

No Net Loss of Forest Canopy Tree Bank

In 1999, The Emory University Board of Trustees adopted a no net loss (nnl) of forest canopy policy. This policy reinforced a similar policy adopted by the Committee on the Environment. Since that time we have been using a calculation for tree replacement developed by James Johnson of Campus Planning. For the method used for calculating no net loss see appendix 1. Frequently, the number of replacement trees requires is more than the building site can accommodate. This document outlines the no net loss tree bank that will be used for determining how much money should be set aside from the building budget to accommodate the trees that will be planted off-site

1. For a building project, calculate the amount of nnl canopy replacement.
2. Translate the canopy replacement to the number of replacement trees.
3. Calculate replacement cost based on 2.5 to 3 inch or 3.5 to 4 inch caliper trees.
4. Determine the number and sizes of trees that reasonably can be replanted on the project site (or areas immediately adjacent to the site).
5. Calculate the cost of individual trees. Replacement cost of the individual trees will be set at the beginning of the project based on the average installed cost of trees typically available. The Emory Project Manager will meet with the Director of Engineering and Exterior Services and the Campus Landscape Architect to determine the cost.
6. Subtract the replacement value (#5) from the nnl (#3) to determine the leftover nnl tree replacement money.
7. If the value of #6 is positive, then transfer that amount into the tree fund.
8. Use the tree fund for planting trees as designated in the current reforestation plan.
9. Tree bank funds are not intended for street trees (unless street trees are planted in contiguous groups or groves) or for tree maintenance.
10. Species replacement should be consistent with the campus master plan.

Appendix 1

No Net Loss of Forest Canopy Policy

Executive Summary

In the past five years Emory University has experienced unprecedented growth. A consequence of this growth has been a significant loss in the quantity and quality of Emory's forested areas. The Emory University Senate adopted a Position Statement On Forest Use that included support of the policy of no net loss of forest. However no mechanism was put in place to insure that trees removed during development were replaced in a way to achieve no net loss. The only means available is the DeKalb County Tree Preservation Ordinance. However, the county ordinance is not designed with no net loss in mind. The goal of the county ordinance is to provide for a minimum number of canopy trees in commercial and residential development. It does not provide for the replacement of the actual number of trees removed during development or for the replacement of equally valuable understory, shrub, and groundcover vegetation. The following No Net Loss of Forest Policy attempts to provide a simple and reasonable method for calculating forest replacement by providing for:

1. A formula to determine individual and total tree canopy.
2. A formula for replacement canopy.
3. A formula for replacement shrub and groundcovers.
4. Recommendations for implementing the policy in new construction projects.

Introduction

The intent of the No Net Loss of Forest Policy is to achieve no overall loss of forest canopy due to construction or renovation of new buildings. Secondary goals are to improve the quality of existing forested areas and increase the overall quantity of forested areas on the Emory University campus.

Following is an explanation of the method to be used to determine forest canopy and the resultant replacement requirement.

Determining Tree Canopy

In arboricultural practice the tree canopy and root zone is assumed to be directly proportional to the caliper or diameter of the tree's trunk. The canopy and root zone is assumed to equal 1' (one foot) to 1.5' (one and one-half feet) of radius per 1" (one inch) of trunk diameter (diameter measurement is taken at a point 4'-6" (four feet six inches) above the ground elevation. This measurement is commonly referred to as Diameter Breast Height or DBH.

Existing trees to be removed shall be categorized as follows:

1. Mature Hardwoods, deciduous trees greater than 6" (six inches) but less than 24" (twenty-four inches) DBH.
2. Specimen Hardwoods, deciduous trees 24" (twenty-four inches) and greater DBH.
3. Mature Softwoods, evergreen trees greater than 6" (six inches) but less than 24" (twenty-four inches) DBH.

4. Specimen Softwoods, Evergreen trees 24" (twenty-four inches) and greater DBH.
5. Immature/Understory, all trees less than 6" (six inches) DBH.
6. Specimen Understory, understory trees greater than 10" (ten inches) DBH.

Calculations for determining existing canopy shall be as follows:

1. Mature Hardwoods; 1' (one foot) canopy radius (CR) per 1" (one inch) of DBH.
2. Specimen Hardwoods; 1.5' (one and one-half feet) CR per 1" (one inch) of DBH.
3. Mature Softwoods; 1' (one foot) CR per 1" (one inch) of DBH.
4. Specimen Softwoods; 1.5' (one and one-half feet) CR per 1" (one inch) of DBH.
5. Immature/Understory trees shall be replaced on a tree for tree basis with the replacement tree being a minimum 2" (two inch) caliper tree.
6. Specimen Understory; 1' (one foot) CR per 1" (one inch) of DBH.

The canopy area for each individual tree is determined with the formula for the area of a circle: $\text{area} = \pi (3.142) * r^2$ (radius squared). All individual areas are added together to determine the total canopy area of removed trees (rounding to the nearest whole number).

Formula examples

A 10" DBH Oak tree would have a canopy radius of 10', or an area of 314 sq. ft.

A 26" DBH Oak tree would have a canopy radius of 39', or an area of 4779 sq. ft.

Calculating Replacement Canopy

Replacement canopy will be achieved by replanting with species similar to those being removed or as approved by Emory Facilities Management. The intent is to reach a compromise between economy and environment. Replacing tree for tree will not adequately meet the environmental needs and does not reflect the true value of a mature tree. While on the other hand, replacing the total square footage of canopy to be removed with new canopy could place an undue hardship on the building construction budget. Therefore it is necessary to determine a standard value for each replacement tree. The replacement trees shall be 2 – 2.5" caliper or 3 – 4" caliper trees with a predetermined replacement canopy area value depending tree type. The replacement canopy area values were determined by averaging the expected mature canopy areas (as listed in Dirr, Michael. 1990. *Manual of Woody Landscape Plants.*) of those trees included in the Landscape Master Plan Palette of the Emory University Campus Design Guidelines. The replacement canopy area of a 2 – 2.5" tree will be 1/3 of the mature canopy area and a 3 – 4" tree will be 2/3 of the mature canopy area. The total replacement canopy shall meet or exceed the total canopy area of removed trees. The replacement trees shall have the following replacement canopy area values:

Hardwoods and Softwoods

1. 2 – 2.5" (two to two and one-half inches) equals 471 sq. ft. of replacement canopy
2. 3 – 4" (three to four inches) equals 942 sq. ft. of replacement canopy.

Understory

1. 2 – 2.5" (two to two and one-half inches) equals 100 sq. ft. of replacement canopy
2. 3 – 4" (three to four inches) equals 200 sq. ft. of replacement canopy.

Formula examples

If a building project were required to remove a number of trees, which had a total canopy area of 41,234 sq.ft. the replacement could be achieved several ways. For example:

1. 44 3 – 4” caliper Hardwood and/or Softwood trees ($44 * 942 = 41,448$ sq.ft.).
2. 88 2 – 2.5” caliper Hardwood and/or Softwood trees ($88 * 471 = 41,448$ sq.ft.).
3. 30 3 – 4” caliper Hardwood and/or Softwood trees and 65 3 – 4” caliper Understory trees ($30 * 942 + 65 * 200 = 41,260$ sq.ft.).

Calculating Shrub and Groundcover Replacement

The preceding formulas provide for the replacement of canopy and understory trees but do not provide for the replacement of the shrub and groundcover vegetation. Replacement of only the canopy and understory does not accurately reflect the forest ecosystem. For that reason it is necessary to replace the shrub and ground layer vegetation. The first step is to determine the complexity of the forest being removed. The complexity of a forested area is measured by the level of stratification in the plant materials that make up the forest. Those plant materials are the canopy trees, understory trees, shrubs and groundcover plants. Determining the complexity is a subjective exercise in judging the level of stratification present in a wooded area. This exercise will be completed by Campus Planning and the Committee on the Environment during the design phase using the following levels of forest complexity:

1. High stratification. Indicated by a complex distribution of canopy trees, understory trees, shrubs, and groundcovers. Examples of this type of forest complexity are Baker Woodlands, Harwood Forest, and Wesley Woods Forest,
2. Moderate stratification. Indicated by a small distribution of understory trees, shrubs, or groundcovers. Examples of this type are the Cox Hall Ravine and the wooded area adjacent to Boisfeullet Jones Center, Dowman Drive and Oxford Road.
3. Low stratification. Indicated by little or no understory, shrub, or groundcover vegetation. Examples of this type are the wooded areas adjacent to Clifton Road at the Law School and Performing Arts Center.

Once a determination of the complexity has been made a multiplier can be applied to the area of forest to be removed to calculate the quantity of shrubs and groundcover plants required to be installed. The levels of complexity will have the following multipliers:

1. High stratification - 0.75
2. Moderate stratification - 0.5
3. Low stratification – 0

Replacement shrubs and groundcovers will be native species included in the Plant Palette included in this document. Each replacement shrub will be a 3 gallon container (min.) with a replacement canopy value of 45 sq.ft. and each replacement groundcover will be a 1 gallon container with a replacement canopy value of 10 sq.ft. or 4” pots with

a replacement canopy value of 7.5 sq.ft. Replacement shrubs and groundcovers can only be utilized to meet the required shrub and groundcover replacement.

Formula examples

Using the previous assumption of a building project removing a total canopy area of 41,234 sq.ft. and assuming that the forested area has a High Stratification, the required shrub and groundcover replacement would be:

$$41,234 * 0.75 = 30,925.5 \text{ sq.ft.}$$

An example of meeting the 30,925.5 sq.ft. requirement is:

$$501 \text{ 1 gallon groundcover plants and } 347 \text{ 3 gallon shrubs } (699 * 10 + 532 * 45 = 30,930 \text{ sq.ft.}).$$

Replacement Plantings

The replacement trees and plants should be planted as near as possible to the area that was disturbed and in such a way as to create a new forested area or enhance an existing forested area. Due to the nature of the forest, shrubs and groundcovers and their shade requirements it may not be possible to plant all of the replacement plant material in one location. The canopy and understory trees could be planted at or near the building site. But the shrubs and groundcovers may need to be planted in another area with suitable conditions (existing dense canopy for example)

In addition, not all plant materials included in a building landscape plan can qualify towards meeting the replacement requirements. To qualify towards the replacement requirements the trees, shrubs, and groundcovers must be situated in such a way as to extend existing contiguous canopy, to enhance an existing wooded area, or to create large areas of potential contiguous canopy. Non-native plant species do not qualify as replacement canopy (refer to the plant palette).

No Net Loss / County Ordinance Comparison

It is difficult to compare the proposed No Net Loss Policy and the DeKalb County Tree Protection and Preservation Ordinance since the two have differing objectives.

The county ordinance is intended to insure that a minimum number of trees are left onsite post-development. Also the county ordinance is intended to deter wholesale clear cutting of forested areas in the construction of commercial and large-scale residential developments.

In contrast, the proposed No Net Loss Policy is intended to be used as a development tool for evaluating proposed construction sites and building design. Often, Emory projects either have the benefit of two or more possible sites or several building layouts. The proposed No Net Loss Policy encourages the study of sites and building designs to minimize site disturbance thereby affecting the fewest number of trees possible. It also provides a realistic method of calculating the required replacement quantity based on the actual impact of construction.

The Proposed No Net Loss Policy has been used experimentally in several recent Emory University construction projects of varying scales and the impact to cost has been minimal. For the Schwartz Performing Arts Center the additional cost was \$22,000. However, the removal of the trees allowed for a simplification of a wall design that saved the project approximately \$70,000. Applying the No Net Loss calculation to the Emory Conference Center Pavilion increased the cost by approximately \$6400. Applying the No Net Loss calculations to the Shuttle Road project added an additional \$19,840 to the total budget. As a percentage of the construction budget we estimate that the implementation of the No Net Loss Policy would result in a .4 to .6% increase in total construction cost.

Plant Palette

The following list is the recommended species of plant materials for plantings required by the No Net Loss calculations. Additional species will be considered for individual projects.

Canopy Trees

Acer rubrum	Red Maple
Acer saccharum	Sugar Maple
Betula nigra	River Birch
Carya glabra	Pignut Hickory
Carya tomentosa	Mockernut Hickory
Catalpa bignonioides	Southern Catalpa
Celtis lavaegata	Hackberry
Fraxinus americana	White Ash
Fraxinus pennsylvanica	Green Ash
Fagus grandifolia	American Beech
Ilex opaca	American Holly
Juniperus virginiana	Eastern Red Cedar
Liquidambar styraciflua	Sweet Gum
Liriodendron tulipifera	Tulip Tree
Nyssa sylvatica	Black Gum
Platanus occidentalis	Sycamore
Quercus alba	White Oak
Quercus falcata	Southern Red, Spanish Oak
Quercus coccinea	Scarlet Oak
Quercus lyrata	Overcup Oak
Quercus michauxii	Swamp Chestnut Oak
Quercus nigra	Water Oak
Quercus phellos	Willow Oak
Quercus prinus	Chestnut Oak
Quercus stellata	Post Oak
Quercus velutina	Black Oak
Pinus taeda	Loblolly Pine
Prunus serotina	Black Cherry
Salix nigra	Black Willow
Tilia americana	Basswood
Ulmus alata	Winged Elm

Ulmus americana

American Elm

Understory

Alnus serrulata

Tag Elder

Amelanchier arborea

Shadbush

Aralia spinosa

Devil's Walking Stick

Asimina triloba

Common Pawpaw

Carpinus caroliniana

Ironwood

Cercis canadensis

Eastern Redbud

Chionanthus virginicus

White Fringetree

Cladrastis lutea

Yellowwood

Cornus florida

Flowering Dogwood

Magnolia acuminata

Cucumber Tree

Magnolia virginiana

Sweetbay Magnolia

Ostrya virginiana

Eastern Hop Hornbeam

Oxydendrum arboreum

Sourwood

Robinia pseudoacacia

Black Locust

Sassafras albidum

Sassafras

Shrub

Aesculus sylvatica

Painted Buckeye

Cornus amomum

Swamp Dogwood

Dirca palustris

Leatherwood

Fothergilla major

Witch Alder

Hydrangea arborescens

Native Hydrangea

Ilex decidua

Deciduous Holly

Lindera benzoin

Spicebrush

Parthenocissus quinquefolia

Virginia Creeper

Rhododendron canescens

Piedmont Azalea

Rhododendron carolinianum

Catawba Rhododendron

Vaccinium spp.

Blueberry - Huckleberry

Vaccinium arboreum

Sparkelberry

Viburnum dentatum

Viburnum

Viburnum nudum

Smooth Witherod

Viburnum prunifolium

Black Haw

Groundcover

Campsis radicans

Trumpet Vine

Osmunda cinnamomea

Cinnamon Fern

Polystichum acrostichoides

Christmas Fern

Reforestation Plan

Documentation regarding the reforestation plan to be included when completed.

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