PIONEER VALLEY MOSQUITO CONTROL DISTRICT

2024 Annual Report

MEMBER COMMUNITIES

AMHERST
BERNARDSTON
BUCKLAND
CHICOPEE
DEERFIELD
EAST LONGMEADOW
ERVING
GILL
GRANBY
GREENFIELD
HADLEY
HEATH
HOLYOKE
LEYDEN
NORTHAMPTON
NORTHFIELD
PALMER
ROWE
SHELBURNE
SHUTESBURY
SOUTH HADLEY
SOUTHAMPTON
SUNDERLAND
WEST SPRINGFIELD

Table of Contents – Click on the heading to navigate to the desired section.

Summary

Introduction and Mission Statement

- **Overview**: The Pioneer Valley Mosquito Control District (PVMCD) annual report details arbovirus surveillance and mitigation efforts in the Pioneer Valley region.
- **Testing Period**: Surveillance testing occurred from June 11 to October 11, focusing on identifying and monitoring potential disease vectors, particularly West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE).
- **Surveillance Program**: PVMCD's program involves collecting mosquitoes and testing targeted species to identify potential vectors of WNV and EEE, aiding public health efforts with early detection and monitoring.
- **Pilot Larval Mitigation**: Implemented in five member communities with a history of positive EEE and/or WNV mosquitoes, targeting vector species' habitats to reduce mosquito numbers and lower disease transmission risk.
- **Purpose:** Safeguard the health of communities in Franklin, Hampden, and Hampshire Counties from mosquito-borne diseases by monitoring and mitigating disease transmission through an Integrated Mosquito Management (IMM) program.
- **IMM Program**: Utilizes environmentally conscious and scientifically proven strategies to reduce risk and avoid wide-area adulticide applications. Based on mosquito biology, life cycles, and disease dynamics, ensuring public safety and minimal environmental impact.

Mosquito-Borne Diseases Impacting the Commonwealth

- **West Nile Virus (WNV)**
  - Discovered in Uganda in 1937; reached the U.S. in 1999.
  - Endemic in Massachusetts since 2000, with 259 human cases by December 2024.
  - 80% of infected individuals are asymptomatic; severe symptoms are rare but can include neurological issues.
  - Transmission involves mosquitoes (Culex species), birds, and mammals; humans and horses are dead-end hosts.
- **Eastern Equine Encephalitis (EEE)**
  - First detected in Massachusetts in 1938; endemic in North America.
  - 119 documented human cases in Massachusetts since 1938.
  - 40% mortality rate among infected individuals from 2003 to 2022.
  - Transmission cycle involves mosquitoes (Culiseta melanura and other species), birds, and mammals; humans and horses are dead-end hosts.
- **Jamestown Canyon Virus (JCV)**
  - Identified in 1961 in Colorado; found across the U.S. and Canada.
  - One confirmed human case in New Hampshire in 2024; 13 cases in Massachusetts since 2011.
  - Transmission involves mosquitoes, deer, and humans; deer are primary reservoirs.
- **Dengue Fever**
  - Not native to Massachusetts but can be locally transmitted by Ae. albopictus mosquitoes.
  - 125 travel-acquired cases in Massachusetts by November 2024.
  - Significant global outbreak in 2024 with over 12.3 million infections, driven by climate change.

Primary Vector Species in Massachusetts

- **Culiseta melanura**:
  - Feeds on birds, amplifying EEE and WNV.
  - Multivoltine, with multiple generations each year influenced by climate.
  - Typically produces two generations in Massachusetts but may increase with warming temperatures.
  - Adults die off with the first hard frost; larvae overwinter in swamps.
- **Culex pipiens**:
  - Key player in WNV transmission cycle.
  - Prefers avian hosts but also feeds on mammals at dusk.
  - Multiple generations through the warm season, increasing with warmer temperatures.
  - Overwinters in man-made structures; prefers stagnant water habitats.
- **Additional Bridge Vector Species**:
  - Include **Coquillettidia perturbans, Aedes vexans, Culex salinarius**, and **Ochlerotatus canadensis**.
  - Play roles in virus transmission cycles.

Historical Trends and Surveillance Challenges of Arboviruses in Massachusetts

- **Positive Pools Locations**: Most occur in eastern, southeastern, and central parts of the state (Bristol, Essex, Middlesex, Norfolk, Plymouth, Suffolk, Worcester).
- **Surveillance Gaps**: Franklin, Hampden, and Hampshire counties lacked comprehensive surveillance until 2017, potentially affecting data accuracy before that year.
- **Improved Monitoring**: Enhanced surveillance since 2017 has increased the ability to monitor and respond to arbovirus threats in these areas.
- **Surveillance Challenges**: Gaps in surveillance, particularly in rural and underserved areas, hamper early detection and timely response, often due to funding and resource limitations.
- **Importance of Increased Efforts**: Enhanced surveillance is crucial for identifying hotspots, implementing targeted interventions, and developing effective control strategies to reduce arboviral disease burdens and safeguard public health.

Arbovirus Surveillance Coverage in Pioneer Valley

- A total of 408 traps were strategically deployed across 212 trap sites within PVMCD member communities (see figure 3) to capture targeted mosquito species.

Pioneer Valley Arbovirus Surveillance

- **Testing Efforts**: 612 pools (5-50 mosquitoes each) tested, totaling 25,047 vector mosquitoes.
- **WNV Positive Cases**: 6 WNV-positive isolations detected, with 5 from Culex species.
- **Impacted Communities**: East Longmeadow, Greenfield, Holyoke, Wales, and West Springfield.
- **EEE Results**: No EEE-positive pools or human cases in Pioneer Valley.
- **Human Cases**: 2 human cases of WNV confirmed in Hampden County.

Individual Member Community Surveillance Data and Regional Variations

- **Overview:** Table provided includes surveillance data for each member community.
- **Surveillance Schedule**: Each community had a week off due to Juneteenth and July 4, with 15 weeks of arbovirus surveillance services.
- **Testing**: Each pool (5-50 mosquitoes) was tested for WNV and EEE.
- **Franklin County**:
    - Rural and forested landscape.
    - Well-drained soils, leading to lower mosquito populations.
- **Hampshire County**:
    - Mix of agricultural fields, forests, and suburban areas.
    - Soils range from well-drained to clayey, supporting varied mosquito habitats.
- **Hampden County**:
    - Urban centers with diverse soils.
    - Clayey soils support wetlands and higher mosquito populations.
- **Artificial Containers**:
    - Urban areas have many artificial containers (storm drains, tires, kiddie pools, etc.).
    - These containers provide breeding sites for mosquitoes, including Culex pipiens, the primary vector for WNV.
- **Impact of Variations**:
    - Differences in landscape, topography, soil composition, and artificial containers influence mosquito populations and their distribution across the region.

Human Cases across the Commonwealth

- **EEE Cases**: 4 human cases and 4 animal cases; 97 positive mosquito pools.
- **WNV Cases**: 18 human cases reported, up from 6 the previous year; 333 positive mosquito pools.
    - Majority of human cases involved neuroinvasive illness.
    - Notable surge in infections in 2018, with 49 human cases (44 neuroinvasive).
- **Concentration**: Arbovirus transmission mainly in Middlesex (2 EEE, 5 WNV) and Suffolk (4 WNV) counties.
- **Importance**: Highlights the need for continued vigilance and public health measures.

Weather Impacts

- **Steady Precipitation**: Consistent through most of the summer.
- **Lack of Rain in August**: Significantly impacted mosquito populations and behavior.
    - **Culex *pipiens***: Thrives in artificial containers, remaining productive even during drought.
    - **Wetland-Dependent Species**: Populations declined due to reduced rainfall.
- **Seasonal Changes**: Natural decline in mosquito populations as temperatures drop.
- **Population Graph**: Reflects the effects of drought and seasonal changes on mosquito populations.

Climate Change and its Impact on Mosquitoes

- **Aedes *albopictus* (Asian tiger mosquito)**:
    - Introduced to the U.S. in the mid-1980s, likely via used tire shipments.
    - Spread to many states, including Massachusetts; first established population collected in region this year.
    - Aggressive daytime biter, capable of transmitting diseases like dengue fever, chikungunya, Zika virus, and dog heartworm.
    - Breeds in very small amounts of water, eggs can survive up to 8 months and endure mild winters.
- **Climate Change Effects**:
    - Rising temperatures and changing precipitation patterns create favorable conditions for mosquito breeding and survival.
    - Warmer winters and extended growing seasons lead to longer breeding periods and larger populations.
- **Surveillance and Mitigation**:
    - Continued surveillance and mitigation efforts are essential to protect at-risk communities.
    - Utilization of GIS software for spatial analysis to identify potential breeding areas and entry points.
    - High density of discarded tires in urban areas identified as hotspots for Ae. *albopictus.*
- **Other Species Discovered**:
    - **Culex *erraticus***: Found in higher numbers this year, potential vector for EEE and WNV.
    - **Psorophora *columbiae*:** Known livestock pest, increase in presence within the region.
- **Public Health Concerns**:
    - Both species are aggressive biters and pose significant public health risks.
    - Climate change likely contributing to their northward expansion.

Pilot Larval Mitigation

- **Program Implementation**: Acquired a facility and added seasonal staff to target mosquito habitats in Amherst, Deerfield, Northampton, South Hadley, and West Springfield.
- **Targeted Habitats**: Focused on deciduous swamps, stagnant ditches, flooded meadows, and over 500 discarded tires breeding Ae. *albopictus*.
- **Treated Area**: Approximately 4 acres of mosquito habitat, targeting Ae. *vexans*, Cx. *salinarius*, and Oc. *canadensis*.
- **Monitoring:** Inspected wetlands and ditches before and after treatments to assess larval mortality and non-target impacts. Avoided treating areas with predatory species or low biodiversity.
- **Storm Drains**: Treated 2,287 storm drains to reduce Culex pipiens populations in areas with a history of WNV.
- **Products Used**: FourStar CRG granules and FourStar 45/90-day briquets containing Bti (Bacillus thuringiensis subspecies *israelensis*), targeting mosquito larvae without harming humans and pets.

2025 Season Outlook

- **Factors Influencing Disease**: Infection rates in birds, vector species abundance, and favorable weather conditions.
- **Predicting Outbreaks**: More challenging than predicting vector populations due to complex interactions between mosquitoes, birds, and the environment.
- **Impact of Precipitation**: Winter and spring precipitation affects mosquito populations, particularly Cs. *melanura* and Cq. *perturbans*, which overwinter in the larval phase.
- **Proactive Measures**: Larval sampling in fall and spring to assess Cs. *melanura* population densities, helping predict adult populations in May.
- **Seasonal Generations**: Cs. *melanura* has two generations, with the first generation amplifying EEE among birds if the virus is present.
- **Surveillance and Strategy**: Continuous monitoring and informed strategies based on weather forecasts and larval assessments to mitigate risks of WNV and EEE.

Introduction

The Pioneer Valley Mosquito Control District (PVMCD) annual report provides an overview of arbovirus surveillance and mitigation efforts conducted within the Pioneer Valley region. The arbovirus surveillance testing period spanned from June 11 to October 11, focusing on the identification and monitoring of potential disease vectors, particularly those carrying West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE).

PVMCD's comprehensive surveillance program not only involves the collection of mosquitoes but also emphasizes the testing of targeted mosquito species to identify potential vectors of WNV and EEE. This proactive and targeted strategy contributes to public health efforts by providing valuable data for the early detection and monitoring of mosquito-borne diseases in the Pioneer Valley Region.

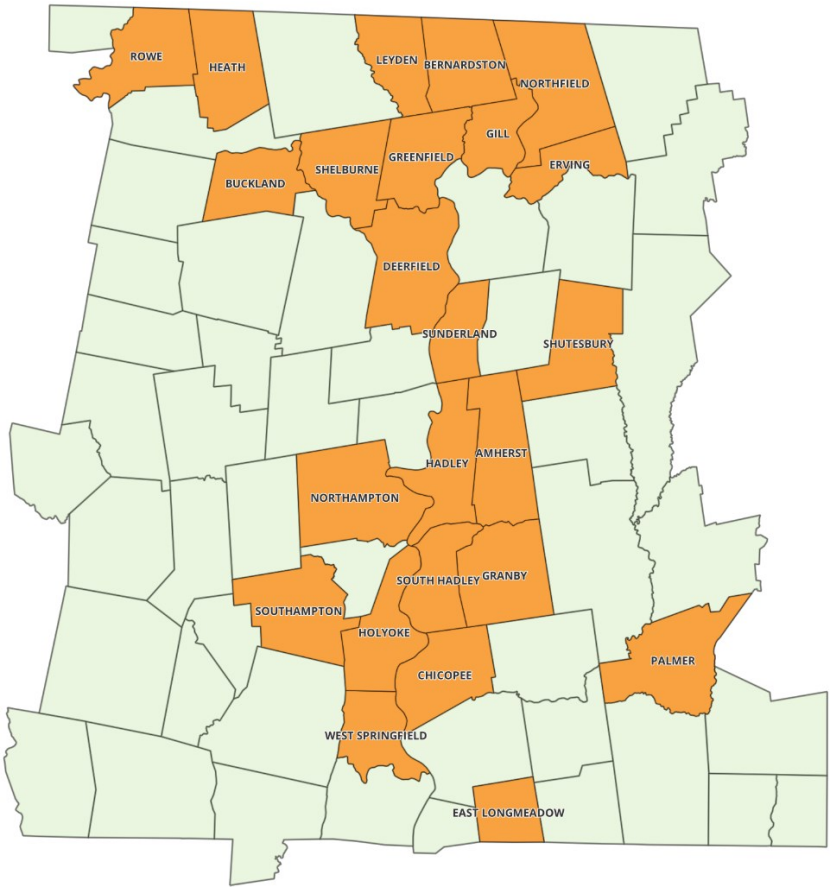
Pilot larval mitigation services were implemented in five member communities, all of which have a recent history of positive EEE and/or WNV mosquitoes. The pilot larval mitigation program specifically targeted vector species' habitats for to reduce the number of mosquitoes and lower the risk of disease transmission.

Our Mission

The Pioneer Valley Mosquito Control District (PVMCD) is dedicated to safeguarding the health of its member communities in Franklin, Hampden, and Hampshire Counties by addressing the public health risks associated with mosquito-borne diseases. Our primary objective is to meticulously monitor and effectively mitigate the transmission of these diseases through the implementation of a robust Integrated Mosquito Management (IMM) program. This program is designed to encompass a wide range of environmentally conscious and scientifically proven mitigation strategies, aiming to prevent the need for extensive wide-area adulticide applications.

The IMM program employs techniques for mosquito control grounded in a comprehensive understanding of mosquito biology, the life cycle of mosquitoes, and disease dynamics. When implemented correctly, these scientifically proven strategies not only reduce mosquito populations but also pose no danger to the public and have minimal to no environmental impact.

PVMCD Service Area and 2024 Member Communities



Return to Table of Contents

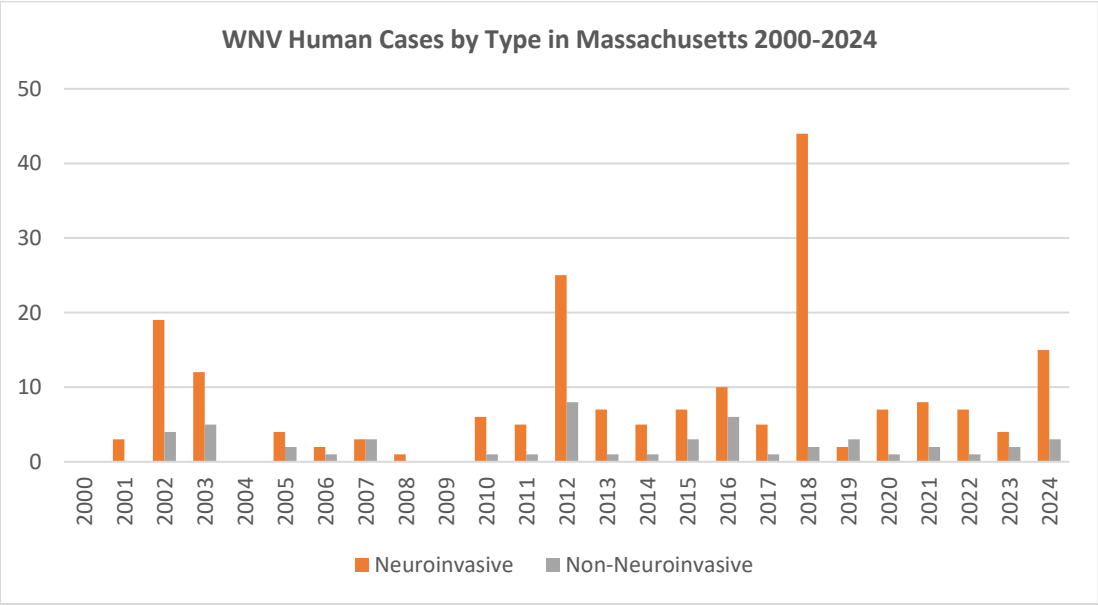
Mosquito-Borne Diseases Impacting the Commonwealth

West Nile Virus (WNV) is a flavivirus belonging to the Japanese encephalitis virus group and was originally discovered in the West Nile District of Uganda in 1937. The virus was not detected in the United States until the summer of 1999, in New York City. Since then, WNV has significantly expanded its reach across North America.

WNV was first confirmed in Massachusetts in 2000 and has since become endemic, with human cases occurring regularly throughout the Commonwealth. As of December 2024, there have been a total of 259 of human cases in Massachusetts (see figure 1). This spread underscores the importance of ongoing surveillance and public health efforts to reduce the risk of transmission.

Severe illness is very rare, and roughly 80% of people infected with the virus do not develop any symptoms. People over the age of 50 are considered at a higher risk for developing more severe symptoms of neuroinvasive disease, which include: stiff neck, muscle tremors, seizures, changes in vision, and weakness or paralysis. Less severe symptoms of febrile illness include headache, fever, muscle aches, joint pain, fatigue, and rash. The onset of symptoms typically appears within 2 to 14 days of being bitten by an infected mosquito.

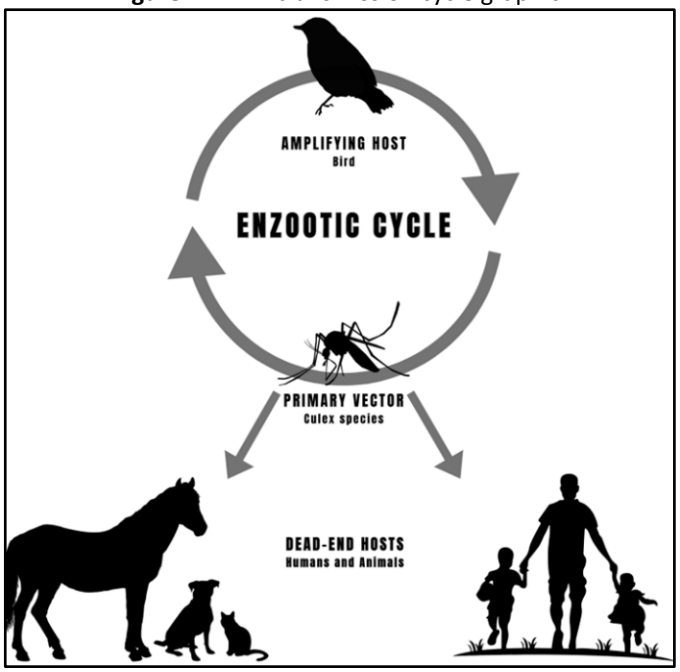
Figure 1: Historical WNV Human Case Data



The WNV transmission cycle involves several key players: mosquitoes, birds, and mammals, including humans (see figure 2). The cycle begins when mosquitoes, particularly Culex species, feed on infected birds. Birds are the primary reservoirs of the virus, carrying high levels of the virus in their bloodstream. After feeding on an infected bird, the virus replicates within the mosquito and eventually reaches its salivary glands.

When the infected mosquito bites another bird or a mammal (such as a human or horse), it transmits the virus through its saliva. Humans and horses are considered dead-end hosts because they do not develop high enough levels of the virus in their bloodstream to infect other mosquitoes, thus not contributing to the spread of the virus. In rare cases, WNV can also be transmitted through blood transfusions, organ transplants, and from mother to baby during pregnancy, delivery, or breastfeeding.

Figure 2: WNV transmission cycle graphic.

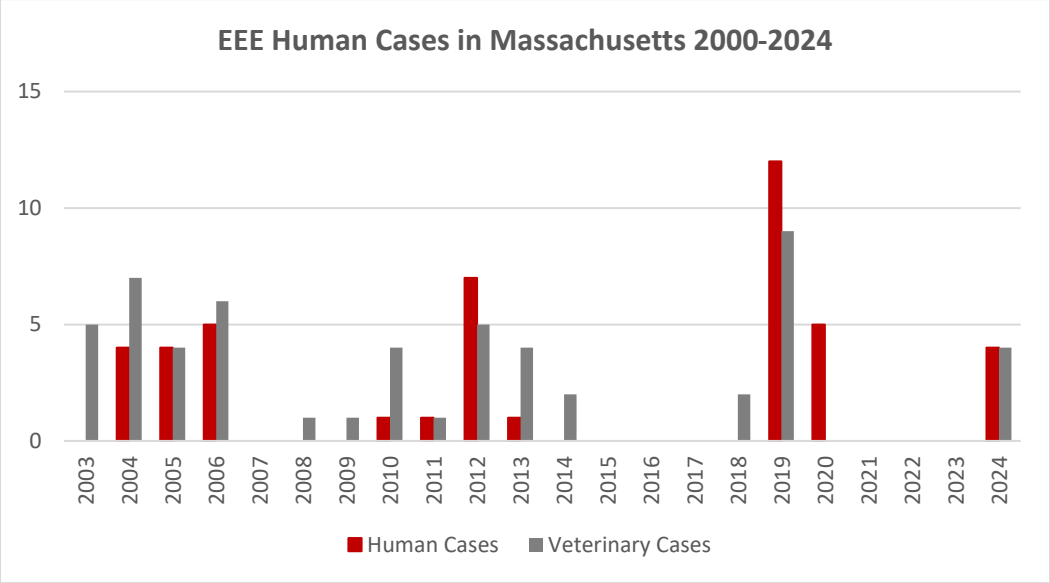


Return to Table of Contents

Eastern Equine Encephalitis (EEE) virus is a severe alphavirus that was first detected in humans during the historic 1938 outbreak in Massachusetts. Instances of viral transmission of EEE to humans and horses occur regularly in North America, where it is considered endemic. Since its first detection in Massachusetts in 1938, there have been about 119 documented human cases of the disease (see figure 3). Historically, EEE has been more prevalent in Bristol, Plymouth, and Norfolk Counties. However, in recent years, EEE has also had a significant impact on additional communities located in Central and Western Massachusetts.

The transmission of EEE to humans is very rare, however, approximately 40% of cases have resulted in death from 2003 to 2022. Children and the elderly are at a higher risk of dying from the disease. The onset of symptoms for EEE ranges from 4 to 10 days. The symptoms for the neuroinvasive disease include fever, headache, seizures, changes in behavior, vomiting, diarrhea, and coma. Those who recover from neuroinvasive disease often experience long-term cognitive impairments that require life-long medical interventions. Febrile illness is a less severe form of the disease and typically includes the following symptoms: fever, muscle and joint pain, and chills – not unlike the flu. Recovery from febrile illness tends to occur within 1 to 2 weeks of the onset of symptoms (see table 1).

Figure 3: Historical EEE Human and Veterinary Case Data

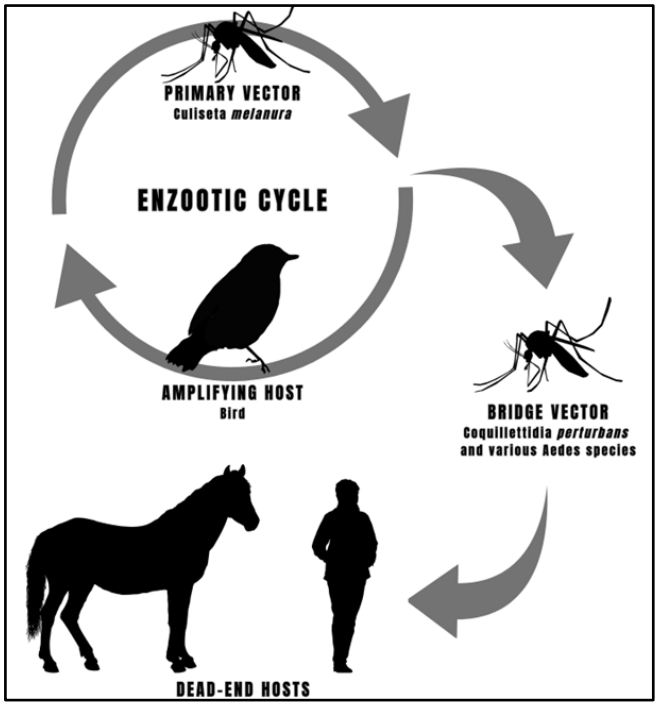


The EEE transmission cycle involves mosquitoes, birds, and mammals, including humans and horses. The cycle begins when Culiseta *melanura* mosquitoes, which breed in freshwater swamps, feed on infected birds (see figure 4). Birds are the primary reservoirs of the virus, harboring it in their bloodstream without showing symptoms.

After feeding on an infected bird, the virus replicates within the mosquito. The mosquito can then transmit the virus to other birds, continuing the cycle. Other mosquito species, such as Aedes, Coquillettidia, and Culex, which are bridge vectors, feed on both birds and mammals, transmitting the virus from birds to humans and horses.

Like WNV, humans and horses are considered dead-end hosts because they do not develop high enough levels of the virus in their bloodstream to infect other mosquitoes, thus not contributing to the spread of the virus.

Figure 4: EEE transmission cycle graphic.



Return to Table of Contents

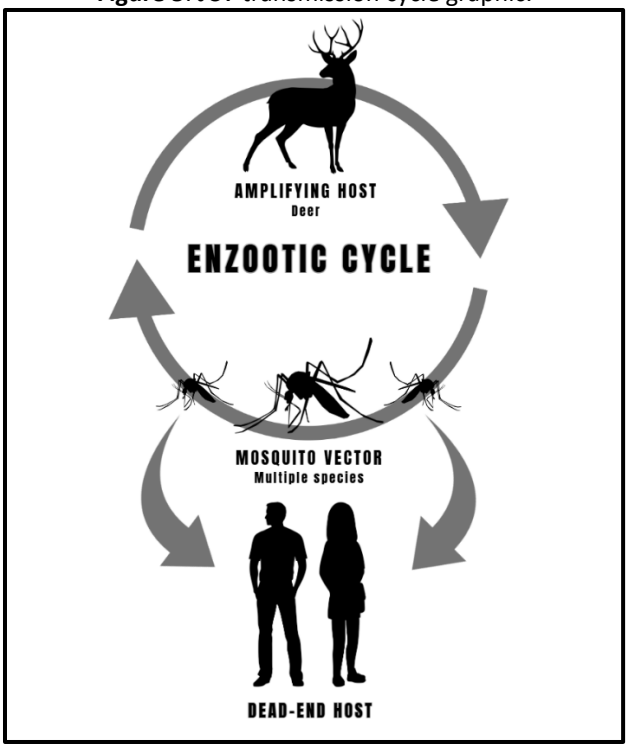
Jamestown Canyon Virus (JCV) was first identified in 1961 in mosquitoes collected from Jamestown Canyon, Colorado. It belongs to the California serogroup of bunyaviruses and is closely related to La Crosse encephalitis virus. Since its discovery, JCV has been found in various mosquito species across the United States and Canada, and it continues to be a concern due to its potential to cause severe neuroinvasive diseases and death**.**

In 2024, there was one confirmed human case of JCV in New Hampshire. Since 2011, there have been 13 reported cases in Massachusetts, 19 in New Hampshire, 4 in Maine, 4 in Rhode Island, 1 in Connecticut, and 5 in New York. According to the CDC, there have been a total of 308 JCV cases across the country, with 10 deaths from 2011 to 2023.

The JCV transmission cycle involves mosquitoes, deer, and humans. The cycle begins when mosquitoes, particularly those that feed on deer, become infected with the virus (see figure 5). Deer serve as the primary reservoirs, carrying the virus in their bloodstream without showing symptoms.

After feeding on an infected deer, the virus replicates within the mosquito. When the infected mosquito bites another host, such as a human or another deer, it transmits the virus through its saliva. Humans are considered dead-end hosts because they do not develop high enough levels of the virus in their bloodstream to infect other mosquitoes, thus not contributing to the spread of the virus.

Figure 5: JCV transmission cycle graphic.

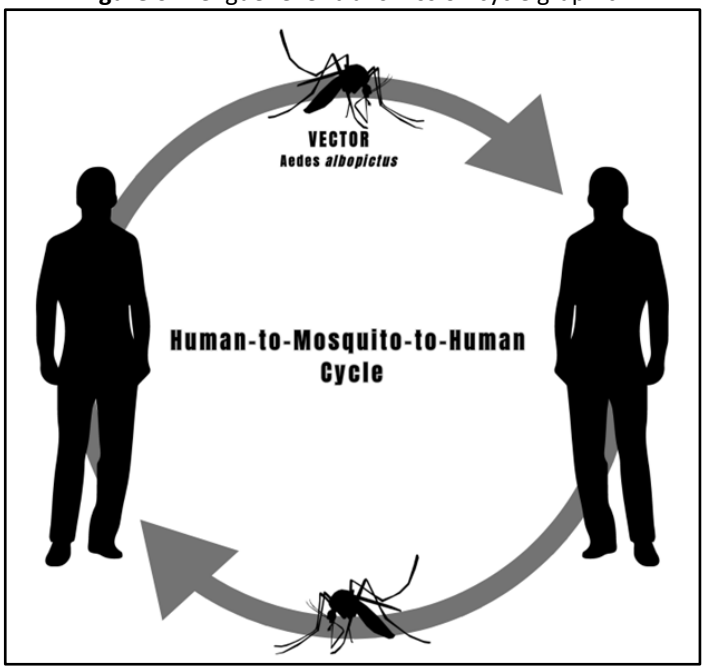


Dengue Fever is not native to Massachusetts; however, it can be locally transmitted through the human-to-mosquito-to-human cycle (see figure 6), especially in areas where Ae. albopictus mosquitoes are established. These mosquitoes are capable of carrying and transmitting dengue, posing a potential risk for local outbreaks.

Typically, dengue transmission occurs in the Caribbean, Central America, South America, Southeast Asia, and the Pacific Islands. Travel to these regions increases the likelihood of importing cases. As of November 2024, Massachusetts has reported 125 dengue cases, all acquired through travel.

Dengue saw a significant outbreak in 2024, where cases reached record levels, with over 12.3 million infections. This surge in cases can be attributed to rising global temperatures and changing weather patterns, which have extended the mosquito season and increased the risk of transmission.

Figure 6: Dengue fever transmission cycle graphic.



Primary Vector Species in Massachusetts

Culiseta *melanura* feed primarily on avian species and are responsible for amplifying both EEE and WNV among the wild bird population. Culiseta *melanura* are multivoltine, meaning they have multiple generations throughout the warmer months. Climate plays a major role in how many generations Cs. *melanura* can produce each year. For instance, in southern states, Cs. *melanura* can produce three or more generations, whereas in Massachusetts, it can reach only two generations. However, this number may increase due to warming temperatures. Adult Cs. *melanura* and many other mosquito species will die off with the first hard frost (28°F for at least 2 hours), and the larvae will overwinter in what is referred to as "crypts", found in red maple and white cedar swamps.

Culex *pipiens* play a significant role in the transmission cycle of WNV by amplifying the virus within the wild bird population. Similar to Cs. *melanura* mosquitoes, *pipiens* prefer avian hosts; however, they will also feed on mammals around dusk. Culex *pipiens* have multiple generations throughout the warm season, and an extended growth season with warmer temperatures in September will result in more generations. Once temperatures begin to cool, adult female Cx. *pipiens* will typically seek out man-made structures such as houses, sheds, and discarded tire piles to begin overwintering. Regarding habitat, *pipiens* prefer very stagnant water that can be found in catch basins, discarded tires, "green" swimming pools, and ditches around livestock animals.

There are additional species that play a role as bridge vectors in the virus transmission cycle such as Coquillettidia *perturbans*, Aedes *vexans*, Culex *salnarius*, and Ochlerotatus *canadensis*. Please see the Targeted Mosquito Species in table 1 below for more information regarding medical importance, habitat, and phenology.

Table 1: Targeted Vector Species

Species Name	Description	Habitat	Months Active
Aedes *albopictus*	An invasive species that is an aggressive and relentless day biter. Ae. *albopictus* prefer to feed on humans and can transmit chikungunya, dengue, and Zika.	Discarded tires and other containers.	June-October Peak: July
Aedes *vexans*	An aggressive biter that falls within the "flood water" species. Ae. *vexans* is a bridge vector for EEE and will feed on both birds and mammals.	Temporary freshwater pools such as flood meadows, retention ponds, and vernal pools.	May-October Peak: Varies and is dependent on precipitation.
Culiseta *melanura*	Cs. *melanura* mosquitoes are a primary vector for EEE. Cs. *melanura* feed mainly on avian species and are responsible for amplifying the virus to the point that it spills over into bridge vectors.	Tree root cavities or "crypts" covered by peat moss in red maple and cedar swamps.	May-December Peak: July-August and mid-September
Culex *pipiens* and *restuans*	These two mosquito species are abundant in Massachusetts and can amplify WNV in the bird population and infecthumans. While Cx. *pipiens* is more implicated in WNV transmission, both Cx. *pipiens* and *restuans* are grouped together because differentiating between the two species with 100% reliability if very difficult.	Artificial containers such as "green" swimming pools, catch basins, discarded tires, buckets, etc.	May-October Peak: July-August
Coquillettidia *perturbans*	Cq. *perturbans* is one of the most abundant mosquitoes in Massachusetts and are considered a competent bridge vector for both EEE and WNV. Cq. *pertubans* will feed on both birds (reservoir for EEE) and mammals.	Permanent bodies of water with emergent vegetation such at cattails.	May-September Peak: July
Ochlerotatus *canadensis*	Oc. *canadensis,* is a bridge vector that can transmit both EEE and WNV to humans.	Woodland/vernal pools.	May-October Peak: June
Ochlerotatus *japonicus*	An invasive species that is a potential bridge vector for WNV and EEE.	Discarded tires and other containers	May-October Peak:
Culex *salinarius*	*Cx. salinarius* are considered bridge vectors for both EEE and WNV, readily feeding on mammals.	Brackish and freshwater swamps.	May-November Peak: August
Other species	There are many other species that PVMCD staff will submit to the Arbovirus Surveillance Laboratory at DPH for testing. These species are considered potential vectors in transmitting arboviruses.		

Historical Trends and Surveillance Challenges of Arboviruses in Massachusetts

Historically, most arbovirus mosquito positive pools have occurred in the eastern, southeastern, and central parts of the state, particularly in counties such as Bristol, Essex, Middlesex, Norfolk, Plymouth, Suffolk, and Worcester (see table 2). It should be noted that all the counties listed in table 2, with the exception of Franklin, Hampden, and Hampshire, have had consistent and comprehensive arbovirus surveillance provided by mosquito control districts/projects since 2004. Franklin, Hampden, and Hampshire counties did not receive comprehensive surveillance until 2017. This gap in surveillance may have impacted the detection and management of arbovirus activity in these counties. Consequently, the data from these counties might not fully represent historical trends prior to 2017. As surveillance efforts have improved, the ability to monitor and respond to arbovirus threats in these areas has significantly increased.

Table 2: Historical WNV and EEE positive mosquito pools by county.

County	WNV Positive Pools	EEE Positive Pools	Testing Period
Barnstable	86	23	2004-Present
Berkshire	184	6	2004-Present
Bristol	455	525	2004-Present
Dukes	12	0	2004-Present
Essex	336	59	2004-Present
Franklin	68	2	2017-Present
Hampden	103	13	2017-Present
Hampshire	53	0	2017-Present
Middlesex	660	40	2004-Present
Norfolk	401	71	2004-Present
Plymouth	389	686	2004-Present
Suffolk	518	0	2004-Present
Worcester	342	85	2004-Present

Given this historical context, addressing arbovirus surveillance gaps remains a critical challenge in effectively managing and mitigating the risks posed by vector-borne diseases such as WNV and EEE. In municipalities where comprehensive surveillance is lacking, early detection of virus activity is hampered, potentially leading to delayed responses and increased human exposure. These gaps can be attributed to limitations in funding, resources, and infrastructure, particularly in rural and underserved areas. Increasing surveillance efforts is crucial for the timely identification of arbovirus hotspots, enabling public health officials to implement targeted interventions and preventive measures. Enhanced surveillance not only improves the accuracy of disease prevalence data but also supports the development of robust control strategies, reducing the overall burden of arboviral diseases on communities. By addressing these gaps, we can enhance our preparedness and response capabilities, ultimately safeguarding public health.

Arbovirus Surveillance Coverage in Pioneer Valley

A total of 408 traps were strategically deployed across 212 trap sites within PVMCD member communities (see figure 7) to capture targeted mosquito species.

Figure 7: PVMCD 2024 Trap Site Coverage Map

Two distinct types of traps were utilized:

1. **CDC Trap:** This trap is baited with carbon dioxide (CO_2) and designed to attract a variety of mammal-biting mosquitoes. The use of CO_2 mimics the exhalation of potential hosts, making it an effective tool for capturing mosquitoes seeking blood meals from mammals. Some CDC traps were also baited with Octenol, a chemical used to attract Ae. *albopictus* mosquitoes.

2. **Gravid Trap:** Characterized by its unappealing aroma, the gravid trap is baited with hay-infused water. This unpleasant scent is specifically attractive to Culex *pipiens* mosquitoes, which are drawn to the trap for egg deposition. This targeted approach aids in the surveillance of a specific mosquito species known for its potential to transmit WNV.

Pioneer Valley Arbovirus Surveillance Summary

A total of 612 pools (5-50 mosquitoes in each PCR tube), amounting to 25,047 vector mosquitoes, were submitted for testing, focusing on the detection of WNV and EEE (see tables 3 and 4). Altogether, there were 6 WNV-positive isolations detected in Pioneer Valley, 5 of which were from Culex species. Impacted communities included East Longmeadow, Greenfield, Holyoke, Wales, and West Springfield (see figure 8). There were no EEE positive pools detected or any human cases in Pioneer Valley. The Massachusetts Department of Public Health confirmed 2 human cases of WNV in Hampden County.

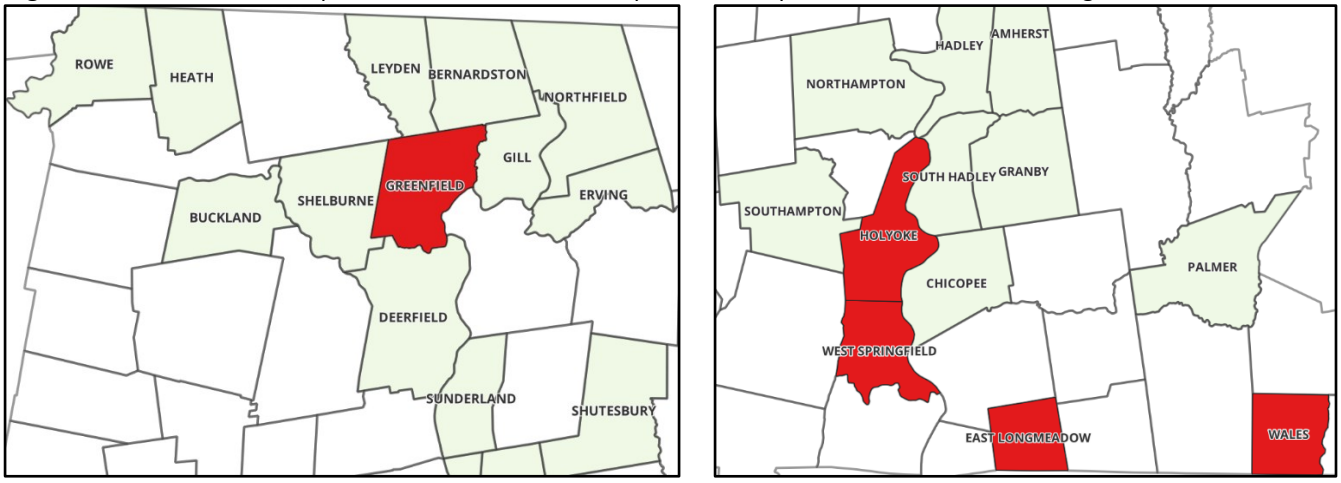
Table 3: Cumulative surveillance totals.

Cumulative Totals: EPI Weeks 24-40				
Species	**Cumulative Specimens**	**Cumulative Pools**	**Cumulative WNV+**	**Cumulative EEEV+**
Cx. *pipiens/restuans*	**1373**	**75**	**1**	**0**
Cs. *melanura*	**167**	**47**	**0**	**0**
Cq. *perturbans*	**16322**	**228**	**1**	**0**
Oc. *canadensis*	**580**	**23**	**0**	**0**
Oc. *japonicus*	**966**	**74**	**0**	**0**
Cx. *salinarius*	**1077**	**55**	**4**	**0**
Ae. *albopictus*	**116**	**9**	**0**	**0**
Ps. *ferox*	**403**	**15**	**0**	**0**
An. *quadrimaculatus*	**689**	**11**	**0**	**0**
Ae. *vexans*	**431**	**32**	**0**	**0**
Cx. *erraticus*	**456**	**9**	**0**	**0**
An. *punctipennis*	**1136**	**12**	**0**	**0**
Ae. *cinereus*	**107**	**3**	**0**	**0**
Oc. *triseriatus*	**329**	**1**	**0**	**0**
Oc. *trivittatus*	**895**	**14**	**0**	**0**
Totals	**25047**	**608**	**6**	**0**

Table 4: 2024 Mosquito Surveillance Data by County

County	Mosquito Pools Tested	WNV Positive Pools	EEE Positive Pools	Most Abundant Species and Total	Total Number of Mosquitoes Collected
Franklin	**234**	**1**	**0**	**Cq. *perturbans* (5,838)**	**9,537**
Hampden	**190**	**5**	**0**	**Cq. *perturbans* (11,255)**	**17,530**
Hampshire	**184**	**0**	**0**	**Cq. *perturbans* (2,710)**	**16,186**

Figure 8: Red-colored municipalities indicate where WNV positive mosquitoes were detected throughout the 2024 season.



Return to Table of Contents

Individual Member Community Surveillance Data and Regional Variations

Each member community received arbovirus surveillance services for 15 weeks. Every pool submitted consisted of 5-50 mosquitoes and were tested for both WNV and EEE. Individual trap data can be provided upon request. Please see table 5 below for specific member community surveillance data.

Table 5: Arbovirus surveillance data by town.

Municipality	Pools	WNV Pools	EEE Pools	Total Mosquitoes Collected	Cs. *melanura* totals	Most Prevalent Vector Species (Total)	2nd Most Prevalent Vector Species (Total)
Amherst	34	0	0	1,341	4	Cq. *perturbans* (632)	Cx. *pipiens/restuans* (362)
Bernardston	23	0	0	579	25	Cq. *perturbans* (160)	Cx. *pipiens/restuans* (54)
Buckland	8	0	0	274	0	Cq. *perturbans* (163)	Oc. *spp.* (96)
Chicopee	55	0	0	5,090	134	Cq. *perturbans* (3,477)	Cs. *melanura* (134)
Deerfield	25	0	0	620	1	Cq. *perturbans* (147)	Cx. *pipiens/restuans* (128)
East Longmeadow	31	2	0	1,192	32	Cq. *perturbans* (942)	Cx. *pipiens/restuans* (49)
Erving	17	0	0	515	5	Cq. *perturbans* (289)	Oc. *japonicus* (59)
Gill	18	0	0	1,664	8	Cq. *perturbans* (1,337)	Cx. *salinarius* (46)
Granby	35	0	0	1,645	10	Cq. *perturbans* (885)	An. *quadrimaculatus* (471)
Greenfield	28	1	0	679	1	Cq. *perturbans* (234)	Oc. *japonicus* (66)
Hadley	36	0	0	1,286	0	Cq. *perturbans* (665)	Cx. *salinarius* (187)
Heath	7	0	0	197	2	Cq. *perturbans* (88)	Cx. *pipiens/restuans* (39)
Holyoke	30	1	0	1,114	2	Cq. *perturbans* (524)	Cx. *salinarius* (100)
Leyden	10	0	0	119	0	Oc. *japonicus* (56)	Oc. *japonicus* (56)
Northampton	34	0	0	3,840	1	Cq. *perturbans* (3,173)	Cx. *pipiens/restuans* (92)
Northfield	23	0	0	1,833	12	Cq. *perturbans* (1,401)	Ae. *vexans* (173)
Palmer	25	0	0	1,598	26	Cq. *perturbans* (1,111)	Cx. *salinarius* (294)
Rowe	8	0	0	279	1	Cq. *perturbans* (152)	Cx. *pipiens/restuans* (33)
Shelburne	16	0	0	953	0	Cq. *perturbans* (749)	An. *quadrimaculatus* (29)
Shutesbury	13	0	0	550	14	Cq. *perturbans* (430)	Oc. *japonicus* (21)
South Hadley	31	0	0	1,245	20	Cq. *perturbans* (561)	Oc. *canadensis* (265)
Southampton	14	0	0	791	0	Cq. *perturbans* (608)	Oc. *canadensis* (23)
Sunderland	41	0	0	1,275	1	Cq. *perturbans* (640)	Cx. *salinarius* (49)
West Springfield	50	1	0	1,742	0	Cq. *perturbans* (530)	Cx. *erraticus* (455)

The landscape and topography change significantly from Franklin County down to Hampden County. Franklin County, in the northern part of the Pioneer Valley, has a more rural and forested landscape, with numerous small streams and rivers contributing to its diverse wetlands. The soils here are generally well-drained and tend to dry out quickly. Therefore, these soils are less likely to support wetlands, resulting in lower mosquito populations.

The Hampshire County landscape transitions into a mix of agricultural fields, forests, and suburban areas. The soils in Hampshire County are a mix of well-drained and clayey soils. The central part of the county has soils that are good for agriculture but can also retain moisture, leading to a variety of mosquito habitat.

Lastly, Hampden County, situated at the southern end of the Pioneer Valley, is made up of urban centers, such as Springfield, as well as more developed infrastructure and industrial areas. The soils in this region are diverse, with some areas having well-drained soils suitable for agriculture, while other areas have more clayey soils that retain moisture. These clayey soils are more likely to support wetlands, providing ideal breeding grounds for mosquitoes and resulting in higher mosquito populations.

Artificial containers such as storm drains, tires, kiddie pools, birdbaths, and buckets contribute significantly to mosquito production, especially in urban areas. These containers provide ideal breeding sites for mosquitoes, including the primary vector for WNV, Culex *pipiens*.

This variation in landscape, topography, soil composition, and the prevalence of artificial containers influences mosquito populations and their habitats, impacting the distribution and abundance of different species across the region.

Human Cases across the Commonwealth

The past season saw a total of 4 positive EEE human cases, 4 EEE animal cases, and 18 positive WNV human cases (see table 5). Additionally, there were 97 positive EEE mosquito pools and 333 positive WNV mosquito pools. Please refer to table 6 below for more information regarding human cases.

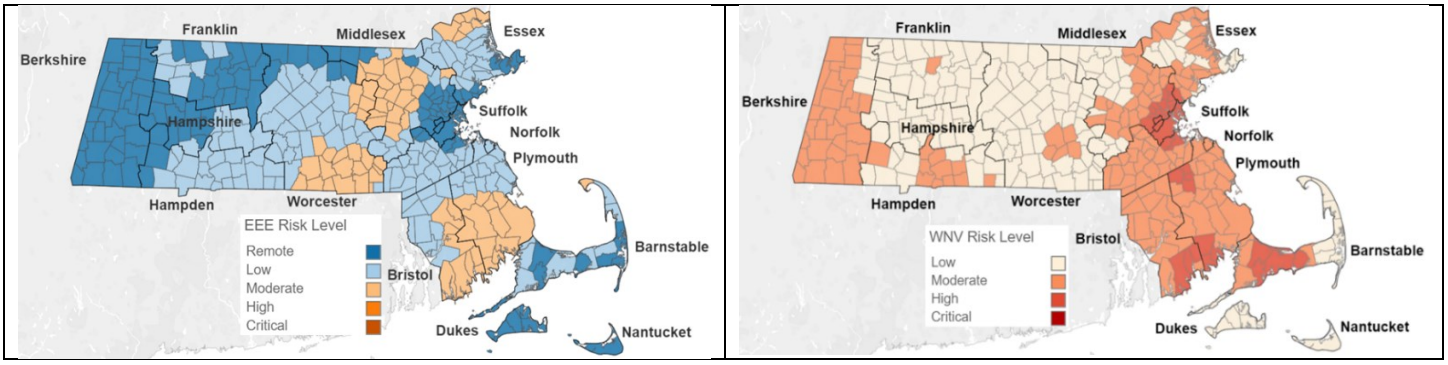
Table 6: Arbovirus human cases across the Commonwealth in 2024.

	Onset of Symptoms	County	Age Range	Gender	Clinical Presentation
EEE Human Cases	August 6, 2024	Worcester	80-89	Male	Encephalitis
	August 12, 2024	Middlesex	50-59	Female	Meningoencephalitis
	August 17, 2024	Plymouth	30-39	Female	Meningoencephalitis
	August 22, 2024	Middlesex	70-79	Male	Meningoencephalitis
WNV Human Cases	July 22, 2024	Hampden	40-49	Male	Meningitis
	July 26, 2024	Middlesex	70-79	Male	Encephalitis
	August 7, 2024	Bristol	60-69	Female	Fever
	August 13, 2024	Suffolk	60-69	Male	Meningitis
	August 16, 2024	Middlesex	70-79	Male	Encephalitis
	August 16, 2024	Suffolk	50-59	Male	Meningoencephalitis
	August 17, 2024	Norfolk	60-69	Male	Meningitis
	August 17, 2024	Suffolk	60-69	Male	Encephalitis
	August 18, 2024	Essex	50-59	Male	Neuroinvasive
	August 22, 2024	Middlesex	80-89	Male	Meningoencephalitis
	August 24, 2024	Barnstable	60-69	Male	Encephalitis
	August 26, 2024	Middlesex	60-69	Male	Encephalitis
	August 28, 2024	Middlesex	60-69	Female	Fever
	August 31, 2024	Suffolk	20-29	Male	Fever
	September 2, 2024	Essex	40-49	Male	Meningitis
	September 11, 2024	Hampden	80-89	Female	Encephalitis
	September 13, 2024	Barnstable	70-79	Female	Meningoencephalitis
	September 15, 2024	Worcester	70-79	Female	Encephalitis

The state experienced a spike in WNV infections, with 18 human cases reported, compared to 6 human cases the previous year. Neuroinvasive illness impacted the majority of human cases, which is not uncommon, considering these cases display sever illness that is more commonly reported than infected people suffering from a mild fever. In 2018, there was an unprecedented 49 human cases, 44 of which were neuroinvasive. These surges in infection rates, coupled with the common prevalence of neuroinvasive disease, highlights the importance of continued vigilance and public health measures to monitor and mitigate the impact of WNV.

Arbovirus transmission was primarily concentrated in Middlesex County (2 EEE cases, 5 WNV cases) and Suffolk County (4 WNV cases). All areas impacted by positive mosquito pools and human cases can be viewed in the final arbovirus risk maps provided by the MA Department of Public Health (see figures 9 and 10).

Figures 9 and 10: Final risk maps for EEE and WNV from MA Dept. of Public Health.



Return to Table of Contents

Weather Impacts

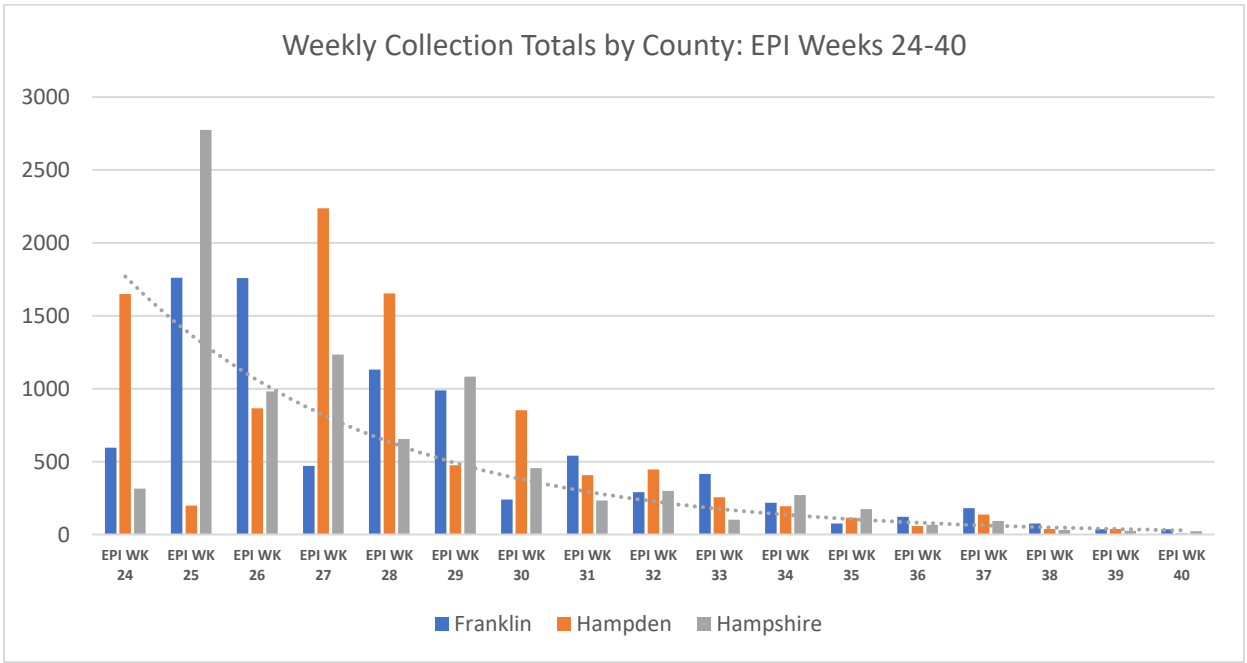
Precipitation in Massachusetts remained fairly steady throughout most of the summer (see table 7). However, the onset of a drought in August significantly impacted mosquito populations. This climatic shift caused a notable change in the behavior and breeding patterns of different mosquito species. For instance, Culex *pipiens*, the primary vectors for WNV, thrive in artificial containers such as storm drains and unmaintained swimming pools. As a result, they tend to remain productive even during drought conditions, maintaining their population levels.

In contrast, other mosquito species that rely on wetlands for breeding experienced a decline in their populations due to the lack of water. These species depend heavily on natural water sources, which diminished during the drought, leading to a decrease in their numbers. Additionally, the phenology of mosquito species in Massachusetts shows that populations naturally decline due to seasonal changes. As temperatures drop, mosquito activity decreases, leading to a natural reduction in their populations. This trend is evident in the population graph (see figure 11), which reflects the effects of drought and seasonal changes on overall mosquito populations.

Table 7: Weather data taken during EPI weeks 24-40.

Station	Name	EPI Week	PRCP Total (in.)	TMAX AVG (°F)	TMIN AVG (°F)
USC00190120	AMHERST, MA US	**24**	**0.57**	**75.43**	**54.14**
USC00190120	AMHERST, MA US	**25**	**1.79**	**84.71**	**61.14**
USC00190120	AMHERST, MA US	**26**	**1.64**	**81.86**	**59.14**
USC00190120	AMHERST, MA US	**27**	**2.08**	**81.71**	**58.29**
USC00190120	AMHERST, MA US	**28**	**1.5**	**89**	**69.9**
USC00190120	AMHERST, MA US	**29**	**1.89**	**87.14**	**64.43**
USC00190120	AMHERST, MA US	**30**	**0.64**	**81.71**	**62**
USC00190120	AMHERST, MA US	**31**	**1.22**	**84.43**	**64.57**
USC00190120	AMHERST, MA US	**32**	**2.8**	**80.57**	**64.71**
USC00190120	AMHERST, MA US	**33**	**0.15**	**80.86**	**57**
USC00190120	AMHERST, MA US	**34**	**1.46**	**74.28**	**55.28**
USC00190120	AMHERST, MA US	**35**	**0.12**	**80.86**	**57**
USC00190120	AMHERST, MA US	**36**	**0.00**	**77.43**	**52.14**
USC00190120	AMHERST, MA US	**37**	**0.35**	**75**	**46.29**
USC00190120	AMHERST, MA US	**38**	**0.04**	**80.57**	**54.14**
USC00190120	AMHERST, MA US	**39**	**0.42**	**68**	**51.29**
USC00190120	AMHERST, MA US	**40**	**0.02**	**72.29**	**51.29**

Figure 11: Weekly mosquito population trends by county.



Climate Change and its Impact on Mosquitoes

Aedes *albopictus*, commonly known as the Asian tiger mosquito, was first introduced to the United States in the mid-1980s. Ae. albopictus likely made its way into the country through shipments of used tires sent from Asia to Houston for tire retreading. This invasive species has since spread to many states, including Massachusetts. Ae. *albopictus* is a highly aggressive daytime biter. It wasn't until this year that Ae. *albopictus* was discovered for the first time in the region at a discarded tire facility in Hampden County (see figure 12).

Figure 12: Ae. *albopictus* collected from CDC traps baited with Octenol and CO2 near a discarded tire facility in Hampden County.

Unlike some other native mosquito species, Ae. *albopictus* is known for its rapid and repeated biting behavior. This makes it a significant nuisance and potential health threat. Ae. *albopictus* is capable of transmitting several serious diseases. These include dengue fever, which causes severe flu-like symptoms, and chikungunya, known for its debilitating joint pain. The mosquito is also a potential carrier of Zika virus, which can lead to severe birth defects when transmitted to pregnant women. Moreover, it can transmit dirofilariasis, commonly known as dog heartworm, which poses a threat to pets.

One of the key factors contributing to the success of Ae. *albopictus* is its ability to breed in very small amounts of water. Even a small amount of water found in bowls, cups, fountains, tires or vases, can serve as a breeding ground for these mosquitoes. Female mosquitoes lay their eggs on the inner walls of containers holding water, and these eggs are capable of surviving for up to 8 months and can endure winter conditions in milder climates.

Climate change plays a significant role in success and proliferation of Ae. *albopictus*. Rising temperatures and changing precipitation patterns create more favorable conditions for these mosquitoes to breed and survive. Warmer winters and extended growing seasons allow for longer breeding periods, increasing their population.

The aggressive biting behavior combined with its ability to transmit multiple diseases, makes it essential to focus on continued surveillance and mitigation efforts to protect at-risk communities. Enhanced surveillance, public awareness campaigns, and targeted control strategies are crucial in managing the risks associated with this invasive species.

Surveillance for Ae. *albopictus* begins with spatial analysis or the utilization of GIS software to pinpoint potential breeding areas and entry points. Using this method, PVMCD staff were able to identify hotspots or where the presence of this invasive mosquito species is most likely. One particular urban area with a high density of discarded tires produced 124 Ae. *albopictus* adult females throughout the season.

In addition to Ae. *albopictus*, PVMCD found two rare species that are typically found in warmer climates: Culex *erraticus* and Psorophora *columbiae* (see figures 13 and 14). A single specimen of Ps. *columbiae* was first collected in Bristol County during the 2021 season. Since then, only 8 additional specimens have been found. This year, PVMCD found a total of 10 Ps. *columbiae*, indicating a potential increase in their presence within the region. For Culex *erraticus*, a total of 63 specimens had been collected since 2007 across the state. Remarkably, PVMCD found an unprecedented 463 Cx. *erraticus* this past season.

Figure 13: Ps. *columbiae*

Figure 14: Cx. *erraticus*

Both species are known to be aggressive biters and pose public health concerns. Cx. *erraticus* is a potential vector for both EEE and WNV, while Ps. *columbiae* is a known livestock pest and can cause sever nuisance due to its incessant biting. The discovery of these species by PVMCD is likely due to climate change and warming temperatures, making it crucial to continue monitoring their expansion northward.

Pilot Larval Mitigation Summary

With the acquisition of a facility and the addition of seasonal staff, PVMCD was able to implement its pilot larval mitigation program in Amherst, Deerfield, Northampton, South Hadley, and West Springfield, at a practical level of capacity. Throughout the 2024 season, PVMCD staff specifically targeted mosquito vector habitat in deciduous swamps, stagnant ditches, flooded meadows. Additionally, over 500 discarded tires breeding Ae. *albopictus* were treated. Altogether, approximately 4 acres of mosquito habitat was treated, targeting the following vector species capable of transmitting EEE and/or WNV: Ae. *vexans,* Cx. *salinarius*, and Oc. *canadensis*.

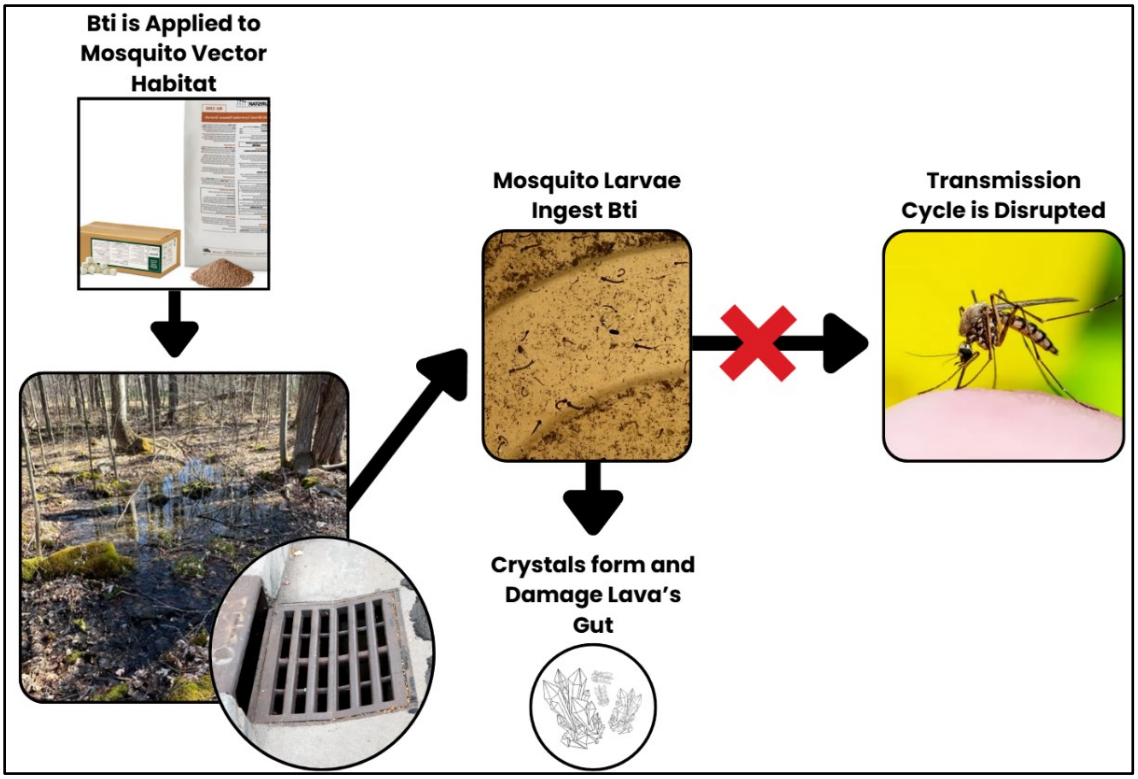
Figure 15: An example of low biodiversity and high abundance of mosquito larvae. Sample taken from a backed-up ditch.

All wetlands and ditches were inspected before and after treatments to monitor larval mortality and any non-target impacts. To minimize indirect trophic effects, areas where predatory species such as dragonfly larvae were found did not receive treatment. Only areas with either an absence of predatory species or low biodiversity and a high abundance of mosquito larvae were treated (see figure 15).

Storm drains or catch basins were targeted for the purpose of reducing Culex *pipiens*, the primary vector for WNV. All areas and neighborhoods where storm drains were treated had a recent history of WNV. In total, 2,287 storm drains were treated.

The two products used were FourStar CRG granules for treating wetlands and tires, and FourStar 45/90-day briquets for treating. Both products contain Bti, also known as Bacillus thuringiensis subspecies israelensis, which is a naturally occurring soil bacteria that is harmless to humans and pets. Bti specifically targets mosquito larvae through the first instar instar phases, where the larvae are actively eating before they transition to pupae. The higher pH levels found in the mosquito's gut activates Bti crystals that eventually damage the gut lining, causing the mosquito to die (see figure 16). Black flies and non-biting midges are the only other organisms that Bti will kill. As mentioned in the above paragraph, indirect trophic effects are considered with every application of Bti.

Figure 16: Flow chart showing how Bti works in reducing mosquito larval populations.



2025 Season Outlook

The prevalence of mosquito-borne disease depends on several factors, including infection rates in the bird population, vector species abundance, and weather conditions that must remain favorable for mosquito populations. These factors collectively create a complex web that influences when and where outbreaks occur. While it is relatively easier to predict vector population numbers through weather forecasts, surveillance, and tracking mosquito habitats, predicting outbreaks of diseases such as WNV and EEE is much more challenging. This difficulty arises because disease transmission dynamics involve numerous variables and unpredictable interactions between mosquitoes, birds, and environmental conditions.

Precipitation over the winter and spring months will impact mosquito populations, specifically Cs. *melanura* and Cq. *perturbans*. These two species not only play a significant role in the EEE transmission cycle, but also are the only two species in Massachusetts that overwinter in the larval phase. Because of this, Cs. *melanura* and Cq. *perturbans* rely on permanent water sources to support their populations. As a proactive measure, PVMCD staff conduct larval sampling in the during the fall and spring at established Cs. *melanura* adult surveillance sites to assess populations densities (see figures 17-19). Monitoring Cs. *melanura* larval populations, along with analyzing long-term weather outlooks, can help us to predict this species' abundance once they emerge as adults in May. Having this information is crucial because Cs. *melanura* has two generations throughout the season, and it's the first generation that amplifies EEE among the bird population if the virus is present.

Figure 17: PVMCD staff observe Cs. *melanura* larvae in a pipette.

Figure 18: PVMCD staff sample a "crypt" for Cs. *melanura* in a white cedar swamp.

Figure 19: Identification of Cs. *melanura* larvae can easily be accomplished in the field due to its uniquely long syphon.

By understanding the complex interplay of factors that influence mosquito populations and disease transmission, we can better anticipate and mitigate the risks associated with mosquito-borne diseases like WNV and EEE. Continuous surveillance, coupled with informed strategies based on long-term weather forecasts and larval population assessments, will enhance our ability to protect public health and reduce the impact of these diseases in Massachusetts.

FAQ

FAQ	Answer
What is a primary vector?	A primary vector is a species of mosquito that plays a significant role in the virus cycle.
What is a bridge vector?	Once EEE and/or WNV are amplified enough in the bird population, spill over into other mosquito species will occur. Species that are competent vectors and feed on both birds and humans will create a "bridge" for virus transmission to occur.
How long do mosquitoes live?	Lifespan varies from a few weeks to several months depending on species, environmental conditions, and resource availability. Additionally, some species can lay multiple batches of eggs while others will lay a single batch and die shortly after.
What is an instar phase?	Mosquito larvae go through 4 instar phases where they molt. The 4th instar phase is when larvae stop eating and molt into pupae. It is important to understand these phases when applying larvicide products that have one mode of action via ingestion.
How long does it take mosquitoes to develop?	This period of development will vary in the spring depending on environmental conditions. In the summer, however, it typically takes a week for mosquitoes to develop from egg to adult.
What are mosquito pools?	A pool consists of 5-50 mosquitoes placed into a PCR tube for arbovirus testing.
What is a Gravid trap?	A gravid trap is one of the two main traps used by PVMCD. The trap primarily targets "gravid" Culex mosquitoes (WNV vector) seeking out suitable habitat to lay their eggs. Culex species look for bacteria rich (foul smelling and stagnant) water to lay their eggs. The Gravid trap essentially replicates an artificial container habitat.
What is a CDC trap?	A CDC trap is the second main trap used by the PVMCD. It is used to target mosquitos that feed on mammals and are capable of transmitting EEEV or WNV to humans. The CDC trap utilizes CO2, which mimics the breath of a potential blood meal.
Why are there pools submitted from one trap but not the other?	Not every trap yields enough targeted vector species to submit for testing. Factors influencing this are weather, habitat, and equipment failures.
What is a "trap failure" (TF)?	Sometimes faulty parts or wear from regular use result in trap failures. Trap failures are inevitable but do not occur that often.
What does "no collection recorded" (NCR) mean?	A "no collection recorded" or "NCR" means no mosquitoes were collected from a trap deployed in the field. This will occur throughout the season but tends to be more frequent during the earlier and later parts of the season.
Does PVMCD offer control services?	PVMCD implemented a pilot larval mitigation program in 2024 at a practical level of capacity. Control services consisted of targeting vector species habitat via larvicide granule formulations primarily in the spring to mitigate arbovirus.
What is Bti?	Bti stands for *Bacillus thuringiensis israelensis* and is naturally occurring soil bacteria that is used to control larval mosquito populations. Bti is safe for humans, animals, and the environment when used as directed. It is effective in reducing mosquito larvae that are feeding during the first 3 instar phases. The timing of application is imperative to Bti's effectiveness in controlling mosquito populations.

FOURSTAR®

Bti CRG

Specimen Label

Multi-Brood Controlled Release Granule

ACTIVE INGREDIENTS:

Bacillus thuringiensis subspecies ***israelensis*** Strain BMP 144 solids, spores and insecticidal toxins*	10%
OTHER INGREDIENTS:	90%
TOTAL:	100%

* Equivalent to 700 International Toxic Units (ITU/mg).

Note: The percent active ingredient does not indicate product performance, and potency measurements are not federally standardized.

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS – CAUTION:

Causes moderate eye irritation. Harmful if absorbed through skin. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet. Remove and wash contaminated clothing before reuse.

Mixers / loaders and applicators not in enclosed cabs or aircraft must wear gloves and a dust / mist filtering respirator meeting NIOSH standards of at least N-95, R-95, or P-95. Repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.

FIRST AID	
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth if possible. • Call a poison control center or doctor for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, and then continue rinsing eyes. • Call poison control center or doctor for treatment advice.
If on skin	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call poison control center or doctor for treatment advice.
HOT LINE NUMBER	
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-248-7763 for emergency medical treatment information.	

ENVIRONMENTAL HAZARDS:

Do not contaminate water when disposing of equipment washwaters or rinsate. Do not apply to treated, finished drinking water reservoirs or drinking water receptacles when the water is intended for human consumption.

DIRECTIONS FOR USE

It is a violation of Federal law to apply this product in a manner inconsistent with its labeling.

APPLICATION DIRECTIONS

FourStar® Bti CRG is a highly selective multi-brood microbial insecticide granule effective against mosquito larvae in a variety of aquatic habitats for up to 40 days or more. **FourStar® Bti CRG** releases effective levels of ***Bacillus thuringiensis*** subspecies ***israelensis*** to the water surface and throughout the water column over time.

FourStar® Bti CRG can be applied prior to flooding (i.e. "pre-hatch") to known breeding sites that flood intermittently. In such areas, one application of **FourStar® Bti CRG** prevents adult mosquito emergence for up to four subsequent floodings. The actual length of control depends on the duration and frequency of flooding events. Alternate wetting and drying will not reduce granule effectiveness.

Apply uniformly according to rates listed below by conventional aerial or ground equipment as needed to maintain mosquito control. Reapply after 40 days under typical environmental conditions. More frequent applications may be made if monitoring indicates that larval populations have reestablished or weather conditions have rendered initial treatments ineffective.

APPLICATION SITES

Apply **FourStar® Bti CRG** pre-hatch or post-hatch as directed above to temporary and permanent water sites, which support mosquito larval development. **FourStar® Bti CRG** can be applied to areas that contain aquatic life, fish and plants as well as areas in contact with humans, animals, horses, livestock, pets, birds or wildlife.

Examples of application sites include: tidal water, salt marshes, mangroves, estuaries, freshwater marshes, cattail marshes, woodland pools and meadows, grassy swales, floodplains, flood water, standing water, roadside ditches, canals, woodland pools, catch basins, storm drains, storm water collection areas, retention and detention impoundments, lakes and ponds, abandoned swimming pools, water holding receptacles, and other natural and man-made sites where mosquitoes may develop.

Avoiding spray drift at the application site is the responsibility of the applicator. The interaction of many equipment and weather related factors determine the potential spray drift. The applicator and treatment coordinator are responsible for considering all these factors when making decisions.

FOURSTAR®

Bti CRG

APPLICATION RATES

To control mosquito larvae, apply 7.5 to 10 lbs of **FourStar® Bti CRG** per acre. Use 10 to 20 lbs of **FourStar® Bti CRG** per acre where late instar larvae predominate, larval populations are high, water is heavily polluted and/or algae are abundant, or under conditions where local experience indicates the need for higher rates to achieve extended control.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

Pesticide Storage: Store in a cool, dry place.

Pesticide Disposal: To avoid wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program (often such programs are run by state or local governments or by industry).

Container Handling: Nonrefillable container. Do not reuse or refill this container. Completely empty bag into application equipment by shaking and tapping sides and bottom to loosen clinging particles. Then offer for recycling if available, or dispose of empty bag in a sanitary landfill or by incineration. Do not burn unless allowed by state and local ordinances.

NOTICE TO USER

To the extent consistent with applicable law, seller makes no warranty express or implied, of merchantability, fitness or otherwise concerning the use of this product other than as indicated on the label. To the extent consistent with applicable law, user assumes all risks of use, storage or handling not in strict accordance with label instructions.

Net Contents: 35 lbs (15.86 kg)

Lot No.: _____

Manufactured for: FourStar Microbial Products LLC | 1501 E Woodfield Road, 200W, Schaumburg, IL 60173 | ©2013-2016 Fourstar
EPA Reg. No. 85685-4 | EPA Est. No. 2724-TX-1 | FourStar and the FourStar design are trademarks of B2E Microbials LLC

DUAL ACTION RELEASE

VEC 16-013

Safety Data Sheet

FOURSTAR®

Briquets

Specimen Label

Sustained Release 90 Day Microbial Briquets

ACTIVE INGREDIENTS:

*_Bacillus sphaericus_ 2362, Serotype H5a5b, Strain AML614 ..... fermentation solids, spores and insecticidal toxins	6.00%
**_Bacillus thuringiensis_ subspecies _israelensis_ Strain BMP 144 ..... fermentation solids, spores and insecticidal toxins	1.00%
OTHER INGREDIENTS:	93.00%
TOTAL:	100.00%

* Equivalent to *60 Bs ITU/mg and **70 ITU/mg respectively. The percent active ingredient does not indicate product performance and potency measurements are not federally standardized.

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS – CAUTION:

Harmful if inhaled. Causes moderate eye irritation. Avoid contact with skin, eyes, or clothing. Avoid breathing dust. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet. Remove and wash contaminated clothing before reuse. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

ENVIRONMENTAL HAZARDS:

Do not apply to treated, finished drinking water reservoirs or drinking water receptacles when the water is intended for human consumption.

FIRST AID	
If inhaled	• Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth to mouth if possible. • Call poison control center or doctor for treatment advice.
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately with plenty of water for 15-20 minutes. • Call poison control center or doctor for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, and then continue rinsing eyes. • Call poison control center or doctor for treatment advice.
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-248-7763 for emergency medical treatment information.	

DIRECTIONS FOR USE

It is a violation of Federal law to apply this product in a manner inconsistent with its labeling.

APPLICATION DIRECTIONS

FourStar® Briquets are a highly selective microbial insecticide effective against mosquitoes in a variety of habitats for up to 90 days or more. **FourStar® Briquets** release effective levels of ***Bacillus sphaericus*** and ***Bacillus thuringiensis*** subspecies ***israelensis*** to the water surface over time as the briquet dissolves.

APPLICATION SITES

FourStar® Briquets can be applied to areas that contain aquatic life, fish and plants, as well as areas used by or in contact with humans, animals, horses, livestock, pets, birds or wildlife. Examples of application sites include, but are not limited to: storm drains, catch basins, underground drainage systems, storm water retention areas, retention ponds, abandoned swimming pools, ornamental fountains and ponds, fish ponds, water gardens, animal drinking troughs, standing water, water holding receptacles, man-made and natural sites where mosquitoes may develop.

APPLICATION RATES

For control of mosquito larvae, place one (1) briquet in sites up to 100 square feet of surface area. For large sites, apply 1 additional briquet for each additional 100 square feet of water surface, regardless of water depth. When mosquito populations are high, water is heavily polluted, and/or algae are abundant, double the above application rate.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

Pesticide Storage: Store in a cool, dry place.

Pesticide Disposal: Wastes resulting from use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Nonrefillable container. Do not reuse or refill empty carton or packaging material. Offer for recycling if available or crush and discard carton in a sanitary landfill or by incineration or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

NOTICE TO USER

Seller makes no warranty express or implied, of merchantability, fitness or otherwise concerning the use of this product other than as indicated on the label. User assumes all risks of use, storage or handling not in strict accordance with label instructions.

Always read the label before using this product. For product information, call 1-800-248-7763 or visit our web site: **www.fourstarmicrobials.com**

DUAL ACTION RELEASE

Manufactured for: B2E Microbials LLC
DBA FourStar Microbials LLC
1501 East Woodfield Road, #200W
Schaumburg, Illinois, 60173 U.S.A.

EPA Reg. No. 83362-3 | EPA Est. No. 86884-OR-1

VEC 13-009

[Safety Data Sheet]

Outreach Resources and Public Education Materials

- CDC Dengue Fever Information
- DPH Mosquito PE Materials: https://www.mass.gov/lists/mosquito-borne-disease-educational-materials
- DPH Arbovirus Toolkit: https://www.mass.gov/lists/arbovirus-information-for-local-boards-of-health#toolkit-
- CDC Press Kit: https://www.cdc.gov/mosquitoes/communication-resources/press-kit-mosquitoes.html
- DPH Tick PE Materials: https://www.mass.gov/info-details/tick-borne-educational-materials
- DPH Arbovirus Phased Response Plan: https://www.mass.gov/doc/2024-arbovirus-surveillance-and-response-plan/download

Recommended Public Messaging

Key Facts:

- **Eastern Equine Encephalitis (EEE)** is a very rare but serious disease transmitted by infected mosquitoes that can cause severe illness and even death.
    - The last human case of EEE occurred in 2020.
    - There is no specific treatment for EEE; prevention is crucial.

- **West Nile virus (WNV)** differs from EEE in its severity and impact on communities. Roughly 80% of people infected with WNV do not develop any symptoms. Severe symptoms may occur in about 1 in 150 infected people.
    - WNV is endemic and occurs annually.

Preventative Measures:

- Use EPA approved bug-repellent
- Cover skin/wear long sleeves and pants
- Avoid outdoor activities during peak mosquito times (between dusk and dawn)
- Repair window screens
- Containers in yards with standing water should be emptied to reduce mosquito breeding

For questions about spraying events in response to EEE:

Massachusetts Department of Public Health: Mosquito Control and Spraying: Frequently Asked Questions About Spraying for EEE

For questions about aerial spraying, contact MDAR Crop and Pest Services at mosquitoprogram@mass.gov.

PIONEEER VALLEY MOSQUITO CONTROL DISTRICT

FIGHT THE BITE

AND HELP PREVENT THE SPREAD OF MOSQUITO BORNE DISEASES

USE REPELLENT

Be sure to apply EPA approved insect repellents containing plant based eucalyptus or DEET when outdoors.

AVOID DUSK AND DAWN

Most mosquito species are very active at dusk and dawn. Avoid engaging in outdoor activities during these times whenever possible.

WEAR PROPER CLOTHING

Wearing long-sleeves and pants will significantly help reduce mosquito bites.

PREVENT ARTIFICIAL HABITAT

Buckets, plant pots, kiddie pools, tire swings, and anything that holds water should be emptied to prevent mosquito habitat.

FIX DOORS AND WINDOWS

Screens with holes should be repaired and be sure that all doors and windows are working properly to keep the mosquitoes out.

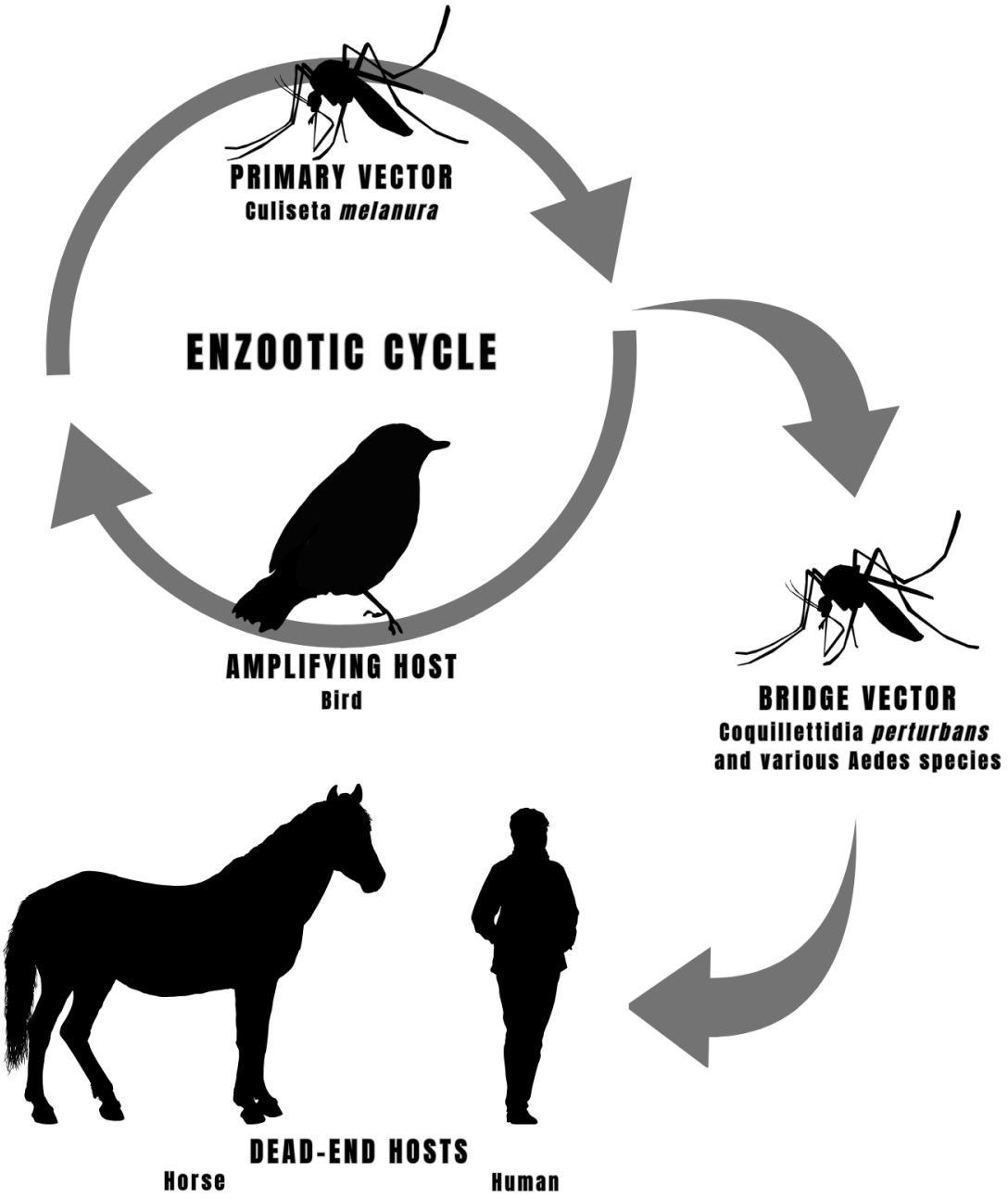
FIRST AID FOR BITES

Wash bite with soap and water and apply anti-itch cream. If necessary, apply a cold cloth to reduce swelling.

Email: john.c.briggs@mass.gov
Web: mass.gov/info-details/pioneer-valley-mosquito-control-district-pvmcd

PIONEEER VALLEY MOSQUITO CONTROL DISTRICT

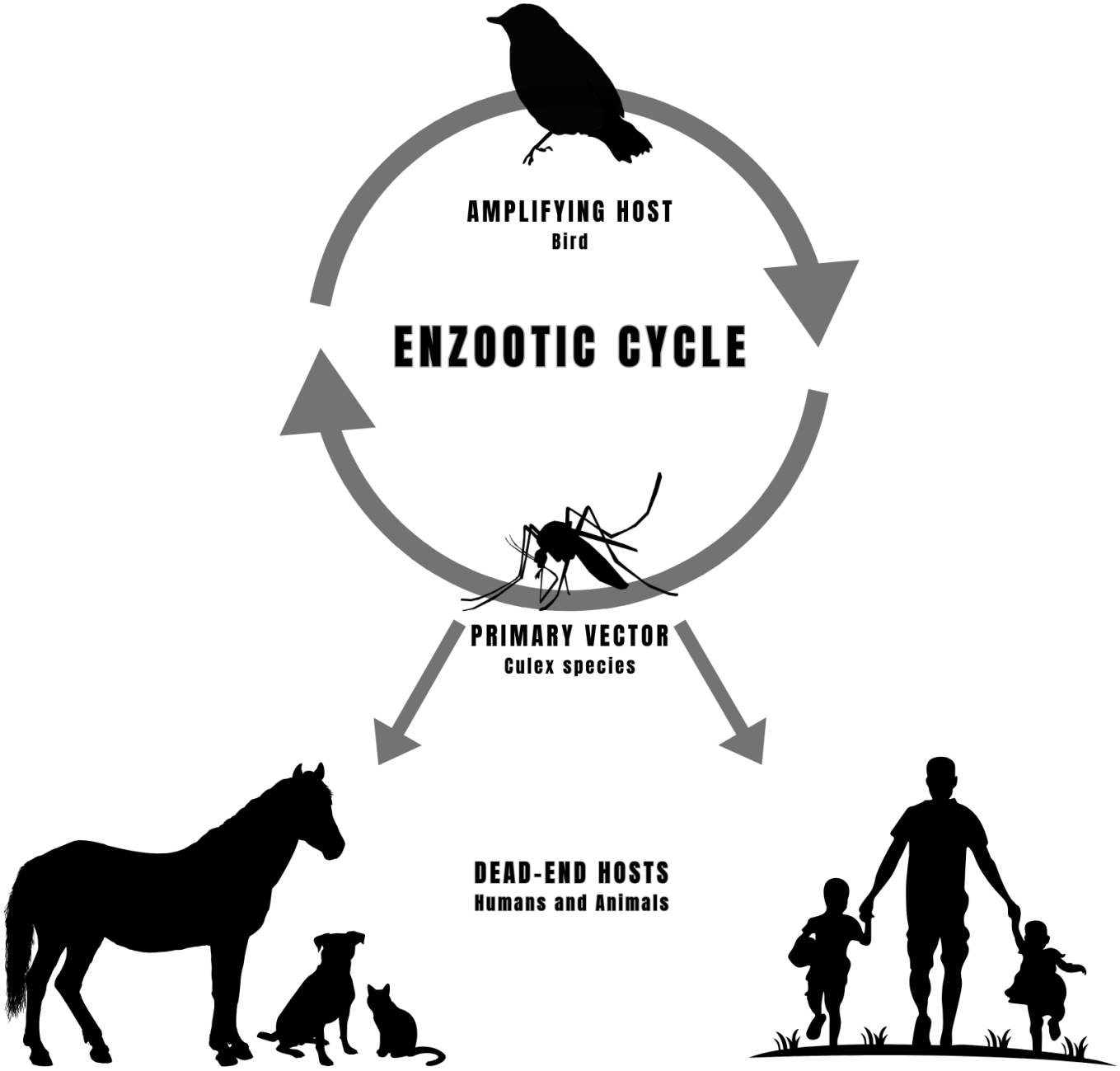
EASTERN EQUINE ENCEPHALITIS VIRUS TRANSMISSION CYCLE



Email: john.c.briggs@mass.gov
Web: mass.gov/info-details/pioneer-valley-mosquito-control-district-pvmcd

PIONEEER VALLEY MOSQUITO CONTROL DISTRICT

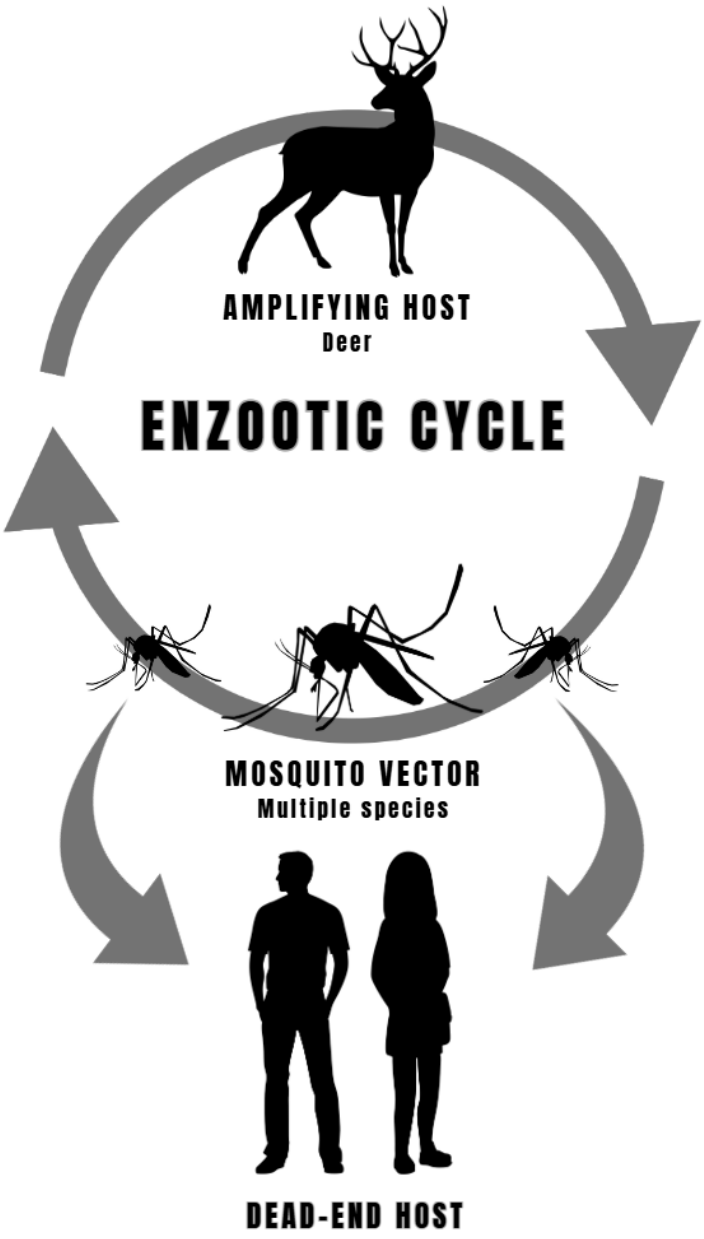
WEST NILE VIRUS TRANSMISSION CYCLE



Email: john.c.briggs@mass.gov
Web: mass.gov/info-details/pioneer-valley-mosquito-control-district-pvmcd

PIONEEER VALLEY MOSQUITO CONTROL DISTRICT

JAMESTOWN CANYON VIRUS TRANSMISSION CYCLE



Email: john.c.briggs@mass.gov
Web: mass.gov/info-details/pioneer-valley-mosquito-control-district-pvmcd

WNV, EEE, and JCV Symptoms Chart

Disease	Onset	Symptoms
WNV	**2 to 14 Days**	**Febrile Illness** • Fever • Muscle aches • Joint Pain • Fatigue • Rash **Neuroinvasive Disease** • Stiff neck • Muscle Tremors • Seizures • Changes in vision • Weakness or paralysis
EEE	**4 to 10 Days**	**Febrile Illness** • Fever • Muscle aches • Joint pain • Chills **Neuroinvasive Disease** • Fever • Headache • Seizures • Behavioral changes • Vomiting • Diarrhea • Coma
JCV	**Unknown**	**Febrile Illness** • Fever • Muscle aches • Fatigue • Headache • Nausea • Cough **Neuroinvasive Disease** • Fever • Stiff neck • Headache • Seizures • Altered mental status

PVMCD
8 Conway Street
S. Deerfield, MA 01373
Tel: 401.580.6397

EEE Horse Vaccination

- Eastern equine encephalitis (EEE) is a mosquito-borne disease that can cause inflammation of the brain in horses, humans, and other animals.
- EEE is rare, however, the virus can cause serious illness and has a high mortality rate in both humans and horses.
- Horse owners speak to their veterinarian about the EEE vaccination and establish an appropriate vaccine schedule that ensures protection through September.

Pioneer Valley Mosquito Control District

Bacillus thuringiensis israelensis (Bti) Fact Sheet

What is Bti?

- *Bacillus thuringiensis israelensis* (Bti) is a naturally occurring bacterium found in soil.
- It produces toxins that specifically target and kill mosquito larvae, black flies, and fungus gnats.

How Does Bti Work?

- Bti toxins are ingested by mosquito larvae, disrupting their digestive systems and causing death before they can mature into biting adults.
- It is effective only against larvae and does not affect adult mosquitoes.

Forms of Bti:

- Bti is available in various forms, including dunks, tablets, briquettes, pellets, granules, and liquid.
- These forms can be applied to standing water where mosquito larvae are present.

Application Methods:

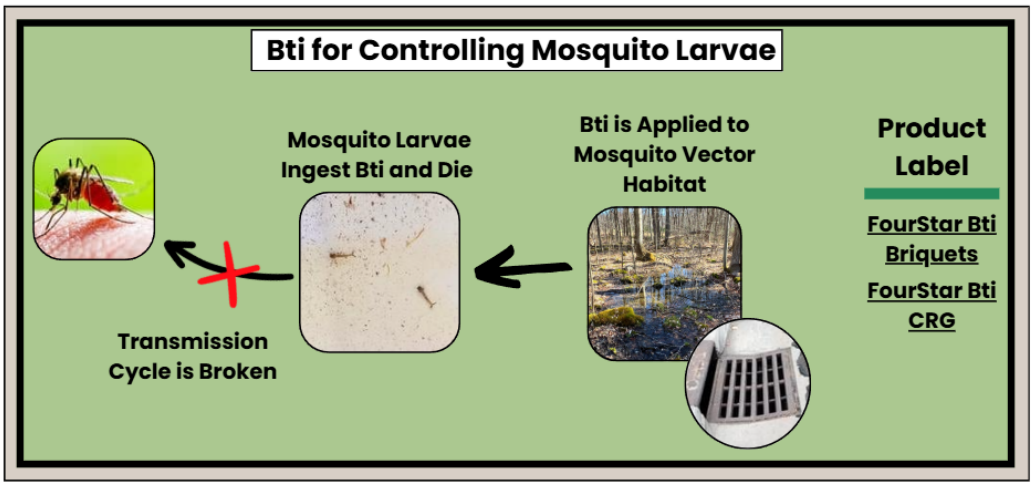
- Bti can be applied using trucks, airplanes, handheld sprayers, or by hand.
- Common application sites include catch basins/storm drains, rain barrels, fountains, septic tanks, and unused pools.

Safety and Environmental Impact:

- Bti is not harmful to humans, pets, wildlife, or the environment when used as directed.
- It does not affect non-target organisms such as honeybees, fish, or other aquatic life.
- Bti is approved for use in organic farming and is considered safe for food crops and water supplies.

Effectiveness:

- Bti is most effective when used as part of an integrated mosquito management plan.
- It helps reduce mosquito populations by targeting larvae before they can develop into adults.



Contact: john.c.briggs@mass.gov