

# 2021 Tree Inventory Executive Summary



## City of Terre Haute

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November 30, 2021



## Introduction

On Wednesday, May 5, 2021, Certified Arborists from Great Lakes Urban Forestry Management (GLUFM) began collecting data for the first phases of a comprehensive tree inventory update of parkway trees within the municipal boundaries of the City of Terre Haute. This inventory update resulted in a count of 11,508 updated trees, 3,983 planting spaces, 149 stumps and 2,888 removed trees. The data in this report represents an analysis of the 2021 updated tree inventory and planting space data (about 80% of the entire population) along with the existing data that was not updated by GLUFM in 2021 (about 20% of the total population). By including the entire population's data, we can provide a more complete snapshot of the health, age, and diversity of the urban forest in Terre Haute. This executive summary is a brief statistical overview of all the inventory data and will address some of our observations, as well as some potential mitigation measures and other recommendations. GLUFM is pleased to provide its tree inventory and GIS mapping services along with this summary and analysis of the tree population. Terre Haute is now equipped to use this valuable information to address short term concerns, long term management considerations, and overall planning objectives.

## Collection Parameters

The following is a detailed description of data that was collected for each tree.

### X and Y

These are the X and Y coordinates of the tree location, recorded as NAD 1983 State Plane Indiana West FIPS 1201 coordinate system in feet.

### TREE STATUS

For this inventory, the primary status fields indicates that the site is home to an Active Tree, Planting Space, or a Stump.

### SPECIES

All tree species are listed using common and botanical names and were identified to the species level. Specific cultivars, hybrids, or varieties were not identified.

### STEMS

The Stems field indicates how many stems diverge below 4.5 feet above the ground.

### DBH

Trees were measured using DBH (Diameter at Breast Height, 4.5' above ground level), a standard forestry measure of tree diameter, using a forester's DBH tape. This method of measurement provides the most accurate reading of tree diameter, which can be highly variable depending on the dimension in which it is linearly measured.

### CONDITION

Condition ratings are based on a normal standard distribution. Much like in academic circles, we expect the greatest number of trees in the average category (3), fewer trees in the good and poor categories (2 and 4, respectively), and the fewest number of trees in the excellent and very poor categories (1 and 5, respectively). Condition is a continuous variable, meaning that anywhere along the curve we supplied, you should be able to estimate the number of trees that are (e.g.) a 2.5 condition, even though condition was only recorded as whole number integers. See table below.

<b>Condition 1</b>	<b>Specimen</b> – Tree has no observable defects, wounds, diseases, and has textbook perfect form for the species. In addition, since young trees have a tendency to be trouble free and homogenous, a condition 1 tree must by definition be greater than 16" DBH. These are legacy trees, and as such are rare.
<b>Condition 2</b>	<b>Above Average</b> – Tree may have a small amount of deadwood, or a very limited number of minor defects. The overall form of the tree must be good, and consistent for the species in question. These trees should also be larger than 8" DBH for the reason listed above. Often the difference between condition 2 and 3 is form or growth habit.
<b>Condition 3</b>	<b>Average</b> – Tree has moderate but acceptable amounts if deadwood, wounds, or other defects, but is generally healthy. A wide variety of forms is acceptable for this group, which is meant to define the middle ground around which better or worse trees can be defined and identified.

<b>Condition 4</b>	<b>Below Average</b> – Tree has defects, deadwood, wounds, disease, etc. that have the potential to cause a need for removal. Very poor form or architecture can put an otherwise healthy tree in this category as well, due to the potential for tree or root failure.
<b>Condition 5</b>	<b>Very Poor/ Dead</b> – Tree must be removed. Physical or health defects are too far gone for the tree to be reasonably saved. Like Condition 1 trees, these are relatively rare; generally, trees getting to this level are removed before they die.

### TREE MAINTENANCE

Maintenance recommendations are provided to assist in managing the tree population. These are very general guidelines for pruning and care to be used for managing and prioritizing maintenance.

<b>Prune- Cycle</b>	Tree is in good health, and will require standard pruning or maintenance on a 3-5 year cycle.
<b>Prune- Train</b>	Tree is within the 1-6 inch DBH range and requires structural pruning to establish good architecture.
<b>Prune- Other</b>	Tree has not been properly pruned during its developmental years, has suffered damage, is overgrown, has deadwood, or for other reasons is in need of pruning sooner than a 3-5 year standard cycle.
<b>Remove</b>	Tree should be removed according to its Maintenance Priority
<b>Risk Assessment- Standard</b>	A Level 2 or Level 3 Risk Assessment is recommended based on the tree value and the presence of a defect that needs a more in depth analysis to determine potential risk.
<b>Monitor</b>	Tree has an structural defect or other significant issue that requires monitoring for further change or decline over time.
<b>Maintenance- Other</b>	Tree requires maintenance not related to pruning or removal. Typically used for situations such as leaning new plants, chemical treatment, mulching, girdling objects, etc.

### MAINTENANCE PRIORITY

The above recommended tree maintenance was prioritized as follows:

<b>Low</b>	Maintenance that can be scheduled when time allows, such as cyclical pruning.
<b>Medium</b>	This maintenance has an elevated priority that should be investigated by the Owner/Manager and scheduled as soon as practical, such as a standard removal.
<b>High</b>	This is a top priority maintenance item that should be scheduled by the Owner/ Manager as soon as possible, such as a priority removal.

### RECOMMENDATION REASON

Reasons for the arborist recommendations above are listed here. This is a limited list but includes the most common observed issues that justify the condition and arborist recommendation for that tree.

<b>Clearance</b>	Branches are blocking/ touching building, sidewalk, street, or sign	
<b>Dead</b>	Tree is dead or nearly so	
<b>Deadwood</b>	Large Limb	One or more larger dead limbs requiring removal but not moderate or severe deadwood by percentage
	Moderate	Tree contains 11-30% deadwood, by ocular estimate
	Severe	Tree contains more than 30% deadwood, by ocular estimate
<b>Decay Column</b>	Tree has visible or audible decay in central trunk(s)	
<b>Defect</b>	Other	Tree has other defect not listed, specifics noted in comments field
	Unobservable	Tree has a potential defect that is not observable from the ground
<b>Dieback</b>	Tree crown is dying back	
<b>Girdling Object</b>	A nondescript object is girdling the tree or tree part	
<b>Hanger</b>	Branches are hanging in crown, partially attached or free hanging	
<b>High Location Value</b>	Justification for Risk Assessment; tree is in prominent location and has ecological value	
<b>Included Bark</b>	Tree branches have tight V-shaped union(s) and have developed bark inclusions	
<b>Insects/Disease</b>	Tree has observable signs or symptoms of pests or pathogens	

<b>Lean</b>		Tree is leaning at undesirable angle
<b>Mechanical Damage</b>		Basal damage caused by landscaping equipment, or other physical damage
<b>New Planting</b>		Justification for establishment pruning, staking, mulching, etc
<b>Other</b>		Other notable observance not listed; specifics noted in comments field
<b>Overgrown</b>		Excessive branch or sucker growth requiring priority pruning
<b>Poor Form</b>		Tree has poor architecture, often due to limited growspace or improper pruning
<b>Roots</b>	Compacted	Observed or inferred signs of soil compaction
	Girdling	Observed girdling roots or severe trunk flattening
	Heaving	Observed evidence of root or soil heaving
	Multiple Issues	Two or more root issues
	Still BB	Roots confined to ball & burlap due to intact twine and basket, treated burlap, or other observed factor
	Wounded	Root damage from construction, hardscape, mowing equipment, or other factor
<b>Rot</b>	Heartwood	Observable internal decay; decay column, cavity, etc
	Basal	Observable decay at the base of the tree
	Sapwood	Observable vascular tissue decay
	Other	Other signs of decay such as wetwood, root rot, etc
<b>Mushroom/Conk</b>		Visible fungal fruiting bodies
<b>Topped</b>		Tree had its apical meristem or terminal leader removed; typically due to poor pruning practice, utility pruning, or storm damage
<b>Weak Trunk Union</b>		Weak union caused by included bark or poor branching angles that have compromised structural stability
<b>Wounds</b>	Crown	Scaffold or secondary branch wounds affecting tree health and/or stability
	Trunk	Trunk wounds affecting tree health and/or stability
<b>Utility Conflict</b>		Pruning required due to interference with wires, street lamp, traffic light, or other utility
<b>Sign Conflict</b>		Pruning required due to obstruction of signage
<b>Storm Damage</b>		Tree has recent damage due to storm or winds such as torn limbs

#### LAND USE

For the purposes of this inventory, land use designations include Agricultural, Cemetery, Commercial, Golf Course, Industrial, Institutional, Multifamily, Park, Residential, Transportation, Utility, Vacant and Other.

#### LAWN WIDTH

For street tree inventories, this field is used to record the distance from the curb to the sidewalk or such other soil volume conditions or restrictions.

<b>&lt;4 Feet</b>	Parkway width is less than 4 feet
<b>4-6 Feet</b>	Parkway width is 4-6 feet
<b>6-8 Feet</b>	Parkway width is 6-8 feet
<b>8-10 Feet</b>	Parkway width is 6-8 feet
<b>&gt;10 Feet</b>	Parkway width is greater than 10 feet
<b>Raised Planter</b>	Tree is planted in a container or raised planting bed
<b>Tree Pit</b>	Tree is planted in a pavement cutout pit
<b>No Sidewalk</b>	No sidewalk is present
<b>Cul-de-Sac</b>	Tree is planted in a cul-de-sac median
<b>Open</b>	Tree is growing in an open area, used primarily for trees in Park settings
<b>Other</b>	Any other category not described above

**RISK LEVEL**

This is the equivalent of a Level 1 Limited Visual Risk Assessment and denotes a condition observed by the Arborist that would appear, in their judgement at the time of the inventory, to pose possible risk to people or property. The specific condition would be reflected in the above Arborist Recommendations and Reasons.

<b>None Observed</b>	No observable risk noted at the time of the inventory.
<b>Elevated</b>	Moderate level of risk to people or property that should be investigated by the Owner/ Manager
<b>Substantial</b>	Higher level of risk to people or property that should be investigated by the Owner/Manager and mitigated as soon as practical.
<b>Critical</b>	Extreme level of risk to people or property that should be mitigated by the Owner/ Manager as soon as possible.

**SIDEWALK DAMAGE**

If applicable, observations were made noting heaving or significant cracking of adjacent sidewalks from tree roots. Categorized as None, Moderate, or Severe.

**UTILITIES**

Utilities were defined as overhead wires, streetlights or traffic lights. Designated as Yes or No only.

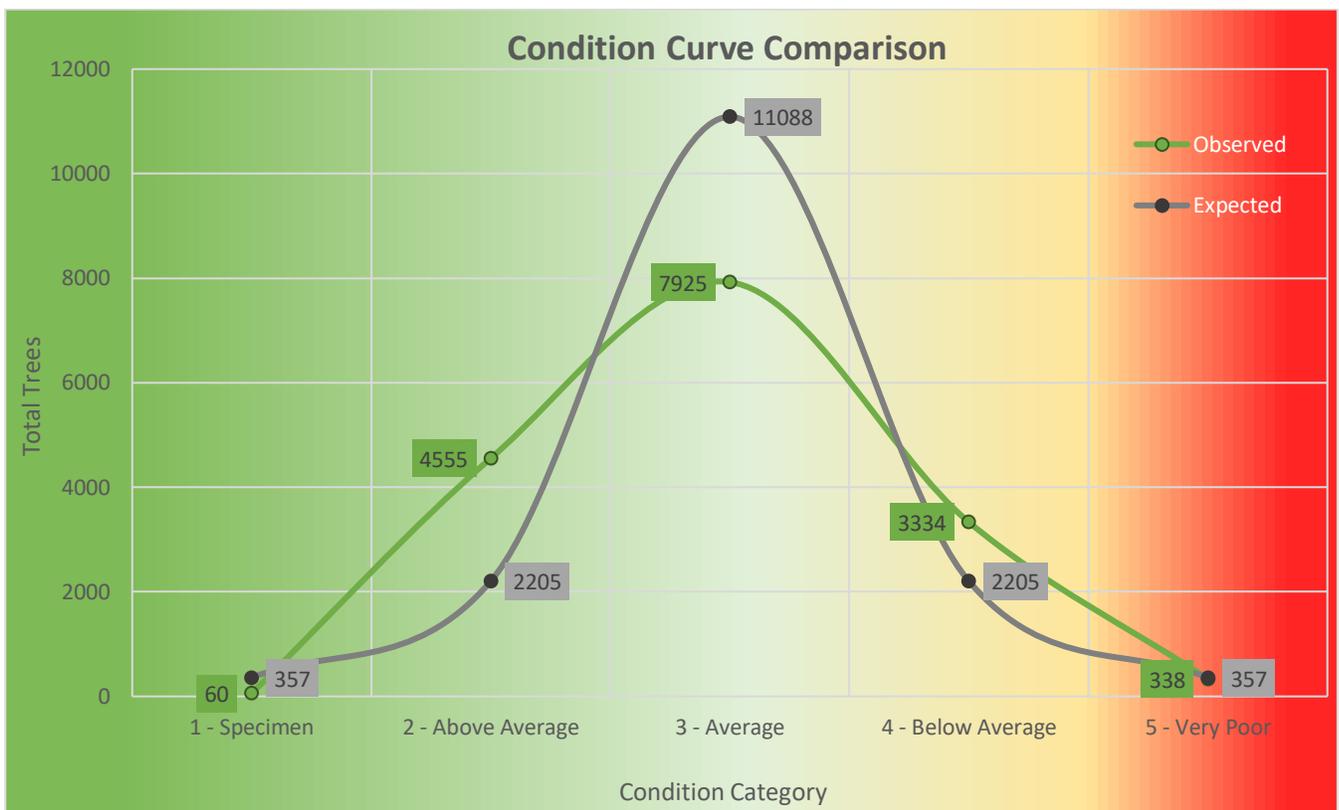
**COMMENTS**

Comments have been included as a courtesy to denote any conditions worthy of note. These comments will be standardized as much as possible, though certain situations certainly exist where nonstandard comments were utilized.

**Statistical Overview**

(As stated above, data includes updated 2021 tree data, as well as data not updated in 2021)

Number of Trees in Inventory	16,212
Number of Stumps in Inventory	342
Number of Planting Spaces in Inventory	3,983
Total Number of Species	147
Total Diameter Inches	282,621"
Average Tree Diameter	17.43"
Average Tree Condition	2.96 (Slightly Above Average)
Average Mature (8" and up) Tree Condition	2.97 (Slightly Above Average)



This curve represents the distribution of trees in each of the categories enumerated above. As stated in the collection parameters section, deviations from the expected normal standard distribution can serve as a useful tool in analyzing the overall health of a tree population, and for this reason, we have included a theoretical curve representing a normal distribution so that comparisons can readily be made. The green line with green labels represents what we observed in the field, and the grey line with grey labels is the predicted normal distribution. The Condition Curve for the Terre Haute inventory indicates a tree population that is in overall above average condition.

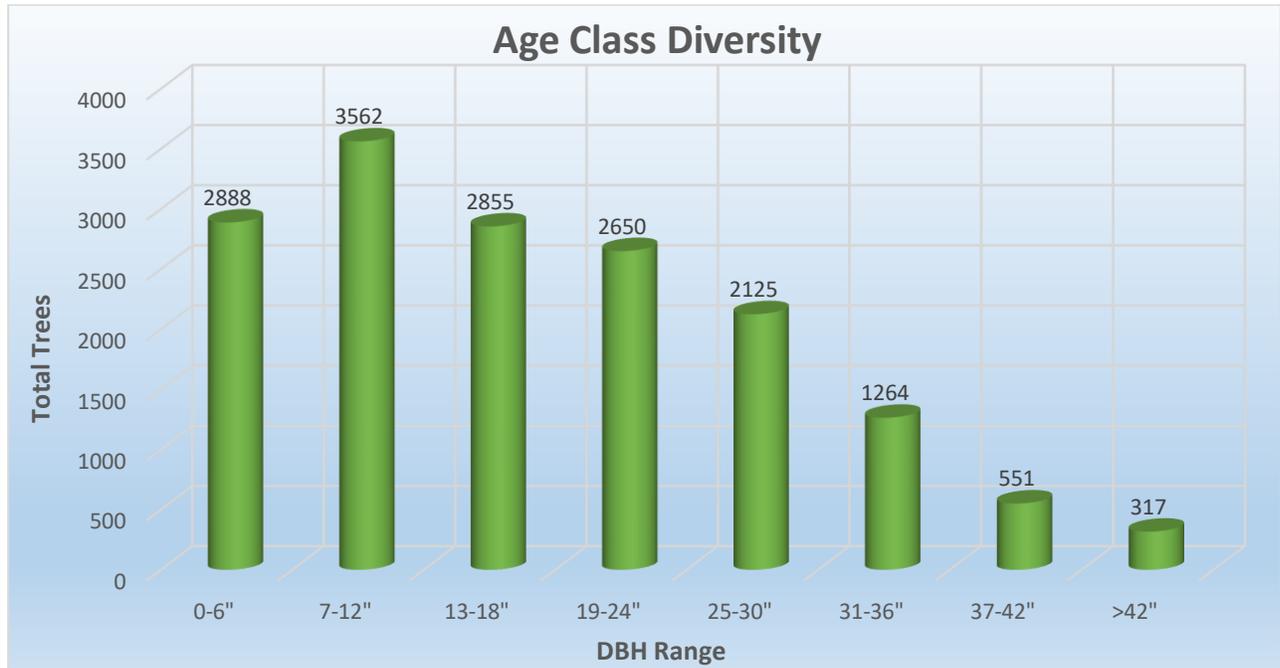
The Condition 1, or specimen trees, were lower than would be predicted by the standard distribution alone, but we always expect that the specimen trees (and often Condition 5 trees as well) will come in lower than their statistical norm because of their rarity. A Condition 1 tree, by definition, must be at least 16” DBH (and generally much larger), have textbook perfect architecture for the species, and have no observable defects. Over 50% of Terre Haute trees have a DBH 16” or greater and are large enough to qualify for the Condition 1 category, however many of these trees are aging trees that have developed defects that render them ineligible for Condition 1 status. We find that if trees are properly planted, mulched, watered, and established, and site selection for the trees is well matched to the species, followed with cyclical pruning and maintenance, trees will often mature with good form and without significant defects. Many of these trees should develop with good health and structure and mature to become Condition 2 and eventually Condition 1 trees.

The Condition 5, or very poor trees, are slightly below the expected norm. It is recommended that Condition 5 trees be prioritized and removed in a timely manner.

The Condition 2, or above average trees, are higher than statistical analysis would predict. Like the Condition 1 category, Condition 2 trees need to have good structure that is consistent with the species in question, be free of major defects, and be over 8” DBH. Almost 80% of the trees in Terre Haute are 8” or larger and many of them met these standards, giving a higher-than-average percentage of Condition 2 ratings. While Terre Haute should be commended for this, there is an opportunity, with proper care, to increase the number of trees in the Condition 1 category. Regular pruning and maintenance will result in more trees moving up into the Condition 1 and 2 categories.

The Condition 4, or below average trees, were higher than what would be statistically expected. This data represents the significant number of overgrown, storm damaged, and aging trees that have developed structural defects, decay, and deadwood. Terre Haute can use the data from this inventory to locate Condition 4 trees and prioritize them for maintenance or removal. Terre Haute can look to further decrease this number over the next few years as they move forward and attend to issues that have been identified.

The trees in the Condition 3, or average, category are lower than the expected norm. The reason for this is the higher number of trees in Categories 2 and 4. As below average trees are maintained or are removed and replaced, the number of Category 3 trees will increase, improving the overall condition of the City’s trees.



This age class analysis chart illustrates a somewhat typical trend in the overall age spread of a tree population seen in a municipal setting. Often, we see many trees being younger to middle aged and a relatively lower number of trees in the older age categories. The Terre Haute tree population has 40% of the tree population measuring less than 13” DBH, an indication of a commitment to continual tree planting. Almost 18% of the total population has a DBH of 6” or less which we generally consider to be less than about 15 years old. It is assumed that most trees grow on average approximately ½” per year, although that figure varies significantly depending on the species in question. Nearly 22% of Terre Haute’s trees have a DBH of 7-12” which are generally considered to be about 15-25 years old. The 13-18” DBH category makes up almost 18% of the population; these trees are approximately 25-35 years old. The 2,650 trees (16%) in the 19-24” DBH category are generally mature trees over 35-45 years old.

Trees measuring over 24” DBH account for 26% of the total tree population. The 4,257 trees in the 25”+ DBH categories are considered to be about 45+ years old. Many of these may be nearing the end of their natural life. One-third of these trees are in below average or worse condition as compared with 23% in below average or poor condition for the population as a whole. This is can be expected since trees in the 30”+ categories are sometimes found to be in poorer condition due to the natural senescence and decline of older trees in urban settings.

The somewhat equal number of trees in each age classification is indicative of a consistent focus on tree planting and tree maintenance in Terre Haute over the years and shows that the right trees are being planted in the correct locations. As younger trees continue to grow, Terre Haute will have an opportunity over time, to bring the tree age classes to an even more balanced level. Going forward, Terre Haute should continue to focus on the care and establishment of new trees, and the care of trees in all age classifications.



In terms of Maintenance Recommendations for the Terre Haute tree population, the statistics displayed above show that one-third of the population is recommended for a mitigation other than cycle prune. Most importantly, 964 trees are recommended for removal. These trees include a variety of tree species which have declined or have developed structural defects and are beyond the point of salvaging. Many of these trees are aging trees in various stages of retrenchment, which is the natural die back of a tree’s crown due to old age. These should be addressed by their Risk Level and Maintenance Priority and removed accordingly.

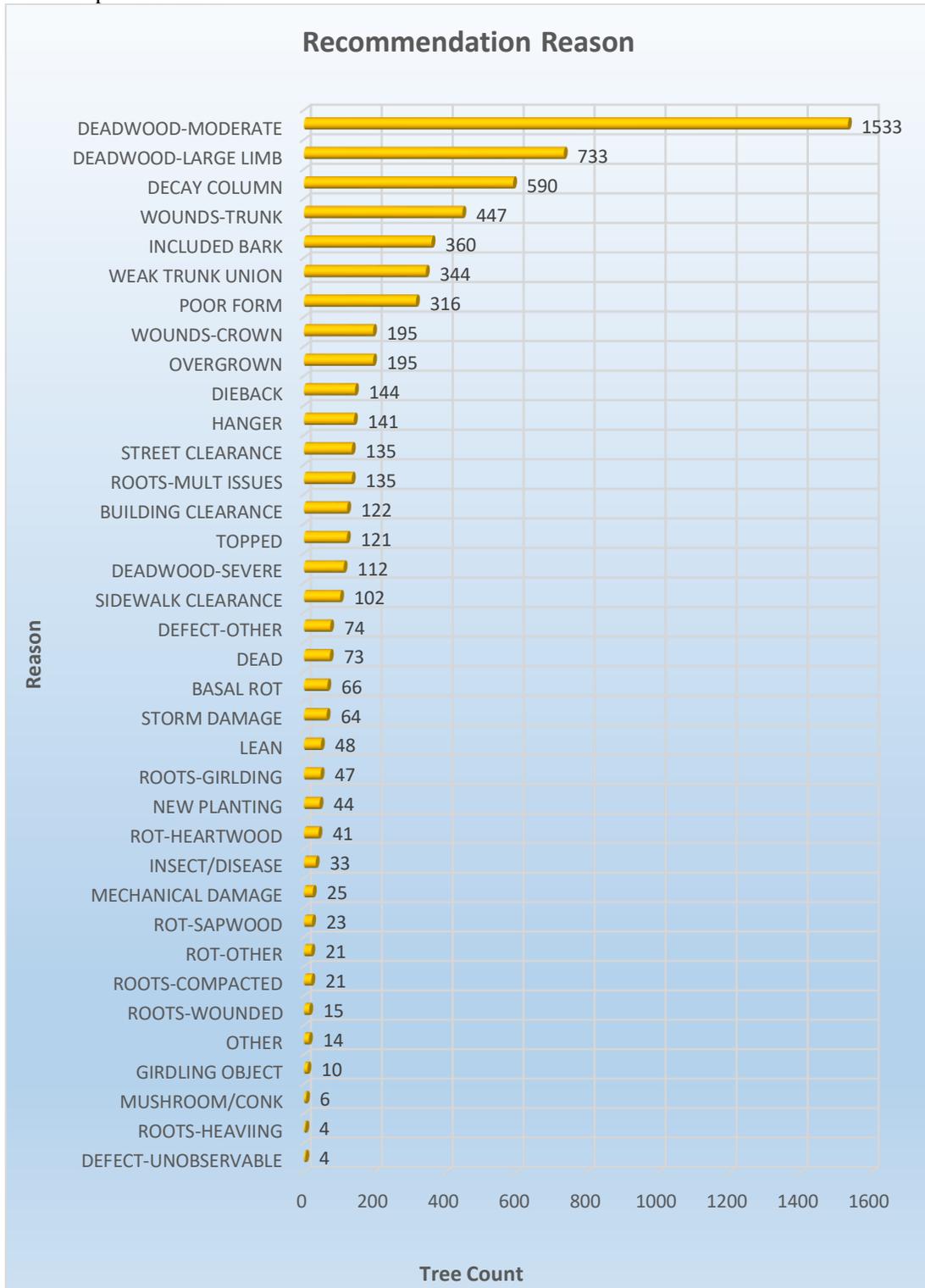
The 2,098 trees designated for “Prune-Other” are trees which are simply overgrown or have parts which need to be removed promptly and should have pruning prioritized over the trees in the cyclical prune set. Generally, we consider this to be a “within 1-3 year” level of pruning. These can be sorted by Risk Level and Maintenance Priority and the work prioritized in the same manner. Any of these that are Low Priority with no observed risk level can be pruned at the City’s discretion as time and budgets allow.

The 838 trees in the “Monitor” category are trees that may be showing signs of potentially developing more serious issues or general decline which must be observed over time. These trees should be reassessed periodically and their maintenance status updated.

The 1,305 trees categorized as “Prune-Train” are generally trees smaller than 6” DBH that have structural issues or are overgrown and require selective pruning to establish better architecture. Establishment pruning, or the pruning of young trees to establish proper branching habit and structure, is one of the least expensive, yet most effective maintenance items that can be performed on a young tree.

The 11 trees in the “Maintenance-Other” category typically need some other form of maintenance not covered in the rest of the categories. A description of the maintenance needed should be found in the comments field.

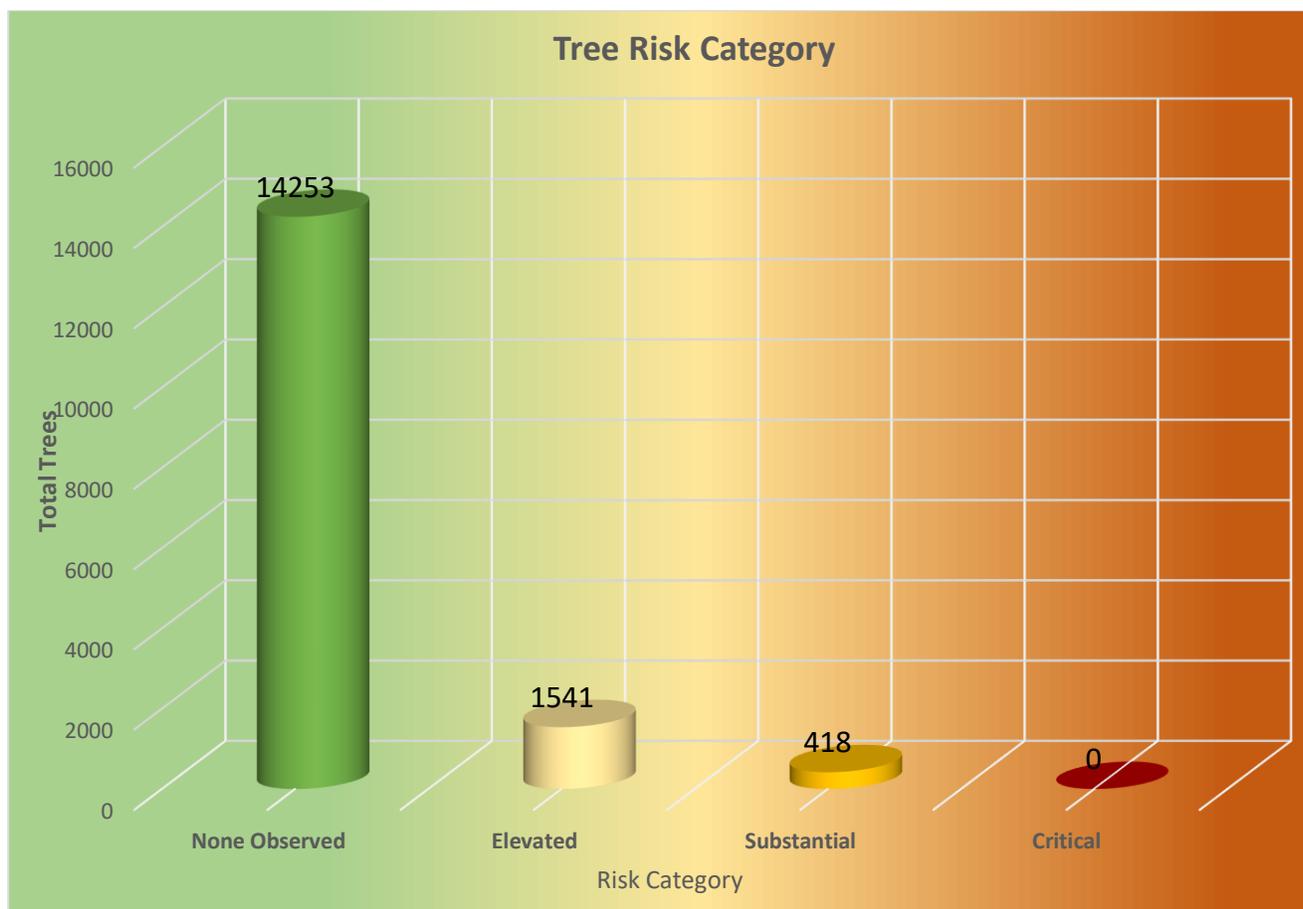
The trees assigned to the “Risk Assessment” categories should be evaluated by the City and, based on the value of the tree to the City, considered for a Level 2 or Level 3 risk assessment to evaluate any defects that need a more in-depth analysis to determine potential risk.



The arborist recommendation reasons summarize field observations into the main factor that justify the Arborist Recommendation and the condition rating of each tree. Some trees may have more than one factor, but the most prominent issue that directly pertained to the maintenance recommendation or condition was noted. Terre Haute can use this inventory data to query specific defects and prioritize mitigation actions. This chart illustrates an interesting overview of the overall health, defects, and maintenance needs of Terre Haute’s tree population.

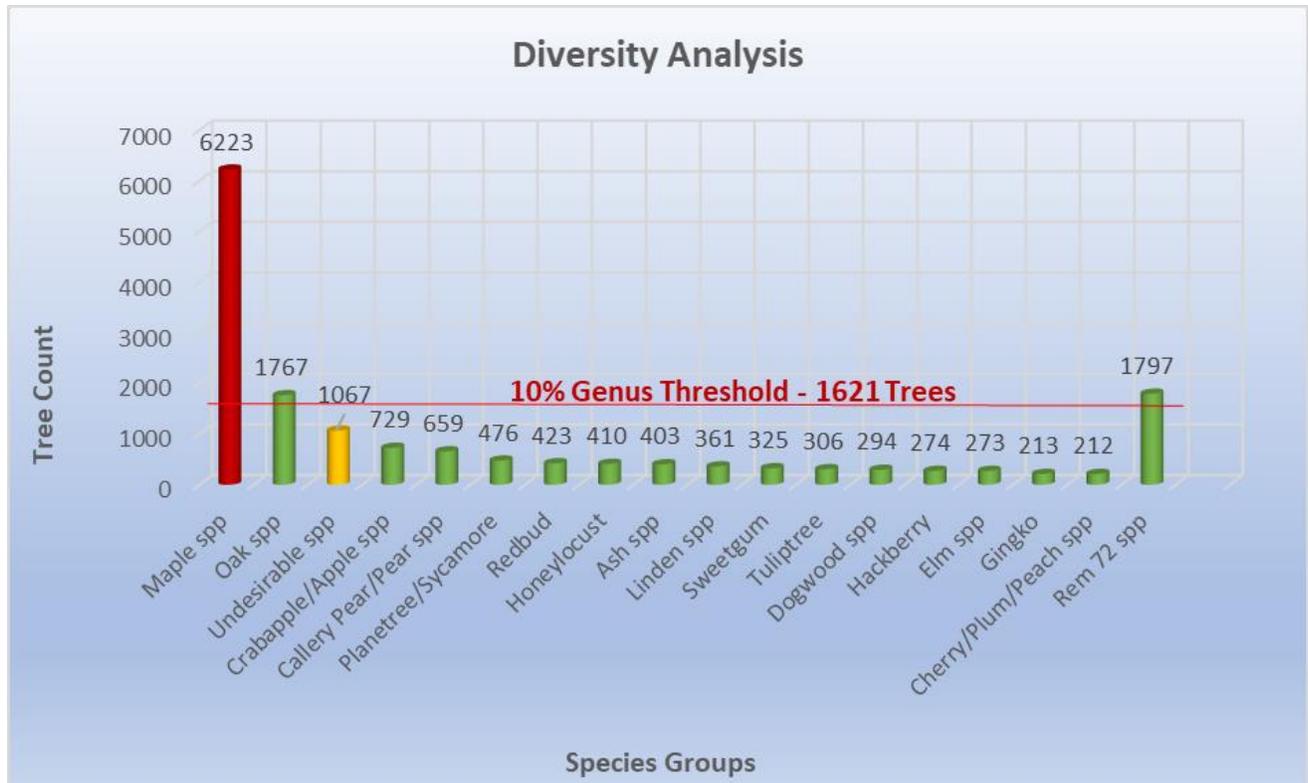
## Risk Level Summary

We cannot stress enough that these were Rapid Assessments, and not full Risk Assessments, and as such, are meant to indicate a need for further study, and do not represent a legal description of these trees' risk levels. These assessments are not legally binding and are not intended to be utilized as evidence in a court of law. They serve primarily for internal record keeping, and a means of locating trees which require more detailed study before making a final decision as to management strategy. Since the Risk Level field is part of the data collection parameters for the Terre Haute inventory, it is recommended that Terre Haute develop and implement a Tree Risk Assessment Policy so that consistency and accountability is successfully achieved.



As illustrated in the chart above, 1,541 trees were found with some observable Elevated risk level and 418 were found to pose a Substantial risk level. Trees that fall into the Substantial or Critical risk level category should receive a Level 2 Risk Assessment and/or a mitigating action. Any tree found to pose an Elevated risk level should be monitored and/or inspected by Terre Haute and a threshold of risk tolerance be established. Some Elevated risk level trees may also be considered for a Level 2 Risk Assessment and/or mitigating action. Great Lakes Urban Forestry Management would be pleased to assist Terre Haute in any aspect of developing or managing a Tree Risk Assessment Policy or performing Level 2 Basic Risk Assessments or Level 3 Advanced Risk Assessments.

## Diversity Statistics



The “20-10-5” rule has been adopted as a Best Management Practice in Urban Forestry. This rule simply states that a tree population should ideally have no more than 20% of any single family, no more than 10% of any single genus, and no more than 5% of any single species. As we have learned from the EAB infestation and Dutch Elm Disease, when a pest or pathogen that attacks specific tree genera is introduced into a region where those specific genera are overrepresented, tree populations can take a devastating hit. We have included a 10% genus threshold line on the diversity analysis graph above. With the exception of three species of Maple, no other individual species was found that composed more than 5% of the population.

Maple species account for over 38% of Terre Haute’s tree population. It is quite common for Maple species to be the highest represented species in municipalities and in other urban settings because they are an adaptable and hardy shade tree that are widely grown commercially. However, if a pest or pathogen that attacks only the Maple genus were introduced into our region, Terre Haute could potentially lose a substantial portion of its tree population. It is highly recommended that the City limit any new plantings of Maples.

The 1,067 trees in the “Undesirable spp” category include trees such as Ailanthus, Boxelder, Black Cherry, Cottonwood, Siberian Elm, Mulberry, and Willow spp. These trees are known for either being invasive or weak-wooded trees that often develop a variety of structural defects as they mature. For safety, aesthetic, and ecological reasons, it is recommended that the City set a goal of gradually reducing the number of undesirable trees on its parkways and replanting them with a diverse set of tree species to further increase overall diversity and improve tree population stability.

The City should be commended for the fact that, aside from the overplanting of Maples, the tree population’s diversity is quite exceptional, with 147 species represented. As mentioned above, except for the overabundance of Maples, no other species exceeds the 5% threshold, and the Oaks just barely exceed the Genus threshold, which is not of any concern considering the existing diversity. Although an in-depth diversity analysis is beyond the scope of this inventory executive summary, Terre Haute can use the tables and graphs that have been provided as a reference when

choosing species to plant in the future. Proper planning will help Terre Haute protect the investment in each new tree and to create a future tree population that is even more resilient and diverse than the current one.

The table below, which lists species that each account for less than 1% of the total tree population, can be used as a resource when choosing future species to plant. This list is limited and does not represent the other options that are not present in the Terre Haute population but are available for planting in this region. Going forward, Terre Haute should plan to take a targeted approach when it comes to choosing new species to plant on its parkways and focus on planting a wide variety of tree species and genera. When planting in the coming years, focus on increasing the numbers of trees in all species represented, with the exception of Maples.

CATALPA	156		MAGNOLIA-SAUCCER	21		AMUR MAACKIA	3
EASTERN REDCEDAR	147		MAGNOLIA-SPP	18		BEECH-EUROPEAN	3
SERVICEBERRY-SPP	138		PERSIMMON	15		HICKORY-MOCKERNUT	3
WALNUT-BLACK	128		MAGNOLIA-CUCUMBER	14		BEECH-SPP	2
LILAC-TREE	123		PINE-SCOTCH	13		CHESTNUT-CHINESE	2
PINE-WHITE	119		BUCKEYE-OHIO	12		FALSE CYPRESS-SPP	2
SPRUCE-BLUE	84		HEMLOCK-EASTERN	12		HAZELNUT-AMERICAN	2
ZELKOVA	79		HOLLY-AMERICAN	12		PINE-JACK	2
HAWTHORN-SPP	66		HAWTHORN-COCKSPUR	11		AMUR CORKTREE	1
BIRCH-RIVER	55		KENTUCKY COFFEETREE	11		ASPEN-QUAKING	1
SPRUCE-NORWAY	53		PINE-RED	11		BIRCH-GRAY	1
HORSECHESTNUT	45		BEECH-AMERICAN	10		BUTTON BUSH	1
UNKNOWN	43		BIRCH-WHITE	10		CHESTNUT-AMERICAN	1
BALDCYPRESS	39		SPRUCE-SPP	8		DAWN REDWOOD	1
BLACKGUM	32		MAGNOLIA-STAR	7		DOUGLAS FIR	1
ARBOR VITAE	29		PINE-AUSTRIAN	7		ELDERBERRY	1
ROSE OF SHARON	29		SPRUCE-WHITE	7		FIR-BALSAM	1
YELLOWWOOD	28		HONEYSUCKLE	5		HICKORY-SHAGBARK	1
SMOKETREE	26		JUNIPER-SPP	5		HORNBEAM-AMERICAN	1
SASSAFRAS	25		FIR-SPP	4		KATSURA	1
MIMOSA TREE	24		HICKORY-BITTERNUT	4		OTHER	1
HICKORY-PECAN	23		IRONWOOD	4		PAWPAW	1
GOLDEN RAIN TREE	21		LILAC-SHRUB	4		SPRUCE-BLACK	1
HORNBEAM-EUROPEAN	21		PINE-VIRGINIA	4		YEW	1

## iTree Data

### iTree Streets Results

Using basic budget figures provided by the City, some information about the City such as average home values and numbers of street miles, along with the tree inventory data itself, iTree Streets is able to calculate the benefits (or ecological services) provided by trees each year, and then compare the costs to the benefits provided. The results are below in a table format.

Benefits	Total (\$) Standard Error	\$/tree Standard Error	\$/capita Standard Error
Energy	124,568 (N/A)	7.64 (N/A)	2.05 (N/A)
CO2	18,579 (N/A)	1.14 (N/A)	0.31 (N/A)
Air Quality	43,288 (N/A)	2.66 (N/A)	0.71 (N/A)
Stormwater	413,816 (N/A)	25.39 (N/A)	6.81 (N/A)
Aesthetic/Other	463,919 (N/A)	28.47 (N/A)	7.63 (N/A)
<b>Total Benefits</b>	<b>1,064,171 (N/A)</b>	<b>65.30 (N/A)</b>	<b>17.51 (N/A)</b>
<b>Costs</b>			
Planting	51,200	3.14	0.84
Contract Pruning	127,950	7.85	2.10
Pest Management	2,500	0.15	0.04
Irrigation	2,500	0.15	0.04
Removal	218,000	13.38	3.59
Administration	75,000	4.60	1.23
Inspection/Service	2,500	0.15	0.04
Infrastructure Repairs	2,500	0.15	0.04
Litter Clean-up	2,500	0.15	0.04
Liability/Claims	0	0.00	0.00
Other Costs	0	0.00	0.00
<b>Total Costs</b>	<b>484,650</b>	<b>29.74</b>	<b>7.97</b>
<b>Net Benefits</b>	<b>579,521 (N/A)</b>	<b>35.56 (N/A)</b>	<b>9.53 (N/A)</b>
<b>Benefit-cost ratio</b>	<b>2.20 (N/A)</b>		

Per the above chart, the city spends approximately \$485,650 each year on its tree population, and in return, obtains benefits from that tree population of \$1,064,171 annually; a nearly 120% return on investment. We will analyze the iTree Streets data in detail in the accompanying Urban Forestry Management Plan.

### **iTree Eco Results**

The iTree Eco analysis, which as stated above, looks more into the standing value of the tree population as well as the ecological services described above, resulted in the following data:

- **Pollution Removal: 7.614 tons/year (\$52.9 thousand/year)**
- **Carbon Storage: 16.06 thousand tons (\$2.74 million)**
- **Carbon Sequestration: 227.7 tons (\$38.8 thousand/year)**
- **Oxygen Production: 607.1 tons/year**
- **Avoided Runoff: 578 thousand cubic feet/year (\$38.6 thousand/year)**
- **Building energy savings: N/A – data not collected**
- **Avoided carbon emissions: N/A – data not collected**
- **Replacement values: \$73.4 million**

As with the iTree Streets data, we will analyze iTree Eco in detail in the accompanying Urban Forestry Management Plan.

## Conclusion

It has been a pleasure for Great Lakes Urban Forestry Management to provide this tree inventory update, data analysis, and executive summary to the City of Terre Haute. The City's urban forest adds tremendous value to the community and the staff is to be commended for their prioritizing this inventory update, understanding that the management of this resource is of utmost importance. The updated data and analysis of the tree data has been summarized in this report and has also been utilized to create an updated Urban Forestry Management Plan, submitted along with this Executive Summary. This Plan will outline long-term strategies and budgets for tree planting and management of the urban forest in Terre Haute. We look forward to the opportunity to partner with Terre Haute to assist in planning, performing Tree Risk Assessments, or assisting in any other tree or natural resource related initiatives. Thank you for the opportunity to partner with you, and we look forward to continuing to serve as your Tree, Natural Resource, and Geospatial Data experts.



## Appendix A: All Trees

The table below is an itemized list of all tree species present in the Terre Haute tree population, along with average DBH (in inches) and average condition rating for each species. The average condition ratings combined with higher average DBHs can be used as a guide as to what species are growing well in Terre Haute.

<u>SPECIES</u>	<u>COUNT</u>	<u>% OF TOTAL</u>	<u>AVG DBH</u>	<u>AVG COND</u>
MAPLE-SILVER	2349	14.49%	26.16	3.15
MAPLE-RED	1502	9.26%	18.02	2.89
MAPLE-SUGAR	1470	9.07%	20.08	3.02
OAK-PIN	786	4.85%	26.12	2.83
APPLE-CRAB SPP	715	4.41%	9.60	2.93
PEAR-CALLERY	652	4.02%	12.06	3.12
ELM-SIBERIAN	472	2.91%	22.45	3.41
MAPLE-NORWAY	468	2.89%	12.04	2.78
REDBUD	423	2.61%	12.06	3.20
SYCAMORE	413	2.55%	24.56	2.86
HONEYLOCUST	410	2.53%	11.13	2.62
SWEETGUM	325	2.00%	17.71	2.65
TULIPTREE	306	1.89%	23.60	2.81
OAK-RED	292	1.80%	15.22	2.66
LINDEN-LITTLELEAF	275	1.70%	13.00	2.85
HACKBERRY	274	1.69%	24.38	2.82
DOGWOOD-FLOWERING	248	1.53%	8.34	2.90
MULBERRY-SPP	239	1.47%	12.51	3.31
ASH-GREEN	214	1.32%	16.60	3.70
GINKGO	213	1.31%	7.05	2.84
ASH-WHITE	189	1.17%	14.83	3.07
CHERRY-SPP	179	1.10%	5.74	3.01
CATALPA	156	0.96%	26.93	3.26
OAK-SOUTHERN RED	152	0.94%	17.41	2.51
EASTERN REDCEDAR	147	0.91%	10.08	2.68
MAPLE-AUTUMN BLAZE	139	0.86%	10.06	2.75
SERVICEBERRY-SPP	138	0.85%	5.01	2.89
CHERRY-BLACK	136	0.84%	20.14	3.03
ELM-HYBRID	130	0.80%	11.32	2.79
WALNUT-BLACK	128	0.79%	17.18	2.76
LILAC-TREE	123	0.76%	4.57	2.85
OAK-SWAMP WHITE	123	0.76%	9.85	2.54
MAPLE-BLACK	122	0.75%	23.08	2.99
PINE-WHITE	119	0.73%	19.67	2.60
AILANTHUS	96	0.59%	18.43	3.22
OAK-SHINGLE	94	0.58%	22.95	2.55
ELM-AMERICAN	92	0.57%	22.37	3.04
SPRUCE-BLUE	84	0.52%	8.32	2.81

ZELKOVA	79	0.49%	11.35	3.06
OAK-SHUMARD	78	0.48%	16.62	2.55
OAK-WHITE	78	0.48%	16.90	2.41
LINDEN-AMERICAN	68	0.42%	24.03	3.06
HAWTHORN-SPP	66	0.41%	5.39	2.94
OAK-BURR	66	0.41%	9.05	2.89
LONDON PLANETREE	63	0.39%	9.52	2.52
MAPLE-AMUR	63	0.39%	8.19	2.70
BIRCH-RIVER	55	0.34%	16.64	2.71
BLACK LOCUST	54	0.33%	23.76	3.06
SPRUCE-NORWAY	53	0.33%	14.79	2.51
HORSECHESTNUT	45	0.28%	6.07	2.51
MAPLE-MIYABEI	45	0.28%	5.11	2.51
UNKNOWN	43	0.27%	11.05	4.21
BALDCYPRESS	39	0.24%	8.31	2.79
MAPLE-JAPANESE	38	0.23%	6.79	2.87
ELM-RED	34	0.21%	14.35	3.03
BLACKGUM	32	0.20%	6.16	3.00
ARBOR VITAE	29	0.18%	3.79	2.69
OAK-ENGLISH	29	0.18%	13.24	2.48
ROSE OF SHARON	29	0.18%	4.00	3.00
YELLOWWOOD	28	0.17%	4.43	3.18
SMOKETREE	26	0.16%	7.81	3.15
SASSAFRAS	25	0.15%	10.64	2.80
BOXELDER	24	0.15%	18.38	3.58
MIMOSA TREE	24	0.15%	14.17	3.50
DOGWOOD-SPP	23	0.14%	6.00	3.30
HICKORY-PECAN	23	0.14%	12.48	2.09
WILLOW-SPP	23	0.14%	10.87	2.87
PLUM-SPP	22	0.14%	6.91	3.14
GOLDEN RAINTREE	21	0.13%	12.48	3.24
HORNBEAM-EUROPEAN	21	0.13%	2.19	2.33
MAGNOLIA-SAUCCER	21	0.13%	17.05	2.71
OAK-SCARLET	20	0.12%	10.70	2.60
LINDEN-SILVER	18	0.11%	8.94	2.56
MAGNOLIA-SPP	18	0.11%	9.39	3.28
COTTONWOOD	16	0.10%	30.44	2.63
ELM-CHINESE	15	0.09%	22.27	3.67
PERSIMMON	15	0.09%	11.33	2.93
APPLE-EDIBLE	14	0.09%	6.36	3.07
MAGNOLIA-CUCUMBER	14	0.09%	16.93	2.79
MAPLE-HEDGE	13	0.08%	9.00	2.54
OAK-CHINKQUAPIN	13	0.08%	4.77	2.92
PINE-SCOTCH	13	0.08%	14.69	4.08
BUCKEYE-OHIO	12	0.07%	9.33	2.83
HEMLOCK-EASTERN	12	0.07%	18.00	2.75
HOLLY-AMERICAN	12	0.07%	8.33	2.92

DOGWOOD-PAGODA	11	0.07%	7.36	3.27
HAWTHORN-COCKSPUR	11	0.07%	3.64	2.73
KENTUCKY COFFEETREE	11	0.07%	14.27	2.27
PINE-RED	11	0.07%	15.36	2.73
BEECH-AMERICAN	10	0.06%	19.10	2.90
BIRCH-WHITE	10	0.06%	13.80	2.60
DOGWOOD-KOUSA	9	0.06%	3.78	2.33
MAPLE-TATARIAN	9	0.06%	11.89	3.11
PEACH	8	0.05%	4.38	3.25
SPRUCE-SPP	8	0.05%	9.88	4.25
MAGNOLIA-STAR	7	0.04%	13.29	2.71
OAK-BLACK	7	0.04%	29.86	2.71
OAK-CHESTNUT	7	0.04%	12.29	2.71
OAK-CHINQUAPIN	7	0.04%	7.14	3.00
PEAR-EDIBLE	7	0.04%	6.57	2.86
PINE-AUSTRIAN	7	0.04%	17.29	3.00
SPRUCE-WHITE	7	0.04%	8.00	2.86
HONEYSUCKLE	5	0.03%	10.40	3.40
JUNIPER-SPP	5	0.03%	17.20	2.80
OAK-OVERCUP	5	0.03%	10.60	2.80
OAK-SPP	5	0.03%	2.00	3.00
FIR-SPP	4	0.02%	13.00	3.00
HICKORY-BITTERNUT	4	0.02%	20.25	2.25
IRONWOOD	4	0.02%	10.50	3.00
LILAC-SHRUB	4	0.02%	6.25	3.00
MAPLE-PAPERBARK	4	0.02%	4.00	3.50
PINE-VIRGINIA	4	0.02%	11.25	3.00
AMUR MAACKIA	3	0.02%	2.33	2.00
BEECH-EUROPEAN	3	0.02%	7.33	3.33
CHERRY-PURPLE LEAF	3	0.02%	10.00	3.67
DOGWOOD-ROUGH LEAF	3	0.02%	2.00	2.00
HICKORY-MOCKERNUT	3	0.02%	1.00	3.00
OAK-SAWTOOTH	3	0.02%	6.67	3.33
WILLOW-WEeping	3	0.02%	6.33	2.67
BEECH-SPP	2	0.01%	1.50	3.50
CHESTNUT-CHINESE	2	0.01%	9.00	3.00
FALSE CYPRESS-SPP	2	0.01%	7.50	3.00
HAZELNUT-AMERICAN	2	0.01%	18.00	2.50
OAK-BEBB	2	0.01%	3.00	3.00
PINE-JACK	2	0.01%	15.50	3.00
POPLAR-WHITE	2	0.01%	20.00	3.50
AMUR CORKTREE	1	0.01%	21.00	3.00
ASPEN-QUAKING	1	0.01%	18.00	4.00
BIRCH-GRAY	1	0.01%	19.00	3.00
BUCKTHORN	1	0.01%	1.00	3.00
BUTTON BUSH	1	0.01%	2.00	3.00
CHESTNUT-AMERICAN	1	0.01%	18.00	5.00

DAWN REDWOOD	1	0.01%	6.00	3.00
DOUGLAS FIR	1	0.01%	15.00	3.00
ELDERBERRY	1	0.01%	6.00	3.00
ELM-ENGLISH	1	0.01%	11.00	2.00
ELM-SPP	1	0.01%	3.00	4.00
FIR-BALSAM	1	0.01%	25.00	2.00
HICKORY-SHAGBARK	1	0.01%	13.00	3.00
HORNBEAM-AMERICAN	1	0.01%	21.00	4.00
KATSURA	1	0.01%	1.00	3.00
MAPLE-SPP	1	0.01%	5.00	5.00
OTHER	1	0.01%	1.00	4.00
PAWPAW	1	0.01%	1.00	3.00
POPLAR-SPP	1	0.01%	12.00	4.00
SPRUCE-BLACK	1	0.01%	16.00	4.00
YEW	1	0.01%	1.00	3.00