Town Branch Commons
Methods

Research Fellow:
Jordan Phemister
Lecturer
University of Kentucky

Research Assistant:
Mitchell Kubera
BSLA Candidate
University of Kentucky

Firm Liaison:
Erin Masterson
Senior Landscape Architect
Gresham Smith

This investigation was conducted as part of the Landscape Architecture Foundation's 2025 *Case Study Investigation* (CSI) program. CSI matches faculty-student research teams with design practitioners to document the benefits of exemplary high-performing landscape projects. Teams develop methods to quantify environmental, social, and economic benefits and produce Case Study Briefs for LAF's *Landscape Performance Series*.

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The full case study can be found at: https://landscapeperformance.org/case-study-briefs/Town-Branch-Commons

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Acknowledgements

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– Chase Wright, Project Manager and Civil Engineer, Strand Associates
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Research Strategy

The first phase of research focused on articulating the big picture, learning from the project's long history and evolution, and determining broad priorities for landscape performance benefits and potential data sources. Firm liaison, Erin Masterson, was instrumental in making connections to and scheduling numerous meetings with project clients, key partners, and stakeholders during this initial scoping effort. Each of these meetings led to a list of additional contacts and resources which was instrumental in helping the research team connect to the many people and organizations involved in this project. This phase concluded with an open house event in March 2025 coordinated and hosted by our firm partner, Gresham Smith. We shared our draft list of proposed benefits (see Figures 1-3) and gathered input on priorities from attendees, which included project clients, partners, and stakeholders, as well as local and state government employees and elected officials.

In addition to gathering input and feedback, the open house provided an informal opportunity to connect with a broad range of community members and build awareness about Town Branch Commons and LAF's CSI program. Numerous one-on-one and small group conversations allowed our firm partners and research team to discuss the importance of landscape performance in the hopes of elevating public understanding of this type of work, how we measure the impacts of these kinds of projects, and potentially informing how the community sets goals for future projects in the city and state. This phase set up an overall framework for our research and opened key lines of communication. In phase 2, we engaged with visitors and stakeholders in a formalized way through surveys and interviews.

Figure 1. Community members 'voted' for their top landscape benefit priorities.

Figure 2. Informal conversations among attendees at open house event.

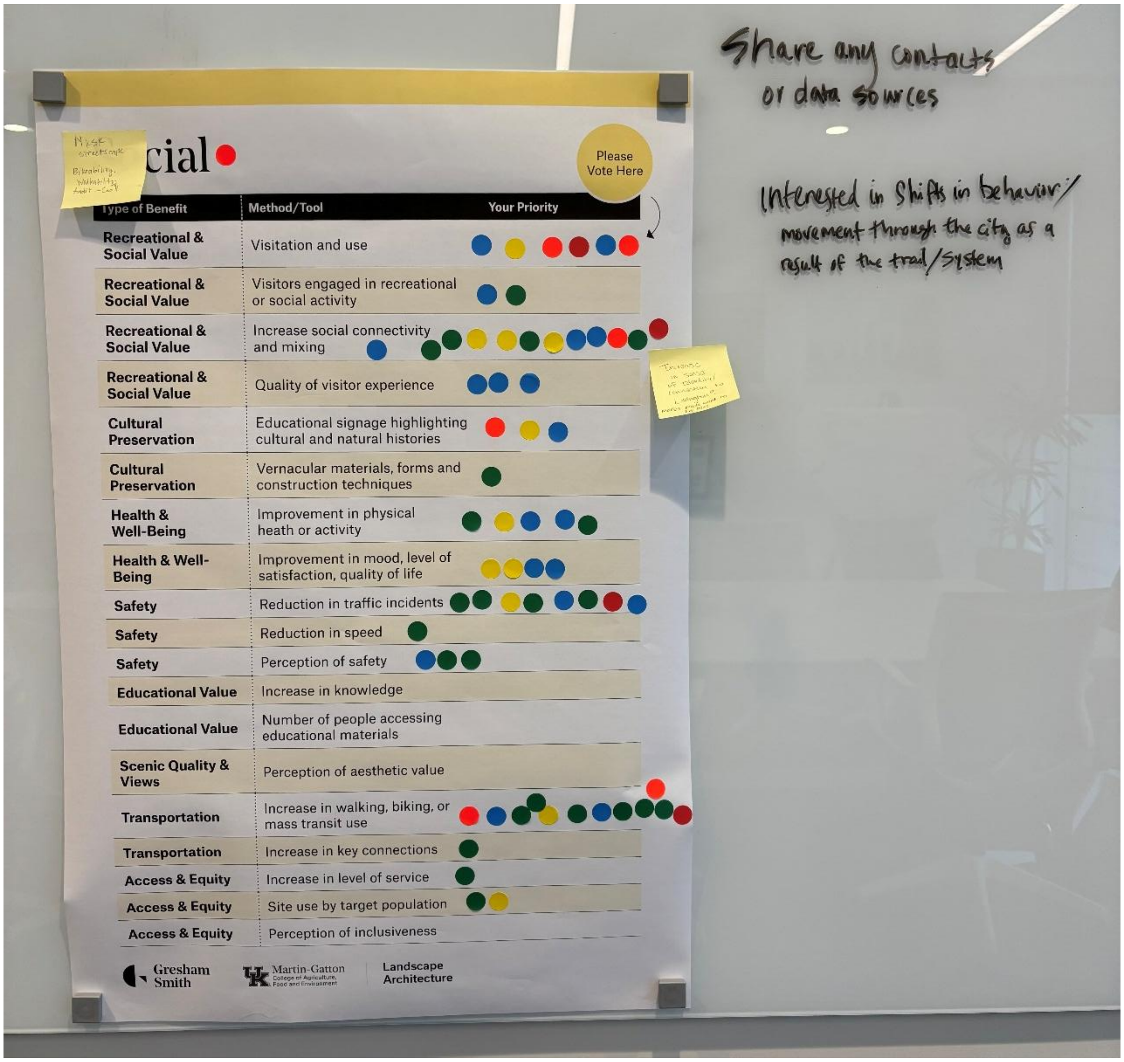


Figure 3. Attendee votes and notes for the draft landscape benefits.

The second phase of research entailed narrowing in on a list of benefits that were feasible to measure and reflective of input received at the open house event. The research team developed a survey and related individual interview questions, which were determined to be important tools for documenting many environmental, social, and environmental benefits. In addition, we conducted a second round of fact-finding meetings with a focused list of project stakeholders related to bike and pedestrian use, traffic safety, tree benefits and stormwater. Field data collection included a tree inventory and water quality sampling.

Survey and Interview Overview

Survey and Interview Background

To measure the majority of social benefits of Town Branch Commons, we conducted a general survey and individual interviews in summer 2025. The general survey was directed at residents, visitors, and commuters aged 18 and above. The interviews focused on local developers. Refer to Appendix A for the general survey and Appendix B for interview questions.

Town Branch Commons is located near and travels through a variety of neighborhoods, commercial areas and civic assets, including parks, a library, transit center, government buildings, and large-scale sports and entertainment venues, along its 2.2-mile corridor.

Survey Method

A general survey (see Appendix A) targeted individuals who live near, are familiar with, and/or frequent the trail. We identified the 'catchment area' as the group of census blocks surrounding the trail and are contiguous to one another (Figure 4). Based upon the total population of the combined zip-codes from this area (4,942), our minimum sample size is 67 responses (90% confidence level and 10% margin of error, Qualtrics).

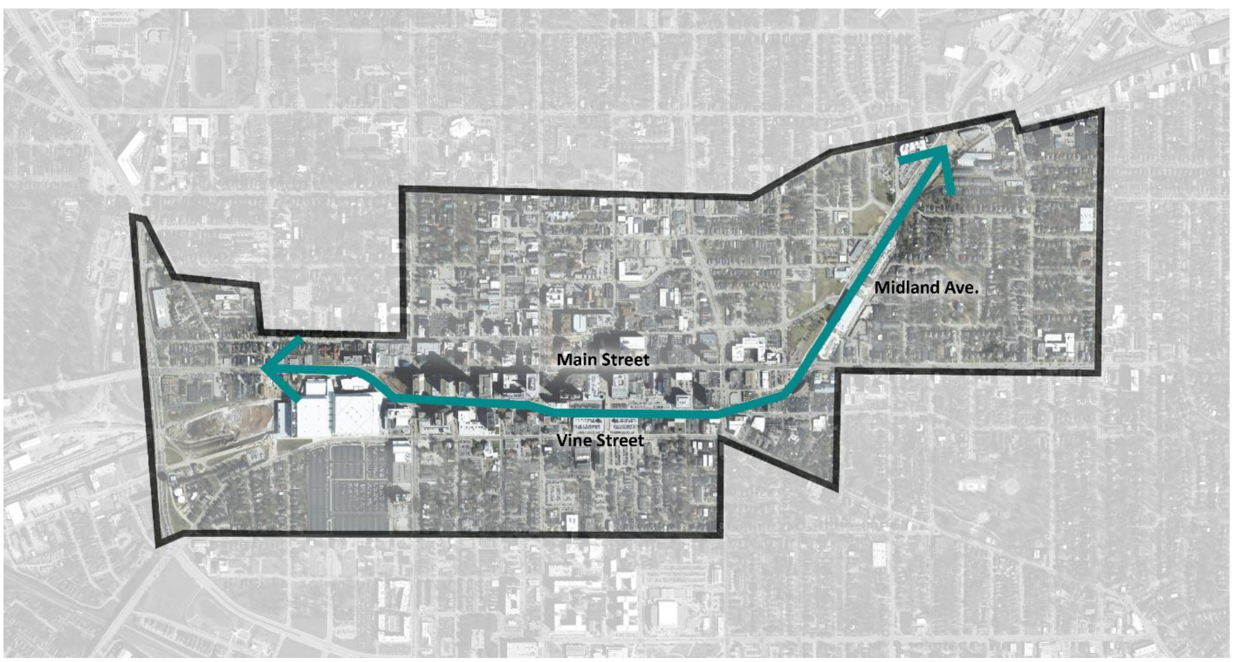


Figure 4. Census Block 'Catchment Area'.

We conducted the general survey using two outreach strategies: indirect and on-site.

1. Indirect: Provided a link to an online survey through email distribution lists, and flyers posted at nearby businesses and organizations.
    a. Shared with Representatives of Neighborhood and Home Owners Associations within broader catchment area: Ashland, Ashland Park, Aylesford, Bell Court, Fairway, Gratz Park, Historic Western Suburb, Historic South Hill, Historic

Woodward Heights, Kenwick, Martin Luther King, Mentelle Park, The Midlands, North Limestone, Northside, Transylvania Park, William Wells Brown, Woodland Triangle

b. Shared with all Members of the Lexington Fayette Urban County Council: Dan Wu, At-Large and Vice Mayor; Chuck Ellinger II, At-Large; James Brown, At-Large; Tyler Morton, District 1; Shayla Lynch, District 2; Hannah LeGris, District 3; Emma Curtis, District 4; Liz Sheehan, District 5; Denise Gray, District 6; Joseph Hale, District 7; Amy Beasley, District 8; Whitney Elliott Baxter, District 9; Dave Sevigny, District 10; Jennifer Reynolds, District 11; Hil Boone, District 12

2. On-site: Identified local events along/nearby Town Branch Commons for tabling and research recruitment. Displayed informational poster about case study research and handed out flyers to recruit participants for survey and focus groups. Printed materials contained QR codes for people to access and complete the survey, as well as learn more about the project and the case study program. Events attended are listed below:
    a. StreetFest (5/17/25)
    b. Downtown Farmer's Market (6/21/25, 6/28/25)
    c. National Avenue Farmer's Market (6/12/25)
    d. Outdoor Yoga at Charles Young Park (7/5/25, flyer distribution only)

General Survey Data and Distribution Summary

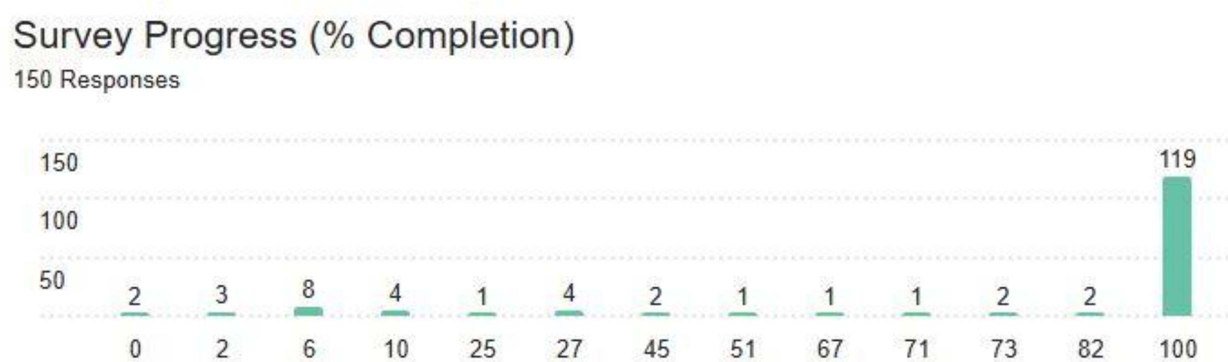


Figure 5. Survey progress showing number of respondents on y-axis and percentage completion on x-axis.

Sample size: 67 responses (90% confidence level and 10% margin of error, Qualtrics)
Total Completed Surveys: 119 responses
Total Surveyed: 150 responses

Distribution Summary
Access through anonymous link: 114 responses
Access through QR code: 36 responses

General Survey Limitations

- Online-only survey may exclude some trail users due to lack of access to technology.
- English-only survey may create language barrier to non-English speaking trail users.
- Some survey participants did not respond to the full questionnaire leading to some questions having a smaller sample size.

Survey Sources:

LFUCG GIS. "Census Block Groups 2020 (Current)." January 15, 2025.
https://data.lexingtonky.gov/maps/d0a5997a49c14646838994859e285661

LFUCG GIS. "Zip Code Boundaries." September 13, 2024.
https://data.lexingtonky.gov/maps/ccbd92bd68734f4098a844dc85d5a383

Qualtrics. "Sample Size Calculator." December 8, 2023.
https://www.qualtrics.com/blog/calculating-sample-size/

TIGER Grant Project Boundaries

Federal Highway Administration grant funding (FY 2016 TIGER Grant No. 7) reporting data was used for the following benefits: Social-Bike and pedestrian activity, and Economic-Leveraged and connected unique funding streams. The project area for the TIGER grant encompassed and went beyond the boundaries of Town Branch Commons (Figure 6). This Case Study focuses on Zones 1-4, but benefit language for the benefits identified above reflect all project zones.

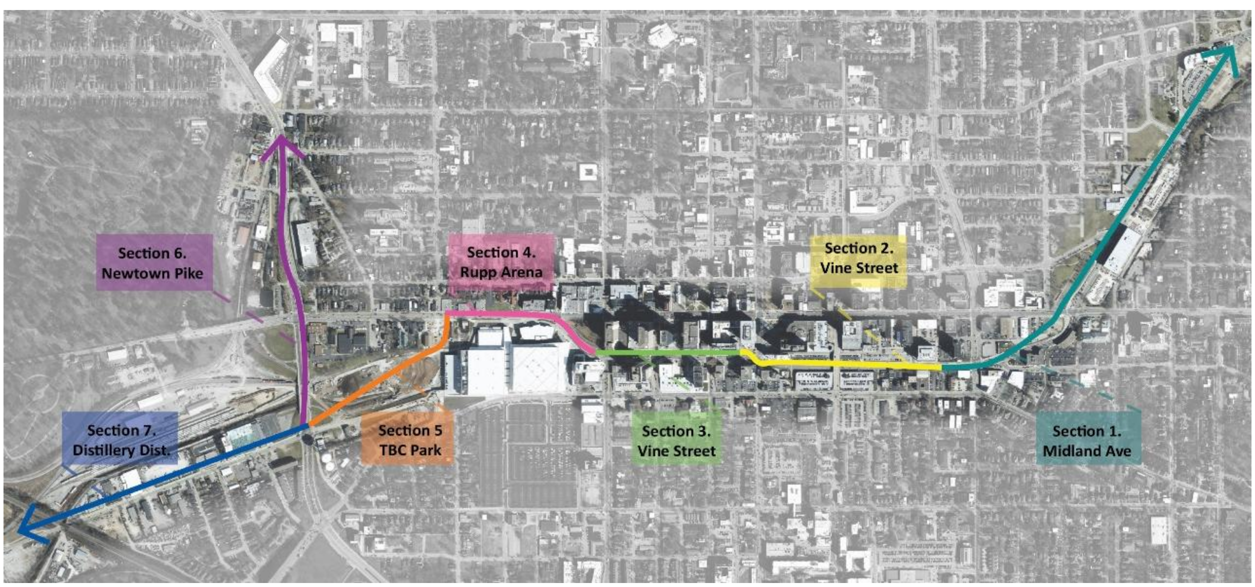


Figure 6. TIGER Grant project zones.

Environmental Benefits

- ***Captures and treats approximately 25,000 cu ft of stormwater in urban rain gardens. This meets 231% of municipal requirements for water quality treatment of the 'first flush.'***

Background:

This complete street project includes planting areas and a green infrastructure system consisting of curb cuts, inlets, and flumes that collect and direct stormwater runoff into a series of 22 rain gardens with specialized soil mixes and plantings designed to support infiltration. In addition, permeable pavement in strategic locations helps reduce and absorb runoff from the trails. The city designates a 1.2-inch rain event for treating the 'first flush' of rainfall or 10,800 cu ft falling within identified catchment areas during a 1.2-inch rain event.

Survey questions asked users about how they rated the importance of various design goals for Town Branch Commons, including reducing stormwater runoff and improving water quality (Figure 7). There is broad public support for this benefit, with 98% of surveyed users rating it important. For additional information, refer to survey overview under Social Benefits.

Method:

Researchers analyzed project documents and stormwater submittals to calculate storage volume required by the Lexington Fayette Urban County Government (LFUCG), as well as the below-ground, and above-ground storage volumes provided by each of the rain gardens. Below-ground storage volumes were calculated using void ratios for soil, sand, and stone provided by LFUCG, and above-ground storage volumes were calculated by multiplying the surface area of each rain garden by its ponding depth. Above-ground storage volumes were adjusted to account for side slopes around the perimeter of rain gardens, and the associated reduction in storage as follows:

- 10% volume reduction for 0-0.7' ponding depth
- 15% volume reduction for .7'-1.4' ponding depth
- 20% volume reduction for 1.4'+ ponding depth

Calculations:

RAIN GARDEN	STORMWATER RUNOFF				RAIN GARDEN								PERFORMANCE
	Drainage area (ac)	Approx. % impervious	Impervious area (ac)	LFUCG Design Storm (1.2") storage volume required (cf)	Rain Garden soil, 18% void ratio (cy)	Rain Garden sand, 30% void ratio (cy)	Rain Garden #9's and #57's, 40% void ratio (cy)	Below-ground storage volume provided by soil, sand, and stone (cf)	Ponding depth to overflow (ft)	Surface area of Rain Garden (sf)	Above-ground storage volume (using RG area) (cf)	Total storage volume at full ponding depth (cf)	LFUCG Design Storm (1.2") storage volume met
1	0.273	50%	0.137	595	47.0	6.0	24.0	536.2	0.56	581.7	293.2	829.4	139%
1A	0.297	50%	0.149	647	38.0	5.0	19.0	430.4	.50*	469.3	211.2	641.6	99%
2	0.045	70%	0.032	137	24.0	3.0	12.0	270.5	0.93	186.9	147.7	418.3	305%
3	0.092	85%	0.078	341	12.0	2.0	9.0	171.7	0.68	180.0	110.2	281.9	83%
4	0.304	70%	0.213	927	93.0	10.0	40.0	965.0	0.74	1069.3	672.6	1,637.6	177%
5	0.258	75%	0.194	843	86.6	8.4	33.5	850.8	0.72	905.1	553.9	1,404.7	167%
6	0.231	70%	0.162	704	24.5	6.1	24.5	432.7	0.85	660.6	477.3	910.0	129%
7	0.194	60%	0.116	9	61.2	15.3	61.2	1,082.5	0.87	1652.6	1222.1	2,304.6	25606%
8	0.066	70%	0.046	201	37.1	5.6	22.3	466.3	0.60	601.7	324.9	791.2	393%
9	0.091	80%	0.073	317	42.5	3.6	14.6	393.2	0.50	393.2	176.9	570.1	180%
10	0.047	60%	0.028	123	48.4	4.9	19.7	487.5	0.57	531.3	272.6	760.0	619%
11	0.069	60%	0.041	180	12.6	2.0	7.9	162.9	0.71	214.3	129.3	292.2	162%
12	0.081	60%	0.049	212	90.0	8.5	33.5	868.1	0.39	909.5	319.2	1,187.3	561%
13	0.045	30%	0.014	59	58.0	5.0	20.0	538.4	0.63	518.4	293.9	832.3	1415%
14	1.158	35%	0.405	1765	80.7	13.8	55.4	1,102.6	1.67	1495.0	1997.3	3,099.9	176%
15	0.089	40%	0.036	155	30.7	9.7	19.4	436.7	0.66	1046.1	621.4	1,058.1	682%
16	0.064	60%	0.038	167	14.2	4.1	8.1	189.5	1.52	438.1	532.7	722.2	432%
17	0.102	40%	0.041	178	6.3	3.1	6.3	123.3	0.66	337.7	200.6	323.9	182%
18	0.352	70%	0.246	1073	86.2	11.0	44.0	983.3	2.60	1188.3	2471.7	3,455.0	322%
19	0.234	75%	0.176	764	10.5	2.0	7.9	152.7	2.17	213.5	370.6	523.3	68%
20	0.334	60%	0.200	873	119.7	17.1	68.4	1,459.4	0.32	1847.4	532.1	1,991.5	228%
21	0.194	70%	0.136	592	27.3	5.6	22.6	422.5	1.29	610.1	669.0	1,091.5	185%
TOTALS	**4.62**		**2.608**	**10,862**				**12,526.0**		**16,050.1**	**12,600.4**	**25,126.4**	**231%**

Data highlighted in grey provided by Strand Associates
Rain Garden soils data collected from project documents *Assumed depth
10% volume reduction for 0-.7' depth

TBC Zones 1-4 - Bioswale Performance Evaluation
Void ratios found in LFUCG Water Quality Spreadsheet
15% volume reduction for .7'-1.4' depth

Date: 12/07/18
20% volume reduction for 1.4'+ depth

Table 1. Stormwater volume requirements and rain garden performance for 1.2-inch rain event. Source: Strand Associates, LFUCG, project documents.

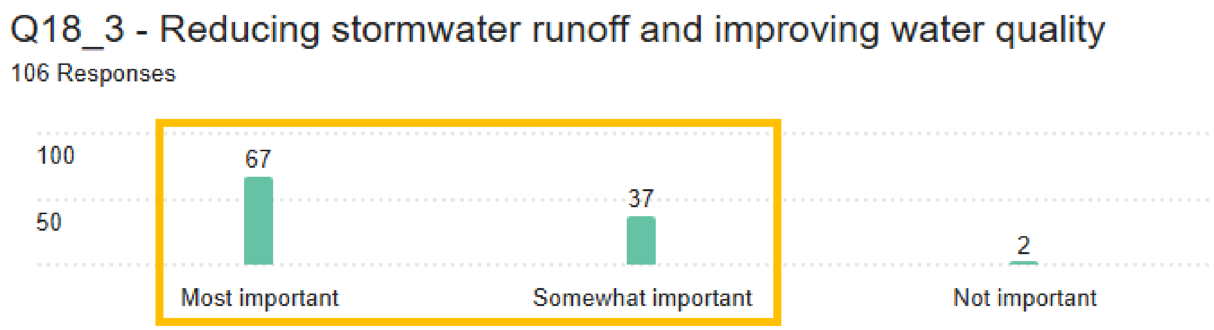


Figure 7. Survey responses rating the importance of stormwater design goal.

67 + 37 = 104

104 ÷ 106 = 98.1% of users rated stormwater design goal as important

Sources:

Project documents

LFUCG. "New development, redevelopment, construction and demolition projects: Water Quality Spreadsheet." Accessed July 15, 2025. https://www.lexingtonky.gov/government/departments-programs/environmental-quality-public-works/engineering/new-development-redevelopment-construction-demolition-projects

Limitations:

- Calculated results are estimates and not based on observation of actual rain events.
- Only accounts for delineated urban rain garden zones and associated soils, which are part of larger network of planting areas and karst features that help collect and treat stormwater
- Does not account for plant interception or evapotranspiration.
- Potential discrepancies between project documents and as-built conditions.

- ***Reduces annual runoff by 29% (11.8 in) and impervious surfaces within the project area by 3.6% (14,363 sf).***

Background:

The corridor traces the historic path of Town Branch, a highly urbanized watershed draining much of downtown Lexington, and the project encompasses a small portion of the overall watershed (see Inconclusive Benefit on water quality). In spite of these spatial constraints, Town Branch Commons has significantly reduced annual runoff by re-aligning and reducing the lane widths of vehicular streets through a ‘road diet’. A green infrastructure system consisting of urban rain gardens (see previous benefit), dense vegetation (see next benefit), and strategically placed pervious pavement complements the decrease of impervious surfaces, further contributing to runoff reduction from the site.

Method:

The research team used the EPA National Stormwater Calculator (see Appendix C) to estimate the site’s performance during rain events (see Figure 8). Pre-construction land cover was estimated using a combination of 2010 and 2018 orthoimagery and project documents. The 22 urban rain gardens were aggregated and classified as street planters with weighted averages derived from project documents for the following parameters: ponding height, soil media thickness, and gravel bed thickness (see Table 2). Design parameters for pervious pavement were based on construction detail from project documents as follows: 3” pavement thickness and 14” gravel (2” setting bed + 4” base + 8” subbase). The following assumptions and calculations were made when determining urban rain garden data:

- If greater than or equal to 100% of LFUCG Design Storm (1.2”) storage volume (Table 2, column L) was met, the final ‘% Impervious area of rain garden drainage treated’ (Table 2, column M) is equal to ‘Approx. % impervious’ (Table 2, column K). For example, Rain Garden 1 meets 139% of LFUCG Design Storm, and therefore treats the full 50% of the approximate impervious area within its drainage area.
- If less than 100% of LFUCG Design Storm (1.2”) storage volume (Table 2, column L) was met, the final ‘% Impervious area of rain garden drainage treated’ (Table 2, column M) is equal to the product of ‘Approx. % impervious’ (Table 2, column K) × LFUCG Design Storm (1.2”) storage volume met (Table 2, column L). For example, Rain Garden 3 meets 83% of LFUCG Design Storm, and therefore treats: 85% × 83% = 70.3% of the approximate impervious area within its drainage area. See yellow highlighted cells in Table 2 for other similar cases.

The team referenced project documents and current orthoimagery to estimate the current landcover (meadow classification used for all planting areas), street planters (classification used for urban rain gardens since it included gravel layer), and pervious pavement along the trail (see Table 3). This data was entered into the EPA National Stormwater Calculator using the following parameters: clay loam soil, moderately flat, and default soil conductivity (0.04).

Calculations:

See Appendix C for EPA Stormwater Calculator Report.

National Stormwater Calculator Report

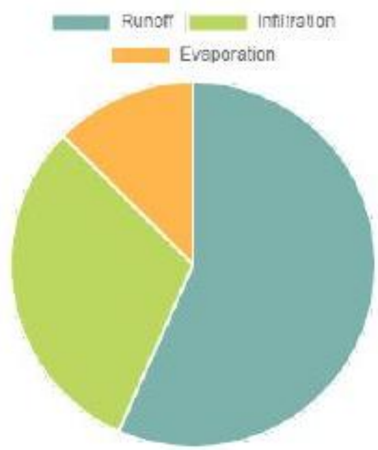
Results

Site Summary

Town Branch Commons

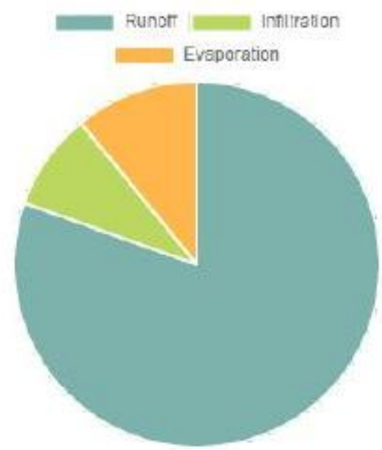
Current Scenario

Annual Rainfall: 49.25 in.



Baseline Scenario

Annual Rainfall: 49.25 in.



Statisic	Current Scenario	Baseline Scenario
Average Annual Rainfall (inches)	49.25	49.25
Average Annual Runoff (inches)	28.00	39.81
Days per Year with Rainfall	83.80	83.80
Days per Year with Runoff	62.77	71.71
Percent of Wet Days Retained	25.10	14.43
Smallest Rainfall w/ Runoff (inches)	0.10	0.10
Largest Rainfall w/o Runoff (inches)	0.31	0.23
Max Rainfall Retained (inches)	1.18	0.38

Figure 8. EPA Stormwater Calculator summary page for Town Branch Commons.

URBAN RAIN GARDEN DATA (ENTERED AS STREET PLANTER IN STORMWATER CALCULATOR)															
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Rain Garden	Area of Rain Garden (sf)	Proportion of total Rain Garden area	Ponding depth to overflow (in)	Weighted average ponding depth (in)	Soil depth (in)	Weighted average soil depth (in)	Gravel + sand depth (in)	Weighted average gravel + sand depth (in)	Rain Garden drainage area (ac)	Approx. % impervious	LFUCG Design Storm (1.2") storage volume met	% Impervious area of rain garden drainage treated	Area (sf) of impervious rain garden drainage treated	% Capture Ratio: Rain Garden area ÷ impervious area treated	% Impervious area treated: area of rain garden drainage treated ÷ total site
1	581.7	3.6%	7	0.24	26.5	0.96	15	0.54	0.273	50%	139%	50.0%	5,945.9		
1A	469.3	2.9%	6*	0.18	26	0.76	15	0.44	0.297	50%	99%	49.6%	6,415.7		
2	186.9	1.2%	11	0.13	23	0.27	15	0.17	0.045	70%	305%	70.0%	1,372.1		
3	180.0	1.1%	8	0.09	21	0.24	15	0.17	0.092	85%	83%	70.3%	2,818.8		
4	1069.3	6.7%	9	0.59	28	1.87	15	1.00	0.304	70%	177%	70.0%	9,269.6		
5	905.1	5.6%	9	0.49	31	1.75	15	0.85	0.258	75%	167%	75.0%	8,428.9		
6	660.6	4.1%	10	0.42	12	0.49	15	0.62	0.231	70%	129%	70.0%	7,043.7		
7	1652.6	10.3%	10	1.07	12	1.24	15	1.54	0.194	60%	25606%	60.0%	5,070.4		
8	601.7	3.7%	7	0.27	20	0.75	15	0.56	0.066	70%	393%	70.0%	2,012.5		
9	393.2	2.4%	6	0.15	35	0.86	15	0.37	0.091	80%	180%	80.0%	3,171.2		
10	531.3	3.3%	7	0.23	29.5	0.98	15	0.50	0.047	60%	619%	60.0%	1,228.4		
11	214.3	1.3%	9	0.11	19	0.25	15	0.20	0.069	60%	162%	60.0%	1,803.4		
12	909.5	5.7%	5	0.27	19.5	1.10	15	0.85	0.081	60%	561%	60.0%	2,117.0		
13	518.4	3.2%	8	0.24	18	0.58	15	0.48	0.045	30%	1415%	30.0%	588.1		
14	1495.0	9.3%	20	1.87	17.5	1.63	15	1.40	1.158	35%	176%	35.0%	17,654.9		
15	1046.1	6.5%	8	0.52	9.5	0.62	9	0.59	0.089	40%	682%	40.0%	1,550.7		
16	438.1	2.7%	18	0.50	10.5	0.29	9	0.25	0.064	60%	432%	60.0%	1,672.7		
17	337.7	2.1%	8	0.17	6	0.13	9	0.19	0.102	40%	182%	40.0%	1,777.2		
18	1188.3	7.4%	31	2.31	23.5	1.74	15	1.11	0.352	70%	322%	70.0%	10,733.2		
19	213.5	1.3%	26	0.35	16	0.21	15	0.20	0.234	75%	68%	51.3%	5,232.9		
20	1847.4	11.5%	4	0.44	21	2.42	15	1.73	0.334	60%	228%	60.0%	8,729.4		
21	610.1	3.8%	15	0.59	14.5	0.55	15	0.57	0.194	70%	185%	70.0%	5,915.4		
TOTALS	16,050.1	100%		11.2		19.7		14.3					110,552.0	14.5%	29%

Table 2. Summary of rain garden data which was entered into EPA Stormwater Calculator as 'street planters'. Source: Data highlighted in grey provided by Strand Associates, other data derived from project documents.

Capture Ratio for rain garden (Table 2, Column O) was calculated as follows:

Total Area of Rain Gardens (Table 2, Column B) ÷ Area (sf) of impervious rain garden drainage treated (Table 2, Column N)

16,050 sf ÷ 110,552 sf = 14.5% Capture Ratio for rain garden (street planters)

STORMWATER QUANTITY DATA											
A	B	C	D	E	F	G	H	I	J	K	L
	Impervious	Pervious: Lawn	Pervious: Meadow	Total Area (sf)	Total Area (ac)	LID: Street Planters	Street Planters: % Impervious area treated	Pavement (sf of permeable pavers + crushed stone)	Pervious Pavement: % Impervious area treated	Average annual runoff (in)	Days per year with runoff
Baseline Condition (pre-construction)	397,114	37,345	16,864	451,323	10.36	0		0		39.81	71.71
e	88.0%	8.3%	3.7%								
Current Condition (post-construction)	382,751	0	68,572	451,323	10.36	16,050	29%	7,009	1.8%	28.00	62.77
e	84.8%	0.0%	15.2%			See Rain Garden table for details					
Change	14,363	37,345	(51,708)						Change	11.81	8.94
Percent Change	-3.6%	-100.0%	306.6%						Percent Change	29.7%	12.5%

Table 3. Summary of baseline (pre-construction) and current (post-construction) stormwater quantity data and impacts on runoff. Source: Project documents, EPA Stormwater Calculator.

LID Control % Impervious area treated for street planters (urban rain gardens) was calculated as follows:

Total area (sf) of impervious rain garden drainage treated (Table 2, Column N) ÷ Current Impervious Area (Table 3, Column B)

110,552 sf ÷ 382,751 sf = 28.8% LID Control % impervious area treated for street planter

Sources:

Project documents

Google Earth

EPA. "National Stormwater Calculator." Accessed July 15, 2025. https://www.epa.gov/water-research/national-stormwater-calculator

NOAA National Centers for Environmental information. "Climate at a Glance: County Time Series." Accessed July 15, 2025. https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/time-series

NWS. "Lexington Climate." Accessed July 20, 2025. https://www.weather.gov/lmk/clilex

Limitations:

- Modeled results are estimates and not based on observation of actual rain events.
- EPA Stormwater calculator does not account for tree canopy and rainfall interception.
- Potential discrepancies between project documents and as-built conditions.

- ***Creates 68,572 sf of new habitat composed of 85% native plant species. 48% of species have special value for pollinators and beneficial insects according to the Xerces Society.***
- ***Increases plant species richness, achieving a Shannon Index value of 2.74 for trees (94% of maximum value), 1.92 for shrubs (83% of maximum value), and 2.24 for perennials (90% of maximum value).***

Background:

This downtown corridor was formerly dominated by hardscape and devoid of green, except for a few struggling street trees. Narrow ribbons of planting create a significant impact in this urban setting with a mix of trees and shrubs which are complemented by densely planted perennial and grass plugs.

Survey questions asked users about how they rated the importance of various design goals for Town Branch Commons, including incorporating native plants to increase biodiversity and habitat (Figure 11). There is broad public support for this benefit, with 97% of surveyed users rating it important. For additional information, refer to survey overview under Social Benefits.

Figure 9. Diversity of plants found along Town Branch Commons. From upper left row 1: joe pye weed (Eupatorium fistulosum); rattlesnake master (Eryngium yuccifolium); prairie dropseed (Sporobolus heterolepis); row 2: yellow coneflower (Ratibida pinnata), winterberry (Ilex verticillata 'Red Sprite' and 'Jim Dandy'), bald cypress (Taxodium distichum) and switchgrass (Panicum virgatum 'Shenandoah'); summersweet (Clethra alnifolia 'hummingbird'),; row 3: purple coneflower (Echinacea purpurea); mountainmint (Pycnanthemum tenuifolium, substituted for P. muticum); purple prairie clover (Dalea purpurea); row 4: swamp milkweed (Asclepias incarnata); carolina rose (Rosa carolina); black eyed susan (Rudbeckia hirta), london plane tree (Platanus x acerifolia), and prairie dropseed (Sporobolus heterolepis).

Method:

Habitat Creation

Area of habitat created derived from project document area takeoffs for planting areas and rain gardens. Karst stone features on ground plane in rain gardens were subtracted from these totals and area of soil cells below trees planted in pavement were added to these totals as a surrogate to account for habitat created by tree canopy above-ground (see Figure 10).

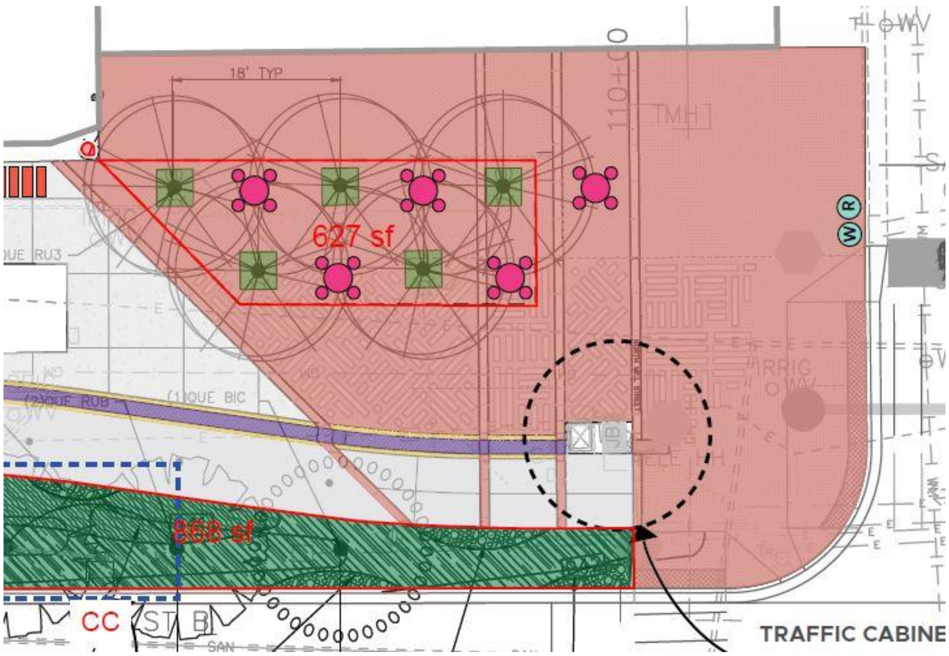


Figure 10. Example of area takeoffs for soil cells below trees planted within pavement. Source: Gresham Smith.

Native Plant and Pollinator Status

Native plant status determined using USDA PLANTS Database and Missouri Botanical Plant Finder. Pollinator and beneficial insect value determined consulting Xerces Society plant lists for the following regions: Southeast (includes Kentucky), Mid-Atlantic (borders Kentucky to east), Great Lakes (borders Kentucky to north), and Southern Plains (borders Kentucky to west). In addition, researchers referred to James article (accessed July 15 2015).

Shannon Diversity Index

Plant count and species data was collected from project documents. The data was analyzed using the Shannon diversity index (also known as the Shannon-Weiner index). Researchers analyzed the overall planting plan, and divided plantings into five categories: trees, shrubs, grasses, perennials, and groundcovers. This breakdown gave a more nuanced interpretation of diversity for plantings along Town Branch Commons. Values for each category were then compared to their maximum value, which is calculated by assuming even distribution of plants among all species in each category. Calculations were tabulated in an Excel spreadsheet using the equations below.

Calculations:

See Appendix D for full plant list, native and pollinator status, and Shannon data set.

Habitat Creation

HABITAT CREATED		
Sheet	Rain Gardens w/o Karst Features (sf)	Planted areas including area of soil cells below trees in pavement (sf)
1	2,886	
2	265	
3	2,298	3,555
4		3,641
5	655	1,669
6	941	1,262
7	1,284	1,910
8		2,268
9		1,910
10	667	888
11	1,497	1,033
12	1,906	1,009
13	2,159	1,155
14	1,006	1,227
15		901
16	2,027	300
17	942	803
18	1,574	1,015
19		413
20		
21		1,255
22	7,391	
23	1,433	1,251
24	276	823
25		2,712
26	1,829	2,151
27	686	2,472
28	1,227	
Subtotals	*32,949*	*35,623*
	TOTAL HABITAT CREATED	**68,572**

Table 4. Habitat created in planting areas along Town Branch Commons.

Native Plant and Pollinator Status

40 native plant species ÷ 47 total plants species = 85.1% native plants

23 beneficial species ÷ 47 total plants species = 48.9% plants for pollinators and beneficial insects

Shannon Diversity Index

Species Richness:

The sum (Σ) of plants identified. The total number of plants specified in the planting plans across the 2.2-mile trail was 42,270.

Species Diversity:

The equation provided below was used to calculate the compositional index of plant community diversity. The index considers the number of unique species living in a habitat (richness) and their relative abundance (evenness), or proportion of plants from each unique species. The actual values were calculated using project planting plans and then compared to a maximum species diversity value, which was calculated by assuming the total number of plants are equally divided among each unique species. For all plantings (trees, shrubs, grasses, perennials, and groundcovers), the calculation produced a result of 1.69 out of a maximum diversity of 3.85 (43%) which translates to a moderate level of compositional diversity.

Denoted as H, this index is calculated as $H = -\Sigma p_i \times \ln(p_i)$ where:

- Σ: A Greek symbol that means 'sum'
- ln: Natural log
- pi: The relative proportion of an individual species in relation to the entire plant community assessed (the categories listed in left-most column below)

SHANNON DIVERSITY VALUES BY PLANT CATEGORY			
Category	**Actual**	**Maximum**	**Percentage Achieved**
All plants	1.68640825	3.8501476	43.8%
Trees	2.73934328	2.89037176	94.8%
Shrubs	1.92056505	2.30258509	83.4%
Perennials	2.24219271	2.48490665	90.2%
Groundcovers	0.97003716	1.38629436	70.0%
Grasses	0.4597298	1.09861229	41.8%

Table 5. Summary of Shannon diversity values for different plant types found along Town Branch Commons.

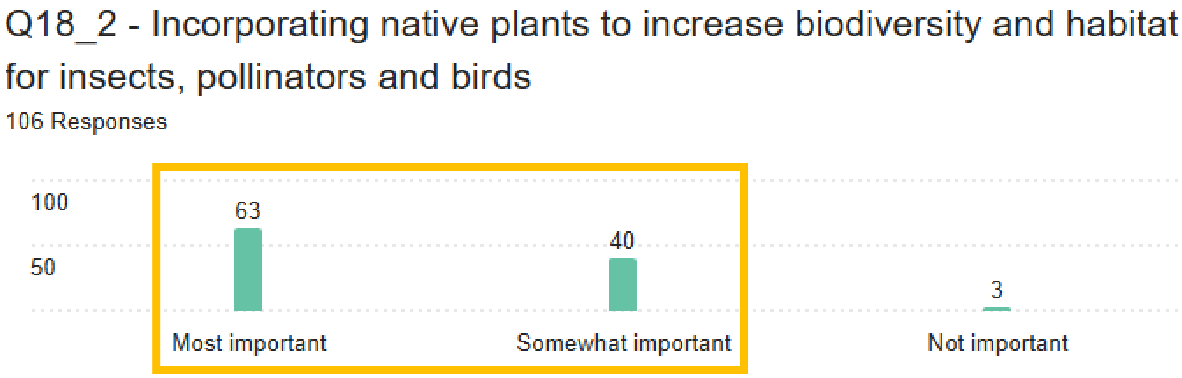


Figure 11. Survey responses rating the importance of biodiversity design goal.

63 + 40 = 103

103 ÷ 106 = 97.1% of users rated biodiversity design goal as important

Sources:

Project documents

Bobbit, Zach. "Shannon Diversity Index: Definition & Example." Statology, April 20, 2022. https://www.statology.org/shannon-diversity-index/.

Dramstad, Wenche E, James D Olson, and Richard T. T Forman. *Landscape Ecology Principles in Landscape Architecture and Land-Use Planning*. Washington, D.C: Island Press, 1996.

James, Beverly. "Wildlife Connections: Trees for Bees." Accessed July 14, 2025. https://ufi.ca.uky.edu/treetalk/wildlife-trees-bees.

Missouri Botanical Garden. "Plant Finder." Accessed July 15, 2025. https://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx.

USDA. "USDA Plants Database." Accessed July 22, 2025. https://plants.usda.gov/.

Xerces Society. "Pollinator Conservation Resource Center." Accessed July 3, 2025. https://www.xerces.org/pollinator-resource-center.

Limitations:

- Shannon Diversity Index values were aggregated across entire site and do not account for specific mixes of species within different planting zones along the 2.2-mile corridor.
- Pollinator and beneficial insect habitat may be negatively impacted by gaps and road intersections between planting areas.
- There may be discrepancies between the project planting plan and actual planted conditions in the field. Plant mortality and migration are not accounted for.

- ***Sequesters an estimated 1,440 lbs of atmospheric carbon annually in 255 newly planted trees and is projected to sequester an additional 45.70 tons over the next 30 years.***

Background:

The site design incorporated more than 250 newly planted trees, improving people's experience along the corridor, especially as they mature and provide additional shade, while providing environmental benefits.

Method:

The research team used the USFS iTree Eco Version 6 (iTree V6, see Appendix E) toolkit to inventory individual trees and their carbon sequestration benefits

The calculation of the current atmospheric carbon benefit was made using a tree count by the research team implemented into iTree V6. The measurements gathered by the team of each tree consist of DBH (diameter at breast height), estimated crown condition, total tree height, crown height width and depth, estimated percent crown missing, and number of sides exposed to sunlight.

The future tons of sequestered carbon absorbed by new trees planted at Town Branch Commons is based on a 30-year projection. iTree V6 was also used to project this metric.

To estimate the gross amount of carbon sequestered annually, average diameter growth from the appropriate genera and diameter class and tree condition was added to the existing tree diameter (year x) to estimate tree diameter and carbon storage in year x+1.

Calculations:

See Appendix D for full plant list and Appendix E for full iTree report.

Species	Trees Number	Carbon Storage (ton)	Carbon Storage ($)	Gross Carbon Sequestration (ton/yr)	Gross Carbon Sequestration ($/yr)
Downy serviceberry	11	0.05	21.25	0.01	6.47
Smooth service berry	5	0.02	7.97	0.01	3.59
Eastern redbud	24	0.24	103.38	0.06	24.49
Green hawthorn	12	0.08	36.60	0.02	10.79
Thornless honeylocust	18	0.30	130.56	0.07	29.06
Kentucky Coffee tree	12	0.20	87.67	0.04	16.97
Sweetbay	6	0.04	16.30	0.01	6.33
Black tupelo	34	0.18	78.43	0.07	28.75
Eastern hophornbeam	16	0.07	30.30	0.02	8.41
Sycamore spp	23	0.21	91.67	0.05	20.33
Oak spp	1	0.06	27.39	0.01	3.82
Swamp white oak	17	0.45	195.26	0.13	54.97
Scarlet oak	18	0.17	71.61	0.07	29.44
Northern red oak	48	0.39	170.74	0.12	52.38
Sassafras	1	0.00	1.48	0.00	0.91
Baldcypress	9	0.11	45.71	0.03	14.95
Total	**255**	**2.58**	**1,116.32**	**0.72**	**311.65**

Figure 12. Carbon sequestration by tree species. Source: iTree V6.

Unit Conversion: 1 US ton = 2,000 pounds

0.72 tons × 2000 pounds = 1,440 pounds

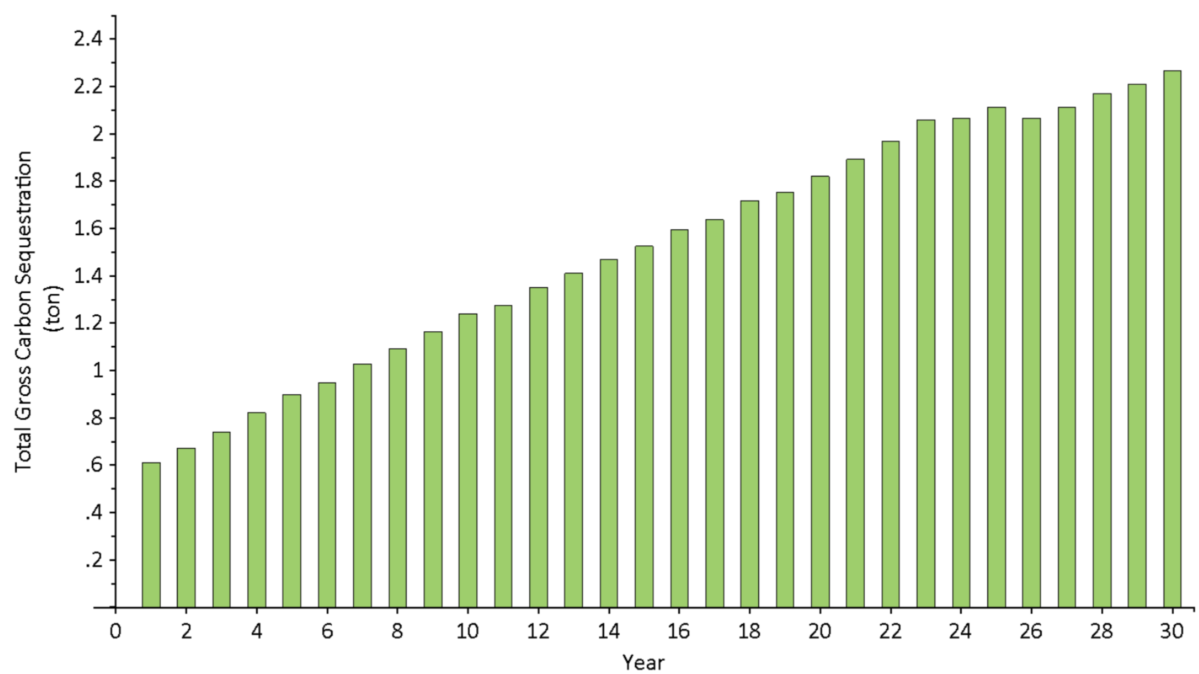


Figure 13. Carbon sequestration forecast. Source: iTree V6.

Year	Total Gross Carbon Sequestration (ton)
1	0.61
2	0.67
3	0.74
4	0.82
5	0.90
6	0.95
7	1.03
8	1.09
9	1.16
10	1.24
11	1.27
12	1.35
13	1.41
14	1.47
15	1.53
16	1.60
17	1.64
18	1.72
19	1.75
20	1.82
21	1.89
22	1.97
23	2.06
24	2.07
25	2.11
26	2.07
27	2.11
28	2.17
29	2.21
30	2.27
Total	**45.70**

Figure 14. Carbon sequestration forecast. Source: iTree V6.

Sources:

Project documents used to inform in-field tree inventory

iTree Eco V6. Accessed June 15, 2025. https://www.itreetools.org/tools/i-tree-eco.

Town Branch Commons iTree Report and Forecast (see Appendix E)

Limitations:

- iTree calculations are based on field inventory of trees informed by project documents. Calculations do not account for potential current and future carbon sequestration by shrubs, perennials, grasses, and trees under 8 feet tall.

- There were some discrepancies between the project planting plan and what the research team found in the field, and some species may have been misidentified.
- iTree calculations are done off site and some variables are out of the researcher's control.
- Climate data required for carbon sequestration forecasting is based on historical data and may not accurately predict future days per year without frost.

Social Benefits

- ***Enhances recreational opportunities, increasing bike activity by 100% (hourly counts of bikers increased from 5 to 10) and pedestrian activity by 31% (hourly counts of people increased from 58 to 76) on weekdays between 2018 and 2024. Predicted annual activity estimates jumped by 100% for biking (from 43,527 to 87,054 predicted trips) and 30% for walking (from 508,929 to 661,431) on weekdays over the same time period.***
- ***Offers a range of activities, with 77% of 111 surveyed users indicating that they engage in at least two social and/or recreational opportunities. 62% use the trail at least one to three times a month. The primary activities users engage in along the trail are walking (44%), biking (20%), and commuting (14%).***

Background:

This complete street corridor includes bike and pedestrian trails which are separated from vehicular traffic, link eight public parks, and complete a 22-mile regional trail network, connecting the downtown core to the surrounding Bluegrass region to the north and northwest. Federal Highway Administration grant funding (FY 2016 TIGER Grant No. 7, see Research Overview) requires pre-project baseline measurement and interim reporting to document impacts of funding by Lexington-Fayette Urban County Government (LFUCG). Data for this benefit was derived from March 2020 Pre-Project Report and March 2025 Interim-Project Report.

TIGER Grant funding encompassed and extended beyond the boundaries of Town Branch Commons (Figure 15). This Case Study focuses on Zones 1-4, but this benefit language reflects all project zones (see Method for additional detail).

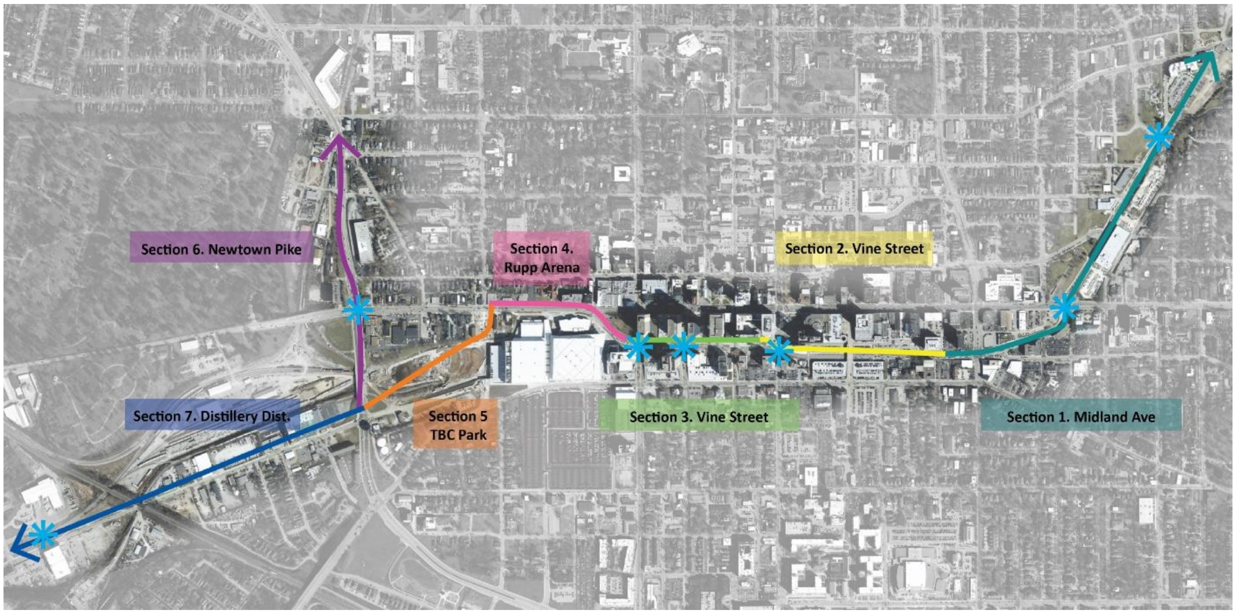


Figure 15. TIGER Grant project zones with bike and pedestrian monitoring locations indicated by blue asterisk symbol.

Method:

Daily bicycle and pedestrian counts were conducted prior to the pre-install baseline and interim measurement deadlines (April, May, June, August, and September of 2018, and 2024, respectively) by consultants hired by LFUCG Division of Traffic Engineering. Consultants used National Bicycle & Pedestrian Documentation Project methodology and conducted hourly counts at key locations (see  in Figure 15) in the study area. Consultants collected counts on a typical weekday, Saturday, and Sunday, and conducted them monthly to produce a quarterly average. Consultants analyzed and extrapolated hourly count data to predict annual biking and walking trips for the entire corridor.

Survey questions asked users about what types of activities they engage in along TBC, their primary activity, and their visit frequency. For additional information, refer to Survey Overview.

Calculations:

Percent change calculated as follows: [(2024 data – 2018 data) ÷ 2018 data] × 100

ACTUAL: ANNUAL AVERAGE DAILY COUNTS PER HOUR			
Bike Activity	**2018**	**2024**	**% Change**
Weekday	5	10	100%
Saturday	3	6	100%
Sunday	3	5	67%
Pedestrian Activity			
Weekday	58	76	31%
Saturday	27	35	30%
Sunday	21	26	24%
PREDICTED: EXTRAPOLATION OF ANNUAL TRIP ESTIMATES			
Bike Activity	**2018**	**2024**	**% Change**
Weekday	43,527	87,054	100%
Saturday	26,786	52,855	97%
Sunday	24,554	48,077	96%
Pedestrian Activity	**2018**	**2024**	**% Change**
Weekday	508,929	661,431	30%
Saturday	234,375	308,312	32%
Sunday	187,500	224,752	20%

Table 6. Actual daily counts and predicted annual trip estimates for bike and pedestrian activity.

Survey Questions and Results:

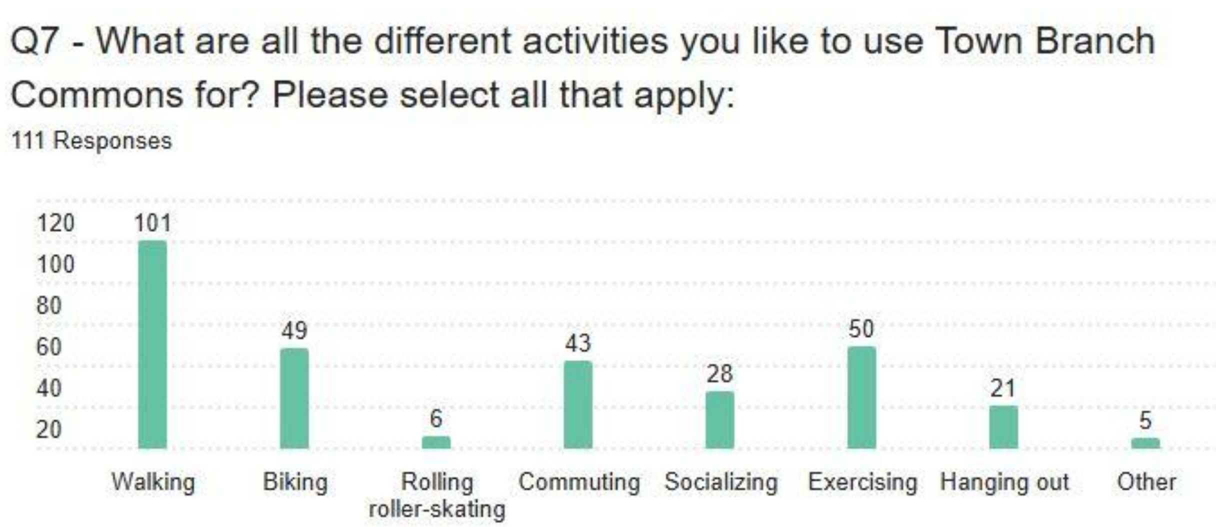


Figure 16. Survey responses indicating variety of social and recreational activities users engage in along Town Branch Commons.

A data filter of the complete survey data found that 86 users use Town Branch Commons for more than one activity:

86 ÷ 111 = 77.5% of users use Town Branch Commons for more than one activity

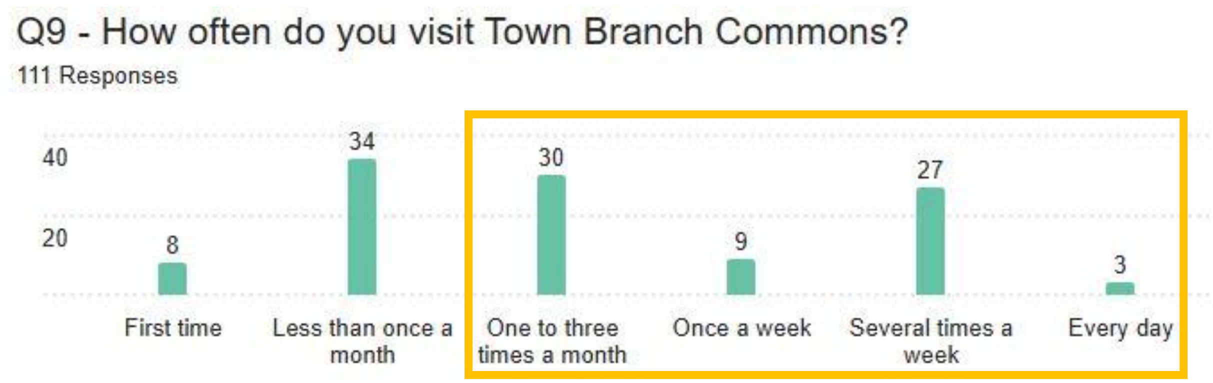


Figure 17. Survey responses indicating frequency of visits to Town Branch Commons.

30 + 9 + 27 + 3 = 69

69 ÷ 111 = 62.2% of users visit Town Branch Commons at least one to three times a month

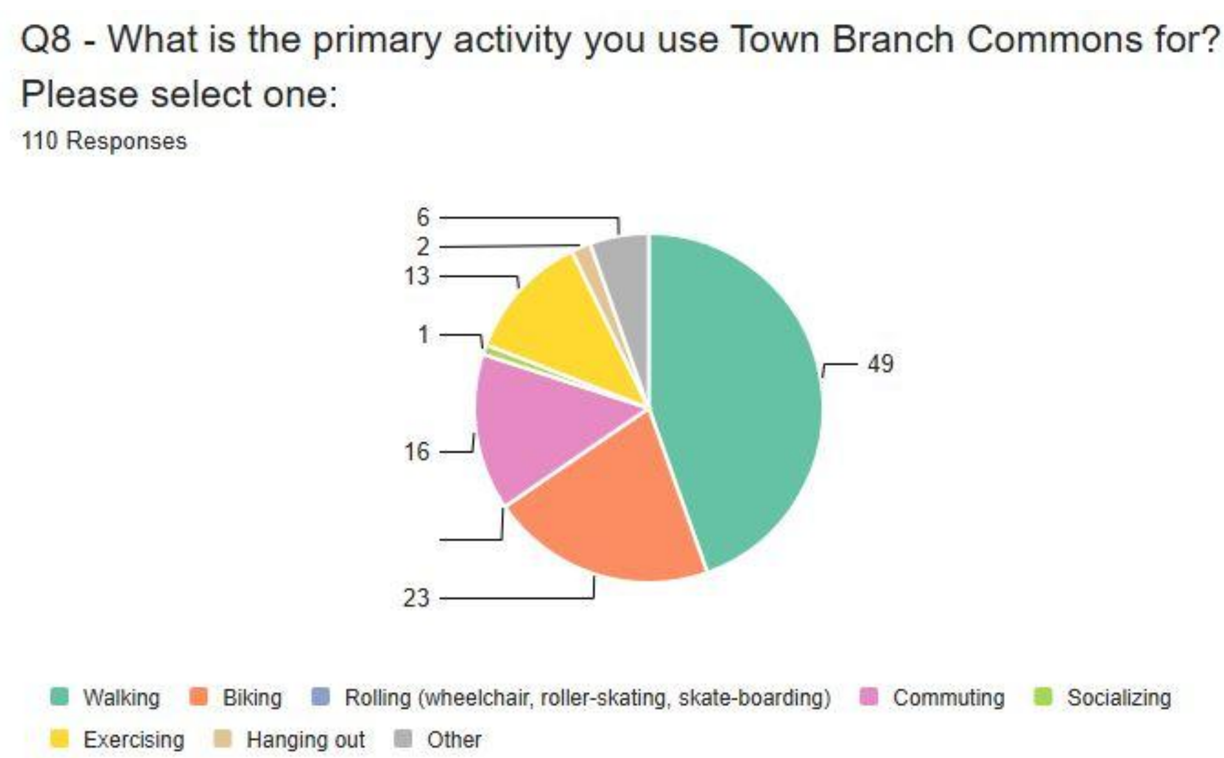


Figure 18. Survey responses indicating primary social or recreational activity users engage in along Town Branch Commons.

49 ÷ 110 = 44.5% of respondents primarily use Town Branch Commons for walking

23 ÷ 110 = 20.9% of respondents primarily use Town Branch Commons for biking

16 ÷ 110 = 14.5% of respondents primarily use Town Branch Commons for commuting

Sources:

Bike and pedestrian data provided by Brandi Peacher, Director of Project Management and Complete Streets Coordinator, Office of the Mayor, Lexington-Fayette Urban County Government.

Alta Planning and Design and Institute of Transportation Engineers, Pedestrian and Bicycle Council. "National Bicycle and Pedestrian Documentation Project." Accessed July 3, 2025. https://bikepeddocumentation.org/

Keith, Samuel J., Lincoln R. Larson, C. Scott Shafer, Jeffrey C. Hallo, and Mariela Fernandez. "Greenway use and preferences in diverse urban communities: Implications for trail design and management." *Landscape and Urban Planning* 172 (2018): 47-59.

LFUCG TIGER Grant Reports

Online Survey by CSI research team:

"Town Branch Commons Anonymous Survey." Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

***Limitations** (see more in Survey Overview):*

- Bike and pedestrian data derived from TIGER Grant Reports includes areas beyond the project boundary, as it was not possible to isolate data related solely to Town Branch Commons in such a large, complex project.

- ***Encourages social connection and interactions, with 55% of 104 surveyed users agreeing that "Town Branch Commons makes me feel connected to people" and 19% indicating they have met someone for the first time along the trail.***

Background:

In addition to connecting Lexington's downtown to the Bluegrass countryside, the trail links a variety of neighborhoods to downtown. Although 55% may initially appear like a weak result, considering this is a linear park and trail system focused on mobility, researchers consider this finding to be substantive. Survey questions asked users about how they rated the importance of various design goals for Town Branch Commons, including providing recreational and social opportunities. There is broad public support for this benefit, with 90% of surveyed users rating it as important. For additional information, refer to survey overview under Social Benefits.

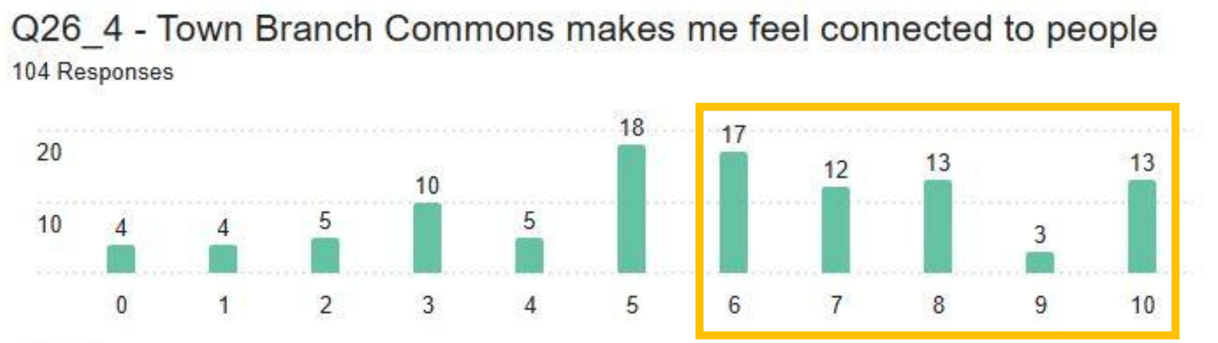
Method:

Survey questions asked users about social connections and interactions. For additional information, refer to survey overview.

Calculations:

Survey Questions and Results:

For question 26_4, a 10-point scale was used (0 = “Strongly disagree,” 5 = “Neither agree nor disagree,” 10 = “Strongly agree”).



Field	Min	Max	Mean	Standard Deviation	Variance	Responses	Sum
Town Branch Commons makes me feel connected to people	0.00	10.00	5.78	2.68	7.17	104	601.00

Figure 19. Survey responses indicating whether Town Branch Commons makes users feel connected to people.

When asked about how strongly, on a scale of 1-10, that Town Branch Commons makes users feel connected to people, the mean response was 5.78 (SD: 2.68). Response scores > 5 (“Neither Agree nor Disagree”) were counted towards this benefit and calculated as follows:

17 + 12 + 13 + 3 + 13 = 58

58 ÷ 104 = 55.8% of users indicate Town Branch Commons makes them feel connected to people

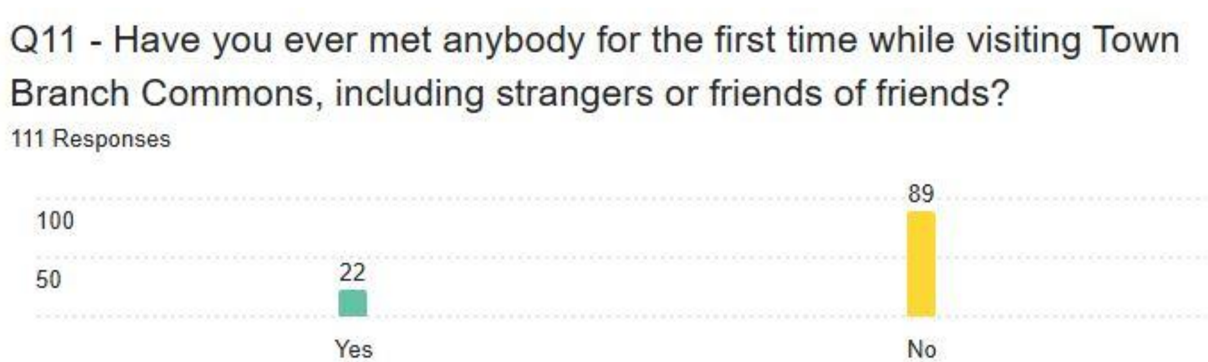


Figure 20. Survey responses indicating whether users have met anybody for the first time along Town Branch Commons.

22 ÷ 111 = 19.8% of users met somebody for the first time

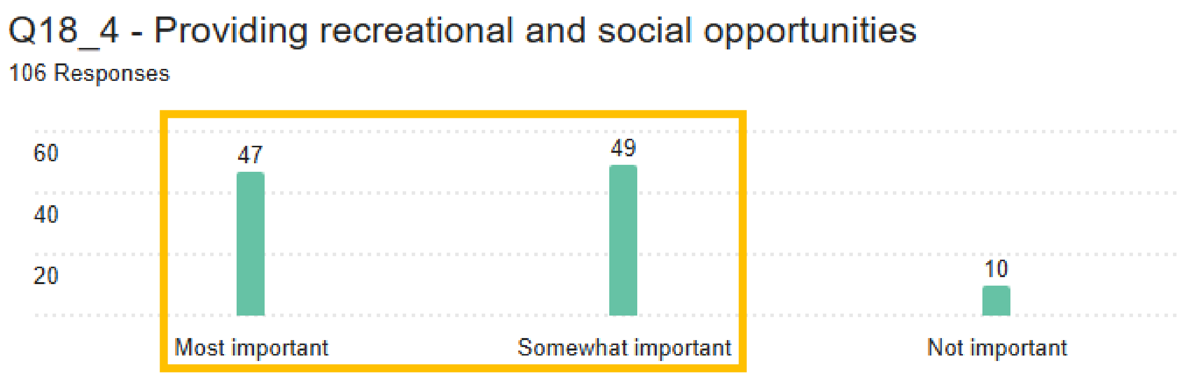


Figure 21. Survey responses rating the importance of recreational and social opportunities design goal.

47 + 49 = 96

96 ÷ 106 = 90.6% of users rate recreational and social opportunities design goal as important

Sources:

Online Survey by CSI research team:

"Town Branch Commons Anonymous Survey." Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- See survey overview.

- ***Provides a high-quality visitor experience, with 81% of 106 surveyed users indicating that Town Branch Commons (TBC) has improved their perception of Lexington and 74% responding that they would like to see more government spending on public spaces like TBC.***

Background:

The spacious path and planting bed widths, dense native plantings, custom materials and details, and placemaking features combine to make an enjoyable experience for people using Town Branch Commons. It is a unique urban design element in Lexington's downtown.

Method:

Survey questions asked users about the quality of their experience. For additional information, refer to survey overview.

Calculations:

Survey Question and Results:

Figure 22. Survey responses indicating whether Town Branch Commons changed users' perception of Lexington.

28 + 58 = 86

86 ÷ 106 = 81.1% of users indicated Town Branch Commons has improved their perception of Lexington

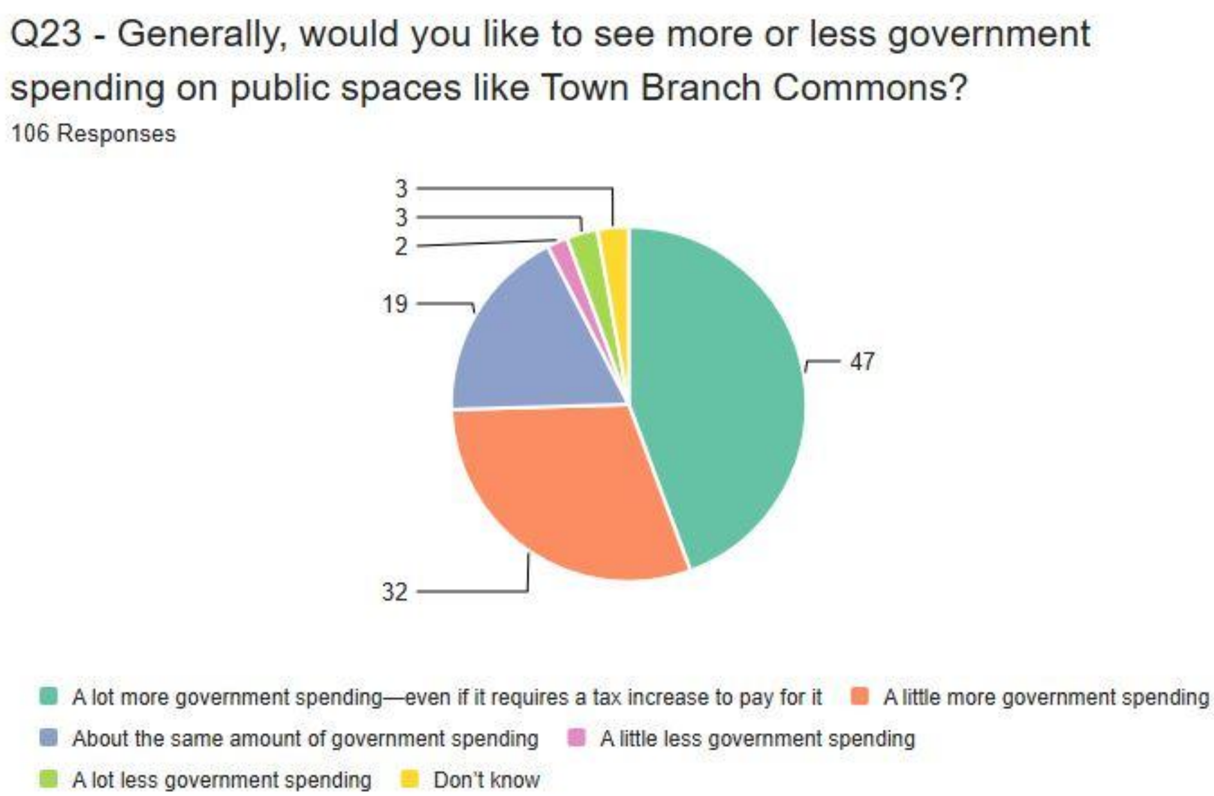


Figure 23. Survey responses indicating whether users would like to see more or less government spending on public spaces like Town Branch Commons.

Responses for “A lot more-” or “A little more government spending” were counted towards this benefit and calculated as follows:

47 + 32 = 79

79 ÷ 106 = 74.5% of users indicate Town Branch Commons enhances their sense of community

Sources:

Online Survey by CSI research team:

“Town Branch Commons Anonymous Survey.” Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- See survey overview.
- Survey respondents were not told how much the TBC project cost, which may have impacted their response regarding supporting additional government spending on public spaces.

- ***Expresses regional identity, with 84% of 106 surveyed users agreeing that Town Branch Commons reflects the natural environment and history of the Bluegrass region.***

Background:

Educational signage, plant and material selection, and design elements, such as the limestone walls and recirculating water features, evoke and reflect the local natural environment, most notably its limestone karst geology and historical drystone construction techniques vernacular within the region. Similarly, visitors believe it is important to reflect a sense of place, or ‘genius loci’, with 90% of 106 surveyed users indicating this is an important design goal for the project. This benefit demonstrates that the project achieves this desired design goal, aligning with Meyer’s assertion that aesthetic environmental experience should be given equal consideration to ecological, social, and economic performance in the sustainability agenda.

The site-specificity and aesthetic quality of the design expresses a unique sense of place that resonates with visitors, which Meyer contends landscape architects should strive for in their designs. This will improve both the experience and sustainability of a site, provoking a response where visitors become more aware of their impacts upon the environment, and may be moved to take action.

Method:

Survey questions asked users about the connection between Town Branch Commons and the natural environment and history of the Bluegrass region. For additional information, refer to survey overview.

Calculations:

Survey Question and Results:

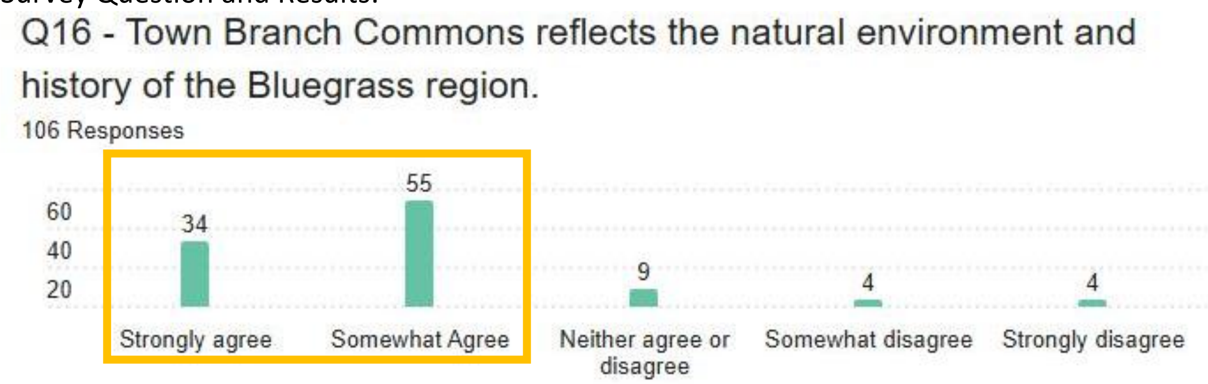


Figure 24. Survey responses indicating whether users think that Town Branch Commons reflects the natural environment and history of the Bluegrass region.

34 + 55 = 89

89 ÷ 106 = 84.0% of users agree that Town Branch Commons reflects the natural environment and history of the Bluegrass region

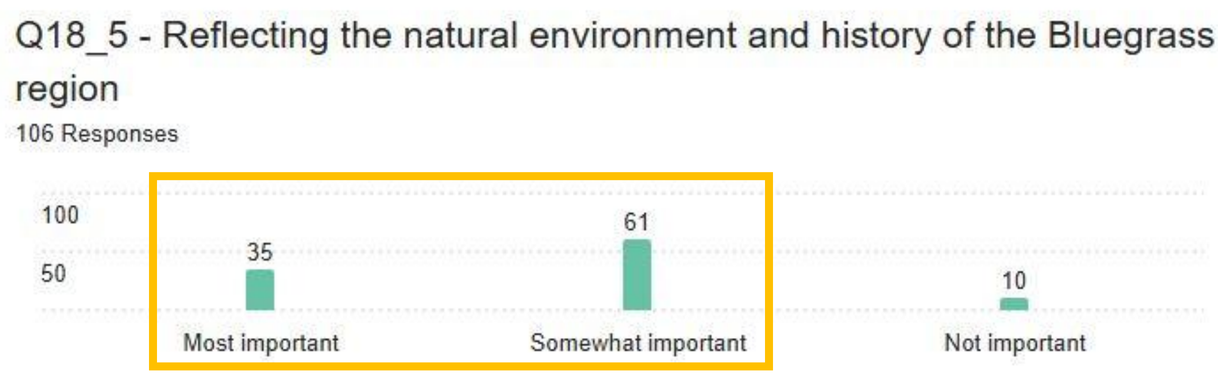


Figure 25. Survey responses rating the importance of regional identity design goal.

35 + 61 = 96

96 ÷ 106 = 90.6% of users rated regional identity design goal as important

Sources:

Kentucky Geological Survey, "Karst is a Landscape." Accessed July 20,2025. https://www.uky.edu/KGS/karst/index.php

Melcher, Katherine. "Aesthetic intent in landscape architecture: The particularity of beauty, meaning, and experience." *Landscape Journal* 41, no. 2 (2022): 73-92.

Meyer, Elizabeth K. "Sustaining beauty. The performance of appearance: A manifesto in three parts." *Journal of Landscape Architecture* 3, no. 1 (2008): 6-23.

Murray-Wooley, Carolyn, and Karl Raitz. *Rock fences of the bluegrass*. University Press of Kentucky, 1992.

Thompson, Ian. "What use is the genius loci?." In *Constructing Place*, pp. 66-76. Routledge, 2004.

Online Survey by CSI research team:

"Town Branch Commons Anonymous Survey." Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- See survey overview.
- Survey respondents were not asked which specific design features expressed regional identity.

- ***Promotes understanding of vernacular materials, forms, and construction techniques, with 81% of 106 surveyed users being able to identify the primary material used or the source of inspiration for the signature wall detail.***

Background:

More than 2,400 tons of dry-laid limestone walls installed along 2,900 linear feet of the corridor create a central placemaking feature for Town Branch Commons (see Figure 26). The modern interpretation of this historic masonry technique, typically seen only in more rural areas, makes this material, fabrication, and construction visually and physically accessible to a larger number of people.

Figure 26. Signature wall detail found along Town Branch Commons composed of leaning limestone slabs set in stone dust and bracketed by pre-cast concrete wall inserts.

Method:

Survey questions asked users about what they learned from educational signage along Town Branch Commons and the materials used in its construction. Text responses were analyzed for question 22 for answers that included 'limestone' or references to historic stone walls found within the region. For additional information, refer to survey overview.

Calculations:

Survey Question and Results:

Q22 - What do you think is the primary material used in the walls along Town Branch Commons and why do you think it was used?
106 Responses

Figure 27. Survey responses in word cloud format indicating what users think is the primary material used in the walls along Town Branch Commons.

81 responses included 'limestone'
5 responses referenced historic stone fences around the region

81 + 5 = 86

86 ÷ 106 = 81.1%

Sources:

Online Survey by CSI research team:

"Town Branch Commons Anonymous Survey." Qualtrics, July 21 2025.
https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- See survey overview.

- ***Supports health, well-being, and quality of life, with 84% of 104 surveyed users indicating they feel happy or energized when visiting the trail. 91% use the trail primarily for various forms of active recreation or mobility. In addition, 81% agree Town Branch Commons (TBC) improves their quality of life; 76% agree TBC improves their mental health; 69% agree TBC improves their physical health; and 64% agree TBC makes them feel connected to nature.***

Background:

The social and recreational opportunities afforded by the trail and its ability to connect people to other people and nature are foundational to human health and well-being. Below are a few responses from the open-ended response to question 25, which asks users to describe any "decrease in physical ailments such as stress, asthma, and/or general poor health since you started visiting Town Branch Commons."

"I already walk frequently, so did not notice many improvements other than decrease in stress. I really enjoy meeting up with friends, getting a cup of coffee, and walking along the walking path. It has greatly enhanced the beauty of our city and I love seeing the native plants along the trail and walking safely throughout downtown and the east end. I have loved the temporary art installations (like displaying the painted horses) and would love to see more traveling or permanent art installations that celebrate Bluegrass and community/youth artists along the trail! I feel lighter, more energized, less stressed/weighed down by life after using the trail."

"It allows me to exercise more which makes me happier."

"My stress has significantly lowered before going into work and when I get off."

"I can walk much more easily to places downtown from my house. This has resulted in an increase in my physical activity level, and as a result, I am not as fat."

Method:

Survey questions asked users about what they like to do along Town Branch Commons, and how visiting Town Branch Commons impacted their health and well-being. For additional information, refer to survey overview.

Calculations:

Survey Question and Results:

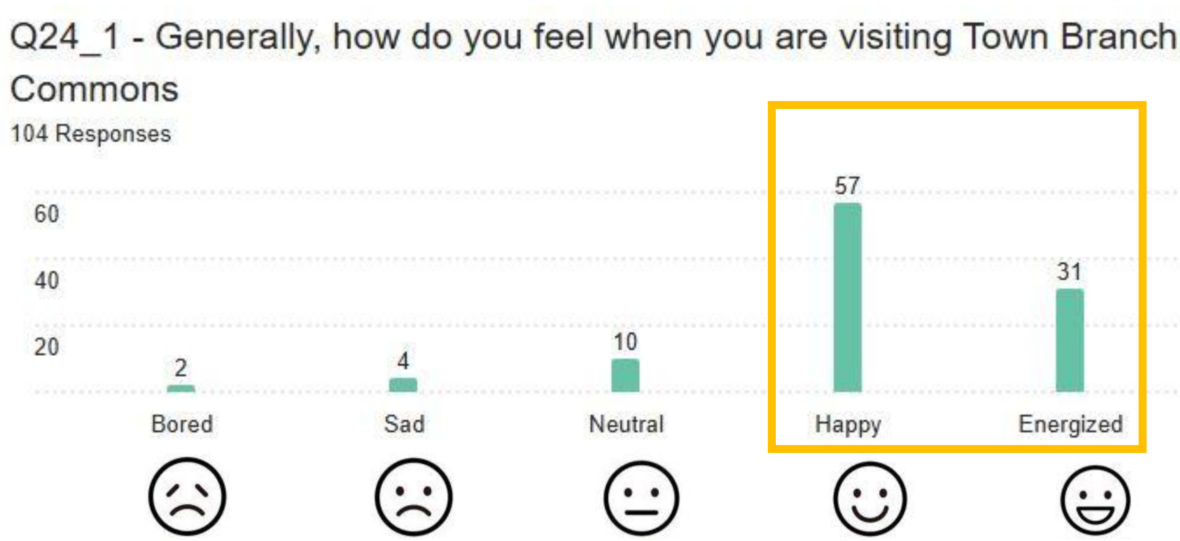


Figure 28. Survey responses rating users' feeling when visiting Town Branch Commons.

57 + 31 = 88

88 ÷ 104 = 84.6% of users feel happy or energized while visiting Town Branch Commons

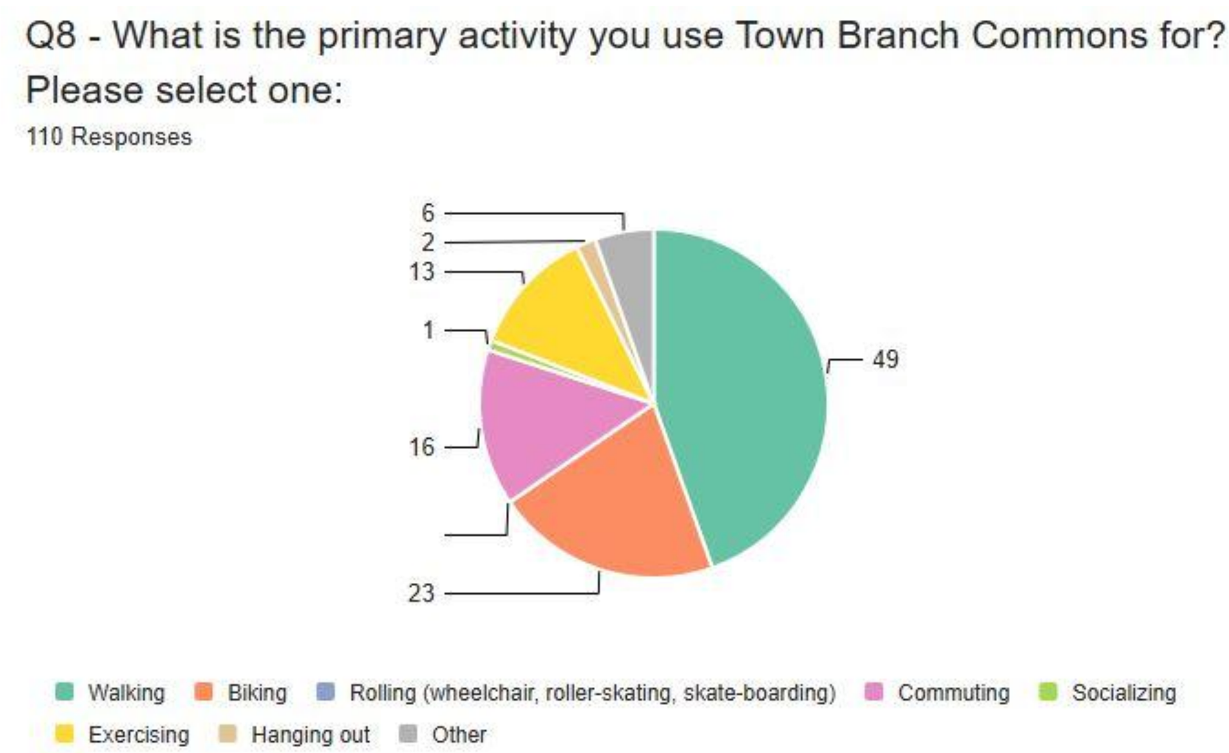


Figure 29. Survey responses indicating primary social or recreational activity users engage in along Town Branch Commons.

49 ÷ 110 = 44.5% of respondents primarily use Town Branch Commons for walking

23 ÷ 110 = 20.9% of respondents primarily use Town Branch Commons for biking

16 ÷ 110 = 14.5% of respondents primarily use Town Branch Commons for commuting

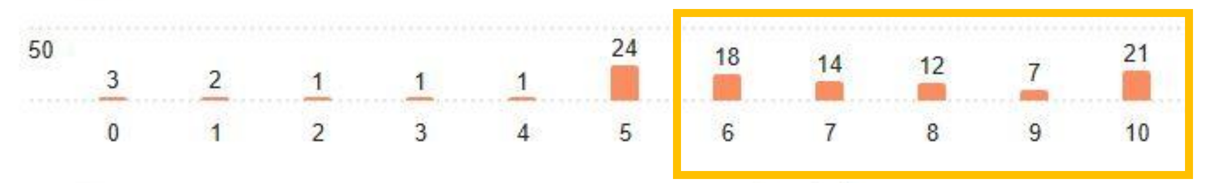
13 ÷ 110 = 11.8% of respondents primarily use Town Branch Commons for exercising

44.5% + 20.9% + 14.5% + 11.8% = 91.7% of respondents use Town Branch Commons for active recreation or mobility

For questions 26_1-5, a 10-point scale was used (0 = “Strongly disagree,” 5 = “Neither agree nor disagree,” 10 = “Strongly agree”).

Q26_1 - Visiting Town Branch Commons improves my physical health

104 Responses



Field	Min	Max	Mean	Standard Deviation	Variance	Responses	Sum
Visiting Town Branch Commons improves my physical health	0.00	10.00	6.79	2.42	5.84	104	706.00

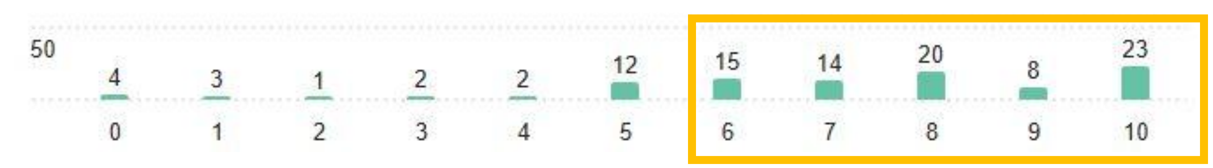
Figure 30. Survey responses indicating how Town Branch Commons affects users’ physical health.

When asked about how strongly, on a scale of 1-10, that Town Branch Commons affects users’ physical health, the mean response was 6.79 (SD: 2.42). Response scores > 5 (“Neither Agree nor Disagree”) were counted towards this benefit and calculated as follows:
18 + 14 + 12 + 7 + 21 = 72

72 ÷ 104 = 69.2% of users indicate Town Branch Commons improves their physical health

Q26_2 - Visiting Town Branch Commons improves my mental health

104 Responses

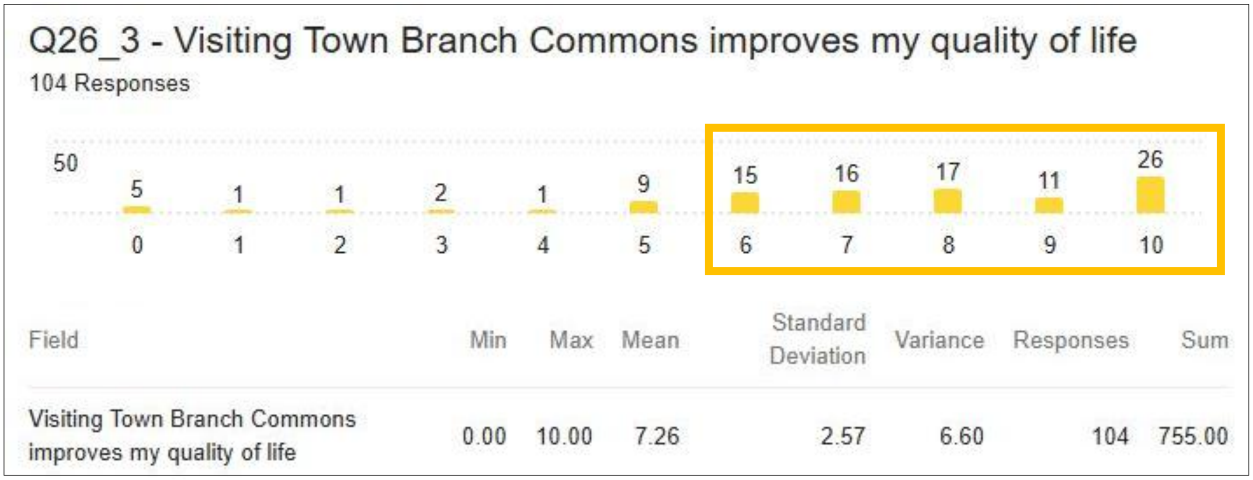


Field	Min	Max	Mean	Standard Deviation	Variance	Responses	Sum
Visiting Town Branch Commons improves my mental health	0.00	10.00	7.01	2.60	6.74	104	729.00

Figure 31. Survey responses indicating how Town Branch Commons affects users’ mental health.

When asked about how strongly, on a scale of 1-10, that Town Branch Commons affects users’ mental health, the mean response was 7.01 (SD: 2.60). Response scores > 5 (“Neither Agree nor Disagree”) were counted towards this benefit and calculated as follows:
15 + 14 + 20 + 8 + 23 = 80

80 ÷ 104 = 76.9 % of users indicate Town Branch Commons improves their mental health



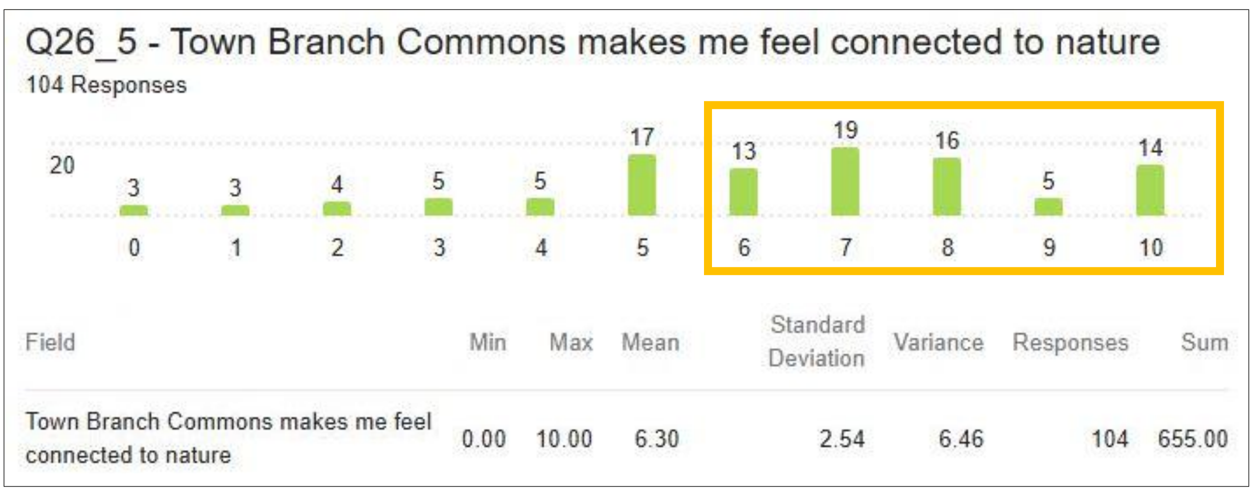
Field	Min	Max	Mean	Standard Deviation	Variance	Responses	Sum
Visiting Town Branch Commons improves my quality of life	0.00	10.00	7.26	2.57	6.60	104	755.00

Figure 32. Survey responses indicating how Town Branch Commons affects users' mental health.

When asked about how strongly, on a scale of 1-10, that Town Branch Commons affects users' quality of life, the mean response was 7.26 (SD: 2.57). Response scores > 5 ("Neither Agree nor Disagree") were counted towards this benefit and calculated as follows:
15 + 16 + 17 + 11 + 26 = 85

85 ÷ 104 = 81.7 % of users indicate Town Branch Commons improves their quality of life

See social connection benefit for analysis of Q24_4



Field	Min	Max	Mean	Standard Deviation	Variance	Responses	Sum
Town Branch Commons makes me feel connected to nature	0.00	10.00	6.30	2.54	6.46	104	655.00

Figure 33. Survey responses indicating how Town Branch Commons affects users' connection to nature.

When asked about how strongly, on a scale of 1-10, that Town Branch Commons affects users' connection to nature, the mean response was 6.30 (SD: 2.54). Response scores > 5 ("Neither Agree nor Disagree") were counted towards this benefit and calculated as follows:
13 + 19 + 16 + 5 + 14 = 67

67 ÷ 104 = 64.4 % of users indicate Town Branch Commons makes them feel connected to nature

Sources:

Hartig, Terry, Richard Mitchell, Sjerp De Vries, and Howard Frumkin. "Nature and health." *Annual review of public health* 35, no. 1 (2014): 207-228.

Heerwagen, Judith. "Biophilia, health, and well-being." *Restorative commons: Creating health and well-being through urban landscapes* (2009): 39-57.

Kaplan, Stephen. "The restorative benefits of nature: Toward an integrative framework." *Journal of environmental psychology* 15, no. 3 (1995): 169-182.

Roe, Jenny, and Layla McCay. *Restorative cities: Urban design for mental health and wellbeing*. Bloomsbury Publishing, 2021.

Online Survey by CSI research team:

“Town Branch Commons Anonymous Survey.” Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- See survey overview.

- ***Contributes to the reduction of injury and non-injury vehicular crashes per 100 Million Vehicle Miles Traveled (VMT) by 67% and 22%, respectively, from 2018 to 2024.***

Background:

In addition to dedicated bike and pedestrian trails, the decrease in vehicular lane width, as well as the addition of signaled intersections, crosswalks, and bus queue have transformed a car-dominated corridor into a more pedestrian and bike-friendly environment. Federal Highway Administration grant funding (FY 2016 TIGER Grant No. 7, see Research Overview) requires pre-project baseline measurement and interim reporting to document impacts of funding by Lexington-Fayette Urban County Government (LFUCG). Data for this benefit was derived from March 2020 Pre-Project Report and March 2025 Interim-Project Report.

Method:

LFUCG Police Department gathered crash rates data for 12 months prior to the pre-install baseline (October 2017-October 2018) and interim reporting date (January-December 2024) deadlines. The Lexington Area Metropolitan Planning Organization (LAMPO) and Kentucky Transportation Cabinet (KYTC) collected Vehicle Miles Traveled (VMT) data. Using both sets of data, information was compared to determine the required measurement to be reported as crashes per 100 million Vehicle Miles Traveled (VMT) and have been identified by severity categories. Data was collected for five different segments encompassed under the TIGER grants, and researchers analyzed data from segments 1 and 2 in Figure 34 to calculate this benefit, as this is where the project is located.

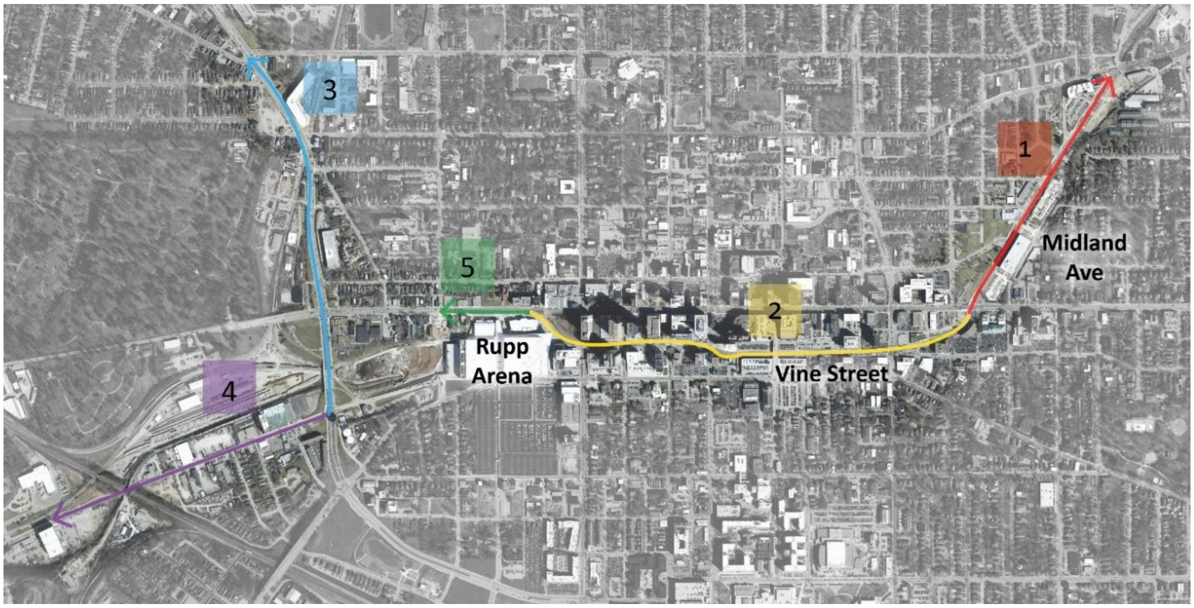


Figure 34. Road segments monitored for crash data; research team focused on segments 1 and 2.

Calculations:

Percent change calculated as follows: [(2024 data – 2018 data) ÷ 2018 data] × 100

VEHICULAR CRASHES PER 100 MILLION VEHICLE MILES TRAVELED			
SEGMENT 1: Midland Ave between E Main St and E Third St-Winchester Rd	Oct 1, 2017-Oct 1, 2018	Jan 1, 2024-Dec 31, 2024	**% Change**
Fatal Collisions	0	0	--
Injury Collisions	377	82	-78%
Non-injury Collisions	1074	953	-11%
SEGMENT 2: Vine St between W Main St-W Vine St and E Main St-Midland Ave	Oct 1, 2017-Oct 1, 2018	Jan 1, 2024-Dec 31, 2024	**% Change**
Fatal Collisions	0	0	--
Injury Collisions	405	176	-57%
Non-injury Collisions	2793	2044	-27%
TOTALS FOR SEGMENTS 1 + 2	Oct 1, 2017-Oct 1, 2018	Jan 1, 2024-Dec 31, 2024	**% Change**
Fatal Collisions	0	0	--
Injury Collisions	782	258	-67%
Non-injury Collisions	3867	2997	-22%

Table 7. Vehicular crash data for key segments pre- and post-construction of Town Branch Commons.

Sources:
Crash and VMT data collected by LFUCG Police Department, LAMPO, and KYTC, and provided by Brandi Peacher, Director of Project Management and Complete Streets Coordinator, Office of the Mayor, Lexington-Fayette Urban County Government.

LFUCG TIGER Grant Reports

Limitations:

- Focused on segments 1 and 2 only, as there was an unusual spike for segment 5 which may have been related to road realignment during renovations to the convention center.

- ***Contributes to a 17% decrease in average vehicular speeds along key segments of Town Branch Commons from an average of 29.4 mph to 24.2 mph along Eastbound Midland Avenue from 2018 to 2023. Reduces average speeds along Westbound Midland Avenue for the highest 100 hours traveled during daytime peak hours (7am-7pm) by 16% from an average of 32.6 mph to 27.2.***

Background:

See background for previous benefit.

Method:

David Filiatreau, City Traffic Engineer, ran reports from the National Performance Management Research Data Set (NPMRDS) to analyze key segments and travel times. According to the NPMRDS website, the data set "contains field-observed travel time and speed data collected anonymously from a fleet of probe vehicles (cars and trucks) equipped with mobile devices. Using time and location information from probe vehicles, the NPMRDS generates speed and travel time data aggregated in 5-minute, 15-minute, or 1-hour increments." The 'highest 100 hours' is a measure of extreme speeds which run a higher risk of injury and was evaluated to determine whether Town Branch Commons had an effect on more extreme cases of speeding along the corridor.

Calculations:
Percent change calculated as follows: [(2023 data – 2018 data) ÷ 2018 data] × 100

AVERAGE SPEED (MPH) FOR KEY SEGMENTS AND TIMES					
Segment	**Direction**	**Category**	**2018**	**2023**	**% Change**
Midland Avenue (Main to 3rd)	Eastbound	Average Speed: weekdays, 7AM-7PM	25.71	23.6	-8.21%
Midland Avenue (Main to 3rd)	Westbound	Average Speed: weekdays, 7AM-7PM	28.44	25.35	-10.86%
Midland Avenue (Main to 3rd)	Eastbound	Average Speed: weekends, 11AM-2PM	29.44	24.19	-17.83%
Midland Avenue (Main to 3rd)	Westbound	Average Speed: weekends, 11AM-2PM	33.7	28.74	-14.72%
Vine Street	One-way	Average Speed: Highest 100 hours (7AM-7PM)	32.6	27.21	-16.53%
Midland Avenue	Eastbound	Average Speed: Highest 100 hours (7AM-7PM)	36.13	31.75	-12.12%
Midland Avenue	Westbound	Average Speed: Highest 100 hours (7AM-7PM)	39.4	35.35	-10.28%

Table 8. Vehicular speed data for key segments and times pre- and post-construction of Town Branch Commons. Source: NPMRDS

Sources:

Traffic speed data provided by: David Filiatreau, Traffic Engineering Manager, Traffic Engineering Manager, Division of Traffic Engineering, Lexington-Fayette Urban County Government.

Haas, Astrid RN. "Key considerations for integrated multi-modal transport planning." *Cities That Work* (2019).

U.S. Department of Transportation. "National Performance Management Research Data Set." https://ops.fhwa.dot.gov/publications/fhwahop20028/index.htm

Limitations:

- Data quality and availability varies.

- ***Improves sense of safety, with 81% of 99 surveyed users agreeing that they "feel safe walking, biking and rolling along Town Branch Commons," compared to only 62% agreeing that they "feel safe walking, biking and rolling in downtown Lexington" as a whole. 92% feel safe along the trail during the day and 64% feel safe there at night.***

Background:

Wider, dedicated walking and biking trails constructed of a custom concrete mix provide beneficial grip to bikers. The trails are separated from adjacent vehicular roads by vegetation and punctuated at intersections by high-contrast paving patterns to provide visual cues to help walkers, bikers and drivers slow down and improve safety. The multi-fixture lighting system helps minimize light pollution while improving safety along the trail. 98% of 106 surveyed users indicate this is an important design goal for the project.

Method:

Survey questions asked users about their perception of safety along Town Branch Commons as compared to downtown Lexington. In addition, visual preference questions asked users to indicate their choice for where they would like to walk, roll or bike. Paired photographs illustrate the 'treated' and 'untreated' side of the corridor, and users were asked to describe the reason for their selection.

Calculations:

Survey Question and Results:

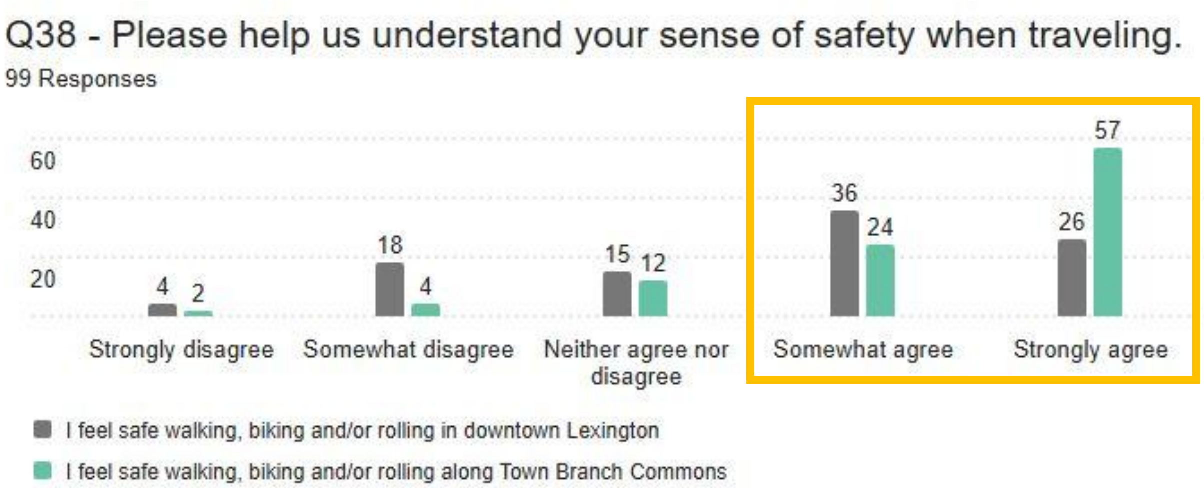


Figure 35. Survey responses comparing sense of safety when traveling in downtown Lexington versus along Town Branch Commons.

36 + 26 = 62

62 ÷ 99 = 62.6% of users feel safe walking, biking and/or rolling in downtown Lexington

24 + 57 = 81

81 ÷ 99 = 81.8% of users feel safe walking, biking and/or rolling along Town Branch Commons

Figure 36. Survey responses comparing sense of safety along Town Branch Commons during the day versus at night.

26 + 66 = 92

92 ÷ 99 = 92.9% of users feel safe along Town Branch Commons during the day

43 + 21 = 64

64 ÷ 99 = 64.6% of users feel safe along Town Branch Commons at night

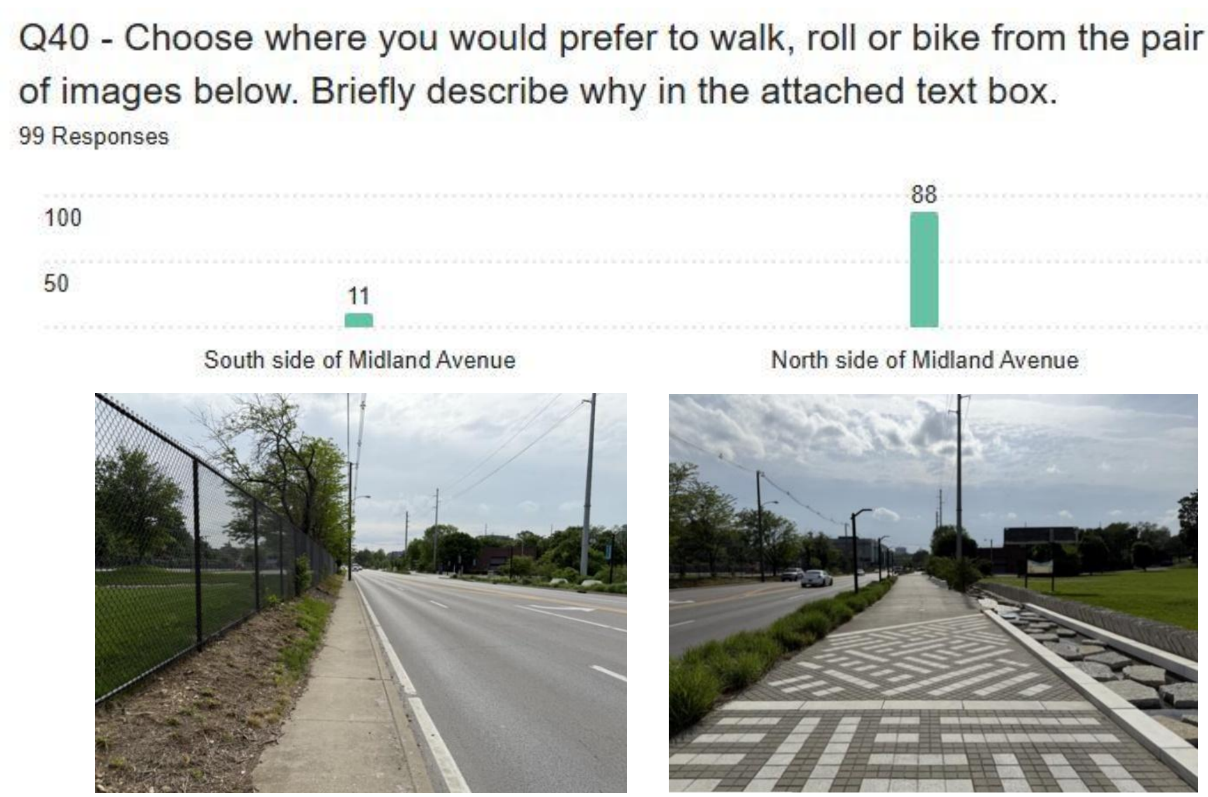


Figure 37. Visual preference question asking users to indicate their preference for where they would like to walk, roll or bike using paired photographs to illustrate the 'untreated' (left) and 'treated'(right) sides of the corridor.

88 ÷ 99 = 88.9% of users preferred the ‘treated’ side of Town Branch Commons

Common themes among extended responses included: safety; aesthetics; lane width and separation from cars, as well as between bikes and pedestrians; accessibility; and equity. One humorous survey respondent wrote that “the other picture looks like a good way to get run over by a car driving off the road.”

Figure 38. Visual preference question asking users to indicate their preference for where they would like to walk, roll or bike using paired photographs to illustrate the ‘untreated’ (left) and ‘treated’(right) sides of the corridor.

96 ÷ 99 = 97.0% of users preferred the ‘treated’ side of Town Branch Commons

Common themes among extended responses included a smooth surface in addition to those previously mentioned from previous question. One particularly thoughtful survey respondent wrote:

“The walking space allocated in the above image lets me know I can share the space with other walkers, cyclists, pets, and wheelchair users without needing to step into the road. The green space between the walking space and the road helps me feel there is space between myself and cars on the road. I have a general sense that the city cared to build infrastructure that protects pedestrians rather than leave safety up to chance or implied safety rules that painted lanes suggest.”

Figure 39. Survey responses rating the importance of safe mobility design goal.

100 + 4 = 104

104 ÷ 106 = 98.1% of users rated stormwater design goal as important

Sources:

Keith, Samuel J., Lincoln R. Larson, C. Scott Shafer, Jeffrey C. Hallo, and Mariela Fernandez. "Greenway use and preferences in diverse urban communities: Implications for trail design and management." *Landscape and Urban Planning* 172 (2018): 47-59.

Online Survey by CSI research team:

"Town Branch Commons Anonymous Survey." Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

– See survey overview.

– ***Promotes public awareness of the natural environment and history of the Bluegrass region, with 66% of 106 surveyed users having read educational signs along Town Branch Commons (TBC) trail and being able to recall related topics.***

Background:

Educational signs (Figure 40) along the trail highlight a variety of ecological, cultural and historical themes, and an online Town Branch Water Walk website, accessed via QR codes as well as the city's dedicated project website helps visitors dig deeper into topics such as watersheds, stormwater, biodiversity, transportation and limestone karst geology. 67% of 106 surveyed users indicated "Teaching me things I didn't know about" was an important design goal for the project.

Figure 40. Image of educational sign on Town Branch Commons.

Method:

Survey questions asked users about design goals for Town Branch Commons and what they learned from educational signage along the trail. For additional information, refer to survey overview.

Calculations:

Survey Question and Results:

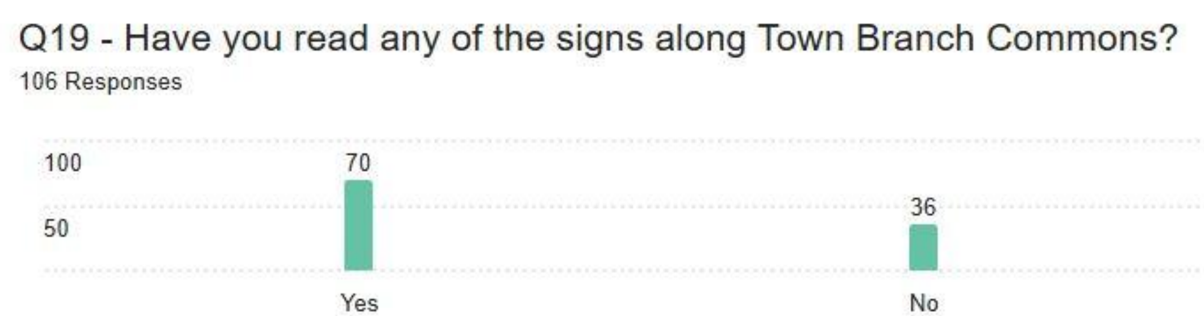


Figure 41. Survey responses indicating whether users have read any of the signs along Town Branch Commons.

70 ÷ 106 = 66.0% of users have read signs along Town Branch Commons

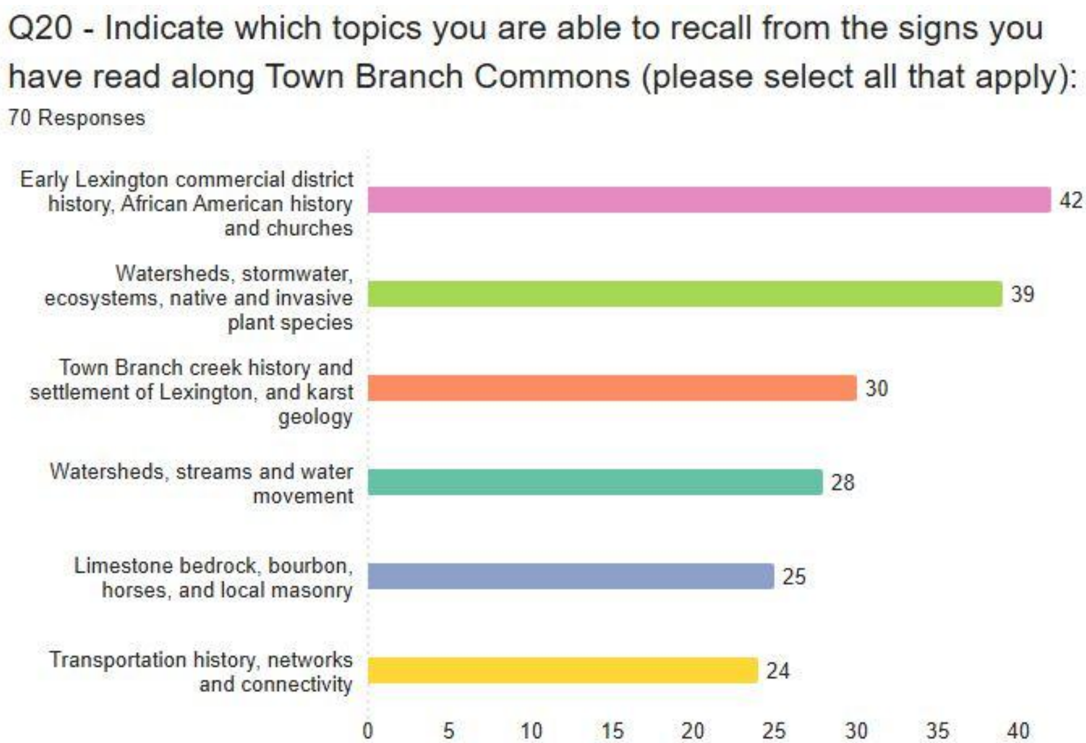


Figure 42. Survey responses indicating what topics users recall from reading educational signage along Town Branch Commons.

The most highly recalled topics related to Lexington history, watersheds, and Town Branch creek history.

42 ÷ 70 = 60.0% of users recalled “Early Lexington commercial district history, African American history and churches”

39 ÷ 70 = 55.7% of users recalled “Watersheds, stormwater, ecosystems, native and invasive plant species”

30 ÷ 70 = 42.9% of users recalled “Town Branch creek history and settlement of Lexington, and karst geology”

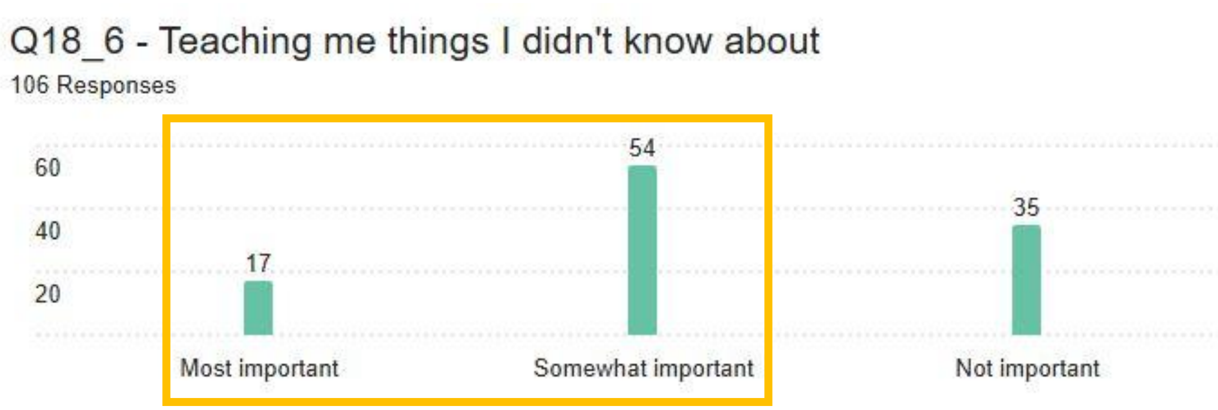


Figure 43. Survey responses rating the importance of education design goal.

17 + 54 = 71

71 ÷ 106 = 67.0% of users rated education design goal as important

Sources:

Online Survey by CSI research team:

“Town Branch Commons Anonymous Survey.” Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- See survey overview.
- Question 20 did not include option for users to indicate that they did not recall information from the educational signage, which may lead to response bias.

- ***Enhances visual quality of the corridor, with 82% of 103 surveyed users describing its visual appearance as attractive. Additionally, 93% liked the water features and 91% liked the variety of plants.***

Background:

Landscape architecture theorists have articulated the need for greater cultural awareness and acceptance of ecologically rich and functional landscapes in order to achieve broader sustainability goals related to landscape performance. The combination of paving, stone walls, water features, and plant textures, colors and ornamental qualities combine to make a visually rich and varied experience along the corridor. The mix of light fixtures provides continuous low-level illumination and accent lighting for an inviting nighttime experience. 93% of 106 surveyed users rated “Making the city more attractive” as an important design goal.


Figure 44. Image of fountain on Town Branch Commons.


Figure 45. Image of walkable water feature on Town Branch Commons.

Method:

Survey questions asked users about their aesthetic perceptions of Town Branch Commons. For additional information, refer to survey overview.

Calculations:

Survey Question and Results:

Question 27 asked surveyed users "How would you rate the appearance of Town Branch Commons?"

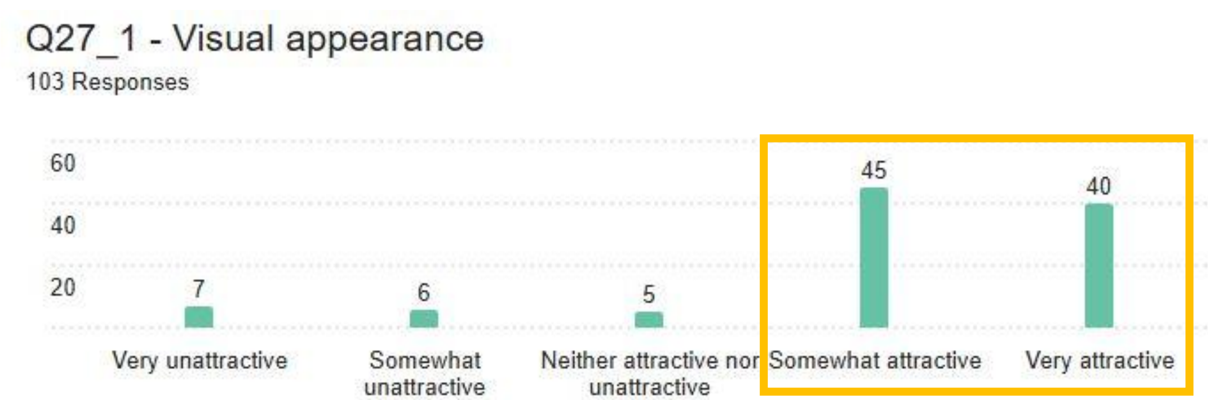


Figure 46. Survey responses indicating how users rate the appearance of Town Branch Commons.

45 + 40 = 85

85 ÷ 103 = 82.5% of users rated stormwater design goal as important

Question 28 asked surveyed users to briefly describe why they gave their visual appearance rating and the following word cloud generated from their responses demonstrates the importance of plants, landscape, visual appearance, and beauty.

Figure 47. Survey responses in word cloud format describing why users selected a visual appearance rating for Town Branch Commons.

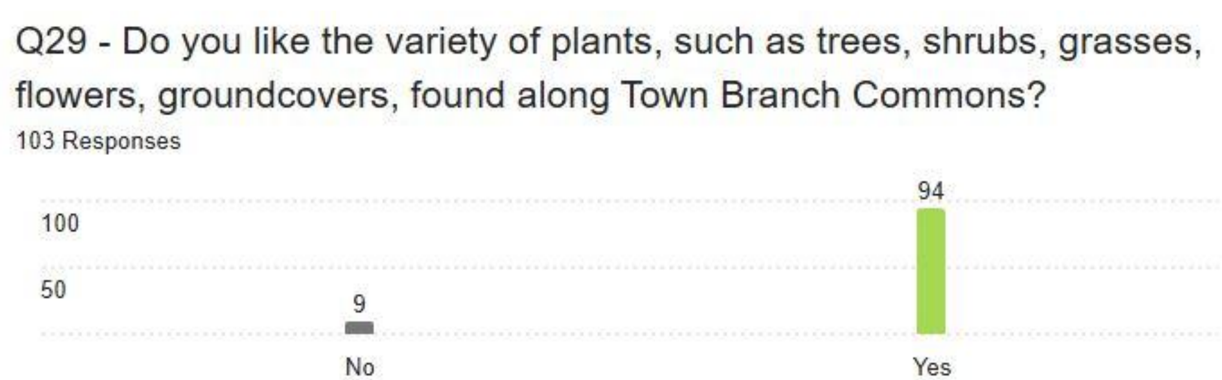


Figure 48. Survey responses indicating whether users like the variety of plants found along Town Branch Commons.

94 ÷ 103 = 91.3% of users like the variety of plants found along Town Branch Commons

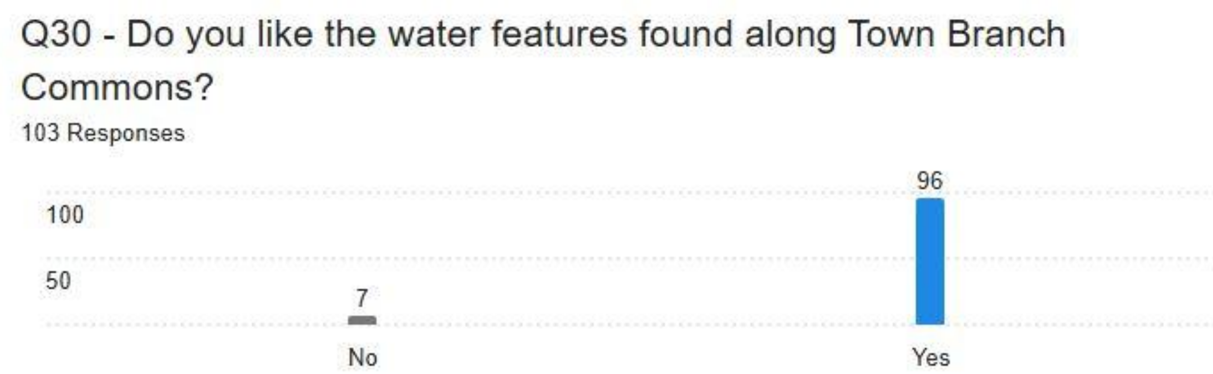


Figure 49. Survey responses indicating whether users like the water features found along Town Branch Commons.

96 ÷ 103 = 93.2% of users like the water features found along Town Branch Commons

Question 18 asked surveyed users to rate the importance of a variety of design goals.

Figure 50. Survey responses rating the importance of aesthetics design goal.

68 + 31 = 99

99 ÷ 106 = 93.4% of users like the water features found along Town Branch Commons

Sources:

Gobster, Paul H., Joan I. Nassauer, Terry C. Daniel, and Gary Fry. "The shared landscape: what does aesthetics have to do with ecology?." *Landscape ecology* 22, no. 7 (2007): 959-972.

Meyer, Elizabeth K. "Sustaining beauty. The performance of appearance: A manifesto in three parts." *Journal of landscape Architecture* 3, no. 1 (2008): 6-23.

Nassauer, Joan Iverson. "Cultural sustainability: aligning aesthetics and ecology." Island Press, 1997.

Nassauer, Joan Iverson. "Messy ecosystems, orderly frames." *Landscape journal* 14, no. 2 (1995): 161-170.Online Survey by CSI research team:

“Town Branch Commons Anonymous Survey.” Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- See survey overview.

- ***Encourages active recreation and alternative modes of transportation, with 69 surveyed users reporting that Town Branch Commons (TBC) has contributed to them spending more time walking (66%), exercising (52%), and biking (46%), and less time driving (47%). 68% of users state that TBC makes it easier for them to get around Lexington.***

Background:

Well-designed, safe, and attractive walking and biking trails that connect downtown to other trail systems, civic assets and neighborhoods encourage people to use them for recreation, commuting, running errands, and navigating the city in different ways. A significant majority of surveyed users agree that "Connecting to different neighborhoods and downtown" (96%) and "Increasing accessibility and connecting trails" (95%) are important design goals. 59% of users travel to nearby places using Town Branch Commons with restaurants (83.3%), parks (53%), the library (55%), and work (43%) being the most popular destinations.

Method:

Survey questions asked users about how Town Branch Commons has impacted their mobility. For additional information, refer to survey overview.

Calculations:

Survey Question and Results:

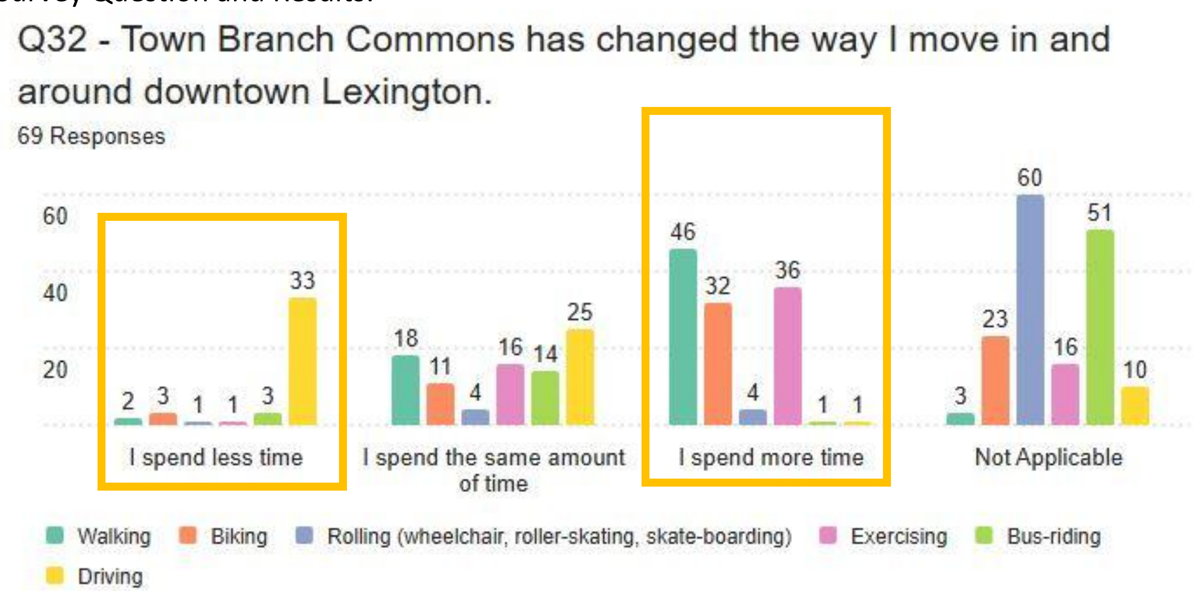


Figure 51. Survey responses indicating how Town Branch Commons has changed the way users move in and around downtown Lexington.

Spend more time walking: 46 ÷ 69 = 66.7%

Spend more time exercising: 36 ÷ 69 = 52.2%

Spend more time biking: 32 ÷ 69 = 46.4%

Spend less time driving: 33 ÷ 69 = 47.8%

Figure 52. Survey responses indicating whether Town Branch Commons makes it easier to get around Lexington.

71 ÷ 103 = 68.9% of users indicate Town Branch Commons makes it easier to get around Lexington

Common themes among extended responses included: comfort; ease and safety for recreation and commuting; walkability; accessibility; aesthetics; mode-shift away from driving to more walking, biking and exercising; and increased connectivity between different destinations within the city and beyond to the regional trail network. A selection of responses highlighting these themes are included here:

"It makes walking along the downtown highway nicer. I find I drive slower next to the planted areas (especially when the grass is grown in). Slower driving means I have more time to react to pedestrians or other cars."

"It makes it easier to get around downtown. My friends and I have walked from the east end, through downtown, and all the way to the Distillery District which is not something we had done before the trail as completed!"

"It makes it easier for me to choose to park my car in one area of downtown, or ride the bus to the transit center, and then set out on foot for the day instead of driving from one end to the other."

"I used to avoid Main Street, Vine Street and Midland Ave when possible. Now I find ways to use these streets because of the TB Commons."

"I bike from Chevy chase to the legacy trail, so town branch commons has made a part of that commute safer and more enjoyable."

"I can run a route where I feel safer than running in the streets or, in some cases, on the sidewalks."

"I feel safer walking along roads using the TBC. While I don't yet have the ability to ride a bike, I am planning on getting a bike soon and feel more confident and comfortable biking knowing TBC lanes exist."

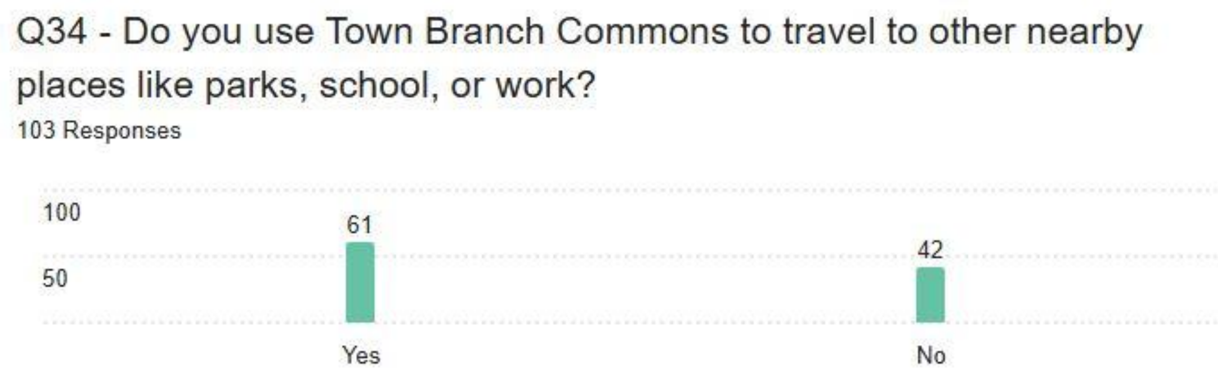


Figure 53. Survey responses indicating whether people use Town Branch Commons to travel to nearby places.

61 ÷ 103 = 59.2% of users indicate they use Town Branch Commons use Town Branch Commons to travel to nearby places

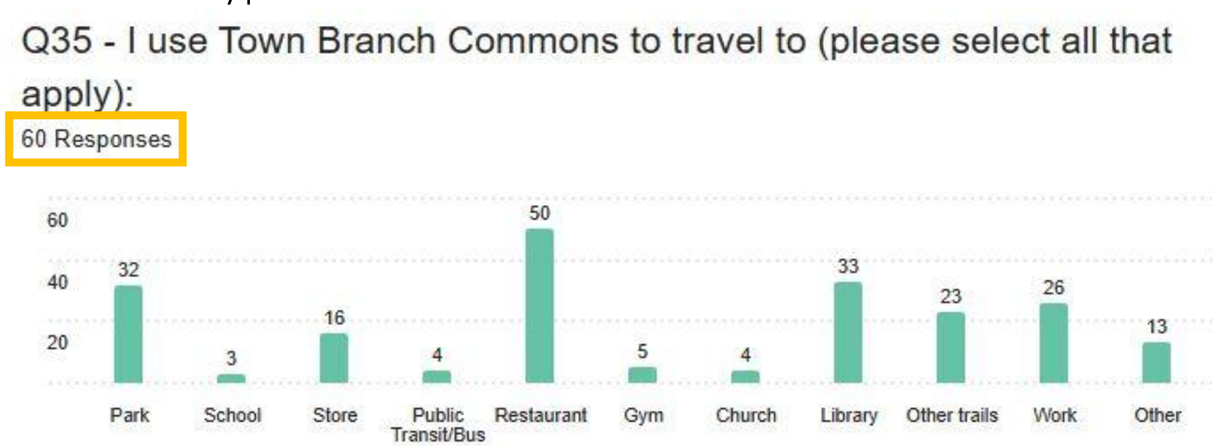


Figure 54. Survey responses indicating travel destinations for which they use Town Branch Commons; although this responses to this question did not meet the sample size (67), it provides useful information.

Use Town Branch Commons to travel to restaurants: 50 ÷ 60 = 83.3%

Use Town Branch Commons to travel to parks: 32 ÷ 60 = 53.3%

Use Town Branch Commons to travel to library: 33 ÷ 60 = 55.0%

Use Town Branch Commons to travel to work: 26 ÷ 60 = 43.3%

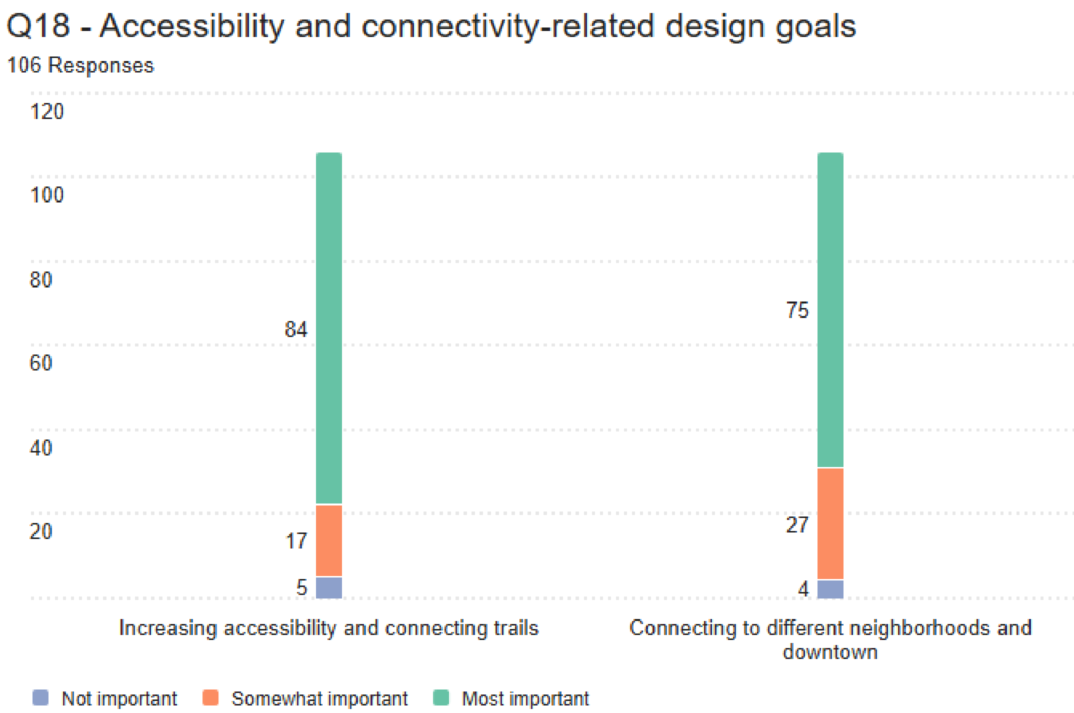


Figure 55. Survey responses rating the importance of accessibility and connectivity design goals.

Increasing accessibility and connecting trails

84 + 17 = 101

101 ÷ 106 = 95.3% of users rated accessibility and trail connectivity design goal as important

Connecting to different neighborhoods and downtown

75 + 27 = 102

102 ÷ 106 = 96.2% of users rated accessibility and connectivity design goal as important

Sources:

Online Survey by CSI research team:

"Town Branch Commons Anonymous Survey." Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- See survey overview.
- Q32 had a lower response rate of 69, but still met the sample size threshold of 67.
- Q35 did not meet the sample size threshold but provided useful information.

- ***Supports a sense of inclusiveness and community cohesion, with 75% of 106 surveyed users stating that it has enhanced their sense of community.***

Background:

This project strategically focused investment to improve accessibility, connectivity, safety, and aesthetics in an area that was formerly hostile to anyone on foot or bike. It is now possible and much more pleasant to walk and bike through the downtown core. 52% of users feel welcome along Town Branch Commons, a positive, albeit underwhelming, statistic that could be related to the fact that this is a linear park and trail system focused on mobility instead of gathering (see social connectivity benefit), or a mistake in the wording for the response scale to question 14-1 (see Figure 57 and Limitations for this benefit).

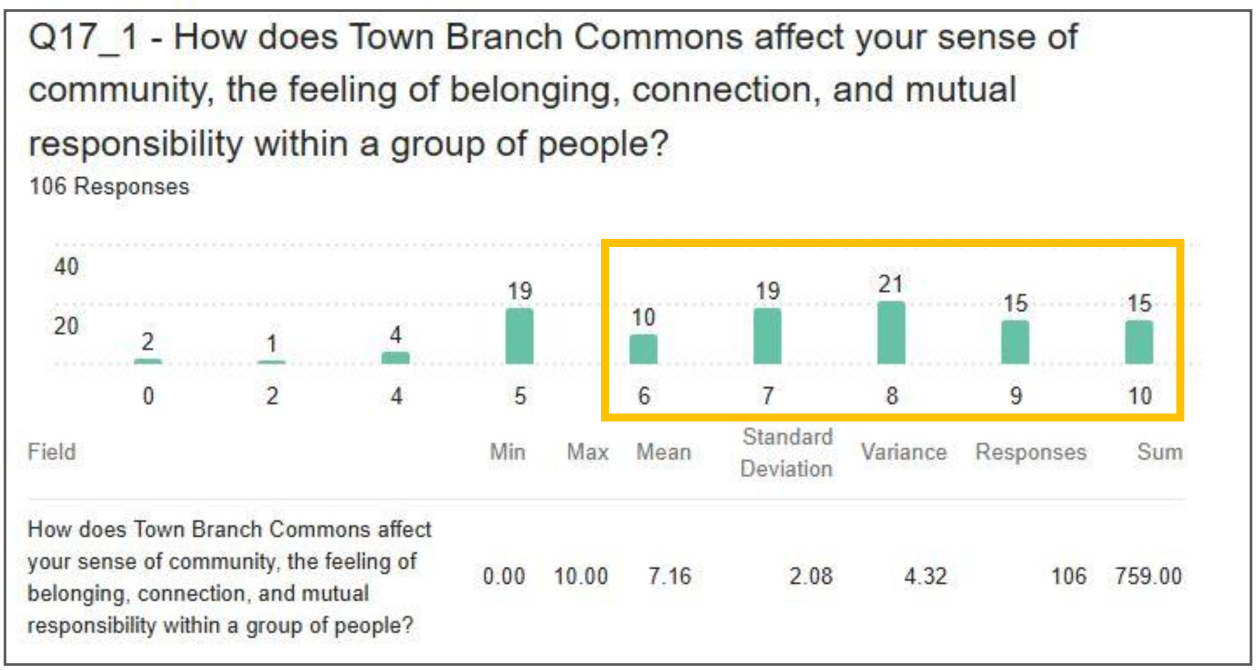
Method:

Survey questions asked users about how Town Branch Commons affects their sense of community and inclusion. For additional information, refer to survey overview.

Calculations:

Survey Question and Results:

For question 17, a 10-point scale was used (0 = “Strongly diminishes sense of community,” 5 = “Neither diminishes nor enhances sense of community,” 10 = “Strongly enhances sense of community”).



Field	Min	Max	Mean	Standard Deviation	Variance	Responses	Sum
How does Town Branch Commons affect your sense of community, the feeling of belonging, connection, and mutual responsibility within a group of people?	0.00	10.00	7.16	2.08	4.32	106	759.00

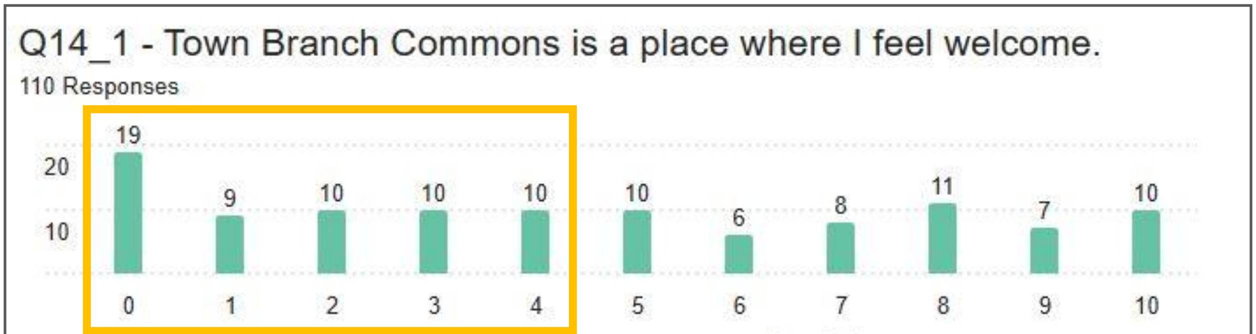
Figure 56. Survey responses indicating how Town Branch Commons affects their sense of community.

When asked about how strongly, on a scale of 1-10, that Town Branch Commons affects users' sense of community, the mean response was 7.16 (SD: 2.08). Response scores > 5 ("Neither Agree nor Disagree") were counted towards this benefit and calculated as follows:

10 + 19 + 21 + 15 + 15 = 80

80 ÷ 106 = 75.5% of users indicate Town Branch Commons enhances their sense of community

For question 14, a 10-point scale was used (0 = "Strongly agree," 5 = "Neither agree nor disagree," 10 = "Strongly disagree").



Field	Min	Max	Mean	Standard Deviation	Variance	Responses	Sum
Town Branch Commons is a place where I feel welcome.	0.00	10.00	4.47	3.34	11.16	110	492.00

Figure 57. Survey responses indicating whether Town Branch Commons is a place where people feel welcome.

When asked about how strongly, on a scale of 1-10, that they agree with the statement "Town Branch Commons is a place I feel welcome," the mean response was 4.47 (SD: 3.34). Response scores < 5 ("Neither Agree nor Disagree") were counted towards this benefit and calculated as follows:

19 + 9 + 10 + 10 + 10 = 58

58 ÷ 110 = 52.7% of users indicate Town Branch Commons is a place where they feel welcome

Sources:

Online Survey by CSI research team:

"Town Branch Commons Anonymous Survey." Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- Researchers mistakenly flipped order in Q14_1 language (0 = "Strongly agree," 5 = "Neither agree nor disagree," 10 = "Strongly disagree"). Typically, and for similar questions throughout this survey, '0' is negative, and '10' positive. This may have confused survey participants, skewing the responses towards feeling less welcome and resulting in a higher level of response deviation (3.34).

Economic Benefits

– ***Increases visitor spending in local businesses along corridor, with 73% of 102 surveyed users responding that they visit nearby businesses and 69% frequenting businesses 'sometimes' or more often when they visit the trail.***

Background:

Several businesses are located along or near the trail and receive increased foot traffic from trail users.

Method:

Survey questions asked users about how Town Branch Commons impacts their visits to nearby businesses and restaurants. Responses to questions 36 and 37 were combined to give a more accurate and representative response.

Calculations:

Survey Question and Results:

Figure 58. Survey responses indicating whether users visit nearby businesses or restaurants and how frequently they do so when spending time along Town Branch Commons.

75 ÷ 102 = 73.5% of users visit nearby businesses or restaurants as part of their visit to Town Branch Commons

27 'no' responses from Q36 + 74 responses from Q37 = 101 responses

11 ('Every visit') + 29 ('Often') + 30 ('Sometimes') = 70 users frequently nearby businesses or restaurants

70 ÷ 101 = 69.3% of users visit nearby businesses or restaurants 'Sometimes' or more frequently as part of time spent along Town Branch Commons

Sources:

Online Survey by CSI research team:

"Town Branch Commons Anonymous Survey." Qualtrics, July 21, 2025. https://uky.az1.qualtrics.com/jfe/form/SV_dpq78EeO5TWLqDA

Limitations:

- See survey overview.

- ***Contributed to the development or renovation of six commercial, multi-family residential, and mixed-use projects within two blocks of the trail.***
- ***Catalyzed more than $110 million in municipal, grant, and philanthropic investments in the development or renovation of three parks and a career technical education center for the local school district.***

Background:

The design of and investment in Town Branch Commons created an inviting and connective spine, spurring on other considerable investments along Vine Street, Midland Avenue, and Main Street. A number of projects improving Lexington's public realm have been completed or are nearing completion, and additional investments in mixed-use and commercial developments are scheduled to break ground in the coming years.

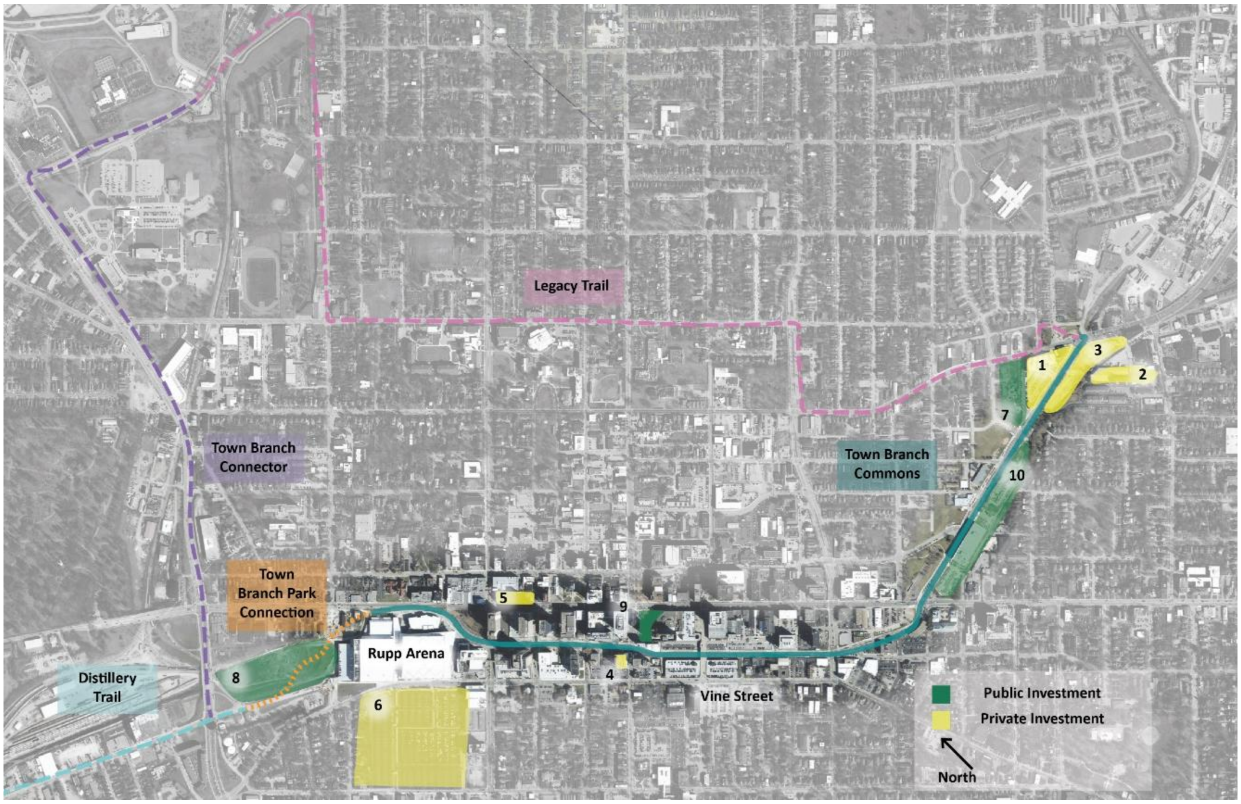


Figure 59. Map showing locations of public and private investments along Town Branch Commons and connections to regional trail network.

Method:

The research team conducted long-form interviews with two local real estate investors and property owners to discern how Town Branch Commons has affected their investment decisions and benefited their property's performance, and searched for local news articles, websites related to projects, real estate development, and construction happening adjacent to and within a two-block radius of Town Branch Commons. See Appendix B for a list of interview questions.

Calculations:

NUMBER	PROPERTY	TYPE	STAGE OF DEVELOPMENT
1	The MET	Mixed-use	Completed (2021)
2	PKL Lex + Country Boy Brewing	Commercial	Completed (2025)
3	Midland Station	Mixed-use	Raising capital
4	Ethereal Brewing	Commercial	Completed (2020)
5	325 West Main	Commercial	Under construction
6	High Street Development	Mixed-use	Raising capital

Table 9. List of private development projects. Source: local news articles, interviews.

NUMBER	PROJECT	SPONSOR	ESTIMATED COST	COMPLETION DATE
7	Splash Pad at Charles Young Park	Lexington Parks and Recreation	$ 1.5 M	2023
8	Gatton Park on the Town Branch	Gatton Park on the Town Branch	$ 39 M	2025
9	Phoenix Park	Lexington Parks and Recreation	$ 4.6 M	2025
10	The Hill Technical Education Center	Fayette County Public Schools	$ 65 M	2025
		TOTAL	**$ 110.1 M**	

Table 10. List of public development projects. Source: local news articles.

One real estate developer expressed a commitment to residential infill downtown and indicated Town Branch Commons influenced their location for a future rental apartment building, explaining that "the whole idea is that we want people to walk downtown."

They went on to explain the importance of Town Branch Commons' ability to connect: "This is what the experts tell you to do, which is to build a spine to help people get from one place to another." They praised the identity of the project and the statement it made to the public. "When you create a trail like this, it is a statement that we want you here. . . (Town Branch Commons) is an invitation to walk downtown." Their focus and investments have been shaped by the lack of available residential rental properties downtown and the willingness of the City to invest in projects that improve the public realm such as Town Branch Commons.

Another perspective is provided here by a local real estate manager: "So when they're looking at three different spaces, and one is not on Town Branch Commons in the iconic downtown district of Lexington, you might not have higher rents," indicating that properties immediately adjacent to Town Branch Commons could command higher rents. They elaborated further on the benefits it gives to those who work near the trail: "having Town branch Commons is a great release to be able to go down on your break, walk a quick half a mile."

Both interviewees were strong believers in public projects that inspire people to walk and bike in a safer and more inviting downtown environment. When asked whether they think that governments should invest in projects like this, both were highly supportive, with one responding: "they have to."

Sources:

Local real estate investor and developer interviews conducted by the research team.

Barr, Peter. "325 West Main - Lexington, KY." Accessed June 10, 2025. https://www.325westmain.com/.

Bela, John. "SplashJAM." JB, 2024. https://www.johnbela.com/work/splashjam#:~:text=%E2%80%9CA%20new%20playground%2C%20resurfaced%20basketball,million%20coming%20from%20private%20funds.

"East End at the MET." Manchester Coffee Company. Accessed June 10, 2025. https://www.manchestercoffeeco.com/locations#:~:text=East%20End%20at%20The%20MET,Lexington%2C%20KY%2040508.

Kehn, Daniel. "$4.6 Million Phoenix Park Upgrade Set in Downtown Lexington." *Lexington Herald Leader*. May 24, 2024. https://www.kentucky.com/news/local/article288644230.html.

Patton, Janet. "DV8 Kitchen Opening Second Location in East End ." *Lexington Herald Leader*. June 16, 2020. https://www.kentucky.com/lexgoeat/restaurants/article243542267.html.

Patton, Janet. "Lexington's Ethereal Brewing Public House Opens during ." *Lexington Herald Leader*. April 24, 2020. https://www.kentucky.com/lexgoeat/restaurants/article242240001.html.

Spears, Valerie. "Fayette School Board Gets Update on Career and Tech Center Construction, Including Name." *Lexington Herald Leader*. October 11, 2023. https://www.kentucky.com/news/local/education/article280343344.html.

Willis, Stephanie. "'A New Landmark.' Lexington Breaks Ground on $39 Million Downtown Park." Gatton Park on the Town Branch, May 21, 2024. https://www.gattonpark.org/news-2/a-new-landmark-lexington-breaks-ground-on-39-million-downtown-park.

Limitations:

- There may be more developments or renovations that are not verifiable through newspapers or interviews.
- Real estate development and investment is complex, and it is impossible to determine precisely how Town Branch Commons may have influenced project locations and investments.
- Official dollar amounts may differ from actual construction and project costs due to timeliness and accuracy of publicly available information, as well as fluctuating prices.
- Although local government has proactively worked to address green gentrification, as noted in Lessons Learned, it remains a potential concern.

- ***Leveraged and connected unique funding streams for significant, concurrent investment totaling $48 million in transportation infrastructure and the public realm. The three-pronged approach sourced 55% ($26.2 million) of project funding from federal grant dollars, 21% ($10 million) from state grant dollars, and 25% ($11.8 million) from city government.***

Background:

This project blended multiple funding sources, the most significant of which was a Transportation Investment Generating Economic Recovery (FY 2016 TIGER Grant No. 7, see Research Overview) grant. After being denied in their initial application in 2015, the project team successfully reapplied in 2016 and leveraged multiple funding sources through their efforts. As noted in Lessons Learned, sources of funding were tied to specific zones of a project that encompassed and went beyond the boundaries of Town Branch Commons (Figure 60). This Case Study focuses on Zones 1-4, but this benefit funding language reflects all project zones (see Method for additional detail).

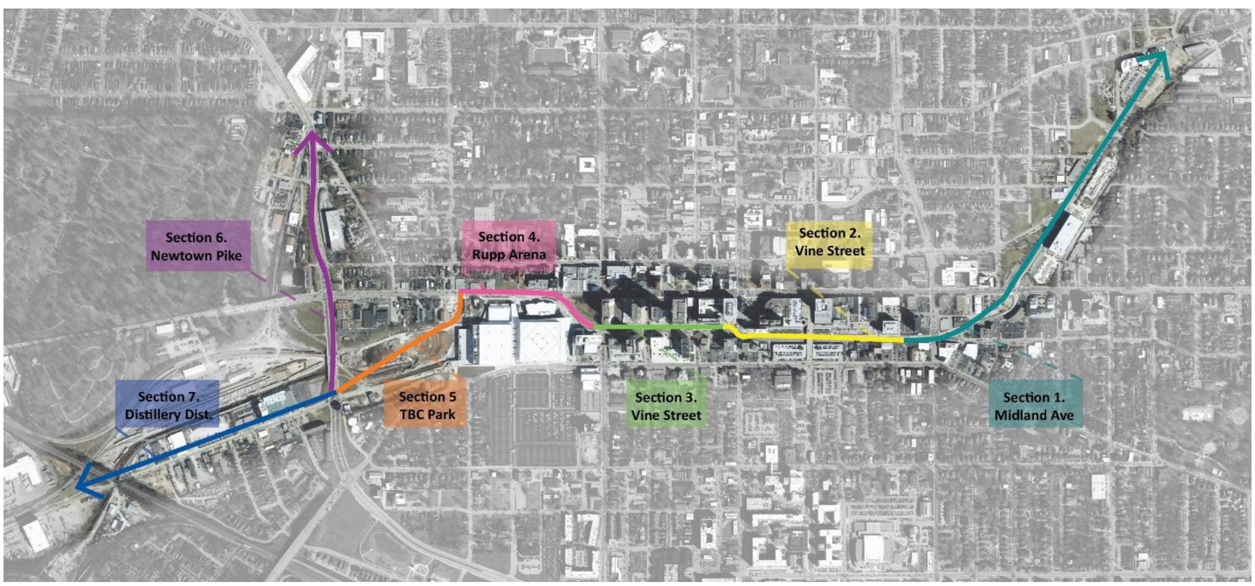


Figure 60. TIGER Grant project zones.

Method:

The data for this benefit comes from Lexington-Fayette Urban County Government. Funding went toward the planning, design/engineering, adjustments to right-of-way, utility upgrades, and construction for all zones in Figure 60.

Calculations:

	GRANT PROGRAM	AMOUNT	PERCENTAGE OF TOTAL BUDGET ($48 M)
FEDERAL	Transportation Investment Generating Economic Recovery (TIGER)	$ 14.1 M	
	Transportation Alternatives Program (TAP)	$ 2.3 M	
	Congestion, Mitigation and Air Quality (CMAQ)	$ 5.2 M	
	Statewide Transportation Improvements Program (SLX Grants)	$ 4.6 M	
	Subtotal	**$ 26.2 M**	**55%**
STATE	Kentucky Infrastructure Authority (KIA)	$ 10 M	**21%**
CITY	Lexington Fayette Urban County Government (LFUCG)	$ 11.8 M	**24%**
TOTAL		**$ 48 M**	**100%**

Table 11. Summary of funding sources for Town Branch Commons.

Sources:

Funding data and project information provided by Brandi Peacher, Director of Project Management and Complete Streets Coordinator, Office of the Mayor, Lexington-Fayette Urban County Government.

"Town Branch Commons Corridor Project." Town Branch TIGER. Accessed July 2, 2025. https://townbranchtiger.com/

Limitations:

- The funding totals reflect areas beyond the project boundary, as it was not possible to isolate spending related solely to Town Branch Commons in such a large, complex project.

Inconclusive Benefit

- ***Has the potential to improve water quality of Town Branch where it daylights downstream from the project site.***

Background:

Town Branch, the stream alongside which the city of Lexington was built and oriented towards in the late 18th century, is buried and culverted below Town Branch Commons (TBC) and daylights in Gatton Park on the Town Branch (Park), which opened in August 2025. TBC's linear system represents a small fraction of the overall Town Branch watershed (see Figure 61), which is heavily impacted by urbanization. Although it is impossible to control for development and changes in land use prior to and since TBC's construction, this is a symbolic moment and prominent location for raising public awareness at the much-anticipated park.

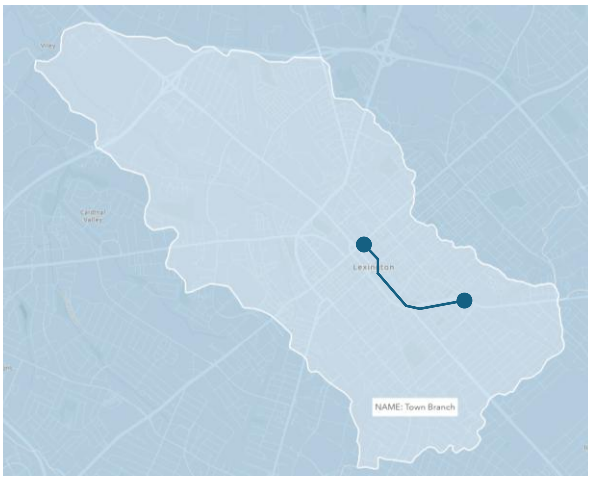


Figure 61. Town Branch watershed. Source: LFUCG Data Hub.

Figure 62. Research team taking water quality measurements in Town Branch where it daylights in Gatton Park on the Town

The research team gathered water samples in June and July 2025 (Figure 62) while the surrounding site was still under active construction. The site was formerly a parking lot that served the nearby convention center, performance venue, and churches. A central focus of the park's design is to celebrate the location where Town Branch first daylights within the city, and construction involved clearing mostly invasive species and laying back the banks of the highly incised stream corridor.

Method:

Impact on Town Branch Watershed

Total planting area (total habitat value from Environmental Benefits section which included rain gardens, planted areas, and soil cells for trees planted in pavement) was added to area of permeable pavement to determine the total area within Town Branch Commons capable of providing some level of stormwater treatment (infiltration, interception, evapotranspiration).

Water Quality Monitoring

Samples collected from middle of water body at Town Branch 12 monitoring site (see Figure 63,

Appendix F). In Situ measurements (dissolved oxygen, pH, temperature, conductivity) conducted by research team with Hanna Water Quality Multimeter Probe. Water grab samples collected in (1) 4 oz plastic bottle with $NA_2S_20_3$ (E. coli) and (1) 10 oz plastic bottle (total suspended solids, total phosphorus, ammonia, nitrate) on the following dates:

- 6/13/2025 after a 72-hour dry period
- 6/24/2025 after a rain event the day prior to measurement
- 6/26/2025 after a 72-hour dry period
- 7/07/2025 after a 72-hour dry period

Research team placed samples on ice in a cooler and delivered to Town Branch Laboratory, a state-certified wastewater laboratory managed by Lexington-Fayette Urban County Government's Division of Water Quality (LFUCG), for chemical analysis.

Data was compared to volunteer monitoring data from 2021, as well as a combination of EPA water quality standards and watershed-specific benchmarks outlined in a technical memorandum regarding Town Branch Watershed-Focused Monitoring (dated February 25, 2022) that was developed for LFUCG by Third Rock, an environmental consulting firm. These watershed-specific benchmarks are based on applicable designated uses, established by state law and enforced by the Kentucky Division of Water, of warm water aquatic habitat, primary contact recreation, and secondary contact recreation.

Calculations:

68,572 sf of habitat + 5,238 sf of permeable pavement = 73,810 sf of stormwater treatment within TBC

73,810 sf ÷ 43,560 = 1.69 ac

[1.69 ac (TBC) ÷ 5,592.74 ac (Town Branch watershed)] × 100 = 0.03% of Town Branch watershed treated by TBC

Refer to Appendix F for complete water quality data

Key comparisons are between 'Dry' samples collected by research team (2025), which were most similar to volunteer collection samples (2021) conducted prior to TBC completion. Additional data comparison made between research team sampling and summer collection period by volunteers in 2021 (6/8, 6/22, 7/7, 7/20) to mimic similar climatic conditions (temperature, precipitation). Data, units, and methods, as well as key findings summarized below. Refer to Table 12 for benchmarks.

In Situ

- DO: Dissolved Oxygen, mg/L
    - Increased between 8.3% (summer) and 19.2% (all samples) as compared to 2021. Average 'Dry' measurement of 9.35 meets benchmark (> 5.0)

- pH: standard units
  - Increased between 0.28% (summer) and 0.54% (all samples) as compared to 2021. Average 'Dry' measurement of 7.57 is within the optima for most aquatic organisms (pH 6.5-8)
- Temperature: ° Celsius
  - Increased between 2.4% (all samples) and 7.6% (summer) as compared to 2021, making the increased DO values more unusual. Average 'Dry' measurement of 19.67 meets benchmark (< 31.7)
- Conductivity: µS/cm (microsiemens/centimeter)
  - Increased between 12.7% (summer) and 14.4% (all samples) as compared to 2021. Average 'Dry' measurement of 832.3 is above the healthy range to support fish and macroinvertebrates (150-500)

Laboratory Analysis. Chemistry Analyte Name, Units, Test Method

- TSS: Solids, Total Suspended, mg/L, SM 2540 D
  - Increased between 566.7% (all samples) and 966.7% (summer) as compared to 2021. High average 'Dry' measurement of 5.3 likely a result of active construction zone surrounding monitoring site
- EC: E Coli, CFU/100mL, EPA 1603
  - Decreased between 18.8% (summer) and 43.7% (all samples). Although this represents a move in the right direction, average 'Dry' measurement of 7,261 exceeds primary contact recreation benchmark (< 240) by more than 3,000%, so much work is left to be done
- PT: Total Phosphorus, mg/L as PSM, 4500-P E
  - Increased by 14.7% (summer) and decreased by 9.1% (all samples) as compared to 2021. Average 'Dry' measurement of 0.35 meets benchmark (< 0.5)
- NH3: Nitrogen, Ammonia, mg/L as N, EPA 350.1
  - Increased by 7.0% (summer) and decreased by 83.3% (all samples) as compared to 2021. Average 'Dry' measurement of 0.09 meets benchmark (< 0.5)
- NO3: Nitrogen, Nitrate, mg/L as N, EPA 300.0
  - Increased by 3.3% (all samples) and decreased by 6.7% (all samples) as compared to 2021. Average 'Dry' measurement of 3.18 exceeds benchmark (< 2.0) by nearly 160%

PCR and SCR Regulatory Water Quality Standard	
E. coli[1]	PCR Instantaneous: <240 CFU/100mL (MPN treated as equivalent to CFU) SCR Instantaneous: <676[2] CFU/100mL (MPN treated as equivalent to CFU)
WAH Regulatory Water Quality Standard	
pH	Between 6.0 and 9.0 SU, and not to fluctuate more than 1.0 SU over 24 hours
Temperature	<31.7°C (89°F)
Flow	Not altered to a degree that will adversely affect the aquatic community
Dissolved Oxygen	>5.0 mg/L as a 24-hour average; or >4.0 mg/L for instantaneous
Conductivity	Indigenous aquatic community is not adversely affected
Total Suspended Solids	Indigenous aquatic community is not adversely affected
Nutrients	Not elevated to a level that results in a eutrophication problem
WAH Non-Regulatory Benchmark	
Conductivity	<500 µS/cm
Total Phosphorus	<0.5 mg/L
Nitrate - Nitrogen	<2.0 mg/L
Ammonia - Nitrogen	<0.5 mg/L
Detergents	<0.5 mg/L
Chlorine	<0.25 mg/L
Fluoride	<0.5 mg/L
Total Suspended Solids	<80 mg/L

Table 12. Water quality benchmarks for Town Branch Watershed. Source: Third Rock technical memorandum provided by LFUCG Division of Water Quality.

Sources:

EPA. "Monitoring and assessing water quality - volunteer monitoring." Accessed July 20, 2025. https://archive.epa.gov/water/archive/web/html/index-18.html

EPA. "pH." Accessed July 20, 2025. https://www.epa.gov/caddis/ph#tab-1

LFUCG. "Municipal separate storm sewer system." Accessed July 20, 2025. https://www.lexingtonky.gov/government/departments-programs/environmental-quality-public-works/water-quality/municipal-separate-storm-sewer-system-ms4

LFUCG. "Town branch laboratory." Accessed July 20, 2025. https://www.lexingtonky.gov/government/departments-programs/environmental-quality-public-works/water-quality/town-branch-laboratory

LFUCG. "Town branch watershed." Accessed July 20, 2025. https://www.lexingtonky.gov/government/departments-programs/environmental-quality-public-works/water-quality/watersheds/town-branch-watershed

Kentucky Administrative Regulations, Title 401, Chapter 10, Regulation 031, "Surface Water Standards."

Third Rock. *Town Branch watershed-focused monitoring water quality monitoring technical memorandum.* February 25, 2022.

Limitations:

- Results were inconsistent, inconclusive, and based on a highly limited sample size post-construction.
- Limited impact of stormwater treatment within TBC, as it represents a small fraction (0.03%) of the highly urbanized Town Branch watershed.
- Elevated dissolved oxygen (DO) levels measured in water with warmer temperatures in 2025 inconsistent with fact that colder water is capable of holding more oxygen.
- Although temperature benchmark of 31.7 (89° F) seems high for supporting aquatic life, it is specified as such in Title 401 Chapter 10 Regulation 031, "Surface Water Standards."

Appendix A: General Survey

Town Branch Commons

Q1 **University of Kentucky Consent to Participate in Research**
Research Title: Town Branch Commons Case Study Investigation
Protocol #: 103709
Researcher: Jordan Phemister, MLA, PLA, Lecturer, Department of Landscape Architecture, Martin-Gatton College of Agriculture, Food and Environment, University of Kentucky
Contact Information: 859-257-3826, jph235@uky.edu
Research Sponsor: Landscape Architecture Foundation
Purpose, Procedure, and Duration: We are researchers from the University of Kentucky inviting you to participate in a survey. We want to learn more about the landscape performance of Town Branch Commons and determine whether project objectives such as recreational, educational and social value, transportation and safety have been met. If you agree to participate in our study, you will be asked to complete an anonymous survey. The survey will take about 10 minutes to complete and we expect 1,000 people to respond.
Eligibility: You must be at least 18 years old to participate in this research study.
Benefits: You may not benefit personally from being in this study, but your answers could help us understand more about landscape performance, or how the way we design and build outdoor spaces benefit people and nature.
Risks: Some of our questions may make you feel uncomfortable, and you can stop the survey at any time. If you do not complete the survey, we will analyze the data collected from any questions you chose to answer. We will make every effort to safeguard your data. However, we cannot guarantee the security of data obtained via the internet. For the online version of the survey, we will use Qualtrics to collect your responses. They may have Terms of Service and Privacy policies outside of the control of the University of Kentucky that allow them to use your data for other purposes
Reward: You will not receive any rewards or payment for taking part in the study.
Alternative Opportunities: We will also be conducting focus group interviews. Please complete this form to indicate your interest in this alternative opportunity.
Privacy and Future Use: Your responses to the research survey are anonymous. That means we won't know which responses are yours. We won't collect names, internet addresses, email addresses, or any other identifiable information. We may use your responses in future research or share them with other researchers.
Complaints or Concerns: If you have questions about the study, please contact the researcher using the contact information provided above. If you have complaints or concerns about your rights as a research volunteer, you can contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 1-866-400-9428.

Thank you for taking the time to consider our study. You do not have to participate in our study, but we hope you will. To ensure your responses will be included in our research, please complete the survey July 3, 2025.

To continue with this survey, please click the arrow at the bottom right side of your screen.

Q2 Please answer the following questions to determine your eligibility for this survey. Your responses will help us ensure that participants meet the necessary criteria for this research. **By filling out the survey, you agree to participate in our research study.**

Q3 Are you 18 or older?
- o No
- o Yes

Q4 Have you visited Town Branch Commons, the bike and pedestrian trail along Midland Avenue and Vine Street in downtown Lexington?
- o No
- o Yes

Q5 Why haven't you visited Town Branch Commons?
- ▢ Unsure
- ▢ It's out of the way
- ▢ It feels unsafe
- ▢ I haven't heard of it
- ▢ Not sure what I'd do there
- ▢ I don't have time
- ▢ Other

Q6 For each of the following questions, please select the option that best represents your opinion or experience. You can only choose one answer for each question unless otherwise specified.

Q7 What are all the different activities you like to use Town Branch Commons for? Please select all that apply:
- ▢ Walking
- ▢ Biking
- ▢ Rolling (wheelchair, roller-skating, skate-boarding)
- ▢ Commuting
- ▢ Socializing
- ▢ Exercising
- ▢ Hanging out
- ▢ Other ____

Q8 What is the primary activity you use Town Branch Commons for? Please select one:

- o Walking
- o Biking
- o Rolling (wheelchair, roller-skating, skate-boarding)
- o Commuting
- o Socializing
- o Exercising
- o Hanging out
- o Other ____

Q9 How often do you visit Town Branch Commons?

- o First time
- o Less than once a month
- o One to three times a month
- o Once a week
- o Several times a week
- o Every day

Q10 During a visit, how much time do you spend along Town Branch Commons?

- o Less than 5 minutes
- o 5 to 30 minutes
- o 30 minutes to an hour
- o 1 to 2 hours
- o More than 2 hours
- o Passing through only (for example, commuting to work by bike)

Q11 Have you ever met anybody for the first time while visiting Town Branch Commons, including strangers or friends of friends?

- o Yes
- o No

  Q12 Thinking of any new people you met there, have they been:

  - o Friends of friends
  - o Strangers
  - o Both

  Q13 Thinking of any new people you met there, in what way did they seem similar to you, or different from you?

Q14 Town Branch Commons is a place where I feel welcome.

Strongly Agree										Strongly Disagree
0	1	2	3	4	5	6	7	8	9	10

Q15 Town Branch Commons has changed my perception of Lexington.

- o Significantly improved my perception
- o Somewhat improved my perception
- o Neither improved nor worsened my perception
- o Somewhat worsened my perception
- o Significantly worsened my perception

Q16 Town Branch Commons reflects the natural environment and history of the Bluegrass region.

- o Strongly agree
- o Somewhat Agree
- o Neither agree or disagree
- o Somewhat disagree
- o Strongly disagree

Q17 How does Town Branch Commons affect your sense of community, the feeling of belonging, connection, and mutual responsibility within a group of people?

Strongly diminishes sense of community		Somewhat diminishes sense of community		Neither diminishes or enhances sense of community			Somewhat enhances sense of community		Strongly enhances sense of community	
0	1	2	3	4	5	6	7	8	9	10

Q18 Rate how important the following design goals for Town Branch Commons are to you:

	Most important	Somewhat important	Not important
Providing safe places to walk, roll and bike	o	o	o
Incorporating native plants to increase biodiversity and habitat for insects, pollinators and birds	o	o	o
Reducing stormwater runoff and improving water quality	o	o	o
Providing recreational and social opportunities	o	o	o
Reflecting the natural environment and history of the Bluegrass region	o	o	o
Teaching me things I didn't know about	o	o	o
Making the city more attractive	o	o	o
Increasing accessibility and connecting trails	o	o	o
Connecting to different neighborhoods and downtown	o	o	o

Q19 Have you read any of the signs along Town Branch Commons?

o Yes

o No

Q20 Indicate which topics you are able to recall from the signs you have read along Town Branch Commons (please select all that apply):

- Transportation history, networks and connectivity
- Watersheds, stormwater, ecosystems, native and invasive plant species
- Watersheds, streams and water movement (
- Limestone bedrock, bourbon, horses, and local masonry
- Early Lexington commercial district history, African American history and churches
- Town Branch creek history and settlement of Lexington, and karst geology

Q21 Have you visited the Town Branch Water Walk, an online educational virtual tour of Town Branch Commons?

o No
o Yes. Using keywords or short sentences, briefly describe what you are able to recall.

Q22 What do you think is the primary material used in the walls along Town Branch Commons and why do you think it was used?

Q23 Generally, would you like to see more or less government spending on public spaces like Town Branch Commons?

o A lot more government spending—even if it requires a tax increase to pay for it
o A little more government spending
o About the same amount of government spending
o A little less government spending
o A lot less government spending
o Don't know

Q24 Generally, how do you feel when you are visiting Town Branch Commons

	Bored	Sad	Neutral	Happy	Energized
	o	o	o	o	o

Q25 Have you noticed a decrease in physical ailments such as stress, asthma, and/or general poor health since you started visiting Town Branch Commons?

o Yes (please describe)
o No

Q26 Health + Well-being

Strongly disagree		Somewhat disagree			Neither agree nor disagree		Somewhat agree		Strongly agree	
0	1	2	3	4	5	6	7	8	9	10

Visiting Town Branch Commons improves my physical health

Visiting Town Branch Commons improves my mental health

Visiting Town Branch Commons improves my quality of life

Town Branch Commons makes me feel connected to people

Town Branch Commons makes me feel connected to nature

Q27 How would you rate the appearance of Town Branch Commons?

	Very unattractive	Somewhat unattractive	Neither attractive nor unattractive	Somewhat attractive	Very attractive
Visual appearance	o	o	o	o	o

Q28 Why did you give Town Branch Commons this rating? Please describe using 1-2 words.

Q29 Do you like the variety of plants, such as trees, shrubs, grasses, flowers, groundcovers, found along Town Branch Commons?

o No
o Yes

Q30 Do you like the water features found along Town Branch Commons?

o No
o Yes

Q31 Has Town Branch Commons changed the way you move in and around downtown Lexington?

- o Yes
- o No

Q32 Town Branch Commons has changed the way I move in and around downtown Lexington in the following ways (please select one option for each movement category):

	I spend less time	I spend the same amount of time	I spend more time	Not Applicable
Walking	o	o	o	o
Biking	o	o	o	o
Rolling (wheelchair, roller-skating, skate-boarding)	o	o	o	o
Exercising	o	o	o	o
Bus-riding	o	o	o	o
Driving	o	o	o	o

Q33 Does Town Branch Commons make it easier for you to get around Lexington?

- o Yes (please describe how)
- o No

Q34 Do you use Town Branch Commons to travel to other nearby places like parks, school, or work?

- o Yes
- o No

Q35 I use Town Branch Commons to travel to (please select all that apply):

- ○ Park
- ○ School
- ○ Store
- ○ Public Transit/Bus
- ○ Restaurant
- ○ Gym
- ○ Church
- ○ Library
- ○ Other trails
- ○ Work
- ○ Other

Q36 Have you visited any nearby businesses or restaurants as part of your visit to Town Branch Commons?

- o Yes (please list which ones)
- o No

Q37 How often do you visit nearby businesses or restaurants as part of time spent along Town Branch Commons?

- o Every visit
- o Often
- o Sometimes
- o Rarely
- o Never

Q38 Please help us understand your sense of safety when traveling.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I feel safe walking, biking, and/or rolling in downtown Lexington	o	o	o	o	o
I feel safe walking, biking, and/or rolling along Town Branch Commons	o	o	o	o	o

Q39 Please help us understand your sense of safety at different times of day.

	Very unsafe	Somewhat unsafe	Neither safe or unsafe	Somewhat safe	Very safe
Generally speaking, how safe do you feel along Town Branch Commons during the day?	o	o	o	o	o
Generally speaking, how safe do you feel along Town Branch Commons at night?	o	o	o	o	o

Q40 Choose where you would prefer to walk, roll or bike from the pair of images below. Briefly describe why in the attached text box

Image 1

Image 2

Q41 Choose where you would prefer to walk, roll or bike from the pair of images below. Briefly describe why in the attached text box.

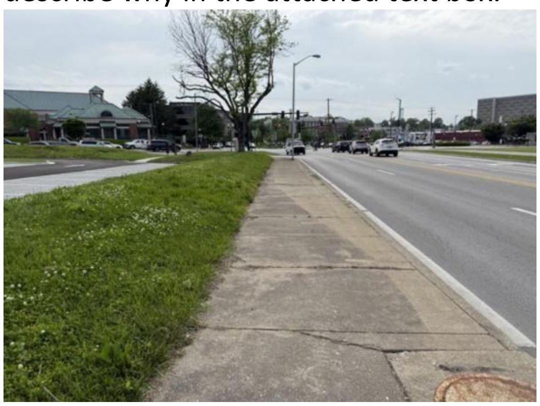


Image 1

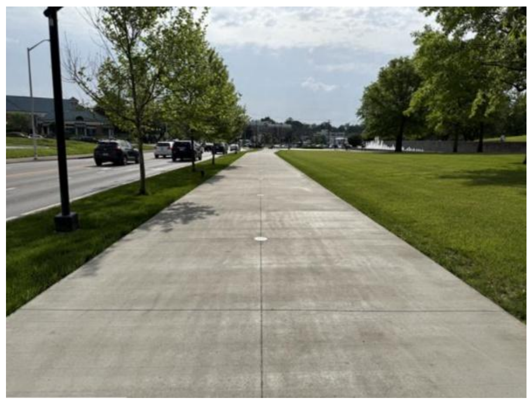


Image 2

Q42 Choose where you would prefer to walk, roll or bike from the pair of images below. Briefly describe why in the attached text box.

Image 1

Image 2

Q43 Please tell us about yourself.

Q44 What is the zip code of your primary residence?

Q45 Please select your age range:
- o 18-24
- o 25-34
- o 34-44
- o 45-54
- o 55-64 (5)
- o 65+ (6)
- o Prefer not to answer

Q46 How do you identify yourself?
- o Female
- o Male
- o Other

Q47 Which of the following best describes your race or ethnicity?
- o Asian (1)
- o Black or African-American
- o Hispanic or Latino
- o Native American
- o Pacific Islander
- o White
- o Other ____

Q48 Please select the highest level of education you have completed.
- o Masters or PhD
- o Some graduate work
- o Bachelor's degree
- o Associate's degree or Certificate program
- o Some college but no degree
- o High school or GED
- o Less than high school
- o Prefer not to say

Q49 Please share household information.
- o Single and live alone
- o Single with room-mate(s)
- o Live with partner and/or family
- o Prefer not to say

Q50 Please share the approximate total income of everyone who lives in your household.

- o $150,000 or more
- o $75,000-$149,000
- o $40,000-$74,000
- o $20,000-$39,000
- o Under $20,000
- o Prefer not to say

Q51 Please share anything else you would like us to know related to your experience or opinion of Town Branch Commons.

Appendix B: Interview and Short Survey Questions

Real Estate/Development Interview Questions

1. What real estate/development project(s) have you been involved with near Town Branch Commons? Describe your role and length of involvement.
2. How has Town Branch Commons changed your perception of Lexington?
3. How has Town Branch Commons influenced your real estate investment/development approach within Lexington? Share specific examples.
4. How do you think it has influenced and will continue to shape the overall real estate investment/development landscape within Lexington? Share specific examples.
5. Do you think government (local, state, federal) should invest in projects like Town Branch Commons? Why or why not?
6. Please share anything else you would like us to know related to your experience or opinion of Town Branch Commons.

Appendix C: EPA Stormwater Calculator Report

National Stormwater Calculator Report

Results

Site Description

Town Branch Commons

Parameter	Current Scenario	Baseline Scenario
Site Characteristics		
Site Area (acres)	10.36	10.36
Hydrologic Soil Group	C	C
Hydraulic Conductivity (in/hr)	0.04	0.04
Surface Slope (%)	5	Mod. Flat (5% Slope)
Precip. Data Source	BLUE GRASS AIRPORT	BLUE GRASS AIRPORT
Evap. Data Source	BLUE GRASS AIRPORT	BLUE GRASS AIRPORT
Extreme Storm Scenario	None	None
Land Cover		
% Forest	0	0
% Meadow	15	4
% Lawn	0	8
% Desert	0	0
% Impervious	85	88
LID Controls		
% Disconnection	0	0
% Rain Harvesting	0	0
% Rain Gardens	0	0
% Green Roofs	0	0
% Street Planters	29 / 14.5	0
% Infiltration Basins	0	0
% Permeable Pavement	2 / 100	0
Analysis Options		
Years Analyzed	20	20
Ignore Consecutive Wet Days	False	False
Wet Day Threshold (inches)	0.1	0.1

National Stormwater Calculator Report

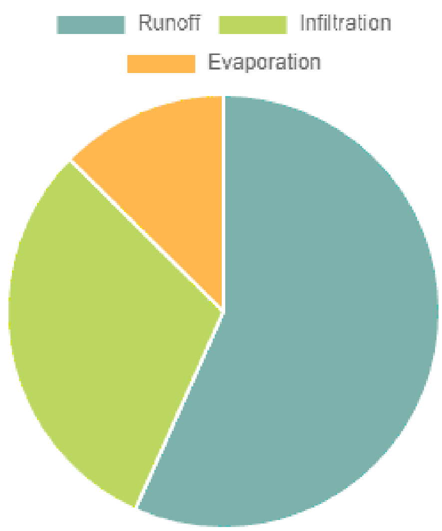
Results

Site Summary

Town Branch Commons

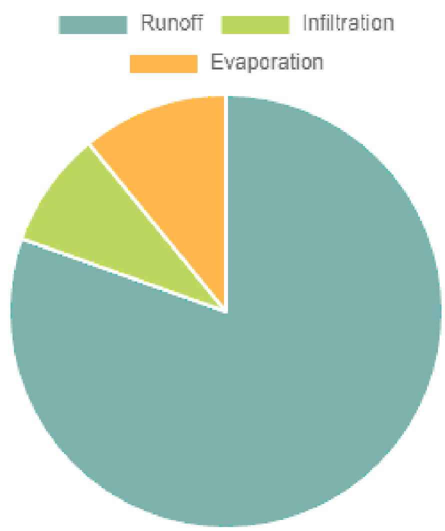
Current Scenario

Annual Rainfall: 49.25 in.



Baseline Scenario

Annual Rainfall: 49.25 in.



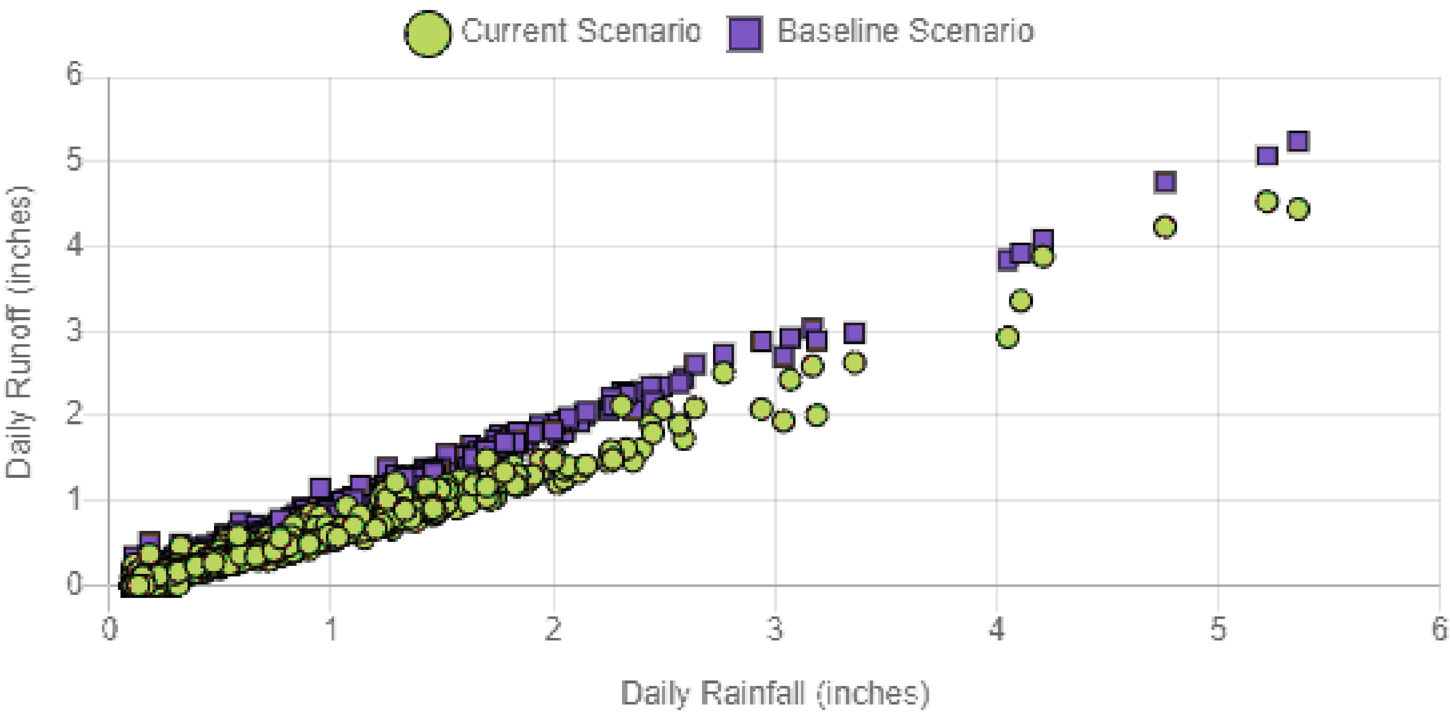
Statistic	Current Scenario	Baseline Scenario
Average Annual Rainfall (inches)	49.25	49.25
Average Annual Runoff (inches)	28.00	39.81
Days per Year with Rainfall	83.80	83.80
Days per Year with Runoff	62.77	71.71
Percent of Wet Days Retained	25.10	14.43
Smallest Rainfall w/ Runoff (inches)	0.10	0.10
Largest Rainfall w/o Runoff (inches)	0.31	0.23
Max Rainfall Retained (inches)	1.18	0.38

National Stormwater Calculator Report

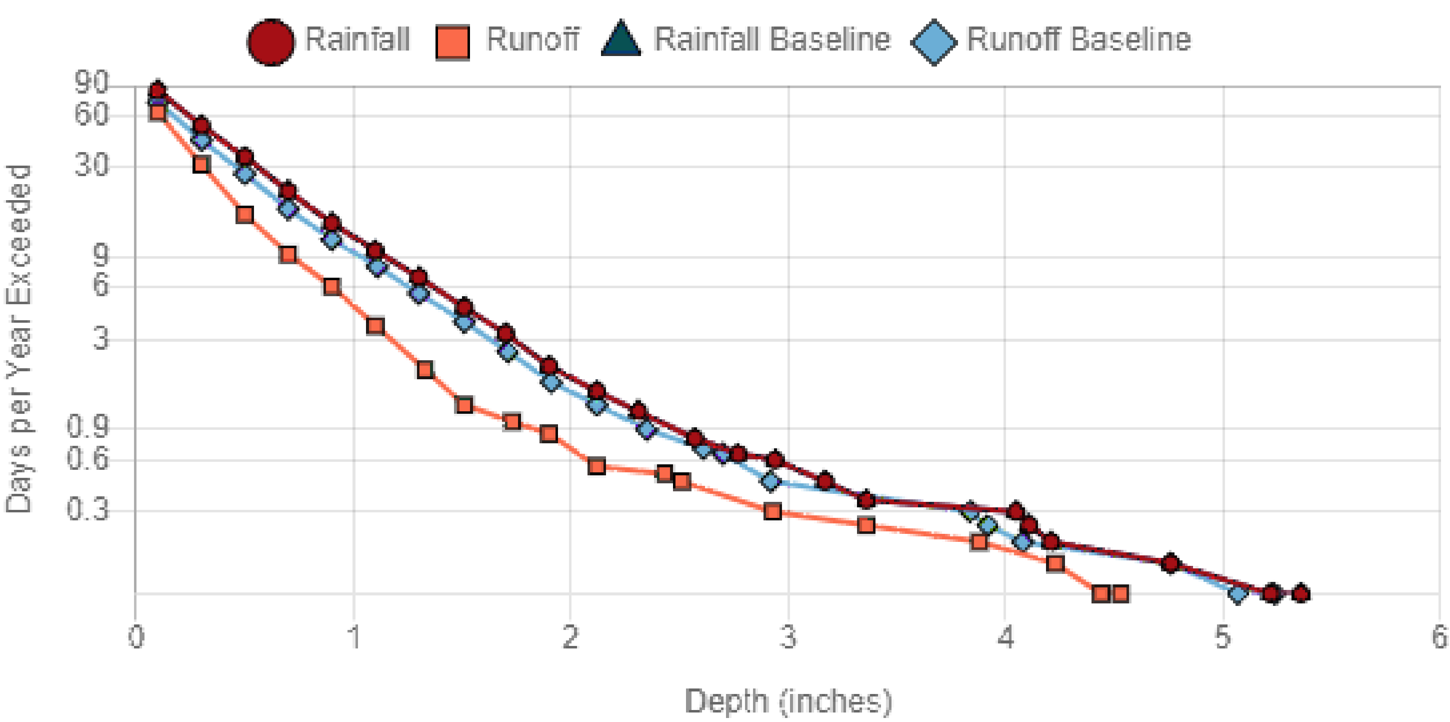
Results

Town Branch Commons

Rainfall / Runoff Events



Rainfall / Runoff Exceedance Frequency

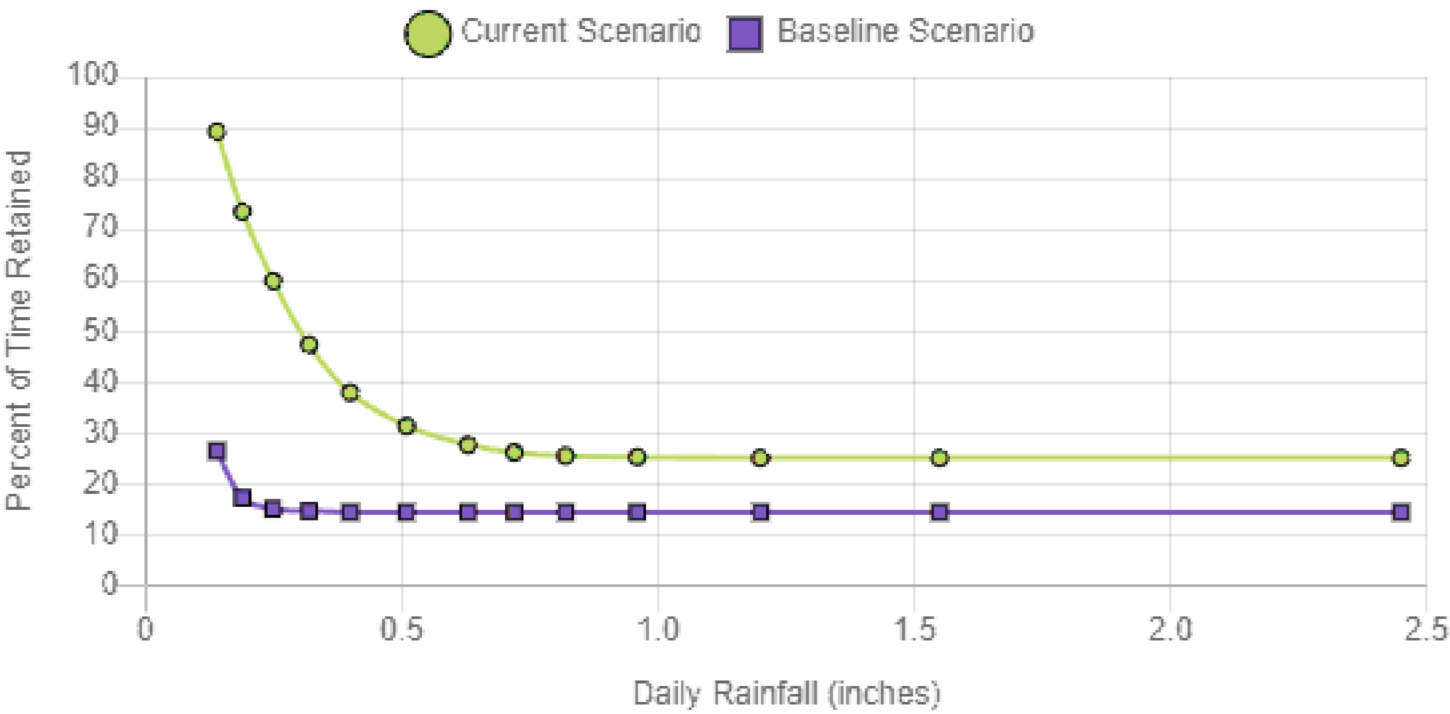


National Stormwater Calculator Report

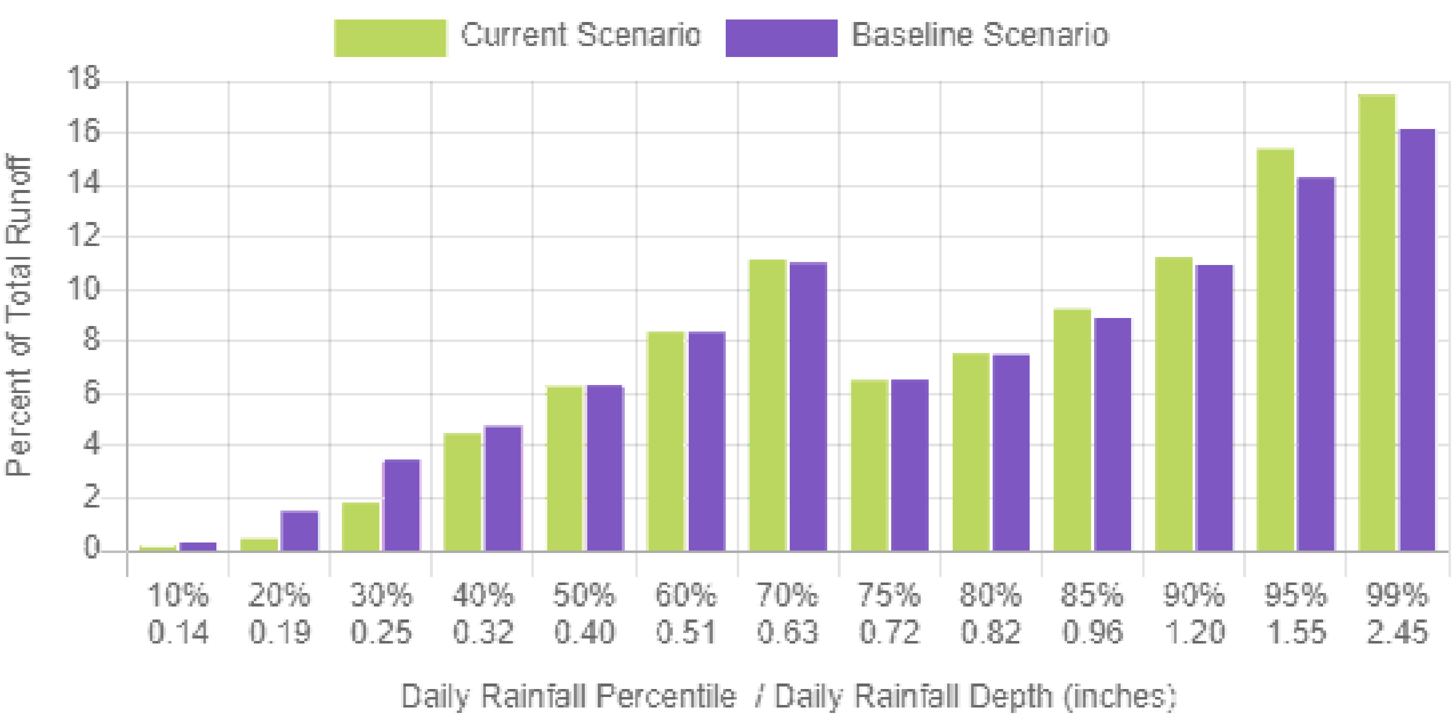
Results

Town Branch Commons

Rainfall Retention Frequency



Runoff Contribution by Rainfall Percentile



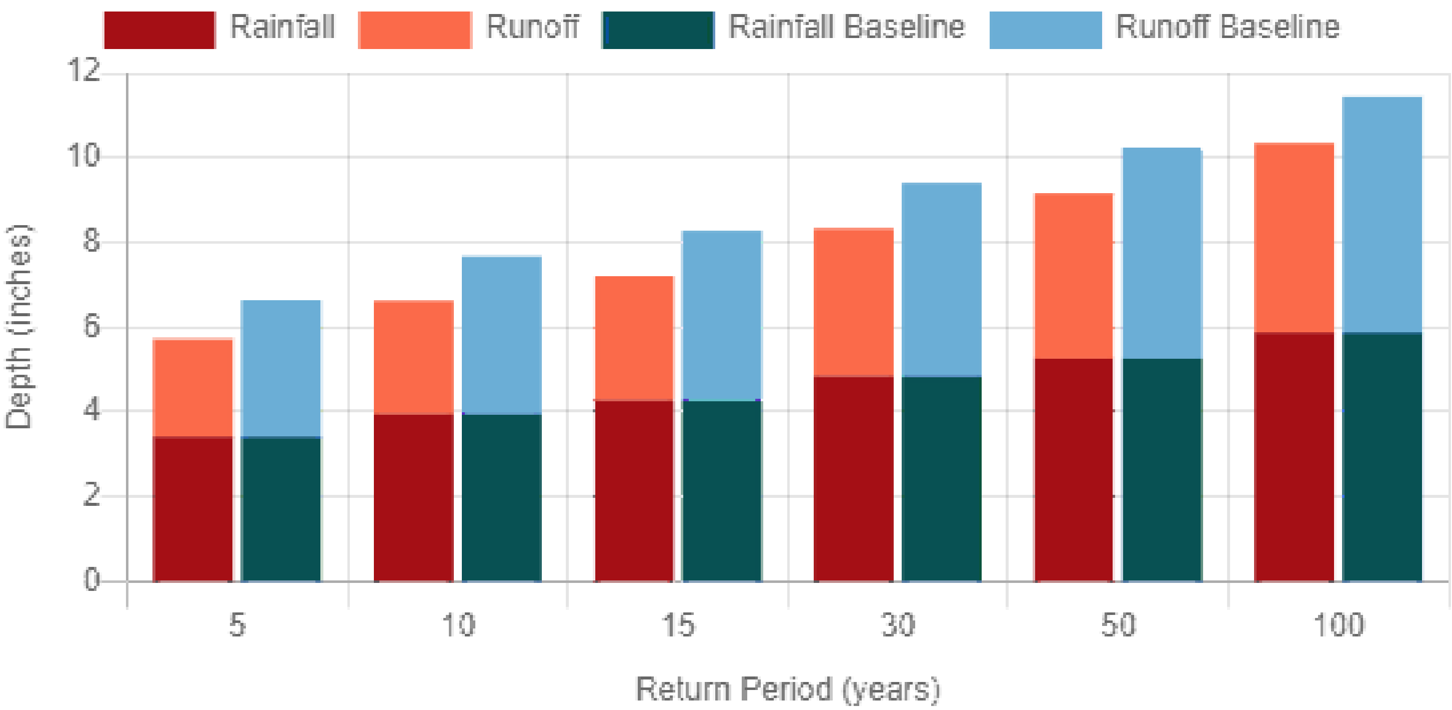
National Stormwater Calculator Report

Results

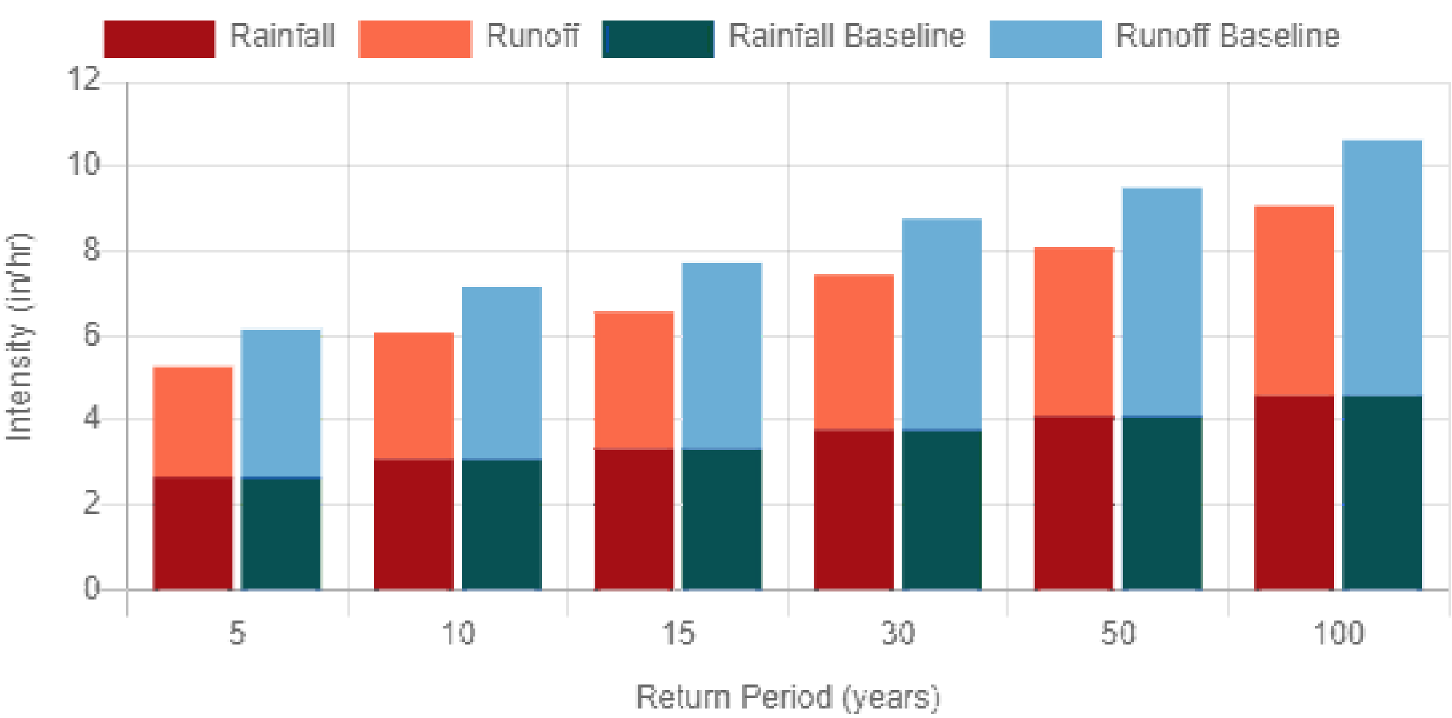
Town Branch Commons

Extreme Event Rainfall / Runoff

Extreme Event Rainfall / Runoff Depth



Extreme Event Peak Rainfall / Runoff



National Stormwater Calculator Report

Results

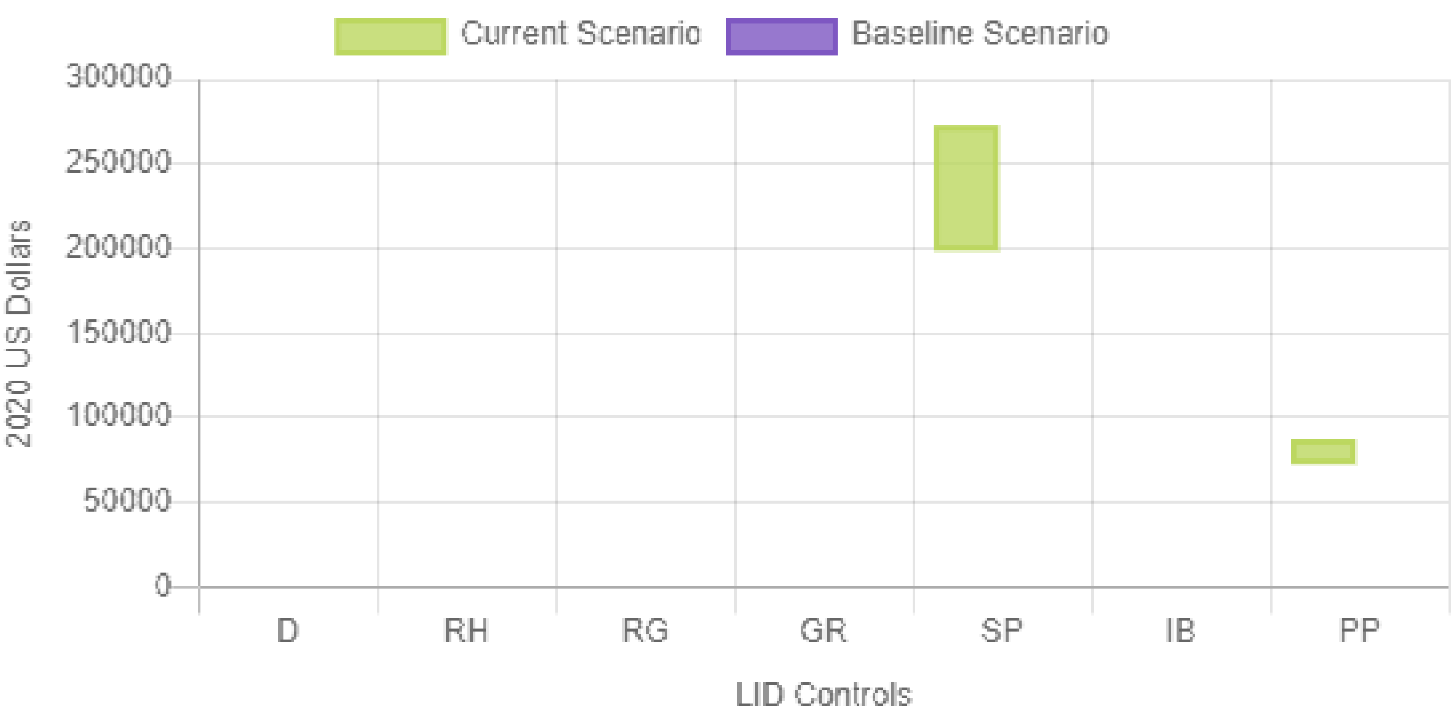
Town Branch Commons

Cost Summary

Estimate of Probable Capital Costs (estimates in 2020 US.$)

	Drainage Area %	Has Pre-Treatment?	Area Treated (C)	Area Treated (B)	Difference (C-B)
D	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
RH	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
RG	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
GR	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
SP	29 (C) / 0 (B)	NA (C) / NA (B)	$198866.97 - $272805.48	$0.00 - $0.00	$198866.97 - $272805.48
IB	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
PP	2 (C) / 0 (B)	NA (C) / NA (B)	$72921.86 - $87290.50	$0.00 - $0.00	$72921.86 - $87290.50

Key	LID Control
D	Disconnection
RH	Rain Harvesting
RG	Rain Gardens
GR	Green Roofs
SP	Street Planters
IB	Infiltration Basins
PP	Permeable Pavement



National Stormwater Calculator Report

Results

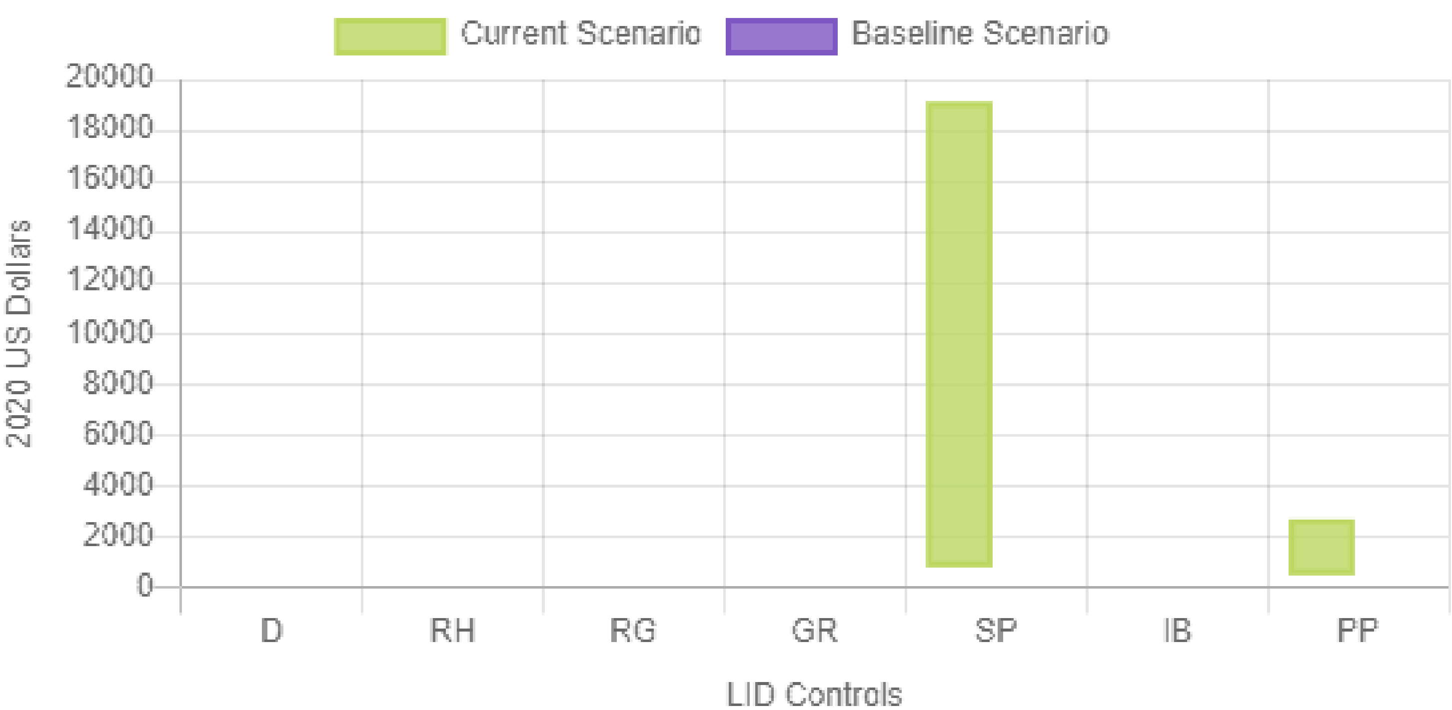
Town Branch Commons

Cost Summary

Estimate of Annual Probable Maintenance Costs

	Drainage Area %	Has Pre-Treatment?	Area Treated (C)	Area Treated (B)	Difference (C-B)
D	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
RH	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
RG	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
GR	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
SP	29 (C) / 0 (B)	NA (C) / NA (B)	$804.04 - $19113.02	$0.00 - $0.00	$804.04 - $19113.02
IB	0 (C) / 0 (B)	NA (C) / NA (B)	$0.00 - $0.00	$0.00 - $0.00	$0.00 - $0.00
PP	2 (C) / 0 (B)	NA (C) / NA (B)	$495.54 - $2706.55	$0.00 - $0.00	$495.54 - $2706.55

Key	LID Control
D	Disconnection
RH	Rain Harvesting
RG	Rain Gardens
GR	Green Roofs
SP	Street Planters
IB	Infiltration Basins
PP	Permeable Pavement



Appendix D: Plant Habitat and Diversity Data

NATIVE + POLLINATOR STATUS AND SHANNON DIVERSITY INDEX CALCULATIONS FOR ALL PLANTS														
NATIVE + POLLINATOR STATUS				**SHANNON DIVERSITY INDEX: ACTUAL**					**SHANNON DIVERSITY INDEX: COMPARISON TO EVEN DISTRIBUTION**					
Nearby Native?	**Native to KY?**	**Xerces**	**Type**	**Name**	**Number**	**Proportion**	**Natural Log**	**H Value**	**Type**	**Name**	**Number**	**Proportion**	**Natural Log**	**H Value**
OK, AR			Ground	AMSONIA HUBRICHTII	129	0.00305181	-5.7920205	-0.01768	Ground	AMSONIA HUBRICHTII	899.36	0.0212766	-3.8501476	-0.08192
	yes		Ground	ASARUM CANADENSE	886	0.02096049	-3.8651159	-0.08101	Ground	ASARUM CANADENSE	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	ASCLEPIAS INCARNATA	153	0.00361959	-5.621395	-0.02035	Ground	ASCLEPIAS INCARNATA	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	ASCLEPIAS TUBEROSA	77	0.00182162	-6.3080275	-0.01149	Ground	ASCLEPIAS TUBEROSA	899.36	0.0212766	-3.8501476	-0.08192
	yes		Ground	BAPTISIA AUSTRALIS	480	0.01135557	-4.4780468	-0.05085	Ground	BAPTISIA AUSTRALIS	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	DALEA PURPUREA	2136	0.05053229	-2.9851427	-0.15085	Ground	DALEA PURPUREA	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	ECHINACEA PURPUREA	1340	0.03170097	-3.451408	-0.10941	Ground	ECHINACEA PURPUREA	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	ERYNGIUM YUCCIFOLIUM	437	0.0103383	-4.5718997	-0.04727	Ground	ERYNGIUM YUCCIFOLIUM	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	EUTROCHIUM FISTULOSUM (spec'd as Eupatorium)	187	0.00442394	-5.4207243	-0.02398	Ground	EUPATORIUM FISTOLOSUM (spec'd as Eupatorium)	899.36	0.0212766	-3.8501476	-0.08192
	yes		Ground	IRIS VERSICOLOR	667	0.01577951	-4.1490428	-0.06547	Ground	IRIS VERSICOLOR	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	LIATRIS ASPERA	710	0.01679678	-4.0865679	-0.06864	Ground	LIATRIS ASPERA	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	PYCNANTHEMUM MUTICUM	322	0.0076177	-4.8772813	-0.03715	Ground	PYCNANTHEMUM MUTICUM	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	RATIBIDA PINNATA	467	0.01104802	-4.5055036	-0.04978	Ground	RATIBIDA PINNATA	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	RUDBECKIA HIRTA	555	0.01312988	-4.3328648	-0.05689	Ground	RUDBECKIA HIRTA	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Ground	SCHIZACHYRIUM SCOPARIUM	2612	0.06179323	-2.7839614	-0.17203	Ground	SCHIZACHYRIUM SCOPARIUM	899.36	0.0212766	-3.8501476	-0.08192
	yes		Ground	SPOROBOLUS HETEROLEPIS	1312	0.03103856	-3.4725249	-0.10778	Ground	SPORABOLUS HETEROLEPIS	899.36	0.0212766	-3.8501476	-0.08192
	yes		Ground	TIARELLA CORDIFOLIA	24	0.00056778	-7.4737791	-0.00424	Ground	TIARELLA CORDIFOLIA	899.36	0.0212766	-3.8501476	-0.08192
TN, VA		yes	Shrub	CLETHRA ALNIFOLIA 'HUMMINGBIRD'	327	0.00773598	-4.8618727	-0.03761	Shrub	CLETHRA ALNIFOLIA 'HUMMINGBIRD'	899.36	0.0212766	-3.8501476	-0.08192
NC, AL			Shrub	FOTHERGILLA GARDENII	367	0.00868228	-4.746471	-0.04121	Shrub	FOTHERGILLA GARDENII	899.36	0.0212766	-3.8501476	-0.08192
Intr: TN			Shrub	HYPERICUM CALYCINUM 'FIESTA'	530	0.01253844	-4.3789559	-0.05491	Shrub	HYPERICUM CALYCINUM 'FIESTA'	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Shrub	ILEX VERTICILLATA 'JIM DANDY'	16	0.00037852	-7.8792442	-0.00298	Shrub	ILEX VERTICILLATA 'JIM DANDY'	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Shrub	ILEX VERTICILLATA 'RED SPRITE'	347	0.00820913	-4.8025081	-0.03942	Shrub	ILEX VERTICILLATA 'RED SPRITE'	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Shrub	ITEA VIRGINICA 'HENRY'S GARNET'	257	0.00607996	-5.1027568	-0.03102	Shrub	ITEA VIRGINICA 'HENRY'S GARNET'	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Shrub	PANICUM VIRGATUM 'SHENANDOAH'	27149	0.64227585	-0.4427374	-0.28436	Shrub	PANICUM VIRGATUM 'SHENANDOAH'	899.36	0.0212766	-3.8501476	-0.08192
no			Shrub	PRUNUS LAUROCERASUS 'OTTO LUYKEN'	74	0.00175065	-6.3477678	-0.01111	Shrub	PRUNUS LAUROCERASUS 'OTTO LUYKEN'	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Shrub	RHUS AROMATICA 'GRO-LOW'	8	0.00018926	-8.5723914	-0.00162	Shrub	RHUS AROMATICA 'GRO-LOW'	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Shrub	ROSA CAROLINA	108	0.002555	-5.9697017	-0.01525	Shrub	ROSA CAROLINA	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Shrub	VIBURNUM NUDUM 'WINTERTHUR'	251	0.00593802	-5.12638	-0.03044	Shrub	VIBURNUM NUDUM 'WINTERTHUR'	899.36	0.0212766	-3.8501476	-0.08192
AL, PA			Tree	AESCULUS PARVIFLORA	12	0.00028389	-8.1669262	-0.00232	Tree	AESCULUS PARVIFLORA	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	AMELANCHIER ARBOREA	10	0.00023657	-8.3492478	-0.00198	Tree	AMELANCHIER ARBOREA	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Tree	AMELANCHIER LAEVIS	18	0.00042583	-7.7614611	-0.00331	Tree	AMELANCHIER LAEVIS	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Tree	CERCIS CANADENSIS	14	0.0003312	-8.0127756	-0.00265	Tree	CERCIS CANADENSIS	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Tree	CRATAEGUS VIRIDIS 'WINTER KING'	26	0.00061509	-7.3937364	-0.00455	Tree	GLEDITSIA TRIACANTHOS INERMIS	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	GLEDITSIA TRIACANTHOS INERMIS	19	0.00044949	-7.7073939	-0.00346	Tree	GLEDITSIA TRIACANTHOS INERMIS	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	GYMNOCLADUS DIOICUS 'ESPRESSO'	12	0.00028389	-8.1669262	-0.00232	Tree	GYMNOCLADUS DIOICA 'ESPRESSO'	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	HAMAMELIS VIRGINIANA	25	0.00059144	-7.4329571	-0.0044	Tree	HAMAMELIS VIRGINIANA	899.36	0.0212766	-3.8501476	-0.08192
TN, VA			Tree	MAGNOLIA VIRGINIANA	7	0.0001656	-8.7059227	-0.00144	Tree	MAGNOLIA VIRGINIANA	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	NYSSA SYLVATICA	36	0.00085167	-7.068314	-0.00602	Tree	NYSSA SYLVATICA	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	OSTRYA VIRGINIANA	20	0.00047315	-7.6561006	-0.00362	Tree	OSTRYA VIRGINIANA	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	PLATANUS X ACERIFOLIA	12	0.00028389	-8.1669262	-0.00232	Tree	PLATANUS X ACERIFOLIA	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	QUERCUS BICOLOR	17	0.00040218	-7.8186195	-0.00314	Tree	QUERCUS BICOLOR	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	QUERCUS COCCINEA	7	0.0001656	-8.7059227	-0.00144	Tree	QUERCUS COCCINEA	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	QUERCUS PHELLOS	22	0.00052046	-7.5607904	-0.00394	Tree	QUERCUS PHELLOS	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	QUERCUS RUBRA	48	0.00113556	-6.7806319	-0.0077	Tree	QUERCUS RUBRA	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	RHUS TYPHINA	4	9.463E-05	-9.2655385	-0.00088	Tree	RHUS TYPHINA	899.36	0.0212766	-3.8501476	-0.08192
	yes	yes	Tree	SASSAFRAS ALIBIDUM	20	0.00047315	-7.6561006	-0.00362	Tree	SASSAFRAS ALIBIDUM	899.36	0.0212766	-3.8501476	-0.08192
	yes		Tree	TAXODIUM DISTICHUM	13	0.00030755	-8.0868835	-0.00249	Tree	TAXODIUM DISTICHUM	899.36	0.0212766	-3.8501476	-0.08192
Totals	**40**	**23**		**47**	**42270**			-1.68641	**Totals**	**47**	**42270**			-3.85015
	85.1%	**48.9%**			**ACTUAL**	**1**	**H**	**1.686408**			**MAXIMUM**	**1**	**H**	**3.850148**
				Even distribution of plants:	899.361702						**COMPARISON**			**43.8%**

Table 13. Native and pollinator status and Shannon Diversity Index for all plants. Source: Project documents, USDA PLANTS database, Missouri Botanical Garden Plant Finder, Xerces Society.

SHANNON DIVERSITY INDEX CALCULATIONS FOR PLANT CATEGORIES											
ACTUAL						**COMPARISON TO EVEN DISTRIBUTION**					
Type	**Name**	**Number**	**Proportion**	**Natural Log**	**H Value**	**Type**	**Name**		**Proportion**	**Natural Log**	**H Value**
Grass	PANICUM VIRGATUM 'SHENANDOAH'	27149	0.87371673	-0.1349991	-0.11795	Grass	PANICUM VIRGATUM 'SHENANDOAH'	10357.67	0.33333333	-1.0986123	-0.3662
Grass	SCHIZACHYRIUM SCOPARIUM	2612	0.08406012	-2.4762231	-0.20815	Grass	SCHIZACHYRIUM SCOPARIUM	10357.67	0.33333333	-1.0986123	-0.3662
Grass	SPOROBOLUS HETEROLEPIS	1312	0.04222315	-3.1647866	-0.13363	Grass	SPOROBOLUS HETEROLEPIS	10357.67	0.33333333	-1.0986123	-0.3662
Totals	**3**	**31073**			-0.45973	**Totals**	**3**	**31073**			-1.09861
	Σ	**ACTUAL**	**1**	**H**	**0.45973**			**MAX**	**1**	**H**	**1.098612**
Even distribution of plants:		10357.667						**COMPARISON**			**41.8%**
ACTUAL						**COMPARISON TO EVEN DISTRIBUTION**					
Ground	ASARUM CANADENSE	886	0.24776286	-1.3952832	-0.3457	Ground	ASARUM CANADENSE	894.00	0.25	-1.3862944	-0.34657
Ground	DALEA PURPUREA	2136	0.59731544	-0.5153099	-0.3078	Ground	DALEA PURPUREA	894.00	0.25	-1.3862944	-0.34657
Ground	HYPERICUM CALYCINUM 'FIESTA'	530	0.14821029	-1.9091231	-0.28295	Ground	HYPERICUM CALYCINUM 'FIESTA'	894.00	0.25	-1.3862944	-0.34657
Ground	TIARELLA CORDIFOLIA	24	0.00671141	-5.0039463	-0.03358	Ground	TIARELLA CORDIFOLIA	894.00	0.25	-1.3862944	-0.34657
Totals	**4**	**3576**			-0.97004	**Totals**	**4**	**3576**			-1.38629
		ACTUAL	**1**	**H**	**0.970037**			**MAX**	**1**	**H**	**1.386294**
Even distribution of plants:		894						**COMPARISON**			**70.0%**
ACTUAL						**COMPARISON TO EVEN DISTRIBUTION**					
Perennial	AMSONIA HUBRICHTII	129	0.02335264	-3.7570451	-0.08774	Perennial	AMSONIA HUBRICHTII	460.33	0.08333333	-2.4849066	-0.20708
Perennial	ASCLEPIAS INCARNATA	153	0.02769732	-3.5864196	-0.09933	Perennial	ASCLEPIAS INCARNATA	460.33	0.08333333	-2.4849066	-0.20708
Perennial	ASCLEPIAS TUBEROSA	77	0.01393917	-4.2730521	-0.05956	Perennial	ASCLEPIAS TUBEROSA	460.33	0.08333333	-2.4849066	-0.20708
Perennial	BAPTISIA AUSTRALIS	480	0.08689356	-2.4430714	-0.21229	Perennial	BAPTISIA AUSTRALIS	460.33	0.08333333	-2.4849066	-0.20708
Perennial	ECHINACEA PURPUREA	1340	0.24257784	-1.4164326	-0.3436	Perennial	ECHINACEA PURPUREA	460.33	0.08333333	-2.4849066	-0.20708
Perennial	ERYNGIUM YUCCIFOLIUM	437	0.07910934	-2.5369243	-0.20069	Perennial	ERYNGIUM YUCCIFOLIUM	460.33	0.08333333	-2.4849066	-0.20708
Perennial	EUTROCHIUM FISTULOSUM (spec'd as Eupatorium)	187	0.03385228	-3.3857489	-0.11462	Perennial	EUTROCHIUM FISTULOSUM (spec'd as Eupatorium)	460.33	0.08333333	-2.4849066	-0.20708
Perennial	LIATRIS ASPERA	710	0.12853005	-2.0515925	-0.26369	Perennial	LIATRIS ASPERA	460.33	0.08333333	-2.4849066	-0.20708
Perennial	PYCNANTHEMUM MUTICUM	322	0.05829109	-2.842306	-0.16568	Perennial	PYCNANTHEMUM MUTICUM	460.33	0.08333333	-2.4849066	-0.20708
Perennial	RATIBIDA PINNATA	467	0.08454019	-2.4705283	-0.20886	Perennial	RATIBIDA PINNATA	460.33	0.08333333	-2.4849066	-0.20708
Perennial	RUDBECKIA HIRTA	555	0.10047067	-2.2978894	-0.23087	Perennial	RUDBECKIA HIRTA	460.33	0.08333333	-2.4849066	-0.20708
Perennial	IRIS VERSICOLOR	667	0.12074584	-2.1140675	-0.25526	Perennial	IRIS VERSICOLOR	460.33	0.08333333	-2.4849066	-0.20708
Totals	**12**	**5524**			-2.24219	**Totals**	**12**	**5524**			-2.48491
		ACTUAL	**1**	**H**	**2.242193**			**MAX**	**1**	**H**	**2.484907**
Even distribution of plants:		460.33333						**COMPARISON**			**90.2%**
ACTUAL						**COMPARISON TO EVEN DISTRIBUTION**					
Shrub	AESCULUS PARVIFLORA	12	0.00679117	-4.9921318	-0.0339	Shrub	AESCULUS PARVIFLORA	176.70	0.1	-2.3025851	-0.23026
Shrub	CLETHRA ALNIFOLIA 'HUMMINGBIRD'	327	0.18505942	-1.6870783	-0.31221	Shrub	CLETHRA ALNIFOLIA 'HUMMINGBIRD'	176.70	0.1	-2.3025851	-0.23026
Shrub	FOTHERGILLA GARDENII	367	0.20769666	-1.5716766	-0.32643	Shrub	FOTHERGILLA GARDENII	176.70	0.1	-2.3025851	-0.23026
Shrub	ILEX VERTICILLATA 'JIM DANDY'	16	0.0090549	-4.7044498	-0.0426	Shrub	ILEX VERTICILLATA 'JIM DANDY'	176.70	0.1	-2.3025851	-0.23026
Shrub	ILEX VERTICILLATA 'RED SPRITE'	347	0.19637804	-1.6277137	-0.31965	Shrub	ILEX VERTICILLATA 'RED SPRITE'	176.70	0.1	-2.3025851	-0.23026
Shrub	ITEA VIRGINICA 'HENRY'S GARNET'	257	0.14544426	-1.9279624	-0.28041	Shrub	ITEA VIRGINICA 'HENRY'S GARNET'	176.70	0.1	-2.3025851	-0.23026
Shrub	PRUNUS LAUROCERASUS 'OTTO LUYKEN'	74	0.04187889	-3.1729734	-0.13288	Shrub	PRUNUS LAUROCERASUS 'OTTO LUYKEN'	176.70	0.1	-2.3025851	-0.23026
Shrub	RHUS AROMATICA 'GRO-LOW'	8	0.00452745	-5.3975969	-0.02444	Shrub	RHUS AROMATICA 'GRO-LOW'	176.70	0.1	-2.3025851	-0.23026
Shrub	ROSA CAROLINA	108	0.06112054	-2.7949072	-0.17083	Shrub	ROSA CAROLINA	176.70	0.1	-2.3025851	-0.23026
Shrub	VIBURNUM NUDUM 'WINTERTHUR'	251	0.14204867	-1.9515855	-0.27722	Shrub	VIBURNUM NUDUM 'WINTERTHUR'	176.70	0.1	-2.3025851	-0.23026
Totals	**10**	**1767**			-1.92057	**Totals**	**10**	**1767**			-2.30259
		ACTUAL	**1**	**H**	**1.920565**			**MAX**	**1**	**H**	**2.302585**
Even distribution of plants:		176.7						**COMPARISON**			**83.4%**
ACTUAL						**COMPARISON TO EVEN DISTRIBUTION**					
Tree	AMELANCHIER ARBOREA	10	0.03030303	-3.4965076	-0.10595	Tree	AMELANCHIER ARBOREA	18.33	0.05555556	-2.8903718	-0.16058
Tree	AMELANCHIER LAEVIS	18	0.05454545	-2.9087209	-0.15866	Tree	AMELANCHIER LAEVIS	18.33	0.05555556	-2.8903718	-0.16058
Tree	CERCIS CANADENSIS	14	0.04242424	-3.1600353	-0.13406	Tree	CERCIS CANADENSIS	18.33	0.05555556	-2.8903718	-0.16058
Tree	CRATAEGUS VIRIDIS 'WINTER KING'	26	0.07878788	-2.5409961	-0.2002	Tree	CRATAEGUS VIRIDIS 'WINTER KING'	18.33	0.05555556	-2.8903718	-0.16058
Tree	GLEDITSIA TRIACANTHOS INERMIS	19	0.05757576	-2.8546537	-0.16436	Tree	GLEDITSIA TRIACANTHOS INERMIS	18.33	0.05555556	-2.8903718	-0.16058
Tree	GYMNOCLADUS DIOICUS 'ESPRESSO'	12	0.03636364	-3.314186	-0.12052	Tree	GYMNOCLADUS DIOICUS 'ESPRESSO'	18.33	0.05555556	-2.8903718	-0.16058
Tree	HAMAMELIS VIRGINIANA	25	0.07575758	-2.5802168	-0.19547	Tree	HAMAMELIS VIRGINIANA	18.33	0.05555556	-2.8903718	-0.16058
Tree	MAGNOLIA VIRGINIANA	7	0.02121212	-3.8531825	-0.08173	Tree	MAGNOLIA VIRGINIANA	18.33	0.05555556	-2.8903718	-0.16058
Tree	NYSSA SYLVATICA	36	0.10909091	-2.2155737	-0.2417	Tree	NYSSA SYLVATICA	18.33	0.05555556	-2.8903718	-0.16058
Tree	OSTRYA VIRGINIANA	20	0.06060606	-2.8033604	-0.1699	Tree	OSTRYA VIRGINIANA	18.33	0.05555556	-2.8903718	-0.16058
Tree	PLATANUS X ACERIFOLIA	12	0.03636364	-3.314186	-0.12052	Tree	PLATANUS X ACERIFOLIA	18.33	0.05555556	-2.8903718	-0.16058
Tree	QUERCUS BICOLOR	17	0.05151515	-2.9658793	-0.15279	Tree	QUERCUS BICOLOR	18.33	0.05555556	-2.8903718	-0.16058
Tree	QUERCUS COCCINEA	7	0.02121212	-3.8531825	-0.08173	Tree	QUERCUS COCCINEA	18.33	0.05555556	-2.8903718	-0.16058
Tree	QUERCUS PHELLOS	22	0.06666667	-2.7080502	-0.18054	Tree	QUERCUS PHELLOS	18.33	0.05555556	-2.8903718	-0.16058
Tree	QUERCUS RUBRA	48	0.14545455	-1.9278916	-0.28042	Tree	QUERCUS RUBRA	18.33	0.05555556	-2.8903718	-0.16058
Tree	RHUS TYPHINA	4	0.01212121	-4.4127983	-0.05349	Tree	RHUS TYPHINA	18.33	0.05555556	-2.8903718	-0.16058
Tree	SASSAFRAS ALIBIDUM	20	0.06060606	-2.8033604	-0.1699	Tree	SASSAFRAS ALIBIDUM	18.33	0.05555556	-2.8903718	-0.16058
Tree	TAXODIUM DISTICHUM	13	0.03939394	-3.2341433	-0.12741	Tree	TAXODIUM DISTICHUM	18.33	0.05555556	-2.8903718	-0.16058
Totals	**18**	**330**			-2.73934	**Totals**	**18**	**330**			-2.89037
		ACTUAL	**1**	**H**	**2.739343**			**MAX**	**1**	**H**	**2.890372**
Even distribution of plants:		18.333333						**COMPARISON**			**94.8%**

Table 14. Shannon Diversity Index for plant categories. Source: Project documents.

PLANTING LIST		
Latin Name	**Common Name**	**Number**
AESCULUS PARVIFLORA	BOTTLEBRUSH BUCKEYE	12
AMELANCHIER ARBOREA	DOWNY SERVICEBERRY	10
AMELANCHIER LAEVIS	ALLEGHENY SERVICEBERRY	18
AMSONIA HUBRICHTII	ARKANSAS BLUE-STAR	129
ASARUM CANADENSE	CANADIAN WILD GINGER	886
ASCLEPIAS INCARNATA	SWAMP MILKWEED	153
ASCLEPIAS TUBEROSA	BUTTERFLY MILKWEED	77
BAPTISIA AUSTRALIS	BLUE WILD INDIGO	480
CERCIS CANADENSIS	EASTERN REDBUD	14
CLETHRA ALNIFOLIA 'HUMMINGBIRD'	SUMMERSWEET	327
CRATAEGUS VIRIDIS 'WINTER KING'	HAWTHORN	26
DALEA PURPUREA	PURPLE PRAIRIE CLOVER	2,136
ECHINACEA PURPUREA	PURPLE CONEFLOWER	1,340
ERYNGIUM YUCCIFOLIUM	RATTLESNAKE MASTER	437
EUTROCHIUM FISTULOSUM (SPEC'D AS EUPATORIUM)	JOE PYE WEED	187
FOTHERGILLA GARDENII	DWARF FOTHERGILLA	367
GLEDITSIA TRIACANTHOS INERMIS	THORNLESS COMMON HONEYLOCUST	19
GYMNOCLADUS DIOICUS 'ESPRESSO'	KENTUCKY COFFEETREE	12
HAMAMELIS VIRGINIANA	COMMON WITCH HAZEL	25
HYPERICUM CALYCINUM 'FIESTA'	ST. JOHNS WORT	530
ILEX VERTICILLATA 'JIM DANDY'	WINTERBERRY	16
ILEX VERTICILLATA 'RED SPRITE'	WINTERBERRY	347
IRIS VERSICOLOR	BLUE FLAG IRIS	667
ITEA VIRGINICA 'HENRY'S GARNET'	SWEETSPIRE	257
LIATRIS ASPERA	ROUGH BLAZING STAR	710
MAGNOLIA VIRGINIANA	SWEET BAY	7
NYSSA SYLVATICA	BLACK GUM	36
OSTRYA VIRGINIANA	AMERICAN HOPHORNBEAM	20
PANICUM VIRGATUM 'SHENANDOAH'	SWITCH GRASS	27,149
PLATANUS X ACERIFOLIA	LONDON PLANE TREE	12
PRUNUS LAUROCERASUS 'OTTO LUYKEN'	CHERRY LAUREL	74
PYCNANTHEMUM MUTICUM	MOUNTAINMINT	322
QUERCUS BICOLOR	SWAMP WHITE OAK	17
QUERCUS COCCINEA	SCARLET OAK	7
QUERCUS PHELLOS	WILLOW OAK	22
QUERCUS RUBRA	RED OAK	48
RATIBIDA PINNATA	YELLOW CONEFLOWER	467
RHUS AROMATICA 'GRO-LOW'	FRAGRANT SUMAC	8
RHUS TYPHINA	STAGHORN SUMAC	4
ROSA CAROLINA	CAROLINA ROSE	108
RUDBECKIA HIRTA	BLACK EYED SUSAN	555
SASSAFRAS ALIBIDUM	SASSAFRAS	20
SCHIZACHYRIUM SCOPARIUM	LITTLE BLUESTEM	2,612
SPOROBOLUS HETEROLEPIS	PRAIRIE DROPSEED	1,312
TAXODIUM DISTICHUM	BALD CYPRESS	13
TIARELLA CORDIFOLIA	FOAMFLOWER	24
VIBURNUM NUDUM 'WINTERTHUR'	SMOOTH WITHEROD	251
47		**42,270**

Table 15. Complete plant list. Source: Project documents.

Appendix E: iTree Report and Forecast

i-Tree
Ecosystem Analysis

Town Branch Commons

Urban Forest Effects and Values
July 2025

Summary

Understanding an urban forest's structure, function and value can promote management decisions that will improve human health and environmental quality. An assessment of the vegetation structure, function, and value of the Town Branch Commons urban forest was conducted during 2025. Data from 255 trees located throughout Town Branch Commons were analyzed using the i-Tree Eco model developed by the U.S. Forest Service, Northern Research Station.

- Number of trees: 255
- Tree Cover: 20.89 thousand square feet
- Most common species of trees: Northern red oak, Black tupelo, Eastern redbud
- Percentage of trees less than 6" (15.2 cm) diameter: 98.8%
- Pollution Removal: 15.48 pounds/year ($12.8/year)
- Carbon Storage: 2.58 tons ($1.12 thousand)
- Carbon Sequestration: 1440 pounds ($312/year)
- Oxygen Production: 1.921 tons/year
- Avoided Runoff: 3.002 thousand gallon/year ($26.8/year)
- Building energy savings: N/A – data not collected
- Avoided carbon emissions: N/A – data not collected
- Replacement values: $41.9 thousand

Ton: short ton (U.S.) (2,000 lbs)
Monetary values $ are reported in US Dollars throughout the report except where noted.
Ecosystem service estimates are reported for trees.
With Complete Inventory Projects, oxygen production is estimated from gross carbon sequestration and does not account for decomposition. Oxygen production in Plot Inventory Projects is estimated from net carbon sequestration.

For an overview of i-Tree Eco methodology, see Appendix I. Data collection quality is determined by the local data collectors, over which i-Tree has no control.

I. Tree Characteristics of the Urban Forest

The urban forest of Town Branch Commons has 255 trees with a tree cover of Northern red oak. The three most common species are Northern red oak (18.8 percent), Black tupelo (13.3 percent), and Eastern redbud (9.4 percent).

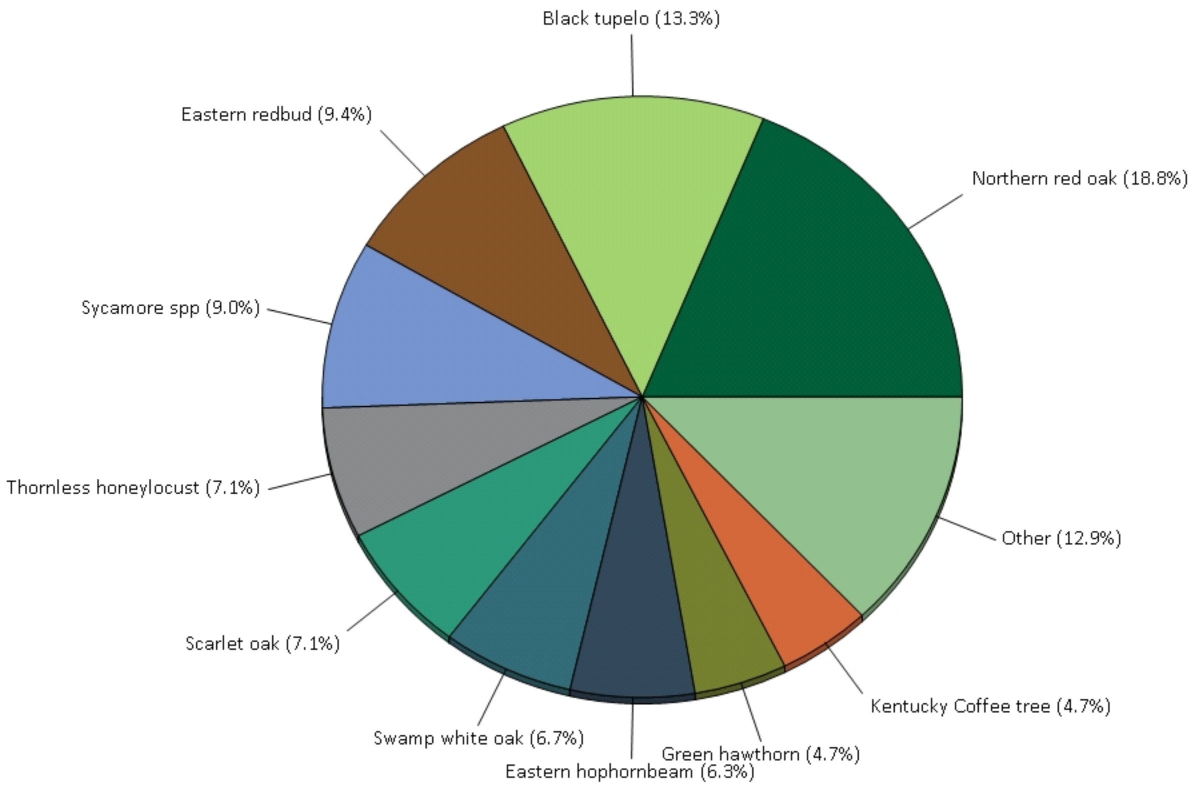


Figure 1. Tree species composition in Town Branch Commons

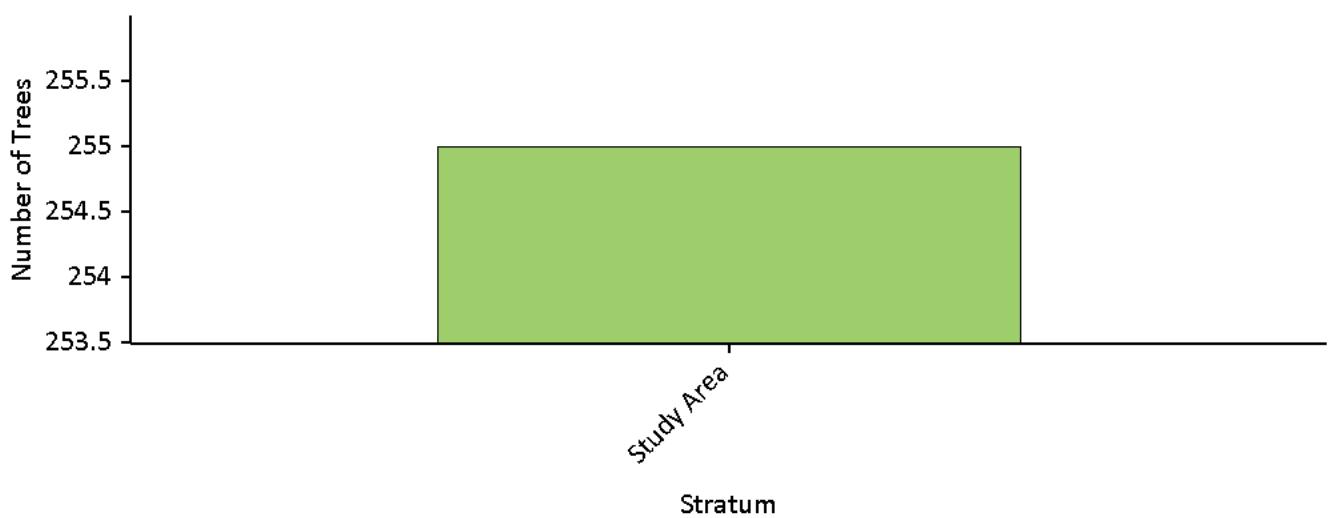


Figure 2. Number of trees in Town Branch Commons by stratum

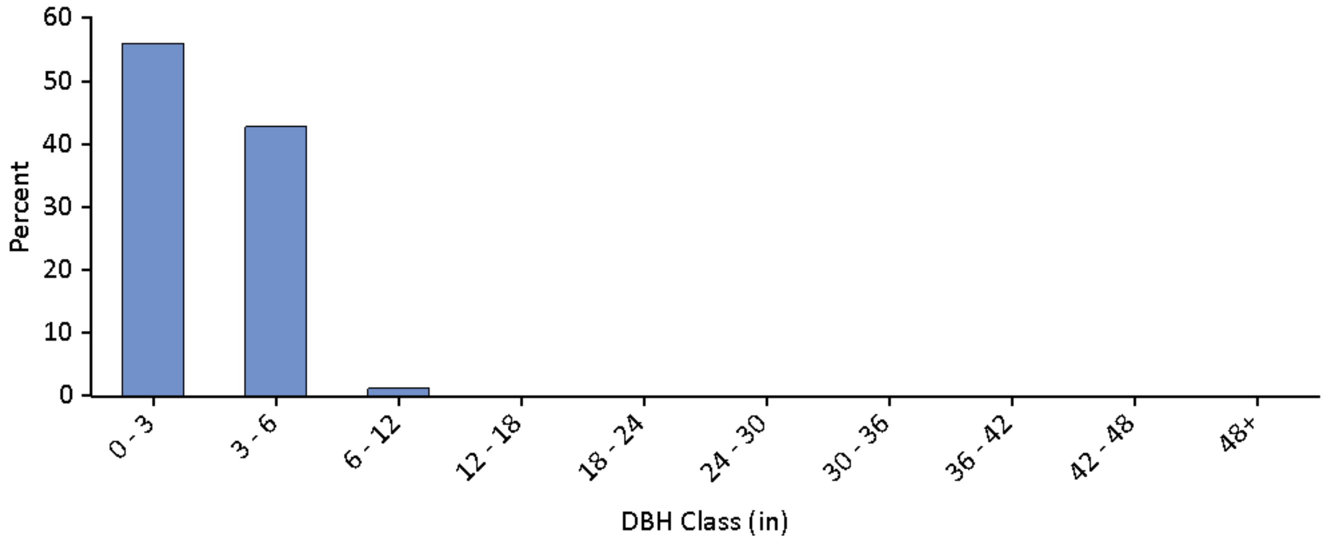


Figure 3. Percent of tree population by diameter class (DBH - stem diameter at 4.5 feet)

Urban forests are composed of a mix of native and exotic tree species. Thus, urban forests often have a tree diversity that is higher than surrounding native landscapes. Increased tree diversity can minimize the overall impact or destruction by a species-specific insect or disease, but it can also pose a risk to native plants if some of the exotic species are invasive plants that can potentially out-compete and displace native species. In Town Branch Commons , about 83 percent of the trees are species native to North America, while 81 percent are native to Kentucky. Species exotic to North America make up 17 percent of the population. Most exotic tree species have an origin from North America + (10 percent of the species).

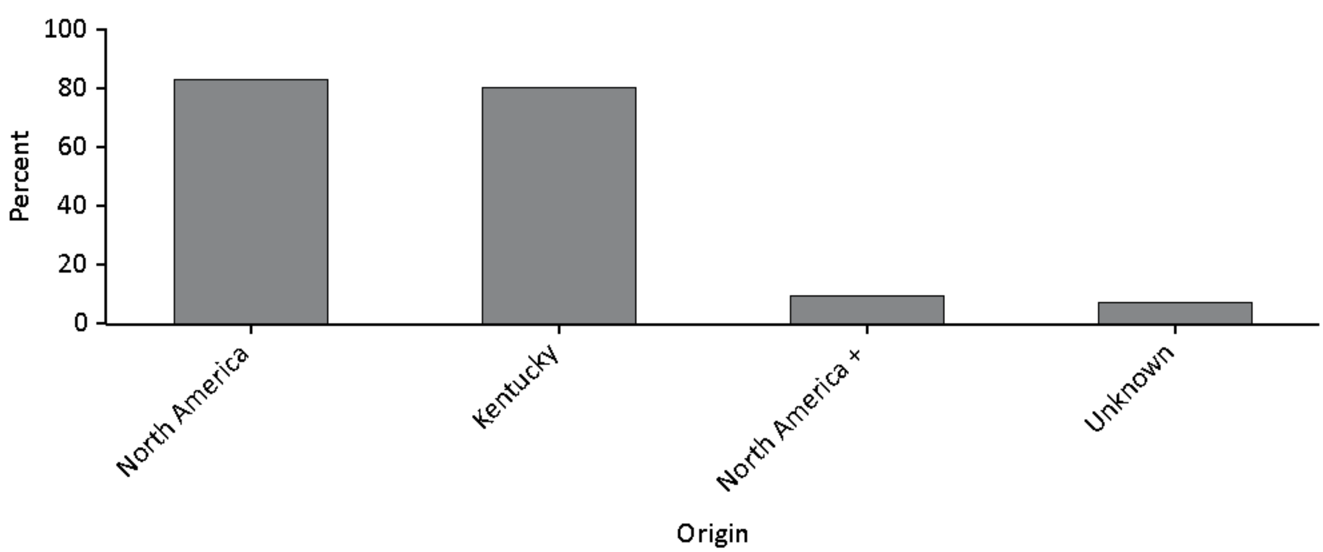


Figure 4. Percent of live tree population by area of native origin, Town Branch Commons

The plus sign (+) indicates the tree species is native to another continent other than the ones listed in the grouping.

Invasive plant species are often characterized by their vigor, ability to adapt, reproductive capacity, and general lack of natural enemies. These abilities enable them to displace native plants and make them a threat to natural areas. Zero of the 16 tree species in Town Branch Commons are identified as invasive on the state invasive species list (Kentucky Exotic Pest Plant Council 2013).

II. Urban Forest Cover and Leaf Area

Many tree benefits equate directly to the amount of healthy leaf surface area of the plant. Trees cover about 20.89 thousand square feet of Town Branch Commons and provide 0.8719 acres of leaf area.

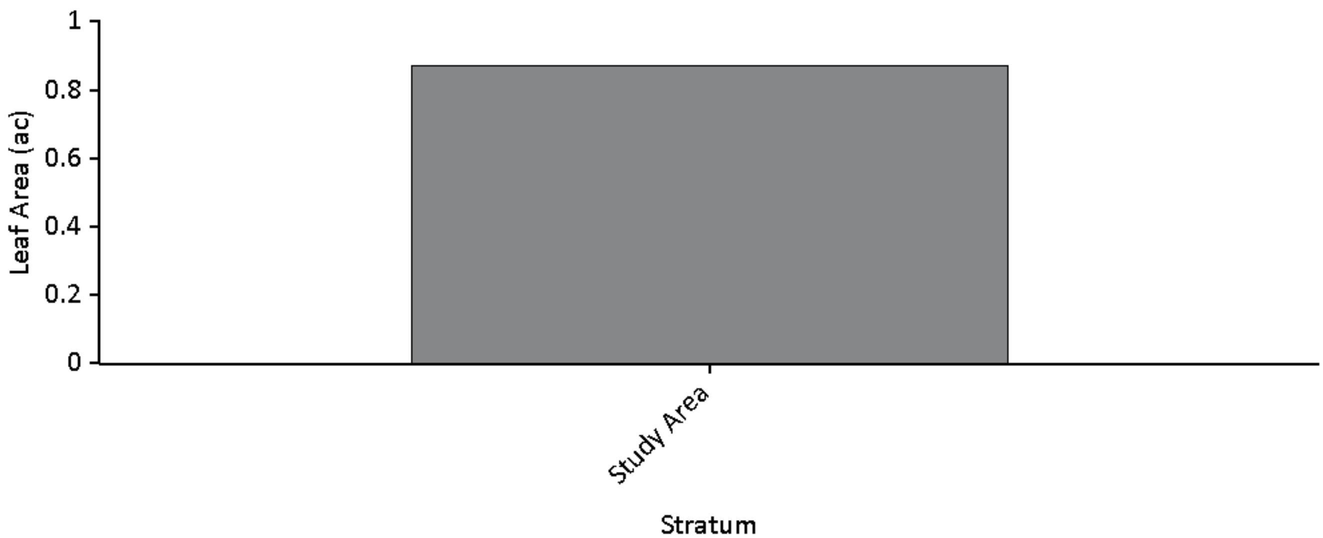


Figure 5. Leaf area by stratum, Town Branch Commons

In Town Branch Commons , the most dominant species in terms of leaf area are Sycamore spp, Thornless honeylocust, and Northern red oak. The 10 species with the greatest importance values are listed in Table 1. Importance values (IV) are calculated as the sum of percent population and percent leaf area. High importance values do not mean that these trees should necessarily be encouraged in the future; rather these species currently dominate the urban forest structure.

Table 1. Most important species in Town Branch Commons

Species Name	*Percent Population*	*Percent Leaf Area*	*IV*
Northern red oak	18.8	13.8	32.7
Sycamore spp	9.0	18.7	27.7
Thornless honeylocust	7.1	17.7	24.8
Black tupelo	13.3	4.9	18.2
Kentucky Coffee tree	4.7	13.3	18.0
Eastern redbud	9.4	6.4	15.8
Scarlet oak	7.1	5.7	12.8
Swamp white oak	6.7	5.2	11.9
Eastern hophornbeam	6.3	3.8	10.1
Green hawthorn	4.7	3.1	7.8

Common ground cover classes (including cover types beneath trees and shrubs) in Town Branch Commons are not available since they are configured not to be collected.

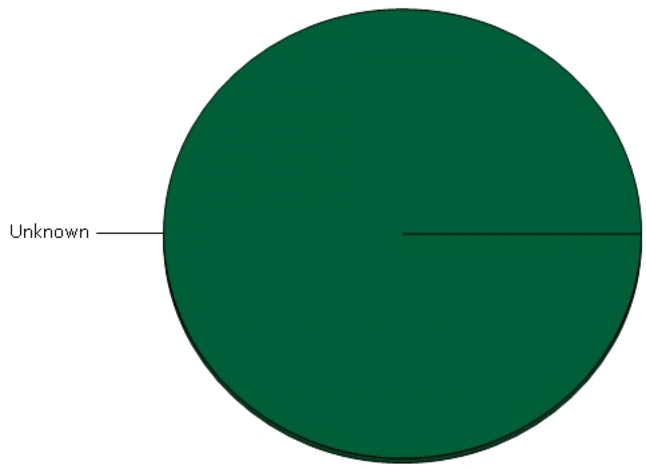


Figure 6. Percent of land by ground cover classes, Town Branch Commons

III. Air Pollution Removal by Urban Trees

Poor air quality is a common problem in many urban areas. It can lead to decreased human health, damage to landscape materials and ecosystem processes, and reduced visibility. The urban forest can help improve air quality by reducing air temperature, directly removing pollutants from the air, and reducing energy consumption in buildings, which consequently reduces air pollutant emissions from the power sources. Trees also emit volatile organic compounds that can contribute to ozone formation. However, integrative studies have revealed that an increase in tree cover leads to reduced ozone formation (Nowak and Dwyer 2000).

Pollution removal[1] by trees in Town Branch Commons was estimated using field data and recent available pollution and weather data available. Pollution removal was greatest for ozone (Figure 7). It is estimated that trees remove 15.48 pounds of air pollution (ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), particulate matter less than 2.5 microns (PM2.5), particulate matter less than 10 microns and greater than 2.5 microns (PM10*)[2], and sulfur dioxide (SO2)) per year with an associated value of $12.8 (see Appendix I for more details).

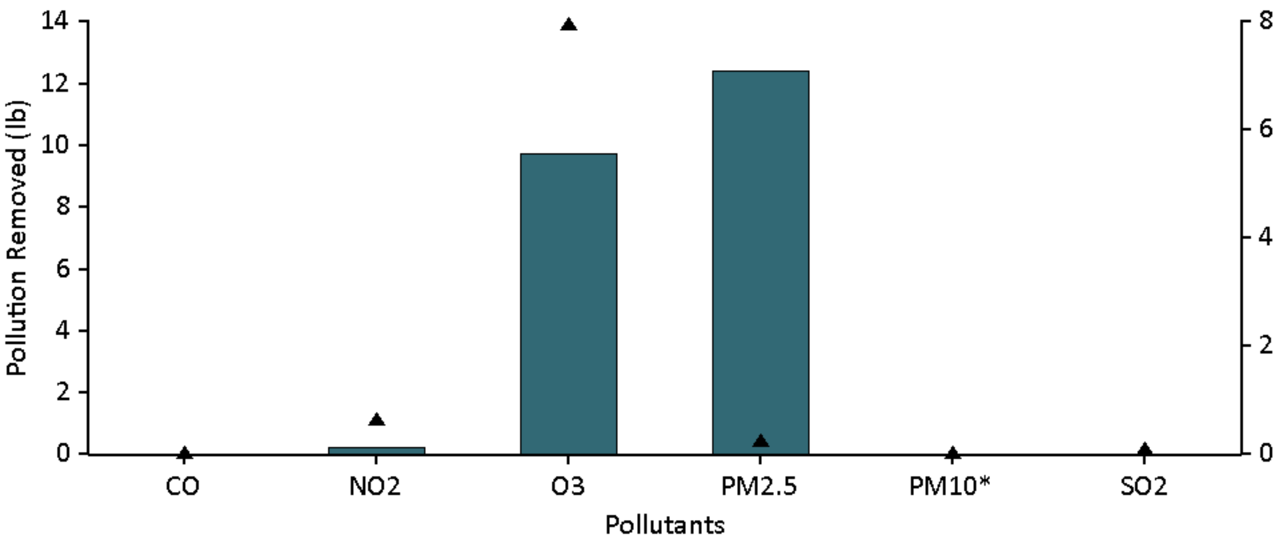


Figure 7. Annual pollution removal (points) and value (bars) by urban trees, Town Branch Commons

[1] PM10* is particulate matter less than 10 microns and greater than 2.5 microns. PM2.5 is particulate matter less than 2.5 microns. If PM2.5 is not monitored, PM10* represents particulate matter less than 10 microns. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

[2] Trees remove PM2.5 and PM10* when particulate matter is deposited on leaf surfaces. This deposited PM2.5 and PM10* can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors (see Appendix I for more details).

In 2025, trees in Town Branch Commons emitted an estimated 14.48 pounds of volatile organic compounds (VOCs) (10.02 pounds of isoprene and 4.457 pounds of monoterpenes). Emissions vary among species based on species characteristics (e.g. some genera such as oaks are high isoprene emitters) and amount of leaf biomass. Fifty- eight percent of the urban forest's VOC emissions were from Northern red oak and Swamp white oak. These VOCs are precursor chemicals to ozone formation.[3]

General recommendations for improving air quality with trees are given in Appendix VIII.

[3] Some economic studies have estimated VOC emission costs. These costs are not included here as there is a tendency to add positive dollar estimates of ozone removal effects with negative dollar values of VOC emission effects to determine whether tree effects are positive or negative in relation to ozone. This combining of dollar values to determine tree effects should not be done, rather estimates of VOC effects on ozone formation (e.g., via photochemical models) should be conducted and directly contrasted with ozone removal by trees (i.e., ozone effects should be directly compared, not dollar estimates). In addition, air temperature reductions by trees have been shown to significantly reduce ozone concentrations (Cardelino and Chameides 1990; Nowak et al 2000), but are not considered in this analysis. Photochemical modeling that integrates tree effects on air temperature, pollution removal, VOC emissions, and emissions from power plants can be used to determine the overall effect of trees on ozone concentrations.

IV. Carbon Storage and Sequestration

Climate change is an issue of global concern. Urban trees can help mitigate climate change by sequestering atmospheric carbon (from carbon dioxide) in tissue and by altering energy use in buildings, and consequently altering carbon dioxide emissions from fossil-fuel based power sources (Abdollahi et al 2000).

Trees reduce the amount of carbon in the atmosphere by sequestering carbon in new growth every year. The amount of carbon annually sequestered is increased with the size and health of the trees. The gross sequestration of Town Branch Commons trees is about 1440 pounds of carbon per year with an associated value of $312. See Appendix I for more details on methods.

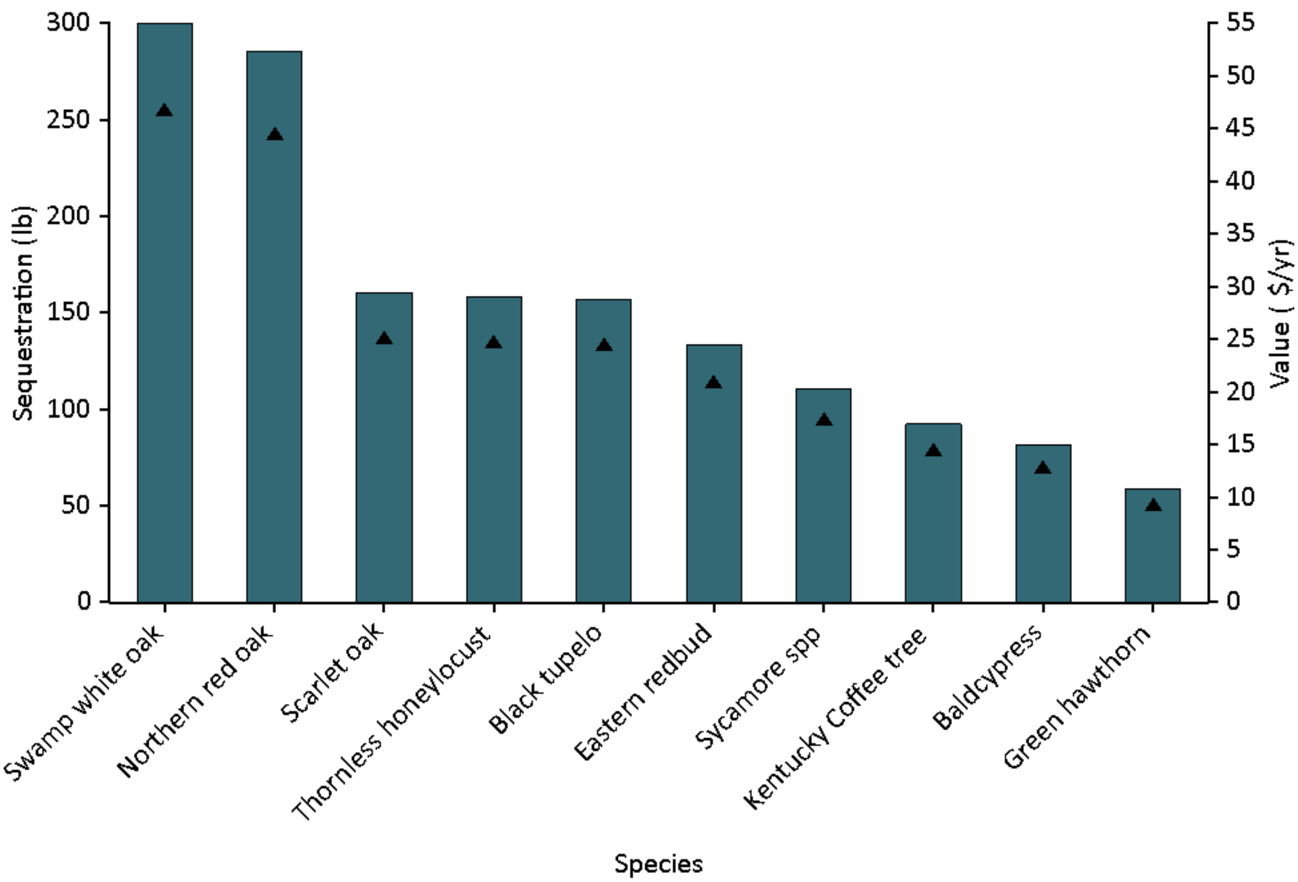


Figure 8. Estimated annual gross carbon sequestration (points) and value (bars) for urban tree species with the greatest sequestration, Town Branch Commons

Carbon storage is another way trees can influence global climate change. As a tree grows, it stores more carbon by holding it in its accumulated tissue. As a tree dies and decays, it releases much of the stored carbon back into the atmosphere. Thus, carbon storage is an indication of the amount of carbon that can be released if trees are allowed to die and decompose. Maintaining healthy trees will keep the carbon stored in trees, but tree maintenance can contribute to carbon emissions (Nowak et al 2002c). When a tree dies, using the wood in long-term wood products, to heat buildings, or to produce energy will help reduce carbon emissions from wood decomposition or from fossil-fuel or wood-based power plants.

Trees in Town Branch Commons are estimated to store 2.58 tons of carbon ($1.12 thousand). Of the species sampled, Swamp white oak stores and sequesters the most carbon (approximately 17.5% of the total carbon stored and 17.6% of all sequestered carbon.)

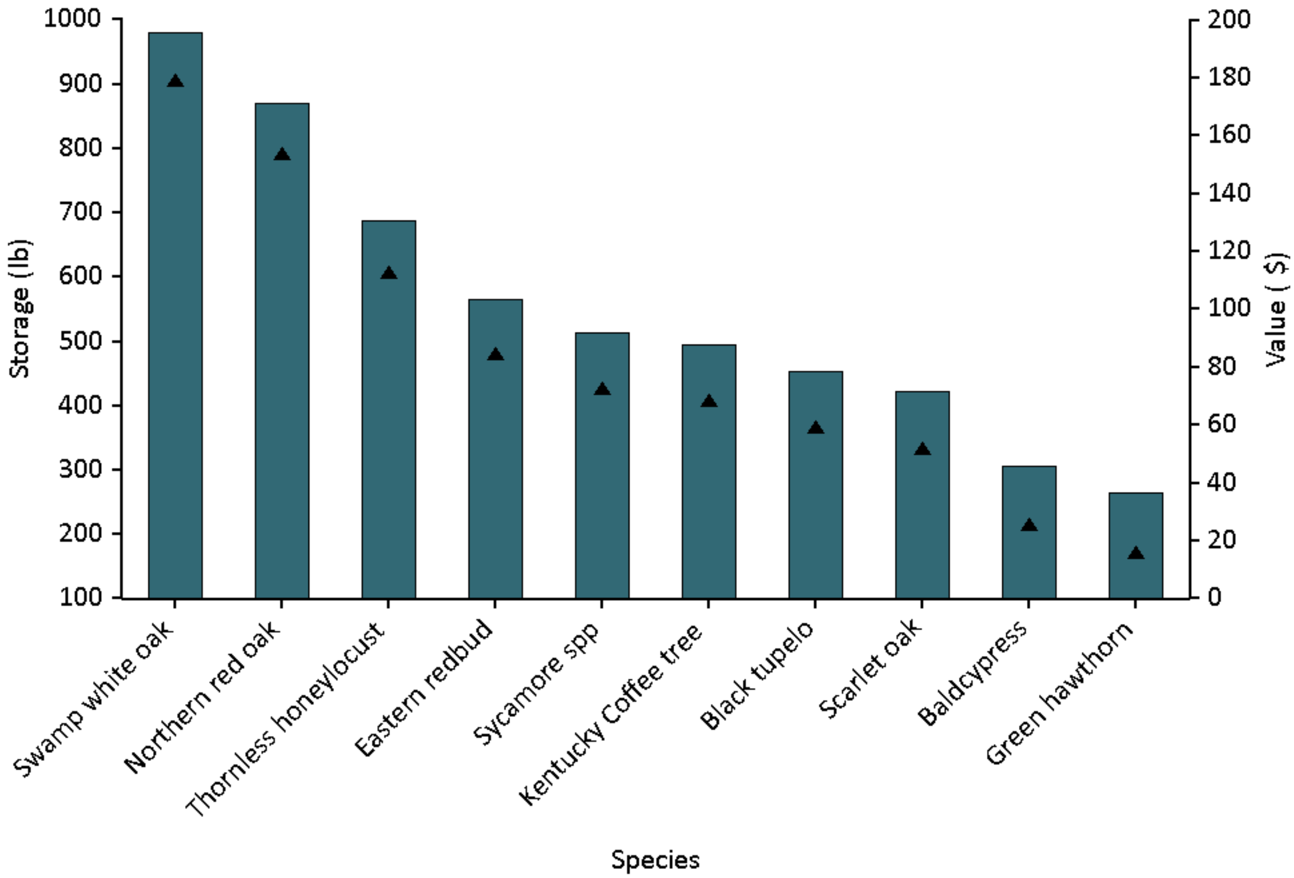


Figure 9. Estimated carbon storage (points) and values (bars) for urban tree species with the greatest storage, Town Branch Commons

V. Oxygen Production

Oxygen production is one of the most commonly cited benefits of urban trees. The annual oxygen production of a tree is directly related to the amount of carbon sequestered by the tree, which is tied to the accumulation of tree biomass.

Trees in Town Branch Commons are estimated to produce 1.921 tons of oxygen per year.[4] However, this tree benefit is relatively insignificant because of the large and relatively stable amount of oxygen in the atmosphere and extensive production by aquatic systems. Our atmosphere has an enormous reserve of oxygen. If all fossil fuel reserves, all trees, and all organic matter in soils were burned, atmospheric oxygen would only drop a few percent (Broecker 1970).

Table 2. The top 16 oxygen production species.

Species	*Oxygen (pound)*	*Gross Carbon Sequestration (pound/yr)*	*Number of Trees*	*Leaf Area (square feet)*
Swamp white oak	677.51	254.07	17	0.00
Northern red oak	645.58	242.09	48	0.01
Scarlet oak	362.81	136.05	18	0.00
Thornless honeylocust	358.20	134.33	18	0.01
Black tupelo	354.30	132.86	34	0.00
Eastern redbud	301.80	113.17	24	0.00
Sycamore spp	250.53	93.95	23	0.01
Kentucky Coffee tree	209.18	78.44	12	0.01
Baldcypress	184.21	69.08	9	0.00
Green hawthorn	132.97	49.87	12	0.00
Eastern hophornbeam	103.68	38.88	16	0.00
Downy serviceberry	79.80	29.92	11	0.00
Sweetbay	77.97	29.24	6	0.00
Oak spp	47.11	17.67	1	0.00
Smooth service berry	44.22	16.58	5	0.00
Sassafras	11.15	4.18	1	0.00

VI. Avoided Runoff

Surface runoff can be a cause for concern in many urban areas as it can contribute pollution to streams, wetlands, rivers, lakes, and oceans. During precipitation events, some portion of the precipitation is intercepted by vegetation (trees and shrubs) while the other portion reaches the ground. The portion of the precipitation that reaches the ground and does not infiltrate into the soil becomes surface runoff (Hirabayashi 2012). In urban areas, the large extent of impervious surfaces increases the amount of surface runoff.

Urban trees and shrubs, however, are beneficial in reducing surface runoff. Trees and shrubs intercept precipitation, while their root systems promote infiltration and storage in the soil. The trees and shrubs of Town Branch Commons help to reduce runoff by an estimated 3 thousand gallons a year with an associated value of $27 (see Appendix I for more details). Avoided runoff is estimated based on local weather from the user-designated weather station. In Town Branch Commons , the total annual precipitation in 2023 was 42.5 inches.

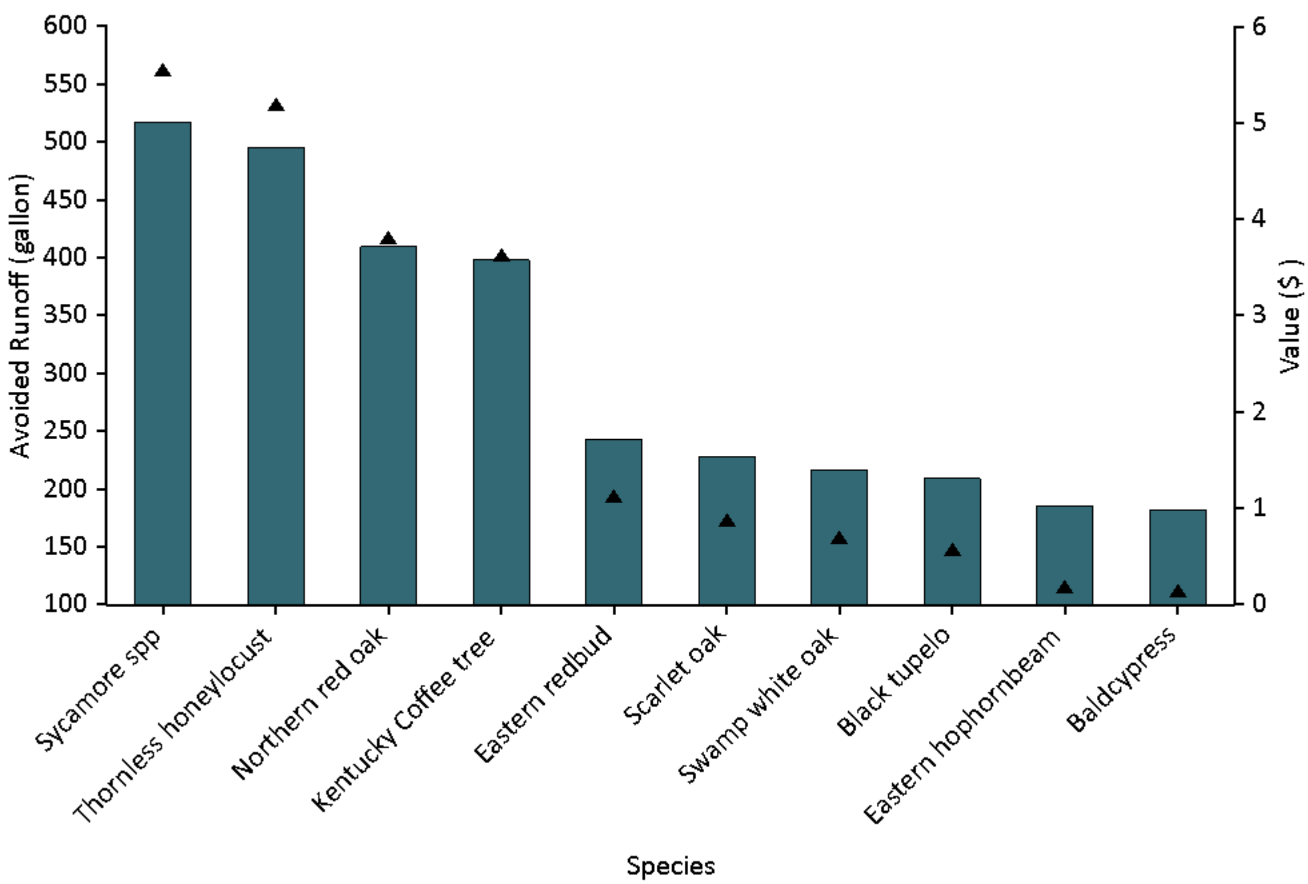


Figure 10. Avoided runoff (points) and value (bars) for species with greatest overall impact on runoff, Town Branch Commons

VII. Trees and Building Energy Use

Trees affect energy consumption by shading buildings, providing evaporative cooling, and blocking winter winds. Trees tend to reduce building energy consumption in the summer months and can either increase or decrease building energy use in the winter months, depending on the location of trees around the building. Estimates of tree effects on energy use are based on field measurements of tree distance and direction to space conditioned residential buildings (McPherson and Simpson 1999).

Because energy-related data were not collected, energy savings and carbon avoided cannot be calculated.

Table 3. Annual energy savings due to trees near residential buildings, Town Branch Commons

	Heating	*Cooling*	*Total*
MBTU[a]	0	N/A	0
MWH[b]	0	0	0
Carbon Avoided (pounds)	0	0	0

[a]MBTU - one million British Thermal Units

[b]MWH - megawatt-hour

Table 4. Annual savings [a]($) in residential energy expenditure during heating and cooling seasons, Town Branch Commons

	Heating	*Cooling*	*Total*
MBTU[b]	0	N/A	0
MWH[c]	0	0	0
Carbon Avoided	0	0	0

[b]Based on the prices of $111.4 per MWH and $12.0383200336993 per MBTU (see Appendix I for more details)

[c]MBTU - one million British Thermal Units

[c]MWH - megawatt-hour

[5] Trees modify climate, produce shade, and reduce wind speeds. Increased energy use or costs are likely due to these tree-building interactions creating a cooling effect during the winter season. For example, a tree (particularly evergreen species) located on the southern side of a residential building may produce a shading effect that causes increases in heating requirements.

VIII. Replacement and Functional Values

Urban forests have a replacement value based on the trees themselves (e.g., the cost of having to replace a tree with a similar tree); they also have functional values (either positive or negative) based on the functions the trees perform.

The replacement value of an urban forest tends to increase with a rise in the number and size of healthy trees (Nowak et al 2002a). Annual functional values also tend to increase with increased number and size of healthy trees. Through proper management, urban forest values can be increased; however, the values and benefits also can decrease as the amount of healthy tree cover declines.

Urban trees in Town Branch Commons have the following replacement values:
- Replacement value: $41.9 thousand
- Carbon storage: $1.12 thousand

Urban trees in Town Branch Commons have the following annual functional values:
- Carbon sequestration: $312
- Avoided runoff: $26.8
- Pollution removal: $12.8
- Energy costs and carbon emission values: $0

(Note: negative value indicates increased energy cost and carbon emission value)

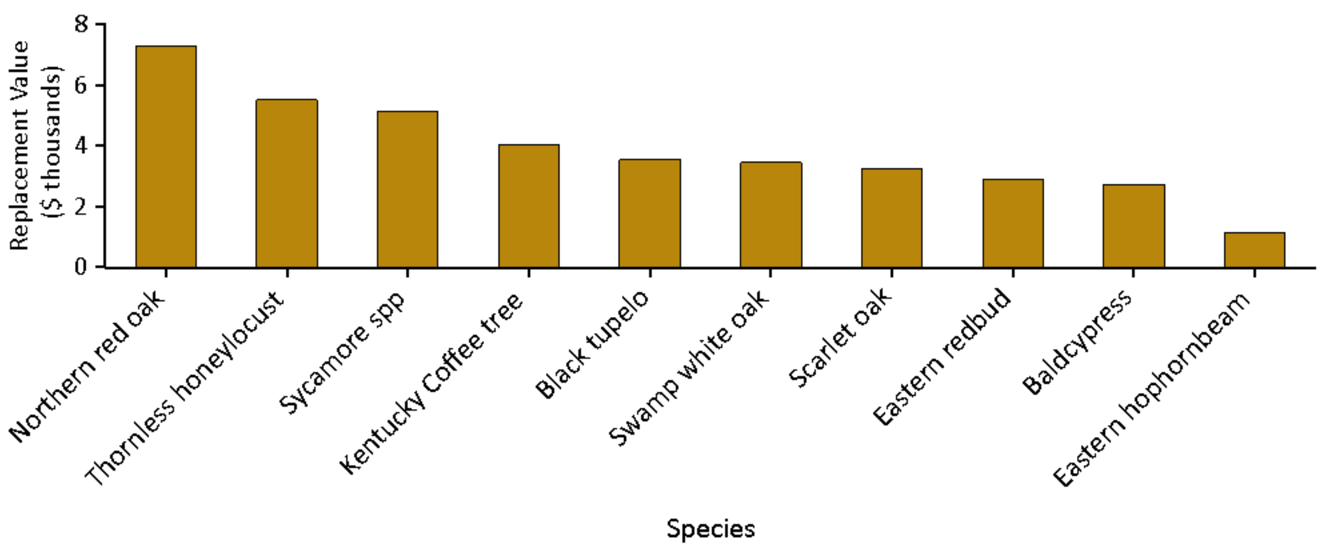


Figure 11. Tree species with the greatest replacement value, Town Branch Commons

IX. Potential Pest Impacts

Various insects and diseases can infest urban forests, potentially killing trees and reducing the health, replacement value and sustainability of the urban forest. As pests tend to have differing tree hosts, the potential damage or risk of each pest will differ among cities.Fifty-three pests were analyzed for their potential impact and compared with pest range maps (Forest Health Technology Enterprise Team 2014) for the conterminous United States to determine their proximity to Fayette County. Seven of the fifty-three pests analyzed are located within the county. For a complete analysis of all pests, see Appendix VII.

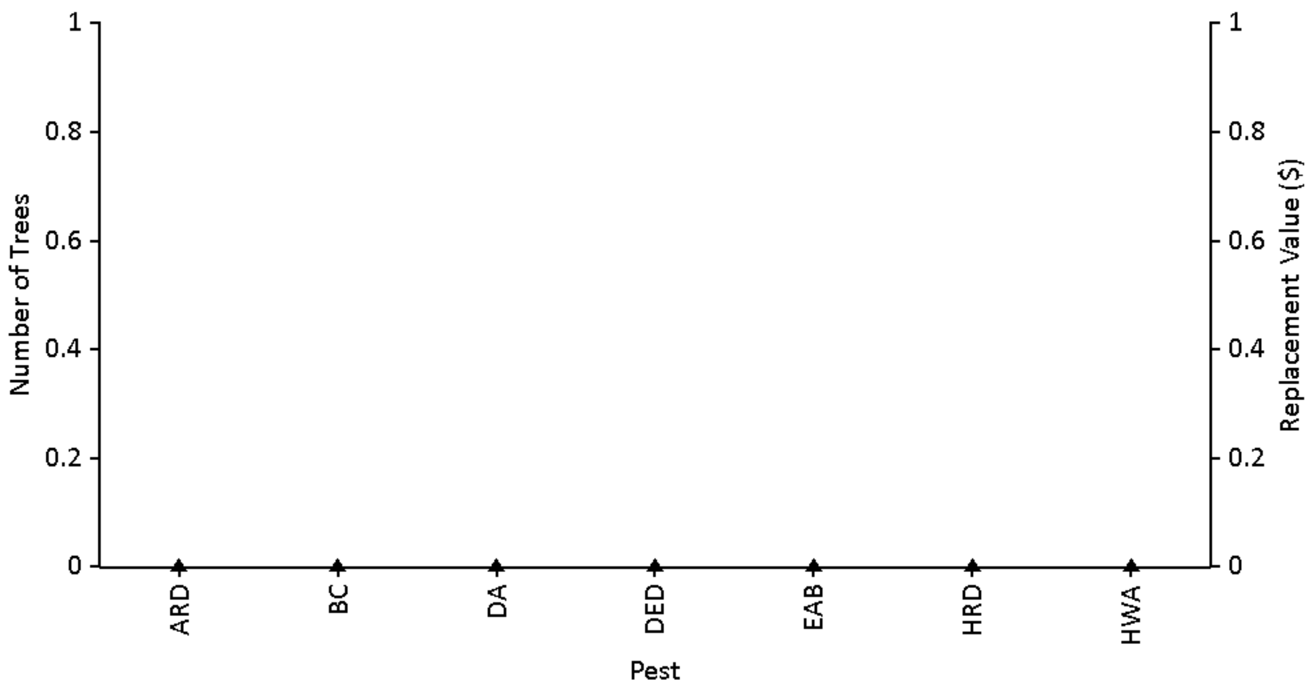


Figure 12. Number of trees at risk (points) and associated compensatory value (bars) for most threatening pests located in the county, Town Branch Commons

Armillaria Root Disease (ARD) poses a threat to 0.0 percent of the Town Branch Commons urban forest, which represents a potential loss of $0 in replacement value.

Butternut canker (BC) (Ostry et al 1996) is caused by a fungus that infects butternut trees. The disease has since caused significant declines in butternut populations in the United States. Potential loss of trees from BC is 0.0 percent ($0 in replacement value).

Dogwood anthracnose (DA) (Mielke and Daughtrey) is a disease that affects dogwood species, specifically flowering and Pacific dogwood. This disease threatens 0.0 percent of the population, which represents a potential loss of $0 in replacement value.

American elm, one of the most important street trees in the twentieth century, has been devastated by the Dutch elm disease (DED) (Northeastern Area State and Private Forestry 1998). Since first reported in the 1930s, it has killed over 50 percent of the native elm population in the United States. Although some elm species have shown varying degrees of resistance, Town Branch Commons could possibly lose 0.0 percent of its trees to this pest ($0 in replacement value).

Emerald ash borer (EAB) (Michigan State University 2010) has killed thousands of ash trees in parts of the United States. EAB has the potential to affect 0.0 percent of the population ($0 in replacement value).

Heterobasidion Root Disease (HRD) poses a threat to 0.0 percent of the Town Branch Commons urban forest, which represents a potential loss of $0 in replacement value.

As one of the most damaging pests to eastern hemlock and Carolina hemlock, hemlock woolly adelgid (HWA) (U.S. Forest Service 2005) has played a large role in hemlock mortality in the United States. HWA has the potential to affect 0.0 percent of the population ($0 in replacement value).

Appendix I. i-Tree Eco Model and Field Measurements

i-Tree Eco is designed to use standardized field data and local hourly air pollution and meteorological data to quantify urban forest structure and its numerous effects (Nowak and Crane 2000), including:

- Urban forest structure (e.g., species composition, tree health, leaf area, etc.).
- Amount of pollution removed hourly by the urban forest, and its associated percent air quality improvement throughout a year.
- Total carbon stored and net carbon annually sequestered by the urban forest.
- Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power sources.
- Replacement value of the forest, as well as the value for air pollution removal and carbon storage and sequestration.
- Potential impact of infestations by pests, such as Asian longhorned beetle, emerald ash borer, spongy moth, and Dutch elm disease.

Typically, all field data are collected during the leaf-on season to properly assess tree canopies. Typical data collection (actual data collection may vary depending upon the user) includes land use, ground and tree cover, individual tree attributes of species, stem diameter, height, crown width, crown canopy missing and dieback, and distance and direction to residential buildings (Nowak et al 2005; Nowak et al 2008).

During data collection, trees are identified to the most specific taxonomic classification possible. Trees that are not classified to the species level may be classified by genus (e.g., ash) or species groups (e.g., hardwood). In this report, tree species, genera, or species groups are collectively referred to as tree species.

Tree Characteristics:

Leaf area of trees was assessed using measurements of crown dimensions and percentage of crown canopy missing. In the event that these data variables were not collected, they are estimated by the model.

An analysis of invasive species is not available for studies outside of the United States. For the U.S., invasive species are identified using an invasive species list (Kentucky Exotic Pest Plant Council 2013)for the state in which the urban forest is located. These lists are not exhaustive and they cover invasive species of varying degrees of invasiveness and distribution. In instances where a state did not have an invasive species list, a list was created based on the lists of the adjacent states. Tree species that are identified as invasive by the state invasive species list are cross-referenced with native range data. This helps eliminate species that are on the state invasive species list, but are native to the study area.

Air Pollution Removal:

Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, particulate matter less than 2.5 microns, and particulate matter less than 10 microns and greater than 2.5 microns. PM2.5 is generally more relevant in discussions concerning air pollution effects on human health.

Air pollution removal estimates are derived from calculated hourly tree-canopy resistances for ozone, and sulfur and nitrogen dioxides based on a hybrid of big-leaf and multi-layer canopy deposition models (Baldocchi 1988; Baldocchi et al 1987). As the removal of carbon monoxide and particulate matter by vegetation is not directly related to transpiration, removal rates (deposition velocities) for these pollutants were based on average measured values from the literature (Bidwell and Fraser 1972; Lovett 1994) that were adjusted depending on leaf phenology and leaf area. Particulate removal incorporated a 50 percent resuspension rate of particles back to the atmosphere (Zinke 1967). Recent updates (2011) to air quality modeling are based on improved leaf area index simulations, weather and pollution processing and interpolation, and updated pollutant monetary values (Hirabayashi et al 2011; Hirabayashi et al 2012;

Hirabayashi 2011).

Trees remove PM2.5 and PM10* when particulate matter is deposited on leaf surfaces (Nowak et al 2013). This deposited PM2.5 and PM10* can be resuspended to the atmosphere or removed during rain events and dissolved or transferred to the soil. This combination of events can lead to positive or negative pollution removal and value depending on various atmospheric factors. Generally, PM2.5 and PM10* removal is positive with positive benefits. However, there are some cases when net removal is negative or resuspended particles lead to increased pollution concentrations and negative values. During some months (e.g., with no rain), trees resuspend more particles than they remove. Resuspension can also lead to increased overall PM2.5 and PM10* concentrations if the boundary layer conditions are lower during net resuspension periods than during net removal periods. Since the pollution removal value is based on the change in pollution concentration, it is possible to have situations when trees remove PM2.5 and PM10* but increase concentrations and thus have negative values during periods of positive overall removal. These events are not common, but can happen.

For reports in the United States, default air pollution removal value is calculated based on local incidence of adverse health effects and national median externality costs. The number of adverse health effects and associated economic value is calculated for ozone, sulfur dioxide, nitrogen dioxide, and particulate matter less than 2.5 microns using data from the U.S. Environmental Protection Agency's Environmental Benefits Mapping and Analysis Program (BenMAP) (Nowak et al 2014). The model uses a damage-function approach that is based on the local change in pollution concentration and population. National median externality costs were used to calculate the value of carbon monoxide removal (Murray et al 1994).

For international reports, user-defined local pollution values are used. For international reports that do not have local values, estimates are based on either European median externality values (van Essen et al 2011) or BenMAP regression equations (Nowak et al 2014) that incorporate user-defined population estimates. Values are then converted to local currency with user-defined exchange rates.

For this analysis, pollution removal value is calculated based on the prices of $0 per ton (carbon monoxide), $801 per ton (ozone), $242 per ton (nitrogen dioxide), $58 per ton (sulfur dioxide), $37,694 per ton (particulate matter less than 2.5 microns), $0 per ton (particulate matter less than 10 microns and greater than 2.5 microns).

Carbon Storage and Sequestration:

Carbon storage is the amount of carbon bound up in the above-ground and below-ground parts of woody vegetation. To calculate current carbon storage, biomass for each tree was calculated using equations from the literature and measured tree data. Open-grown, maintained trees tend to have less biomass than predicted by forest-derived biomass equations (Nowak 1994). To adjust for this difference, biomass results for open-grown urban trees were multiplied by 0.8. No adjustment was made for trees found in natural stand conditions. Tree dry-weight biomass was converted to stored carbon by multiplying by 0.5.

Carbon sequestration is the removal of carbon dioxide from the air by plants. To estimate the gross amount of carbon sequestered annually, average diameter growth from the appropriate genera and diameter class and tree condition was added to the existing tree diameter (year x) to estimate tree diameter and carbon storage in year x+1.

Carbon storage and carbon sequestration values are based on estimated or customized local carbon values. For international reports that do not have local values, estimates are based on the carbon value for the United States (U.S. Environmental Protection Agency 2015, Interagency Working Group on Social Cost of Carbon 2015) and converted to local currency with user-defined exchange rates.

For this analysis, carbon storage and carbon sequestration values are calculated based on $433 per ton.

Oxygen Production:

The amount of oxygen produced is estimated from carbon sequestration based on atomic weights: net O2 release (kg/yr) = net C sequestration (kg/yr) × 32/12. To estimate the net carbon sequestration rate, the amount of carbon sequestered as a result of tree growth is reduced by the amount lost resulting from tree mortality. Thus, net carbon sequestration and net annual oxygen production of the urban forest account for decomposition (Nowak et al 2007). For complete inventory projects, oxygen production is estimated from gross carbon sequestration and does not account for decomposition.

Avoided Runoff:

Annual avoided surface runoff is calculated based on rainfall interception by vegetation, specifically the difference between annual runoff with and without vegetation. Although tree leaves, branches, and bark may intercept precipitation and thus mitigate surface runoff, only the precipitation intercepted by leaves is accounted for in this analysis.

The value of avoided runoff is based on estimated or user-defined local values. For international reports that do not have local values, the national average value for the United States is utilized and converted to local currency with user-defined exchange rates. The U.S. value of avoided runoff is based on the U.S. Forest Service's Community Tree Guide Series (McPherson et al 1999; 2000; 2001; 2002; 2003; 2004; 2006a; 2006b; 2006c; 2007; 2010; Peper et al 2009; 2010; Vargas et al 2007a; 2007b; 2008).

For this analysis, avoided runoff value is calculated based on the price of $0.01 per gallon.

Building Energy Use:

If appropriate field data were collected, seasonal effects of trees on residential building energy use were calculated based on procedures described in the literature (McPherson and Simpson 1999) using distance and direction of trees from residential structures, tree height and tree condition data. To calculate the monetary value of energy savings, local or custom prices per MWH or MBTU are utilized.

For this analysis, energy saving value is calculated based on the prices of $111.40 per MWH and $12.04 per MBTU.

Replacement Values:

Replacement value is the value of a tree based on the physical resource itself (e.g., the cost of having to replace a tree with a similar tree). Replacement values were based on valuation procedures of the Council of Tree and Landscape Appraisers, which uses tree species, diameter, condition, and location information (Nowak et al 2002a; 2002b). Replacement value may not be included for international projects if there is insufficient local data to complete the valuation procedures.

Potential Pest Impacts:

The complete potential pest risk analysis is not available for studies outside of the United States. The number of trees at risk to the pests analyzed is reported, though the list of pests is based on known insects and disease in the United States.

For the U.S., potential pest risk is based on pest range maps and the known pest host species that are likely to experience mortality. Pest range maps for 2012 from the Forest Health Technology Enterprise Team (FHTET) (Forest Health Technology Enterprise Team 2014) were used to determine the proximity of each pest to the county in which the urban forest is located. For the county, it was established whether the insect/disease occurs within the county, is within 250 miles of the county edge, is between 250 and 750 miles away, or is greater than 750 miles away. FHTET did not have pest range maps for Dutch elm disease and chestnut blight. The range of these pests was based on known occurrence and the host range, respectively (Eastern Forest Environmental Threat Assessment Center; Worrall 2007).

Relative Tree Effects:

The relative value of tree benefits reported in Appendix II is calculated to show what carbon storage and sequestration, and air pollutant removal equate to in amounts of municipal carbon emissions, passenger automobile emissions, and house emissions.

Municipal carbon emissions are based on 2010 U.S. per capita carbon emissions (Carbon Dioxide Information Analysis Center 2010). Per capita emissions were multiplied by city population to estimate total city carbon emissions.

Light duty vehicle emission rates (g/mi) for CO, NOx, VOCs, PM10, SO2 for 2010 (Bureau of Transportation Statistics 2010; Heirigs et al 2004), PM2.5 for 2011-2015 (California Air Resources Board 2013), and CO2 for 2011 (U.S. Environmental Protection Agency 2010) were multiplied by average miles driven per vehicle in 2011 (Federal Highway Administration 2013) to determine average emissions per vehicle.

Household emissions are based on average electricity kWh usage, natural gas Btu usage, fuel oil Btu usage, kerosene Btu usage, LPG Btu usage, and wood Btu usage per household in 2009 (Energy Information Administration 2013; Energy Information Administration 2014)

- CO2, SO2, and NOx power plant emission per KWh are from Leonardo Academy 2011. CO emission per kWh assumes 1/3 of one percent of C emissions is CO based on Energy Information Administration 1994. PM10 emission per kWh from Layton 2004.
- CO2, NOx, SO2, and CO emission per Btu for natural gas, propane and butane (average used to represent LPG), Fuel #4 and #6 (average used to represent fuel oil and kerosene) from Leonardo Academy 2011.
- CO2 emissions per Btu of wood from Energy Information Administration 2014.
- CO, NOx and SOx emission per Btu based on total emissions and wood burning (tons) from (British Columbia Ministry 2005; Georgia Forestry Commission 2009).

Appendix II. Relative Tree Effects

The urban forest in Town Branch Commons provides benefits that include carbon storage and sequestration, and air pollutant removal. To estimate the relative value of these benefits, tree benefits were compared to estimates of average municipal carbon emissions, average passenger automobile emissions, and average household emissions. See Appendix I for methodology.

Carbon storage is equivalent to:

- Amount of carbon emitted in Town Branch Commons in 0 days
- Annual carbon (C) emissions from 2 automobiles
- Annual C emissions from 1 single-family houses

Carbon monoxide removal is equivalent to:

- Annual carbon monoxide emissions from 0 automobiles
- Annual carbon monoxide emissions from 0 single-family houses

Nitrogen dioxide removal is equivalent to:

- Annual nitrogen dioxide emissions from 0 automobiles
- Annual nitrogen dioxide emissions from 0 single-family houses

Sulfur dioxide removal is equivalent to:

- Annual sulfur dioxide emissions from 1 automobiles
- Annual sulfur dioxide emissions from 0 single-family houses

Annual carbon sequestration is equivalent to:

- Amount of carbon emitted in Town Branch Commons in 0.0 days
- Annual C emissions from 1 automobiles
- Annual C emissions from 0 single-family houses

Appendix III. Comparison of Urban Forests

A common question asked is, "How does this city compare to other cities?" Although comparison among cities should be made with caution as there are many attributes of a city that affect urban forest structure and functions, summary data are provided from other cities analyzed using the i-Tree Eco model.

I. City totals for trees

City	*% Tree Cover*	*Number of Trees*	*Carbon Storage (tons)*	*Carbon Sequestration (tons/yr)*	*Pollution Removal (tons/yr)*
Toronto, ON, Canada	26.6	10,220,000	1,221,000	51,500	2,099
Atlanta, GA	36.7	9,415,000	1,344,000	46,400	1,663
Los Angeles, CA	11.1	5,993,000	1,269,000	77,000	1,975
New York, NY	20.9	5,212,000	1,350,000	42,300	1,676
London, ON, Canada	24.7	4,376,000	396,000	13,700	408
Chicago, IL	17.2	3,585,000	716,000	25,200	888
Phoenix, AZ	9.0	3,166,000	315,000	32,800	563
Baltimore, MD	21.0	2,479,000	570,000	18,400	430
Philadelphia, PA	15.7	2,113,000	530,000	16,100	575
Washington, DC	28.6	1,928,000	525,000	16,200	418
Oakville, ON , Canada	29.1	1,908,000	147,000	6,600	190
Albuquerque, NM	14.3	1,846,000	332,000	10,600	248
Boston, MA	22.3	1,183,000	319,000	10,500	283
Syracuse, NY	26.9	1,088,000	183,000	5,900	109
Woodbridge, NJ	29.5	986,000	160,000	5,600	210
Minneapolis, MN	26.4	979,000	250,000	8,900	305
San Francisco, CA	11.9	668,000	194,000	5,100	141
Morgantown, WV	35.5	658,000	93,000	2,900	72
Moorestown, NJ	28.0	583,000	117,000	3,800	118
Hartford, CT	25.9	568,000	143,000	4,300	58
Jersey City, NJ	11.5	136,000	21,000	890	41
Casper, WY	8.9	123,000	37,000	1,200	37
Freehold, NJ	34.4	48,000	20,000	540	22

II. Totals per acre of land area

City	*Number of Trees/ac*	*Carbon Storage (tons/ac)*	*Carbon Sequestration (tons/ac/yr)*	*Pollution Removal (lb/ac/yr)*
Toronto, ON, Canada	64.9	7.8	0.33	26.7
Atlanta, GA	111.6	15.9	0.55	39.4
Los Angeles, CA	19.6	4.2	0.16	13.1
New York, NY	26.4	6.8	0.21	17.0
London, ON, Canada	75.1	6.8	0.24	14.0
Chicago, IL	24.2	4.8	0.17	12.0
Phoenix, AZ	12.9	1.3	0.13	4.6
Baltimore, MD	48.0	11.1	0.36	16.6
Philadelphia, PA	25.1	6.3	0.19	13.6
Washington, DC	49.0	13.3	0.41	21.2
Oakville, ON , Canada	78.1	6.0	0.27	11.0
Albuquerque, NM	21.8	3.9	0.12	5.9
Boston, MA	33.5	9.1	0.30	16.1
Syracuse, NY	67.7	10.3	0.34	13.6
Woodbridge, NJ	66.5	10.8	0.38	28.4
Minneapolis, MN	26.2	6.7	0.24	16.3
San Francisco, CA	22.5	6.6	0.17	9.5
Morgantown, WV	119.2	16.8	0.52	26.0
Moorestown, NJ	62.1	12.4	0.40	25.1
Hartford, CT	50.4	12.7	0.38	10.2
Jersey City, NJ	14.4	2.2	0.09	8.6
Casper, WY	9.1	2.8	0.09	5.5
Freehold, NJ	38.3	16.0	0.44	35.3

Appendix IV. General Recommendations for Air Quality Improvement

Urban vegetation can directly and indirectly affect local and regional air quality by altering the urban atmosphere environment. Four main ways that urban trees affect air quality are (Nowak 1995):

- Temperature reduction and other microclimate effects
- Removal of air pollutants
- Emission of volatile organic compounds (VOC) and tree maintenance emissions
- Energy effects on buildings

The cumulative and interactive effects of trees on climate, pollution removal, and VOC and power plant emissions determine the impact of trees on air pollution. Cumulative studies involving urban tree impacts on ozone have revealed that increased urban canopy cover, particularly with low VOC emitting species, leads to reduced ozone concentrations in cities (Nowak 2000). Local urban management decisions also can help improve air quality.

Urban forest management strategies to help improve air quality include (Nowak 2000):

Strategy	*Result*
Increase the number of healthy trees	Increase pollution removal
Sustain existing tree cover	Maintain pollution removal levels
Maximize use of low VOC-emitting trees	Reduces ozone and carbon monoxide formation
Sustain large, healthy trees	Large trees have greatest per-tree effects
Use long-lived trees	Reduce long-term pollutant emissions from planting and removal
Use low maintenance trees	Reduce pollutants emissions from maintenance activities
Reduce fossil fuel use in maintaining vegetation	Reduce pollutant emissions
Plant trees in energy conserving locations	Reduce pollutant emissions from power plants
Plant trees to shade parked cars	Reduce vehicular VOC emissions
Supply ample water to vegetation	Enhance pollution removal and temperature reduction
Plant trees in polluted or heavily populated areas	Maximizes tree air quality benefits
Avoid pollutant-sensitive species	Improve tree health
Utilize evergreen trees for particulate matter	Year-round removal of particles

Appendix V. Invasive Species of the Urban Forest

The following inventoried tree species were listed as invasive on the Kentucky invasive species list (Kentucky Exotic Pest Plant Council 2013):

Species Name[a]	*Number of Trees*	*% of Trees*	*Leaf Area (ac)*	*Percent Leaf Area*
Total	**0**	**0.00**	**0.00**	**0.00**

[a]Species are determined to be invasive if they are listed on the state's invasive species list

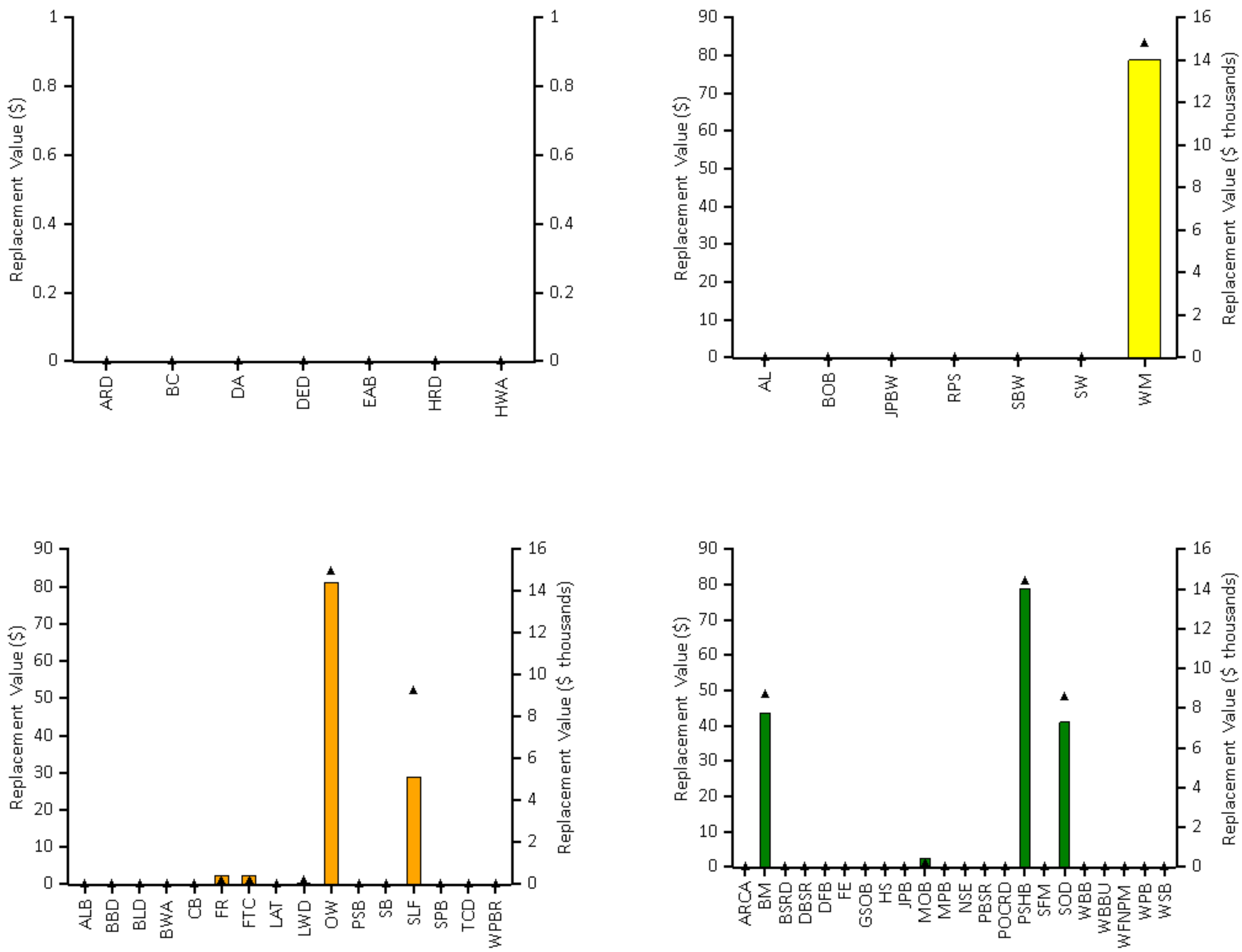
Appendix VI. Potential Risk of Pests

Fifty-three insects and diseases were analyzed to quantify their potential impact on the urban forest. As each insect/ disease is likely to attack different host tree species, the implications for {0} will vary. The number of trees at risk reflects only the known host species that are likely to experience mortality.

Code	Scientific Name	Common Name	Trees at Risk (#)	Value ($ thousands)
AL	Phyllocnistis populiella	Aspen Leafminer	0	0.00
ALB	Anoplophora glabripennis	Asian Longhorned Beetle	0	0.00
ARCA	Neodothiora populina	Aspen Running Canker	0	0.00
ARD	Armillaria spp.	Armillaria Root Disease	0	0.00
BBD	Neonectria faginata	Beech Bark Disease	0	0.00
BC	Sirococcus clavigignenti juglandacearum	Butternut Canker	0	0.00
BLD	Litylenchus crenatae mccannii	Beech Leaf Disease	0	0.00
BM	Euproctis chrysorrhoea	Browntail Moth	49	7.73
BOB	Tubakia iowensis	Bur Oak Blight	0	0.00
BSRD	Leptographium wageneri	Black Stain Root Disease	0	0.00
BWA	Adelges piceae	Balsam Woolly Adelgid	0	0.00
CB	Cryphonectria parasitica	Chestnut Blight	0	0.00
DA	Discula destructiva	Dogwood Anthracnose	0	0.00
DBSR	Leptographium wageneri var. pseudotsugae	Douglas-fir Black Stain Root Disease	0	0.00
DED	Ophiostoma novo-ulmi	Dutch Elm Disease	0	0.00
DFB	Dendroctonus pseudotsugae	Douglas-Fir Beetle	0	0.00
EAB	Agrilus planipennis	Emerald Ash Borer	0	0.00
FE	Scolytus ventralis	Fir Engraver	0	0.00
FR	Cronartium quercuum f. sp. Fusiforme	Fusiform Rust	1	0.42
FTC	Malacosoma disstria	Forest Tent Caterpillar	1	0.42
GSOB	Agrilus auroguttatus	Goldspotted Oak Borer	0	0.00
HRD	Heterobasidion irregulare/ occidentale	Heterobasidion Root Disease	0	0.00
HS	Neodiprion tsugae	Hemlock Sawfly	0	0.00
HWA	Adelges tsugae	Hemlock Woolly Adelgid	0	0.00
JPB	Dendroctonus jeffreyi	Jeffrey Pine Beetle	0	0.00
JPBW	Choristoneura pinus	Jack Pine Budworm	0	0.00
LAT	Choristoneura conflictana	Large Aspen Tortrix	0	0.00
LWD	Raffaelea lauricola	Laurel Wilt	1	0.05
MOB	Xyleborus monographus	Mediterranean Oak Borer	1	0.42
MPB	Dendroctonus ponderosae	Mountain Pine Beetle	0	0.00
NSE	Ips perturbatus	Northern Spruce Engraver	0	0.00
OW	Bretziella fagacearum	Oak Wilt	84	14.44
PBSR	Leptographium wageneri var. ponderosum	Pine Black Stain Root Disease	0	0.00
POCRD	Phytophthora lateralis	Port-Orford-Cedar Root Disease	0	0.00
PSB	Tomicus piniperda	Pine Shoot Beetle	0	0.00

Code	Scientific Name	Common Name	Trees at Risk (#)	Value ($ thousands)
PSHB	Euwallacea nov. sp.	Polyphagous Shot Hole Borer	81	14.01
RPS	Matsucoccus resinosae	Red Pine Scale	0	0.00
SB	Dendroctonus rufipennis	Spruce Beetle	0	0.00
SBW	Choristoneura fumiferana	Spruce Budworm	0	0.00
SFM	subalpine fir mortality summary	Subalpine Fir Mortality	0	0.00
SLF	Lycorma delicatula	Spotted Lanternfly	52	5.14
SOD	Phytophthora ramorum	Sudden Oak Death	48	7.30
SPB	Dendroctonus frontalis	Southern Pine Beetle	0	0.00
SW	Sirex noctilio	Sirex Wood Wasp	0	0.00
TCD	Geosmithia morbida	Thousand Canker Disease	0	0.00
WBB	Dryocoetes confusus	Western Balsam Bark Beetle	0	0.00
WBBU	Acleris gloverana	Western Blackheaded Budworm	0	0.00
WFNPM	western five-needle pine mortality summary	Western Five-Needle Pine Mortality	0	0.00
WM	Operophtera brumata	Winter Moth	83	14.01
WPB	Dendroctonus brevicomis	Western Pine Beetle	0	0.00
WPBR	Cronartium ribicola	White Pine Blister Rust	0	0.00
WSB	Choristoneura occidentalis	Western Spruce Budworm	0	0.00

In the following graph, the pests are color coded according to the county's proximity to the pest occurrence in the United States. Red indicates that the pest is within the county; orange indicates that the pest is within 250 miles of the county; yellow indicates that the pest is within 750 miles of the county; and green indicates that the pest is outside of these ranges.



Note: points - Number of trees, bars - Replacement value

Based on the host tree species for each pest and the current range of the pest (Forest Health Technology Enterprise Team 2014), it is possible to determine what the risk is that each tree species in the urban forest could be attacked by an insect or disease.

Spp. Risk	Risk Weight	Species Name	AL	ALB	ARCA	ARD	BBD	BC	BLD	BM	BOB	BSRD	BWA	CB	DA	DBSR	DED	DFB	EAB	FE	FR	FTC	GSOB	HRD	HS	HWA	JPB	JPBW	LAT	LWD	MOB	MPB	NSE	OW	PBSR
Orange	14	Oak spp								Green											Orange	Orange									Green			Orange	
Orange	8	Northern red oak								Green																								Orange	
Orange	6	Scarlet oak																																Orange	
Orange	6	Sassafras																												Orange					
Orange	5	Swamp white oak																																Orange	
Orange	3	Black tupelo																																	
Orange	3	Eastern hophornbeam																																	
Green	1	Baldcypress																																	
Green	1	Sweetbay																																	

Spp. Risk	Risk Weight	Species Name	POCRD	PSB	PSHB	RPS	SB	SBW	SFM	SLF	SOD	SPB	SW	TCD	WBB	WBBU	WFNPM	WM	WPB	WPBR	WSB
Orange	14	Oak spp								Orange											
Orange	8	Northern red oak			Green						Green							Yellow			
Orange	6	Scarlet oak			Green													Yellow			
Orange	6	Sassafras								Orange											
Orange	5	Swamp white oak																Yellow			
Orange	3	Black tupelo								Orange											
Orange	3	Eastern hophornbeam								Orange											
Green	1	Baldcypress			Green																
Green	1	Sweetbay			Green																

<u>Note:</u>
Species that are not listed in the matrix are not known to be hosts to any of the pests analyzed.

<u>Species Risk:</u>

- Red indicates that tree species is at risk to at least one pest within county
- Orange indicates that tree species has no risk to pests in county, but has a risk to at least one pest within 250 miles from the county
- Yellow indicates that tree species has no risk to pests within 250 miles of county, but has a risk to at least one pest that is 250 and 750 miles from the county
- Green indicates that tree species has no risk to pests within 750 miles of county, but has a risk to at least one pest that is greater than 750 miles from the county

<u>Risk Weight:</u>
Numerical scoring system based on sum of points assigned to pest risks for species. Each pest that could attack tree species is scored as 4 points if red, 3 points if orange, 2 points if yellow and 1 point if green.

<u>Pest Color Codes:</u>

- Red indicates pest is within Fayette county
- Red indicates pest is within 250 miles county
- Yellow indicates pest is within 750 miles of Fayette county
- Green indicates pest is outside of these ranges

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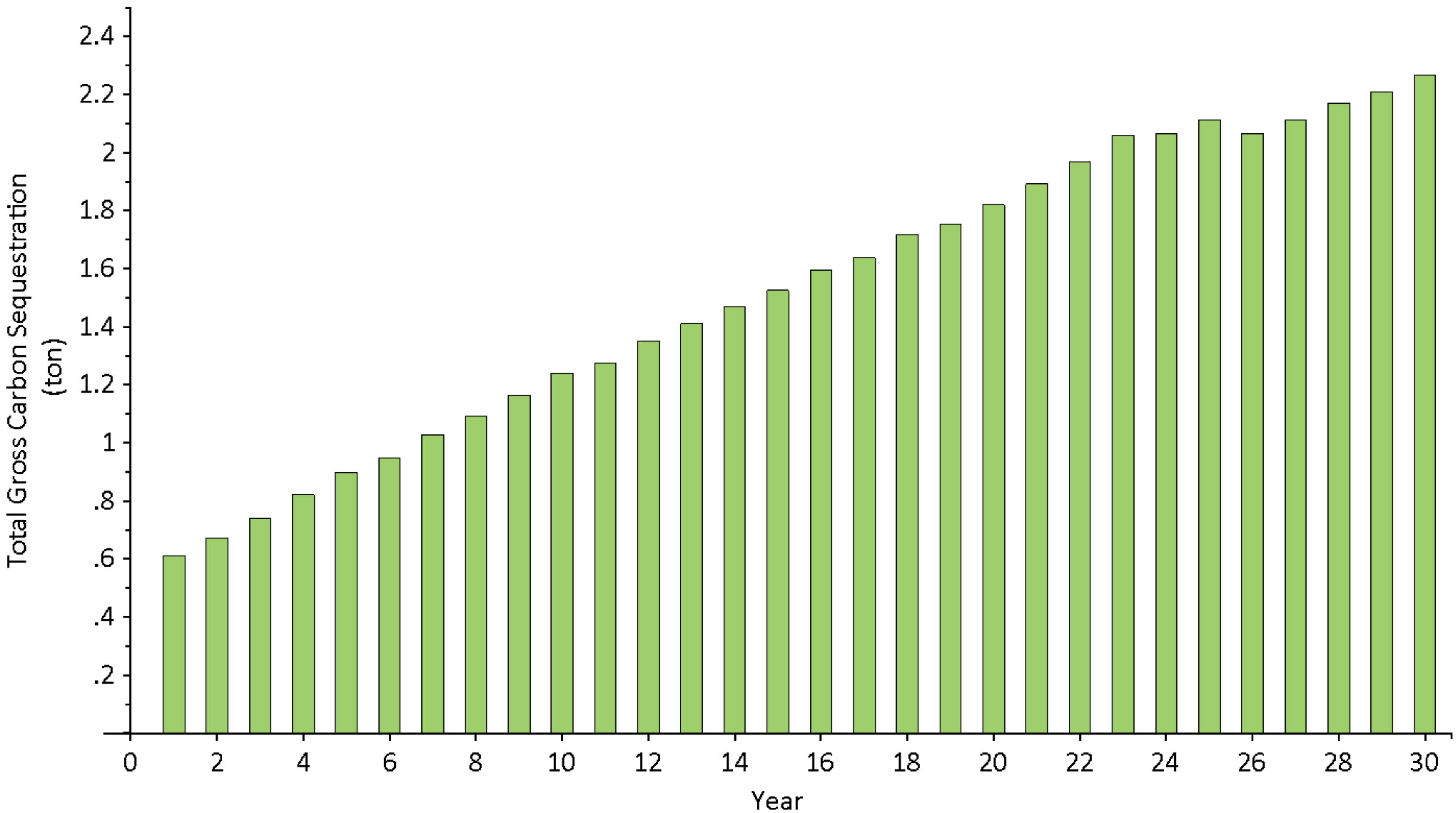
Carbon Sequestration Over Time

Location: Lexington-Fayette, Fayette, Kentucky, United States of America
Project: Town Branch Commons , Series: one, Year: 2025, Forecast: Default_2
Generated: 7/14/2025



Carbon Sequestration Over Time

Location: Lexington-Fayette, Fayette, Kentucky, United States of America
Project: Town Branch Commons , Series: one, Year: 2025, Forecast: Default_2
Generated: 7/14/2025

Year	Total Gross Carbon Sequestration (ton)
1	0.61
2	0.67
3	0.74
4	0.82
5	0.90
6	0.95
7	1.03
8	1.09
9	1.16
10	1.24
11	1.27
12	1.35
13	1.41
14	1.47
15	1.53
16	1.60
17	1.64
18	1.72
19	1.75
20	1.82
21	1.89
22	1.97
23	2.06
24	2.07
25	2.11

Carbon Sequestration Over Time

Location: Lexington-Fayette, Fayette, Kentucky, United States of America
Project: Town Branch Commons , Series: one, Year: 2025, Forecast: Default_2
Generated: 7/14/2025

Year	Total Gross Carbon Sequestration (ton)
26	2.07
27	2.11
28	2.17
29	2.21
30	2.27
Total	**45.70**

Appendix F: Town Branch Watershed Water Quality Exhibits

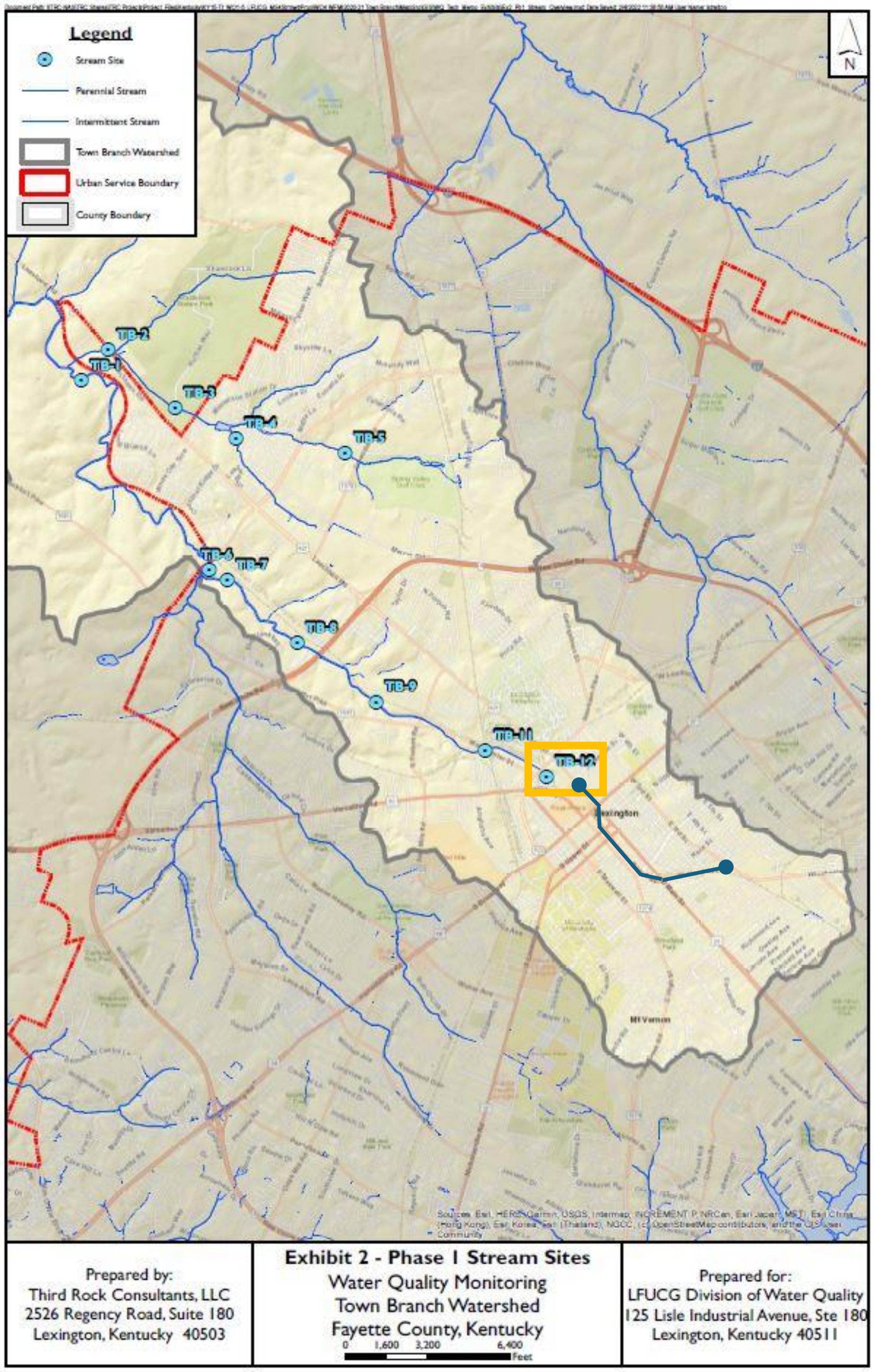


Figure 63. Town Branch watershed water quality monitoring locations.
Source: LFUCG Division of Water Quality with modifications by research team.

Table 16. Water quality data for Town Branch 12 monitoring site.

TOWN BRANCH WATER QUALITY DATA																				
				Collected / Assessed			*In Situ* Measurements				Lab Analysis									
	Watershed	Site ID	Type	By	Date	Task	DO mg/L	PH SU	TEMP °C	COND uS/cm	Total Suspended Solids	TSS mg/L	E. coli	EC MPN/100mL	Total Phosphorus	PT mg/L	Ammonia	NH3 mg/L	Nitrate	NO3 mg/L
VOLUNTEER MEASUREMENTS	Town Branch	TB-12	Stream	Volunteers	05/25/21	WFMP Phase 2 WQ: Dry	10.39	7.79	17.93	790	AVG	3	AVG	4,711	AVG	0.360	AVG	0.114	AVG	2.940
	Town Branch	TB-12	Stream	Volunteers	06/08/21	WFMP Phase 2 WQ: Dry	8.20	7.51	17.69	776		0		969		0.290		0.087		3.170
	Town Branch	TB-12	Stream	Volunteers	06/22/21	WFMP Phase 2 WQ: Dry	7.76	7.44	17.90	685		0		17,233		0.313		0.109		3.440
	Town Branch	TB-12	Stream	Volunteers	07/07/21	WFMP Phase 2 WQ: Dry	9.23	7.79	18.59	690		2		15,152		0.303		0.099		3.520
	Town Branch	TB-12	Stream	Volunteers	07/20/21	WFMP Phase 2 WQ: Dry	9.35	7.47	18.98	803		0		2,405		0.317		0.024		3.510
	Town Branch	TB-12	Stream	Volunteers	08/03/21	WFMP Phase 2 WQ: Dry	5.72	7.30	19.66	707		0		20,459		0.627		2.100		2.270
	Town Branch	TB-12	Stream	Volunteers	08/17/21	WFMP Phase 2 WQ: Dry	4.11	7.46	20.39	766		2		51,721		0.635		2.470		2.520
	Town Branch	TB-12	Stream	Volunteers	08/31/21	WFMP Phase 2 WQ: Dry	7.25	7.15	20.48	688		0		9,086		0.321		0.056		3.370
	Town Branch	TB-12	Stream	Volunteers	09/14/21	WFMP Phase 2 WQ: Dry	8.20	7.67	20.97	883		0		2,954		0.378		0.026		2.890
	Town Branch	TB-12	Stream	Volunteers	09/28/21	WFMP Phase 2 WQ: Dry	8.21	7.75	19.43	488		1		4,347		0.315		0.026		3.180
						SUMMER PRE-CONSTRUCTION AVERAGES	8.64	7.55	18.29	739		1		8,940		0.306		0.080		3.410
						PRE-CONSTRUCTION AVERAGES	7.84	7.53	19.20	727.60		0.80		12903.70		0.39		0.51		3.08
CSI MEASUREMENTS	Town Branch	TB-12	Stream	CSI Team	06/13/25	LAF CSI: Dry	9.81	7.71	18.02	757		3		15,648		0.378		0.168		3.700
	Town Branch	TB-12	Stream	CSI Team	06/24/25	LAF CSI: Wet	6.98	7.39	18.53	682		8		8,130		0.145		0.062		3.640
	Town Branch	TB-12	Stream	CSI Team	06/26/25	LAF CSI: Dry	10.79	7.35	19.47	965		3		2,590		0.318		0.018		3.330
	Town Branch	TB-12	Stream	CSI Team	07/07/25	LAF CSI: Dry	7.45	7.66	21.52	775		10		3,544		0.356		0.070		2.520
						POST-CONSTRUCTION AVERAGES (ALL)	8.76	7.53	19.39	795		6		7,478		0.299		0.080		3.298
						POST-CONSTRUCTION AVERAGES (DRY ONLY)	9.35	7.57	19.67	832.33		5.33		7,261		0.35		0.09		3.18
				COMPARISON TO ALL CSI SAMPLES		**PERCENT CHANGE (SUMMER)**	1.42%	-0.33%	5.99%	7.62%		1100.00%		-16.35%		-2.13%		-0.31%		-3.30%
						PERCENT CHANGE (ALL SAMPLES)	11.67%	-0.07%	0.95%	9.23%		650.00%		-42.05%		-22.45%		-84.45%		7.03%
				COMPARISON TO DRY CSI SAMPLES		**PERCENT CHANGE (SUMMER)**	8.28%	0.28%	7.55%	12.71%		966.67%		-18.78%		14.69%		7.00%		-6.65%
						PERCENT CHANGE (ALL SAMPLES)	19.23%	0.54%	2.44%	14.39%		566.67%		-43.73%		-9.13%		-83.30%		3.32%

Appendix G: Additional References

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