APPENDIX B
MOORE SQUARE TREE INVENTORY & MANAGEMENT PLAN
THE BARTLETT INVENTORY SOLUTIONS TEAM

Moore Square
Tree Inventory & Management Plan | 2012

Prepared for
CCSGC, P.C.

Submitted by
The Bartlett Inventory Solutions Team

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MAKING THE MOST OF YOUR INVENTORY MANAGEMENT PLAN

Those who operate a large business or institution understand how inventory impacts operations and budgeting. One must know what's there, how much or how many, and where it all is. But the task doesn't end there. To obtain the greatest benefit from inventory, owners or their designees must *manage* it. Are a company's tools, for example, old and defective, in need of repair, in short supply, or useless and taking up space that could be better occupied?

A good management plan will address these issues and keep the inventory current, in good condition, and functioning for the benefit and safety of those involved.

Managing trees on a large property can seem like an overwhelming task, but the same principles of inventory management apply. This inventory and management plan should provide managers the data they need to develop realistic budgets for their tree maintenance needs, and it will help make Moore Square a safer and more beautiful environment.

The following tips will assist you in making the most of this document:

Who's Who

Those who conducted the inventory and prepared this document are members of the Bartlett Inventory Solutions (BIS) team. They are also employees of Bartlett Tree Experts and operate from the Bartlett Tree Research Laboratories in Charlotte, North Carolina. Readers may interpret the terms "Bartlett Tree Experts," "Bartlett," "the BIS team," "the team," "we," and "our" as the Bartlett company and those who conducted the inventory and prepared this management plan.

Subject Trees

In this document, the term "subject trees" refers (depending on context) to some or all of the 68 trees included in the inventory.

Definitions & Bolded Terms

Some definitions or specifications are detailed within a given section to explain how readers should interpret certain terms or classifications. We have also appended a Glossary for other terms that appear throughout the document. The first reference to each of these terms appears in bold for the reader's convenience.

How This Document is Organized

As usual, the Table of Contents provides an effective road map to document contents, but following it are a List of Tables and List of Maps that users will find helpful in locating specific findings, recommendations, or tree locations. Also, a handy outline appears on page 7 that introduces the order in which results, recommendations, and the Entire Inventory will appear. All tables, photos, maps, and diagrams have numbered captions for quick reference. Starting with the Introduction, pages are numbered consecutively up to the "Entire Inventory" at the back. So that it can stand alone as a main inventory document, the Entire Inventory starts over with page -1-.

EXECUTIVE SUMMARY

In October, 2012, the Bartlett Inventory Solutions (BIS) Team from Bartlett Tree Experts was retained by CCSGC, P.C. to conduct an inventory of trees on the Moore Square. We identified 68 trees or groupings of trees that included 46 different species. The attributes that we collected include tree latitude and longitude, size, age and condition class, and a visual assessment of tree structure, health, and **vigor**.

We conducted the attribute collection using a sub-meter accuracy Global Positioning Satellite Receiver (GPSr) device with an error-in-location potential of not greater than three meters. Our recommendations for the subject trees over the next three-year period include:

Pruning
Prune 17 trees (25 for safety, health, structure, and appearance. Pruning will comply with American National Standards Institute (ANSI) A300 for pruning and ANSI Z133.1 for safety.

Advanced Tree Risk Assessments (Level 3)
Provide an andvanced tree risk assessment for 5 trees (7%) to evaluate the impact of wood decay in **stems** and **buttress roots** that show potential for failure.

Cabling, Bracing & Ground Support
Install new structural support systems in 1 trees (1%) to reduce risk of branch or whole tree failure.

Root Collar Excavations
Perform **root collar** excavations to 31 trees (46%) to lower risk of damaging conditions such as **girdling roots**, basal cankers, masking of root decay and lower-stem decay, and predisposing trees to various insect and disease pests.

Plant Health Care (PHC)
Implement Bartlett's PHC program to monitor pests and diseases on the subject trees. Treatments are therapeutic and preventive, and treatment timing is based on pest life cycle.

Soil Samples
Collect soil samples throughout the landscape and submit them for analysis that includes presence of soil nutrients, pH, organic matter, and **cation exchange capacity**.

Bulk Density Samples
Collect bulk density samples throughout the landscape to determine the extent of **soil compaction**.

Root Invigoration
Perform Bartlett's patented Root Invigoration program on trees affected by construction activities to improve aeration and promote more efficient root growth, especially for high-value trees in disturbed areas.

INTRODUCTION

In October, 2012, CCSGC, P.C. retained Bartlett Tree Experts to perform an inventory of trees in Moore Square, Raliegh, NC. Team member Michael Sherwood visited the site on October 9th to work with Jeff Kish to conduct the inventory.

The inventory included:

- identifying trees
- identifying the trees' condition, health, and vigor;
- recommending risk evaluations and removals of appropriate trees;
- recommending pruning, soil care, and plant health care treatments to promote tree safety, health, appearance, and longevity; and
- mapping the trees using GPSr hardware and Geographic Information System (GIS) software.

The methods and procedures we used to make the above determinations and recommendations are detailed in the following sections.

GOALS & OBJECTIVES

An effective management plan communicates clear goals and the specific objectives designed to carry out those goals. We intend "goal" to mean the overall aim or result we expect to achieve for the client in producing the inventory and management plan. The objectives are the specific actions taken or recommended to support goal completion. Table 1 below describes each goal and its corresponding objective(s).

Table 1: GOALS & OBJECTIVES

GOAL	OBJECTIVES TO ACCOMPLISH GOAL
Establish the tree inventory (per numbers agreed) at Moore Square.	Using Trimble GeoXT GPSr hardware and ArgGIS 9.3 software, collect data such as tree name, location, size, age class, and condition class.
	Use existing tree id #'s provided by CCSGC, P.C.
Provide mechanism for managing inventory, recommendations, and related budget planning.	Provide map or maps of the inventoried trees and tree grouping to assist the client in managing property areas.
	Submit a comprehensive management plan that documents and organizes findings and provides other resources to assist the client in efficient use of the information.
Maximize client understanding and implementation of management plan.	Include in management plan specific explanations and visuals related to plan recommendations.
	Provide appended resources that address health, procedures, and preservation standards related to tree care.
	Make periodic contact with client to follow up and answer any questions about the management plan's contents.
Maximize immediate and long-term tree health and aesthetics.	Implement recommended plant-health-care program that uses • plant health care • soil care • maintenance pruning
Manage immediate and long-term risk associated with trees in high-use areas.	Implement recommended risk-management measures that include • risk-reduction pruning • required removals • tree structure evaluations

DATA COLLECTION & TREE INSPECTION METHODOLOGY

In conducting the inventory, we used specialized equipment and software and followed specific procedures to determine tree characteristics, risk evaluations, and recommendations. The following explanation will assist the reader in interpreting the findings of this management plan.

Data Collection Equipment & Attribute Data

The BIS team used the Trimble GeoXT global positioning system receiver (GPSr) hardware unit and accompanying ArgGIS 9.3 software. The attribute data we collected on site are listed below.

- botanical name and regional common name according to local ISA Chapter Tree Species List
- tree location based on GPS coordinate system
- tag number
- diameter at breast height (**DBH**)
- canopy radius
- age class
- height class

- condition class
- root zone infringement, based on **dripline** and estimated **grayscape** (e.g., sidewalks) impact on root zone
- infrastructure interaction (between trees and grayscape that may cause an undesirable condition
- priority of tree care (based on 3-year management plan)
- pruning
- need for and inspection of existing cables and braces
- need for and inspection of existing lightning protection
- need for advanced tree risk assessments (Level 3)
- tree removals
- soil care recommendations
- plant health care recommendations

Specifications/Definitions

Age Class

New Planting	Tree not yet established
Young	Established tree but not in the landscape for many years
Semi-mature	Established tree but has not yet reached full growth potential
Mature	Tree within its full growth potential
Over-mature	Tree that is declining or beginning to decline due to its age

Height Class

Small	Less than 15 feet
Medium	15 to 40 feet
Large	Greater than 40 feet

Condition Class

Dead	
Poor	Most of the canopy displays dieback and undesirable leaf color, inappropriate leaf size or inadequate new growth. Tree or parts of tree are in the process of failure.
Fair	Parts of canopy display undesirable leaf color, inappropriate leaf size, and inadequate new growth. Parts of the tree are likely to fail.
Good	Tree health and condition are acceptable.

Priority of Tree Care

Priority class recommendations are based on a three-year management plan that takes into consideration tree species, condition, location, age, and proximity to infrastructure. We intend that this rating system assist decision makers in prioritizing tree pruning, cabling and bracing, and tree lightning protection recommendations. *Trees with a priority of 1 and an Overall Risk Rating of Extreme or High (see definitions in the next section) should be addressed immediately.* Prioritization does not take into account any budgetary or financial considerations.

Recommendations for Priorities 1, 2, and 3 are all based on observations by the inventory arborist. The following additional information clarifies each priority class:

Priority 1 To be addressed in years 1 or 2 of the management cycle. Priority 1 may include trees with large dead wood, structural defects, located in exposed sites, high aesthetic value, and/or parts that are currently negatively interacting with infrastructure, such as branches that touch buildings, interfere with signage or lighting, or obstruct pathways.

Priority 2 To be addressed in years 2 or 3 of the management cycle. Priority 2 may include trees with small dead wood, developing structural defects, located in semi-exposed sites, moderate esthetic value, and/or parts that are anticipated to negatively interact with infrastructure, such as branches that touch buildings, interfere with signage or lighting, or obstruct pathways.

Priority 3 To be addressed in year 3 of the management cycle. Priority 3 may include trees with small dead wood, developing structural defects, located in lesser used sites, and/or parts that are anticipated to negatively interact with infrastructure, such as branches that rub on buildings, interfere with signage or lighting, or obstruct pathways.

Pruning

Each of the following is a selective pruning technique to achieve the pruning goal described:

Clean Remove one or more of dead, diseased, and/or broken branches

Raise Provide vertical clearance

Thin Reduce density of live branches

Reduce Reduce height or spread

Structure Select live branches and stems to influence orientation, spacing, growth rate, strength of attachment, and ultimate size of branches and stems

ISA Tree Risk Assessment & Risk Rating System

The International Society of Arborculture (ISA) developed a Tree Risk Assessment Protocol and Risk Rating System that Bartlett employs while conducting tree inventories. The BIS team conducts a basic tree risk assessment (Level 2) for each tree. When catergorizing tree risk the factors considered are the Likelihood of Tree Failure Impacting a **Target** and the Consequence of the Failure (Smiley *et al*. 2011). Examples of targets are people, vehicles, buildings, and other valuable objects. After assessing any targets the BIS team looks for any defects or conditions in the roots, stem, and crown that may impact a target. The team then estimates the Likelihood of a Tree Failure Impacting a Specified Target. The Consequence of Failure is then catergorized. An Overall Risk Rating is then estimated by entering the Liklihood of Failure and Impact and Consequences into the Risk Rating matrix.

The categories for Liklihood of Failure and Impact are: *Unlikely, Somewhat likely, Likely, and Very likely.*

The categories for Consequence of Failure are: *Negligible, Minor, Significant, and Severe.*

The categories for the Overall Risk Rating are: *Low, Moderate, High, and Extreme.*

The following tables describe the Overall Risk Rating in more detail:

Table 2: CONSEQUENCES OF FAILURE DEFINITIONS

Consequences of Failure	
Negligible	Low value property damage that can be replaced or repaired, and do not involve personal injury.
Minor	Low to moderate property damage, small disruptions to traffic and communications or very minor injury.
Significant	Moderate to high value property damage, considerable disruption, or personal injury.
Severe	Involves serious personal injury or death, high value property damage, or disruption of important activities.

*(Smiley *et al.* 2011)

Table 3: OVERALL RISK RATING DEFINITIONS

Overall Risk Rating	
Low	Some trees with level of risk may benefit from mitigation or maintenance measures, but immediate action is not usually required.
Moderate	Mitigation and/or retaining and monitoring may be recommended. The decision for mitigation and timing of treatment depends upon the risk tolerance of the tree owner or manager.
High	Mitigation measures should be taken. The decision for mitigation and timing of treatment depends upon the risk tolerance of the tree owner or risk manager.
Extreme	Failure is imminent and there is a high likelihood of impacting the target. Mitigation measures should be taken as soon as possible which may include immediate restriction or access to the target zone area to avoid injury to people.

*(Smiley *et al.* 2011)

Table 4: ISA MATRIX USED TO ESTIMATE THE OVERALL RISK RATING

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

*(Smiley *et al.* 2011)

Pruning and structural support system procedures can reduce the risk of branch and leader failure to an acceptable level. We emphasize, however, that *all large trees pose a certain degree of inherent risk and this evaluation does not preclude all possibility of failure especially during severe storms*.

For those trees that the client considers hazardous and representing an immediate safety concern, we recommend placing a sign, tape, or other warning indicator near those trees until such time as the hazard can be remedied.

Trees inherently pose a certain degree of risk from breakage, failure, or other causes and conditions. Recommendations that are made by the Bartlett Tree Experts Company are intended to minimize or reduce hazardous conditions that may be associated with trees. However, there is and there can be no guaranty or certainty that efforts to correct unsafe conditions will prevent breakage or failure of a tree. Our recommendations should reduce risk of tree failure but they cannot eliminate such risk, especially in the event of a storm or any other act of God. Some hazardous conditions in landscapes are apparent while others require detailed inspection and evaluation. While a detailed inspection and evaluation should and normally does result in the detection of potentially hazardous conditions, there can be no guaranty or certainty that all hazardous conditions will be detected.

RESULTS & RECOMMENDATIONS

In reviewing the results and recommendations, the reader will find useful the specifications and definitions detailed on pages 3-4 above. We used the following categories to organize the results and recommendations, which are displayed in tables:

- **Results**
  - Stand Dynamics – This characterizes the subject trees according to
    - Condition Class
    - Age Class
    - Tree Groupings
    - Tree Species Identified
    - Tree Size per DBH
    - Estimated Value
  - Conditions or Defects Observed
- **Recommendations**
  - Advanced Tree Risk Assessments (Level 3) and Tree Removal
  - Pruning and Structural Support Systems by ISA Risk Rating and Priority
  - Lightning Protection Systems
  - Soil Care
  - Plant Health Care
- **Entire Inventory**
  Due to the length and detail of this table, we placed it last, under a major heading, for handy reference.

Where appropriate, we have included explanations, photos, drawings, or other information to illuminate the table contents.

Stand Dynamics

Condition Class

The breakdown of tree condition follows:

Table 5: CONDITION CLASS BREAKDOWN

Condition Class	Quantity	% of Total
Good	33	49%
Fair	31	46%
Poor	4	6%
Dead	0	0%

Age Class

The breakdown of tree age class follows:

Table 6: AGE CLASS BREAKDOWN

Age Class	Quantity	% of Total
Over-mature	3	4%
Mature	43	63%
Semi-mature	12	18%
Young	10	15%

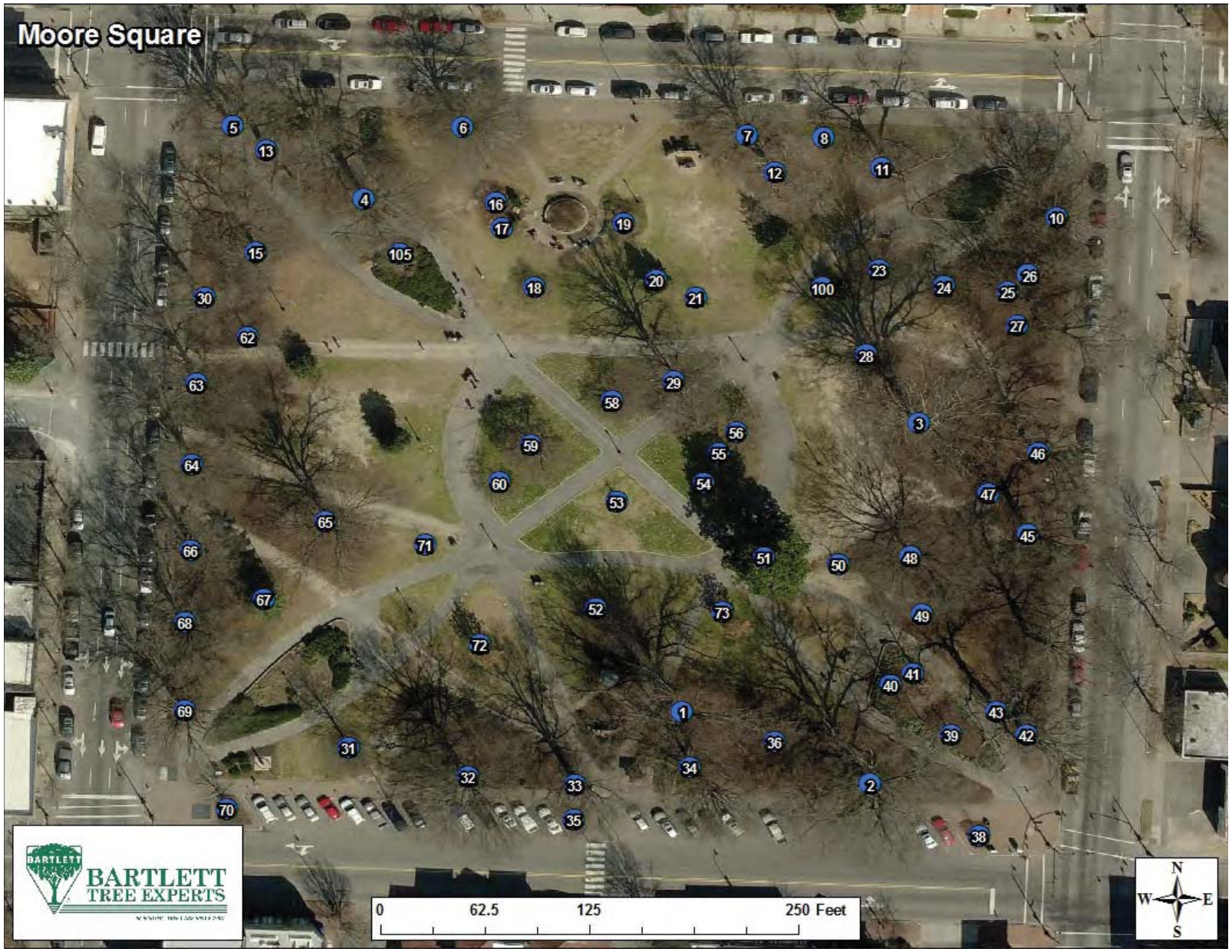
Tree Species Identified

Our inventory revealed 46 different species of trees, as detailed in the following table:

Table 7: TREE SPECIES IDENTIFIED

Genus	Species	Common Name	Count	% Distribution of Total
Acer	buergerianum	trident maple	1	1%
	campestre	hedge maple	1	1%
	palmatum	Japanese maple	9	13%
	rubrum	red maple	2	3%
	saccharum	sugar maple	1	1%
Acer Total			**14**	**21%**
Carya	illinoinensis	pecan	3	4%
Cedrus	deodara	Deodar cedar	1	1%
Cornus	florida	flowering dogwood	1	1%
Ilex	spp.	holly	2	3%
Magnolia	grandiflora	southern magnolia	1	1%
	x soulangiana	saucer magnolia	1	1%
Magnolia Total			**2**	**3%**
Malus	spp.	crabapple	1	1%
Picea	pungens	Colorado blue spruce	1	1%
Prunus	x yedoensis	Yoshino cherry	1	1%
Quercus	alba	white oak	2	3%
	michauxii	swamp white oak	5	7%
	nuttallii	Nuttall oak	1	1%
	palustris	pin oak	2	3%
	phellos	willow oak	24	35%
	prinus	chestnut oak	1	1%
	shumardii	shumard oak	2	3%
Quercus Total			**37**	**54%**
Sabal	minor	palmetto	1	1%
Taxodium	distichum	common baldcypress	3	4%
Ulmus	americana	hybrid elm	1	1%
Grand Total			**68**	**100%**

Map 1: 2012 TREE INVENTORY



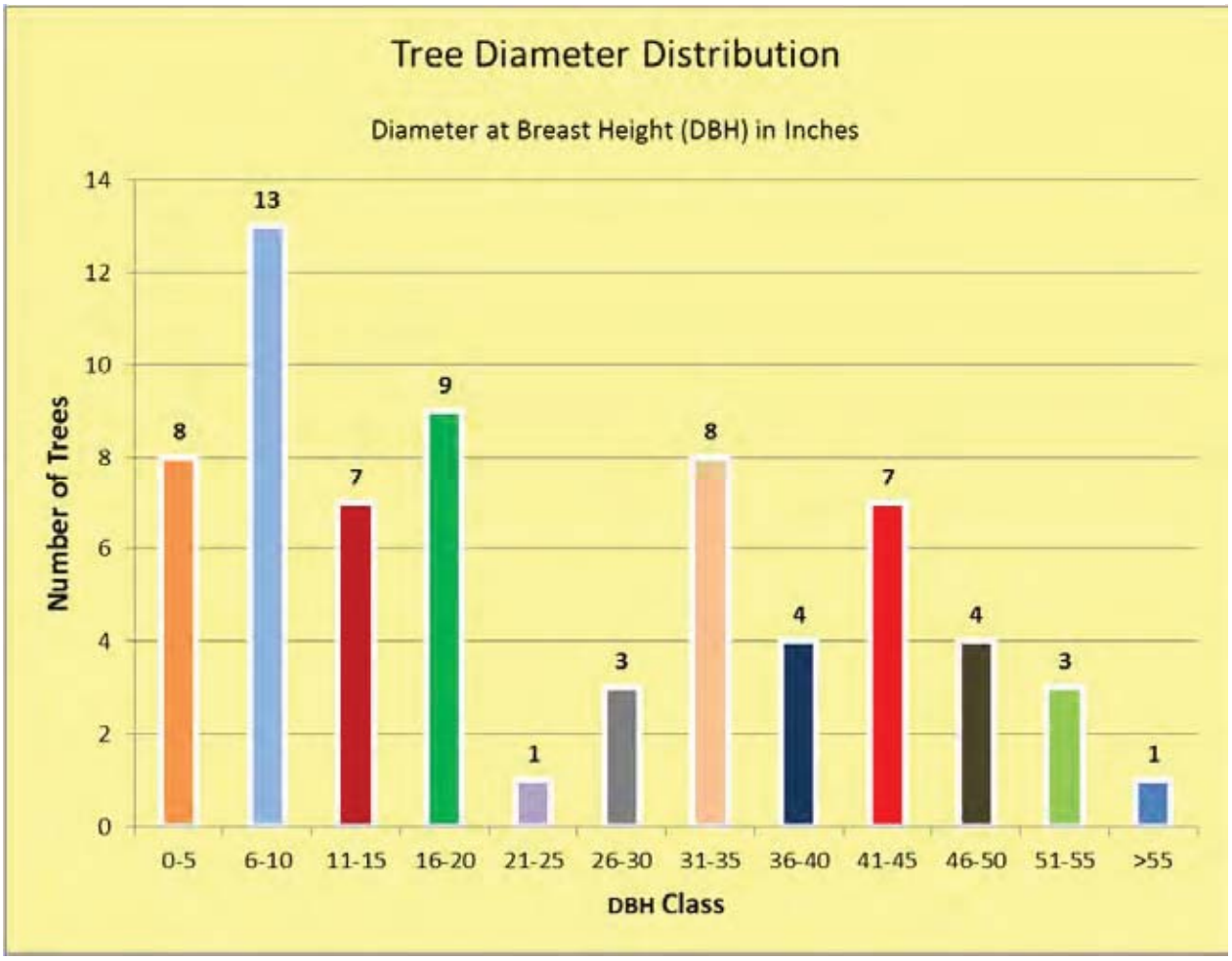
Map 2: TREES BY AGE CLASS

Map 3: TREES BY CONDITION CLASS

Tree Size (DBH)

The following chart illustrates numbers of trees according to size per DBH:

Table 8: TREE SIZE ACCORDING TO DBH



Estimated Value

As part of the Bartlett inventory process, we have included an estimated value for each tree and a cumulative total for all trees inventoried. To calculate the estimated value, we use a modified version[1] of the Trunk Formula Method published by the Council of Tree and Landscape Appraisers in *The Guide for Plant Appraisal,* 9th Edition.

[1] This version does not consider cost of purchase and installation of the largest available "like tree."

The following data fields are used in this formula:

Table 9: DATA FIELDS FOR DETERMINING ESTIMATED TREE VALUE

Estimated Value	Size, species factor, condition factor, and location value
Size	Based on tree DBH (4.5 feet above grade)
Species Factor	Relative species desirability based on 100% for the tree in that geographical location. In most cases, species desirability ratings, published by the International Society of Arboriculture, are used for adjustment.
Condition Factor	Rating of the tree's structure and health based on 100%
Location Factor	Average rating for the site and the tree's contribution and placement, based on 100%

The cumulative total value[2] for all trees inventoried is **$1,052,307.93.** The following table lists the eleven trees with the highest estimated values:

Table 10: TOP TEN TREES - HIGHEST ESTIMATED VALUE

Tree ID #	Common Name	DBH	Estimated Value
2	willow oak	65	$51,715.02
66	willow oak	46	$50,335.33
6	willow oak	4g3	$46,051.58
4	willow oak	53	$42,487.51
13	willow oak	50	$39,791.11
32	willow oak	48	$37,907.08
1	swamp white oak	52	$36,983.05
65	swamp white oak	40	$36,933.46
3	swamp white oak	51	$36,184.04
68	willow oak	46	$35,953.81

Map 4: TOP 10 TREES - HIGHEST ESTIMATED VALUE

Conditions or Defects Observed

Finally, in this (results) section, we list in Table 14 trees on which we observed conditions, defects, or other structural issues. Figure 1 provides an example of a tree with branch wound..

Figure 1: Tree #32 with a branch wound present.

Table 11: LIST OF TREES WITH CONDITIONS, DEFECTS, OR OTHER STRUCTURAL ISSUES

Tree ID #	Common Name	DBH	Condition or Defect	Condition or Defect	Condition or Defect
2	willow oak	65	wound-branch	storm damage	lightning damage
3	swamp white oak	51	wound-stem	deadwood >2	...
4	willow oak	53	deadwood <=2	...	...
6	willow oak	43	deadwood <=2	...	...
12	sugar maple	32	fungi/conks	...	...
16	Japanese maple	8	deadwood <=2	...	...
17	Japanese maple	4	deadwood <=2	...	...
18	paperbark maple	8	wound-stem	...	...
25	willow oak	17	supressed	...	...
26	willow oak	17	codominant leaders	...	...
27	willow oak	42	lean	...	...
28	willow oak	20	poor branch structure	...	...
29	white oak	37	fungi/conks	...	...
31	pin oak	18	girdling roots present	...	...
32	willow oak	48	wound-branch	...	...
34	willow oak	34	other	poor branch structure	...
39	common baldcypress	10	supressed	...	...
42	willow oak	36	uneven crown	wound-stem	...
43	pecan	36	lean	overextended branch	...
50	Yoshino cherry	11	wound-stem	...	...
51	southern magnolia	29	wound-stem	...	...
52	red maple	15	girdling roots present	cavity-stem	...
54	Japanese maple	12	wound-stem	...	...
56	Japanese maple	6	deadwood >2	...	...
58	Japanese maple	17	cavity-stem	...	...
59	Japanese maple	25	cavity-branch	codominant leaders	...
60	Japanese maple	16	wound-stem	wound-branch	...
71	red maple	5	wound-stem	...	...
72	swamp white oak	8	wound-stem	...	...

Advanced Tree Risk Assessments (Level 3) & Tree Removal

This section begins our coverage of recommendations. As part of the inventory process, the BIS team conducts a basic assessment (Level 2) from the ground. In this type of examination, the inspector can determine whether some aspect of tree structure or health indicates that a more comprehensive tree structure evaluation (Level 3) is needed to more thoroughly evaluate tree condition and risk of failure. Figure 2 provides an example of a tree defect that merits further evaluation.

Figure 2: The presence of fungal conks on Tree #29 necessitates an advanced tree risk assessment to more thoroughly assess internal decay and risk of failure.

In such cases, we may recommend advanced assessments of the roots, stem, or crown. These assessments may include climbing inspections, examination of the root system using a compressed-air tool (that avoids damage to roots and underground utilities), and one or more of the following: resistance drilling; the IML Resistograph, a precision drilling instrument that provides graphical output (preferred drilling method); or sound-wave examinations that produce estimates of decay percentages in targeted areas. The goal is to use the appropriate method to evaluate impact of wood decay in stems and buttress roots that show potential for failure and to determine presence and condition of the root system.

Once we complete such advanced assessments, we can then recommend appropriate measures, such as remediation, maintenance, or removal. (A technical report on tree structure evaluation appears in the Appendix.)

The trees listed in Table 12 below met the conditions for advanced assessments (Level 3).

Table 12: TREE RECOMMENDED FOR ADVANCED ASSESSMENTS (LEVEL 3)

Tree ID #	Common Name	DBH	Roots	Stem	Crown	Condition or Defect	Condition or Defect	Condition or Defect
2	willow oak	65	...	...	yes	wound-branch	storm damage	lightning damage
3	swamp white oak	51	...	...	yes	wound-stem	deadwood >2	...
11	pecan	32	...	...	yes	...	...	...
12	sugar maple	32	yes	yes	...	fungi/conks	...	...
29	white oak	37	yes	yes	...	fungi/conks	...	...

Map 5: TREES RECOMMENDED FOR ADVANCED ASSESSMENTS (LEVEL 3)

Pruning & Structural Support Systems

A commonly offered service among tree companies, pruning trees is one of the most poorly executed practices by tree workers who lack training in the basics of tree biology. "Lion's tailing," topping, and flush cuts are a few examples, and these can lead to hazardous conditions over time.

Because this practice is so misunderstood, and because specific standards exist to perform pruning correctly, the BIS team decided to include some explanation in the main body of this management plan.

Tree owners and tree-care practitioners should always keep in mind that *any pruning cut is a wound*. Informed tree-care professionals have learned to manage that wounding to preserve the health, safety, and integrity of the tree.

Improper Pruning Practices

A few of the most common pruning abuses are

- Lion's Tailing – pruning that removes interior branches along the stem and scaffold branches. This encourages poor branch taper, poor wind load distribution, and risk of branch failure. It also deprives the tree of foliage it needs to produce **photosynthates**. See Figure 4.
- Topping – pruning cuts that reduce a tree's size by using heading cuts that shorten branches to a predetermined size. This also deprives the tree of adequate foliage. See Figure 5.
- Flush Cuts – pruning cut through the **branch collar**, flush against the trunk or parent stem, causing unnecessary injury. See Figure 6.
- Using Climbing Spikes Inappropriately – Using climbing spikes on a healthy tree, for example, wounds healthy stem tissues and can lead to infection by fungal pathogens.

Figure 3: Black oval indicates general area of excessive foliage removal.

Figure 4: Examples of topping

Figure 5: Examples of flush cuts

Correct Pruning Practices

For specific standards on pruning practices, readers will find ANSI Standards on this topic in the Appendix. We have, however, included below some key pruning categories and diagrams to illuminate the goal of each.

Cleaning

Selective pruning to remove one or more of the following parts: dead, diseased, and/or broken branches.

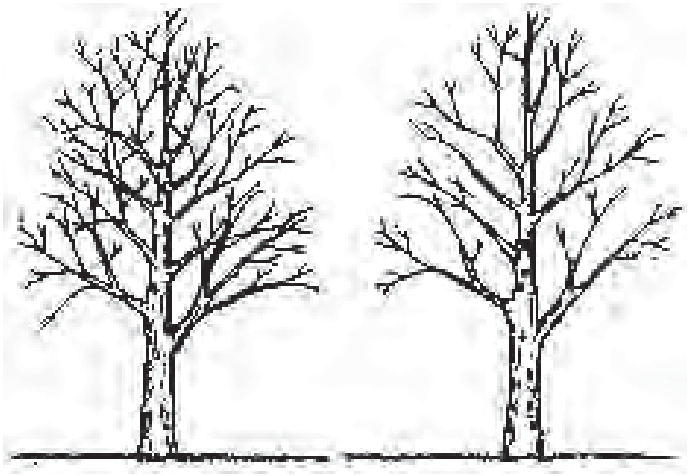


Figure 6: Illustration of crown cleaning

Raising

Selectively pruning to provide vertical clearance.

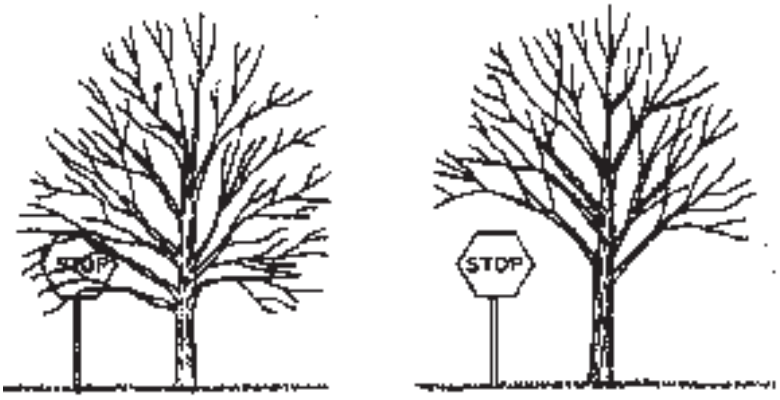


Figure 7: Illustration of crown raising

Thinning

Selective pruning to reduce density of live branches.

Figure 8: Illustration of thinning

Reducing (Reduction Pruning)

Selective pruning to reduce height or spread.

Figure 9: Illustration of reduction pruning

Structural

Selective pruning of live branches and stems to influence orientation, spacing, growth rate, strength of attachment, and ultimate size of branches and stems.

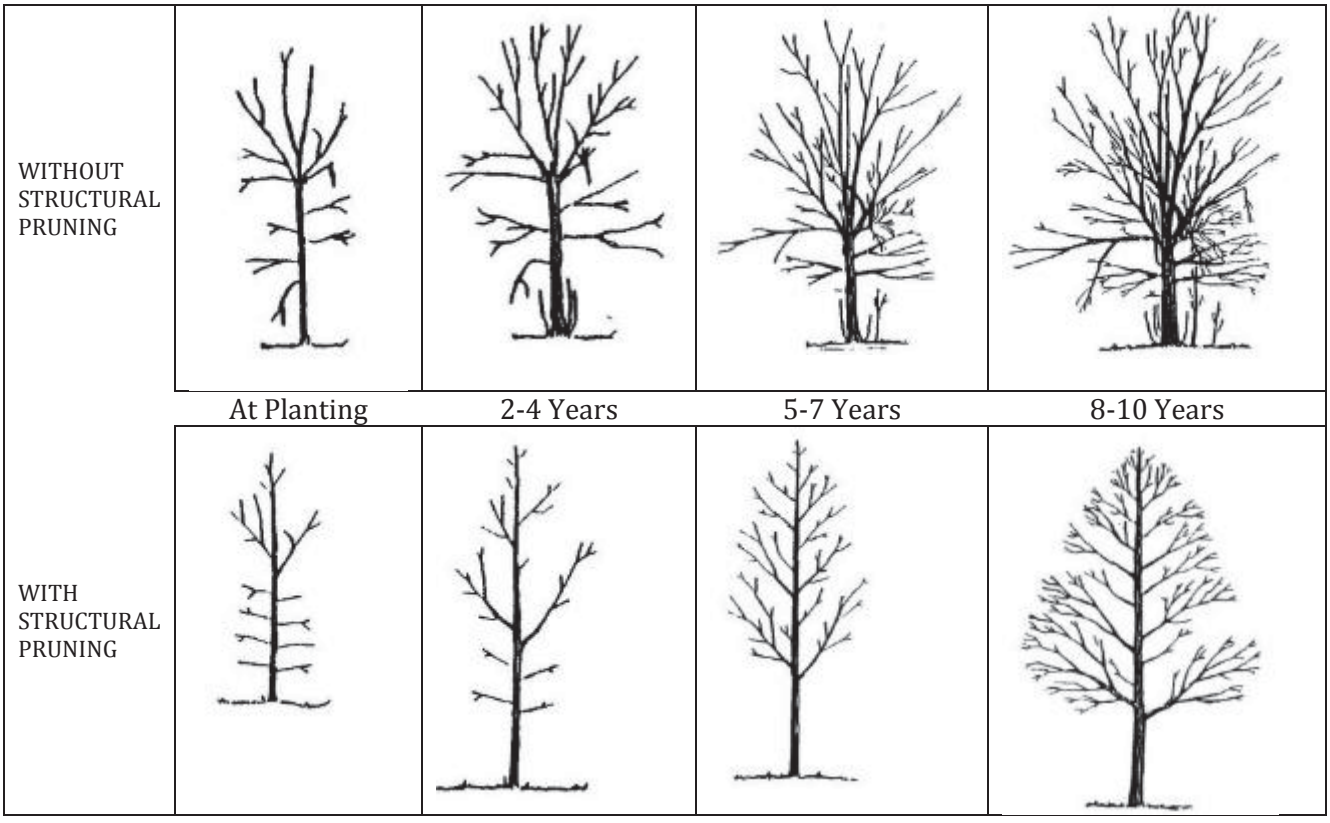


Figure 10: Illustration of structural pruning

We recommended pruning on the following trees:

Table 13: TREES RECOMMENDED FOR PRUNING

Tree ID #	Common Name	DBH	Tree Care Priority	Risk Rating	Clean	Thin	Structural
43	pecan	36	1	low	yes	...	...
3	swamp white oak	51	1	...	yes	...	...
21	Shumard oak	6	1	...	...	...	yes
36	willow oak	10	1	...	...	...	yes
38	hybrid elm	7	1	...	...	...	yes
45	willow oak	44	1	...	yes	...	...
49	Shumard oak	3	1	...	...	...	yes
100	palmetto	7	1	...	yes	...	...
4	willow oak	53	2	...	yes	...	...
6	willow oak	43	2	...	yes	...	...
16	Japanese maple	8	2	...	yes	...	...
17	Japanese maple	4	2	...	yes	...	...
18	paperbark maple	8	2	...	yes	...	...
31	pin oak	18	2	...	...	yes	yes
73	swamp white oak	8	2	...	...	...	yes
56	Japanese maple	6	3	...	yes	...	...
72	swamp white oak	8	3	...	...	...	yes

Map 6: TREES BY TREE CARE PRIORITY

Structural Support Systems

Cabling, bracing, and guying are structural support systems that can reduce risk of failure by limiting movement of stems or branches in certain situations. Examples include co-dominant stems or overextended branches with heavy foliage loads. Often cabling and bracing are combined with pruning to lighten the load on these branches or stems. Figure 12 illustrates a tree that could benefit from cabling.

We recommend that the following trees have new support systems installed:

Table 14: TREE RECOMMENDED FOR STRUCTURAL SUPPORT SYSTEMS

Tree ID #	Common Name	DBH	Tree Care Priority	Support System	Support System Details
43	pecan	36	1	yes	New 1

Map 7: TREES RECOMMENDED FOR STRUCTURAL SUPPORT SYSTEMS

Soil Care

Urban soils (as opposed to forest soils) are often mixed with the byproducts of construction activities that build our foundations, driveways, streets, parking lots, and other structures and grayscapes. This material compromises the physical, chemical, and biological properties that create healthy soils. Bartlett Tree Experts recommends several procedures and treatments that address soil quality. We address some of these below.

Soil Testing

Collecting soil samples and having them tested helps determine nutrients that may be lacking, unfavorable soil pH values, and adequacy of soil organic matter. Following laboratory test results, we can implement a prescription fertilization program to balance soil chemistry and optimize conditions for plant growth.

Mulch Application

Proper mulching provides many benefits to trees and shrubs. It moderates soil temperatures, reduces soil moisture loss, reduces soil compaction, provides nutrients, and improves soil structure. This practice results in more root growth and healthier plants. Mulch is frequently applied incorrectly, so we recommend that readers inspect the technical report on mulch application guidelines that appears in the Appendix. Figure 13 illustrates root growth density under grass versus mulch.

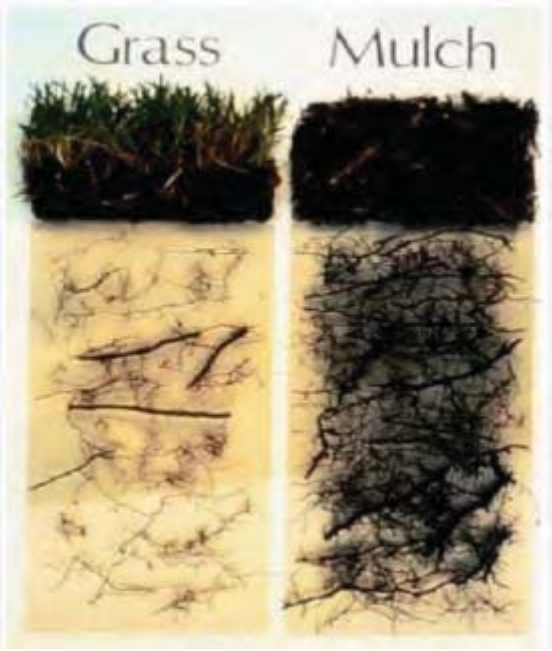


Figure 11: Example of root density under grass versus mulch

Bulk Density

Compacted soils are regrettably common in the urban setting. A bulk density test, which requires an undisturbed core sample, measures the level of soil compaction. Arborists can use the results to diagnose problems or to determine what size holes to dig for planting. If soil density exceeds a measured threshold for a given soil type and tree species, we recommend Bartlett's Root Invigoration program.

Root Invigoration

The aim of Bartlett's patented Root Invigoration Program is to improve soil conditions by addressing soil compaction and promoting efficient root growth, especially for high-value trees in disturbed areas. The process includes taking soil samples to determine what nutrients are deficient, performing a root collar excavation, "air-tilling" a portion of the root zone to find fine roots, incorporating organic matter, fertilizing (based on soil sample), and applying mulch. The area of the root system treated can vary by tree. For the Root Invigoration Program to be successful, proper watering techniques must be employed after the process is complete.

Root Collar Excavation

Excavating the root collar is necessary for trees whose buttress roots are covered by excess soil or mulch. Buried root collars can contribute to tree health problems, including girdling roots, basal cankers, and masking root and lower stem decay.

Figures 14, 15, and 16 provide examples of some of the above issues.

Figure 12: No root flare is visible at this tree's base. The root collar is buried.

Figure 13: Example of exposed root collar.

Figure 14: Example of improper mulch application, known as "volcano mulch."

The following trees are recommended for root collar excavations:

Table 15: TREES RECOMMENDED FOR ROOT COLLAR EXCAVATIONS

Tree ID #	Common Name	DBH
4	willow oak	53
5	white oak	35
6	willow oak	43
8	flowering dogwood	4
11	pecan	32
12	sugar maple	32
13	willow oak	50
15	pecan	27
16	Japanese maple	8
17	Japanese maple	4
18	paperbark maple	8
20	holly	9
21	Shumard oak	6
23	pin oak	20
30	willow oak	33
31	pin oak	18
35	trident maple	3
36	willow oak	10
49	Shumard oak	3
50	Yoshino cherry	11
52	red maple	15
53	Colorado blue spruce	7
59	Japanese maple	25
62	willow oak	18
65	swamp white oak	40
67	Deodar cedar	16
69	willow oak	43
70	Nuttall oak	4
71	red maple	5
72	swamp white oak	8
73	swamp white oak	8

Map 8: TREES RECOMMENDED FOR ROOT COLLAR EXCAVATION

Plant Health Care

The BIS team also recommends a Plant Health Care (PHC) Program for trees in the formal landscape. A PHC program monitors for potentially damaging insects, diseases and cultural problems that are often seasonal and were not evident during our inventory visits. These pests include, but are not limited to, the following:

- Anthracnose – on flowering dogwood
- Boring Insects – on a variety of tree species
- Caterpillar Defoliators – on a variety of tree species, especially oak
- Suspected Phytophthora Root Rot and Canker – on a variety of tree species, especially beech species
- Scab and Rust Fungi – on crabapple and apple species.
- Scale Insects – on a variety of tree species, especially oak
- Spider Mites – on a variety of tree species

We identified the following trees for a PHC program at this time:

Table 16: TREES RECOMMENDED FOR PHC PROGRAM

Tree ID #	Common Name	DBH	Pest or Disease
1	swamp white oak	52	cankers
23	pin oak	20	cankers
55	Japanese maple	15	scale
66	willow oak	46	borers
67	Deodar cedar	16	borers
70	Nuttall oak	4	mites
71	red maple	5	cankers

Map 9: TREES RECOMMENDED FOR PHC PROGRAM

ENTIRE INVENTORY

Table 17: ENTIRE INVENTORY

Tree ID #	Genus	Species	Common Name	DBH	Age Class	Height Class	Tree Care Priority	Estimated Value
1	Quercus	michauxii	swamp white oak	52	mature	large	...	$36,983.05
2	Quercus	phellos	willow oak	65	over-mature	large	...	$51,715.02
3	Quercus	michauxii	swamp white oak	51	over-mature	large	1	$36,184.04
4	Quercus	phellos	willow oak	53	mature	large	2	$42,487.51
5	Quercus	alba	white oak	35	mature	large	...	$24,772.58
6	Quercus	phellos	willow oak	43	mature	large	2	$46,051.58
7	Quercus	phellos	willow oak	29	mature	large	...	$23,873.61
8	Cornus	florida	flowering dogwood	4	semi-mature	small	...	$324.42
10	Quercus	phellos	willow oak	43	mature	large	...	$32,893.99
11	Carya	illinoinensis	pecan	32	mature	large	...	$25,315.33
12	Acer	saccharum	sugar maple	32	mature	large	...	$20,568.70
13	Quercus	phellos	willow oak	50	mature	large	...	$39,791.11
15	Carya	illinoinensis	pecan	27	mature	large	...	$18,394.89
16	Acer	palmatum	Japanese maple	8	mature	small	2	$1,816.78
17	Acer	palmatum	Japanese maple	4	semi-mature	small	2	$324.42
18	Acer	campestre	paperbark maple	8	semi-mature	small	2	$1,614.91
19	Magnolia	x soulangiana	saucer magnolia	5	mature	small	...	$551.97
20	Ilex	sp.	holly	9	mature	small	...	$2,120.52
21	Quercus	shumardii	Shumard oak	6	young	medium	1	$851.62
23	Quercus	palustris	pin oak	20	mature	large	...	$4,505.90
24	Malus	sp.	flowering crabapple	11	mature	medium	...	$1,908.25
25	Quercus	phellos	willow oak	17	semi-mature	large	...	$5,859.92
26	Quercus	phellos	willow oak	17	semi-mature	large	...	$5,859.92
27	Quercus	phellos	willow oak	42	mature	large	...	$31,839.61
28	Quercus	phellos	willow oak	20	mature	large	...	$4,866.37
29	Quercus	alba	white oak	37	mature	large	...	$27,184.25
30	Quercus	phellos	willow oak	33	mature	large	...	$21,570.24
31	Quercus	palustris	pin oak	18	semi-mature	large	2	$5,109.69
32	Quercus	phellos	willow oak	48	mature	large	...	$37,907.08
33	Quercus	phellos	willow oak	33	mature	large	...	$30,198.34
34	Quercus	phellos	willow oak	34	mature	large	...	$13,668.31
35	Acer	buergerianum	trident maple	3	young	small	...	$249.81
36	Quercus	phellos	willow oak	10	young	medium	1	$2,838.72
38	Ulmus	sp.	hybrid elm	7	young	medium	1	$540.93

39	Taxodium	distichum	common baldcypress	10	semi-mature	medium	...	$2,027.66
40	Taxodium	distichum	common baldcypress	13	semi-mature	medium	...	$4,797.43
41	Taxodium	distichum	common baldcypress	15	mature	medium	...	$6,387.11
42	Quercus	phellos	willow oak	36	mature	large	...	$15,089.47
43	Carya	illinoinensis	pecan	36	mature	large	1	$22,354.78
45	Quercus	phellos	willow oak	44	mature	large	1	$33,931.32
46	Quercus	prinus	chestnut oak	43	mature	large	...	$29,239.10
47	Ilex	sp.	holly	4	semi-mature	medium	...	$418.87
48	Quercus	phellos	willow oak	34	mature	large	...	$31,892.71
49	Quercus	shumardii	Shumard oak	3	young	small	1	$212.90
50	Prunus	x yedoensis	Yoshino cherry	11	mature	small	...	$1,363.03
51	Magnolia	grandiflora	southern magnolia	29	mature	large	...	$17,052.58
52	Acer	rubrum	red maple	15	mature	medium	...	$6,245.18
53	Picea	pungens	Colorado blue spruce	7	young	small	...	$419.50
54	Acer	palmatum	Japanese maple	12	mature	small	...	$2,919.82
55	Acer	palmatum	Japanese maple	15	mature	small	...	$6,387.11
56	Acer	palmatum	Japanese maple	6	mature	small	3	$729.96
58	Acer	palmatum	Japanese maple	17	mature	small	...	$5,859.92
59	Acer	palmatum	Japanese maple	25	over-mature	small	...	$17,741.98
60	Acer	palmatum	Japanese maple	16	mature	small	...	$7,267.12
62	Quercus	phellos	willow oak	18	semi-mature	medium	...	$9,197.44
63	Quercus	phellos	willow oak	41	mature	large	...	$30,767.92
64	Quercus	phellos	willow oak	34	mature	large	...	$31,892.71
65	Quercus	michauxii	swamp white oak	40	mature	large	...	$36,933.46
66	Quercus	phellos	willow oak	46	mature	large	...	$50,335.33
67	Cedrus	deodara	Deodar cedar	16	semi-mature	medium	...	$4,614.04
68	Quercus	phellos	willow oak	46	mature	large	...	$35,953.81
69	Quercus	phellos	willow oak	43	mature	large	...	$32,893.99
70	Quercus	nuttallii	Nuttall oak	4	young	medium	...	$338.12
71	Acer	rubrum	red maple	5	young	small	...	$693.91
72	Quercus	michauxii	swamp white oak	8	young	medium	3	$1,614.91
73	Quercus	michauxii	swamp white oak	8	young	medium	2	$1,614.91
100	Sabal	minor	palmetto	7	semi-mature	small	1	$1,390.97
105	Acer	palmatum	Japanese maple	9	mature	small	...	$985.44

LIST OF APPENDED ITEMS

Technical Reports

ANSI A300 (Part 1) – *2008* Pruning
Girdling Roots
Maintenance Pruning Program
Root Collar Disorders
Tree Structure Evaluation

Glossary

Bibliography

Smiley, E. T., N. Matheny, and S. Lilly. 2011. Best Management Practices: Tree Risk Assessment. International Sociecty of Arboriculture, Champaigne, IL.