WEC278

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Conservation Subdivision: Construction Phase – Protecting Trees and Conserved Natural Areas[1]

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Figure 1. A large live oak tree with a raised boardwalk constructed nearby. Photo Credit: Mark Hostetler

As urban communities grow, design and management strategies for new developments become critical factors that determine impacts on natural resources. How can we accommodate growth and yet conserve natural resources, such as biodiversity, water, and energy? In this document, we focus on conserving biodiversity when land is subdivided. The term biological diversity or *biodiversity* refers to the variety of life and its processes. Biodiversity includes species diversity, habitat diversity, and genetic diversity. For the purposes of this article, we focus on biodiversity of *native* species. Native species are plants and animals that were present within a specific region before Europeans made first contact. Non-native (or exotic) plants or animals are defined as those species that were not present in the region before European contact.

Recently, a popular concept called *clustered development* or *conservation subdivision* has been advanced by the landscape architecture community. Conservation subdivision is intended to integrate growth with biodiversity conservation. Conservation subdivisions typically are developments where homes are clustered on small lots with the remaining areas conserved as open space.

The concept of conservation subdivision has gained traction in many planning and design fields. The goals for conservation subdivisions are twofold: 1) to improve biodiversity within a designated a subdivision; and 2) to minimize development-related impacts on surrounding habitats. Often, though, most of the effort is on the design of the entire site. To conserve and improve biodiversity within urban environments effectively, one must consider the following three phases of development: design, construction, and post-construction.

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The design phase is typically where, among other aspects, lot size and open space are designated, and roads are distributed throughout the site. Goals for the development project are discussed and prioritized. In this phase, homes and lots are placed across the site and the remaining area designated as (natural) open space. Basically, everything is laid out on paper and vertical structures (i.e. buildings) and horizontal structures (i.e. roads, lots, conserved areas, and shared spaces) are given specific spaces within the development.

Next, during the construction phase, a whole host of built environment professionals (e.g., architects, contractors, and subcontractors) take whatever is on paper and implement this on the ground, constructing homes, streets, waste treatment systems, and landscaped areas (i.e. sections and parks). In the absence of fully trained or engaged contractors or landscapers, many things can happen during this phase that could impact the viability of onsite and nearby natural habitat. For example, even if the most important large trees are preserved across the subdivision and built areas are designed around them, the placement of topsoil and routes used by heavy construction vehicles could impair the survival of these trees. If heavy vehicles continually run over the root zone of a tree or if topsoil is placed against the tree trunk, the roots may not be able to acquire nutrients, water, and oxygen and the tree may die.

In the final phase, post-construction, buyers purchase the homes, move into the community, and manage their own homes, yards, neighborhoods, and common areas. It is now the responsibility of residents to manage in ways that do not compromise the original intent of the community. Additional problems can arise if residents are not fully engaged – imagine residents moving in and planting invasive exotic plants in each of their yards. Residents could also improperly apply fertilizers and pesticides. The spread of invasive plants and stormwater runoff could then destroy or at least severely reduce the diversity of animals and plants found in the conserved areas.

Overall, these three phases must be addressed in order to create and maintain biodiversity within residential subdivisions. A series of EDIS documents, titled "Conservation Subdivision," discuss biodiversity conservation pertaining to all three phases of development: design, construction, and post-construction. This fact sheet focuses on decisions made in the construction phase. During the construction phase, conserved trees and natural areas can be heavily impacted by the construction process. Earthwork machines and the individual decisions contractors make can actually kill designated trees and harm the integrity of natural areas. This fact sheet discusses techniques and strategies that will minimize impacts on conserved trees and natural areas.

Construction Phase: Protecting Individual Trees

Trees and their root systems must be protected from damage during the construction process. Roots absorb the water and nutrients that are essential to tree health. Damage to the roots can therefore lead to the death of the tree, and compaction of the soil can hinder the tree's absorption of nutrients. Fences will prevent trucks and other heavy vehicles from running over the root zone, damaging trunks, and compacting the soil. Pay special attention to how much of the area around the tree is protected. It is not enough to have a fence or flagging just around the trunk of the tree. The roots extending all the way to the drip line (the outer edge of the leafy canopy) should be protected by a sturdy fence (Figure 2). Even with this method, 50% or more of the roots will be impacted by construction.

The single best factor that will help ensure the survival of a protected tree is irrigation during the construction phase. Stressed trees need plenty of water during the construction process, and this means watering each tree about 2–3 times per week to a soil depth of 30 cm. An application of 10–15 cm of organic mulch within the tree protection zone helps maintain soil moisture; do not place mulch against tree trunks because it could cause fungus growth near the base. If roots need to be pruned, first dig a 45-cm-deep trench on the outside of the tree protection zone with an air spade (which uses compressed air) and then cut the roots cleanly with a saw. This root pruning technique will limit extensive damage to the root zone.

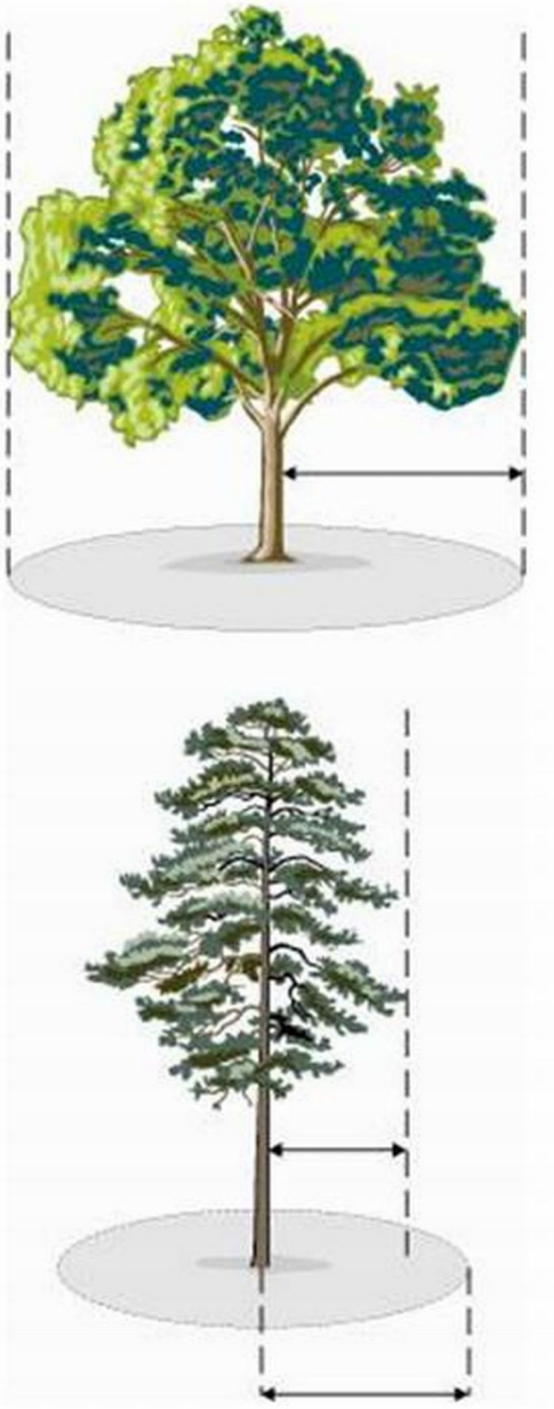

Figure 2. The top illustration demonstrates where the fence should be placed to protect the dripline for trees with wide crowns. For the bottom illustration, tall trees require a tree protection zone that is 1.5 times the dripline radius. Both techniques protect approximately 50% of the root zone. *Illustration Credit: Barbara Halderman*

Lowering or raising the soil grade around trees even by a few centimeters can effectively kill the trees, particularly in the tree protection zone. Lowering the grade removes important root mass and raising the grade smothers the roots and prevents oxygen from reaching them. Dumping fill near a tree and paving over the soil will also smother roots. Again, fences marking boundaries are essential: under no circumstances should heavy machinery be allowed to run over the soil within the tree protection zone. Over 90% of the relative compaction of the soil occurs within the first three tire passes, so if a truck mistakenly strays into the protection zone and backs out again immediately, the damage is done. Generally, hiring a certified arborist to oversee tree management can go a long way to protecting the health of preserved trees.

Another potential tree hazard can involve the placement of utilities. Typically, most utility lines (cable, telephone, etc.) are laid by digging trenches throughout the site. If the site is heavily forested, trenching can impact a large number of roots. The best and most cost-effective solution is to lay the utilities beneath the roads in the subdivision. In some cases, a road, footpath or some type of pavement may be placed near a tree, causing compaction and introducing an impervious surface where one did not previously exist. Depending on the tree species, a portion of the root zone can be compacted or paved over and the tree will remain healthy. If you see a tree that is located near construction, note how much of the root zone was protected. Ask a tree expert about the ability of that tree species to withstand soil compaction or pavement underneath the drip line.

How construction debris and chemicals are discarded is also important. Designate disposal zones away from any trees meant to be preserved. This debris can be toxic or can change soil pH due to leeching of chemicals into the ground, quickly killing the tree.

Finally, tree pruning is important and is best conducted or supervised by a trained arborist. Topping, a common but unfortunate pruning method of untrained individuals, involves shearing off large branches at the top of the tree. This method can cause decay in the branch stubs and trunk, weaken roots, and attract pests. Additionally, sprouts that form from topped trees are poorly attached and can break off.

Construction Phase: Protecting Natural Areas

Strictly regulate project site operations in and around protected areas during construction. At a minimum, there should be well-maintained silt fences around any wetlands or water bodies to prevent silt from entering these areas during construction. Runoff from a few storm events can carry enormous amounts of silt into a wetland and damage the ecosystem. Install silt fences properly and maintain them throughout the construction process.

Create natural buffers or transitional zones between human-disturbed areas and the protected areas. If the protected area is right up against a built area like a house or a road, then stormwater will run directly into the protected area from the human-dominated areas. Wetlands and small ponds with lawn extending to their margins are likely to be damaged. Lawns are usually managed using fertilizers, pesticides, and herbicides. Without a buffer, lawn chemicals can drain directly into nearby basins of water.

Flora (plant) and fauna (animal) surveys during the design phase will have identified invasive exotic plants and animals in the area. In addition to the design phase surveys, earthwork machines should be checked for invasive plant material, which can be carried from one construction site to the next. Most invasive plants are adapted to highly disturbed sites, and they can gain a foothold on a site during construction. Many invasive exotic plants can be identified during construction and removed before they start spreading. Mark such plants for removal by machinery or, in certain situations, chemical means. The construction phase is also the best time to begin a trapping program to control for pest animals like Cuban treefrogs.

Make an effort to keep contractors engaged and well-informed about appropriate construction techniques that minimize damage across a site. Where possible, train construction site superintendents to make them aware of environmental responsibilities during the construction phase. The main goal is to minimize the footprint of construction activity. Below, we highlight some of the most important sustainable construction practices:

1. Use stem wall construction for houses. Often, fill dirt is required to raise the grade of the lot to meet flood requirements. Fill dirt in the root zones of trees can be harmful, but stem wall construction allows only the footprint of the house to be raised to meet flooding standards. This way, the whole site does not need to be graded; the topsoil is conserved on a lot-by-lot basis. Additionally, supplemental landscaping is likely to establish more easily and grow better on a foundation of pre-existing topsoil rather than imported fill dirt.

2. Use construction site access and routes that coincide with eventual streets and roads. This will limit compaction of the soil to areas that will contain roadways for the subdivision. Clearly mark these vehicle routes.

3. Designate parking and staging sites for vehicles and building materials. Mark and limit these areas so contractors know where to park vehicles and to mix and store building materials. On individual lots, locate equipment and building materials in areas that are planned for future hardscapes, such as patios, pavement, etc.

4. Mix chemicals and materials only in designated areas that are properly managed. Even small chemical "spills" can leach into the ground and affect soil chemistry and ultimately plant growth.

5. Install significant fencing to protect significant areas and trees. Yellow plastic tape is not enough.

6. Take extra care with construction sited under trees, such as gazebos, decks, etc. Contractors should leave a minimal footprint and avoid compacting soil within the drip line of protected trees.

7. Avoid lowering or raising the grade around trees and natural areas because lowering the grade damages roots and raising the grade smothers them.

8. Do not run utilities through protected areas. Instead, lay them in shared trenches near or under pavement.

9. Carefully select equipment used on a site: the heaviest equipment is not always the best choice. Heavy equipment compacts and disrupts the soil, frequently more than necessary when lighter equipment would work just as well or better. Alternative equipment and systems can move heavy pieces of slabs or rocks; examples include pole slings and tripods with block and tackle. Much of this equipment, for instance motorized augers for post holes, is light enough to be carried by hand.

10. Develop covenants and contracts for site construction and have all contractors and subcontractors who come onto the site sign these agreements. In particular, contracts should clearly identify areas and landscape features that are protected; financial penalties should be listed for contractors who damage these areas. Better yet, include bonuses for contractors who do no damage to protected areas.

Additional Resources

For additional information on conservation subdivisions and conserving urban biodiversity, a variety of online guides, books and other publications exist.

Books and Scientific Publications

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Department of Wildlife Ecology and Conservation Extension http://www.wec.ufl.edu/extension/

Florida Fish and Wildlife Conservation Commission – Planting a Refuge for Wildlife http://myfwc.com/RECREATION/View_iybrefuge.htm

Living Green http://www.livinggreen.ifas.ufl.edu

Program for Resource Efficient Communities
http://www.buildgreen.ufl.edu

Sustainable Site Initiative
http://www.sustainablesites.org/

United States Department of Transportation, Fish Passage Synthesis Report
http://www.fhwa.dot.gov/engineering/hydraulics/pubs/07033/index.cfm

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