City of Encinitas

Level 3 Assessment of Blue Gum Tree
Near 751 2nd Street
Asset I.D. # 5357TREE

SUBMITTED TO:

John Ugrob
Utility & Maintenance Supervisor
Street/NPDES Division
City of Encinitas

PREPARED BY:

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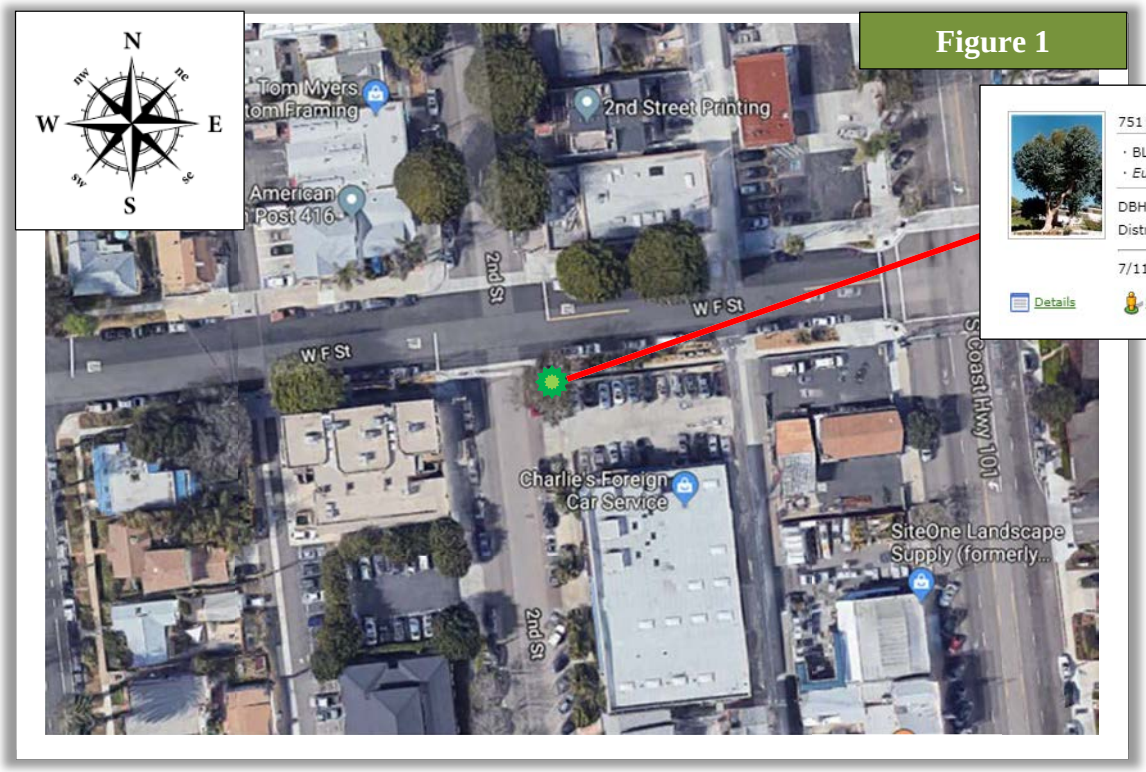
Qualified Tree Risk Assessor

SEPTEMBER 26, 2018

BACKGROUND AND ASSIGNMENT

In September of 2018, West Coast Arborists, Inc., (WCA) was contacted by the City of Encinitas in regard to the assessment of a Blue Gum (*Eucalyptus globulus*) tree located in front of 751 2nd Street. In ArborAccess (WCA's tree inventory database), the tree is inventoried as 751 2ND ST F-1 (see Figure 1 below).



The City's arborist had previously evaluated this tree and had concerns regarding its health and structure. The City requested that WCA perform a **Level 3 Advanced Assessment** to collect further information regarding the structure of the tree and the associated hazards to the community. Assessments performed as part of this report are valid for a period of two years from the date of inspection and are based on the conditions present at the time of inspection. This time frame should not be considered a guarantee period for the risk assessment.

OBSERVATIONS

I inspected the subject tree on September 18, 24, and 25 of 2018. On site, I performed a **Level 3 Advanced Assessment**[1] with the use of sonic tomography and a resistograph to assess potential trunk decays (see Appendix B for details)**.** I assessed the health and structural integrity of the tree using the **Best Management Practices (BMPs)** for tree risk assessment. I visually inspected the **crown** and **stem** of the tree, looking for structural defects such as **included bark**, **cavities**, **fungal fruiting bodies**, and/or **decay**. My inspection of defects in the crown was limited to a ground-level visual inspection. On site, I observed the following:

(Refer to photos in Appendix A)

- The tree was located on the north- west corner of 751 2nd Street within a parkway.
- The tree had a DSH[2] measurement of 49 inches and a height of about 40 feet.
- Judging by the color and density of the foliage, the tree was in fair to good health for the species and time of year. There was some chewing damage observed on some of the foliage (likely Eucalyptus tortoise beetle).
- There was a large fungal fruiting body resembling *Laetiporus gilbertsonii* on the north side of the tree near the base of the trunk surrounding a decaying wound. There were also remnants of what appeared to be more conks on the south-west side of the tree.
- Sounding wood for signs of decay was not very effective because of the large amount of exfoliating bark common on this species of Eucalyptus. Sounding around the root collar resulted in a dull resonance in several locations indicating some decay.
- The tree's canopy structure was fair, there were some defects such as a slight lean towards the north- east, some bark inclusions, and branches crossed over each other.
- The sidewalk adjacent to the tree had a light tone indicating it was likely replaced less than 10 years ago.
- The planting area surrounding the tree was irrigated by sprinklers. The trunk of the tree appeared to be getting sprayed by water frequently.

[1] Terms appearing in boldface type are defined in the Glossary at the end of this report.
[2] Diameter at Standard Height (DSH) is the trunk diameter measured 4.5 feet above grade level.

RISK ASSESSMENT

Risk Assessment Methodology

Data collected from tree inspection is used to derive a level of risk based on the matrices found in the ISA Best Management Practices (BMPs) for tree risk assessment (see Appendix C – Tree Risk Matrices). The level of risk determined (*low, moderate, high, or extreme*) is to be used by risk managers to help in tree management decisions. When assessing risk, the value of targets is taken into consideration in order to categorize the *consequences of failure* (*negligible, minor, significant, or severe*). The people who use and frequent the target zone are generally the most important target with buildings, structures, and cars being secondary in importance.

Limitations of Tree Risk Assessment

According to the *Tree Risk Assessment Manual,* published by the International Society of Arboriculture (ISA), it is impossible to maintain trees free of risk: "There is no way to guarantee that a tree will not fail. Tree benefits increase as the age and size of trees increase; however, some level of risk must be accepted to experience the benefits provided. The goal in assessing and managing trees is to strike a balance between the risk that a tree poses and the benefits that individuals and communities derive from trees."

"A considerable level of uncertainty is typically associated with tree risk assessment due to our limited ability to predict natural processes (rate of progression of decay, response growth, etc.), weather events, traffic and occupancy rates, and potential consequences of failure."

"Conditions affecting trees change constantly; none of us will ever be able to predict every tree failure. Conducting a tree risk assessment neither ensures nor requires perfection. Risk assessment should, however, ensure that all reasonable efforts have been made to identify the *likelihood of failure*, the *likelihood of impact*, and the *consequences of failure* present at the time of assessment."

"Abnormally extreme storms, such as tornadoes, hurricanes, and heavy freezing rain, are not predictable and, in most cases, are not considered for categorizing *likelihood of failure*."

Risk Assessment of Subject Blue Gum Tree

Likelihood of Failure[4]

After completing the advanced trunk assessment, the defect of greatest concern was basal/ root decay. This is due to the large clusters of fungal fruiting bodies (likely *Laetiporus gilbertsonii)*, evidence of asymmetrical basal/ root decay, a slight lean, and unknown root pruning history. *Laetiporus gilbertsonii* is a fairly aggressive parasitic brown rot fungi commonly found in mature Eucalyptus trees and it is known provoke unpredictable failures (e.g. tree falling over). In addition, this asymmetrical/ off-center decay is more prone to failures than a central decay with an intact shell of intact wood. The *likelihood of failure* because of basal/ root decay was assessed as **possible** within the next 2 years. This failure would most likely occur towards the north- east during a seasonal wind or storm event.

Likelihood of Impacting Target

Based on short-term observations of occupancy rates and protection factors, the likelihood of this possible basal/ root failure causing the tree to impact a target was assessed as *low* for a pedestrian and moving vehicle, *medium* for parked vehicles, and high for powerlines and the road itself.

Consequences

The consequences should a failure and target impact scenario occur were assessed as likely being *significant* for disruptions to the road or powerlines and *severe* for a pedestrian or vehicle.

Based on the categorization of the above risk factors, the Blue Gum tree under discussion is currently presenting an overall *moderate* risk. **Refer to Appendix C for an example of going through the risk assessment matrices for a specified failure and target(s).**

DISCUSSION AND RECOMMENDATIONS[3]

The subject tree was assessed as having an overall moderate level of risk (see Risk Assessment on page 4 & 5). In order to manage this tree and its potential hazards, I present two options:

Mitigation Pruning/ Monitoring – Perform an overall crown reduction of approximately 20 percent (about 8 feet) through the use of **reduction pruning** and **removal pruning cut** techniques. This crown reduction should lessen the mechanical forces applied on the tree's defects of concern and should achieve a reduction in risk to an overall low. For the remaining life of the tree, I would recommend maintaining the newly reduced canopy size and to have the tree periodically monitored for hazards and progression of decay. Adjustment of the irrigation to not spray the tree trunk should also be considered as this can expedite and facilitate wood decay.

Removal – Removal of the tree should be considered if the City does not view other mitigation options as fiscally reasonable for preservation of a tree with an incurable fungal disease that will continue to deteriorate its health and structure. This decision would completely eliminate the associated risks, and make space for a healthy new tree(s) to help beautify and diversify the City's urban forest. You would also lose all the benefits this mature tree is currently providing.

[3] It is with the health and safety of the community in mind for which I present these recommendations.

APPENDIX A – PHOTOS

Photo #1

- The tree was located on the north- west corner of 751 2nd Street within a parkway.
- The tree had a DSH[1] measurement of 49 inches and a height of about 40 feet.
- Judging by the color and density of the foliage, the tree was in fair to good health for the species and time of year.
- The tree's canopy structure was fair, there were some defects such as a slight lean towards the north- east, some bark inclusions, and branches crossed over each other.
- Sounding wood for signs of decay was not very effective because of the large amount of exfoliating bark common on this species of Eucalyptus. Sounding around the root collar resulted in a dull resonance in several locations indicating some decay.

APPENDIX A – PHOTOS

Photo #2

Close-up of fungal fruiting bodies

- There was a large fungal fruiting body resembling *Laetiporus gilbertsonii* on the north side of the tree near the base of the trunk surrounding a decaying wound. There were also remnants of what appeared to be more conks on the south-west side of the tree.
- The sidewalk adjacent to the tree had a light tone indicating it was likely replaced less than 10 years ago.

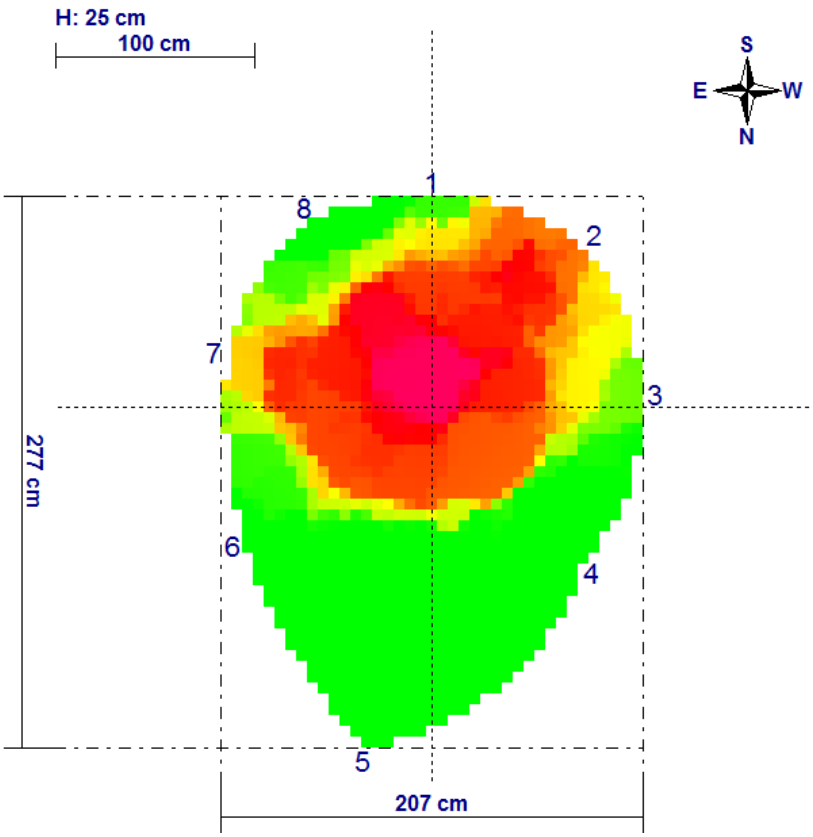
APPENDIX A – PHOTOS

Photo #3

- There was some chewing damage observed on some of the foliage (likely Eucalyptus tortoise beetle).
- The planting area surrounding the tree was irrigated by sprinklers. The trunk of the tree appeared to be getting sprayed by water frequently.

APPENDIX B – ADVANCED TRUNK ANALYSIS

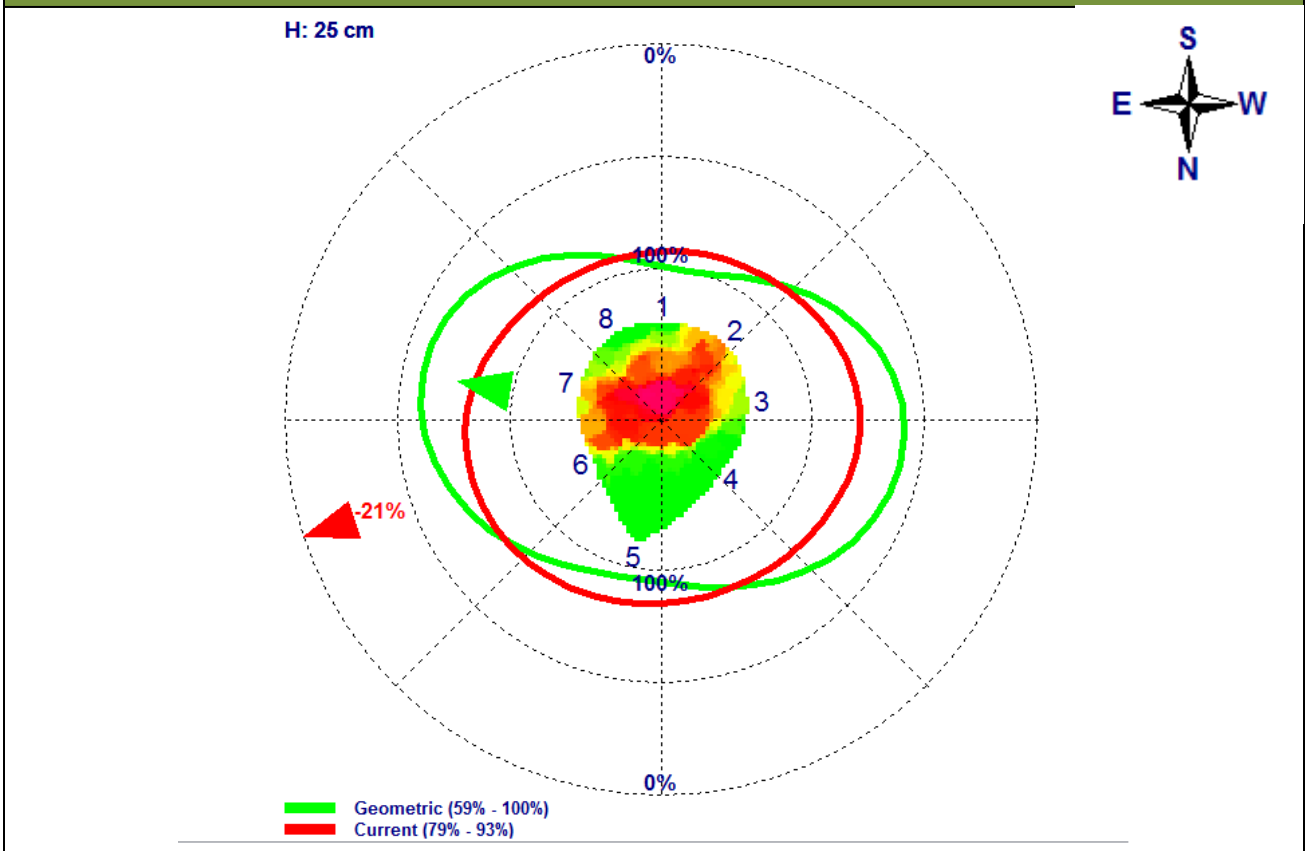
Sonic Wave Tomography (Arbotom)



The Arbotom is an impulse-detecting tomographic instrument: it simultaneously records the time that impulses or sound waves take to travel through wood from one sensor to others placed around a tree's cross-section. Sound waves travel more slowly through defective wood than through sound wood. After each sensor is tapped in turn to send sound waves to the other sensors, the differential measurements of the time each sound wave travels between sensors can be analyzed by the software. To determine more precise information, measurements with a resistograph were also taken (see page 12-15).

APPENDIX B – ADVANCED TRUNK ANALYSIS

Sonic Wave Tomography (Arbotom)

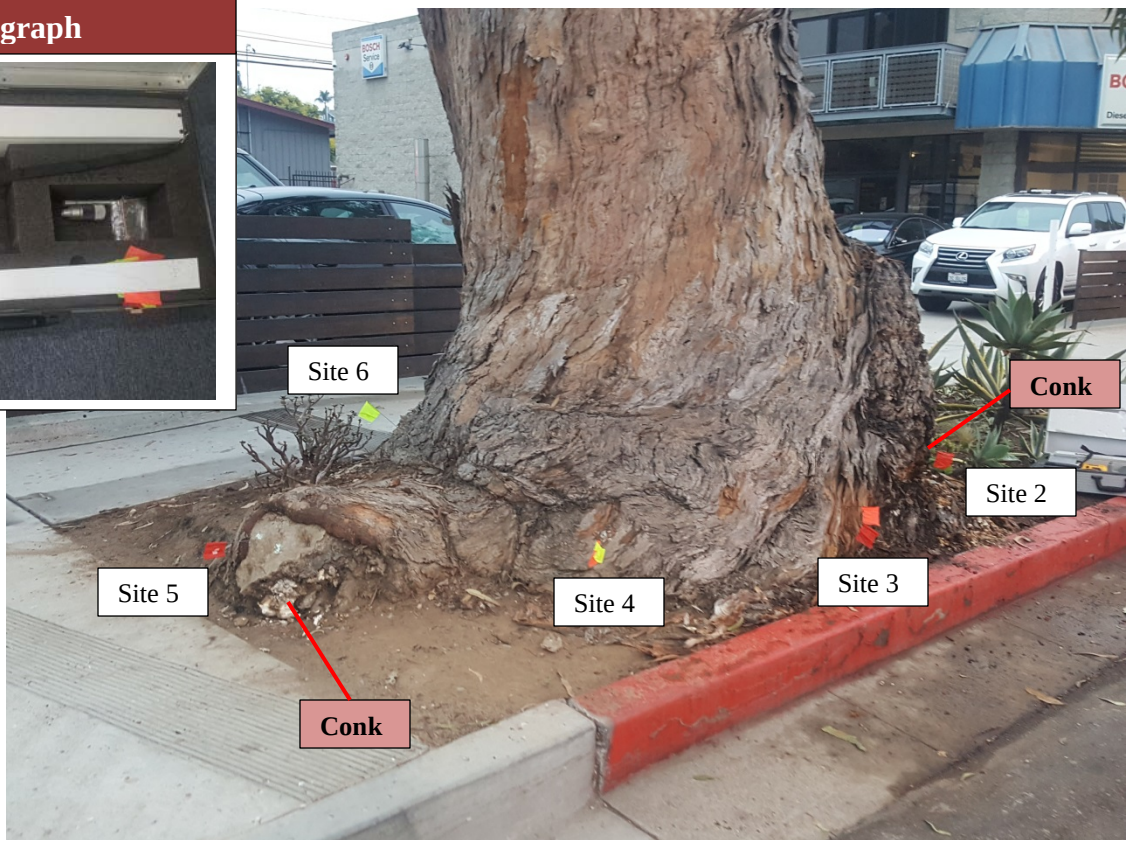


The image above shows a mechanical graph module that estimates the weakest point of the tree in response to loads such as wind. The graph above indicates that the tested cross-section is approximately 21% weaker to a wind load coming from the south- west than if it was intact.

APPENDIX B – ADVANCED TRUNK ANALYSIS

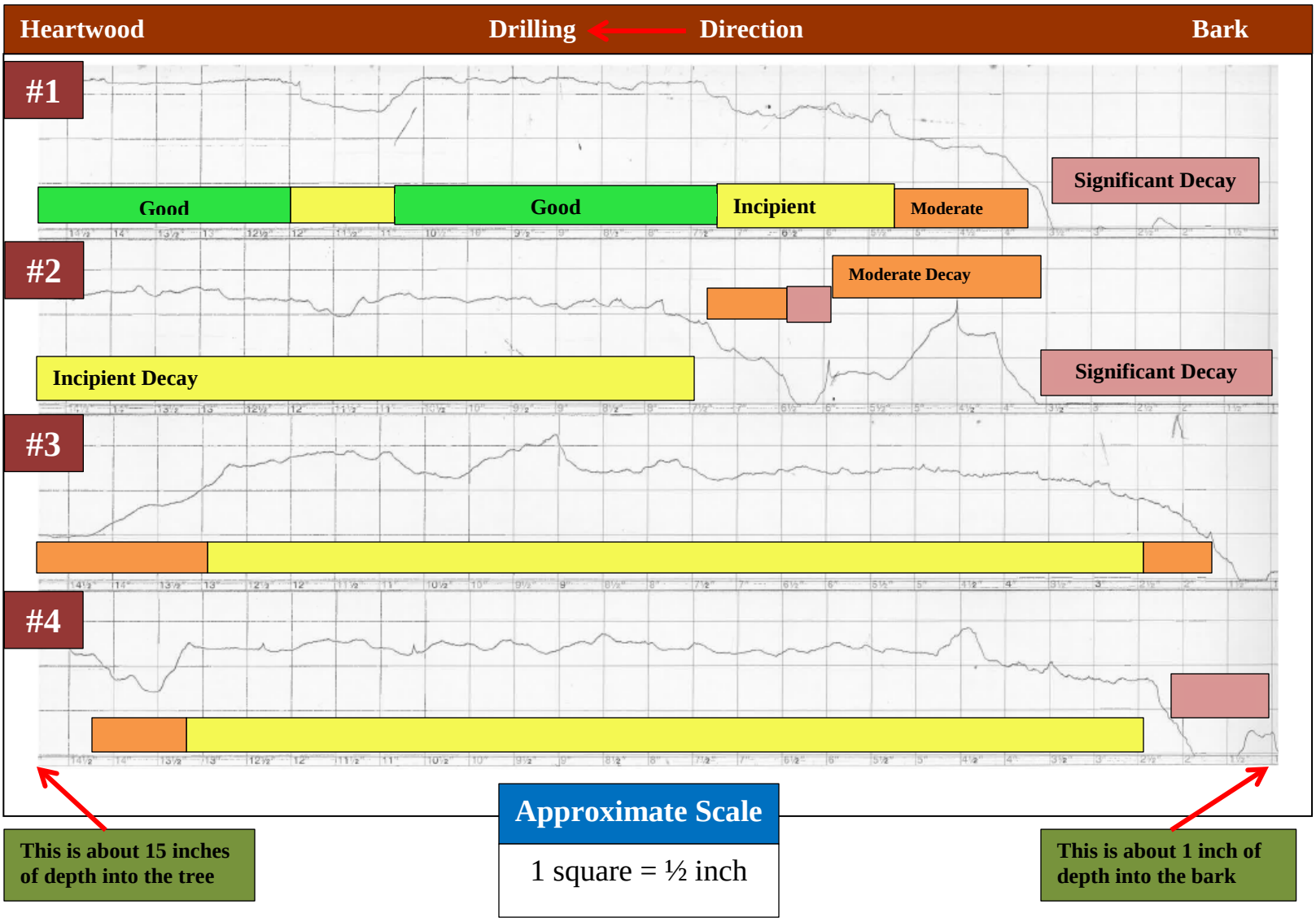
Resistograph (test locations)

Resistograph



Shown above in the box to the left is a photo of the resistograph that was used to analyze the tree's basal area at about 8-10 inches above grade. This instrument uses a micro drill bit to measure wood resistance as it enters the tree. This data is translated into a graph to evaluate internal wood decay (see resistograph data and analysis on page 13- 15). The color of the flags correlates with the level of decay that was interpreted in the field.

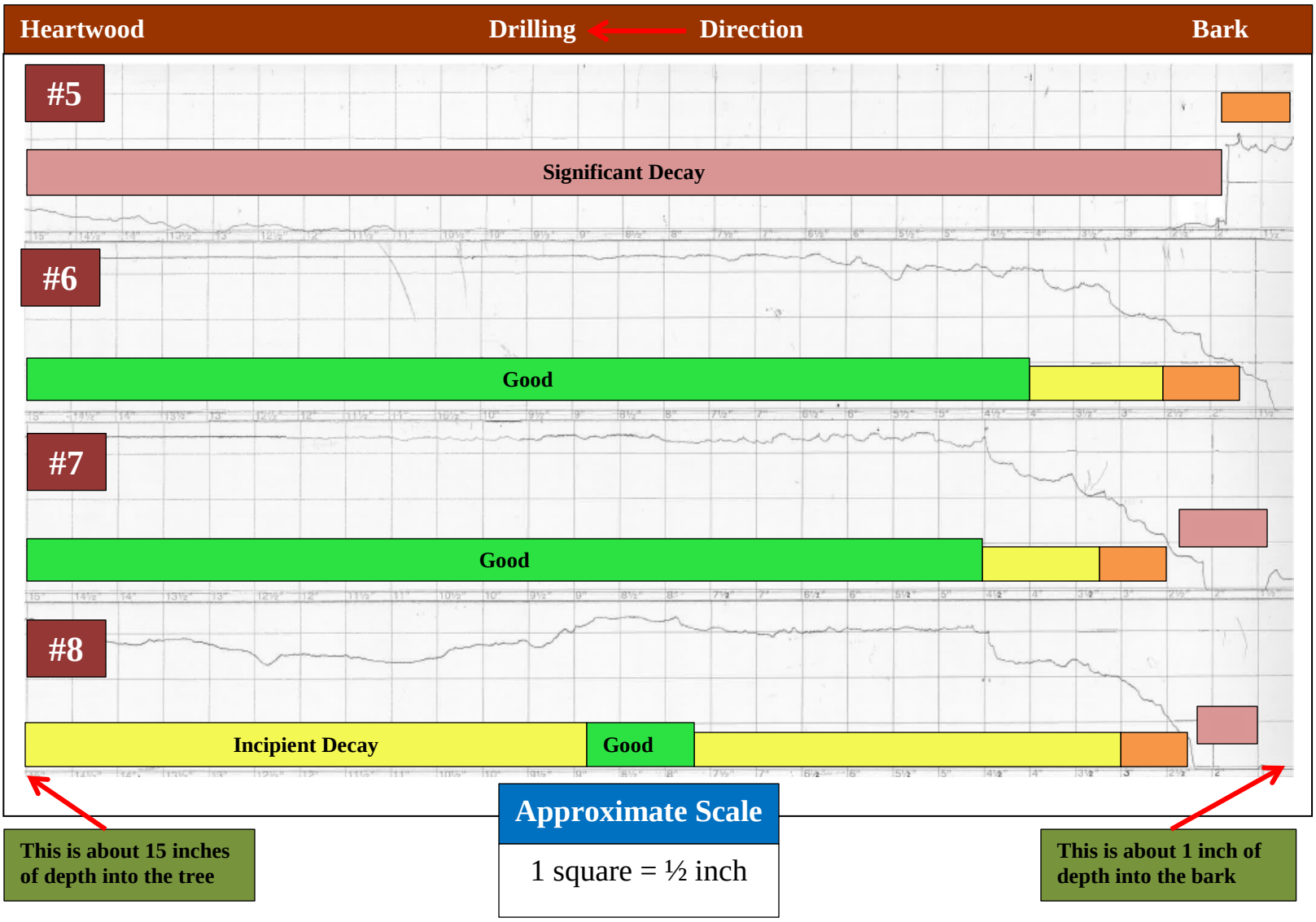
APPENDIX B – ADVANCED TRUNK ANALYSIS (TEST LOCATIONS #1 - #4)



Interpreting Graph Data

- The line is a measurement of resistance in trunk tissues and travels from right to left on the graph.
- A dip or low line on the graph is an indicator of decayed wood. The lower the line on the graph, the less resistance/ more decayed the wood tissues are.
- The pink boxes in the graph represent areas that were interpreted as having significant/ advanced decay or a cavity.
- Orange boxes in the graph represent areas that were interpreted as having moderate amounts of decay.
- The yellow boxes in the graph represent areas that were interpreted as having incipient decay (early stages of wood decay).

APPENDIX B – ADVANCED TRUNK ANALYSIS (TEST LOCATIONS #5 - #8)

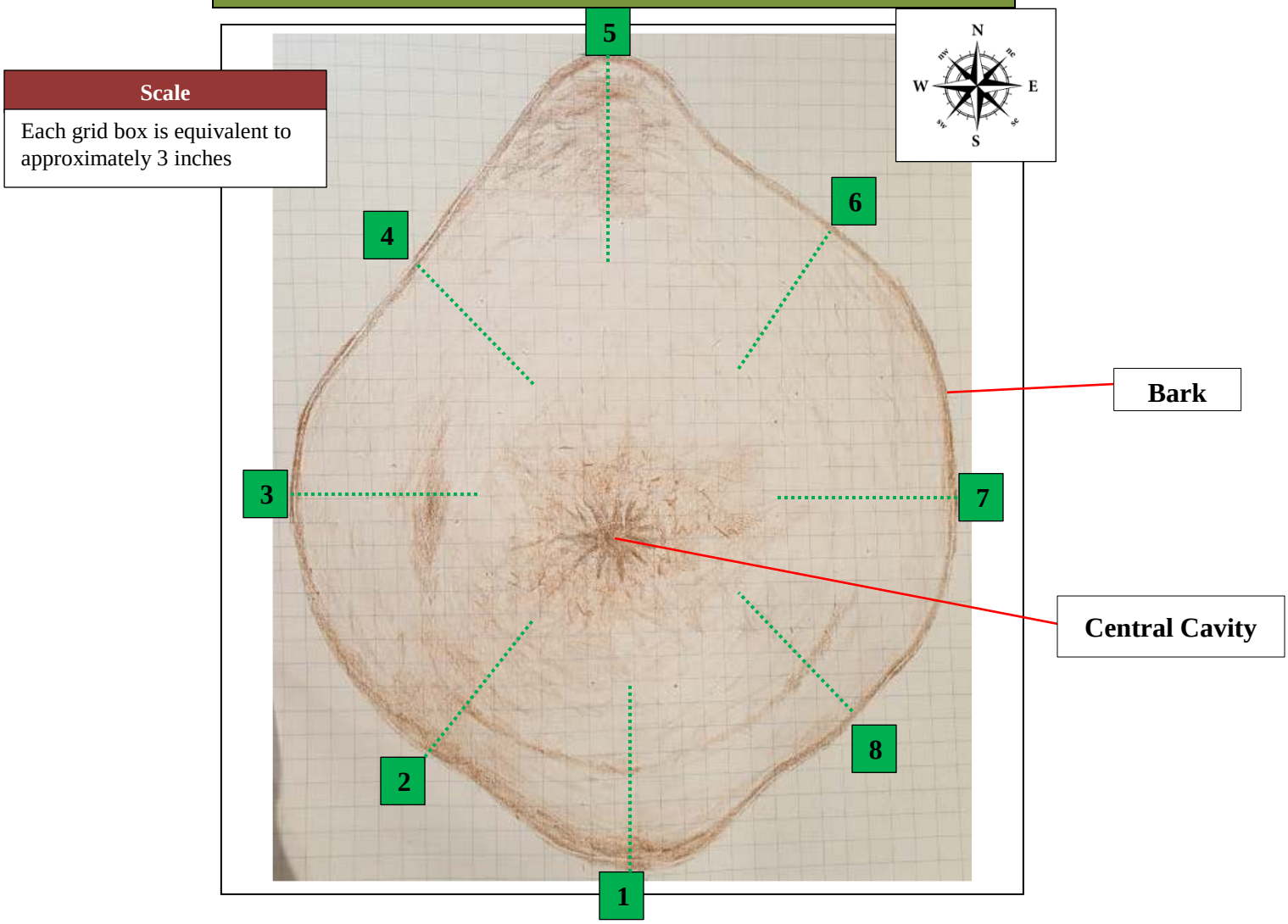


Interpreting Graph Data

- The line is a measurement of resistance in trunk tissues and travels from right to left on the graph.
- A dip or low line on the graph is an indicator of decayed wood. The lower the line on the graph, the less resistance/ more decayed the wood tissues are.
- The pink boxes in the graph represent areas that were interpreted as having significant/ advanced decay or a cavity.
- Orange boxes in the graph represent areas that were interpreted as having moderate amounts of decay.
- The yellow boxes in the graph represent areas that were interpreted as having incipient decay (early stages of wood decay).

APPENDIX B – ADVANCED TRUNK ANALYSIS

Interpreted Cross-Sectional Trunk Drawing



- Shown above is an interpreted cross-sectional trunk drawing at approximately 8 inches above grade with an approximate 260 inch circumference. Data from sonic tomography and the resistograph was used in combination to get a more realistic interpretation of the internal decay.
- 1-8 numbering in green refers to the individual resistograph or sonic tomography test locations and the green dotted lines indicate the approximate depth that the resistograph's drill bit entered the tree.
- In this graph, the shade of brown correlates with the level of internal decay that was interpreted. The darker the shade of brown, the more decayed the wood in that region.
- The data that was collected suggests that there is likely a central cavity surrounded by some significant decay, moderate to significant decay and exfoliating bark around the tree's outer 3 inches or so, moderate to significant decay near site 2 and 5 (where there was evidence of conks), and incipient decay scattered throughout.

APPENDIX C - RISK MATRICES

The red arrows are used to guide you through the process of determining the overall risk associated with the subject tree.

Matrix 1 (Basal/ Root Failure)

This matrix is used to estimate the likelihood of the specified tree failure and impact to the powerlines or the road itself. The pink box exemplifies a somewhat likely failure and impact scenario in the next two years if no mitigation is implemented.

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

Matrix 2 (Basal/ Root Failure)

This matrix is used to determine the overall level of risk associated with the subject tree by using the likelihood of failure and impact in combination with severity of the consequences. The pink box exemplifies an overall moderate risk for the tree under discussion at its current state.

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

ASSUMPTIONS AND LIMITING CONDITIONS

1. Care has been taken to obtain all information from reliable sources. All data has been verified insofar as possible; however, the Consultant can neither guarantee nor be responsible for the accuracy of information provided by others. Standard of Care has been met with regards to this project within reasonable and normal conditions.

2. The Consultant will not be required to give testimony or to attend court by reason of this report unless subsequent contractual agreements are made, including payment of an additional fee for such services as described in the fee schedule and contract of engagement.

3. Loss or alteration of any part of this report invalidates the entire report.

4. Possession of this report or a copy thereof does not imply right of publication or use for any purpose by any other than the person to whom it is addressed, without the prior written consent of the Consultant.

5. This report and any values expressed herein represent the opinion of the Consultant, and the Consultant's fee is in no way contingent upon the reporting of a stipulated result, a specified value, the occurrence of a subsequent event, nor upon any finding to be reported.

6. Unless expressed otherwise: 1) information contained in this report covers only those items that were examined and reflects the condition of those items at the time of inspection; and 2) the inspection is limited to visual examination of accessible items without dissection, excavation, or coring, unless otherwise stated. There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the tree(s) or property in question may not arise in the future.

7. Arborists are tree specialists who use their education, knowledge, training, and experience to examine trees, recommend measures to enhance the beauty and health of trees, and attempt to reduce the risk of living near trees. It is highly recommended that you follow the arborist recommendations; however, you may choose to accept or disregard the recommendations and/or seek additional advice.

8. Arborists cannot detect every condition that could possibly lead to the structural failure of a tree. Trees are living organisms that fail in ways we do not fully understand. Conditions are often hidden within trees and below ground. Arborists cannot guarantee that a tree will be healthy or safe under all circumstances, or for a specific period of time.

9. Any recommendation and/or performed treatments (including, but not limited to, pruning or removal) of trees may involve considerations beyond the scope of the arborist's services, such as property boundaries, property ownership, site lines, disputes between neighbors, and any other related issues. Arborists cannot take such considerations into account unless complete and accurate information is disclosed to the arborist. An arborist can then be expected to consider and reasonably rely on the completeness and accuracy of the information provided.

10. The author has no personal interest or bias with respect to the subject matter of this report or the parties involved. He/she has inspected the subject tree(s) and to the best of their knowledge and belief, all statements and information presented in the report are true and correct.

11. Unless otherwise stated, trees were examined using the risk assessment criteria detailed by the International Society of Arboriculture's publications *Best Management Practices – Tree Risk Assessment* and the *Tree Risk Assessment Manual*.

BIBLIOGRAPHY

Harris, Richard W., James R. Clark, and Nelda P. Matheny. *Arboriculture: Integrated Management of Landscape Tree, Shrubs, and Vines.* New Jersey: Prentice Hall, 2004. Print (ISA) *International Society of Arboriculture*. Web. 15 March 2014.

Smiley, Thomas E., Nelda Matheny, and Sharon Lilly. *Best Management Practices: Tree Risk Assessment.* Illinois: International Society of Arboriculture, 2011. Print.

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Edward F. Gilman, Brian Kempf, Nelda Matheny, Jim Clark. *Structural Pruning, A Guide For The Green Industry:* Urban Tree Foundation, 2013.

Christopher J Luley. Wood Decay Fungi Common to Urban Living Trees in the Northeast and Central United States: Urban Forestry LLC, 2005 Print

GLOSSARY

Best Management Practices (BMPs) – The International Society of Arboriculture has developed a series of Best Management Practices (BMPs) for the purpose of interpreting tree care standards and providing guidelines of practice for arborists, tree workers, and the people who employ their services.

Bending Moment - The algebraic sum of all the moments to one side of a cross-section ofa beam or other structural support.

Buttress Root- Large structural roots most common to trees native to rainforest soils where nutrients are not as abundant or accessible in the deeper soil layers.

Canopy – The part of the crown composed of leaves and small twigs (Harris, Clark, and Matheny 526).

Cavity – An open wound, characterized by the presence of decay and resulting in a hollow (Harris, Clark, and Matheny 527).

Codominant – Equal in size and relative importance, usually associated with either the trunks/stems or scaffold limbs/branches in the crown (Harris, Clark, and Matheny 527).

Compartmentalization – Natural defense process in trees by which chemical and physical boundaries are created that act to limit the spread of disease and decay organisms.

Crown – The leaves and branches of a tree measured from the lowest branch on the trunk to the top of the tree (Harris, Clark, and Matheny 527).

Decay – Process of degradation of woody tissues by fungi and bacteria through the decomposition of cellulose and lignin (Harris, Clark, and Matheny 527).

Elevated Root Bridging- Root bridging and ramps can be used to create a spatial separation between infrastructure elements (typically sidewalks) and the root zone. This is an important yet costly remedial design option when root pruning is not possible. An added benefit of this technique is the facilitation of root evaluation when fitted with removable steel plates. Coarse aggregate material and drains can be implemented to reduce water and debris accumulation within the gap if necessary.

Failure – Breakage of stem, branch, roots, or loss of mechanical support in the root system (Smiley, Matheny, and Lilly 48).

Fungal Fruiting Bodies – Any complex fungal structure that contains or bears spores.

Frass- Solid fecal matter produced by certain insects.

Included Bark – Pattern of development at branch junctions where bark is turned inward rather than pushed out (Harris, Clark, and Matheny 529).

Level 2 Basic Assessment: - A Level 2 or basic assessment is a detailed visual inspection of a tree and its surrounding site, and a synthesis of the information collected. It requires that a tree risk assessor walk completely around a tree looking at the site, buttress roots, trunk, and branches. A basic assessment may include the use of simple tools to gain additional information about the tree or defects. This is the standard assessment that is performed by arborists in response to a client's request for tree risk assessment (Smiley, Matheny, and Lilly 15).

Level 3 Advanced Assessment: – Advanced assessments (generally more time intensive) that are performed in conjunction with or after a Level 2 assessment to provide detailed information about specific tree parts, defects, targets, or site conditions. Specialized equipment, data collection and analysis, and/or expertise are usually required for advanced assessments. Procedures and methodologies should be selected and applied as appropriate, with consideration for what is reasonable to specific conditions and situations. All technologies involve some uncertainty and have their limitations; any evaluation of an individual tree will not be an accurate measure, but a qualified estimation. Information collected from advanced assessments can aid in making a final tree removal or retention recommendation.

Live Crown Ratio – The ratio of the height of the live crown to the height of the entire tree.

Minor Consequence – A consequences that involves low to moderate property damage, small disruptions to traffic or communication utility, or a very minor injury, examples include:

- A small branch striking a house roof from a high height.
- A medium sized branch striking a deck from a moderate height.
- A large part striking a structure and causing moderate monetary damage.
- Short term disruption of power at a service drop to a house.
- Temporary disruption of traffic on a neighborhood street.

Negligible Consequence – A consequence that involves low-value property damage or disruption that can be replaced or repaired; they do not involve personal injury, examples include:

- A small branch striking a fence.
- A medium-sized branch striking a shrub bed.
- A large branch striking a structure and causing low monetary damage.
- Disruption of power to landscape lighting.

Resistograph – A specialized instrument that uses a micro drill bit to measure wood resistance as it enters the tree. This data is translated into a graph to evaluate internal wood decay.

Reduction Pruning – Pruning cut that reduces the length of a branch back to live lateral branch large enough to assume apical dominance. Typically at least one-third the diameter of the cut parent branch.

Response Growth - New wood produced in response to loads to compensate for higher strain in marginal fibers; includes reaction wood (compression and tension) and woundwood (Smiley, Matheny, and Lilly 50).
Removal Pruning Cut: A pruning cut that takes off a branch back to the trunk or parent stem to just beyond the branch collar.

Risk – The combination of the likelihood of an event and the severity of the potential consequences. In the context of trees, risk is the likelihood of a conflict or tree failure occurring and affecting a target, and the severity of the associated consequence—personal injury, property damage, or disruption of activities (Smiley, Matheny, and Lilly 50).

Severe Consequence – A consequence that could involve serious personal injury or death, disruption of important activities, damage to high-value property, examples include:

- Injury that may result in hospitalization or permanent damage.
- A medium- sized part striking an occupied vehicle.
- A large part striking an occupied house.
- Serious disruption of high-voltage distribution and transmission powerline.
- Disruption of arterial traffic or motorways.

Significant Consequence – A consequence that involves property damage of moderate – high value, considerable disruption, or personal injury, examples include:

- A medium sized part striking an unoccupied vehicle from a moderate to high height.
- A large part striking a structure and resulting in high monetary damage.
- Disruption of distribution primary or secondary voltage power lines, including individual services and street- lighting circuits.
- Disruption to traffic on a secondary street.

Sonic Wave Tree Decay Detector –The Sonic Wave Tree Decay Detector is an instrument that is used for detecting decay in trees. The tool measures the time (in microseconds per foot) it takes for sound waves to travel from between the two probes as well as giving you a basic graph of the sound wave.

Stem – The main trunk of a tree or other plant (Harris, Clark, and Matheny 533).

Structural Pruning – Pruning that influences the orientation, spacing, growth rate, strength of attachment or ultimate size of branches and stems, resulting in a strong tree.

Target – People, property, or activities that could be injured, damaged, or disrupted by a tree (Smiley, Matheny, and Lilly 50).

Target zone – The area where a tree or branch is likely to land if it were to fail (Smiley, Matheny, and Lilly 50).

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