	100.00	141.7	63.39	43.1	19.29	38.5	17.25
NLCD 2011	Block Group	N/A	250214042013	292.2	100.00	172.8	59.68	62.6	21.63	54.5	18.82
NLCD 2011	Block Group	N/A	250214042021	307.4	100.00	141.5	46.21	90.9	29.68	73.9	24.14
NLCD 2011	Block Group	N/A	250214042023	382.9	100.00	202.4	52.90	104.2	27.23	75.6	19.75
NLCD 2011	Block Group	N/A	250214042022	427.4	100.00	210.2	49.38	79.1	18.57	136.5	32.08
NLCD 2011	Block Group	N/A	250214041001	675.4	100.00	323.0	50.37	198.4	30.94	120.0	18.72
NLCD 2011	Block Group	N/A	250214041002	266.8	100.00	127.7	50.20	83.7	32.90	43.2	17.00
Selection Total:				6,724.8	100.00	3,491.4	54.50	1,518.8	23.71	1,395.7	21.79

Dataset ▢	Type ▢	Name ▢	ID ▢	Area acre ▢	Area % ▢	Canopy acre ▢	Canopy % ▢	Impervious acre ▢	Impervious % ▢	Plantable Space acre ▢	Plantable Space % ▢
NLCD 2011	Block Group	N/A	250214041003	158.8	100.00	92.8	58.47	36.1	22.74	29.6	18.65
NLCD 2011	Block Group	N/A	250214042014	131.1	100.00	67.0	52.44	35.8	28.01	25.4	19.92
Selection Total:				6,724.8	100.00	3,491.4	54.50	1,518.8	23.71	1,395.7	21.79

Tree Benefits

Carbon and CO_2 (High Resolution UTC)

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Dataset ▢	Type ▢	Name ▢	ID ▢	Carbon Storage $ ▢	Carbon Storage Short Ton ▢	Carbon Sequestration $/yr ▢	Carbon Sequestration t/yr (Short Tons per year) ▢	CO₂ Equivalent Storage $ ▢	CO₂ Equivalent Storage Short Ton ▢	CO₂ Equivalent Sequestration $/yr ▢	CO₂ Equivalent Sequestration t/yr (Short Tons per year) ▢
NLCD 2011	Block Group	N/A	250214043014	507,390	2,975.0	16,759	98.2	507,390	10,908.4	16,759	360.3
NLCD 2011	Block Group	N/A	250214043015	406,374	2,382.8	12,676	74.3	406,374	8,736.6	12,676	272.5
NLCD 2011	Block Group	N/A	250214043023	1,110,989	6,514.1	25,466	149.4	1,110,989	23,885.1	25,466	547.5
NLCD 2011	Block Group	N/A	250214044005	4,437,374	26,018.0	59,794	350.6	4,437,374	95,399.0	59,794	1,285.5
NLCD 2011	Block Group	N/A	250214044004	232,081	1,360.8	7,201	42.2	232,081	4,989.5	7,201	154.8
NLCD 2011	Block Group	N/A	250214044003	620,991	3,641.0	18,398	107.9	620,991	13,350.6	18,398	395.5
NLCD 2011	Block Group	N/A	250214044002	1,122,936	6,584.2	30,448	178.6	1,122,936	24,141.9	30,448	654.6
NLCD 2011	Block Group	N/A	250214044001	710,290	4,164.6	17,708	103.8	710,290	15,270.5	17,708	380.7
NLCD 2011	Block Group	N/A	250214043021	577,767	3,387.6	19,084	111.9	577,767	12,421.4	19,084	410.3
NLCD 2011	Block Group	N/A	250214043022	245,531	1,439.6	8,110	47.5	245,531	5,278.6	8,110	174.4
NLCD 2011	Block Group	N/A	250214043012	409,149	2,399.0	13,514	79.3	409,149	8,796.3	13,514	290.6
NLCD 2011	Block Group	N/A	250214043013	903,906	5,299.9	20,839	122.1	903,906	19,433.1	20,839	448.0
NLCD 2011	Block Group	N/A	250214043011	1,310,341	7,683.0	38,824	227.6	1,310,341	28,171.0	38,824	834.7
NLCD 2011	Block Group	N/A	250214042012	1,104,442	6,475.7	35,939	210.8	1,104,442	23,744.3	35,939	772.6
NLCD 2011	Block Group	N/A	250214042011	834,821	4,894.8	27,171	159.3	834,821	17,947.8	27,171	584.1
NLCD 2011	Block Group	N/A	250214042013	1,098,794	6,442.6	30,461	178.6	1,098,794	23,623.0	30,461	654.9
NLCD 2011	Block Group	N/A	250214042021	846,481	4,963.3	26,730	156.7	846,481	18,198.5	26,730	574.6
NLCD 2011	Block Group	N/A	250214042023	1,380,185	8,092.5	32,593	191.1	1,380,185	29,672.6	32,593	700.7
NLCD 2011	Block Group	N/A	250214042022	1,597,914	9,369.1	28,346	166.2	1,597,914	34,353.5	28,346	609.4
NLCD 2011	Block Group	N/A	250214041001	2,214,996	12,987.3	51,598	302.6	2,214,996	47,620.2	51,598	1,109.3
NLCD 2011	Block Group	N/A	250214041002	822,533	4,822.8	22,160	130.0	822,533	17,683.6	22,160	476.4
NLCD 2011	Block Group	N/A	250214041003	580,044	3,401.0	16,708	98.0	580,044	12,470.3	16,708	359.2
NLCD 2011	Block Group	N/A	250214042014	396,699	2,326.0	12,786	75.0	396,699	8,528.6	12,786	274.9
Selection Total:				23,472,028	137,624.9	573,314	3,361.5	23,472,028	504,624.7	573,314	12,325.7
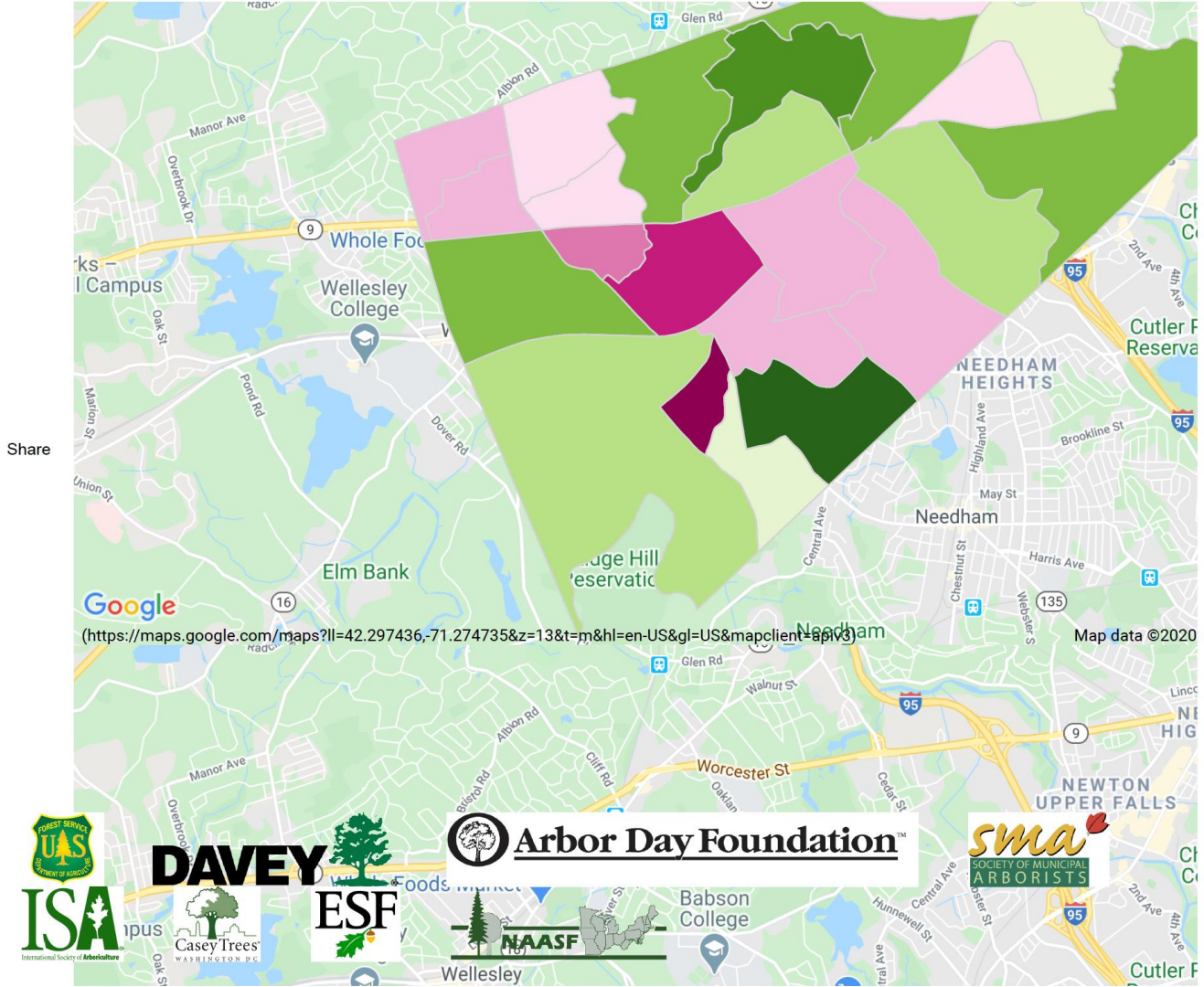
5. Future Considerations

The applications outlined in this report are powerful tools to help advocate for the urban forest, and justify expenses related to planting and maintenance programs. Given the quality of the Town's existing data about the current Tree canopy, an analysis using iTree Eco is recommended. This would require reformatting of the existing dataset, but would allow a more comprehensive analysis of real tree population, health and other demographics. The graphs and maps in this report are those generated directly from the iTree software suite. Immediate next steps will be to condense this report into single page infographics for distribution.