THE FOREST'S ROLE IN PRODUCING QUALITY WATER

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Before discussing any subject, we need to define our terms. What is "Quality" water? "Quality" usually refers to the combined physical, chemical, and biological characteristics of water which determine the adequacy of any supply to satisfy the requirements of its uses. Water is never found in its pure state in nature. All natural water contains impurities derived from the natural environment or from the waste products of man's activities. The use of the water determines the amounts of these impurities that can be tolerated.

In some instances, forests may contribute to particular impurities that are critical to a particular use. Water from swamps, bogs, and marshes may contain vegetative residues which cause the water to be highly colored and exhibit a disagreeable odor and taste which render it unsuitable for certain uses. Streams fed by water percolated through the soil mantle in a forest area may contain a higher mineral content than if the water was delivered to the stream by oversurface flow.

The relative lack of bacterial contamination of forest streams may be more the result of a scarcity of habitation than the effect of the forest vegetation. The Public Health Service has found a high fecal coleoform count in some forested streams in southern Mississippi. Presumably this contamination source is livestock or wildlife use of the watershed. However, I think it is significant to call attention to the research being conducted at Pennsylvania State University on the filtering effects of the soil mantle. They have demonstrated that secondary sewage effluent sprayed on forage crops or forested lands can be almost completely renovated. Results included increased production of forage crops, increased growth of trees, a raising of the water table, and a breakdown of all toxic materials before the effluent reaches the water table. Municipalities should consider this type of treatment before the installation of expensive tertiary treatment.

Forested areas are also effective in filtering impurities from water draining from other areas. Guidelines established for the Northern Rocky Mountains show that forested filter strips

40 to 100 feet in width are effective in preventing sediment from road drainage from reaching the streams.1/ Similar filter strips should be effective in urban areas to filter out pollution from construction areas, parking lots, and other high pollution sources.

We hear quite a bit these days about thermal pollution - the increase in water temperature above the tolerable limits of some uses, primarily fish life. The forest canopy protects the water from the warming effects of the sun. The removal of the forest canopy increased the growing season maximum water temperature by an average of 8° Fahrenheit on the Fernow Experimental Watershed in the central Appalachians.

The greatest contributor to the pollution of surface waters, however, is sediment. It has been estimated that 4 billion tons of sediment reach our waterways every year - 700 times the loading caused by sewage discharge. Sediment not only impairs water quality by itself but contributes to other pollutants. Sediments carry phosphates and pesticides. Bacteria, both harmless and pathogenic, are carried on sediment. According to Dr. Daniel Hale2/ a member of the Public Advisory Committee on Soil and Water Conservation to the USDA, of even greater import is the fact that nematodes are transported on sediment. Nematodes may carry at least 65 different diseases - causing viruses within their bodies. As nematodes are not affected by chlorination and filtration, they protect the viruses from usual procedures of treatment and deliver them unharmed to the person drinking the water.

The prevention and control of sediment may best be accomplished by the control of its source - erosion. Erosion is basically the result of two factors - the force of the water and the cohesiveness of the soil. The force of water is basically a factor of volume and velocity. Forest vegetation has a beneficial effect on reducing the volume and velocity of water and increasing the cohesiveness of the soil to greatly reduce the rate of erosion and consequent stream sedimentation.

The tree canopy and the litter of the forest floor intercept the rain drops and reduce the force of the impact which dislodge soil particles on unprotected areas. Humus mixed with mineral soil generally improves the soil structure and increases pore volume. Aeration and infiltration rates are increased. Tree roots, fungi, and other soil flora bind and hold the soil particles together. The litter and humus layer increases the roughness co-efficient and serve to reduce the velocity of overland flow. Reduced velocity and increased infiltration reduces the volume of overland flow, which reduces the volume of channel flow and subsequent channel and bank erosion, a major source of sedimentation in most streams.

The Tennessee Valley Authority reports that after twenty years, tree planting and small structure measures installed on the 88-acre watershed of Pine Tree Branch in Henderson County, Tennessee, reduced surface runoff volumes of individual storms by 52 to 89 percent. Peak discharges of moderate to large storms were reduced by 70 to 90 percent. The rate of sediment removal was reduced by 69 percent in the first 10 year period and by 96 percent after 20 years.3/

Ursic and Dendy, working in the Yazoo-Little Tallahatchie Project area in northern Mississippi, found that erosion from forested watersheds did not exceed 0.5 tons per acre annually whereas gullies in the same locality were losing up to 400 tons of soil per acre annually.4/ Preliminary figures show that loblolly pine cover reduced the soil flow from eroding gullies from 300 tons per acre per year to less than 30 tons in 10 years; and in old fields, from 200 tons to 3 tons per acre per year in 20 years.

In summary, although forests affect many of the factors determining the quality of water, their greatest contribution is in the reduction of sediment through the control of erosion. The establishment of an adequate cover of vegetation is the only permanent means of effective erosion control. Mechanical measures must be considered temporary and effective only for the design life of the structure. Properly managed vegetative cover not only is permanent but its efficiency improves with the passage of time.

References:

1/ Packer, Paul E. - 1967 - Criteria for Designing and Locating Logging Roads to Control Sediment. In Forest Science, Vol. 13, No.1, March 1967.

2/ A report of Proceedings - Meeting of Public Advisory Committee on Soil and Water Conservation to the USDA - October 9-11, 1968.

3/ Tennessee Valley Authority - 1962 - Reforestation and Erosion Control Influences Upon the Hydrology of the Pine Tree Branch Watershed, 1941 to 1960.

4/ Ursic, S. J., and Dendy, F. E. - 1965 - Sediment Yields from small watersheds under various land uses and forest covers. In Federal Inter-Agency Sedimentation Conference Proceedings. 1963: 47-52. USDA Misc. Pub. 970.