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Arborist OnSite®

Horticultural Consulting, Inc.

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ISA Certified Arborist Report

Submitted To:

West Coast Arborists Inc.
8524 Commerce Ave. Suite B
San Diego, California 92121

Project Location:

City of Encinitas
682 second street
Encinitas, California

Submitted By:

Robert Booty, Registered Member # 487
ISA Qualified Tree Risk Assessor
The American Society of Consulting Arborists
ISA Certified Arborist WC-4286
March 27, 2018

Limits of Assignment

This assignment is limited to one Ficus Tree #5952. My investigation involves root locating to determine the structural stability of the tree and trunk imaging at one elevation on the trunk to determine the internal health of the tree. Ground penetrating radar can not identify the presence of structural defects in roots located below ground, such as cracks or girdling roots that can be associated with tree failures. GPR can evaluate only depth, location and depending on the MHz of the antenna, targeting root size. Because trees continually change, this evaluation is valid only for the date of this inspection.

Disclaimer

Although studies have shown ground penetrating radar to have a high degree of accuracy[1] for below-ground root identification, these are not photographs but images of predicted root targets or changes in wood composition as in the case of trunk imaging . Arborist OnSite endeavors to use equipment that generates useful information to prepare reports that will reflect its best judgment in light of the facts as it knows them.

Assignment

I have been retained by Michael Palat who is the Area Manager for west coast arborists. I have been requested to utilize ground penetrating radar to evaluate the root structure and density of one Ficus tree. I am also to provide one trunk imaging scan to evaluate the internal condition of the tree.

Observations

I visited the site February 15, 2018. This is a mature Ficus tree. The canopy appears to have normal leaf development and color and appears in good health.

[1] Nina Bassuk, "Ground-Penetrating Radar Accurately Locates Tree Roots in Two Soil Media Under Pavement" Arboriculture & Urban Forestry, International Society of Arboricultural 2011.

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Conclusions

The results of the single trunk imaging indicated that there were no internal changes to the wood composition at the testing area.

For our root study a 400 MHz radar antenna was used, which begins identifying structural roots one inch in diameter and larger. Five half circle scans were completed in the street to a distance of fifteen feet. Two more scans were performed over the city sidewalk. All scans penetrated the soil to a depth of five feet. The radar indicated that there are a lot unidentified materials other than soil in our scanning area, which made it difficult to identify roots or even voids within the soil, which we were also trying to identify.

In spite of this I did find structural roots to forty-six inches in depth. With most being in the thirty-nine to thirty-four inch depth range. Keep in mind smaller roots than one inch are also present in this soil profile but not identified in this report, they would be more plentiful than the structural roots.

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Methodology

How does it work?

Ground-Penetrating Radar (GPR) is an established technology that has been used worldwide for over 30 years. Radar is an object-detection system that uses *electromagnetic waves* – specifically *radio waves* – to identify the range, altitude, direction, or speed of both moving and fixed objects. When an electromagnetic wave[2] emitted from a small surface transmit antenna / receiver encounters a boundary between objects with different electromagnetic properties, it will reflect, refract, and or diffract from the boundary in a predictable manner. Radar waves or signals are reflected especially well by materials of considerable *electrical conductivity*.

The radar signals that are reflected back towards the antenna are the desirable ones that create the image and make radar work. An air-filled tree trunk (*with a decayed hollow*) or a partially air-filled incipient (early stage) decay zone inside a cell wall within a tree are excellent reflectors for detection by GPR systems. Use of GPR instrumentation for internal tree trunk decay detection and below ground root locating is one of its latest uses in the field of tree risk assessment.

Its uses today seem endless. When you look at the weather report, you are looking at a Doppler weather radar scan; it will tell you where the heaviest amounts of rain will fall in your area. It works like this, the radar signal, as it passes through the clouds is reflected back to a transmit receiver antenna that measures the density of the moisture in them and the speed they are traveling. You can then determine approximately when it will start raining and how much rain will fall in a given area. Radar is used in aviation, automobiles, law enforcement and locating objects below ground.

How does radar distinguish between decayed and healthy wood?

Wood decay fungi[3] decompose lignified cell walls in living wood tissue by using enzymatic and non-enzymatic systems. In time this creates a microscopically detectable hollow or void within the cell walls of the wood, thereby reducing normal wood strength. Radar imaging can identify these small microscopic changes (voids) in the wood composition; they reflect a radio wave from them. It's the loss of the woods mechanical strength by these wood digesting organisms that is inherently linked to hazardous situations, often resulting to injuries or property damage.

Ground penetrating radar is one of the latest non-invasive forensic technologies used for wood decay analyses; its sensitivity to hollows, internal cracks or voids enables it to detect and create an image of these small internal molecular changes in wood density and composition. Incipient decay or *early-stage* decay is the very beginning of the biodegradation process of living wood tissue by decay causing pathogens; radar imaging can detect these minute early changes.

[2] Daniels, D.J. 1996, Surface-Penetrating Radar. The Institute of Electrical Engineers, ISBN 0-85296-0.
[3] Giovanni Nicolitti, Paolo Gonthier, Fabio Guglielmo and Matteo M. Garbelotto 2009. A Biomolecular Method for the Detection of Wood Decay Fungi: A Focus on Tree Stability Assessment. Arboriculture & Urban Forestry, Scientific Journal of the International Society of Arboriculture.

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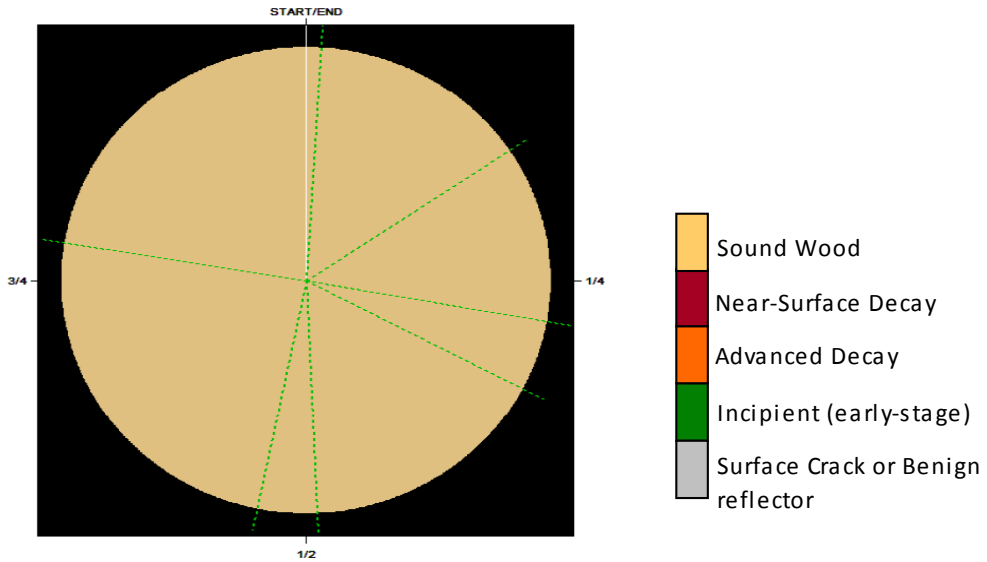
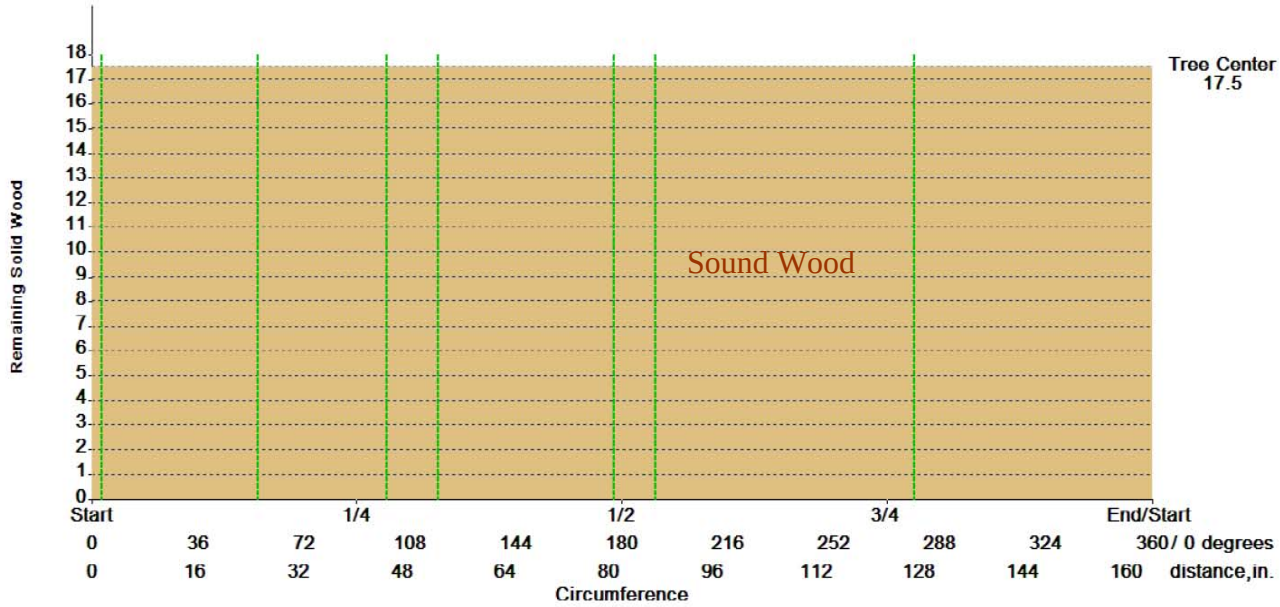
E Tree 5952 682 Second Street Date February 15, 2018 Ficus Tree Trunk Diameter 35 inches Elevation 57 Inches





Analyst Notes; No decay detected.

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Root Mapping

An Introduction to Below-Ground Tree Root Mapping using
Ground – Penetrating Radar (GPR)

Ground-Penetrating Radar used as a method of mapping tree roots has several of the following advantages over other methods of root locating,

1. It is capable of scanning the root systems of multiple trees under field conditions in a short time.
2. It is completely non-invasive and does not disturb the soils or damage the trees being examined, and causes no harm to the environment.
3. Being non-invasive, it allows repeated measurements that reveal long-term root system development.
4. It allows observation of root distribution beneath hard surfaces (concrete, asphalt, and bricks) roads and buildings.

It's accuracy is sufficient to resolve structural roots with diameters from less than 1 cm (0.4 in.) to 3 cm (1.2 in.) or more. It can characterize roots at both the individual tree and stand levels, facilitating correlations with tree and stand level measurements of physiological processes in complex ecological studies.

This is how the radar looks at the existing roots, as the antenna is moved along the ground every 2/10ths of an inch a radar signal is released into the soil at a predetermined depth.

As this signal encounters a root it is reflected off its top and back to a receiver inside the antenna. This returned signal is displayed as an x in the final report indicating the presence of a root, the colored x indicates the depth of the root.

Secondly one can observe all roots within a given soil profile depth, on the following pages you will notice 3 soil profiles depicted. When looking at the virtual trench view of maps keep in mind that each x marks the presence of a root. These roots are connected to the tree or root flare as they grow into the soil and then grow out ward in all directions, some have indicated roots that have no obstructions can travel laterally twice the height of the tree; this is what gives the tree stability.

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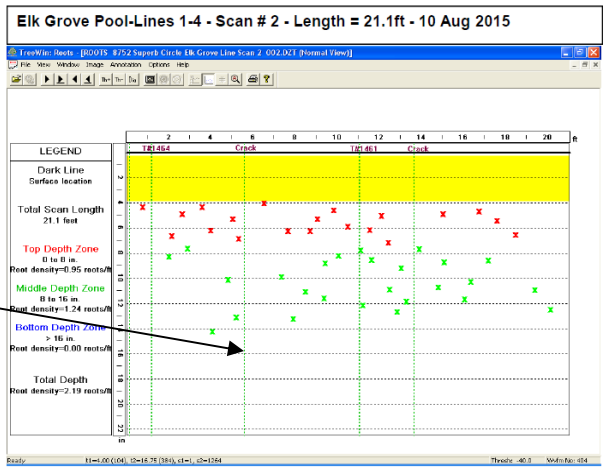
The use of green markers

During the scan markers are placed on the field computer by the technician. These markers are used to identify points of interest along the scan line such as in this case, passing of object landmarks such as a numbered tree. These manually placed markers show up in the final root analysis and can then be used to compare roots found below ground in relation to the physical crack or landmark such as a tree located above ground.

Green dotted lines are markers physically placed on the field computer by the technician during the scanning.



Virtual Trench View

A way of viewing the root data is as a virtual trench. The following panels represent each of the seven individual radar line scans from the site as if they were the walls of a trench. Think of this as if you were excavating a deep trench with a back-hoe. As you dig, tree roots will be encountered at various levels in the soil profile, after you have completed your trench you then are able to walk down and stand in the bottom.

Looking up at the earthen wall you are able to see the severed tree roots from your trenching protruding from the soil at the various depths of your trench. As you look at the following individual 7 virtual trench scans each x on the wall represents a severed root. Each colored x represents a different depth where the root is located.

One advantage of the trench view is that one can look at individual roots within their 3 represented depth zones and see the actual depth of each individual root.

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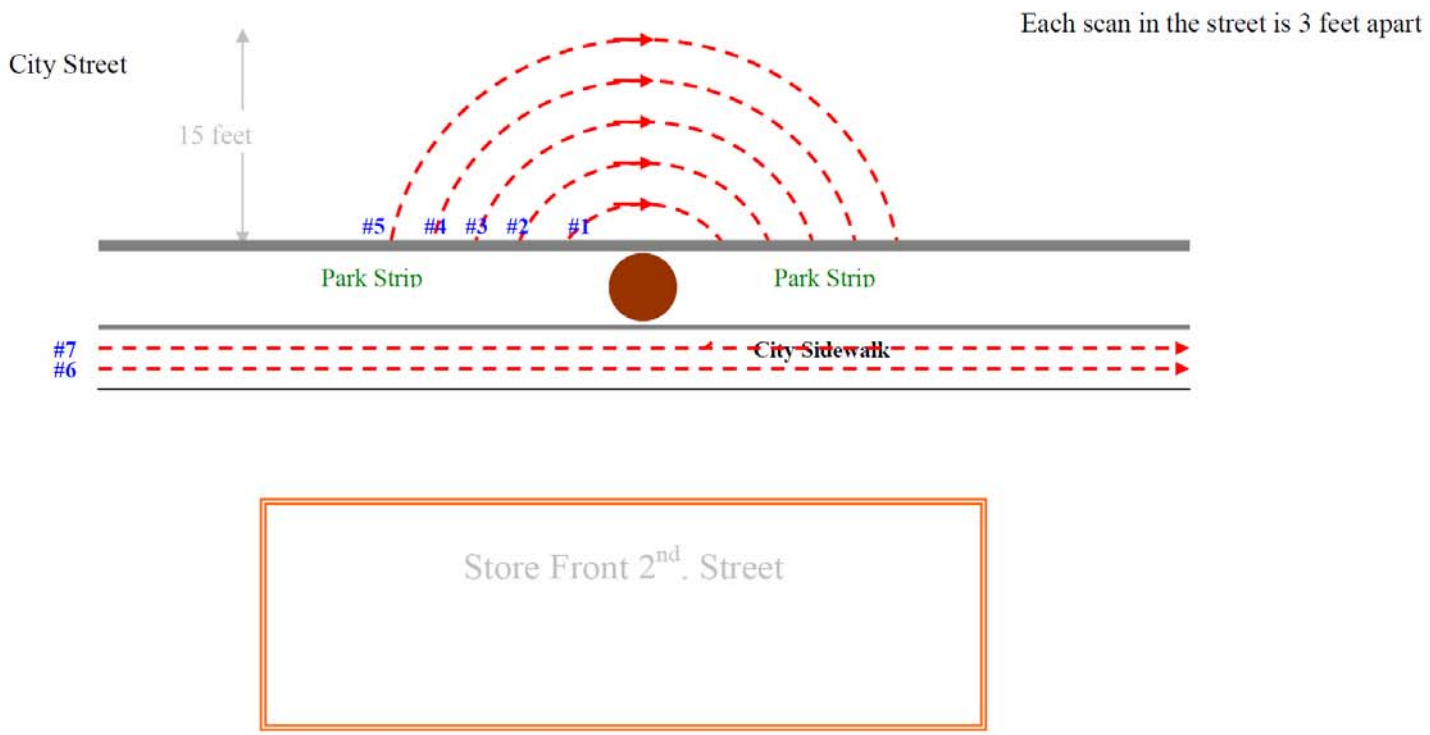
Site Map

Not to scale

Ficus Tree, Facility ID #5952 E-Tree



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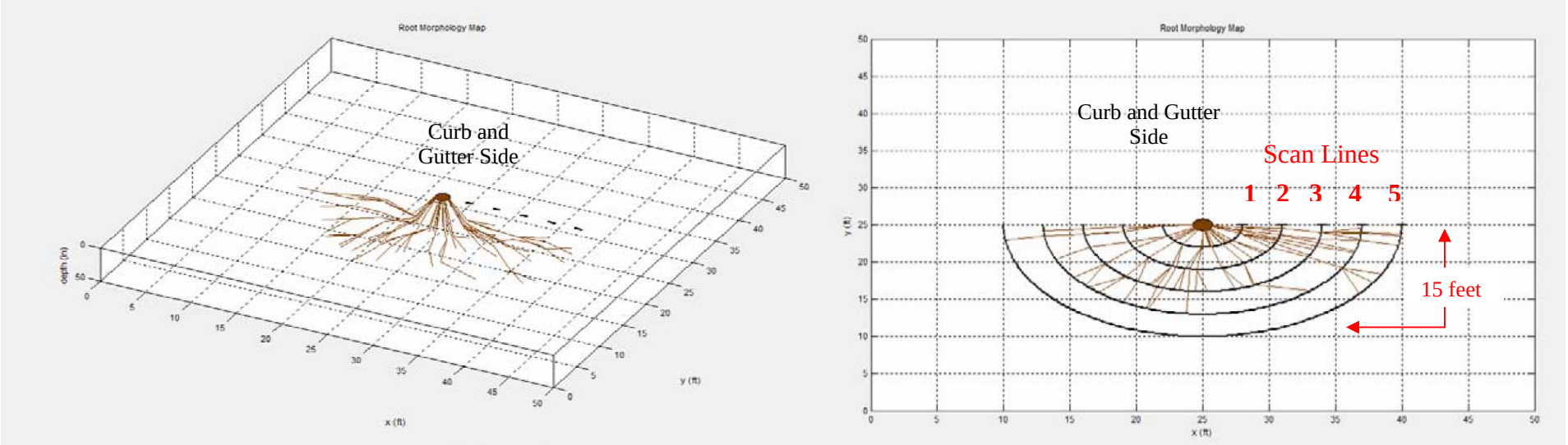
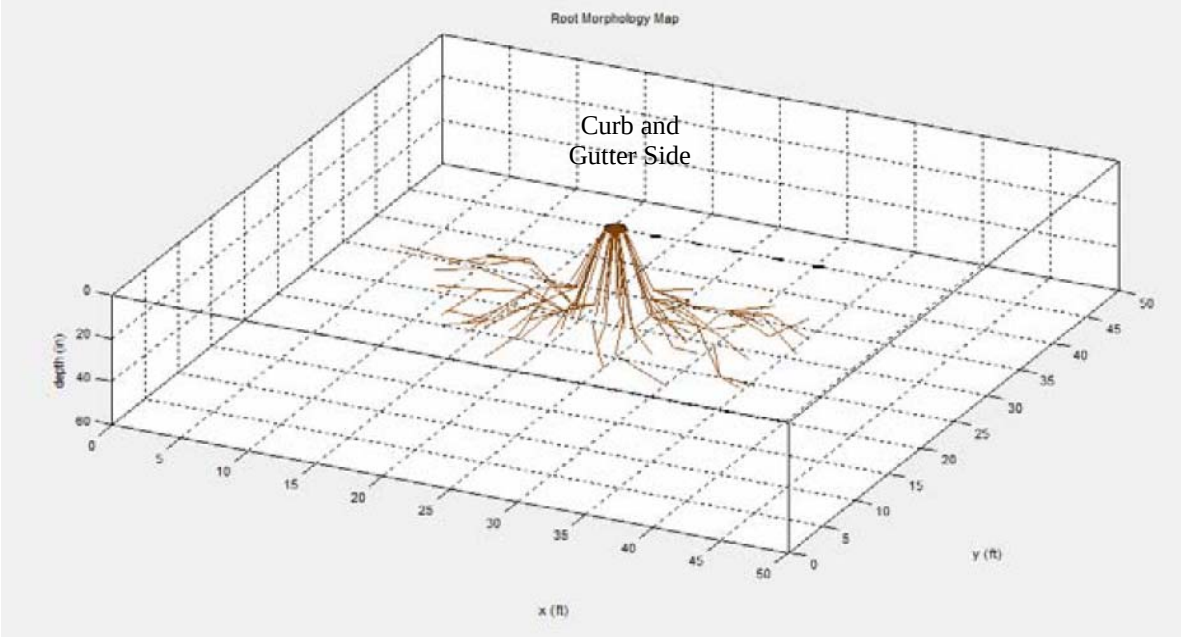
Conceptual 3D Top-Down diagram for tree #5952





This is a conceptual 3D Top-Down diagram of what the structural root system may look like below the street of tree #5952. It is obtained from the root depth data of the scans over the city street involving half the root structure, starting at the curb. The software uses the results of the predicted root locations in the street from the following five half circle scans generated from the virtual trench data from the flowing pages and connects the dots, creating what you see on this page. This provides a visualization concept of what the root density may look like below ground. The scan begins and ends with a distance of 20ft. on each side of the tree for a total distance along the curb of 40ft. The last scan #5 is 15ft. away from the tree. The scan depth is 5ft. The roots you see here and on the following pages are structural roots 1 inch in diameter and larger. Smaller absorbing, surface roots less than 1 inch in diameter are present in the soil profile, but are not identified in this root study.

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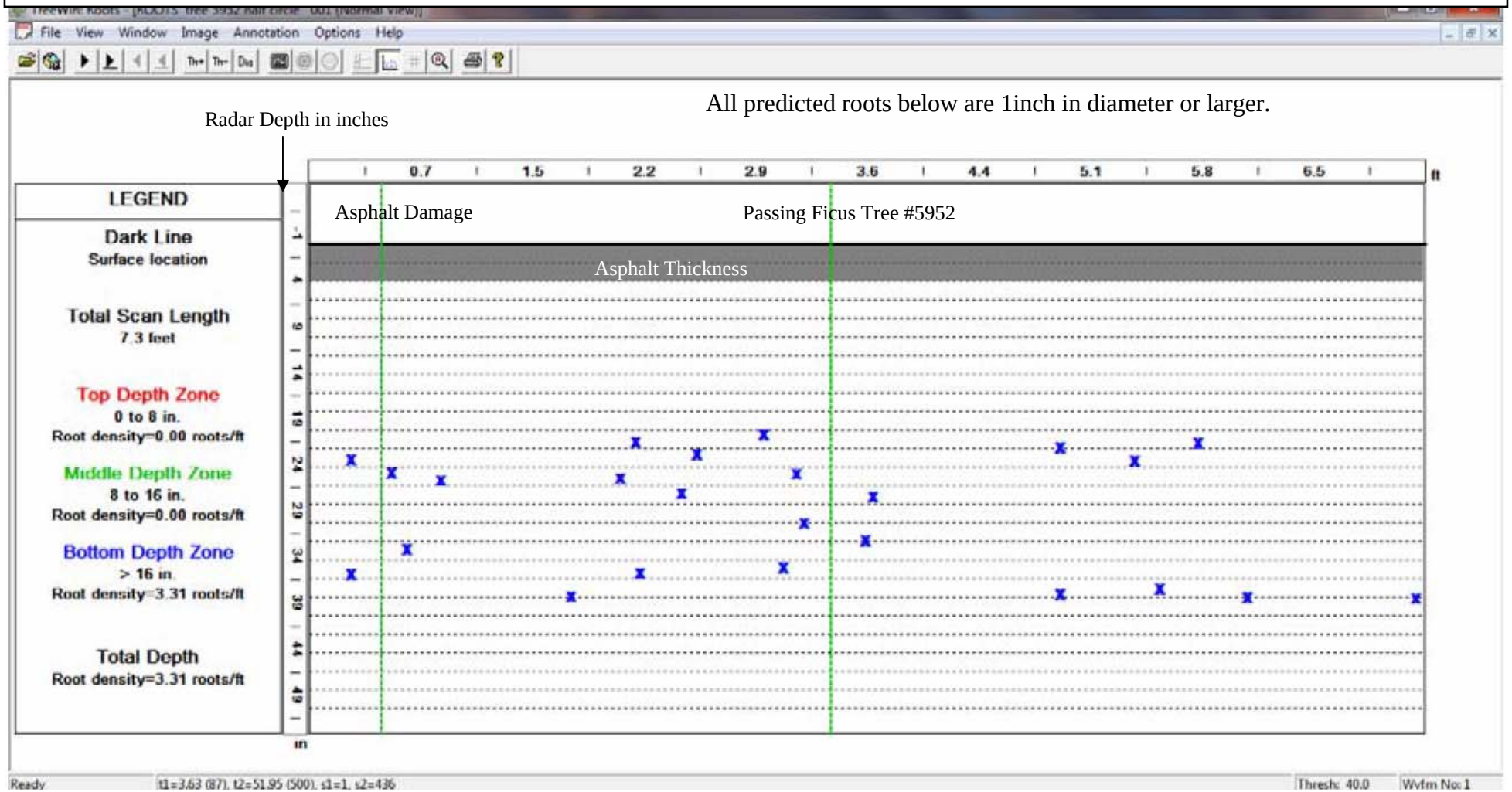
Ficus Tree #5952

February 15, 2018, 402 Second Street Encinitas, Ca. Root scan #1 over City Street. 3 feet from the tree.



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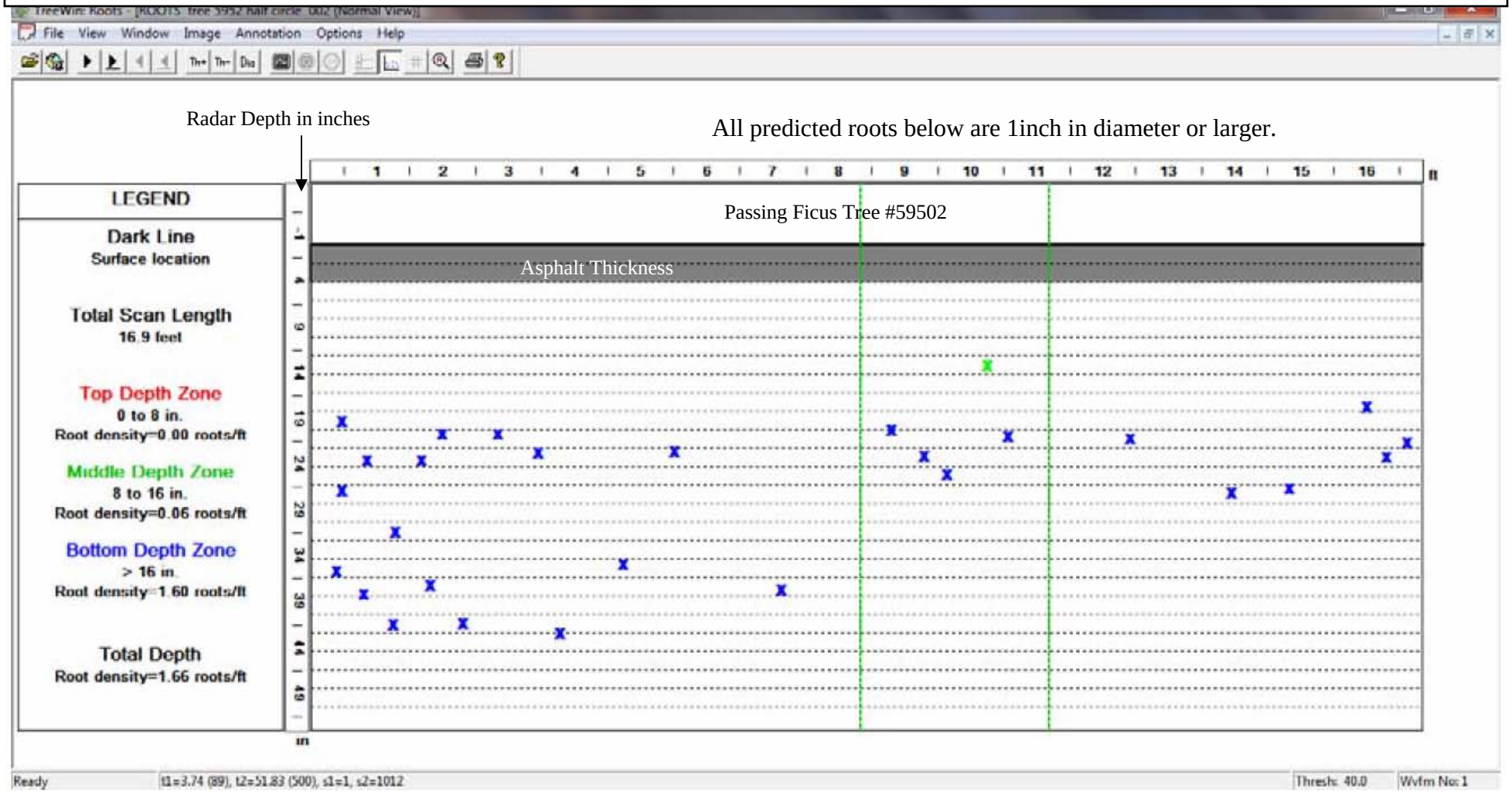
Ficus Tree #5952

February 15, 2018, 402 Second Street Encinitas, Ca. Root scan #2 over City Street. 6 feet from the tree.



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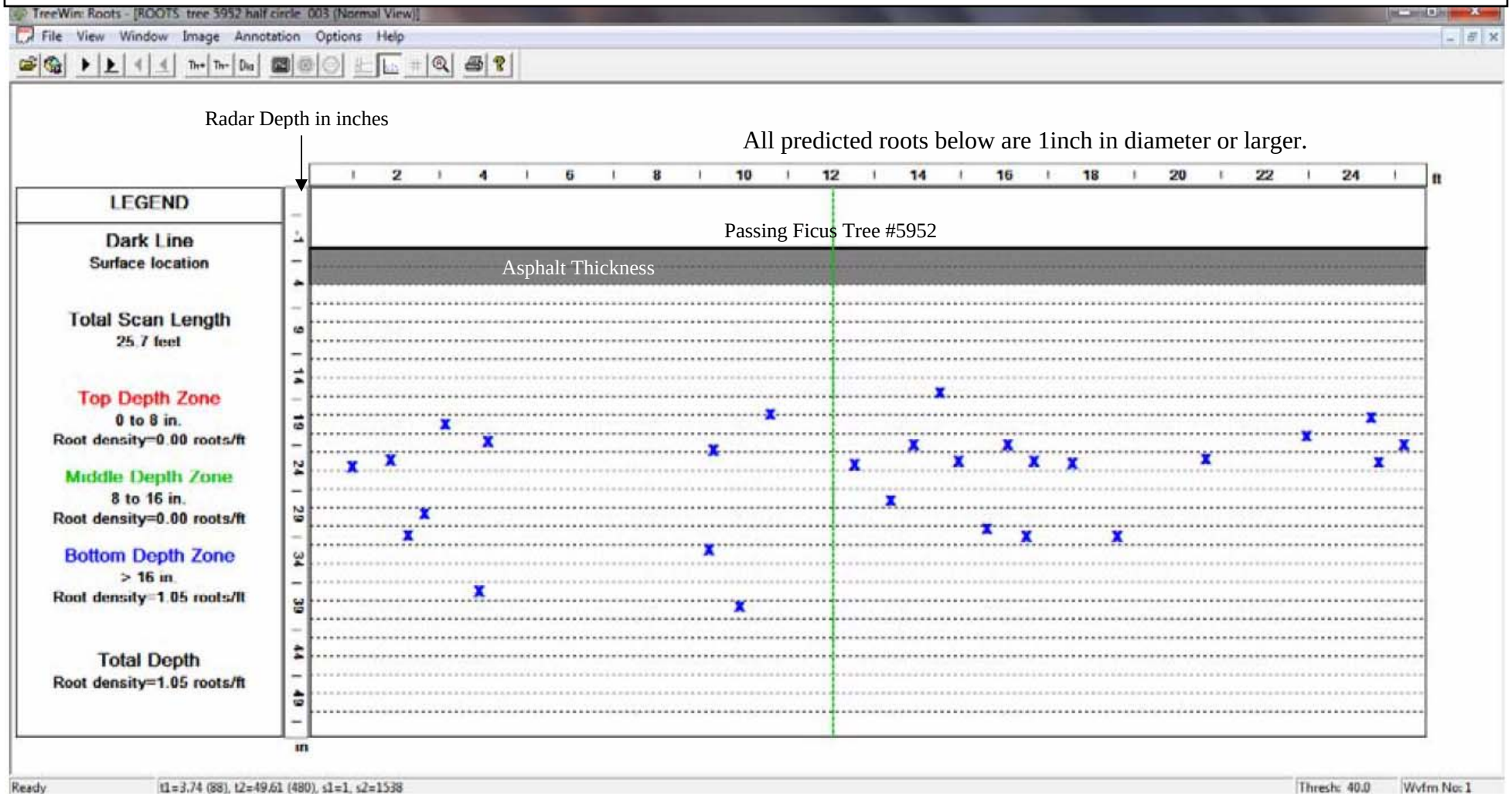
Ficus Tree #5952

February 15, 2018, 402 Second Street Encinitas, Ca. Root scan #3 over City Street. 9 feet from the tree.



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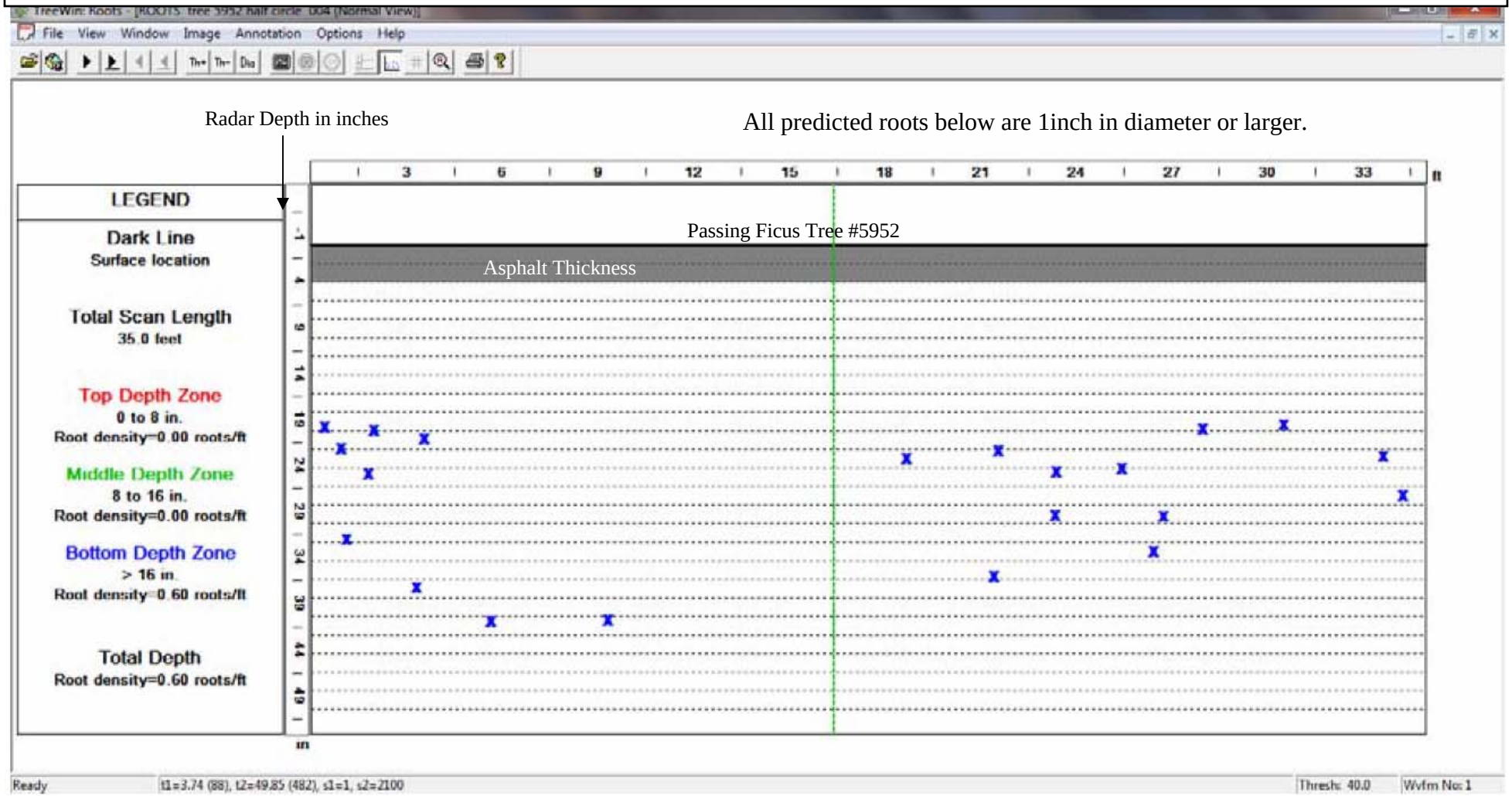
Ficus Tree #5952

February 15, 2018, 402 Second Street Encinitas, Ca. Root scan #4 over City Street. 12 feet from the tree.



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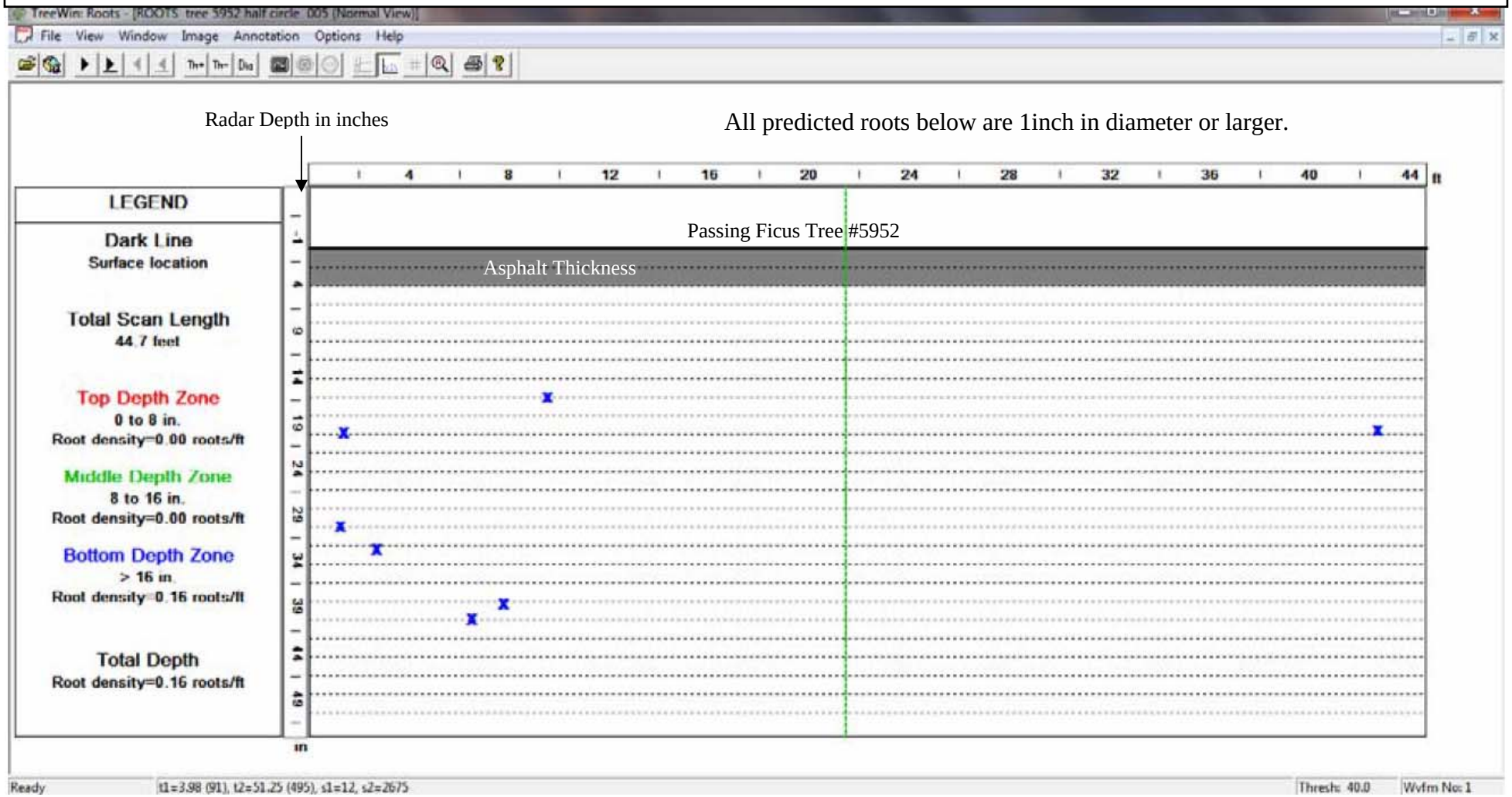
Ficus Tree #5952

February 15, 2018, 402 Second Street Encinitas, Ca. Root scan #5 over City Street. 15 feet from the tree.



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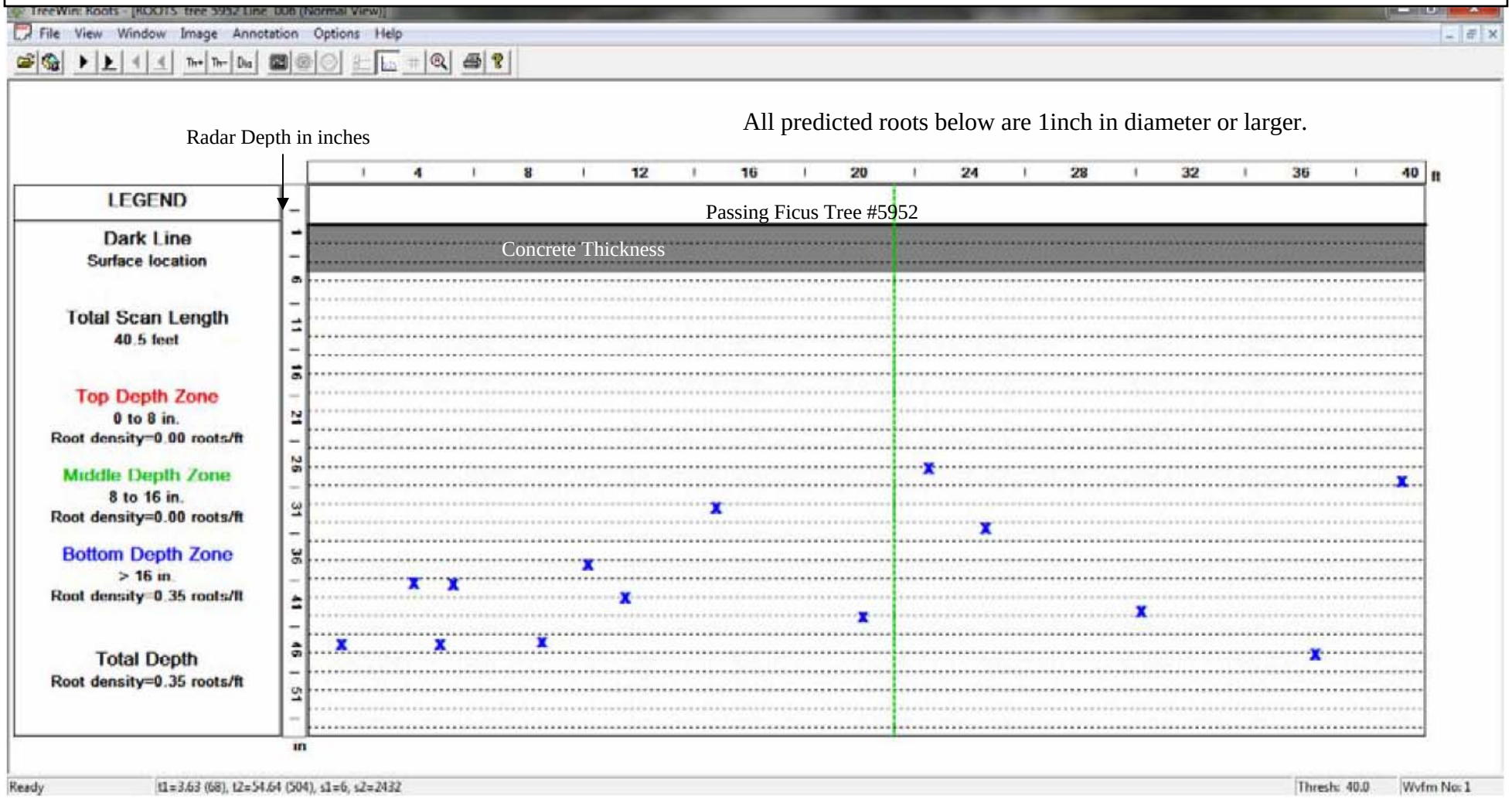
Ficus Tree #5952

February 15, 2018, 402 Second Street Encinitas, Ca. Root scan #6 over City Sidewalk.



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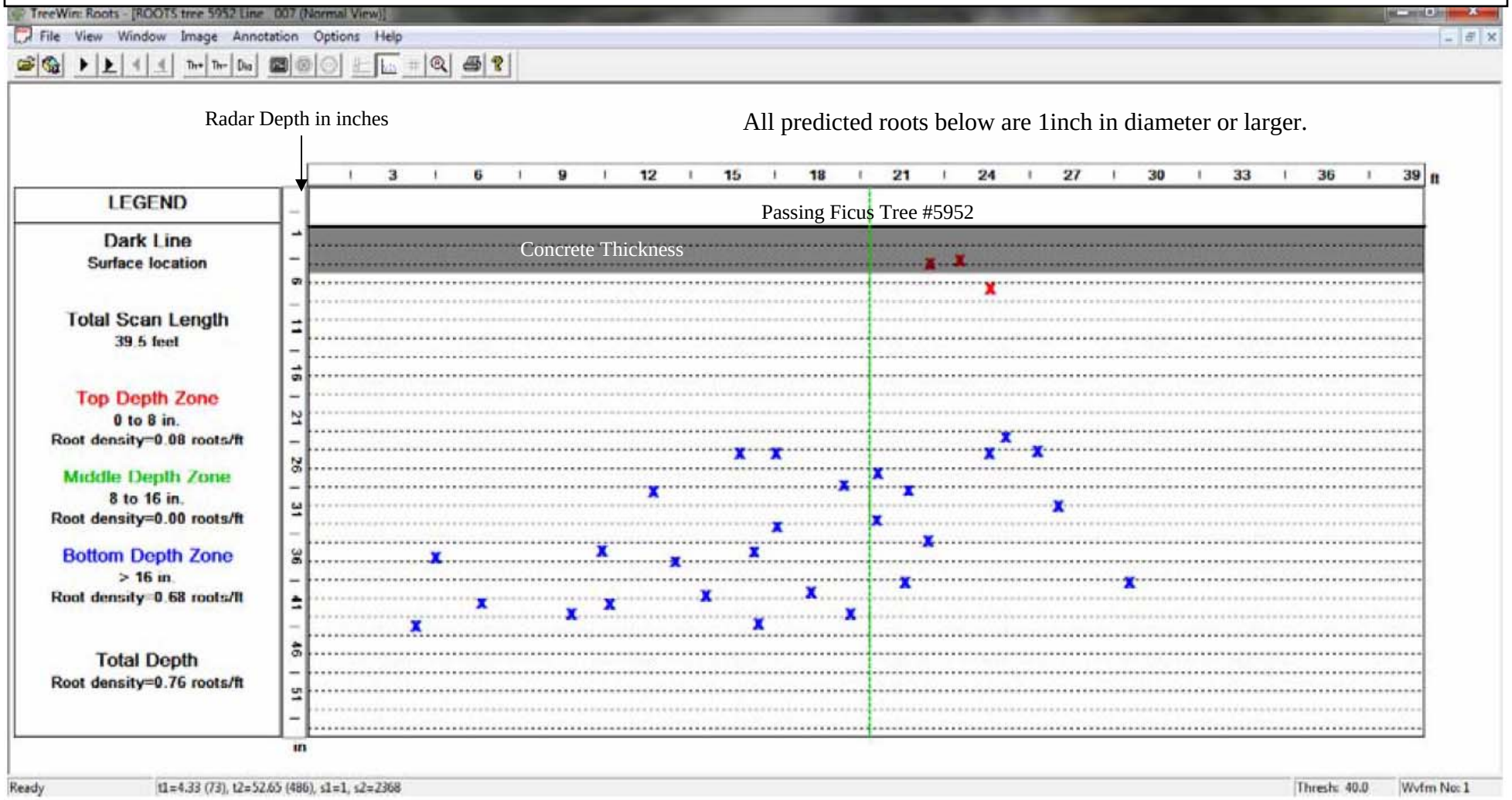
Ficus Tree #5952

February 15, 2018, 402 Second Street Encinitas, Ca. Root scan #7 over City Sidewalk.



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Arborist Disclosure / Performance of Services

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Since trees are living organisms, conditions are often hidden within the tree and below ground. Arborists cannot guarantee that a tree will be healthy or safe under all circumstances, or for a specific period of time. Likewise, remedial treatments cannot be guaranteed. Trees can be managed but they cannot be controlled. To live near trees is to accept some degree of risk and the only way to eliminate all risk associated with trees is to eliminate all trees.

2. Indemnification from current and future tree failures. Although radar imaging has no known harmful physical affects on trees the client agrees to indemnify, defend and hold Arborist OnSite Inc. and TreeRadar inc. harmless from and against any and all claims, liabilities, suite, demands, losses, costs and expenses, including, but not limited to, reasonable attorneys' fees and all legal expenses and fees incurred through appeal, and all interest thereon, accruing or resulting to any and all persons, firms or any other legal entities on account of any damages or losses to property or persons, including injuries or death, or economic losses, arising out of the Services and/or this Agreement, *except to the extent that said damages or losses are caused by Consultant's gross negligence or willful misconduct.* This indemnity, shall survive any expiration or termination of this Agreement with regard to any claims arising during, or related to, facts or circumstances that occurred during the term of this Agreement or any extension thereof.

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4 General Conditions. Client acknowledges that it has read and agrees to the General Conditions contained in this document which are incorporated herein and made a part of this Agreement and report and shall apply to all services performed by Consultant. If this document is attached to another form of agreement whose terms and conditions conflict with this Agreement the General Conditions contained in this document shall prevail.

Assumptions and Limiting Conditions

1. Any legal description provided to the consultant is assumed to be correct. No responsibility is assumed for matters legal in character nor is any opinion rendered as to the quality of any title.
2. The consultant can neither guarantee nor be responsible for accuracy of information provided by others, information not provided or disclosed.
3. The consultant shall not be required to give testimony or to attend court by reason of this consultation/reports unless subsequent written arrangements are made, including payment of an additional fee for services.
4. Loss or removal of any part of this report invalidates the entire report/evaluation.
5. Possession of this report or a copy thereof does not imply right of publication or use for any purpose by any other than the persons(s) to whom it is addressed without written consent of this consultant.
6. This report represents the opinion of consultant, and the consultant's fee is in no way contingent upon the reporting upon any pre-determined findings.
7. Sketches, diagrams, graphs, photos, ect., in this report, being intended as visual aids, are not necessarily to scale and should not be construed as engineering reports or surveys.
8. This report has been made in conformity with acceptable evaluation/diagnostic reporting techniques and procedures, as recommended by the International Society of Arboriculture.
9. No tree described in this report was climbed, unless otherwise stated. Arborist OnSite® cannot assume responsibility for any defects which could only have been discovered by climbing. A full root collar or root crown inspection, consisting of excavating the soil around the tree to uncover hidden defects or disease involving the root collar and major buttress roots, was not performed, unless otherwise stated. Arborist OnSite® cannot accept responsibility for any root defects which could only have been discovered by such an inspection.

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Certification of Performance

I, Robert Booty, certify:

- That I have personally inspected the tree(s) and/or the property referred to in this report, and have stated my findings accurately. The extent of the evaluation and or appraisal is stated in the attached report and the terms and conditions;

- That I have no current interest in the vegetation or the property that is the subject of this report, and I have no personal interest or bias with respect to the parties involved;

- That the analysis, opinions and conclusions stated herein are my own, and are based on current scientific procedures and facts;

- That my compensation is not contingent upon the reporting of a predetermined conclusion that favors the cause of the client or any other party, nor upon the results of the assessment, the attainment of stipulated results, or the occurrence of any subsequent events;
- That my analysis, opinions, and conclusions were developed and this report has been prepared according to commonly accepted arboricultural practices;

- That no one provided significant professional assistance to the consultant, except as indicated within the report.

I further certify that I am a Registered Member of the American Society of Consulting Arborists, and I am an International Society of Arboriculture Certified Arborist. I have been involved in the practice of arboriculture and the care and study of trees for over 49 years.

Signed: Robert Booty

Date: April 3, 2018

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