



Guidance on Usage of Trees in Detention Ponds for Carbon Sequestration & Water Quality Improvement

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1.0 Introduction

Planting trees in stormwater detention basins can offer several benefits including improving water quality, providing shade to reduce water temperature, and enhancing wildlife habitat and aesthetics. Trees also play a crucial role in carbon sequestration, which is the process of capturing and storing atmospheric carbon dioxide (CO₂). This memorandum will discuss key points about how trees contribute to the capture and storage of CO₂ and present methods for calculating carbon sequestration and water quality benefits of trees. Also, the logistics of planting trees in detention ponds, such as where to plant them, will be discussed. The findings of this memo are all based on information found in the sources included in the references section of this memo.



2.0 Trees in Detention Ponds

2.0.1 Benefits of Trees in Detention Ponds

Planting trees in detention ponds offers several benefits in addition to water quality and carbon sequestration. Trees also create habitats for various wildlife species, enhancing biodiversity in and around detention ponds. Furthermore, trees improve the visual appeal of detention ponds, potentially increasing property values in the surrounding area.

2.0.2 General Planting Guidelines

Trees or shrubs should never be planted on dam embankments or within 25 to 50 feet of the toe of the embankment. Roots can penetrate and weaken the embankment, increasing the risk of erosion and structural failure. Additionally, tree roots can facilitate the creation of seepage paths through an embankment, creating additional opportunities for failure. Trees also make maintenance such as mowing more difficult on dam embankments. Lastly, if a tree on or near a dam embankment falls, it can damage the dam.

Trees should also not be placed within 25 feet of inlets, outlets, spillways, and other pipe systems. Roots near risers and other structures can cause structural damage and interfere with the operation and maintenance of these critical components. Plant roots can obstruct water flow and damage these structures, leading to potential flooding or malfunction. Trees should also be kept away from sand filter bottoms as their roots can disrupt the filtration process.

If critical areas discussed above are avoided, trees may be planted on pond slopes that do not act as embankments, where the top of the pond ties into natural ground. Site specific conditions, tree choice, side slope, and maintenance issues should be considered before planting in these locations.

2.0.3 Tree Species in Detention Ponds

When selecting trees for detention basins, it is crucial to choose species that can tolerate both wet and dry conditions due to fluctuating water levels. Some well-suited trees include Bald Cypress, Red Maples, River Birches, and Sweetgums. A more thorough guide to tree choice and landscaping criteria in general is presented in the 2000 Maryland Stormwater Design Manual, Volume II, Stormwater Design Appendix A: Landscaping Guidance for Stormwater BMPs. A link to this document is provided in the **References** section.

2.0.4 Maintaining Trees in Detention Basins

Trees in detention basins should be inspected at least twice a year in the spring and fall, and after significant storm events. To ensure the health and longevity of trees in detention basins, a comprehensive maintenance plan is essential. Regular inspections should be conducted to identify signs of disease, pest infestations, or physical damage to evaluate the health and stability of the trees. Water management, mulching, soil health monitoring, and seasonal care are all fundamental practices that apply to trees in detention ponds just as they apply to trees in most other environments.



Erosion control measures such as planting ground cover or using erosion control blankets should be implemented around the tree roots. Finally, if pond volume loss is a concern, trimming the limbs along the tree trunk up to the 100-year water level elevation could preserve storage.

3.0 Trees and Carbon Sequestration

Trees play a crucial role in carbon sequestration, which is the process of capturing and storing atmospheric CO₂. There are two main types of carbon sequestration: geologic and biologic.

The geologic method involves storing CO₂ in underground geological formations. Biologic, or biosequestration, refers to the natural process of storing CO₂ in vegetation, soils, and aquatic environments. Plants absorb CO₂ during photosynthesis and store it in their tissues. This carbon can also be transferred to the soil, where it can remain for long periods of time. Forests, grasslands, and wetlands are significant contributors to biologic carbon sequestration. Additionally, certain practices like reforestation and soil management can enhance this natural process.

3.0.1 Role of Trees in Carbon Sequestration

Trees absorb CO₂ from the atmosphere through photosynthesis, storing it in their wood, leaves, and roots. They also contribute to soil carbon storage when organic matter decomposes. Protecting existing forests and managing them sustainably is crucial, as mature forests store significant amounts of carbon.

3.0.2 Method for Calculating Carbon Sequestration of Trees

The 1998 Environmental Protection Agency (EPA) memo titled "Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings" provides a detailed methodology for estimating the amount of carbon sequestered by individual trees in urban and suburban environments. According to the EPA memo, the subsequent steps should be followed in order to apply the EPA's method for calculating carbon sequestration by trees in urban and suburban settings:

1. Gather Tree Data

- Species: Identify the species of each tree.
- Age: Determine the age of each tree from the time it was planted.
- Size: Measure the diameter at breast height (DBH) of each tree.

2. Use Growth Rate Tables

- Refer to the growth rate tables provided in the document to find the appropriate growth rate for each tree species based on its age and size.

3. Calculate Annual Carbon Sequestration

- Apply the formula provided in the document to estimate the annual carbon sequestration for each tree. The formula typically involves multiplying the growth rate by the biomass of the tree.



4. Consider Non-Standard Trees

- For trees that do not fit the typical profiles used in the tables, the guidelines provided by the EPA should be followed for calculating carbon sequestration for non-standard trees.

The i-Tree Tools suite, which was developed by the United States (U.S.) Forest Service and will be discussed further in Section 4.0.2, also has the ability to calculate carbon sequestration capabilities of trees. The carbon dioxide tab specifically calculates the amount of CO₂ a tree can sequester over its lifetime, providing both current and future estimates.

There are several other tools available for calculating carbon sequestration, such as the Biological Carbon Sequestration Calculator by WKC Group which can calculate carbon sequestration specifically for trees. It allows users to input data related to tree planting and forest areas to estimate the amount of carbon dioxide that trees can capture and store, and EcoMatcher's CO₂ Sequestration Calculator can calculate the carbon sequestration for a single tree.

4.0 Trees and Water Quality

Safeguarding existing trees and introducing new ones in urban environments can help municipalities meet water quality standards, including total maximum daily load (TMDL) requirements and other federal stormwater management regulations.

4.0.1 Effects of Trees on the Quality of Stormwater Runoff

Trees significantly improve the quality of stormwater runoff through several mechanisms. Tree canopies intercept rainfall, reducing the volume and intensity of runoff, which helps to minimize soil erosion and surface water pollution. The shade provided by trees can reduce the temperature of the water in detention ponds, helping to prevent thermal pollution in downstream water bodies. Through the process of evapotranspiration, trees draw moisture from the soil and release it into the atmosphere, increasing soil water storage potential and reducing runoff.

Additionally, tree roots create channels in the soil, enhancing their ability to absorb and filter stormwater. Trees also absorb nutrients from the soil, which helps to reduce nutrient loads in stormwater runoff. Furthermore, tree roots stabilize the soil (except at dam embankments), preventing erosion and reducing sediment in runoff. These effects collectively contribute to better water quality and more effective stormwater management in urban areas.

Urban trees, particularly street trees, may contribute phosphorus to the environment due to the lack of a forest floor or intact riparian ecosystem to process leaf degradation. However, most studies have focused on the positive effects of urban trees on stormwater runoff quality.

4.0.2 i-Tree

The i-Tree Tools suite, developed by the U.S. Forest Service, helps quantify the benefits of urban trees, particularly in terms of runoff and pollutant removal. The i-Tree tool can be accessed through [i-Tree | U.S. Forest Service Research and Development](#). Two helpful components of this suite that estimate water quality benefits of trees planted are the following tools:



1. i-Tree Design is a tool that helps estimate the benefits of trees in urban and suburban settings. To use it, one must provide variables such as the tree species, diameter at breast height (DBH), tree condition, and location details (address, climate region). Building footprints and the age of nearby buildings can also be provided to assess energy savings gained from planting trees adjacent to buildings. The output data includes estimates of carbon sequestration, air pollution removal, stormwater interception, and energy savings due to shading and windbreak effects. These can be quantified for one year or over a period of many years.
2. MyTree is a more user-friendly tool designed to quickly assess the water quality benefits of trees. The tool requires most of the same input data as i-Tree Design. MyTree produces output data in a different visual style, placing focus on the economic benefits of carbon sequestration, air pollution removal, and stormwater interception benefits. The i-Tree suite also includes tools like i-Tree Eco, which evaluates tree inventory data to estimate environmental benefits, and i-Tree Canopy, which uses aerial imagery to estimate land cover and tree canopy. Other tools include i-Tree Landscape for mapping tree canopy and census data and i-Tree Species for selecting tree species based on ecosystem services. These tools help urban planners and environmentalists assess and enhance the benefits provided by urban forests.



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