



**Maine Department of Health and Human Services
Maine Center for Disease Control and Prevention**

Arboviral (Mosquito-Borne) Illness

Surveillance, Prevention, and Response
Guidance

for Maine Towns and Communities

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INTRODUCTION

The purpose of this document is to provide guidance to local communities on operational aspects of surveillance, prevention, and response to control mosquitoes and mosquito-borne diseases. The intent is to minimize the risk to Maine residents of being exposed to, and infected with, vectorborne diseases. This model plan was developed by Maine CDC in collaboration with the Maine Vectorborne Work Group, which was formed in 1986 in anticipation of the increased threat posed by the emergence of vectorborne diseases in Maine. This is the result of analysis and review of surveillance data and response plans from Maine, and other state and federal sources. Maine CDC will continue to seek advice from its partners and collaborators and modify this guidance document as appropriate.

The Maine Vectorborne Workgroup convenes bimonthly to develop and collaborate on a statewide coordinated strategy to reduce the risk of vectorborne (mosquito and tick) diseases in Maine. The work group and its committees meet more frequently as warranted with dialogue and updates continuing throughout the year. Information provided from the Maine Vectorborne Work Group meetings guides the statewide mosquito arboviral response plan which aims to guide proactive community planning and actions to reduce the risk of human disease from mosquito-borne arboviruses. The role of Maine CDC and its partners is to support local communities through the following:

- Supporting locally-based mosquito plan development and response;
- Monitoring trends of mosquito-borne arboviruses in Maine;
- Providing timely, detailed and summary information on the distribution and intensity of mosquito-borne arboviruses in the environment;
- Laboratory diagnostic testing of mosquito-borne arboviruses for humans, mosquitoes, non-human mammals such as emus and horses, and other animals such as birds; and
- Communicating guidelines, advice, and support to communities and the general public on activities that can effectively reduce the risk of mosquito-borne disease.

This document will be reviewed at least annually.

I. DISEASE BACKGROUND

The three main mosquito-borne viruses (also known as arboviruses, for **arthropod-borne viruses**) recognized in Maine, and known to cause human and animal disease are Eastern Equine Encephalitis (EEE) virus (EEEv), Jamestown Canyon virus (JCV), and West Nile virus (WNV). EEE and WNV are routinely tested for in mosquitoes, symptomatic animals, and humans in Maine. JCV is currently tested for in mosquitoes and humans. The first Maine-acquired case of EEE occurred in 2008 in an out-of-state resident. This case was counted in their home state. The first identified case in a Maine resident for EEE was in 2014, JCV in 2017, and WNV in 2012. In 2018, Maine identified the first case of WNV in a horse. In 2021, Maine also identified WNV in a blood donation made by a Maine resident. Since 2001, Maine CDC has reported 14 cases of human mosquito-borne arboviral illness, including 3 EEE cases, 4 JCV cases, and 7 WNV cases. One EEE case and one JCV case proved fatal.

Different types of mosquitoes, with species-specific feeding habits (birds and/or mammals) and habitats (environments where they are found) carry these diseases. These differences are important in developing strategies for controlling the mosquitoes involved.

Infected mammals (e.g., humans, horses) are considered “dead-end” hosts for EEE and WNV. Mosquitoes that bite humans or equines infected with EEE or WNV do not pick up enough virus particles to transmit the disease to the next human or animal they bite. The risk of disease in humans is directly related to the amount of exposure to infectious mosquitoes.

A. Eastern Equine Encephalitis Virus

EEE virus is an *alphavirus*, present in some passerine (perching song birds) species found in fresh-water swamp habitats. The virus is transmitted among wild birds in these areas primarily by *Culiseta melanura*, a mosquito species that prefers to feed on birds. EEE virus has a cycle of natural infection among wild bird populations with occasional infections of humans, non-human mammals (most often horses), and large domesticated birds (emus, ostriches, etc). Bridge vectors (i.e., mosquito species that will feed on birds or mammals) are responsible for transferring the EEE virus to humans.

Some people infected with EEE may get only a mild flu-like illness with fever and headache. However, for people with infection of the central nervous system, a sudden high fever, severe headache, and stiff neck can be followed quickly by seizures, coma, and death. The cost of a single human case of EEE is estimated to range from \$21,000 for mild, transient illness, to as much as \$3 million for individuals who suffer permanent neurologic damage.

The incidence of EEE infection in humans varies by geographic area. Human EEE disease is more common in areas that support dense populations of passerine birds and have favorable habitats for the larvae of the primary mosquito vector. In Maine, these areas consist mainly of large and mature white cedar and red maple swamps.

Maine has evidence of EEE infection in all 16 counties. This evidence is obtained through a combination of EEE seroprevalence studies in animals and regular surveillance activities performed by Maine CDC. Seroprevalence indicates previous exposure to the virus, not active illness. Testing is performed on samples from deer, moose, bear, wild and domestic turkeys, and a variety of songbirds in conjunction with federal CDC.

Additionally, the likelihood of mosquito exposure is a key factor in determining the risk of human EEE infection. The abundance of specific species of mosquitoes at critical periods during the transmission season, in part determined by groundwater levels and the timing of rainfall during the mosquito season, is important in determining the likelihood of mosquito exposure. The use of personal protective measures (avoidance of mosquitoes, use of repellent) by people reduces their risk of exposure and infection.

B. West Nile Virus

WNV is a *flavivirus*. Similar to EEE, WNV is also maintained in the environment in a cycle that involves birds, with bridge vector mosquitoes infecting humans and other mammals. WNV causes sporadic disease in humans, and occasionally results in significant outbreaks.

An estimated 80% of people who become infected with WNV never develop symptoms attributable to the infection. For those who do develop symptoms: severe symptoms can include high fever, headache, neck stiffness, disorientation, coma, tremors, convulsions, muscle weakness, vision loss, and paralysis. These symptoms may last weeks, and neurological effects may be permanent. Up to 20% of the people who become infected will display symptoms of WNV fever, including fever, headache, body aches, and can include swollen lymph glands. Symptoms can last for days to months. People over 50 years of age are at a higher risk of developing serious symptoms of WNV.

West Nile virus activity varies from year to year. When there are a high proportion of infected mosquitoes in a relatively small geographic area the risk of transmission of virus to humans will increase.

C. Jamestown Canyon Virus

JCV is an *orthobunyavirus* that comes from the California serogroup, a class of viruses that can cause febrile illnesses and serious neurological complications. JCV is an emerging virus and much about the disease is still unknown. JCV was first isolated from a pool of *Culiseta* mosquito species in Jamestown Canyon, CO in 1961. The virus has since been identified across the United States in humans and throughout North America in various mammals. The virus is generally reported in northern states and can be found as far south as Georgia. In the United States, human cases of JCV are rare. It is unknown how this disease affects animal populations.

Unlike EEE and WNV, the cycle of JCV is maintained through transmission to and from larger mammals, mainly white-tailed deer. Symptoms of JCV appear between two days and two weeks after transmission and include fever, headache, and non-specific cold like symptoms. In two thirds of reported cases subjects developed neuroinvasive disease which includes neck stiffness, severe headaches, and other symptoms typical of meningitis and meningoencephalitis. The most common age group to be infected with JCV is adults with the median reported age as 48.

D. Imported Arboviral Illnesses

There are several viruses carried by mosquitoes that are not present in Maine. The most significant of these are Chikungunya, Dengue, and Zika viruses. All three of these viruses are carried by *Aedes* mosquitoes particularly *Aedes aegypti* and *Aedes albopictus*. Neither mosquito is found in Maine, although Maine is at the northern edge of the *A. albopictus* range. Other imported arboviruses of concern include Oropouche Fever, Western Equine Encephalitis, and Yellow Fever. Current U.S. CDC arbovirus travel health notices can be found online on the following website: wwwnc.cdc.gov/travel/notices.

- **Chikungunya:** Most people infected will develop some symptoms, usually within 3-7 days after being bitten. The most common symptoms are fever and joint pain.

- **Dengue:** Symptoms of dengue include a high fever and at least two of the following: severe headache, severe eye pain, joint pain, muscle and/or bone pain, rash, mild bleeding, low white cell count. Dengue can be serious and can require immediate medical assistance in some cases.
- **Oropouche Fever:** Symptoms start 4-8 days after exposure and can include headache, fever, muscle aches, stiff joints, nausea, vomiting, chills, or photophobia. Severe cases may result in meningitis.
- **Western Equine Encephalitis:** Most people infected with WEEV either have mild or no symptoms. Symptoms of severe illness may include high fever, headache, neck stiffness, photophobia, confusion, somnolence, coma, or seizures. Severe neurologic disease such as meningoencephalitis and myelitis can occur.
- **Yellow Fever:** Most people with Yellow Fever remain asymptomatic. Symptoms usually start 3-6 days after infection and can include backache, chills, fever, headache, myalgia, nausea, vomiting, and prostration. Severe cases may develop hemorrhagic symptoms, jaundice, shock, and multisystem organ failure.
- **Zika:** Most people infected with Zika won't have symptoms. The most common symptoms of Zika are fever, rash, joint, pain, and conjunctivitis (red eyes).

Updated information on arboviral activity in Maine including case counts can be found on this website: www.maine.gov/dhhs/mecdc/infectious-disease/epi/vector-borne/arboviral-surveillance.shtml.

II. GOALS OF PREVENTION

Timely and accurate information provided by Maine CDC may offer an early warning of increased risk of EEE, JCV, and WNV infection of humans, non-human mammals, birds, and local mosquito populations. Based on surveillance information, actions to reduce disease transmission can be implemented early when the impact can be lessened. Maine CDC works cooperatively with other state agencies, federal agencies, local communities, and selected interest groups to identify and support the use of risk reduction, disease prevention and integrated pest management methods that are specific to the cause of the diseases, use the least intrusive and most appropriate prevention methods, and support planning and practices that minimize the use of pesticides.

Town Level Responsibilities

1. Develop and update a local Integrated Pest Management (IPM) program
 - a. Conduct mosquito surveillance to identify local arboviruses (EEE, JCV, and WNV) as part of a comprehensive IPM program.
 - b. Conduct mosquito control to manage mosquito populations to reduce the risk of mosquito bites.
2. Provide information to the public on
 - a. Mosquito-borne disease and disease risk, and
 - b. How to take precautions to reduce the risk of infection.

III. PREVENTION AND CONTROL

Ultimately, the key to reducing the risk of arboviral disease is education and outreach to the public regarding the need for mosquito-bite prevention to protect against diseases such as EEE, JCV, and WNV. The emergent public health threat posed by arboviral illness requires a vigilant outreach effort. As the state public health entity, Maine CDC will continue to take a lead role in providing public education efforts to promote prevention, by working with our partners to maximize the opportunity to alert our residents to the dangers posed by mosquito-borne illness. This will include working with the media, local communities, businesses, and special populations such as schools, the homeless, and others who spend considerable time outdoors such as those who hunt, fish, or farm.

Maine CDC provides information to the public and communities to guide planning and actions to reduce the risk of human disease from EEE, JCV, and WNV.

Towns and individuals can take a number of simple steps that will greatly reduce the risk of mosquito-borne viruses to them, their families, and their communities. Ways individuals can help prevent the spread of mosquito-borne diseases in Maine include:

- Choosing to wear protective clothing (e.g., long pants, long-sleeve shirts)
- Using effective Environmental Protection Agency (EPA) approved repellents, and
- Minimizing opportunities for mosquitoes to breed.

Community efforts, such as public education, mosquito surveillance, and integrated pest management (IPM) measures aimed at mosquito larvae may be necessary to decrease the local risk of EEE, JCV and WNV. Information on EPA approved repellents is available through this website: www.epa.gov/insect-repellents/find-repellent-right-you.

A. Prevention Through Public Education

The goal of all mosquito-borne virus public outreach activities is to provide Maine's residents with helpful, accurate, and specific information in order to approach this problem with the appropriate level of caution.

Maine CDC's website includes general background information and surveillance updates as well as links to other informational websites including other state and federal agency sites. Printed materials can be ordered through this website: www.maine.gov/dhhs/order.

Maine CDC developed frequently asked question related to mosquitoes and the illnesses they can carry. The answers to these questions contain the peer-reviewed journal article source and can be viewed on this website: www.maine.gov/dhhs/mosquitofaq.

Epidemiologists from Maine CDC are also available to conduct trainings and give presentations on arboviral diseases and can be contacted by e-mail at disease.reporting@maine.gov or by phone at 1-800-821-5821.

B. Town Level Prevention Action Steps

1. Preventing Mosquito Breeding Opportunities: By reducing exposure to mosquitoes and by eliminating mosquito breeding grounds, Maine residents can greatly reduce their risk of mosquito-borne virus exposure. Many species of mosquitoes lay their eggs in standing water. Standing water is any collection of water that is not moving. Fresh water swamps and coastal areas provide larval habitat for the mosquito species commonly associated with EEE. Weeds, tall grass, and bushes may provide resting areas for the mosquitoes that are most often associated with WNV.

Towns should eliminate mosquito breeding sites on town-owned properties, and encourage their residents to eliminate breeding sites on their personal property. Maine CDC recommends the following steps to prevent mosquito breeding:

- Eliminate artificial sources of standing water around residential and commercial areas by discarding outdoor artificial containers such as tin cans, plastic containers, glass bottles, or similar water-holding containers.
- Remove all discarded tires from all properties. Used tires are the most common site for mosquito breeding in the United States. Tires used to anchor agricultural covers (such as silage tarps) should be drilled or otherwise modified to prevent water pooling.
- Dispose of or drill holes in the bottom of containers left outdoors, such as recycling containers or flowerpots. Drainage holes on the sides of containers will still allow enough water for mosquitoes to breed. Do not overlook containers that have become overgrown by vegetation.
- Make sure roof gutters drain properly. Clean clogged gutters in the spring and fall and as often as necessary to eliminate standing water.
- Clean and chlorinate swimming pools, outdoor saunas, and hot tubs following disinfectant label directions. If not in use, keep them empty and covered. Do not allow these covers to collect standing water.
- Aerate ornamental pools or stock them with native fish. Water gardens become major mosquito producers if they are allowed to stagnate.
- Turn over wheelbarrows and plastic wading pools when not in use. Both provide breeding sites for domestic mosquitoes.
- Change water in birdbaths at least once a week.
- Remind or help neighbors to eliminate mosquito breeding sites on their property.
- Consult with local mosquito control companies licensed by the Maine Board of Pesticides Control (BPC) (go to www.maine.gov/dacf/php/gotpests/solutions/tick-mosquito-companies.htm to see an updated list of licensed companies) for additional solutions to decrease mosquito-breeding activity in nearby areas. Products are available that can be used to reduce mosquito populations (see Mosquito Control Activities below).
- The management of ponds, marshlands, and wetlands is regulated under existing state law and administrative rule. Alteration may require the approval of state and possibly federal agencies. Contact the Maine Department of Environmental Protection (DEP) for further information www.maine.gov/dep/contact/index.html.

2. Personal Protective Measures: Residents can take simple steps to minimize mosquito bites. Such steps are critical in reducing the risk of EEE, JCV, and WNV infections. Town officials should take steps to inform residents of Maine CDC recommendations to protect themselves, particularly from June to October, when mosquitoes are most active:

- If outside during evening, nighttime, and dawn hours, or at any time mosquitoes are actively biting, children and adults should wear protective clothing such as long pants, long-sleeved shirts, and socks, and consider the use of personal repellent.
- EPA approved repellents include: DEET, Picaridin (KBR3023), IR3535, and Oil of Lemon Eucalyptus. The length of time a repellent is effective varies with ingredient and concentration. Always follow the manufacturer's instructions on the label.
- Permethrin is an EPA approved repellent product that can be used on clothing or fabrics. This product should not be applied directly to the skin. Be aware that use of permethrin requires planning, as application needs to happen outdoors and clothing needs two or more hours to dry outdoors before being worn. Always follow the manufacturer's instructions on the label.
- Do not allow young children to apply repellent themselves and do not apply repellent directly to children. Apply to your own hands and then put it on the child's skin.
- Infants and children should be protected by placing mosquito nets over strollers in the evening, nighttime, and dawn hours or at any time mosquitoes are actively biting.
- After returning indoors, wash treated skin with soap and water or bathe. Also, wash treated clothing before wearing again.
- Store repellent out of reach of children.
- For additional information about chemicals contained in repellents, visit the National Pesticide Information Center (NPIC) website at npic.orst.edu/repel.html or contact the Maine BPC at 207-287-2731.
- Make sure that doors and windows have tight-fitting screens. Repair or replace all screens in your home that have tears or holes.
- Vitamin B, ultrasonic devices, incense, and bug zappers have not been shown to be effective in preventing mosquito bites.

3. Mosquito Control Activities: The objective of public health mosquito control is to prevent transmission of mosquito-borne disease to humans. Reduction of mosquito species is not carried out by Maine public health agencies. It is important to emphasize that in most circumstances local communities make the final decision regarding mosquito control activities. Communities are responsible for developing, maintaining, and financing local mosquito control programs. Maine CDC, Maine Department of Agriculture, Conservation, and Forestry, Maine Board of Pesticides Control, and Maine Department of Environmental Protection are available to provide guidance and recommendations to assist municipalities in plan development and when faced with response decisions.

All discussion regarding pesticide applications discussed in this plan will be in accordance with the principles of Integrated Pest Management (IPM). IPM is a sustainable approach to managing mosquitoes by combining biological, physical and chemical tools in a way that minimizes economic, health and environmental risks. IPM involves preventive control and suppressive control, including:

- Source reduction (remove, cover, drain, fill) of larval habitats that are not environmentally sensitive or protected
- Mechanical control (the use of barriers such as screens to prevent the movement of mosquitoes and the use of traps en masse)
- Chemical / Biological Pesticide control (the use of registered pesticides, according to label directions that act against mosquitoes)

Deciding which product and method of application to use will depend on environmental conditions, targeted species, and state/local regulations. For information regarding pesticide rules and regulations, contact the Maine BPC at 207-287-2731. For legal use, larvicide and adulticide products must be registered in the State of Maine. To check registration status, please contact the Maine BPC at 207-287-2731 or go to npirspublic.ceris.purdue.edu/state/state_menu.aspx?state=ME. To gauge the relative risk of larvicides or adulticides, go to the BPC web site at www.maine.gov/dacf/php/pesticides/documents2/technical_resources/BPC_FINAL_3-7-14_Mosq_Adulticide_Review_small.pdf

Larviciding. Larviciding is a proactive measure that can be useful in reducing the risk of mosquito-borne disease throughout the season and tends to be more effective at reducing mosquito populations than adulticiding. Larviciding occurs in response to larval mosquito surveillance and habitat identification. The intent of a larvicide program is to control targeted mosquito species before they reach the adult stage, when they are able to transmit diseases such as EEE, JCV, and WNV. Several active ingredients, found in various pesticide formulations are labeled for mosquito larviciding. Products are microbial, botanical, or synthetically derived and can be classified as microbial, insect growth regulators, surface films, and organophosphates. Most are effective only during certain stages of mosquito development, thus timing of application is important. Permits from Maine DEP may be necessary prior to use of these products (www.maine.gov/dep/permits).

- Microbial-based Larvicides: Products derived from *Bacillus thuringiensis israelensis* (Bti) and *Bacillus sphaericus* (Bs) (naturally occurring bacteria) are effective against mosquito larvae. When ingested by mosquito larvae, they alter gut permeability, killing the larvae. They are believed to pose a minimal risk to non-target species.
- Insect Growth Regulators: Methoprene (e.g., Altosid) mimics the action of a mosquito growth-regulating hormone and prevents the larvae from maturing into adults. It has low toxicity to birds and fish.
- Surface Films: Petroleum derivatives (e.g., Golden Bear Oil) produce a thin film on the surface of the water that prevents the transfer of oxygen causing the mosquito larvae/pupae to drown. Ethoxylated alcohols (e.g., Agnique) produce a thin surface film, making it difficult for mosquito larvae, pupae, and emerging adults to attach to the water's surface, causing them to drown. The window of opportunity for use of these agents is limited by the mosquito life cycle, especially when dealing with species that require little or no surface contact for breathing. These agents also prevent the natural transfer of oxygen into the water. There are potential impacts to non-target species that rest on the water surface.

- Organophosphates: Temephos is the only organophosphate labeled for larvicidal use. It acts against mosquitoes by inhibiting nerve signal transmission. Although it presents relatively low risk to birds and terrestrial species, available information suggests that it is more toxic to non-target aquatic invertebrates than alternative larvicides.

Adulticiding. Adulticide involves the application of fine “mists” of pesticide over a relatively broad area to bring about the rapid knockdown of adult mosquitoes. Adulticiding occurs in response to current adult mosquito surveillance activity. Adulticiding can quickly reduce existing, biting adult mosquitoes throughout a spray area, but its effects are relatively short lived, raising the possibility of repeat applications. In addition, adulticide spray sites are most likely to be areas of high human population density.

Mosquito adulticides are dispersed either by truck-mounted equipment, backpack, or from aircraft. Barrier treatments, using compounds with residual characteristics, may also be used. Adulticides labeled for mosquito control include natural pyrethrins, synthetic pyrethroids, and organophosphates. These compounds affect the nervous system. The organophosphates have the potential to affect mammals and birds at lower doses than the pyrethrins and pyrethroids. There is high potential for acute and chronic risks to fish and invertebrates with the use of any insecticides within these three classes for adult mosquito control. To reduce the risks and to assure a legal application the pesticide labels must be followed. Insecticide selection and timing of application should be based on the distribution and behavior of the target mosquito species, and the availability and cost of the materials.

- Pyrethrins and synthetic pyrethroids: Pyrethrins are derivatives from chrysanthemum flowers that have a relatively low mammalian and non-target vertebrate toxicity. Some products containing pyrethrins may be designated “organic” if all of the components are derived from natural sources. Synthetic pyrethroids (e.g. permethrin, permethrin and d-phenothrin) are synthetically derived pesticides chemically similar to pyrethrins, with greater toxicity to the mosquitoes and have greater residual effects. Pyrethroids are relatively low in toxicity to mammals and non-target vertebrates. *NOTE: Pyrethrins and pyrethroids used in mosquito control are often mixed with a synergist compound, such as piperonyl butoxide, which enhances the effectiveness of the active ingredient to kill adult mosquitoes on contact.*
- Organophosphates: Compounds (e.g., malathion and Naled) comprise another group of mosquito adulticides. While their risk from exposure for humans, birds, and mammals are higher than the pyrethrins and pyrethroids, the risks are within the EPA’s level of concern.

Pesticides may pose their own risk to the health of humans, animals, plants, and the environment. Thus pesticides are only one component of a coordinated effort to control mosquitoes.

IPM dictates that control efforts should be tied to thresholds. In an ideal IPM program, non-chemical methods should be employed to keep pest levels below the risk level that might trigger a pesticide response, meaning that pesticides are a last, rather than first response to an EEE, JCV, or WNV threat.

Suggested Options for Mosquito Control Activities

Once a community identifies the need for an organized response to the risk of a mosquito-borne disease, it is necessary to decide on the type of response and the magnitude of the effort. These decisions are impacted by a variety of considerations, such as the severity of the problem, the financial resources of the community, public perceptions and attitudes, and the availability of technical expertise. Listed below are suggested options for local mosquito control programs. It is important to remember mosquito control is a year-round activity; many of these activities can be performed during the “off season.” Communities interested in developing or enhancing their mosquito control programs should review the document “Public Health Confronts the Mosquito” available at <https://www.astho.org/topic/report/public-health-confronts-the-mosquito/>.

- Institute a public information program emphasizing personal responsibility, ways in which people can prevent mosquito breeding, and how they can reduce the risk of being bitten by observing personal protection measures.
- Stay up-to-date on statewide and regional virus activity and recommendations by visiting www.maine.gov/dhhs/vectorborne.
- Contact insect repellent manufacturers to determine the availability of community or municipal discounts for bulk purchases of repellent products.
- Encourage local reporting to town officials of suspected areas where mosquitoes may be breeding (larval habitats). Such areas may then be evaluated by mosquito control personnel.
- Institute community cleanup programs to eliminate larval habitats from backyards, commercial sites and abandoned premises. Efforts may be aimed at removing, covering, or draining such artificial habitats.
- If needed, develop provisions in the local ordinances to deal with public health nuisances (e.g., unmaintained swimming pools that may serve as mosquito breeding habitat).
- Define the scope of the mosquito control program.
 - Create a clearly defined statement of services or deliverables, and a clear performance evaluation document.
 - Establish what activities will be performed.
 - Determine what resources (equipment, staff, insecticides, etc.) will be needed and what is available.
 - Decide where, when, and how often activities are to occur.
 - Emphasize public education and source reduction, augmented by larval and adult mosquito control, if appropriate.
 - Ensure that all staff are appropriately trained and licensed (see commercial pesticide applicator licensing requirements at www.maine.gov/dacf/php/pesticides/applicators/licensing.html)
 - Investigate training opportunities to develop local expertise, such as in mosquito trapping and identification, and/or pesticide application.

- Institute basic mosquito population monitoring to define the problem. Monitoring species, abundance, and virus infection rates in adult mosquitoes provides critical early, predictive data for surveillance and control.
 - Consider monitoring for emerging species of concern (i.e. *Aedes albopictus*)
- Consider coordinating mosquito control efforts with neighboring jurisdictions.
- Once these decisions are made, create a community-specific mosquito control plan.

C. Pesticide Control Board Regulations

The use of pesticides in Maine is governed by state law 22MRSA§1471 A-X and 7MRSA§ 601-625 and by the Administrative Rules of the Board of Pesticides Control, CMR01-026. Chapters 10 – 90. These statutes and rules require people applying pesticides, other than homeowners on their own property, to hold licenses issued by the Maine Board of Pesticides Control. Municipal employees must be licensed as a commercial pesticide applicator if the use of a pesticide is part of their official duties. Municipal entities needing licenses include municipal and quasi-municipal organizations like Parks and Recreation Departments, Public Works, Cemetery Maintenance, Water & Sewer Districts, Housing Authorities, etc.

The Board of Pesticides Control also requires licensing whenever pesticides are applied in areas open to the public. These areas could include parks, campgrounds, apartment or condominium grounds, common areas of apartment buildings and many other areas. If a municipality hires an outside company to do pest control, that municipality must be sure the applicator company has the appropriate commercial pesticide applicator licenses. We recommend obtaining proof of licensure even before entertaining a bid from an outside pest control company.

Pesticides covered by these rules include insecticides to kill mosquito larvae like *Bacillus thuringiensis* (var. *israelensis*) (Bti), *Bacillus sphaericus* (Bs), methoprene, and temephos, and insecticides to kill adult mosquitoes like malathion, naled and the pyrethroids, or any other pest control products whether organic, natural or synthetic.

Pesticide applicator licenses are required to handle and apply even the over-the-counter product varieties, like mosquito dunks or natural and organic products, when applications are performed by government employees or in public areas because of the greater potential for public exposure and the added liabilities resulting from that use. PERSONAL USE OF REPELLENTS DOES NOT REQUIRE A LICENSE.

D. Department of Environmental Protection Pesticide Rules

Although certain pesticide products are available for sale in the marketplace to control mosquito larvae, application of these products to any surface waters in Maine is governed through permits obtained from the Maine Department of Environmental Protection. Questions regarding how to apply for such special permits should be directed to the Maine Department of Environmental Protection at 207-287-7688 (www.maine.gov/dep).

In the event an EEE, JCV, or WNV threat is identified, the Commissioner of Health and Human Services may declare a Public Health Threat. If an arboviral threat persists or if recommended otherwise by the emergency arboviral panel, the Governor may declare a Public Health Emergency and instruct the Department of Environmental Protection to commence the expedited special permit process – that is, provide an application form and other pertinent information to the appropriate town official(s) through the local health officer. The special permit will be issued with the greatest possible speed, preferably within 72 hours.

Pesticide Applicator Licenses

Application of pesticides anywhere except to one's own property requires a commercial pesticide applicators license. A listing of the current Maine licensed pesticide applicators certified to control mosquitoes can be requested from the Maine BPC (207-287-2731, pesticides@maine.gov or www.maine.gov/dacf/php/gotpests/solutions/tick-mosquito-companies.htm). Successful applications require in-depth knowledge of the community's planned pesticide use for mosquito control. Communities may also decide to license their own staff to apply pesticides. The licensing process for commercial applicators is described on the BPC website at www.maine.gov/dacf/php/pesticides/applicators/licensing.html#comm.

IV. STATE SPONSORED SURVEILLANCE

A. Mosquito Surveillance

Mosquitoes are the best early indicator of human risk for arboviral disease. The objective of a mosquito surveillance program is to determine the presence of arboviruses, including EEE, JCV, and WNV, in mosquito species common to our area. An effective program begins by targeting mosquito species considered to be important in transmitting disease among birds (primary vector) and transmitting disease from birds to humans (bridge vectors). Monitoring mosquito abundance is accomplished through various surveillance methods including but not limited to measuring larvae (dip counts) and adult mosquitoes (use of light/CO₂ baited traps, gravid traps and resting boxes). Results must be evaluated by mosquito species, as each species has unique biological characteristics that should be incorporated into control decisions. Maine CDC uses a comprehensive and flexible strategy that modifies certain surveillance activities in response to trends in disease risk.

Based on historic and current epidemiology in Maine and the United States, Maine CDC only tests particular mosquito species for EEE, JCV, and WNV. Testing decisions are based on the most current knowledge and fiscal considerations. Such decisions will be announced to Town Officers and mosquito contractors well in advance. Regardless of testing decisions, communities financing mosquito surveillance are encouraged to conduct surveillance and utilize the testing services at HETL from May through October in order to evaluate the relative abundance of particular mosquito species. Mosquito larvae and adult abundance, arboviral testing results, and coverage of mosquito surveillance efforts play a critical decision-making role in overall need, scope, and method of control. The state may monitor for emerging species of concern as funding is available.

1. Routine Mosquito Surveillance: Maine CDC is the lead agency responsible for state-level mosquito surveillance activities. Maine CDC will work with its partners in coordinating efforts for appropriate placement of traps, collection, packaging and transport of mosquito specimens.

Routine, fixed long-term trap sites provide the best baseline information for detecting state-wide trends in mosquito abundance, virus prevalence and estimating the risk of human infection from EEE, JCV, and WNV but are insufficient for identifying risk at the local level. Maine CDC works together with contract employees to determine long term trap sites. If your town or community has interest in collecting mosquitoes locally for testing, please consult with Maine CDC for more information on collection requirements and testing ability.

2. Rapid Response Mosquito Surveillance: In the case of a positive test of an arbovirus in non-human mammals, birds, mosquitoes, or humans, state sponsored activities may include:

- Notifying city and town municipal officials of positive virus isolation or a confirmed case of a mosquito-borne disease.
- Providing short-term mosquito surveillance and laboratory specimen preparation in the absence of a local town led surveillance or local mosquito control program in predetermined selected areas.
- Coordinating training and lending expertise to local health officials and state personnel.
- Evaluating current trap locations based on criteria including habitats conducive to mosquito breeding and bridge vector collection, and level of human use (e.g., schools, parks, athletic fields).
- Reviewing and determining the need for expanding trapping in the area surrounding the positive identification.

B. Communication of Surveillance Information

1. Routine Information: Arboviral information will be available on Maine CDC's website at www.maine.gov/dhhs/vectorborne.

2. Positive EEE, JCV & WNV Findings: Maine CDC ensures the rapid and accurate dissemination of positive test results. Following an EEE, JCV, or WNV positive mosquito pool, bird, non-human mammal, or human, an investigation will be initiated and an epidemiologist will notify the Town Manager or Selectman as well as the district liaison for that area. The Town Manager or Selectman should notify all pertinent local officials, including high-level elected and appointed officials and, as warranted, the municipal Emergency Management Director and Animal Control Officer. Weekly reports are posted to the website during the arboviral season www.maine.gov/dhhs/mecdc/infectious-disease/epi/vector-borne/arboviral-surveillance.shtml. Information about positive findings on the weekly report will include at minimum:

- Human positives – species, collection date, county of residence, agent
- Non-human animal positives – species, collection date, county, agent
- Mosquito positives – species, collection date, town, county, agent

3. Press Releases/ Health Alerts: Maine CDC may issue press releases or health alerts to inform the public of conditions that may warrant additional precautions to reduce the risk of

disease. The Health Alert Network (HAN) will be utilized by Maine CDC to disseminate information to health care providers in the State. Providers can register with the Health Alert Network through mainehan.org.

4. Arboviral Public Health Threat or Emergency (Critical Risk). Information about how a public health threat or emergency is declared, and what happens after it is declared is available in [Appendix II](#).

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APPENDICES

Appendix I - Arboviral Surveillance Responsibilities

Arboviral surveillance is largely a town level responsibility. Maine CDC coordinates the state level response with mosquito trapping in historically significant sites, or sites with long term data. This information may not be sufficient for local risk levels. Towns are encouraged to begin or maintain a comprehensive Integrated Pest Management (IPM) strategy that includes mosquito surveillance. This chart details which entity is responsible for the different aspects of an arboviral response.

Event	Who is responsible?	
	Local (Municipality)	State (Maine CDC)
Mosquito Surveillance		
• Routine town level mosquito surveillance	X	
• Long term historical mosquito trap sites		X
• Rapid response mosquito trapping	X	X
Mosquito Control		
• Routine town level mosquito control	X	
• Town owned public lands mosquito control	X	
• Widespread mosquito control during a declared public health emergency	X	X
Public Awareness		
• Routine messaging on risks of mosquito borne diseases	X	X
• Emergency messaging after positive result detected	X	X

Appendix II - Arboviral Public Health Threat or Emergency

Purpose: A public health threat or emergency declared in response to an arboviral threat will allow local jurisdictions the option to rapidly receive permits, help provide authority for IPM, and otherwise implement interventions to reduce the risk of human illness from mosquitoes. An arboviral public health threat or emergency may be declared at the county or state level.

To request the declaration of an arboviral public health threat or emergency:

Any local, county, or state official may request consideration of an arboviral public health threat or emergency. Requests should be made by phone at 1-800-821-5821 or in writing to disease.reporting@maine.gov.

Maine CDC will consider recommending an arboviral public health threat or emergency if any of the following conditions exist:

- Any confirmed human case of EEE, WNV, JCV, or a travel related virus with a local vector risk
- Three or more veterinary cases of EEE, WNV, or JCV within a defined area (city, county, etc.)
- Ten percent bridge vector mosquito pools test positivity for EEE, WNV, or JCV within a single week

If any of these conditions exist, or if an official requests consideration, a panel will be convened to determine if Maine CDC will recommend the declaration of an arboviral public health threat or emergency. This panel will consist of at least:

- State Epidemiologist
- Vectorborne Epidemiologist
- Infectious Disease Epidemiology Program Director
- State Veterinarian
- State Integrated Pest Management Specialist
- Representative from Maine Board of Pesticides Control
- Vector Biologist (or contracted mosquito collection agency)
- May include a local representative.

If the panel decides to recommend an arboviral public health threat or emergency, the State Epidemiologist will submit the recommendation to the Director of Maine CDC, who will submit to the commissioner's office. The Commissioner of Health and Human Services can declare a mosquito-borne disease public health threat and the Governor can declare a Public Health Emergency.

When an Arboviral Public Health Emergency is declared:

- Maine CDC will stand up an Emergency Operations Center (EOC)
- The EOC will identify a public information officer (PIO)
 - The PIO will be responsible for all public information releases and all press inquiries
- The Vectorborne Epidemiologist will be the point of contact for the VBWG as well as serve as a subject matter expert for the EOC
- Any member of the VBWG may be asked to participate in the EOC and provide expertise in their subject areas
- The EOC will be deactivated when either: 1) public demand decreases to a manageable level, 2) the emergency is declared over, OR 3) two weeks after the second hard frost

Appendix III: Mosquito Collection and Testing

Please find below information pertaining to mosquito testing through Maine's Health and Environmental Testing Laboratory (HETL). Mosquitoes will be tested for Eastern Equine Encephalitis (EEE) virus, Jamestown Canyon virus (JCV), and West Nile virus (WNV). Any new municipality considering submitting mosquito specimens for testing should first consult with Maine CDC. Requests and consultations can be made through disease.reporting@maine.gov or by phone at 1-800-821-5821.

1. Mosquito pools may contain a maximum of 50 mosquitoes. Please be careful not to exceed the 50-mosquito pool size, as there may not be remaining space for adding the necessary reagents. HETL will REJECT for testing any pools that they cannot process due to excessive pool size. These pools will be held at HETL.
2. Please be sure to include detailed information on trap location. Trap location may be used for GIS mapping as well as analyzing location-specific changes over time. Both uses require detailed address information to ensure consistent results and tracking.
3. The early mosquito season will begin on May 15 and go through July 1; it may extend through the summer. Only JCV testing is performed during this time. Municipalities interested in conducting early season testing should contact Maine CDC to determine what mosquito species are accepted by HETL for JCV testing.
 - a. **Phase I** – May 15 through July 1, or longer as necessary (dates pertain to date of collection)
 - i. Early season mosquito vector species (i.e., snowmelt mosquitoes).
4. The regular mosquito season will begin on July 1 and go through October 1; it may extend through the end of fall. Testing will be performed in the following manner:
 - a. **Phase II** – July 1 through August 15, or first Maine or New Hampshire EEE or WNV detection (dates pertain to date of collection):
 - i. *Cs. melanura*, *Cs. morsitans*, *Cx. pipiens*, *Cx. restuans*, and *Cx. pipiens/restuans*: Only these species will be tested. Any pool size may be submitted for testing but pool size cannot exceed 50 mosquitoes. As soon as EEE or WNV is detected in Maine or New Hampshire, mosquito submissions will follow phase III.
 - ii. Other mosquito species: During the mosquito season, please discard (or hold internally if interested) any mosquitoes that are not *Cs. melanura*, *Cx. pipiens*, *Cx. restuans*, or *Cx. pipiens/restuans*. Other mosquito species may be tested on a case by case basis, as resources and time allow. As soon as EEE or WNV is detected in Maine, mosquito submissions will follow phase III.
 - b. **Phase III** – August 15 or first Maine or New Hampshire EEE or WNV detection through October 1 (dates pertain to date of collection):
 - i. *Ae. cinereus*, *Ae. vexans*, *Cq. perturbans*, *Cs. melanura*, *Cs. morsitans*, *Cx. pipiens*, *Cx. restuans*, and *Cx. pipiens/restuan*, *Cx. salinarius*, *Oc. candensis* and *Oc. sollicitans*
 - ii. Other mosquito pools not meeting the above criteria: Other mosquito species may be tested on a case by case basis, as resources and time allow. Otherwise, please discard (or hold internally if interested) any mosquitoes that do not meet the above criteria.

Appendix IV: Maine Vectorborne Work Group

Chair: Sara Robinson, Maine Center for Disease Control and Prevention (Maine CDC)

Bartiromo, Curtis	MaineHealth Institute for Research
Benowitz, Isaac	Maine CDC
Bonthius, Jessica	Maine CDC
Camuso, Judy	Maine Department of Inland Fisheries and Wildlife
Cosenza, Danielle	MaineHealth Institute for Research
Decato, Sarah	Maine Department of Education
Dill, Griffin	University of Maine, Tick Laboratory
Dyer, Robin	US Department of Agriculture
Elias, Susan	MaineHealth Institute for Research, University of Maine Orono
Fish, Gary	Maine Department of Agriculture, Conservation, and Forestry
Fiske, Rachael	Maine Department of Agriculture, Conservation, and Forestry
Gardner, Allison	University of Maine, School of Biology and Ecology
Henderson, Elizabeth	MaineHealth Institute for Research
Hill, Dana	University of Maine, Veterinary Diagnostic Laboratory
Jensen, Gary	Swamp, Inc.
Kanoti, Allison	Maine Forest Service
Kantar, Lee	Maine Department of Inland Fisheries and Wildlife
Lubelczyk, Charles	MaineHealth Institute for Research
Matluk, Nick	Health and Environmental Testing Laboratory
Meagher, Molly	MaineHealth Institute for Research
Meak, Sim	Health and Environmental Testing Laboratory
Morris, Jesse	US Department of Agriculture
Morrison, Mike	Municipal Pest Management
Patterson, Megan	Maine Department of Agriculture, Conservation, and Forestry
Peacock, Alexander	Board of Pesticides Control
Pearson, Taryn	Maine Department of Agriculture, Conservation, and Forestry
Peterson, Hillary	Maine Department of Agriculture, Conservation, and Forestry
Porter, Megan	Maine CDC
Rietdyk, Marlys	Maine Department of Agriculture, Conservation, and Forestry
Rivard, Trevor	Health and Environmental Testing Laboratory
Robich, Rebecca	MaineHealth Institute for Research
Robinson, Sara	Maine CDC
Rounsville, Thomas	University of Maine, Tick Laboratory
Schappach, Brittany	Maine Forest Service
Schmeelk, Thomas	Maine Forest Service
Smith, Rob	MaineHealth Institute for Research
Sohail, Haris	Maine CDC
Staples, Joe	University of Maine, Department of Environmental Science and Policy
Szantyr, Beatrice	Physician, Lincoln Maine
Szymanska, Kasia	Maine Department of Agriculture, Conservation, and Forestry
Taylor, Tegwin	Maine Department of Inland Fisheries and Wildlife
Urcuqui, Andres	University of Maine, School of Forest Resources
Webb, Nathan	Maine Department of Inland Fisheries and Wildlife
Webber, Lori	Health and Environmental Testing Laboratory

To reach a member of the VBWG or to express interest in joining this workgroup contact disease.reporting@maine.gov

Appendix V: State of Maine Agency Contacts

Agency	Phone	E-mail
Maine Center for Disease Control and Prevention	800-821-5821	disease.reporting@maine.gov
Maine Board of Pesticide Control	207-287-2731	pesticides@maine.gov
University of Maine Cooperative Extension	800-287-0279	extension@maine.edu
Maine Forest Service	207-287-2791	forestinfo@maine.gov
Maine Department of Education	207-624-6600	
Maine Department of Environmental Protection	207-287-7688	www.maine.gov/dep/contact
Maine Department of Inland Fisheries and Wildlife	207-287-8000	info.ifw@maine.gov
Maine Department of Agriculture, Conservation, and Forestry	207-287-3200	dacf@maine.gov
MaineHealth Institute for Research Vectorborne Disease Laboratory	207-396-8246	charles.lubelczyk@mainehealth.org