International Tree Failure Database

User Manual

Prepared to accompany the International Tree Failure Database

http://ftcweb.fs.fed.us/natfdb/

E. Thomas Smiley, PhD, Bartlett Tree Research Laboratory, Charlotte, NC

Nelda Matheny, HortScience, Pleasanton CA

Jim Clark, PhD, HortScience, Pleasanton CA

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Contents

Introduction

Hazard caused by tree failure

Tree failures, especially in urban areas and outdoor recreation areas, often result in property damage or personal injury. While many of these failures are predictable, there remains a dearth of information on species failure tendencies as well as the importance of specific tree structural defects, site disturbances, and weather events associated with failures. The International Tree Failure Database (ITFD) collects information on tree failures, evaluates the patterns of failure, and disseminates analysis for use in managing trees and enhancing public safety.

A similar system was conceived and developed in California in 1987 as the California Tree Failure Report Program (CTFRP). The California program has been well received by the arboricultural community and has developed tree failure profiles of common California tree species. Due to the success of the CTFRP, the USDA Forest Service, in cooperation with the International Society of Arboriculture (ISA), developed the ITFD, a similar system that can be used throughout the world.

California Tree Failure Report Program

The ITFD operates in the following manner. Information on each failed tree is recorded on a standard report form and then submitted to the program's database through its Web site, http://ftcweb.fs.fed.us/natfdb/. Over time the results will be assembled and analyzed, and reports

will be prepared and made available. Ultimately, this database will improve detection and understanding of tree hazards prior to failure.

For the ITFD to be successful, active input from cooperators around the world is essential. Tree managers, foresters, and arborists can become cooperators by attending a training session. Ideally, every cooperator would report at least four failures per year. We anticipate that professionals in charge of large populations of trees will report the majority of their failures.

The ITFD's definition of a tree failure is **a structural failure or physical breakage of the tree trunk, one or more branches, or one or more tree roots**. This definition of tree failure does *not* include dead standing trees (even if they are likely to fail soon), or trees knocked over by automobiles, other equipment, other trees, or extreme natural catastrophes (ie., floods, tornadoes, earthquakes, avalanches, landslides, volcanoes, meteors). Trees that fail during snow or ice storms, thunderstorms, micro-bursts and hurricanes should be recorded. Dead trees that fall over or otherwise fail should be recorded. Trees that have been or will be intentionally removed, felled, or pulled or pushed over due to a high likelihood of natural failure should *not* be reported. Generating reports from photographs or verbal descriptions can introduce unacceptable error into the system and should be avoided.

Most terms used in the ITFD are well known to forestry professionals and arborists. However, for the sake of completeness and to aid less-experienced data collectors, all technical terms are defined in the glossary and are available in the **Live help** feature of the ITFD data entry program. Live help allows the user to access definitions while using the Web site by clicking on underlined words. Data collection terms in this manual are in the same order as they appear on the paper-based Tree Failure Report Form. For ease of reference, a copy of the report form is included at the end of this manual. Copies of the report form can be downloaded from the ITFD Web site, http://ftcweb.fs.fed.us/natfdb/ under **Help** and **Downloads**, or by going directly to http://ftcweb.fs.fed.us/natfdb/ITFD_Form_12_17_04.pdf.

Downloads from the ITFD

Depending upon the type of failure (root, trunk or branch), seven or eight fields must be completed in order to make a valid report. Required fields are marked with an asterisk (*) on the paper report form. Required fields for all types of failure are:

- tree genus and species
- state or province and country where the tree was located
- diameter at breast height
- type of failure (trunk, branch or root)

For a trunk failure, the height of failure above grade and diameter at the break are also required. For a branch failure, the diameter of the failed limb at the break point is required. For root failure, the nature of the failure is required.

While only a limited number of fields are required, more comprehensive reports are desirable. The more complete the information, the greater the value of the report. In any case, it is better to enter a small amount of information than none at all.

Some items in the report including trunk diameter and branch length require accurate measurement. While an experienced cooperator can visually estimate the height to a break, the diameter of the tree or branch may need to be more accurately measured using diameter tape. The length of a fallen tree or tree parts on the ground can either be measured with a tape measure or paced off to acquire acceptable accuracy. In general, the smaller the tree part, the more accurately it should be measured.

Measuring tree parts with a tape measure

At this time, the ITFD cannot accept photographs. This capacity may be added at a future date. We encourage cooperators to take photographs for their own files and save them for future inclusion in the database or to present at regional ITFD meetings.

Not all failure situations can be covered by the ITFD program. Cooperators are encouraged to use professional judgment. Supplemental information can be entered in the **Additional Comments** part of Section 9 of the report form and program. If a situation or feature not found in the report form is common in your area, please notify the system administrator for possible

inclusion in future ITFD revisions.

The Web site permits entering only one tree failure at a time. The **Copy** function allows additional trees with the same species, size, or location attributes to be repeated in the next record. Be sure to make the changes required for each new entry so that the data is unique for subsequent trees.

Information contained in the ITFD is subject to the U.S. Freedom of Information Act and can be accessed by the public. Reports should provide only information appropriate for general use. If a tree failure may become involved in future litigation, we recommend delaying entry into the database until the situation is resolved. The USDA Forest Service and other Web site managers will not attempt to protect any information on the database from legal disclosure or discovery.

Throughout this manual, as well as on the Web site and in the paper-based report form, an asterisk (*) indicates required information.

Getting Online with the ITFD

In order to become a cooperator in tree failure analysis with the ITFD, a training class is required. This session is typically 2 to 3 hours long and may be conducted entirely indoors or may be a combination of indoor and field training. U.S. federal personnel may have alternative training options; contact your USDA Forest Service Forest Health Protection group for details.

An ITFD training class

The ITFD Report Form will be provided at training sessions. Additional copies can be downloaded from the ITFD Web site (http://ftcweb.fs.fed.us/natfdb/) using the **Help** and **Download** tabs, or printed directly from the link (http://ftcweb.fs.fed.us/natfdb/ITFD_Form_12_17_04.pdf). A PDA-based data collection and report system may become available in the future.

At the end of the training session, you will have the opportunity to become a cooperator, receiving a user name and password to access the Web site reporting screens. Notify the site administrator (wo_ftcol_natfd@fs.fed.us) if you experience any problems accessing the Web site. Check the Web site routinely for updates of the report form, system changes, and meeting announcements**. It is the cooperator's responsibility to notify the system administrator of any change in their e-mail address**.

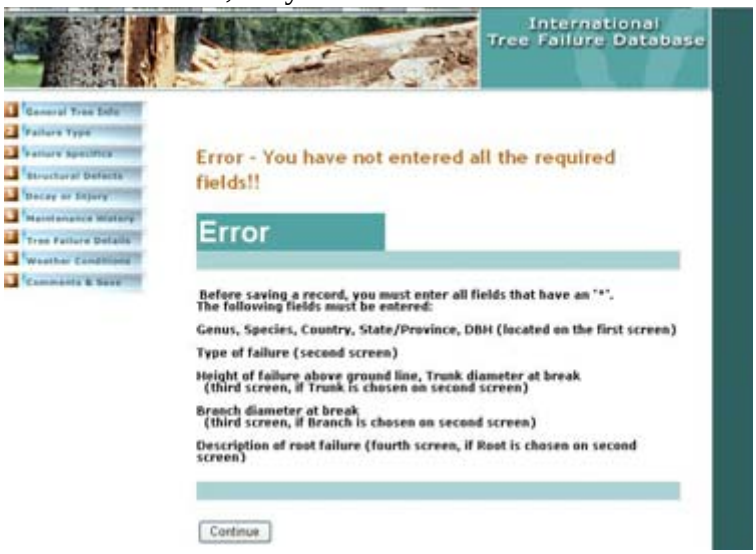
Those wishing to become ITFD trainers must complete an approved training class, acquire the current version of the ITFD training presentation, and be approved by the ITFD steering committee. Contact the system administrator for more information.

Completing the Field Report Form and Reporting a Failure

The paper-based ITFD Report Form mirrors the Web site's report entry format. The order of data entry and the terms employed are the same in both. It is assumed that in most cases cooperators would make field observations on the paper report form and report data via the Web site. The upper left corner of the report form gives the numbers of the major divisions of a report. The Web site uses the same format. Please note that Sections 3 through 6 appear in three different places, depending on the failure type selected.

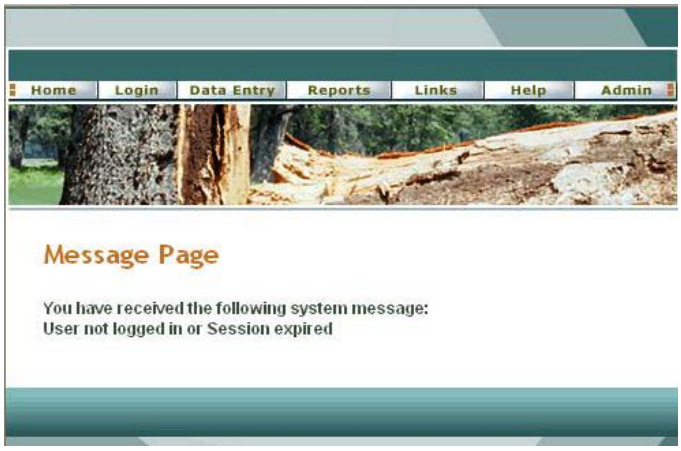
Required fields are marked with an asterisk (*)

On the Web site, if you leave fields marked with an asterisk blank or enter inappropriate information (e.g., text for trunk diameter), the report will be rejected when you submit it. For example, if the species is spelled incorrectly, you will be prompted after clicking **Continue**. You will then need to review all required fields and make sure the data is entered correctly.



Required fields

A time-out function is built in the ITFD Web site. If you have not entered data for 1 hour, the system will disconnect and the previously entered data will be lost.



Time out

Form ID number

Once a submission is accepted by the database, it will be given a unique identification number. You can enter this number in the upper right corner of the paper report form. This verifies that the tree failure has been entered on the Web site. Recording the form ID number is most useful if you retain the paper report form for future reference. Record of reports you submit may also be used to receive discounts or rewards at regional ITFD meeting.

Form ID number

Measurement Units

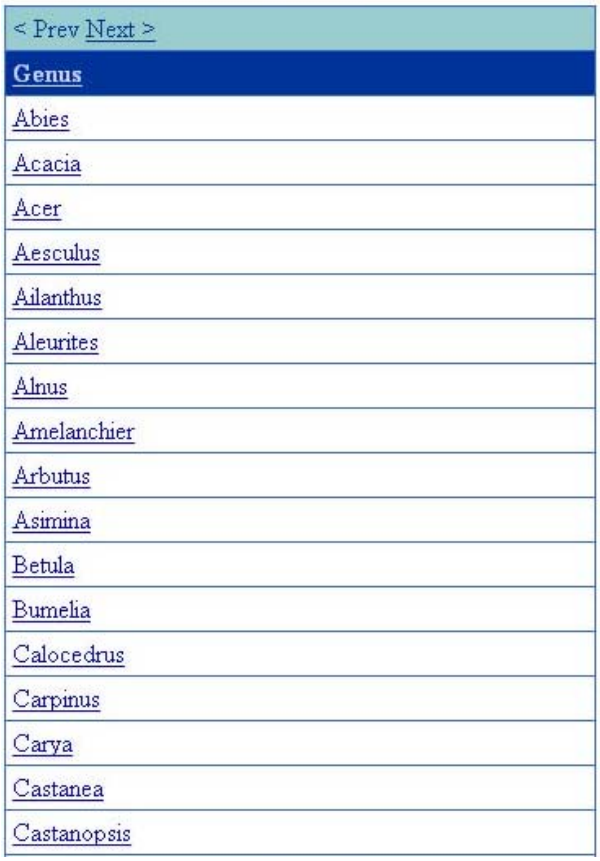
Data can be entered using metric or English (American, Imperial) units. The default system is English. Click the **Switch to Metric Data Entry** box on the first page of the Web-based data entry screen to change to metric. Once a selection has been made, all entries in a report must use that system. You cannot combine units in an individual tree entry.

Switch to metric

Section 1: General Tree Information

Tree genus*

This is a required field. Enter the scientific genus name only. For example, for *Eucalyptus globulus*, *Eucalyptus* is the genus. Enter *Eucalyptus* or, on the Web site, select it from the pull-down list. If the genus you are trying to enter is not on the list, you will receive an error message; contact the system administrator through the ITFD home page. Do not enter common names.



Species*

This is a required field. Enter the scientific species name (the "specific epithet"). For example, for *Eucalyptus globulus*, *globulus* is the specific epithet. Enter *globulus* or, on the Web site, select it from the pull-down list. The pull-down list will also provide a common name for the species entered. If the genus was not selected from the pull-down list, the species name and common name will not be available.

Cultivar

Enter the cultivar name, if known. For example, for *Pyrus calleryana* 'Bradford,' Bradford is the cultivar. On the Web site, pull-down lists are not provided.

Country*

This is a required field. Enter the country where the tree is located. On the Web site, use the pull-down list.

State/province*

This is a required field. Enter the state or province where the tree is located. For example, enter the two-character postal abbreviation "MI" for Michigan, or, on the Web site, pull down "Michigan" from the list. Using the pull-down list rather than the two-digit postal abbreviation will link the subsequent county list.

County

Enter the county (or equivalent political subdivision) where the tree is located. This can be entered on the Web site by typing the county name or by pulling down the list of counties. If the state was entered as a two-digit postal code rather than by using the pull-down list, the county pull-down list will not be available.

Measuring DBH of a fallen tre

DBH*

This is a required field. Enter the diameter at breast height (DBH, or DSH, diameter at standard height) measured 4.5 feet (55 inches or 1.4 m) above grade. Record this value whether this portion of the tree is still standing or is lying on the ground. For multiple stemmed trees, measure the diameter below the stem junction, if possible. If the junction is so close to the ground line that it can not be measured, each stem should be considered an individual tree. Do not enter the circumference.

Height

Enter an estimate of the total height of the tree prior to failure. Depending on the condition of the failure, this is measured from the root collar to the highest twigs of the tree. In the case of a trunk break, add the stump height to the length of the portion of the tree separated from the stump. This can be determined with a tape measure or paced off if the tree is lying on the ground. If the tree is still standing, as in the case of a branch failure, the total tree height can be a visual estimate or measured with a clinometer. For wind-thrown trees, do not include the depth of the roots below the original soil line. Use whole numbers to the nearest foot or meter.

Estimating height visually

Age

Enter the number of years from initial seed germination, if known. Do *not* enter years from the last transplanting. Age can be determined from planting records or ring counts.

Tree/site ownership

Enter the category of land ownership for the site on which the tree grew. Choose the category below that best describes the land ownership.

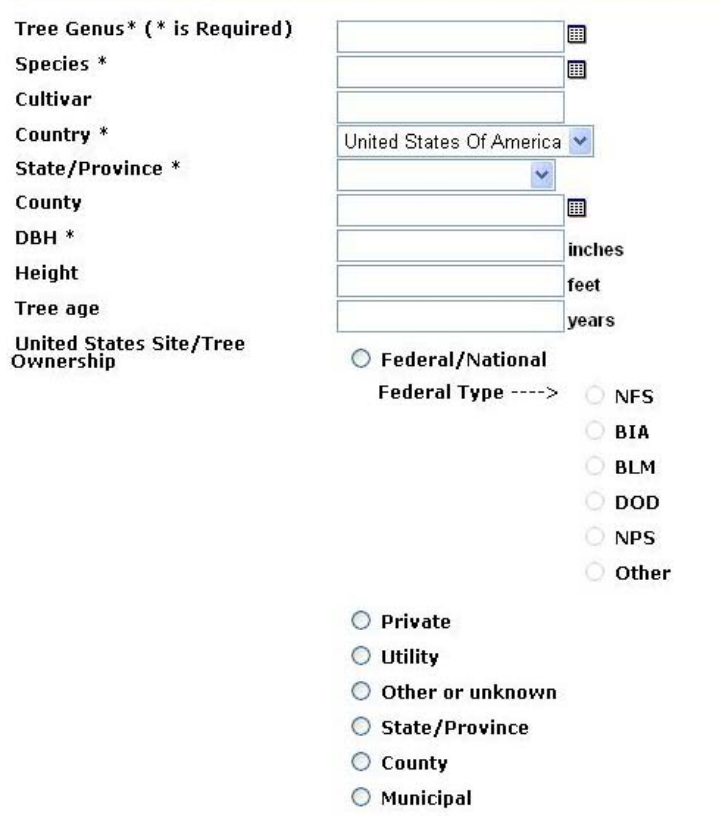
Private

Property owned by an individual, corporation, or institution, including homes, yards, or gardens (even if trees are in a street, utility easement, or right-of-way); commercial sites; industrial sites;

apartment, hotel, or condominium complexes; property owned or managed by a subdivision or homeowner association (HOA); shopping malls; or businesses and business parks.

Utility

Property wholly owned by a utility, such as substations, generating plants, railroads, or water treatment plants. This does not include right-of-way (ROW) trees.



Federal/national

For land owned by the U.S. or other national government, choose this option as well as the agency responsible for the land management. In the United States, options include **NFS** (National Forest System), **BIA** (Bureau of Indian Affairs), **BLM** (Bureau of Land Management) **DOD** (Department of Defense), and **NPS (**National Park Service). For all other federal government landowners, choose **Other** on the Web site (this is not an option on the field report form). For governments other than the U.S. federal government, select the closest equivalent land management agency. To enter information on USDA Forest Service or USDI National Park Service land, the Web site allows for additional information: **Forest Service Region, Forest, Ranger District, National Park or Monument,** and **Campground**. Since the field report form does not provide space for this information, record notes on these items in the **Address/Site** line of the form, if needed.

State/province

State or provincial lands and facilities, including parks, recreation sites, government offices, police stations, National Guard centers, and state-maintained highway property, including state-maintained federal interstate highways and their interchanges.

County

County-owned property, such as office complexes, maintenance facilities, jails or detention centers, parks, recreational facilities, and county-maintained roads.

Municipal

City hall building grounds or complexes, cemeteries, parks, maintenance facilities, golf courses, recreation facilities, greenways, and city-owned streetside trees. Street trees on private property in the street or road ROW are *not* included here.

Other or unknown

Land ownership is unknown and could conceivably be more than one other type as listed here.

Address/site name

Enter the physical (street) address of the site, facility name, or name of the campground, municipal park, trailhead, or other site descriptor. Although the name and order are slightly different on the report form, this information corresponds to the **Additional description of site location** on the Web site. This information may assist the cooperator with retrieving or sorting trees that were submitted.

Cell phone GPS

GPS: Latitude and longitude

Enter the physical location of the tree as described in latitude and longitude using a geographic positioning system (GPS) receiver. The ITFD employs the NAD83 system. Locations are described in decimal degrees rather than minutes and seconds. A link is provided to the Federal Communications Commission Audio Division Web site (http://www.fcc.gov/mb/audio/bickel/DDDMMSS-decimal.html) for converting locations from minutes and seconds to decimal degrees. To avoid difficulties associated with converting to NAD83, set your GPS unit to NAD83 and decimal degrees prior to data collection.

Federal Communications Commission Audio Division Website

Section 2: Failure Type*

Section 2 is a required field. This section answers one question: What part of the tree failed? Categorize the failure as a trunk, branch, or root failure. Upon making a selection, answer questions specific to that failure type. The choices are as follows.

Trunk failure

Trunk failure occurs on the aboveground portion of the main stem. It includes breakage of the trunk above the root collar, even if the root collar and lower trunk are below grade. Include trunk failures due to constriction by girdling roots if there is no other root involvement. If the tree has two or more codominant stems, breakage in any one of the stems would be considered a trunk failure. A failure that encompasses both roots and trunk should be classified as a root failure rather than a trunk failure. In trees with a strong central leader, the trunk may fail at any point from base to the top of the tree. In trees lacking a strong central leader, the trunk will transition to a series of scaffold branches.

Branch failure

Any significant aboveground failure other than failure in the trunk.

Root failure

Failure of the roots, even if they are above grade, as well as failures that involve both roots and a portion of the lower trunk. Root failure encompasses broken roots, cut roots, and root plate lifting out of the ground (windthrow). Failures due to constriction of the stem by girdling roots are considered trunk failures if there is no other root involvement.

Section 3: Trunk Failure Specifics

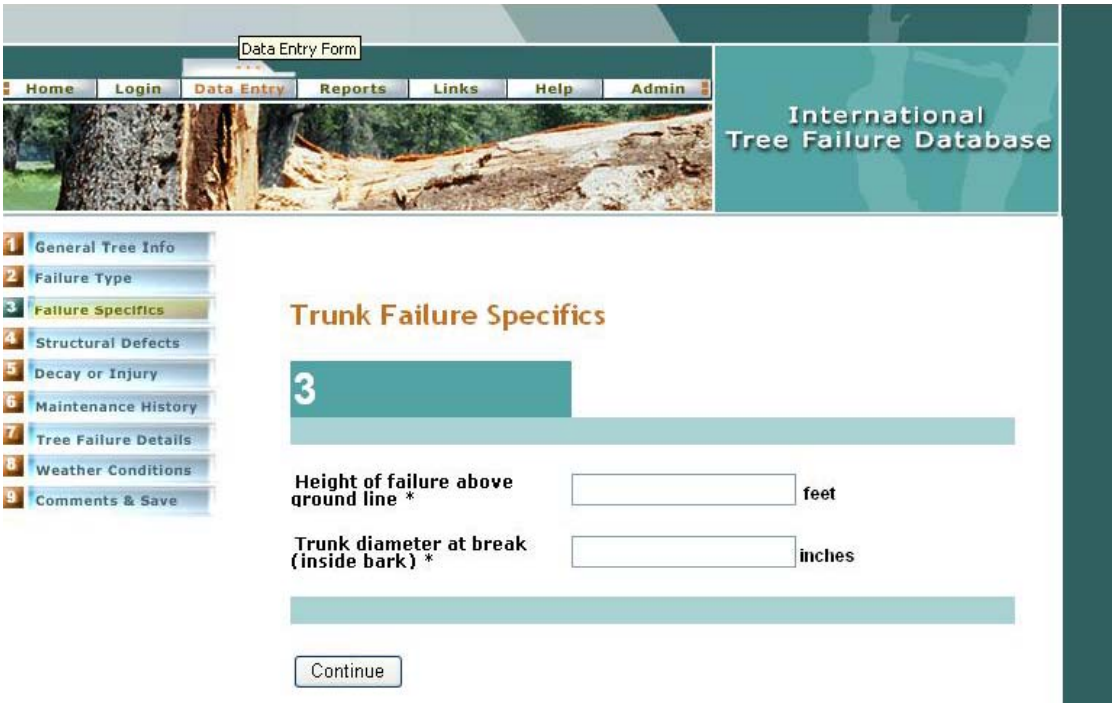
If **Trunk Failure** was selected in Section 2 of the report form, provide the following information for the two items in Section 3, Trunk Failure Specifics; then complete the sections 4 through 6 that apply to trunk failure.

Height of failure above grade*

This is a required field when **Trunk Failure** is selected. Enter the height above the ground in feet or meters at which the trunk failure occurred. Round to the nearest whole number (e.g., 2 rather than 1.8 or 1-3/4). Enter 0 if the trunk failure is at ground level. For breaks that are at an angle, use the midpoint between top and bottom of the break.

Diameter at break (inside bark)*

This is a required field when **Trunk Failure** is selected. Enter the diameter of the trunk in inches or centimeters at the point where the failure occurred. If the failure is an angled break, use the measurement at the midpoint of the break. This is an "inside the bark" measurement. Either subtract the bark thickness from the measurement of trunk diameter or measure the trunk inside the bark. Round to the nearest whole number.



Trunk failure specifics

Section 4: Defects Associated with Trunk Failure

This section covers common defects that are associated with trunk failures. You may select as many of these defects as needed as long as the defect contributed to or was associated with the failure. Do not select a defect merely because it was present on the tree.

None

No associated defects were apparent on the outside or inside of the trunk.

Unknown

You were not able to examine the trunk completely and therefore were not able to determine whether any defects were present; or, a defect was present but it could not be identified.

Failed portion dead

The trunk was dead prior to the failure, as indicated by discoloration, wood moisture content, fungal growth, or other features.

Decay

Wood and/or bark were degraded by the activity of a decay organism. The decay may have affected the sapwood, heartwood, or both. Decay includes brown rot, white rot, cubical rot, canker rot, pocket rot, and others. Discolored or dry but structurally strong wood is not considered decayed.

A simple method for detecting early stages of decay without specialized equipment is the pick-and-pry or splinter test (see Zabel and Morrell 1992). Drive a sharp screwdriver, knife tip, or awl into the wood at an acute angle, across the grain, and bend it back to snap a small piece from the surface. Examine the break characteristics of the piece removed and compare them with known sound wood from the same tree. Brash breaks (breaking across the grain) suggest loss of fibrous strength and decay, whereas splintery breaks reflect sound wood. The same characteristics can be studied on the original failure surface to determine whether decay contributed to the failure. The presence of severe decay can also be verified in the field by pressing on the suspect wood with a finger or pen. If the wood deflects under this pressure, it is considered severely decayed.

Canker

Canker is a disease of the bark, cambium or sapwood. Perennial cankers may have a target or concentric ring pattern. Other cankers may be diffuse, growing throughout the bark and into the trunk. Cankers may or may not have exposed xylem. Resin flow, or bleeding, may indicate the presence of a canker. Fruiting structures may be very small, such as in Nectria canker, or larger and growing on the bark, such as in Hypoxylon canker. Mistletoe can also cause swellings that can die and become cankers. To qualify as a defect associated with failure, the canker must be associated with the failure and not simply be present on the stem. If you select this item, and if you know the causal agent, enter the scientific name after **Species**. Please enter the genus and species if known or just genus if only that is known.

Multiple trunks/codominant stems

Some trees contain trunks of similar size and/or relative importance arising from the base or the lower trunk, known as multiple trunks or codominant stems. To qualify, the trunks must have split at this point or must be associated with the failure in other ways and not simply present in the tree.

Dense crown

A crown is classified as dense when it is relatively heavy or poses high wind resistance due to excess scaffolds and shoots. High density may also be caused by abundant vigorous growth, such as from watersprouts or other adventitious growth. It is difficult to see any sky through a dense crown.

Flush cuts

Flush cuts are pruning wounds made in stem tissue rather than at the branch collar. This type of cut may lead to internal decay and is therefore considered improper.

Topped

Topping (dehorning, round-over, lopping, or hat-racking) is a pruning technique used to reduce height of a tree by making heading cuts on large branches. Select this item if there is evidence that the tree was topped prior to trunk failure and that topping contributed to the failure.

One-sided

In a one-sided tree, a majority of branches are centered on one side of the tree, or the tree grew in such a way that branches grew only on one side of the stem.

Low live crown ratio

If a majority of live branches were in the upper third (33%) of the total tree height, the tree has a low live crown ratio. This can be a result of self-pruning, competition from adjacent trees, raising for roadway or other clearance, lion's tailing (removing all or most of the secondary branches from the inner crown, leaving branches only at the edges), or previous limb failure.

Included bark

Included bark is bark embedded at the junction between the two stems. This condition can be observed if the failure occurred at a branch or stem junction so that the interior of the junction can be seen.

Leans

Several types of lean are considered. If you had prior knowledge of the tree or if the trunk bend is evident, indicate which of the following types of lean was present prior to failure.

Bow

An uncorrected lean in which the top of the tree has either a downward bend or curve at a greater angle than the lower portion of the trunk or a constant angle throughout the tree. The tops of bowed trees occasionally touch the ground. Heavy snow loads or strong winds often cause bows.

Crook

An abrupt or broad bend in the trunk. A crook may be the result of thinning to a lateral, loss of a codominant stem, death of a previous top, or other factor.

Sweep

A gradual upward bend that may result from a change in trunk angle to reach sunlight or as a result of wind. This type of lean can be recognized in a tree with a leaning lower stem and a more vertically growing top. It is also known as a corrected lean.

Uncorrected lean

A trunk that is leaning at approximately the same angle from top to bottom. It is also referred to as a straight lean.

Cracks in wood

A crack is a vertical or horizontal split in the stem, involving bark, cambium, and xylem. It may be possible to differentiate between cracking that occurs at the time of failure and cracking that existed before the failure by looking for weathering of the wood or callus growth at the crack. Select this item only if the crack was present prior to the tree failure. If you select this item, characterize the crack angle as either **Vertical** or **Horizontal** on the intact tree prior to failure.

Lightning injury

The quintessential lightning strike leaves a vertical line of missing bark and a valley in the sapwood midway between the bark edges. Lightning injury may also be seen as areas of missing patches of bark and wood, vertical lines with exposed wood, shattered stems, or bark totally removed from the xylem. Lightning may also spiral down a stem.

Animal injury

Animals can create many types of damage to a tree. The presence of tooth or claw marks in the sapwood or bark may indicate activity of porcupines, squirrels, bear, deer, beaver, pigs, horses, goats, or voles. If the animal injury was the most likely entry for decay fungus, select both **Animal injury** and **Decay**.

Fire injury

Damage caused by fire is commonly seen as blackening and charring of the bark or xylem usually within several yards (meters) of the ground line. Trees near houses that have burned or where forest fires or prescribed burns were severe will have symptoms at higher levels in the trees. In forests, many trees in the area will usually have the same symptoms if fire was the cause of failure.

Insect injury

The primary injury of concern is that caused by wood borers, termites, carpenter ants, or other wood feeders. Bark beetles, shot hole borers, sucking insects (e.g., aphids, scales, adelgids) or other insects that do not significantly weaken the wood structure should *not* be included even though they may have actually killed the tree.

Mechanical injury

A human-caused injury that significantly weakened the tree as determined by the proximity of the injury to the failure point. Examples include damage by vehicles, string trimmers, or mowers, as well as vandalism with hatches, axes, saws, and so on. A nearby tree or severed branch can also cause mechanical injury by falling into the tree. Injury caused by animals should be noted in the **Animal injury** category above.

Girdling

If tight wrapping caused significant mechanical constriction in trunk growth, note it here. Roots, chains, straps, wire, or other hardware can cause girdling. This section does *not* include bark or sapwood removal by people or animals; this type of girdling should be classified as mechanical injury if done by humans or animal injury if done by other animals.

Section 5: Location of Trunk Decay

This section characterizes damage done by decay fungi if fungi were present and involved in the failure. If fungi were not present or not involved in the failure, skip this section and proceed with Section 6, Trunk Maintenance History.

Heartwood

If the decay is a heart rot, inner decay, or heartwood decay, the deteriorated wood will be mainly in the interior of the stem. Cavities may be present and are usually surrounded by nondecayed wood. If the tree had canker rots or the combination of heart rots and a sapwood rot, select both **Heartwood** and **Sapwood**.

Average sound wood thickness

With heart rots, there is usually sound wood surrounding the decay. This sound shell contains sapwood and may also contain nondecayed heartwood. Do not include partially decayed wood in the sound wood thickness. Measure the thickness of the wood outside the decay in at least three places around the circumference of the trunk. *Do not include the thickness of the bark in these measurements*. Take measurements at the midpoint of the failure if the failure is not horizontal. The average sound wood thickness equals the sum of the individual thickness measurements divided by the number of measurements made.

Opening (cavity) at failure?

Heart rots often have an opening to the outside known as a cavity opening or simply a cavity. If the line of failure included the cavity opening, select **Yes** and determine the opening's percentage of the trunk circumference. Occasionally there is a thin layer of dry wood with decay behind it and no bark over the front, this would be included as a cavity opening. The percentage of cavity opening equals the width of the cavity at the point of failure divided by the circumference of the trunk at cavity height, with the result multiplied by 100. In some cases, it may be necessary to visually estimate the percentage of cavity opening rather than measuring it. Enter a whole percentage number (15%), not the decimal equivalent (0.15). If the cavity had no opening to the outside or if the opening was not involved in the failure, enter **No** and do not record a percentage of circumference.

Sapwood

If the decay was a sapwood rot or sapwood decay, the deteriorated wood will be mainly around the exterior of the stem, and it may include the bark. With this type of decay, the wood toward the center of the tree (heartwood) is usually not decayed. If the tree had canker rots or the combination of heart rot and sapwood rot, select both **Heartwood** and **Sapwood**.

Average depth of sapwood rot

Enter the average thickness of decayed sapwood at the point of failure. Make at least three measurements or visual estimates of sapwood decay thickness around the circumference of the trunk. The measurement should not include bark thickness. The average sapwood rot thickness equals the sum of the individual thickness measurements divided by the number of measurements made.

Circumference rotted

If sapwood rot is present, give the percentage of the circumference that was decayed. If the decay entirely circles the trunk at the plane of failure, enter 100 percent. If the decay encompasses less than 100 percent of the circumference, determine the percentage of the circumference that is rotted. The percentage of circumference rotted equals the circumference of the decay divided by the circumference of the trunk at the same height, with the result multiplied by 100. Enter whole numbers (15%), not the decimal equivalent (0.15).

Type of decay

Wood decay is categorized by the components of the xylem that are digested by the decay fungus and the resulting appearance. In brown rot, only the polysaccharides (cellulose and hemicelluloses) are substantially degraded. In white rot, all wood components, including polysaccharides and lignin, are degraded. Decay produced by white rots tends to have a whitish coloration and residual fibrous texture, and decay produced by brown rots often has a brown color and little fibrous texture. Brown-rotted wood shrinks and breaks readily across the grain, so it is often called cubical brown rot. White rots are more common in hardwoods, and brown rots are more common in conifers. If the type of decay is not known,

Brown rot

Canker rot

select **Unknown**. If the decay is a brown rot or white rot, select the appropriate item. If there is decay in both the sapwood and heartwood caused by a canker rot fungus, select **Canker rot**. More than one selection can be made, but do *not* select additional items if unknown, white rot, or brown rot are selected. Select two items only if one of them is canker rot.

Conks/mushrooms/other signs of decay

Indicate whether fungal structures or other signs of the fungus were visible prior to the failure. These structures must be caused by wood decay fungi associated with the failure; they include mushrooms, conks, mycelial fans, rhizomorphs, bracket fungi (bracts), and other decay fruiting structures. If structures were visible or if positive diagnosis of the decay fungus can be made from other features of the decay, and the name of the decay fungus is known, enter it after **Name.** Please indicate the genus and/or species, not the common name.

Distance from nearest conk to failure point

Where fungal fruiting structures are apparent on the trunk or root collar, determine the closest distance between the fruiting structures and the point of failure. Enter 0 if structures are at the point of failure.

Section 6: Hardware/Trunk Maintenance History

Enter all hardware or maintenance items that were present on the trunk, likely to have contributed to the failure, or were present and did not prevent the failure.

None

Select **None** if an item on the following list was not involved in the failure or was not present in the tree.

Girdling hardware

A wire, rope, fence, webbing, trunk wrap, guy, metal strap, or other piece of hardware was wrapped partially or completely around the stem and contributed to the failure.

Cable

A tree support cable made of steel, stainless steel, rope, or chain was present in the crown of the tree at the time of failure, and it either broke at the time of failure or did not prevent the failure. Include trunk failures that occurred at or near the point of cable attachment as well as failures at the branch-stem junction that the cable was suppose to protect. If the cable was still attached and unbroken, select **Intact**. If the cable, associated hardware, or stem near point of cable attachment was broken, select **Failed**.

Guying

If a guy wire connected the trunk of the tree to the ground, another tree, or other anchoring device, and the guy failed or did not prevent the failure, select this item. If the guy, termination hardware, anchor, or stem at or near the point of guy attachment failed, select **Failed**. If the guy was intact after the failure, select **Intact**.

Prop

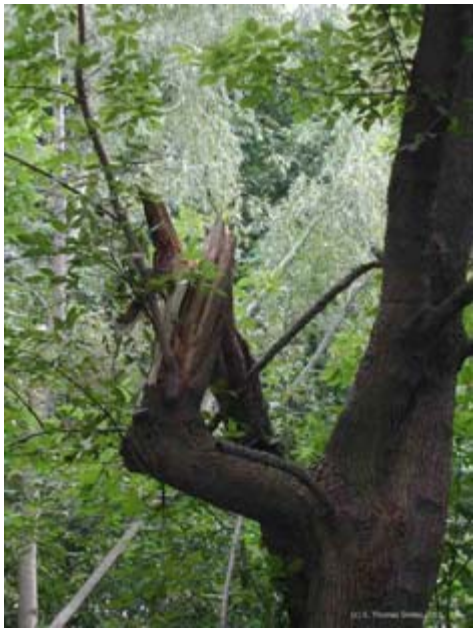
Props are mechanical devices that hold up branches or stems. They are usually wood beams or metal pipes installed below the stem or a branch, linking it to the ground. Occasionally, props have multiple vertical or angled legs or an A frame. If a prop was present and the tree moved horizontally, rolling off the prop, or the prop or prop anchor broke, select **Failed**. If the prop survived the failure, select **Intact**.

Brace/bolt

Brace rods, rigid braces, through braces, or bolts are used to reduce the risk of failure in codominant stems. They can be installed above or below the junction of two or more codominant stems. Select this item if one or more brace rods were present in the failed tree. If the brace rod broke, pulled out of the stem, was surrounded by decay that made it ineffective, or otherwise did not work properly at the time of tree failure, select **Failed**. If the brace rod did not break during or before the failure, select **Intact**.

Section 3: Branch Failure Specifics

Branch failures occur in an aboveground portion of the tree that is not a trunk or main stem.



Branch diameter at break measured inside bark*

This is a required field when **Branch Failure** is selected. Measure the branch diameter at or close to the break in an area representative of the branch

diameter at the break. If the break is angled, measure the diameter near the center of the break. If measuring with a diameter tape, subtract two times the bark thickness to obtain the diameter of only the branch.

Total length of failed branch (feet/meters)

Measure the entire length of the failed branch from its point of attachment to the small twigs at the tips of the branch. If the failure occurred at a point other than the junction, add the length of the failed portion (the part on the ground) to the length of the stub on the tree. Use whole numbers (9) rather than decimals (8.75) or fractions (8¾).

Is break at branch attachment?

Indicate whether the break occurred at the point where the branch was attached to the rest of the tree (the crotch).

- **No**. The failure did not occur at the point of attachment. Enter how far the break was from the attachment (the length of the stub remaining on the tree). Use whole numbers.
- **Yes**. The failure occurred at the point of attachment. No length measurement is required even if there are splinters sticking out of the break.

Section 4: Defects Associated with Branch Failure

This section contains a list of common defects associated with branch failures. Enter only structural defects that were associated with the branch failure. Enter as many of these defects as were observed as long as they were significantly associated with the failure.

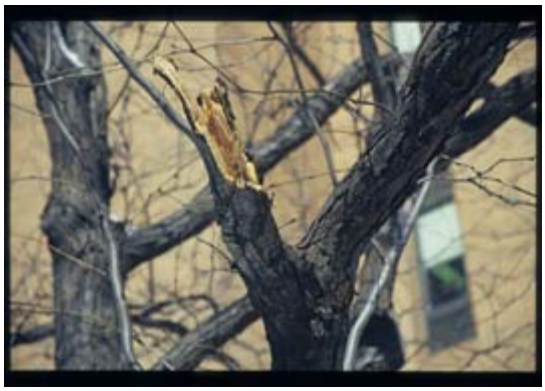
None

No defects were apparent on the outside or inside of the branch.

Unknown

You were not able to examine the branch completely and therefore were not able to say whether defects were present; or, a defect was present but you could not identify it.

Failed portion dead



The branch was dead before failure occurred, as indicated by lack of foliage, dead buds, wood discoloration, wood moisture contact, fungal growth, lack of bark, or other factors.

Decay

Xylem was degraded by the activity of a decay organism. The decay may have deteriorated the sapwood, heartwood, or both. Decay is characterized by the absence of xylem or by structurally weak xylem. This includes brown rot, white rot, cubical rot, canker rot, pocket rot, and other types of wood decay. Discolored or dry structurally strong wood is not considered decayed.

A simple method for detecting early stages of decay without specialized equipment is the pick-and-pry or splinter test (see Zabel and Morrell 1992). Drive a sharp screwdriver, knife tip, or awl into the wood at an acute angle, across the grain, and bend it back to snap a small piece from the surface. Examine the break characteristics of the piece removed and compared them with known sound wood from the same tree. Brash breaks (breaking across the grain) suggest loss of fibrous strength and decay, whereas splintery breaks reflect sound wood. The same characteristics can be studied on the original failure surface to determine whether decay contributed to the failure. The presence of severe decay can also be verified in the field by pressing on the suspect wood with a finger or pen. If the wood deflects under this pressure, the wood is considered severely decayed.

Dense crown

A crown becomes dense when it is relatively heavy or poses high wind resistance due to excess branches and shoots. High density may also be result of abundant vigorous growth, such as from watersprouts, mistletoe, or other adventitious growth. It is difficult to see any sky through a dense crown.

Heavy lateral limbs/heavy ends

Limbs that have unusually long length for their diameter and/or a heavy foliage load, especially concentrated near the ends, are considered to be heavy. This category also includes failures associated with heavy fruit loads.

Included bark

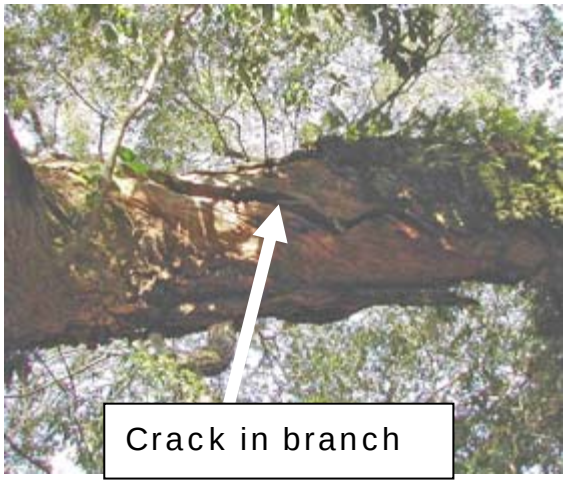
Included bark is bark embedded at the junction between the two stems. This condition can be observed if the failure occurred at a branch or stem junction so that the interior of the junction can be seen.

Crook

A crook is an abrupt bend in a branch that may have been the result of thinning to a lateral.

Failed portion is an epicormic branch

The branch that failed was originally an epicormic branch or watersprout. These often develop after branch breakage, topping, lion's tailing, or other times when excessive foliage is removed from the crown.



Cracks in wood

Cracks are vertical or horizontal splits in a branch involving bark, cambium, and xylem. It may be possible to differentiate between cracking that occurs at the time of failure and cracking that existed before the failure by evidence of weathering on wood and associated callus production. Select this item only if the crack was present prior to the tree failure.

Mistletoe or epiphyte

Select this item if a significant population of mistletoe or an epiphyte on the failed branch caused the failure. Epiphytes include vines, ball moss, Spanish moss, resurrection ferns, and bromeliads. Mistletoe includes both leafy and dwarf species. Include dodder and other parasitic plants only if present at significant levels. Describe the epiphyte or parasite in the **Additional Comments** part of Section 9.

Mechanical injury

Injury that has significantly weakened the tree as determined by the proximity of the injury to the failure point. Mechanical injury may be caused by vehicle or tool damage, vandalism with hatches, axes, saws, and so on. This category excludes damage from animals.

Lightning injury

The quintessential lightning strike leaves a vertical line of missing bark and a valley in the sapwood midway between the bark edges. Lightning injury may also be seen as areas of missing patches of bark and wood, vertical lines with exposed wood, or shattered stems. If lightning injury predisposed the wood to decay, select this item as well as **Decay**.

Insect injury

The main type of injury of concern is that caused by wood borers, termites, carpenter ants, or other wood feeders. Bark beetles, shot hole borers, sucking insects (e.g., aphids, scales, or adelgids) or other insects that do not significantly weaken the wood structure should *not* be included even though they may have actually killed the tree.

Animal injury

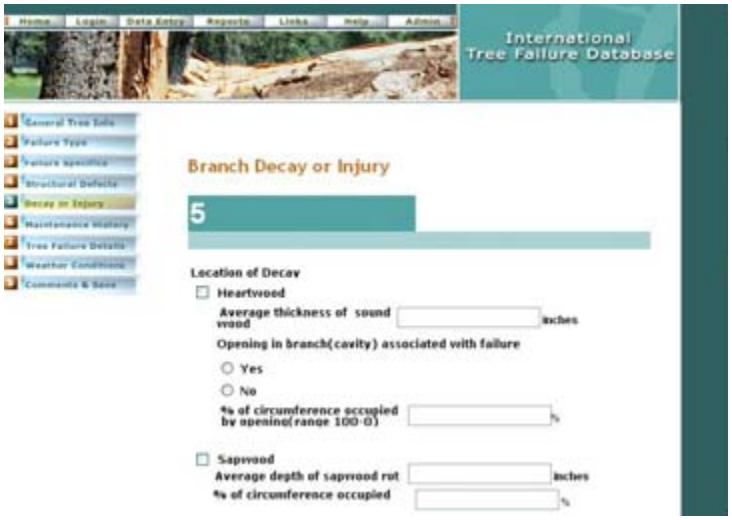
Animals can cause many types of mechanical damage in a tree. Animal injury can usually be confirmed by the presence of tooth or claw marks in the sapwood or bark. Animals that commonly injure branches include porcupines, squirrels, and bears. If the animal injury leads to decay, select both **Animal Injury** and **Decay**.

Canker

Canker is disease of the bark and possibly the sapwood. Perennial cankers may have a target-shaped or concentric ring pattern. Other cankers may be diffuse, growing throughout the bark in a limited area or a large portion of the branch. Cankers may or may not have exposed xylem. Resin flow, or bleeding, may indicate the presence of a canker. Fruiting structures may be very small, as with Nectria canker, or larger and growing on the bark, as with Hypoxylon canker. To make this selection, the canker must be associated with the failure and not just present on the stem. Mistletoe can also cause swelling that can die and become cankers. If you select this item and know the causal agent, enter the name after **Species**. Enter the genus and species if known or just the genus if only that is known.

Section 5: Location of Branch Decay

This section characterizes damage caused by decay fungi if they were present and involved in the failure. If fungi were not present skip this section and proceed with Section 6, Hardware.



Heartwood

If the decay is a heart rot, inner decay, or heartwood decay, the deteriorated wood will be mainly on the interior of the branch. This type of decay may have openings to the outside, but the openings are usually surrounded by nondecayed wood. If the tree had canker rots or the combination of heart rot and sapwood rot, select both **Heartwood** and **Sapwood**.

Average sound wood thickness

With heart rots, there is usually sound wood surrounding the decay. This sound wood contains sapwood and may also contain non-decayed heartwood. Measure the thickness of the wood outside the decay in at least three places around the circumference of the branch. Do not include the thickness of the bark in these measurements. Take measurements at the midpoint of the failure if the failure is not horizontal. The average sound wood thickness equals the sum of the individual thickness measurements divided by the number of measurements made.

Opening (cavity) at failure?

Heart rots often have an opening to the outside called a cavity opening or simply a cavity. If the line of failure included the cavity opening, select **Yes** and determine the opening's percentage of branch circumference. Occasionally there is a thin layer of dry wood with decay behind it and no bark over the front, this would be included as a cavity opening. The percentage of cavity opening equals the width of the cavity divided by the circumference of stem at the

same height, with the result multiplied by 100. In some cases, it may be necessary to visually estimate the percentage of cavity opening rather than measuring it. Enter a whole percentage number (15%), not the decimal equivalent (0.15). If there was no opening to the outside or if the opening was not involved in the failure, enter **No** and do not record a percentage of circumference.

Sapwood

If the decay was a sapwood rot or sapwood decay, the deteriorated wood will be mainly around the exterior of the branch, and it may include the bark. With this type of decay, the wood toward the center of the branch (heartwood) is usually not decayed. Canker rots or the combination of heart rots and a sapwood rot are the only cases in which both the **Heartwood** and **Sapwood** should be selected.

Average depth of sapwood rot

Enter the average thickness of decayed sapwood at the point of failure. Make at least three measurements or visual estimates of sapwood decay thickness around the circumference of the branch. The measurements should not include bark thickness. The average sapwood rot thickness equals the sum of the individual thickness measurements divided by the number of measurements taken.

Circumference rotted

If sapwood rot is present, give the percentage of the circumference that was decayed. If the decay entirely circles the branch at the plane of failure, enter 100 percent. If the decay encompasses less than 100 percent of the circumference, determine the percentage of the circumference that is rotted. The percentage of the circumference rotted equals the length of the circumference rotted divided by the diameter of the stem at the same height, with the result multiplied by 100. Enter a whole percentage number (15%), not the decimal equivalent (0.15).

Type of decay

Wood decay is categorized by the components of the xylem that are digested by the decay fungus and the resulting appearance. In brown rot, only the polysaccharides (cellulose and hemicelluloses) are substantially degraded. In white rot, all wood components, including polysaccharides and lignin, are degraded. Decay produced by white rots tends to have a whitish coloration and residual fibrous texture and decay produced by brown rots often has a brown color and little fibrous texture. Brown-rotted wood shrinks and breaks readily across the grain, so it is often called cubical brown rot. If the type of decay is not known, select **Unknown**. If the decay is a **brown rot** or **white rot**, select the appropriate item. If there is decay in both the sapwood and heartwood caused by a canker rot fungus, select **Canker rot**. More than one selection can be made, but do *not* select additional items if unknown, white rot, or brown rot are selected. Select two items only if one of them is canker rot.

Conks/mushrooms/other signs of decay

Indicate whether fungal fruiting structures or other signs of the fungus visible prior to the failure. These structures must be from wood decay fungi associated with the failure and include mushrooms, conks, mycelial fans, bracket fungi (bracts) and other decay fruiting structures. If structures were visible or if positive diagnosis of the decay fungus can be made from other features of the decay, and the name of the decay fungus is known, enter in after **Name.** Please indicate the genus and/or species, *not* the common name.

Distance from nearest conk to failure point

Where fruiting structures are apparent on the branch, determine the closest distance between the fruiting structures and the point of failure. Enter 0 if structures are at the point of failure. Measurements are in feet or meters.

Section 6: Hardware/Branch Maintenance History

Enter all hardware or maintenance items that were on the branch, likely to have contributed to the failure or were present and did not stop the failure.

None

Select **None** if an item on the following list was not involved in the failure or was not present on the tree.

Girdling hardware

A wire, rope, fence, webbing, guy, metal strap or other piece of hardware was wrapped partially or completely around the branch and contributed to the failure.

Cable

A tree support cable made of steel, stainless steel, rope, or chain was present in the crown of the tree at the time of failure, and it either broke at the time of failure or did not prevent the failure. This includes branch failures that occurred at or near the point of cable attachments or at the branch-stem junction that the cable was supposed to protect. If the cable was still attached and unbroken, select **Intact**. If the cable, associated hardware or stem near point of cable attachment broke, select **Failed**.

Guying

If a guy connected the branch of the tree to the ground, another tree or other anchoring device, and the guy either failed or did not stop a type of failure, select this item. If the guy, termination hardware, anchor or stem at or near the point of guy attachment failed, select **Failed**. If the guy was intact after the failure, select **Intact**.

Prop

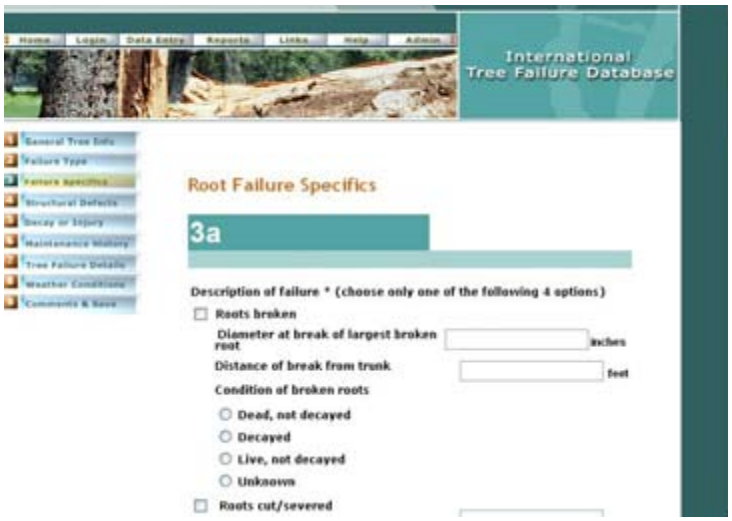
Props are mechanical devices that hold up branches and are used when cables are not appropriate. They are usually wood beams or steel pipes installed vertically from the branch to the ground. Occasionally props have multiple vertical or angled legs or an A frame suspended from above. If a prop was present and the branch moved horizontally, rolling off the prop, or the prop or prop anchor broke, select **Failed**. If the prop survived the failure, select **Intact**.

Brace/bolt

Brace rods, rigid braces, through braces or bolts are used to reduce the risk of failure in codominant stems or branches. They are installed above or below the junction. Select this item if one or more brace rods were present. If the brace rod broke, pulled out of the branch, was surrounded by decay that made it ineffective, or otherwise did not work properly at the time of tree failure, select **Failed**. If the brace rod did not break during or before the failure, select **Intact**.

Section 3: Root Failure Specifics

This category describes failures that occur at or below the soil line, failure of the roots (even if they are above grade), and failures involving roots and a portion of the lower trunk. Root failures may be caused by broken roots, cut roots, and the root plate or ball being lifted out of the ground (windthrow or soil failure). Trunk failures due to constriction by girdling roots are considered trunk failures if the failure occurs above grade and other root failures were not involved.



Four categories of root failure are listed: **Roots broken**, **Roots cut/severed**, **Root plate lifted out of ground**, and **Roots restricted**. Choose the one that best describes the failure. The last two failure types are very similar. Both describe a type of failure in which large-diameter roots did not break and were not cut. The difference between them is that with **Root plate lifted out of ground**, there are no physical structures in the vicinity that limited root growth and were associated with the failure. In the second category, **Roots restricted**, a structure or other feature restricted the growth of the tree's root system, leading to a failure.

If you select **Root Failure**, you must choose one of the four failure types.

Roots broken

With this type of failure, large roots (typically 2 inches [5 cm] or greater in diameter on medium- or large-diameter trees) fairly close to the trunk broke. This category includes both decayed and sound roots.

Diameter of largest broken root

Measure the diameter of the largest root that can be seen at the point of failure. If this is an angled failure, measure the diameter at the midpoint of the break. Since root bark tends to be thin, include bark thickness in this diameter. For roots that are oval in cross-section, use the average of the large and small diameters. Measurements are in inches or centimeters.

Distance from the break to the trunk

Obtain the average distance from the break, or midpoint of an angled break, to the face of the trunk. When multiple roots are broken, use the average radial distance from the face of the trunk. Measurements are in feet or meters.

Condition of broken roots

Determine whether the roots were dead or alive at the time of failure and whether decay present and a factor in the failure. Choose one of the four categories:

- **Dead, no decay.** The majority of the failed roots were dead at the time of the failure and decay was not present.
- **Live, no decay.** The majority of the roots that failed were healthy, as determined by whitish sapwood and/or green cambium, and decay was not a factor at the point of failure.

- **Decayed.** The majority of the failed roots deteriorated due to fungal infection. Decay is often seen more on the lower side of roots than on the top. The presence of decay can be verified in the field by pressing or picking on the suspect wood with a knife, finger or pen. For a complete description of this techniques, see the Trunk Decay section.
- **Unknown.** The root system was not visible for inspection or it could not be determined whether the roots were living, dead, or decayed at the time of the failure.

Roots cut/severed (not decayed or broken)

Root severance is more common in urban areas and "root raked" forest areas or parks where construction, trenching, or landscaping occurred close to the tree. Root severance can be identified by inspecting the end of the cut roots. Straight cuts typically indicate root severance by a trenching machine, rock cutter, root cutter, or saw. Torn or shattered ends often indicate tearing by a backhoe, bulldozer, or root rake. Decay is often present in severed roots; however, if the severance was the most important factor in the failure, select this category should rather than **Roots broken**, above.

Root plate lifted out of ground

This is one of the two categories that are used to categorize windthrow or soil failures (the other category is **Root restricted,** below). In this category, the smaller size (usually less than 2 inches [5cm] on medium- and large-diameter trees) roots broke some distance from the trunk, and those roots were not restricted in their growth due to any impenetrable barriers. Soil is usually still attached to the root plate in this type of failure. Measure the average **Root plate radius** from the face of the trunk to the edge of the root plate. **Root plate depth** is the average distance from the top of the soil surface to the bottom of the root plate measured halfway from the trunk center to the outer edge of the root plate.

Roots restricted

This category differs from **Root plate lifted out of ground** in that a major predisposing factor for the failure was a restriction in the rooting space available to the tree. If this was the case, select any of the following restricting factors that were involved.

Containers

Plastic, concrete, wood or other structures that confine root growth inside a given space. These include plastic pots, concrete aboveground and belowground containers, and other types of pots.

Root barriers

Plastic, metal, or fabric materials installed vertically in the ground to redirect root growth. Products include Deep Root Barriers, Biobarrier, and some geotextiles.

Sidewalk/curbs

Sidewalks are concrete, brick, or stone surfaces installed for pedestrian use typically with a thickness of 4 inches (10 cm) ± 2 inches (5 cm). Curbs are structures that delimit streets and are raised to restrict the travel of vehicles and/or water along a street.

Natural features

Rocks; streams or high water table; valleys, cliffs, or other cuts in the soil; soil density or texture changes; hard pans; or other naturally occurring features may restrict root growth and lead to tree failure.

Wall/foundations

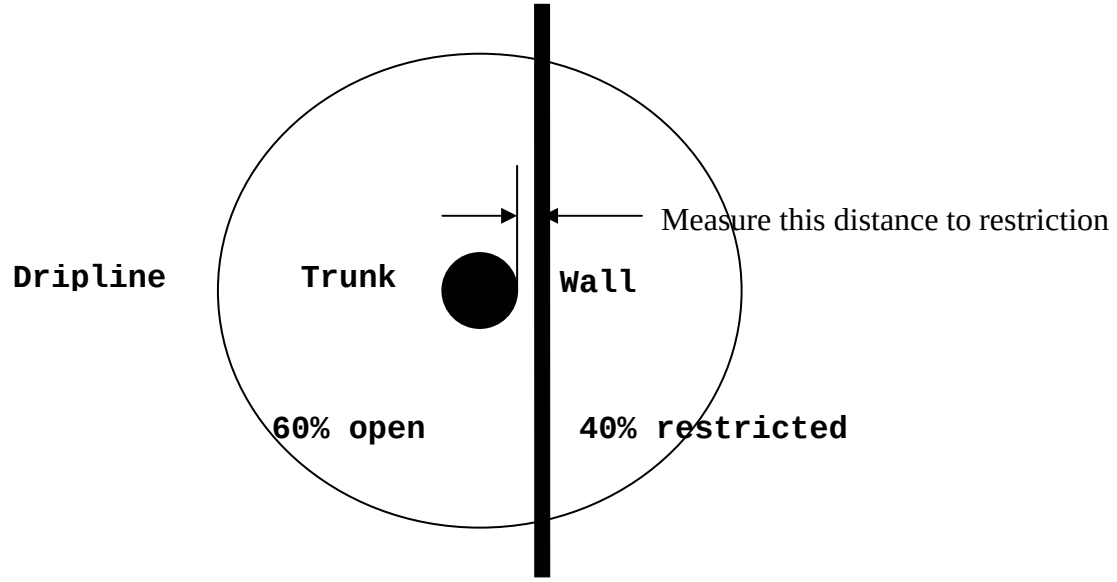
Root-impenetrable barriers associated with buildings, walls, or other man-made structures that enter the ground.

Other

Other features that restrict root growth include chemical soil contamination, manmade open trenches that did not sever roots, or other factors not listed above.

Distance from trunk to the restriction

If root restriction caused the failure, measured and record the distance from the trunk face to the closest portion of the restriction. Also give the **Percentage of root zone restricted**. Assume that 100 percent of the roots are within the tree's dripline; for example, if the root restriction is a wall that comes as close as 1 foot (30 cm) to the trunk face, approximately 40 percent of the root system is restricted.



Root collar girdled

If growth was restricted in a significant portion of the root collar area, select **Yes**; if not, select **No.** A girdling root, strap, wire basket, sidewalk, curb, landscape fabric, or other factor may have caused the restriction. If Yes is selected, enter the **Percentage of circumference girdled**. Calculate this by dividing the length of the restriction by the total root collar circumference at the plane of the girdling and multiply the result by 100. Select **Root collar girdled** along with any other root failure specifics that led to the failure.

Site/soil conditions

Enter the following soil information regardless of which type of root failure was involved.

Soil composition

The *predominant* soil texture component of the soil at the failure site. If this is not known, select **Unknown**.

Soil moisture at the time of failure

Estimate the relative water content of the soil at the time the failure occurred. If the water content was not known, for example, if you are examining the site some time after the failure, select **Unknown**.

- **Dry** soil indicates that there was no rain immediately prior to the failure and that any irrigation system present was not operated immediately prior to the failure.
- **Saturated** indicates that there was a significant amount of rain prior to the failure, or an irrigation system provided excess irrigation, but no freestanding water was present on top of the soil. If the hole left by the root plate is partially filled with water, it typically indicates a saturated condition.
- **Moist** indicates that there had been adequate rain or irrigation recently so that the soil was neither dry nor saturated.
- **Flooded** indicates that the area around the tree had been covered with standing or moving water at the time of failure, and the soil was saturated with water.

Restricted rooting depth

Select items in this section if the soil beneath the tree was impenetrable or inhospitable to root growth. This includes the soil directly beneath the tree to a depth of about 3 feet (1 m). If the restriction was at a greater depth, select these items only if it is obvious that a root restriction existed. The presence of these factors at a greater depth without evidence of root restriction does not warrant their inclusion. Root depth restricting factors include:

- **Poor drainage**. This is usually seen as a saturated layer of soil with the smell of anaerobic decomposition and a gray color. Mottled (light and dark) soil is often seen immediately above the saturated layer. Poor drainage conditions usually exist due to high clay content in the soil that did not allow the soil to drain, or excessive input of irrigation water.
- **Shallow or layered soil**. This restriction may be due to impenetrable rock, rock ledge, or incompatible soil texture layers that restrict downward root growth.

- **High water table.** Similar to poor drainage, this condition exists regardless of water input from irrigation, rainfall, or soil texture. High water tables are often found near bodies of water.
- **Compaction.** Compacted subsoil conditions exist when the subsoil has been mechanically pressed down during construction or other human activities. Compaction may also occur naturally when soils with high clay content are present without good soil structure. If only the

surface soil is compacted, note this in the **Other site conditions** section (below) rather than in this section.

- **Other. Include** conditions that affect downward root growth not listed above here. A description of these conditions may be given in the **Additional Comments** part of Section 9.

Other site conditions

This section includes other conditions that had an effect on the tree failure, such as:

- **Soil eroded from around roots**. Soil has been washed out or otherwise removed from around the buttress roots of the tree. This is often seen along streams, shorelines, places where water flows across the soil surface, or in association with some digging animals.

- **Compaction.** Surface soil can be compacted by construction and other human or animal activities. This category is for surface soil compaction rather than the subsoil compaction in the previous section. Compaction must be high enough to have restricted root development.

- **Grade change.** This includes both soil cuts and fills within the dripline of the tree. Grade change is usually associated with construction around the tree but may also be caused by landslides or other natural actions. Do not include cuts or fills of less than 2 inches (5 cm).

- **Well surrounding the trunk**. If fill soil was brought into the dripline area of the tree, but was limited by a well around the trunk, select this item rather than the **Grade change**.

- **Fill soil against trunk or planted too deep.** Select this item when buttress roots are not visible; this can be selected in conjunction with **Grade change** or other factors. However, if the soil against the trunk is due to deep planting, select this item only.

- **Depth of excess soil.** If **Fill soil** is selected, enter the depth of the soil (feet or meters) above the first horizontal section of buttress root or above the natural grade.

Fill soil against trunk

Normal root flare present (no fill soil)

Section 4: Defects Associated with Root Failure

This section contains common defects that are associated with root or soil related failures. You may check as many of these defects as needed as long as they were associated with the failure.

None

No defects were apparent on the outside or inside of the buttress roots.

Unknown

You were not able to examine the roots completely and therefore were not able to say whether defects were present; or, a defect was present but it could not be identified. This category is not the same as None.

Fire scar/injury

Damage caused by fire was visible on the buttress roots of the tree. Fire injury is commonly seen as blackening and charring of the bark or xylem usually within several yards (meters) of the ground line. Trees near houses that have burned or where forest fires or prescribed burns were severe will have symptoms at higher levels in the trees. In forests, many trees in the area usually have the same symptom.

Basal wound

This is mechanical damage to the buttress or first-order lateral roots. Basal damage may be caused by equipment, lightning, insects, or disease. If animals or fire caused the damage, note this under the specific categories. If a lawn mower, weed trimmer, or lawn maintenance related device caused damage but not on the basal portion of the trunk, select **Surface root**, below.

Low live crown ratio

If a majority of branches were in the upper third (33%) of the total tree height, the tree is said to have a low live crown ratio. This can be a result of raising for roadway or other clearance, lion's tailing, previous limb failure, or canopy competition at an earlier stage of growth.

Corrected lean/sweep

A sweep is a gradual bend that may result from a change in trunk angle to reach sunlight or as a result of wind. This type of lean can be identified in a tree with a leaning lower stem and a more vertically growing top. This type of lean is also referred to as a corrected lean.

Uncorrected lean

A trunk that is leaning at approximately the same angle from top to bottom. It is also known as a straight lean.

Animal injury

Animals can create many types of mechanical damage in a tree. Animal injury can usually be confirmed by the presence of tooth or claw marks in the sapwood or bark. Animals that commonly cause injury to trees include porcupines, squirrels, bears, deer, gophers, beavers, pigs, horses, goats, and voles.

Cracks in wood prior to failure

A crack is a vertical or horizontal split in the lower stem and buttress roots involving bark, cambium, and xylem. It may be possible to differentiate between cracking that occurs at the time of failure and cracking that existed before the failure by evidence of weathering on the wood. Select this item only if the crack was present prior to the tree failure.

Surface roots or root collar wounded

Mechanical wounds to the root collar area, buttress roots, or first-order lateral roots caused by lawn mowers, weed trimmers, or other devices. This category is a more specific subset of the **Basal wound** category mentioned above.

Section 5: Location of Root Decay

This section characterizes damage done to roots by decay fungi if the fungi were present and decay was involved in the failure. If no decay was present, proceed to Section 6, Surface Treatments. Note that the Web site has the check box **Root decay does not exist**, which is absent from the field report form.

Percentage of roots decayed

If decay was present on the buttress or structural roots of the failed tree, report the percentage of roots decayed. This can be calculated by dividing the number of buttress roots with significant decay by the total number of buttress roots on the tree and multiplying the result by 100. If it is not possible to determine the number of roots, use a percentage of the circumference of the butt or lower portion of the trunk that has decayed roots associated with it.

Conks/mushrooms/other signs?

Indicate whether fungal fruiting structures or other signs of the fungus were present. Signs include mushrooms, conks, bracts, brackets, mycelial fans, rhizomorphs, and other fruiting structures. If you can identify the fungus, enter the scientific **Name** (genus and species, or genus only if available).

Type

Wood decay is categorized by the components of the xylem that are digested by the decay fungus and the resulting appearance. In brown rot, only the polysaccharides (cellulose and hemicelluloses) are substantially degraded. In white rot, all wood components, including polysaccharides and lignin, are degraded. Decay produced by white rots tends to have a whitish coloration and residual fibrous texture, and decay produced by brown rots often has a brown color and little fibrous texture. Brown-rotted wood shrinks and breaks readily across the grain, so it is often called cubical brown rot.

If the type of decay is not known, select **Unknown**. If the decay is a **brown rot** or **white rot**, select the appropriate item.

Section 6: Surface Treatments

Report the condition of the soil surface for root or soil-related failures. If you are not able to determine the condition of the soil surface, select **Unknown**. Common surface treatments are described below.

Mulch

Mulch consists of organic materials added on top of the soil such as wood chips, pine bark, pine needles, shredded cypress bark, shredded and colored wooden pallets, or other materials. Do not include gravel or rock ground cover in this category.

Bare soil

Areas where there is no other vegetation around the trunk of the tree due to herbicide use, hand weeding, or natural factors.

Turf

Grass growing to the trunk of the tree.

Ground cover

Ground covers include plants that were installed to grow around the trunk such as ivy, myrtle, pachysandra, and other low-growing species.

Natural forest litter

Plant matter on the forest floor including dead leaves, twigs, and sparse growth of other herbaceous and woody plants are considered to be natural forest litter.

Gravel/rock

Gravel is inorganic mulch material added around the trunk, including river rock, volcanic rock, sharp gravel, limestone, and marble chips.

Pavement

Select this item if the tree was planted after or before paving was installed. Pavement includes brick pavers, concrete, and asphalt, but does not include gravel walks, driveways, or raised wood decks.

Other

Surface treatments not listed above are included in this group. You may describe these conditions in the **Additional Comments** part of Section 9. More than one treatment type can be selected if there is more than one treatment within the tree's dripline.

Irrigation

If there is an irrigation system installed around the tree, select one of the four choices that describe its usage.

- **Unknown.** The usage pattern is not known.
- **Infrequent.** Water is rarely applied, such as only during droughts or on a schedule that is less than or equal to once every two weeks.
- **Frequent.** Irrigation is run daily to weekly.
- **Never** An irrigation system is present but not used.

Section 7: Additional Information

This section applies to all failure types.

Tree condition and pruning history/tree failure details

Were the defects associated with failure visible before the tree failed?

In trying to predict tree failures, it is important to know if a defect that was associated with the failure was externally visible to a trained observer prior to the failure. Sometimes it is hard to determine whether the defect was visible; in that case, select **Unknown**. Select **Yes** if the most important defect was visible prior to the failure; if it was not visible, select **No**.

At the time of failure was the tree dead, declining or alive?

Dead trees can be recognized by discolored inner bark. If the tree has been dead for some time (days or weeks), the leaves should have died or fallen off, or they should have turned brown and been retained on the twigs. If the tree has been dead for somewhat longer (months), small branches may be falling off and patches of bark may be loosely attached or falling off. If the tree has been dead many months or years, the bark may have completely fallen off and medium-sized branches may be falling. **Decline** is the progressive decrease in the health of organs or the entire plant, usually caused by a series of interacting factors. Declining trees are still alive in at least a portion of their trunk, root, and branch systems. The crown exhibits dieback or thinning. Leaves may be green or a chlorotic yellow color and sparse. **Live** trees do not need to be completely foliated, especially in the winter, but evergreen hardwoods and conifers should be. The majority of the live crown should have green leaves attached during the growing season.

Was there construction around this tree?

This question refers to construction that may be related to the death or decline of the tree or that may have predisposed it to failure. Consider only construction that occurred within the dripline of the tree or is otherwise known to have impacted the tree. If there was construction, indicate how many years prior to the time of failure the construction took place.

Pruning history

If there is no evidence of pruning, select **No pruning.** If the tree has been pruned, give the type of pruning, if known (see below). Types of pruning are described in the American National Standard Institute A300 Standard for tree care. Additional information on these standards can be found at the ANSI A300 Standards for Tree Care Operations Web site, http://www.natlarb.com/content/laws/a-300.htm; at the

ANSI Tree Care Web site, http://www.ansi.org/news_publications/media_tips/tree_care.aspx?menuid=7; or at the International Society of Arboriculture Standards and Practices Web site, https://secure.isa-arbor.com/comersus/store/comersus_listCategoriesAndProducts.asp?idCategory=32,
Pruning types include the following.

Cleaned

Selective pruning to remove dead, diseased, and/or broken branches.

Lion's tailed

An improper practice of removing all or most secondary and tertiary branches from the interior portion of the crown, leaving most live foliage at the edge of the canopy.

Thinned

Selective pruning to reduce the density of live branches in the crown .

- **Proper** thinning is hard to detect since only 10 to 25 percent of small branches (1/2 to 2 inches [1 to 5 cm] diameter at the cut) were removed from near the edge of the crown.
- **Excessive** thinning is the removal of a higher percentage of branches or the removal of larger branches (> 3 inches [7.5 cm] diameter).

Reduced/directionally pruned

Shortening the length of a branch or stem to a lateral branch large enough to assume the terminal role (thinning to a lateral, lateral pruning, or drop crotch pruning). This type of pruning is often done under utility wires and near buildings to shorten the height or spread of a tree. **Proper** reduction removes no more than 25 percent of the foliage and does not make large (> 4 inches [10 cm] in diameter) cuts. **Excessive** reduction either removes too much live tissue (> 25%) or makes cuts that are large (> 4 inches [10 cm] in diameter) and is therefore less likely to compartmentalize.

Crown raised

Crown raising is selective pruning to provide vertical clearance. This type of pruning is common in urban areas. It is done to allow passage under the crown of the tree for pedestrians, vehicles, mowers, and light. If this type is selected, provide the **Percentage of height**. Calculate this by dividing the distance from the ground line to the lowest remaining branch and by the total heath of the tree and multiplying the result by 100.

Main stem(s) topped (heading cuts)

Topping (dehorning, round-over, lopping, or hat-racking) is an improper pruning technique used to reduce the height of a tree. It is done by making heading cuts on large branches. One easily recognizable result of topping is the leaving of large branch stubs. If the tree was topped and stubs are present, provide the **Diameter of the *largest* stub**.

Habitat information

This section deals with the site in which the tree had been growing.

Trees recently removed in vicinity of failed tree?

Determine whether other trees were removed from the area adjacent to the failed tree within the previous 4 years. Tree removal may have been forest thinning, removals on a construction site, or removal of adjacent high-risk or dead trees.

History of previous failures at site?

Determine whether other trees have failed in a similar way (trunk, branch, or root) near this failure. This may represent a disease center, site-related problem, lack of wind-resisting strength, or other factor. For branch failures, have there been other branch failures on this tree?

Setting

Give information on the use of the area around the failed tree. (Ownership of the land was covered in Section 1 and should not be confused with this section.) For example, the tree may be located in a national forest (federal ownership) but sited next to a power line or in parking lot. Select only one category: the best representation of the area use or the factor most related to the failure. The categories are:

- **Forest.** Trees growing in groups with natural undisturbed forest litter ground cover.

- **Campground.** A partially or fully developed forest area intended for overnight stays.

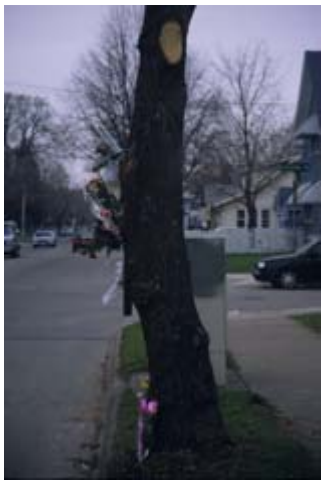
- **Picnic area.** A partially or fully developed forest area intended for day use, including picnicking.

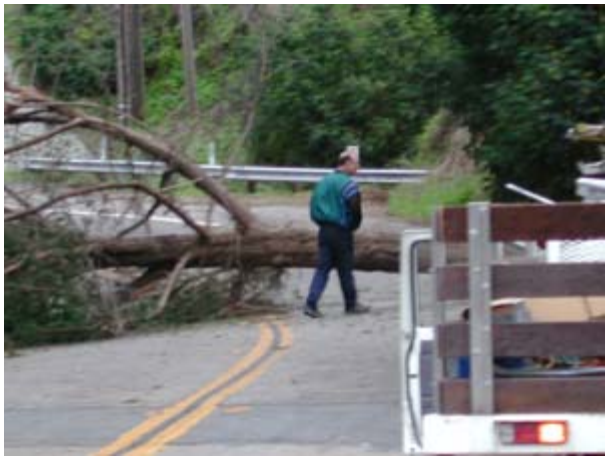
- **Trailhead.** An area with access to a hiking, horseback riding, bike, motorcycle, or off-road vehicle trail that allows vehicle parking.

- **Other developed forest sites** include water access sites, day use sites, wildlife viewing areas, interpretive, administrative or visitor information sites or other developed or partially developed forest sites.

- **Commercial site/institution**. Businesses, manufacturing plants, hospitals, college campuses, corporate campuses, government facilities, condominium associations, apartment buildings, and other similar sites.

- **Street tree/median**. Urban sites include sites next to streets or in road median or boulevards. This category excludes sites along highways or in interchanges even if they are in urban areas.





- **Roadside trees**. Sites along roads, interchanges, and highways even if those highways are in an urban area.

- **Utility right-of-way**. Sites within a maintained utility right-of-way, especially electrical power line right-of-ways. Other right-of-ways include gas pipelines, water flumes, irrigation ditches, and sewer pipe lines. These may be in rural or urban areas.

- **Yard/garden**. Sites located on private home sites, including sites both in front of and behind houses.

- **Park.** A public or private park-like settings, within or adjacent to an urban area. This includes cemeteries.

- **Golf course**. Trees growing in or adjacent to a private or public golf course.

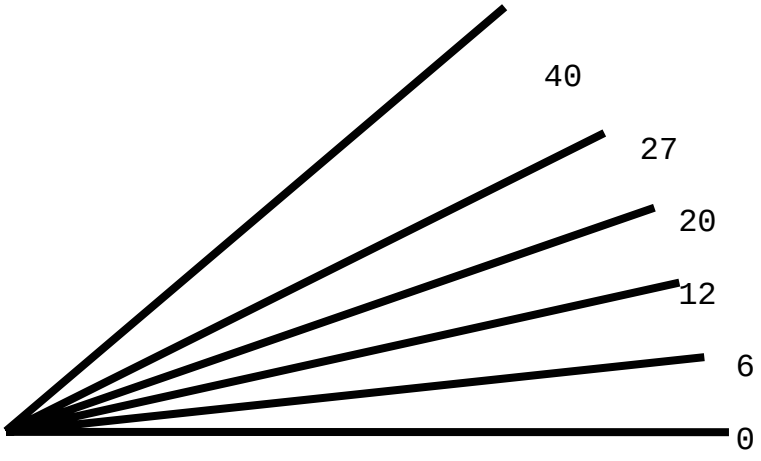
- **Parking lot.** Trees adjacent to or within a designated and paved parking lot. These trees must have pavement within the dripline on at least one side of the tree.
- **Other**. All remaining settings including agricultural sites (eg. farms, fields ranches, orchards). You may describe these conditions in the **Additional Comments** part of Section 9.

Aspect

If the tree is growing on a slope, determine the direction or bearing of the slope face. Enter that direction as the aspect.

Slope

If the tree is on a slope, determine the amount of slope as measured in degrees. The following illustrations shows angles with degrees labeled:



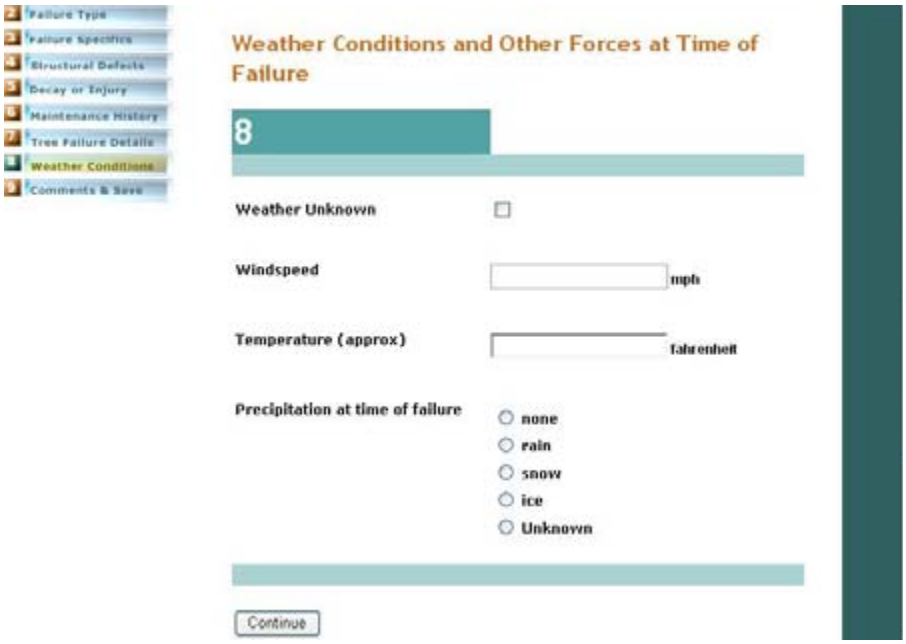
Date/time of failure

- **Date/Season unknown.** You were not able to determine the date or time of the failure.
- **Date of failure.** If known, enter the month, day, and year: for example, enter December 9, 2004, a 12/9/2004. Also enter the **Time of the failure** if it is known or the time of the peak of a storm in which the tree fell if that is known.
- **Season of failure**. Enter the season of failure only if you do not know the exact date and time of failure. A tree that fails in December 2004 but is not inspected until March 2005 it is acceptable to report as failing in winter 2005.

Section 8: Weather and Other Forces at Time of Failure

Unknown
You were not able to determine the weather or other conditions at the time of failure.

Wind speed
If known, enter either the wind speed at the time of failure or the maximum **wind speed** reported during the storm event. Use miles per hour or kilometers per hour.



Temperature
Enter the temperature at the time of failure or the typical temperature for that time of day. Use Centigrade or Fahrenheit.

Precipitation
Select the type of precipitation at the time of failure or that was related to the failure.

Section 9: Cause/Result of Tree Failure

Why did this failure occur?

Describe the factors that you believe caused the failure of the tree. This is especially important if you were not able to find a category under Section 2 -Failure type, that accurately described the predisposing factors. Provide as many details as are needed.

Results of tree failure

Select the type of damage that occurred due to this tree failure.

None

No damage beyond the loss of a few branches from this tree or minor landscape disturbance. If the entire tree needed to be removed, select **Removal of this tree**.

Property damage

Damage to personal property such as vehicles, houses, commercial buildings, pavement, picnic tables, landscapes, or other items.

Personal injury

A person was killed or injured due to this tree failure. Do not include injuries sustained during the cleanup of the failed tree, but do include injuries indirectly caused by the failure, such as, for example, injury due to a fire caused by a tree contacting a power line. Describe any personal injuries in **Additional Comments**, below.

Fire

A fire started as a result of the tree failure, such as by a lightning strike on the tree or by the tree contacting or arcing to a power line.

Power outage

The tree failure damaged a power line and that caused a power outage on that circuit or beyond.

Removal of this tree

The only damage was that the failed tree or remaining portions of this tree had to be removed.

Loss of other trees

The failed tree fell into adjacent tree(s) resulting in the death, serious injury, or removal of other trees.

Other damage

Damage did occur but it does not fit into the other categories. Describe the damage in the **Additional Comments** section, below.

Property damage estimate

If property damage occurred, enter an estimate of the total replacement value of the items damaged. Enter U.S. dollars. Currency conversions are available at many Web sites, such as the Oanda.com site, http://www.oanda.com/convert/classic.

Cleanup costs

If the tree or fallen branches needed to be removed or otherwise disposed of, give the costs involved. If a tree service company did the work, enter the amount of the invoice. If cleanup was done by a government agency, corporate staff, or as part of the routine tasks of a landscape contractor, multiply the hourly personnel cost by the number of man-hours involved and add any cost of equipment hours used or equipment rented to do the job, hauling, and disposal costs. If a homeowner did the cleanup, multiply the man-hours involved by a reasonable hourly rate and add any rental equipment or disposal costs. Enter U.S. dollars.

Additional comments

Include descriptions of personal injury, other targets that were damaged, or other information that could quantify the damages that occurred due to the failure.

Completing the Entry

At this point on the Web site, you can submit the report by clicking on the **Submit Report** button. Once this has been done, the data cannot be changed. You will be provided a verification of submission screen that also has a **Form ID Number** on it. If you plan to save the paper copy of the field report form, we recommend entering the **Form ID number** on the top right corner of the report form to verify that the data has been submitted and to act as a reminder not to submit the data again.

If several people working out of one office collect tree failure information, the **Cooperator name** can be signed at the bottom of the report form to keep track of who inspected the failed tree. The **Date** of inspection can also be entered.

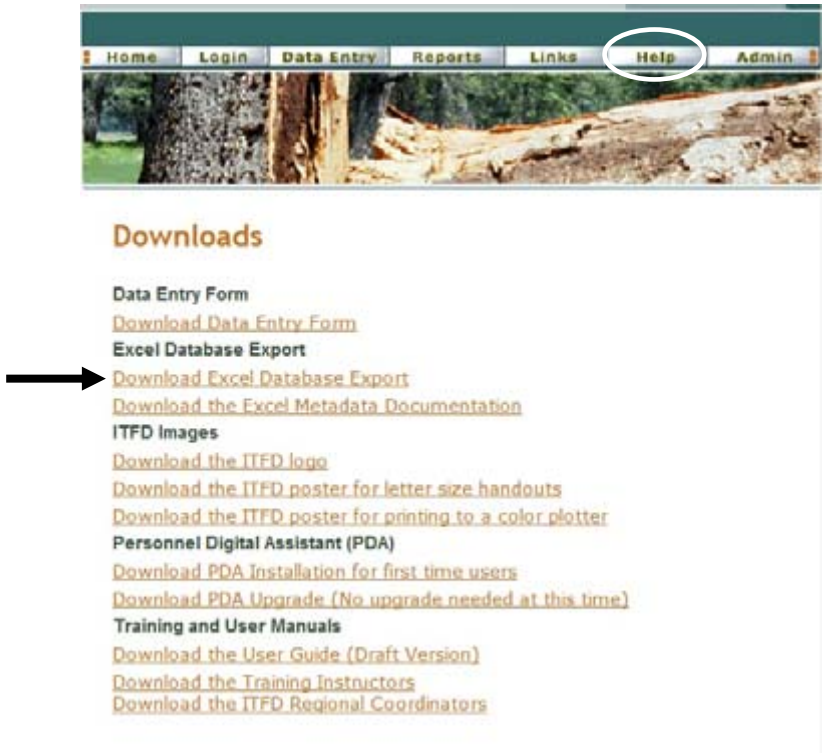
Following successful submission of a report on the Web site, you will have three options:

- **Exit** the system.
- **Report another tree**, starting with a blank form.
- **Report another tree**, starting with the data from the previous failure. This is recommended when reporting multiple failures from a localized geographic area, multiple failures that occurred during the same storm, or failures of many of the same species of tree. By changing only the different fields between one tree and the next, significant time can be saved. It is important, however, to make sure that all of the differences between the two trees are entered and that mistaken data is not repeated from one tree to the next tree.

Acquiring Information from the ITFD

Once the database has sufficient data, it will be possible to acquire summary reports from the Web site. To do this, go to the ITFD Home Page, click on the **Reports** tab at the top of the page. As reports become available they will be posted at this at this site.

You may also generate your own reports by downloading a complete copy of the database and manipulating it yourself. The database online is found under the **Help** tab, **Downloads** section. This copy of the complete database is updated on a quarterly basis and is available as an *Excel* file.



Glossary

ANSI. American National Standards Institute.

Aspect. The compass direction that a slope faces.

BIA. Bureau of Indian Affairs, U.S. Department of the Interior.

BLM. Bureau of Land Management, U.S. Department of Interior.

BMP. Best management practice.

Bolting/bracing. Installation of metal rods through weak portions of a tree.

Bow. A type of uncorrected lean characterized by the lower portion of the stem growing more vertically than the upper portion, or an equal curve from the top to the bottom. The top of the tree may be in contact with the ground.

Branch. Secondary division of tree trunk; a stem arising from the central leader.

Branch attachment. The structural union of a lateral limb to the trunk or another branch.

Branch failure. Breakage of a scaffold or lateral limb, either at or away from the attachment to the trunk.

Brown rot. A type of decay in which fungi degrade polysaccharides (cellulose and hemicelluloses) in the cell walls, creating a brown color in the decayed wood. Most common in conifers.

Buttress root. Large woody roots that arise at the base of the trunk and support the transition from vertical to horizontal orientation; structural roots.

Cable/cabling. Installation of thick, heavy wire, synthetic fiber, or rope and associated hardware in the crown of a tree to provide support.

Canker. A localized area of dead tissue on a stem or branch caused by fungal or bacterial organisms and characterized by progressive or intermittent killing at the margin; may be perennial or annual. Includes stem galls for the purpose of the ITFD.

Canker rot. A fungal disease that involves both cankering and wood decay.

Canopy. The combined crowns of many trees.

Cavity. An open wound characterized by the presence of decay and resulting in a hollow.

Clean (cleaning). Selective pruning to remove dead, diseased, and/or broken branches.

CODIT. Compartmentalization of decay in trees. Model of tree response to wounding.

Codominant stem. Stems equal in size and relative importance, usually associated with either the trunks and stems or scaffold limbs and branches in the crown. In the context of crown class, trees whose crowns form the bulk of the upper layer of the canopy but which are crowded by adjacent trees.

Conk. Woody or leathery spore-producing body of wood decay fungi, generally forming on the external surface of branches and trunks.

Corrected lean. A gradual bend in a tree trunk recognized by off-vertical growth in the lower stem and more vertical growth of the upper stem; a sweep.

Crack. A failure of wood fibers, creating either a longitudinal or horizontal split in the wood.

Crook. An abrupt bend in the branch or trunk. A crook may have been the result of thinning to a lateral branch, branch breakage, death of the leader, or topping cuts.

Crown. Portion of the tree that bears leaves and branches, from the lowest branch to the topmost leaf.

DBH. Diameter at breast height. Diameter of the trunk measured at 4.5 feet [1.4 m, 55 inches] above the ground; the same as DSH, diameter at standard height.

Decay. Process of degradation of structural woody tissues by fungi through the decomposition of cellulose, hemicelluloses, and lignin.

Decline. A symptom of tree disease or disorder characterized by progressive dieback of branches and loss of leaves. “Decline” is also used to refer to the discoloration of leaves, dieback of branches, premature leaf drop, excessive watersprouting, and other symptoms generally affecting stands of trees. In this general context, “decline” may better be replaced with specific symptoms.

Dense crown. A tree crown that is relatively heavy or poses high wind resistance due to an excess of major scaffold branches or minor branches and shoots. It is difficult to see the sky through a dense crown.

Directional pruning. Pruning to a lateral branch with the goal of directing future growth.

DOD. U.S. Department of Defense.

Epicormic. Shoot that arises from a latent or adventitious bud on roots, stems, or branches. An upright-growing branch uncharacteristic of the tree species.

Epiphyte. A plant growing on but not nourished by another plant. Examples include Spanish moss, vines, ball moss, and bromeliads.

Failure (tree). Physical breakage of the tree trunk, one or more branches, or one or more tree roots.

Flush cut. Pruning technique in which both branch and stem tissue are removed; generally considered poor practice.

Gall. In branches, roots, and stems, an abnormal localized growth, generally seen as a large knob of undifferentiated woody tissue.

Girdling roots. Roots that grow around the trunk in a circular manner, constricting other roots or restricting trunk growth.

GPS. Global positioning system; latitude and longitude derived from satellite data.

Grade change. A layer of soil that is added (fill) or removed (cut) from around a tree.

Ground cover. A plant that grows in the soil beneath a tree. Usually an herbaceous plant such as ivy or myrtle.

Guy. Hardware used to provide support to the tree following transplanting or root failure. Installed from the trunk or a lateral branch to an anchor placed in the ground.

Heartwood. Wood toward the center of a stem or root that has become physiologically inactive. Heartwood is often darker than sapwood and often more resistant to decay. It no longer functions for the transport of water and nutrients, but may be a site for storage.

Heart rot. Decay located in the inner xylem or heartwood of a trunk or branch.

Heavy end weight. Branches with unusually long length for their diameter, and/or having a heavy foliar or fruit or cone load, especially concentrated near the ends of the branch.

Heavy lateral limb. Branches with unusually long length for their diameter.

Included bark. Bark embedded between two stems, preventing formation of the branch bark ridge; embedded bark.

Lean. A tree trunk that is not vertical.

Lion's-tailing. An improper practice of removing all or most secondary and tertiary branches from the interior portion of the crown, leaving most live foliage at the edge of the canopy.

Live crown ratio (LCR). The length of the crown relative to the overall tree height, expressed on a percentage basis.

Mistletoe. A parasitic higher plant that has leafy and dwarf forms.

NAD83. The global positioning system data used in this database.

NFS. National Forest System, U.S. Department of Agriculture Forest Service.

NPS. National Park Service, U.S. Department of Interior.

One-sided crown. A crown that is predominantly located on one side of a tree.

Prop. A mechanical device that supports branch or trunk weight from below.

Rising. Selective pruning to provide vertical clearance, previously known as lifting.

Reduction pruning. Reducing the length of a branch or stem back to a lateral branch large enough to assume the terminal role; thinning to a lateral; drop crotch.

Removal cut. Removes branch at its point of attachment to the trunk or parent limb; thinning cut; thinning.

Root. Underground portion of the tree, including woody and nonwoody tissues.

Root barrier. Plastic, metal, or fabric installed vertically in the ground to direct root growth downwards.

Root collar. Area around the base of the tree where the trunk and root system merge; the root crown.

Root failure. Failure at or below the soil line; breakage of one or more buttress roots or uplifting of the root plate.

Root plate. An area around the trunk of a tree where there is a high concentration of buttress roots (primary lateral roots) and support roots.

Sapwood. Outer and youngest layers of secondary xylem in a trunk or stem that function in conduction and storage of water, mineral elements, and carbohydrates.

Scaffold branch. A main limb that arises from the central leader and supports other branches.

Slope. The degree or deviation of a surface from horizontal, measured in a numerical ratio, percent, or degrees.

Sound wood. Wood that has not been degraded by decay organisms.

Stub. The portion of a branch attached to a tree after an improper pruning cut or branch break.

Sweep. A gradual bend in a tree trunk recognized by off-vertical growth in the lower stem and more vertical growth of the upper stem. Also referred to as a corrected lean.

Thinning. 1) Selective pruning to reduce the density of live branches in the crown. 2) To selective removal of individual trees in a forest stand (this definition is not used in the ITFD).

Topping. Pruning to reduce the height or spread of a tree crown by heading of large branches; dehorning, lopping, or hat-racking. Generally considered poor practice.

Trailhead. An area with access to a hiking, biking, horseback riding, or off-road vehicle trail where parking is permitted.

Tree well. A structure built around a tree to hold fill soil away from the trunk. Usually circular in shape and created by a wood or masonry wall.

Trunk. The main woody part of the tree, connecting roots, and branches.

Trunk failure. Breakage of the central leader (or leaders) above the roots; stem failure.

Uncorrected lean. A trunk lean characterized by the trunk moving off of the vertical at a constant angle from top to bottom; a straight lean or unnatural lean.

Utility right-of-way. An area on either side of a utility system that is maintained to reduce the risk to the system and allow access to the system for maintenance or repair.

White rot. Wood decay in which fungi break down all cell wall components, including polysaccharides and lignin, creating a white color and fibrous texture to the residual tissue. More common in hardwoods.

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Form ID Number_____

INTERNATIONAL TREE FAILURE DATABASE - REPORT FORM

*REQUIRED FIELD

1 General Tree Info
2 Failure Type
3 Failure Specifics
4 Structural Defects
5 Decay or Injury
6 Maintenance History
7 Tree Failure Details
8 Weather Conditions
9 Comments & Save

1 Tree Genus*_____ Species*_____
Cultivar_____ Country*_____
State/Province*_____ County_____
DBH*_____in/cm Height_____ft/m Age_____years
Tree/Site Ownership: ○ Private ○ Utility ○ Other or unknown
○ Fed./Nat.: (○ NFS ○ BIA ○ BLM ○ DOD ○ NPS)
○ State/Province ○ County ○ Municipal
Address/Site name_____
GPS: Latitude_____._____ Longitude_____._____ (NAD83)

2 FAILURE TYPE* (select one)

○ TRUNK FAILURE ○ BRANCH FAILURE ○ ROOT FAILURE

3 Trunk Failure Specifics

Height of failure above grade*_____ft/m
Dia. at break (inside bark)*_____in/cm

4 Defects Associated with Failure

☐ None
☐ Unknown
☐ Failed portion dead
☐ Decay ☐ Canker Species:_____
☐ Multiple trunks/codominant stems
☐ Dense Crown ☐ Flush cuts
☐ Topped ☐ One-Sided
☐ Low live crown ratio ☐ Included Bark
☐ Bow ☐ Crook ☐ Sweep/corrected lean
☐ Uncorrected lean
☐ Cracks in wood:
○ Vertical ○ Horizontal
☐ Lightning Injury ☐ Animal Injury
☐ Fire Injury ☐ Insect Injury
☐ Mechanical Injury ☐ Girdling

5 Location of Decay

☐ HEARTWOOD
Avg. sound wood thickness_____in/cm
Opening (cavity) at failure? ○ No
○ Yes, opening_____% of trunk circ.
☐ SAPWOOD
Avg. depth of rot_____in/cm
Circumference rotted_____%

Type of Decay

☐ Unknown ☐ Brown rot
☐ Canker rot ☐ White rot
Conks/mushrooms/other signs? ○ No
○ Yes Name:_____
Distance from conk to failure:_____ft/m

6 Hardware

☐ None
☐ Girdling hardware
☐ Other device
☐ Cable ○ Intact ○ Failed
☐ Guying ○ Intact ○ Failed
☐ Prop ○ Intact ○ Failed
☐ Brace/bolt ○ Intact ○ Failed

3 Branch Failure Specifics

Dia. at break (inside bark)*_____in/cm
Total length failed branch_____ft/m
Break at attachment: ○ Yes ○ No
If No, distance from the attachment to break:_____ft/m

4 Defects Associated with Failure

☐ None ☐ Unknown
☐ Failed portion dead ☐ Decay
☐ Dense Crown
☐ Heavy lateral limbs/Heavy ends
☐ Included bark ☐ Crook
☐ Failed portion is an epicormic branch
☐ Cracks in wood
☐ Mistletoe or epiphyte
☐ Mechanical Injury ☐ Lightning Injury
☐ Insect Injury ☐ Animal Injury
☐ Canker/Gall
Species _____

5 Location of Decay

☐ HEARTWOOD
Avg. sound wood thickness_____in/cm
Opening (cavity) at failure? ○ No
○ Yes, opening_____% of branch circ.
☐ SAPWOOD
Avg. depth of rot_____in/cm
Circumference rotted_____%

Type of Decay

☐ Unknown ☐ Brown rot
☐ Canker rot ☐ White rot
Conks/mushrooms/other signs? ○ No
○ Yes Name:_____
Distance from conk to failure:_____ft/m

6 Hardware

☐ None
☐ Girdling hardware
☐ Other device
☐ Cable ○ Intact ○ Failed
☐ Guying ○ Intact ○ Failed
☐ Prop ○ Intact ○ Failed
☐ Brace/bolt ○ Intact ○ Failed

3 Root Failure Specifics* (select one)

○ **Roots broken**
Dia. of largest broken root_____in/cm
Distance from break to trunk_____ft/m
Condition of broken roots:
☐ Dead, no decay ☐ Decayed
☐ Live, no decay ☐ Unknown
○ **Roots cut/severed** (not decayed or broken)
Dia.of largest broken root at cut_____in/cm
Distance from trunk to cut_____ft/m
% of roots cut_____
○ **Root plate lifted out of ground**
Root plate radius_____ft/m
Root plate depth_____in/cm
○ **Root restricted due to:**
☐ Container ☐ Root barrier
☐ Sidewalk/curb ☐ Wall/foundation
☐ Natural Feature ☐ Other
Distance from trunk to restriction_____ft/m
% of root zone restricted_____
Root collar girdled? ☐ Yes ☐ No
% circumference girdled_____

Site/Soils Conditions

Soil composition: ○ Sand ○ Silt ○ Loam
○ Clay ○ Rock/gravel ○ Unknown
Soil moisture at time of failure: ○ Unknown
○ Dry ○ Saturated ○ Moist ○ Flooded
Restricted rooting depth due to:
☐ Poor drainage ☐ Shallow or layered soil
☐ High water table ☐ Compacted ☐ Other
Other Site Conditions:
☐ Soil eroded ☐ Compaction
☐ Grade change ☐ Well surrounds trunk
☐ Fill soil against trunk or planted too deep
Depth of excess soil_____in/cm

4 Defects associated with failure

☐ None ☐ Unknown
☐ Fire scar/injury ☐ Basal wound
☐ Low live crown ratio
☐ Corrected lean (sweep)
☐ Uncorrected lean ☐ Animal Injury
☐ Cracks in trunk prior to failure
☐ Surface roots or root collar wounded

5 Location of Decay

% of roots decayed_____
Conks/mushrooms/other signs?
☐ No ☐ Yes Name:_____
Avg. sound wood thickness_____in/cm
Type: ☐ Unknown ☐ Brown rot ☐ White rot

6 Surface Treatment ☐ Unknown

☐ Mulch ☐ Bare soil ☐ Turf
☐ Ground cover ☐ Natural forest litter
☐ Gravel/rock ☐ Pavement ☐ Other
Irrigation: ○ Unknown
○ Infrequent ○ Frequent ○ Never

7 ADDITIONAL INFORMATION
Tree Condition and Pruning History

Were the defects associated with failure visible before the tree failed?
○ Yes ○ No ○ Unknown

At time of failure the tree was:
○ Dead ○ Declining ○ Alive

Was there construction around this tree?
○ Yes ○ No
If Yes, when_____years ago

PRUNING HISTORY
☐ No pruning ☐ Cleaned ☐ Lions-tailed
☐ Thinning:
○ Proper ○ Excessive
☐ Reduction/Directional pruning:
○ Proper ○ Excessive
☐ Crown raised_____% of height
☐ Topped Diameter of stub at cut_____in/cm

Habitat Information

Trees recently removed in the vicinity of the failed tree:
○ Yes ○ No

History of prior failures at site:
○ Yes ○ No

Setting
○ Forest ○ Campground
○ Picnic area ○ Trailhead
○ Other developed forest site
○ Commercial site / Institution
○ Street tree / Median-Urban
○ Road side - Rural
○ Utility right-of-way
○ Yard / Garden
○ Park - Urban ○ Golf course
○ Parking lot ○ Other

Aspect
○ N ○ NE
○ E ○ SE
○ S ○ SW
○ W ○ NW
○ Not applicable / Flat

Slope
○ No slope ○ <5
○ 5-15 ○ 15-30
○ 30-45 ○ >45

Date / Time of Failure

☐ Date / Season Unknown

Date of failure (Mo/Day/Yr):_____ **OR** Season of failure:
○ Spring ○ Summer ○ Fall ○ Winter
Time of failure hour_____
○ A.M. ○ P.M. ○ Unknown
Year_____

8 WEATHER AND OTHER FORCES AT TIME OF FAILURE

☐ Unknown
Wind speed (approx.)_____mph/kph
Temperature (approx.)_____ °F/°C
Precipitation: ○ None ○ Rain ○ Snow ○ Ice ○ Unknown

9 CAUSE / RESULT OF TREE FAILURE

Why did this failure occur?

Result of tree failure:
☐ None (No damage other than the failure described) ☐ Property damage ☐ Personal injury
☐ Fire ☐ Power outage ☐ Removal of this tree ☐ Loss of other trees ☐ Other damage
Property damage estimate $_____(US) Cleanup costs $_____(US) If personal injury describe below.
Additional Comments (injury, target, damage, etc.):

Cooperator name_____ Date_____
Please enter data at: **http://ftcweb.fs.fed.us/natfdb/** ITFD Field Form Revised 12/16/2004