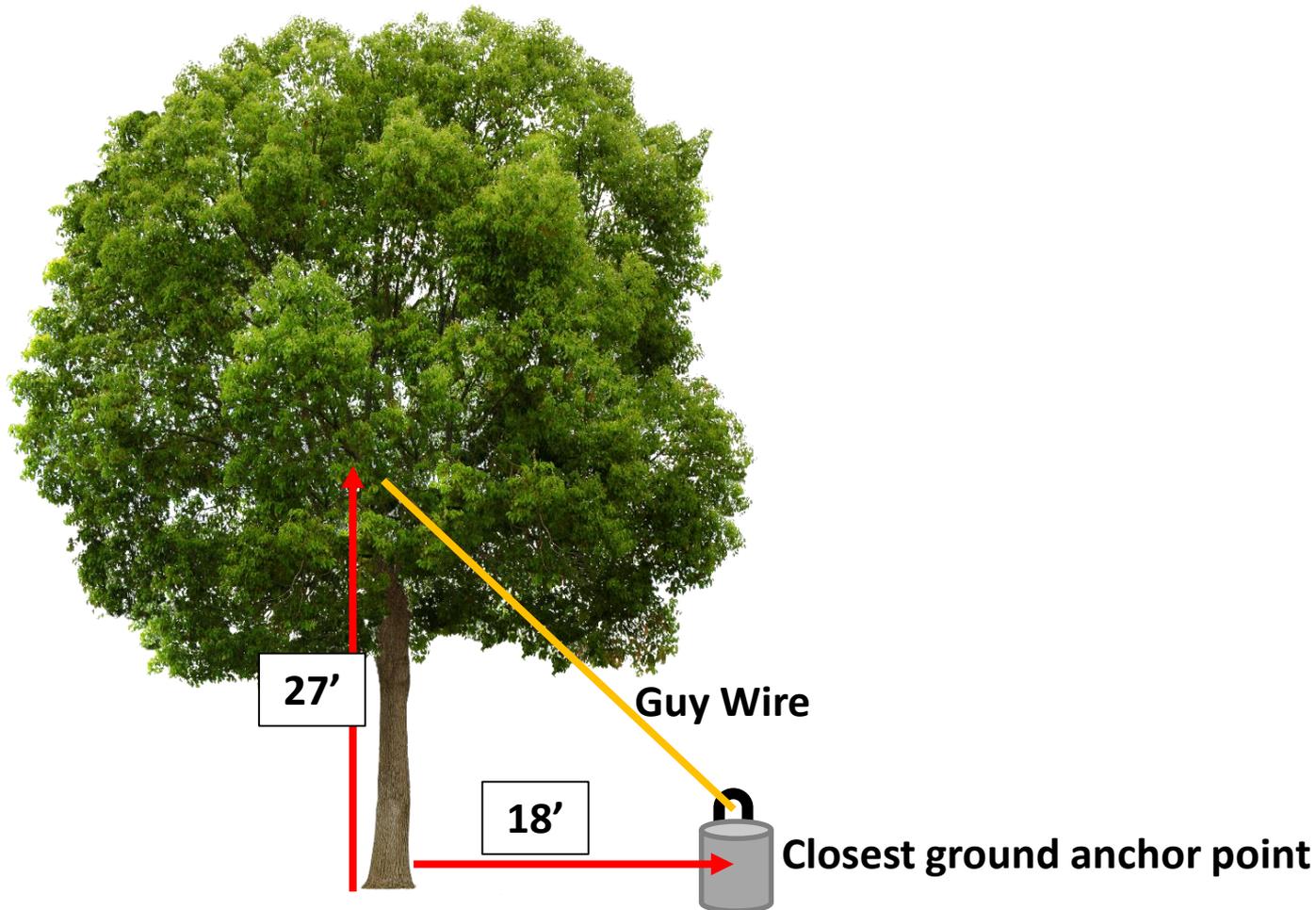


Guying Installation

Guying to the Ground:

- place ground anchor(s) no closer to the trunk than $\frac{2}{3}$ the distance from the ground to the lowest attachment in the tree



Guying Installation

Guying to another Tree:

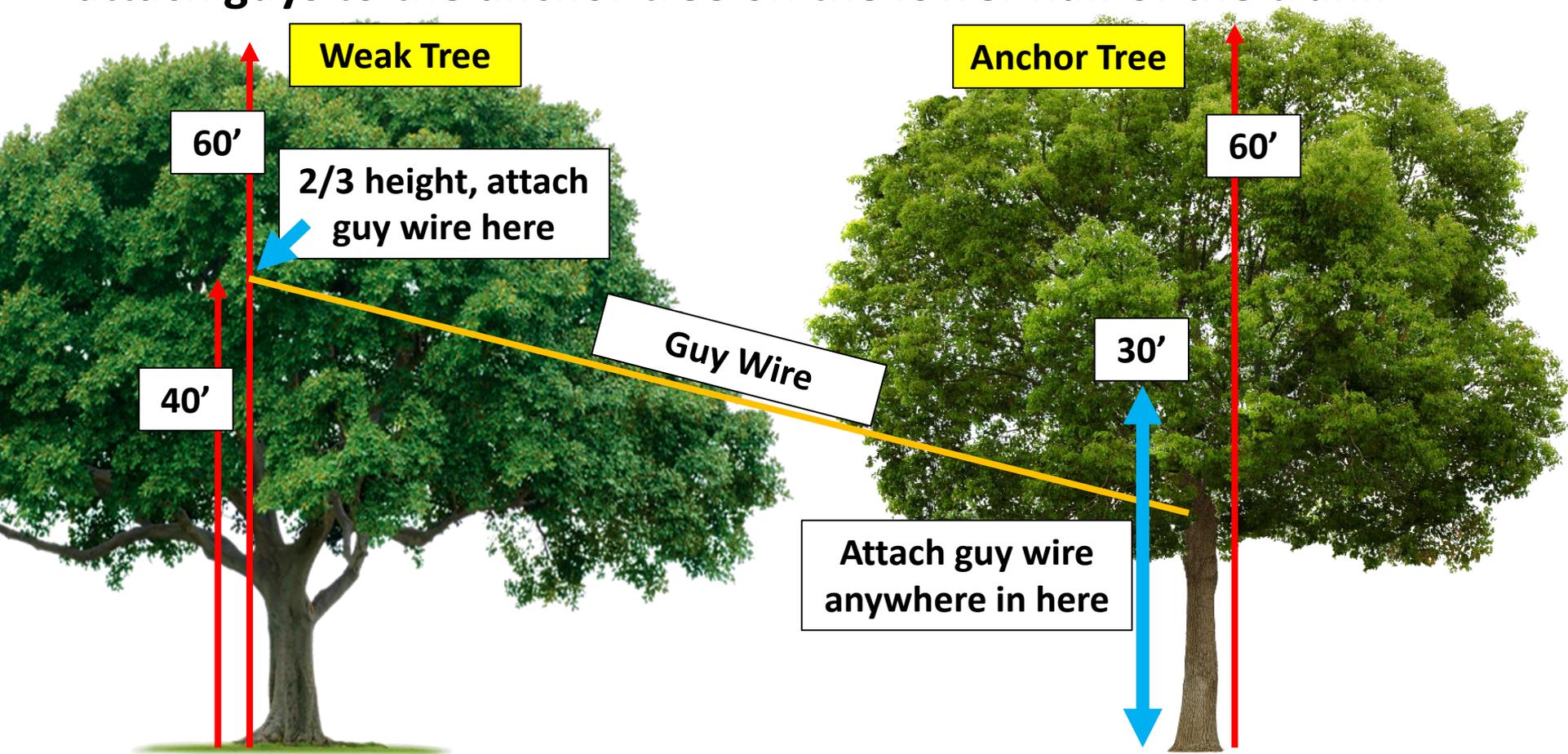
- attached using same methods as cable installation
- inspect anchor tree to ensure it has enough structural integrity and strength to support the weak tree



Guying Installation

Guying to another Tree:

- attach guys to the weak tree above the midpoint, preferably at about $2/3$ the height of the tree
- attach guys to the anchor tree on the lower half of the trunk



Guying Public Safety

Tree-to-Ground Guys:

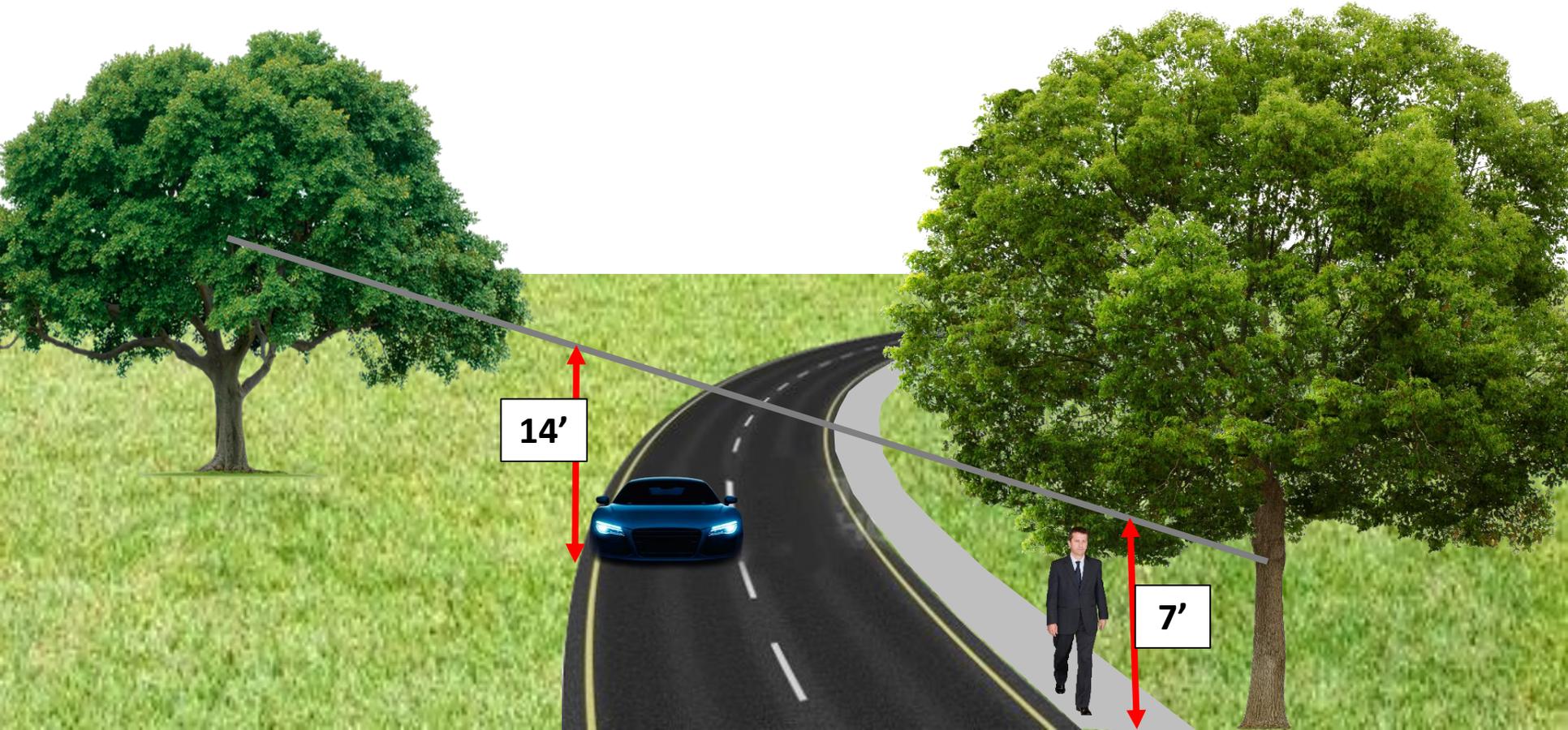
- clearly marked & protected from inadvertent contact
- advised to place mulch ring around ground attachment to reduce lawn mower damage



Guying Public Safety

Tree-to-Tree Guys:

- install high enough to reduce the risk of any hazards
- greater than 7' if pedestrian traffic is present
- greater than 14' if vehicular traffic is present



Tree Support Systems

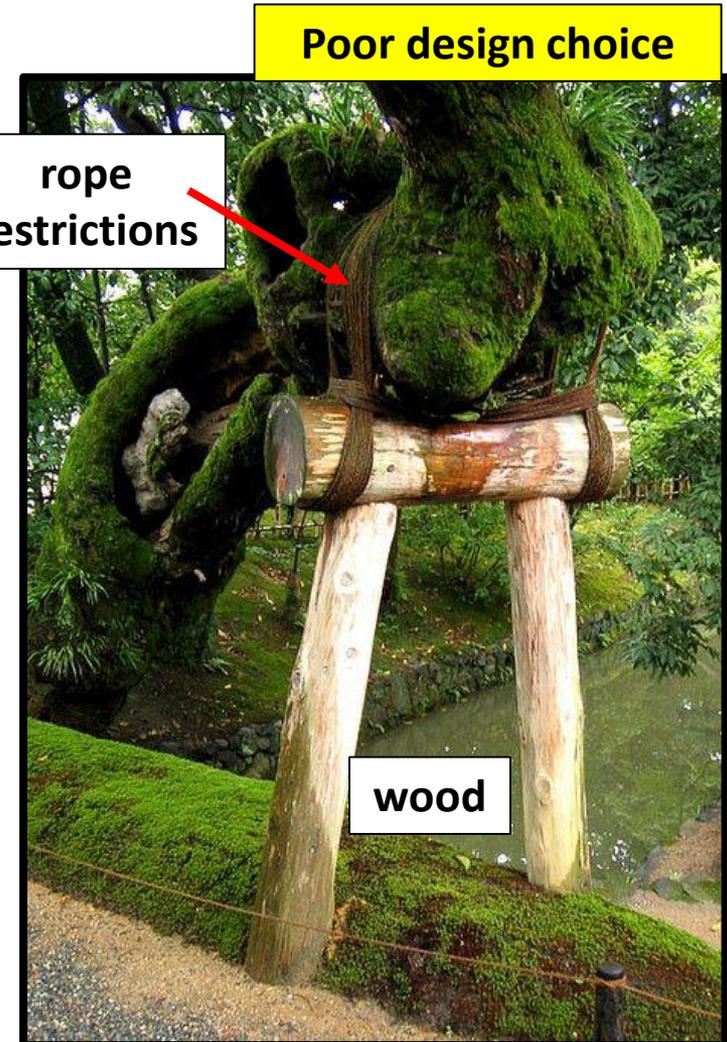
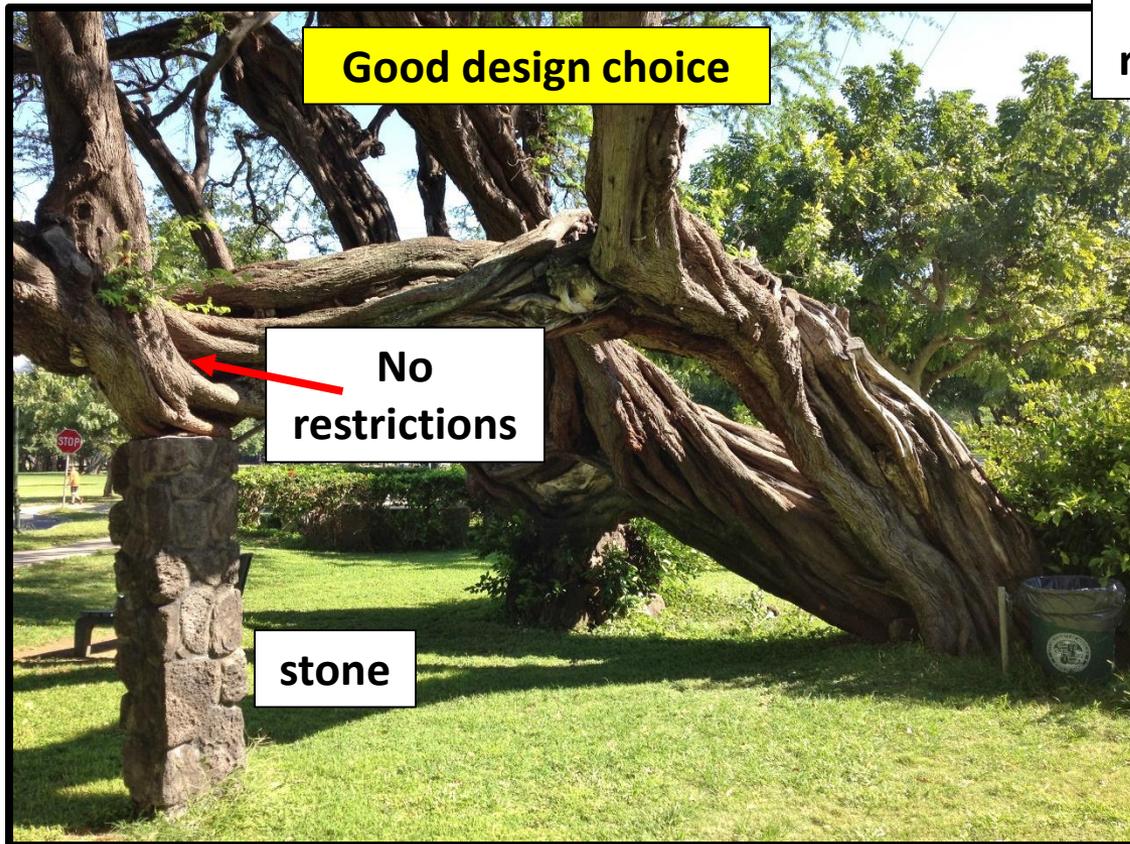
Propping:

- installation of rigid braces/structures between the ground & a branch or trunk, acting in compression, to provide support to a tree, or tree branch
- used under branches or leaning trunks to keep off the ground or a structure, or to provide clearance
- typically used on branches that are nearly horizontal or downward growing



Propping Design

- little information about use & design is available
- cannot restrict the growth of the branch
- should be protected from deterioration



Propping Design

- needs a provision to keep the branch from falling off of the prop
- the prop must be anchored to the ground to keep it from moving excessively
- consider root damage if a hole must be dug for the ground anchor

<http://hort.ufl.edu/woody/propping.shtml>



Propping Materials

- can be made from wood, steel, concrete, or other materials
- materials must have sufficient strength to support the expected load
- wood can rot & steel can rust, weakening the prop and creating risk



Objective 5

Explain how, by installing a supplemental support system in a tree, the arborist takes on a future responsibility to a client. Periodic inspection of the hardware and installation is required to ensure proper functioning of the support system.

Inspection & Maintenance of Tree Support Systems

- **ongoing responsibility**
- **arborist must explain prior to installation that cables, braces, guys, & props must be inspected routinely**
- **periodic inspection of the tree & limbs for structural integrity, condition of the hardware & support system, cable tension, & position of cables must be done**
- **as tree matures, new cables may need to be installed higher**
- **old systems should not be removed until new system has been properly installed**
- **cable trees may need to be pruned periodically to remove excessive weight**

Objective 6

Identify the circumstances under which a lightning protection system may be recommended for trees.

Introduction to Lightning in Trees

Side Flash:

- phenomenon of a lightning strike leaving its current path & “jumping” to reach a better-grounded conductor



Introduction to Lightning in Trees

Side Flash:

- that conductor can be another tree, a structure, a person, or an animal



<https://sciencebasedlife.wordpress.com>

Introduction to Lightning in Trees

Side Flash:

- occurs on unprotected trees
- can cause serious damage to structures, often starting fires or damaging electrical systems or appliances



Introduction to Lightning in Trees

Step Voltage:

- significant difference in electrical potential, which can lead to electrocution if contacted simultaneously
- occurs at the soil surface when lightning exits an unprotected tree through the roots & the charge dissipates into the soil
- if a person or animal is standing with their feet apart in the area, a potentially deadly flow of electricity may go through their body



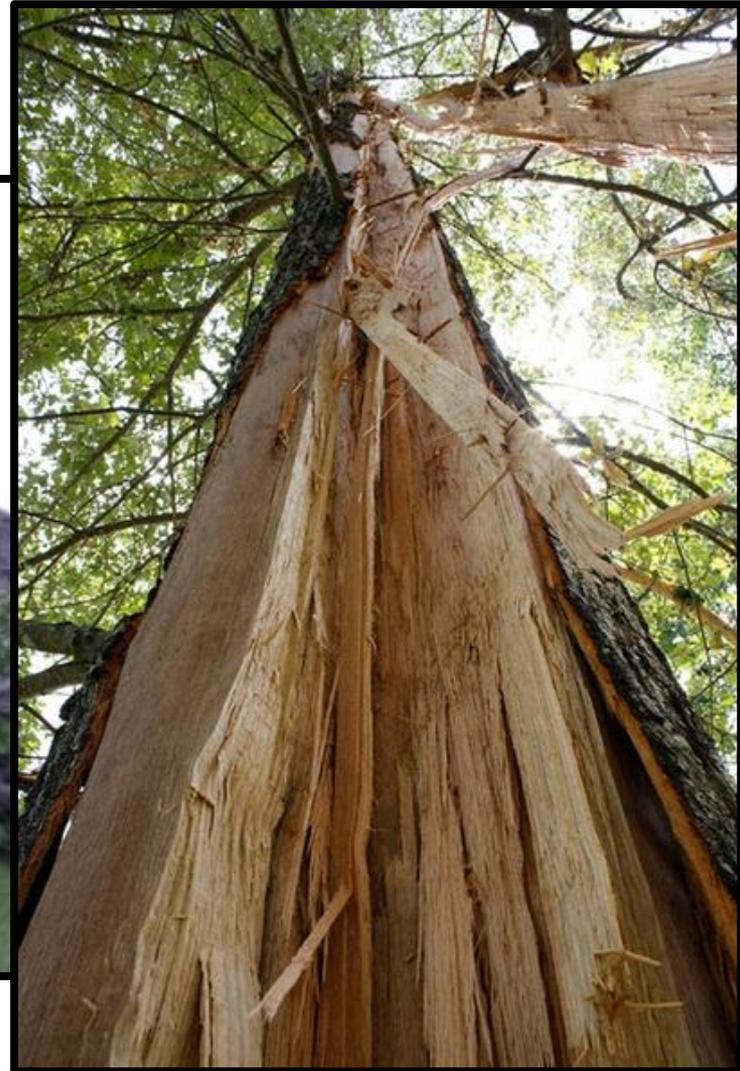
Lightning & Tree Damage

➤ can destroy whole tree at once



Lightning & Tree Damage

- may cause significant structural damage that creates risk & requires removal of tree



Lightning & Tree Damage

- most trees struck are not killed outright
- 20% of trees struck carry no visible injuries
- no immediate signs of damage does not mean no damage

<http://preservationtree.com>



<http://www.walterreeves.com>

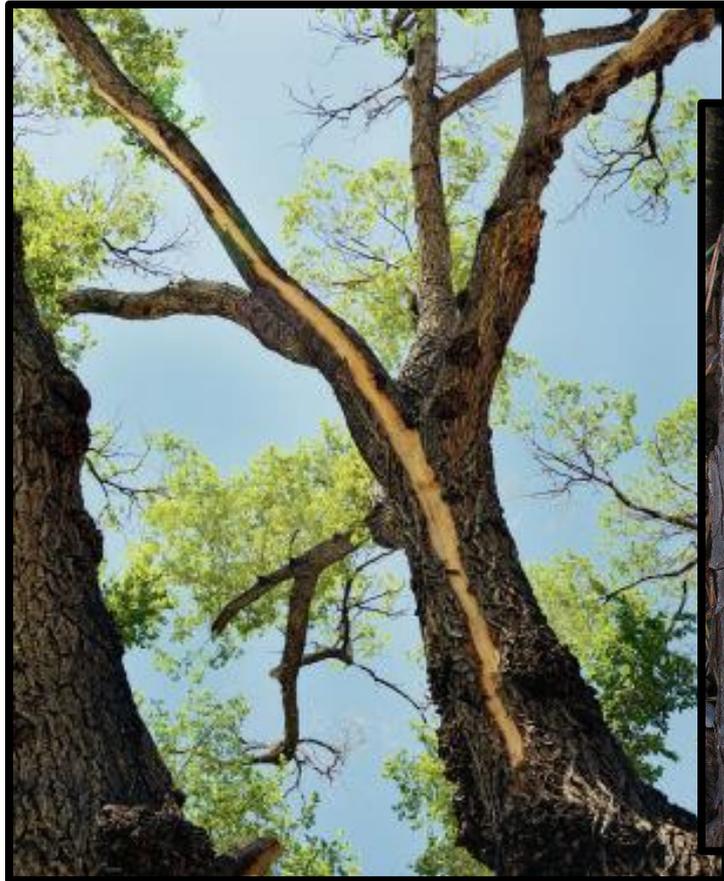


<https://aultparksunrise.com>



Lightning & Tree Damage

- lightning damage to the vascular system increases stress, reduces defense, & increases pest attacks
- disruption of nutrient & water uptake can take a year to become visible



Lightning & Tree Damage

- factors affecting damage include bark thickness, wood porosity, & moisture content



Candidates for Protection

- trees close to houses or other buildings that are much taller than these structures



Candidates for Protection

- trees of historic interest & high economic value
- trees located within recreational areas, parks, golf courses, or other areas where people congregate



Candidates for Protection

Significant Factors of a Tree being Struck by Lightning:

➤ tallest tree in a group



Candidates for Protection

Significant Factors of a Tree being Struck by Lightning:

- tree growing in an open area

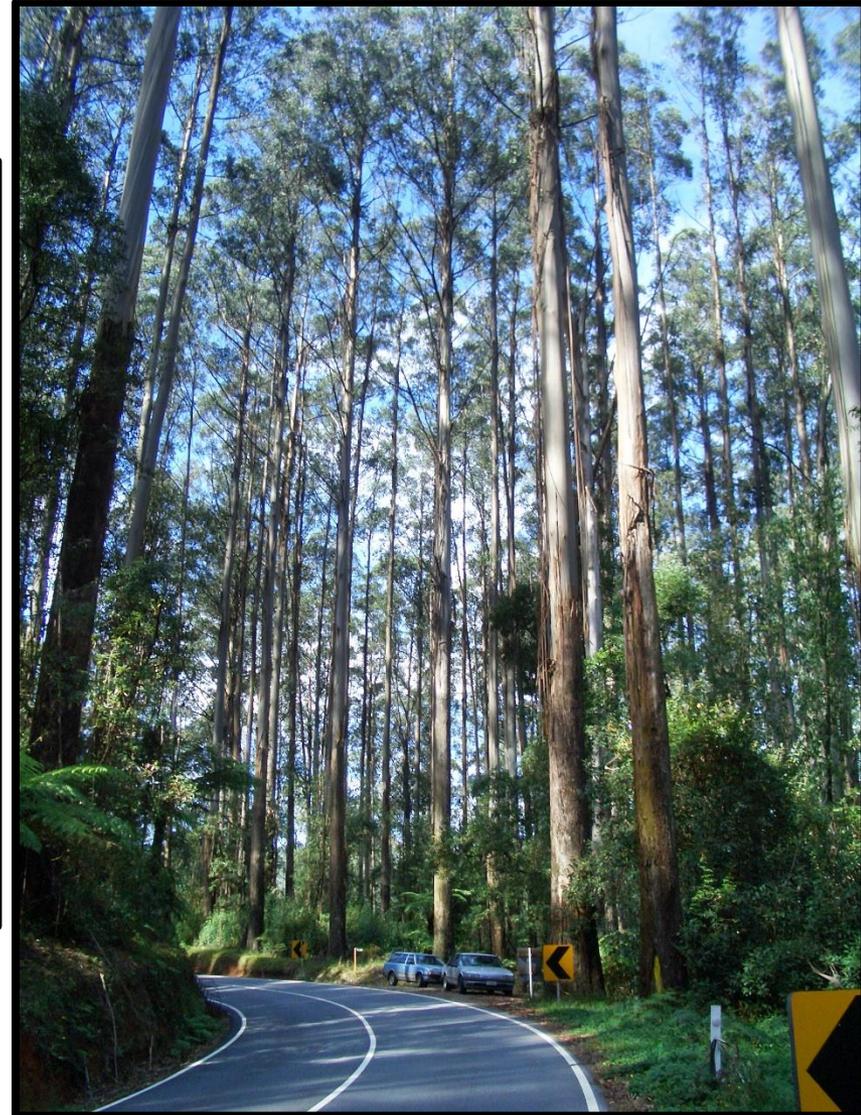


<http://www.lifebyphil.com>

Candidates for Protection

Significant Factors of a Tree being Struck by Lightning:

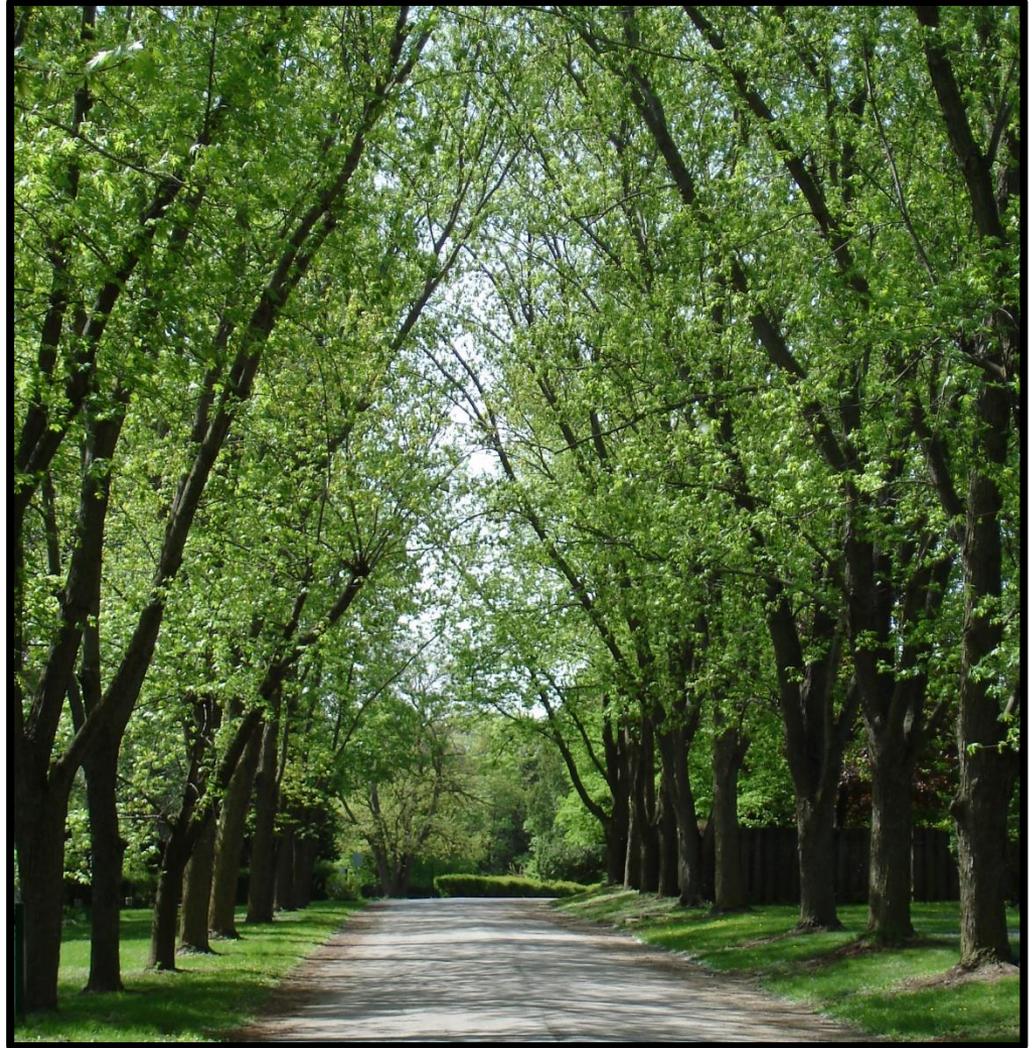
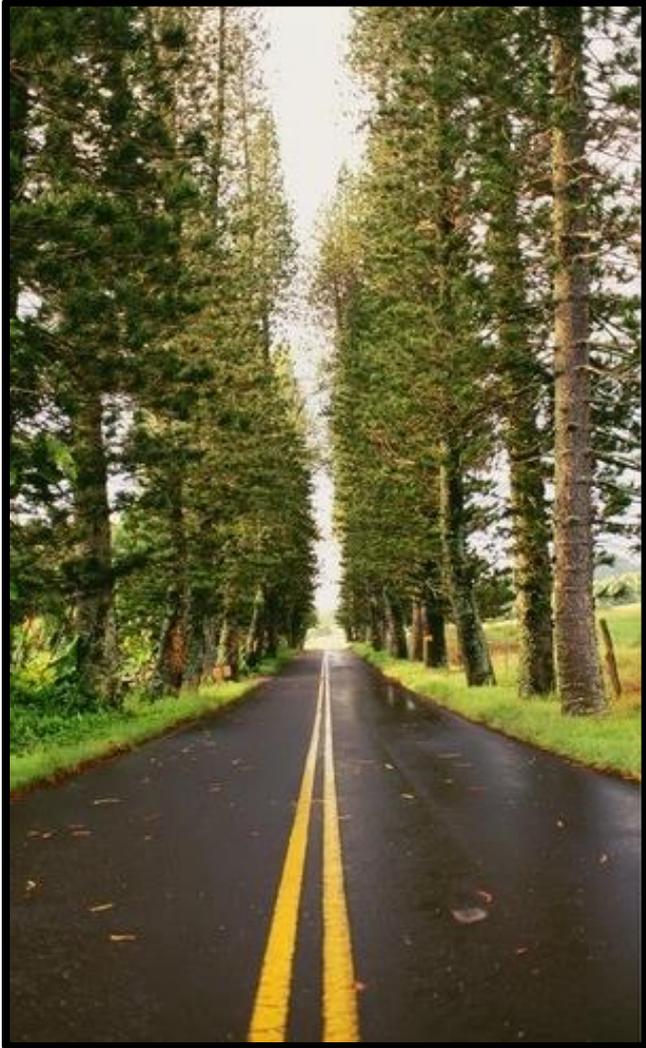
- tall trees that border woods



Candidates for Protection

Significant Factors of a Tree being Struck by Lightning:

- tall trees that line a street



Candidates for Protection

Significant Factors of a Tree being Struck by Lightning:

- trees near large bodies of water



Candidates for Protection

Significant Factors of a Tree being Struck by Lightning:

- trees on hilltops

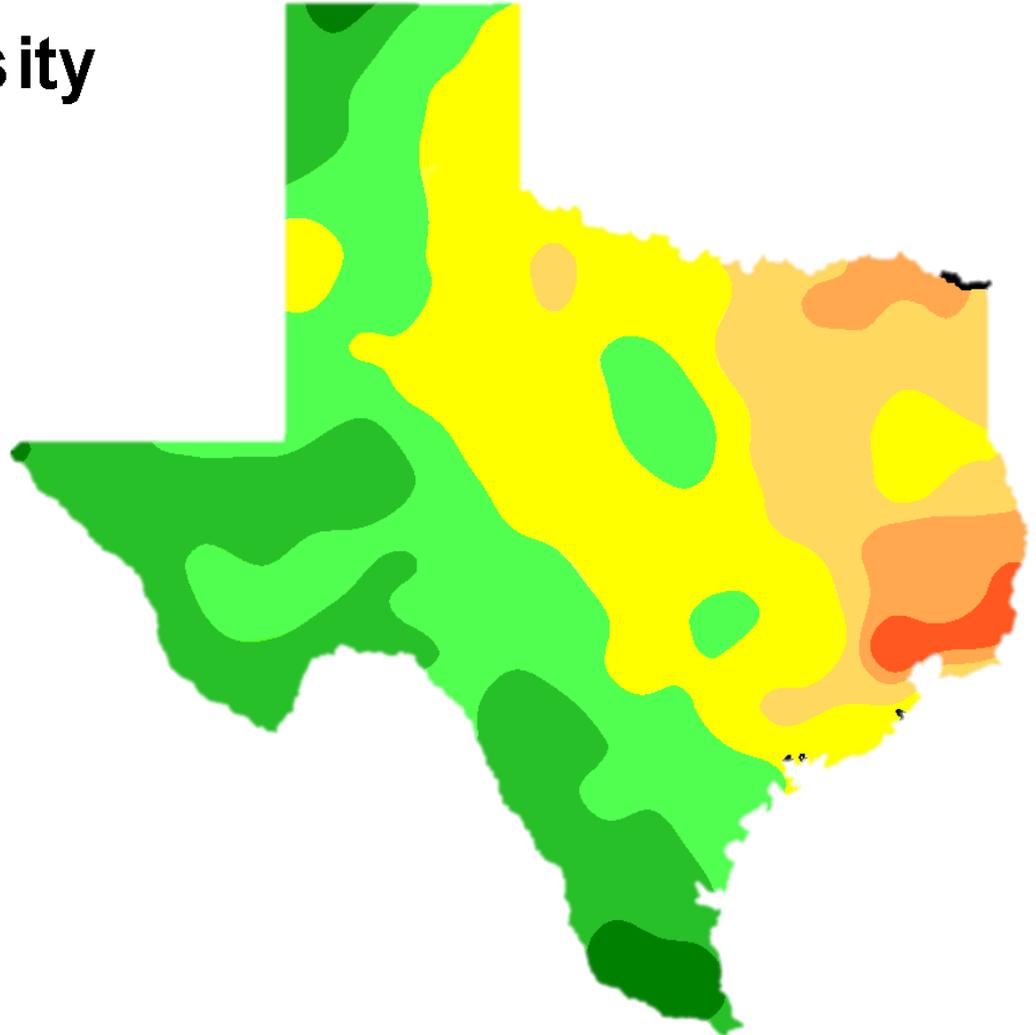
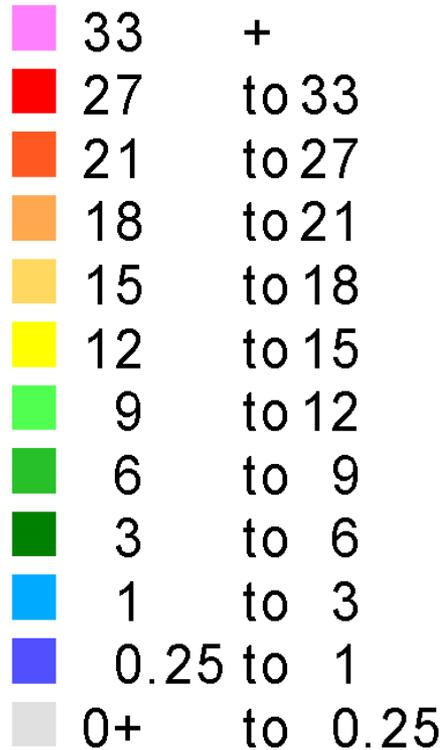


Candidates for Protection

Significant Factors of a Tree being Struck by Lightning:

➤ trees in geographic regions where lightning is common

Average Flash Density
fl/sq mi/yr



Objective 7

Describe the

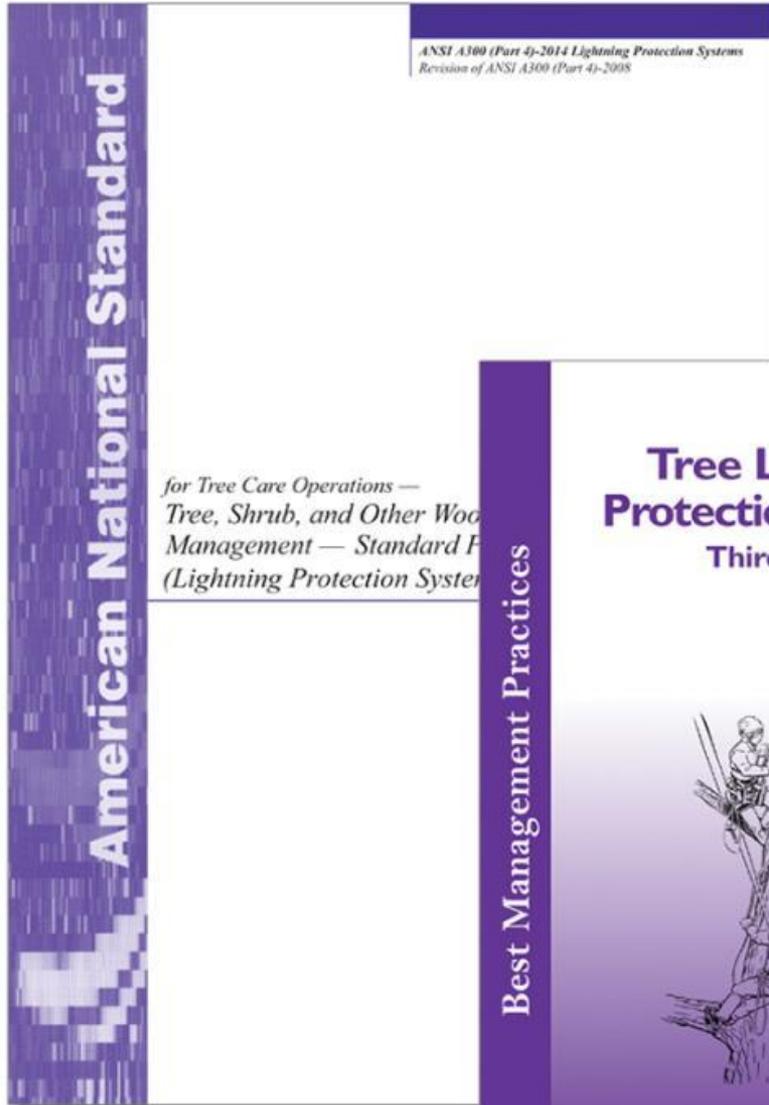
techniques and

materials used in the

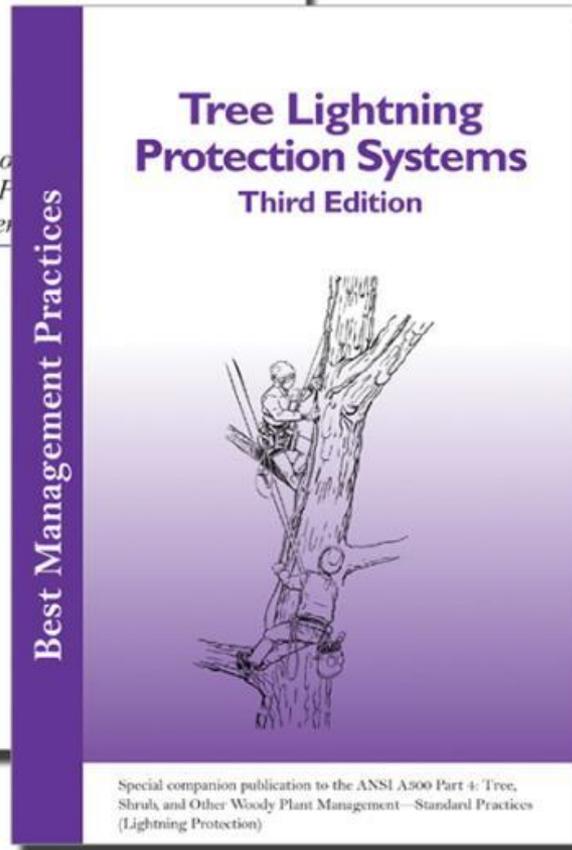
installation of lightning

protection for trees.

Lightning Protection Systems



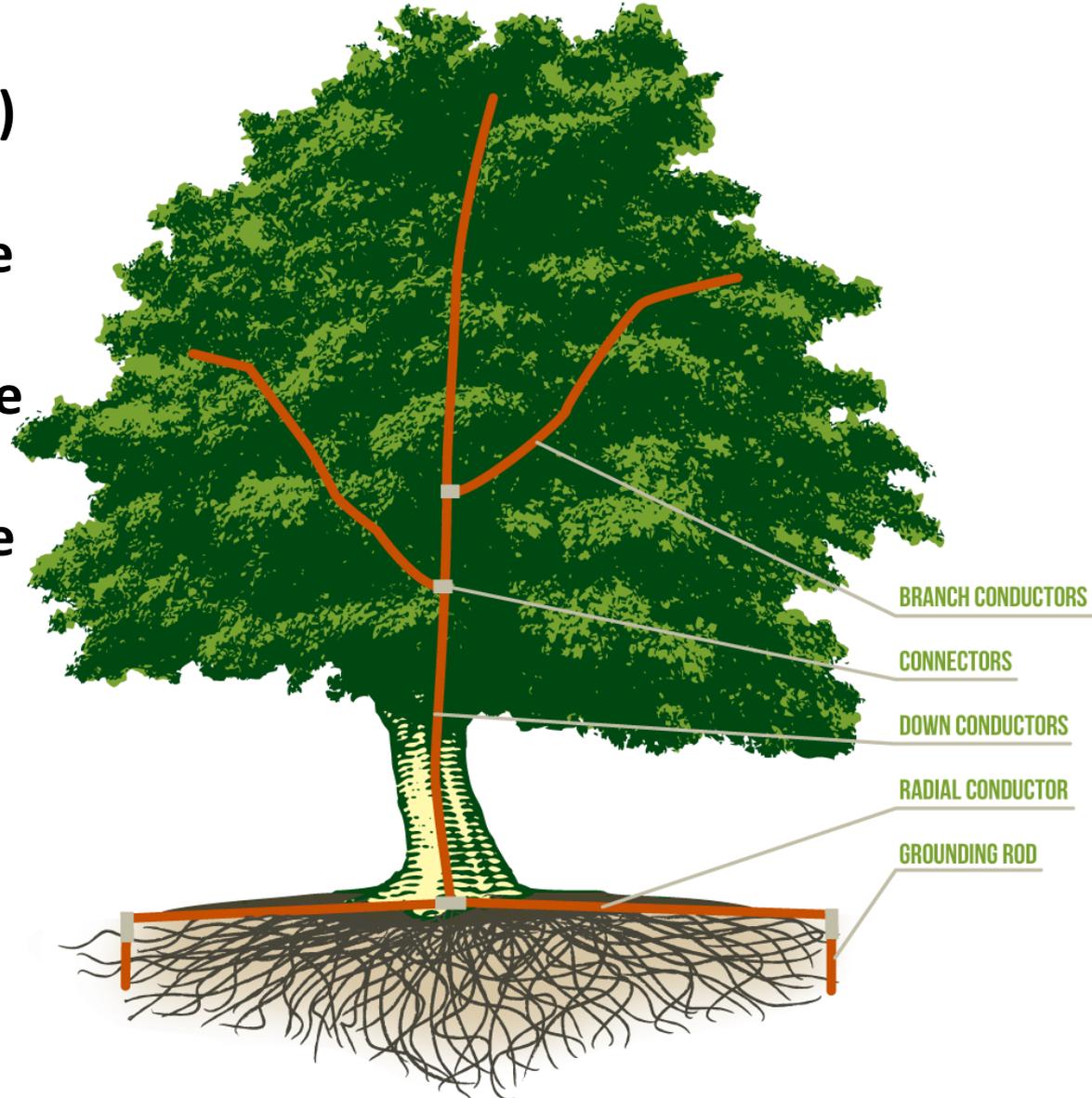
**ANSI A300 (Part 4)-2002,
Lightning Protection Systems**



**BMP – Tree Lightning
Protection Systems**

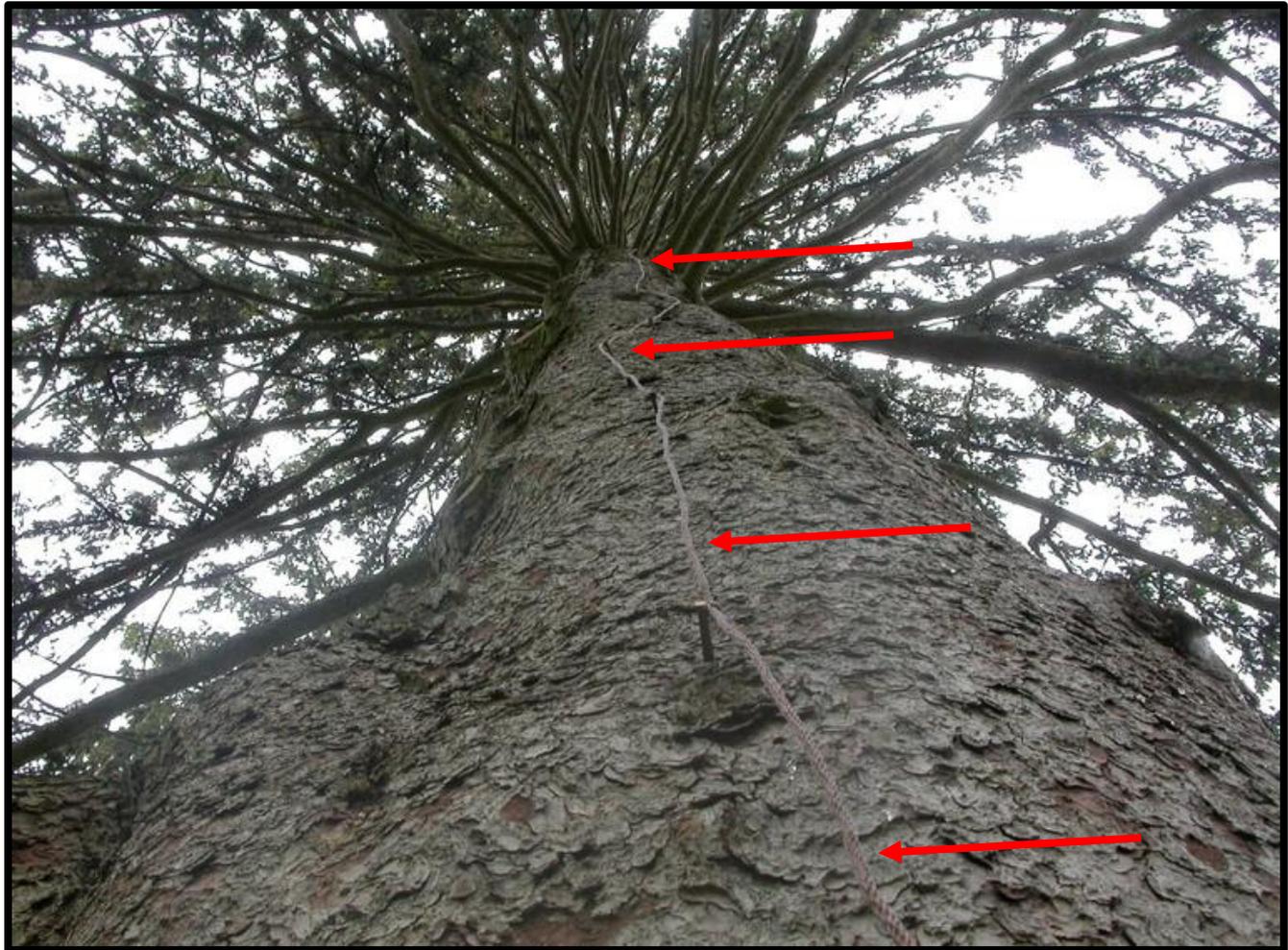
Lightning Protection Systems

➤ consists of a heavy copper conductor (cable) that is connected from the highest part(s) of the tree & extends from the top of the tree, down the main branches & trunk, & out into the soil where it is grounded to a grounding system



Lightning Protection Systems

- instead of lightning passing down a tree, a conductor is used to create an alternate path (of lower resistance) for the electrical charge of the lightning strike to go from the top of the tree to the ground



Lightning Protection Systems

- are effective in preventing tree damage
- not intended to directly protect people from strikes or step voltage
- protected trees cannot be considered safe havens from lightning strikes during storms

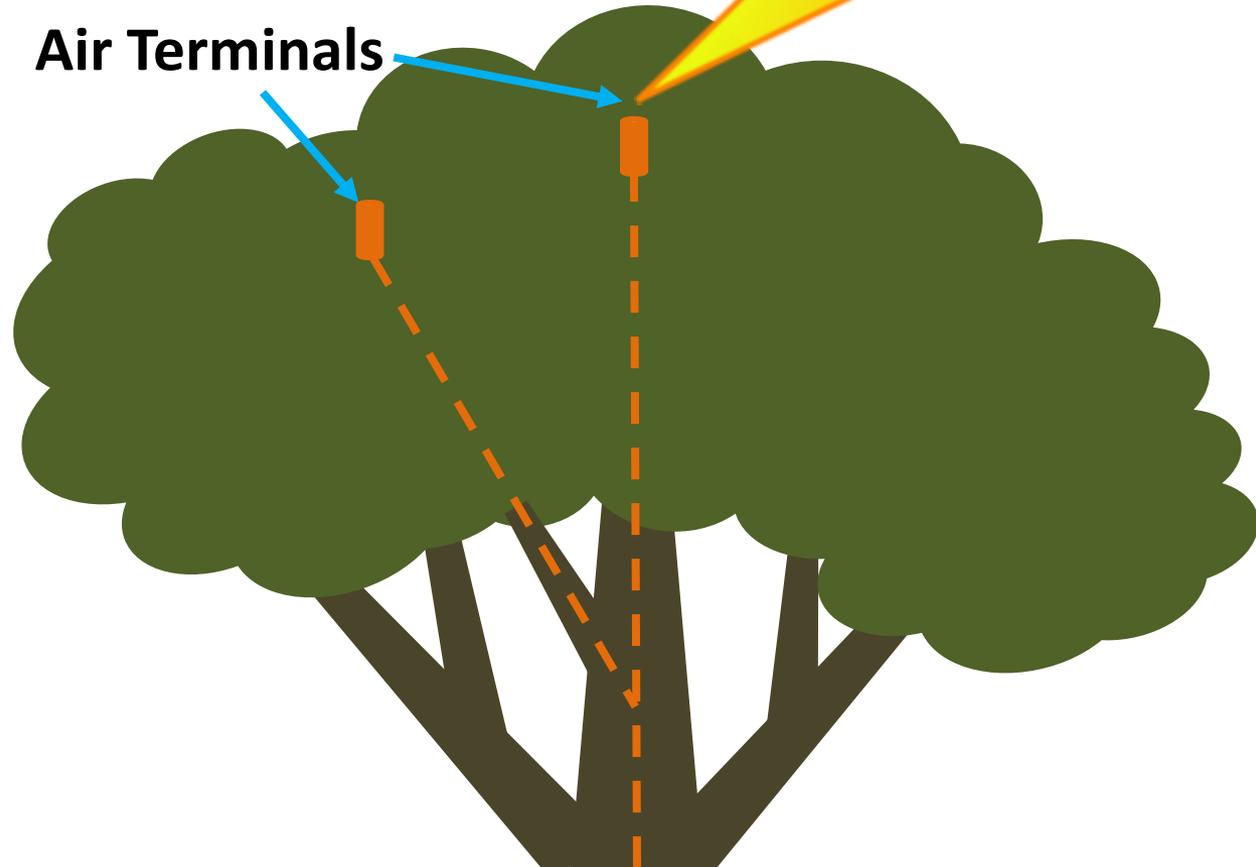


<http://shadetreeexpert.com>

Lightning Protection Systems Hardware

Air Terminal:

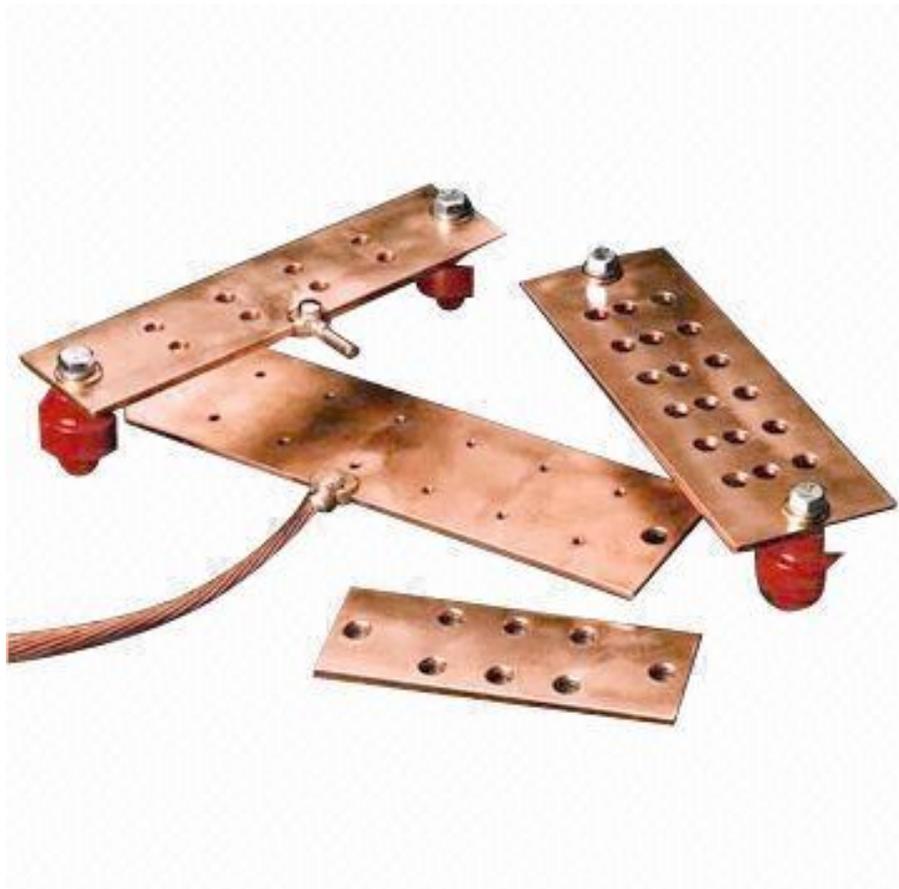
- uppermost point of a tree lightning protection system
- intended to intercept the lightning strike
- should be installed as high on the tree as possible
- all branches or trunk sections above it may be damaged by a strike



Lightning Protection Systems Hardware

Conductors:

- metal wires, cables, and bus bars used for carrying electrical current
- may be solid or stranded (built up by an assembly of smaller, solid conductors)



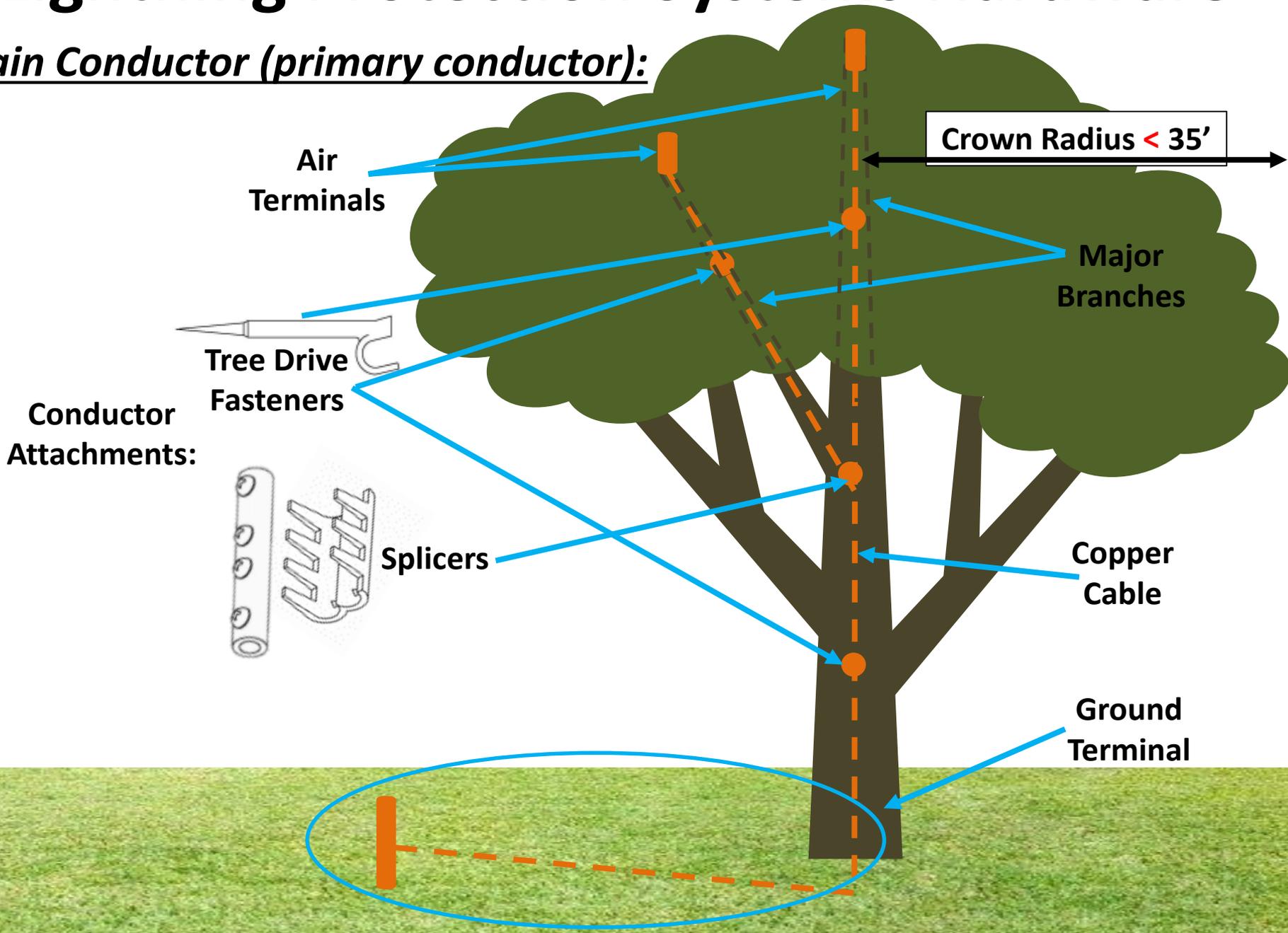
Lightning Protection Systems Hardware

Main Conductor (primary conductor):

- a copper cable connected to the air terminal, which runs down a major branch & the trunk
- should run straight down the tree on the side where the ground terminal is located
- attached to the tree at regular intervals (usually 3'-6') using approved conductor attachments
- path should follow the natural shape of the tree, avoiding sharp bends, kinks, & crotches
- only conductor required for trees with crown radius smaller than 35'

Lightning Protection Systems Hardware

Main Conductor (primary conductor):

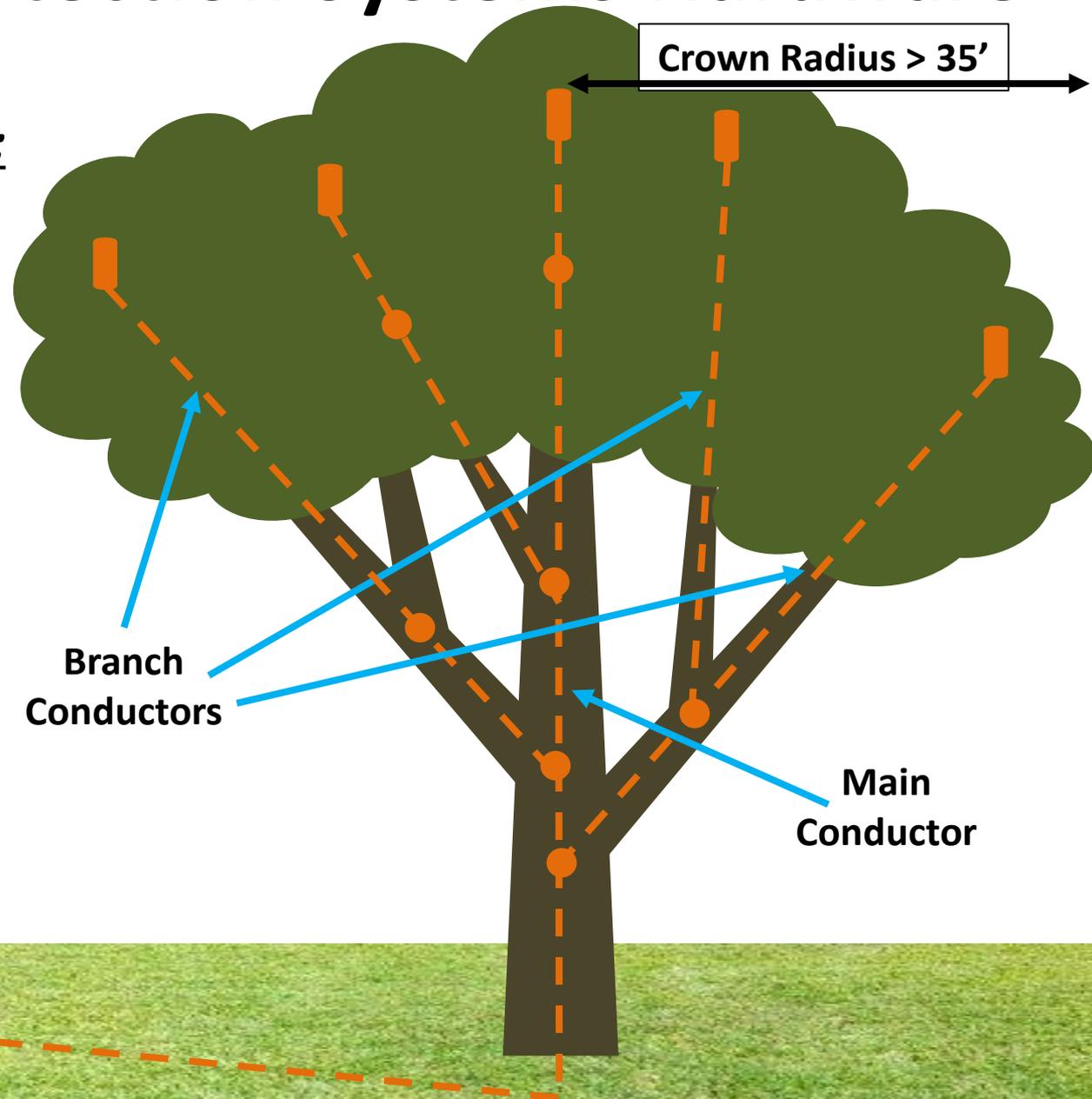


Lightning Protection Systems Hardware

Branch Conductors

(Secondary Conductors):

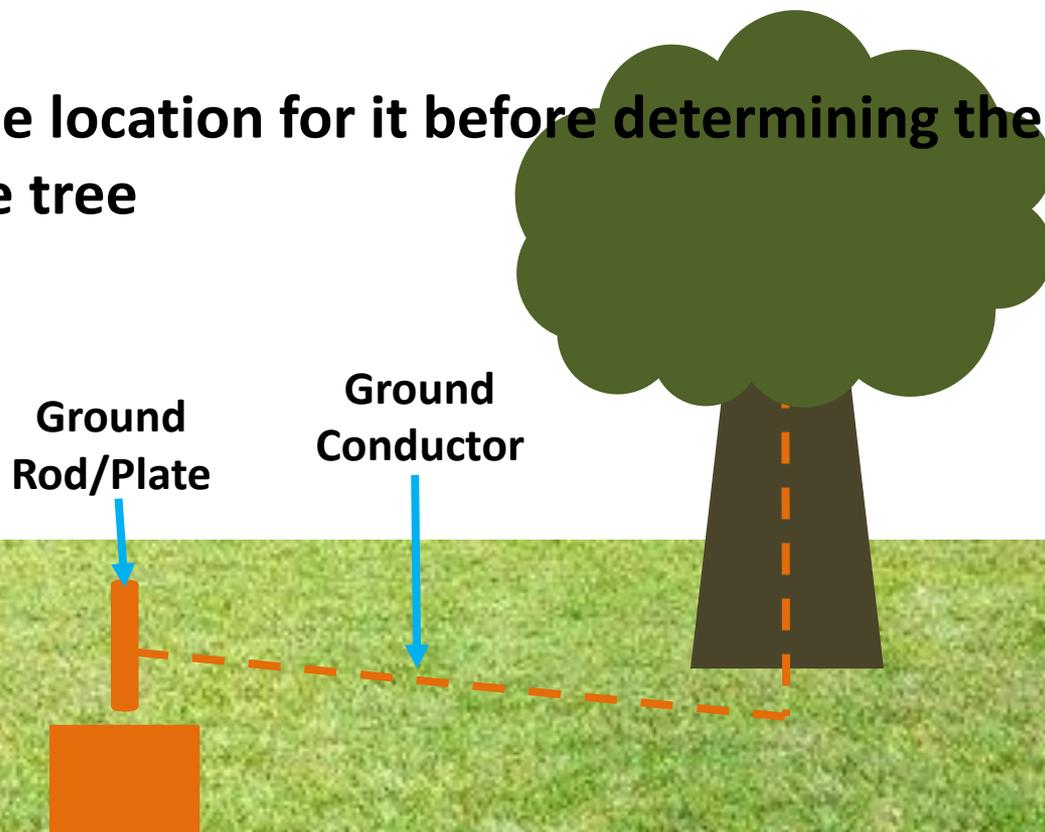
- recommended for trees with a radius greater than 35'
- connect to the main conductor on the trunk



Lightning Protection Systems Hardware

Ground Terminal:

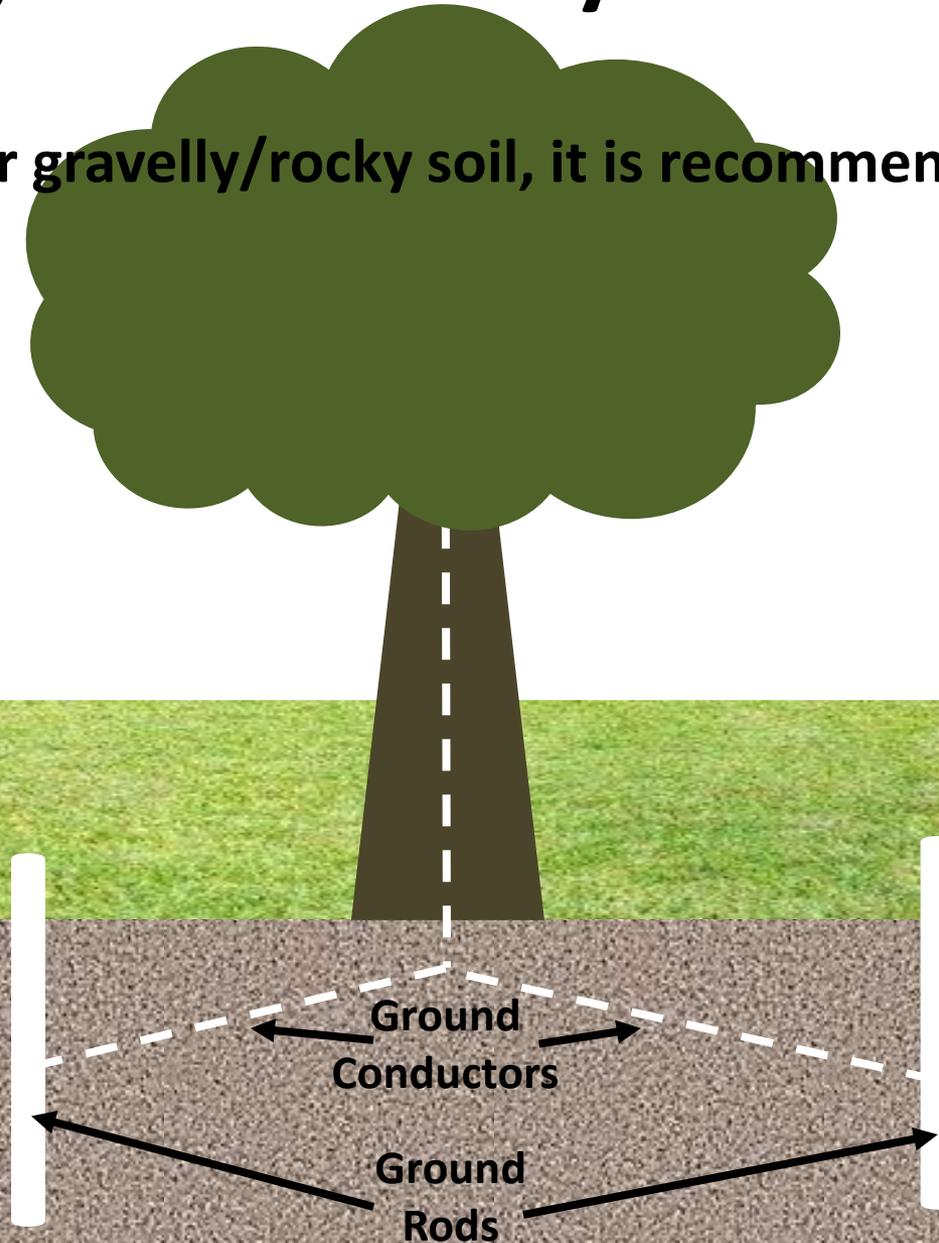
- consist of a ground conductor(s) & either a ground rod(s) or ground plate(s), & all other associated connectors
- installed for the purpose of providing electrical contact with the ground
- best to select the location for it before determining the path for the conductor in the tree



Lightning Protection Systems Hardware

Ground Terminal:

- in dry, sandy, or gravelly/rocky soil, it is recommended to install 2 ground rods



Lightning Protection Systems Hardware

Ground Rod/Ground Plate:

- metal rod/plate used in grounding a tree lightning protection



Grounding
Rod Driver

Grounding
Rod

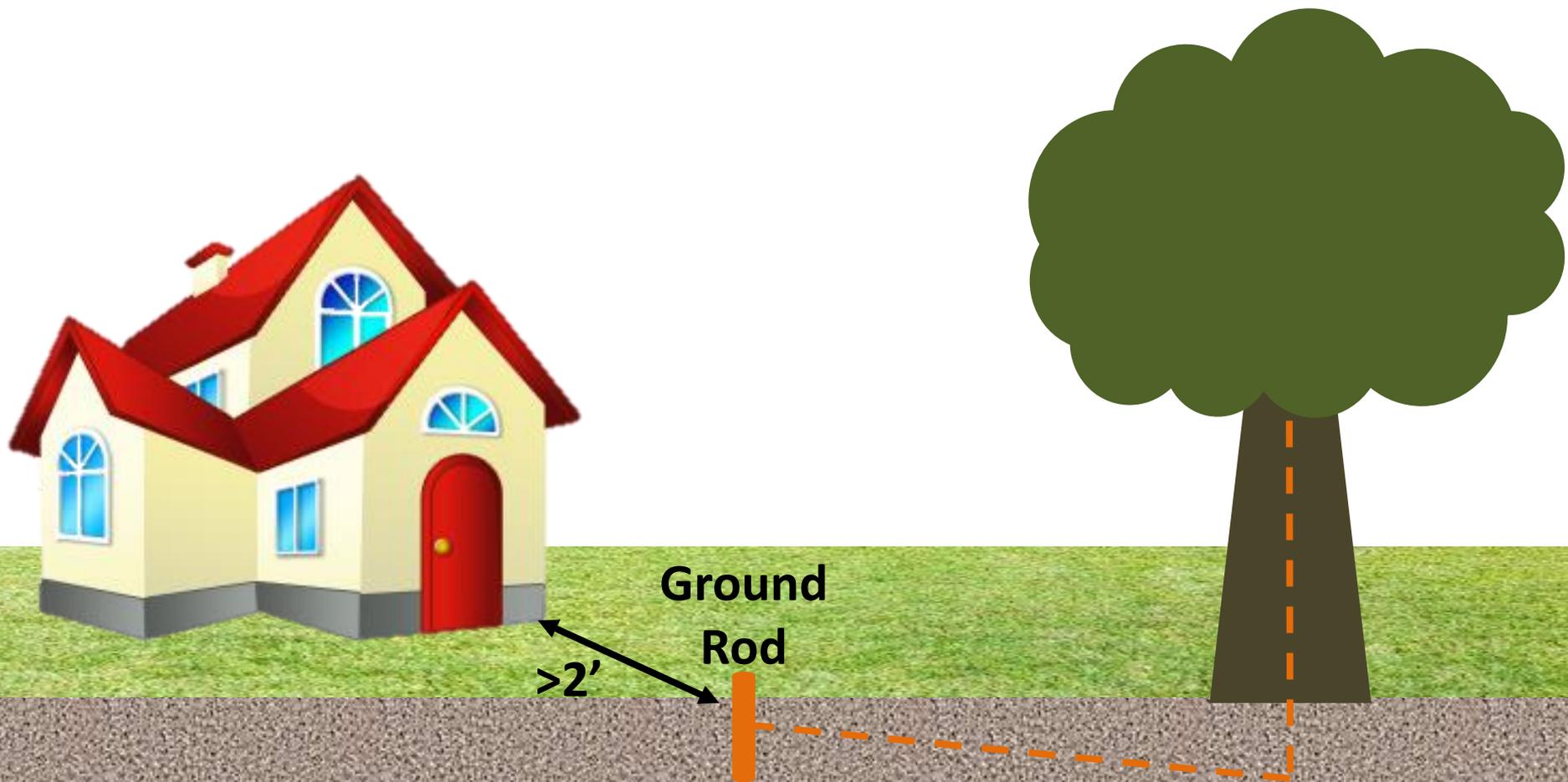


Grounding
Plate

Lightning Protection Systems Hardware

Installation of a Ground Terminal:

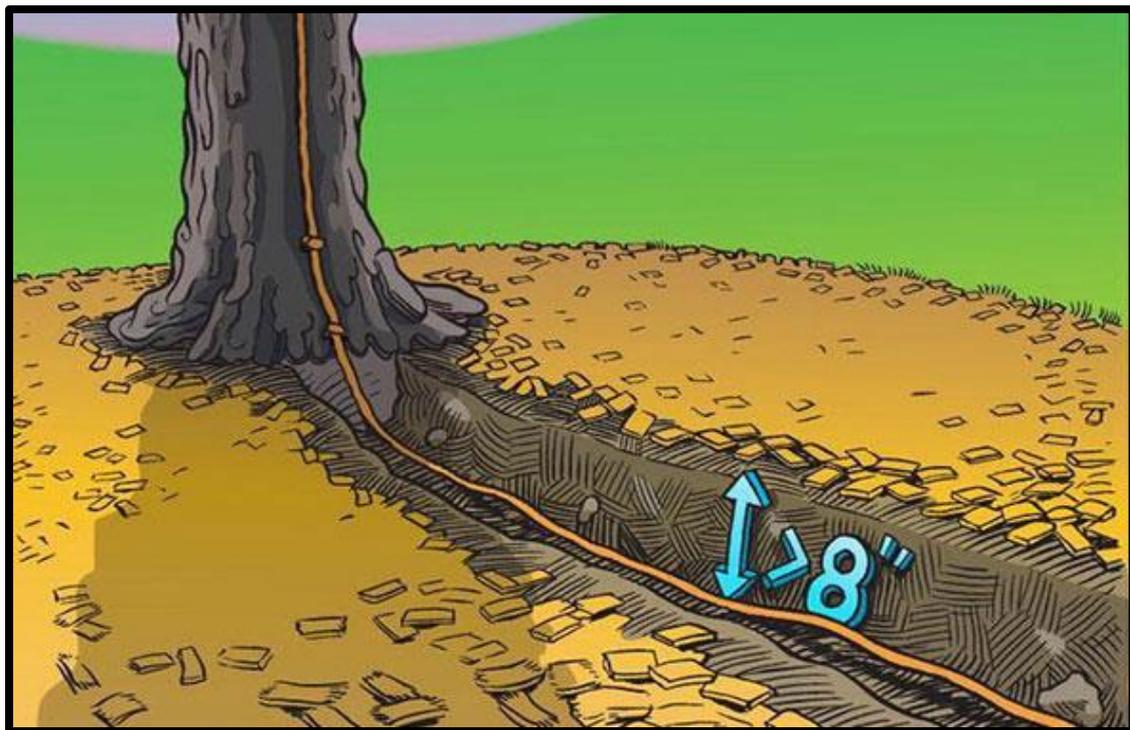
- must not be installed within 2' of a structure's foundation
- should not be installed within 2' of other underground installations



Lightning Protection Systems Hardware

Installation of a Ground Terminal:

- underground portion installed in trench that starts as close to trunk as practical
- trench should be 8" deep unless restricted by roots, rocks, or impenetrable soil
- avoid damaging roots greater than 2" when digging the trench
- avoid splicing ground conductors



Inspection & Maintenance of Lightning Protection Systems

- inspect periodically: all splices & connections still have continuity
- once tree has grown taller than air terminals, the conductor cables & air terminals should be extended



<http://wblightningrods.com>

Inspection & Maintenance of Lightning Protection Systems

- tree may grow enough in girth to envelope conductors if not periodically refastened
- overgrown system will still be functional as long as no break occurs in the conductor
- overgrown systems are harder to inspect



TREE SUPPORT & LIGHTNING PROTECTION CHAPTER 9



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TEXAS A&M
FOREST SERVICE