CRITERIA MANUAL FOR URBAN FOREST

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Revisions:

- 2004 – Reference Ordinance 1772 – Sec 82-5 (Ordinance) & Sec 3.2.2 (Criterial Manual) – defined reasonable distance for replacement trees, changed required replacement to include one 4" tree for every 10" & established the UFEF.
- 2005 – Reference Ordinance 1800 – Table 7-3: Open & Previous Area – requires at least 1 Qualified Tree in front yard on building sites with 5,000 sq ft or more.
- 2006 – Reference Ordinance 1826 – Section 82-8 (Ordinance) – changed requirement for urban Forester allowing City Manager to designate person that may not necessarily be employed by the City.
- 2010 – Reference Ordinance 1929 – Section 82-5 (Ordinance) & Appendix A (Criterial Manual) – requires species diversity in replacement plantings, minimum grow space for replacement plantings, and changed Qualified Tree List.
- 2018 – Reference Ordinance – 2044 – Section 82-2 (Ordinance) – Defined "Front Yard" and changed UFEF plantings to be allowed in street right of way and front and side yards of building sites.

Contents

IMPORTANT NOTE

This manual is to be used and interpreted in accordance with the City's ordinances on urban forest preservation and enhancement, codified as Chapter 82 of the City's Code of Ordinances. Unless the context indicates that another meaning is intended, terms used in this manual have the same meanings as Chapter 82.

INTRODUCTION: PHILOSOPHY AND GENERAL RULE

It is the intent of the City to preserve the Urban Forest as a whole through two approaches:

- Preservation or replacement of existing trees. The City seeks to: (i) avoid tree damage wherever feasible; (ii) mitigate damage when it occurs; (iii) require on-site replacement of trees that must be removed, and (iv) require off-site replacement of trees that cannot be replaced on-site; either by direct planting or through a Tree Trust.

- Require sites where major development takes place to attain a Minimum Planting Standard for trees, regardless of the number of pre-existing trees.

1. TREE SURVEY STANDARDS

1.1 REQUIRED FIELD DATA

Tree data submitted for a Tree Survey or Tree Disposition Conditions must be obtained from a ground survey. The data that must be obtained in the field are Tree locations, circumferences, types (species), and crown areas (the dripline).

1.1.1 Location

Tree surveys must be as accurate as possible, but need not be certified. Levels of inaccuracy that will result in a failure to comply with the City ordinance and construction specifications may necessitate new surveys and plan adjustments prior to permit approval.

Trees on City right-of-way adjoining the site must be surveyed.

Trees with 30% or more of their Critical Root Zones extending onto an affected Subject Site or project easement must be surveyed. Trunk locations of off-site trees may be estimated to avoid trespass problems.

Methods for locating trees may vary depending on the size of the project and number of trees. In most cases, taping the distance to the center of the trunk from two (2) known points is a viable option.

1.1.2 Circumference

The circumference of a tree trunk is measured 4.5 feet above the ground using an ordinary tape measure or diameter tape. (A tree on a slope shall be measured from the high side). Measurement is taken just above or below any unusual swells in the trunk, as closely as possible to the 4 and one-half foot level. For Multiple-Trunk Trees, the trunk

circumference is deemed to equal the circumference of the largest trunk plus half the circumference of each additional trunk. Measurements should be accurate to the nearest ½ inch.

1.1.3 Type (Species)

Tree types should be accurate to the species level and may be listed by common names or botanical names (e.g. Post Oak or Quercus stellata).

Good field references for Houston are: Texas Trees, a Friendly Guide, by Paul W. Cox and Patty Leslie, The Trees for Texas Resource Guide, Field Guide to Texas Trees, by Benny J. Simpson; and Trees, Shrubs and Woody Vines of East Texas, by Elray Nixon.

1.1.4 Critical Root Zone; Crown

The Critical Root Zone (or "CRZ") means. For any given tree, the area within a circle centered on the trunk location. The circle's diameter is one-half the sum of the broadcast and the narrowest dripline diameters.

The dripline and crown information will also be useful in assessing the impact of projected construction.

1.2 RECOMMENDED ADDITIONAL FIELD DATA

1.2.1 Crown Clearance

This information is often critical in determining whether a given structure of vehicular use area can practically be placed within the dripline of a tree. If this information is recorded, the surveyor should consider the vertical distance to any major branches.

1.2.2 Condition

This is one of the principal factors in determining whether a tree should or should not be preserved. Surveyors should not speculate about the condition of trees unless they have the necessary credentials; however, if a tree is obviously in poor condition, it should be noted.

1.2.3 Spot Evaluation

Taking an elevation reading near the trunks of some trees will provide valuable information for project designers. Since grade changes have a very destructive impact on trees, it is important to get the most accurate information possible.

1.3 PLAN GRAPHICS

The standard tree graphics discussed below are important to provide consistent information in the most useful format for efficient plan review.

1.3.1 Trunk Location

The trunk location on the plan must represent the center of the trunk at ground level. If the tree leans substantially above the point, show the direction of the lean with an arrow.

1.3.2 Critical Root Zone (CRZ); Crown, Retained Trees

The Critical Root Zone should be indicated by a circle centered on the trunk. If the crown is significantly skewed or irregular, show also a circle with a radius in feet equal to the diameter of the tree in inches or per measurement of

crown area whichever is greater. The actual crown may also be shown if it is skewed and will have a significant impact on construction. Note that the actual amount of critical roots for any tree will depend upon many factors (see Section 2.2.1 Root Zone Impacts).

Trees proposed to be retained are to be represented by circles drawn with a solid line, while trees proposed to be removed are to be represented by dashed lines. Proposed replacement trees should be graphically differentiated.

1.3.3 Sizes and Types

Tree circumferences and types must also be shown on the plan. This information should be shown adjacent to each trunk location. For sites with a large number of trees, this data should be shown in legend form referenced by a tree number adjacent to each trunk location. Legends can be useful because they allow for the presentation of other data such as crown configuration, height, condition, etc.

1.4 SMALL-SCALE PROJECTS

The Urban Forester may prescribe the contents for a simple, low-cost Tree Survey for small-scale projects. For these projects, the Urban Forester may allow the deletion of some data and details otherwise required and may make provisions to assist lay persons preparing their own surveys.

2. TREE EVALUATION AND SITE PLANNING

The Urban Forester shall use the following criteria to evaluate trees shown in Tree Surveys and, working with the applicant and City building officials, the Urban Forester shall prepare or approve Tree Disposition Conditions complying with: Chapter 82 of the Code of Ordinances, this Chapter 2, the provisions of Chapter 3 (relating to mitigation, if applicable) and the other applicable provisions of this manual.

The Urban Forester may prescribe simple, low-cost Tree Disposition Conditions for small-scale projects. For such projects, the Urban Forester may allow the deletion of some data and details otherwise required and may make provisions to assist lay persons preparing their own plans.

While the guidelines set forth here are intended to be as comprehensive as possible, no printed document can substitute for the knowledge and experience of a qualified urban forester. The recommendations of the City Urban Forester may differ from a simple “face value” interpretation of these guidelines; however, the Forester should work cooperatively with the applicant and with City building officials to reach a mutually agreeable solution. The Forester should also be prepared to justify “non-standard decisions” by presenting the special circumstances that apply.

The process of tree evaluation and site planning will include:

- The identification of valuable trees;
- An assessment of minimum standards for tree preservation;
- An analysis of design constraints and alternatives; and
- The negotiation of mitigative measure when necessary.

2.1 TREE EVALUATION

The City's ordinances address the preservation of Large Trees. However, not all Large Trees have the same value, due to such factors as type (species) or condition. Conversely, some smaller trees may have greater value due to their rarity, screening potential or other factors.

2.1.1 Tree Evaluation Method

The following factors must all be considered in determining the value of any tree. Weighing factors are included to aid in this determination.

Using these criteria, a designer can walk the project area and perform a rough analysis of the tree situation before starting the design of the project. The Urban Forester should use these same factors in approving the Tree Disposition Conditions.

Ten factors are included: condition, type, size, aesthetics, energy conservation and heat abatement, safety, adjacent trees, water quality protection and soil conservation, wildlife habitat and historic significance.

The sum of scores for all ten factors determines the relative value of a tree. In general, highly valued trees (total rating of 30 or more out of a possible 40) should be preserved if at all possible. In all cases, the initial calculation of replacement inches required will depend on the valuation and size of the tree being removed.

2.1.2 Condition

In accessing a tree's condition, the forester considers trunk condition, growth rate, tree structure, insect and disease problems, crown development and life expectancy. A score is assigned as follows:

1 = Poor
2 = Fair
3 = Good
4 = Excellent

2.1.3 Type

The species of trees found in the City have been divided into four classes based on overall quality. The chart in Appendix A indicates how each species fits in this general classification. A score is assigned as follows:

1 = Class IV
2 = Class III
3 – Class II
4 = Class I

2.1.4 Size

Tree sizes are divided into four categories. A score is assigned for each size category as follows:

1 = Less than 25 inches circumference (8 inches diameter)
2 = Between 25 inches cf. and 50 inches cf. (16 inches diameter)
3 = Between 50 inches cf. and 75 inches cf. (25 inches diameter)
4 = More than 75 inches cf.

2.1.5 Screening; Aesthetics

Trees may score high in this area if they provide screening and privacy to the property or if they are in good condition and have exemplary form. A score is assigned as follows:

1 = Poor
2 = Fair
3 = Good
4 = Excellent

2.1.6 Energy Conservation and Heat Abatement

If a tree is shading a building or pedestrian use area in its existing situation, it received a high score under this category. The energy conservation and heat abatement potential is also considered even if there are not obvious benefits, since trees in general cool the air. For example, large trees west of a building area will score high. A score is assigned as follows:

1 = Poor
2 = Fair
3 = Good
4 = Excellent

2.1.7 Safety

If a tree is in a hazardous situation due to external factors related to man-made features (*not inherent in the condition of the tree*), for example, its location relative to a road intersection, etc., it receives a low score. Scores reflect the feasibility of mitigating the safety problems and are assigned as follows:

1 = Hazardous; low mitigation potential
2 = Hazardous; medium mitigation potential
3 = Hazardous; high mitigation potential
4 = Not hazardous

2.1.8 Adjacent Trees

The proximity of other trees has a bearing on a tree's value. Everything else being equal, a lone tree has greater value than one tree of many. The fate of other trees in the vicinity also affects this rating factor. A score is assigned as follows:

1 = Many trees; high retention potential of adjacent trees
2 = Many trees; low retention potential of adjacent trees
3 = Few adjacent trees
4 = Lone tree

2.1.9 Water Quality Protection and Soil Conservation

Trees help reduce storm water runoff and enhance ground water recharge by breaking the impact of raindrops and improving soil structure. A tree's effectiveness is this capacity is correlated with the size of the crown and root area. Large trees with full crowns and unrestricted root areas score highest in this category. A score is assigned as follows:

1 = Poor
2 = Fair

3 = Good
4 = Excellent

2.1.10 Wildlife Habitat

This factor is rated on the basis of the intrinsic value of the type of tree as a provider of food and forage and general wildlife cover characteristics, or the basis of field observations of a particular tree.

Regarding field observations, an individual tree may rate higher than the assigned intrinsic value of the genus due to such things as the presence of food-bearing parasites or epiphytes or due to the potential for or actual presence of wildlife nesting cavities. A score is assigned as follows:

1 = Poor
2 = Fair
3 = Good
4 =-Excellent

2.1.11 Historical significance

The highest rating in this category is reserved for trees that fit one of the following criteria:

- The tree is on a registry of historic or especially important trees.
- The tree has been documented as historically significant.
- The tree is rare in the Houston area.
- Due to its location and size, the tree serves as a significant landmark on the landscape.

Since historical significance is largely a function of age, the Urban Forester's estimate of the age of the tree also has a bearing on this value. A score is assigned as follows:

1 = Less than 20 years old.
2 = Between 20 and 40 years old.
3 = Greater than 40 years old.
4 = Registered, rare or landmark tree.

2.2 TREE PRESERVATION CRITERIA

2.2.1 Root Zone Impacts

Although a tree's root system ranges well beyond the dripline, for the practical purposes of this Criterial Manual and the ordinances, the Critical Root Zone (CRZ) has been established.

As more completely described in Chapter 4, most of the important roots are shallower than three feet, so the Urban Forester will normally require much less protection (or no protection) for subsurface areas deeper than three feet, even if they are nominally within a CRZ. Boring of utility lines, for example, might have very little or no impact on tree roots if carried out deeper than three feet.

Because existing development on a site may affect the actual distribution of tree roots, the Urban Forester may require protection of areas outside the CRZ and may determine that is it not necessary to protect areas within the CRZ where there may be few, if any, significant roots. For example, a tree growing next to a house on a slab will not normally have as many significant roots beneath the slab as the side of the root system growing without the covering

of a non-porous surface. This will allow new buildings to be erected on the site of the old slab near a tree to be preserved.

Design constraints often dictate the trees slated for preservation have some encroachment on the CRZ. Weighing this fact with what appears to be an acceptable degree of risk to most trees, the following maximum allowable impacts have been established for trees with normal CRZ's:

- A minimum of 75% of the CRZ must be preserved at natural grade, with natural ground cover.
- No cut or fill greater than two (2) inches will be located within the 75% of the CRZ being preserved.

In order to ensure that root zones are adequately preserved, protective fencing should be erected to enclose areas with significant roots. Root areas that will be covered with permeable paving must be protected by fencing until the immediate time for a construction of the permeable paving. If this is not possible (due to limited access to the site), mitigative measures must be taken to protect the roots as much as possible (see Section 3.1.2).

2.2.2 Crown Impacts

The following is the maximum allowable for tree crowns:

- A maximum of 30% of the viable portion of a trees crown may be removed.

Construction methods must also be considered. For example, a building wall may only require the removal of 30% of the crown, but the scaffolding necessary to construct the building may require the removal of another 20% of the crown.

2.2.3 Deviations from Criteria

These criterial represent minimum standards for determining whether or not a tree is "preserved". Greater impacts may be allowed, provided that all design alternatives have been proven unfeasible and that some acceptable form of mitigation such as a remedial care program is negotiated (see Section 3.1.1). Conversely, some cases may require that a larger area of root area be preserved to increase the survival potential of particularly valuable trees.

These design criteria are enforced in the field as well as on the plan. Plan adjustments made during construction must be reviewed and approved by the City Urban Forester prior to the adjustments being made.

2.3 DESIGN CONSTRAINTS AND ALTERNATIVES

In addition to the preservation of valuable trees, many other factors can affect site planning; reasonable and lawful use of the property, cut and fill limitations, access and egress restrictions, parking and driveway requirements, and impervious cover limitations. Tree preservation is intrinsically less definite than most of these restrictions, and all factors must be considered together to arrive at a reasonable solution. In some cases it may be desirable or necessary to remove trees and replace them with newly planted trees.

In order to best provide for the preservation of trees, the project designer should carefully consider different design alternative in the *initial* planning of the project. Meeting with the City Urban Forester in a preliminary consultation prior to submitting plans for review is advised when there appear to be conflicts.

In the review of a proposed project, the first indicator of how well trees have been incorporated in the design process is the impact on Large Trees. These trees are considered on an individual basis, and a proposal to remove any of them is carefully scrutinized.

Another indicator is how the proposal will impact smaller, valuable trees. These trees are typically considered in mass as they relate to the overall preservation of the character of the site.

The following sections describe some design alternative that can be used to preserve trees.

2.3.1 Permeable Paving

This alterative is less preferable than leaving 75% of the root area natural. The qualities that make a good paving surface are in direct conflict with the qualities necessary to save tree roots. Permeable paving is permitted, however, provided the installation meets City specifications and the following criteria:

- Finished grade of the permeable paving surface may be required to be set above existing grade, if necessary to provide room for base and paving material without unreasonable cutting, and if elevating the paving would not cause significant problems not related to trees.
- A minimum of 60% of the CRZ must remain at natural grade with a natural ground cover.
- The combined area of permeable paving and natural cover around a tree must be at least 80% of the CRZ.
- Permeable paving is only permitted in parking spaces and low traffic drives.

2.3.2 Building Alternatives

In many cases Buildings have been erected very close to the tree with little adverse effect on the tree. Construction methods that make this possible include:

- Pier and beam foundations, with sufficient air space to allow oxygen to penetrate into the soil for the roots.
- Finished floor elevations that minimize cut and fill.
- Buildings notched around significant trees.
- Buildings designed to fit under crowns of adjacent trees.

To comply with the design criteria requiring retention of 70% of a tree's crown, consideration must be given to the following:

- Providing adequate work space during construction;
- Providing a safe distance between limbs and walls, eaves, roofs, etc.; and
- Applying proper pruning techniques.

2.3.3 Sidewalks

Sidewalks appear innocuous on plans, but can be very detrimental to trees because of grading requirements. Some design alternatives that should be considered are:

- Move sidewalks as far from tree trunks as possible.
- Construct sidewalk on grade in the location of the original sidewalk.
- Provide a finished grade above existing grade for sidewalks required in close proximity to a tree trunk.
- Route drainage under sidewalks where elevated grade is required.
- Reduce width of sidewalk.

2.3.4 Grading

A grade change of a few inches can be extremely detrimental to a tree. Some design alternatives that can be used to preserve trees are as follows:

- Provide tree well and/or aeration systems for trees in fill areas.
- Provide retaining walls to mitigate cuts and fills.

2.3.5 Utilities

Underground water and sewer lines, lawn irrigation systems have significant impact on trees, as do overhead electric and telephone utilities. Some typical design alternatives that should be conserved are as follows:

- Establish the trenches for underground utilities where they will have the least impact on trees.
- Stack underground utility lines to reduce the number of trenches required.
- Bore or tunnel under trees to minimize root impacts.
- Hand-dig trenches to avoid cutting any roots larger than (1) inch diameter.
- When planting trees, plant low-growing trees under power lines.

3. MITIGATIVE MEASURES AND REPLACEMENT TREES

Many of the existing trees in the City grow very slowly, making preservation very critical to avoid long-term impacts. At the same time, land is at a premium, and there is considerable pressure to build on as much land as possible. In many cases, it will be difficult to meet the above minimum standards, in which case, the Urban Forester may specify that Replacement Trees be planted or that special mitigative measures be taken to protect existing trees.

3.1 MITIGATIVE MEASURES

To protect Large Trees in cases in which it is not possible to meet the minimum design criteria, the Urban Forester may stipulate mitigative measures. Some of these mitigative measures include:

3.1.1 Tree Maintenance

A remedial care program can increase the survival potential to an acceptable level in many cases. The City Urban Forester must review the remedial care program to estimate whether it will accomplish what is necessary to maintain the viability of affected trees. Such a program might include schedules for watering, feeding, soil aeration, spraying, etc.

- A signed service contract for review and approval by the City; and
- Fiscal security in an amount equal to the going rate for the approved service plus 15% to cover administrative costs.

These measures are necessary because the remedial care program must typically extend over a minimum 12-month period after completion of the project.

3.1.2 Special Construction Techniques

In conjunction with remedial care, mitigation may include special construction techniques not normally required in standard specifications. Some of these techniques include the following:

- Leaving existing sidewalks and driveways in place for storage of materials and vehicular access, until construction of the building is complete.
- Prior to excavation within tree driplines or the removal of trees adjacent to other trees that are to remain, make a clean cut between the disturbed and undisturbed root zones with a rock saw or similar equipment to minimize root damage.

- In significant root areas that cannot be protected during construction with fencing and where vehicular traffic is anticipated, cover those areas with four (4) inches of organic mulch or gravel topped by two-inch road boards to minimize soil compaction and root damage.
- Perform all grading within significant root areas by hand or with small equipment to minimize root damage.
- Water all trees most heavily impacted by construction activities deeply once a week during periods of hot, dry weather. Spray tree crowns with water periodically to reduce dust accumulation on the leaves.
- When installing concrete adjacent to significant roots of a tree, use a plastic vapor barrier behind the concrete to prohibit leaching of lime into the soil.''

3.2 REPLACEMENT TREES

The most common measure used to mitigate tree removals is the planting of Replacement Trees. The following factors affect tree replacement:

- The quantity of Replacement Trees;
- The available planting area;
- The anticipated rate of survival of trees planted;
- The types of trees proposed.

3.2.1 Quantities of Replacement Trees

Replacement tree values will be expressed in terms of caliper inches (diameter) measured per standards outlined in the American Standard of Nursery Stock, a publication prepared by the American Association of Nurserymen and approved by the American National Standards Institute. Measurements are to be taken as follows:

*6 inches from the ground for trees up to and including 4 inches diameter
*12 inches from the ground for trees 4-1/2 inches up to and including 8 inches diameter
*4-1/2 feet above the ground for trees 9 inches diameter and larger.

For trees with a value greater than 30 points using the criterial in Section 2.1, replacement calculations will initially require 100% of the diameter of the tree in question. For example, a tree with a 75-inch circumference (24 –inch diameter) will require 24 caliper inches of replacement trees, which could be met by six trees of 4 inches each or four trees of 6 inches each.

For trees with a value from 20 to 30 points, replacement calculations will initially require 75% of the diameter of the tree in questions. In this case, a tree with a 75-inch circumference (24-inch diameter) will require 18 caliper inches of replacement trees.

For trees with a value from 10 to 19 points, replacement will initially require 50% of the diameter of the tree in question.

In cases where a tree is dead or judged by the Urban Forester to be in such poor condition that it will not live more than another year, no replacement is required.

In all cases a reduction shall be allowed in the number and sizes of replacement trees if the applicant requests a reduction, and if the applicant demonstrates clearly that there are sufficient remaining, pre-existing trees on the affected Subject Site to meet 1.5 times the minimum planting standard set forth in Section 3.2.5. Notwithstanding the minimum planting standards, each of the remaining pre-existing trees must be Class I or II large trees six inches or more in diameter.

3.2.2 On-Site and Off-Site Replacement

(a) Permittees must submit proof reasonable satisfactory to the Urban Forester that the requisite replacement inches have been planted or otherwise provided, by one or more of the methods allowed by Chapter 82 and this criterial manual, as chose by the permittee. Such proof may include proof of actual planting or "replacement inch" certificates issued by a tree trust or the Urban Forest Enhancement Fund (UFEF).

(b) To be effective a "replacement inch" certificate from a tree trust must state unconditionally:
1. The name of the applicant and the project to which the "replacement inches" apply;
2. That the tree trust will plant the specified "replacement inches" within 1,000 feet of the subject site, and within the City limits on or before a specified planting date, which must fall within 365 days following the date of the certificates;
3. That the "replacement inches" will be planted and maintained in accordance with the provisions of this ordinance and the criterial manual; and
4. That all costs have been paid

(c) To be effective, a "replacement inch" certificate from the UFEF must state unconditionally;
1. The name of the applicant and the project to which the "replacement inches" apply;
2. That a deposit to the UFEF has been made for that applicant and that project; and
3. That the deposit is equivalent to a calculated number of "replacement inches" (calculated at the rate of $2,000 per each 4" tree and $250.00 of one inch deposited.

(d)A replacement inch certificate may be conditioned so that it would only become effective if the applicant fails to plant other trees by the specified planting date.

3.2.3 Survival Potential; Irrigation and Maintenance

Before approving any replacement option, the Urban Forester will assess the probability that trees planted will survive. This typically requires that some type of irrigation and maintenance capability be implemented for a minimum of 12 months. Irrigation or maintenance may not be required for the full 12 months if it can be adequately demonstrated that, given the size and type of trees planted, the planting site and the time of year the trees are planted, the mortality rate is likely to be low. The applicant may be required to conform to the maintenance guidelines set for in 3.1.1 Tree Maintenance.

3.2.4 Types of Replacement Trees

In order to enhance the general quality of the urban forest, 75% of the Replacement Trees required must normally be Class I or II species (see Appendix A). The Urban Forester may recommend trees from other classes. All trees must be suitable for the environment of the immediate planting site.

3.2.5 Minimum Standards for Total Number of Trees

Regardless of the number of trees present on a Subject Site before development or construction, each Subject Site must attain the Minimum Planting Standard whenever there is Major Development. This standard has been determined by the Urban Forester as a reasonable expectation for property within the City, given current open space and setback requirements. To satisfy the Minimum Planting Standard requirement, a tree must be at least two inches in diameter measured 6 inches above the ground. Pre-existing trees may be of any species, while trees planted to meet the minimum Planting Standard requirement must be Class I or Class II trees as set forth in this Criteria Manual. The number of trees required depends on the size of the affected Building Site and is set forth in the following table:

Size of Building Site in square feet	Number of Trees required
5,000 or less	2
5,001 to 7,500	3
7,501 to 10,000	4
10,001 to 12,500	5
12,501 to 15,000	6
15,001 or more	7

3.2.6 Enforcement Criteria; Delayed Plantings

The location, size and type of all Replacement Trees and all trees planted to attain the Minimum Planting Standard must be shown or referenced in the Tree Disposition Conditions in a manner in which will allow verification of their installation at the time of inspection for certificate of occupancy.

Optimum planting times do not always correspond to project completion. For that reason, planting of replacement trees and trees planted to attain the Minimum Planting Standard may take place after a certificate of occupancy is issued, if approved by the Urban Forester, and if: (i) the permittee posts fiscal security in an amount equal to the going rate for installed trees with a one-year guarantee, plus 15% to cover administrative cost, together with all necessary rights of entry, (ii) the permittee provides a "post-dated" replacement inch certificate to guarantee planting at a specified future date if the permittee fails to provide the required trees by that date, and such a certificate can be made returnable to the permittee in case the permittee provides the required trees, or (iii) the permittee provides other sufficient assurance that the trees will be provided. Certificates of occupancy may be issued conditionally in this case.

4. TREE PHYSIOLOGY

The following is a collection of facts regarding tree physiology which provide the basis for the subsequent design standards for preservation.

4.4.1 Roots

Roots provide three primary functions: 1) support, 2) intake of nutrients and water and 3) storage of food reserves. Cutting a large root has the triple effect of reducing the tree's anchorage, destroying the nutrient intake potential beyond that point and reducing food reserves by a substantial amount.

Trees roots must respire in order to survive. Conditions which restrict the availability of oxygen effectively suffocate affected roots. Such conditions will also result in the accumulation of carbon dioxide and other toxic gases in the soil which adversely affect associated soil microfauna as well as the roots. Typical conditions which inhibit this essential gas exchange are compaction of the soil, addition of new soil (fill) and ponding of water.

Roots of adjacent trees are typically intermingled through the sharing of rootstock by several stems, grafting of roots by like species of trees or a general sharing of the same space. It is important to make a clean cut when severing roots rather than tearing them. A ripping action (as with a dozer) affects roots of one (1) or more trees far beyond the point of contact. Roots left jagged are also unable to produce the callous growth necessary to close the wound; thus decay becomes more extensive. In addition, cleanly cut roots can generate new roots more readily than torn roots.

The soil pH is an important factor in the functioning of the root system. Leaching of the lime from concrete can increase alkalinity to potentially lethal levels.

Approximately 99 percent of a tree's roots occur within the first three (3) feet of soil and most of the fine feeder roots which collect the moisture and nutrients are located in the first twelve (12) inches of soil.

Typically, a tree's root system extends as much as two (2) to three (3) times the distance to the dripline.

4.4.2 Trunk

A tree's trunk serves as a conduit for nutrients and water going to the leaves and food materials going to the roots. In addition, it is a major food reserve storage area.

The sapwood contains the cells which serve as the upward transport system for nutrients and water. In most trees, the sapwood is found within the last few inches of the outer trunk wood.

The phloem, located in a very thin layer of cells just inside the bark, serves as the downward transport system for food materials, enzymes, hormones and other materials produced by the leaves.

The cambium is the tissue layer located between the phloem and sapwood that creates the cells for both transport systems.

The proximity of all these important structures to the outer extremities of the trunk and branches make their protection against injury so critical.

Contrary to popular belief, tree wound dressing is not a corollary to antiseptics used on animal wounds which prevent infection and promote healing. The only sure cure is prevention where trees are concerned. Trees never "heal" wounds, but rather, seal off or compartmentalize the affected area provided all conditions are right for such activity. There are arboricultural techniques which can increase the chances of a tree successfully compartmentalizing some wounds, but simply applying tree wound dressing is not chief among them. (Note: Because tree wound dressing masks the wounds from insect vectors, it is a vital procedure in the protection of oak trees against the oak wilt fungus. Tree wound dressing should be applied to oaks immediately after wounding).

The root collar is the interface of the tree trunk and root system evidenced by a flaring of the trunk near the ground surface. The proximity of this structure to the root system promotes the misconception that the root flare can be covered with fill such as top soil dressing. This portion of the trunk is not adapted to the same conditions as the underground roots. In addition to reducing aeration, fill material which tends to keep the root flare and trunk area moist, can facilitate invasion by soil borne fungi and insects. When this happens, the tree trunk can be girdled by decay agents, resulting in death. Some species of trees are more susceptible to this than others; however, covering the root flare should be avoided as a general rule.

4.4.3 Crown

The tree's branches and leaves make up the crown. Branches serve the same transport and food storage function as the trunk in addition to giving rise to the leaves. Leaves manufacture the food and other substances required to sustain the whole tree.

Removal of more than 30 percent of a tree's crown can severely impact the tree's ability to provide sufficient food quantities for continued growth or protection against debilitation by disease.

APPENDIX A: WEST UNIVERSITY PLACE QUALIFIED TREE LIST

Trees are divided into four classes. Class one and two trees are considered the most valuable in enhancing the environment and are the most likely to prosper in this area. Trees in Class 1 and 2 are considered qualified trees.

Qualified trees are Class 1 and 2 trees with a minimum of 2 inches diameter. The trunk is measured 6" above the ground.

For every 10" of replacement inches required, the applicant must plant at least one 4" diameter tree in a 100-gallon container of species Class 1 or 2. For example; if the replacement is 37" diameter, the applicant must plant at least 3 (three) 4" diameter trees in 100-gallon container of species Class 1 or 2 and remaining inches can be qualified trees (minimum 2" diameter). The total inches planted would still have to equal to or more than the required 37" diameter.

CLASS I

COMMON NAME	**BOTANICAL NAME**
Live Oak	*Quercus virginiana*
Shumark Oak	*Quercus shumardii*
Nuttall Oak	*Quercus nuttallii*
Water Oak	*Quercus nigra*
Durrand Oak	*Quercus durrandii*
Bur Oak	*Quercus macrocarpa*
White Oak	*Quercus alba*
Swamp Chestnut Oak	*Quercus michaauxii*
Laurel Oak	*Quercus laurifolia*
Polymorpha Oak	*Quercus polymorpha*
Chinquapin Oak	*Quercus muhlenbergii*
Winged Elm	*Ulmus alata*
Cedar Elm	*Ulmus crassifolia*
Overcup Oak	*Quercus lyrata*
Drummond Red Maple	*Acer rubrum var. drummundii*
Bald Cypress	*Taxodium distichum*
Montezuma Cypress	*Taxodium mucrunatum*
Southern Magnolia	*Magnolia grandiflora*
Little Gem Magnolia	*Magnolia virginiana "Little Gem"*
Mexican Sycamore	*Plantanus mexicana*
Loblolly Pine	*Pinus taeda*
Longleaf Pine	*Pinus palustrus*

CLASS II

White Ash	*Fraxinus Americana*
Green Ash	*Fraxinun pennsylvanica*
Hickory species	*Carya*

Black Walnut	*Juglans nigra*
American Holly (tree form)	*Ilex spp (Suitable for restricted grow space and power lines)*
Sweetgum	*Liquidambar styraciflua*
Chinese Pistache	*Pistacia chinensis (Suitable for restricted grow space and power lines)*
Texas Pistache	*Pistacia texana (Suitable for restricted grow space and power lines)*
River Birch	*Butula nigra*
American Elm	*Ulmus Americana*
Lacebark Elm	*Ulmus parvifolia*
American Sycamore	*Platanus occidentalis*
Redbud	*Cercis Canadensis (Suitable for restricted grow space and power lines)*
Texas Mountain Laurel	*Sophora secundiflora(Suitable for restricted grow space and power lines)*
Saucer Magnolia	*Magnolia soulengeona(Suitable for restricted grow space and power lines)*
Gum Bumelia	*Bumelia lanuginose*
Eastern Red Cedar	*Juniperus virginiana*
Black Tupelo	*Nyssa aquatic*
Red Bay	*Persea borbonia (Suitable for restricted grow space and power lines)*
Parsley Hawthorne	*Crataegus marshallii (Suitable for restricted grow space and power lines)*
Trident Maple	*Acer buergerianum*
Anacua	*Ehertia anacua*
Cherry Laurel	*Prunus caroliniana(Suitable for restricted grow space and power lines)*
Basswood	*Tilia Americana*
Fringe Tree	*Chionanthus spp (Suitable for restricted grow space and power lines)*
Hophornbeam	*Carpinus caroliniana (Suitable for restricted grow space and power lines)*
Flameleaf Sumac	*Rhus spp (Suitable for restricted grow space and power lines)*

CLASS III

Any species not included in Class I, II or IV

CLASS IV

Chinese Tallow	*Triadica sebifera*
Sugarberry (Hackberry)	*Celtis laevigata*
Silver Maple	*Acer saccharinum*
Arizona Ash	*Fraxinus velutina*
Chinaberry	*Melia azedarach*
Camphor	*Cinnamomum camphora*

APPENDIX B. WARNING SIGN REQUIRED FOR TREE PROTECTION FENCES

Each warning sign must be weatherproof and printed in black on a white background at least 8.5 x 11 inches in size, except for the two lines indicated by "", which must be red. The print shall be at least as large as shown below. The phone numbers shall be filled-in with the current phone numbers supplied by the Urban Forester.*

TREE PROTECTION FENCING

Required by Code of Ordinances City of West University Place

DO NOT REMOVE!*

FINE: $100 OR MORE. JOB MAY BE SHUT DOWN. FOR PERMISSION FOR TEMPORARY REMOVAL CALL _____. TO REPORT VIOLATIONS, CALL _____

CERCAS PARA PROTECCION de ARBOLES

Require por Ordenanciones de la Cuidad de West University Place

*FAVOR DE NO REMOVER**

MULTA DE: $100 O MAS. TRABAJO PUEDE SER TERMINADO. PARA PERMISO TEMPORAL DE REMOER LLAME:_____. PARA REPORTAR VIOLACIONES LLAME:_____