Article 15

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Stormwater Pollution Source Areas Isolated in Marquette, Michigan

Much of our knowledge about the source of stormwater pollutants in urban watersheds is confined to broad land use categories, such as residential, commercial, or industrial. Often, engineers need much more detailed information on the individual source areas of pollutants to design more effective stormwater management practices or to craft better pollution prevention plans. For example, residential land use is actually a mosaic of streets, driveways, rooftops and lawns. Each of these individual source areas can contribute vastly different runoff volumes or pollutant concentrations. Consequently, engineers are interested in discovering precisely which source areas in the urban landscape contribute the bulk of the pollutant loads measured at the end of the stormwater pipe, particularly for those pollutants that are potentially toxic.

Urban source area monitoring methods were first pioneered by Roger Bannerman and his colleagues at the Wisconsin DNR (see article 7). They typically involve the installation of very small and specialized sampling devices that collect stormwater runoff from a few thousand square feet of each source area. Several hundred samples are collected, and then geometric mean concentrations are computed. The first major source area monitoring study was conducted in a subwatershed located in Madison, Wisconsin (Bannerman *et al.*, 1993).

A second major source area monitoring study was recently completed in Marquette, Michigan by Jeff Steuer and his colleagues (1997). They investigated a 289 acre subwatershed that drains to Lake Superior. The subwatershed is primarily residential with most of the development built 50 to 100 years ago (Table 1). Although the subwatershed had 37% impervious cover, its sandy soils generated relatively little surface runoff (runoff coefficient of 0.14 during the course of the study).

Table 1: A Profile of the Marquette, a Michigan Subwatershed

Drainage Area	289 acres
Land Use	
Residential	55 %
Open Space	29 %
Commercial	9 %
Institutional	7 %
Pervious Area	63 %
Impervious Area	37 %
Soil Type	Sandy, HSG "A"
Runoff Coefficient	0.14
Age of Development	50 to 100 years
Average Annual Precipitation	31.9 inches
Total Rainfall During Source Sampling	13.2 inches

Steuer and his team deployed 34 different source area monitoring devices in the subwatershed and collected more than 550 source samples during 12 storm events. The source area monitoring was performed during the growing season (i.e., snowmelt and winter runoff were not sampled). Eight key source areas were targeted in the sampling effort: commercial parking lots; low, medium and high traffic streets; commercial and residential rooftops; residential driveways and lawns. More than 40 different pollutants were measured in the study, including sediment, nutrients, total and dissolved metals and a wide range of polycyclic aromatic hydrocarbons (PAHs). The study team also sampled pollutant levels at the bottom of the entire subwatershed. This enabled them to calibrate the Source Load and Management Model (SLAMM). The SLAMM model simulates subwatershed hydrology and source area pollutant concentrations to relate the how pollutant loads from individual source areas compared to the subwatershed as a whole (Pitt and Voorhees, 1989).

The SLAMM model did an excellent job of predicting pollutant loads from for the subwatershed. Typically, the pollutant load computed from component source areas was within 90 to 110% of the total subwatershed pollutant load measured over the 12 storm events.

Source Areas: Runoff Production

The load of a stormwater pollutant from any source area is a product of its pollutant concentration and its runoff volume. Thus, it is of considerable interest to