Barton Springs Municipal Pool

Austin, TX 78746

Pecan Tree Risk Assessment Report

PREPARED FOR:

City of Austin
Attn: Joshua Erickson
200 S. Lamar Boulevard
Austin, TX 78704
512-974-9545
Joshua.Erickson@austintexas.gov

PREPARED BY:

Zach Powers
Associate Consulting Arborist
ISA Certified Arborist #PN-8465A
ISA Tree Risk Assessment Qualified
[redacted]

PROVIDED BY:

Michael Embesi
Consulting Arborist Representative
ASCA Registered Consulting Arborist #710
ISA Tree Risk Assessment Qualified
2403 Howard Lane
Austin, TX 78728

BARTLETT TREE EXPERTS
SCIENTIFIC TREE CARE SINCE 1907

Submitted on August 29, 2023

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SUMMARY

In August 2023, The City of Austin requested the completion of a ***Level 2: Basic assessment*** and ***Level 3: Advanced assessment*** of **tree risk** of one over-mature pecan (*Caryo illinoinensis*) located adjacent to the Barton Springs Municipal Pool to determine the **overall risk rating**. The initial concern was to determine the structural health of the tree after the confirmation of Kretzschmaria at the root flare.

I visited the property to assess the pecan on August 24, 2023. The Resi™ Resistance Drill detected a loss of structural integrity at *all* three drilling locations. Using the methods outlined in this report and the results of the assessment of this tree, it is my professional judgement that the overall risk rating for the pecan was ***high*** because of a ***high*** risk rating for stem/root failure within the next three years.

Options to mitigate the risk associated with the tree are listed below. Please make sure the estimated overall residual risk rating is acceptable to you before deciding on a specific option.

- Option One: Remove the entire tree to eliminate the risk of root, root collar, trunk, crown, and branch failure. Grind the resulting stump and back fill the hole. There will be no residual risk for the trunk, crown, or branches, but there may be a tripping hazard with the remaining roots, stump, or grindings that you will need to address.
- Option Two: Prune to reduce the spread of the southern scaffold branch from over the pool. Prune to reduce overall canopy spread and weight. Prune to remove large diameter branches (3-inches in diameter and greater) from the crown to alleviate weight on leaning stem. The tree would remain ***high*** risk. Inspections are recommended semi-annually and after significant weather events.
- Option Three: If you elect not to remove the tree or perform the recommended pruning, the tree will remain ***high*** risk for stem and/or root failure. The tree's risk may increase in the future as a result of not performing mitigation. Inspections are recommended semi-annually and after significant weather events.

I recommend Option One. With the confirmation of a wood-decaying fungus, as well as the presence of several support systems and its location within a high-use area, I do not believe this tree is a good candidate for continued preservation.

Tree risk assessment definitions are provided at the end of this report to help with understanding the terminology and with selecting the level of risk you are comfortable with when making decisions on your tree care needs.

INTRODUCTION

In August 2023, Bartlett Tree Experts conducted a tree risk assessment of one regulated pecan with a measured 46-inch trunk diameter located on the northern slope of Barton Springs Municipal Pool in central Austin, TX to help determine future management of the tree. The result of the project would be a written report describing our observations, findings, and recommendations.

After a conversation with Joshua Erickson (Urban Forestry Program Manager) regarding the history of the site, it was agreed that the assignment was to:

1. Perform a *Level 2: Basic assessment* of the tree and site to determine the tree or tree part's **likelihood of failure**, **likelihood of impact** to **targets**, and the **consequences** of failure and impact, in order to determine tree risk.
2. Perform a *Level 3: Advanced assessment* to provide additional information for the risk assessment. This assessment will include the use of a wood resistance drill to identify the potential loss of structural integrity within the lower trunk of the tree.
3. Provide a written report that documents the tree conditions of concern/defects detected, specific targets assessed, results of the assessments, results of the resistance drill, risk ratings, mitigation options with estimated **residual risk**, and a recommended inspection interval(s).

ASSESSMENT PROCEDURES

The risk of root, root collar, trunk, crown and branch failure for the pecan via a ground and aerial-based assessment was performed. In addition, the stem of the branch extending over the walkway and pool had an advanced assessment for failure performed using resistance drilling. It was not practical to use resistance drilling on the main stem due to the column of concrete holding the stem in place. The assessments occurred on August 24, 2023 and followed the *International Society of Arboriculture's (ISA) Best Management Practices for Tree Risk Assessment and American National Standards Institute A300 Tree Risk Assessment Standard)*.

Tree risk ratings are derived from a combination of three factors: the likelihood of failure, the likelihood of the failed tree part impacting a target, and the consequences of the target being struck. These factors are then used to categorize tree risk as extreme, high, moderate, or low. The factors used to define your risk rating are identified in this report.

Tools used in the assessment included: a rubber mallet and the IML PD-400 resistance drill.

In addition, resistance drilling was used to identify the potential loss of structural integrity within the trunk and roots, and provide images used for analysis within this report. The device uses a small diameter drill bit to drill into the tree and measure the amount of resistance encountered. The drill bit will encounter more resistance in wood that is intact and not structurally compromised. The drill bit will move easily through compromised areas such as a crack, cavity, decay, or void,

causing a drop in resistance. The amount of resistance measured is presented as a graphic image from areas with high structural integrity to areas of no structural integrity.

OBSERVATIONS

The mature pecan was located at the toe of a slope approximately 20 feet north of the sidewalk and pool. The pecan was situated in a landscaped bed within the slope and behind a 5 feet concrete wall. At the top of the wall was metal pipe rail fencing with 3.6 feet opening where the main stem rest horizontally on top of the wall. During my visual assessment I observed the large stem cavity on the north side or top portion of the trunk. Two vertical stems attached to the horizontal stem, one extending west and the other took a vertical bend off the main trunk at 17 feet. Three feet beyond that point the branch headed south extending over the pool. The vertical stem was propped up with an elaborate scaffold system created out of three main steel poles. The vertical poles were connected by three horizontal poles at 9 feet. Two of the poles that extended from that elevated base were embedded into the main stem. The middle of the tripod was secured with several horizontal metal pieces secured to a saddle (approximately 14 feet from base) that cradled the main stem.

The large cavity in the main stem began at grade and extended to 9 feet; the cavity widest at the base and tapered as it extended up the stem. The bark was absent on the top portion of the stem up to 9 feet and mostly detached underneath the cavity. It appeared that the main stem was not wood, but rather held in place by the concrete poured as a foundation and up through the stem. I noted the presence of large cavities on both the east (18 inched depth) and west 17 inches depth) of the main stem where it was in contact with the soil at the edge of the wall. One foot from the trunk on the east was a pop-up irrigation sprinkler head. I measured the available soil moisture using a 15-inch soil probe and incorporated the USDA NRCS “feel and appearance” method to be in the 0-25 % range. A pop-up irrigation sprinkler head that had been broken was located 17 inches from the base of the stem to the west. The available soil moisture on that side of the tree was in the lower 25-50% available soil moisture range. It may be that the base of the tree was in the direct line of the water distribution area. Just beyond the wall on the lower portion of the stem was evidence of fungi that was previously identified as *Kretzschmaria deusta*– a wood decay fungus also known as brittle cinder fungus. The fungus was growing in what appeared to be an old wound that was approximately 4 to 5 feet in length. The fungus was sampled by the City of Austin and sent to Texas A&M University, where they diagnosed the pathogen.

Several other cavities on the main stem included:

- East side of stem at 17-18 feet from base; 3.5 feet deep with 5-6 inches of reaction wood.
- North (top) of stem at 14 feet
- South (lower) portion of stem 12 inches from post; measured 8X8 inches wide.
- South (lower) portion of stem 7 inches east of post; measured 6X6 inches wide; 4 inches depth.
- South (lower) stem just above saddle (approximately 14 feet from base) tapered between 4-6 inches wide and 3 inches long; approximately 3 inches in depth.

The overall condition of the pecan was *poor* due to the presence of the stem cavity and evidence of *Kretzschmaria*. The canopy had minor dieback present but overall, the canopy somewhat dense with good colored foliage. The crown of the pecan was asymmetrical in form, the main stem horizontal. Crown weight was distributed to the west and south towards the sidewalk and pool. Prevailing winds are from the west and southwest in spring and summer, with northern and northwestern winds prevalent during fall and winter months. The pecan was fully exposed to prevailing winds except from the northeast where a semi-mature pecan (#6556) with a 22.6 inch trunk diameter and in good health was growing approximately 3.5 feet away.

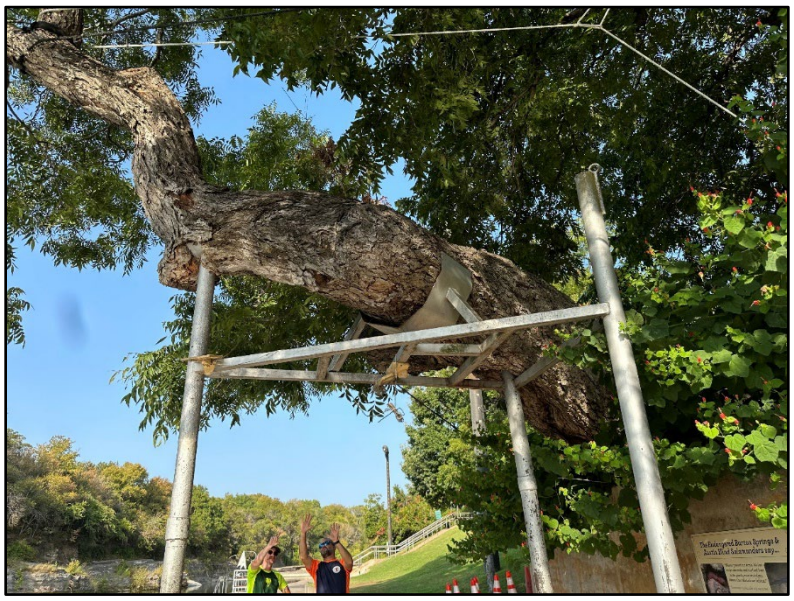


Image 1: View from the sidewalk under the pecan. Previously installed props and a soft "cabling" system pictured.

The table below summarizes major observations made by Zach Powers during the tree inspection conducted on August 24, 2023:

TABLE 1. TREE OBSERVATIONS

Attribute	Observation
Species	Pecan (*Caryo illinoinensis)*
DBH	46 inches
Height	~30 feet
Condition	Poor
Observations	Stem cavities Branch cavities Prop installed for stem support 'Soft' cable support

TREE RISK ASSESSMENT

After discussing the site's usage and **occupancy rates** throughout the course of the year with Joshua Erickson, the Urban Forestry Program Manager and combined with my observations during the assessment, we determined that within the tree's **target zone.**

- People near the tree were a **frequent** target and
- Sidewalk/coping for infrastructure and pool were **constant** targets

In determining the risk ratings, I considered a tree or tree part failure impacting a person to have one of the highest consequences, either **significant** or **severe**.

I considered a tree or tree part failure impacting the sidewalk as having **minor** or **significant** consequences.

I used a time frame of three years when I assessed the likelihood of tree or tree part failure. Following industry standards, the time frame is one factor used in the equation to determine tree risk. Trees and sites change on a daily basis. You should not consider this time frame a "guarantee period" for the risk assessment or that the tree will not fail or is safe within this time frame.

The main concerns observed during the assessment and their associated risk ratings are provided in the following paragraph. Information not specifically summarized was not considered a significant factor at the time of assessment.

The overall risk rating for this tree is considered *high*, indicated by the highest likelihood of failure for the tree parts assessed which is improbable, the likelihood of impacting a target listed above is medium and the consequences of the failure and impact could be severe. Low risk trees do not usually need immediate attention but may have conditions of concern that should be proactively managed.

TREE RISK ASSESSMENT AND RATINGS

Tree Part of Concern	Condition of Concern	Target	Likelihood of Failure	Likelihood of Impact	Likelihood of Failure & Impact	Consequences	Risk Rating
Crown & Branches	Loss of structural integrity	People in target zone	Possible	Low	Unlikely	Severe	Low
Crown & Branches	Loss of structural integrity	Sidewalk/Coping	Possible	High	Somewhat likely	Minor	Low
Trunk	Loss of structural integrity	People in target zone	Probable	Low	Unlikely	Severe	Low
Trunk	Loss of structural integrity	Sidewalk/Coping	Probable	High	Likely	Significant	High
Roots & Root Collar	No visible structural roots	People in target zone	Possible	Low	Unlikely	Severe	Low
Roots & Root Collar	No visible structural roots	Sidewalk/Coping	Possible	High	Somewhat likely	Significant	Moderate

Using the methods outlined in this report and the results of the assessment of this tree, it is my professional judgment that this tree has an overall tree risk rating of ***high.***

DISCUSSION

I began my assessment of the pecan by probing cavities in the lower stem. I observed structural wood loss in the main stem due to the extent of the large cavity that was 9 feet long. It tapered as it went up the stem and was widest at the base. The cavity had been filled with concrete reinforced with rebar from below grade up to 9 feet and beyond that point, the cavity appeared to be filled with some type of spray foam (approximately 3 feet). Portions of the concrete were eroding. The remaining bark on the lower portion of the stem did not appear to be attached. I began the *Level 3 Advanced assessment* by performing resistance drilling on the upper south stem that extended off the main trunk using the IML PD-400 resistance drill. I performed three drillings around the stem at 216 inches (18 feet) above grade just above the attachment of the large scaffold branch. The drilling data at 216 inches indicated significant wood strength loss on the north, east, and west side.

Image 3: Approximate location of drilling plane (red line) on the north side of the lower stem. Drillings at 216 inches (18 feet). The drilling sites at 216 inches were made above the scaffold branch.

The over mature pecan has historical significance worth noting:

- 1920 photos indicate the tree was semi-mature in development with an approximate trunk diameter of 15 inches.
- 1925 photos indicate the pecan was leaning approximately 45 degrees.
- 1926 photos indicate a stack stone wall approximately 2 feet in height below the tree.
- 1935 -1940 photos indicate historic floods.
- 1940 photos indicate a stacked stone wall was replaced with a concrete wall (5 feet).
- 1940 photos indicate the pecan had approximately a 35-degree lean.
- 1958 photos indicate the lower stem was filled with concrete, rebar wire, and expanding foam, as well as two props had been erected.

CONCLUSION & RISK MITIGATION OPTIONS

Based on the results of my visual observations of the tree and site, as well as the results of the resistance drilling, it is my professional opinion that this tree is in decline and should be removed. The immediate risk to people near the tree and sidewalk can be mitigated with removal or gradual, significant reductions to scaffold limbs. Risk management options to modify pool and/or sidewalk were not considered due to impracticalities.

Options to mitigate the risk associated with the tree are listed below. Please make sure the estimated overall residual risk rating is acceptable to you before deciding on a specific option.

- Option One: Remove the entire tree to eliminate the risk of root, root collar, trunk, crown, and branch failure. Grind the resulting stump and back fill the hole. There will be no residual risk for the trunk, crown, or branches, but there may be a tripping hazard with the remaining roots, stump, or grindings that you will need to address.
- Option Two: Prune to reduce the spread of the southern scaffold branch from over the pool. Prune to reduce overall canopy spread and weight. Prune to remove large diameter branches (3-inches in diameter and greater) from the crown to alleviate weight on leaning stem. The tree would remain ***high*** risk. Inspections are recommended semi-annually and after significant weather events.
- Option Three: If you elect not to remove the tree or perform the recommended pruning, the tree will remain ***high*** risk for stem and/or root failure. The tree's risk may increase in the future as a result of not performing mitigation. Inspections are recommended semi-annually and after significant weather events.

I recommend Option One. With the confirmation of a wood-decaying fungus, as well as the presence of several support systems and its location within a high-use area, I do not believe this tree is a good candidate for continued preservation.

All recommended work should be performed by qualified arborists and in accordance with industry accepted standards and best management practices set forth by the *American National Standards Institute* and the *International Society of Arboriculture.*

LIMITATIONS

Assignment

My assessment of the designated pecan at Barton Springs Municipal Pool was based on a single site visit on August 24, 2023. All photographs, samples, and readings, if applicable, were taken at the time the assessment was performed. The assessment was limited to the visible and accessible tree parts described in the assignment.

Resistance Drilling

Resistance drilling devices can provide sophisticated results related to tree structure. This is done by measuring the amount of resistance the drill bit encounters. However, as with any higher-level

technology, the amount of structural integrity loss shown can vary based on the version of the program software used. Therefore, this technology can be limited and should not be used by the tree owner/manager as the sole decision-making criteria, but rather one of many factors used in the decision-making process.

Tree Risk Assessments

It is important for the tree owner or manager to know and understand that all trees pose some degree of risk from failure or other conditions. The information and recommendations within this report have been derived from the level of tree risk assessment identified in this report, using the information and practices outlined in the *International Society of Arboriculture's Best Management Practices for Tree Risk Assessment and Assessment and American National Standards Institute A300 Tree Risk Assessment Standard*, as well as the information available at the time of the inspection. However, the overall tree risk rating, the mitigation recommendations, or any other conclusions do not preclude the possibility of failure from undetected conditions, weather events, or other acts of man or nature. Trees can unpredictably fail even if no defects or other conditions are present. Tree failure can cause adjacent trees to fail resulting in a "domino effect" that impacts targets outside the foreseeable target zone of this tree. It is the responsibility of the tree owner or manager to schedule repeat or advanced assessments, determine actions, and implement follow up recommendations, monitoring and/or mitigation.

Bartlett Tree Experts can make no warranty or guarantee whatsoever regarding the safety of any tree, trees, or parts of trees, regardless of the level of tree risk assessment provided, the risk rating, or the residual risk rating after mitigation. The information in this report should not be considered as making safety, legal, architectural, engineering, landscape architectural, land surveying advice or other professional advice. This information is solely for the use of the tree owner and manager to assist in the decision-making process regarding the management of their tree or trees. Tree risk assessments are simply tools which should be used in conjunction with the owner or tree manager's knowledge, other information and observations related to the specific tree or trees discussed, and sound decision making.

Thank you for the opportunity to provide this information. Please contact me if you wish to review these results or discuss the next steps to take with mitigation, or if I can be of any other service in the management of your landscape.

Zach Powers

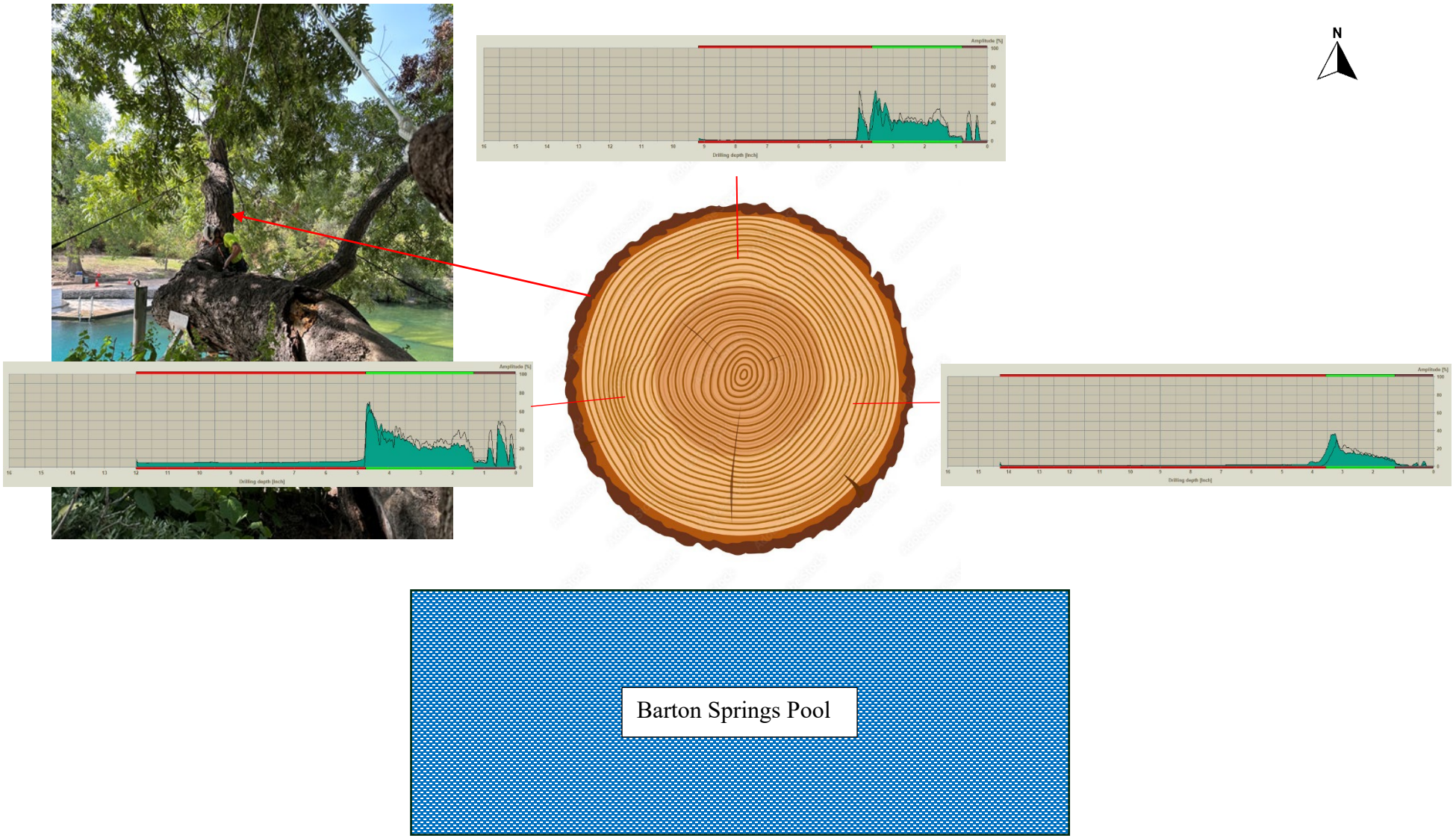
Zach Powers, Associate Consulting Arborist
ISA Certified Arborist #PN-8465A
ISA Tree Risk Assessment Qualified

Enclosures **Site Map**
Advanced Assessment Readings
Site Photos (Past & Present)
Laboratory analysis
Tree Risk Assessment Vocabulary

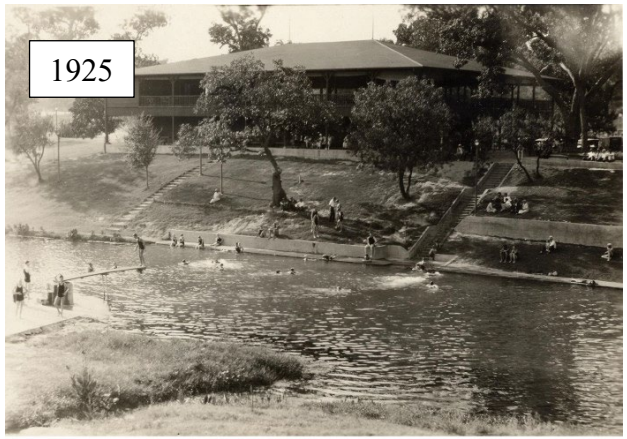
Site Map

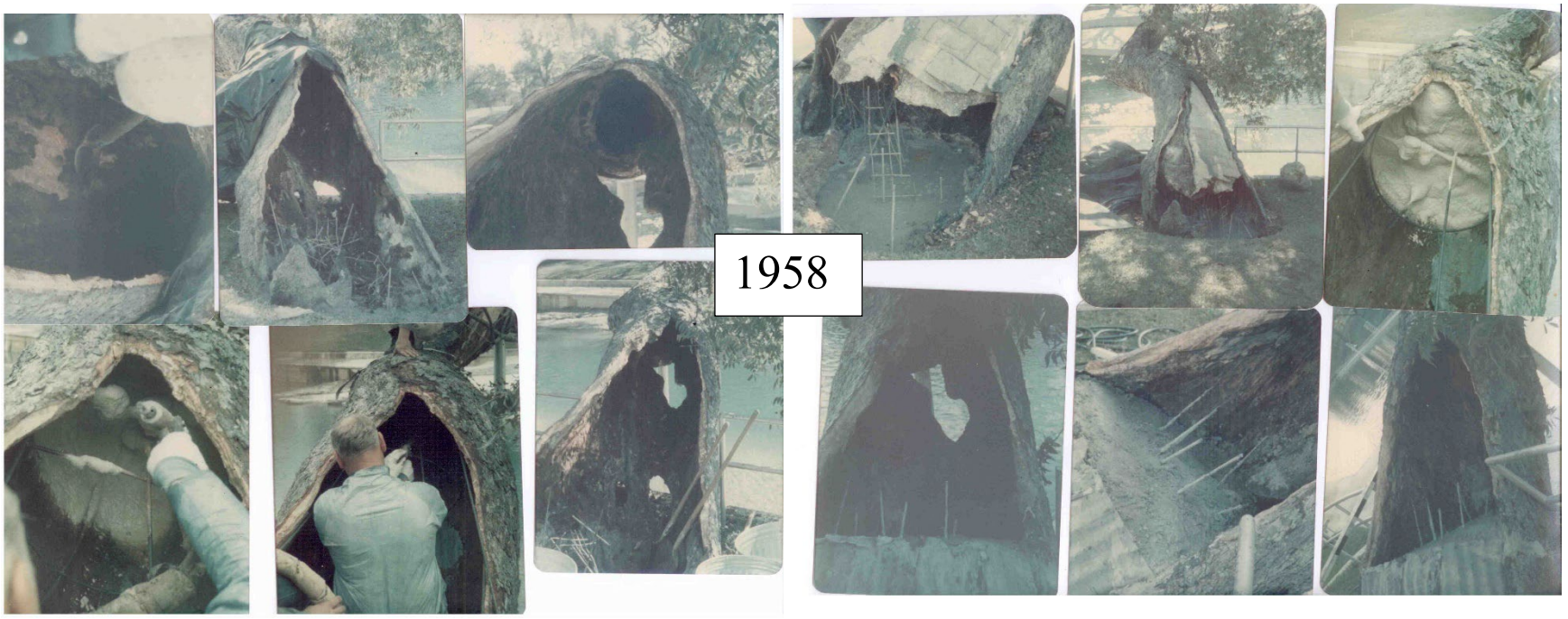

ATX MetroBike Station
ChargePoint Charging Station
William Barton Dr
Train park
Temporarily closed
Zilker Eagle Miniature Train
Restroom
Austin Splash-Aquifer Exhibit
Barton Springs Municipal Pool
Zilker Metro Park-Barton Springs Pool Pedestrian Walkway
Barton Springs
Pecan 'Flo'
Barton Springs
Swimming, picnicking & rare wildlife

Resi™ Resistance Drill Readings



Historical Photos





Present Day Photos

Image 4. Previously installed props used to support weight of the pecan's leaning stem.

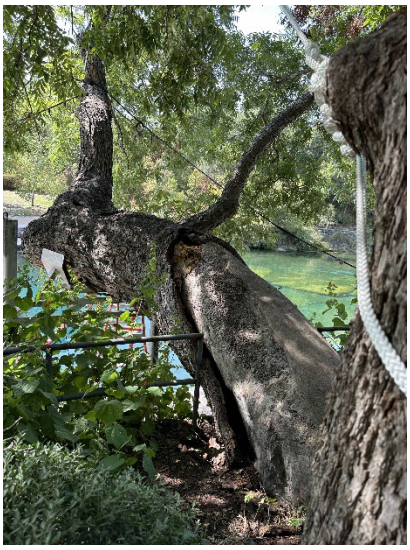


Image 5. Concrete filled cavity leaning over guardrail and sidewalk below. Rebar and expanding foam was also observed.

Image 6. Area where Kretzschmaria deusta was confirmed. This is the largest area of intact wood and live tissue throughout the stem.

Image 7. Overview of pecan and its lean over the pool and walkway.

Laboratory Analysis (by others)

Texas Plant Disease Diagnostic Laboratory
1500 Research Parkway
Suite A130
http://plantclinic.tamu.edu
College Station, TX 77845
Phone: 979-845-8032Fax: 979-845-6499
Email: PlantClinic@tamu.edu

PLANT SPECIMEN DIAGNOSTIC REPORT **Specimen # 2023-2182**

SUBMITTED BY Shannon Slivinske City of Austin Parks and Rec 2525 S Lakeshore Blvd Austin, TX 78741 [redacted]		PLANT Pecan *(Carya illinoinensis)* VARIETY INTERNAL LAB NO.	METHOD SUBMITTED COURIER - FedEx/UPS CLASS TREE - fruit/nut REPLY FROM LAB August 7, 2023
PHONE [redacted]	COUNTY TRAVIS, TX	PLANT MATERIAL FUNGAL TISSUE	RECEIVED BY LAB July 19, 2023
CONDITION UPON ARRIVAL ADEQUATE SAMPLE; COMPLETE FORM		DIAGNOSTICIAN(s) S. Knackstadt -Assistant Diagnostician	
GENERAL OBSERVATIONS Charcoal colored fruiting body to I.D. exhibiting		DIAGNOSTIC TECHNIQUE(S) X GROSS VISUAL · X MICROSCOPE · _ CULTURE · _ SPECIALIZED MEDIA · _ BIOASSAY _ BIOCHEMICAL · _ CHEMICAL ASSAY · _ MOLECULAR · _ NEMATODE · _ PCR _ REGULATORY · _ SEROLOGICAL · _ SITE VISIT · _ REFERRAL	

Diagnosis/Recommendations

Diagnosis: Brittle Cinder Fungus *(Kretzschmaria deusta)*

Category: FUNGAL

Comments: LAB SUMMARY:

Upon examination of fungal mat submitted, it appears the tree is infected with brittle cinder fungus. Brittle cinder fungus, or Kretzschmaria deusta, appears at the bases of trees and roots as a white or gray fungal mat. As it ages, it turns black and starts to resemble burnt bark. This pathogen infects many hardwood trees through open wounds and other stress factors. Kretzschmaria deusta will eventually break down the cellulose and lignin of the tree causing wood decay/rot.

Management:

Currently, there are no effective fungicides to control brittle cinder fungus. Maintaining a sound tree maintenance program that promotes good vigor can help minimize infection; such as utilizing proper fertilization, pruning, and mulching practices. Trees in which the infection has already progressed extensively have likely lost significant structural integrity and should be considered for removal to avoid damage to property or life.

Tree Risk Assessment Vocabulary

Tree risk assessment has a unique set of terminology with specific meanings. A complete list of tree risk vocabulary and procedures may be found in the International Society of Arboriculture's (ISA) *Best Management Practice (BMP) for Tree Risk Assessment* or the *American National Standards Institute (ANSI) A300 Tree Risk Assessment Standard*. The following information is provided to assist the owner/client with understanding some of the common industry phrases or language, and some of the procedures and methodologies associated with the industry language used in the proposal and/or report.

Vocabulary Used Throughout Proposals and Reports

Inspection interval is the recommended amount of time between inspections or assessments.

Occupancy rates categorize the estimated time a target is physically within a target zone. Occupancy rate is classified as rare, occasional, frequent, or constant.

Overall risk rating is the highest individual risk identified for the tree.

Residual risk is the estimated level of risk that will remain after the recommended mitigation efforts to reduce the risk have been made. This estimate is provided to help the client understand that some level of risk may still exist and plan appropriately for future risk management.

Risk is the likelihood of an event and its consequences.

Risk rating for a tree or tree part is the combination of the likelihood of failure, the likelihood of impact, and the consequences.

Time frame is the period the assessor uses in which to estimate the likelihood of failure in all categories except the "imminent" category. The use of a time frame is meant solely to help the assessor better determine the portions of the risk analysis which are time dependent. The owner/client should never consider the time frame a "guarantee period" for the risk assessment or that the tree will not fail or is safe within the stated time frame.

Targets are people, property, or activities that could be injured, damaged or disrupted by a tree or tree part failure.

Target occupancy rates are typically identified based on information obtained from the owner/client prior to conducting the assessment, as well as information gained during the limited time the assessor evaluates the tree and site. Targets, target zones, and occupancy rates may be adjusted based on observations during the assessment.

Target zones are the areas where a tree or tree part is likely to land if it were to fail. The target zone(s) is determined in the field at the time of the assessment.

Trees can generally be defined as a woody perennial plant with a single trunk, defined crown, and will reach a minimum height of 15 feet at maturity.

Tree parts include branches, fruit, and trunks.

Tree risk is the likelihood of a tree failure impacting a target and the severity of the consequences.

Tree risk assessment is the systematic process used to identify, analyze, and evaluate tree risk. Tree risk assessments are conducted to assist the tree owner or client in better understanding the risk their trees pose so they can make management decisions to reduce or minimize those risks. Tree risk assessments focus on evaluating the structural integrity of the tree crown, branches, trunks, and roots and root collar.

Tree risk assessors are trained arborists or qualified professionals with experience in performing tree risk assessments.

Vocabulary Used to Communicate Occupancy Rates

Constant indicates a target is present in the target zone at nearly all times, 24 hours a day, seven days a week.

Frequent indicates a target is present in the target zone for a large portion of the day or week.

Occasional indicates a target is present in the target zone infrequently or irregularly.

Rare indicates a target zone that is not commonly used by people or other mobile/movable targets.

Vocabulary Used to Communicate the Likelihood of Failure

Imminent indicates that failure has started or is most likely to occur in the near future, even if there is no significant wind or increased load.

Probable indicates that failure may be expected under normal weather conditions within the specified time frame.

Possible indicates that failure could occur, but is unlikely under normal weather conditions within the specified time frame.

Improbable indicates that failure is not likely during normal weather conditions, and it may not fail in extreme weather conditions within the specified time frame.

Vocabulary Used to Communicate the Likelihood of a Failure Impacting a Target

Very likely to impact a target is reached by an imminent likelihood of failure and high likelihood of impact.

Likely to impact a target can be reached by an imminent likelihood of failure and medium likelihood of impact; or probable likelihood of failure and high likelihood of impact.

Somewhat likely to impact a target can be reached by one of the following combinations; an imminent likelihood of failure and low likelihood of impact; probable likelihood of failure and medium likelihood of impact; or possible likelihood of failure and high likelihood of impact.

Unlikely to impact a target can be reached by one of the following combinations; a possible or probable likelihood of failure and low likelihood of impact; possible likelihood of failure and medium likelihood of impact; improbable likelihood of failure with any likelihood of impact rating; or any likelihood of failure rating with very low likelihood of impact.

Vocabulary Used to Communicate the Consequences of Failure and Impact

Severe consequences could involve serious personal injury or death, high-value property damage, or major disruption to important activities.

Significant consequences are those that could involve substantial personal injury, property damage of moderate to high value, or considerable disruption of activities.

Minor consequences are those that are believed will only cause minor personal injury, low-to-moderate-value property damage, or small disruption of activities.

Negligible consequences are those that are believed will not result in personal injury, will only involve low-value property damage, or disruptions that can be replaced or repaired.

Vocabulary Used to Communicate Overall Risk Ratings

Extreme risk applies in situations in which failure is imminent, there is a high likelihood of impacting the target, and the consequences of the failure are severe.

High risk situations are those for which consequences are significant and likelihood is very likely or likely; or consequences are severe and likelihood is likely.

Moderate risk situations are those for which consequences are minor and likelihood is very likely or likely; or likelihood is somewhat likely and consequences are significant or severe.

Low risk situations are those for which consequences are negligible and likelihood is unlikely; or consequences are minor and likelihood is somewhat likely.

The *Likelihood of Failure and Impact* is defined by Table 1, the Likelihood Matrix:

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

The *Likelihood and Consequences* is defined by Table 2, the Consequences Matrix:

Likelihood of Failure & Impact	Consequences of Tree Failure			
	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

Overall tree risk rating is the highest individual risk identified for the tree.

Explanation of Tree Risk Levels

The three levels of tree risk assessment defined in the ANSI A300 Tree Risk Assessment Standard are:

I. Level 1: Limited Visual Assessment

This level of assessment provides a visual assessment from a defined perspective (e.g., from the sidewalk, street, or aerial view) of an individual tree or population of trees to assess risk to specified targets from obvious defects or specified conditions.

Level 1 assessments are typically performed to quickly assess large populations of trees or conduct a rapid assessment of an individual tree. The assessor views only one side of the tree while walking on a sidewalk, being unable to access a neighboring property, looking from a slow-moving car, or from above with a drone, helicopter, or airplane.

A Level 1 assessment requires the client to identify the location and/or selection criteria of trees to be assessed. The assessor may:

1. Determine the most efficient route and document the route taken.
2. Assess the tree(s) within the area from the defined perspective (e.g., walk-by or drive-by).
3. Record the location of trees that meet the defined criteria (e.g., significant defects or other conditions of concern).
4. Evaluate the risk (risk rating is optional).
5. Identify trees requiring a higher level of assessment (Level 2 or Level 3) and/or prompt action.
6. Submit risk mitigation recommendations and/or a report.

Limitations: Level 1 assessments are the least thorough means of assessment. They are typically from one perspective, such as a walk-by, a drive-by, or aerial view. This level of assessment is most commonly used to prioritize higher-risk trees within larger groups of trees when there are budgetary, time, or other management constraints. Some defects or conditions will not be visible to the inspector, nor will all conditions visible at all times of the year; therefore, not all higher-risk trees will be accurately identified. In addition, the assessment may not provide enough information to assign a risk rating, make a risk mitigation recommendation, or determine residual risk.

II. Level 2: Basic Assessment

A Level 2 assessment is a detailed visual inspection of a tree and its surrounding site and a synthesis of the information collected. It requires a 360Â° ground-based inspection around a tree, including the site conditions, visible buttress roots, trunk, branches, and crown.

The Level 2 assessment may include using tools such as binoculars, mallet, or probe at the discretion of the assessor or at the request of the owner/client.

At this level, the assessor may:

1. Locate and identify the tree or trees to be assessed.
2. Determine the targets and target zone for the tree or tree part(s) of concern.
3. Review the site history and conditions, and species failure profile.
4. Assess potential load on the tree and its parts.
5. Assess general tree health.
6. Inspect the tree visually which may include the use of common tools such as binoculars, mallet, probes, and/or shovels, as specified in the Scope of Work.
7. Record observations of site conditions, defects, indicators of internal defects, and response growth.
8. If necessary, recommend a Level 3 advanced assessment.
9. Analyze data to determine the likelihood of failure, likelihood of impact, and consequences of failure to evaluate the degree of risk.
10. Develop mitigation options and estimate residual risk for each option.
11. Recommend a re-inspection interval.
12. Prepare and submit a report.

Limitations: Level 2 assessments only include conditions and defects that can be detected from a ground-based visual inspection on the day of the assessment. Below-ground, internal, or upper-crown conditions, decay, and defects may not be detected.

III. Level 3: Advanced Assessment

A Level 3 assessment is performed to provide detailed information about specific tree parts, defects, targets, or site conditions. These are usually conducted in conjunction with or after a Level 2 assessment with owner/client approval. Specialized equipment, data collection and analysis, and/or expertise are usually required for Level 3 assessments.

At this level, the assessor may:

1. Locate and identify the tree or trees to be assessed.
2. Determine the targets and target zone for the tree or tree part(s) of concern.
3. Review the site history and conditions, and species failure profile.
4. Assess potential load on the tree and its parts.
5. Assess general tree health.
6. Inspect the tree and/or site using advanced techniques as specified in the Scope of Work.
7. Record results from advanced techniques.
8. Analyze data to determine the likelihood of failure, likelihood of impact, and consequences of failure to evaluate the degree of risk.
9. Develop mitigation options and estimate residual risk for each option.
10. Recommend a re-inspection interval.
11. Recommend other advanced assessments, if necessary.
12. Prepare and submit a report.

*Items 1-5 may be included in the associated Level 2 assessment.

Procedures and Methodologies Often Used For Level 3 Assessments

Level 3 procedures and methodologies, which are referred to as technologies, may include:

Procedure	Methodology
Aerial inspection and evaluation of structural defects in upper stems and branches	• visual inspection from within the tree crown or from a lift • unmanned aerial vehicle (UAV) photographic inspection • decay testing of branches
Detailed target analysis	• property value of anything potentially impacted by tree failure • use and occupancy statistics • potential disruption of activities such as road blockage or an electrical outage
Detailed site evaluation	• history evaluation • soil profile inspection to determine root depth • soil mineral and structural testing
Decay and wood analysis	• increment boring • drilling with small-diameter bit • resistance-recording drilling • single path sonic (stress) wave • sonic tomography • electrical impedance tomography • radiation (radar, X-ray) • advanced analysis for pathogen identification
Health evaluation	• tree ring analysis (in temperate zone trees) • shoot length measurement • detailed health/vigor analysis • starch assessment
Root inspection and evaluation	• root and root collar excavation • root decay evaluation • ground-penetrating radar
Storm/wind load analysis	• detailed assessment of tree exposure and protection • computer-based estimations according to engineering models • wind reaction monitoring over a defined interval
Measuring and assessing the change in trunk lean	• visual documentation • digital level
Load testing	• hand pull • measured static pull • measured tree dynamics

Limitations: Level 3 assessments that include specialized technologies may have uncertainty and require qualified estimations. Exact measures may not be feasible.

Conclusion

Regardless of the level of assessment conducted, every assessment is limited to the trees identified in the scope of work, conditions detectable at the time of the assessment, the level of communication with the owner/client, and other conditions that affect the assessor's ability to collect information. Not all defects and conditions are detectable, and not all tree failures can be predictable. Trees are living organisms, and as such, every tree's structural conditions change over time.