



Trees and Water

**TREE CITY USA®
BULLETIN**

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Editor: Dr. James R. Fazio • \$3.00



***A**s the population of our nation grows and cities expand, the care of our finite water resource is becoming increasingly important. Trees play an integral role in the future quality and quantity of the surface water and groundwater that sustain us.*

A soils professor once told his students, “Don’t ever let me hear you call soil ‘dirt.’ Soil is not dirt. That thin layer of soil that covers our earth is essential to our very existence.” So it can be said of water — another resource we sometimes take too much for granted. Certainly there is plenty of it. As most schoolchildren know, oceans cover 71 percent of the earth’s surface. Unfortunately, that salty mass represents 97 percent of the world’s water supply, leaving only 3 percent fresh and drinkable.

Trees and water have an inextricable relationship and one that deserves the attention of tree boards, urban foresters, and anyone else concerned with the sustainability of our communities. George Perkins Marsh, considered by some to be the father of environmentalism, recognized this relationship and began sounding the alarm in 1874, just two years after

The intricate relationship between trees and water is increasingly important and represents two precious resources in need of careful management.

the first Arbor Day. In his book, *The Earth as Modified by Human Action*, Marsh warned of what happened to nations in the Mediterranean region when they stripped the trees from their land. His writing laid the foundation for forest reform in America and the laws and agencies that have protected our land and waterways since the dawn of the 20th century.

Today there is renewed concern. At least 36 states anticipate freshwater shortages in the near future. Climate change and mega-wildfires threaten our forests that provide surface water to more than 180 million Americans. Importantly, urban trees are part of the water picture, but they present us with a paradox. Our community trees use and need water, but they also contribute to the water cycles that make rain and provide a cost-effective way to help purify waterways through stormwater retention.



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How Trees Help

The majority of freshwater for our communities comes from streams and rivers that flow through forests. While rural forests are important for the essential service of filtering, storing, and slowly releasing water from rain and snow, urban trees provide services, too. In short, every tree counts.

MAKING RAIN

“If the forest disappears, the sky-roof of the world will collapse; nature and man will perish together,” a Native American proverb warns. Other native wisdom includes the Hawaiian saying, “The rain follows the forest.” Scientists debate about the degree to which these concepts hold up, and it is apparent that geography plays a role, but the basic idea that there is an important relationship between trees and atmospheric moisture is sound.

Evapotranspiration is at the heart of the rain-making concept. The “evapo” part comes from rainwater evaporating from surfaces, including leaves, and returning moisture to the atmosphere. The rest of the word is from the phenomenon by which water is drawn from the soil by roots, raised to leaves, and released into the air. Scientists believe that up to 40 percent of precipitation is due to evapotranspiration from forests; that number can be even higher in summer. Urban trees contribute to that life-giving water cycle right along with their rural cousins.

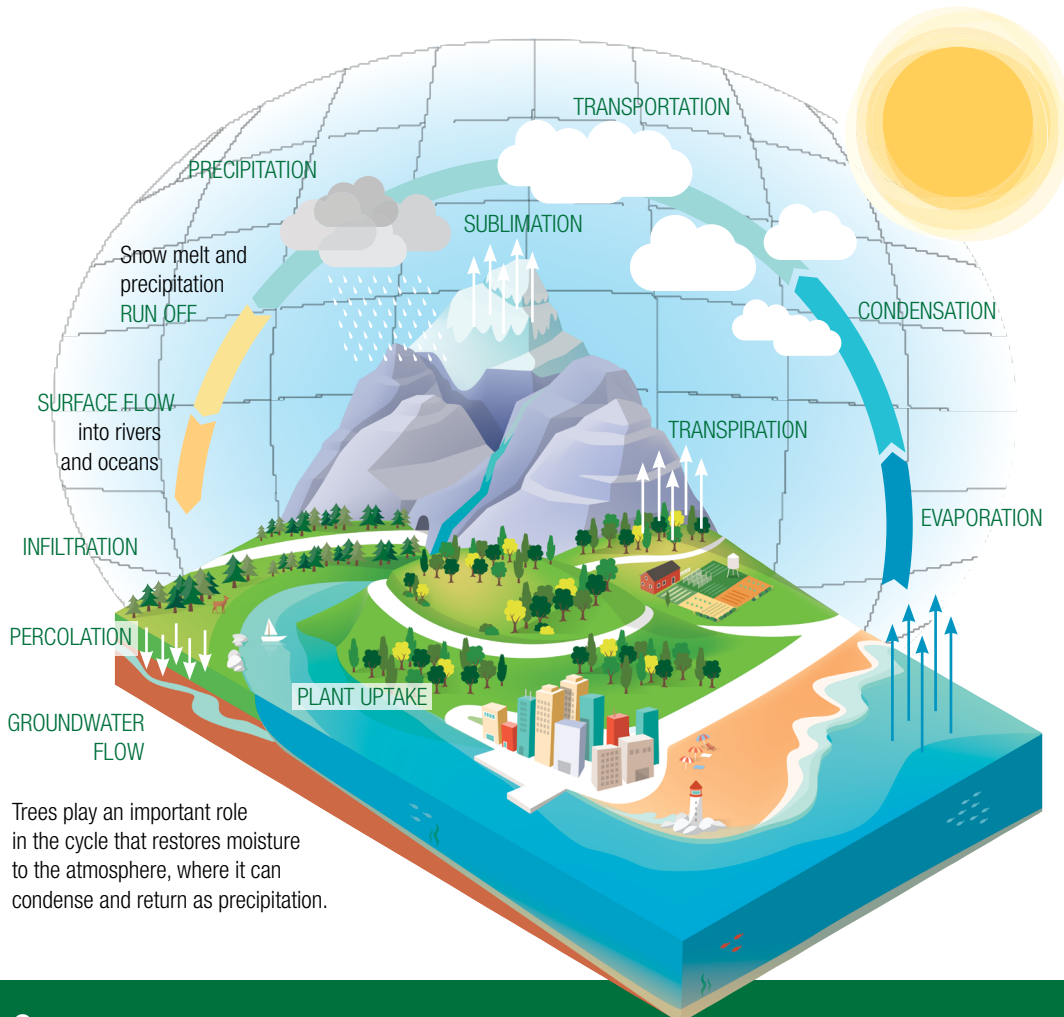


Depending on species and time of year, water retained on leaves can be significant.

RETAINING WHAT WE GET

Although community trees contribute to atmospheric moisture and help cool the hot summer air, their ability to help control stormwater is equally as important. “When it rains, it pours,” goes the old saying. And when this happens, it is important to reduce the quantity of water running into storm drains or cascading down streets and steep park areas. Trees tame stormwater by retaining huge quantities of water on their leaves and bark, making it available for evaporation or slowly releasing it into the soil. Trees also break the force of falling rain, preventing erosion. Fallen leaves even make a contribution by helping to make soil more spongy and absorbent. Together, not only does tree cover help harvest precipitation, it cleans our waterways by reducing the kind of fast runoff that picks up oils and landscape chemicals and deposits them as pollutants.

From an economic standpoint, the greater the tree canopy, the greater the retention of stormwater, and the less stress there is on sewer systems, catchment basins, and water treatment facilities. This attribute of trees can be measured, and its value to the community quantified. See page 7 for an example in El Paso, Texas.



Trees play an important role in the cycle that restores moisture to the atmosphere, where it can condense and return as precipitation.

i-TREE HYDRO

An innovative computer program called i-Tree Hydro has been developed by the U.S. Forest Service, the Davey Institute, and the SUNY College of Environmental Science and Forestry. This tool allows urban planners, foresters, and other stakeholders to simulate the effects of changes in tree and impervious cover characteristics on stream flow and water quality within a defined watershed. The model can graphically illustrate how best management practices (including urban forestry) can affect water quality. By altering precipitation inputs into the model to simulate storms, the relationship of management practices on flooding can also be shown. The implications for planning developments or other land use practices are almost endless.

Both rural and urban trees affect water quality; i-Hydro allows modeling a wide range of management scenarios.

The use of Hydro, like other i-Tree programs for assessing and managing community forestry, can be a powerful tool for planning and for showing the benefits of planting and caring for trees. More information is available at www.itreetools.org.

STORMWATER POSTER AVAILABLE FOR EDUCATION

The center pages of this issue are a reprint from an earlier issue of the Arbor Day Foundation's newsletter, Arbor Day. Visit arborday.org/trees/stormwater.cfm to find an interactive version of the poster. Move a lever across a scale from "Few Trees" to "Abundant Trees," and watch the urban landscape change dramatically; brief explanations pop up to highlight the importance of urban trees. The poster is also available to download for use as a striking visual aid and is free for educational purposes.



Trees Tame Stormwater

RAIN REFRESHES THE LAND AND NOURISHES THE GREEN LANDSCAPE.

But as houses, stores, schools, roads, and parking lots spread and natural tree cover is lost, so is the absorbing effect of vegetation and soil. The welcome rain becomes costly stormwater runoff. Without the benefit of trees and vegetated infrastructure, waterways are polluted as oils, heavy metal particles, and other harmful substances are washed away. Fish and wildlife suffer, drinking water becomes expensive or impossible to reclaim, property values are reduced, and our living environment is degraded.

Trees make a difference and every tree matters. It's never too late for municipalities, homeowners, businesses, and schools to plant abundant trees to retain more water on-site, enhance percolation into the soil, reduce the expense of pipes and treatment plants, and protect environmental quality.

FEW TREES

1 TREELESS PARKING LOTS are unsightly, add to stormwater runoff and are a source of heat that is not only uncomfortable, but increases air pollution.

2 TREELESS STREETS deprive the community of social benefits and ecological services. Following storms, water rushes along the street sides.

3 ASPHALT PLAYGROUNDS are unnatural places for children to play, contributing to a disconnect with nature. The solid surface also prevents rain from slowly recharging groundwater, instead adding extra volume to runoff.

4 TREELESS HOMES AND YARDS reduce property values, increase energy costs, and allow rainfall to rush into gutters.

5 EROSION-PRONE RIVERS eat away at adjoining property, destroy fish habitat, and fill in reservoirs and waterways with silt.

6 COMPACTED LAWNS without trees are not only less appealing, they often can't soak up heavy rains fast enough. Excessive runoff flows across sidewalks and down driveways and streets.

7 OVERWHELMED SEWAGE SYSTEMS can lead to untreated sewage being swept into waterways. Upgrades are expensive, adding to local tax burdens.





LEAVES break the force of falling rain and reduce soil erosion.

PERVIOUS MATERIALS let rainwater enter the soil.

TREE ROOTS bind the soil and guard against erosion. They also take up quantities of water that would otherwise be added to runoff.

ABUNDANT TREES

1 WELL-LANDSCAPED PARKING LOTS can be designed to slow storm runoff and beautify the community. They cool parked cars, reducing evaporated gasoline that contributes to air-polluting ozone. Tree shade also adds longevity to paved surfaces.

2 TREE-LINED STREETS retain large volumes of rainfall, reducing and cleansing runoff. They also increase property values, encourage shopping and business, reduce air pollution, calm traffic, and lower noise levels.

3 NATURE EXPLORE CLASSROOMS at schools can be combined with nearby community gardens and natural areas to serve as neighborhood parks. Their unpaved surfaces increase rainwater retention as they provide nature-rich play and learning spaces for children.

4 SHADED HOMES AND TREE-FILLED YARDS make urban life more pleasant and provide practical benefits such as lower heating and air conditioning costs and increased re-sale values. The tree canopy is also a major contributor to stormwater runoff reduction.

5 RIPARIAN BUFFERS consisting of trees and shrubs along waterways slow flood waters, reduce erosion, cool the water for fish, and filter harmful runoff from adjoining land.

6 RAIN GARDENS hold water on-site, reducing wasteful runoff and providing moisture for tree roots and flower beds. They also filter chemicals draining from walks, driveways, and streets.

7 MANAGEABLE STORMWATER RUNOFF results from abundant trees, multi-use catch basins and rain gardens, reduced impervious surfaces, and increased ground vegetation. The benefits are lower costs and a more liveable, sustainable environment.



How to Help Trees and Save Water

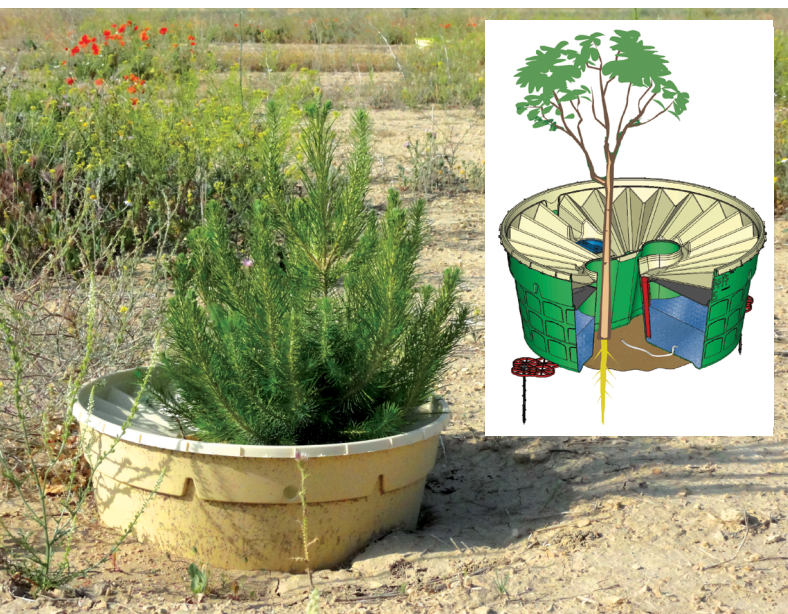
Enjoying trees in the landscape and saving water, even in drought-prone areas, can be compatible. Here are a few techniques that can help.

ESTABLISHING ROOTS

There is no getting around the need to water newly planted trees. However, here are two ways to keep watering to a minimum until roots are well-established.



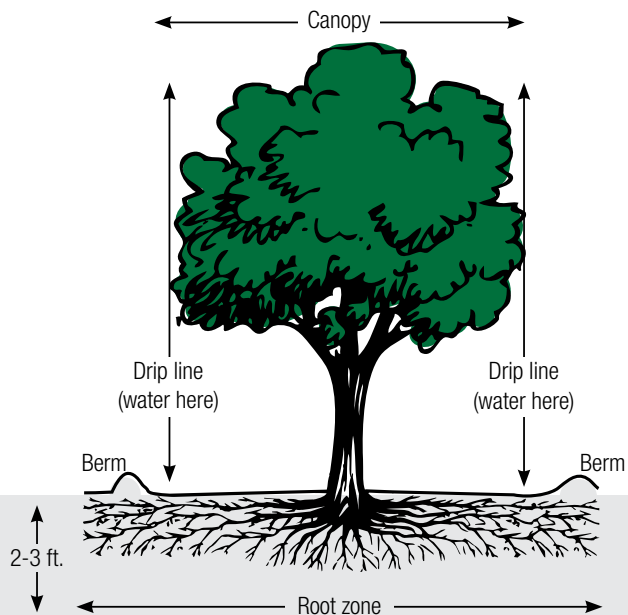
The Ooze Tube watering system available from the Arbor Day Foundation holds 15 gallons and has an adjustable drip gauge. It reduces water frequency and can be used on trees up to 6 inches in diameter.



The Groasis Waterboxx Plantcocoon® is a relatively recent invention from Holland and claims to eliminate watering. It is called a self-replenishing water battery and collects dew and infrequent rain and distributes it to the roots. Available from Dew Harvest L.L.C.

WATERING THE ROOT ZONE

As trees grow, most of the water-absorbing roots are at the drip line and beyond, not right next to the trunk. Water basins (shallow berms) will hold water where you want it, but make the basin diameter as wide as practical. Include 2–4 inches of mulch to help retain soil moisture and keep out weeds, but keep mulch several inches from the trunk.



MORE WATERING TIPS

- ✓ Water to the depth of root growth, usually 2–3 feet for trees beyond the sapling stage.
- ✓ Weekly watering may be sufficient, but frequency and depth of water saturation depends on climate, wind, and soil. Test for water penetration with a probe after watering. It should penetrate easily until it hits dry soil.
- ✓ Instead of relying on sprinklers or turf irrigation, use drip systems, bubblers, or soaker hoses.
- ✓ Expand your watering area as the tree grows. Roots usually spread up to four times the width of the canopy.
- ✓ Avoid wetting leaves with irrigation water.
- ✓ Use curb cuts, roof drains, and swales to direct rainwater to trees.

Trees and Water: The El Paso Example

Officials in the city of El Paso, Texas, face quite a challenge. The population is growing, water is not abundant, to say the least, and they know the value of trees. A 2014 community forest assessment using i-Tree Eco revealed 1.2 million trees but a canopy cover of only 5.1 percent. Annual ecoservices of the urban forest were placed at more than \$69 million. Included was the finding that El Paso's urban trees reduce 32.9 million cubic feet of stormwater, for a value of \$2.19 million in avoided costs. It also identified the tree species that are most effective at stormwater retention, providing a potential guide to future planting.

El Paso faces its community challenge in a number of ways:

PLANNING

Recognizing the importance of water and a changing future, a 50-year water resource management plan was completed in 1991 with several subsequent updates.

WATER STRATEGIES

In addition to the use of surface and groundwater, the city's multipronged approach to its situation includes:

- An aggressive water conservation program that involves both education and enforcement.
- A payment program on a per-square-foot basis created as an incentive for residents to convert turf to Xeriscape landscaping. Similarly, rebates are made

With a population of 700,000 and only 8 inches of annual precipitation, El Paso is a city that is challenged to carefully manage both its water and its trees.

available to residents to convert water-wasting "swamp coolers" to more efficient air conditioning systems.

- Reclaimed water used in golf courses, parks, school lawns, industries, and the electric power plant. Part of the city is served by a network known as "Purple Pipes," painted as their name implies to make them highly visible and part of public education.
- Desalination of irrigation return flow. The treatment plant is the first of its kind in the inland United States.

THE URBAN FOREST

City arborist Brent Pearson points out several ways that trees and water use are made compatible, with both serving the community sustainably.

- A list of site-appropriate trees and other plants is available to residents and developers.
- Tree planting on city-owned property, including street rights-of-way, is encouraged through the use of a 5,000-tree nursery. Reclaimed water is used at the nursery, which supplies about 1,000 new trees each year.
- Developers are required to plant approved, drought-tolerant trees. Xeriscapes and rock landscapes must also include trees.
- An irrigation system with battery-powered controls is used to establish trees in medians.
- Reclaimed water is used where available.
- Curb cuts have been made to harvest rainfall.
- Swales and the use of mulch are actively encouraged.



Urban Waters Partnership

Numerous state and federal agencies are involved with issues that impact trees and water. Perhaps the oldest are the U.S. Department of Agriculture's Forest Service and the Natural Resources Conservation Service, once called the Soil Conservation Service. Both have long been involved with best management practices that affect water, including using trees as streamside buffers. Another is the National Agroforestry Center. More recently and especially germane to city trees is the Urban Waters Federal Partnership, which is part of the Environmental Protection Agency. Created to improve coordination among federal and local organizations, it can help communities gain the greatest benefits from their water resources. This federal program:

- Promotes clean urban waters.
- Establishes the connection between urban residents and waterways.
- Fosters economic growth and improvements.
- Encourages water conservation.
- Determines community values and environmental issues.
- Measures success and monitors progress.

The Urban Waters Federal Partnership also has a grant program with a scope of interest that includes green infrastructure projects.



FOR MORE INFORMATION ...

In the coupon to the right, please note previous bulletins related to trees and water. Those of particular interest are in bold. For links to other helpful sources, please visit arborday.org/bulletins and click on the Supplemental Resources Library.

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All bulletins about trees relate in some way to the interaction of trees and water. However, the following may be of particular interest.

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|---|-----------------------|
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