

Forest-to-Faucet Partnership

How Can Streamside Management Zones Influence Water Quality?

Streamside Management Zones (SMZ) are areas, or strips, of trees and vegetation adjacent to a stream or other body of water where management activities are planned, implemented, and, adjusted to reduce or prevent nonpoint source pollution associated with land use. Examples of values protected from a SMZ are water quality, aquatic wildlife, and wildlife habitat. Streamside management zones are known by a variety of names including riparian management zones, riparian forests, filter strips, forest buffers, and vegetated filter strips.

The Functions and Values of Streamside Management Zones

Streamside Management Zones provide a variety of functions and values and is the last area of protection in providing clean water for streams, wildlife, and people.

SMZs filter sediment, nutrients, and pollutants from overland flow as well as subsurface flow. As water moves through the SMZ, the organic layer (needles, leaves, and decaying matter) slows down overland flow, sediment is trapped and stored, and water flows into the soil. Dissolved nutrients and pollutants can be taken up by plants and soil microbes-reducing the amount entering the stream. The



longer the residence time in the SMZ the greater likelihood that pollutants will be immobilized and transformed. Increases in the rate of overland flow decrease residence time. Steep slopes can also cause more rapid overland flow and subsurface flow, thereby decreasing residence time. Soil permeability-high in sands and low in clays-also has a direct influence on the rate of water flow. By allowing the water to filter through the SMZ, peak flow rates are reduced and groundwater is recharged.

SMZs help maintain stream temperatures in summers by shading streams. This keeps the water viable for aquatic life.



Stabilize streambanks. Trees and other vegetation stabilize streambanks through their root systems holding the soil together against the constant force of streamflow. Soil erosion is also reduced by the trees and plants dissipating the energy of raindrops.

Provide food and shelter. The base of the food chain for aquatic life in forested streams starts with the organic inputs (leaves, twigs, branches, etc.) from the SMZ. Microbial communities break down the organic matter, thereby releasing nutrients that can be used by macroinvertebrates (e.g. insects and crustaceans) and plants, and in turn become food for other macroinvertebrates and fish. Coarse woody debris brings habitat diversity by altering streamflow to provide pools for shelter and a refuge for smaller fish from predators.

The many functions of SMZs are critical for sustaining aquatic life and in maintaining water quality.

Fixed versus Variable Width

The width of SMZ is determined in one of two ways: a fixed minimum width or a variable width based on site conditions, such as slope. A SMZ's effectiveness can be enhanced by analyzing specific watershed criteria, such as land use, plant composition, soils, topography, and climate – temperature and precipitation.

Watershed characteristics influence the residence time of water, sediment, and dissolved nutrients and pollutants in the SMZ. Fixed width SMZs have advantages. They are easily enforced, do not require specialized knowledge of ecological principles, allow for future planning, and require smaller expenditures of time and money.

However, fixed width SMZs do not consider site specific conditions and therefore may not adequately protect their associated aquatic resources or aid in the maintenance of water quality. Variable width SMZs are generally based on a combination of functional values and adjacent land use intensity, and consider site-specific conditions. Their impediments to implementation are they typically require a greater expenditure of resources and a higher level of training of personnel.

Forest Practices

A Streamside Management Zone is not excluded from silvicultural activities but rather a place where such activities are carefully supervised and managed. Examples of management activities appropriate in a SMZ are:

- avoiding the use of heavy equipment in SMZ to minimize ground disturbance;
- Using directional felling;
- retaining a diversity of tree species and age classes;
- avoiding pesticide use in the SMZ;
- encouraging natural revegetation;
- careful planning of roads, landings, skid trails, and stream crossings to minimize disturbance within SMZ; and
- leaving a no-cut strip of trees to provide bank stabilization, shade and future source of course woody debris.



Streamside Management Zones provide ecosystem functions necessary to protect water quality. They are designated areas bordering streams and other bodies of water that are protected and managed in order to mitigate the adverse impacts of human activity. The ability of the SMZ to protect water quality will vary in relation to site characteristics as well as the management of the SMZ to these conditions.

For Further Reading

Castelle, A.J., and A.W. Johnson, and C. Conolly. 1994. Wetland and Stream Buffer Size Requirements-A Review. *Journal of Environmental Quality* 23:878-882.

Daniels, B., D. McAvoy, M. Kuhns, and R. Gropp. 2004. Managing Forests for Water Quality: Streamside Management Zones. Utah State Cooperative Extension Service

de La Crétaz, A.L., and P. K. Barten. 2007. Land Use Effects on Streamflow and Water Quality in the Northern United States. CRC Press, Boca Raton, FL, USA.

Ochterski, J. 2004. Finger Lakes Forests Best Management Practices. Cornell Cooperative Extension

Vaidya, O.C., T.P. Smith, H. Fernand, and N.R. McInnis Leak. 2008. Forestry Best Management Practices: Evaluation of Alternate Streamside Management Zones on Stream Water Quality in Pokwock Lake and Five Mile Lake Watersheds in Central Nova Scotia, Canada. *Environmental Monitoring and Assessment* 137:1-14.