ALABAMA A&M AND AUBURN UNIVERSITIES

ANR-790-4.7.2

The Urban Environment And NPS Pollution

Understanding Urban Stormwater Runoff

Precipitation is a necessary component of the water cycle that constantly replenishes our water supplies. However, precipitation can become a nuisance when it flows off lawns, streets, paved areas, and rooftops during and after a rainstorm and must be managed.

Called urban stormwater runoff, this rain removes chemicals and suspended particles from the air. As it flows across the ground, it gathers dust, debris, litter, animal refuse, and toxic substances. This means that any polluting agent left exposed to natural rainfall—whether by negligence, accident, or on purpose—has the potential to cause water pollution in urban environments.

Managing stormwater runoff can create pollution problems, too. Highly efficient methods for getting stormwater runoff away from streets and into nearby rivers, lakes, or wetlands has degraded water quality, damaged or destroyed many natural wetlands, increased flooding problems, and even reduced natural groundwater levels in some areas.

Stormwater runoff with its associated contaminants has been identified as the largest remaining source of nonpoint pollution in the United States. Up to 70 percent of the surface water problems are caused by nonpoint pollution—in both urban and rural environments. Virtually every metropolitan area has this pollution problem.

What Factors Increase Pollutants From Urban Stormwater Runoff

Three critical factors affect the amount of water pollution generated from urban runoff: (1) the intensity of the storm, (2) the proportion of land covered by impervious surfaces, and (3) the system used to carry stormwater to a nearby waterway or wastewater treatment plant.

Storm Intensity. Very intense rain storms affect the amount of pollution generated from urban runoff. The greater the intensity and duration, the more erosion and more runoff a storm produces. Therefore, it is useful to know how often rainstorms of certain intensities and duration occur.

The most common classification system for storms uses intensity, duration, and frequency of occurrence. Intensity is how much it rains per unit of time such as 1 inch per hour, 6 inches per hour, or 6 inches per 24 hours. Duration is how long the storm lasts in minutes or hours. Frequency of occurrence is how often a rainstorm of similar characteristics occurs, such as once every 5 years. For example, a rainstorm that delivers 12 inches in a 24-hour period may occur on the average of once every 100 years in a particular area, and rainstorms of 1 inch in 24 hours may occur several times each year. In general, a 1-year 24-hour rainstorm in Alabama ranges from 3 to 4 inches, while a 100-year 24-hour rainstorm ranges from 8 to more than 11 inches, depending on location in the state. Severe flooding and property damage usually occur with 100 year storms or greater.

Most areas in Alabama receive from 70 to 125 measurable rainfall events during a given year. Only about 20 to 25 percent of these storms produce significant stormwater runoff. However, during the most intense part of a storm, almost all precipitation may go to runoff. The probable maximum precipitation that climatologists believe could occur in a 24-hour period is 30 inches. The highest precipitation in a 24-hour period recorded in the southeastern United States has been 20 to 24 inches.

Storms are quite different from one location to another. For example, it is possible for a 25-year 24-hour storm to produce 2 inches of rainfall in one area and as much as 8 inches in another area just a few miles away. This variability can occur because of major differences in topography and weather patterns.

Surface Cover. The type of surface cover also affects the pollution generated from urban runoff. In an urban area, the cover usually consists of both impervious (impermeable) and pervious (permeable) surfaces. Impervious surfaces include roofs, streets, side-

walks, driveways, and parking lots. Pervious surfaces include lawns, parks, gardens and playing fields.

About 30 percent of a typical urban area is covered by impervious surfaces such as buildings or pavement. As the number of impervious surfaces increases, the rate and volume of runoff increase. The increasing speed and volume of runoff cause an increase in the amount of pollutants carried in the water and in the frequency of flooding problems.

A higher concentration of impervious areas and less vegetation cause more runoff from small storms in urban areas than in rural areas. For small rainfall events most of the runoff comes from impervious areas while for the larger, less frequent storms both pervious and impervious areas contribute to runoff.

Types Of Systems. How stormwater runoff is transported can influence the amount of pollution entering surface water. In many large cities urban stormwater enters either a combined sewer system, which carries both municipal sewage and stormwater runoff, or a separate stormwater sewer, which takes the stormwater directly to the nearest lake or stream. In smaller municipalities, stormwater runoff can be transported by natural drainage channels.

Combined sewers transport stormwater to a wastewater treatment plant, possibly overloading the plant, or by-passing it to flow directly to surface waters. Thus, it is not just stormwater that enters lakes and rivers when there is a treatment plant overflow in some cities, but stormwater mixed with raw sewage.

Natural drainage channels provide a chance for pollutants to be filtered out or absorbed by soil and vegetation. Consequently, fewer pollutants are carried from areas drained by natural channels.

In Alabama most cities do not have combined sewer systems. Instead, most municipalities rely on separate stormwater sewers and natural drainage channels.

What Are The Pollutants From Urban Stormwater Runoff

Pollutants reaching water bodies from urban areas are as diverse and as intense as the activities and land uses which occur there. Pollutants resulting from stormwater runoff include sediment, nutrients, toxic substances including metals, and organic materials.

Sediment. As with agricultural runoff, suspended solids are the major contaminants found in urban stormwater runoff. Generally, these come from either one of two sources: established urban areas or areas undergoing development. Sediment has both short- and long-term impacts on surface waters. Among the immediate adverse impacts of high concentrations of sediment are increased turbidity, reduced light penetration, and decreased submerged aquatic vegetation. When turbidity increases and light penetration and vegetation decrease, the aquatic communities are adversely impacted. This can impair commercial and recreational fishing.

Nutrients. Phosphorus is the plant nutrient which is usually least abundant naturally in many freshwater lakes and streams. In rural areas most phosphorus reaches streams in association with sediment. In urban areas the primary sources are phosphate-containing cleaners or detergents, human and animal waste, and lawn fertilizers. When excessive phosphorus enters water it can trigger the rapid growth of algae and aquatic weeds. Water clogged with weeds is undesirable for most recreational uses, such as swimming and boating. In addition, when these weeds die and decompose, they consume the oxygen in water. Severe oxygen shortages may result in fish kills. Decaying algae and lake weeds also cause taste and odor problems in drinking water.

Toxic Substances. Heavy metals, industrial solvents, petroleum products, lawn-care products, and many common household products and waste by-products are washed into our waters daily.

The danger of toxic metal contamination has increased in waters adjacent to urban areas. Metals of most concern in urban stormwater are lead, zinc, copper, chromium, cadmium, nickel, and mercury. Lead, zinc, and copper are the metals found most often. Accidental spills and leaks from storage tanks and pipelines as well as corrosion and leaching from disposal and junkyard sites can cause severe water contamination problems.

Petroleum hydrocarbons are derived from oil products, and the source of most such pollutants found in urban runoff is vehicles—auto and truck engines that drip oil. Many do-it-yourself auto mechanics dump used oil directly into storm drains. Concentrations of petroleum-based hydrocarbons are often high enough to kill aquatic organisms.

Lawn-care products such as pesticides can be transported by wind, rain, or groundwater to lakes and streams. After entering the water, pesticides may decompose to toxic or nontoxic substances or they may persist in their original forms. Aquatic organisms may concentrate these chemicals in their bodies well above the average concentration in water.

Common household products like ammonia-based cleaners, car waxes, paints, paint thinners, varnishes, sealers, drain cleaners, degreasers, toilet cleaners, chrome or silver polishes, and roach and ant killers find their way into stormwater runoff.

Organic Materials. Plant debris and animal wastes contribute nutrient- and oxygen-demanding materials to our waters. Bacteria decompose these organic materials and consume oxygen in the process. If the supply of organic materials is excessive, the oxygen supply in the water may become seriously depleted. In general, the less dissolved oxygen in a lake or stream, the less capable the water is of supporting a variety of fish and aquatic life.

Urban runoff typically contains elevated levels of pathogenic organisms. Potential disease-causing organisms may be delivered to waterbodies in runoff containing sewer overflows, septic tank wastes, and animal wastes. These organisms live in the intestines of humans and animals and some are bound to enter lakes and streams in runoff. The presence of pathogens in runoff may result in waterbody impairments such as closed beaches, contaminated drinking water sources, and shellfish bed closings.

Conclusion

Although the urban environment often seems cleaner after rainfall, in reality stormwater runoff has merely carried pollution from one place to another. Unfortunately, what is washed from the streets, parking lots, and rooftops may turn up in the water supply somewhere else.

If every industry in every city stopped discharging wastes immediately, more than half of the pollution from urban areas would continue to reach our rivers, lakes, and streams. Stormwater runoff pollution is a collective result of every citizen's action. Consequently, nonpoint source pollution prevention relies on the collective effort of every citizen who lives in the urban environment.

References

Berg, Vincent E., and Paul F. Clement. 1992. Maryland's Stormwater Park Brings Control To Runoff. Land And Water Magazine (November/December): 26-31. Fort Dodge, Iowa.

Bracht, Betty. 1990. Urban Runoff And Stormwater Management Handbook. The Terrene Institute. Washington DC or U.S. Environmental Protection Agency Water Division. Chicago, IL.

Climatological Data—Alabama. 1991. National Oceanic And Atmospheric Administration. National Climatic Data Center. Asheville, NC.

Taggart, Judith, and Betty Bracht. 1991. Handle With Care: Your Guide To Preventing Water Pollution. The Terrene Institute. Washington, DC.

U.S. Environmental Protection Agency. 1993. Management Measures For Urban Areas. In Guidance Specifying Management Measures For Sources Of Nonpoint Pollution In Coastal Waters, Ch 4. USEPA/840-B-92-002. Office of Water. Washington, DC.

Weber, Susan, ed. 1988. USA By Numbers: A Statistical Portrait Of The United States. Zero Population Growth Inc. Washington, DC.

This publication, supported in part by a grant from the Alabama Department of Environmental Management and the Tennessee Valley Authority, was prepared by James E. Hairston, *Extension Water Quality Scientist,* assisted by Leigh Stribling, *Technical Writer.*

For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

ALABAMA COOPERATIVE Extension SYSTEM

ANR-790-4.7.2

UPS, **New June 1995,** Water Quality 4.7.2