

The Pennsylvania Local Roads Program

Standing Water Plus Mosquitoes Equal West Nile Virus Risk

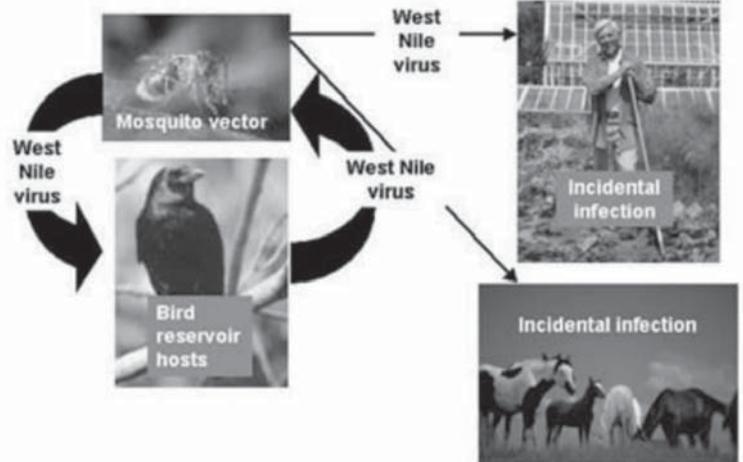
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**LTAP
TECHNICAL
INFORMATION
SHEET
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Do you remember the three most important items associated with road maintenance and construction? If you answered “drainage, drainage, and drainage,” chances are you have attended the LTAP Roads Scholar course, *Drainage: The Key to Roads that Last*. You understand the importance of maintaining drainage systems to ensure a successful service life for the roadway structure, but what about the importance of drainage to preserve the quality of life? There is a potential public health risk associated with standing water. If not properly maintained, drainage systems can provide abundant habitat for the breeding of mosquitoes, which transmit diseases such as the West Nile virus.

This tech sheet will provide information on how West Nile virus spreads and steps local agencies can take to control the spread.

West Nile Virus Transmission Cycle



(from www.cdc.gov)

WEST NILE VIRUS

The West Nile virus (WNV) is a mosquito-borne disease that made its first appearance in the United States in 1999. Since then it has rapidly spread across the North American continent into the lower 48 states, Canadian provinces and Mexico. According to the Centers for Disease Control and Prevention (CDC), over 15,000 people have tested positive for WNV infection since 1999, and more than 500 people have died from the disease. In Pennsylvania, WNV was first detected in birds, mosquitoes and a horse in 2000. Since then more than 300 human cases have been reported, and 20 Pennsylvanians have died. (See the table on the next page.)

SYMPTOMS

Most people who become infected with WNV have no symptoms. About 20 percent develop West Nile fever with its mild flu-like symptoms—fever, headache, body aches, rash and swollen lymph glands—within 3 to 15 days following the bite of an infected mosquito. Less than 1 percent of those infected will develop a life-threatening inflammation of the brain (encephalitis) or inflammation of the membrane surrounding the brain and spinal cord (meningitis). Most cases of disease occur in people over 50 and those with weakened immune systems. However, since people of all ages can develop illness, it is important for people to protect themselves from mosquito bites to minimize the chance of contracting WNV.

TRANSMISSION

West Nile virus cycles primarily between infected birds and mosquitoes that bite them. Mosquitoes become infected when they bite or take a blood meal from infected birds. The virus enters the mosquito’s system and settles in its salivary glands. When the infected mosquito bites an animal or a human, the virus then enters the host’s bloodstream, where it may cause illness. The primary route of human infection

With a mission to help Pennsylvania’s municipalities solve road and bridge management problems, LTAP is sponsored by the Pennsylvania Department of Transportation, the Federal Highway Administration and The Pennsylvania State University in partnership with the Governor’s Center for Local Government Services. For information about LTAP services across the state that include Roads Scholar courses, on-site training (road shows), technical assistance and publications, write or call:

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is through the bite of an infected mosquito. In rare cases, WNV can be transmitted through blood transfusions, organ transplants, pregnancy (mother to unborn child), and breast milk and to laboratory workers involved with WNV surveillance and research.

Scientists have identified more than 138 bird species that can be infected and more than 43 mosquito species that can transmit WNV. In Pennsylvania, there are about 60 different species of mosquitoes. While most of these species do not transmit WNV, several do, including *Culex* and *Aedes* species. See the figure on the first page for the basic transmission cycle of WNV.

West Nile Virus Activity					
National			Pennsylvania		
Year	Human Cases	Deaths	Year	Human Cases	Deaths
2004	2470	88	2004	15	2
2003	9862	264	2003	237	9
2002	4156	284	2002	62	9
2001	66	9	2001	3	0
2000	21	2	2000	0	0
1999	62	7			

HABITAT

All mosquitoes have one common requirement: they need standing water to complete their life cycles. Mosquitoes can develop into adults in a minimum of four days. Therefore, to control mosquito populations, it is important to quickly attend to locations where rain water pools. There are two basic groups of mosquitoes that utilize aquatic habitat: the *Culex* species, commonly known as the Northern House Mosquito, and the *Aedes* species, known as the Common Floodwater Mosquito. The Northern House Mosquito is considered a common domestic pest that reaches its greatest numbers in urban areas because it thrives in polluted water habitats such as catch basins. Northern House Mosquitoes lay their eggs directly on the surface of the water or in leaves of aquatic plants. Common Floodwater Mosquitoes, which occur in much larger numbers, are avid biters of humans and the ideal bridge vector (to humans and birds) for WNV in suburban areas. They lay their eggs in any area where transient water may collect, such as flood plains or even moist soil. The eggs hatch only when submerged by rising water levels.

Natural and man-made environments provide suitable habitats for mosquitoes. As noted earlier, catch basins are a main breeding site for the Northern House Mosquito. Organic materials such as collected grass clippings and leaves will increase the number of mosquitoes. Drainage ditches can provide prime mosquito producing habitat, because they often contain warm, standing water that is loaded with nutrients. Road building and some maintenance activities can temporarily impede drainage, creating areas of standing water that are mosquito breeding grounds. Construction activities often leave tire ruts in the soil. Such depressions are ideal breeding sites for the Common Floodwater Mosquito. Stormwater management facilities can contribute to the production of mosquitoes if not properly designed or maintained.

PREVENTION

Preventive measures to reduce your chances of becoming infected by WNV include control of mosquito breeding sites and prevention of mosquito bites. Proper maintenance of drainage systems to promote flow and prevent pooling of water can eliminate breeding grounds.

Guidelines to reduce mosquito breeding sites associated with drainage ditches include:

- Drain, fill or grade as needed to encourage flow and prevent water from pooling for periods of four days or more.
- Remove accumulated sediment from the bottoms of ditches; the sediment can remain wet enough to hold mosquito eggs until the next rain can hatch them.
- Improve flow in ditches by periodic removal of debris and by adjusting grades and widths.
- Mow more frequently in ditches where water drains slowly to aid flow.
- Consider running a narrow, deep ditch down the center of a wide, shallow ditch, even though this is not a preferred ditch shape from a maintenance viewpoint.

Recommendations to minimize the production of mosquitoes associated with stormwater management facilities are:

- Maintain and clean out temporary erosion and sedimentation control traps and basins.
- Conduct annual vegetation management, such as removing weeds and restricting growth of vegetation around ponds.
- Remove grass cuttings, trash and other debris, especially at outlet structures.
- Avoid producing ruts when mowing.
- Maintain dry ponds, infiltration trenches, sand filter structures, and underground structures so they do not retain water longer than four days.

PERSONAL PROTECTION

The best way to avoid WNV is to prevent mosquito bites. People can reduce their risk of WNV exposure by taking the following steps:

- Limit outdoor activity during dawn, early evening and dusk when mosquitoes are most active.
- Wear light-colored clothing, long-sleeved shirts, long pants, socks and shoes when working outdoors, especially when working in infested areas.
- Use an insect repellent containing DEET. Studies have shown DEET repellents are more effective than other products currently available. Read and follow label directions when using DEET. Use repellents sparingly, and use the lowest effective concentration, especially on children. It is generally recommended that adults use repellents that contain DEET at a level of 30 percent or less. For children, it is best to be conservative and keep the concentration at 10 percent or less.

For additional information, see the CDC website to view Recommendations to Protect Outdoor Workers from West Nile Virus Exposure at www.cdc.gov/niosh/topics/westnile/recout.html.

CONTROL

Mosquito-borne diseases affect millions of people throughout the world each year. Species of mosquitoes in the United States can transmit diseases such as encephalitis, dengue fever, and malaria to humans, too. To combat mosquitoes and the potential public health hazards they present, many states and localities have established mosquito control programs. These programs can include non-chemical forms of control, along with ground and aerial application of pesticides. If WNV activity is detected, pesticides such as larvicides, approved by the U.S. Environmental Protection Agency (EPA), may be used to kill mosquito larvae before they develop into adult mosquitoes. In addition, EPA-approved adulticides can be used to kill adult mosquitoes when other control methods are impractical or ineffective, or to prevent a WNV outbreak.

WHAT IS PENNSYLVANIA DOING?

To combat the spread of WNV, Pennsylvania has developed a comprehensive program consisting of three parts: education, surveillance, and control. The program covers all 67 counties and includes trapping mosquitoes, collecting dead birds and monitoring horses, people and selected chickens. For information about whom to contact in your county, the website at www.westnile.state.pa.us lists WNV surveillance county coordinators. You may also call 1-877-PA-HEALTH to obtain information about WNV in Pennsylvania.

Crows are the birds that appear most susceptible to the disease. Reporting of dead birds is a good way to help authorities track WNV activity in your area. If you find a dead bird, in particular a crow, blue jay, hawk or owl, contact your state or local health department. You may also assist the Pennsylvania Dead Bird Surveillance Program by reporting dead bird sightings on line at the website above or by calling 1-877-PA-HEALTH for further instruction.

WHAT IS PENN STATE DOING?

Penn State's College of Agricultural Sciences formed a West Nile Virus Coordinating Committee in 2000. The committee has developed several publications that are accessible through the Penn State website at www.pested.psu.edu/issues/wnv. Penn State Cooperative Extension and Outreach has a designated person in each county office to serve as a WNV contact. If you have any questions about WNV, they are excellent sources of information. Their contact information can be obtained at www.extension.psu.edu.

LTAP CENTERS

The University of New Hampshire Technology Transfer Center has assembled a package of recently published articles from *Stormwater* magazine addressing WNV and road drainage. This information can be accessed at www.t2.unh.edu/pubs/mosquitoes.pdf.

SOURCES

Centers for Disease Control and Prevention, West Nile Virus, www.cdc.gov/ncidod/dvbid/westnile.

Pennsylvania West Nile Virus Control Program, www.westnile.state.pa.us.

Pennsylvania State University, West Nile Virus, www.pested.psu.edu/issues/wnv.

U.S. Environmental Protection Agency, Mosquito Control, www.epa.gov/pesticides/factsheets/skeeters.htm.

University of New Hampshire Technology Transfer Center, Road Drainage and West Nile Virus, www.t2.unh.edu/pubs/mosquitoes.pdf.

Mayo Clinic, West Nile Virus, www.mayoclinic.com/invoke.cfm?id=DS00438.

West Nile Virus Facts, www.westnilevirusfacts.org.

Upper Thames River Conservation Authority, West Nile Virus, www.thamesriver.org.

Vector Control: Mosquitoes & Stormwater Management. Stormwater Management Technical Bulletin No. 8. Virginia Department of Conservation, www.dcr.virginia.gov/sw/docs/tecbltn8.pdf.

Metzger, Marco E., Messer, Dean F., Beitia, Catherine L., Myers, Charles M., Kramer, Vicki L. "The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs." *Stormwater*. March 2003, www.forester.net.

Deatrich, Monte and Brown, Warren S. *Stormwater Best Management Practices, Mosquitoes, and West Nile Virus*. Available at www.udfcd.org/usdcm/Tri-County%20BMPs%20&%20Mosquitos.pdf.