2001 WATER SYMPOSIUM:

Water Pollution In Urban And Rural Settings

MARCH 2001

Environmental and Energy Study Institute

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The Environmental and Energy Study Institute, the Federal Water Quality Association and the National Capital Chapter of the American Water Resources Association co-hosted the 2001 *Water Symposium: Water Pollution In Urban And Rural Settings*. The symposium examined the relative contributions of urban and rural areas to nonpoint source water pollution, and examined innovative approaches and possible synergies to improve water quality in both urban and rural portions of watersheds.

Timothy L. Miller, chief of the U.S. Geological Survey's National Water Quality Assessment Program (NAWQA), outlined the major findings from 10 years of monitoring and assessing both surface and groundwater contamination in 140 rural/agricultural watersheds and more than 40 urbanized watersheds. The assessments show that water quality is affected by local land and water uses and practices, as well as population density. The urbanized study areas typically involved suburban type residential and commercial land use and low to medium population density, rather than heavily developed urban cores. Urbanized areas grew by 16 million acres between 1992 and 1995, or four to five million acres per year.

For both urban and agricultural areas, nonpoint source chemical contamination is a problem. Generally such contamination was found to occur more frequently and at greater concentrations in urbanized areas, which cover less than 5 percent of the land in the continental United States, than in farming areas, which cover more than 50 percent. In both agricultural and urban settings, nutrients and pesticides were found, but the urban areas also contained volatile organics, trace metals and high insecticide concentrations. Contamination from urban areas also appeared to have a more significant detrimental influence on aquatic life. In response to a question, Miller said that arsenic exceeding the current 50 ppb (parts per billion) federal standard was found in a handful of samples, but many more exceeded the proposed 10 ppb standard.

AGRICULTURAL WATER QUALITY

Following World War II there was a six-fold increase in use of commercial fertilizers, although use began to plateau in the 1980s. Pesticide use also increased beginning in the 1960s, but amounts and compounds have changed continuously. Almost every stream, most fish and about 60 percent of groundwater sampled by NAWQA in agricultural areas contained one or more pesticides; especially atrazine, metolachlor, cyanazine and alachlor, four of the most frequently used agricultural herbicides. In addition, the long-lived compound DDT continued to show up in sediments and fish tissue even though its use was banned 30 years

PANELISTS

Timothy L. Miller
Chief, National Water-Quality Assessment Program, U.S. Geological Survey

Mary Lorsung
Chair, Patuxent River Commission

Larry Coffman
Associate Director, Department of Environmental Resources, Prince George's County

Max Schnepf
Coordinator, National Conservation Buffer Initiative and Public Affairs Liaison to the Soil and Water Conservation Society, Natural Resources Conservation Service, U.S. Department of Agriculture

Allison Weideman
Program Manager, Chesapeake Bay Program Office, U.S. Environmental Protection Agency

ago. Pesticides were found less often and in lower concentrations in groundwater than in surface waters. Two-thirds of the agricultural stream samples contained five or more pesticides while only 20 percent of groundwater samples contained two or more. Maximum contaminant levels were rarely exceeded, but such standards have been set for only about half of the pesticides found, and they do not account for mixtures.

In streams, nitrogen and phosphorus concentrations from chemical fertilizer or manure applications commonly exceeded levels that cause excessive algae and other plant growth, which can lead to low dissolved oxygen levels and harm fish and other aquatic life. About 15 percent of shallow wells sampled were above the maximum contaminant level of 10 mg/l for nitrogen. Elevated groundwater nitrogen levels were especially notable where soils are typically sandy or course, as in the Central Valley of California, parts of the Pacific Northwest and the Mid-Atlantic region. By contrast, areas in the upper Mid-West, where soils are more compact or agricultural drain tiles are in use, had barely detectable groundwater nitrogen levels with similar fertilizer use.

Some states have begun to require reports for agricultural chemical use, but urban chemical use information is virtually nonexistent.
-Timothy L. Miller, National Water-Quality Assessment Program

URBAN WATER QUALITY

Phosphorous levels were generally as high in urban as in agricultural areas, with 70 percent of sampled streams exceeding the EPA desired goal for preventing nuisance plant growth, likely as a result of fertilizer use on lawns, golf courses and cemeteries. The concentrations were generally decreasing or stable, which could be attributed to phosphate controls on laundry detergent or upgraded wastewater treatment. Concentrations of fecal coliform bacteria, associated with human and animal waste, commonly exceeded recommended standards for water-contact recreation in urban streams.

Stream and fish samples from urbanized areas generally contained more pesticides and in higher concentrations than those from agricultural areas. More than half of the stream sites in urbanized areas were found to have a pesticide exceeding the standards for aquatic life, versus about 20 percent in agricultural areas. They were more likely to be insecticides like diazinon or malathion, or herbicides like simazine or prometon, that are used on lawns, golf courses or roadsides, than those used on agricultural crops. For example, 100 percent of the samples tested in urbanized areas of the Sacramento River Basin exceeded aquatic life standards for diazinon. In King County, Washington, homeowner use was found to result in residues of insecticides such as diazinon and herbicides such as 2,4-D commonly sold in retail stores. But almost half of the pesticides found in the streams had no retail sales in the surrounding area, indicating that they probably were applied commercially along roads or in parks and recreation areas, rather than by homeowners. Most findings of volatile organic compounds, including the gasoline additive methyl tertiary-butyl ether (MTBE) and solvents such as trichloroethylene (TCE), perchloroethylene (PCE), methylene chloride and trichloromethane (THM), were in shallow groundwater in urbanized areas. Standards exist for only about half of such contaminants.

Among the trends in urban water quality identified from sediment core analysis dating back 50 years, lead increased from the late 1940s to the 1970s, but has declined since its use in gasoline was banned, although concentrations have not declined to background levels. The same pattern holds for other banned chemicals, such as the pesticides DDT, chlordane and polychlorinated biphenyls (PCBs). But sediments in urban streams showed higher frequencies of DDT, chlordane and dieldrin, and higher concentrations of the latter two, than in agricultural stream sediments. Sediment-quality guidelines for organochlorine pesticides were exceeded at 36 percent of sampled urban sites.

Residues of polycyclic aromatic hydrocarbons (PAHs) associated with the burning of fossil fuels, road and tire wear, and use in building materials such as asphalt roofing, have been identified as toxic to some aquatic life and a possible human carcinogen. PAHs have steadily increased in urban stream sediments since the 1950s and in some lakes are now at the highest concentrations yet measured. The increases are statistically related to increased motor vehicle traffic in urbanizing watersheds.

Aquatic insect communities have been degraded in urban streams by increased concentrations of ammonia, atrazine, chloride, nitrate, potassium, sodium and sulfate. Aquatic communities were dominated by pollution tolerant algae, worms, midges and omnivorous fish; an indication of stressed conditions. Stream bottoms in urban areas may have concentrations of DDT, chlordane, dieldrin and other organic compounds that show up in fish tissue at high enough levels to cause the issuance of fish consumption advisories. One or more of these compounds was detected in 97 percent of whole fish samples collected at urban sites, and PCBs were found in 80 percent. Concentrations in whole fish of these compounds and polychlorinated biphenyls (PCBs)

exceeded guidelines for the protection of fish-eating wildlife at about 20 percent of urban and agricultural sites sampled between 1992 and 1996. Concentrations of organochlorine compounds exceeded guidelines to protect wildlife at more than 10 percent of urban sites and PCB concentrations exceeded the guidelines at nearly 70 percent of the sites.

The difficulty of drawing meaning from many of the NAWQA results was pointed out by Miller, who noted that there are benchmarks on less than half of the 80 pesticides and 60 industrial compounds involved in NAWQA sampling. Those that do exist do not account for mixtures of compounds found in most samples at low concentrations. In addition, many of the existing standards have not been applied to organisms that are sensitive to the exposure, nor has the reproductive impact been examined. As a result, the story is not complete and the risk to humans and the environment is unclear.

Some states have begun to require reports for agricultural chemical use, but urban chemical use information is virtually nonexistent. One exception is Oregon, where information is being required from commercial applicators and homeowner surveys. This kind of information was characterized by Miller as "crucial." He concluded, "With such information, one can eventually know which watersheds are sensitive and which ones are not, how application practices can vary to change the water quality impact and where chemical use is of relatively little impact."

PREVENTIVE STRATEGIES OUTLINED

Mary Lorsung, chair of the Patuxent River Commission, described the political bridge building process that headed off a looming "civil war" between southern and northern jurisdictions on the Chesapeake Bay. She said elected leaders have bought into the idea of conservation in recent years, rather than standing aside as before. Progress on the Patuxent River, a major tributary of the bay, was achieved in part through the appointment of nine strategic committees focusing on different remedial areas. A priority of the committees at present is the upgrading of water treatment facilities, but nutrient management to prevent runoff from fertilizer, manure and other nonpoint sources is an important part of current planning. The biggest challenge for the future, she said, is the development of land that is agricultural or fallow at present.

Aerial view of the Sacramento River in the Sacramento Valley (Rand Schaal, Ph. D., pilot and photographer)

Larry Coffman, associate director of the Prince George's County Department of Environmental Resources, noted that the Anacostia River, which enters the Potomac River in Washington, D.C, has already gone through such development. Conventional site design has led to many of the present problems on the river, he said, but fortunately urban areas are always rebuilding, thus allowing designers and developers to take advantage of strategic placement of greenery and other natural forces. Moreover, the Anacostia is not a forgotten river, Coffman maintained. The Anacostia Business Association has spent about $50 million on wetlands restoration and other restorative and preventive methods. A multiple approach to new site design is necessary, he said, and described many methods his and allied organizations are using to counter the dramatic increases in toxic substances in the river's water from the surrounding urban landscape. He cited storage and use of roof rainwater, permeable sidewalk design and other practices designed to preserve natural water flows. He displayed a slide of a modern version of the traditional rain barrel, using large, covered catch basins for recycling water for commercial heating and cooling systems. He also referred to "rain gardens" in which rainwater can be led into areas for cleanup through soil filtration and other natural processes.

Despite these efforts at best management practices, said Coffman, further increases in the load of heavy metals and other toxics can be expected. Education of property owners, zoning officials and developers is critical to the success of the programs. However, ecological restoration and habitat preservation are very complex, and present technology does not tell us how to overcome all of the problems, Coffman concluded.

A more traditional use of green buffers was described by Max Schnepf, coordinator of the National Conservation Buffer Initiative of the U.S. Department of Agriculture. He said that in 1993, the National Research Council delivered a very positive view on the ability of buffering to protect water quality when combined with other management options. He believes the buffer concept has "great potential" for a number of reasons. Schnepf noted that 70 percent of land in the United States is privately owned and is predominantly agricultural. "How private land is used has a great deal to do with environmental quality," he said. Schnepf sees a potential for use of buffers on eight to 10 million acres of cropland, compared to the four million for which they are being used at present; as well as great potential for buffer use in urban areas.

Despite their importance, buffers have their limitations. The effect of buffers on an entire watershed has not been documented, Schnepf noted. Further, most buffers are prohibited by statute in cane and grazing areas, and most buffer areas are limited in size. Schnepf sees a need for broader incentives than the one-on-one approach now being used, which could be incorporated into the 2002 Farm Bill. As an example, the restrictions on haying and grazing on Conservation Reserve lands should be lifted, Schnepf proposed. In addition, the USDA should coordinate its voluntary buffer program with EPA's regulations. Schnepf stressed that buffers must be maintained, and that buffers will not accomplish the entire conservation goals by themselves.

Allison Weideman, program manager of the Environmental Protection Agency's Chesapeake Bay Program Office, described EPA's efforts to encourage trading of "effluent rights" in the Bay area. The program is patterned on the successful air emissions trading program in which a company that exceeds emission targets can sell the leftover "credits" to companies that for one reason or another, except the lack of trying, cannot meet the standards. EPA foresees the program applying region-by-region, such as in the Susquehanna or Potomac river basins, rather than across the entire Chesapeake watershed, which stretches from New York to West Virginia. The guidelines took two and a half years to plan and draft, including 18 months of negotiation among environmental and effluent source groups.

Fundamental principles of trading as outlined by Weideman included:

- Not allowing known polluters to participate. "Only the good guys can trade."
- Trading must be consistent with the over-all Chesapeake Bay program.
- The trades must result in a net reduction in nutrient loading. Participants may not trade one-for-one. More reduction will be required.
- Implementation should aim for a goal of 40 percent reduction, not a one-to-one buying process. Buyers will have to show that they need the credits.
- The process will be accessible to the public.

Advantages cited by proponents of trading include more rapid effectiveness, compared to a regulatory approach; a cheaper way to promote cleanup technology; encouragement of a watershed based approach and provision of an option to offset growth and development along streams and other waters.

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Special thanks to the Surdna Foundation and the George Gund Foundation for their support of this briefing.