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S.C. Department of Health and  
Environmental Control

**Bureau of Environmental Health Services  
Medical Entomology Section**

## **Recommendations for Mosquito Control Activities in Response to West Nile Virus**

The mention of trade names of commercial products in this manual is for illustration purposes, and does not constitute endorsements or recommendations for use by the South Carolina Department of Health and Environmental Control.

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# Recommendations for Mosquito Control Activities in Response to Mosquito-Borne Diseases

## SC DHEC Bureau of Environmental Health Services (BEHS)

### PURPOSE

This document describes recommendations the South Carolina Department of Health and Environmental Control (SC DHEC) may provide to local jurisdictions for conducting mosquito control activities in response to mosquito-borne diseases detected in birds, mosquitoes, people and animals (e.g., horses). This guidance is targeted to local jurisdictions to establish appropriate mosquito control practices to lower the risk of mosquito-borne disease. This guidance also enables suitable educational information to be disseminated so individuals are aware of and use appropriate personal protection practices. SC DHEC encourages jurisdictions to use existing funding to support these activities. Funds are not available from SC DHEC to support implementation of this guidance.

These recommendations are established upon generally accepted principles and practices of scientifically sound mosquito control and disease prevention. Any of these recommendations are subject to modification as may be necessary to respond to specific disease risks and occurrences. Modifications may be jointly prescribed by public health and mosquito control specialists.

Any mosquito control efforts undertaken based on routine surveillance information provided by SC DHEC is to be conducted in accordance with established and generally recognized Integrated Mosquito Management Practices such as those outlined by the American Mosquito Control Association in the *Best Practices for Mosquito Control 2017: a Focused Update*. (Mount Laurel, NJ: American Mosquito Control Association, 2017. 58 pp.) <http://www.mosquito.org/page/training>.

Any insecticide used should be registered by the Environmental Protection Agency (EPA) for use in South Carolina and should be applied as directed on the product label and in accordance with Clemson University Regulatory Services, Department of Pesticide Regulations. Particular attention should be devoted to suitable practices to protect pollinators (bees).

The recommendations outlined in this plan do not imply that a public and/or animal health threat or emergency have been issued, nor do these recommendations automatically activate pesticide label language that would enable the application of insecticide products when pollinators are present. These recommendations cannot be used as a reason to vary from the pesticide label's directives for ordinary or customary applications for nuisance mosquito control.

Only in the event of a most unusual disease outbreak or formally declared public health emergency will recommendations be issued that will include specific language that will allow an applicator to vary from the pesticide label's directives for controlling nuisance mosquitoes and towards allowances for applications during a public and/or animal health threat.

If a pesticide applicator must vary use from normal nuisance mosquito control to address a disaster or threat to public and/or animal health, then the applicator must notify Clemson University Department of Pesticide Regulation (DPR) and seek approval prior to implementing such insecticide applications.

Upon request, Clemson University DPR may obtain a copy of SC DHEC's case report(s) and recommended guidelines provided to the local jurisdiction during their investigation of any pesticide incident. Sharing of information between SC DHEC, Clemson University DPR, and potential pesticide applicators will ensure that all are working from the same information.

### DEFINITIONS

- **Focal Area.** An area of interest that may incorporate multiple communities, towns, or cities. Factors considered in the assessment of human risk and the outlining of a particular focal area include: mosquito habitat, prior virus isolations in surveillance specimens from previous years, human population densities, type and timing of recent isolations of virus in mosquitoes, occurrence of human case(s) in the current or previous years, current and predicted weather patterns, and seasonality of conditions needed to present risk of human disease.
- **Treatment Area.** An area in which enhanced surveillance, mosquito control, communication, outreach, and other response efforts should be initiated. The recommended treatment zones for mosquito control are based on the flight ranges of the primary vectors and/or bridge vectors for each mosquito-borne disease virus and is subject to revision based on the situation. Please note that one-square mile (1/2-mile radius) is the minimum area that can be sprayed on state contract.
- **Local Transmission.** Mosquito-borne disease infection in a person who *has not* traveled from an area with active transmission or *has not* had sexual exposure or other known exposure to body fluids of an infected person.
- **Non-Local Transmission.** Mosquito-borne disease infection in a person who *has* traveled from an area with active transmission or *has had* sexual exposure or other known exposure to body fluids of an infected person.

### SEASONAL CONSIDERATION

Mosquito control is not necessary if environmental conditions are not conducive to mosquito transmission (for example, cold weather). Mosquitoes are active above 60°F, sluggish between 50°F to 60°F, and generally inactive below 50°F. Controlling adult

mosquitoes with ultra-low volume (ULV) applications of insecticides is ideally made when the air temperature is between 60°F to 85°F.

For nuisance mosquito control, performing ULV applications when nighttime temperatures are above 60°F is reasonable. ULV applications below 55°F are less effective and not ideal. For public health mosquito control, several applications at less-than-ideal temperatures may be needed to get the desired control.

Read and follow directions on the pesticide label. The first treatment should be made as soon as possible, even with marginal weather conditions, but subsequent treatments should be more selective of optimal weather conditions. Applications may be considered when the nighttime temperature at the time of the application is at least above 50°F, but not below the minimum temperature as specified on the label. The physical properties of the chemical determine the temperature at which it can be applied.

## PESTICIDE-RELATED QUESTIONS

Labels and labeling are legal documents providing directions on how to mix, apply, store, and dispose of pesticide products. By law, pesticide users are required to comply with all the instructions and use directions found on pesticide labels and labeling. The label is the information printed on or attached to the pesticide container or wrapper. The labeling may include brochures, leaflets, and other information that accompanies the pesticide product.

For specific questions regarding pesticides, please contact the Clemson University Department of Pesticide Regulation:

(P) 864.646.2150; 511 Westinghouse Road, Pendleton, SC 29670; <https://www.clemson.edu/public/regulatory/pesticide-regulation>.

## DISCLOSURE REQUIREMENTS FOR PUBLIC HEALTH APPLICATIONS OF PESTICIDES

Beekeepers, organic farmers, and people with allergies or asthma may wish to avoid insecticides used for adult mosquito control. For non-commercial applicators only, or for commercial applicators making applications for and under the direct supervision of a governmental entity, pesticide applicators must disclose the following information, as a minimum, to the public in a statement that is fully legible:

- (1) Company/firm/agency or local mosquito control program name and address
- (2) The pest to be controlled or purpose of the pesticide application
- (3) The chemical or common name of the active ingredient(s), not the brand name, of the pesticide applied
- (4) Name(s) of the responsible licensed applicator(s)

These requirements may be met by an announcement or publication of the nature and timing of pesticide applications in the appropriate mass media outlets not less than 24 hours prior to the pesticide application (<https://www.clemson.edu> > [Outreach](#) > "Agricultural Services" > [Regulatory Services](#) > [Pesticide Regulation](#) > [Rules and Regulations for the Enforcement of the SC Pesticide Control Act](#), Section 27-1083) [<http://www.clemson.edu/public/regulatory/pesticide-regulation/pdfs/rules-and-regs-dpr.pdf>].

For specific questions regarding disclosure requirements and their implementation, please contact the Clemson University Department of Pesticide Regulation:

(P) 864.646.2150; 511 Westinghouse Road, Pendleton, SC 29670; <https://www.clemson.edu/public/regulatory/pesticide-regulation>.

## NOTIFY BEEKEEPERS TO LIMIT INADVERTANT BEE KILL DURING MOSQUITO CONTROL OPERATIONS

### Obtain a list of beekeepers in your jurisdiction.

- Consult your local mosquito control office's beekeeper notification list and Clemson University's Voluntary Beehive Mapping/Bee Stewardship Program to locate and avoid spraying beehives in the designated mosquito treatment zone before any pesticides are applied. In Clemson's system, you can draw your mosquito target zone, and any beekeepers registered within that zone will be notified. Keep in mind that not everyone has registered their beehives on Clemson University's Voluntary Beehive Mapping Program.
  - Pesticide applicator portal: <http://www.kellysolutions.com/clemson/pesticideapplicationnotifications/>
- Consult with beekeepers' associations to assist with locating hives in your jurisdiction. Not all local association members are members of the state association, so contacting both state and local associations is a good idea. Find out what social media resources they have, so you can post spray notifications in a timely manner.
  - South Carolina Beekeepers Association: <http://scstatebeekeepers.com/about-beekeeping/contact-a-beekeeper/>
  - Local beekeepers' associations: <http://scstatebeekeepers.com/home/local-associations/>

**Notify Beekeepers.** Release your intentions to spray through Clemson University's Voluntary Beehive Mapping Program, the media, individual contacts, and/or a reverse 911 operating system.

Mosquito Control Activities in Response to WEST NILE	
Probability of Human Outbreak for a Focal Area	Mosquito Control Activities to Perform
<p style="text-align: center;"><b>Low (Cat. 1)</b></p> <ul style="list-style-type: none"> <li>• Limited to sporadic WNV activity<sup>1</sup> in dead birds or mosquitoes -and-</li> <li>• No animal or human cases</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Duration of Activities:</b> As long as needed to be effective</li> <li>• <b>Treatment Area:</b> 0.5-mile radius (minimum) from virus activity</li> <li>• <b>Public Education:</b> Initiate programs focused on source reduction and personal protection, especially among elderly, outdoor workers, and the homeless.</li> <li>• <b>Monitor:</b> Monitor virus activity in animals (equids), birds, and mosquitoes. Report dead birds to local county environmental or public health offices.</li> <li>• <b>Source reduction:</b> Eliminate water-holding containers.</li> <li>• <b>Adulticiding and Larviciding.</b> The decision to use larvicides and/or ground-based adult mosquito control will depend on critical modifying variables, including the time of year, mosquito population abundance, and proximity of virus activity to human populations, especially elderly populations.</li> </ul>
<p style="text-align: center;"><b>High (Cat. 2)</b></p> <ul style="list-style-type: none"> <li>• Sustained WNV activity<sup>2</sup> in dead birds or mosquitoes -or-</li> <li>• High mosquito infection rates<sup>3</sup> -or-</li> <li>• Multiple positive mosquito species -or-</li> <li>• High dead bird densities (&gt;0.1 per sq mi per week) -or-</li> <li>• One horse or mammal case -or-</li> <li>• One human case or one viremic blood donor</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Duration of Activities:</b> As long as needed to be effective</li> <li>• <b>Treatment Area:</b> 1-mile radius (minimum) from virus activity</li> </ul> <p><i>Response as in Category 1, plus:</i></p> <ul style="list-style-type: none"> <li>• <b>Public Education:</b> Enhance by including messages on signs and symptoms of illness and to seek medical care if needed. Conduct door-to-door education and inspection of properties for mosquito breeding sites. Intensify visible activities in the community to increase attention to WNV transmission risk and personal protection measures.</li> <li>• <b>Adulticiding:</b> Use ground and/or aerial applications for a minimum of 2 treatments, but 3 treatments are preferred, in 10-14 day intervals, unless the pesticide label specifies longer intervals. Continue until Cat. 1 threshold is reached.</li> <li>• <b>Larviciding:</b> Use 45-day briquettes in storm drains and in obvious mosquito breeding areas on public properties or rights of way and schools.</li> </ul>
<p style="text-align: center;"><b>Outbreak in Progress (Cat. 3)</b></p> <ul style="list-style-type: none"> <li>• Conditions favor continued transmission to people <ul style="list-style-type: none"> <li>○ Persistent high infection rate in mosquitoes<sup>3</sup></li> <li>○ Mammal-feeding mosquito species<sup>5</sup> other than <i>Culex pipiens</i> complex are infected with WNV</li> <li>○ Seasonal mosquito population decreases not anticipated for weeks</li> <li>○ Continued avian mortality -or-</li> </ul> </li> <li>• Multiple confirmed animals or human cases or viremic blood donors clustered in time and space</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Duration of Activities:</b> No less than 45 days after the date of onset of the last known case.</li> <li>• <b>Treatment Area:</b> 1-2 mile radius from virus activity. Use a 2-mile radius after multiple confirmed human cases or viremic donors.</li> </ul> <p><i>Response as in Category 2, plus:</i></p> <ul style="list-style-type: none"> <li>• <b>Public Education:</b> Conduct full-scale media campaign. Alert physicians and veterinarians. Emphasize urgency of personal protection, including use of repellents, through community leaders and media outlets.</li> <li>• <b>Monitor:</b> Monitor effectiveness of vector control efforts<sup>4</sup>.</li> <li>• <b>Adulticiding:</b> Consider aerial application of adulticides when large areas must be treated quickly and often. Intensify emergency adult mosquito control and repeat applications as necessary to achieve adequate control. Multiple, closely spaced treatments are needed for effectiveness (at least 3 treatments in 10-14 day intervals, unless the pesticide label specifies longer intervals).</li> </ul>

<sup>1</sup>**Sporadic WNV activity** - when WNV activity is detected in 1-2 mosquito samples or birds during non-consecutive weeks within a focal area; <sup>2</sup>**Sustained WNV activity** - when WNV activity is detected for at least 2 consecutive weeks within a focal area.

<sup>3</sup>**Infection rate** in a vector population is an estimate of the prevalence of arbovirus-infected mosquitoes in the population and is a good indicator of human risk. The **Vector Index** is an estimate of the abundance of infected mosquitoes in an area and incorporates information describing the vector species that are present in the area, relative abundance of those species, and the WNV infection rate in each species into a single index. The mosquito-based surveillance indicators, Infection Rate and Vector Index, have two important roles in WNV surveillance and response programs.

- Identify thresholds for vector abundance and infection rate that are below levels associated with disease outbreaks.
- Determine when proactive measures have been insufficient to dampen virus amplification, which would indicate that more aggressive measures, such as wide-scale aerial application of mosquito adulticides and more aggressive public education messaging, are required to prevent or stop an outbreak.

**Interpretation of Infection Rate and Vector Index Values for *Culex pipiens* complex mosquitoes.** The values in the table below are subject to change. Past sample sizes of West Nile virus cases in people and mosquitoes have not been adequate to accurately predict the implication of infection rate and vector index value ranges in South Carolina.

Infection Rate	Vector Index	Level of Virus Activity	Interpretation
0	0	<b>None</b>	Suggests no viral activity in the area
0.10 to 1.59	0.01 to 0.19	<b>Low</b>	Increased vigilance and testing are needed.
1.60 to 3.99	0.20 to 0.49	<b>Moderate</b>	Human cases are possible.
4.0 or above	0.5 and above	<b>High</b>	Human infections are imminent (if not already present); prompt action is required.

<sup>4</sup>**Recommended adulticiding action thresholds**

Monitoring Tool	Threshold
Landing Rate Counts	1 adult/minute
CDC Light Traps or BG Sentinel Traps	25 adults/24 hours*

\*If a pathogen is detected, a single infected adult mosquito meets the threshold

<sup>5</sup>Examples of mammal-biting mosquito species that are competent vectors for WNV: *Aedes aegypti*, *Aedes albopictus*, *Aedes atlanticus/tormentor*, *Aedes canadensis*, *Aedes cinereus*, *Aedes sollicitans*, *Aedes taeniorhynchus*, *Aedes vexans*, *Anopheles crucians* complex, *Anopheles punctipennis*, *Anopheles quadrimaculatus s.l.*, *Coquillettidia perturbans*, *Culex erraticus*, *Culex nigripalpus*, *Culex pipiens* complex, *Culex salinarius*, *Psorophora ciliata*, *Psorophora columbiae*, and *Psorophora ferox*.

*Culex pipiens* complex is the primary vector for WNV. The larvae of *Culex pipiens* complex mosquitoes prefer to live in **nutrient-rich, organic (often polluted) sites**, such as leakage from septic tanks, abandoned swimming pools, clogged gutters, and similar organically enriched water containers. *Culex pipiens* complex mosquitoes are generally weak fliers and do not move far from home, although they have been known to fly up to two miles. *Culex pipiens* complex mosquitoes are inactive during the day and are most active at night (after 8 PM).

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