# Mosquitoes Call Stormdrains "Home"

*In the battle against mosquitoes carrying West Nile Virus, it's time for public health to wade into questions of stormwater management.*

*Merilee D. Karr*

Public health professionals following the course of West Nile virus across North America expected Oregon, one of the holdouts of 2002, to face at least a few infections last year in animals, humans, or both. Despite expectations, West Nile virus has not yet appeared in Oregon—the only continental state that has not turned up a single positive mosquito, bird, mammal, or human.

That respite will give Oregon another year to prepare—and part of the preparation includes a new collaboration between mosquito control and water management agencies.

From the Roman aqueducts to Bonneville Dam, humans have built structures to moderate the extremes of natural water flow. Some of these structures, from Roman cisterns to the catch basins under modern city streets, have inadvertently supplied mosquitoes with standing water, their preferred breeding habitat. The urban environment is rich with mosquito habitat, from old tires to paper cups left out on the deck. Even more mosquito habitat may have been created in the last decade by a change in the Clean Water Act of 1972.

The original drive behind the Act was the elimination of sewage and industrial discharge into waterways. In the 1990s, new regulations aimed at preventing pollution due to urban stormwater runoff. The problem is that there are two basic methods of cleaning stormwater: filtering through earth, vegetation, or manufactured filters, and retaining the water to let particulates settle. New studies show that water retention methods, such as the familiar catch basin, may breed mosquitoes. Even if retention structures are designed to minimize mosquito habitat by draining quickly, they may malfunction without regular maintenance.

## Mosquito habitat and stormwater

In 2002 a group of scientists with the California Department of Health Services reported in the journal *Stormwater* on a nationwide survey of public works agencies, regarding their experience with mosquitoes in stormwater management structures—manholes, catch basins, filters, vegetated swales, and others. Fully 86 percent of the reporting agencies had seen mosquito production in these structures.

A follow-up observational study in Southern California showed mosquitoes' clear preference for certain styles of stormwater management architecture. Those that maintained standing water in ponds, basins, or sumps for more than a few days supported mosquito hatcheries. Those that drained rapidly, such as swales and other filtration devices, rarely harbored mosquitoes.

In Portland, mosquito surveillance and control activities are performed by the Multnomah County Vector and Nuisance Control unit, part of the Environmental Health division of the health department. Since the 1930s, when Portland faced regular outbreaks of malaria, this department or its predecessors have quietly worked to prevent diseases carried by mosquitoes and other vectors. Multnomah County may have one of the oldest continuously active mosquito control programs in the western United States.

Multnomah County catch basins and manholes were studied in 2002 for the presence of mosquito larvae. Chris Wirth, supervisor of Multnomah County Vector and Nuisance Control, and David Turner, supervisor of Field Operations in the same department, reported on their study in *Stormwater Treatment Northwest*. Of more than ten thousand manholes, 99 percent harbored mosquito larvae. Of almost two thousand catch basins, 75 percent supported mosquito larvae. After treatment with the microbial larvicide *Bacillus sphaericus*, all structures remained free of larvae for up to four weeks.

Stormwater professionals are now reviewing existing equipment and proposed designs, trying to balance the old imperative of pollution reduction and the new one of mosquito habitat reduction. Modifying existing structures can be laborious and expensive.

Moreover the structures mandated by the Clean Water Act are not the only ones that produce mosquitoes. Most cities began building their stormwater collection systems in the early decades of their history to prevent flooding. Many older, pre-Clean Water Act stormwater management structures, including thousands of catch basins and manholes, already provide abundant mosquito habitat.

## Keeping it flowing

Stormwater structures on private property present another set of problems, according to a recent study by Michael J. Pronold, City of Portland environmental program manager. Since the late 1990s, new construction projects in Portland have been required to incorporate on-site

stormwater treatment structures. However, there is no requirement for inspection of these structures. With inadequate maintenance, vegetation or debris could reduce the drainage of water through such structures and therefore allow mosquito-friendly water accumulation. Manufactured stormwater filtration systems also need regular changing of the filters.

Pronold randomly selected thirty-five sites, residential, commercial, and industrial, most less than two years old. Of 33 structures he inspected, only 18 owners or other responsible parties knew of the stormwater structure on their property. Only 6 were following an approved maintenance plan. At several sites, different stormwater structures had been built than the ones for which the permit had been issued.

Pronold recommends inspection for stormwater structures on private property. But with available staff and resources, he writes, "It is apparent that the majority of the residential properties will not be inspected."

*The Chicago Tribune*, in a postmortem analysis of the 2002 West Nile epidemic in Illinois, reported that the failure to make the connection between stormwater management structures and mosquito habitat was a major contributor to the epidemic. The south suburban mosquito control district did not begin to treat mosquito-producing catch basins with mosquito larvicide until August, when Chicagoans were already dying, and streets and yards were littered with dead crows. By the end of that summer, Chicago had seen 884 human infections and 64 deaths. More than a thousand catch basins were also rediscovered in wet backyards, built decades ago and never recorded in any database.

In 2003, Chicago catch basins were treated with larvicide early and often, and Illinois saw only 50 infections and one death due to the virus. The pattern of disease incidence, seen repeatedly across the country, is of a sharply decreased case count in the second year of the epidemic. In some localities, the drop in cases occurred in the third year. It can not be known how much of the case reduction has been achieved by the improvement, or in some areas commencement, of mosquito control activities, which have been initiated by public demand in virtually every jurisdiction.

## *Tracing stormwater structures*

Pinning disease outbreaks to nearby stormwater structures, deploying scarce environmental and public health resources, and controlling mosquitoes in largely invisible stormwater structures will require a systematic approach. Maps and databases can be difficult to compile, especially in older urban areas, since many of these structures were built decades ago, and the records may no longer be accurate or even exist. Some municipalities have good databases, but no data-sharing capacity with adjacent communities within a mosquito's flight range. When public health departments confront most disease outbreaks, they make good use of a directory of human habitat—the phone book. A similar directory of mosquito habitat (stormwater structures) could be helpful in combating mosquito-borne diseases.

West Nile virus has given new visibility to stormwater structures. New designs are needed to prevent mosquito production. In the meantime, much needs to be done with the stormwater structures already in the ground. Although the studies done in California and Portland demonstrate that mosquito production is likely in catch basins and manholes, these studies do not demonstrate that all catch basins and manholes are hatching out mosquitoes or that, even if they are, those mosquitoes belong to disease-carrying species. Nevertheless, municipalities should look at their stormwater systems with new concern, even if the evidence does not support blanket larvicide application. Stormwater structures, ubiquitous as they are under urban and suburban streets, may be significant contributors to summer mosquito swarms. Mosquito surveillance and species identification are essential if disease prevention is to be achieved and resources used efficiently.

This opportunity could be wasted, however, if agencies cannot locate all of their stormwater structures. Information management was not a concern when most stormwater structures were built. They could be trusted to do their underground water control work without human attention. But vector control will require regular staff attention to stormwater structures. Databases will need to be compiled, using information technology that is compatible with that of regional partners within a mosquito's flight range.

Preventing both vector-borne disease and water pollution will take collaboration, interdisciplinary and interagency, between vector control and stormwater professionals. Both fields stand to gain new skills, new tools, and new understanding from each other.

West Nile virus is not nearly as serious a public health problem as influenza, which is not mosquito-borne, or malaria, which is. But, mild as West Nile may be, it is the first mosquito-borne disease in a long time that has attacked North America with any large numbers of infections, and it has captured the public imagination. And most importantly, it has clearly disclosed the erosion of the nation's public health system's capacity to respond to vector-borne disease outbreaks. We can hope that the attention paid to West Nile virus, however disproportionate, will strengthen our leaking public health systems, drained by public complacency.

### *Resources*


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