Agroforestry

Working Trees for Water Quality

Working Trees: a partner in watershed management.

Agroforestry helps to protect water quality while achieving both landowner and community objectives.

Water is a precious national resource. Often, human activities degrade the quality of the water in the streams, lakes, estuaries, wetlands and aquifers on which we depend. Pollutants from agricultural and urban sources have made many of our waters unsuitable for swimming and fishing. Excessive sedimentation, pesticides and fertilizers are harming fish and other aquatic life. Changes in land use also have had a dramatic effect on floodwater damage and frequency. Both surface and subsurface drinking water supplies are being impacted by human activities.

Water quality is the end result of the individual actions of all the "neighbors" in a watershed. Rural landowners and community residents need to look beyond their own boundaries to improve water quality and coordinate water resource management.

Working Trees can help alleviate water quality and quantity problems. From upland areas down to the water's edge, *Working Trees* reduce and slow runoff and trap pollutants in both rural and urban settings.

Working Trees means putting the right trees in the right places and in the correct design to do specific jobs. Land managers, community planners and watershed residents can all use *Working Trees* to make high-quality water a reality.

This brochure illustrates water resource problems and ways the *Working Trees for Water Quality* are part of the solution.

Water Resource Problems

Too Much Runoff

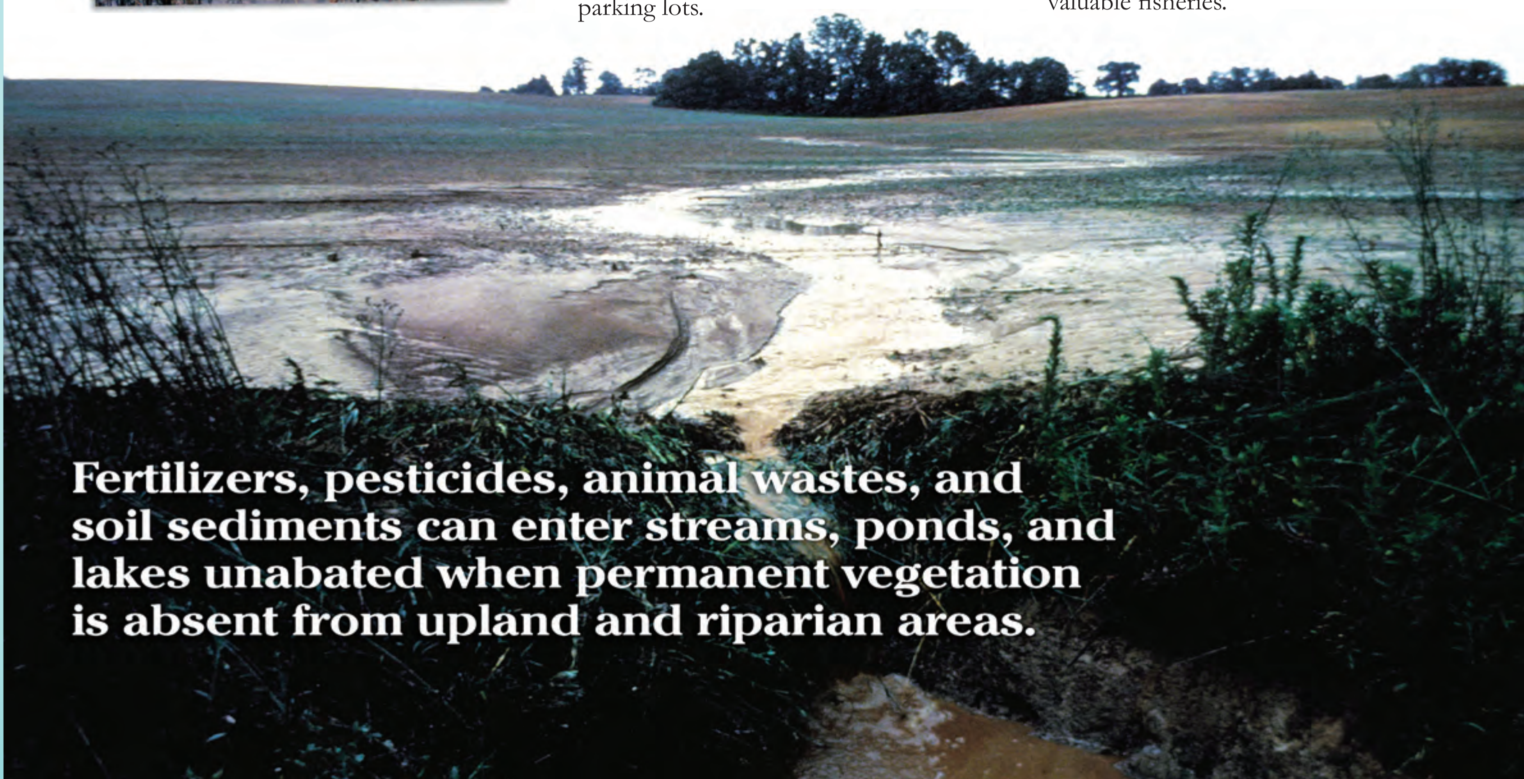
Displacement of permanent vegetation such as trees, shrubs and grasses by annual crops or community development increases the amount of runoff into streams and lakes, as well as the speed at which those waters are delivered. This rapidly moving runoff creates flooding and transports high levels of sediments, attached pollutants and dissolved contaminants into surface water. Increased runoff also causes the erosion of streambanks, resulting in the degradation of aquatic habitats and the accelerated deposition of sediments into rivers and reservoirs. When rain moves quickly off the land rather than being allowed to soak into the ground, it can't recharge soil moisture or maintain groundwater base flows.

Too Many Pollutants

Unfortunately, contaminants in many groundwater and surface water sources exceed national health and safety standards. Nonpoint source pollution, the leading cause of these water-quality problems, comes from both rural and urban sources:

- Fertilizers, herbicides and insecticides from agricultural fields and urban lawns
- Nutrients and bacteria from concentrated livestock operations
- Sediment from croplands, urban construction sites and eroding streambanks
- Oils, antifreeze and salts from city streets and parking lots.

The problems are spilling over into our coastal marine estuary ecosystems. The cumulative effect of a little more runoff from each field or community leads to very large problems, such as the 8,000-square-mile hypoxic zone in the Gulf of Mexico that develops each summer. Hypoxic conditions occur when excess nitrogen from the Mississippi River Basin enters the Gulf and triggers a biological chain reaction that depletes dissolved oxygen from the water, impairing valuable fisheries.



Incorporating *Working Trees* into the landscape at strategic positions in the watershed provides ecological services that protect water resources and meet landowner objectives.

Integrated Watershed Approach

Most watersheds support a mixture of land uses, such as agriculture, forestry and communities. An integrated watershed approach is an effective way to manage water resource issues. This approach coordinates the planning and activity of all land uses to address ecological, social and economic concerns throughout the watershed. A linked system of upland and riparian agroforestry plantings, in conjunction with other conservation practices, can restore many ecological functions and reconnect hydrologic processes.

A. Silvopasture

Combined timber/grazing systems increase a farm's per-acre income and minimize water-quality problems associated with livestock waste.

B. Windbreaks

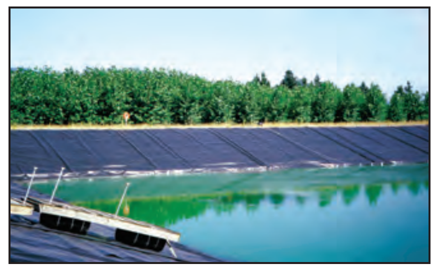
Airborne pollutants, including dust and chemicals, are trapped and filtered by windbreaks, preventing deposition into road ditches, streams and lakes.

C. Alley Cropping

Growing agricultural crops between rows of trees can provide on-farm income from annual and long-term products, while reducing soil erosion and improving water quality.

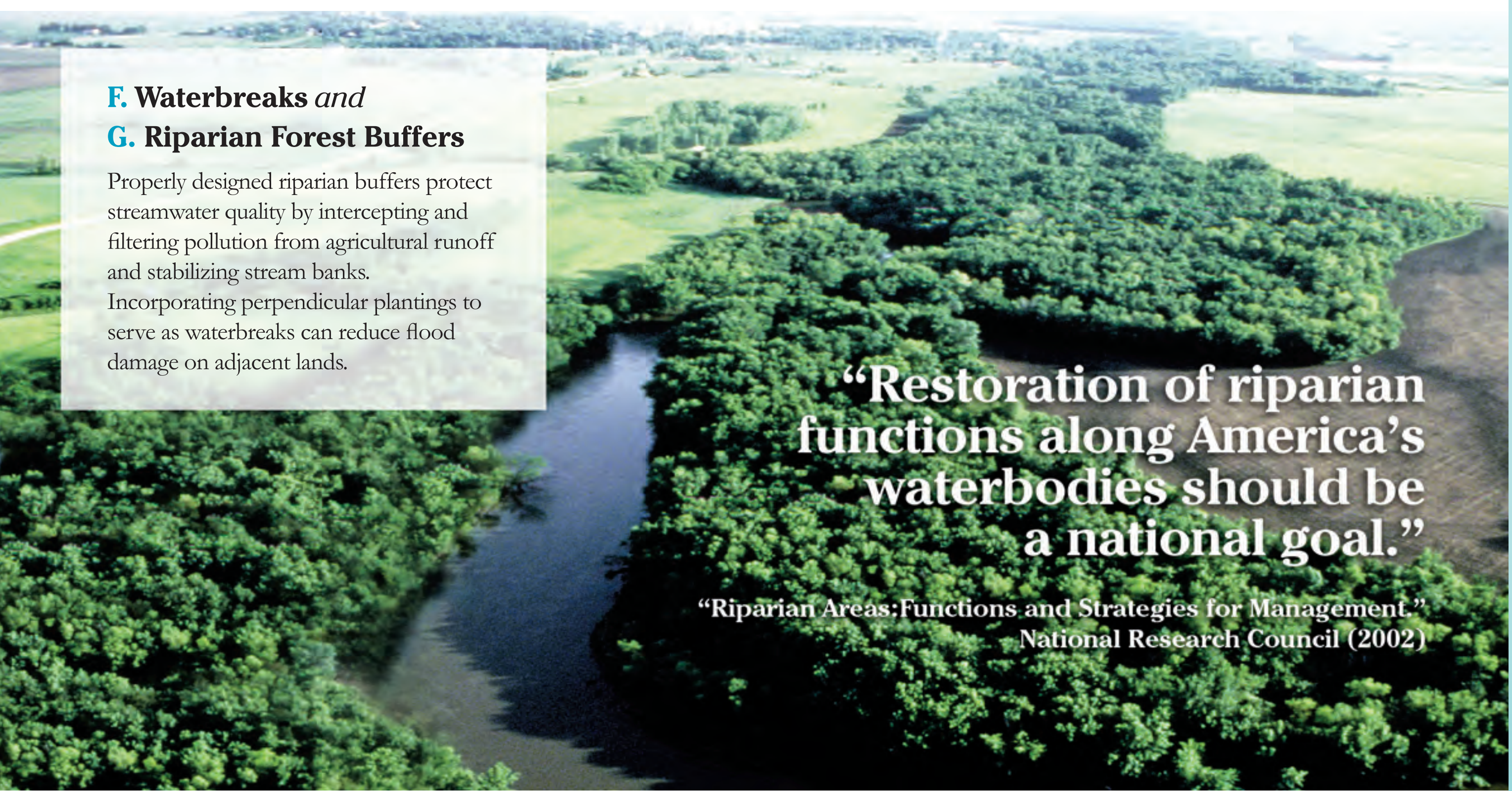
D. Green Infrastructure

Agroforestry technologies can be adapted to help communities use vegetation to restore ecological functions to manage stormwater runoff and address rural/urban interface issues.



E. Wastewater Treatment

Rapidly growing tree species can effectively uptake excess nutrients in the runoff from irrigated fields and livestock operations, as well as from municipal and industrial wastewaters.



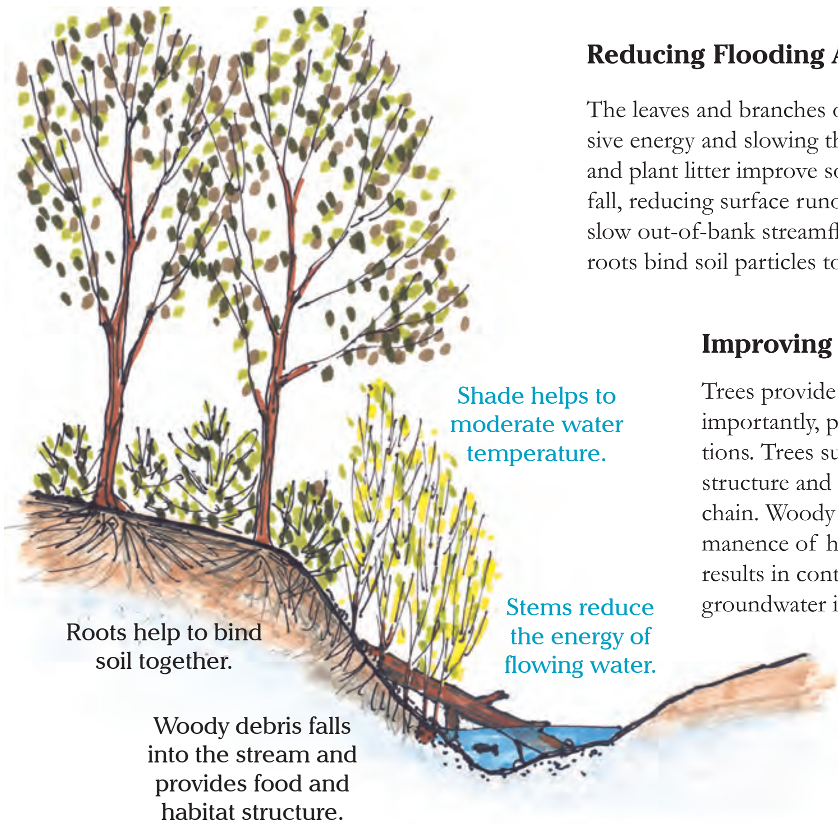
F. Waterbreaks *and* G. Riparian Forest Buffers

Properly designed riparian buffers protect streamwater quality by intercepting and filtering pollution from agricultural runoff and stabilizing stream banks. Incorporating perpendicular plantings to serve as waterbreaks can reduce flood damage on adjacent lands.

"Restoration of riparian functions along America's waterbodies should be a national goal."

"Riparian Areas:Functions and Strategies for Management."
National Research Council (2002)

Restoring Ecological Services



Reducing Flooding And Flood Damage

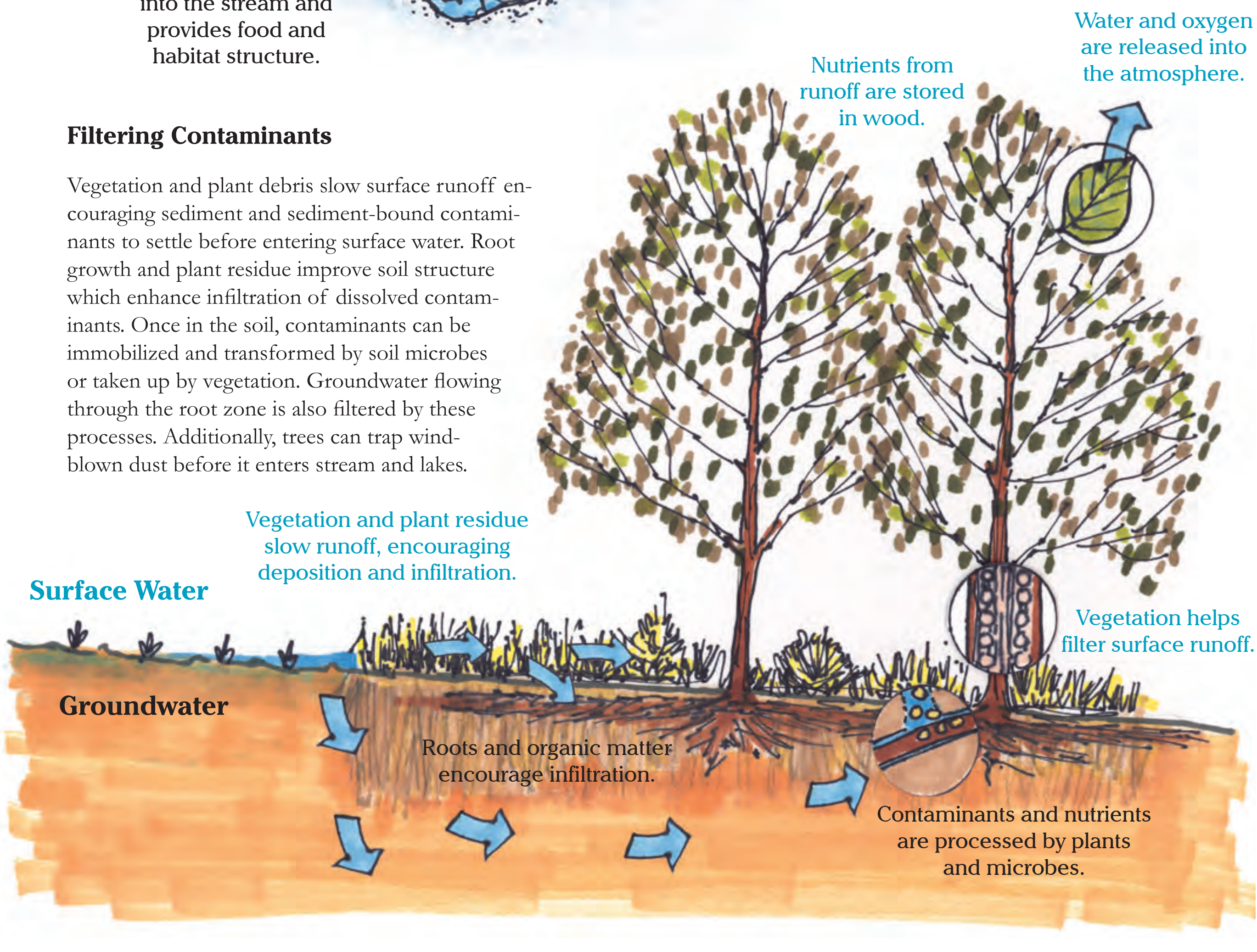
The leaves and branches of trees intercept rainfall, reducing its erosive energy and slowing the movement of rain water. Root growth and plant litter improve soil structure and enhance infiltration of rainfall, reducing surface runoff. Stiff stems of trees and shrubs resist and slow out-of-bank streamflow. Plant debris protects exposed soil and roots bind soil particles to resist erosion and stabilize slopes.

Improving Aquatic Habitat

Trees provide shade that reduces water temperature and, more importantly, prevents large and sudden temperature fluctuations. Trees supply debris to streams which creates habitat structure and detritus which contributes to the aquatic food chain. Woody roots promote stream channel stability and permanence of habitat structure. Improved infiltration of runoff results in contaminant filtering and the gradual release of groundwater into streams, which helps maintain base flow.

Filtering Contaminants

Vegetation and plant debris slow surface runoff encouraging sediment and sediment-bound contaminants to settle before entering surface water. Root growth and plant residue improve soil structure which enhance infiltration of dissolved contaminants. Once in the soil, contaminants can be immobilized and transformed by soil microbes or taken up by vegetation. Groundwater flowing through the root zone is also filtered by these processes. Additionally, trees can trap wind-blown dust before it enters stream and lakes.



Planning & Designing

To effectively address water quality issues, rural and urban residents should view themselves as watershed partners whose land-use decisions affect one another. When planning *Working Trees*, it is useful to ask several questions:

What functions should *Working Trees* perform?

Upland and riparian tree-based buffers can perform a variety of functions. Buffer design and the choice of plant materials will influence performance. For example, the management of soluble nutrients like nitrogen rely on designs that detain and infiltrate water into the soil, while insoluble nutrients, like phosphorus, are commonly bound to soil particles and can be controlled by the same design elements that control sediments. Once primary functions have been considered, other benefits can often be built into the design.

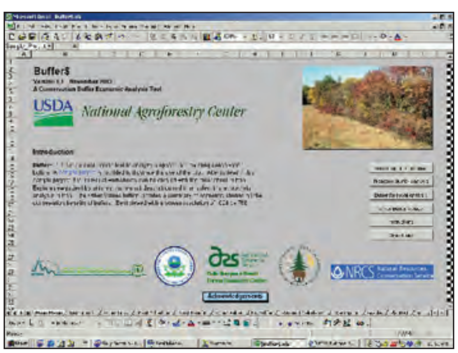
Where on the landscape should *Working Trees* be located?

Since it is not practical to install *Working Trees* in all locations on the landscape, it is desirable to have some process of determining which locations will produce the greatest benefit for water quality. Landscape-scale assessments should be conducted to guide the strategic placement of upland and riparian buffers in watersheds for the purpose of maximizing water protection, while optimizing for other benefits, such as wildlife habitat, carbon sequestration and economic diversification.

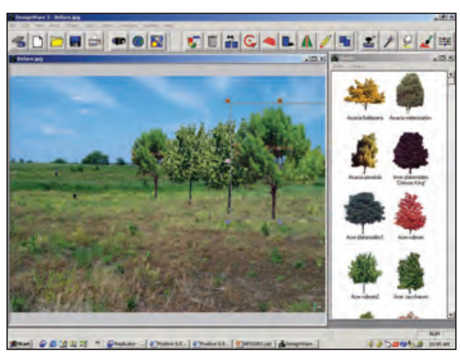
What is the best design for the site?

A site-based assessment is useful for improving the design and success of a *Working Trees* system. Site considerations include soils, hydrology and topography. Native varieties of trees, shrubs, grasses and sedges should be considered, as they will often be best adapted to the site. However, if the hydrology adjacent to a stream has been significantly altered, it may be necessary to incorporate more drought-tolerant upland species in riparian zones.

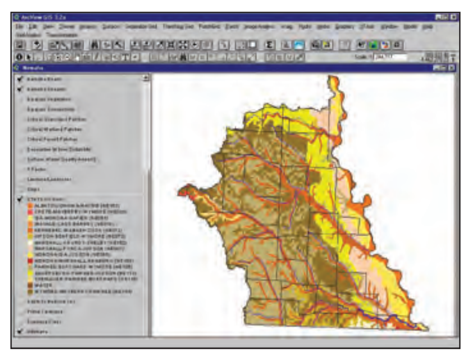
More information from NAC *www.unl.edu/nac*



Buffer$: An economic tool for making conservation buffer decisions



CanVis: A software tool for illustrating photo-realistic design alternatives.



GIS assessments: A map tool for locating buffers to achieve multiple goals.

USDA National Agroforestry Center

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