TREE INVENTORY ANALYSIS & MAINTENANCE STRATEGY PREPARED FOR

The Town of Weaverville

Weaverville Management Plan & Five-Year Budget

December 2025

Prepared By:

Riley Eddins
Project Manager
Davey Resource Group, Inc.
3101 Poplarwood Ct, Suite 120
Raleigh, NC 27604
Cell: 864.384.8006
E-mail: riley.eddins@davey.com

DAVEY Resource Group

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Acknowledgements

This project supports Weaverville's vision to promote and enhance community well-being through public tree conservation and improved forestry management practices. This Tree Inventory Analysis & Maintenance Strategy offers expert recommendations for preserving and expanding urban canopy so the environmental, economic, and social benefits it provides are maximized today and for future generations.

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.

Executive Summary

The Town of Weaverville Tree Inventory Analysis & Maintenance Strategy, prepared by Davey Resource Group, Inc. (DRG), focuses on analyzing inventory data, quantifying the benefits provided by the community's inventoried trees and identifying their maintenance needs.

DRG completed a tree inventory for the Town of Weaverville in October of 2025 and analyzed the inventory data to understand the structure of the City's inventoried tree resource and provide recommendations on priority and routine maintenance programs for future tree care. The data was also analyzed using i-Tree Eco to calculate the economic value of the community's inventoried public trees and their environmental benefits (i.e., stormwater, carbon, and air pollution).

The Weaverville inventoried trees have an estimated replacement value of over $1.7 million and provide $8,455 annually in stormwater, air quality, and carbon benefits each year.

Calculating Tree Benefits

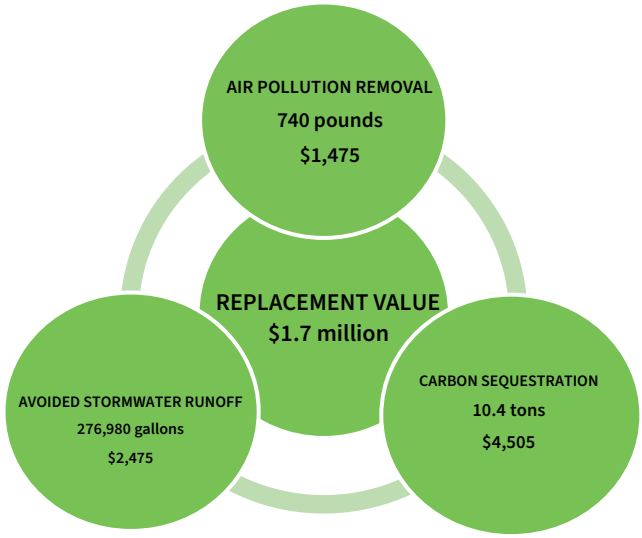
The benefits of Weaverville's inventoried trees presented in this Plan are calculated using i-Tree Eco.

i-Tree is the industry recognized suite of tools used to measure and quantify the ecosystem benefits that trees provide.

i-Tree is a partnership between the USDA Forest Service, The Davey Tree Expert Company, the Arbor Day Foundation, the International Society of Arboriculture, Society of Municipal Arborists, Casey Trees, and SUNY College of Environmental Science and Forestry. It was released in 2006, and its models are updated regularly based on the latest science and research.

Supporting and funding proactive maintenance of Weaverville's public trees is a sound long-term investment that will maximize tree benefits, reduce tree care costs over time, and increase the value of the urban forest. While other municipal infrastructure loses value over time (depreciates), the value of public trees increases (appreciates).

High priority tree removal and pruning, while initially requiring a significant portion of the Year 1 budget in the five-year schedule as depicted in Table 5, bring valuable benefits. As this essential work is accomplished, budgets are anticipated to decrease and become more stable. This shift marks the progression of tree management that focuses on a proactive maintenance strategy. Notably, this proactive approach plays a crucial role in increasing tree benefits and diminishing the emergence of new elevated risk trees over time by preventing minor tree defects from deterioration.



Inventory Analysis Summary

Inventoried Sites

Trees = 960

Planting Sites = 209

Stumps = n/a

Total Sites= 1,169

Stocking Level

"Stocking level" refers to the ratio of planting sites in the street right-of-way (ROW) occupied by trees to the total street ROW sites suitable for trees. Weaverville's current stocking level is 82%.

Annual Benefits

Avoided Stormwater Runoff = $2,475

Air Pollution Removal = $1,475

Carbon Sequestration = $4,505

Top 5 Inventoried Species

SPECIES	% OF INVENTORIED POPULATION
Black walnut	13%*
Tulip tree	12%*
Southern red oak	8%
Eastern white pine	6%
Black cherry	5%

*Exceeds industry guidelines of no more than 10% of one species in tree population

Top 5 Inventoried Genera

GENUS	% OF INVENTORIED POPULATION
Pinus	16%
Quercus	15%
Juglans	13%
Liriodendron	12%
Acer	10%

*Exceeds industry guidelines of no more than 20% of one genus in tree population

Relative Age Distribution

The approximate age of a tree can be identified by the tree's diameter size. Of the inventoried trees:

- 28% were young (0-8"), compared to the 40% industry guidelines
- 47% were established (9-17"), compared to the 30% industry guidelines
- 17% were maturing (18-24"), compared to the 20% industry guidelines
- 8% were mature (>24"), compared to the 10% industry guidelines

Infrastructure Conflicts

Of the inventoried trees:

- 3% were situated beneath overhead utilities
- 1.5% were currently conflicting with overhead utilities

Condition

Of the 960 inventoried trees, there were:

- 50% in Good condition
- 4% in Poor condition
- 45% in Fair condition
- 1% Dead

Pest Susceptibility

91% of inventoried trees are susceptible to one or more pests common in Weaverville, including:

- Shothole Borer
- Spotted Lantern Fly
- Winter Moth

Recommended Maintenance

Tree Removal

Trees designated for removal have defects that cannot be cost-effectively or practically corrected. Many of the trees in this category have a large percentage of dead crown.

Total = 32 trees
Extreme Risk = 0 trees
High Risk = 1 tree
Moderate Risk = 13 trees
Low Risk = 18 trees
Stumps = n/a

Priority Pruning

Priority pruning removes defects such as dead and dying parts or broken and/or hanging branches. Pruning the defective part(s) can lower risk associated with the tree while promoting healthy growth.

Total = 10 trees
Extreme Risk = 0 trees
High Risk = 0 trees
Moderate Risk = 10 trees

Routine Pruning Cycle

Over time, routine pruning of Low Risk trees can minimize reactive maintenance, limit instances of elevated risk, and provide the basis for a robust risk management program.

Total = 672 trees
Number of trees in cycle each year = approximately 134

New Tree Planting

Planting new trees in areas that have poor canopy continuity or sparse canopy is important to ensure that tree benefits are distributed evenly across the city.

Planting goal: 2:1 replacement to removal ratio

Young Tree Training Cycle

Younger trees may have branch structure that can lead to potential problems as the tree ages, requiring training to ensure healthy growth. Training is generally completed from the ground with a pole pruner or pruning shear.

Total = 34 trees
Number of trees in cycle each year = approximately 7

Routine Inspection & Inventory Updates

Routine inspections and inventory updates are essential to uncovering potential problems with trees and should be performed by a qualified arborist who is trained in the art and science of planting, caring for, and maintaining individual trees.

Total = 928 trees not recommended for removal
Number of trees in cycle each year = approximately 185

Introduction

The Town of Weaverville is home to over 4,500 residents benefiting from public trees in their community. The Town of Weaverville & Public Works manages all trees, stumps, and planting sites along the street right-of-way (ROW) and throughout Lake Lousie Park & Nature Park.

In October 2025, Weaverville worked with DRG to inventory its public trees and develop this Tree Inventory Analysis & Maintenance Strategy. Consisting of three sections, this plan considers the diversity, distribution, and condition of the inventoried tree population and provides a prioritized system for managing Weaverville's public trees.

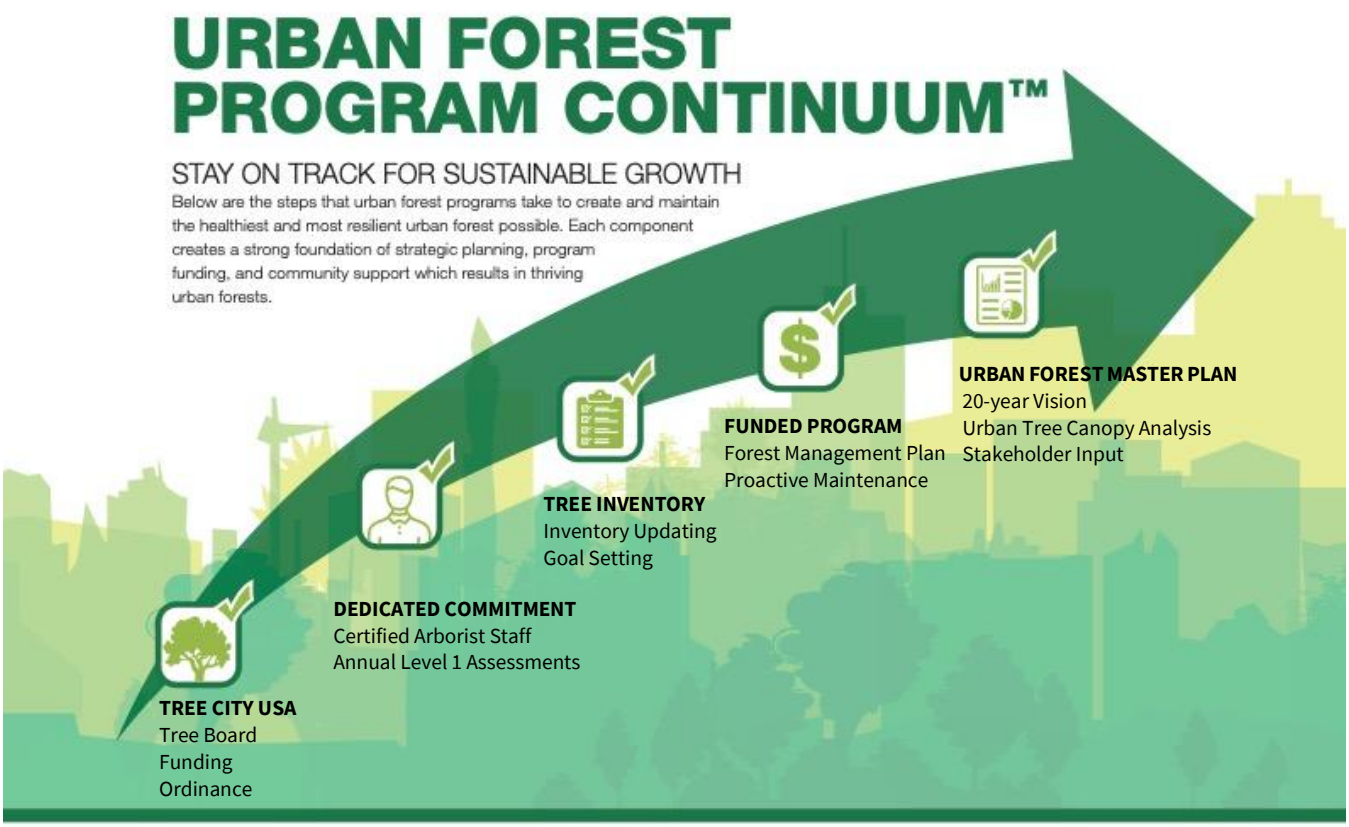
The sections of this plan are as follows:

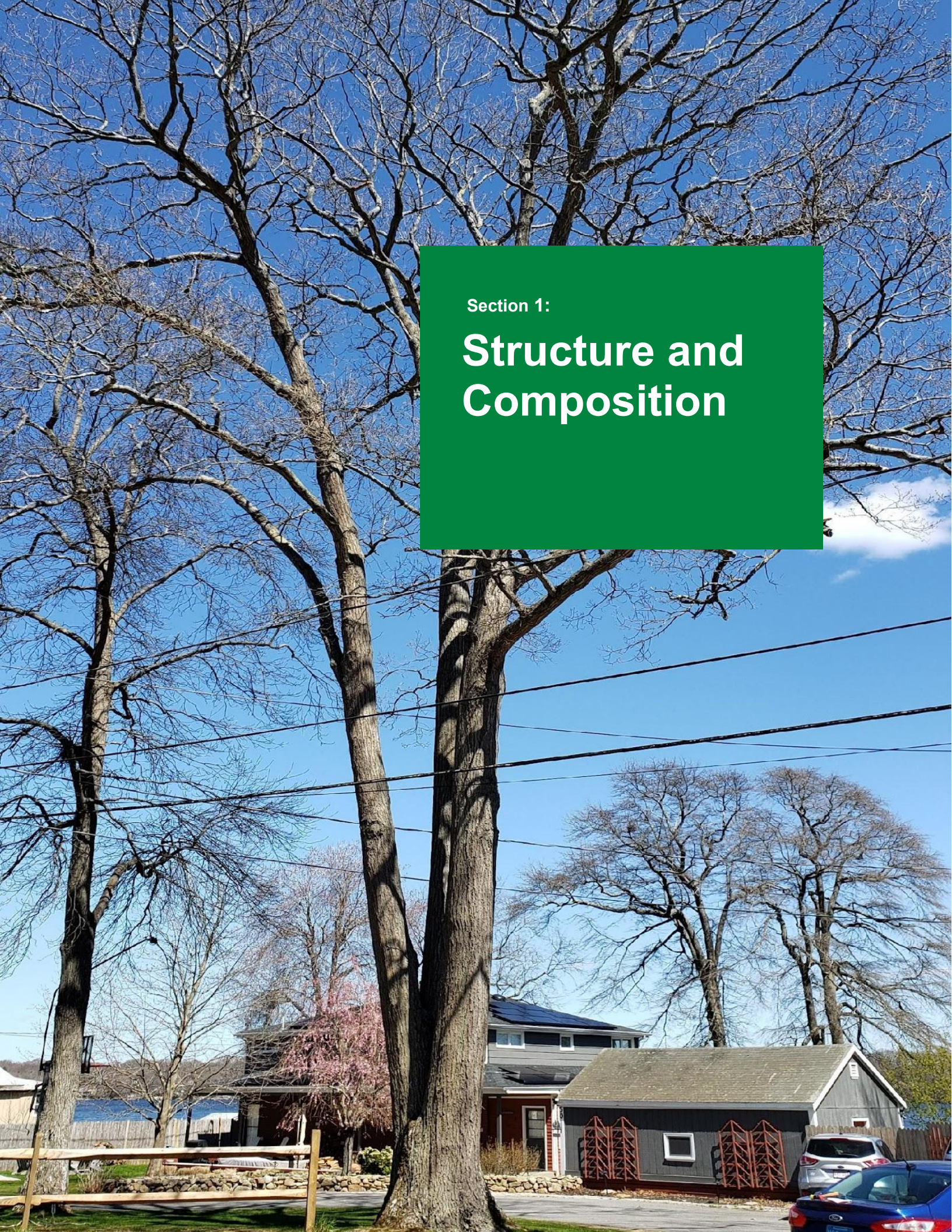
- *Section 1:* Structure and Composition summarizes the inventory data with trends representing the current state of public trees.
- *Section 2:* Functions and Benefits summarizes the estimated value of benefits provided to the community by public trees' various functions.
- *Section 3:* Recommended Maintenance details a prioritized maintenance schedule and provides an estimated budget for recommended maintenance activities over a five-year period.

This *Tree Inventory Analysis & Maintenance Strategy* is designed to help the community understand the current state of its public trees, set future goals and benchmarks, anticipate future program needs, and focus on proactive maintenance.

The Urban Forest Program Continuum (shown on Page 10) outlines the steps to effectively and sustainably manage and care for Weaverville's urban forest. The continuum includes other plans that can support Weaverville's urban forest, including:

- An ***Urban Forest Management Plan*** which establishes a detailed 3- to 5-year work plan to address risk and maintenance needs using current tree inventory data to streamline Weaverville's urban forest management program.
- An ***Urban Forest Master Plan*** which engages stakeholder and community members to provide a comprehensive vision for the future of the City's urban forest, with recommendations and a road map of action steps to reach Weaverville's urban forestry goals.


URBAN FOREST PROGRAM CONTINUUM™
STAY ON TRACK FOR SUSTAINABLE GROWTH
Below are the steps that urban forest programs take to create and maintain the healthiest and most resilient urban forest possible. Each component creates a strong foundation of strategic planning, program funding, and community support which results in thriving urban forests.
TREE CITY USA
Tree Board
Funding
Ordinance
DEDICATED COMMITMENT
Certified Arborist Staff
Annual Level 1 Assessments
TREE INVENTORY
Inventory Updating
Goal Setting
FUNDED PROGRAM
Forest Management Plan
Proactive Maintenance
URBAN FOREST MASTER PLAN
20-year Vision
Urban Tree Canopy Analysis
Stakeholder Input



Section 1:

Structure and Composition

Section 1: Structure and Composition

Arborists collected data on trees, stumps, and planting sites along the street ROW and in public parks throughout Weaverville. The following sites are broken into two primary categories—Streets/ROW which reflect the data gathered in Polygons 2, 4-6, and 8-15. And sites gathered in Parks that reflect the data gathered in Polygon 3 (Lake Louise Park) and Polygon 7 (Nature Park). 960 sites were inventoried, with 45% collected along the street ROW and public Parcels and 55% collected in Parks (Figure 1). See Appendix B for inventory data collection methodology.

SPECIES & GENUS DIVERSITY

Diversity within plant communities is important for increasing their resistance and resilience to disturbance (see side panel, "The Importance of Species Diversity"). The 10-20-30 rule is a common urban forestry industry metric for tree species diversity in which a single species should compose no more than 10% of the population, a single genus no more than 20%, and a single family no more than 30%. Some communities may be in a position to pursue more aggressive diversity goals, such as a 5-10-15 metric.

There are 69 different species within Weaverville's ROW and parks. Figure 2 shows the species diversity breakdown for Weaverville's most common inventoried trees. Black walnut is the most common tree (13%), followed by tulip tree (12%) and southern red oak (8%).

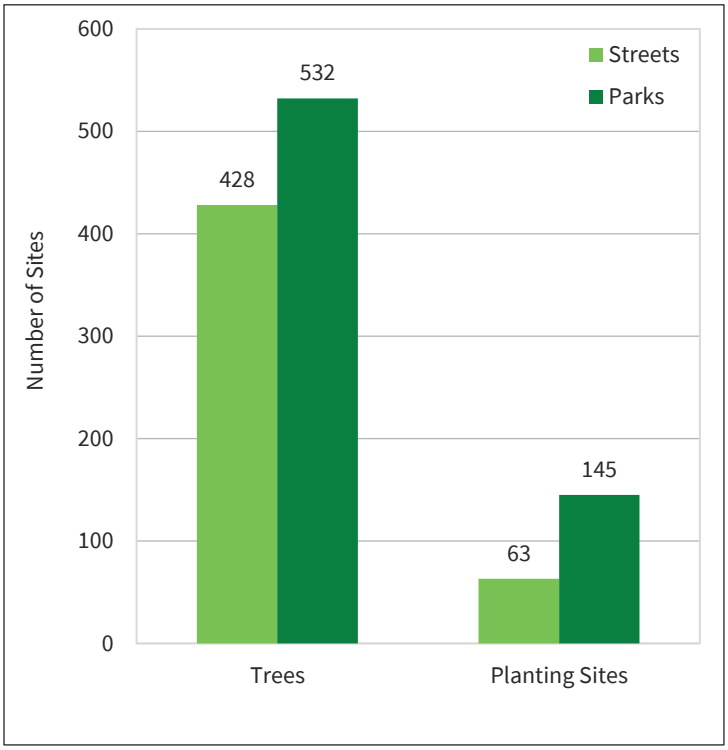


Figure 1. Number of inventoried sites by location and type.

The City's inventoried trees represent 38 distinct genera. Figure 3 shows the genus diversity breakdown for Weaverville's inventoried trees. Pine is the most common genus (16%), followed by oak (15%), walnut (13%), and poplar (12%).

SPECIES & GENUS DIVERSITY RECOMMENDATIONS

- Avoid or limit planting of black walnut and tulip trees and increase planting of other species until black walnut and tulip trees make up less than 10% of public trees.
- Remove volunteer trees that have invasive tendencies, such as Bradford pear, Norway maple, and paper mulberry from maintained public areas while small.
- Increase planting of uncommon species and genera which are well suited to urban environments.

THE IMPORTANCE OF DIVERSITY

The Dutch elm disease epidemic of the 1930s provides a key historical lesson on the importance of diversity. The disease killed millions of American elm trees, leaving behind enormous gaps in the urban canopy of many 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 the US. This invasive beetle continues to devastate ash tree populations across the country.

Other invasive pests and diseases, severe weather events, and climate change threaten our urban forests today, so it's vital that we learn from history and plant a wider variety of tree species and genera to develop a resistant and resilient public tree resource.

THE ROLE OF NON-NATIVE TREE SPECIES IN THE URBAN ENVIRONMENT

Certain non-native tree species that are especially tolerant of harsh urban conditions can be a practical choice to plant, especially when aiming to sustain high levels of species diversity. Non-native species of concern are those that are considered invasive, which should not be planted regardless of the site conditions.

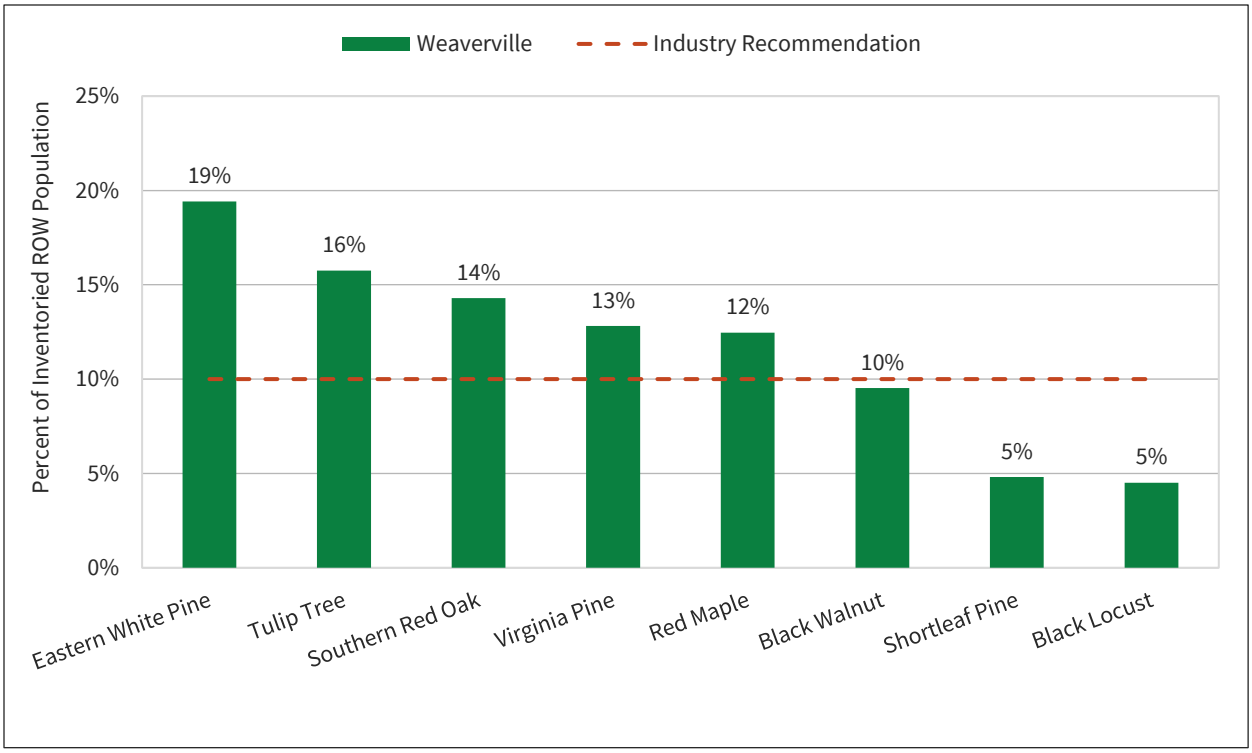


Figure 2. Species diversity of trees which make up at least 4% of the inventoried population.

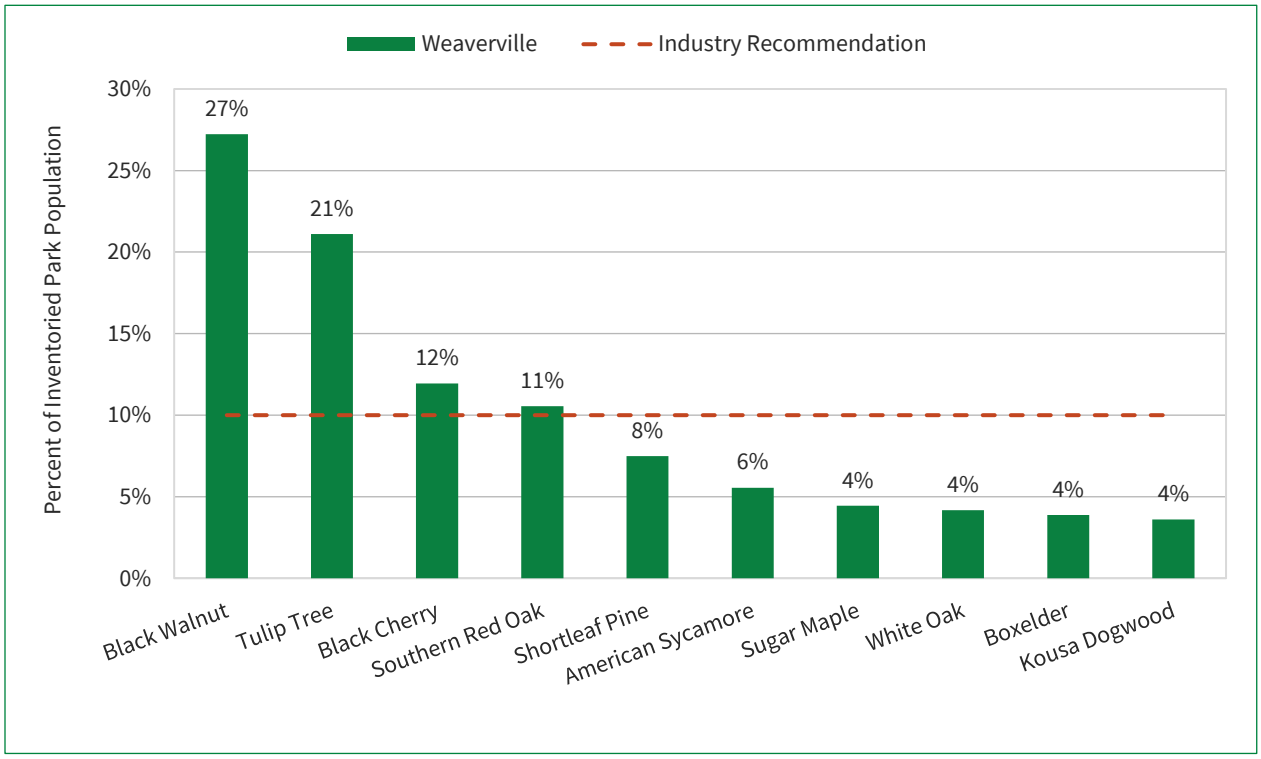


Figure 2a. Species diversity of trees which make up at least 4% of the inventoried population.

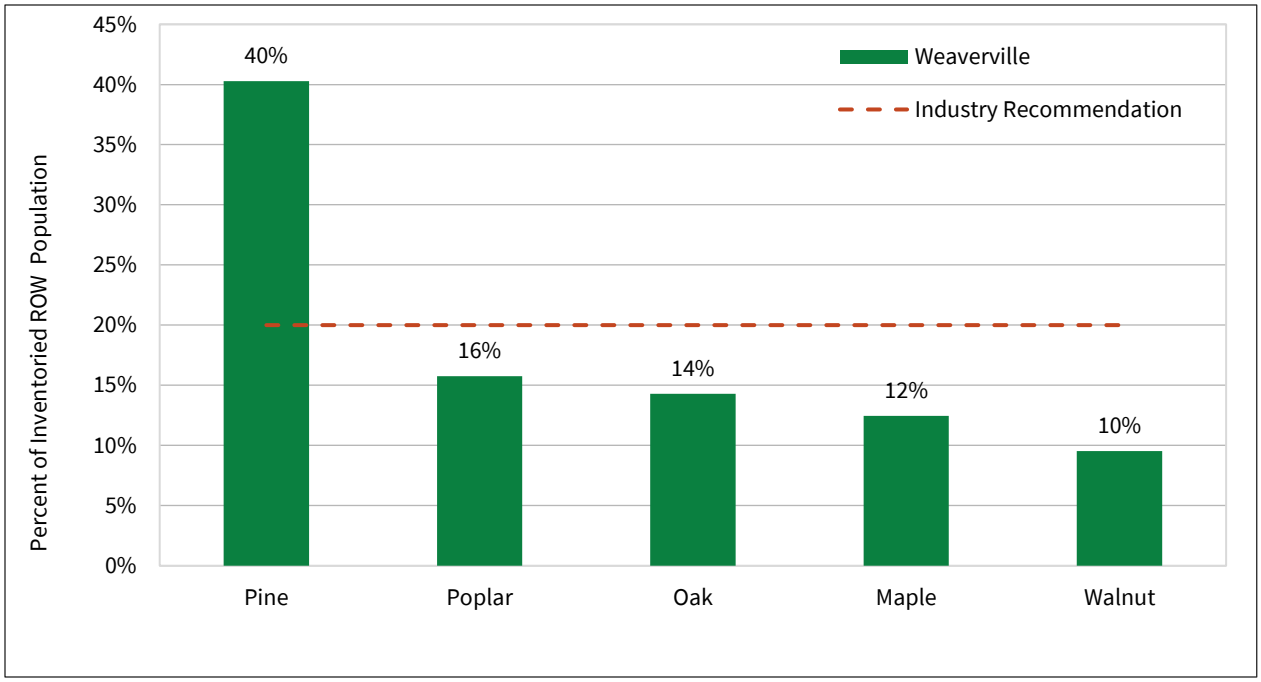


Figure 3. Genus diversity of ROW trees which make up at least 5% of the inventoried population.

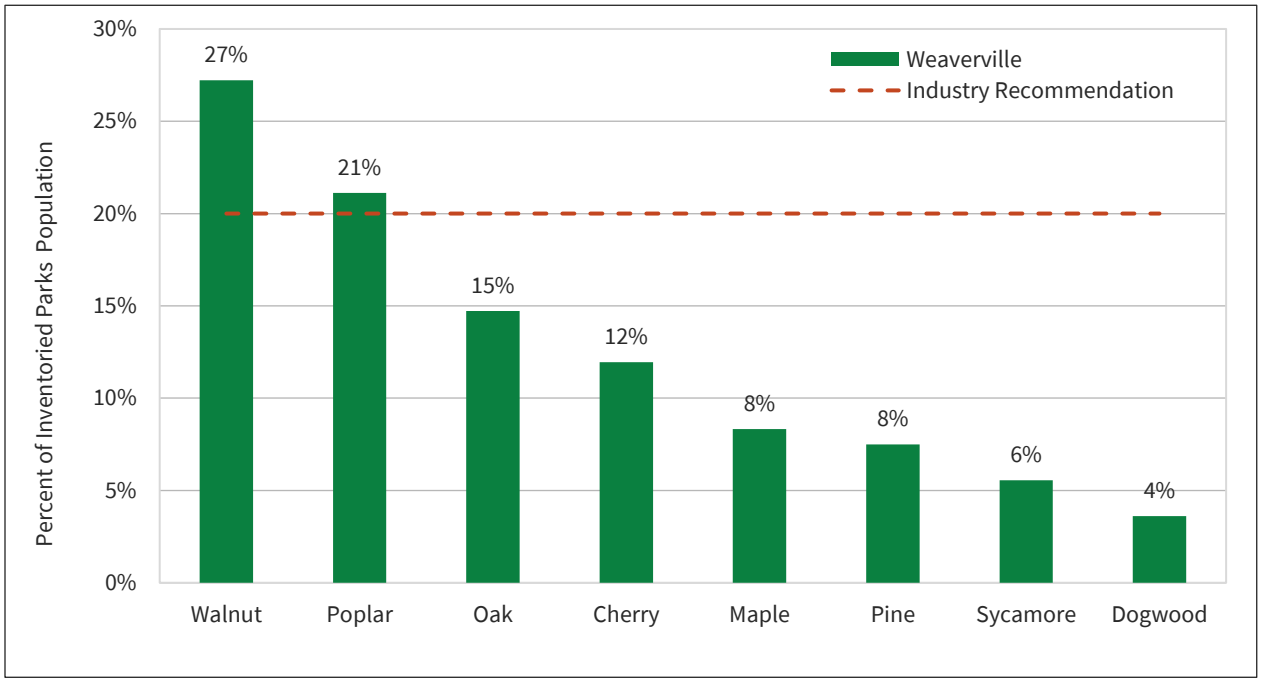


Figure 3a. Genus diversity of park trees which make up at least 5% of the inventoried population.

PEST SUSCEPTIBILITY

Early identification of tree pests and diseases can reduce the impact of infestations on the urban forest. Infestations which are caught while still limited to a small number of trees can be more easily and cost-effectively managed and help prevent the further spread of the pest or disease. Since many pests and diseases have preferred host tree species and genera, the susceptibility of an urban forest to a pest or disease can be predicted based on its species and genus diversity.

Figure 4 presents the percentage of inventoried trees which are susceptible to pests and diseases of concern in North Carolina. It is important to remember that this figure only represents data collected during the inventory, and many more trees throughout Weaverville, such as those on private property, may be susceptible to hosting these invasive pests.

51% of inventoried trees in Weaverville are susceptible to spotted lanternfly. Other pests which could affect a large portion of public trees include shothole borer (57% of Inventoried trees), winter moth (36% of inventoried trees), and oak wilt (20% of inventoried trees).

PEST SUSCEPTIBILITY RECOMMENDATIONS

- Monitor trees for signs and symptoms of pests and diseases on a regular basis. This can be done as part of other routine maintenance activities such as pruning.
- When a pest or disease is suspected, act quickly to confirm the identification and begin management.
- Prepare an invasive species management plan to guide the response to future pest or disease infestations. The tree inventory reflects a portion of the community forest. When assessing pest susceptibility, it is important to also consider privately managed trees, which may include vulnerable species not captured in the inventory.
- Spotted lanternfly can host on many tree genera but prefer tree of heaven. Consider removing or otherwise managing tree of heaven populations to reduce the suitability of Weaverville's urban forest to host spotted lanternfly.
- When planting trees, select pest- or disease-resistant species or cultivars whenever possible.
- Use preventative pesticide treatments on high-value or historic trees that are susceptible to problematic pests and/or diseases in Weaverville.

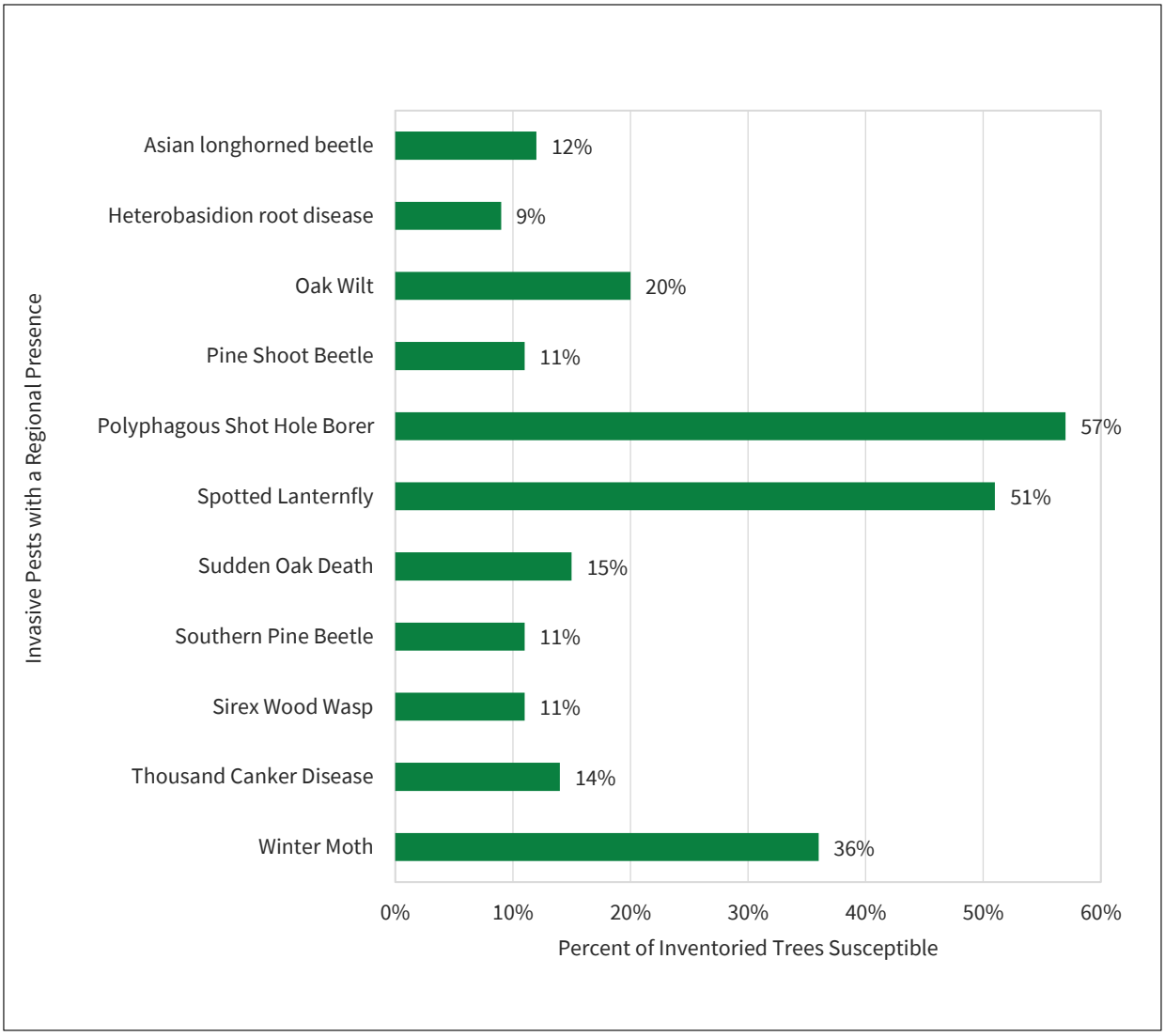


Figure 4. Susceptibility of the tree resource to pests and diseases of concern in North Carolina.

CONDITION

During the inventory, each tree was assigned a condition rating based on several factors, including root characteristics; branch structure, trunk, canopy, and foliage condition; and the presence of pests or disease. Tree conditions were rated as Good, Fair, Poor, and Dead.

Figure 5 provides the condition rating breakdown for street and park trees in Weaverville. Most trees were in Good or Fair condition (95%). Four percent of the street trees and 5% of park trees were in Poor or Dead condition.

CONDITION RECOMMENDATIONS

- Dead and dying trees should be removed as soon as possible in priority order from highest to lowest risk to reduce public hazards, create space for new planting, and improve the appearance of Weaverville's streets and parks.
- Trees in Poor condition not recommended for removal should be maintained to reduce risk associated with defects and should be routinely monitored for further decline that would necessitate removal.
- Condition ratings can be improved over time by instituting proactive maintenance cycles such as routine pruning and young tree training. All tree pruning should follow ANSI A300 (Clause 5) guidelines.

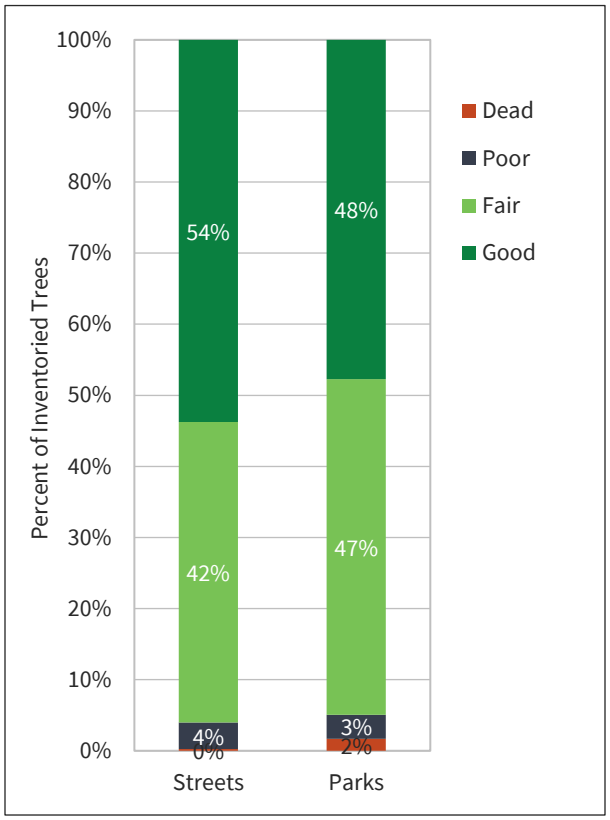


Figure 5. Condition rating of trees.

RELATIVE AGE DISTRIBUTION

Analysis of a tree population's relative age distribution can be performed by assigning age classes to the diameter of trees. While actual tree age cannot be determined by diameter alone, this industry standard method provides an estimate of the approximate age distribution of the inventoried tree population. Since trees at different stages of development need different types and frequencies of maintenance, age distribution can help inform management needs and decisions.

The size classes (right) are based on the industry-recognized ideal relative age distribution, which holds that the largest proportion of the inventoried tree population (40%) should be young trees, smaller portions should be established and maturing trees (30% and 20%, respectively), and the smallest proportion (10%) should be mature trees.

Age/Size Classes

Young: 0-8 inches diameter at breast height (DBH), as measured 4.5' above the ground
Established: 9-17 inches DBH
Maturing: 18-24 inches DBH
Mature: 25+ inches DBH

Figure 6 compares the age distribution of the tree population to standard industry recommendation. Overall, Weaverville's street trees are trending toward the industry recommended age distribution, with a deficit of young trees (2%), a surplus of established trees (15%), a deficit of maturing trees (7%), and a deficit of mature trees (6%). However, in parks, there is an underrepresentation of young trees (21% versus the 40% recommendation) and a surplus of established trees (45% versus the 30% recommendation).

Figure 7 compares tree condition ratings across the relative age classes for inventoried trees. Trees across all age classes are generally in Fair condition, except for the young age class. In general, trees in the young age class are more likely to be in Good condition, while maturing and mature age classes are more likely to have trees in Poor condition.

RELATIVE AGE RECOMMENDATIONS

- The Town of Weaverville's park trees are aging. Weaverville should focus on tree preservation and proactive care for these large-stature trees, and a succession plan should be implemented to ensure that as mature park trees decline in health and are removed, young trees are planted to take their place.
- A large proportion of trees are established (45% of street trees and 45% of park trees). A routine pruning program should be instituted to structurally prune and remove dead wood to ensure good form and improve health as they mature.
- Street tree planting is currently sufficient to maintain the recommended age distribution. However, sustained planting efforts over time will be necessary to retain this age distribution.
- Routine, proactive maintenance, such as young tree training and routine pruning, may help improve tree condition, particularly among maturing and mature trees.

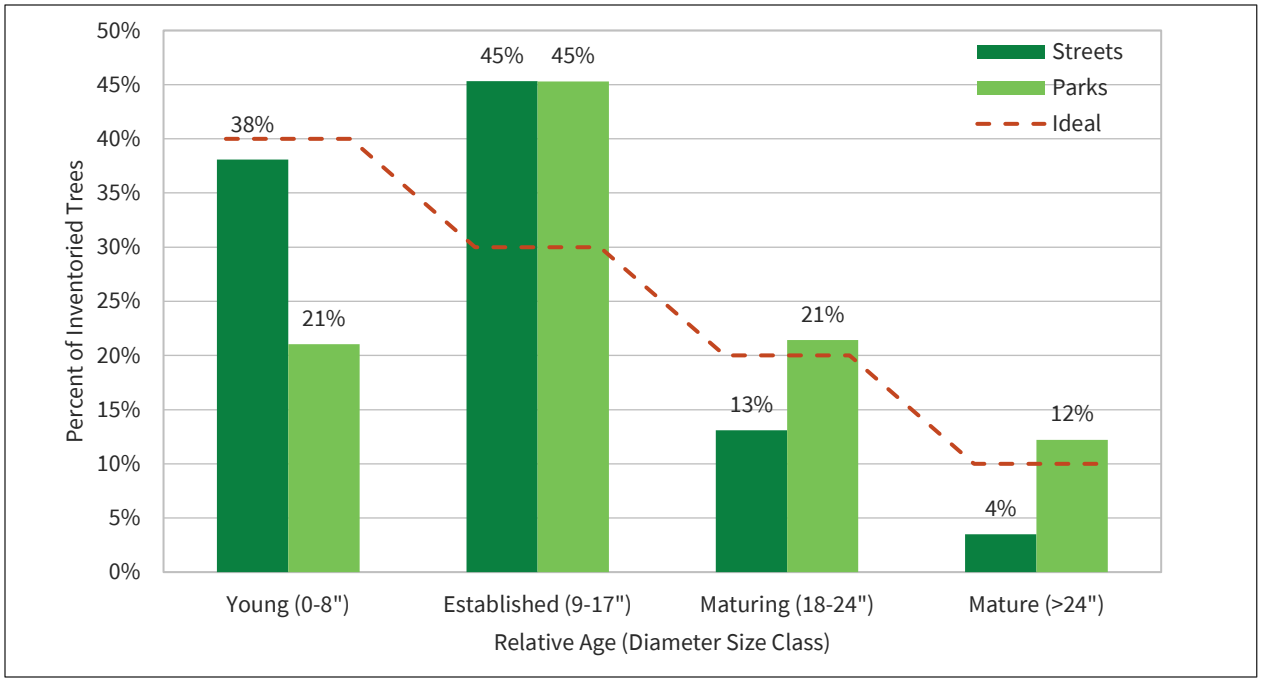


Figure 6. Relative age distribution of both ROW and Park inventoried trees.

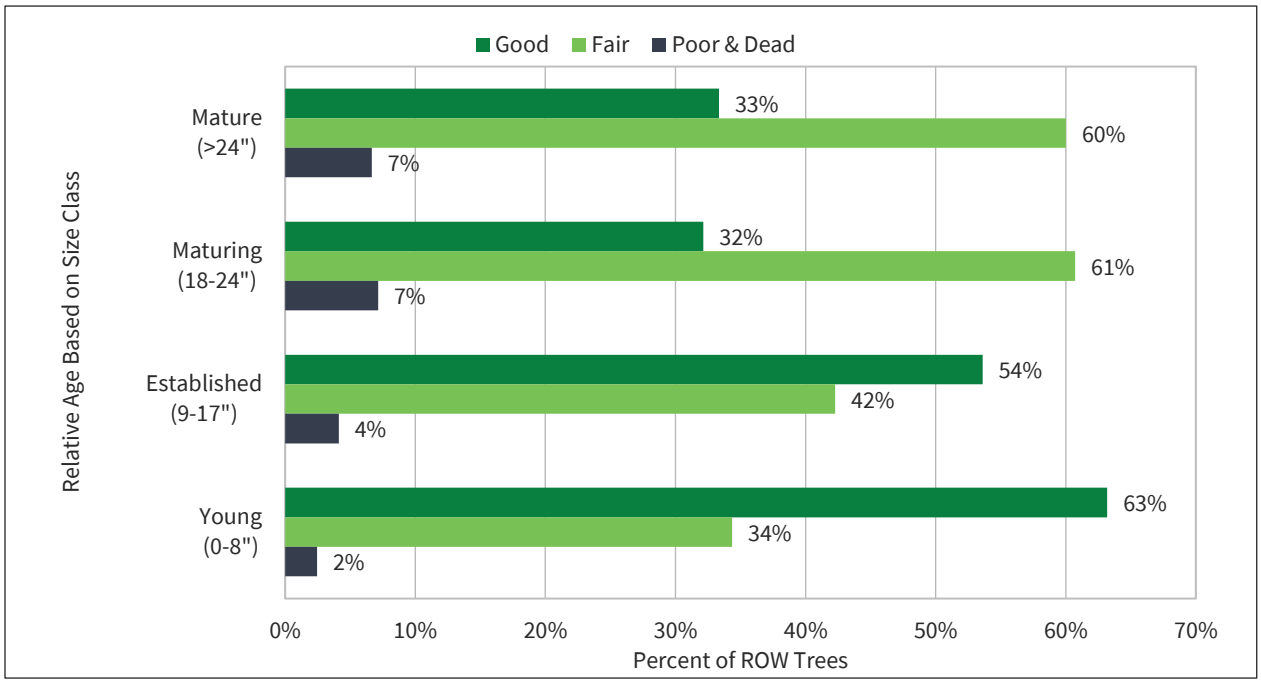


Figure 7. Inventoried ROW tree condition ratings compared to age.

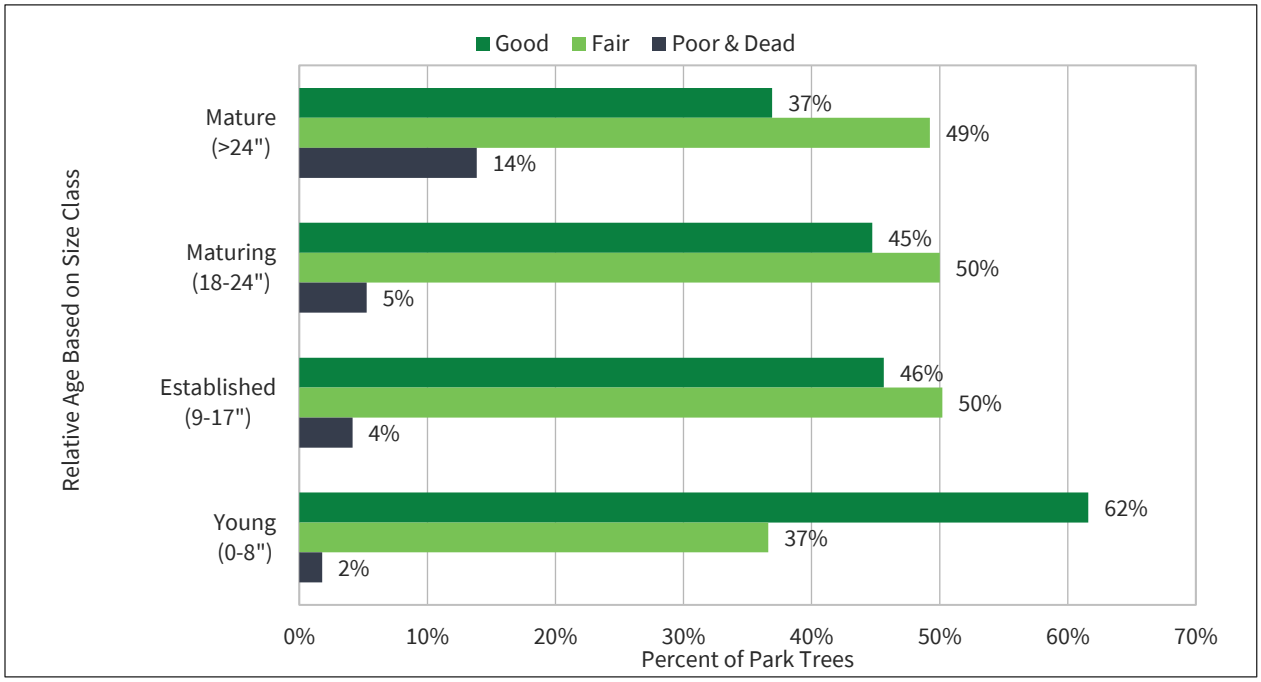


Figure 7a. Inventoried park tree condition ratings compared to age class.

INFRASTRUCTURE AND GROWING SPACE

In developed settings, like a street, growing space for trees can be limited both above and below ground. To maximize tree growth, health, and benefits, it is important to consider the amount of space available (above and below ground) for a tree to grow. Selecting "the right tree, for the right place" not only positively impacts tree health and vigor, but it can improve public safety, reduce utility outages, increase walkability, reduce sidewalk/hardscape damage, and ensure compliance with the American with Disabilities Act (ADA). During the Weaverville inventory, tree conflicts with overhead utilities were observed and recorded.

Two percent of trees with overhead utilities at the time of the inventory, and a further 1.5% of trees, had overhead utilities present but were not currently conflicting with them.

Table 1. Infrastructure conflicts recorded during the inventory

Conflict	Street Trees	Percent Of Street Trees	Park Trees	Percent Of Park Trees
Not Present	**418**	**97%**	**495**	**93%**
Present & Conflicting	**7**	**2%**	**25**	**5%**
Present & not conflicting	**3**	**1%**	**12**	**2%**
Total	**428**	**100%**	**532**	**100%**

INFRASTRUCTURE RECOMMENDATIONS

- Weaverville should reduce tree conflicts with overhead electric lines by planting only small stature trees beneath or near overhead electric utilities.
- Consider looking for dwarf or small cultivars of typically large-stature trees to diversify small-stature planting lists.
- Tree roots can damage water and sewer pipes, gas lines, and electric conduit. Installation and maintenance of these utilities often result in cut tree roots, which may destabilize trees and cause tree failure, reduce tree vigor, or kill the tree.
- Private trees are not included in the inventory, yet they can also conflict with infrastructure. To address this, education and resource-sharing efforts should be directed toward private property owners to promote proactive management and reduce potential impacts.

Plant trees at least 5 feet (or at a distance agreed upon with municipal engineer and/or utility company) from any underground utility to allow room for large, structural roots to develop without impacting the utility.

Conflicts with other infrastructure such as buildings, road signage, streetlights, and driveways should also be considered. Weaverville should develop and document planting guidelines which dictate required clearances for different types of infrastructure.

GROWING SPACE RECOMMENDATIONS

- Right tree, right place. Select tree species based on characteristics of their root systems that match the planting site. Develop standards for tree planting which require specific growing space dimensions and/or soil volumes for various sizes of tree. Planting only small trees where the growing space and soil volume is restricted will help reduce hardscape damage issues due to tree root growth.
- Develop standards for sidewalk, road, private property, and other hardscape design and construction that are tree friendly and are able to accommodate tree root growth and reduce future conflict.

DRG RECOMMENDED MINIMUM SPACING FOR TREE PLANTING

Overhead Utility Clearances:

- Small trees (>30 feet tall at maturity) can be within 20 feet.
- Medium trees (30-45 feet tall at maturity) should be planted 20 feet or further.
- Large trees (>45 feet tall at maturity) should be planted 40 feet or further.

Contact local utility companies for specific local distance requirements.

Other Infrastructure Clearances:

- 40 feet between large trees
- 30 feet from intersections (approaching traffic)
- 30 feet between medium trees
- 20 feet from fire hydrants
- 20 feet between small trees
- 15 feet from utility poles, streetlights, buildings
- 10 feet from driveways, intersections (retreating traffic), crosswalks, important street signage
- 5 feet from underground utilities

Growing Space Dimensions:

- Small trees - 4 feet x 4 feet
- Medium trees - 6 feet x 6 feet
- Large trees - 8 feet x 8 feet

- Encourage collaboration between city planning, engineering, and tree management departments. Considering trees early in the planning process when repairing or redesigning streets and sidewalks allows greater flexibility in the strategies used to ensure trees can be a productive part of the new streetscape.
- Consider a variety of strategies for incorporating sufficient growing space into street and sidewalk designs, including enlarging planting wells or sitting them on the back edge of the sidewalk adjacent to lawns, installing new tree wells or lawns, creating traffic bumps outs, and incorporating Silva Cell or structural soil technology into designs.
- Implement a variety of techniques for retaining mature street trees despite conflicts with hardscape. If possible, reroute sidewalks or build temporary ramps of pavement or wood over tree roots rather than remove healthy, mature trees in favor of sidewalks repairs.
- Recognize that many competing needs intersect when trying to site street trees. City streetscapes must balance needs for driving, parking, pedestrian access, overhead and underground utilities, street furniture, signage, lighting, winter snow removal, and many other considerations. Some areas will not be suitable for trees, and alternatives to street planting should be used in these areas instead of planting street trees.

CANOPY COVER & STOCKING LEVEL

"Stocking" is a term for the density and distribution of trees. In an urban forest, stocking level is the ratio of street ROW spaces occupied by trees to the total street ROW spaces suitable for trees, including occupied (tree/stump) and vacant sites. Park trees and other non-ROW public property trees are excluded from this measurement.

Weaverville has a total of 1,168 current and potential tree sites along streets and within parks (960 trees + 209 planting sites), 960 of which are currently occupied by a tree. Therefore, the City's current stocking level is 82.2%.

Stocking level is a valuable way to compare urban forest coverage over time especially when canopy cover data is not available, such as is the case in Weaverville. "Canopy cover" refers to the percentage of an area which is covered by tree canopy when viewed from above. Canopy cover measurements can be derived in several different ways; the i-Tree Canopy tool is able to provide a basic assessment of the City's total canopy cover, both public and private, as well as estimate the benefits provided by the entire urban canopy. Conducting an Urban Tree Canopy (UTC) assessment, which uses high-resolution aerial imagery, provides detailed analysis of a City's tree canopy and can incorporate socio-economic analyses to inform the level of fair canopy distribution throughout the city.

Research shows that areas with low canopy cover frequently reflect a correlation with income and race; oftentimes, this stems from decades of redlining and other discriminatory policies. Since these communities tend to have fewer trees, their residents are deprived of the benefits that trees offer and likely experience increased air temperature, greater levels of stormwater runoff and flooding, and higher levels of air pollution. The concept of Tree Equity aims to rectify this issue by advocating for equal distribution of trees and their associated benefits across all areas within cities. While a Tree Equity analysis was not conducted as a part of the tree inventory, Weaverville can take steps to analyze and improve the Town of Weaverville's levels of Tree Equity.

CANOPY COVER & STOCKING LEVEL RECOMMENDATIONS

- Both stocking level and canopy cover can be used to set, measure, and track progress toward canopy cover and tree planting goals.
- Goals should be achievable and tailored to the specific needs and challenges of Weaverville. Once initial goals are achieved, further goals can be set. This incremental method of progress can help build capacity and public support for tree planting and care over time.
- The Town of Weaverville should consider planting additional trees in areas with low stocking level/ canopy cover. Creativity may be required in heavily built-up areas of the community, and programs that promote planting trees on private property or parks may be viable alternatives, when site constraints limit street tree planting.

- Most trees typically reside on private property so, achieving canopy growth goals depends on active participation beyond publicly managed trees. Public education and awareness initiatives are recommended to engage property owners in supporting canopy expansion and sustaining a healthy urban forest.

Conducting an Urban Tree Canopy (UTC) assessment may be helpful in setting and eventually achieving Weaverville's tree canopy and equity goals. Weaverville may want to consider a UTC assessment as a next step in their urban forest management program.

Section 2:

Functions and Benefits

Section 2: Functions and Benefits

Trees play a vital role in the environment by providing a wide array of economic, environmental, and social benefits which far exceed 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, among other benefits.

Environmental Benefits

- Trees decrease energy consumption and moderate local climates by providing shade, cooling through their transpiration processes, and acting as windbreaks.
- Trees act as mini reservoirs, helping to slow and reduce the amount of stormwater runoff and pollutants that reaches storm drains, rivers, and lakes by 20-60% (Johnson et al. 2017).
- Trees reduce greenhouse gasses that can trap and retain heat in the atmosphere and cause the city to get warmer.
- Trees can reduce street-level air pollution by up to 60% (Coder 1996).

Improved Public Health

- Trees have been shown to prevent 1,200 heat-related deaths each year in the US (McDonald et al. 2020).
- By intercepting particulate matter, trees save over 850 lives and prevent 670,000 incidents of acute respiratory symptoms in the US each year (Nowak et al. 2014).
- 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).

Increased Safety & Community

- Tree-lined streets slow traffic and are safer for drivers, pedestrians, and cyclists (Swift et al. 1997, Ewing & Dumbaugh 2009).
- A 10% increase in neighborhood tree canopy cover has been associated with a 12-15% reduction in violent and property crimes (Gilstad-Hayden et al. 2015, O'Neil-Dunn 2012).

Economic Benefits

- Properly placing three trees around a home can reduce energy costs for the average household by $100 to $250 per year, while shading air conditioning units can help them run up to 10% more efficiently (U.S. Department of Energy, n.d.).
- Trees in a yard or neighborhood increase residential property values by an average of 10% (USDA Forest Service 2011), and commercial property rental rates are 7% higher when trees are on the property (Wolf 2007).
- Shoppers spend more time and money in shopping districts with mature, healthy tree canopies, and are willing to spend 9-12% more at businesses with trees in front of them (Wolf 2005, Hughes 2013).

i-TREE RESULTS

DRG used i-Tree Eco, a tool within the i-Tree suite, to model benefits provided by Weaverville's inventoried public trees. i-Tree Eco combines tree inventory data with local air pollution and weather data to quantify the environmental benefits of a community's trees (Table 2). By framing trees and their benefits as dollars saved per year, i-Tree models can help communities understand trees as both a natural resource and an economic investment. Understanding the composition, functions, and economic value of trees is essential for making informed planning and management decisions. This knowledge not only helps to better understand how decisions can affect human health and environmental quality but also empowers communities to advocate for the funding required to effectively manage and care for their valuable public trees.

Table 2. Summary of benefits provided by the most common inventoried trees

COMMON NAME	BOTANICAL NAME	TREES (#)	PERCENT OF TOTAL	CO_2 STORED (TONS)	CO_2 SEQUESTERED (TONS/YEAR)	AVOIDED RUNOFF (GAL/YEAR)	AIR POLLUTION REMOVED (LBS/YEAR)	REPLACEMENT VALUE
Black Walnut	*Juglans nigra*	124	13%	73	2	31,571	80	$244,880
Tulip Tree	*Liriodendron tulipifera*	119	13%	70	2	43,767	100	$307,787
Southern Red Oak	*Quercus falcata*	77	8%	64	1	24,457	60	$225,902
Eastern White Pine	*Pinus strobus*	57	6%	15	0	31,092	100	$82,759
Black Cherry	*Prunus serotina*	51	5%	25	1	8,444	20	$58,041
Shortleaf Pine	*Pinus echinata*	49	5%	22	0	30,706	100	$94,968
Red Maple	*Acer rubrum*	45	5%	26	1	9,953	20	$94,958
Virginia Pine	*Pinus virginiana*	40	4%	8	0	13,725	40	$45,708
Black Locust	*Robinia pseudoacacia*	29	3%	4	0	2,427	0	$20,228
American Sycamore	*Platanus occidentalis*	25	3%	28	0	18,215	40	$106,965
White Oak	*Quercus alba*	22	2%	26	0	7,015	20	$70,192
Boxelder	*Acer negundo*	21	2%	7	0	4,061	20	$16,482
Eastern Redbud	*Cercis canadensis*	21	2%	5	0	2,144	0	$21,947
River Birch	*Betula nigra*	20	2%	9	0	4,011	0	$34,514
Sugar Maple	*Acer saccharum*	18	2%	10	0	3,772	0	$27,299
All Other Trees Inventoried		212	23%	70	1	41,585	40	$249,082
Total		**931**	**100%**	**460**	**10.4**	**276,980**	**740**	**$1,701,853**

ANNUAL BENEFITS

The i-Tree Eco model estimates the annual value of three environmental benefits: carbon sequestration, air pollutant removal, and stormwater runoff reduction. The model also calculates the lifetime carbon storage of inventoried trees as well as their replacement value. The inventoried trees in Weaverville provide over $8,454 of air quality, stormwater management, and carbon sequestration benefits each year (Figure 8).

The Number of benefits provided by a tree is also influenced by species. Table 3 summarizes the key tree species that provide the greatest contribution to Weaverville's annual benefits based on the results of the i-Tree Eco analysis of the public tree inventory. Willow oak, as well as southern magnolia, American sycamore, bitternut hickory, and various oak and maple, are major contributors to the annual quantifiable benefits within the public tree resource.

Table 3. The inventoried species which provide the greatest annual benefit per tree

Species	Annual Benefits per Tree
Willow Oak	$22.42
Southern Magnolia	$16.85
American Sycamore	$14.12
Bitternut Hickory	$13.76
American Basswood	$12.94
Bur Oak	$11.07
Shortleaf Pine	$9.76
Red Mulberry	$9.69
Black Walnut	$9.54
Tulip Tree	$9.53
Silver Maple	$9.35
Norway Maple	$9.34
English Oak	$9.24
Red Maple	$9.20
Pin Oak	$8.43

IMPROVING AIR QUALITY

Trees and other vegetation improve air quality by intercepting and filtering particulate matter from the air, including dust, ash, pollen, and smoke. Their leaves also absorb harmful gaseous pollutants like ozone, nitrogen dioxide, and sulfur dioxide; and reduce ozone formation by shading surfaces and reducing air temperatures. Since airborne pollutants can have serious effects on human health, this benefit is extremely important, especially in heavily developed areas. 18% of Weaverville's annual public tree benefits are associated with air pollution removal derived from the air pollutant removal.

The inventoried trees in Weaverville's remove 740 lbs. of airborne pollutants each year; a service valued at $1,474 (Table 2).

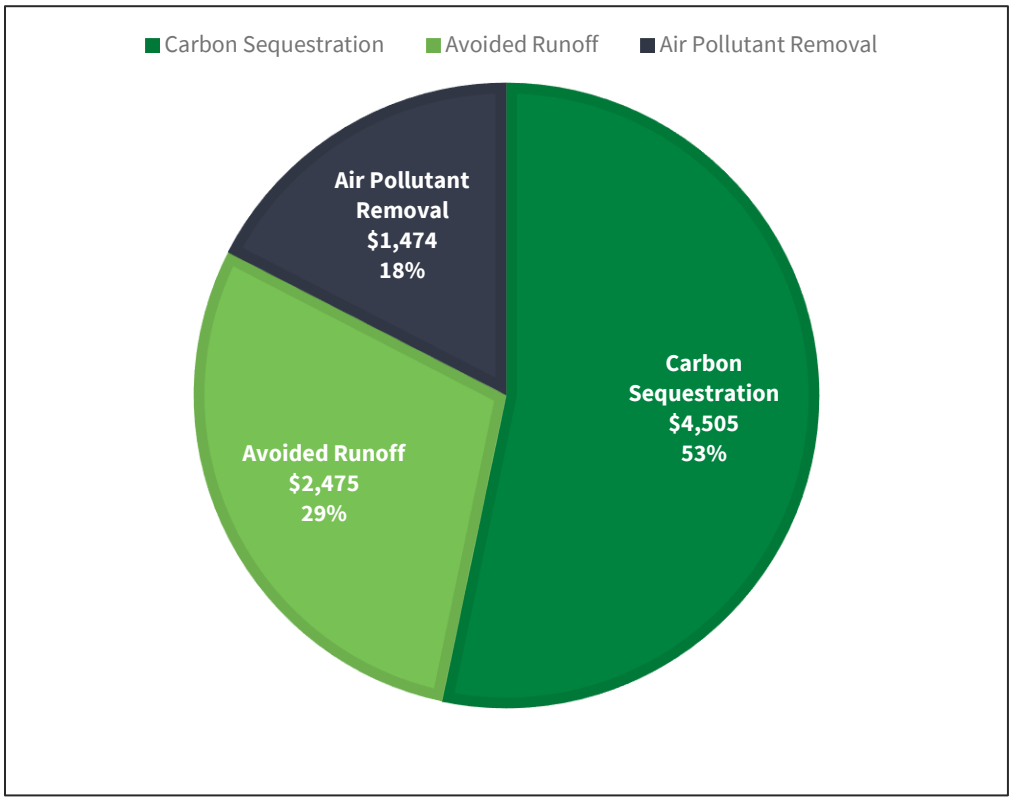


Figure 8. Breakdown of annual benefits.

SEQUESTERING AND STORING CARBON

Trees are carbon sinks, which means they absorb carbon from the atmosphere—the opposite of carbon sources which produce and emit carbon into the atmosphere. While carbon is released from fossil fuel consuming vehicles and smokestacks, it is absorbed by trees during photosynthesis and stored in their tissue as they grow. Weaverville's public street trees sequester (absorb) an estimated 10.41 tons of carbon each year, valued at $4,505, and have stored 460.49 tons of carbon over their lifetime, valued at $199,265 (Table 2).

CONTROLLING STORMWATER

Trees play a significant role in local hydrology and water cycling, helping to reduce the amount of stormwater runoff during rain events (Figure 9). Since stormwater runoff can cause infrastructure damage and flooding, reducing the amount of precipitation that becomes surface runoff can save a community costs in infrastructure repair and flooding mitigation. The inventoried trees in Weaverville divert 276,979 gals. of stormwater each year valued at $2,475 (Table 2).

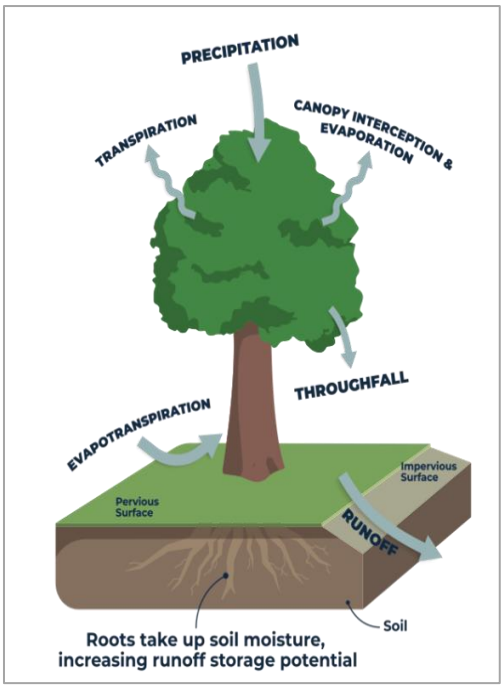


Figure 9. Hydrological functions of trees. Source: 'Stormwater to Street Trees: Engineering Urban Forests for Stormwater Management', EPA publication 841 B 13 001

REPLACEMENT VALUE

Replacement value is the approximate cost to replace an existing tree with a tree of a similar size and species. While doing this is typically not possible, for example, to replace a 20-inch diameter tree with another tree of similar size would not be feasible—replacement value can provide an idea of the overall value of the inventoried public trees in Weaverville.

In total, Weaverville's inventoried trees have a replacement value of $1,701,853. Table 4 compares the replacement value per tree of the street and park trees with the overall highest replacement values. The Weeping willow is the most valuable tree in Weaverville among both the park and street tree populations, with willow oak and American basswood also making the top five. Park trees generally have a greater replacement value per tree than street trees, likely due to the greater age and larger size of park trees versus street trees in Weaverville at the time of the inventory.

Table 4. Inventoried species with the highest replacement value

Common Name	Botanical Name	Trees (#)	Percent of Total	Total Replacement Value	Replacement Value per Tree
Weeping Willow	*Salix babylonica*	1	0.1%	$7,068	$7,068
Willow Oak	*Quercus phellos*	1	0.1%	$6,712	$6,712
American Basswood	*Tilia americana*	1	0.1%	$5,286	$5,286
American Sycamore	*Platanus occidentalis*	25	2.7%	$106,965	$4,279
Bitternut Hickory	*Carya cordiformis*	1	0.1%	$4,233	$4,233
Bur Oak	*Quercus macrocarpa*	1	0.1%	$4,217	$4,217
Shingle Oak	*Quercus imbricaria*	3	0.3%	$9,924	$3,308
White Oak	*Quercus alba*	22	2.4%	$70,192	$3,191
Southern Red Oak	*Quercus falcata*	77	8.3%	$225,902	$2,934
Southern Magnolia	*Magnolia grandiflora*	1	0.1%	$2,802	$2,802
Red Mulberry	*Morus rubra*	2	0.2%	$5,183	$2,592
Tulip Tree	*Liriodendron tulipifera*	119	12.8%	$307,787	$2,586
Red Maple	*Acer rubrum*	45	4.8%	$94,958	$2,110
American Beech	*Fagus grandifolia*	2	0.2%	$3,976	$1,988
Black Walnut	*Juglans nigra*	124	13.3%	$244,880	$1,975
All Other Trees Inventoried		534	54.2%	$601,629	$1,191
Total		**960**	**100%**	**$1,701,853**	**-**

TREE BENEFIT RECOMMENDATIONS

- Large-stature, deciduous trees tend to provide the greatest benefits. Weaverville should plan to plant these types of trees wherever possible to increase the benefits provided by the public trees. This may require enlarging existing tree planting spaces or creating large new tree planting spaces to accommodate large street trees. It also should include preserving existing large-stature trees and providing proactive care to young public trees to ensure they achieve mature status in the future.
- The protection of existing park trees should be a priority, and succession planning to replace park trees and increase tree cover in parks will have a large positive impact on tree benefits in Weaverville in the future.
- The public trees in Weaverville account for only a fraction of the total benefits provided by the Town's trees, indicating that many of the trees which provide benefits to Weaverville are located on private property. Weaverville should consider methods to preserve existing trees and promote new tree planting on private property throughout the city to increase tree benefits.

Section 3:

Recommended Maintenance

Section 3: Recommended Maintenance

A risk rating and a maintenance activity were assigned to each inventoried tree. DRG recommends prioritizing and completing recommended maintenance activities based on a tree's assigned risk rating. This five-year tree maintenance schedule takes a multi-faceted and proactive approach to managing Weaverville's public inventoried trees.

RISK MANAGEMENT AND RECOMMENDED MAINTENANCE

Every tree, regardless of condition, has an inherent risk of whole or partial tree failure. As part of the inventory, a modified Level 2 rapid risk assessment of each inventoried tree was conducted and a risk rating was assigned based on the current editions of ANSI A300 (Clause 13) and the companion publication *ISA Best Management Practices: Tree Risk Assessment, Second Edition*. Trees can have multiple potential modes of failure, each with its own risk rating. The potential mode of failure with the highest risk rating was recorded for each tree during the inventory. The specified time period for the risk assessment was one year. Appendix C provides additional details on the International Society of Arboriculture's (ISA) risk rating system.

DRG recommends that tree maintenance activities are prioritized and completed based on the risk rating that was assigned to each tree during the inventory. Trees with Extreme or High Risk ratings should be attended to first, followed by trees with a Moderate Risk rating. Trees with a Low Risk rating should be maintained once higher risk trees have been pruned or removed. The following sections describe the recommended maintenance activities for each risk rating category.

PRIORITY MAINTENANCE

PRIORITY MAINTENANCE NEEDS

Addressing Extreme and High Risk trees identified in the inventory (Figures 10 & 11) in a timely manner will mitigate risk, improve public safety, maximize tree benefits, and reduce long-term costs. In general, Extreme and High Risk maintenance activities should be completed first for larger diameter trees that pose the greatest risk. Once these trees are addressed, recommended tree maintenance activities should be completed for small diameter trees.

The inventory identified:

- Zero Extreme Risk trees.
- Zero High Risk street trees and park trees are recommended for pruning (Figures 10 & 11).
- Zero High Risk street trees and **one** High Risk park tree recommended for removal (Figures 10 & 11). This High-Risk tree recommended for removal is 35" DBH.

Moderate and Low Risk trees identified in the inventory are categorized as a part of routine maintenance and are discussed in the following Routine Maintenance section.

PRIORITY MAINTENANCE RECOMMENDATIONS

- Trees with Extreme or High Risk ratings recommended for removal should be removed immediately and prioritized based on their risk rating and size class. Tree removal is recommended when pruning will not correct the tree's defects, will not eliminate the risks caused by defects, or when pruning would be cost-prohibitive.

ROUTINE MAINTENANCE

MODERATE AND LOW RISK PRIORITY PRUNING & REMOVALS

Pruning or removing Moderate and Low Risk trees are generally the next priorities for maintenance activities. For efficiency, Moderate and Low Risk removals may also be addressed when removing adjacent higher risk trees. Most trees recommended for pruning with a Low Risk rating can be maintained during proactive, routine pruning cycles. DRG recommends implementing proactive maintenance programs incrementally over time as the backlog of elevated risk trees is reduced.

The inventory identified:

- 0 Moderate Risk street trees and 10 Moderate Risk park trees recommended for pruning (Figures 10 & 11).
- 2 Moderate Risk street trees and 11 Moderate Risk park trees recommended for removal (Figures 10 & 11).
- 242 Low Risk street trees and 448 Low Risk park trees recommended for pruning (Figures 10 & 11).
- 9 Low Risk street trees and 9 Low Risk park trees recommended for removal (Figures 10 & 11),

Low Risk removals are generally small, dead, invasive, or poorly formed trees. Healthy trees growing in poor locations or undesirable species are also included in this category. Eliminating these trees will reduce breeding site locations for insects and diseases and will increase the aesthetic value of the area.

HIGH, MODERATE, AND LOW RISK PRUNING & REMOVAL RECOMMENDATIONS

- Moderate Risk pruning and removals should be performed after all Extreme and High Risk recommended maintenance is complete.
- Low Risk trees should be pruned and removed after all higher risk pruning and removals have been completed and may be performed concurrently with routine pruning (see below).
- Moderate and Low Risk tree pruning and removals can take place at the same time and can also be combined with higher risk removals and pruning when located near these trees to increase maintenance crew efficiency.

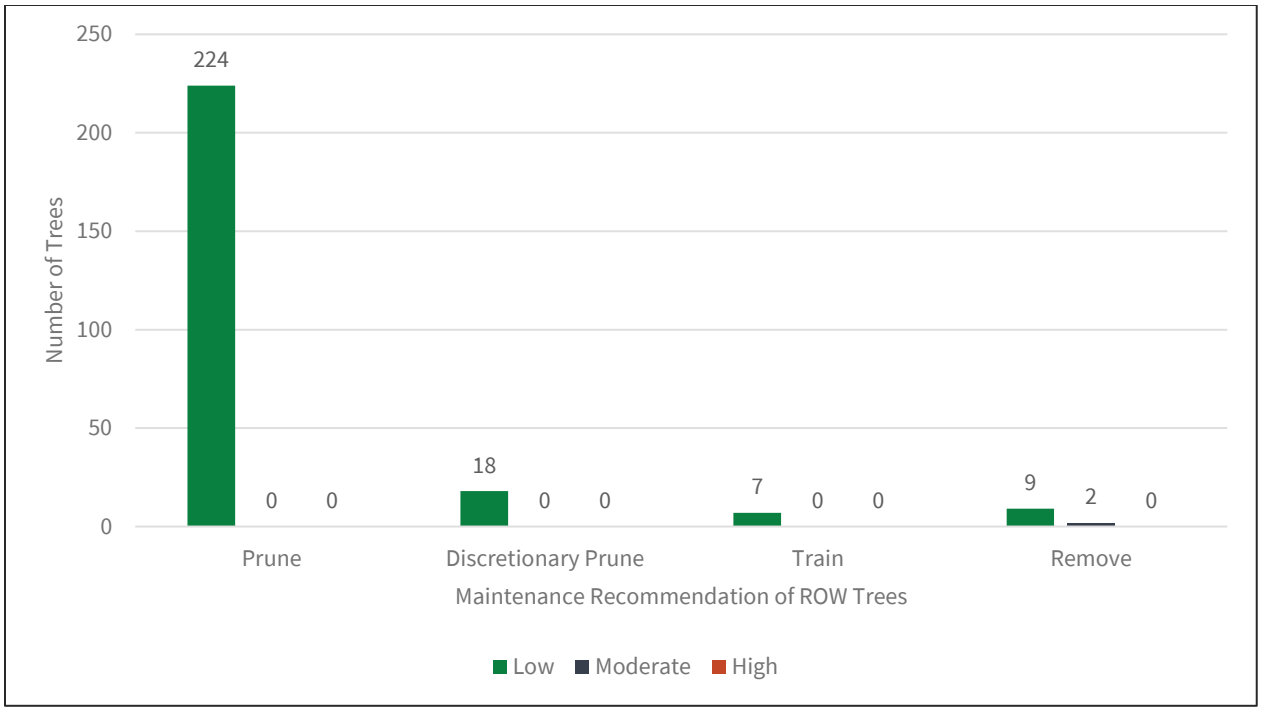


Figure 10. Street ROW Tree Maintenance recommendations according to risk level.

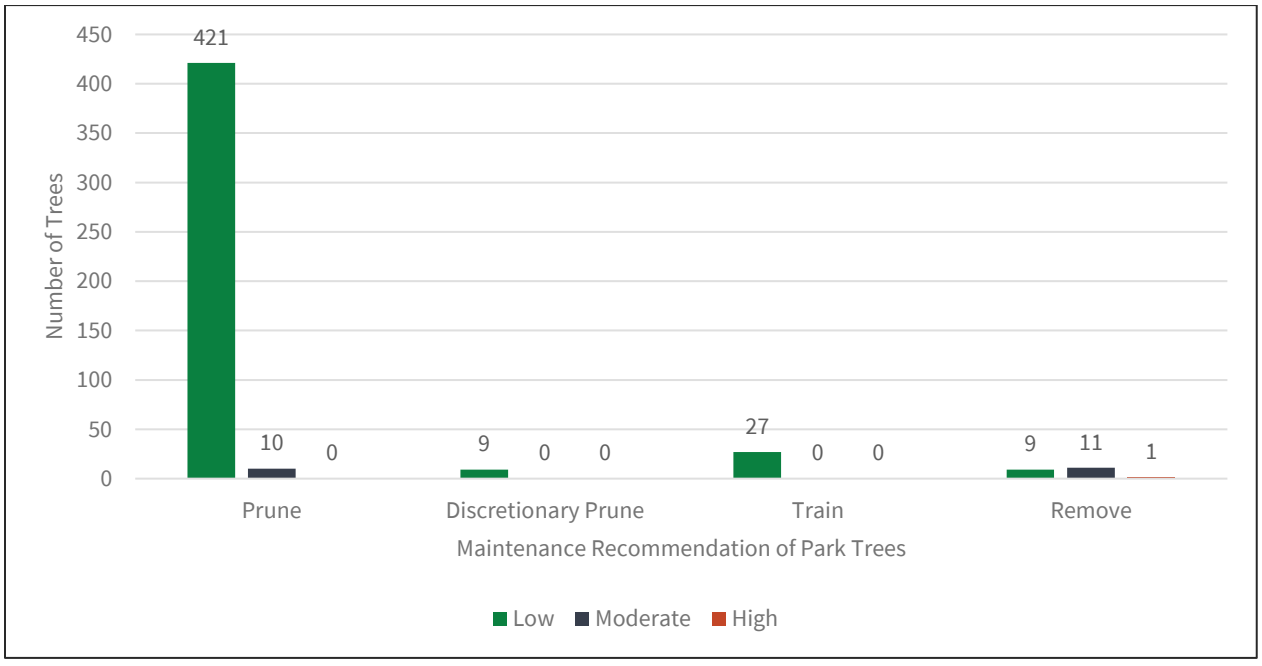


Figure 11. Park Tree Maintenance Recommendations according to risk level.

ROUTINE PRUNING CYCLE

The routine pruning cycle includes all Low Risk trees with a primary maintenance need of 'prune'. These trees pose some risk but have a smaller defect size and/or a lower probability of impacting a target and, therefore, do not require priority maintenance. Over time, routine pruning can minimize reactive maintenance, limit instances of elevated risk, and provide the basis for a robust risk management program.

DRG recommends a five-year routine pruning cycle (see side panel, "Proactive Pruning") to maintain the condition of the inventoried trees. However, this is not always possible based on budgetary constraints, the size of the inventoried tree population, or both. In these cases, extending the length of the routine pruning cycle is an option; however, best practice is to not exceed a 10-year pruning cycle. Tree conditions have been shown to deteriorate significantly after 10 years without regular pruning as once-minor defects worsen, reducing tree health and potentially increasing risk.

A total of 672 trees were rated Low Risk with a maintenance recommendation of "prune" & "discretionary prune" and should be included in a routine pruning cycle (Figure 12).

PROACTIVE PRUNING

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.

ROUTINE PRUNING CYCLE RECOMMENDATIONS

- Weaverville should aim to prune 1/5 of its public trees each year during a five-year routine pruning cycle. A five-year cycle would see around 48 street trees and around 86 park trees assessed and pruned, if needed, each year.
- Trees which are currently recommended for priority pruning (Extreme, High, and Moderate Risk trees with a maintenance recommendation of "prune") should be added to the routine pruning cycle once their immediate defects and elevated risk are mitigated.
- Young trees which grow out of the young tree training cycle (see next section) should also be included in the routine pruning cycle.

- The number of trees to be assessed and routinely pruned each year will vary depending on the number of trees which are planted and the number of trees which are removed in future years.
- Not every tree in the routine pruning cycle will need to be pruned each cycle—thus, the actual cost to maintain a routine pruning cycle will likely be lower than projected in the budget table at the end of this section (Table 5).

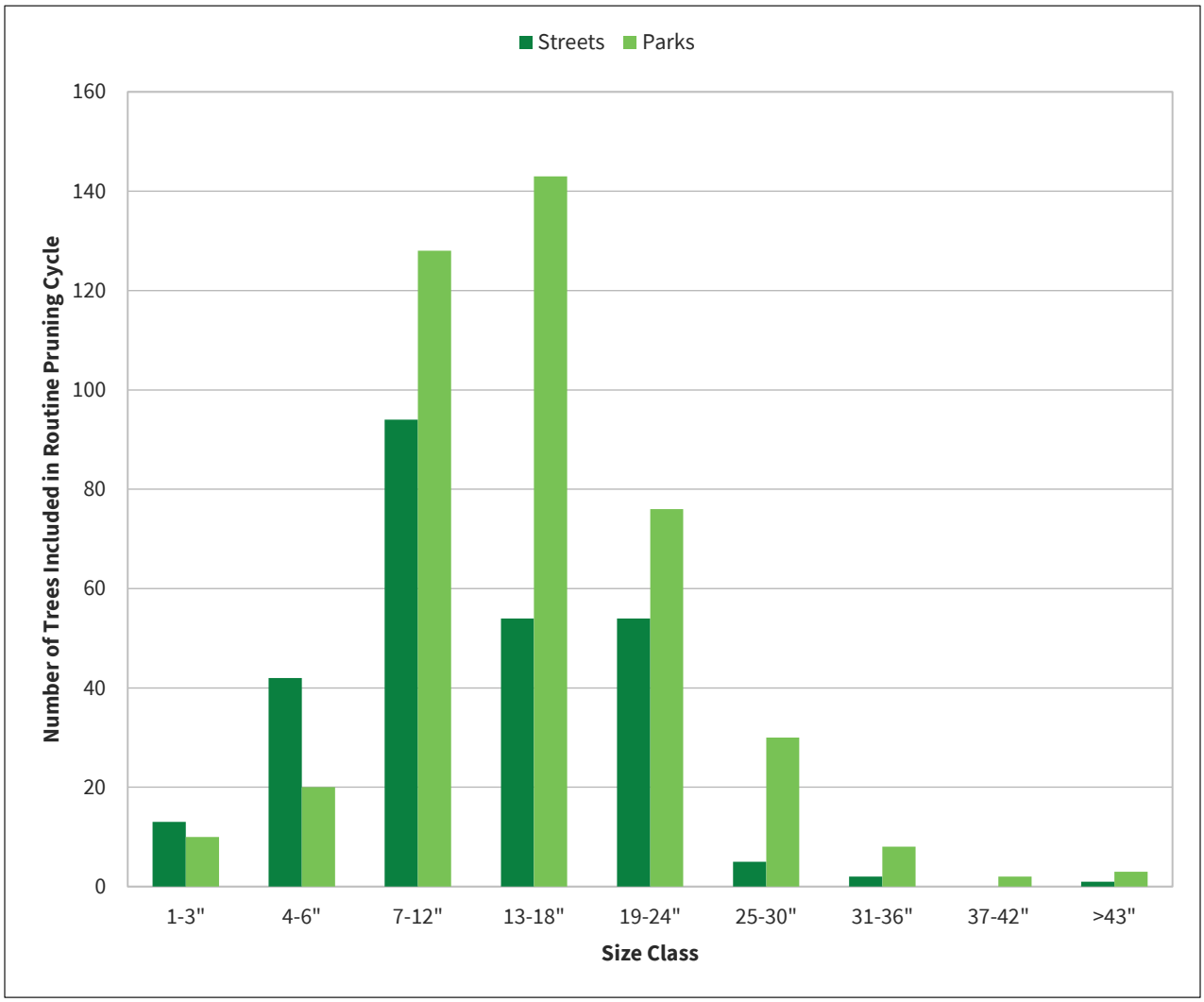


Figure 12. Trees included in the routine pruning cycle as of the completion of the inventory**.**

YOUNG TREE TRAINING CYCLE

Young tree training cycles are recommended to improve the form and structure of young, newly planted trees that are less than 6 inches in diameter. Young tree pruning addresses structural problems such as codominant leaders, multiple limbs attaching at the same point on the trunk, and crossing or interfering limbs that if not corrected can lead to problems as the tree ages.

A three-year cycle is recommended due to the rapid rate that young trees grow and the importance of correcting structural issues while the tree is young to reduce future risks and costly pruning when the tree is larger. The inventory identified 34 small, young trees which should be included in a young tree training cycle.

YOUNG TREE TRAINING CYCLE RECOMMENDATIONS

Weaverville should institute a three-year young tree training cycle beginning after the completion of all recommended higher priority work. With 34 young trees recommended for training at the time of the inventory, approximately 11 need to be assessed and pruned each year during the three-year cycle. In future years, the number of trees in the young tree training cycle will depend on the growth rates of young trees in the city and the number of new plantings.

Young tree training is recommended to begin one to two years after planting and continue every three years until the tree can no longer be safely pruned from the ground with a pole pruner and pruning shears.

- At the time of planting, new trees should be minimally pruned to remove broken or crossing branches.

Not every tree in the young tree training cycle will need to be pruned each cycle – thus, the actual cost to maintain a young tree pruning cycle will likely be lower than projected in the budget table provided at the end of this section (Table 5).

ROUTINE INSPECTIONS AND INVENTORY UPDATES

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. Ideally, the arborist will be ISA Certified and hold the ISA Tree Risk Assessment Qualification (TRAQ) credential. Level 1 and 2 assessments can be completed during regular tree maintenance activities, such as routine pruning, to streamline the process and reduce workloads and cost. 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.

ROUTINE INSPECTIONS AND INVENTORY UPDATE RECOMMENDATIONS

All public trees should be regularly inspected and attended to as needed. Inspections can be particularly effective and necessary after major storms which may cause damage to trees or increase the risk posed by trees.

- Level 1 walk-by or drive-by assessments can be a cost-effective method of inspection for public trees after storm events and can help identify trees which need further detailed inspection.

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 asset management software such as TreeKeeper® to make updates, edits, and keep a log of work records.

Level 2 risk assessments and inventory updates should also be completed on a routine basis, ideally every 5 to 10 years, to identify defects that are not easily observed during Level 1 assessments and to update tree inventory information.

- To keep costs regular, 1/5 of public trees should be re-inventoried each year. With a total of around 928 public trees in the current inventory not recommended for removal, approximately 185 would need to be updated each year during a five-year inventory update cycle.

TREE PLANTING AND STUMP REMOVAL

Routinely planting trees is an important part of maintaining and growing Weaverville's tree canopy and maximizing the tree benefits provided to the community. Opportunity exists in suitable vacant street sites and sites with stumps, as well as in parks and private property. During the inventory, 209 potential planting sites and 0 stumps were identified throughout Weaverville. Most available planting sites were located within parks.

Assessing a tree species growth characteristics, environmental preferences, and tolerance to urban conditions against a planting site's condition is essential when selecting a species for planting. Planting the "right tree in the right place" will ensure the tree thrives, increasing its benefits, improving tree survival and condition, reducing future tree care costs, and minimizing conflicts with other infrastructure. Throughout the parks, 75% of the vacant sites were suitable for a small tree, 24% were suitable for a medium tree, and 1% were suitable for a large tree.

TREE PLANTING AND STUMP REMOVAL RECOMMENDATIONS

- Stump removal should be included in tree removal contracts. Quality assurance and control checks of the contractor's work should be conducted to ensure that stumps are being removed fully and efficiently as part of the tree removal work.
- Stump removal should be done prior to targeted planting of any area to open locations for new tree planting. Planting in a location where a stump was recently removed should be avoided, if possible. Decomposing roots can cause air pockets, nutrient depletion, and space constraints that can impact the establishment of newly planted trees.
- Weaverville should strive to plant the largest possible tree in each vacant planting site. Large-stature, deciduous trees provide the greatest benefits to the community. See the strategies for providing sufficient growing space outlined in the Growing Space Recommendations section.
- To avoid loss of public trees, Weaverville should aim for, at minimum, a 1-for-1 replacement rate of planted trees to removed trees. Ideally, the community will surpass this and establish a 2-for-1 or even a 3-for-1 replacement rate, which will ultimately help to increase the community's public trees. The budget table (Table 5) assumes a 2-for-1 replacement strategy to show the costs of maintaining such a planting program.
- Tree species selection for planting should assess their tolerance to heat, drought, salt, and climate change, among other factors, and appropriate trees should be selected for each individual planting location.
- Where planting space along streets is limited and traditional street tree planting is not possible, the community should consider alternative options for installing and increasing public tree canopy, including:
    - Creation of pocket parks.
    - Improvement and maintenance of existing nearby parks and public grounds.
    - Setback planting programs designed to install public street trees behind the right-of-way but within 20 feet of the public way.
    - Encouraging planting of trees on private property via education, tree giveaways, and other methods.
- Where possible, Weaverville should enlarge and improve tree planting areas along streets by:
    - Enlarging the dimensions and soil volume of planting strips and planting wells.
    - Considering use of structural soils or Silva Cells to improve root movement through soils and reduce infrastructure conflicts.
    - Working with other city departments, such as engineering, to ensure that plans for new development or street improvement consider trees during the design process.
- Continue to seek out and apply for grant funding to support tree planting projects.
- Continue to develop and foster partnerships with groups such as the North Carolina Urban Forest Council and the North Carolina Forest Service who can help promote and support tree planting goals in the community.

MAINTENANCE STRATEGY AND EXAMPLE BUDGET

Using the Weaverville tree inventory data, an example 5-year annual maintenance schedule and budget is provided that details the recommended tasks to complete each year over (Table 5). Budget projections are based on Weaverville's current tree care contract rates, city staff costs, industry knowledge, and public bid tabulations. Following this schedule, or a similar schedule, can help shift the City's tree care program from reactive toward a more proactive model.

To implement the maintenance schedule, Weaverville's tree maintenance budget should be:

- No less than $70,000 for the first year of implementation.
- No less than $65,000 for the second year.
- No less than $40,000 for the third year.
- No less than $38,000 for the fourth year.
- No less than $34,000 for the fifth year.

These annual budget funds are needed to ensure that elevated risk trees are addressed as soon as possible, and that the vital young tree training and routine pruning cycles can be established. If routing efficiencies and/or contract specifications allow more tree work to be completed each year, or if this maintenance schedule requires adjustment to meet budgetary or other needs, then it should be modified accordingly. 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 5. Maintenance schedule and budget for a five-year tree management program

ACTIVITY COST			YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		FIVE-YEAR COST
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
High Priority Removals	1-3"	$30		$0		$0		$0		$0		$0	$0
	4-6"	$60		$0		$0		$0		$0		$0	$0
	7-12"	$250		$0		$0		$0		$0		$0	$0
	13-18"	$750		$0		$0		$0		$0		$0	$0
	19-24"	$1,200		$0		$0		$0		$0		$0	$0
	25-30"	$1,500		$0		$0		$0		$0		$0	$0
	31-36"	$2,000	1	$2,000		$0		$0		$0		$0	$2,000
	37-42"	$3,000		$0		$0		$0		$0		$0	$0
	>43"	$3,500		$0		$0		$0		$0		$0	$0
Activity Total(s)			**1**	**$2,000**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$2,000**
Moderate Priority Removals	1-3"	$30		$0		$0		$0		$0		$0	$0
	4-6"	$60		$0		$0		$0		$0		$0	$0
	7-12"	$250	1	$250		$0		$0		$0		$0	$250
	13-18"	$750	2	$1,500		$0		$0		$0		$0	$1,500
	19-24"	$1,200	6	$7,200		$0		$0		$0		$0	$7,200
	25-30"	$1,500	4	$6,000		$0		$0		$0		$0	$6,000
	31-36"	$2,000		$0		$0		$0		$0		$0	$0
	37-42"	$3,000		$0		$0		$0		$0		$0	$0
	>43"	$3,500		$0		$0		$0		$0		$0	$0
Activity Total(s)			**13**	**$14,950**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$14,950**
Low Priority Removals	1-3"	$30		$0	0	$0		$0		$0		$0	$0
	4-6"	$60		$0	2	$120		$0		$0		$0	$120
	7-12"	$250		$0	8	$2,000		$0		$0		$0	$2,000
	13-18"	$750		$0	4	$3,000		$0		$0		$0	$3,000
	19-24"	$1,200		$0	1	$1,200		$0		$0		$0	$1,200
	25-30"	$1,500		$0	3	$4,500		$0		$0		$0	$4,500
	31-36"	$2,000		$0		$0		$0		$0		$0	$0
	37-42"	$3,000		$0		$0		$0		$0		$0	$0
	>43"	$3,500		$0		$0		$0		$0		$0	$0
Activity Total(s)			**0**	**$0**	**18**	**$10,820**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$10,820**

ACTIVITY COST			YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		FIVE-YEAR COST
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
High Priority Pruning	1-3"	$30		$0		$0		$0		$0		$0	$0
	4-6"	$45		$0		$0		$0		$0		$0	$0
	7-12"	$125		$0		$0		$0		$0		$0	$0
	13-18"	$250		$0		$0		$0		$0		$0	$0
	19-24"	$350		$0		$0		$0		$0		$0	$0
	25-30"	$400		$0		$0		$0		$0		$0	$0
	31-36"	$500		$0		$0		$0		$0		$0	$0
	37-42"	$650		$0		$0		$0		$0		$0	$0
	>43"	$750		$0		$0		$0		$0		$0	$0
Activity Total(s)			**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$0**
Moderate Priority Pruning	1-3"	$30		$0		$0		$0		$0		$0	$0
	4-6"	$45		$0		$0		$0		$0		$0	$0
	7-12"	$125		$0		$0		$0		$0		$0	$0
	13-18"	$250		$0		$0		$0		$0		$0	$0
	19-24"	$350		$0	1	$350		$0		$0		$0	$350
	25-30"	$400		$0	3	$1,200		$0		$0		$0	$1,200
	31-36"	$500		$0	3	$1,500		$0		$0		$0	$1,500
	37-42"	$650		$0	2	$1,300		$0		$0		$0	$1,300
	>43"	$750		$0	1	$750		$0		$0		$0	$750
Activity Total(s)			**0**	**$0**	**10**	**$5,100**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$5,100**
Routine Inspection	Drive-by Assessment	$1	0	$0	0	$0	0	$0	0	$0	0	$0	$0
	Walk-by Assessment	$5	185	$925	185	$925	185	$925	185	$925	185	$925	$4,625
Activity Total(s)			**185**	**$925**	**185**	**$925**	**185**	**$925**	**185**	**$925**	**185**	**$925**	**$4,625**
Young Tree Training (3-year Cycle)	1-3"	$25	18	$450		$0	0	$0	18	$450		$0	$900
	4-6"	$35	13	$455		$0	0	$0	13	$455		$0	$910
	>6"	$55	3	$165		$0	0	$0	3	$165		$0	$330
Activity Total(s)			**34**	**$1,070**	**0**	**$0**	**0**	**$0**	**34**	**$1,070**	**0**	**$0**	**$2,140**

ACTIVITY COST			YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		FIVE-YEAR COST
Activity	Diameter	Cost/Tree	Count	Cost	Count	Cost	Count	Cost	Count	Cost	Count	Cost	
Routine Pruning (5-year Cycle)	1-3"	$25	6	$150	5	$125	5	$125	4	$100	3	$75	$575
	4-6"	$30	15	$450	13	$390	12	$360	12	$360	10	$300	$1,860
	7-12"	$100	50	$5,000	45	$4,500	45	$4,500	45	$4,500	37	$3,700	$22,200
	13-18"	$200	45	$9,000	42	$8,400	40	$8,000	40	$8,000	30	$6,000	$39,400
	19-24"	$300	26	$7,800	26	$7,800	26	$7,800	26	$7,800	26	$7,800	$39,000
	25-30"	$350	10	$3,500	7	$2,450	7	$2,450	6	$2,100	5	$1,750	$12,250
	31-36"	$400	4	$1,600	2	$800	2	$800	1	$400	1	$400	$4,000
	37-42"	$600	1	$600	1	$600	0	$0	0	$0	0	$0	$1,200
	>43"	$700	2	$1,400	1	$700	1	$700	0	$0	0	$0	$2,800
Activity Total(s)			**159**	**$29,500**	**142**	**$25,765**	**138**	**$24,735**	**134**	**$23,260**	**112**	**$20,025**	**$123,285**
Replacement Tree Planting and Maintenance	Purchasing	$250	14	$3,500	18	$4,500		$0	0	$0	0	$0	$8,000
	Planting & Watering	$200	14	$2,800	18	$3,600		$0		$0		$0	$6,400
	Mulching	$25	14	$350	18	$450		$0		$0		$0	$800
Activity Total(s)			**42**	**$6,650**	**54**	**$8,550**	**0**	**$0**	**0**	**$0**	**0**	**$0**	**$15,200**
Natural Mortality (1%)	Tree Removal	$750	10	$7,500	10	$7,500	10	$7,500	9	$6,750	9	$6,750	$36,000
	Stump Removal	$150	10	$1,500	10	$1,500	10	$1,500	9	$1,350	9	$1,350	$7,200
	Replacement Tree	$475	10	$4,750	10	$4,750	10	$4,750	9	$4,275	9	$4,275	$22,800
Activity Total(s)			**30**	**$13,750**	**30**	**$13,750**	**30**	**$13,750**	**27**	**$12,375**	**27**	**$12,375**	**$66,000**
Activity Grand Total			**464**		**439**		**353**		**380**		**324**		**1,960**
Cost Grand Total				**$68,845**		**$64,910**		**$39,410**		**$37,630**		**$33,325**	**$244,120**

Conclusion

When properly cared for, public trees offer valuable, enduring benefits that can significantly surpass the investments of time and resources put into their planting, maintenance, and eventual removal. **The 960 inventoried public trees generate at least $8454 annually in estimated benefits, including stormwater reduction, carbon sequestration, and air pollutant removal. It is important to note that these are just the quantifiable benefits provided by trees in the community**. The complete array of benefits from Weaverville's public trees extends far beyond what can be calculated through inventory data and i-Tree Eco modeling alone. The successful execution of the five-year maintenance program is expected to amplify the benefits that the community's public trees provide.

This five-year maintenance initiative, with a focus on proactive tree care, necessitates a substantial upfront investment. While addressing Extreme, High, and Moderate Risk trees through removal or pruning can be costly, it is a vital step to enhance public safety and reduce long-term tree maintenance expenses. Once this priority work is accomplished, the remaining tasks can be spaced out over a more extended period, as dictated by budget, staffing, or equipment availability. This Tree Inventory Analysis & Maintenance Strategy can assist the community's tree care staff in advocating for increases in the urban forestry budget to support the recommended maintenance efforts.

The community's forestry program is making commendable progress toward cultivating a sustainable and resilient urban forest. To stay on course, it is crucial to establish clear goals, take action to achieve those goals, regularly update inventory data to assess progress, and be prepared to revise objectives as needed in an iterative manner. The Urban Forest Program Continuum, as designed by DRG and illustrated on Page 2, can serve as a valuable roadmap for Weaverville as it continues its ongoing mission to elevate the care of the community's public trees. This mission will enrich the lives of all residents, workers, and recreational enthusiasts within the Town of Weaverville.

EVALUATING AND UPDATING THIS PLAN

This *Public Tree Inventory Analysis & Maintenance Strategy* provides management priorities for the next five years. To ensure the maintenance schedule and budget remain accurate, it is important to update the tree inventory using TreeKeeper® or other asset management software as work is completed, so the software can provide updated species distribution, maintenance needs, and benefit estimates.

Keeping the inventory up to date empowers the community to assess its progress over time and set goals to strive toward by following the adaptive management cycle (flow chart). Below are some examples of implementing the steps of this cycle:

- Preparing planting plans 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 and adjusting future planting plans accordingly.
- Annually comparing the species distribution of the inventoried trees with the previous year after completing planting plans to monitor recommended changes in species and genera abundance.
- Scheduling and assigning high-priority tree work so it can be completed as soon as possible and not reactively addressing new lower priority work requests as they are received.
- Including data collection, such as measuring DSH and assessing condition into standard procedure for tree work and routine inspections, so changes over time can be monitored.

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Appendix A
Summary of Recommendations

Section	Recommendation
Species & Genus Diversity	• Avoid or limit planting of black walnut and tulip trees and increase planting of other species until black walnut and tulip trees make up less than 10% of public trees. • Remove volunteer trees that have invasive tendencies, such as Bradford pear, Norway maple, and paper mulberry from maintained public areas while small. • Increase planting of uncommon species and genera which are well suited to urban environments.
Pest Susceptibility	• Monitor trees for signs and symptoms of pests and diseases on a regular basis. This can be done as part of other routine maintenance activities such as pruning. • When a pest or disease is suspected, act quickly to confirm the identification and begin management. • Prepare an invasive species management plan to guide the response to future pest or disease infestations. The tree inventory reflects a portion of the community forest. When assessing pest susceptibility, it is important to also consider privately managed trees, which may include vulnerable species not captured in the inventory. • Spotted lanternfly can host on many tree genera but prefer tree of heaven. Consider removing or otherwise managing tree of heaven populations to reduce the suitability of Weaverville's urban forest to host spotted lanternfly. • When planting trees, select pest- or disease-resistant species or cultivars whenever possible. • Use preventative pesticide treatments on high-value or historic trees that are susceptible to problematic pests and/or diseases in Weaverville.
Condition	• Dead and dying trees should be removed as soon as possible in priority order from highest to lowest risk to reduce public hazards, create space for new planting, and improve the appearance of Weaverville's streets and parks. • Trees in Poor condition not recommended for removal should be maintained to reduce risk associated with defects and should be routinely monitored for further decline that would necessitate removal. • Condition ratings can be improved over time by instituting proactive maintenance cycles such as routine pruning and young tree training. All tree pruning should follow ANSI A300 (Clause 5) guidelines.

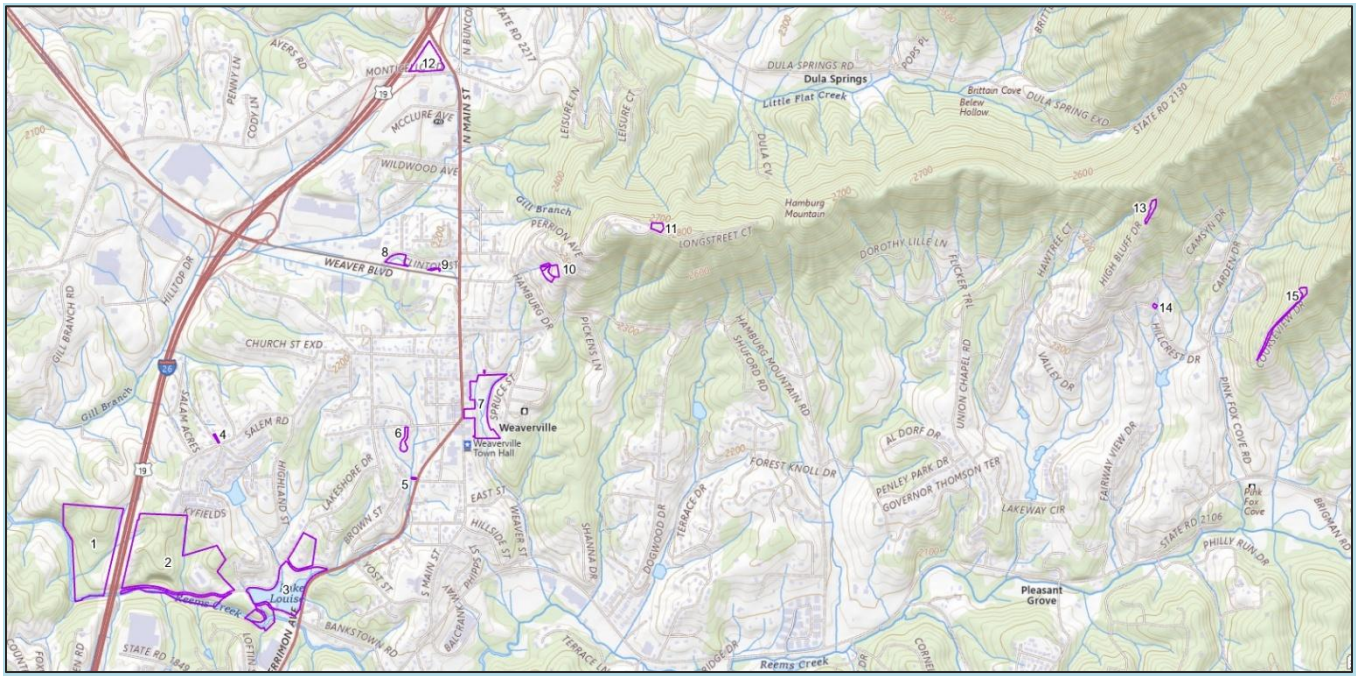
Section	Recommendation
Relative Age Distribution	• The Town of Weaverville's park trees are aging. Weaverville should focus on tree preservation and proactive care for these large-stature trees, and a succession plan should be implemented to ensure that as mature park trees decline in health and are removed, young trees are planted to take their place. • A large proportion of trees are established (45% of street trees and 45% of park trees). A routine pruning program should be instituted to structurally prune and remove dead wood to ensure good form and improve health as they mature. • Street tree planting is currently sufficient to maintain the recommended age distribution. However, sustained planting efforts over time will be necessary to retain this age distribution. • Routine, proactive maintenance, such as young tree training and routine pruning, may help improve tree condition, particularly among maturing and mature trees.
Infrastructure Conflicts	• Weaverville should reduce tree conflicts with overhead electric lines by planting only small stature trees beneath or near overhead electric utilities. • Consider looking for dwarf or small cultivars of typically large-stature trees to diversify small-stature planting lists. • Tree roots can damage water and sewer pipes, gas lines, and electric conduit. Installation and maintenance of these utilities often results in cut tree roots, which may destabilize trees and cause tree failure, reduce tree vigor, or kill the tree. • Private trees are not included in the inventory, yet they can also conflict with infrastructure. To address this, education and resource-sharing efforts should be directed toward private property owners to promote proactive management and reduce potential impacts. • Right tree, right place. Select tree species based on characteristics of their root systems that match the planting site. Develop standards for tree planting which require specific growing space dimensions and/or soil volumes for various sizes of tree. Planting only small trees where the growing space and soil volume is restricted will help reduce hard-scape damage issues due to tree root growth. • Develop standards for sidewalk, road, private property, and other hardscape design and construction that are tree friendly and are able to accommodate tree root growth and reduce future conflict. • Encourage collaboration between city planning, engineering, and tree management departments. Considering trees early in the planning process when repairing or redesigning streets and sidewalks allows greater flexibility in the strategies used to ensure trees can be a productive part of the new streetscape.

Section	Recommendation
Infrastructure Conflicts (Continued)	• Consider a variety of strategies for incorporating sufficient growing space into street and sidewalk designs, including enlarging planting wells or sitting them on the back edge of the sidewalk adjacent to lawns, installing new tree wells or lawns, creating traffic bumps outs, and incorporating Silva Cell or structural soil technology into designs. • Implement a variety of techniques for retaining mature street trees despite conflicts with hardscape. If possible, reroute sidewalks or build temporary ramps of pavement or wood over tree roots rather than remove healthy, mature trees in favor of sidewalks repairs. • Recognize that many competing needs intersect when trying to site street trees. City streetscapes must balance needs for driving, parking, pedestrian access, overhead and underground utilities, street furniture, signage, lighting, winter snow removal, and many other considerations. Some areas will not be suitable for trees, and alternatives to street planting should be used in these areas instead of planting street trees.
Canopy Cover & Stocking Level	• Both stocking level and canopy cover can be used to set, measure, and track progress toward canopy cover and tree planting goals. • Goals should be achievable and tailored to the specific needs and challenges of Weaverville. Once initial goals are achieved, further goals can be set. This incremental method of progress can help build capacity and public support for tree planting and care over time. • The Town of Weaverville should consider planting additional trees in areas with low stocking level/ canopy cover. Creativity may be required in heavily built-up areas of the community, and programs that promote planting trees on private property or parks may be viable alternatives, when site constraints limit street tree planting. • Most trees typically reside on private property so, achieving canopy growth goals depends on active participation beyond publicly managed trees. Public education and awareness initiatives are recommended to engage property owners in supporting canopy expansion and sustaining a healthy urban forest.
Tree Benefits	• Large-stature, deciduous trees tend to provide the greatest benefits. Weaverville should plan to plant these types of trees wherever possible to increase the benefits provided by the public trees. This may require enlarging existing tree planting spaces or creating large new tree planting spaces to accommodate large street trees. It also should include preserving existing large-stature trees and providing proactive care to young public trees to ensure they achieve mature status in the future. • The protection of existing park trees should be a priority, and succession planning to replace park trees and increase tree cover in parks will have a large positive impact on tree benefits in Weaverville in the future. • The public trees in Weaverville account for only a fraction of the total benefits provided by the Town's trees indicating that many of the trees which provide benefits to Weaverville are located on private property. Weaverville should consider methods to preserve existing trees and promote new tree planting on private property throughout the city to increase tree benefits.

Section	Recommendation
Priority Maintenance	• Trees with Extreme or High-Risk ratings recommended for removal should be removed immediately and prioritized based on their risk rating and size class. Tree removal is recommended when pruning will not correct the tree's defects, will not eliminate the risks caused by defects, or when pruning would be cost-prohibitive. • Trees with Extreme or High-Risk ratings recommended for pruning should be pruned immediately and prioritized based on their risk rating and size class. Priority pruning and removals can be performed at the same time to increase efficiency of maintenance crews.
Routine Maintenance	• Weaverville should aim to prune 1/5 of its public trees each year during a five-year routine pruning cycle. A five-year cycle would see around 48 street trees and around 86 park trees assessed and pruned, if needed, each year. • Trees which are currently recommended for priority pruning (Extreme, High, and Moderate Risk trees with a maintenance recommendation of "prune") should be added to the routine pruning cycle once their immediate defects and elevated risk are mitigated. • Young trees which grow out of the young tree training cycle (see next section) should also be included in the routine pruning cycle. • The number of trees to be assessed and routinely pruned each year will vary depending on the number of trees which are planted and the number of trees which are removed in future years. • Not every tree in the routine pruning cycle will need to be pruned each cycle—thus, the actual cost to maintain a routine pruning cycle will likely be lower than projected in the budget table at the end of this section (Table 5). • At the time of planting, new trees should be minimally pruned to remove broken or crossing branches. • To keep costs regular, 1/5 of public trees should be re-inventoried each year. With a total of around 928 public trees in the current inventory not recommended for removal, approximately 185 would need to be updated each year during a five-year inventory update cycle.

Appendix B
Study Area and Data Collection

STUDY AREA



The Town of Weaverville covers **2,054 acres** (**3.21 square miles**), largely nestled in the narrow Reems Creek valley. Its terrain climbs steeply from around **2,000 feet** in elevation at Reems Creek to nearly **2,880 feet** on the ridgelines of Hamburg Mountain. Despite its modest size, the town includes **Lake Louise**, a more-than-five-acre man-made pond inside the 15.5-acre Lake Louise Park. On one side of the valley lies the Town's well-developed core—residential neighborhoods, shops, and civic spaces—while beyond the creek the land rises into forested slopes, a mix of conserved watershed terrain and natural green space, preserving much of Weaverville's mountain character.

The 2025 Weaverville inventory focused data collection within 14 town-owned plots of land including Lake Louise (3), Nature Park (7) and the Weaverville Fire Department (12). Other areas excluded from the inventory include the Police Firing Range (1), and street trees along North Main Street in Downtown Weaverville. All other spatial analyses (i.e., i-Tree Canopy) were restricted to the same area as inventory data collection.

DATA COLLECTION

DRG collects tree inventory data using a customized ArcGIS Online Field Maps, loaded onto a mobile device. At each site, the following data fields were collected:

Address	Overhead Utilities
Species	Comments
*DBH	Risk Rating
Multi-stem	Inventory Date

* measured in inches in diameter at 4.5 feet above ground or diameter at standard height (DSH]).

Maintenance needs are based on Best Management Practices: Tree Risk Assessment, Third Edition (International Society of Arboriculture 2025). The knowledge, experience, and professional judgment of DRG's arborists ensure the high quality of inventory data.

EQUIPMENT AND BASE MAPS

Inventory arborists use mobile devices with an external GNSS receiver. Geographic information system (GIS) map layers are loaded onto these units to help locate sites during the inventory. Arborists use a combination of GPS location data and aerial background imagery to locate and place each site.

ADDRESSING

In addition to XY geographic coordinates for each inventoried site, addressing information was also collected during the inventory with regard to the polygon number and park / street name. While geographic coordinates allow spatial representation of the data within a geographic information system, such as TreeKeeper® or ArcMap, addressing information allows each site to be located in the field without use of a GPS.

Appendix C
Risk Assessment

Every tree, regardless of defects, condition, location, and other factors, has an inherent risk of whole or partial tree failure. Risk assessment seeks to provide a metric of the level of risk associated with any given tree to allow for risk management to be undertaken by a tree manager. The current editions of *ANSI A300* (Clause 13) standards and the ISA's associated publication *Best Management Practices: Tree Risk Assessment* were used to guide an organized, systematic, and reproducible method for assessing tree risk.

Trees can have multiple modes of potential failure with varying levels of risk associated with each. During the inventory, the mode of failure with the greatest associated risk was recorded as the overall risk rating for the tree. The specified time frame for the risk assessment was one year.

Risk ratings can help tree managers set priorities and organize tree work. Generally, trees with higher risk ratings should be maintained or removed first, to lower the risk and liability associated with these trees. It is up to the tree manager to decide what level of risk is acceptable and under what circumstances.

LEVELS OF RISK ASSESSMENT

Arborists assess tree risk using different tools and at different levels of detail. ISA best management practices suggest three levels of risk assessment, from least to most intensive.

LEVEL 1: LIMITED VISUAL ASSESSMENT

A walk-by or drive-by assessment designed to quickly scan a large population of trees and identify those which need a more advanced assessment due to defects with an imminent or probable likelihood of failure. Level 1 assessments do not typically result in risk ratings but rather provide a list of tree locations with any recommended remedial action. A recommendation for which trees should be assessed at the next level of assessment may be recommended. This method may be a good option when funding for a full inventory and risk assessment is not available or after major storms when a rapid survey of damage is needed.

LEVEL 2: BASIC ASSESSMENT

A detailed, 360-degree visual inspection of individual trees assessing the site, roots, trunk, and branches resulting in an assessment of the tree's health and a risk rating that can be used to prioritize tree work within a large population of trees. DRG applies level two guidelines during most inventories and rapid tree assessments.

DRG arborists conducting a Level 2 risk assessment.

LEVEL 3: ADVANCED ASSESSMENT

Additional inspection following a Basic Assessment that uses specialized equipment to provide more detailed information about an individual tree, typically to help make management decisions about that specific tree. Advanced assessments may require use of a bucket truck to reach defects in the crown of the tree, equipment, and experience to perform sonic tomography to map decay pockets, or sampling of diseased plant tissue for identification in a lab, to name a few examples.

PROCESS OF RISK ASSESSMENT

The primary components of a risk assessment in line with the current editions of ANSI A300 (Clause 13) standards and the ISA's *Best Management Practices: Tree Risk Assessment* are as follows.

TIME FRAME

Tree risk should be assessed within a specified time frame. Since all trees are likely to experience whole or partial tree failure at some point during their existence, and since conditions of a tree and site can change dramatically over time, setting a specific time frame for risk assessment is essential to conveying risk accurately and determining appropriate management practices. Most risk assessments will have a specific time frame of one to three years. Predictive power decreases as time increases, so assessments are not typically done for more than a five-year period.

LIKELIHOOD OF FAILURE

The first step in assessing tree risk involves determining the likelihood that the tree or tree part will fail within the specified time frame. Site factors, such as slope, soil texture and saturation, and recent grading or tree removals, are considered in tandem with tree factors such as health, species-specific failure profile, damage, and structural defects. The likelihood of failure is then characterized as either:

- ***Improbable*** **–** The tree or tree part is not likely to fail during normal weather conditions and may not fail in extreme weather conditions within the specified time frame.
- ***Possible*** **–** Failure may be expected in extreme weather conditions, but it is unlikely during normal weather conditions within the specified time frame.
- ***Probable*** **–** Failure may be expected under normal weather conditions within the specified time frame.

LIKELIHOOD OF TARGET IMPACT

The next step is to determine how likely it is that the tree or tree part in question will impact a target if it fails. This involves consideration of the potential targets located around a tree, which may include fixed structures such as houses or playground equipment with a constant occupancy rate and mobile targets such as people or vehicles with lower occupancy rates, as well as an assessment of where a tree or tree part will land if it fails. The likelihood of target impact is then characterized as either:

- ***Very Low*** **–** The chance of the failed tree or tree part impacting the specified target is remote.
- ***Low*** **–** There is a slight chance that the failed tree or tree part will impact the target.
- ***Medium*** **–** The failed tree or tree part could impact the target, but it is not expected to do so.
- ***High*** **–** The failed tree or tree part is likely to impact the target.

COMBINED LIKELIHOOD OF FAILURE & TARGET IMPACT

The likelihood of failure and the likelihood of impacting a target are combined using the matrix below to determine the likelihood of failure impacting a target.

Likelihood of Failure	Likelihood of Impacting 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

CONSEQUENCE OF FAILURE & TARGET IMPACT

The consequences of a tree failing and striking a target are a function of the value of the target and the amount of injury, damage, or disruption that could be caused by the failure and impact. Considerations when determining potential consequences include the size of the part which may fail, the fall distance, characteristics of the target, and whether there are any structures which may protect the target. Consequences of failure and target impact are characterized as either:

- *Negligible* – Does not result in personal injury, involves low-value property damage, or disruptions that can be replaced or repaired.
- *Minor* – Involves minor personal injury, low- to moderate-value property damage, or small disruption of activities.
- *Significant* – Involves substantial personal injury, property damage of moderate- to high-value, or considerable disruption of activities.
- *Severe* – Involves serious personal injury, high-value property damage, or major disruption of important activities.

RISK RATING

The combined likelihood of failure & target impact is then combined with the consequence of failure & target impact in the matrix, below, to produce a risk rating. There may be multiple modes of potential tree failure and multiple targets to consider, and each combination of failure and target will result in a different risk rating. The overall highest risk rating is usually used as the risk rating for the tree.

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

RISK MITIGATION, PRIORITIZATION, AND RESIDUAL RISK

Once a risk rating is assigned, the final step is to determine whether risk mitigation is necessary and prioritize risk mitigation work. Extreme and High-Risk trees should be managed first, followed by Moderate Risk trees as time and budgets allow, or as deemed necessary by the tree manager. Low Risk trees can typically be maintained during routine maintenance cycles or when time and budgets allow.

Risk mitigation can take many forms. Common methods of mitigation include tree removal or pruning to remove parts that may fail. Other forms of mitigation may include cabling and/or bracing weak branch unions, moving targets such as sheds or play equipment outside the anticipated impact zone, excluding targets from the impact zone using fencing or other barriers, and/or monitoring the tree. Ultimately, it is up to the tree manager to decide what mitigation techniques are appropriate for each tree and what level of risk is acceptable.

Residual risk is the risk remaining after mitigation and considering the residual risk after a mitigation action may help tree managers determine the best actions to take. For example, a tree with a large dead limb over a busy intersection might have a High-Risk rating, but removal of that limb would sufficiently mitigate the risk such that the residual risk is low. In this case, it may be best to remove the dead limb but retain the tree. In other cases, there may not be any mitigation option short of tree removal which will reduce risk to an acceptable level, in which case the tree should be removed.