Village of Bartlett, Illinois
2019 Tree Inventory Report

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Introduction

On March 12, 2019, Certified Arborists from Graf Natural Resources Management & GIS began data collection for a comprehensive inventory of the municipally managed trees in the community of Bartlett, Illinois. This inventory included all parkway and ROW trees and resulted in a total of 15,282 trees, 2,993 open planting spaces, and 18 stumps.

As will be discussed in further detail throughout this tree inventory report, the tree population in Bartlett can be characterized as an overwhelmingly younger population, in overall slightly above average condition, with improving diversity. We will address our observations and other recommendations in detail, later in this report. Graf Natural Resources Management & GIS is pleased to provide its tree inventory and GIS mapping services along with this report and analysis of the tree population. The Village of Bartlett 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.

TREE ID NUMBER
Each newly inventoried tree will be designated a Unique ID Number, at the discretion of the Village, to be utilized as a record locator for that specific tree, it's legacy data, and it's maintenance records.

X and Y
These are the X and Y coordinates of the tree location, recorded as NAD 83, Illinois State-Plane East (Northings and Eastings) coordinate system.

TREE STATUS
For this inventory, the status field includes whether the site is home to an Active Tree, a Planting Space, or a Stump.

ADDRESS
The address was recorded as the numerical address at which a tree is located, based on the observed street address, or the listed street address of the GIS parcel data we have available to us.

STREET NAME
The street names conform to the names as listed on Village street signage. The street name is for the address at which the parcel is listed, regardless of how the buildings on the lot are oriented (if on a corner lot).

ON STREET
The on street field is used to identify the street on which the tree actually stands. This data is particularly useful for corner lots and large properties.

LOCATION NOTES
The location notes field is used to provide additional information about a tree's location particulaly is the case of large properties. Examples include industrial and commercail buildings, schools, and parks.

RELATIVE LOCATION (SITE)
All trees are listed by zone, address, street name, on street name, and the following site prefixes, which determine where exactly on a property the tree is located:

F – Front of the property
R – On the right side of the property
L – On the left side of the property
B - Along the back of the property
M - On a median in the center of a street
C – On a cul-de-sac island
A – Across from an address

The order of trees at a parcel with multiple trees will always be labled corresponding to the flow of traffic, even in the case of one-way streets. The flow of traffic numbering system holds true for the left, right, and back sides of the property as well.

SPECIES
All tree species were listed using Common Names and are identified to the species level. Specific cultivars, hybrids, or varieties may be identified when possible. This is mostly due to the fact that certain genera such as Crab Apples, Hybrid Elms, Cherry trees, and other ornamentals have such great variation that it can be very time consuming to identify down to this level.

DBH / CALIPER
Trees were measured using DBH (Diameter at Breast Height), 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.

CROWN HEIGHT / CROWN SPREAD / LCR
Crown Height, Crown Spread, and Live Crown Ratio (LCR) are broadly estimated to approximately the nearest 10 foot interval by a combination of pacing from the drip line to the trunk, and utilizing a combination of clinometers, laser rangefinders, landmarks, and professional judgment. This data was utilized for both 3-Dimensional Mapping, as well as for better calculating rainfall interception rates, carbon sequestration, crown volume, and other such factors.

PARKWAY WIDTH
This is a field which was measured by measuring the distance from the curb to the sidewalk, or other such landmarks (utility poles/junction boxes/etc).

1-3 FEET	Parkway width is 1-3 feet
4-6 FEET	Parkway width is 4-6 feet
7-12 FEET	Parkway width is 7-12 feet
13+ FEET	Parkway width is 13 feet or greater
NO SIDEWALK	No sidewalk is present
OPEN	Tree is growing in an open area, used primarily for VOPs
OTHER	Any other category not described above

1-5 CONDITION RATING
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 summary number that takes into account the tree's overall health, vigor, and structure (see table below)

Condition 1	**Excellent** – 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.
Condition 2	**Good** – 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.
Condition 3	**Average** – 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.
Condition 4	**Poor** – Tree has defects, deadwood, wounds, disease, etc. that have to 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.
Condition 5	**Very Poor** – 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, as generally trees that are getting to this level are removed before they can get there.

ROOTS

Roots are evaluated as part of the Standard Defects Package "at a glance"

Normal	Roots appear normal
Exposed	Roots are exposed and can be damaged by mowers, etc.
Girdling	Observed girdling roots or severe trunk flattening
Compacted	Roots showing observable signs of underground root compaction
Wounded	Roots showing wounds
Multiple Issues	Roots showing a combination of above issues
Still BB	Recently planted tree still balled and burlapped
Heaving	Upward displacement of hardscape and/or soil due to root growth or unbalanced canopy

WOUNDS

Wounds are part of our standard defects package, and include, but certainly aren't limited to: Splits, cavities, callus tissue, holes, or any other mechanical damage. Categorically, "None" was still used if the damage was minor enough that it would not affect the tree.

None	Tree has no wounds
Moderate	Tree has moderate wounds
Severe	Tree has severe wounds

DEADWOOD

Deadwood was evaluated as part of the Standard Defects Package. Generally, trees with a small amount of deadwood fell into the "None" category. This is a scalable evaluation. In other words, 3 dead branches would be "Severe" on a 4" DBH tree, "Moderate" on a 10" DBH tree, and "None" on a 25" DBH tree.

None	Tree contained 0-10% deadwood, by ocular estimate
Moderate	Tree contained 11-30% deadwood, by ocular estimate
Severe	Tree contained more than 31% deadwood, by ocular estimate

ROT

Rot was evaluated as part of the Standard Defects Package, and includes, but certainly isn't limited to: mushrooms, dry rot, brown rot, bleeding, basal rot, burls, or generally anything that appears to have been caused by an organism, and not mechanical damage. In this case, even small amounts of rot were noted as being "moderate", due to the strong possibility that there is much more damage that cannot be seen with the naked eye.

None	No rot visible whatsoever
Moderate	Modest amounts of observable damage were present
Severe	Severe rot was observed

MAINTENANCE RECOMMENDATION

Maintenance recommendations are provided to assist in managing the tree population. They are very general guidelines for pruning and care. See the table below.

Cyclical Prune	Tree is in good health, and will require standard pruning or maintenance on a 3-5 year cycle.
Monitor	Tree has an indiscernible defect, or shows signs of developing issues or general decline which must be observed. Also for healthy Ash trees in EAB infested areas and Ashes currently being treated.
Priority Prune	Tree has not been properly pruned during its developmental years, or suffered damage. Typically overgrown, and in need of pruning sooner than a 3-5 year standard cycle.
Priority Maintenance	Tree requires maintenance such as mulching, removal of a girdling object, or some form of Plant Health Care (i.e. foliar fungicide applications), etc.
Risk Assessment	Tree has deadwood or other defects which are at risk of threatening property, utilities, or human life. These trees need a more thorough inspection to determine if they require removal or other remedial action (see below)
Remove	Tree must be removed. This is only utilized if removal is truly the only reasonable option. For trees that are on the borderline, or may require a Risk Assessment, the phrase "consider removal" will appear in the comments field

Hazard Remove	Tree is hazardous and should be removed as soon as possible.
Hazard Prune	Tree requires pruning within a 1 year time frame in order to correct a potentially high risk situation from developing, or one has already occurred
Establish Prune	Young tree that requires pruning to encourage the development of good structure and form

LAND USE
For the purposes of this inventory, land use designations include Commercial, Industrial, Institutional, Multifamily, Recreational, Residential, Transportaion, and Other.

UTILITIES
The presence of visible utilities of any kind was noted here. This was based on an ocular estimate of wires within approximately 25 feet of any tree part. For this inventory, utility categories included Lamp/Traffic, Many, None, Subterranean, Wires, and both Wires & Subterranean.

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.

NEW PLANTS
Used to note whether younger trees (DBH of 12" and under) were in need of mulching, correcting a lean, or other maintenance.

TRAQ FIELDS
The following 4 fields were used to get a basic risk rating for trees we identified in the field as needing additional examination based on the TRAQ (Tree Risk Assessment Qualification) system. This data is provided in order to determine which trees the Village will need to inspect more closely, and perhaps perform a more detailed assessment. These fields can also be used for Bartlett to track it's internal risk assessments.

We cannot stress enough that these were Rapid Assessments, and not full TRAQ Assessments, and as such, are meant to indicate a need for further study, and do not represent a legal description of Risk. 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. These assessments can be considered approximately a Level 1, or Limited Visual Assessment. Further discussion of the TRAQ data collected in Bartlett will be found later in this report.

FAILURE PART
This is the tree part which might be expected to fail within a 1 year period from the date of survey

ROOTS	Structural roots further from trunk
TRUNK	Trunk defects
SCAFFOLD BRANCHES	Primary large diameter scaffold branches coming off trunk and/or central leader
SECONDARY BRANCHES	Secondary branches coming off scaffold branches. Often used as a default for all trees over approximately 6"
WHOLE TREE	Multiple potential points of failure identified, equally likely to fail

FAILURE LIKELIHOOD
This is the likelihood that the tree or tree part will fail within a period of 1 year from the date of survey.

Improbable	Failure of tree/tree part is highly unlikely within a 1 year time frame
Possible	Failure of tree/tree part is possible, but not probable within a 1 year time frame
Probable	Failure of tree/tree part is likely within a 1 year time frame
Imminent	Tree/Tree Part has already begun to fail and failure is imminent

IMPACT LIKELIHOOD

This is the likelihood that the tree or tree part will impact a target when it fails.

Very Low	Failure of tree/tree part is highly unlikely to impact a target
Low	Failure of tree/tree part is unlikely to impact a target
Medium	Failure of tree/tree part may impact a target but is not expected to do so
High	Failure of tree/tree part is likely to impact a target

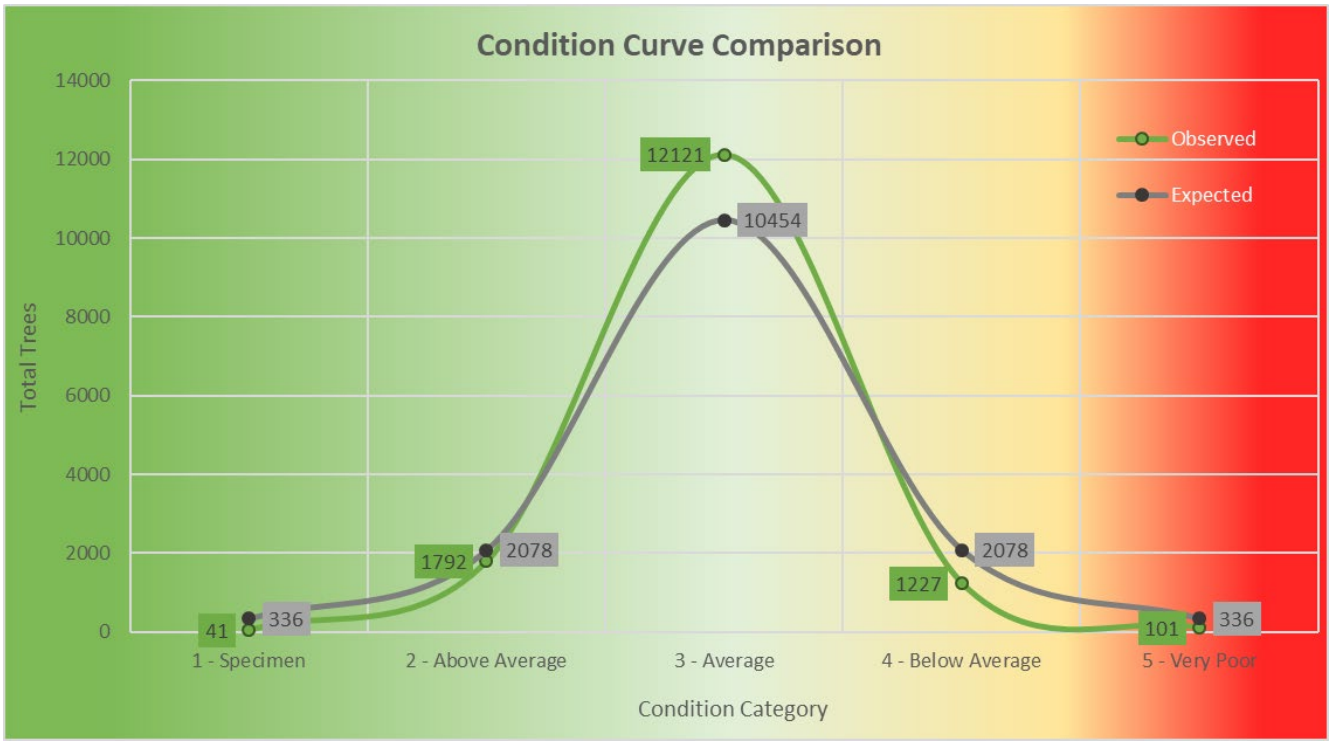
IMPACT CONSEQUENCE

This is the consequence that will be suffered if the tree fails and impacts a target

Negligible	Failure of tree/tree part will have no significant consequence
Minor	Failure of tree/tree part will cause minor damage to property
Significant	Failure of tree/tree part will cause significant damage to property or minor injury to life
Severe	Failure of tree/tree part will cause severe damage to property or life

Tree Data Statistics & Analysis

Total Number of Managed Trees	15,282
Total Number of Plantable Spaces	2,993
Total Number of Stumps	18
Total Number of Species	117
Total Diameter Inches	152,250"
Average Tree Diameter	9.96"
Average Tree Height (ft)	25.36
Average Crown Spread (ft)	19.81
Average Crowding (Height to Spread Ratio)	1.28
Total Canopy Volume	156,067,848.56
Average Canopy Volume	10,224 cu ft
Average Tree Condition	2.97 (Slightly Above Average)
Average Mature (8" and up) Tree Condition	2.89 (Above Average)



The above 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 average tree condition for a parkway tree in Bartlett is 2.97 for all trees, and 2.89 for trees 8" DBH and larger. We make this distinction between the two, because trees under 8" DBH do not qualify for condition 1 or 2 status, and young tree mortality tends to be more common in the urban environment, so it is a more objective evaluation of existing trees. Both these ratings, in this case, are above average which is an indicator of an overall healthy and satisfactorily-maintained tree population.

The condition 1, or specimen trees, were significantly lower than would be predicted by the standard distribution alone, but we always expect that the specimen trees in a municipal parkway setting will come in lower than their statistical norm because of their relative rarity. This is because of the challenging environments in which parkway trees are planted, especially when it comes to poor urban soils and limited below-ground growing space. It is also important to mention that according to our rating system, there is 16" DBH minimum threshold on Condition 1 trees and over 81% of Bartlett's tree population do not meet this DBH threshold. As younger trees continue to mature and are properly pruned and maintained, this category should gradually increase in numbers.

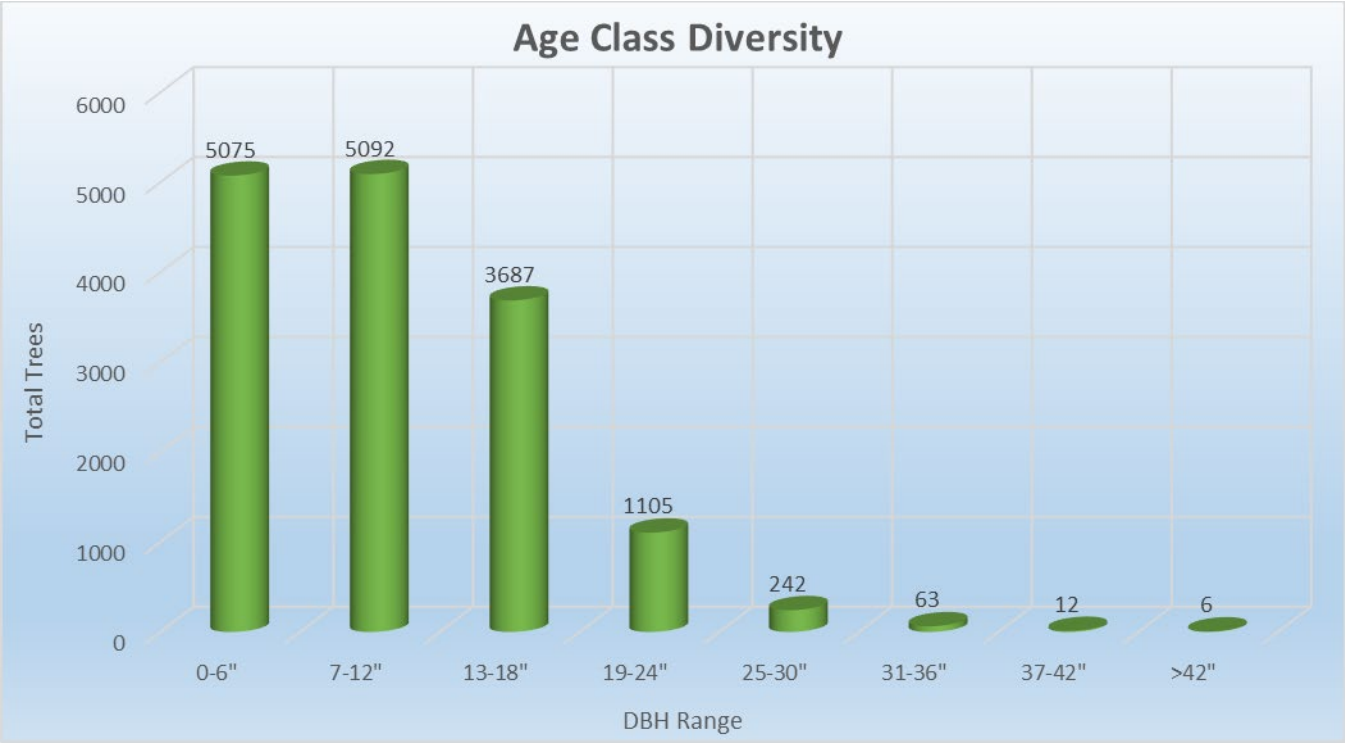
The condition 5, or very poor trees, also came in well below the expected norm. This is mostly due to a high level of awareness the Village has for trees which are in poor condition, high risk, or otherwise in need of removal. The residents of Bartlett likely play a part in this, and notify Village staff when care is needed. The 101 trees in this category should be prioritized and removed.

The Condition 2, or above average trees, are just slightly lower than what statistical analysis would predict. Similar to the Condition 1 category, Condition 2 trees need to have good structure that is consistent with the species in question and also be over 8" DBH. Over 38% of Bartlett's tree population is not eligible to earn a condition 2 designation due to their DBH being below 8". Looking toward the future, the Village has an opportunity to increase the number of trees in the condition 2 category. In general, if trees are properly mulched and maintained, newly installed trees are done so correctly and cared for well, and site selection for the trees is well matched to the species, trees will often mature with good form and without significant defects. These trees can eventually become Condition 2 trees.

The condition 4 trees came in quite a bit lower than what would be statistically expected again indicating an overall healthy and well-maintained tree population. The 1,227 trees in this category include a variety of species that have developed excessive deadwood and/or other structural defects. With proper maintenance, and using this tree inventory to be able to locate trees in need of removal and maintenance, Bartlett can look to further decrease this number over the next few years as they move forward and attend to issues we have identified. These actions will continue to shift the above Condition Curve to more above average.

The trees in the condition 3, or average, category are significantly higher than the expected norm. The reason for this is simply that this is the average category and generally has the most trees in it. Another reason this number is inflated is due to the fact that Bartlett's tree population is overwhelmingly young and all trees under 8" DBH are automatically assigned this category unless they happen to be in worse condition.

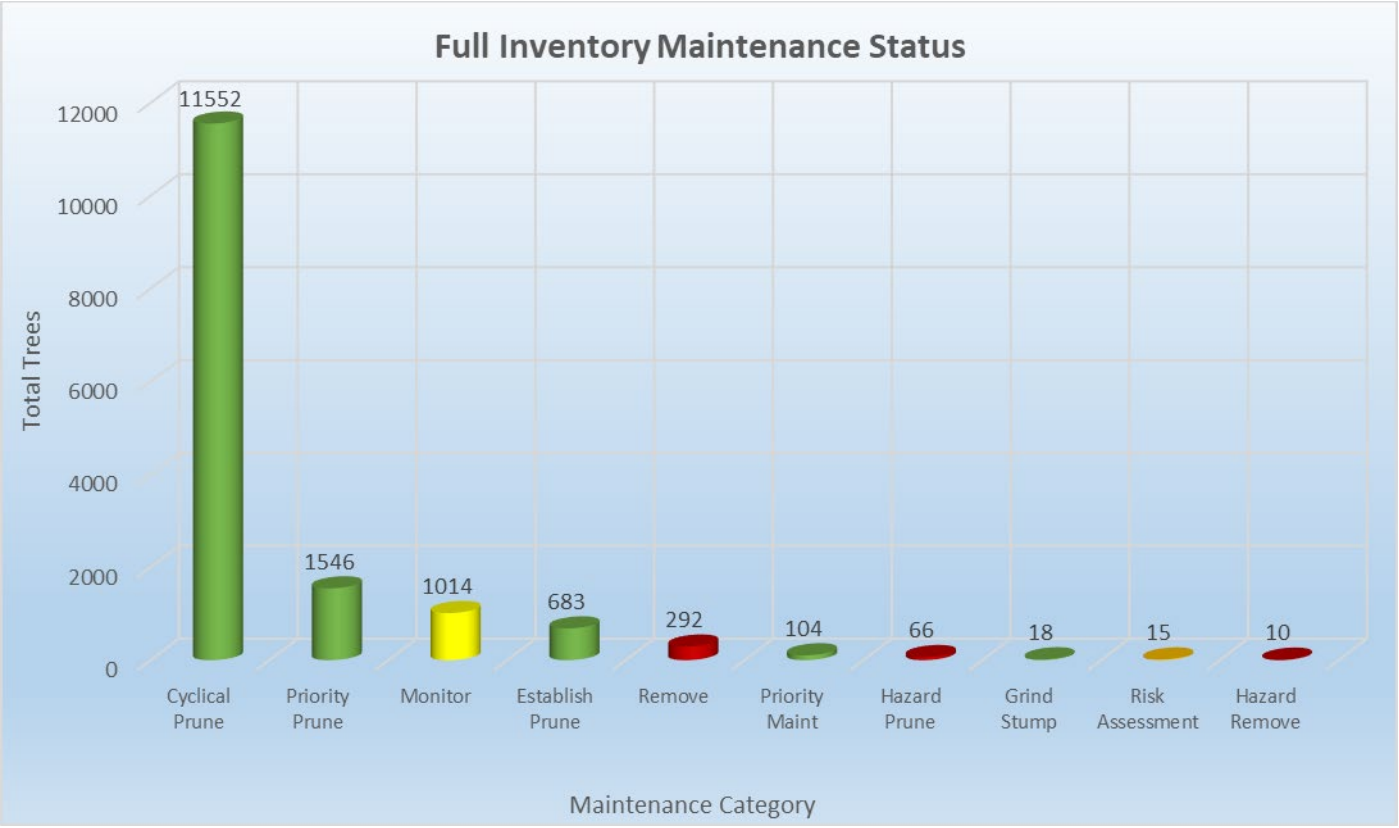
Ideally, tree populations should have an average tree condition somewhere in the 2.5 range, with a sizable population of specimen trees, and a steep drop off in trees after condition 3. The Village can use this tree inventory and the recommendations that accompany it to further improve the overall health of its tree population. With some younger trees which are about to enter a phase where they may become condition 2 trees as opposed to a condition 3, or condition 1 trees as opposed to condition 2, and some mitigating actions to further lower the number of trees in the condition 4 and 5 categories, we anticipate that Bartlett will continue to maintain a vigorous and resilient tree population.



This chart illustrates a somewhat typical trend in the overall age spread of a tree population seen in an urban setting, with many trees being younger and a relatively low number of trees in the older age categories. As shown above, 5,075 of Bartlett's total 15,264 trees (33.2%) have a DBH of 6" or less which we generally consider to be less than about 15 years old. It is broadly estimated that most trees grow on average approximately ½" per year, although that figure varies significantly depending on the species in question. The 7-12" DBH categories make up 33.3% (5,092 of 15,264) of the population and is considered to be about 20-25 years old. The 3,687 trees in the 13-18" DBH categories make up 24.1% of the population and is considered to be about 25-30 years old. There is a steep drop-off moving to the 19-24" DBH category and these 1,105 trees (approximately 7%) in are generally mature trees over 30-40 years old.

The 323 remaining trees in the 25"+ DBH categories are considered to be about 45-50+ years old and some of these may be nearing the end of their natural life. It should be mentioned that the number of trees in the 30"+ categories are often lower due to the natural senescence and ensuing decline of trees on urban parkways. A fairly equal number of trees in each age classification is, within reason, desirable and indicative of a consistent focus on tree planting and tree maintenance in the Village over the years, and shows that the right trees are being planted in the correct locations. As the younger population matures and moves into the next higher category and new trees are planted replacing older, removed trees, the Village has an opportunity, over time, to bring the tree age classes in Bartlett to a more balanced level. The goal of a well-written Urban Forestry Management Plan should be to increase this number and overall long term survivorship.

With 2,993 open planting spaces, primarily due to mass Ash tree loss, and the impending removal of some of the Village's condition 4 & 5 trees as well as some of the poorer condition Ash trees, a Comprehensive Reforestation Plan would be a helpful tool for Bartlett to pursue in the future. Such a plan would not only further improve overall diversity by analyzing the current population and selecting species to plant that are underrepresented, but would also maximize the lifespan of trees on the parkways by carefully matching a tree species requirements and tolerances with each individual planting space. Trees that are well adapted to their growing conditions will establish more quickly, require less maintenance, and be healthier overall and more resistant to disease and insect problems. By matching the right trees with the right planting spaces using a Reforestation Plan, the Village of Bartlett can help protect its investment in each new tree.



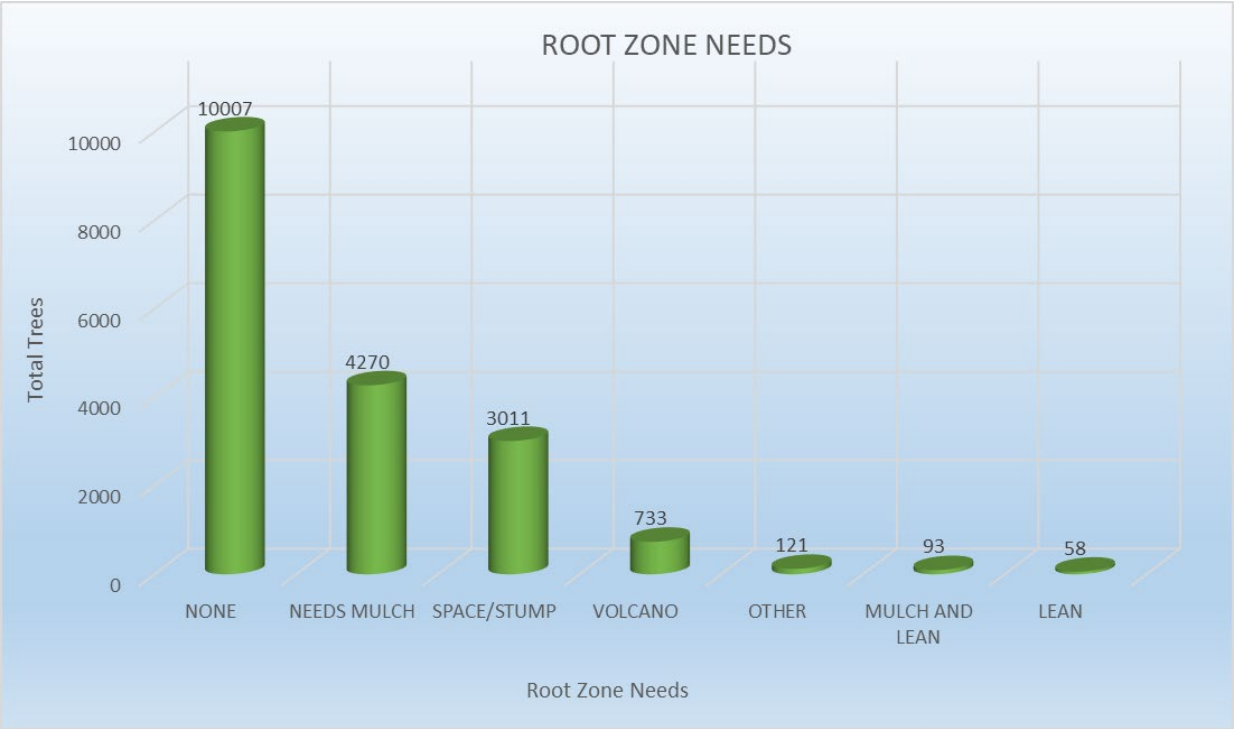
In terms of maintenance status of this inventory of the Bartlett tree population, the statistics displayed above show a positive trend overall. The number of trees in the "cyclical prune" category is quite high which a positive trait in a tree population. This is indicative of a fairly high level of maintenance. It is recommended to develop a 3-7 year pruning cycle, ensuring every tree on the parkways is pruned every 3-7 years, which could raise many trees to the next condition level. 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, and it is also recommended that all new plantings receive an establishment pruning within 5 years of being planted.

The 292 trees in the "Remove" maintenance category should be prioritized and removed in a timely manner. The 1,546 trees in the "priority prune" set 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 years" level of pruning. The "priority maintenance" category is used for trees which were in need of some type of maintenance not related to pruning, such as stake removal, girdling object removal, etc. An explanation of this recommendation will be found in the tree's comments field.

The 1,014 trees in the "monitor" category can be viewed as being in a transitional phase. For the most part, the tree has an indiscernible defect, or shows signs of developing issues or general decline which must be observed. These trees should be reassessed periodically and their maintenance status updated. All remaining Ash trees were assigned the "monitor" category if they were not recommended for pruning or removal, which has inflated this number slightly.

The 66 trees in the "hazard prune" category should be pruned as soon as possible to mitigate a potential hazard risk. We consider these trees as requiring prompt pruning.There were 10 trees in the "hazard remove" category should be removed as soon as possible, as they are posing an elevated level of risk conditions.

The 15 trees which received a "risk assessment" status were in a location where they could pose a hazard to residents or visitors of the Village of Bartlett. These are trees which have developed defects and require a more in-depth inspection and analysis to determine the Village's risk tolerance threshold and the need for mitigation efforts. It is recommended that a Level 2 Basic Risk Assessment or Level 3 Advanced Risk Assessment be performed on these trees (per TRAQ or ANSI A300 Pt 9 Standards), or equivalent (ISA Tree Risk BMP methodology, Matheny and Clark, etc).



As an innovative portion of this inventory program, the Village requested that we pay special attention to the root zone of the trees we inventoried to look for issues associated with mulch and leaning trees. We assessed tree for either the need for mulch, or too much mulch (volcano mulch), the need for correcting a lean, or a combination of the above. What we discovered overall was actually fairly positive compared to other similarly sized communities.

Just over 10,000 trees were listed as “none” which implies that they were properly mulched, or that they were large enough that mulch would not provide any substantial additional benefit to the tree. Above approximately 16”, trees are well established aenough and large enough that damage from weed whips and mowers is no longer a severe concern, and the roots are deep enough that the drought savings associated with mulch become inconsequential.

That said, 4,270 trees in the population required mulch. Of these, over 95% were 12” or less, and 50% were 6” or less. These trees would benefit substantially form the water savings, nutrient from decomposition, and protection from power equipment that mulch provides. Mulch should be spread approximately 3” high at most, andnot piled up against the trunk. And in fact the trees which we have called out for removing could easily be chipped and used as mulch for these 4,270 trees. We would also recommend having a mulch pile where residents can pick up mulch for their own trees, and having a mulch education day each year around Arbor Day so that residents can stay educated about the right and wring ways to mulch trees.

Speaking of which, we did see improper Volcano Mulching evident around 733 trees. Fortunately, armed with the knowledge of where these trees are, a letter may be sent to residents informing them of how to remedy the situation.

Only 58 trees were found to be leaning during the inventory, which is actually a phenomenal figure for a tree population this large An additional 93 were found to be leaning and in need of mulch, for a total of 151 leaning trees. These can be easily remedied, and most were new plantings which are likely still under warranty from the nursery.

3,011 trees fell under the “Space/Stump” category, implying that they were in fact either open planting spaces or stumps, which do not at present require mulch.

Finally, there were 121 trees which fell into the “Other” category, which simply means that they had a variety of other root zone ailments. These will be described in the comments section.

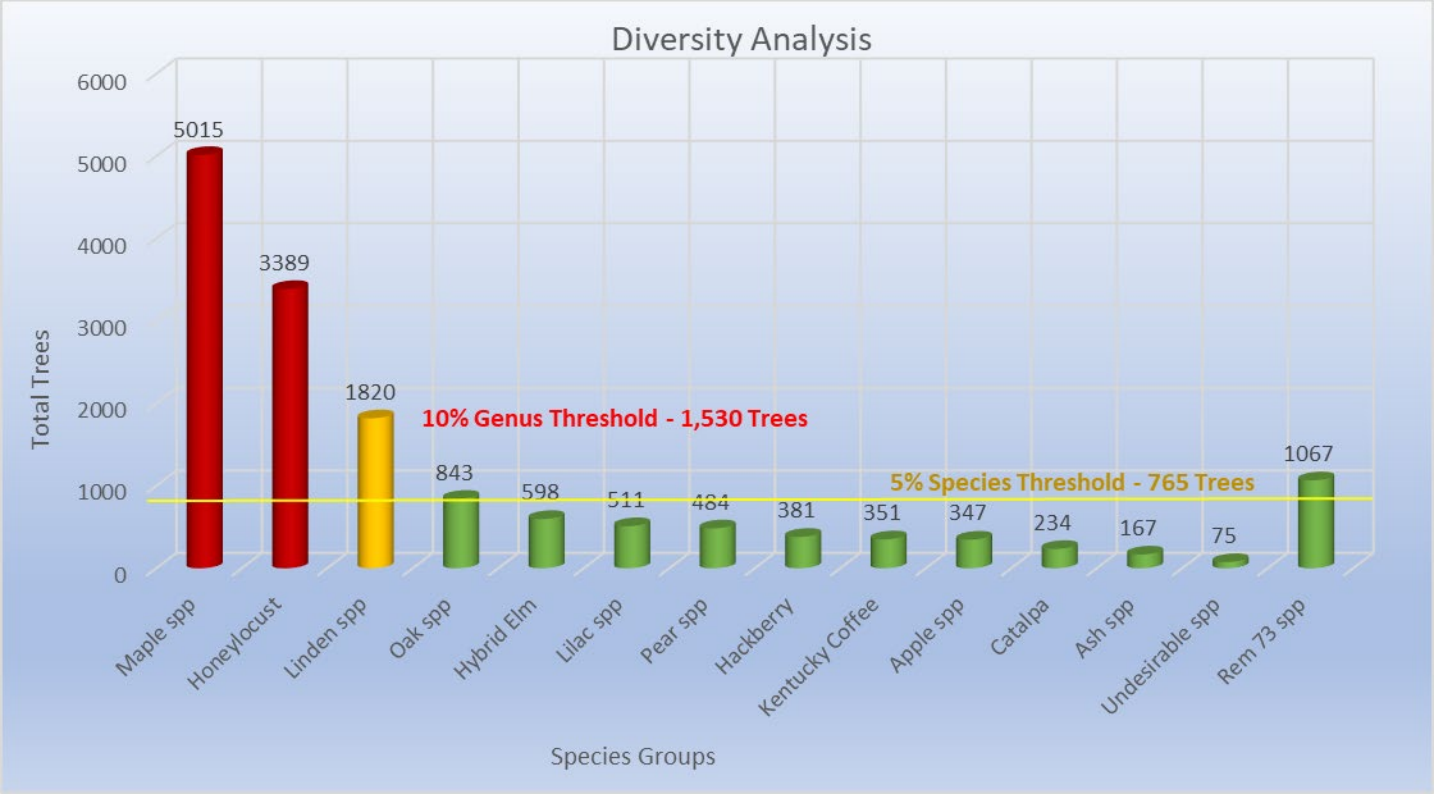
Diversity Analysis

The table below is an itemized list of all tree species present in the Bartlett tree population, along with average DBH, average height & spread, and average condition rating for each species. The average condition ratings can be used as a guide as to what species are growing well on Village parkways.

SPECIES	COUNT	% OF TOTAL	AVG DBH	AVG HEIGHT	AVG SPREAD	AVG COND
HONEYLOCUST	3389	22.18%	14.57	34.30	32.40	2.83
MAPLE-NORWAY	2076	13.58%	11.05	23.61	21.18	3.08
MAPLE-AUTUMN BLAZE	1297	8.49%	6.68	24.39	13.41	2.94
LINDEN-LITTLELEAF	981	6.42%	10.58	27.02	20.04	2.97
MAPLE-RED	817	5.35%	7.30	19.60	16.80	3.06
LINDEN-AMERICAN	751	4.91%	11.87	29.49	19.23	2.83
ELM-HYBRID	598	3.91%	5.62	18.63	11.41	2.96
MAPLE-SILVER	562	3.68%	19.80	43.48	33.32	3.03
LILAC-TREE	508	3.32%	2.94	10.73	5.61	3.04
PEAR-CALLERY	484	3.17%	8.61	22.72	13.97	3.09
HACKBERRY	381	2.49%	6.27	18.11	12.43	2.93
KENTUCKY COFFEETREE	351	2.30%	3.41	13.30	7.56	3.01
APPLE-CRAB SPP	339	2.22%	5.40	11.78	10.40	3.05
OAK-SWAMP WHITE	334	2.19%	4.91	16.84	9.70	2.90
CATALPA	234	1.53%	4.81	14.17	8.48	3.09
MAPLE-SUGAR	176	1.15%	12.35	31.53	23.78	3.11
OAK-BURR	139	0.91%	9.25	25.54	16.22	2.86
OAK-RED	116	0.76%	10.92	27.89	20.91	2.99
GINKGO	113	0.74%	3.42	14.07	7.08	3.05
ASH-GREEN	108	0.71%	19.07	38.61	34.44	2.97
BLACK LOCUST	90	0.59%	3.71	16.56	9.00	3.06
OAK-ENGLISH	89	0.58%	2.56	12.81	5.17	3.06
LONDON PLANETREE	88	0.58%	3.36	16.59	7.73	3.05
AMERICAN REDBUD	87	0.57%	2.78	9.37	5.98	3.08
OAK-PIN	85	0.56%	17.98	51.53	30.06	2.99
BLACKGUM	79	0.52%	2.03	10.00	5.19	3.44
LINDEN-SPP	79	0.52%	12.01	32.66	19.05	3.04
ASH-WHITE	59	0.39%	12.98	29.07	24.92	2.95
YELLOWWOOD	57	0.37%	2.09	9.91	5.79	3.09
HAWTHORN-SPP	56	0.37%	5.07	10.80	8.75	3.16
MAPLE-HEDGE	40	0.26%	8.70	23.13	16.00	2.58
HORNBEAM-EUROPEAN	38	0.25%	2.74	12.50	5.00	3.08
WALNUT-BLACK	34	0.22%	14.24	42.35	24.56	3.24
COTTONWOOD	31	0.20%	9.42	31.29	15.81	3.13
SPRUCE-BLUE	30	0.20%	12.77	33.67	14.67	2.97
OAK-SHINGLE	28	0.18%	4.96	19.46	11.79	2.93
MAPLE-MIYABEI	27	0.18%	4.52	13.70	7.59	3.15
TULIPTREE	26	0.17%	5.00	18.27	9.23	3.15

SPECIES	COUNT	% OF TOTAL	AVG DBH	AVG HEIGHT	AVG SPREAD	AVG COND
CHERRY-SPP	25	0.16%	5.08	12.00	9.60	3.16
OAK-CHINKQUAPIN	25	0.16%	3.12	15.00	7.20	3.88
DOGWOOD-SPP	24	0.16%	1.54	6.04	5.21	3.25
HORSECHESTNUT	24	0.16%	1.92	6.88	5.63	3.25
OAK-WHITE	18	0.12%	17.67	43.61	27.78	2.72
AMERICAN HORNBEAM	17	0.11%	3.18	12.06	5.59	3.12
HICKORY-SHAGBARK	16	0.10%	10.06	43.75	19.06	2.88
ELM-CHINESE	15	0.10%	8.73	21.33	15.67	3.00
BUCKEYE-OHIO	14	0.09%	4.64	13.57	7.50	3.14
SYCAMORE	13	0.09%	14.38	40.77	28.08	2.54
BALDCYPRESS	12	0.08%	2.33	10.00	5.42	3.17
BIRCH-RIVER	12	0.08%	9.33	22.08	17.50	2.67
DAWN REDWOOD	12	0.08%	2.50	9.58	5.42	3.00
BUCKTHORN	10	0.07%	7.50	11.50	10.00	3.40
ELM-SIBERIAN	10	0.07%	15.70	38.50	26.50	3.20
PINE-AUSTRIAN	10	0.07%	9.60	21.50	12.00	3.50
SPRUCE-NORWAY	10	0.07%	11.00	39.50	21.00	2.90
SPRUCE-SPP	10	0.07%	11.10	36.00	14.50	3.00
BOXELDER	9	0.06%	17.56	31.11	30.00	3.44
CHERRY-PURPLE LEAF	9	0.06%	2.11	8.33	5.00	3.22
ELM-AMERICAN	9	0.06%	17.11	35.56	31.11	2.67
LINDEN-SILVER	9	0.06%	13.33	38.89	24.44	3.11
MAGNOLIA-CUCUMBER	9	0.06%	2.44	10.56	5.56	3.00
APPLE-EDIBLE	8	0.05%	5.50	13.75	13.13	3.25
ARBOR VITAE	8	0.05%	5.50	9.38	8.13	2.88
IRONWOOD	8	0.05%	3.00	14.38	5.00	3.00
ZELKOVA	8	0.05%	2.63	10.63	5.63	3.00
BEECH-SPP	7	0.05%	1.43	7.86	5.00	3.00
MAPLE-SPP	7	0.05%	3.71	11.43	7.86	3.29
OAK-SPP	7	0.05%	1.57	7.14	6.43	3.86
PINE-WHITE	7	0.05%	14.86	37.14	20.71	2.43
SERVICEBERRY-SPP	7	0.05%	3.14	10.71	6.43	3.29
JUNIPER-COMMON	6	0.04%	8.33	7.50	8.33	2.83
MULBERRY-SPP	6	0.04%	7.33	13.33	10.83	3.33
PLUM-SPP	6	0.04%	5.83	10.83	8.33	3.67
BIRCH-WHITE	5	0.03%	8.40	26.00	14.00	3.40
ELM-SPP	5	0.03%	9.20	30.00	17.00	3.00
MAPLE-AMUR	5	0.03%	7.20	16.00	15.00	3.00
PINE-RED	5	0.03%	13.00	34.00	18.00	3.60
SWEETGUM	5	0.03%	9.20	26.00	15.00	2.80
WILLOW-SPP	5	0.03%	18.20	20.00	22.00	3.40
CHERRY-BLACK	4	0.03%	17.00	33.75	20.00	3.75
MAPLE-JAPANESE	4	0.03%	1.25	5.00	5.00	3.00
PINE-SCOTCH	4	0.03%	11.50	28.75	20.00	3.50
EASTERN REDCEDAR	3	0.02%	3.67	8.33	6.67	3.00

SPECIES	COUNT	% OF TOTAL	AVG DBH	AVG HEIGHT	AVG SPREAD	AVG COND
ELM-ENGLISH	3	0.02%	2.67	11.67	5.00	3.00
LILAC-SHRUB	3	0.02%	7.33	5.00	6.67	3.00
MAPLE-BLACK	3	0.02%	2.00	10.00	5.00	3.00
OTHER	3	0.02%	4.33	5.00	5.00	3.67
POPLAR-SPP	3	0.02%	7.33	36.67	10.00	3.67
AMUR CORKTREE	2	0.01%	10.00	22.50	17.50	3.50
APRICOT	2	0.01%	1.00	10.00	5.00	3.00
ASH-EUROPEAN	2	0.01%	22.00	30.00	30.00	3.00
BEECH-AMERICAN	2	0.01%	1.00	7.50	5.00	3.00
EUONYMUS	2	0.01%	2.50	7.50	7.50	3.00
HAWTHORN-COCKSPUR	2	0.01%	1.00	5.00	5.00	3.00
MAGNOLIA-TREE	2	0.01%	6.50	12.50	10.00	2.50
OAK-BEBB	2	0.01%	1.50	7.50	5.00	3.00
UNKNOWN	2	0.01%	1.50	7.50	5.00	4.00
ASPEN	1	0.01%	6.00	15.00	5.00	3.00
BARBERRY SPP	1	0.01%	8.00	5.00	5.00	3.00
BIRCH-SPP	1	0.01%	2.00	10.00	15.00	3.00
DOUGLAS FIR	1	0.01%	8.00	30.00	10.00	3.00
ELM-RED	1	0.01%	30.00	70.00	60.00	1.00
FIR-SPP	1	0.01%	1.00	5.00	5.00	3.00
GOLDEN RAINTREE	1	0.01%	3.00	10.00	5.00	3.00
HARDY RUBBERTREE	1	0.01%	2.00	10.00	5.00	3.00
HAZELNUT-TREE	1	0.01%	4.00	10.00	5.00	3.00
MAGNOLIA-SHRUB	1	0.01%	8.00	10.00	10.00	3.00
MAGNOLIA-SPP	1	0.01%	4.00	10.00	15.00	3.00
MAPLE-PAPERBARK	1	0.01%	8.00	15.00	10.00	3.00
PAW PAW	1	0.01%	10.00	20.00	15.00	4.00
PINE-MUGO	1	0.01%	5.00	5.00	15.00	3.00
POPLAR-WHITE	1	0.01%	40.00	50.00	70.00	3.00
SMOKETREE	1	0.01%	1.00	5.00	5.00	3.00
SUGARBERRY	1	0.01%	4.00	15.00	10.00	3.00
WALNUT-WHITE	1	0.01%	1.00	20.00	20.00	3.00
WISTERIA	1	0.01%	2.00	10.00	5.00	3.00
YEW	1	0.01%	2.00	5.00	5.00	3.00



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% or 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. When American Elm trees were dying in large numbers during the 1970s due to Dutch Elm Disease, they were all too often replaced with Ash trees, because Ash were readily available, inexpensive, and are a hardy urban tree. We are now realizing that the lack of foresight in the decision to not give tree populations adequate species diversification has been what led to the EAB being as disastrous as it was. That being said, we will now discuss the details of diversity in Bartlett's tree population.

The graphs and charts above illustrate that Maple species make up 32.8% of Bartlett's tree population. It is quite common for species of Maples to be over planted on parkways and in other urban settings because they are an adaptable and hardy shade tree. However, if a pest or pathogen that attacks only the Maple genus were introduced into our region, Bartlett could potentially lose almost 1/3 of its tree population. The same is true for Honeylocust and Linden trees which make up 22.2% and 11.9%, respectively, of the Bartlett population. We highly recommend that, going forward, the Village moderate new plantings of Honeylocust, Linden, and Maple species and focus on further improving the diversity of its tree population by exploring the use of species that are less numerous in the current population. Using the tables included in this report, the Village should choose to plant underrepresented species particularly those that make up less than 1% of the total population. It is important to reiterate that some species have environmental tolerances and requirements that should be considered when matching them with an open planting space.

The 76 trees in the "undesirables" category are primarily Cottonwood, Willow, Mulberry, Boxelder, Siberian Elm, Buckthorn, Poplar, and Black Cherry trees. These trees are notorious for being fast growing, but weak-wooded or invasive trees that often develop a variety of structural defects as they mature. For safety, aesthetic, and ecological reasons, it is recommended that Bartlett set a goal of gradually reducing the number of undesirable trees in the Village, and replanting them with a diverse set of tree species, to increase overall diversity and tree population stability.

It is apparent that Bartlett has been committed to improving species diversity as evidenced by the variety of species that have been more recently planted. Some examples include Blackgum, Tuliptree, Yellowwood, Gingko, Baldcypress, Dawn Redwood, Cucumber Magnolia, Hazelnut, Beech spp, Ironwood, Zelkova, Chinquapin Oak, Shingle Oak, American Hornbeam, European Hornbeam, Horsechestnut, Ohio Buckeye, Golden Raintree, and Hardy Rubbertree, With some careful planning, the Village of Bartlett has an opportunity to further improve its diversity as it chooses species to plant in the future. As was touched upon earlier in the report, a Comprehensive Reforestation Plan would offer Bartlett a solid framework for planning its future tree population. A Reforestation Plan would provide a comprehensive analysis of the current population, a thorough review of all available planting spaces, and a detailed plan for which tree species may be planted in specific locations. Proper planning will help Bartlett protect the investment in each new tree and to create a future tree population that is more resilient and diverse than the current one. The tables below can be used as a guide when choosing future species to plant.

Under-Represented Species in the Bartlett Population:

SPECIES	COUNT	SPECIES	COUNT	SPECIES	COUNT	SPECIES	COUNT
BLACK LOCUST	90	TULIPTREE	26	BIRCH-RIVER	12	BIRCH-WHITE	5
AMERICAN REDBUD	85	DOGWOOD-SPP	24	DAWN REDWOOD	12	SWEETGUM	5
BLACKGUM	79	HORSECHESTNUT	24	CHERRY-PURPLE LEAF	9	AMUR CORKTREE	2
YELLOWWOOD	57	AMERICAN HORNBEAM	17	MAGNOLIA-CUCUMBER	9	MAGNOLIA-TREE	2
HAWTHORN-SPP	56	HICKORY-SHAGBARK	16	IRONWOOD	8	GOLDEN RAINTREE	1
HORNBEAM-EUROPEAN	38	BUCKEYE-OHIO	14	ZELKOVA	8	HARDY RUBBERTREE	1
WALNUT-BLACK	34	BALDCYPRESS	12	BEECH-SPP	7	HAZELNUT-TREE	1

Other Non-Represented Species to Consider:

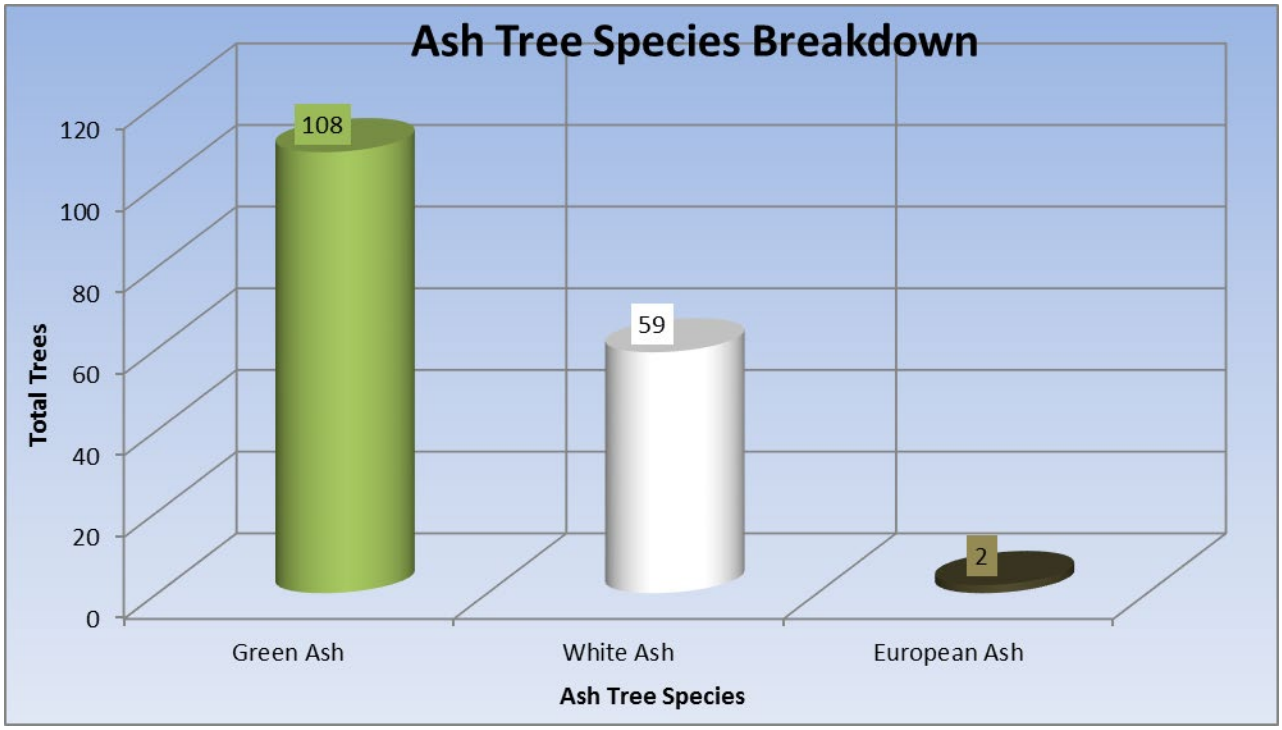
Katsuratree	Larch	Persimmon
Persian Ironwood	Amur Maackia	Witch Hazel
Red/Yellow Buckeye	Pagodatree	Siberian Peashrub
Alder spp	Osage Orange	Seventh Son Flower

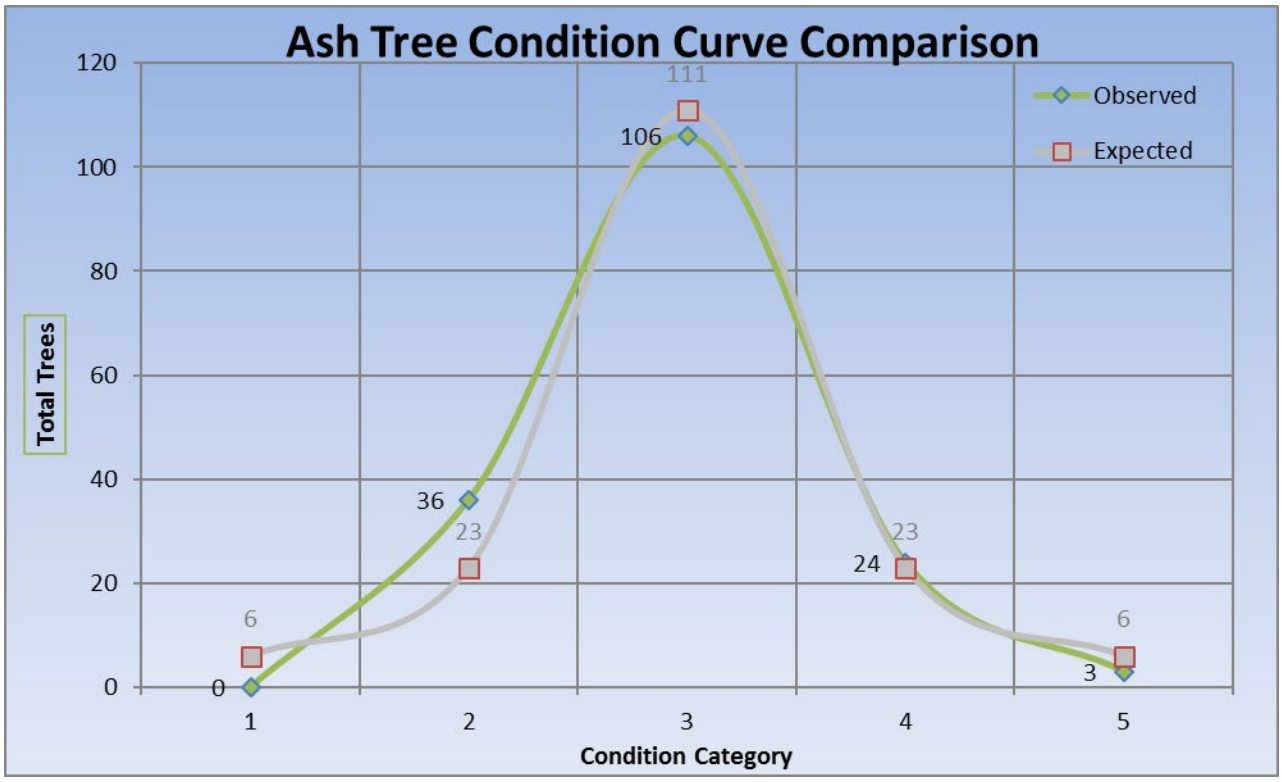
Ash Tree Overview

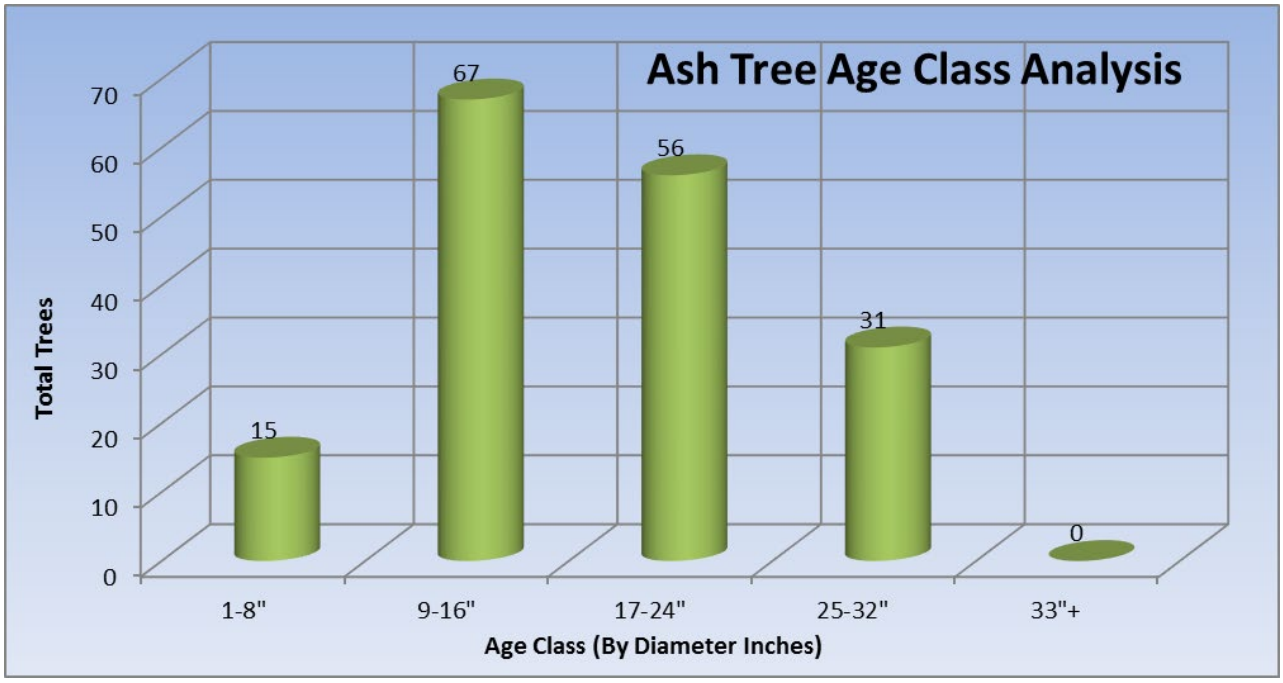
Since a significant number of Ash trees remain in Bartlett, we have included a brief statistical Ash tree overview. Bartlett's remaining Ash trees are in overall above average condition and many were observed to have been treated to control Emerald Ash Borer infestation. There are a fair number of Ash trees which have been treated by residents in the Village of Bartlett, and so far these treatments arrear ti have been successful. Treatment has been done via a variety of methods, including imidicloprid, ememmectin benzoate, and a variety of soil drenches.

With the Emerald Ash Borer largely in the past in northeast Illinois, we would recommend that the Village reach out to the residents who have been proactive in treating their trees, and ensure that these trees are cared after in a manner that help them remain on village parkways as a testament to the resilience of Bartlett in the face of natural diaster such as EAB.

Total Number of Ash Trees	169
Total Number of Ash Species	3
Average Ash Diameter (in)	16.98"
Total Ash Diameter Inches	2,870"
Average Ash Height (ft)	35.18'
Average Ash Canopy Spread (ft)	31.07'
Total Ash Canopy Volume (cuft)	3,923,894
Average Ash Canopy Volume (cuft)	23,218
Average Condition Rating	2.96 (Above Average)


Ash Tree Species Breakdown
120
100
80
60
40
20
0
Total Trees
108
59
2
Green Ash
White Ash
European Ash
Ash Tree Species


Ash Tree Condition Curve Comparison
120
100
80
60
40
20
0
Total Trees
Observed
Expected
111
106
36
23
24
23
6
6
0
3
1
2
3
4
5
Condition Category



TRAQ Fields and Tree Risk Assessment

Since determining response and mitigation measures ultimately relies on a combination of determining acceptable risk and available budgets, we believe that formally documenting the risk any trees pose and, in turn, using this information to compare with available budgets as being a proactive and responsible activity. In arboricultural circles, tree risk is typically assessed on a 1-year cycle (this can be varied), so that a tree is calculated to have certain a risk of failure within 1 year. This has several advantages if used in conjunction with budget considerations, since trees which are found to pose a more immediate risk can be budgeted for and removed this year, but the remaining trees can be categorized and budgeted for in years to come based on the Risk Assessments. Bear in mind that if a tree posed an immediate hazard in the field, we would schedule it for a Hazard Removal.

Below are both the ISA BMP – Likelihood Matrix and Risk Matrix. The TRAQ data collected in the field is used along with these matrices to calculate risk likelihood and consequences. TRAQ is a relatively newer qualitative, and not quantitative, view of Risk, and one limitation is that it is quite rare and difficult to label a tree as being in the “High” or “Extreme” risk categories. In general, anything above "Low" should be considered for a Level 2 Risk Assessment or mitigating action.

We cannot stress enough that these were Rapid Assessments, and not full TRAQ 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.

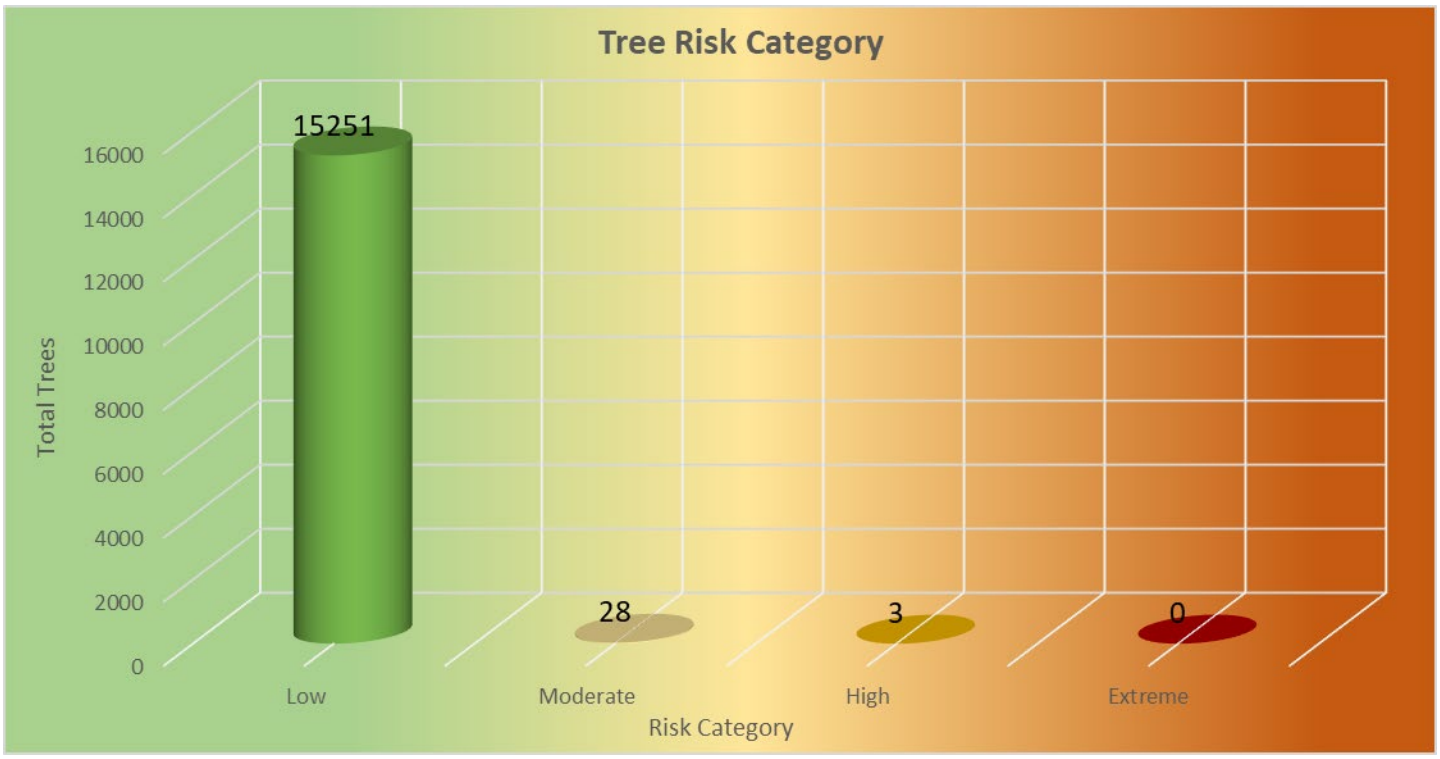
Since the TRAQ fields have been included in the collection parameters for the Bartlett inventory it is recommended that the Village develop and implement a Tree Risk Assessment Policy so that consistency and accountability is successfully achieved.

ISA BMP – Likelihood Matrix

Likelihood of Failure	Likelihood of Impacting the Target			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

ISA BMP – Risk Matrix

Likelihood of Failure & Impact	Consequences			
	Negligible	Minor	Significant	Severe
Very Likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat Likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

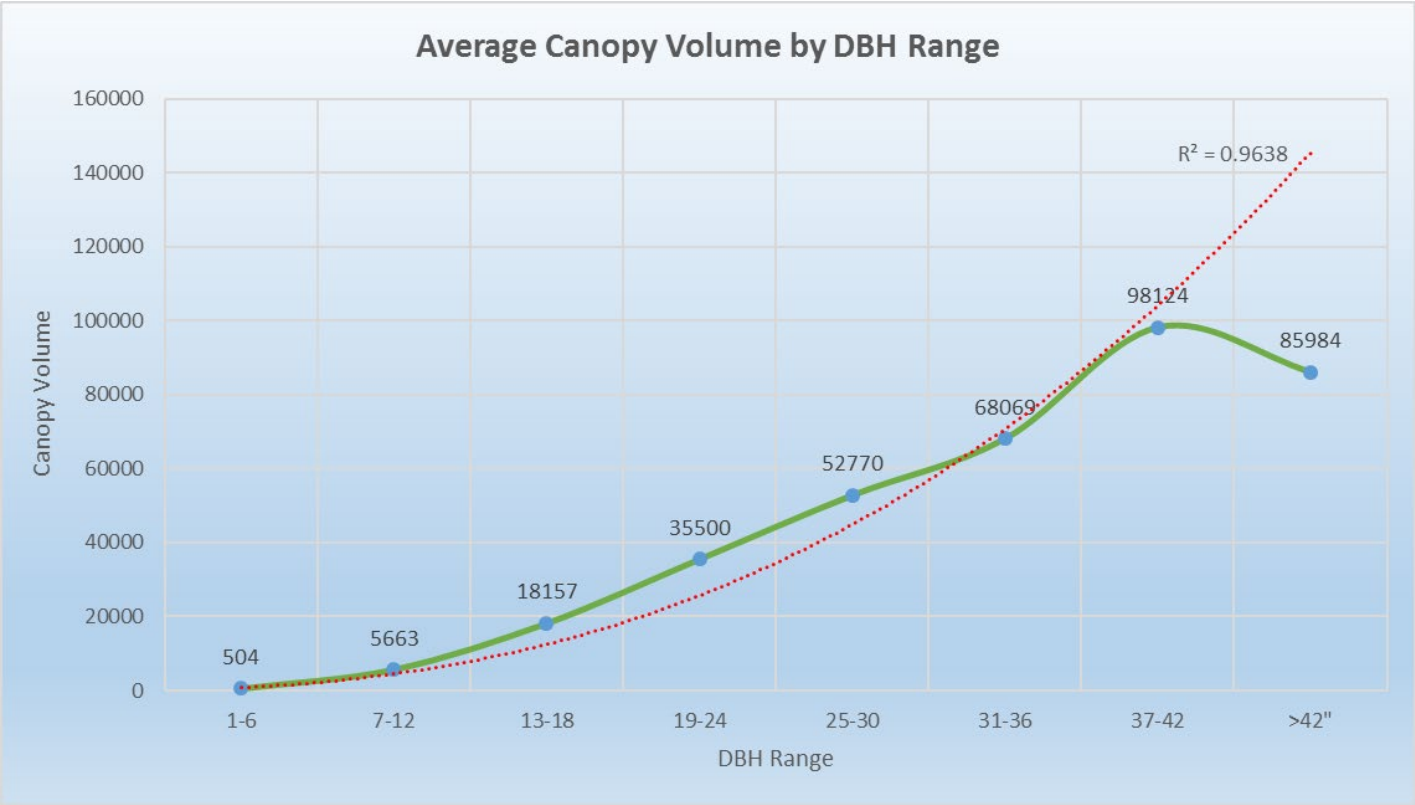


As illustrated in the graph above, the vast majority of trees in Bartlett were found to be low risk based on the data collected and the TRAQ matrices above. The 3 trees that fell in the high risk category should receive a minimum Level 2 Risk Assessment or mitigating action. It is recommended that the 28 trees found to pose a moderate risk be monitored and/or inspected by the Village and a threshold of risk tolerance be established. Some of these trees may also be considered for a Level 2 Risk Assessment or mitigating action. Graf Natural Resource Management & GIS would be pleased to assist the Village 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.

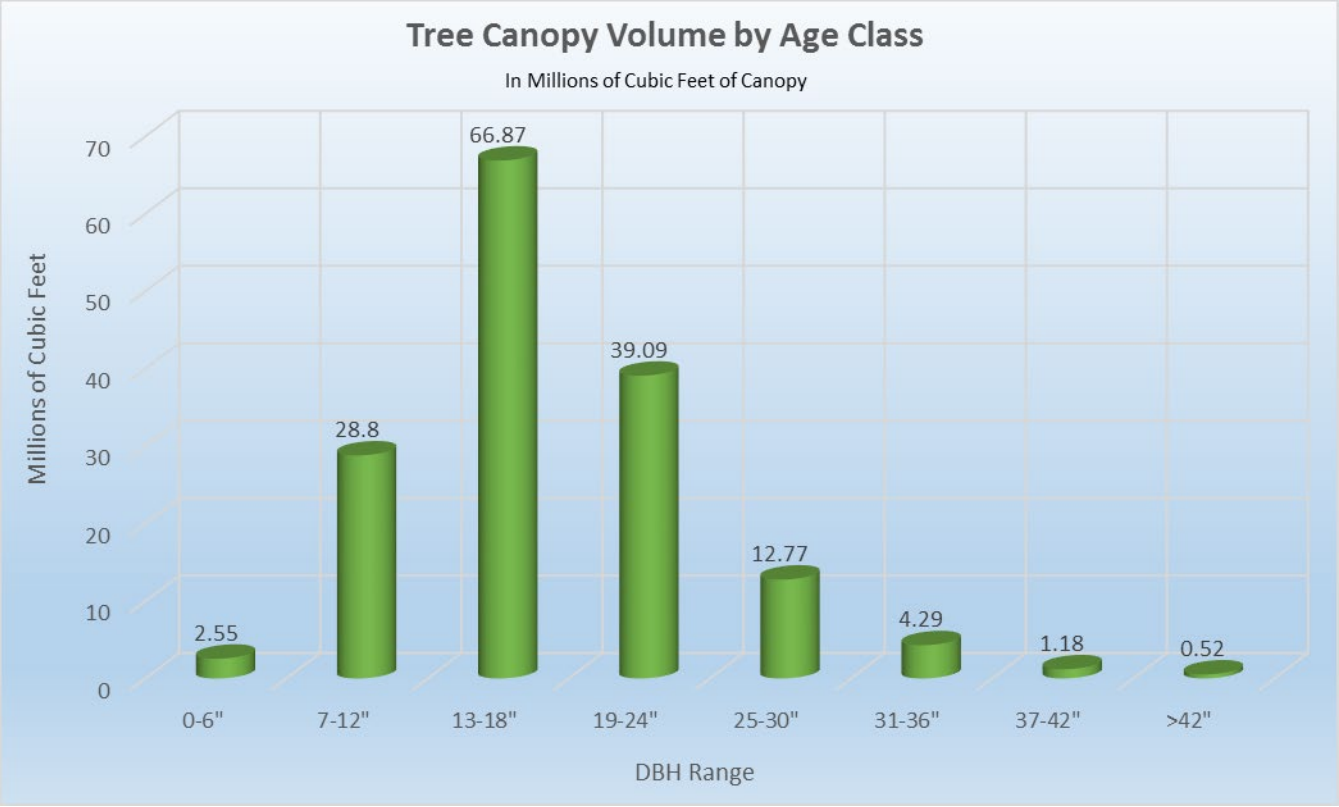
Canopy Volume Analysis

Many times, canopy area (2 dimensions) is assessed during street tree inventories to determine the amount of tree coverage in a geographic area. However, when it comes to stormwater interception, Leaf Area Index (LAI), and other such metrics, we believe that canopy volume (3 dimensions) is a far better tool for determining tree benefits. It also reveals some fascinating things about tree longevity on the parkways. Since we collected data on tree height, crown spread, and calculated live crown ratio we have included this analysis as well.

In order to calculate canopy volume, we utilized the tree height, crown spread, and LCR measurements which we colected in the field to calcalate a live crown ratio estimate for each tree. By using this analysis, we can approximate what the total volume of the tree canopy is in Bartlett. Though the calculations involved with quantifying stormwater benefits and other ecological services are beyond the scope of this report, it can generally be said that increased canopy volume certainly provides more shade, carbon uptake and energy savings, and water storage in the crown, leading to reduced runoff during storm events.

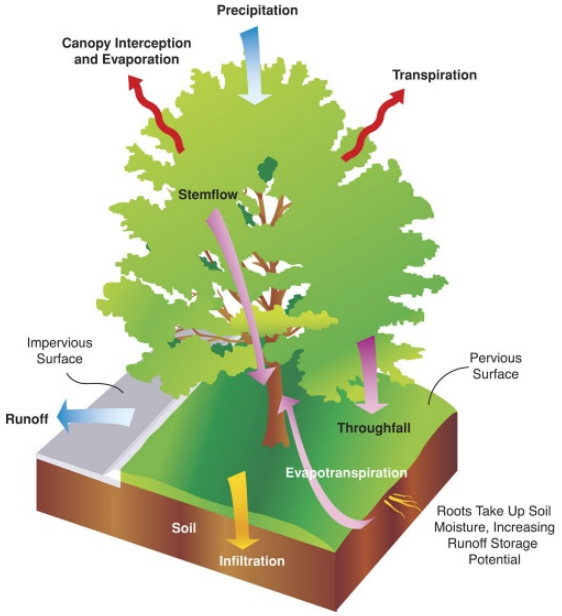


A tree's above ground growth can be used as an overall indicator of it's health and vigor. As can be seen from the above chart, there are several very interesting trends when it comes to tree size (age) and canopy volume. First, we see slow increases in canopy at the smaller diameter range, from 1-12" DBH. This makes sense, as the tree is still developing its root system during these formative years which will eventually lead to increased canopy growth. From the 12" to approximately low-30" size range, we see rapid increases in canopy volume as the tree puts on above ground growth, which is a direct result of it's increased photosynthetic capability. Greater leaf area produces more energy, and the tree is able to grow much more rapidly. Eventually, at approximately the 32" mark, average canopy volume begins to fall below the expected rate. This again makes sense as the urban environment, with its pollutants, concrete, and generally poor soils, prohibit continued vigor, but it is also important to note that Bartlett's tree population has a significantly lower number of trees in these age classes which also accounts for the drop.



Where the line graph of canopy volume shows the average canopy volume at each DBH range, this graph of gross canopy volume at each DBH range tell an even more compelling story. The line graph shows us that canopy volume generally increases with tree age and size, a fact which is easy to understand, but even more tangible when quanitifed. As canopy volume increases, CO2 uptake increases, more stormwater is intercepted or evapotranspirated away, more shade or windblocking is provided, increasing energy savings, and more pollutants are intercepted by leaf area. These benefits save the Village a significant dollar amount annually.

Where the above bar graph becomes important is in the number of trees in each category. Even though canopy volume increases on a per tree basis as DBH increases, we can see a reduction in overall canopy volume between the 13-18" age class and the 19-24" age class and a more significant drop in the 25-30" age class. If one were to reexamine the total number of trees at each of the age classes, it would be seen that the overall number of trees fluxuates in the same manner as canopy volume as illustrated in the bar graph above. The important fact here is that if Bartlett could get even 50% more trees to survive into the 19-24" age class, and then 50% more of those trees to survive into the 25-30" age class, and so on, overall crown volume could increase by a significant amount. This would result in substantial and quantifiable savings for the Village.



A first step to encouraging this to occur is to ensure that a high level of maintenance and a robust cyclical pruning program is a priority for Village trees. More importantly, the ability to move more trees into these larger DBH and volume ranges begins with planting the right tree in the right site. No additional maintenance beyond what the Village already performs is necessary. Targeted reforestation and ongoing planning for new tree plantings is the crucial element in the equation. For areas with small parkways, trees which are tolerant of lower soil volume should be planted. For areas with high exposure to salts and other pollutant, trees which are tolerant of these conditions should be planted. Areas with with predominantly wet or dry soils should have trees planted which are tolerant of these conditions.

As discussed above, planting the right tree in the right site is of paramount importance in allowing trees to live more productive lives in urban situations. Performing planting site analysis to determine available growing space, light levels, salt and nutrient loading, and basic soil characteristics before selecting trees will allow these trees to live longer and more vigorous lives in urban situations. We have calculated the cost of such efforts to be approximately the same as purchasing a watering bag for a newly planted tree, or approximately $30 per tree. This simple activity could add thousands of dollars more in total tree benefits for the Village every year.

Conclusion

Bartlett is now equipped to use this comprehensive tree inventory to develop a formal Urban Forestry Management Plan, which will create long-term strategies and budgets for tree planting and management in the Village. Removed trees should be replaced with diverse tree species that are underrepresented or not present in Bartlett's tree population and continual assessment of the tree diversity at both genus and species level should be taken into account when selecting new trees. Tree species tolerances and requirements should also be carefully matched with the planting site conditions. A Comprehensive Reforestation Plan which would be an extremely valuable resource to further improve the species diversity and to maximize successful establishment of newly planted trees.

By using the information found in this tree inventory report, the Village of Bartlett has an excellent opportunity to create an even more diverse, vigorous, and robust tree population for the enjoyment of generations to come. It has been a pleasure for Graf Natural Resources Management & GIS to provide this tree inventory, data analysis, and GIS mapping services for Bartlett. We look forward to the opportunity to continue to partner with the Village in the future to assist in other urban forestry or natural resource related initiatives.