UNIVERSITY OF ARIZONA CAMPUS ARBORETUM

CAMPUS TREE CARE PLAN

ESTABLISHED 2009

INTRODUCTION

This document was created in 2009, as part of the requirements of the Tree Campus USA designation, as specified by the Arbor Day Foundation. The information can be found at http://www.arborday.org/programs/treeCampusUSA/index.cfm

In order to be a Tree Campus USA, a university or college must have a plan for the care and management of the campus trees, have an outside advisory committee, must specify how trees will be preserved and protected during construction projects, and must have directives in place for storms or emergency tree care.

In 2009, the University of Arizona, through the UA Campus Arboretum, became a Tree Campus USA. Thus, the guidelines described in this document are relevant and in force as of the signature date.

PURPOSE

The Purpose of the University of Arizona Tree Care Plan is to guide the decision-making process of the Campus Arboretum, Facilities Management, Planning Design and Construction, and other campus units who may have reason to impact the health and well being of the 7000 trees on University of Arizona campus in Tucson, Arizona.

The overall goal of the Tree Care Plan is to ensure a safe, attractive and sustainable campus urban forest. Specific objectives of the Plan include the following:

- Promote sustainable and accurate arboriculture practices, as a model for all campus users.
- Display healthy trees, accurately identified, correctly cared for.
- Promote species diversity, as outlined in the Campus Arboretum's Collections Policy.
- Protect high-value trees during UA construction and renovation projects.
- Maintain Tucson's urban forest by retaining or increasing percent canopy cover.
- Support the University of Arizona Comprehensive Campus Plan, as revised in 2009.
- Encourage respect for the 7000 trees that make up the UA campus's urban forest.

ADMINISTRATION

The Campus Tree Care Plan will be jointly administered by Facilities Management/ Grounds Services; Planning, Design and Construction; and the UA Campus Arboretum Director.

TREE CARE COMMITTEE

Two entities will serve as advisory committees to the Campus Arboretum for tree care on the University of Arizona campus:

- The original Campus Arboretum Steering Committee (established in 1999) is made up of University faculty, staff, and students involved in campus landscape design, horticulture, and maintenance. Its members meet on an *ad hoc* basis, and informally through email. There is no term of office. The members' job descriptions determine their fitness for the issues of tree preservation and care. The duties of this committee include assisting with advocacy tasks that require University affiliation.

- The Campus Arboretum's Advisory Board (established in 2000) is made up of former UA staff, current adjunct faculty, graduate students, professionals, and local public garden administrators. Their term of office is 3 years. Members rotate off the Advisory Board after two terms. The duties of this committee include off-campus advocacy, financial support and development, and outreach.

TREE CARE POLICIES

A. Planting

Trees shall be planted four purposes: enhancing the campus landscape, new facility construction, replacement of removed trees, and experimental efforts testing species in the Tucson area. Planting may be performed by landscape contractors, FM personnel, Campus Arboretum staff, and UA students. In no case is a tree to be planted by a member of the public, although volunteers may assist the Campus Arboretum or a tree donor may participate as part of a ceremony.

Tree species to be installed must fit the guidelines of the Campus Arboretum's Collections Policy (Attachment 1), or the Low Water Use Plant List of the Arizona Department of Water Resources. Alternatively, and based on UA's century-old tradition of experimentation, they must show some promise as a potential species in Desert Southwest landscaping. Site considerations play an important role.

Prohibited trees include those species known to be invasive in the Desert Southwest: *Rhus lancea*, *Leucaena leucocephala* are two such species. As the campus continues to use "reclaimed" water (with higher levels of salts), trees which demonstrate intolerance to salinity will be discouraged.

International Society of Arboriculture (ISA) standards are to be used for planting and staking. Because most trees in the Southwest are sold in containers or boxes, guidelines include the following:

- Holes are as deep as the container, but 3-5 times wider.
- No amendments are incorporated into backfill.
- Trees are positioned with the trunk flare slightly above grade.
- Drip irrigation is installed at planting, with emitter size and scheduling appropriate for species and site.
- Staking is not always needed, but if it is required, two or more lodgepoles and flexible ties are used. ANSI and ISA standards are used as reference.
- Trees with multiple trunks (common in the Southwest) are supported with stakes only if needed.
- Pruning is not done at planting except to remove broken branches.

In the Desert Southwest, "establishing" a tree is defined as keeping it on irrigation through at least two summers. Depending on the species, irrigation of UA trees may be removed or reduced after the second summer.

B. Tree Removals

Tree evaluations for the UA campus will be jointly made by the Certified Arborists in Facilities Management and the Campus Arboretum (and its Advisory Board, if necessary), with assistance from the Campus Landscape Architect and Campus Arboretum's Collections Policy.

Healthy trees are only to be removed if they pose a safety hazard to the campus users, if they detract aesthetically from the landscape, or if they are in conflict with campus construction or maintenance. If necessary, an assessment from an independent qualified arborist may be needed.

Trees that form historic groves, allees, architectural line-ups, or in some way represent UA heritage and historicity are considered valuable. Their removal for any reason implies that they will be replaced in as close to the original conformation as is possible. See **Tree Protection and Preservation** below.

Removed trees are documented in the University of Arizona Campus Arboretum's database. Reasons for removal include the following: Decline, Construction, Liability, Storm, Trauma, or Unknown.

Removed trees are to be replaced, not necessarily with the same species, with the goal of retaining the proportion of canopy cover on the UA campus.

C. Maintenance Practices

Tree care on the UA campus is performed by Facilities Management. The Arborist crew includes Certified Arborists, tree workers, and equipment operators. The Irrigation Team includes Certified Irrigation Specialists and technicians.

Pruning is infrequently performed by students, and only under the direction of a faculty member or the Director of the Campus Arboretum.

Pruning – All pruning on the UA campus must be exemplary and follow ISA standards. All pruning shall have a clear objective, whether for safety, health or aesthetics. Examples of decision making include these: trees over walkways require pedestrian clearance; trees showing decline must be evaluated for risk; trees in groves need not be separated as their canopies join; trees near buildings shall not compromise building structure.

Pruning schedule is a function of tree age, placement, function, and weather issues.

- Palms require annual removal of flowers/fruit.
- Young trees are to receive training on an annual basis for the first 5 years.
- Trees that are from 5 to 10 years old require structural pruning every 2-4 years.
- Trees over 10 years old require maintenance pruning to remove dead, diseased, dying, and defective branches from the crown.

Pruning techniques to be used on the UA campus include *thinning, reduction, crown-raising, or cleaning.* Cuts and techniques must follow ANSI 300 Standards, as published in the literature of the International Society of Arboriculture.

Suckers and water sprouts on trunks shall be removed in seasons other than summer (so as to protect bark from intense sun/heat).

- *Thinning:* Thinning of some Southwest species occurs as needed, as preventative maintenance during the season of summer storms. Tree structure must not be compromised: goals are wide branch angles, appropriate spacing, and healthy balanced canopy.

- *Reduction:* Wind load of wide-spreading native trees is lessened by appropriate reduction. Branches shall be cut to a lateral branch which is 1/3 the size of the diameter of the branch being removed.

- *Crown-raising*: Some low-growing trees must be raised for visibility and safety. Wide spreading native trees should be pruned to remove low branches at the point of origin.

- *Cleaning:* More than 2000 palms require annual flower/fruit removal. Freeze damage of tropical trees may require removal of affected branches. Any tree with wind or freeze damage is to be cleaned as soon as possible.

Prohibited Pruning Techniques include Topping and Lion's-Tailing.

Palm Care – Although palms require annual flower and fruit removal, they do not always require foliage removal. Skirts shall be left on the *Washingtonia filiferas* in the Historic Area and along the UA Mall. The Campus Historic Preservation Plan (Attachment 2) calls for *Washingtonia* skirts and foliage to be kept in an 'egg shape'. Other fan palm genera (*Brahea, Trachycarpus*) shall never be pruned above the horizontal (ie., to the "3'oclock and 6 o'clock line). Old foliage on *Phoenix* species shall be pruned to the horizontal. *Chamaerops* palms shall only be pruned to remove dry fronds.

Mulching and Weed Control – Large trees and tree groups shall receive compost annually from the UA's composting facility. Care shall be exercised to use only waste that is fully decomposed, so as to avoid adding salinity to the campus's already saline soils. Mulch shall not be piled up at the base of any tree.

To allow mulching, trees in lawns shall have the sod kept back from the trunk for a distance of at least 4 feet, preferably more. This will prevent trunk injuries from lawn equipment, also.

The areas cleared of sod are to be kept weed free – but no herbicides are to be sprayed onto tree trunks or tree seedlings/suckers. Hand pulling of seedlings and suckers is preferred.

Pathological Agents – Trees which show symptoms of decline are to be noted. Information, with samples, shall be given with the State Extension Specialist in Plant Pathology (housed on this campus.) If specific organisms or environmental conditions are found to be the cause of decline, trees will be evaluated for long term stability and appropriate measures shall be taken to correct any soil or cultural problems. If the long term stability/health continues to decline, the tree may need to be removed, and soil problems shall continue to be addressed.

Fertilizing – Eucalyptus, Crape Myrtle, Citrus and Pyracantha are among those species which must receive yearly applications of Iron and Nitrogen Sulfate. Other trees showing nutrient deficiencies shall receive appropriate fertilization when needed.

Irrigation – Drip Irrigation is used for all new woody plant installations and most of the established trees on the UA campus and along its streets. In the Historic Area, trees also benefit from land contouring (berms from the now-defunct flood irrigation system). In Turf areas, trees must be established with supplemental irrigation for the first two summers.

Irrigation scheduling (drip and lawn sprinkling) on the University of Arizona campus is managed by a CALSENSE "Smart Controller" computer system. Water volume and scheduling respond to historical and actual evapo-transpiration rates on campus, as measured by AZMET weather stations and soil moisture sensors. The computer can respond to rain events, or lack of them, in a 24 hour period. The Irrigation Team is responsible for all scheduling, repairs, and adjustments.

Balancing efficient water use and sensitivity to campus sustainability, all trees on the UA campus shall be watered to the extent required to keep the tree healthy and vigorous, regardless of the seasonal rainfall.

The City of Tucson's "Reclaimed Water", used on over 90% of the campus, contains increased levels of salinity. Application volumes may need to be increased to account for increased salinity. Water quality assessment shall be performed, and if necessary, increased "run times" shall be ordered to move accumulated salts below root zones of trees showing salt symptoms.

Tree workers and Area Crews are responsible for alerting Irrigation staff. Watering guidelines and seasonal notes are on file with Facilities Management/Grounds Services.

D. Storm Response and Recovery

Storm response and recovery are the responsibility of Facilities Management. If special equipment is needed, outside contractors are to be called in. The first priority is to remove tree debris that blocks campus thoroughfares or disrupts operations. Secondly, unsalvageable trees are to be removed and chipped. Stumps may be ground at a later date, but must be removed before a replacement tree is installed. Removals due to Storm must all be documented for the Campus Arboretum's database.

Replacement trees will be the shared responsibility of the UA Campus Arboretum and Facilities Management. See the **Tree Removals** in the **Tree Care Policies** section above.

TREE PROTECTION AND PRESERVATION (also see Tree Care Policies, above)

A. General Protection

There are 20 Heritage Trees on the UA campus. Of these, ten of them are Great Trees of Arizona. Heritage Trees are described on the UA Campus Arboretum's web site and database. Heritage Trees are the highest valued trees in the campus landscape and have the highest priority for tree protection and preservation. They should only be removed in extraordinary circumstances.

Dozens of historic and important trees from the early years of the University are identified in the 2006 Campus Historic Preservation Plan. These trees are also important to the campus community, including the surrounding neighborhoods, and are considered valuable.

B. Construction Protection

Over 1000 University trees have been noted as important for various reasons, requiring justification for removal under any circumstances. This listing is an Excel file held at the offices of Facilities Planning Design and Construction, Facilities Management, and the Campus Arboretum. Its name is "Tree Preservation listing UA".

Guidelines for tree protection, salvage and care during construction projects follow the University's Design Specifications applied to all campus construction projects.

Planning, Design and Construction utilizes a "Tree Preservation listing UA" GIS map during the Design Phase of any new construction project to identify existing trees within the project site. Existing trees that fall within the construction project's boundaries are to be identified, verified, and evaluated (with help from this map) for one of the following actions (in order of priority):

- Preserve in Place during project.
- Salvage and replant on campus.
- Salvage, hold and replant on site.
- Replace tree with new individual on site.
- Propagate tree for planting on another campus site.
- Remove tree.

If the tree is to be 'Preserved in Place' on the site (with a full tree protection zone), the contract protection language is included in these two documents:

- Attachment 3 – Excerpts from 'Tree Preservation, Protection and Salvage Guidelines': Tab C in the University's DSS.
- Attachment 4 – Excerpts from 'Section 01530- Temporary Tree and Plant Protection' in contract documents.

If the tree is to be salvaged from the construction site and immediately replanted on campus, the work is done by Facilities Management or their outside contractor. Guidelines for transport of living trees must follow current ISA standards for planting. FM staff has responsibility for establishment of such trees which have been permanently removed from the construction project.

If the tree is to be salvaged from the site, held and replaced into the project after construction, the following documents describe requirements for care:

- Attachment 5 – Excerpts from 'Section 02481 Tree Salvage for Re-Use on Project Site' in Contract Documents.
- Attachment 6– Excerpts from 'Section 02482 Palm Tree Salvage/Planting' in Contract Documents.

TREE DAMAGE ASSESSMENT (also see "Tree Removal" in TREE CARE, above)

Storm damage – The damaged tree is to be evaluated by a team composed of Certified Arborists from Facilities Management, with assistance from the Director of the Campus Arboretum (or his/her agent). If there are also structural or disease factors, those are to be noted. If the tree is Hazardous, see below. If warranted, the tree shall be removed and replaced (not necessarily with the same species).

Hazard trees - The UA's Certified Arborists and the Director of the Campus Arboretum are responsible for assessing Hazard Trees. Any tree that appears salvageable after a storm, shall be evaluated for its Hazard potential. Hazard trees contain both a structural defect and a potential target (a building or person).

Construction damage - If a tree is damaged during construction, a replacement tree is purchased by the project. Documentation and close attention to the contract language and plans for demolition are required.

Biotic/Disease damage - If a tree is damaged by a biotic agent (insects, disease), the decisions will follow guidelines stated in **Tree Care Policies**.

Human damage - If a tree is damaged by human intervention, decisions about removal must take into consideration the potential for Hazard and possible further decline.

Facilities Management personnel are charged with contacting parties responsible for damage to trees on the University of Arizona property. If a responsible party (student club, department, or team) can be identified, that party shall be notified that the tree damage has occurred. That party in violation shall immediately commence remedial action and shall have five working days after receipt of the notice to stop the damaging action, and/or complete the remedial actions required to reverse the damage.

PROHIBITED PRACTICES

Damage by UA tree crew - Tree crews and Certified Arborists employed at the University of Arizona are prohibited from topping trees, "lion tailing" or performing other work that would impair trees' health and stability.

Student carelessness - Although there are no prohibited practices stated in the University of Arizona's Student Code of Conduct, as a practical matter, students are not allowed to carve tree bark, climb trees, affix signs with nails, or suspend things from tree branches. UA Facilities Management staff has authority to stop a student who is damaging a tree.

Bicycle Restrictions – Language (from UA Parking and Transportation web site) includes the following guidelines for bikes:

> "Bicycle parking is not permitted in any University building; against a tree, plant, bush, signpost, meter, fence, railing, ramp, stairway, public seating fixture or pipe. "(*emphasis ours).* http://parking.arizona.edu/pdf/maps/bike_routes.pdf

DEFINITIONS OF TERMINOLOGY

A. Arborist terms

All tree workers and the Certified Arborists on the Facilities Management Grounds crew adhere to professional definitions as proscribed by the International Society of Arboriculture and the ANSI #300 Standards.

There are very few arborist terms in Arizona that differ from those used around the US. (One such term is multi-trunk, since for many of the native trees, this is the most commonly available form.)

B. Campus Arboretum terms

De-Accession is the term used to remove a tree from the Campus Arboretum's database, and a reason must be stated.

Great Trees of Arizona (designated through the Arizona Community Tree Council program) are valuable, not to be disturbed.

Heritage Trees are the University's oldest or most valuable and are inviolate (no damage, no removals).

Historic Area is the oldest part of campus, housing dozens of stately architectural specimens.

GOALS AND TARGETS

A. Sustainability

One stated target of the University of Arizona is to become more sustainable. As part of this effort, the UA Campus Arboretum has focused on tree inventories using the "i-Tree Suite" of software, developed at the Center for Urban Forest Research. To date, the 2000 trees lining the City of Tucson streets have been inventoried for annual benefits. (See Attachment 7)

The next steps of the effort to evaluate campus trees include the following:

- More accurately refine the specific costs for tree care on campus, to enable the reporting of NET benefits. This requires some re-structuring of the Facilities Management accounting system.
- Expand the i-Tree-based tree inventory to include the remaining 5000 trees, so that quantifiable tree benefits can be used by the University of Arizona sustainability effort as well as by Facilities Management. This will be a grant-funded student project which may use the newly revised "i-TREE ECO" software from i-Tree. http://www.itreetools.org/

B. Training

A second goal is that of increasing training and building resources for staff of Grounds Services.

- The Campus Arboretum often subsidizes Arborists' fees at educational seminars.
- The UA's Cooperative Extension Service collaborates with on-campus personnel.
- More communication and training is needed as staff and organization changes occur.

COMMUNICATIONS STRATEGY – to heighten awareness

A. On Campus

The University of Arizona supports the Campus Arboretum in the stewardship of the campus trees and their heritage.

Prior examples of support by the University administration include the Long Range Campus Plan of 2003, the Campus Historic Preservation Plan of 2006, revision of the Long Range Campus Plan in 2009, and regular inclusion in construction and planning round-tables.

This Campus Tree Care Plan *has been approved* by the following University of Arizona campus units:

- Certified Arborists at Facilities Management/Grounds Services.
- UA Campus Arboretum Advisory Board and Campus Arboretum Steering Committee.
- Staff at ~~Facilities~~ Planning, Design and Construction
- Central UA Administration

B. Off Campus

External Contractors - Design Specification Standards are contract language aimed at external contractors hired for construction projects. They include aforementioned specifications for protection of trees during construction projects. See Attachments 3 - 6. During the Planning Process, contractors must acknowledge and agree to the language.

Neighbors and Alumni - For those beyond the campus community, this Campus Tree Care Plan will be posted on the UA Campus Arboretum web site at http://arboretum.arizona.edu.

Tucson Citizens – A press release will introduce the Campus Tree Care Plan to the greater Tucson community.

Students – Excerpts from this Campus Tree Care Plan will be sent to the student newsletter and posted to the UA's sustainability web site.

Donors - The Campus Arboretum's semi-annual newsletter will be sharing excerpts of the Tree Care Plan with donors and friends.

ATTACHMENTS

1. Campus Arboretum Collections Policy (2003)
2. Campus Historic Preservation Plan excerpts from Manual (2006)
3. – 6. DSS excerpts for tree preservation in construction projects. (2009)
7. Street Tree evaluations press release and iTree web information (2008)

UNIVERSITY OF ARIZONA CAMPUS ARBORETUM

COLLECTIONS POLICY
January, 2003

Attachment 1

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INTRODUCTION

The University of Arizona Arboretum comprises all space on which the University has developed facilities: the Main Campus from Euclid to Campbell Avenue and from Sixth Street north, across Speedway, to the space surrounding the University Medical Center. All plantings on UA property, adjoining UA buildings, and/or defining University open space, in Pima County, Arizona, may be considered as a part of the University of Arizona Arboretum.

The Mission of the Campus Arboretum at The University of Arizona is to preserve manage, enhance, and expand a vital collection of plants in an active, urban Sonoran Desert setting; and to showcase the historic, aesthetic, environmental, economical, and educational value of these plants within our community and the American Southwest.

Purpose of UA Campus Arboretum Collections Policy.

The Purpose of the Collections Policy is to provide guidance and focus to those charged with the planning, development and management of the plant collections of the University of Arizona Campus Arboretum, with the aim of optimizing utilization of available resources to realize the Campus Arboretum's mission through effective and appropriate collections development.

The primary collections of the UA Campus Arboretum are its collections of living plants. A secondary, voucher collection of plants is housed at the University of Arizona Herbarium (ARIZ), a unit mandated by the State of Arizona. The above-cited purposes govern the Arboretum's collections of *living plants.*

Responsibility for Implementation and Review of the Policy.

Collection *planning* to identify specific species acquisition and collection development priorities is the charge of the Collections Committee, with assistance from the Advisory Board's New Plants Committee. Collection planning will be engaged in on an ongoing basis, with annual review of specific collections plans taking place as noted below.

Periodic review and recommendations for *revision of this Policy* shall be the responsibility of the Collections Committee, following formal suggestions from the Campus Arboretum Advisory Board. The Collections Committee shall meet at least once every three years, or at the call of its Chair, to review and recommend revisions to this Policy.

The *administration* of the Policy is the responsibility of the Director, and the implementation of the Policy is the responsibility of the staff.

PURPOSE OF THE COLLECTIONS

The Mission of the University of Arizona Campus Arboretum is to preserve, manage, enhance and expand a vital collection of plants in an active urban Sonoran Desert setting, and to showcase the historic, aesthetic, environmental, economical, and educational value of these plants within our community and the American Southwest. Plants **accessioned** into the University of Arizona's Collection must assist in fulfilling this mission.

To accomplish this mission on the grounds of the University of Arizona requires flexibility. The Campus Arboretum recognizes the need to work with Campus and Facilities Planning, Facilities Design and Construction, Facilities Management and other inter-related units to develop efficient and practical methods for realizing the goals of stewardship of, and education about, the campus plant collection as it contributes to the larger Tucson urban forest.

PLANT RECORD SYSTEM

The UA Campus Arboretum is committed to the maintenance of accurate, up-to-date, and pertinent records on its **accessioned** living collections.

Plants to be Accessioned

All trees will be accessioned. When they are healthy enough, and reproductive, all tree specimens will be vouchered with the UA Herbarium. Shrubs, accents, grasses, and annuals may or may not be accessioned or vouchered. Plants obtained for temporary educational or research purposes may or may not be accessioned or vouchered.

Responsibility for Records System Upkeep

The Registrar of Collections is responsible for the maintenance of current, thorough and accurate input into the records system of information pertinent to the plants within the living collection. Plant classification questions of a technical nature will be addressed to an acknowledged taxonomic authority or reference. Providing information pertaining to planned (and actual) installations is the responsibility of those supervising the project: staff from Facilities Design and Construction or Facilities Management. Providing information pertaining to status of an accessioned item (e.g. change of location, death, removal) is the responsibility of the Facilities Management staff. The administration and oversight of the plant records system is the responsibility of the Director of the Arboretum.

Timeliness of Records Upkeep

Information concerning **germplasm** destined for inclusion in the Arboretum's living collections will be submitted to the Registrar of Collections or to the Director. This information will be entered into the UA Campus Arboretum's database within four weeks of their installation. New plants which are part of a larger construction project should be submitted as an "As Built" list as soon as possible after final walk-through. Changes in the status of an accessioned item (e.g. change of location, death, removal) must be noted in the plant records system as soon as possible after the status change has taken place

Minimum Information Required

Information pertinent to the accession's **taxonomic classification**, place of origin, provenance type, source, date of acquisition, date planted, and mapped location will be kept on all items in the living collections. Data will also be kept with the voucher specimens at the UA Herbarium. Additional information will be kept on specific plants as is needed and practical. The Arboretum will review its plant Names on a regular basis (rotation not to exceed five years) to insure that current taxonomically Accepted Names are utilized whenever possible. The responsibility for this effort will be that of the Collections Committee, under the direction of the Chair, as requested by the Arboretum Director.

Periodic Inventory and Evaluation

Field inventory and evaluation of the living collections will be carried out periodically in order to verify the current status of the collections (living or dead, location) and is the responsibility of the Director.

ACQUISITION

Living plants acquired by the University of Arizona Campus Arboretum should meet the goals and objectives of the Arboretum, as defined by the Mission Statement, and be in accordance with the **selection criteria** delineated in this Policy. New plants to be specified in contracts for new buildings on campus should fall within the Campus Arboretum's selection criteria, as well.

It is of fundamental importance that plants only be acquired by the Arboretum when proper maintenance and care can be assured for them in terms of staff time, water, facilities, and space.

Collaboration with personnel in Facilities Design and Construction, Facilities Management, Campus and Facilities Planning, and the Planning and Design Review Advisory Committee (PADRAC) will enable good communication regarding appropriate plant material.

Selection Criteria

As noted above under Purpose, plants selected for acquisition by the Campus Arboretum should have an emphasis on adaptation to arid or semi-arid conditions or serve some educational value if otherwise. For the purpose of this Policy, **arid and semi-arid** regions shall be defined as those receiving annual rainfall of under 250 mm (10 inches) and under 500 mm (20 inches) respectively. Acquisitions should be adapted to the **ambient temperature** conditions of the site. For practical purposes, this means that specimens should be able to withstand minimum temperatures of -5C to -8C (22 to 18F) for brief periods when mature, and extended maximum temperatures of 42C (107.6F) or more in summer. It is recognized that specific microclimates on the UA Campus may allow use of species that would otherwise not be adapted to normal weather in Tucson, AZ.

In addition to the environmental criteria noted above, **primary plant selection** criteria to be applied to potential acquisitions are: 1. educational/interpretive or research potential; 2. functional or landscape potential; 3. preservation of rare cultivated plants, especially those which honor the University's heritage; 4. dominance or importance within a pertinent eco-geographic region; and 5.economic or ethnobotanic utility; 6. *Ex situ* conservation of taxa..

Acquisitions may be field collected (with proper permits and documentation), salvaged from sites undergoing construction (if properly documented), or come from other botanical institutions, field collectors, commercial sources, or gifts.

Initiation and Approval of Acquisitions

Recommendations for acquisitions to the collections can be initiated by staff, volunteers, persons serving on the Arboretum Advisory Board or Board Committees, or interested members of the campus community and the general public. Acquisitions of individual plants or a small collection are initiated by submitting an *Plant Acquisition Proposal Form* to the Collections Committee. Half of the members of the Collections Committee will constitute a quorum for the purpose of making recommendations concerning accessions. Approval of the species is separate from its actual acquisition.

New species for consideration may also be suggested by the Advisory Board's New Plants committee,

with consultation/discussion with the Collections Committee.

Minor acquisitions (see Glossary) can be accepted by the Horticulturist/ FM staff person responsible for their care. Records on these species, and a general report to the Collections Committee, will allow evaluation for future permanent use. **Major acquisitions** (see Glossary) may arrive as part of campus construction project contracts. Project plant lists will be approved by the Collections Committee and/or the Director as part of the design review process. Acquisitions of plants installed as part of large Facilities Design and Construction projects are to be submitted as 'as built lists' through Facilities Design/Construction or Facilities Management. These lists should be submitted to the Collections Committee or Director as soon as possible after final walk through.

Legal and Ethical Aspects of Acquisitions

The University of Arizona Campus Arboretum is committed to adhering to all laws, regulations, and conventions, be they state, national or international in scope, which govern and regulate the taking and transport of **protected taxa.**

The Campus Arboretum shall have on file a current copy of the policies and lists of the **Convention on International Trade of Endangered Species (CITES).** The Campus Arboretum recognizes that other botanical gardens and arboreta may choose to adhere to those policies in acquisition of living plants, propagules and seeds; our policy will be one of cooperation and respect for those institutions' guidelines. The Arboretum will not acquire such taxa if any doubt or apprehension exists concerning their origin or method of acquisition. Properly documented donations of protected taxa will be accepted. Where doubt exists as to origin of an individual taxa, appropriate authorities will be consulted.

The University of Arizona Campus Arboretum is committed to adhering to all laws, regulations, and conventions, be they state, national or international in scope, including the **Convention on Biological Diversity (CBD)**, which pertain to sharing of benefits resulting from the acquisition of germplasm; and which govern Plant Breeder's Rights (PBR) and other intellectual property rights.

The University of Arizona Campus Arboretum is committed to adhering to all laws, regulations, and conventions, be they state, national or international in scope, which govern and regulate the acquisition

and transport of organisms constituting a known **bio-hazard** (noxious weeds, invasive species, or pests). The Arboretum recognizes The Arizona Department of Agriculture as the state authority on endangered plant species, plant protection laws and noxious weeds. The Arboretum is committed to taking a pro-active, careful and watchful posture as regards the introduction into the local ecosystem of potentially invasive, aggressive or noxious ecosystem weeds, as well as any diseased or infested individuals.

Donations/ Gifts

All potential acquisitions presented to the Arboretum as gifts are subject to the same policies and selection criteria as outlined for acquisitions in general. Plants that are offered as gifts are initiated by the *Plant Acquisition Proposal Form*. Acquisitions received as gifts are considered unconditional in regard to the eventual disposition of the gift. The Arboretum reserves the right to display or not display, give away, or destroy the acquired gift. Any special situations in which legally binding restrictions or conditions on the disposition of a gift may be deemed appropriate shall be reviewed by the Collections Committee with a quorum present. The resulting recommendation from the Committee shall be made to the Advisory Board of the Arboretum, who may seek legal counsel in determining the appropriateness of accepting such a gift. The Arboretum will not appraise collections gifts as to value.

CARE OF THE COLLECTIONS

The living collections of the UA Campus Arboretum are to be maintained in as healthy and attractive a state as is practical by Facilities Management, given the ambient conditions of the University of Arizona Campus and its many uses. Collections of rare or valuable species shall receive priority care. High public profile plants are considered as high priority collections as far as level of maintenance is concerned. If an item in the collections is not performing adequately under the above regime, it should be considered for **de-accessioning.**

Pro-active salvage and propagation efforts are valuable. Collaboration between the Campus Arboretum and Campus & Facilities Planning will allow propagation of species that may be vulnerable to construction projects or that are not performing well, as well as identification of valuable trees that may be protected in place during construction. Salvage is possible with some species, though not all species warrant the risk.

Drafting and periodic review of a *Plant Germplasm Emergency Salvage Guidelines* document shall be the responsibility of the Collections Committee.

Safeguarding Collections

The UA Campus Arboretum is committed to horticulturally safeguarding its living collections within the limits of accepted professional horticultural practices and the constraints of the ambient climatic/environmental conditions of the University of Arizona campus, as noted above. The Arboretum shall safeguard its collections from breaches of security by employment of adequate and practical risk management procedures. In the case of imminent loss of unique or rare germplasm, salvage operations will be initiated as per the *Plant Germplasm Emergency Salvage Guidelines*. Propagation of unique or rare germplasm will be undertaken whenever feasible.

Collections Records shall be safeguarded by means of adequate security provisions and records backup. The UA Campus Arboretum will cooperate with Campus and Facilities Planning to ensure proper records backup.

Transplanting Large Specimens

The Arboretum Director shall provide advice and make reasonable efforts to evaluate the costs and benefits of transplanting historic, rare or otherwise significant specimens, versus the costs/benefits of retaining such specimens on site. A key element of proper transplantation is choice of proper microhabitat, with which the Collections Committee can advise. The *UA Campus Arboretum Tree Valuation (September, 2002*) documents give further guidelines and techniques for evaluating the majority of campus trees.

DEACCESSIONING AND DISPOSAL

It is the policy of the University of Arizona Campus Arboretum that its collections be maintained in the public interest. It is realized, though, that at times it may be in the public interest to remove certain materials from the collections. The following policy applies to material owned by and accessioned into the permanent collections of the Arboretum.

Deaccessioning and disposition of **dead or hazardous plants** shall be handled in accordance with established University of Arizona procedures. Discussion between Grounds Services and a member of the Arboretum Collections Committee is preferred prior to removal. A report summarizing losses shall be submitted to the Collections Committee and Registrar of Collections after a loss has been noted. (Email is OK). The final decision on disposition of dead or hazardous plants lies with Grounds Services, after consultation with representatives of the Campus Arboretum.

Living plants require more forethought. Living plants may be in poor health or chronic decline. They may not be good representatives of their species, nor lend themselves to horticulture display. Requests to deaccession living plants, particularly including the **disposal** or transplant of large older specimens (including any vulnerable to construction projects) will be submitted to the Collections Committee, with discussion to include justification from the point of view of Grounds Services. People in a position to contact the Campus Arboretum Collections Committee to discuss removal or disposal include Facilities Management workers, Campus Planning personnel, people from Facilities Design and Construction, and anyone involved in design review. A quorum (conference call, or email is OK) will be required for any major removal of living plants (whether or not they represent the last member of an accession). The final decision on disposal of individual living plants lies with Grounds Services, after consultation with representatives of the Campus Arboretum. *In*

any case, the decision to dispose of a living tree should be consistent with the goals and mission of the Campus Arboretum.

Donor trees or named trees have the added requirement that the donor be contacted. The Campus Arboretum's *Donor Policy* describes the rights and expectations regarding disposal of old living things which have been adopted by donors. Final decision on whether to dispose of named trees, or donor trees, requires an agreement between the Arboretum Director and a representative of Facilities Management

It is important to avoid unreasonable conflict. At times an public expert's opinion may be sought regarding a valuable or high profile tree.

A. The decision to **deaccession** an individual plant may be made for the following purposes:

To insure that dead accessions are properly reflected in the Arboretum's record system;

To remove plants that are damaged beyond reasonable recovery such that they do not retain their value;

To record stolen plants or missing plants in the collection system

To make reasonable accommodations to UA construction projects or infrastructure changes; however, every effort shall be made to preserve or transplant accessioned living specimens during planning stages of the project, as noted above.

To permit destructive analysis, provided that the information expected to be obtained is deemed to outweigh the value of the specimen and its possible future use;

To remove material that is potentially hazardous to other collections or to human health; or which may become invasive and damaging to the environment;

To transfer to another arboretum, botanical garden, zoo, museums, or educational or scientific institution, material that is deemed by the Campus Arboretum to be significantly more useful and relevant to the collections and programs of the other institution than to those of the Arboretum;

To carry out mutually beneficial exchanges of materials with other arboreta, botanical gardens, zoos, museums, or other educational or scientific institutions;

B. The following restrictions will apply to **deaccessioning**:

No transaction will be carried out if it violates state, federal, or other applicable laws, or University of

Arizona policy;

All records (including those of the UA Herbarium) will be updated.

C. The following principles will govern **disposition**:

If a plant is not healthy, it may be destroyed in accordance with health and sanitation regulations.

Whenever possible, disposition of healthy plants shall be to other arboreta, botanical gardens, zoos, museums, or educational or scientific institutions by exchange of material or services;

No exchanges or privately arranged sales may be made except to other museums or educational or scientific institutions, unless such sale benefits the species, the Campus Arboretum or another University of Arizona interest.

ACCESS TO COLLECTIONS

The living display collections located on the University of Arizona campus, as indicated by UA and Campus Arboretum maps and directional signage, are open to the visiting public. Access to the plant collections *records* and significant requests for *information* from the collections records shall be referred to the Arboretum Director or Registrar of Collections.

Release of Germplasm from the UA Campus Arboretum

Release of germplasm shall be subject to the provisions of the CBD under the authorization of the Director. Provision of limited numbers of **propagules** and other tissue from the living collections may be authorized by the Director provided that the manner of acquisition does not endanger the health or appearance of the chosen plant. Access to the collections for the purpose of obtaining propagules and tissue may be granted to public or private botanical, educational, and horticultural organizations. This is particularly important in the case of taxa that are not practically available elsewhere and for which introduction into the trade is deemed worthy. Availability of propagules and tissue for potential commercialization shall be subject to written agreements approved by the governing authorities of the University of Arizona.

The University of Arizona Campus Arboretum is committed to adhering to all laws, regulations, and conventions, be they state, national or international in scope, which pertain to sharing of benefits resulting from the acquisition of germplasm.

Special Access

Access to the records by persons other than those on the Collections Committee will be grantable by Arboretum staff and will be by appointment. The Director will be made aware in advance where possible, that members of the general public have been granted special access to the collections or records.

GLOSSARY

Accession. The act of formally including an item or group of items in a managed collection. Implies a commitment to long-term care and the keeping of records about the accession (see acquisition.)

Acquisition. Physically taking possession of an item which will be included in a managed collection. Installation is a synonym.

Ambient temperature. Temperatures naturally prevailing at the site.

Arid land plants. Referring to plants adapted to water stress, usually by virtue of having evolved in areas with an arid or semi-arid climate.

Bio-hazard. Plants or organisms that are known, or have potential, to become invasive or cause damage to local flora.

CBD. Convention on Biological Diversity.

CITES. Convention on International Trade in Endangered Species.

Deaccession. The act of formally deleting an item from a managed collection.

Disposal. The act of removing a plant, either dead or alive.

Ecosystem weed. An organism not native to the local eco-system, which exhibits the potential to aggressively reproduce, disrupting eco-system processes in a one-way direction thereby displacing indigenous species and lowering system biodiversity.

Emergency. An unforeseen occurrence; a sudden and urgent occasion for action.

Germplasm. The genetic material comprising the fundamental information governing the development of a particular organism and carried in each cell of the organism.

Governing authorities. The Arizona Board of Regents.

Known wild origin. Having specific, reliable knowledge, either firsthand or otherwise, of the geographic location of the original collection site of an acquisition.

Major acquisitions. Whole collections offered for donations, long-lived perennials, and other plants in large numbers to which the Arboretum must make either a major short-term or long-term commitment.

Minor acquisitions. Annuals, short-lived perennials, or functional plants, all in relatively small numbers, to which the Arboretum has neither a major short-term nor a long-term commitment.

Naturalized Plant. Occurring spontaneously from historically introduced germplasm.

Primary plant selection criteria. Criteria by which a given potential acquisition is evaluated as to its appropriateness to the Arboretum's stated goals and objectives as outlined in this Policy.

Propagules. Units of germplasm utilized to create new individuals, e.g. seed, cuttings, bulbs, etc.

Protected taxa. Taxa listed as rare, threatened or endangered, either by the U.S. Fish and Wildlife Service, the Arizona Department of Agriculture, or by the Botanic Gardens Conservation International.

Specialty collections. Plant collections organized along particular thematic lines.

Sub-collection. A distinct sub-set of a larger collection.

Taxonomic classification. The place in the evolutionary order of organisms (phylogenetic position) to which an organism is assigned by a specialist known as a systematist or a taxonomist.

Taxonomic collections. Plant collections organized along systematic (phylogenetic) lines. i.e. arranged by family or genus, e.g. Desert Legume Collection, Cactus and Succulent Collections.

Approved by the Arboretum Advisory Board Date:_____

_____

_____

C. Landscape Preservation Goals

- Preserve historic campus landscapes in the Historic Core of the campus.

  Strategy: Limit new construction within the Historic Core to the specific projects and buildings identified in the Comprehensive Campus Plan. Understand that historically the campus landscape had areas of open space and respect these spaces as new projects are designed.

  Strategy: Conduct a complete Cultural Landscape Study of the Historic Core.

- Maintain the integrity of the historic landscapes on the campus.

  Strategy: Utilize sound horticultural practices that extend the useful life of landscape plantings. Use replacement plants that are of the same species and variety as the specimen to be replaced where the plant is part of a larger unit or ensemble such as an allee, row or hedge, or a symmetrically disposed pair as at building entries. Plans for replacement of plants within the Historic Core should be reviewed by the Arboretum, Grounds and Campus Facilities and Planning.

- Formally adopt *Maintenance Manual for Historic Landscapes* and institutionalize the document through frequent use. Create schedules for landscape maintenance and necessary tasks to ensure longevity of unique landscape features and elements. Formally adopt national and regional standards that define appropriate landscape management practices.

  Strategy: After collaborative approach to development of maintenance manuals, work with grounds staff during training sessions to convey the over-riding historic preservation goals for both buildings and grounds.

  Strategy: Understand that adequate staffing for grounds is crucial to historic preservation goals. Fund the appropriate level of staff to ensure that cyclical maintenance, repairs, and rehabilitation of the landscape can occur in a timely manner. Undertake an assessment of cyclical maintenance practices and identify deficiencies. Strive to correct the deficiencies and create a schedule for maintenance that will improve the on-going care of the landscape, ultimately improving the appearance and condition of buildings and grounds.

- Retain important historic landscape elements that contribute to the historic character of the campus and that are identified in both the Landscape Character section of this document and the *Maintenance Manual for Historic Landscapes*.

  Strategy: Educate the entire University community with regard to the importance of the historic landscape features through a multifaceted interpretation program. Implement maintenance and preservation recommendations within the Maintenance Manual to ensure this goal is fulfilled.

- Preserve and protect, to the greatest extent feasible, all specimen plants identified as Heritage Trees, Great Trees of Arizona, and valuable trees.

  Strategy: Educate key grounds maintenance staff about the location, character, and requirements of these special plants. Ensure that each species is clearly identified with appropriate signage. Consider providing an introductory tour of the Campus Arboretum to both new and returning grounds staff to discuss maintenance issues.

- In newer portions of the campus, encourage the use of experimentation with various plant species in keeping with the concept of the campus as an Arboretum and as a plant science research facility.

  Strategy: Underscore the importance of a diverse palette to design professionals working on campus and include discussion of this goal in any University standards used by these professionals.

- Understand that some maintenance practices have the potential to affect the historic integrity of the landscape.

  Strategy: Train landscape maintenance crews for the tasks associated with practices that relate to historic landscape elements; provide University maintenance staff with guidelines for completion of the work; or where in-house resources are not available, look outside the University staff for the resources necessary to complete the work to the appropriate landscape preservation standards.

  Strategy: Maximize the knowledge of long-term staff members through documentation of their institutional memory. Encourage mentoring between older and younger groundskeepers and understand the value of craftsmanship learned through years of experience. Engage in pre-retirement and exit interviews with long-term staff members to collect information regarding successful best practices learned over time. Develop a strategy for continued maintenance practices or craftsmanship.

- Encourage a collaborative approach from the Campus Arboretum, Grounds, Campus and Facilities Planning and the consulting Landscape Architect who may be hired for a specific campus project.

  Strategy: Create and institutionalize a forum for regular discussions between these parties especially with regard to the introduction of new plantings.

  Strategy: Respect the campus tradition and philosophy of past University presidents by introducing new trees and plants that will expand the mission of the Campus Arboretum while achieving compatibility with the historic campus landscape.

- Adopt specific pruning and planting standards, such as the International Society of Arborists Standards for Pruning, and best local practice standards for planting.

  Strategy: Make these documents readily available to all groundskeepers, ensure they are up to date, and provide for educational and training opportunities relating to these standards. (See Groundskeeping discussion in Maintenance Manual for Historic Landscapes.)

  Strategy: Use ANSI-A-300 Standard for Tree Care Operations - Tree, Shrub, and other Woody Plant Maintenance and ANSI-Z133.1: American Standard for Tree Care Operations.

THE UNIVERSITY OF ARIZONA®

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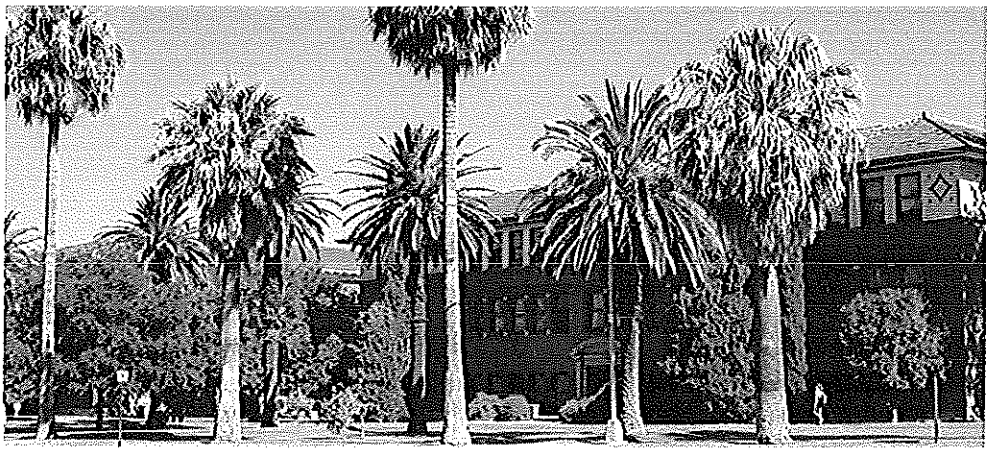
- Documents

Historic Preservation



The University of Arizona is committed to the preservation and stewardship of historical, archaeological, on its main campus and other properties throughout Arizona.

The 33-acre **Campus Historic District** was created in 1986, recognizing the significance of the campus' National Register of Historic Places and showcases buildings and landscapes dating from 1891 through '

The verdant landscapes of the Historic District have been a favorite place for generations of students, sta within the landscape, such as the lava rock wall, the Main Gate, and the fish pond are all part of the histo throughout the campus, the **Campus Arboretum** showcases a world-class collection of desert-adapted p Trees and Great Trees of Arizona.

Buildings in the Historic District display a record of architectural styles ranging from Territorial Queen Ann Revival, and Spanish and Romanesque Revival. The material that ties them all together is red brick, the p throughout its history. Outstanding craftsmanship and exquisite detailing are hallmarks of these buildings located in the District.

Five buildings on campus are individually listed on the National Register. Of these five, Bear Down Gym, House are located on campus but outside of the District.

Old Main, 1887-91
Arizona State Museum, 1923-27
Bear Down Gymnasium, 1926
Smith House, 1904
Cannon-Douglass House, 1906

Sixteen structures are listed as contributing to the District:

Herring Hall, 1903	Steward Observatory, 1921

Douglass, 1904	Center for English as a Second Language, 1935
Communications, 1909	Arizona State Museum South, 1935
South Hall, 1913	Centennial Hall, 1936
Forbes, 1915	Chemistry, 1936
Engineering, 1918	Gila Hall, 1937
Cochise Hall, 1920	Yuma Hall, 1937
Maricopa Hall, 1921	Nugent, 1937

2006 Historic Preservation Plan

The 2006 Historic Preservation Plan was produced as a companion document to the 2003 Compret addresses main campus historic resources. The Plan is comprised of two parts: the general plan, and treatment and preservation of building and landscapes.

Historic Preservation Policy

Official policy on historic preservation.

Historic Preservation Project Review Process

In conjunction with the Historic Preservation Advisory Committee and the Historic Preservation Co compliance with the UA Historic Preservation Policy and state requirements of the State Historic Pres

Campus Historical Overview

A class presentation entitled, "Architecture and Tradition at the University of Arizona." A photogra and architecture at the UA from 1885 to present.

Links

State Historic Preservation Office

National Register of Historic Places

Secretary of the Interior's Standards for the Treatment of Historic Properties

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Maintaining the Landscape

Constructed Features

Treatments

Plants

Maintaining the University of Arizona's Historic Landscape

Campus Landscape Character

It is the singularities and anomalies in the landscape that most firmly impress themselves upon our minds and are most often remembered. The aggregate of these individual features determines the character of a place. In the University's Historic Core such elements include the lava rock wall, Old Main, Boojum trees, the cristate Saguaro at Old Main, Citrus Walk, Lily Pond, the Malls, the Berger Memorial Fountain, Krutch Garden, Observatory Circle, Olive Walks, Palm allées, and the flood irrigation beds. These elements contribute to the campus character. Similar features no longer extant include the Cactus Garden, the Birdcage and the Weeping Mulberry at Old Main.

The basic character of the Historic Core landscape may be simply described as a groundplane of lawn around buildings, in which are scattered a variety of specimen trees, ornamented by various features, with exterior spaces and major circulation ways defined and articulated by rows of olives and palms. The Historic Core essentially attained its present appearance by 1935, although its origins go back to the first university buildings. The period of primary significance for the landscape is therefore roughly defined as 1930-1940. There are insufficient elements remaining to justify an earlier period of significance of 1895-1910.

Landscape Preservation Goals

Preserving a landscape is a contradiction in terms; inanimate objects can be kept with minimal change, but the living landscape cannot be frozen in time. It is always changing, developing and growing. Therefore, landscapes are not preserved, they are managed.

The systematic botanical study of true deserts was in its infancy when the campus was founded, and the earliest plantings were very much experimental, at first drawing upon the flora of the local Sonoran Desert. Inquiry then expanded to species from other deserts and climatic regimes, to see how they would fare under the unique and challenging local conditions of climate and soils. Some have been successful; others are no longer extant for various reasons.

Management of the campus' historic landscape should therefore be concerned with preserving that spirit of inquiry (admirably fostered by the designation of the campus as an arboretum). Additionally, the basic groundplane of generous expanses of lawn supporting a variety of "test trees" (the most successful of which are now Heritage Trees and Great Trees of Arizona), should be maintained. Lastly, the unique man-made campus features and major circulation ways articulated by rows of trees should be the focal point of preservation efforts.

A complete Cultural Landscape Study should be completed for the UA campus in the near future.

Replacing Plants

Plant replacement with the same species in the same location is not a high priority except where the plant is part of a larger unit or ensemble such as an allée, row or hedge, or a symmetrically disposed pair as at building entries. In such cases replacement should occur as soon as possible with the same species and as close a match in size as practicable. Where a matched pair is a strong design consideration, and one of the pair must be replaced, it may be preferable to replace both so that equality of size may be maintained. In some cases, the remaining plant of a pair might be reduced severely in size by selective thinning while the new one catches up in growth.

Likewise, a species now past maturity and senescent, diseased or dead, but which has been successful and is now in popular commerce might be replaced by a species entirely new to the campus so that its possible utility may be observed. Old reliable plant species may become subject to newly introduced diseases, and new resistant species must be found, planted and evaluated, a basic function of arboreta.

The Campus Arboretum has prepared a series of plant lists or palettes from various arid regions of the world that are desired for study and evaluation. Although intended primarily as a guide for landscape architects connected with new building projects, these new species may also be used to guide plant replacement. Some thought should be given to select a

replacement species with similar mass, size and habit to the original. A degree of random distribution will result from this approach, but the same species can also be used again where it can be studied in association with other species from its native habitat.

Careful replacement policies will allow the campus landscape to retain its basic character while still accommodating necessary and inevitable change.

Campus Maintenance Zones

At present, campus landscape maintenance is divided into three zones or sections, each with its own crew and its own schedule of operations. The South Section is the area between University Boulevard and 6th Street; south of Old Main and the Mall. The Central section lies just north of this, from University to Speedway. The North Section includes everything north of Speedway, the Medical Center, and some 120 outlying properties.

Nearly all the Heritage and Great Trees of Arizona are located in the South and Central Sections. While some future additions to the collections will continue to be placed in these sections, some will occur in the North Section, and that crew will need to be apprised of appropriate maintenance for those species. This will require continuing coordination among the Director of the Arboretum, the certified arborist and the crew chief for each section. Any special requirements of these new species or collections will need to be made known to groundskeepers as soon as they are discovered.

Manual Organization & Content

Features

The Maintenance Manual for Historic Landscapes is divided into several sections. The first, the Features section, provides recommendations for the constructed landscape features that help create the overall character of the campus. These features and elements are described and identified further in the "Campus Character" section of the Preservation Plan. Important individual features and clusters of features are briefly described in this section and recommendations are put forward. This discussion follows the same order as the features discussed in the Preservation Plan document.

Treatments

The Treatments section gives an overview of various maintenance treatments for plants and provides guidance relating to the following: Pruning, Managing Plant Maturity, Mulching, Irrigation and Water Management, and Soils Requirements. Additionally guidelines for limiting Visual Clutter in the landscape are put forward. Lastly, recommendations regarding additional groundskeeping personnel, specific equipment requirements, as well as Landscape Review Cycles, and requirements for New Landscape Design are offered.

Plants

The Plants section is divided into three major subsections: Trees; Shrubs and Vines; and Cacti and Succulents. Each section discusses a variety of types of plants found on campus. The origin of the plant's name, its native habitat, when it was brought into cultivation, its location on campus, some of its characteristics are provided and maintenance recommendations are identified.

Old Main and cactus garden in 1915.

Treatments

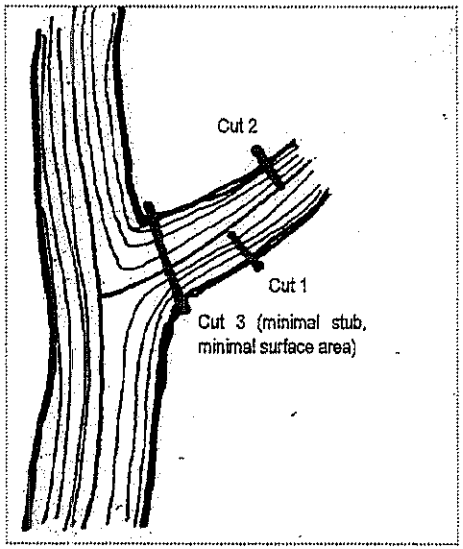
This section gives an overview of various maintenance treatments for plants and provides guidance relating to the following: Pruning, Managing Plant Maturity, Mulching, Irrigation and Water Management, and Soils Requirements. Additionally guidelines for limiting Visual Clutter in the landscape are put forward. Lastly, recommendations regarding groundskeeping personnel, specific equipment requirements, as well as Landscape Review Cycles, and requirements for New Landscape Design are offered. In general, the International Society of Arborists (ISA) Standards should be referenced prior to any treatment put forward on campus.

Pruning Overview

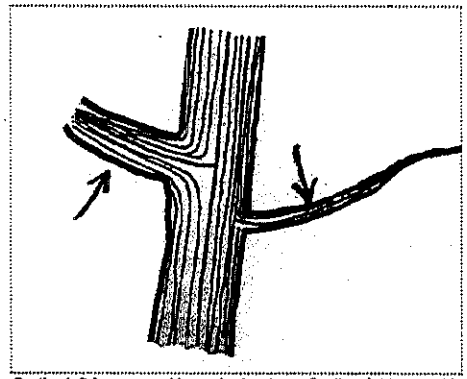
Of all maintenance operations, pruning has the greatest immediate visible effect on plants. In addition to controlling the form and size of plants, proper pruning removes dead or diseased growth contributing to the plant's health. An understanding of the types of pruning cuts, their purposes and their effects results in proper pruning. The more frequently pruning occurs, the smaller the wounds and the sooner the plant heals. Therefore, training in the proper techniques of selective pruning is very important. Selective pruning must be done by hand, and is more labor intensive than using electric hedge clippers. Proper thinning and shaping of trees and shrubs will enhance their natural form, whether free-standing or as a loose billowy hedge.

Recommendations

- Require training of the maintenance staff in proper pruning techniques. Encourage certification and continuing education through professional societies. (See page 28).
- A copy of Eric Johnson's *Pruning, Planting and Care, Johnson's Guide to Gardening Plants for the Arid Southwest,* 1997, should be available to all University groundskeepers.
- Consult campus landscape architect for degree of formality desired at various locations.
- Consult director of Campus Arboretum for specific pruning requirements of arboretum trees, especially Great Trees of Arizona and Heritage Trees.
- Dispose of all diseased clippings off campus. Do not use for compost or organic mulch.
- Remove diseased branches and those with narrow crotches as soon as possible to minimize wound size.



Proper pruning technique for branches over 6 inches in diameter.



On the left is a normal branch structure. On the right a weakly attached branch, originating from an adventitious bud in the bark.

The result of topping the trees with stub cuts eight years ago. Eleven trees were removed in 2005 due to heart rot from the exposed wounds.

Anatomy of a hedge. Ideally the foliage on the top should be narrower than that on the bottom. The sides should have a slight batter in order to allow sunlight down to the base.

Pruning Techniques

There is a plethora of good information that has been published on pruning. All tree pruning at the University of Arizona should be performed in accordance with ISA descriptive directions and according to ANSI standards. There are three basic types of pruning cuts: thinning cuts, heading or stubbing cuts, and shearing which can also be thought of as an extreme case of heading cuts. Each is discussed below.

Heading or Stubbing Cuts

Heading or stubbing are made anywhere along the branch, and always result in a stub end. While usually made at right angles to the axis of the limb, they may also be slanted. It is almost impossible for the bark to re-grow over a right angle. Instead it tends to dry out and pull away, leaving a gap between the bark and the underlying wood, an inviting fungus infection and other diseases. In many species, many small shoots erupt from the bark at the cut end, (a "witch's broom") which present an unsightly appearance. As these "witch's broom" grow directly from the bark and are not integrally connected to the underlying wood, they have weak attachment and are liable to break as they grow and become heavier. Stubbing cuts are therefore not desired in most cases. Moreover, the new growth is usually exactly the opposite of what is desired in the first place.

Thinning Cuts

When the branch, twig or entire limb is cut back all the way to the next largest branch or limb or even to the trunk it is referred to as a thinning cut. The cut is made to leave as short a stub end as possible, balanced against leaving as small a surface area as possible. In no case should a stub be left where the cut surface is at right angles to the bark, as the bark cannot grow back over this right angle. The foliar mass of the plant is reduced and this makes trees less subject to damage from high winds. Thinning cuts reduce the overall size of the plant only slightly, depending upon the severity of pruning, and new growth is stimulated at the ends of the remaining branches.

Shearing

Shearing involves a large number of stubbing cuts applied uniformly over the surface of the plant. This technique is used to increase the density of the foliage as in a hedge, or to shape the plant to a particular form. Shearing may also be thought of as an extreme case of tip-pinching. Previously shearing was done with hand-held clippers, but now is done much more easily with gas or electric powered tools. Generally, the appearance left by shearing is more acceptable on

plants with small leaves rather than those with large leaves, which results in noticeable large cut edges. This technique is appropriate only for formal hedges in the Historic Core - not for native shrubs or Xeriscope sites.

Not all species respond well to shearing. Some will not respond with new growth when cut back to bare wood. The best method for shearing is to cut the plants back to about an inch or so from the last cut. After six or seven years of regular shearing, cut back more severely, about 8 inches. This cutting will remove essentially all the leaves, and should be done in the fall, so the plant can prepare buds during the winter and the spring flush of growth will occur.

Dead or Diseased Wood

Recommendations

- Cut the dead wood out, about an inch into living wood. Check the appearance of the cut end: a small dark spot in the center of the cut is often an indication of a fungus disease.

If this is found, fill a container with a 5% solution of a household disinfectant, or three tablespoons of household bleach to a quart of water. Dip the plant cutter, snips, pruner, lopper or secateurs in the disinfectant and cut the remaining stem three or four inches further. Inspect the cut end again; if the dark spot is still visible, dip the cutters and cut again, continuing until no spot is visible. Dip the cutters and make a final cut another six inches down. Bag all dead and diseased wood and dispose of off the site; do not use for compost.

Suckers and Watersprouts

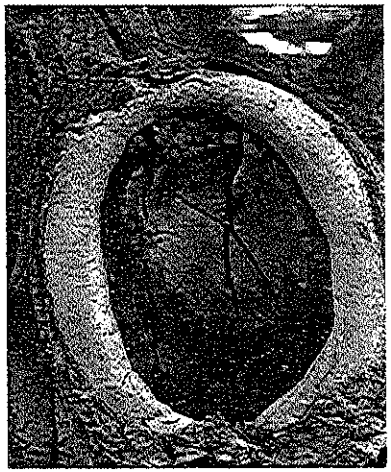
Suckers usually form at either the base or main trunk of the plant. Watersprouts are found on trees rather than shrubs, and are long, thin branches, usually growing vertically from other branches. They are identified by their very rapid growth and lack of side branches and leaves except at the tip. Their presence is often an indication the tree is receiving to much water.

Recommendations

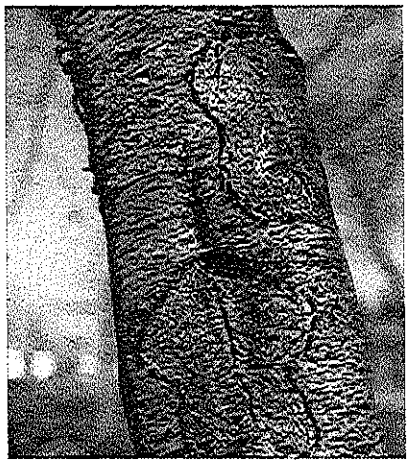
- Pull both suckers and watersprouts to remove the adventitious bud in the bark. Do not cut them, otherwise a cluster of new shoots or watersprouts will form at the edges of the cut.

- Remove watersprouts before they are the thickness of a little finger. Grasp the shoot at its base, and firmly jerk it sideways. A hole will be left in the bark which will quickly fill in. Do not use a tree-sealing compound on the hole.

The thin vertical branches are water sprouts.



Too large a wound. Even though it is trying to heal itself and may close over in time, disease pathogens will have entered the cracks in the wood and go directly down to the heartwood.



Proper healing of smaller wounds.

Narrow Crotches

Some species grow naturally with a small angle between the main trunk and the branches. This does not seem to be a problem in plants with fastigiate forms such as Lombardy Poplars, Italian Cypress and Sentry Maples. Other species, however, such as many types of Ash (Fraxinus spp.) become susceptible to severe breakage because as both the trunk and branch grow, they push against each other, setting up pressure in the trunk which tries to force them apart. A sudden gust of wind will separate these and deep splits between the limb and the trunk can occur. When this happens the entire limb and split portions of the trunk must be removed. The same problem can occur when a plant's growing tip is damaged and twin trunks start to compete.

Recommendations

- Select species or varieties with wider crotch angles.
- A second option is to selectively remove limbs with the narrowest crotches.
- Most labor intensive, is to force the limb away from the trunk with some sort of brace (usually of wood with one end forked to hold the limb). This method has risks, as winds may cause the brace to "work" against the limb, wearing away the bark and cambium layer.
- If twin competing trunks develop, retain the strongest and straightest and remove the other.

Managing Plant Maturity

The University's principal planters were Dr. Robert Forbes, Professor James Tuomey, Steve Fazio, Chuck Raetzman and Warren Jones. The work of Jones often causes difficulties today due to his propensity to plant trees very close to buildings, in some cases only 2 to 4 feet. The trees then grow off balance, both physically and aesthetically, and may in time even pose a threat of abrasive damage to the fabric of the building from limbs scraping in wind.

Significant numbers of plants in the Historic Core landscape have reached maturity, and during the next twenty years, will progress through senescence and will need to be removed. Fortunately good photographic records usually indicate whether a given tree was unique or planted in pairs.

Recommendations

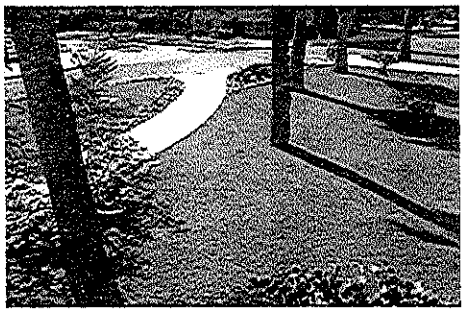
- Honor early campus planters by identifying their introductions with name tags, distinguishing each planter with different color tag, or with brochures listing their contributions.
- When trees must be removed, evaluate them as to their continuing utility. If there is some soil disease or other problem present, replanting the same species may be lost money. If the original species was an experiment that proved successful and the species is now well established in the community, a different plant species will carry on the task of introducing new species "on trial". If the original was planted too close to the building, the replacement can be moved out several feet depending on its mature size.
- Ideally, there will be at least 3 specimens of each major species or variety, one of which should be planted in an area where letting them age on their own will not be visually offensive. The others may need pruning so people can see more of their possible applications in home gardens or on streets.
- Avoid planting trees within 10 feet of buildings.
- Consult the Arboretum's Plant Palettes for desired replacement species.
- Where the Arboretum has only one example of a species, do not prune except for emergencies. Where there are two or more examples, prune one as if it were in a private garden or patio.

Mulching

In general, mulch is a material applied to the surface of planting areas to improve appearance, reduce evaporation of irrigation water, reduce the incidence of weeds and if an organic substance, provide useful nutrients as it decays. Organic mulches decay and disappear in time, and must be periodically replaced. The micro-organisms responsible for the decay need nitrogen for their processes, and therefore, organic mulches need to have about 3/4 of 1% by weight of slow-release soluble nitrogen added. Examples are rice-hulls, pecan-shells, straw, wood chips and ground or shredded bark. The use of composted dried sewage sludge is not recommended. This material has been "cooked" to be microbially inert, but it often has an unpleasant odor when wet. More troubling is the salinity which can be quite high as it may contain a concentration of salts, and the possible presence of toxic heavy metals. Composted material can have some detrimental effects due to high salts.

Decomposed granite migrates down on the slightest slope and makes pavements hazardous for pedestrians.

Decomposed granite in this flat area is appropriate and would reduce the danger of turned ankles.



This gravel mulch at Old Main is an attractive substitute for decomposed granite.

Most organic materials decay with an acidic reaction, especially if there is enough water present to foster the decay. The problem with arid areas is that there is little water constantly available, so organic remains just dry out or mummify. Then when wet at the next rainy season, they decay a bit further, but the process is halted or much slowed down in the following dry period. Thus, it can take decades for a tree to decompose in the desert.

Non-organic mulches include decomposed granite and gravels of various colors, shapes and sizes. Few mulches other than shreaded (not chipped) bark can be used on even small or slight slopes, however, because the particles are dislodged by rain-drops, wind or foot traffic and pulled inexorably downslope by gravity. When it spills out over concrete walks, the granite particles pose a tripping hazard.
The small-scale brown gravel mulch used lately on campus, such as south of Social Sciences and around Old Main is attractive, relatively easy to maintain, and a good use for areas that are too small or irregular in shape for lawns. The two constraints of this material are that the ground must be flat, and there must be a firm edge, preferably just a little higher than the mulch surface to keep it in bounds. Visually it is an improvement over decomposed granite, although if applied in any depth without sufficient fines to bind the particles, it is more difficult to walk on. Its use is relatively recent rather than historic and is a compromise. It shows careful and creative thinking on the part of staff.

Recommendations

- Avoid the use of decomposed granite as a mulch in any area with any slope over 1%. Instead, use brown gravel mulch similar to that near the Social Sciences Building and around Old Main,
- Lower the grade to be flat where such mulches are to be used, and provide positive containment at the edges by either paving or a band of rock revetment, so the mulched level is below the pavement to catch and retain rain water
- Avoid the use of composted sewage sludge.
- If using organic mulches, make sure to have 3/4 of 1% Nitrogen added to it and well mixed.

Irrigation

Water is becoming increasingly scarce and expensive. As the University population increases, lawn areas will come under pressure of increasing use, and will need more water to keep grass growth in balance with heavier use. The purchase of additional reclaimed treated waste water from the city will alleviate the problem of adequate irrigation water on campus for a time.

An example from 1932 of flood irrigation looking north from the west lawn near Old Main. Increasingly fewer people are aware of this 5,000 year-old technique.

Irrigation Zones and Experimentation with Irrigation

Much of the Historic Core is a mix of lawns and trees, more importantly, a variety of trees from diverse locations, accustomed to specific water regimes. The University recently completed an irrigation valve inventory identifying how much water each planting area is receiving. These irrigation zones assist planters in understanding were plants thrive.

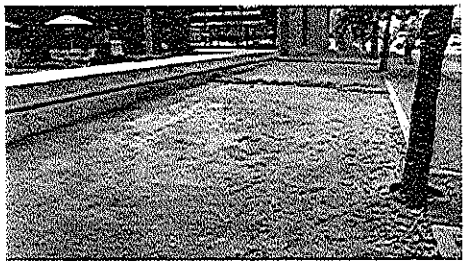
Originally plants were brought to campus and placed where they were most likely to survive. Some did not, but these experiments increased an understanding of species limitations. Such experimentation is still part of the Arboretum's mission, and so several examples of each new species should be planted, in different areas, in different irrigation zones, on different building exposures.

Water Quality

While the quantity of water available is a limiting factor, the quality of that water is also very important. Although Tucson water is continually tested and treated for safe human consumption, the very dissolved minerals that help give it a good taste are problematic for many plants. Arid areas tend to have soils and water that are more alkaline or basic than neutral or acid. This is usually expressed as pH (potential hydrogen) on a logarithmic scale from 0 (very acid) to 7 (neutral) to 14 (very alkaline). Each unit on the scale is 10 times stronger or weaker than the adjacent one.

Tucson water, as measured by the Tucson Water Department in September 2005, from 123 sites, ranged in pH from 7.6 at one site to several at 8.1. This last is the same pH as sea water. Plants vary in their tolerance of common salts in irrigation water; desert plants have survived by evolving to handle these minerals. The use of such mineral-laden water creates other problems, including the *caliche* layer at a variable soil depth. Minerals are carried in ground water by aquifers and to near the surface by capillary attraction. At or near the surface, water evaporates, leaving behind a concentration of salts. From time to time relatively pure surface water from rainfall dissolves some of these minerals and drives them downward some distance,

Museum expansion will take more of this already little-used lawn area. The remainder could be utilized as ground cover, retention basins, or both.



Great location for retention basins, ground cover, or both at the west side of the Aerospace and Mechanical Engineering Buildings.

Six-inch contours in the rice fields Marysville, CA. This image illustrates retention basins that are not rectangular.

where they meet salts moving upward. Where they meet, their concentration is high enough that some salts settle out and accrete together into an impermeable layer that plant roots cannot penetrate nor ordinary rains dissolve. Despite the use of well-chosen and water-thrifty plant species, now and then extra heavy applications of high quality irrigation water will be necessary to flush accumulated salts downward away from active root zones.

Another problem of mineral-laden water is that certain elements interact with other minerals in the soil, sometimes chemically locking them up so they are unavailable for plant nutrition, sometimes changing soil texture or other chemical balances, in turn affecting soil micro-organisms.

As a general rule it is better to irrigate less often but more deeply. This reduces weeds and soil fungus, and encourages deeper root growth. Lawns require two to three times the amount of water per week for good growth compared to most shrubs and trees and they require much more uniform and complete coverage.

The University is already purchasing reclaimed water from the City. Reclaimed water will be the primary source of the water for the campus landscape irrigation, as existing, potable water sources are replaced by reclaimed water. The use of reclaimed water for landscape irrigation is part of the University's response to regional water conservation objectives. The pH and mineral content of this water should be monitored.

Saving Water

The University is to be lauded for its forward thinking of retention and detention of rainwater as a valuable resource. Detention areas help to increase overall soil moisture and allow the rainwater to flood an area and percolate downward into the soil. The success of this depends partly on the depth of the underlying impervious caliche or hard-pan layer in the soil. However, this will take years to replenish the ground water, and while it reduces the need for irrigation shortly after the rains, it may be insufficient as sole source irrigation during the dry months. The great majority of tree roots lie within the first two or three feet of the surface. Once water percolates beyond this depth it is effectively lost to the plant. Detention only detains water, slowing it down so it can percolate. This means the area it is spread upon must be essentially flat. The western edge of the campus in particular shows this method of flood irrigation, a technique almost as old as agriculture itself. Each flooded bed becomes in effect, a percolation pond.

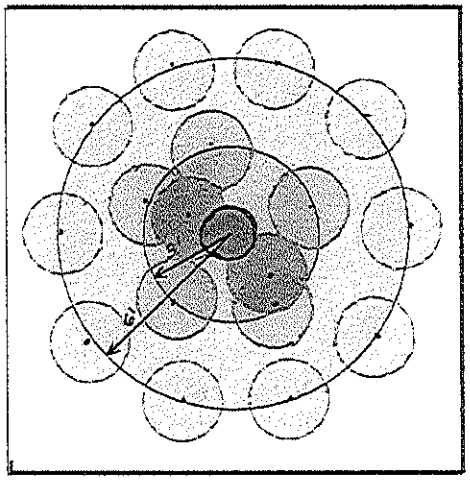
There are many areas on campus where water runoff from paving and roofs is spread out upon sloped land, where much of the water flows off without percolation. Indeed, where water flows across areas of decomposed gravel, as the gravel progressively breaks down into smaller particles, more of it is washed down to paved areas, causing another maintenance problem. These areas need to be graded flat and even broken into smaller areas by means of low earthen berms or check dams. These flat areas should accommodate existing trees, avoiding excavation or fill over eight inches to a foot in depth, in order to disturb as little as possible the relatively shallow depth of roots. There is no particular reason that these areas need to be rectangular, other than tradition.

Detention areas help to augment overall soil moisture, while they prevent water waste through runoff. They are most valuable as an occasional heavy irrigation during the rainy season when less irrigation is needed and its quality is high. Detention of rainwater is valuable for flushing salts from root zones. These shallow areas can retain water on site, making it slowly available to thirsty plants.

Storing rainwater can present some problems, including siltation. The very fine dust and soil particles that blow in the air and wash off buildings settle to the bottom, forming a layer that inhibits further percolation. The only long-term solution is major storage, either in reservoir tanks (typically expensive to construct and usually unsightly in form and ungainly in size) or in open ponds. Subterranean storage is also a viable option as the land resources become increasingly scarce. Ponds have the disadvantages of losing considerable amounts of water through evaporation, having unsightly margins due to annual dry-season draw-down, and by being breeding grounds for mosquitos. Careful contouring and detention will alleviate much of the storage problem and can also minimize standing water.

Gray Water

A third water source, not yet exploited because of relatively high capital costs required for its collection, is gray water from the lavatories and showers on campus, where virtually the only contaminant is detergent or soap, which is actually a wetting agent and even contains some plant nutrients. Also, several buildings on campus produce large amounts of water every day that with very little treatment could be used to irrigate the campus landscape. These are non-potable sources, however, and to prevent the possibility of cross-contamination of the potable water supply, would require the considerable capital expenditure of re-valving and new piping.



Drip Irrigation Diagram

The brown circle represents a 15-gallon tree, freshly planted. The darkest blue small circles represent the two emitters usual at this early stage. All the blue circles represent the horizontal spread of water from emitters of about 2 feet diameter, a generous estimate in sandy-gravelly soils.

The light green circle represents the original plant pit with a diameter of 6', and the location of the hair-fine feeding roots in a couple of year's time, when 5 or 6 emitters would be needed to supply the feeder roots and provide moist soil to encourage their continuing growth. The largest circle is 12 feet in diameter, and represents the position of the tree roots in a few more year's time. Now 10 emitters are barely enough to keep the plant actively growing. In addition, if the area under the tree is planted to shrubs, they will also require water, and the circle of 5 may need to be augmented. As the tree continues to grow, the number of emitters and labor to set them also grows.

Drip Irrigation

The drip irrigation method was originally developed for canned nursery stock, set closely together and easily connected with short water tubes. It was a system that reduced water waste and was easy to adapt to new plants as they were brought in for sale. Drip irrigation was later expanded into large-scale reforestation and orchards. The advantage is that plants generally get the same amount of water, unlike rotary sprinklers. Also, evaporation is minimized as the water is not exposed to dry air or wind. University of Arizona groundskeepers incorporate a practice of setting irrigation feeder lines in a circle at some distance from tree trunks. The first emitters and their lines are then set inside this circle. As the tree roots grow, the emitters can be repositioned outside the circle, thereby encouraging roots to explore further.

There are some observed problems with drip irrigation, including the fact that water from each emitter generally percolates down much faster than it spreads laterally, depending on the soil texture. The lateral spread is a circle with about a maximum 3-foot diameter in clay soils, less in sandy and gravelly soils. As the hair-fine feeding roots of plants explore outward, they need moist soil where nutrients are dissolved and accessible. The range of the original drip emitters is limited, so additional emitters are often needed; 3 in two or three years, then 6 or more, then many more. It is not a system that can easily accommodate plant growth.

A mature tree native to a Mediterranean climate regime of wet winters and dry summers cannot survive on 5 drip emitters. In particular, these species must have more water during the winter to prepare for the hot summers. However, full lawn irrigation during the summer is detrimental to these plants. Most conifers are accustomed to winters with snow or rain, and will not tolerate long-standing water in the warm summer. Lawn irrigation may be too much for them.

Recommendations

- Flush accumulated salts downward away from the active root zones periodically with extra heavy irrigation doses, preferably in the rainy season.
- Irrigate less often but more deeply; once every week to 10 days is preferred for shrub areas except in the hottest season. Lawn areas will require much more frequent watering.
- Continue the exploration of possible water detention areas on campus.
- Expand retaining water on campus through the use of retention ponds and water harvesting topography of the planted areas.

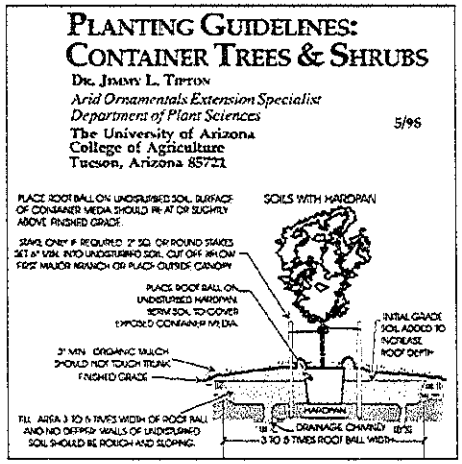
- Study and implement gray water harvesting techniques on campus.

- Review use of drip irrigation for plants that develop wider root systems. When emitters are repositioned from inside the feeder line to outside it, the number of emitters for each tree should be increased by 50%. Locate new feeder lines at least 50% of the distance from the present lines to the trunk further out, to or past the drip line. (For example, if the present line is 8 feet from the trunk, the new line should be at least 12 feet from the trunk.)

- Group plants in new landscape projects according to their irrigation needs, based on both time of year and amount of water.

- Subdivide some existing irrigation batteries (install more but smaller remote control valves) to provide more flexibility in timing and amount of irrigation for sub areas where there are sufficient existing plants that have the same water requirements.

- Consider the benefits of relocating shrubs and small trees to areas with a water regime that more closely fits their requirements. This can be done piecemeal and should be an on-going remedial project.


PLANTING GUIDELINES:
CONTAINER TREES & SHRUBS
Dr. Jimmy L. Tipton
Arid Ornamentals Extension Specialist
Department of Plant Sciences
The University of Arizona
College of Agriculture
Tucson, Arizona 85721
5/96
SOILS WITH HARDPAN
HARDPAN
DRAINAGE CHIMNEY

Planting Guideline with hardpan showing very wide holes to accommodate root spread.

Soils

The soils of Tucson are generally sandy gravel, the result of eons of alluvial outwash deposits from the surrounding canyons. As is common in desert conditions, the water and soil are basic in reaction (pH) and poor in organic material. There is also a hardpan or *caliche* layer of impermeable consolidated salts at a varying depth of 1 to 4 feet. In effect, all the plants are growing in pots with poorly-draining bottoms, and must rely on wide-spreading root systems close to the surface to obtain water and support themselves from wind-throw.

In 1998 Dr. Jimmy L. Tipton of the College of Agriculture prepared two Planting Guidelines, one for situations with hardpan and one without. That for hardpan is shown on page 19; it was published in the November-December edition of *Desert Seasons*, the monthly Newsletter of Mountain States Wholesale Nursery in Glendale, Arizona. All the text is included but it has been rearranged to fit the format of this manual.

Dr. Tipton advocated setting the plant directly on a firm surface. If the plant is on the hardpan, he shows how to make a 'chimney' to the side and through the hardpan to allow drainage. This approach advocates a wide planting hole so that roots excavate laterally, anchoring the plant

Tree Preservation, Protection, & Salvage Guidelines (Draft)
The University of Arizona Design & Specification Standards – Tab C
November 25, 2009

Attachment 3

Introduction

The University values its more than 7000 campus trees for their history, beauty and architectural importance. The UA Campus Arboretum has been established to document, monitor, and sustain the University's collection of trees.

Trees also contribute to campus intellectual open spaces by assisting with climate mitigation, carbon sequestration, and storm-water uptake. As the University strives to become more environmentally sustainable, trees lower the "heat island" effects of buildings and pavement and reduce costs for climate control. General goals include increasing campus shade by expanding the percentage of tree cover.

Any project's design process must include an analysis of existing trees and a plan for preserving, protecting during construction, or salvage. Resources to assist with the assessment plan include the *UA Campus Arboretum's Tree Preservation Table*, available at the Department of Facilities Planning, Design and Construction, and the *GIS campus tree map* on the Campus Arboretum's web site: http://arboretum.arizona.edu .

General Procedures

1) Identify trees in the Campus Arboretum Tree Preservation Table and GIS base map by name and location on within the project site. Identify unique characteristics of the trees where possible, i.e. Heritage Trees, one of a kind on campus or in the state. Field verify tree identity and location.

2) Review proposed project site for impacts to existing trees. Collect additional data, if necessary i.e. size, quality. Prioritize trees for salvage.

3) Develop a tree assessment plan. Determine and identify status of the existing trees. Action in descending order of priority:
   a) Retain in place and preserve during construction,
   b) Salvage and replant in another campus location (identify new site),
   c) Salvage, hold and replant on site,
   d) Replace specimen with new planting on site,
   e) Propagate tree for planting in another campus location (identify new location),
   f) Remove tree

4) Review tree assessment plan with the project design team, Campus Arboretum Director, Campus Landscape Architect, Facilities Management Grounds Services. Determine status for all existing trees. Prioritize for budget and aesthetic considerations. Identify responsibilities and funding sources for tree preservation and salvage.

5) Monitor tree preservation, salvage, storage, replanting for performance to specifications.

SECTION 01530

TEMPORARY TREE AND PLANT PROTECTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Drawings, Contract Forms, Conditions of the Contract, Construction Manager at Risk (CMR) Agreement including Supplemental General Conditions and Exhibits, and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Protection in-place and trimming of existing trees that interfere with, or are affected by, execution of the Work, whether temporary or permanent construction.

B. Related Sections include the following:

1. Division 01 Section "Summary" for limits placed on Contractor's use of the site.

2. Division 01 Sections "Temporary Utilities," "Construction Facilities," and/or "Temporary Controls" as appropriate for temporary tree protection.

3. Division 01 Section "Construction Cleaning."

4. Division 02 Section "Tree Salvage."

5. Division 02 Section "Palm Tree Salvage."

6. Division 02 Section "Demolition."

7. Division 02 Section "Earthwork" for building and utility trench excavation, backfilling, compacting and grading requirements, and soil materials.

8. Division 02 Section "Irrigation" for points of connection and distribution work for landscape irrigation.

9. Division 02 Section "Landscaping" for tree and shrub planting, tree support systems, and soil materials.

1.3 DEFINITIONS

A. Tree Protection Zone: Area surrounding individual trees or groups of trees to remain during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

B. Owner: The University of Arizona and its designated representatives, which should include a Certified Arborist. Unless noted otherwise, all references to Owner shall refer to this person.

C. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Coordination and Meetings."

1. Before constructing and erecting tree protection, meet with the Owner to review tree protection procedures and responsibilities.

1.4 MATERIALS

A. Chain-Link Fence Panels for temporary fencing.

B. Coarse bark mulch to cover area under protected trees.

C. Plant material used to replace damaged plant materials shall be as specified for new plant material in Division 02 Section – Landscaping.

PART 2 – EXECUTION

2.1 PREPARATION

A. Locate and flag with surveyor's tape trees and vegetation to remain or to be removed.

B. Engage Owner's Certified Arborist to direct pruning of trees to remain on site.

C. Temporary Fencing: Install temporary fencing around tree protection zones to protect remaining trees and vegetation from construction damage. Locate fencing as shown on plans. Maintain temporary fence and remove when construction is complete.

D. Mulch tree protection areas with organic matter to a depth of 3 inches.

E. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

F. Do not store construction materials, debris, or excavated material inside tree protection zones. Do not permit vehicles or foot traffic within tree protection zones; prevent soil compaction over root systems. Locate portable restrooms outside tree protection zones.

G. Maintain tree protection zones free of weeds and trash.

H. Arrange with Owner for regular irrigation of protected trees.

2.2 EXCAVATION

A. Install shoring or other protective support systems outside the tree protection zone to minimize sloping or benching of excavations onto root zone of tree.

B. Outside Tree Protection Zone:

1. Pull shovel away from edge of tree protection zone. If roots larger than 1 inch in diameter are encountered outside the tree protection zone, the Owner's Certified Arborist shall be consulted prior to pruning.

2. Redirect roots into backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots cleanly and approximately 3 inches back from new construction.

3. If tree roots larger than 1 inch in diameter require pruning due to construction activities, the Owner's Certified Arborist shall be consulted prior to pruning.

4. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap, and maintain in a moist condition through regular watering.

5. Temporarily support and protect roots from compaction and damage until they are permanently relocated and covered with soil.

C. Within Tree Protection Zone:

1. Where excavation for new construction is required within tree protection zones, do not proceed without the Owner's written approval. Hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.

2. If tree roots larger than 1 inch in diameter require pruning due to construction activities, the Owner's Certified Arborist shall be consulted prior to pruning.

D. Utility Trenches: Where utility trenches are required within tree protection zones, do not proceed without the Owner's written approval. Tunnel under or around roots by drilling, auger boring, pipe jacking, or digging by hand. Use existing utility locations where possible.

1. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop. Do not apply any material to cut faces of roots.

2. If tree roots larger than 1 inch in diameter require pruning due to construction activities, the Owner's Certified Arborist shall be consulted prior to pruning.

2.3 REGRADING

A. Minor Fill: Where existing grade is 6 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single un-compacted layer and hand grade to required finish elevations. Do not grade so that tree trunk is in low spot after finish grading.

B. Change of grade beyond 6 inches: Where existing grade at tree protection zone differs by more than 6 inches from finish grade, construct retaining walls to keep original grade under tree.

2.4 HARDSCAPE AROUND TREES

A. In parking lots, allocate 8 ft x 8 ft uncovered space for trees preserved on site. Asphalt cover: Irrigate tree protection zone well the night before. Slope asphalt slightly into planting pit. Flood irrigate again after asphalt installation.

B. Concrete and impermeable paving: Flood irrigate tree protection zone the night before pouring. Protect tree zone from traffic, trash, or backwash during concrete pour. Irrigate tree again the following day.

C. Structural Soil, Structural Cels, and alternative media: Flood irrigate tree zone well the night before. Protect tree zone from backwash or trash during installation of aggregate. Irrigate again the next day.

2.5 TREE REPAIR AND REPLACEMENT

A. Notify the Owner immediately if trees and shrubs to remain in place are damaged during construction. Do not repair damage except with the Owner's Arborist written direction.

B. Promptly repair trees damaged by construction operations within 24 hours of damage. Treat damaged trunks, limbs, and roots according to Owner's Arborist's written instructions.

C. Remove and replace trees indicated to remain that die or are damaged during construction operations that Owner's Staff Arborist determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size and species as those being replaced; plant and maintain as specified in Division 02 Section "Landscaping."

2. Any and all costs of repair or replacement will be assessed to the contractor.

2.6 DISPOSAL

A. Construction Waste shall be managed in accordance with provisions of Division 01 Section Construction Cleaning. Documentation shall be submitted to satisfy the requirements of that section.

END OF SECTION 01530

SECTION 02481

TREE SALVAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. This section contains specifications for the identification, removal, storage and replanting of existing trees on site.

B. Reference Sheet LO.1 for identification of trees to be salvaged.

C. The Contractor shall be responsible for obtaining all agency approvals, permits and paying required fees.

D. Provide backflow prevention devices for the temporary irrigation system if required by governing codes.

1.3 EXAMINATION OF THE DRAWINGS AND PREMISES

A. Before submitting a bid, the Contractor shall carefully study the drawings and shall make a careful examination of the premises and any existing work. He shall definitely determine in advance the methods of completing the work and shall make himself thoroughly familiar with all of the requirements of the contract.

B. By the act of submitting a proposal for the work required and included in the contract, the Contractor shall be deemed to have made such study and examination, and to be familiar with and accept all conditions of the site.

1.4 REQUIREMENTS FOR BIDDING

A. Qualifications:

1. All bidders must have had at least four years of experience in salvage operations of this nature with these types of plants and be able to provide a list of references of past clients if requested by the Owner's Representative.

2. Not meeting the above qualifications is reason for rejecting Contractor's bid.

B. Bid Submittals: Qualified bidders shall visit the site before submitting bids. Trees to be salvaged are identified on the landscape Demolitions and Salvage Plan, Sheet LO.1.

1. Determine total cost and unit cost for salvage of all tagged trees.

2. Estimate time frame for completion of salvage operation in calendar days.

3. Determine initial price for setup of a temporary irrigation system.

4. Determine weekly maintenance fee.

5. The anticipated holding period is _____. The maintenance fee shall include all labor and materials necessary to maintain plants in good health. Should a holding period of longer or shorter than _____ be required, maintenance fee shall be renegotiated based upon unit costs.

6. Determine total cost and unit cost for replanting of salvaged plants.

7. Estimate time frame for completion of planting operations in calendar days.

C. Holding Yard: The holding yard for this project will be on or adjacent to the project site with an available water source. Water shall be provided by the Contractor.

1.5 IDENTIFICATION OF SALVAGE MATERIAL

A. The selected bidder, Architect and Owner's representatives will determine the final selection of salvage specimens based on specimens already identified, current health, accessibility, viability and appearance.

B. These trees shall be final-tagged with colored tape in conspicuous locations and fenced with temporary construction fence and irrigated to avoid construction damage until they are removed.

C. Contractor is not to remove or work on any salvage material until after the Owner, or designated agent, has determined the limits of the salvage and work area, and has given the Contractor written consent to proceed.

1.6 REMOVAL OF SALVAGE MATERIAL

A. Description of Work: The Contractor shall provide all labor, tools and materials necessary to remove salvage plants from the ground, box them (when required) and transport them to the holding facility.

B. If it is determined that any of the trees to be transplanted can be immediately installed in their new location within the project, the Contractor may do so, but must water, maintain and protect the trees during construction.

C. If any trees are to be transplanted directly onto UA property, the final site will need to be Blue Staked. Allow time to get approval.

D. Access: Access shall be entirely within the Owner's property. Damage to surrounding areas not within the property, including but not limited to buildings, curbs, paving, vegetation and utilities, shall be the Contractor's responsibility.

E. The Architect will also identify areas within the property that are not to be disturbed. Any damage within these areas will also be the Contractor's responsibility. If designation of these areas makes access impossible, Contractor shall notify the Architect.

1.7 PROTECTION

A. Contractor shall provide barrier protection to warn pedestrians about the plant excavations, and reasonably prevent someone from falling into one. Protection shall be selected by the Contractor and suitable for the purpose intended and approved by the Architect and Owner.

B. Protection shall be provided during sidebox operations and following removal of the boxed tree, and shall remain in place until the excavation is filled under grading operations.

1.8 WARRANTY

A. The Contractor shall warranty plants from damage caused by his own operations including boxing, holding and replanting. This warranty includes breakage of major limbs (after trimming), destruction of major root systems, excessive scarring to the trunk, and death from stress or severe insect damage.

B. The Value of the trees to be salvaged shall be determined by a qualified Arborist, and shall be based in whole or in part on the following factors: 1) species appropriateness on site 2) health and vigor prior to start of construction 3) cost of comparable tree at local supplier 4) increase in value of UA tree based on increase in size beyond that of saleable size 5) rarity or uniqueness on UA campus 6) dollar contribution of tree as modeled in USFS i-Tree Suite of software programs

C. Should replacement material be required under this warranty, Contractor is responsible for the procurement and transportation of the replacement material.

D. Plant materials shall be guaranteed for one year following final acceptance of planting operations under this section.

PART 2 - MATERIALS

2.1 BOX MATERIALS

A. Boxes shall be of wood strong enough to allow transport of trees both to and from the storage facility.

B. Boxes shall be of wood, resistant to rot and fungus, and capable of lasting at least three years.

C. Should the box require replacement, or damage occur to the tree as a result of poor box material, the tree shall be replaced as a warranty item at no additional cost to the Owner.

2.2 NUTRIENTS

A. Contractor shall apply chemical nutrients to the tree, as needed, to maintain tree in good health. Balanced fertilizer at ½ strength and Vitamin B-1 shall be used per manufacturer's recommendations with the first watering.

B. Loss of tree from lack of nutrients or over-fertilizing shall be considered a warranty item and the tree shall be replaced at no additional cost to the Owner.

C. Contractor should use an anti-transpiration agent such as Vapor Guard, or approved equal, as needed to prevent excessive wilting and wind damage.

PART 3 - EXECUTION

3.1 TRIMMING AND PRUNING

A. The Contractor shall prune off all dead limbs from the salvage material.

B. Contractor consult with the Owner's Certified Arborist before removing canopy branching from the tree only, as needed, to reduce stress on tree during the moving operation.

C. Pruning cuts shall be clean and outside the branch collar. Techniques shall follow current ANSI 300 Standards for Pruning. Pruning shall be done in such a manner as to retain the original character and structure of the trees.

D. Any tree which is found to be diseased at this stage may be removed from the salvage list with the approval of the Architect.

E. Contractor is responsible for protection of cuts after pruning. No pruning paint shall be applied to wounds.

F. Architect and Owner's Arborist shall inspect tree pruning prior to sideboxing. Trees which, in their opinions, are of unacceptable shape, size or canopy may be removed from the salvage list at this time.

3.2 BOXING

A. Contractor shall identify the size (caliper) of the tree and the corresponding box size. The chart below gives the approximate relationship between box size and caliper size. Contractor may, at his discretion, increase the box size, but should not decrease the box sizes from those listed below. Caliper sizes indicated on the tree inventory plan may vary some from actual conditions. Contractor is responsible for determining actual caliper size for each tree identified for salvage.

	Trunk Diameter in inches	Box Size in Inches
Under	4"	42
	7-1/2"	45
	8-1/2"	48
	10"	51
	13"	54
	14"	57
Over	14"	60 - 120"

B. The Contractor shall sidebox the trees a minimum of 35 days prior to removing the trees.

C. During the sideboxed holding period, the Contractor shall provide water, nutrients and herbicides to the salvaged material, as needed. Failure to provide proper care during this stage, which results in the loss of the material, shall be treated as a warranty item.

D. Removal: As the tree is removed from the ground, the Contractor shall provide reasonable care during this operation to avoid breaking of limbs and scarring of the trunk.

E. Transportation:

1. The Contractor shall transport the trees from their location in the field to the designated holding yard.

2. This transportation includes the loading and unloading of the trees from the truck or other transporting vehicle.

F. Method of Measurement: The Contractor shall establish a salvage price for each tree.

G. Basis of Payment: Contractor shall submit a monthly salvage bill based upon trees boxed and moved to holding yard, or moved to their final location.

3.3 MAINTENANCE OF PLANTS DURING HOLDING PERIOD

A. The Contractor shall provide all labor, tools and materials necessary for the maintenance of the salvage materials in the holding yard during a holding period as previously specified.

B. The Contractor shall be responsible for the replacement of salvage material which dies or is seriously damaged during the holding period. See the warranty section for complete specifics of this warranty.

C. Holding Yard:

1. The Contractor shall store or make arrangements for the storage of all salvaged material in the secure yard during construction. This yard shall be located as designated by the Architect and Owner's Representative.

2. The holding yard shall be open for prearranged inspections on a regular basis by the Architect and Owner's Representative.

3. All salvage material shall be clearly labeled and stored in one specific location if other plant material is stored onsite.

D. Time Limitation: The Contractor shall be responsible for maintenance of the material as previously specified after delivery of the material to the holding yard.

E. Water: The Contractor shall be responsible for provision of a temporary drip irrigation system sufficient to provide water to the salvage material. Salvage contractor shall be responsible for making new connection and removing temporary lines at end of holding period. No meter is required.

F. Fertilizer: The Contractor shall be responsible for provision of nutrients needed to maintain the material in a healthy condition.

G. Other: The Contractor shall be responsible for the provision of any other materials necessary for the maintenance of the salvage material in a healthy condition and secure location.

H. Manpower Requirements:

1. The Contractor shall provide qualified manpower on a regular basis to inspect the trees for health and vigor.

2. The Contractor shall also be available for visits with the Architect and Owner's Representative on a monthly basis for inspection.

I. Method of Measurement:

1. Contractor shall determine a set fee for monthly maintenance of plants. Such fee shall reflect the total of all costs incurred in maintaining plant material in a healthy state, including but not limited to, labor, materials and overhead. Fee shall be expressed as unit cost per tree per month.

2. Contractor shall determine a one-time lump sum fee reflecting the cost of initial improvements and setup of the holding nursery. Such costs shall include, but not be limited to, irrigation supplies, fencing, shade cloth, etc., and shall be itemized.

J. Basis of Payment:

1. Payment shall be made on a monthly basis.

2. There shall be a one-time lump sum payment for holding nursery improvements upon Owner approval of work-in-place.

3. Contractor shall submit a monthly maintenance bill based upon the number of trees in the holding nursery. Bill shall be derived by multiplying the number of trees by the monthly maintenance fees as measured above.

3.4 MONTHLY OPERATIONS

A. The planting of the salvaged material will be done in the same general area as the salvage operations. Exact location will be per the landscape plans. The cost associated with planting the salvaged materials will be a part of this section.

B. Plant hole sizes and planting mixtures will be as shown on the plans.

C. Salvage contractor shall coordinate planting and new irrigation with the general landscape contractor. The general landscape contractor will install the permanent irrigation system. The irrigation system must be functional within a week of tree installation.

D. Method of Measurement: Method of measurement for planting operations shall be a price for each tree.

E. Basis of Payment: Contractor shall submit a monthly planting bill based upon plants in the ground and approved by Architect, as measured above.

3.5 CLEANUP

A. Contractor shall maintain the area of his work free from debris and extraneous material throughout the course of his work.

END OF SECTION

SECTION 02482

PALM TREE SALVAGE / PLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. This section contains specifications for the identification, removal, storage and replanting of existing palm trees on site.

B. Reference Sheet LO.1 for identification of trees to be salvaged.

C. The Contractor shall be responsible for obtaining all agency approvals, permits and paying required fees.

D. Provide backflow prevention devices for the temporary irrigation system if required by governing codes.

1.3 EXAMINATION OF THE DRAWINGS AND PREMISES

A. Before submitting a bid, the Contractor shall carefully study the drawings and shall make a careful examination of the premises and any existing work. He shall definitely determine in advance the methods of completing the work and shall make himself thoroughly familiar with all of the requirements of the contract.

B. By the act of submitting a proposal for the work required and included in the contract, the Contractor shall be deemed to have made such study and examination, and to be familiar with and accept all conditions of the site.

1.4 REQUIREMENTS FOR BIDDING

A. Qualifications:

1. All bidders must have had at least four years of experience in salvage operations of this nature with these types of plants and be able to provide a list of references of past clients if requested by the Owner's Representative.

2. Not meeting the above qualifications is reason for rejecting Contractor's bid.

B. Bid Submittals: Qualified bidders shall visit the site before submitting bids. Trees to be salvaged are identified on the Landscape Demolitions and Salvage Plan, Sheet LO.1.

1. Determine total cost and unit cost for salvage of all tagged trees.

2. Estimate time frame for completion of salvage operation in calendar days.

3. Determine initial price for setup of a temporary irrigation system.

4. Determine weekly maintenance fee.

5. The anticipated holding period is scheduled to be _____The maintenance fee shall include all labor and materials necessary to maintain plants in good health. Should a holding period of longer or shorter than _____be required, maintenance fee shall be renegotiated based upon unit costs.

6. Determine total cost and unit cost for replanting of salvaged plants.

7. Estimate time frame for completion of planting operations in calendar days.

C. Holding Yard: The holding yard for this project will be on the project site, as indicated on the drawings. Water shall be provided by the Contractor.

1.5 IDENTIFICATION OF SALVAGE MATERIAL

A. The selected bidder, Architect and Owner's representatives will determine the final selection of salvage specimens based on specimens already identified, current health, accessibility, viability and appearance.

B. These trees shall be final-tagged with colored tape in conspicuous locations, irrigated, and fenced with temporary construction fence to avoid construction damage until they are removed.

C. Contractor is not to remove or work on any salvage material until after the Owner, or designated agent, has determined the limits of the salvage and work area, and has given the Contractor written consent to proceed.

1.6 REMOVAL OF SALVAGE MATERIAL

A. Description of Work: The Contractor shall provide all labor, tools and materials necessary to remove salvage plants from the ground, frond- and rootball-protect them (when required) and transport them to the holding facility.

B. If it is determined that any of the trees to be transplanted can be immediately located to their new location, the Contractor may do so, but must water, maintain and protect the trees during construction.

C. If any trees are to be installed directly onto another site on UA property, the final site will need to be Bleu staked. Allow time to get approval.

D. Access: Access shall be entirely within the Owner's property. Damage to surrounding areas not within the property, including but not limited to buildings, curbs, paving, vegetation and utilities, shall be the Contractor's responsibility.

E. The Architect will also identify areas within the property that are not to be disturbed. Any damage within these areas will also be the Contractor's responsibility. If designation of these areas makes access impossible, Contractor shall notify the Architect.

1.7 PROTECTION

A. Contractor shall provide barrier protection to warn pedestrians about the plant excavations, and reasonably prevent someone from falling into one.

1. Palms should be planted immediately or stored for no more than 48 hours in a shaded area where the total tree shall be misted frequently.

2. Avoid storing on an asphalt surface.

3. Covering material must allow air movement so that heat does not build up under the covering.

4. Do not use plastic or rubberized tarpaulins.

5. Do not stack palms, but lay them in a single layer on a flat surface.

6. If the trees are stored for more than a day, the rootballs must be covered with a burlap tarp and kept moist.

7. Planting delays may result in rejection of the palm.

B. Tagging and preparation:

1. Exercise extreme caution while pruning palms, to prevent spread of vascular diseases. Dip pruning tools in a sterilizing agent before beginning pruning and before moving from one palm to another.

2. After tagging of the palms, remove all thatch or dead leaves and cut back all resulting leaf bases to within 2 inches of the base of the trunk. Do not use chain type saws for pruning. Do not cut into trunk.

3. The crown of the palm shall be reduced to leave at least 1/3 of the green fronds during shipping.

4. Use soft rope (organic twine) to tie remaining fronds to protect crown bud.

5. Do not permit fronds to become damaged by means of restraint.

C. Loading and unloading:

1. A lattice type crane, a telescoping type crane or a specially designed tree crane is acceptable for lifting and off-loading palm trees.

2. For transporting, the trailer used shall be long enough to avoid damage to the heart of the palm.

3. Loading and unloading of palms must be accomplished with the aid of nylon or fabric sling/straps with a minimum width of 4 inches.

4. Palms should be carefully lifted off the truck setting the choker to the outside so to turn the palm to the inside as it is lifted.

5. Extreme caution must be used to ensure that the heads are not caught, pulled on banged into or shaken; any of these can damage the bud.

6. Excessive scarring or trunk damage will not be permitted and will be cause for rejection of the palms at the project site.

1.8 COORDINATION

A. Prospective Contractors are encouraged to visit the job site prior to bidding on this project, and to satisfy their concerns as to the magnitude of the work involved.

B. Remove all debris, trash and excess materials found on site or generated by the Contractor's operations.

C. Prior to digging and transplanting of palm trees the Contractor shall notify the Owner's Representative at least two (2) working days before starting any work.

D. Contractor is to provide all water and coordinate between temporary and permanent irrigation systems.

1.9 WARRANTY

A. The Contractor shall warranty plants from damage caused by his own operations including boxing, holding and replanting. This warranty includes breakage of major limbs (after trimming), destruction of major root systems, excessive scarring to the trunk, and death from stress or severe insect damage.

B. Should replacement material be required under this warranty, Contractor is responsible for the procurement and transportation of the replacement material.

C. Plant materials shall be guaranteed for one year following final acceptance of planting operations under this section.

D. Guarantee nursery-grown palms against the bud rot *Thielaviopsis paradoxa,* the fungus *Fusarium oxysporum*, and the root disease *Phytophthora palmivora* and similar vascular infections for a period of six months from the start of the beginning of the maintenance period.

E. Replace without additional cost to the Owner all dead palms and all palms not in a vigorous condition as determined by the Owner's Representative. Replacement shall be when directed by the Owner's Representative.

F. Apply "Subdue" per manufacturers recommendation by flooding the planting basin as often as label permits during maintenance period.

G. Coordinate irrigation requirements of new palms with irrigation plans. The Contractor shall maintain the existing landscaping and irrigation systems.

H. Perform tensiometer testing and visual inspection of observation vents regularly during the maintenance period to verify the correct soil moisture at the surface and at the bottom of the rootball, report levels to the Owner's Representative in writing monthly.

I. Payment for Landscape Maintenance and Warranty shall be made in six equal monthly payments. The Landscape Maintenance and Warranty Period is part of the construction period and retention of line items will not be made until final acceptance.

J. Fertilize and apply soil and foliar drench as per Paragraph 3.3C of this Section.

K. Do not trim any green or partially green fronds during the maintenance period.

PART 2- PRODUCTS

3.1 PALM TREES

A. All palms shall have been grown in accordance with good horticultural practices under climatic conditions similar to those for the project for at least two (2) years prior to shipment to the site.

B. All palms shall be specimen quality, well-grown, symmetrical, without curvature or leaning trunk from the perpendicular and so trained or favored in development and appearance as to be superior in form, compactness and symmetry of crown. All palms shall be within one foot above or below the height specified, measured from the bottom of the crown bud to finish grade after installation.

C. All palms shall be sound, healthy and vigorous, well foliated prior to pruning and showing no signs of disease. They shall be free of disease, insect pests, eggs or larvae. They shall also have well developed root systems. All palms shall be

free from physical damage or adverse conditions which would prevent thriving growth.

D. Verify that all field dug palms contain an adequate root ball to guarantee transplantation. Do not wrap root ball in plastic. Do not install palms that have damaged root balls.

E. Minimum box size, minimum trunk caliper, and initial height are identified under each tree species.

F. For palm trees only, the height shall be measured from the ground line to the base of the growing bud.

3.2 ACCESSORIES

A. Clean washed concrete sand.

B. Frond Tie: Minimum 1/2 inch diameter soft sisal rope capable of maintaining frond in tied condition for 4 months.

C. PVC Pipe: Schedule 40, 4 inch diameter perforated pipe.

D. Filter fabric for covering PVC perforated pipe.

3.3 FUNGICIDES:

A. Where a product trade name or company is listed, "or equal" substitutions may be offered.

B. Soil Drench: "Subdue" by CIBA-GIEGY.

C. Foliar Drench:

1. "Kocide" Copper T.S. fungicide.

2. "Manzate", dithane flowable fungicide.

3. "Benelate" fungicide.

3.4 FERTILIZERS AND AMENDMENTS

A. Where a product trade name or company is listed, "or equal" substitutions may be offered.

B. "Wood-Ace" Palm Special fertilizer (11-4-6) as manufactured by Vigoro Industries.

C. "Soluble Stem" micronutrient fertilizer as manufactured by Peters Fertilizer Products of W.R. Grace and Company, Fogelsville, PA 18051.

D. "Minor-Gro" fertilizer as manufactured by W.R. Grace and Company, Fogelsville, PA 18051.

E. Hydrated urea.

F. "Basic H" as manufactured by Shaklee Corporation.

3.5 WATER

A. Water:

1. Clean, fresh, and free of substances or matter which could inhibit vigorous growth of plants.

2. Water shall not contain elements toxic to plant life.

PART 3 - EXECUTION

3.1 EXISTING PALM TREE REMOVAL/SALVAGE

A. Existing palms designated for removal shall be excavated, prepared for salvage, and tree- and rootball-protected.

B. Rootballs of existing palm trees to be transplanted shall have a minimum diameter of the trunk diameter plus 4 feet, and shall be at least 16 inches in depth.

C. Contractor shall protect existing plant material, walls, pavements, and other site amenities from damage.

3.2 EXCAVATION

A. A trenching machine, a backhoe with a narrow bucket or a properly sized tree spade is acceptable as the excavation equipment. The exact equipment used must be approved by the Owner's Representative.

3.3 EXECUTION OF PLANTING NEW PALM TREES

A. Layout palms at locations shown on the plans. Use 3 foot lath, color coded for each palm. The Owner's Representative will check location of palms in the field to exact position before planting begins.

B. Where palms are to be preplanted to permit site improvements to be installed around them, be responsible for the accurate layout of those palms, measured to their centerlines.

C. Provide protection of those palms while work is taking place. Provide bracing per drawings.

D. Provide regular irrigation as necessary until final acceptance. Vitamin B-1 shall be used per manufacturer's recommendations with the first watering.

E. Excavation

1. "Hand dig" planting pits and protect existing utilities, where utilities may be encountered.

2. The palm tree excavation shall be a minimum of 5 feet wide by 5 feet long By depth of rootball plus 12 inches.

3. It is acceptable for the final site grade around the palm to be 6 to 12 inches higher than the original soil line of the root ball.

4. The depth of the pit shall be approved by the Owner's Representative prior to planting the tree.

F. Water-test tree pits:

1. Water test each tree pit for drainage by filling the holes twice in succession with water.

2. If when filled with water the second time the pit fails to drain within 24 hours, then additional excavation is necessary to break through the impermeable layer or to provide a thick under layer of clean washed concrete sand below the root ball.

3. The cost for over excavation and for the installation of a drainage chimney will be considered should the tree pit not drain.

G. Clean moist washed concrete sand should be added to the bottom of the hole and tamped or water jetted, prior to insertion of the tree.

H. Install drainage and viewing vent pipe(s) in each tree pit to assure wetting of the whole root ball and to enable monitoring and viewing of the tree pit chamber.

I. The vents shall be 4 inch diameter perforated PVC, with sufficient length to extend to the bottom of the tree pit. Provide filter cloth to cover perforated PVC pipe.

J. Do not backfill drainage or viewing pipes.

K. Backfill shall be clean site soil. Palms shall be placed in the pit and watered in as they are backfilled. Watering shall be done with a pipe sticker, six foot length topped with a 90 degree elbow and placed on the end of at least a 3/4 inch hose with adequate volume. One laborer shall work the sticker up and down, washing the soil down around the rootball as the backfilling is accomplished. The backfill soil shall be thoroughly saturated, all around the periphery of the root ball, before going on to the next palm. It is of the utmost importance that this procedure occur as each palm is being planted, not later in the day, or the next day.

L. Apply fertilizer amendments during planting by mixing one ounce of "Basic H" and two tablespoons of "Stem" in a 5 gallon container of water. Drench area around each palm when backfilling is almost complete. Water in thoroughly.

M. A 6 inch deep swale shall be made around each palm tree to provide water holding capability.

N. After planting, the crown buds of all the palms shall be within 1 foot of the designated palm height above finish grade.

3.4 FUNGICIDE

A. After planting, drench the soil with the fungicide, "SUBDUE" per manufacturers recommendations by flooding the planting basin. Reapply as often as label permits throughout the maintenance period.

3.5 IRRIGATION

A. It is essential that irrigation be deep enough to assure wetting of the whole root ball. Vitamin B1 shall be used per manufacturer's recommendations with the first watering.

1. Maintain the irrigation system to the existing trees and supplement additional water to newly planted trees as necessary for establishment.

2. Check for water penetration as well as drainage throughout the root zone at least once a week and monthly thereafter for duration of warranty. These findings shall be entered into a log with the dates and initials of person verifying the drainage. Monitoring shall be done the day prior to applying supplemental water. After the initial watering-in, water the palms with a good soaking, 40-50 gallons per palm every day. Watering amounts and schedule are estimates and are subject to change by Owner's Representative after reviewing the log and observing in the field.

3.6 FERTILIZING

A. After four to six weeks, apply four pounds per palm tree and at six month intervals apply 5 to 6 pounds per palm tree of "Woodace Palm Special" fertilizer in a one inch band around the base of each palm.

B. After 14 days then monthly, spray the fronds (foliar drench) with the following mixture. No compounds shall exceed manufacturers recommended rate. The following rates are for a 100 gallon tank mix.

1. "Kocide" 101 w.p. at 3/4 pound; or "Manzate" at one quart.

2. W.R. Grace, "Minor-Gro" at 1/2 cup.

3. Hydrated urea and five cups or 2-1/2 pounds.

4. Spread sticker at 8 ounces "Basic H", by Shaklee Corp., Hayward California.

5. "Benlate" at one pound.

END OF SECTION

Attachment 7

Tools for Assessing and Managing
Community Forests

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Applications

Applications Links

- Applications
- i-Tree Eco
- i-Tree Streets
- i-Tree Hydro

i-Tree Urban Forest Assessment Applications

i-Tree version 3.0 offers two primary urban forest assessment applications: i-Tree Eco, previously known as UFORE and i-Tree Streets, previously known as STRATUM. i-Tree Hydro (beta) is currently in the final stages of development and will be available later during 2009.

Based on years of US Forest Service research and development, these innovative applications provide urban forest managers and advocates with tools to quantify ecosystem services and benefit values of community trees at multiple scales. The ability to articulate the significance of community trees in terms of pollution mitigation, storm water run-off reduction, carbon sequestration and storage and more has allowed i-Tree users to improve tree management, plan strategically, increase community awareness, engage decision makers and build new partnerships. Click on the Learn more links to further explore the i-Tree Applications.

i-Tree Eco

i-Tree Eco – is an adaptation of the Urban Forest Effects (UFORE) model which provides a broad picture of the entire urban forest. It is designed to use field data from complete inventories or randomly located plots throughout a community along with local hourly air pollution and meteorological data to quantify urban forest structure, environmental effects, and value to communities.
Learn more>

i-Tree Streets

i-Tree Streets focuses on the benefits provided by a municipality's street trees. It makes use of a sample or complete inventory to quantify and put a dollar value on the street trees' annual environmental and aesthetic benefits. Streets also describes urban forest structure and management needs to help managers plan for the future.
Learn more>

i-Tree Hydro (beta)

i-Tree Hydro (beta) will be released later during 2009. This new application is designed to simulate the effects of changes in tree and impervious cover characteristics within a watershed on stream flow and water quality.
Learn more>

CAMPUS ARBORETUM
THE UNIVERSITY OF ARIZONA.

UA STREET TREES SHRINK
UA's CARBON FOOTPRINT -

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520-621-1582

The results are in! The Campus Arboretum is proud to report data from our Street Tree Inventory, a project in collaboration with the City of Tucson in documenting tree species distribution, determining annual net costs/benefits, and establishing priorities for maintenance in the urban forest.

The UA Campus is an oasis in the middle of Tucson, with over 2000 UA trees lining the streets we service. These street trees contribute to the quality of life for all our neighbors, providing shade on pavements, and reducing air pollution, storm-water and the University's 'carbon footprint'.

Although there are over 7000 individual trees on the UA campus, only the 2000 trees directly flanking public streets were counted in this study. Since many of the UA's largest trees are situated in the interior of the campus, we can only guess at the greater benefit (possibly 3-4 times larger) that might result from an inventory of the entire collection.

Annual Contributions of the 2000 UA Street Trees:

Annual net CO_2 sequestered/held	246,620 lbs CO_2 per year
Annual reduction in energy costs for UA facilities	$18,230 per year
Total reduction of emission, pollutants, particulates	9,994 lbs particulates per year
Total annual rainfall or storm water intercepted in gallons	1,096,871 gal per year

As trees age, their benefits rise, but then may fall. As we plant more small trees, we ensure increased potential benefits for ensuing years. As older trees are removed, the ratios shift. Sometimes an older tree is less efficient in stormwater uptake, but it holds more Carbon in its trunk and branches. The STRATUM program model calculates yearly benefits for the inventoried species, based on this year's snapshot.

Assumptions of the STRATUM software program, part of the i-Tree Suite developed by the Center for Urban Forest Research at UC Davis:

Each species of tree has an average life span.
Each individual tree's current condition gives potential to reach that life span.
Each tree's current size relates to ability to take up water and provide other benefits.
Orientation on the streets influenced default shade benefit.
Aesthetic benefits relate to median home costs in a particular area.
Energy benefits depend on UA's cost per KWH of electricity and Therm of gas.

September, 2008. Revised from a shorter version published in Campus Arboretum Newsletter, fall 2008.

i-Tree Streets' Value to College Students

In a University of Arizona Campus Arboretum (Tucson, AZ) study, a student used increasingly popular urban tree inventory software STRATUM, now called i-Tree Streets (www.iTreeTools.org), to measure all of the campus street trees. According to the student's report, the several thousand street trees around campus provide an immense ecological benefit to the area population. Roughly 2,000 of an estimated 7,000 total trees on campus sequester one quarter million tons of CO_2 annually and impressively save more than $18,000 in energy costs. These trees take approximately 10,000 pounds of pollutants out of the air, and absorb more than one million gallons of rainfall. AN

California's Urban Forest Health Assessment

According to the U.S. Forest Service, The Center for Urban Forest Research will be conducting a health assessment of California's urban forests using existing tree inventory data. Conducting risk assessments for each population inventoried will result in developing risk reduction considerations. The goal of the assessment is to determine the level of risk posed by pests and diseases to trees in the urban environment. The two-year study is funded by the U.S. Forest Service, Forest Health Protection. AN

Arborist News: Oct 2009. International Society of Arboriculture.

CAMPUS ARBORETUM

THE UNIVERSITY OF ARIZONA.

UNIVERSITY OF ARIZONA CAMPUS TREES

CARBON SEQUESTERED FISCAL YEAR 08-09

The University of Arizona has 7925 trees on the campus in Tucson Arizona. These trees absorb and hold CO2 as they grow and age; the amounts held (sequestered) can be calculated on an annual basis with the use of public-domain software programs.

In 2007-08, using i-Tree software, developed by the USFS Center for Urban Forest Research (see web site at http://www.fs.fed.us/psw/programs/cufr/), the Campus Arboretum has inventoried 2130 trees along the city streets to assist the City of Tucson in a larger city-wide inventory. Those 2130 trees were listed by species, size and condition. Outputs from the software yield the following information:

- CO2 sequestered on an annual basis = 106,182 lbs
- reductions of this amount due to aging = (9501 lbs)
- reductions due to maintenance release = (1391 lbs).
- Net CO2 for the 2130 UA street trees = 95,290 lbs C held in 2007-08

Extrapolating from the data on the 2130 street trees, which comprise 26% of the campus's tree collection, we believe that a 2008-09 calculation would yield the following information:

- CO2 sequestered during 08-09 = 408,392 lbs
- Reductions of this amount due to aging = (36,542 lbs)
- Reductions due to maintenance release = (5350 lbs)
- Net CO2 for ALL (7925) existing campus trees = **366,500 lbs C held in 2008-09**

This extrapolation is probably conservative (i.e., Carbon sequestered during 08-09 might have been a larger figure). The street trees counted in the first inventory are smaller in some cases than the trees on the interior of the campus. However, new trees are planted with each new building or landscape space, and these would be smaller than the street trees.

All the existing UA trees (7925 trees) are healthy for the most part. Those trees not thriving are routinely removed, but young ones are installed in their place. We feel it is safe to use the assumptions of the i-Tree model with respect to the growth rates and healthy carbon uptake.

The i-Tree suite development included handbooks and information measured for specific regions of the country. From the Desert Southwest Community Tree Guide, the following passages (p. 74) describe the Southwest model:

Calculating Carbon Storage: Sequestration, the net rate of CO2 storage in above and below-ground biomass over the course of one growing season, was calculated using tree height and DBG data with biomass equations (Pillsbury et al.1998). Volume estimates were converted to green and dry weight estimates (Markwardt 1930) and divided by 78% to incorporate root biomass. Dry weight biomass was converted to carbon (50%) and these values were converted to CO2. The amount of CO2 sequestered each year is the annual increment of CO2 stored as trees add biomass each year.

Power Equipment releases CO2: A value of 0.08 CO2/inch DBH (0.014 kg CO2/cm DBH) for tree related emissions was utilized for yard and public trees based on gasoline and diesel fuel consumption for street and park tree care in Glendale (Rodriquez and Van Meeteren 2004), recognizing that it may overestimate CO2 released associated with less intensively maintained residential yard trees.

Decomposition releases CO2: To calculate CO2 released through decomposition of dead woody biomass, we conservatively estimated that dead trees were removed and mulched in the year that death occurred, and that 80% of their stored carbon was released to the atmosphere as CO2 the same year (McPherson and Simpson 1999).

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