DAVEY Resource Group

September 2020

TREE PLANTING PLAN

Neighborhoods of Cudell, Detroit Shoreway, and Edgewater

City of Cleveland, Ohio

Prepared for:

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ACKNOWLEDGEMENTS

Detroit Shoreway Community Development Organization (DSCDO) and Cudell Improvement, Inc. would like to express our appreciation to the partners, stakeholders, and community leaders who came together to provide valuable and constructive suggestions, and technical expertise during the planning and development of this program. Their willingness to give their time so generously has been very much appreciated.

City of Cleveland

Matt Zone, Councilman, City of Cleveland

Cleveland Tree Coalition

Cuyahoga County

Cuyahoga County Department of Sustainability

Cuyahoga County Planning Commission

Cuyahoga Soil & Water Conservation District

Davey Resource Group

Holden Forests & Gardens

Sherwick Tree Stewards

Western Reserve Land Conservancy

Funding for this project was provided by the Cuyahoga County *Healthy Urban Tree Canopy Grant Program*, which provides funding to protect and expand Cuyahoga County's tree canopy and is a joint program of the Cuyahoga County Department of Sustainability, the Cuyahoga County Planning Commission, and the Cuyahoga Soil & Water Conservation District

Executive Summary: Project Overview

STANDARD INVENTORY ANALYSIS AND MANAGEMENT PLAN EXECUTIVE SUMMARY

Trees are part of everyday life in the Cudell, Detroit Shoreway, and Edgewater neighborhoods of Cleveland, Ohio. The urban forest creates a sense of place and supplies real benefits to those who live in the community. Trees along streets, in parks, around playgrounds, and in backyards provide shade and beauty and enhance the quality of life by bringing natural elements and wildlife habitats into urban settings. Trees also moderate temperatures, reduce air pollution and energy use, improve water quality, and promote human health and well-being.

Recognizing the benefits a healthy and plentiful urban forest provides, Detroit Shoreway Communty Development Organization in conjuction with Cudell Improvement, Inc. sought to better understand the current state of it's trees and to identify sites where trees could be planted in the future. Using community input, and engaging the greater Cleveland urban forestry community and a professional arboriculture company (Davey Resource Group, Inc. "DRG"), the three neighborhoods of Cudell, Detroit Shoreway, and Edgewater inventoried their trees and developed a tree planting plan to ensure that the neighborhoods will have a resilient, sustainable, and safe urban forest.

TODAY'S URBAN FOREST

Studies have shown that trees not only provide environmental benefits but also, positively affect the overall mental and physical health of the residents of a community. Thus improving a neighborhood's tree canopy coverage could help improve the overall quality of life for its residents. Across all three neighborhoods covered in this report, the canopy coverage ranged from 16% to 30%. Overall the neighborhoods fall short in canopy coverage according to the Cleveland Tree Coalition's tree canopy goal of 30%.

Edgewater's tree canopy cover is 30% (Figure 1) (Davey Resource Group, 2015). Cudell's tree canopy cover is only 16%. Detroit Shoreway's tree canopy cover is only 19%.

Cudell Neighborhood

- 1,761 Trees
- 30 Stumps
- 998 Vacant Planting Sites

Detroit Shoreway Neighborhood

- 4,193 Trees
- 79 Stumps
- 991 Vacant Planting Sites

Edgewater Neighborhood

- 1,369 Trees
- 16 Stumps
- 365 Vacant Planting Sites

It is important to note that only trees, stumps and vacant planting sites found along public right-of-way (ROW) were identified during the inventory, and due to cost considerations, the Edgewater neighborhood ROW north of Clifton Boulevard was omitted from the study. While it lends insight into the overall urban forest dynamics of these three neighborhoods, it does not include sites found in parks/public spaces as well as private property.

TREE PLANTING

A common saying about planting trees attributed to an old Chinese proverb is, "The best time to plant a tree is twenty years ago. The second-best time is now." Now is the time to plant more trees in all three neighborhoods. The tree planting plan only presents what can be accomplished in the short-term within the City's ROW, however planting on private property will be necessary for long-term meaningful impact.

Tree planting requires thoughtful planning to ensure "the right tree is in the right place," and consistent care after planting so that the tree receives the water it needs to establish its root system and pruning from the good branch architecture that will lead to reduced maintenance costs. The planting plan included race/ethnicity, median household income, and population density census data into determining prioritization. Higher priorities of social equity give a focused effort of providing trees and tree canopy to all citizens regardless of social status or health.

At the current stocking level of 63%, the Cudell needs 1,028 additional trees to be fully stocked. At the current stocking level of 79%, Detroit Shoreway needs 1,070 additional trees to be fully stocked. At the current stocking level of 78%, Edgewater needs 381 additional trees to be fully stocked. For each neighborhood, the number of additional trees needed assumes the neighborhoods' tree resource experiences zero loss, which is unlikely. In Cleveland's public ROW's and spaces, tree planting sites must conform to the city's specification and be approved by the City of Cleveland's Urban Forester in advance of planting the tree.

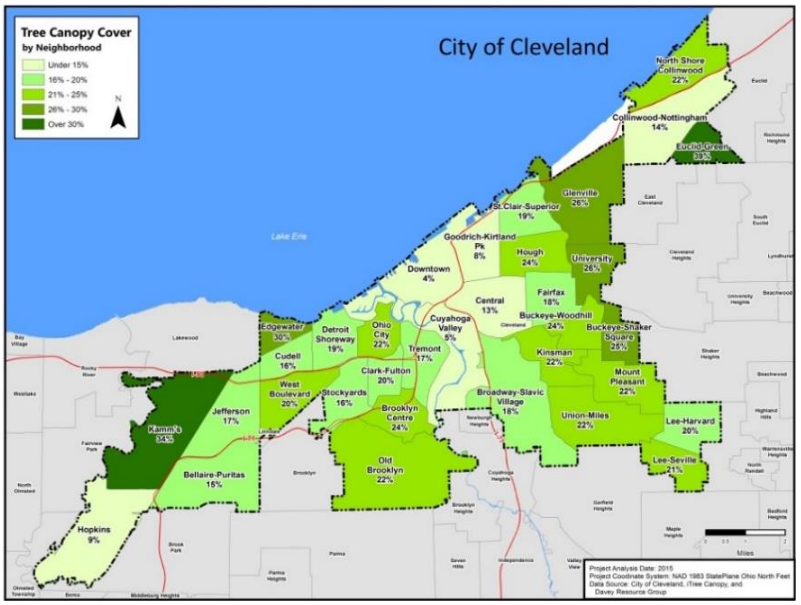


Figure 1. Tree canopy cover by neighborhood. (Davey Resource Group, 2015).

TREE MAINTENANCE

Trees provide many environmental and economic benefits that justify the time and money invested in maintenance. Recommended maintenance needs across the three neighborhoods include: Tree Removal (7%); Stump Removal (1%); Pruning (47%); Young Tree Train (20%); and Plant Tree (24%). Maintenance should be prioritized by addressing trees with the highest risk first. The inventory noted many Priority 1 Removal and Prune trees (2% and 8% of trees assessed, respectively); these trees should be removed or pruned immediately to promote public safety.

Tree Inventory

	Cudell	Detroit Shoreway	Edgewater
 **Tree Inventory** Knowing the composition and structure of the urban forest is an important part of proactively managing a tree resource.	Total = 2,789 Trees = 1,761 Stumps = 30 Planting Sites = 998 Most Common Maintenance Need = Large Tree Routine Pruning	Total = 5,203 Trees = 4,133 Stumps = 79 Planting Sites = 991 Most Common Maintenance Need = Training Prune	Total = 1,750 Trees = 1,369 Stumps = 16 Planting Sites = 365 Most Common Maintenance Need = Large Tree Routine Prune
 **New Tree Planting** Planting new trees in areas that have poor canopy continuity is important, as is planting trees where there is sparse canopy, to ensure that tree canopy cover is sustained for this generation and the next one.	Total Vacant Sites = 998 Large = 39 (4% of all Vacant Sites) Medium = 43 (4% of all Vacant Sites) Small = 916 (92% of all Vacant Sites)	Total Vacant Sites = 991 Large = 143 (14% of all Vacant Sites) Medium = 138 (14% of all Vacant Sites) Small = 710 (72% of all Vacant Sites)	Total Vacant Sites = 365 Large = 35 (10% of all Vacant Sites) Medium = 58 (16% of all Vacant Sites) Small = 272 (74% of all Vacant Sites)
 **Priority 1 Tree Removal** Trees recommended for removal have defects that cannot be cost-effectively or practically corrected. Most of the trees in this category have a substantial percentage of dead crown.	Total Tree Removals = 160 trees Priority 1 Removal = 58 trees (31% of all Tree Removals)	Total Tree Removals = 406 trees Priority 1 Removal = 35 trees (7% of all Tree Removals)	Total Tree Removals = 141 trees Priority 1 Removal = 16 trees (11% of all Tree Removals)
 **Priority 1 Pruning** Priority pruning removes defects such as dead and dying parts or broken and/or hanging branches. Pruning the defected branch(es) can lower risk associated with the tree while promoting healthy growth.	Total Tree Prunes = 1,601 Priority 1 Prunes = 68 (4% of all Tree Prunes)	Total Tree Prunes = 3,727 Priority 1 Prunes = 353 (9% of all Tree Prunes)	Total Tree Prunes = 1,228 Priority 1 Prunes = 159 (13% of all Tree Prunes)
 **Tree Benefits** Trees provide important environmental and economic functions including stormwater management, mitigation of urban heat island effects, wildlife habitat, increases in property values, and aesthetic and community benefits such as improved quality of life.	Total Trees = 1,761 trees Carbon Sequestration = $2,826 annually Avoided Runoff = $2,295 annually Pollution Removal = $12,926 annually	Total Trees = 4,126 trees Carbon Sequestration = $4,654 annually Avoided Runoff = $3,269 annually Pollution Removal = $18,240 annually	Total Trees = 1,369 trees Carbon Sequestration = $1,615 annually Avoided Runoff = $1,165 annually Pollution Removal = $6,507 annually
 **Tree Canopy Cover** The amount of community tree canopy cover directly influences the benefits its urban forest provides. Striving to have more and healthier trees benefits all.	Total Acres in the Cudell Neighborhood = 698 Acres of Tree Canopy = 112 Tree Canopy Cover Percent = 16%	Total Acres in the Detroit Shoreway Neighborhood = 974 Acres of Tree Canopy = 185 Tree Canopy Cover Percent = 19%	Total Acres in the Edgewater Neighborhood = 533 Acres of Tree Canopy = 160 Tree Canopy Cover Percent = 30%

Next Steps

For the neighborhoods of this study to continue to improve the overall health and canopy coverage within, the following steps are recommended:

1. Develop a proactive maintenance program that addresses trees issues through a risk abatement strategy. Using a proactive management strategy will improve the overall condition of the existing tree population and provide additional ecoservices benefits and risk reduction to the community.
2. Promote a tree planting and establishment program that incorporates the findings of this report. A more robust and prioritized planting program will improve the canopy coverage for the individual neighborhoods and serve as a social equity initiative for the community.
3. Engauge private landowners through a public outreach program that promotes canopy improvement, both in coverage and condition. In order to have a more meaningful change to the overall canopy coverage for the neighborhoods, the planting of trees on private property must be a priority.
4. Annual review of the current tree maintenance and planting program to identify and resolve issues. Reassessing tree management strategies and processes will improve the effectiveness and efficiency of the current programs.

"Trees provide vital health and environmental benefits, weather it is reducing stress, which relates to heart disease, filtering air, which relates to asthma, or providing more shade, which can reduce the reliance on electric cooling methods."

~ Sandra Albro, co-chair of the Cleveland Tree Coalition

INTRODUCTION

Founded in 1974, the Detroit Shoreway Community Development Organization (DSCDO) is a non-profit 501(c)3 community development corporation, focused on the physical, econmic, and social development of Cleveland's Detroit Shoreway neighborhood. Today, in collaboration with the Cudell Improvement, Inc. (CII), the organizations provide comprehensive community development services to over 27,000 residents in three Cleveland neighborhoods—Cudell, Detroit Shoreway, and Edgewater.

Recognizing that trees along streets, in parks, and near businesses not only provide shade and beauty, but also create a sense of place, and supply real benefits to those who live and work in the community, DSCDO/CII sought to identify sites along public ROW to plant trees. The tree inventory provided information about the current number of trees and vacant planting sites, the sizes and species present, and tree condition and maintenances needs. Using information from the inventory, plus input from key community stakeholders, including the City of Cleveland's Urban Forester, a tree planting plan was developed for the Cudell, Detroit Shoreway, and Edgewater neighborhoods.

Being a part of the greater Cleveland area, these three neighborhoods are partners and advocates for Cleveland's urban forest. The neighborhoods will soon be able to further Cleveland's goals for tree canopy creation using this *Tree Planting Plan*. The neighborhoods are well on their way to creating a sustainable and resilient public tree resource and helping the City of Cleveland implement the *Cleveland Tree Plan*.

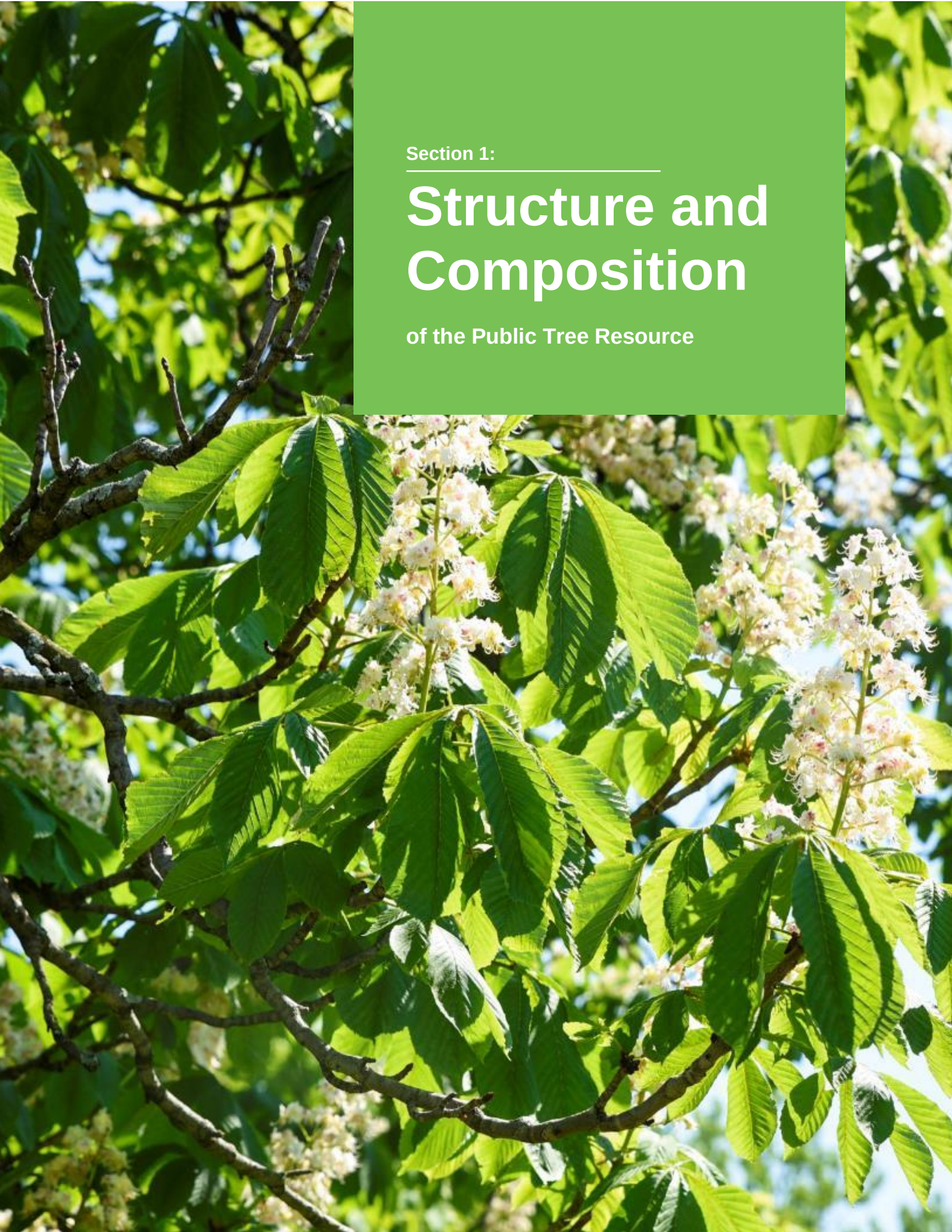
Photograph 1. View of Cleveland skyline from Edgewater Park.

RECOMMENDED APPROACH TO TREE MANAGEMENT

This plan lays out a proactive and systematic program that sets clear and realistic goals, prescribes future action, and informs on how to periodically measure progress. In this plan are the following:

- *Section 1: Structure and Composition of the Public Tree Resource* summarizes the inventory data with trends representing the current state of the tree resource.
- *Section 2: Functions and Benefits of the Public Tree Resource* summarizes the estimated value of benefits provided to the community by public trees' various functions.
- *Section 3: Tree Planting Program for Public Spaces* summarizes the number and size of inventoried vacant planting sites and informs about how to select tree species and plant trees.
- *Section 4: Recommended Management of the Public Tree Resource* lists the inventoried priority tree work and describes other work normally accomplished in a tree management program.

Photograph 2. Trees should be selected to improve species diversity and plant the right tree in the right place. Here, volunteers are adding new trees to the neighborhood.



Section 1:

Structure and Composition

of the Public Tree Resource

SECTION 1: STRUCTURE AND COMPOSITION OF THE PUBLIC TREE RESOURCE

In May 2020, DRG arborists collected site data on trees, stumps, and planting sites along the street ROW for a tree inventory contracted by the DSCDO and CII funded by a grant through Cuyahoga County. Figures 2.a., 2.b., and 2.c. break down the total sites inventoried by type for each location in each neighborhood. See Appendix A for details about DRG's methodology for collecting site data.

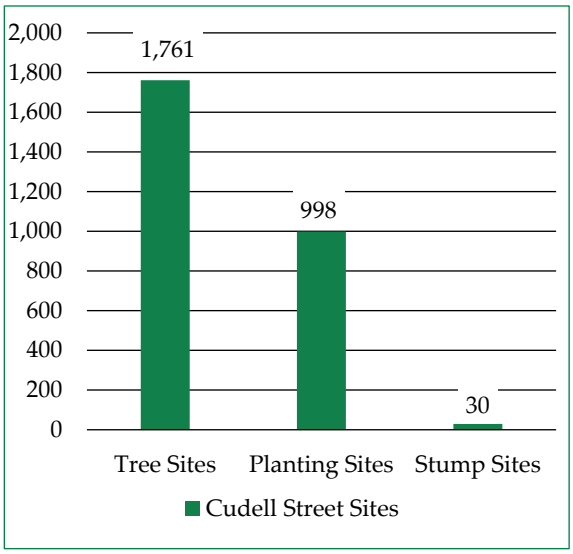


Figure 2.a. Cudell's number of inventoried sites by location and type.

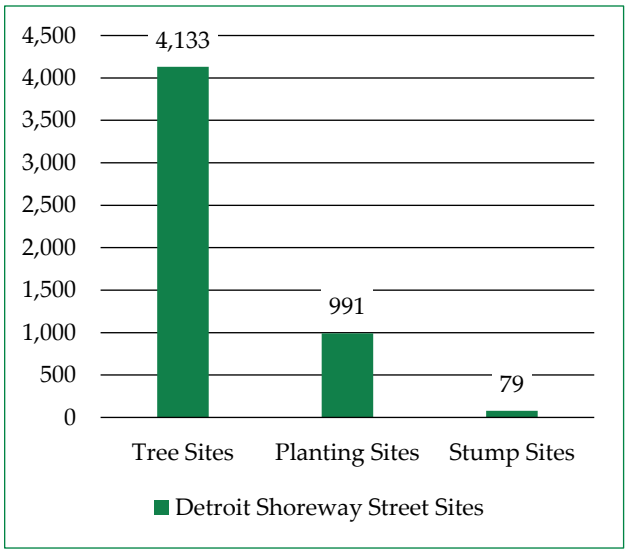


Figure 2.b. Detroit Shoreway's number of inventoried sites by location and type.

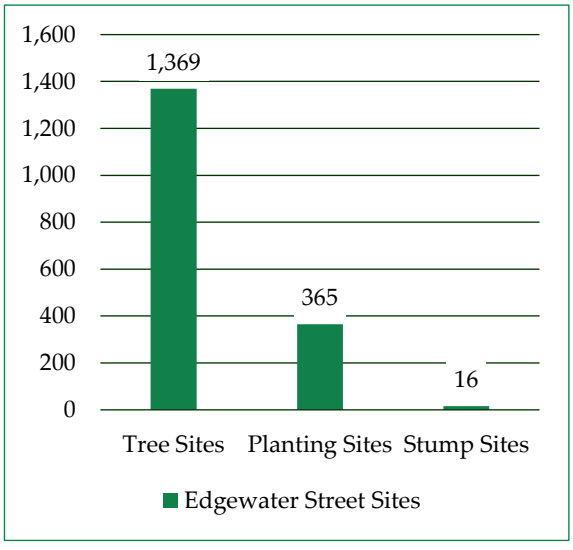


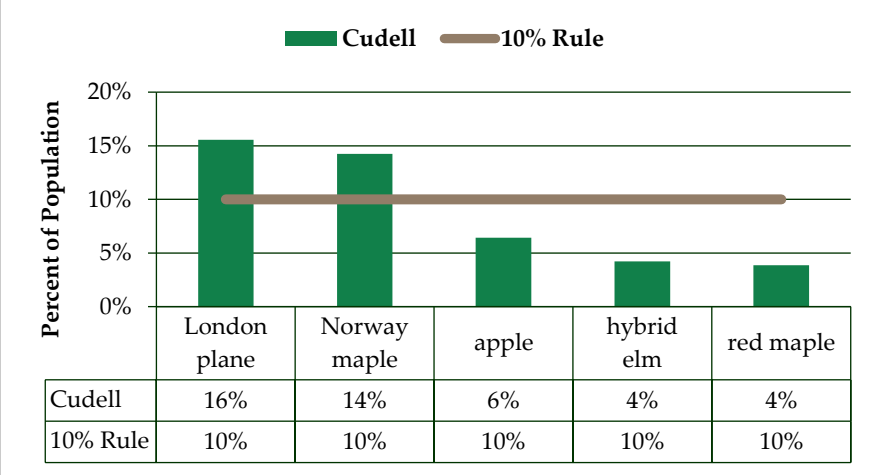
Figure 2.c. Edgewater's number of inventoried sites by location and type.

SPECIES, GENUS, AND FAMILY DISTRIBUTION

The 10-20-30 rule is a common standard for tree population distribution, in which a single species should compose no more than 10% of the tree population, a single genus no more than 20%, and a single family no more than 30% (Santamour 1990).

Figures 3.a, 3.b., and 3.c. show the distribution of the most abundant tree species inventoried compared to the 10% threshold in each neighborhood. London planetree (*Platanus* x *acerifolia*) is the most abundant species with 16% of the tree population and exceeds the 10% threshold in the Cudell neighborhood. Norway maple also exceed the ten percent stocking rate. Norway maple (*Acer plataniodes*) is the most abundant species with 10% of the tree population and just meets the 10% threshold in the Detroit Shoreway neighborhood. Callery pear (*Pyrus calleryana*) is the most abundant species with 12% of the tree population and exceed the 10% threshold in Edgewater.

Callery pear has been recently listed as an invasive species by the Ohio Division of Forestry and will no longer be commercially available starting 2023. Norway maple has a high escape potential and is considered an invasive species with negative impacts on native forests. These species and others at or above the 10% threshold should be discouraged from planting.



	London plane	Norway maple	apple	hybrid elm	red maple
Cudell	16%	14%	6%	4%	4%
10% Rule	10%	10%	10%	10%	10%

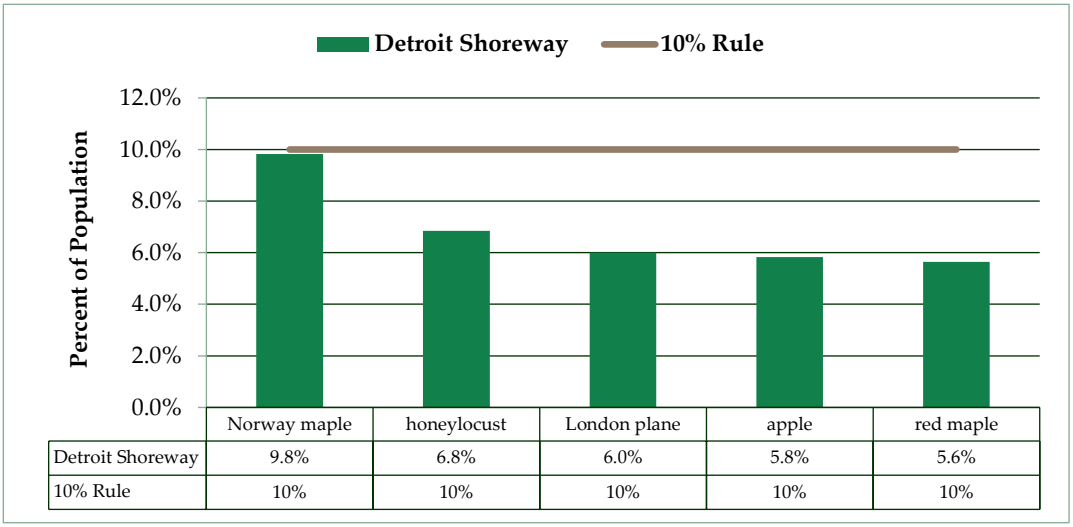
Figure 3.a. Species distribution of the inventoried tree population in Cudell.

RESILIENCE THROUGH DIVERSITY

The Dutch elm disease epidemic of the 1930s provides a key historical lesson on the importance of diversity (Karnosky 1979). The disease killed millions of American elm trees, leaving behind enormous gaps in the urban canopy of many Midwestern communities. In the aftermath, ash trees became popular replacements and were heavily planted along city streets. History repeated itself in 2002 with the introduction of the emerald ash borer into America. This invasive beetle devastated ash tree populations across the Midwest. Other invasive pests spreading across the country threaten urban forests, so it's vital that we learn from history and plant a wider variety of tree genera to develop a resilient public tree resource.

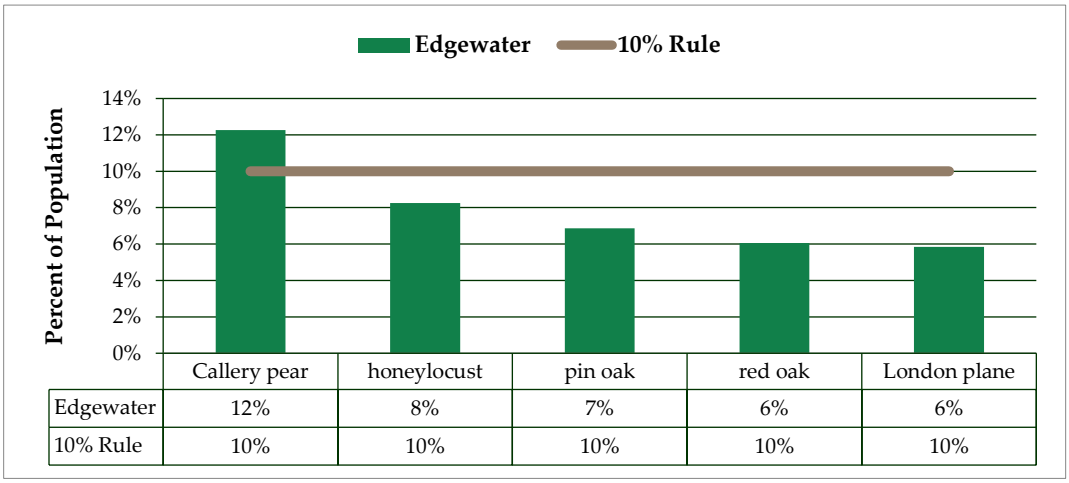
Ash trees in an urban forest killed by emerald ash borer have become a gap in the canopy.

USDA Forest Service (2013), https://www.nrs.fs.fed.us/disturbance/invasive_species/eab/effects_impacts/effects_of_eab/



	Norway maple	honeylocust	London plane	apple	red maple
Detroit Shoreway	9.8%	6.8%	6.0%	5.8%	5.6%
10% Rule	10%	10%	10%	10%	10%

Figure 3.b. Species distribution of the inventoried tree population in Detroit Shoreway.



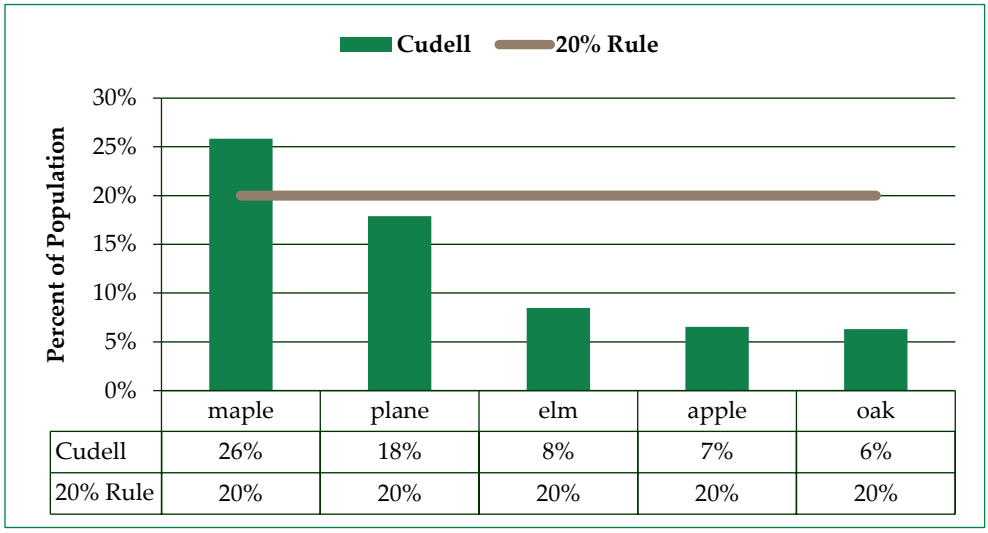
	Callery pear	honeylocust	pin oak	red oak	London plane
Edgewater	12%	8%	7%	6%	6%
10% Rule	10%	10%	10%	10%	10%

Figure 3.c. Species distribution of the inventoried tree population in Edgewater.

Figures 4.a., 4.b., and 4.c. show the distribution of the most abundant tree genera inventoried in each community. In the Cudell neighborhood, the maple genus (*Acer*) is the most abundant with 26% and exceeds the 20% threshold. This indicates that the Cudell neighborhood should discourage further planting of maple trees in the public right-of-way.

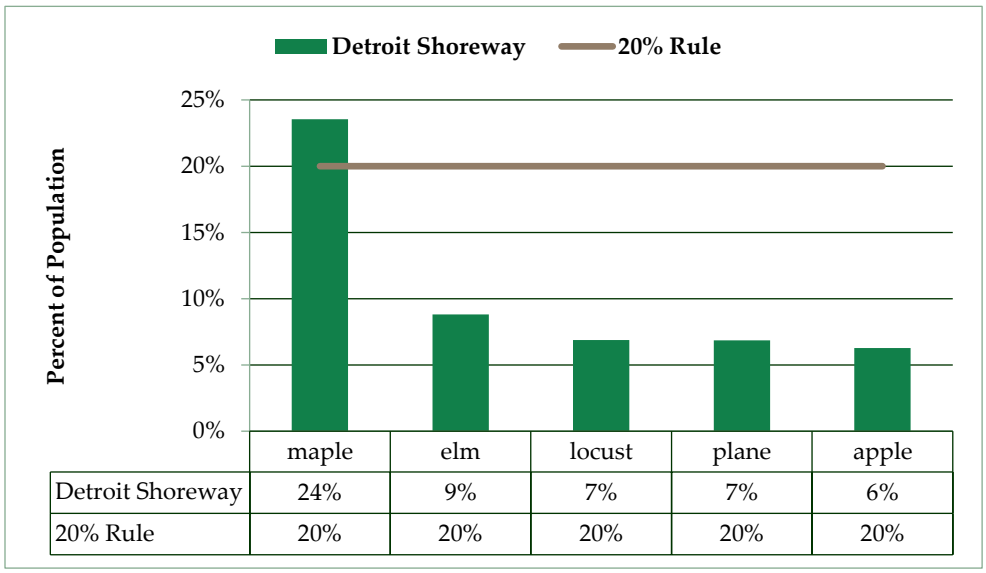
Maple is also the most abundant genus in the Detroit Shoreway neighborhood (16%). While the maple genus (*Acer*) is the most abundant with 24%, it does not approach the 20% threshold in the Edgewater neighborhood.

The genus distribution illustrates how species distribution alone does not completely represent tree population diversity. Genus distribution is an important consideration because some pests, such as emerald ash borer (EAB, *Agrilus planipennis*), target a single genus as its host. Some pests also target a single family as its host, such as the bacterium *Erwinia amylovora*, commonly known as fireblight. Fireblight only affects plants in the rose family (*Rosaceae*), such as serviceberry, hawthorn, apple/crabapple, hawthorn, cherry/plum, and pear.



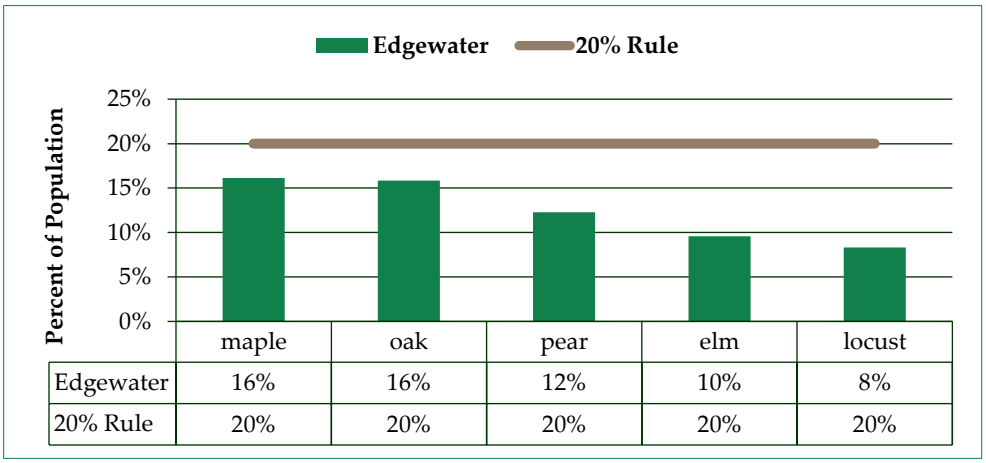
	maple	plane	elm	apple	oak
Cudell	26%	18%	8%	7%	6%
20% Rule	20%	20%	20%	20%	20%

Figure 4.a. Cudell genus distribution of the inventoried tree population.



	maple	elm	locust	plane	apple
Detroit Shoreway	24%	9%	7%	7%	6%
20% Rule	20%	20%	20%	20%	20%

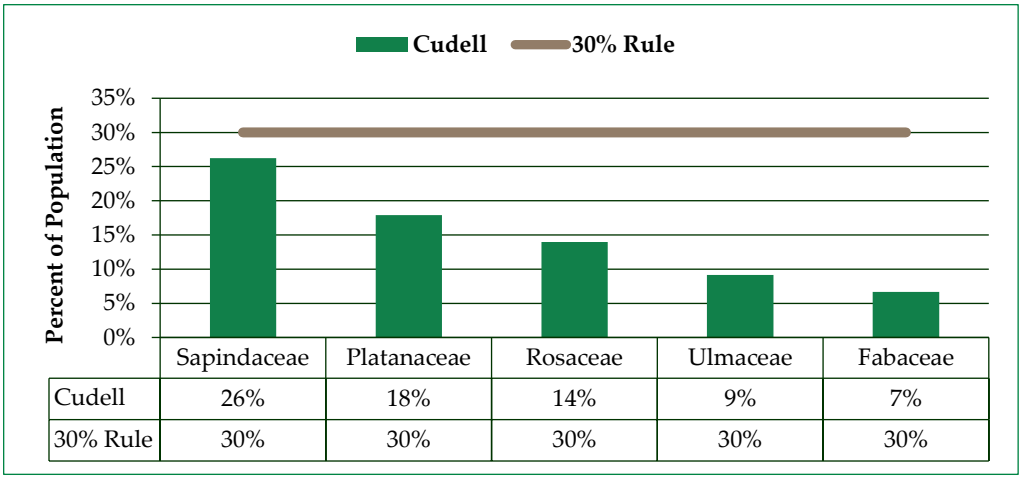
Figure 4.b. Detroit Shoreway genus distribution of the inventoried tree population.



	maple	oak	pear	elm	locust
Edgewater	16%	16%	12%	10%	8%
20% Rule	20%	20%	20%	20%	20%

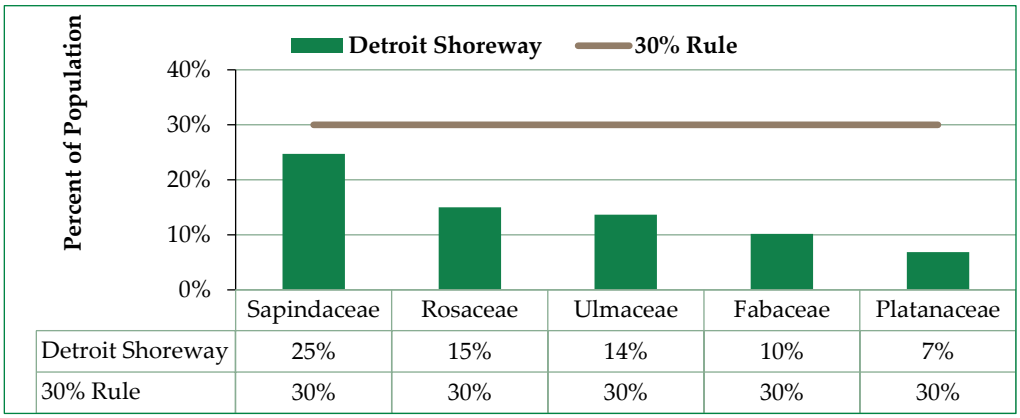
Figure 4.c. Edgewater genus distribution of the inventoried tree population.

Figure 5.a., 5.b., and 5.c. show the distribution of the most abundant tree families inventoried compared to the 30% threshold for each neighborhood. The *Sapindaceae* family is close to approaching the threshold for the Cudell neighborhood, with 26% of trees belonging to that family. *Sapindaceae*, known as the soapberry family, is the family to which the genus *Acer* belongs. The Detroit Shoreway neighborhood also has the *Sapindaceae* family as the highest proportion of the inventoried population at 25%. In the Edgewater neighborhood, the family with the greatest proportion of the inventoried population is the *Sapindaceae* family (20%).



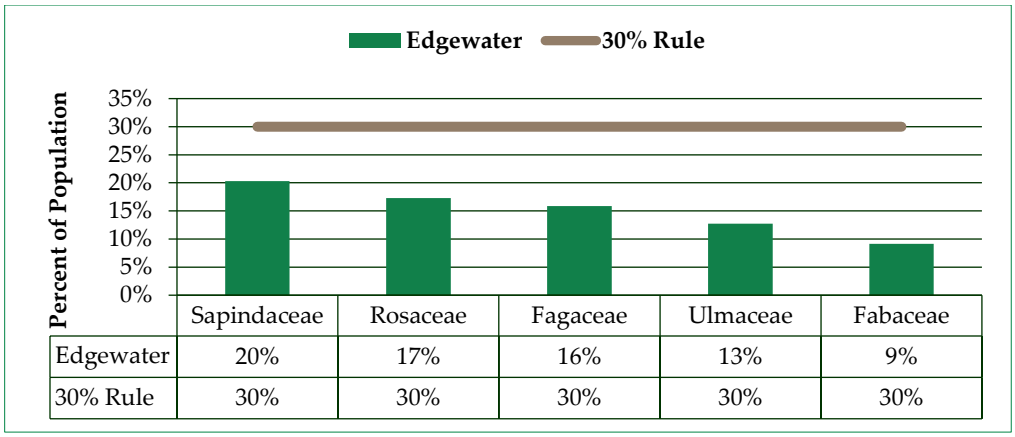
	Sapindaceae	Platanaceae	Rosaceae	Ulmaceae	Fabaceae
Cudell	26%	18%	14%	9%	7%
30% Rule	30%	30%	30%	30%	30%

Figure 5.a. Family distribution of the inventoried tree population for the Cudell neighborhood.



	Sapindaceae	Rosaceae	Ulmaceae	Fabaceae	Platanaceae
Detroit Shoreway	25%	15%	14%	10%	7%
30% Rule	30%	30%	30%	30%	30%

Figure 5.b. Family distribution of the inventoried tree population for the Detroit Shoreway neighborhood.



	Sapindaceae	Rosaceae	Fagaceae	Ulmaceae	Fabaceae
Edgewater	20%	17%	16%	13%	9%
30% Rule	30%	30%	30%	30%	30%

Figure 5.c. Family distribution of the inventoried tree population for the Edgewater neighborhood.

CONDITION

Several factors affecting condition were considered for each tree, including root characteristics, branch structure, trunk, canopy, foliage condition, and the presence of pests. The condition of each inventoried tree was rated by an arborist as Good, Fair, Poor, or Dead. The general health of the inventoried tree population was characterized by the most prevalent condition assigned during the inventory.

Figures 6.a., 6.b., and 6.c. show the condition for inventoried trees in each neighborhood. Most of the inventoried trees in the Cudell neighborhood were recorded in Good or Fair condition, 29% and 51%, respectively. Based on these data, the general health of the inventoried tree population is rated as Fair. Cudell has a low percentage of Dead trees and trees in Poor condition, so the general health of the neighborhood's tree resource is securely in the Fair category and is at low risk of worsening with proper maintenance.

For the Detroit Shoreway neighborhood, most of the inventoried trees were recorded in Good or Fair condition, 25% and 57%, respectively. The general health of the inventoried tree population is rated as Fair, and similar to Cudell, Detroit Shoreway has a low percentage of Dead trees and trees in Poor condition, so the general health of the neighborhood's tree resource is securely in the Fair category.

Trees in the Edgewater neighborhood were mostly recorded in Good or Fair condition, 30% and 48%, respectively. Based on these data, the general health of the inventoried tree population is rated as Fair. Edgewater has a low percentage of Dead trees and trees in Poor condition, so the general health of the neighborhood's tree resource is approaching Good.

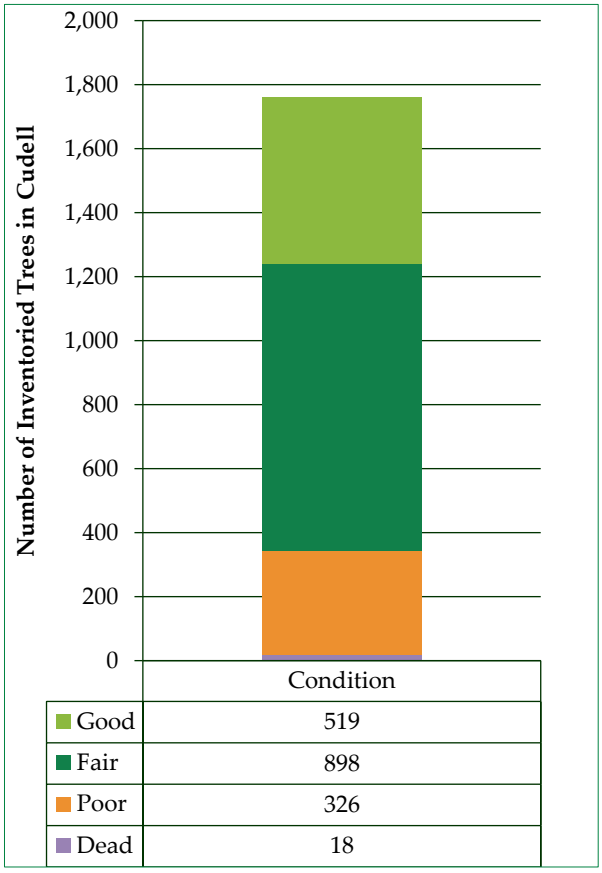


Figure 6.a. Condition of inventoried trees for the Cudell neighborhood.

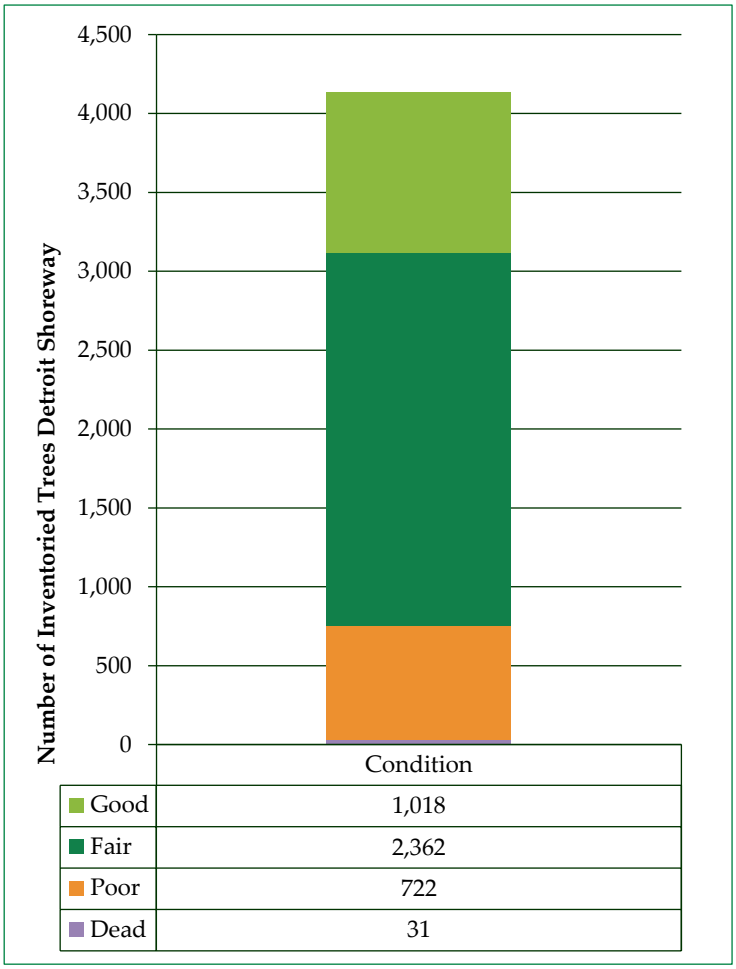


Figure 6.b. Condition of inventoried trees for the Detroit Shoreway neighborhood.

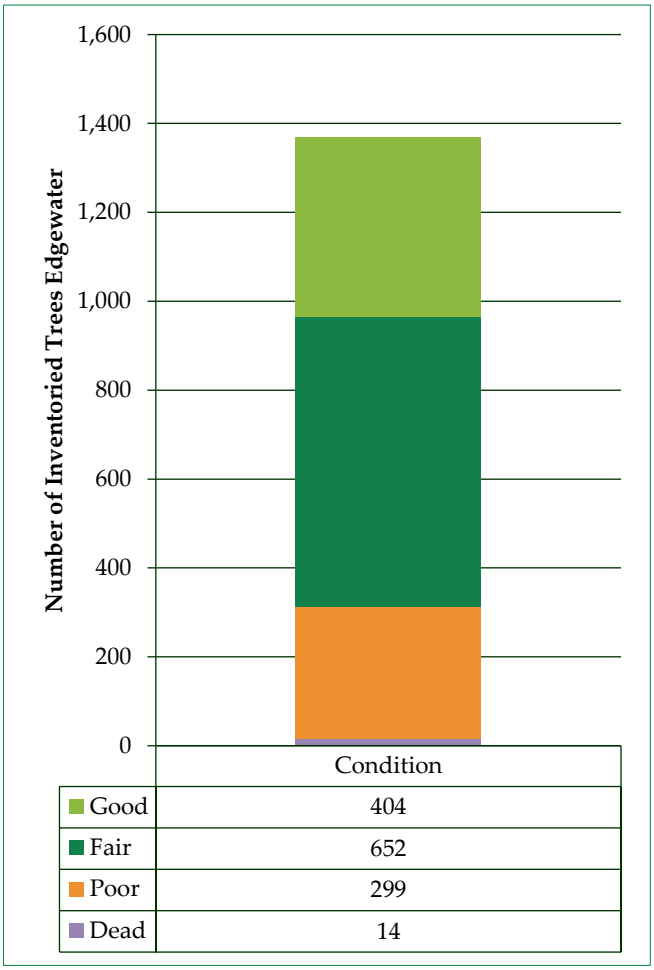


Figure 6.c. Condition of inventoried trees for the Edgewater neighborhood.

RELATIVE AGE DISTRIBUTION

Analysis of a tree population's relative age distribution is performed by assigning age classes to the size classes of inventoried trees, offering insight into the maintenance needs of each neighborhood's tree resource. The inventoried trees are grouped into the following relative age classes:

- Young trees (0–8 inches diameter at breast height [DBH]).
- Established trees (9–17 inches DBH).
- Maturing trees (18–24 inches DBH).
- Mature trees (greater than 24 inches DBH).

These size classes were chosen so that the inventoried tree resource can be compared to the ideal relative age distribution, which holds the largest proportion of the inventoried tree population (approximately 40%) as young trees, while a smallest proportion (approximately 10%) should be mature trees (Richards 1983). Since tree species have different lifespans and mature at different diameters, actual tree age cannot be determined from diameter size class alone, yet size classifications can be extrapolated into relative age classes.

Figures 7.a., 7.b., and 7.c. compare each neighborhood's relative age distribution of the inventoried tree population to the ideal. The Cudell neighborhood's inventoried tree resource is far from the ideal, because young trees fall short by more than 10% and mature trees exceed the ideal by more than 10%. Young trees fall short by 12%, indicating a need to plant young trees in order to be able to meet the replacement needs of older size classes moving forward.

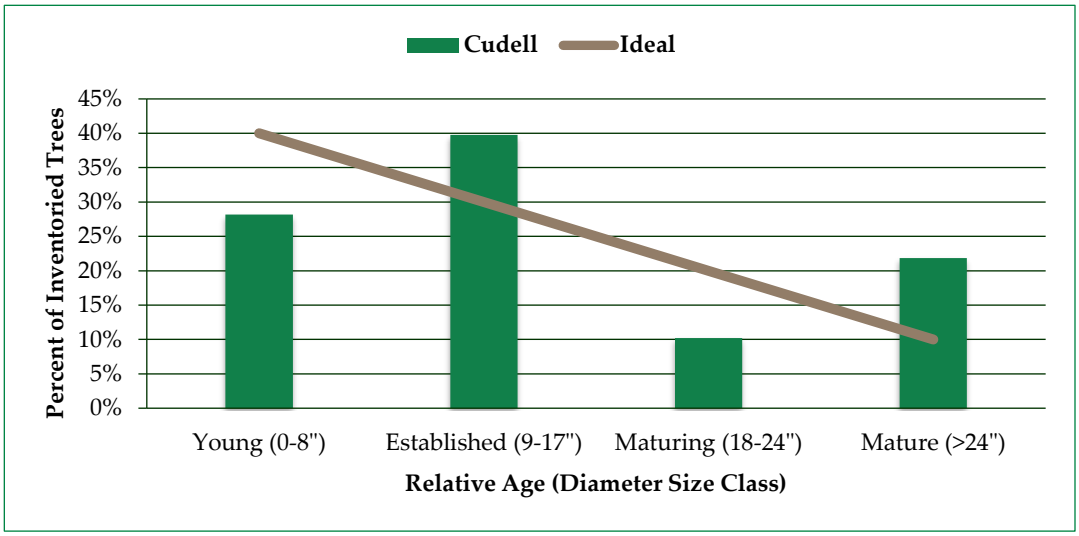


Figure 7.a. Relative age distribution of the inventoried trees for the Cudell neighborhood.

The Detroit Shoreway neighborhood's inventoried tree resource is trending towards the ideal. However, mature trees exceed the ideal by 5%, and young trees exceed the ideal by 7%. Established and maturing trees both falling short by 5% or more emphasizes the need for increased focus on training pruning and routine maintenance pruning to ensure that young and established trees are able to meet the replacement needs of older size classes moving forward. This will increase the condition and survivibilty of the Young tree population. This, along with a strong tree planting intiative, will improve Detroit Shoreway's oveall canopy coverage.

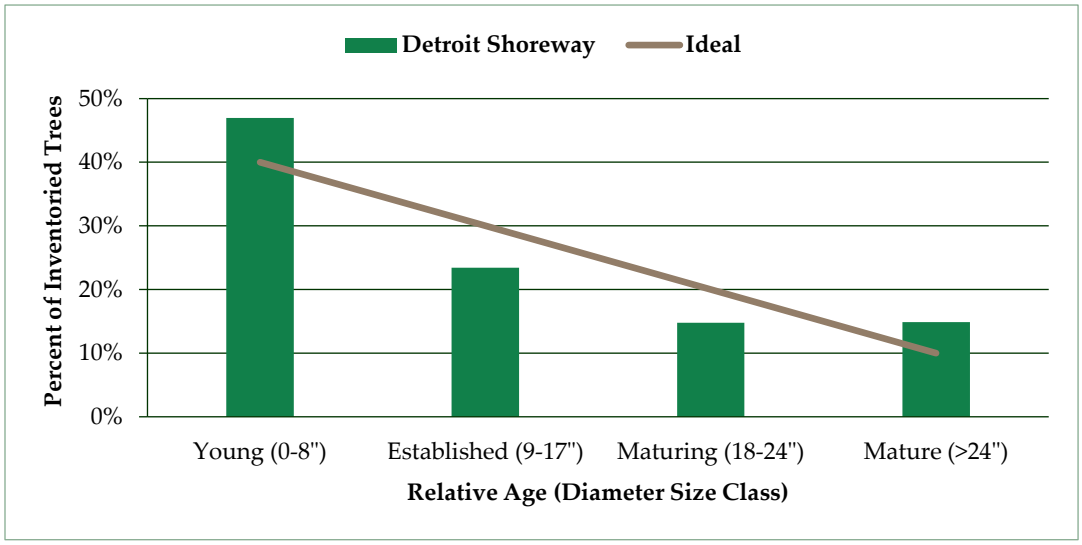


Figure 7.b. Relative age distribution of the inventoried trees for the Detroit Shoreway neighborhood.

In the Edgewater neighborhood, the inventoried tree resource is trending towards the ideal; however, established trees exceed the ideal by 4%, while maturing trees fall short by 3%. Young trees falling short of the ideal by 2% emphasizes the need for additional tree plantings along the Edgewater neighborhood's roadways.

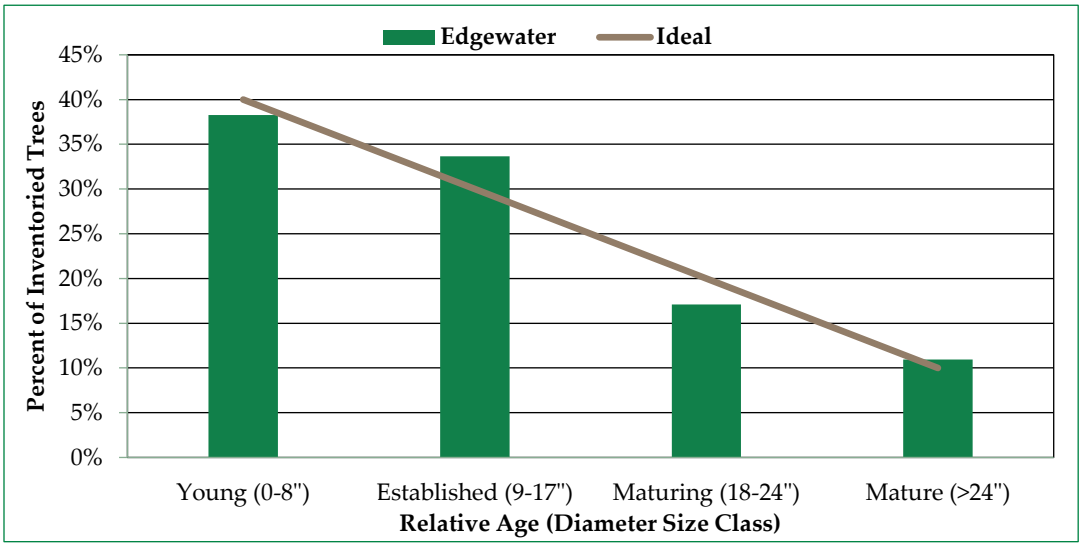


Figure 7.c. Relative age distribution of the inventoried trees for the Edgewater neighborhood.

Figures 8.a., 8.b., and 8.c. cross analyze the condition of the inventoried tree resource with its relative age distribution, providing insight into the inventoried population's stability.

In the Cudell neighborhood, 79% of mature trees and 75% of maturing trees are rated in Fair condition or better; and 81% of established trees and 85% of young trees are rated in Fair condition or better. In the Detroit Shoreway neighborhood, 79% of mature trees and 75% of maturing trees are rated in Fair condition or better; and 81% of established trees and 85% of young trees are rated in Fair condition or better (Figure 8a).

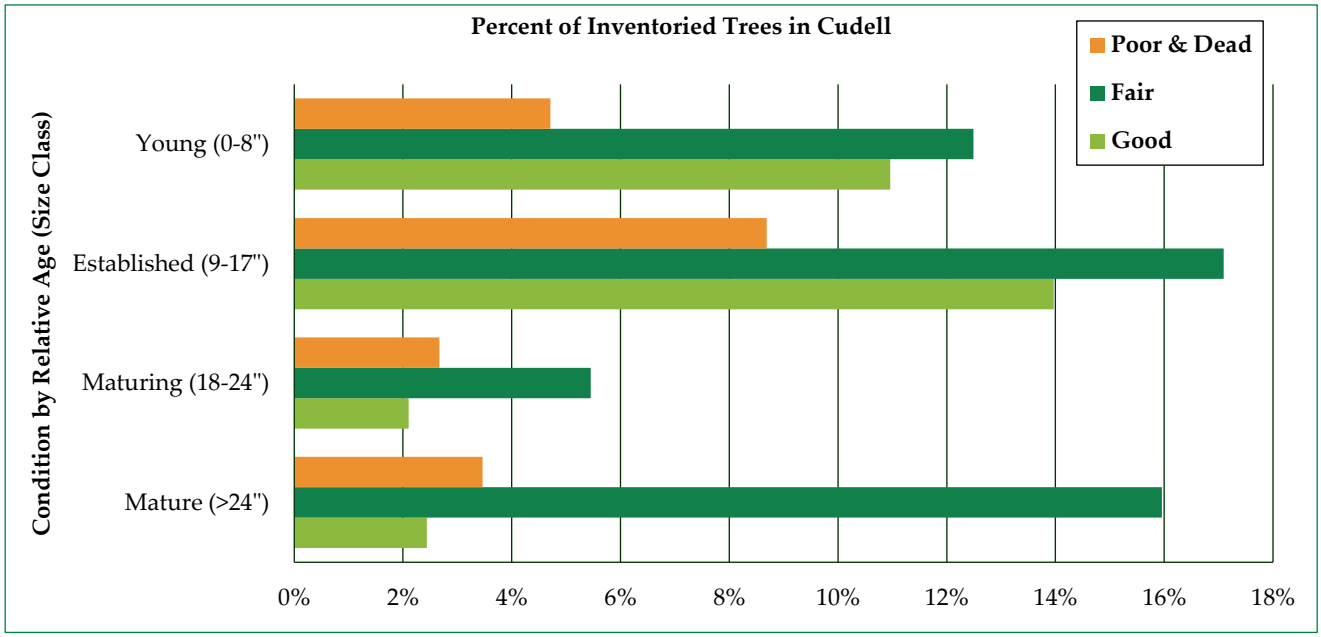


Figure 8.a. Condition of inventoried trees by relative age (size class) for the Cudell neighborhood.

In the Detroit Shoreway neighborhood, 79% of mature trees and 75% of maturing trees are rated in Fair condition or better, which matters because these larger trees would have a more damaging impact in the event of failure. Furthermore, 81% of established trees and 85% of young trees are rated in Fair condition or better, so it is important to provide the maintenance they need to remain healthy as they age and grow, to reduce the proportion of mature and maturing trees in Poor condition or worse.

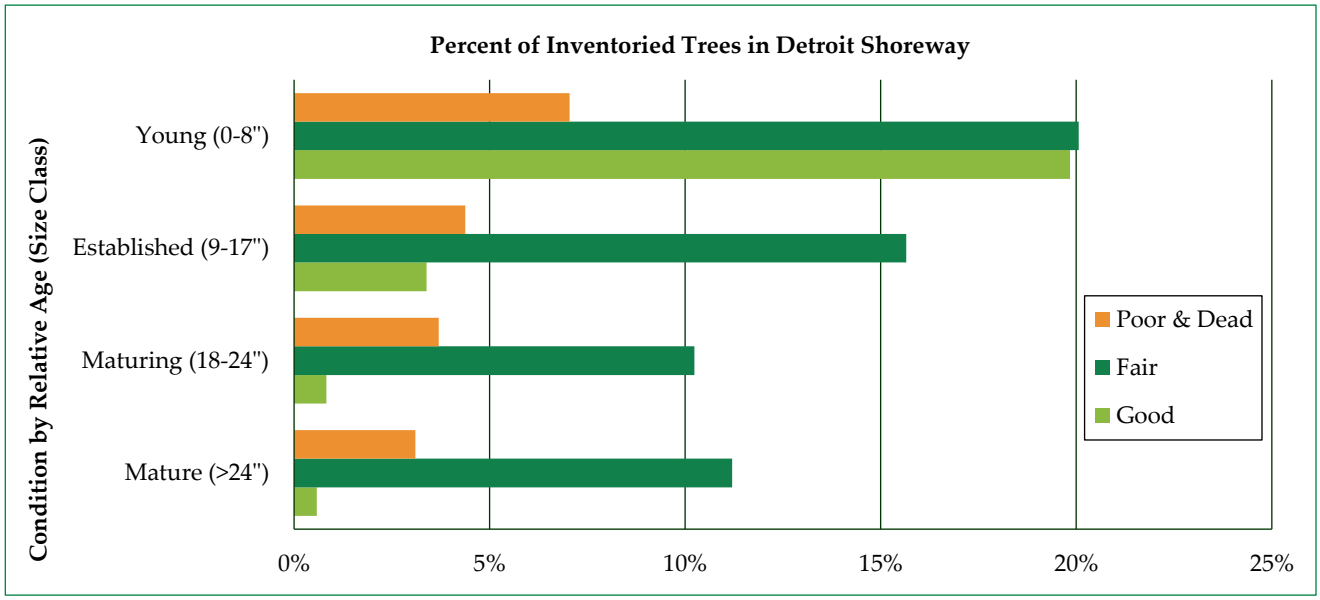


Figure 8.b. Condition of inventoried trees by relative age (size class) for the Detroit Shoreway neighborhood.

In the Edgewater neighborhood, 63% of mature trees and 73% of maturing trees are rated in Fair condition or better, which matters because these larger trees would have a more damaging impact in the event of failure. Furthermore, 79% of established trees and 82% of young trees are rated in Fair condition or better, so it is important to provide the maintenance they need to remain healthy as they age and grow, to reduce the proportion of mature and maturing trees in Poor condition or worse.

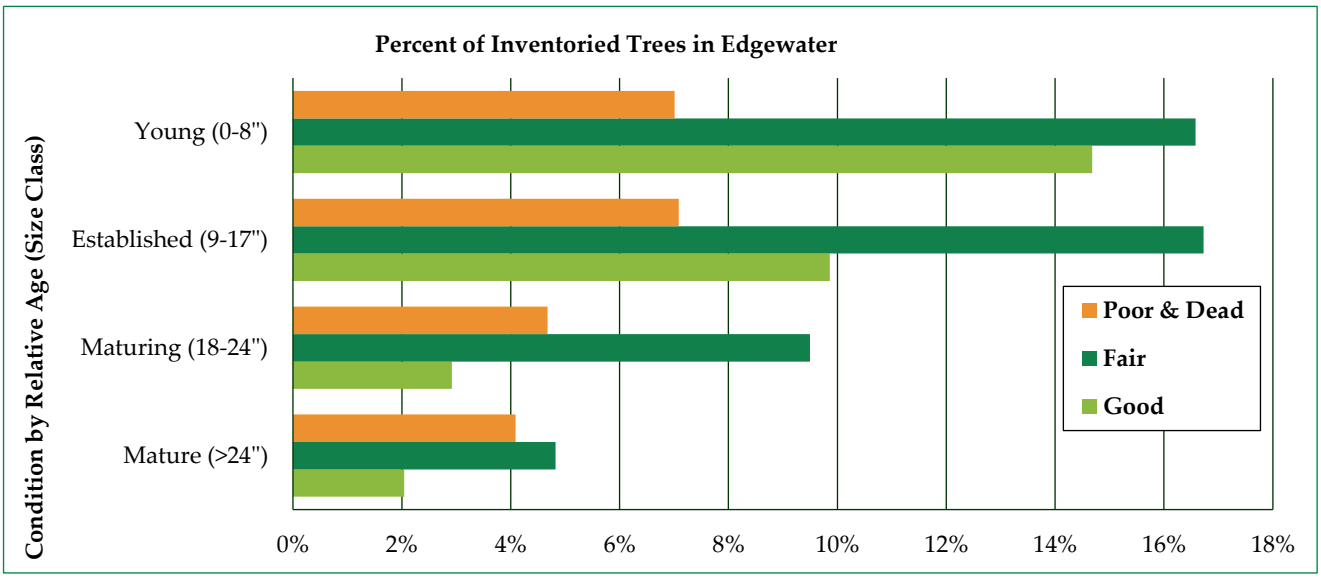


Figure 8.c. Condition of inventoried trees by relative age (size class) for the Edgewater neighborhood.

GROWING SPACE

Information about the type of the growing space was recorded. Growing space types are categorized as follows:

- *Island*—surrounded by pavement or hardscape (for example, parking lot divider).
- *Median*—located between opposing lanes of traffic.
- *Open/Restricted*—open sites with restricted growing space on two or three sides.
- *Open/Unrestricted*—open sites with unrestricted growing space on at least three sides.
- *Raised Planter*—in an above-grade or elevated planter.
- *Tree Lawn/Parkway*—located between the street curb and the public sidewalk.
- *Unmaintained*—located in areas that do not appear to be regularly maintained.
- *Well/Pit*—at grade level and completely surrounded by sidewalk.

A majority (82%) of trees along the street ROW were located in tree lawns in the Edgewater neighborhood. Furthermore, 13% of the trees are located in Medians, Raised Planters, or Well/Pits. The vast majority (97%) of vacant planting sites and stump sites were located in tree lawns areas.

A majority (89%) of trees and stumps along the street ROW were located in tree lawns in the Cudell neighborhood. The remainder (11%) of the trees are located in Medians, Raised Planters, or Well/Pits. Nearly all (96%) vacant planting sites were located in tree lawns areas.

A majority (71%) of trees along the street ROW were located in tree lawns for the Detroit Shoreway neighborhood. The remainder (29%) of the trees are located in Medians, Raised Planters, or Well/Pits. The vast majority (82%) of vacant planting sites and stump sites were located in tree lawns areas.

INFRASTRUCTURE CONFLICTS

In an urban setting, space is limited both above and below ground. Trees in this environment may conflict with infrastructure, such as buildings, sidewalks, utility wires, and pipes, which could pose risks to public safety. Existing or possible conflicts between trees and infrastructure recorded during the inventory included Overhead Utilityconflicts. Tables 1.a., 1.b., and 1.c. show the number of street trees with an Overhead Utility conflicts among the three neighborhoods.

- *Overhead Utilities*—The presence of overhead utility lines above a tree or planting site was noted; it is important to consider these data when planning pruning activities and selecting tree species for planting.

In the Cudell neighborhood, 63% of street trees recorded had an Overhead Utility conflict. There were 1,109 street trees with utilities directly above, or passing through, the tree canopy. Of those trees, 82% were large or medium size trees (Table 1.a.).

Table 1.a. Street ROW trees noted to be conflicting with infrastructure in the Cudell neighborhood.

Conflict	Presence	Number of Trees	Percent of Trees	All Sites	Percent of All Sites
Overhead Utilities	Present	1109	63.0%	1758	63.0%
	Not Present	652	37.0%	1031	37.0%
	Total	1,761	100%	2,789	100%

In the Detroit Shoreway neighborhood, 63% of street trees recorded had an Overhead Utility conflict. There were 2,599 street trees with utilities directly above, or passing through, the tree canopy. Of those trees, 84% were large or medium size trees (Table 1.b.).

Table 1.b. Street ROW trees noted to be conflicting with infrastructure in the Detroit Shoreway neighborhood.

Conflict	Presence	Number of Trees	Percent of Trees	All Sites	Percent of All Sites
Overhead Utilities	Present	2599	62.9%	3276	63.0%
	Not Present	1534	37.1%	1927	37.0%
	Total	4,133	100%	5,203	100%

In the Edgewater neighborhood, 69% of street trees recorded had an Overhead Utility conflict. There were 942 street trees with utilities directly above, or passing through, the tree canopy. Of those trees, 64% were large or medium size trees. This data lends insight of the long-term maintenance and potential issues that may be associated with these trees(Table 1.c.).

Table 1.c. Street ROW trees noted to be conflicting with infrastructure in the Edgewater neighborhood.

Conflict	Presence	Number of Trees	Percent of Trees	All Sites	Percent of All Sites
Overhead Utilities	Present	942	68.8%	1163	66.5%
	Not Present	427	31.2%	587	33.5%
	Total	1,369	100%	1,750	100%

OBSERVATIONS

Observations were recorded during the inventory to further describe a tree's health, structure, or location when more detail was needed (Tables 2.a., 2.b., and 2.c.).

In the Cudell neighborhood, cavity or decay or poor structure were most frequently observed and recorded (7.6% and 5.3% of inventoried trees, respectively). Of these 359 trees, 42 were recommended for removal, of which 26 were rated to be a Priority 1 Removal. Remove Hardware, Improperly Mulched, and Improperly Installed were recorded for only five trees. These observations indicate a high-quality tree planting and post-planting follow-up care. The neighborhood planting crews should be commended for this work and encouraged to continue to work to the existing standards (Table 2.a.).

Table 2.a. Arborist's observations about trees for the Cudell neighborhood.

Observation	Number of Trees	Percent
None	2111	75.7%
Cavity/Decay	211	7.6%
Poor Structure	148	5.3%
Mechanical Damage	129	4.6%
Poor Root System	82	2.9%
Poor Location	58	2.1%
Improperly Pruned	17	0.6%
Serious Decline	17	0.6%
Pest Problem	11	0.4%
Improperly Installed	3	0.1%
Remove Hardware	2	0.1%
	2,789	100%

In the Detroit Shoreway neighborhood, cavity or decay or poor structure were most frequently observed and recorded (22% and 18% of inventoried trees, respectively). Of these 2,038 trees, 281 were recommended for removal, and 27 were rated to be a Priority 1 Removal. Remove Hardware, Improperly Mulched, and Improperly Installed were recorded for 747 trees, a vast majority of which were observed along Cleveland Memorial shoreway. These observations indicate a poor tree planting and post-planting follow-up care. Some root collars were buried, and burlap sacks were seen above ground (Table 2b).

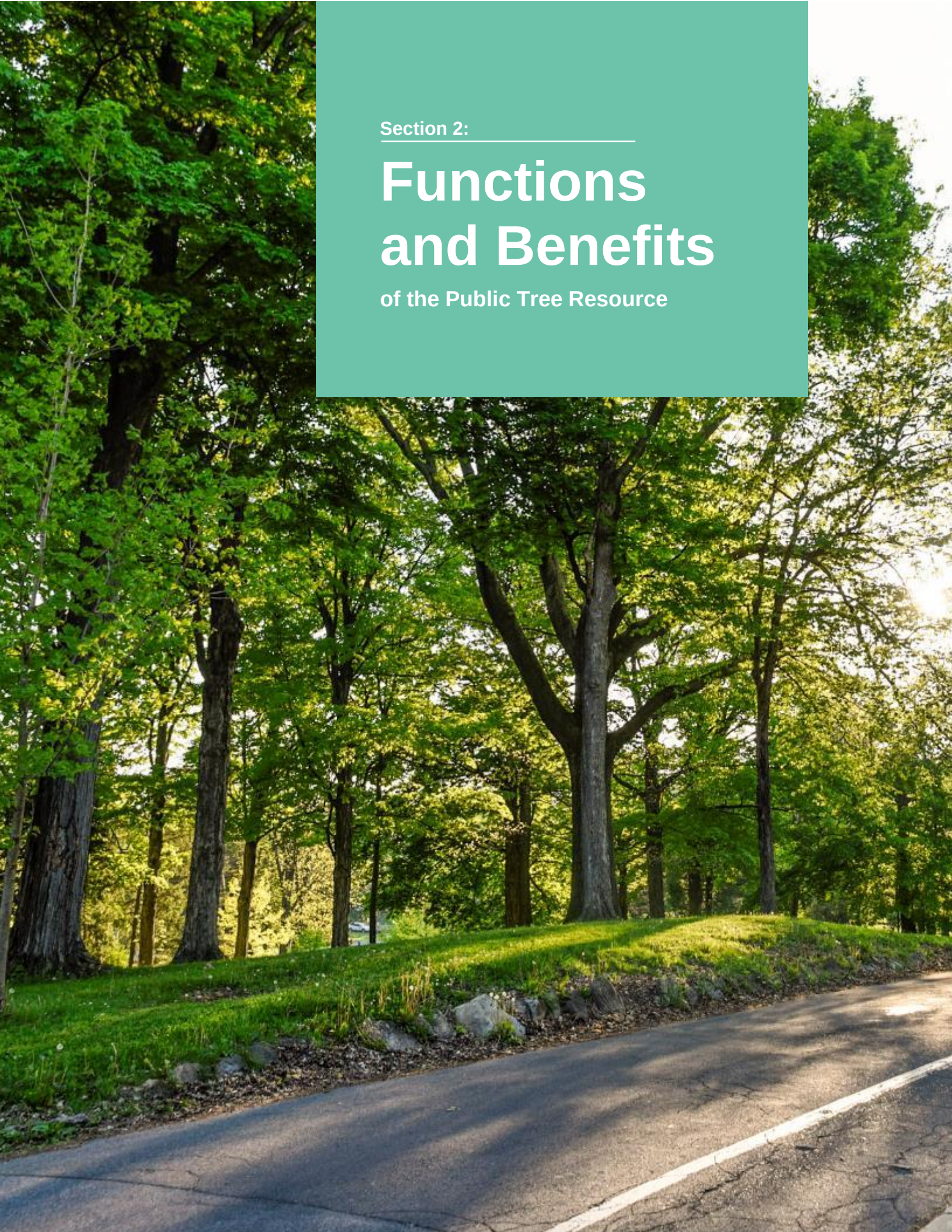
Table 2.b. Arborist's observations about trees for the Detroit Shoreway neighborhood.

Observation	Number of Trees	Percent
None	1825	35.1%
Cavity/Decay	1152	22.1%
Poor Structure	926	17.8%
Remove Hardware	629	12.1%
Poor Root System	168	3.2%
Poor Location	153	2.9%
Mechanical Damage	142	2.7%
Improperly Mulched	102	2.0%
Serious Decline	35	0.7%
Improperly Pruned	30	0.6%
Pest Problem	24	0.5%
Improperly Installed	16	0.3%
Nutrient Deficiency	1	0.0%
	5,203	100%

In the Edgewater neighborhood, poor structure and cavity or decay were most frequently observed and recorded (16% and 13% of inventoried trees, respectively). Of these 500 trees, 39 were recommended for removal, and 8 were rated to be a Priority 1 Removal. Remove Hardware, Improperly Mulched, and Improperly Installed were recorded for 82 trees. These observations indicate a poor tree planting and post-planting follow-up care. Some root collars were buried, and burlap sacks were seen above ground (Table 2.c.).

Table 2.c. Arborist's observations about trees for the Edgewater neighborhood.

Observation	Number of Trees	Percent
None	914	52.2%
Cavity/Decay	278	15.9%
Poor Structure	222	12.7%
Poor Root System	79	4.5%
Remove Hardware	59	3.4%
Poor Location	49	2.8%
Mechanical Damage	39	2.2%
Serious Decline	37	2.1%
Improperly Pruned	35	2.0%
Improperly Mulched	15	0.9%
Pest Problem	14	0.8%
Improperly Installed	8	0.5%
Nutrient Deficiency	1	0.1%
	1,750	100%



Section 2:

Functions and Benefits

of the Public Tree Resource

SECTION 2: FUNCTIONS AND BENEFITS OF THE PUBLIC TREE RESOURCE

Trees occupy a vital role in the urban environment by providing of a wide array of economic, environmental, and social benefits far exceeding the investments in planting, maintaining, and removing them. Trees reduce air pollution, improve public health outcomes, reduce stormwater runoff, sequester and store carbon, reduce energy use, and increase property value. Using advanced analytics, such as i-Tree Eco and other models in the i-Tree software suite, understanding the importance of trees to a community continues to expand by providing tools to estimate monetary values of the various benefits provided by a public tree resource.

Environmental Benefits

- Trees decrease energy consumption and moderate local climates by providing shade and acting as windbreaks.
- Trees act as mini reservoirs, helping to slow and reduce the amount of stormwater runoff that reaches storm drains, rivers, and lakes. One hundred mature tree crowns intercept roughly 100,000 gallons of rainfall per year (U.S. Forest Service 2003).
- Trees help reduce noise levels, cleanse atmospheric pollutants, produce oxygen, and absorb carbon dioxide.
- Trees can reduce street-level air pollution by up to 60% (Coder 1996). Lovasi (2008) suggested that children who live on tree-lined streets have lower rates of asthma.

Economic Benefits

- Trees in a yard or neighborhood increase residential property values by an average of 7%.
- Commercial property rental rates are 7% higher when trees are on the property (Wolf 2007).
- Trees moderate temperatures in the summer and winter, saving on heating and cooling expenses (Evans 2012, Heisler 1986).
- On average, consumers will pay about 11% more for goods in landscaped areas, with this figure being as high as 50% for convenience goods (Wolf 1998b, Wolf 1999, and Wolf 2003).
- Consumers also feel that the quality of products is better in business districts surrounded by trees than those considered barren (Wolf 1998b).
- The quality of landscaping along the routes leading to business districts had a positive influence on consumers' perceptions of the area (Wolf 2000).

Social Benefits

- Tree-lined streets are safer; traffic speeds and the amount of stress drivers feel are reduced, which likely reduces road rage/aggressive driving (Wolf 1998a, 2009).
- Chicago apartment buildings with medium amounts of greenery had 42% fewer crimes than those without any trees (Kuo and Sullivan 2001b).
- Chicago apartment buildings with high levels of greenery had 52% fewer crimes than those without any trees (Kuo and Sullivan 2001a).
- Employees who see trees from their desks experience 23% less sick time and report greater job satisfaction than those who do not (Wolf 1998a).
- Hospital patients recovering from surgery who had a view of a grove of trees through their windows required fewer pain relievers, experienced fewer complications, and left the hospital sooner than similar patients who had a view of a brick wall (Ulrich 1984, 1986).
- When surrounded by trees, physical signs of personal stress, such as muscle tension and pulse rate, were measurably reduced within three to four minutes (Ulrich 1991).

i-TREE ECO ANALYSIS

i-Tree Eco utilizes tree inventory data along with local air pollution and meteorological data to quantify the functional benefits of a community's tree resource. By framing trees and their benefits in a way that everyone can understand, dollars saved per year, i-Tree Eco helps a community to understand trees as both a natural resource and an economic investment. Knowledge of the composition, functions, and monetary value of trees helps to inform planning and management decisions, assists in understanding the impact of those decisions on human health and environmental quality, and aids communities in advocating for the necessary funding to manage their vested interest in the public tree resource appropriately.

ANNUAL RETURN ON INVESTMENT FROM THE PUBLIC TREE RESOURCE

The i-Tree Eco analysis of each neighborhood's inventoried trees quantified the functional benefits of three critical ecosystem services that they provide: air pollution removal, carbon sequestration, and avoided surface runoff (Figures 9.a., 9.b., 9.c.).

Urban environments have unique challenges that make the estimated $18,047 of functional benefits provided by Cudell's inventoried tree population an essential asset to the city (Figure 9.a.). Compared to rural landscapes, urban landscapes are characterized by high emissions in a relatively small area, valuing the 1,140 lbs. of airborne pollutants removed by Cudell's tree resource at an estimated $12,926. Avoiding stormwater runoff reduces the risk of flooding and combined sewer overflow, both of which impact people, property, and the environment, valuing the 256,797 gals. of runoff avoided with Cudell's tree resource at an estimated $2,295. Carbon dioxide ($CO_2$) also impacts people, property, and the environment as the primary greenhouse gas driving climate change, valuing the 33,080 lbs. sequestered by Cudell's tree resource at an estimated $2,826.

The replacement value of the Cudell neighborhood's inventoried tree population is estimated to be $5,547,547. In Cudell, only ten species account for 61% of the public tree resource and 77% of the functional benefits they provide. If any of these species were lost to invasive pests, disease, or other threats, their loss would have significant costs. It is critical to promote species diversity with future plantings to minimize susceptibility to potential threats, and to plant large-statured broadleaf tree species wherever possible to maximize potential environmental and economic benefits.

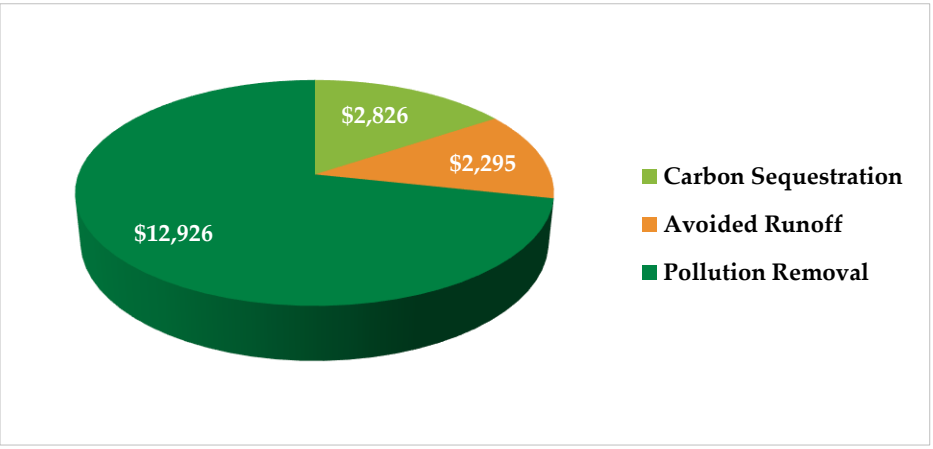


Figure 9.a. Estimated annual value of the inventoried tree resource functional benefits of the Cudell neighborhood.

Urban environments have unique challenges that make the estimated $26,163 of functional benefits provided by Detroit Shoreway's inventoried tree population an essential asset to the city (Figure 9.b.). Compared to rural landscapes, urban landscapes are characterized by high emissions in a relatively small area, valuing the 1,660 lbs. of airborne pollutants removed by Detroit Shoreway's tree resource at an estimated $18,240. Avoiding stormwater runoff reduces the risk of flooding and combined sewer overflow, both of which impact people, property, and the environment, valuing the 365,855 gals. of runoff avoided with Detroit Shoreway's tree resource at an estimated $3,269. Carbon dioxide ($CO_2$) also impacts people, property, and the environment as the primary greenhouse gas driving climate change, valuing the 54,520 lbs. sequestered by Detroit Shoreway's tree resource at an estimated $4,654.

The replacement value of the Detroit Shoreway neighborhood's inventoried tree population is estimated to be $9,146,921. In Detroit Shoreway, only ten species account for 55% of the public tree resource and 60% of the functional benefits they provide. If any of these species were lost to invasive pests, disease, or other threats, their loss would have significant costs. It is critical to promote species diversity with future plantings to minimize susceptibility to potential threats, and to plant large-statured broadleaf tree species wherever possible to maximize potential environmental and economic benefits. See Appendix B for a tree species list recommended by DRG.

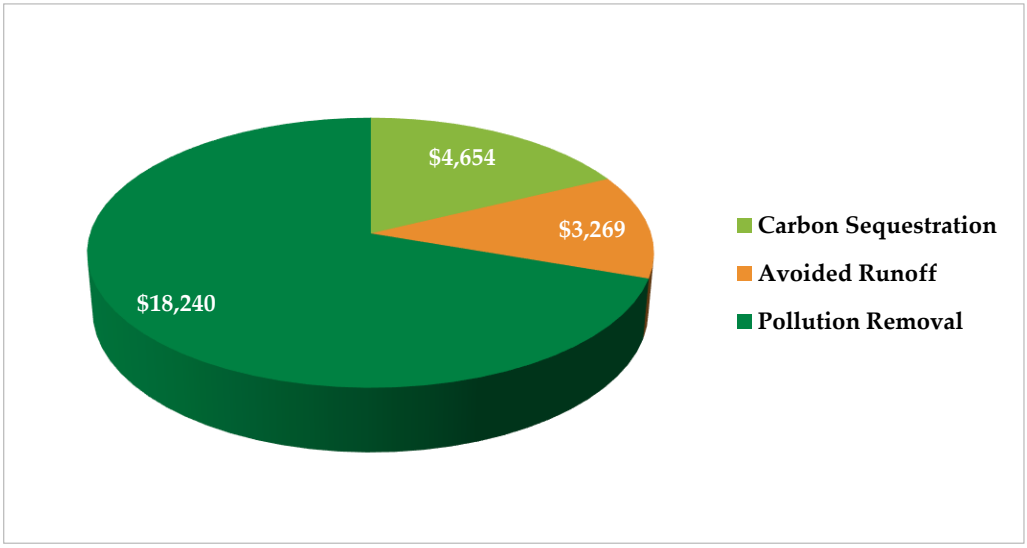


Figure 9.b. Estimated annual value of the inventoried tree resource functional benefits of the Detroit Shoreway neighborhood.

Urban environments have unique challenges that make the estimated $9,287 of functional annual benefits provided by Edgewater's inventoried tree population an essential asset to the community (Figure 9.c.). Compared to rural landscapes, urban landscapes are characterized by high emissions in a relatively small area, valuing the 654 lbs. of airborne pollutants removed by Edgewater's tree resource at an estimated $6,507. Avoiding stormwater runoff reduces the risk of flooding and combined sewer overflow, both of which impact people, property, and the environment, valuing the 130,358 gals. of runoff avoided with Edgewater's tree resource at an estimated $1,165 annually. Carbon dioxide (CO_2) also impacts people, property, and the environment as the primary greenhouse gas driving climate change, valuing the 18,900 lbs. sequestered by Edgewater's tree resource at an estimated $1,615 annually.

The replacement value of Edgewater's inventoried tree population is estimated to be $2,921,187.58. In the Edgewater neighborhood, only ten species account for approximatiely 70% of the public tree resource and of the functional benefits they provide. If any of these species were lost to invasive pests, disease, or other threats, their loss would have significant costs. It is critical to promote species diversity with future plantings to minimize susceptibility to potential threats, and to plant large-statured broadleaf tree species wherever possible to maximize potential environmental and economic benefits.

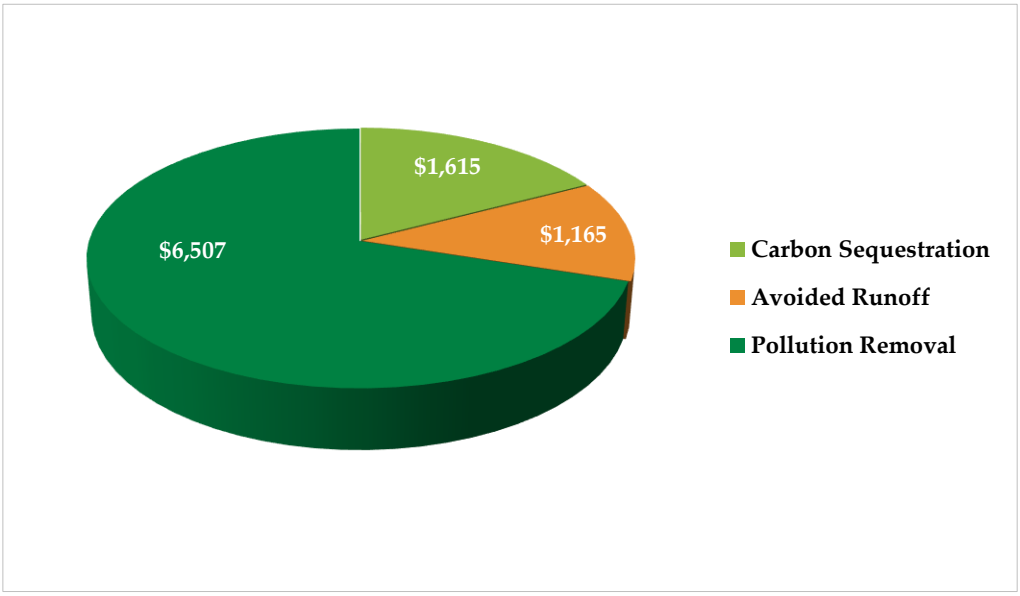


Figure 9.c. Estimated annual value of the inventoried tree resource functional benefits of the Edgewater neighborhood.

SEQUESTERING AND STORING CARBON

Trees are carbon sinks, which are the opposite of carbon sources. While carbon is emitted from cars and smokestacks, carbon is absorbed into trees during photosynthesis and stored in their tissue as they grow. The i-Tree Eco model estimates both the carbon sequestered each year and total carbon stored. Tables 3.a., 3.b., and 3.c. provide a detailed summary of benefits each neighborhood's trees provide.

Cudell's inventoried trees have stored 3,526,060 lbs. of carbon, which is all the carbon each tree has amassed throughout their lifetimes and is valued at $300,686. London planetree (*Platanus* × *acerifolia*) and Norway maple (*Acer platanoides*) store the most carbon: 7,131 lbs. per tree and 946 lbs. per tree, respectively. Both species also sequester the most carbon: 50 lbs. per tree per year and 13 lbs. per tree per year, respectively (Table 3.a.).

Detroit Shoreway's inventoried trees have stored 5,637,760 lbs. of carbon, which is all the carbon each tree has amassed throughout its lifetime and is valued at $480,772. London planetree (*Platanus* × *acerifolia*) and Norway maple (*Acer platanoides*) store the most carbon: 6,084 lbs. per tree and 1,304 lbs. per tree, respectively. Both species also sequester the most carbon: 41 lbs. per tree per year and 15 lbs. per tree per year, respectively (Table 3.b.).

Edgewater's inventoried trees have stored 1,633,180 lbs. of carbon, which is all the carbon each tree has amassed throughout its lifetime and is valued at $139,269.75. London planetree (*Platanus* × *acerifolia*) and pin oak (*Quercus palustris*) store the most carbon: 3,975 lbs. per tree and 3,706 lbs. per tree, respectively. Both species also sequester the most carbon: 33 lbs. per tree per year and 30 lbs. per tree per year, respectively (Table 3.c.).

Table 3.a. Summary of benefits provided by inventoried trees ranked by species importance value for the Cudell neighborhood.

Most Common Trees Collected During Inventory		Number Trees on the ROW	Percent of Total Trees	Benefits Provided by Street Trees				
				Stormwater Intercepted	Avoided Runoff	CO_2 Sequestered	CO_2 Stored	Air Pollution Removed
Common Name	Botanical Name		%	gal / yr	gal / yr	lbs / yr	lbs	lbs / yr
London planetree	*Platanus* x *acerifolia*	274	15.6%	638,573.1	117,939.2	13,680	1,953,820	560
Norway maple	*Acer platanoides*	251	14.3%	160,005.8	29,551.8	3,180	237,340	140
apple spp	*Malus* spp.	113	6.4%	15,520.0	2,866.4	540	15,640	20
elm spp	*Ulmus* spp.	74	4.2%	51,514.0	9,514.2	1,020	65,820	40
red maple	*Acer rubrum*	68	3.9%	41,438.5	7,653.4	1,280	136,320	40
Callery pear	*Pyrus calleryana*	66	3.7%	10,447.5	1,929.5	480	22,800	0
thornless honeylocust	*Gleditsia tricanthos inermis*	64	3.6%	17,574.0	3,245.8	1,160	81,960	20
northern red oak	*Quercus rubra*	62	3.5%	35,019.0	6,467.7	1,140	60,640	40
silver maple	*Acer saccharinum*	59	3.4%	53,746.6	9,926.6	1,140	181,960	40
Freeman maple	*Acer* x *freemanii*	49	2.8%	37,585.3	6,941.7	780	47,760	40
Kentucky coffeetree	*Gymnocladus dioicus*	48	2.7%	19,259.8	3,557.1	500	14,960	20
smoothleaf elm	*Ulmus minor*	46	2.6%	29,610.3	5,468.8	620	47,160	20
littleleaf linden	*Tilia cordata*	45	2.6%	19,249.3	3,555.2	380	34,260	20
white mulberry	*Morus alba*	42	2.4%	7,037.9	1,299.8	200	10,320	0
northern hackberry	*Celtis occidentalis*	41	2.3%	22,382.3	4,133.8	440	16,640	20
serviceberry spp	*Amelanchier* spp.	37	2.1%	2,121.6	391.9	100	1,580	0
hybrid planetree	*Platanus hybrida*	33	1.9%	68,504.5	12,652.2	1,740	220,840	60
river birch	*Betula nigra*	31	1.8%	17,029.0	3,145.1	560	24,180	20
American hornbeam	*Carpinus caroliniana*	31	1.8%	5,659.3	1,045.3	160	4,920	0
other street trees	41 genera and 60 species	327	18.6%	138,132.2	25,512.0	3,980	347,140	40
ROW Total	**81 genera and ~79 species**	**1,761**	**100%**	**1,390,410**	**256,797**	**33,080**	**3,526,060**	**1,140**

Table 3.b. Summary of benefits provided by inventoried trees ranked by species importance value for the Detroit Shoreway neighborhood.

Most Common Trees Collected During Inventory		Number Trees on the ROW	Percent of Total Trees	Benefits Provided by Street Trees				
				Stormwater Intercepted	Avoided Runoff	CO_2 Sequestered	CO_2 Stored	Air Pollution Removed
Common Name	Botanical Name		%	gal / yr	gal / yr	lbs / yr	lbs	lbs / yr
Norway maple	*Acer platanoides*	406	9.8%	316,922	58,361.9	6,060	529,500	280
thornless honeylocust	*Gleditsia tricanthos inermis*	283	6.8%	79,972.5	14,727.1	5,180	379,560	80
London plane	*Platanus* x *acerifolia*	248	6.0%	404,539.1	74,496.8	10,060	1,508,760	380
apple spp	*Malus* spp.	241	5.8%	22,434.2	4,131.4	660	17,200	20
red maple	*Acer rubrum*	233	5.6%	127,797.2	23,534.2	3,460	295,580	120
Japanese zelkova	*Zelkova serrata*	201	4.9%	68,114.8	12,543.5	2,300	223,780	60
Amur corktree	*Phellodendron amurense*	189	4.6%	88,376.3	16,274.7	4,100	364,700	80
elm spp	*Ulmus* x	184	4.5%	64,499.4	11,877.7	1,460	136,100	60
Callery pear	*Pyrus calleryana*	162	3.9%	27,508.8	5,065.8	1,300	62,660	20
northern red oak	*Quercus rubra*	112	2.7%	10,696.1	1,969.7	360	22,420	0
ginkgo	*Ginkgo biloba*	111	2.7%	11,444.1	2,107.5	380	11,900	20
northern hackberry	*Celtis occidentalis*	103	2.5%	46,507.2	8,564.5	940	54,920	40
Freeman maple	*Acer* x *freemanii*	87	2.1%	68,511.9	12,616.6	1,620	209,280	60
sweetgum	*Liquidambar styraciflua*	86	2.1%	66,317.3	12,212.5	1,320	169,180	60
littleleaf linden	*Tilia cordata*	82	2.0%	53,733.4	9,895.1	980	85,800	40
Chinese elm	*Ulmus parvifolia*	68	1.6%	9,207.0	1,695.5	160	6,080	0
hedge maple	*Acer campestre*	67	1.6%	15,835.8	2,916.2	360	12,200	20
pin oak	*Quercus palustris*	65	1.6%	41,979.9	7,730.7	1,800	222,460	40
Kentucky coffeetree	*Gymnocladus dioicus*	57	1.4%	5,142.8	947.0	100	1,540	0
other street trees	50 genera and ~101 species	1,148	27.8%	457,158.8	84,186.9	11,920	1,324,140	280
ROW Total	57 genera and ~120 species	4,133	100%	1,986,698.2	365,855.3	54,520	5,637,760	1,660

Table 3.c. Summary of benefits provided by inventoried trees ranked by species importance value for the Edgewater neighborhood.

Most Common Trees Collected During Inventory		Number Trees on the ROW	Percent of Total Trees	Benefits Provided by Street Trees				
				Stormwater Intercepted	Avoided Runoff	CO_2 Sequestered	CO_2 Stored	Air Pollution Removed
Common Name	Botanical Name		%	gal / yr	gal / yr	lbs / yr	lbs	lbs / yr
Callery pear	*Pyrus calleryana*	168	12%	33,825	6,219	1,520	79,840	40
honey locust	*Gleditsia triacanthos*	113	8%	28,050	5,158	1,620	89,380	20
pin oak	*Quercus palustris*	94	7%	65,684	12,077	2,860	348,340	60
northern red oak	*Quercus rubra*	83	6%	25,108	4,617	840	68,680	20
London planetree	*Platanus* x *acerifolia*	80	6%	118,665	21,819	2,640	318,020	100
red maple	*Acer rubrum*	75	5%	43,719	8,039	1,080	81,620	40
elm spp	*Ulmus* spp.	73	5%	33,342	6,131	580	35,180	40
Norway maple	*Acer platanoides*	68	5%	42,776	7,865	820	69,080	40
smoothleaf elm	*Ulmus carpinifolia*	52	4%	48,190	8,861	860	66,540	40
littleleaf linden	*Tilia cordata*	51	4%	37,785	6,948	660	48,820	40
crabapple species	*Malus* species	49	4%	4,926	906	140	3,820	0
Japanese zelkova	*Zelkova serrata*	43	3%	12,719	2,339	420	36,180	20
red horsechestnut	*Aesculus x carnea*	37	3%	11,715	2,154	220	4,520	20
Freeman maple	*Acer x freemanii*	36	3%	20,600	3,788	440	51,940	20
northern hackberry	*Celtis occidentalis*	28	2%	14,120	2,596	260	8,840	20
green ash	*Fraxinus pennsylvanica*	26	2%	21,913	4,029	300	31,480	20
sweetgum	*Liquidambar styraciflua*	21	2%	14,006	2,575	260	25,020	20
sawtooth oak	*Quercus acutissima*	21	2%	8,122	1,493	280	10,060	0
hardy rubber tree	*Eucommia ulmoides*	16	1%	31,481	432	60	1,680	0
American sycamore	*Platanus occidentalis*	16	1%	2,348	5,788	760	79,100	20
other street trees	*40 genera and ~65 species*	219	16%	89,875	16,526	2,280	174,960	73
ROW Total	**47 genera and ~85 species**	**1,369**	100%	**708,970**	**130,358**	**18,900**	**1,633,100**	**654**

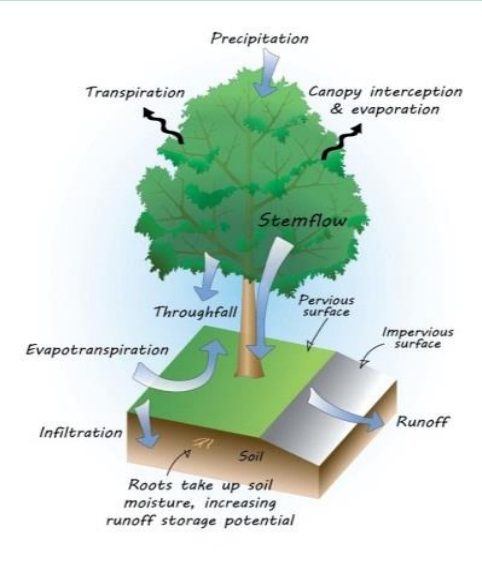
CONTROLLING STORMWATER

Trees intercept rainfall with their leaves and branches, helping lower stormwater management costs by avoiding runoff. The inventoried trees in the Cudell neighborhood avoid 256,797 gals. of runoff annually. Avoided runoff accounts for 12.7% of the annual functional benefits provided by Cudell's public tree resource. The inventoried trees in Detroit Shoreway avoid 365,855 gals. of runoff annually. The avoided runoff accounts for 12.5% of the annual functional benefits provided by Detroit Shoreway's public tree resource. The inventoried trees in Edgewater's tree avoid 130,358 gals. of runoff annually. Avoided runoff accounts for approximately 13% of the annual functional benefits provided by the neighborhood's public tree resource.

Of all species inventoried, London planetree contributed the most annual stormwater benefits for all three neighborhoods. The London planetree population avoided 117,939 gals. of runoff for the Cudell neighborhood (16.0% of inventoried trees), avoided 74,497 gals. of runoff for the Detroit Shoreway meighnorhood (6.0% of inventoried trees), and avoided 21,819 gals. of runoff per year for the Edgewater community (5.8% of inventoried trees).

The most abundant species in the Edgewater inventoried tree population, Callery pear (12.3%), only avoided approximately 6,219 gals. of runoff. On a per-tree basis, large trees with leafy canopies provided the most functional benefits. This means that London planetree avoids approximately four times as much as Callery pear did in the Edgewater neighborhood, despite only having about a half of its population size. This illustrates how large-statured trees with wide canopies provide significantly greater benefits.

CANOPY FUNCTIONS



Trees provide many functions and benefits all at once simply by existing, such as:

- Catching rainfall in their crown so it drips to the ground with less of an impact or flows down their trunk.
- Helping stormwater soak into the ground by slowing down runoff.
- Creating more pore space in the soil with their roots, helping stormwater to move through the ground.
- Cooling the surrounding landscape by casting shade with their canopy and releasing water from their leaves.
- Catching airborne pollutants on their leaves and absorbing them with their roots when they wash off in the rain.
- Transforming some pollutants into less harmful substances and preventing other pollutants from forming.

IMPROVING AIR QUALITY

The Cudell inventoried tree population annually removes 1,140 lbs. of air pollutants. The i-Tree Eco model estimated the value of this benefit at $12,926, which is 71.6% of the value of all annual benefits. As shown in Figure 10.a., a small reduction of $PM_{2.5}$ is more valuable than any of the other pollutants removed. The trees that provided the highest annual air quality benefits were London planetree (*Platanus* × *acerifolia*) and Norway maple (*Acer platanoides*), which removed 2.0 lbs. of pollutants per tree per year and 0.6 lb. of pollutants per tree per year, respectively.

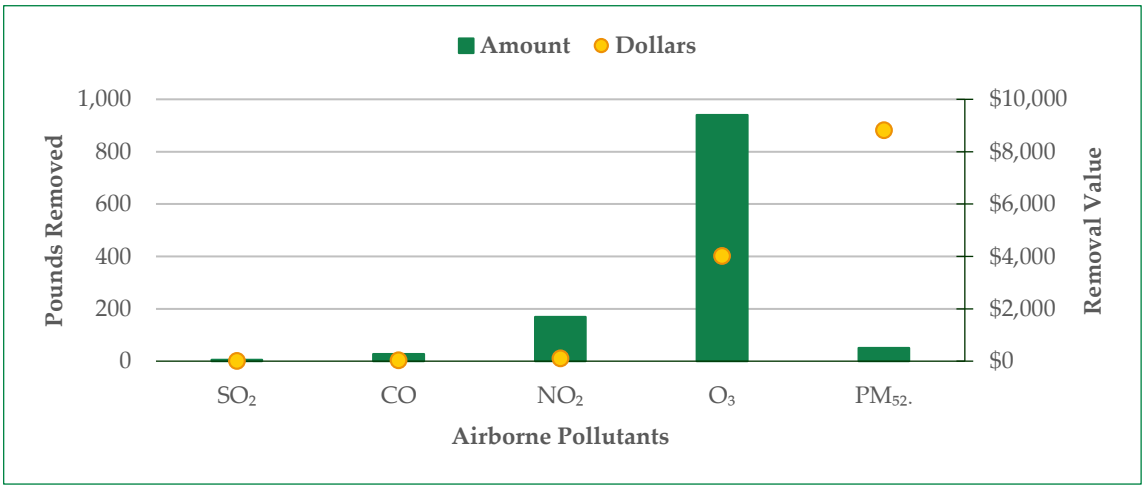


Figure 10 a. Cudell's estimated value of removing airborne pollution by weight and type. Amount removed indicated by points, dollar values by bars.

The Detroit Shoreway neighborhood's inventoried tree population annually removes 1,660 lbs. of air pollutants. The i-Tree Eco model estimated the value of this benefit at $18,240, which is 69.7% of the value of all annual benefits. As shown in Figure 10.b., a small reduction of $PM_{2.5}$ is the more valuable than any of the other pollutants removed. The trees that provided the highest annual air quality benefits were London planetree (*Platanus* × *acerifolia*) and Norway maple (*Acer platanoides*), which removed 1.5 lbs. of pollutants per tree per year and 0.7 lb. of pollutants per tree per year, respectively.

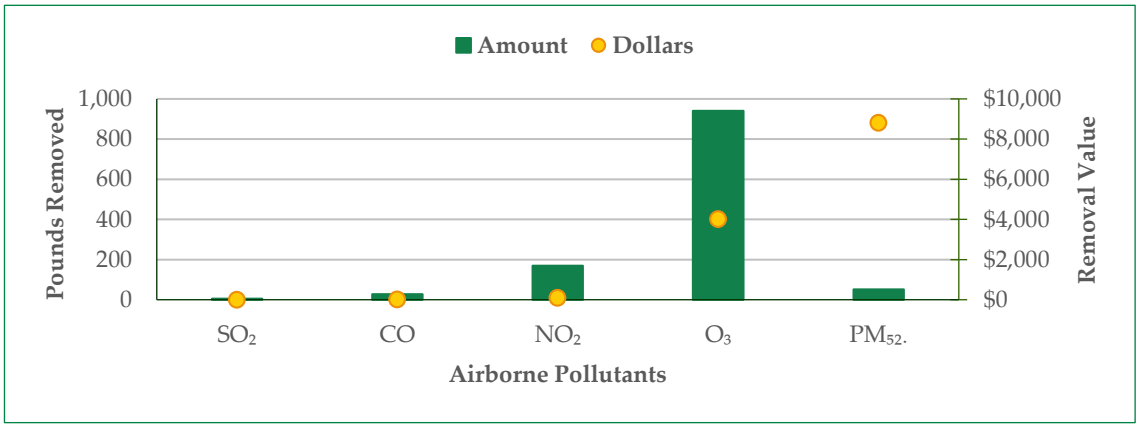


Figure 10.b. Detroit Shoreway's estimated value of removing airborne pollution by weight and type. Amount removed indicated by points, dollar values by bars.

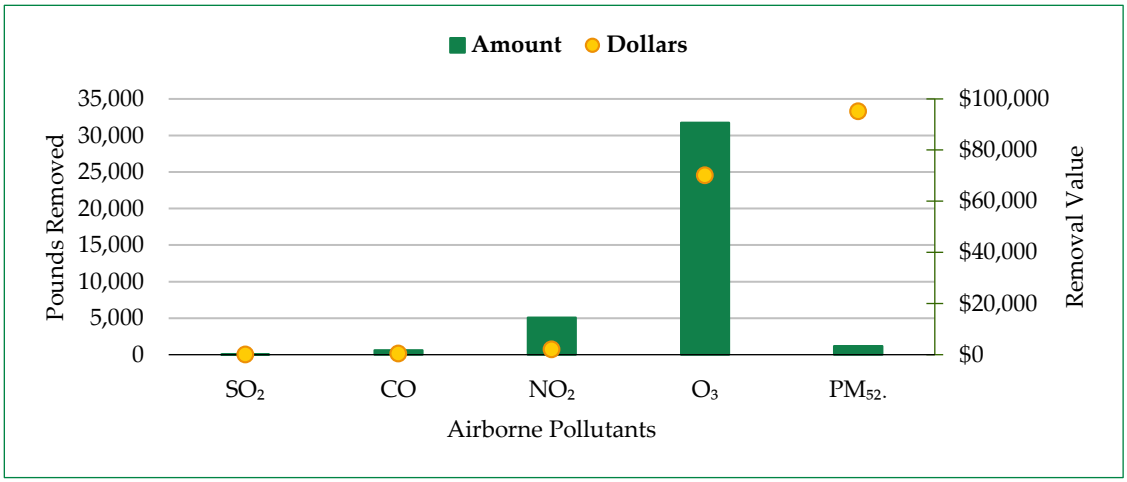
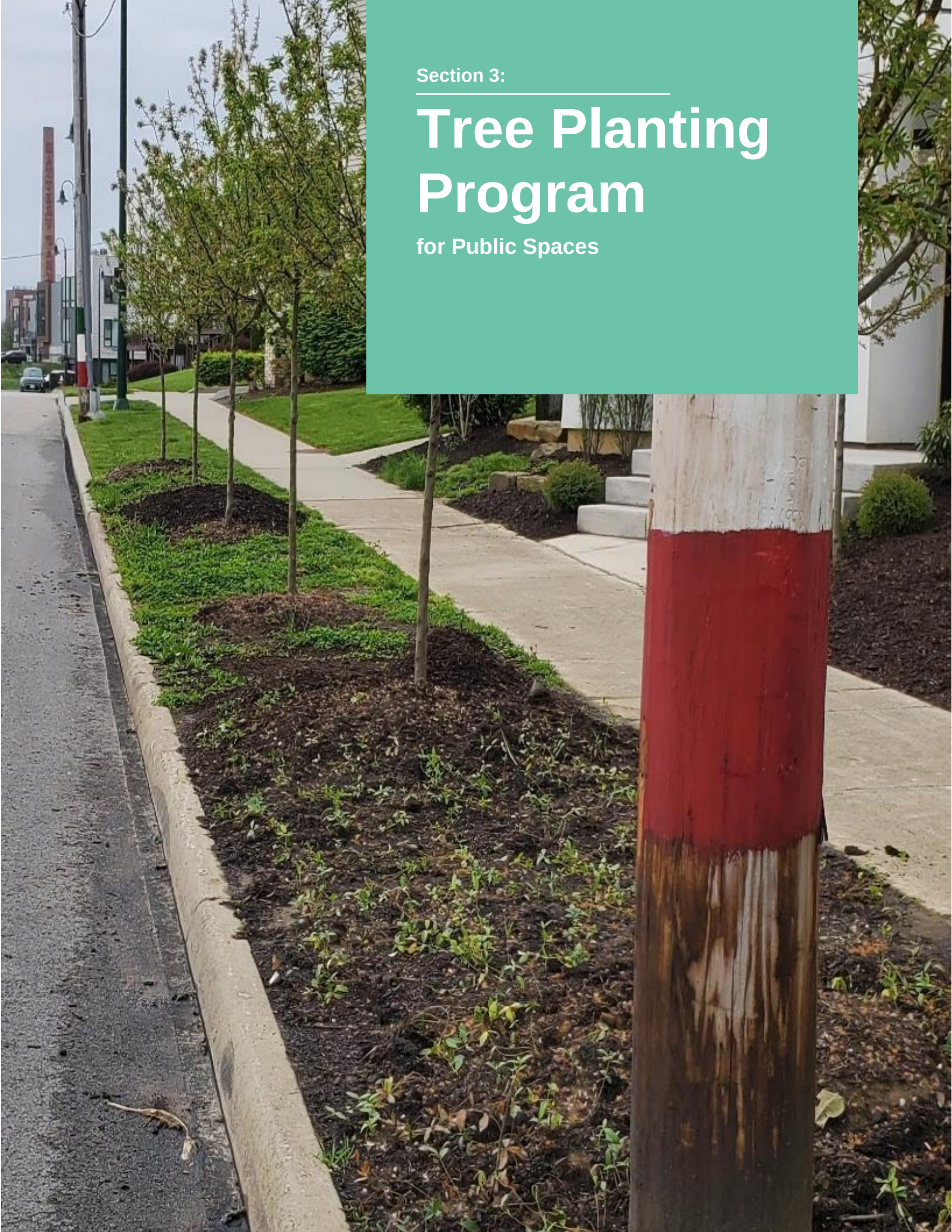


Figure 10.c. Edgewater's estimated value of removing airborne pollution by weight and type. Amount removed indicated by points, dollar values by bars.

The Edgewater inventoried tree population annually removes 654 lbs. of air pollutants, including sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and particulate matter ($PM_{2.5}$). The i-Tree Eco model estimated the value of this benefit at $6,507, which is 70.0% of the value of all annual benefits.

As shown in Figure 10.c., a small reduction of $PM_{2.5}$ is more valuable than any of the other pollutants removed. The trees that provided the highest annual air quality benefits were London planetree (*Platanus* × *acerifolia*) and pin oak (*Quercus palustris*), which removed 1.25 lbs. of pollutants per tree per year and 0.64 lb. of pollutants per tree per year, respectively.



Section 3:

Tree Planting Program

for Public Spaces

SECTION 3: TREE PLANTING PROGRAM FOR PUBLIC SPACES

This Tree Planting Program was developed for the three neighborhoods using tree inventory data, the City of Cleveland's tree planting specifications, and input for the project advisors including community leaders, neighborhood residents and administrators, and the City of Cleveland's Urban Forester.

THE RIGHT TREE IN THE RIGHT PLACE

The right tree in the right place is a mantra for tree planting used by the Arbor Day Foundation and many utility companies nationwide. Trees come in many different shapes and sizes, and often change dramatically over their lifetimes. Before selecting a tree for planting, make sure it is the right tree—know how tall, wide, and deep it will be at maturity. Equally important to selecting the right tree is choosing the right spot to plant it. Blocking an unsightly view or creating some shade may be a priority, but it is important to consider how a tree may impact existing utility lines and hardscape as it grows taller, wider, and deeper. If the tree at maturity will reach overhead lines, or conflict with sidewalks and curbs, it is best to choose another tree or a different location.

MIDPOINT MEETING

We also recognize the following individuals who participated in the June 4, 2020 Midpoint Meeting which was held via videoconference:

- Sandra Albro, Director of Community Partnerships, Holden Forests & Gardens and Co-Chair, Cleveland Tree Coalition
- Christopher Brown, Safety and Community Outreach Coordinator, Cudell Improvement, Inc.
- Brent Eysenbach, Senior Program Manager, Cuyahoga Soil & Water Conservation District and Edgewater Neighborhood Resident
- Dean Van Farowe, Board member, DSCDO and Pastor, Calvary Reformed Church
- Jim Jenkins, ISA Board Certified Master Arborist and Project Manager, DRG
- Phil Kidd, Sherwick Tree Steward and Special Projects Manager, DSCDO
- Jennifer Kipp, City of Cleveland Urban Forester
- Heather Lazar, Ward 15 Neighborhood Advocate, Office of Councilman Matt Zone
- Andria Loczi, Block Club Leader and Detroit Shoreway Neighborhood Resident
- Sasha Ottoson-Deal, Sherwick Tree Steward and Detroit Shoreway Neighborhood Resident
- Claire Posius, Board Member, Cudell Improvement, Inc. and Edgewater Neighborhood Resident
- Jenny Spencer, Managing Director, DSCDO and Cudell Improvement, Inc.
- Jonathan Steirer, Board Member, Cudell Improvement, Inc. and Cudell Neighborhood Resident
- Shirley Vaughn, ISA Arborist and Municipal Specialist, DRG
- Dolores Watson, Sherwick Tree Steward and Detroit Shoreway Neighborhood Resident
- Matt Zone, Ward 15 Councilman, City of Cleveland

TREE PLANTING GOALS

The following three goals are the focus of the each neighborhood's tree planting program:

- Plant large trees whenever possible to maximize future canopy cover and benefits.
- Target areas with low canopy coverage.
- Encourage private property owners to plant trees.

COMMUNITY CONSIDERATIONS

When planting new trees, the neighborhoods should consider species, site, street, neighborhood, and city wide variables such as stocking level, diversity, conflicts with infrastructure, and growing space size, type and costraints, and adhere local ordinances and specifications and follow best practices (Appendices C, D, and E). **In all cases, the neighborhood must coordinate tree planting with the City of Cleveland.**

STOCKING LEVEL

Stocking is a traditional forestry term used to measure the density and distribution of trees. For an urban/community forest, stocking level is used to estimate the total number of sites along the street ROW that could contain trees. Stocking level is the ratio of street ROW spaces occupied by trees to the total street ROW spaces suitable for trees. Park trees and other non-ROW public property trees are excluded from this measurement.

DRG found that Cudell had 998 planting sites and 30 stumps. The current street ROW tree stocking level for Cudell is 63%. Detroit Shoreway had 991 planting sites and 79 stumps. The current street ROW tree stocking level for the Detroit Shoreway is 79%. The Edgewater neighborhood had 365 planting sites and 16 stumps, which should be considered potential planting sites because they will become vacant after stumps are removed. Based on the data collected during this inventory, the current street ROW tree stocking level for the Edgewater neighborhood is 78%.

An ideally stocked tree resource promotes canopy continuity, and knowing the existing stocking level of a tree population will inform a community's planting needs and associated budget. Generally, this entails a planned planting program that includes new installation routine maintenance activities. At the current stocking level of 63%, Cudell needs 1,028 additional trees to be fully stocked. At the current stocking level of 79%, Detroit Shoreway needs 1,070 additional trees to be fully stocked. At the current stocking level of 78%, Edgewater needs 381 additional trees to be fully stocked. For each neighborhood, the number of additional trees needed assumes the neighborhoods' tree resource experiences zero loss, which is unlikely.

CUDELL TREE PLANTING RECOMMENDATION

Over the course of the five-year program, a total of 160 existing trees are recommended for removal. Additionally, the tree resource is susceptible to various threats, including storms, invasive pests, and disease. Typical annual mortality rates range from 1–3% of the population. Given the inventoried population's overall condition rating of Fair, Cudell's tree resource is more likely to be on the lower end of the given range. Using a 1% annual mortality rate of 18 trees per year, the neighborhood can anticipate removing an additional 90 trees over a five-year period. When accounting for scheduled removals and annual mortality, DRG finds it necessary to plant 1,278 trees over the course of five years in order to have a fully stocked tree resource.

1,028 trees to reach stocking level of 100%

+

160 trees recommended for removal

+

90 additional trees lost over 5 years (+/- 1 % annual mortality rate of 18 trees/year)

=

1,278 total trees required to achieve 100% stocking level by Year 5.

In order to have a fully stocked street ROW, DRG strongly recommends that the neighborhood of Cudell invests in planting at least 256 new trees per year.

DETROIT SHOREWAY TREE PLANTING RECOMMENDATION

Over the course of the five-year program, a total of 406 existing trees are recommended for removal. Additionally, the tree resource is susceptible to various threats, including storms, invasive pests, and disease. Given the inventoried population's overall condition rating of Fair, Detroit Shoreway's tree resource is more likely to be on the lower end of the given range. Using a 1% annual mortality rate of 42 trees per year, the neighborhood can anticipate removing an additional 210 trees over a five-year period. When accounting for scheduled removals and annual mortality, DRG finds it necessary to plant 1,686 trees over the course of five years in order to have a fully stocked tree resource.

1,070 trees to reach stocking level of 100%

+

406 trees recommended for removal

+

210 additional trees lost over 5 years (+/- 1 % annual mortality rate of 42 trees/year)

=

1,686 total trees required to achieve 100% stocking level by Year 5.

In order to have a fully stocked street ROW, DRG strongly recommends that the neighborhood of Detroit Shoreway invests in planting at least 337 new trees per year.

EDGEWATER TREE PLANTING RECOMMENDATION

A total of 141 existing trees are recommended for removal. Additionally, the tree resource is susceptible to various threats, including storms, invasive pests, and disease. Given the inventoried population's overall condition rating of Fair, Edgewater's tree resource is more likely to be on the mean of the given range. Using a 1% annual mortality rate of 27 trees per year, the neighborhood can anticipate removing an additional 140 trees over a five-year period. When accounting for scheduled removals and annual mortality, DRG finds it necessary to plant 650 trees over the course of five years in order to have a fully stocked tree resource.

369 trees to reach stocking level of 100%

+

141 trees recommended for removal

+

140 additional trees lost over 5 years (+/- 1 % annual mortality rate of 27trees/year)

=

650 total trees required to achieve 100% stocking level by Year 5.

In order to have a fully stocked street ROW, DRG strongly recommends that Edgewater invests in planting at least 130 new trees per year.

DIVERSITY

Healthy urban forests are managed for diversity. A diverse tree population is widely viewed as a key component in the resilience of street tree populations to pests, diseases, and climate change.

Photograph 3. Trees should be selected to improve species diversity and plant the right tree in the right place. Here, volunteers are adding new trees to the neighborhood.

Species diversity affects maintenance costs, planting goals, canopy continuity, and the forestry program's ability to respond to threats from invasive pests or diseases. Monocultures or low species diversity (large number of trees of the same species) can lead to severe losses in the event of species-specific epidemics. Emerald ash borer (EAB, *Agrilus planipennis*) and Asian longhorned beetle (ALB, *Anoplophora glabripennis*) are non-native insect pests that attack some of the most prevalent urban shade trees and certain agricultural trees throughout the country. Their devastating effects are due to their attack of not only weaker trees but also the ability to kill healthy, thriving trees.

OVERHEAD UTILITIES

Planting only small-growing trees within 20 feet of overhead utilities, medium-size trees within 20–40 feet, and large-growing trees outside 40 feet will help improve future tree conditions, minimize future utility line conflicts, and reduce the costs of maintaining trees under utility lines. Figure 11.a., 11.b., and 11.c. show each neighborhood's available planting sites and if overhead wires are present.

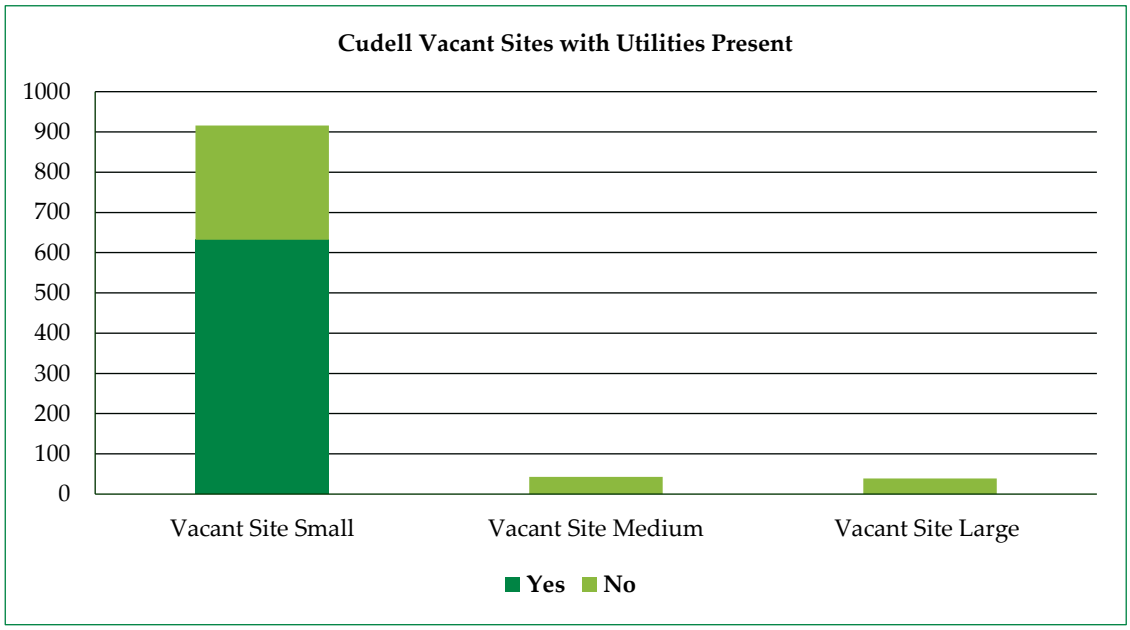


Figure 11.a. Inventoried vacant planting sites and overhead utilities for Cudell.

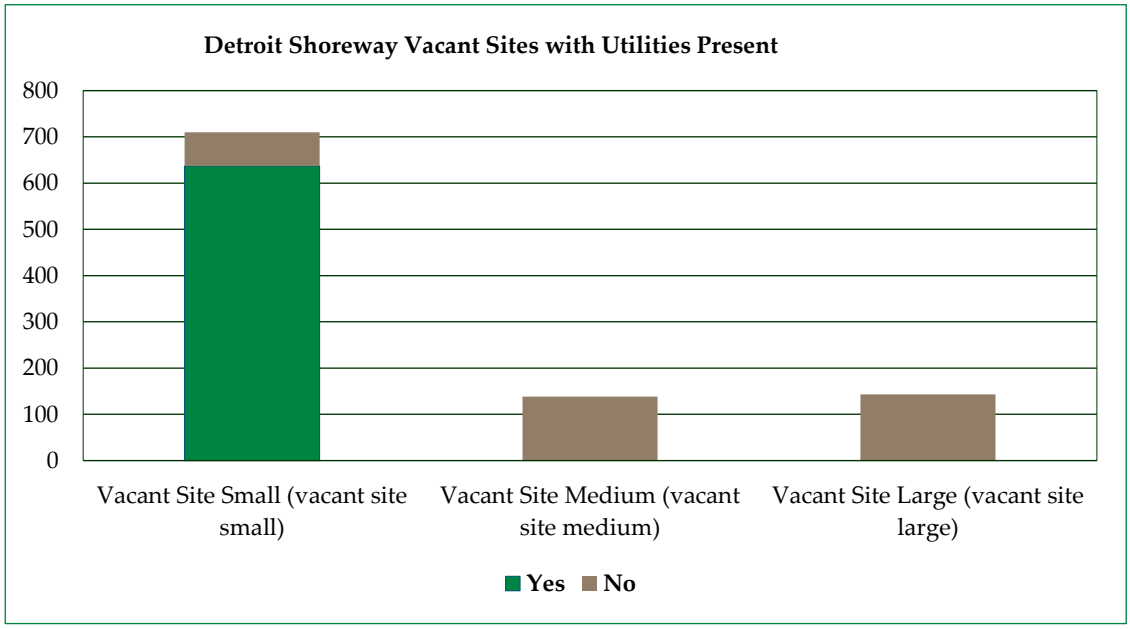


Figure 11.b. Inventoried vacant planting sites and overhead utilities for Detroit Shoreway.

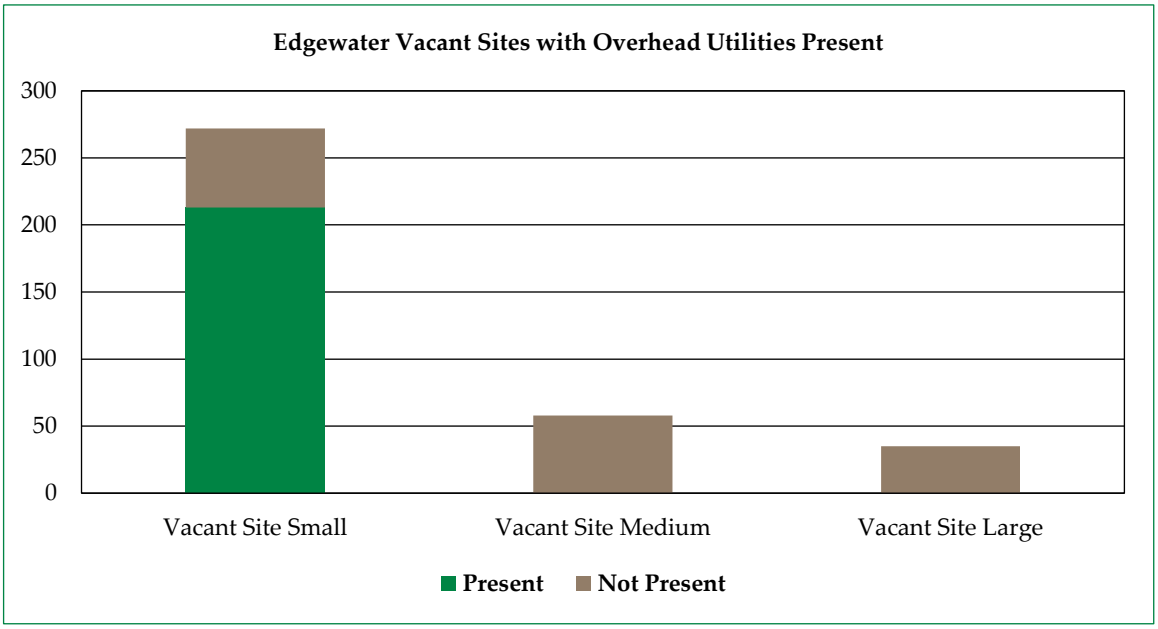


Figure 11.c. Inventoried vacant planting sites and overhead utilities for Edgewater.

HARDSCAPES

When planting around hardscape, it is important to give the tree enough growing room above ground. Guidelines for planting trees among hardscape features are as follows: give small-growing trees 4–6 feet, medium-growing trees 7–9 feet, and large-growing trees 10 feet or more between hardscape features. In most cases, this will allow for the spread of a tree's trunk taper, root collar, and immediate larger-diameter structural roots.

In addition to this, the city has provided the following requirements for tree planting within the city's ROW:

- Do not plant in front of building entrances in order to permit easy access by the Fire Department.
- Do not plant within bus stops.
- Minimum distance between trees (trunk to trunk) shall be 30 feet, and maximum of 40 feet depending upon the tree species and other local conditions.
- Minimum distance from a streetlight to the tree trunk is 25 feet (this may vary with tree species).
- Minimum distance from a stop sign to the tree trunk is 30 feet.
- Minimum distance from other traffic signs to the tree trunk is 6 feet.
- Suggested distance from a parking meter back to tree trunk shall be no more than 5 feet to allow for the swing of car doors.
- Minimum distance from a gas or water valve to the tree trunk is 6 feet.
- Minimum distance from a fire hydrant to the tree trunk is 6 feet.
- Minimum distance from the corner of a street intersection to the tree trunk is 40 feet.

- Minimum distance from the edge of the pit to any opposite obstruction (building wall, stoop, railing, property line, etc.) is from 4 to 6 feet, depending upon local conditions and the amount of sidewalk traffic.
- Minimum width of tree lawn required to plant a tree is 4 feet.

Photograph 4. Newly planted amur maple trees along the Franklin Boulevard streetscape in the Edgewater neighborhood.

LARGER TREES PROVIDE GREATER BENEFITS

Creating larger growing sites for trees in the municipal ROW can be the single most beneficial management practice to improve the survival rate of planted and developing trees. Increasing planting space can also reduce the amount of tree-related infrastructure conflicts, as the trees will be planted further from curbs and sidewalks. Depending on the site, there are several methods available to create and/or increase the growing space for newly planted trees:

- Install or enlarge tree wells/pits in existing sidewalks of sufficient width. Ideally, the minimum growing space of a small-sized tree is 32 square feet. Where then neighborhoods have sidewalks of a sufficient width and length, the city could install tree pits with enough space remaining for the sidewalk to still comply with American Disability Act (ADA) standards.
- Planting trees 4 feet behind a curb without a sidewalk, or 4 feet behind an existing sidewalk, can be a low-cost alternative to more construction intensive methods. This can result in less damage to the sidewalk and give tree roots room to grow into the open soil.
- Re-routing the sidewalk around an area to create designated large tree sites is a relatively cost-effective method to increase growing spaces. This method can also be applied to existing large tree sites, where tree roots have already come in conflict with the sidewalk.
- A landscape bump-out/curb extension is a vegetative area that protrudes into the parking lane of a street, to provide a growing space for plants or trees. These spaces can be used quite effectively by municipalities to beautify a streetscape, provide greater storm water retention, along with the added benefit of slowing car speeds at the bump-out location.
- Planting new trees in areas where there is sparse canopy already is the most important. It is also important to plant more trees in areas with poor canopy continuity or gaps in

existing canopy.

GROWING SPACE SIZE

In Cleveland's public ROW's and spaces, tree planting sites must conform to the city's specification and be approved by the City of Cleveland's Urban Forester in advance of planting the tree.

YOUNG TREE TRAINING CYCLE

Trees included in the Young Tree Training cycle are generally less than 8 inches DBH. These younger trees sometimes have branch structures that can lead to potential problems as the tree ages. Potential structural problems include codominant leaders, multiple limbs attaching at the same point on the trunk, or crossing/interfering limbs. If these problems are not corrected, they may worsen as the tree grows, increasing its risk and creating potential liability. The recommended length of a Young Tree Training cycle is three years because young trees tend to grow at faster rates than mature trees.

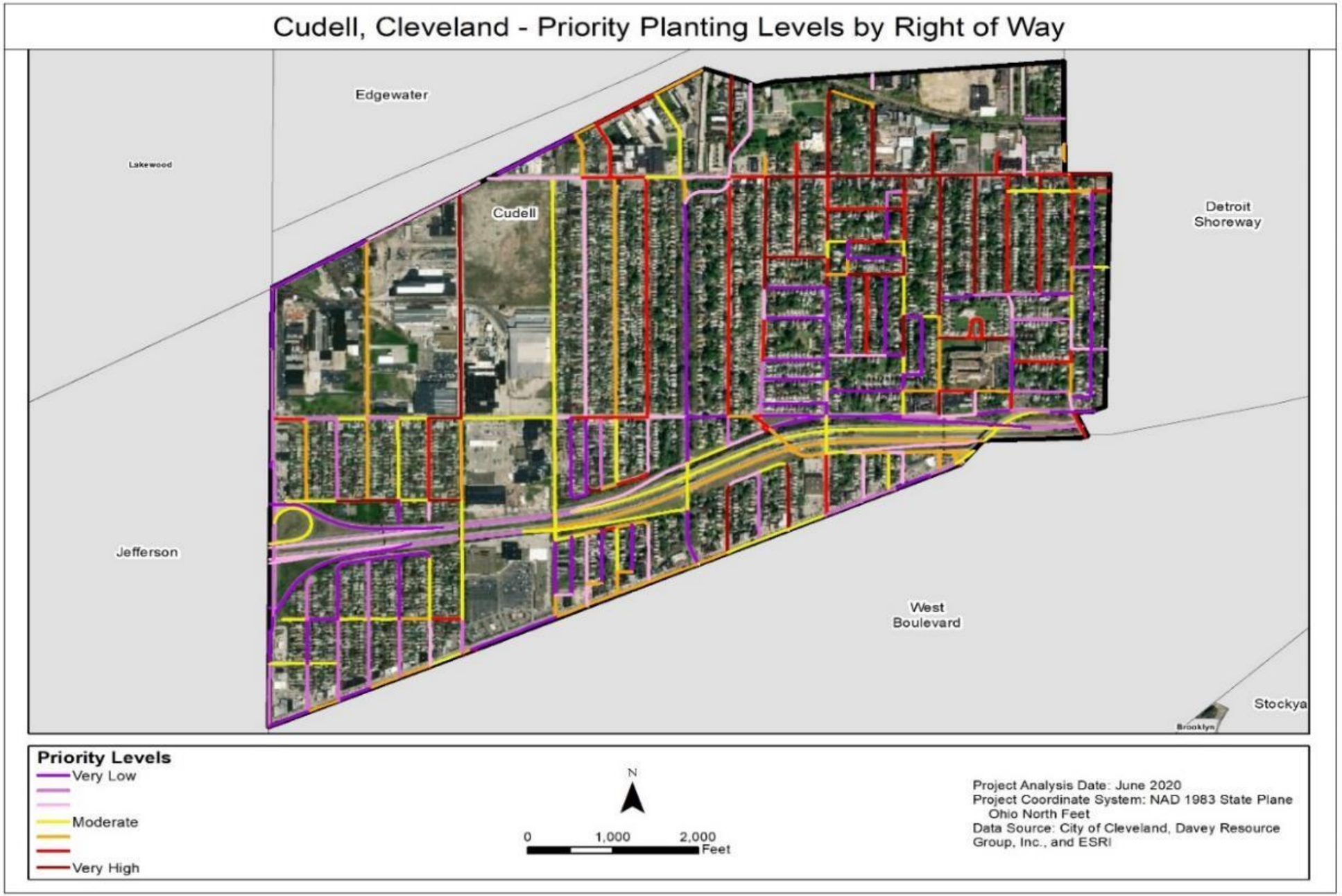
The Young Tree Training cycle differs from the Routine Pruning cycle in that the Young Tree Training cycle generally only includes trees that can be pruned from the ground with a pole pruner or pruning shear.

When new trees are planted, they should enter the Young Tree Training cycle after establishment, typically within 2–3 years after planting. In future years, the number of trees in the Young Tree Training cycle will be based on tree planting efforts and growth rates of young trees. Each neighborhood should strive to training prune approximately one-third of its young trees each year.

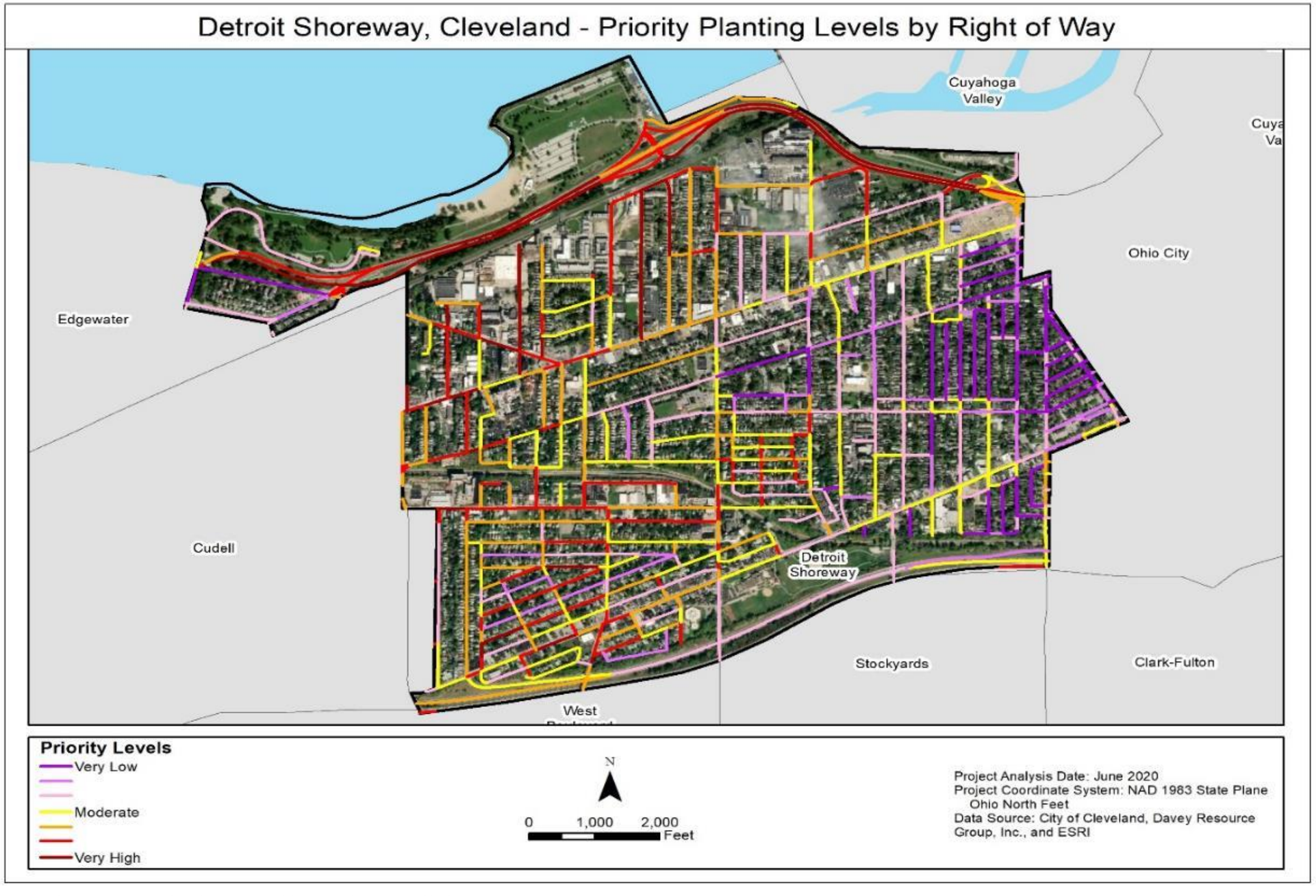
TREE PLANTING PRIORITIZATION

DRG assessed and prioritized planting areas; these areas are preferred because planting these locations will maximize ecological and service social-equity goals. These priority planting areas can be assessed individually for their suitability, potential capacity for new trees, and species selection to purposefully maximize the benefits provided by each neighborhood's tree canopy. This analysis shows areas within the neighborhood that could benefit the most and be most receptive to additional planting activities. The planting plan included race/ethnicity, median household income, and population density census data into determining prioritization. Higher priorities of social equity give a focused effort of providing trees and tree canopy to all citizens regardless of social status or health.

It is not enough to simply plant more trees to increase canopy cover and benefits. Planning and funding for tree care and management, public outreach, and education must complement planting efforts to ensure the success of new plantings. See Appendix C for tree planting tips. Communty organizations only have direct influence over a component of urban forest. To help ensure the benefits desired are being realized, a management strategy towards maintaining a healthy urban forest must involve partnerships in both public and private sectors. To make a difference, the City of Cleveland, its residents, and partners can support the urban forestry program by promoting the benefits that trees offer to the community, fulfilling routine maintenance for both public and private trees, and maximizing the space available for new trees.



Map 1. Planting Priority Map along the streetscape of the Cudell Neighborhood.



Map 2. Planting Priority Map along the streetscape of the Detroit Shoreway Neighborhood.

Map 3. Planting Priority Map along the streetscape of the Edgewater Neighborhood.

The distribution of tree canopy varies across the city, changing over decades, sometimes gradually, and sometimes abruptly due to weather, climate, disease, economics, and development factors. This variability leads to an inequitable distribution of tree canopy, meaning neighborhoods with lower tree canopy receive less benefits. Comparing social equity factors (like median income gathered from census data) and the distribution of tree canopy across the city can help prioritize tree planting and care in neighborhoods with fewer trees that can stand to benefit the most from additional trees and tree care (Maps 1–3).

PLANTING LIST

A list of suggested tree species is provided in Appendix B. These tree species are specifically selected for the climate of these three neighborhoods. This list is not exhaustive but can be used as a guideline for species that meet community objectives and to enhance any existing list of approved species.

TREE PLANTNG SCHEDULE AND BUDGET

Utilizing 2020 neighborhood tree inventory data, the following annual tree planting schedule was developed detailing the recommended tasks to complete each year (Tables 4.a., 4.b., 4.c.). DRG made budget projections using industry knowledge and public bid tabulations. Figures 12.a., 12.b., and 12.c. show the number of planting sites along with the estimated costs to fill and maintain the newly planted trees over five years in each neighborhood.

To implement the schedule, Cudell's tree planting budget should be:

- No less than $191,140 for the first three years of implementation.
- No less than $196,260 for the final two years of the schedule.

Detroit Shoreway's tree planting budget should be:

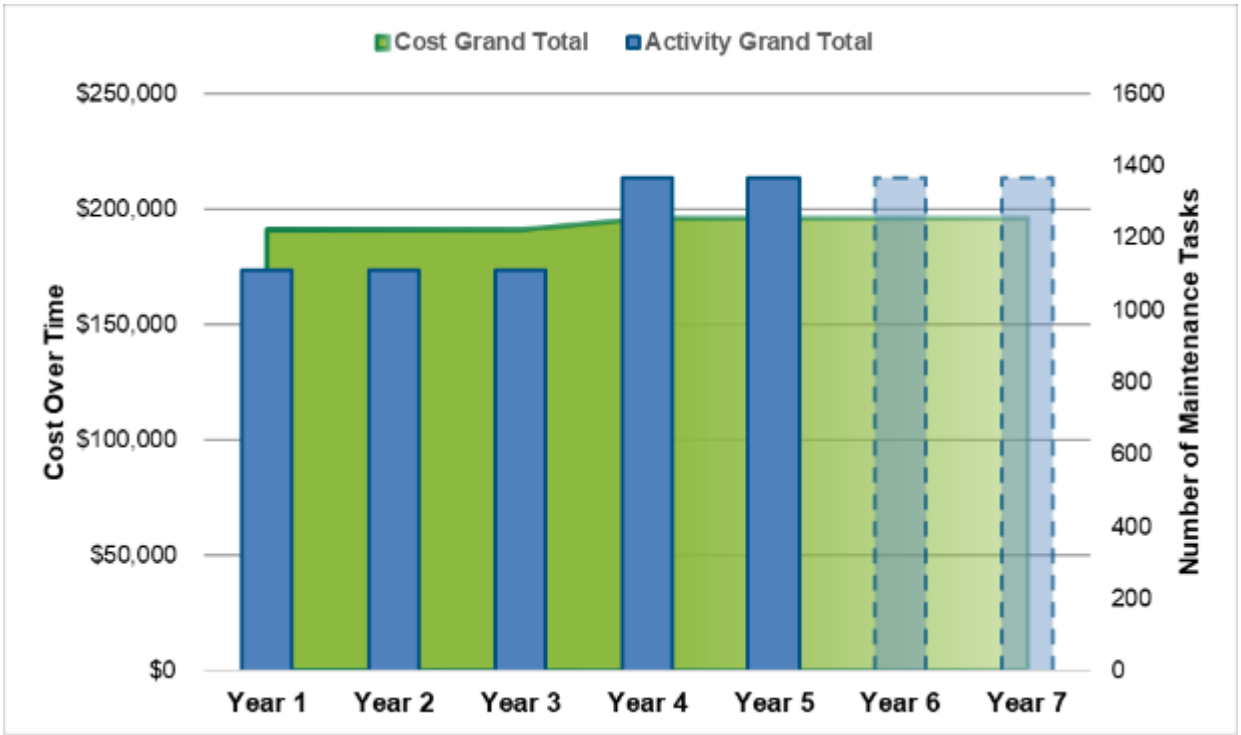


Figure 12.a. Cudell's five-year tree planting and young tree maintenance program budget vs. labor over time with projection into future.

- No less than $260,115 for the first three years of implementation.
- No less than $268,540 for the final two years of the schedule.

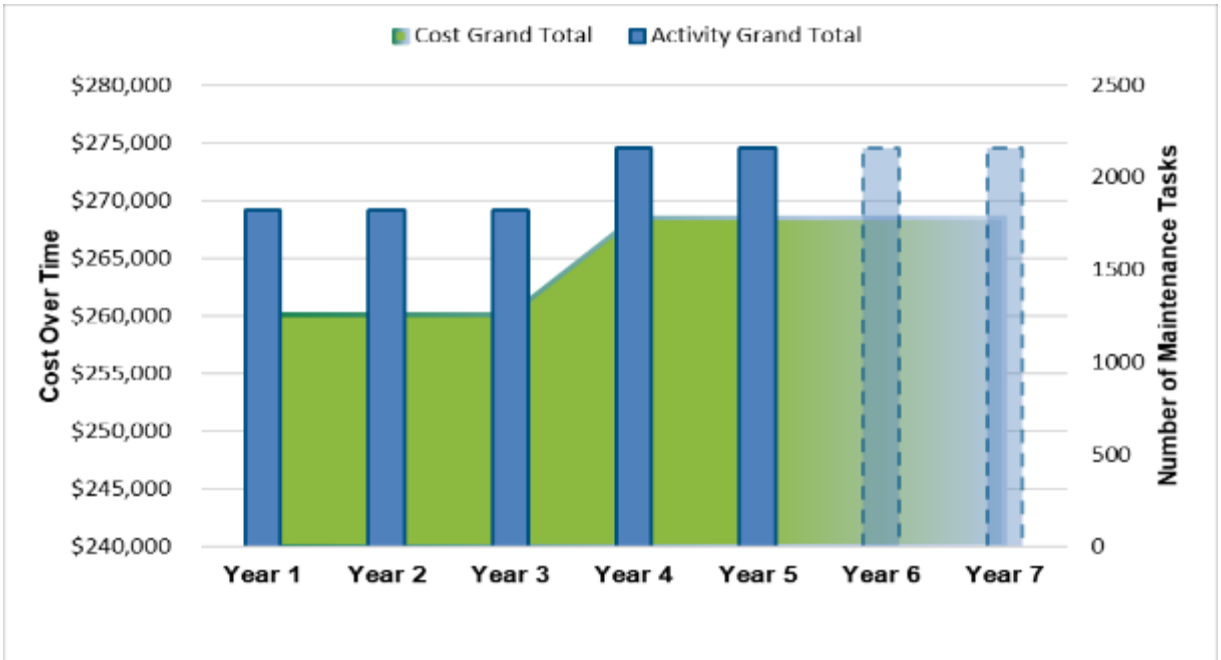


Figure 12.b. Detroit Shoreway's five-year tree planting and young tree maintenance program budget vs. labor over time with projection into future.

Edgewater's tree planting budget should be:

- No less than $98,605 for the first three years of implementation.
- No less than $101,855 for the final two years of the schedule.

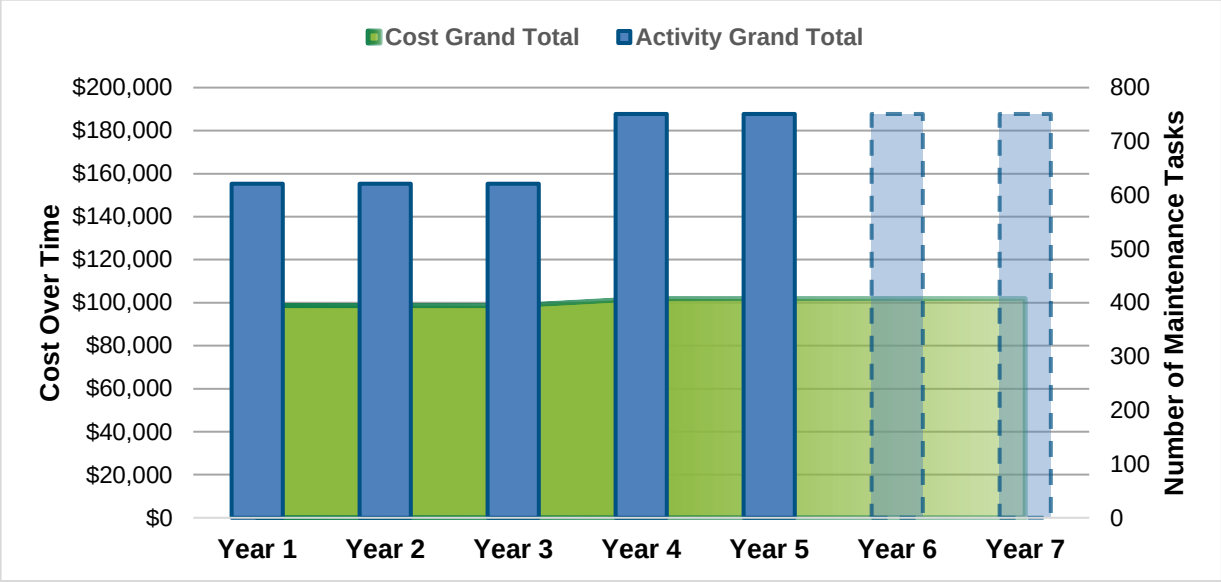


Figure 12.c. Edgewater's five-year tree planting and young tree maintenance program budget vs. labor over time with projection into future.

Also, ensure that annual budget funds are provided so that high priority trees are expediently managed and that the vital young tree training and routine pruning cycles can begin as soon as possible (see Section 4 of this plan). Unforeseen situations such as severe weather events may arise and change the maintenance needs of trees. If maintenance needs change, then budgets, staffing, and equipment should be adjusted to meet the new demand.

Table 4.a. Estimated costs for five-year tree planting program for the Cudell neighborhood.

Estimated Costs for Each Activity			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	
Young Tree Training (3-year cycle)	1-2"	$20	18	$360	18	$360	18	$360	274	$5,480	274	$5,480	$12,040
	3-5"	$25	59	$1,180	59	$1,180	59	$1,180	59	$1,180	59	$1,180	$5,900
	6-8"	$30	8	$160	8	$160	8	$160	8	$160	8	$160	$800
Activity Total(s)			**85**	**$1,700**	**85**	**$1,700**	**85**	**$1,700**	**341**	**$6,820**	**341**	**$6,820**	**$18,740**
Annual Tree Planting	Purchasing	$300	256	$76,800	256	$76,800	256	$76,800	256	$76,800	256	$76,800	$384,000
	Planting	$240	256	$61,440	256	$61,440	256	$61,440	256	$61,440	256	$61,440	$307,200
Activity Total(s)			**512**	**$138,240**	**512**	**$138,240**	**512**	**$138,240**	**512**	**$138,240**	**512**	**$138,240**	**$691,200**
Annual Tree Maintenance	Mulching	$100	256	$25,600	256	$25,600	256	$25,600	256	$25,600	256	$25,600	$128,000
	Watering	$100	256	$25,600	256	$25,600	256	$25,600	256	$25,600	256	$25,600	$128,000
Activity Total(s)			**512**	**$51,200**	**512**	**$51,200**	**512**	**$51,200**	**512**	**$51,200**	**512**	**$51,200**	**$256,000**
Activity Grand Total			**1,109**		**1,109**		**1,109**		**1,365**		**1,365**		
Cost Grand Total				**$191,140**		**$191,140**		**$191,140**		**$196,260**		**$196,260**	**$965,940**

Table 4.b. Estimated costs for five-year tree planting program for the Detroit Shoreway neighborhood.

Estimated Costs for Each Activity			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	
Young Tree Training (3-year cycle)	1-2"	$20	261	$5,220	261	$5,220	261	$5,220	261	$5,220	261	$5,220	$26,100
	3-5"	$25	169	$4,225	169	$4,225	169	$4,225	506	$12,650	506	$12,650	$37,975
	6-8"	$30	43	$1,290	43	$1,290	43	$1,290	43	$1,290	43	$1,290	$6,450
Activity Total(s)			**473**	**$10,735**	**473**	**$10,735**	**473**	**$10,735**	**810**	**$19,160**	**810**	**$19,160**	**$70,525**
Annual Tree Planting	Purchasing	$300	337	$101,100	337	$101,100	337	$101,100	337	$101,100	337	$101,100	$505,500
	Planting	$240	337	$80,880	337	$80,880	337	$80,880	337	$80,880	337	$80,880	$404,400
Activity Total(s)			**674**	**$181,980**	**674**	**$181,980**	**674**	**$181,980**	**674**	**$181,980**	**674**	**$181,980**	**$909,900**
Annual Tree Maintenance	Mulching	$100	337	$33,700	337	$33,700	337	$33,700	337	$33,700	337	$33,700	$168,500
	Watering	$100	337	$33,700	337	$33,700	337	$33,700	337	$33,700	337	$33,700	$168,500
Activity Total(s)			**674**	**$67,400**	**674**	**$67,400**	**674**	**$67,400**	**674**	**$67,400**	**674**	**$67,400**	**$337,000**
Activity Grand Total			**1,821**		**1,821**		**1,821**		**2,158**		**2,158**		
Cost Grand Total				**$260,115**		**$260,115**		**$260,115**		**$268,540**		**$268,540**	**$1,317,425**

Table 4.c. Estimated costs for five-year tree planting program for the Edgewater neighborhood.

Estimated Costs for Each Activity			Year 1		Year 2		Year 3		Year 4		Year 5		Five-Year Cost
Activity	Diameter	Cost/Tree	of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	
Young Tree Training (3-year cycle)	1-2"	$20	34	$680	34	$680	34	$680	34	$680	34	$680	$3,400
	3-5"	$25	57	$1,425	57	$1,425	57	$1,425	187	$4,675	187	$4,675	$13,625
	6-8"	$30	10	$300	10	$300	10	$300	10	$300	10	$300	$1,500
Activity Total(s)			**101**	**$2,405**	**101**	**$2,405**	**101**	**$2,405**	**231**	**$5,655**	**231**	**$5,655**	**$18,525**
Annual Tree Planting	Purchasing	$300	130	$39,000	130	$39,000	130	$39,000	130	$39,000	130	$39,000	$195,000
	Planting	$240	130	$31,200	130	$31,200	130	$31,200	130	$31,200	130	$31,200	$156,000
Activity Total(s)			**260**	**$70,200**	**260**	**$70,200**	**260**	**$70,200**	**260**	**$70,200**	**260**	**$70,200**	**$351,000**
Annual New Tree Maintenance	Mulching	$100	130	$13,000	130	$13,000	130	$13,000	130	$13,000	130	$13,000	$65,000
	Watering	$100	130	$13,000	130	$13,000	130	$13,000	130	$13,000	130	$13,000	$65,000
Activity Total(s)			**260**	**$26,000**	**260**	**$26,000**	**260**	**$26,000**	**260**	**$26,000**	**260**	**$26,000**	**$130,000**
Activity Grand Total			**621**		**621**		**621**		**751**		**751**		
Cost Grand Total				**$98,605**		**$98,605**		**$98,605**		**$101,855**		**$101,855**	**$499,525**

Section 4:

Recommended Management

of the Public Tree Resource

SECTION 4: RECOMMENDED MANAGEMENT OF THE PUBLIC TREE RESOURCE

During the inventory, a prioritized maintenance activity was assigned to each tree. DRG recommends completing each tree's recommended maintenance activity based on the assigned priority.

RISK MANAGEMENT AND RECOMMENDED MAINTENANCE

Although tree removal is usually considered a last resort, and may sometimes create a reaction from the community, there are circumstances in which removal is necessary. Trees fail from natural causes such as diseases, insects, and weather conditions, and from physical injury due to vehicles, vandalism, and root disturbances. DRG recommends that trees be removed when corrective pruning will not adequately mitigate risk or when correcting problems would be cost-prohibitive. We also suggest that tree maintenance activities are prioritized and completed based on the the prioirity that was assigned to each tree during the inventory.

Figures 13.a., 13.b., 13.c., 14.a., 14.b., and 14.c. present tree pruning and tree removals by priority and diameter size class. The following sections briefly summarize the recommended removals identified during the inventory.

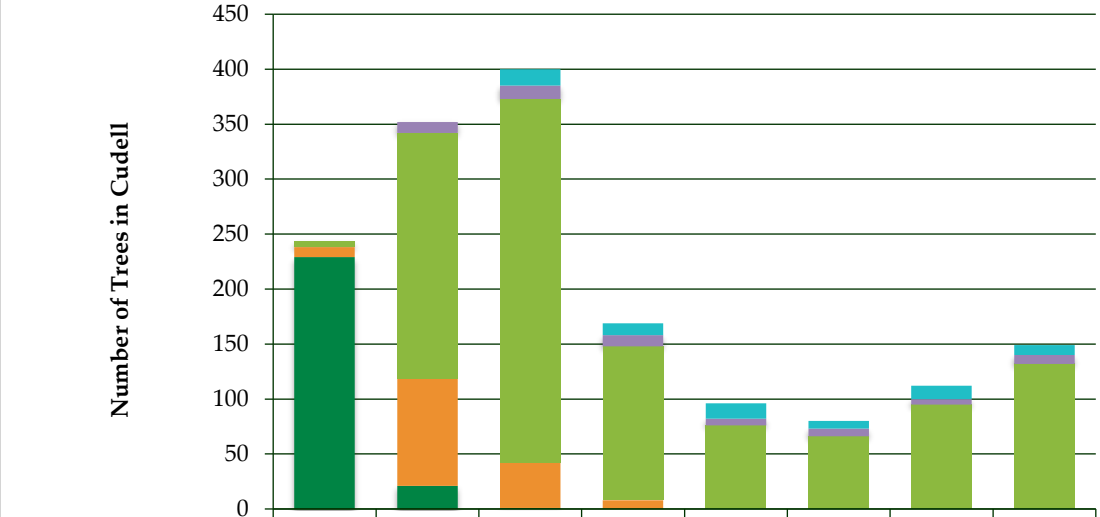
PRIORITY ONE RECOMMENDED MAINTENANCE

Trees designated as Priority One have defects that cannot be cost-effectively or practically treated. The majority of the trees in this category have a large percentage of dead crown and pose an elevated level of risk for failure. Any hazards that could be seen as potential dangers to persons or property and seen as potential liabilities to the client would be in this category. Large dead and dying trees that are high-liability risks are included in this category. These trees are the first ones that should be removed.

PRIORITY ONE PRUNING RECOMMENDATIONS

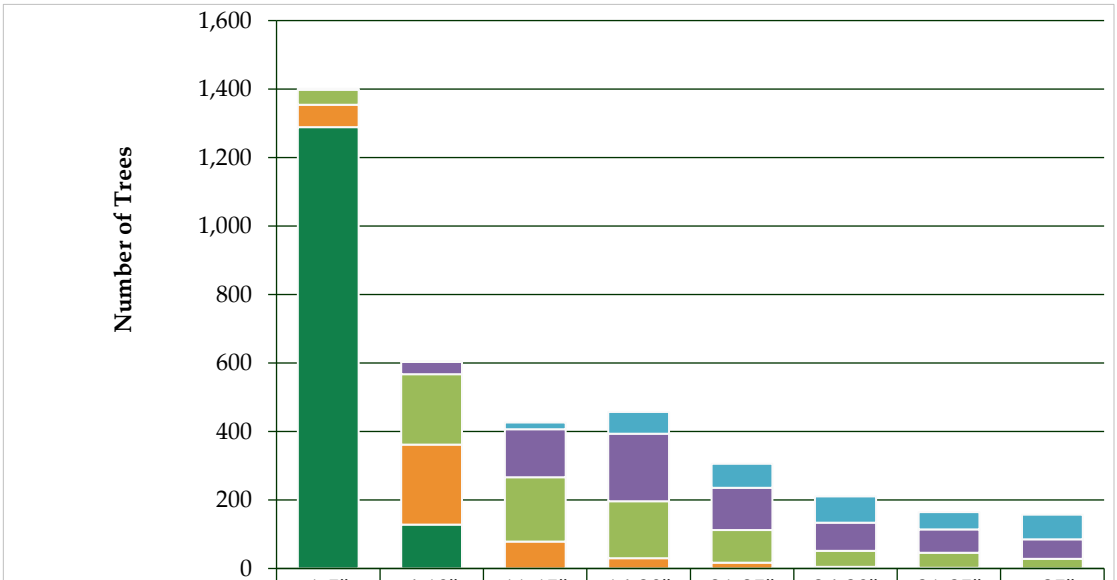
Trees that require Priority One Pruning are recommended for trimming to remove hazardous deadwood, hangers, or broken branches. These trees have broken or hanging limbs, hazardous deadwood, and dead, dying, or diseased limbs or leaders greater than 4 inches in diameter. Priority One trees should be pruned, which generally requires removing defects such as dead and dying parts, broken and/or hanging branches, and missing or decayed wood that may be present in tree crowns, even when most of the tree is sound, immediately based on tree diameter and tree condition. In these cases, when pruning the defected branch(es) can correct the problem, the risk associated with the tree is reduced while promoting healthy growth.

The Edgewater inventory identified 159 Priority One Prune trees. The diameter size classes for trees with recommended high-priority pruning ranged between 11–15 inches DBH and >35 inches DBH. The Cudell inventory identified 68 Priority One trees. The diameter size classes for trees with recommended high-priority pruning ranged between 11–15 inches DBH and >35 inches DBH. The Detroit Shoreway inventory identified 353 Priority One trees. The diameter size classes for trees with recommended high-priority pruning ranged between 6–10 inches DBH and >35 inches DBH. This maintenance should be performed immediately based on tree condition and may be performed concurrently with other Priority One Removals.



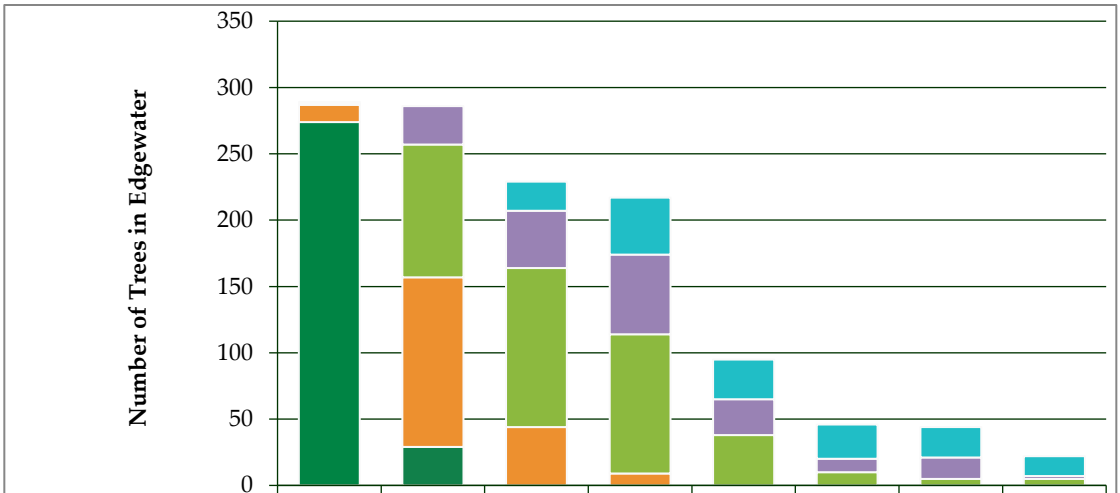
Diameter Size Class	1-5"	6-10"	11-15"	16-20"	21-25"	26-30"	31-35"	>35"
Priority 1	0	0	15	11	14	7	12	9
Priority 2	0	10	12	10	6	7	5	8
Large Tree Routine	5	223	331	140	76	66	95	132
Small Tree Routine	9	98	41	8	0	0	0	0
Training Prune	229	21	1	0	0	0	0	0

Figure 13.a. Recommended pruning by size class and priority for the Cudell neighborhood.



Diameter Size Class	1-5"	6-10"	11-15"	16-20"	21-25"	26-30"	31-35"	>35"
Priority 1	1	1	19	63	70	76	51	72
Priority 2	2	37	141	198	124	82	68	57
Large Tree Routine	44	205	187	166	95	47	44	28
Small Tree Routine	65	234	79	30	17	5	2	0
Training Prune	1,289	128	0	0	0	0	0	0

Figure 13.b. Recommended pruning by size class and priority for the Detroit Shoreway neighborhood.



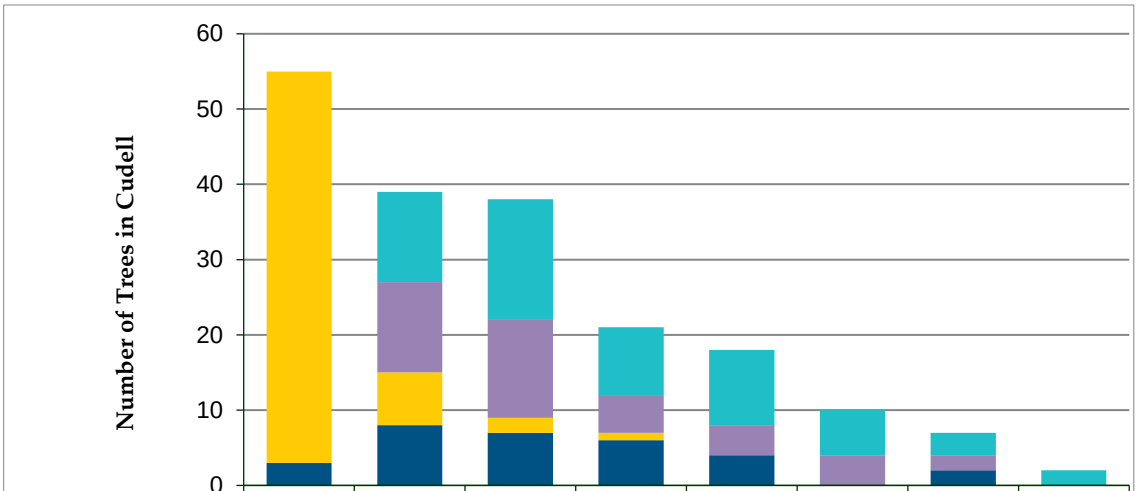
Diameter Size Class	1-5"	6-10"	11-15"	16-20"	21-25"	26-30"	31-35"	>35"
Priority 1	0	0	22	43	30	26	23	15
Priority 2	1	29	43	60	27	10	16	2
Large Tree Routine	1	100	120	105	38	10	5	5
Small Tree Routine	13	128	44	9	0	0	0	0
Training Prune	274	29	0	0	0	0	0	0

Figure 13.c. Recommended pruning by size class and priority for the Edgewater neighborhood.

PRIORITY ONE REMOVAL RECOMMENDATIONS

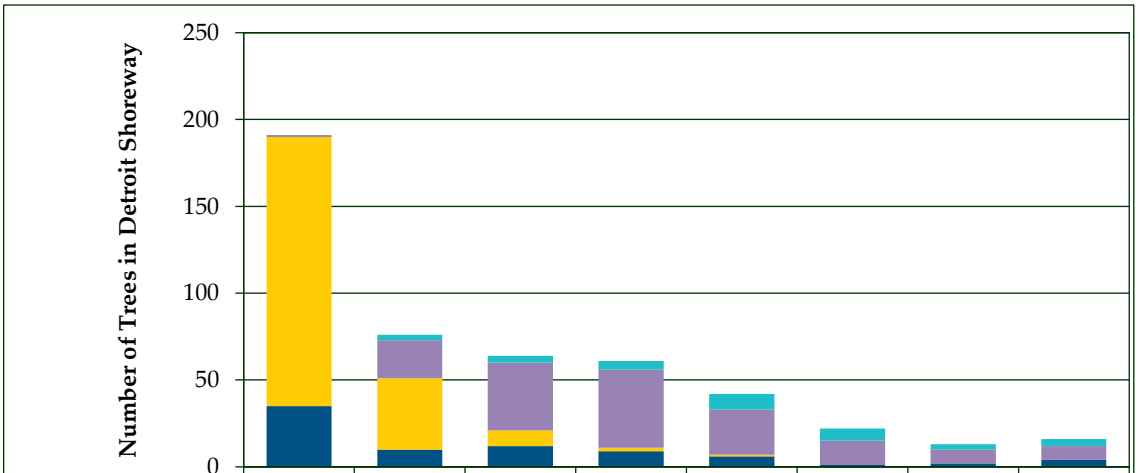
Removing Priority 1 trees is strongly recommended and should be accomplished in a systematic manner and completed as soon as possible. DRG recommends that trees be removed when pruning will not correct their defects, eliminate the risks that their defects cause, or when corrective pruning would be cost-prohibitive. These trees should be removed immediately based on their prioirity and size class. In general, maintenance activities should be completed first for the largest diameter trees (>25") that pose the greatest risk or standing dead trees. Once addressed, recommended tree maintenance activities should be completed for smaller diameter trees (<25") that pose the greatest risk. Addressing Priority One trees in a timely and proactive manner often requires significant resources to be secured and allocated. However, peforming this work expediently will mitigate risk, improve public safety, and reduce long-term costs.

DRG identified 16 Priority One trees recommended for removal for Edgewater. The diameter size classes for Priority 1 trees ranged between 11–15 inches DBH and >35 inches DBH. There are 14 dead trees which also need removed. For Cudell, 58 Priority One trees were recommended for removal. The diameter size classes for Priority One trees ranged between 6–10 inches DBH and >35 inches DBH. There are a total of 18 dead trees which need to be removed. For Detroit Shoreway, 35 Priority One trees were recommended for removal. The diameter size classes for Priority One trees ranged between 6–10 inches DBH and >35 inches DBH. There are a total of 31 dead trees which need to be removed.



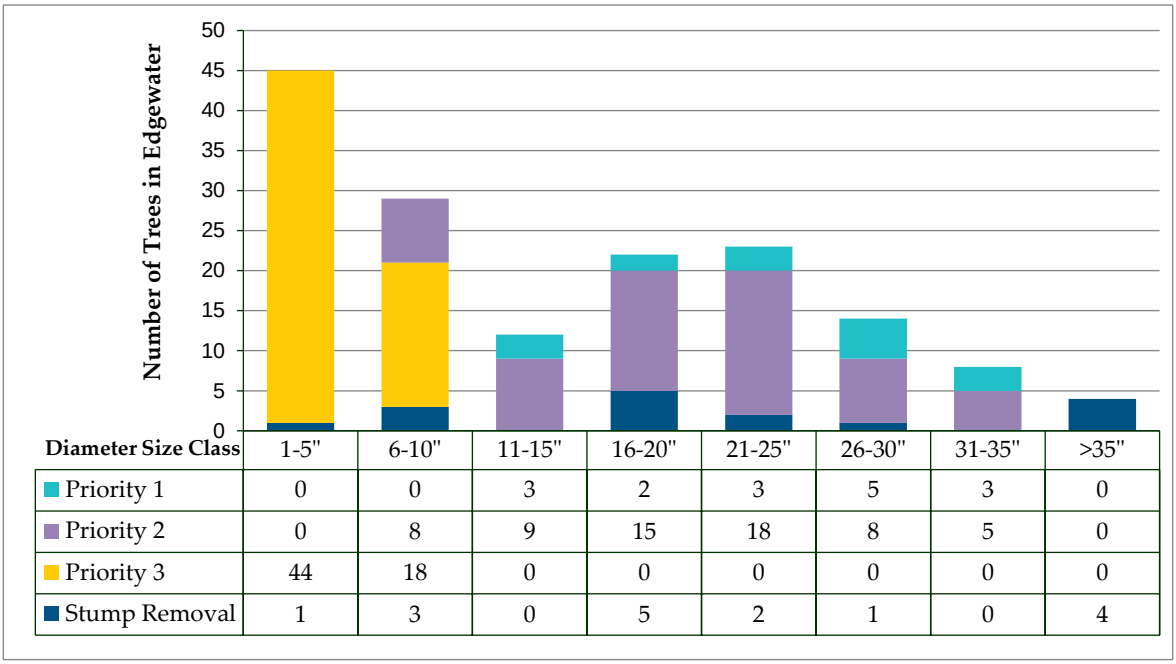
Diameter Size Class	1-5"	6-10"	11-15"	16-20"	21-25"	26-30"	31-35"	>35"
Priority 1	0	12	16	9	10	6	3	2
Priority 2	0	12	13	5	4	4	2	0
Priority 3	52	7	2	1	0	0	0	0
Stump Removal	3	8	7	6	4	0	2	0

Figure 14.a. Recommended tree removals by size class and priority for the Cudell neighborhood.



Diameter Size Class	1-5"	6-10"	11-15"	16-20"	21-25"	26-30"	31-35"	>35"
Priority 1	0	3	4	5	9	7	3	4
Priority 2	1	22	39	45	26	14	8	8
Priority 3	155	41	9	2	1	0	0	0
Stump Removal	35	10	12	9	6	1	2	4

Figure 14.b. Recommended tree removals by size class and priority for the Detroit Shoreway neighborhood.



Diameter Size Class	1-5"	6-10"	11-15"	16-20"	21-25"	26-30"	31-35"	>35"
Priority 1	0	0	3	2	3	5	3	0
Priority 2	0	8	9	15	18	8	5	0
Priority 3	44	18	0	0	0	0	0	0
Stump Removal	1	3	0	5	2	1	0	4

Figure 14.c. Recommended tree removals by size class and priority for the Edgewater neighborhood.

PRIORITY TWO AND THREE RECOMMENDED MAINTENANCE

Pruning or removing Priority 2 and Priority 3 trees are generally the next priorities for maintenance activities. For efficiency, lower-risk removals may also be addressed when removing adjacent higher risk trees. Most trees recommended for pruning with these risk levels can be maintained during routine pruning cycles. DRG recommends implementing proactive maintenance programs incrementally over time as the backlog of risk is reduced.

OTHER TREE MAINTENANCE

In addition to priority maintenance, DRG found trees in need of pruning or inspections or stumps which require removal. Figures 14.a., 14.b., and 14.c. list the identified work and the following sections describe its nature and importance.

ROUTINE INSPECTIONS

Inspections are essential to uncovering potential problems with trees. They should be performed by a qualified arborist who is trained in the art and science of planting, caring for, and maintaining individual trees. Arborists are knowledgeable about the needs of trees and are trained and equipped to provide proper care. Ideally, the arborist will be ISA Certified and also hold the ISA Tree Risk Assessment Qualification credential.

All trees along the street ROW should be regularly inspected and attended to as needed. When trees require additional or new work, they should be added to the maintenance schedule. The budget should also be updated to reflect the additional work. Utilize computer management software such as TreeKeeper® to make updates, edits, and keep a log of work records. In addition to locating trees with unidentified defects, inspections also present an opportunity to look for signs and symptoms of pests and diseases. Each neighborhood has a large population of trees that are susceptible to pests and diseases, including ash, maple, and oak.

DRG recommends that the neighborhoods perform routine inspections of inventoried trees by windshield survey (inspections performed from a vehicle) in line with *ANSI A300 (Part 9)* annually and after all severe weather events, to identify defects with heightened risk, signs of pest activity, and symptoms of disease. When trees need additional maintenance, they should be added to the work schedule immediately. Use asset management software such as TreeKeeper® to update inventory data and schedule work records.

STUMP REMOVAL

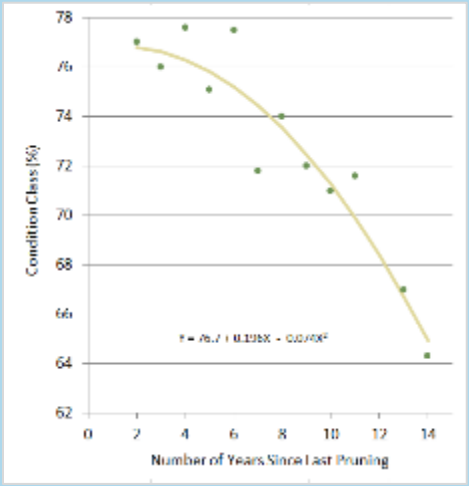
The Cudell neighborhood inventory had 30 stumps recommended for removal, with a wide range of sizes from 4 to 33 inches in diameter. Detroit Shoreway had 79 stumps recommended for removal, with a wide range of sizes from 2 to 50 inches in diameter. The Edgewater inventory identified 16 stumps recommended for removal, with a wide range of sizes from 3”–46” in diameter. Stump removals should occur when convenient and be included in regular planting plans if the site would be feasible for planting after the stump is removed. For this reason, it is most convenient to remove all stumps in areas with scheduled tree planting work, so all feasible sites in an area are stocked at once.

PROACTIVE PRUNING

ROUTINE PRUNING CYCLE

The Routine Pruning cycle includes all Low Risk trees that received a "Prune", "Discretionary Prune", or "None" maintenance recommendation. These trees pose some risk but have a smaller defect size and/or a lower probability of impacting a target. Over time, routine pruning can minimize reactive maintenance, limit instances of elevated risk, and provide the basis for a robust risk management program.

Based on Miller and Sylvester's research, DRG recommends five-year Routine Pruning cycles to maintain the condition of the inventoried tree resource. However, not all municipalities are able to remain proactive with a five-year cycle based on budgetary constraints, the size of the public tree resource, or both. In these cases, extending the length of the Routine Pruning cycle is an option; however, it is in the municipality's best interest to not approach or exceed a 10-year pruning cycle. The reason is that this is around when tree condition deteriorates significantly without regular pruning, because their once minor defects have worsened, reducing tree health and potentially increasing risk (Miller and Sylvester 1981).



Relationship between tree condition and years since previous pruning.

(adapted from Miller and Sylvester 1981)

Miller and Sylvester studied the pruning frequency of 40,000 street trees in Milwaukee, Wisconsin. Trees that had not been pruned for more than 10 years had an average condition rating 10% lower than trees that had been pruned in the previous several years. Their research suggests that a five-year pruning cycle is optimal for urban trees.

Routine pruning cycles help detect and correct most defects before they reach higher risk levels. DRG recommends that pruning cycles begin after all Extreme and High Risk tree maintenance has been completed.

DRG recommends two pruning cycles: a Young Tree Training cycle and a Routine Pruning cycle. Newly planted trees will enter the Young Tree Training cycle once they become established and will move into the Routine Pruning cycle when they reach maturity. A tree should be removed and eliminated from the Routine Pruning cycle when it outlives its usefulness.

TREE INVENTORY WORKBOOK

In addition to the information in Section 4 of this plan, Detroit Shoreway and Cudell were provided with the following lists (Davey Resource Group 2020) to help them plan for and accomplish the recommended tree maintenace activities. The lists were developed using the tree inventory data.

- Complete Tree Site Listing
- Priority 1 Trees Recommended for Removal
- Priority 2 Trees Recommended for Removal
- Priority 3 Trees Recommended for Removal
- Priority 1 Trees Recommended for Prune
- Priority 2 Trees Recommended for Prune
- Large Routine Trees Recommended for Prune
- Small Routine Trees Recommended for Prune
- Trees Recommended for Training Prune
- Trees Recommended for Further Inspection and Monitoring
- Potential Planting Sites
- Stump Removals Sites

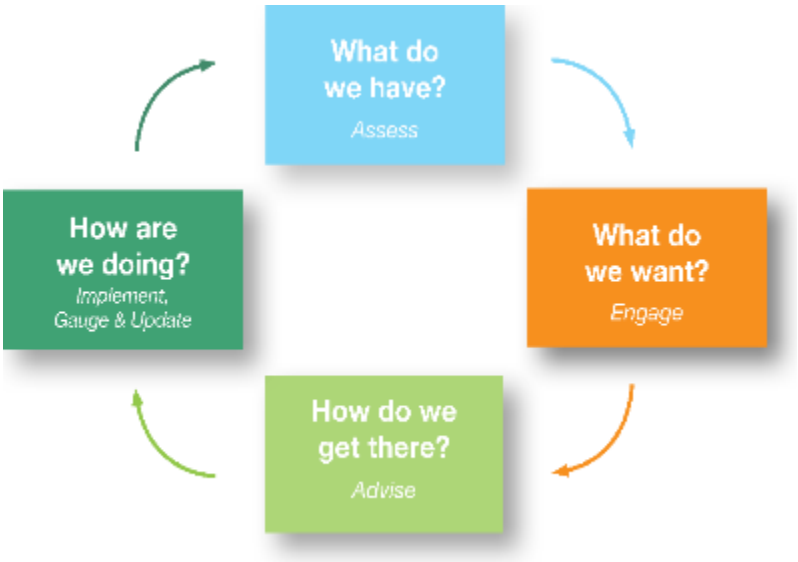
CONCLUSION

When properly maintained, the valuable benefits trees provide over their lifetime far exceed the time and money invested in planting, pruning, and inevitably removing them. The 1,761 public trees inventoried provide $18,047 in estimated annual economic value for the Cudell neighborhood. Detroit Shoreway neighborhood's 4,133 public trees inventoried provide $26,163 in estimated annual economic value, and Edgewater's 1,369 public trees inventoried provide $9,287 in estimated annual economic value. Successfully implementing the five-year tree planting program may increase each neighborhood's return on investmest over time, or at least maintain it over the years.

The program is ambitious and is a challenge to complete in five years. This *Tree Planting Plan* could potentially help the neighborhood advocate for an increased urban forestry budget to fund the recommended maintenance activities and to plant more trees. Getting started is the most difficult part because of community buy-in and even fear, and the expense of buying, planting, and maintaining trees. However, as the urban forest grows, the benefits enjoyed by the neighborhoods and their residents will increase as well. Inventoried trees are only a fraction of the total trees when including private property, which is why it is also important to encourage private landowners to care for their trees and to plant new ones.

EVALUATING AND UPDATING THIS PLAN

This Tree Planting Plan provides management priorities associated with planting and new tree maintenance for the next five years, and it is important to update the tree inventory using TreeKeeper® as work is completed, so the software can provide updated species distribution and benefit estimates. This empowers Cudell and Detroit Shoreway to self-assess their neighborhood's progress over time and set goals to strive toward by following the adaptive management cycle. Below are some ways of implementing the steps of this cycle:



- Prepare planting plans well enough in advance to schedule and complete stump removal in the designated area, and to select species best suited to the available sites.
- Annually comparing the number of trees planted to the number of trees removed and the number of vacant planting sites remaining, then adjusting future planting plans accordingly.
- Annually comparing the species distribution of the inventoried tree resource with the previous year after completing planting plans to monitor recommended changes in abundance.
- Schedule and assign high-priority tree work so it can be completed as soon as possible instead of reactively addressing new lower priority work requests as they are received.
- Include data collection such as measuring DBH and assessing condition into standard procedure for tree work and routine inspections, so changes over time can be monitored.

Notice of Disclaimer: Inventory data provided by Davey Resource Group, Inc. "DRG" are based on visual recording at the time of inspection. Visual records do not include individual testing or analysis, nor do they include aerial or subterranean inspection. DRG is not responsible for the discovery or identification of hidden or otherwise non-observable hazards. Records may not remain accurate after inspection due to the variable deterioration of inventoried material. DRG provides no warranty with respect to the fitness of the urban forest for any use or purpose whatsoever. Clients may choose to accept or disregard DRG's recommendations or to seek additional advice. Important: know and understand that visual inspection is confined to the designated subject tree(s) and that the inspections for this project are performed in the interest of facts of the tree(s) without prejudice to or for any other service or any interested party.

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APPENDIX A
DATA COLLECTION AND SITE LOCATION METHODS

DATA COLLECTION METHODS

DRG collects tree inventory data using a customized ArcPad program, called Rover, loaded onto pen-based field computers. At each site, the following data fields were collected:

Address	Notes
Condition	Observations
Date of Inventory	Overhead Utilities
Defects	Priority Maintenance
Further Inspection	Species
Grow Spacing Type and Size	Tree Size*
Multi-stem	

*Measured in inches in diameter at 4.5 feet above ground or diameter at breast height (DBH]).

Maintenance needs are based on *Best Management Practices: Tree Risk Assessment* (International Society of Arboriculture 2011). The knowledge, experience, and professional judgment of DRG's arborists ensure the high quality of inventory data.

EQUIPMENT AND BASE MAPS

Inventory arborists use CF-19 Panasonic Toughbook® units with internal GPS receivers. Geographic information system (GIS) map layers are loaded onto these units to help locate sites during the inventory. The table to the right lists these base map layers, along with each layer's source and format information.

Individual street ROW sites (trees, stumps, or planting sites) were located using a methodology that identifies sites by *address number*, *street name*, *side*, and *on street*. This methodology was developed by DRG to help ensure consistent assignment of location.

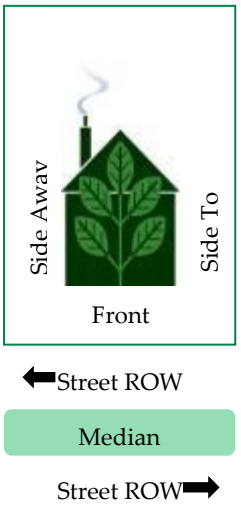
Base Map Layers Utilized for Inventory

Imagery/Data Source	Date	Projection
Shapefiles Cuyahoga County Open Data https://data-cuyahoga.opendata.arcgis.com	2018-2019	NAD 1983 StatePlane Ohio North; Ft
Neighborhood Districts Davey Resource Group GIS/IT Department	2020	
Nearmap Inc. 1ft Nearmap.com	2020	NAD 1983 StatePlane Ohio North; Ft

ADDRESS NUMBER AND STREET NAME

Where there was no GIS parcel addressing data available for sites located by a vacant lot, or by an occupied lot without a posted address number on a building, the arborist used their best judgment to assign an address number based on opposite or adjacent addresses. An "X" was then added to the number in the database to indicate that it was assigned, for example, "37X Choice Avenue."

Sites in medians or islands were assigned an address number by cover using parcel and streets geographical data. Each segment was numbered with an assigned address that was interpolated from addresses facing that median/island. If there were multiple median/islands between cross streets, each segment was assigned its own address. The *street name* assigned to a site was determined by street ROW parcel information and posted street name signage.



Side values for street ROW sites.

SIDE VALUE

Each site was assigned a *side value* and *site number*. Side values include *front*, *side*, *median*, or *rear* based on the site's location in relation to the lot's street frontage. The *front* is the side facing the address street. *Side* is either side of the lot that is between the front and rear. *Median* indicates a median or island surrounded by pavement. The *rear* is the side of the lot opposite of the address street.

i-TREE ECO METHODOLOGY

Structural value is a compensatory value calculated based on the local cost of having to replace a tree with a similar tree. In other words, it is a measurement of the value of the resource itself. The structural value of an urban forest is the sum of the structural values of all the individual trees contained within. Monetary values are assigned based on valuation procedures of the Council of Tree and Landscape Appraisers using information on species, diameter, condition, and location (McPherson 2007) and (Nowak et al. 2008).

Carbon sequestration refers to the capture and storage of carbon from the earth's atmosphere. i-Tree Eco analysis reports on the gross annual amount of carbon sequestered as well as the total amount of carbon stored over the lifetime of the tree. For this analysis, carbon storage and sequestration values are calculated at a rate of $171 per ton. Carbon storage is considered both a functional benefit and a structural benefit of trees; the carbon is physically integrated into the wood of the tree.

Air pollution removal refers to the removal of ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and particulate matter less than 2.5 microns ($PM_{2.5}$). For this analysis, the pollution removal value is calculated based on the prices of $4,322 per ton of ozone, $427 per ton of sulfur dioxide, $952 per ton of nitrogen dioxide, $1,380 per ton carbon monoxide, and $150,053 per ton of particulate matter less than 2.5 microns.

Avoided runoff measures the amount of surface runoff avoided when trees intercept rainfall during precipitation events. Surface runoff from rainfall contributes to the contamination of streams, rivers, lakes, and wetlands by washing oils, pesticides, and other pollutants, either directly into waterways or into drainage infrastructure that ultimately empties into waterways. For this analysis, annual avoided runoff is calculated based on the estimated amount of intercepted rainfall and the local weather in Cleveland, Ohio, where annual precipitation in 2016 equaled 36.5 inches. The monetary value of avoided runoff is based on the U.S. Forest Service's Community Tree Guide Series at a rate of $0.07 per cubic foot.

APPENDIX B
TREE PLANTING LIST

While the use of a limited number of species can simplify the decision-making process for landscape managers, careful deliberation and selection of a wide palate of trees can benefit all and save money. Planting a variety of species can decrease the impact of species-specific pests and diseases by limiting the number of trees that are susceptible in a population. This, in turn, reduces the time and money spent on mitigating problems resulting from any such episodes. Also, a wide variety of tree species may help to limit the impacts from a number of physical events such as strong storms, wind, ice, flooding, drought, etc. because tree species react differently to stress.

The list is based on the City of Cleveland's current contractor tree planting list, the Cleveland Tree Plan, and species diversity.

KEY

Height Class
Commonly achieved mature tree height classification
S = Small: 15 to 25 feet
M = Medium: 25 to 40 feet
L = Large: 40 feet and taller

Crown Class
Commonly achieved mature tree crown width classification
VS = Very Small: 15 foot crown diameter
S = Small: 25 foot crown diameter
M = Medium: 35 foot crown diameter
L = Large: 45 foot crown diameter

Fall Color
Color of foliage in the season of fall
= Bronze or brown
= Multi-colored: maroon, red, orange, yellow
= Orange
= Red
= Yellow
I = Insignificant color change

Fall Color
Color of foliage in the season of fall
B = Bronze or brown
MU = Multi-colored: maroon, red, orange, yellow
O = Orange
R = Red
Y = Yellow
I = Insignificant color change

Flower Color
Typical flower color of "showy" flowering trees
= Green
= Purple
= Multiple colors: white, pink, purple, red, or others
= Pink
= Red
= White
= Yellow
I = Insignificant flowers: small and/or unremarkable color

Flower Color
Typical flower color of "showy" flowering trees
G = Green
L = Purple
MU = Multiple colors: white, pink, purple, red, or others
P = Pink
R = Red
W = White
Y = Yellow
I = Insignificant flowers: small and/or unremarkable color

Drought Tolerance
Tolerance level of species to infrequent or prolonged periods without rain
L = Low: not tolerant
M = Moderate: tolerant to moderately tolerant
H = High: very tolerant

	Latin Name	Species Common Name	Physical Characteristics						Uses	
			Height Class	Crown Class	Fall Leaf Color	Flower Color	Flowering Time	Drought Tolerance	Street/Tree Lawn	Parks and Other Large Plots including Residential Land
Small	*Prunus* 'Accolade'	Cherry 'Accolade'	S	S			Spring	H		
	Malus x 'Centzan'	Crabapple 'Centurion'	S	S			Spring	M-L		X
	Syringa reticulata subsp. *reticulata*	Lilac Tree (Japanese)	S	S			Spring	L	X	X
	Acer buergerianum	Maple, Trident	S	S - M			Spring	M	X	X
	Quercus prinoides Willd	Oak, Dwarf Chinkapin	S	VS		I	Spring	L	X	
	Cercis canadensis	Redbud	S	S - M			Spring	H		X
	Sophora japonica	Japanese Pagodatree	S - L	S - L			Summer	H	X	X
	Japanese zelkova	Zelkova (Japanese)	S - L	S - L		I	Spring	H	X	X
Medium	*Maackia amurensis*	Amur Maackia	M	M	I		Summer	H	X	X
	Prunus serrulata 'Kanzan'	Cherry 'Kwanzan'	M	M			Spring	M		
	Ulmus parvifolia	Elm, Chinese Lacebark	M	M		I	Summer	H	X	X
	Koelreuteria paniculata	Golden Raintree	M	M			Summer	H	X	X
	Celtis x	Hackberry	M	L			Spring	H	X	X
	Crataegus crus-galli var. *inermis*	Hawthorn (Thornless Cockspur)	M	M	I		Spring	M		
	Carpinus caroliniana	Hornbeam, American	M	M		I	Spring	M		X
	Carpinus betulus	Hornbeam, European	M	M			Spring	H	X	X
	Acer miyabei	Maple, Miyabe	M	S - M		I	Spring	H	X	X
	Quercus x 'Nadler'	Oak, Kindred Spirit	M	VS		I	Spring	L	X	X
	Parrotia persica	Parrotia	M	S - M			Spring	H	X	
	Sophora japonica	Japanese Pagodatree	S - L	S - L			Summer	H	X	X
	Japanese zelkova	Zelkova (Japanese)	S - L	S - L		I	Spring	H	X	X

	Latin Name	Species Common Name	Physical Characteristics						Uses	
			Height Class	Crown Class	Fall Leaf Color	Flower Color	Flowering Time	Drought Tolerance	Street/Tree Lawn	Parks and Other Large Plots including Residential Land
Large	*Taxodium distichum*	Common Baldcypress	L	M		I	Spring	H	X	X
	Metasequoia glyptostroboides	Dawn Redwood	L	S		I	Spring	M		X
	Ulmus x	Elm, American (hybrid)	L	L		I	Spring	H	X	X
	Ginkgo biloba	Gingko (Male)	L	M - L		I	Spring	H	X	X
	Eucommia ulmoides	Hardy Rubber Tree	L	M		I	Spring	H		
	Gleditsia triacanthos f. inermis	Honey Locust (Thornless)	L	M - L		I	Spring	H	X	X
	Ostrya virginiana	Hophornbeam	L	M			Summer	H	X	X
	Gymnocladus dioicus	Kentucky Coffeetree (male clone)	L	L			Spring	H	X	X
	Tilia cordata	Linden, Littleleaf	L	M			Summer	M	X	X
	Tilia tomentosa	Linden, Silver	L	M - L			Summer	L	X	X
	Platanus x acerifolia	London Plane Tree	L	L			Spring	H	X	X
	Acer freemanii	Maple, Freeman	L	M - L		I	Spring	H	X	X
	Quercus macrocarpa	Oak, Bur	L	L		I	Spring	L	X	X
	Quercus muehlenbergii	Oak, Chinkapin	L	L		I	Spring	H	X	X
	Quercus palustris 'Green Pillar®	Oak, Columnar Pin	L	VS		I	Spring	M	X	X
	Quercus palustris	Oak, Pin	L	L		I	Spring	M	X	X
	Quercus rubra	Oak, Red	L	L		I	Spring	H	X	X
	Quercus x warei 'Long'	Oak, Regal Prince	L	S - M		I	Spring	L	X	X
	Quercus imbricaria	Oak, Shingle	L	L		I	Spring	L	X	X
	Quercus shumardii	Oak, Shumard	L	L		I	Spring	H	X	X
	Quercus bicolor	Oak, Swamp White	L	L		I	Spring	L	X	X
	Betula nigra	River Birch (Tree Form/Single Stem)	L	L		I	Winter/Spring	M	X	X
	Nyssa sylvatica	Sour Gum/ Black Gum (Tupelo)	L	M			Spring	H		X
	Sophora japonica	Japanese Pagodatree	S - L	S - L			Summer	H	X	X
	Japanese zelkova	Zelkova (Japanese)	S - L	S - L		I	Spring	H	X	X

APPENDIX C
TREE PLANTING TIPS

The following tips will help to ensure a successful tree planting experience.

TIME OF YEAR

Keep in mind that spring and fall are the best times of the year to plant trees, but some trees do better when transplanted in spring rather than fall, and vice versa. Check with your nursery or an expert to make sure you are planting the tree at the right time of year.

TREE SELECTION

- Pick trees that are the right size for your site when fully grown.
- Select trees that show normal growth and are free of serious insect and disease problems. The trees should exhibit good vitality, appearing undamaged, have good leaf color, and bud appearance.
- Single-stemmed trees should not have clumped foliage arising from the same point on the stem. Such a condition, while providing an initial tree form, will ultimately cause branching problems, such as weak crotches, and should be avoided.

BALLED-AND-BURLAPPED AND CONTAINERIZED TREE

When buying a tree, it will typically be a balled-and-burlapped tree, with soil surrounding the root system or a containerized tree, generally grown in the container in which they are sold.

Balled-and-burlapped tree roots are slower to dry out than bare-root trees, as the roots are inside a soil ball. However, the burlap may cover dead or poorly pruned roots and should be inspected before planting. The type of soil surrounding the roots should not be too different from the soil on the site or the tree roots may not extend sufficiently into the surrounding soil from the root ball. In such a case, the backfill soil should be amended to provide a transition between the two types of soil.

Container-grown trees have an undisturbed root system and can be planted with the intact root system. If the tree has been in the container for too long; however, the tree may be pot-bound with the roots encircling the inside perimeter of the pot. The roots should be sliced or partially separated in order to improve the ability of the tree to extend the roots into the surrounding soil.

TRANSPORT

Handle trees with care. Trees are living organisms and, thus, are perishable. During transport and when loading and unloading, protect trees from damage. Use care and don't break branches or lift by the trunk. If trees are stored prior to planting, keep the roots moist.

THE PLANTING HOLE

The size of the hole you dig is very important. **The planting hole is wider (two to three times) than the root ball and not quite as deep as the root ball.** The hole should be dug shallow and wide. It should not be any deeper than the root ball. The root flair (which is the area at the base of a tree where the trunk transitions from trunk into the root system tissues) should be at or just above ground level. Loosen heavy clay soils around the perimeter of the hole, if present, to allow for root penetration.

PLACING THE TREE

The tree should be planted to the same depth or slightly higher than it was growing at the nursery. A high mound should be avoided as the soil can dry out quickly in the summer and freeze in the winter.

BACKFILLING WITH SOIL

The backfill soil should be added gradually and watered carefully to settle the soil but not to saturate it. Balled-and-burlapped trees should have any untreated burlap pulled away from the top of the root ball and cut away, not buried, so that none of the burlap is exposed at the soil surface. Otherwise, the burlap can wick moisture away from the roots of the freshly planted tree.

STAKING THE TREE

Stakes should only be used to support trees on windy sites or for smaller trees with weak trunks. The stakes should be placed before the backfill is added to avoid damaging any large roots. A stake is meant to provide a temporary support and should be removed within a year to allow the tree to develop trunk strength and to limit the potential for physical damage from the stakes and support ties.

Wooden stakes, metal pipe, fence stakes, and metal reinforcing bars may all be used for support. Anything used for a tie should have a flat, smooth surface and be somewhat elastic to allow for slight movement for the tree. Suitable materials include rubber strips or webbing and belting. Wire covered with hose or tubing should not be used.

WATERING

Because a newly transplanted tree may have lost much of its root system, watering is critical for successful establishment.

- Water at the time of planting.
- Water weekly, or bi-weekly particularly during dry periods.
- A newly planted tree will benefit from at least an inch of water a week.

MULCHING

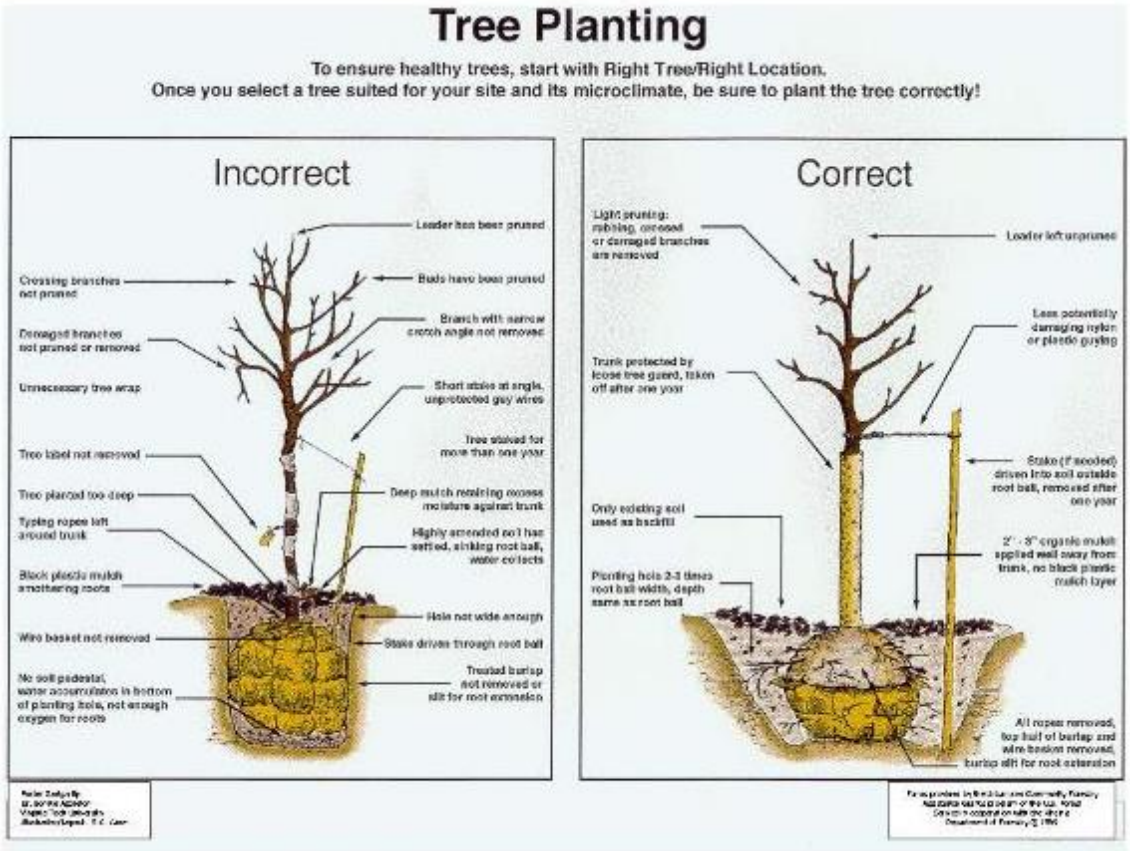
Newly planted trees respond well to mulch placed around the tree. This reduces initial root competition with turf and limits the possibility of physical damage by mowers.

The mulch should not be piled (mulch 'volcanoes') around the tree and should not actually touch the tree trunk.

Apply no more than a 2- to 3-inch depth of mulch, with it being no more than ½ inch deep closest to the tree.

PRUNING

When planting a tree, only dead or broken branches should be removed. All living branches should be left on the tree to help promote tree establishment. Once the tree has been established on the site, training pruning can be done to promote good branching patterns, but no more than 1/4 of the branches should be removed at any one time.



FERTILIZING

Fertilizer is not generally necessary at the time of planting and, indeed, if placed improperly in the planting hole can injure roots. The addition of nitrogen, in a slow-release form, however, can benefit a newly planted tree, and it may be efficient to apply at the time of planting.

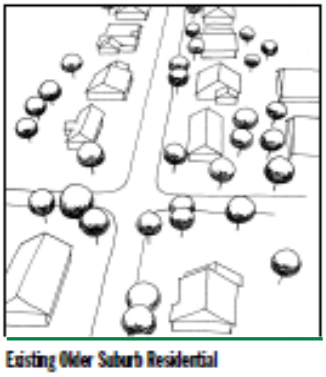
Poster Design by: Dr. Bonnie Appleton, Virginia Tech University, Illustrations/Layout by S.K. Kane; Funds provided by the Urban and Community Forestry Assistance Grants Program of the U.S Forest Service in cooperation with the Virginia Department of Forestry, 1995

APPENDIX D
STRATEGIES FOR REFORESTATION

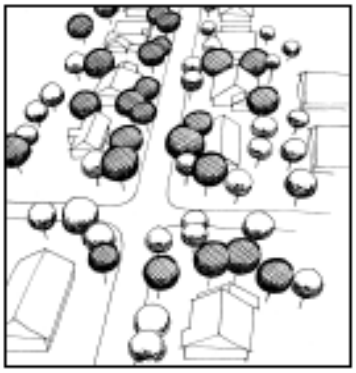
The following figures illustrate strategies for planting trees in residential areas and urban core. Diagrams on these pages are from the Georgia Model Urban Forest Book.

Georgia Forestry Commission. 2001. Georgia Model Urban Forest Book. 78p.

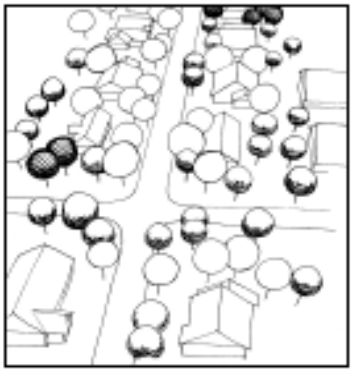
RESIDENTIAL



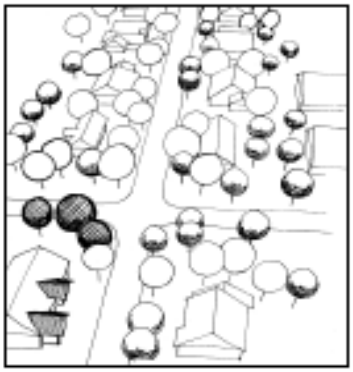
In existing residential



Encourage homeowners to plant trees on their land.



Require redevelopment and remodeling applicants to plant a minimum number of shade trees per lot.



Preserve trees, instead of removing them, during remodeling projects.