BUREAU DE SANTÉ DE MIDDLESEX-LONDON HEALTH UNIT

VECTOR-BORNE DISEASE REPORT

West Nile Virus, Lyme Disease, and Eastern Equine Encephalitis Surveillance and Control Activities for 2013

December 2013

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Cite reference as:
Middlesex-London Health Unit. (2013). Vector-Borne Disease Report: West Nile Virus, Lyme Disease and Eastern Equine Encephalitis Surveillance and Control Activities for 2013. London, Ontario: Middlesex-London Health Unit.

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Acknowledgements

This Vector-Borne Disease (VBD) report would not have been possible without the efforts and dedication of the Middlesex-London Health Unit's Vector-Borne Disease Team. This report was written by Elizabeth Milne and Jeremy Hogeveen, with contributions from Hugo Ortiz-Saavedra. Iqbal Kalsi, Amy Pavletic and Michelle Marcus edited this report.

The VBD Team would like to thank the VBD Stakeholders group, the City of London and the municipalities of Middlesex County. Special thanks to Billy Hacklander for his Storm Water Management expertise and to Tony Van Rossum and his summer staff for assisting with larval surveillance and control at Pollution Control Plants.

The Vector-Borne Disease Team would like to thank Dr. Christopher Mackie, Dr. Bryna Warshawsky, Wally Adams, Tristan Squire-Smith and John Millson for their direction, and to Melody Couvillon and Mark Riedl of Operations and Dan Flaherty, Trudy Sweetzir and Alex Tyml in Communications. A special thanks to the Public Health Inspectors for their assistance with dead bird and tick reporting, and to Bernie Lueske for his assistance with data and spatial analysis. The VBD Team would like to express gratitude to Karen Pelkman-Lynch, Lynn Vander Vloet, Sharon Stein and Janice Zielinski for their ongoing administrative support. The MLHU would also like to thank its service providers, GDG Environnement and The Canadian Centre for Mosquito Management, for efforts to ensure the continued success of the Vector-Borne Disease Program. Lastly, the MLHU would like to recognize the support of Dr. Curtis Russell at Public Health Ontario.

This Vector-Borne Disease Program would not be possible without the financial support from our funding partners; the City of London, Middlesex County, and the Province of Ontario, in addition to continued support from the Middlesex-London Board of Health.

Executive Summary

This year the Vector-Borne Disease (VBD) Program focused on local tick and mosquito surveillance to reduce the burden of illness to residents of Middlesex-London. This report will provide an overview of the Middlesex-London Health Unit's (MLHU) VBD Program highlighting activities, accomplishments and trends. Program goals for the 2013 season included a focus on enhancing Lyme disease (LD) knowledge at the local level and increasing participation in education initiatives to promote personal protection messages.

The MLHU works to reduce vector mosquito larvae each season so that adult mosquitoes cannot emerge and transmit West Nile Virus (WNV) to humans. By reducing vector mosquitoes in larval form, fewer adult mosquitoes will be present in the community to transmit illness. In 2013, three WNV human cases were reported, four WNV-positive mosquito traps were detected, and nine WNV-positive dead birds were detected. Surveillance and control of mosquito larvae ensures the successful reduction of vector populations in highly populated regions. In total, 857 treatments were conducted at approximately 250 standing water sites. This total includes treatments conducted at Environmentally Sensitive Areas and Pollution Control Plants. A comprehensive surveillance and control program focused on reducing WNV vector species, contributing to the successful reduction of WNV within the community this season. Focused vector-control strategies also included three rounds of catch-basin larviciding for a total of 88,103 roadside catch basin treatments.

The MLHU continues to observe an increasing number of human cases, tick submissions and LD-related inquiries each year. This season there were four confirmed LD-positive human cases and one probable LD human case reported to the MLHU. There was also a 41% increase in the number of ticks submitted for identification. Of the 145 specimens submitted, a majority were identified as dog ticks (86%), a non-vector species. Blacklegged ticks (6%) were the second most common species identified; this species is the vector for Lyme disease. The VBD Team performed tick dragging in Glencoe, Melbourne, Lambeth and North London. Local dragging did not identify any additional populations of blacklegged ticks. All blacklegged ticks identified from within Middlesex-London tested negative for Lyme disease.

A comprehensive education campaign focused on sharing personal protection information with colleagues and community partners this season. The VBD Team shared resources with the Early Years Team, presenting to Public Health Nurses and providing information and materials on WNV and LD. Presentations were also well received at Well Baby Clinics located in Strathroy, Glencoe, Parkhill, Mount Brydges and Dorchester. Extending VBD messages cross-functionally and at community events allowed the team to share valuable information in a cost-effective manner. In 2014, the VBD Program would like to further extend the scope of its public education initiatives, targeting specific community groups who spend time outdoors.

In 2013 the VBD Program continued to receive vector-borne disease concerns from the public. Overall 309 VBD-related concerns were received this year. The MLHU will continue to educate residents and encourage vector-borne disease prevention through education and the resolution of VBD-related concerns.

The VBD Program aims to enhance public education strategies each season to ensure the public is aware of services offered by the MLHU to protect against insect bites and prevent the transmission of vector-borne diseases. Increased public engagement will allow for increased uptake of personal protection behaviours to reduce tick and mosquito bites. A focus on Lyme disease prevention, by promoting personal protection, identification of symptoms, proper tick removal and tick submission to the MLHU will remain focal points for public messaging in 2014. Although populations of blacklegged ticks have not yet become established in Middlesex-London, it is important to continue local tick surveillance. This includes conducting risk assessments, identifying samples and monitoring the changing regional incidence of blacklegged tick populations. The VBD Program will continue to measure and enhance education initiatives in order to make informed decisions regarding public health strategies. A comprehensive surveillance, control and education-focused program will provide information to empower residents and encourage the uptake of personal protective behaviours, prior to the transmission of illness.

Chapter 1: West Nile Virus

1.1 Introduction

West Nile Virus (WNV) is a mosquito borne virus that is spread to humans through the bite of an infected mosquito. West Nile Virus was first recognized in West Nile, Uganda in 1937. It was first identified in the United States in 1999 and in Canada in 2001. Since then, WNV has spread across North America (PHAC, 2008a). West Nile Virus was first identified in Middlesex-London in 2002, and has continued to be present since the outbreak year. The Middlesex-London Health Unit (MLHU) began its Vector-Borne Disease Program (formerly the West Nile Virus surveillance program), in 2002, following the identification of WNV in Middlesex-London.

Humans get West Nile Virus from the bite of an infected mosquito. The transmission cycle (how the virus is spread) begins when vector mosquitoes feed on the blood of an infected bird. Not all mosquitoes can transmit WNV, only vector mosquitoes can transmit West Nile Virus illness from a bird to a human. Once a mosquito bites an infected bird, it becomes a carrier of WNV and could possibly transmit the virus to humans through a mosquito bite (PHAC, 2012a). The main mosquito vectors in Ontario that can bite both birds and humans to transmit WNV are the species *Culex pipiens* and *Culex restuans*. *Culex pipiens/restuans* can be found in significant numbers in urban areas throughout Middlesex-London. Additionally, the preferred habitat of these competent vectors is artificial containers and catch basins.

1.2 Mosquito Life Cycle

Mosquitoes go through four stages of development: egg, larva, pupa, and adult [**Figure 1-1**]. Adult females are the only mosquitoes that bite, as they require a blood meal to obtain nutrients to produce eggs.

Once nourished with a blood meal from a human, bird, mammal or amphibian, a female mosquito can lay one hundred to several hundred eggs. Depending on the mosquito species, eggs can be laid directly on the water or on dry soil along the edges of waterways. (Wood, et al., 1979)

Eggs laid on the edges of waterways can survive in dry soil for several years before hatching. Once the eggs hatch, the second stage of development is larva, which can develop only in water. Mosquito larvae prefer standing water that contains high organic matter. This type of condition is ideal for egg laying and larval growth, as vegetation protects larvae from predators, and standing water provides a warm, calm, safe environment for larvae to develop successfully into adult mosquitoes.

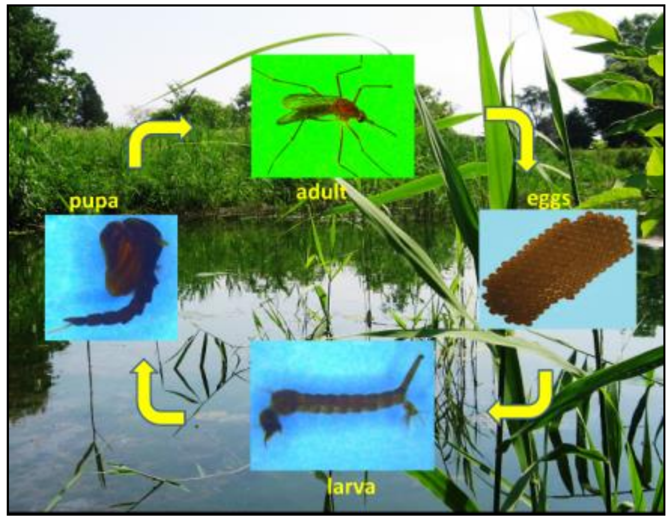


Figure 1-1: Mosquito life cycle.

Ideal locations for larval development include: edges of swamps, shallow ponds, woodland pools, temporary flood water pools, storm water ponds, catch basins, eaves troughs, discarded tires and bird baths. Larvae feed on organic matter from surrounding vegetation. Once fully grown, the larva molts into a pupa, the third stage of development. From the pupal stage, the adult mosquito emerges out of pupal skin. The newly emerged adult mosquito, if female, seeks a blood meal right away, which is why it is imperative to identify and remove mosquito habitat from around the home to protect family members from mosquito bites. (Wood, et al., 1979)

1.3 Transmission of West Nile Virus

The WNV transmission cycle is initiated when infected mosquitoes start to feed on birds, which is often in the spring and early summer [**Figure 1-2**]. Eventually the vector mosquitoes that feed on birds and mammals will contract WNV and in turn, may spread the virus to humans. Birds are typically known to be the “reservoir” hosts for WNV, while humans and other mammals become “incidental” hosts when bitten by an infected mosquito. (PHAC, 2006)

1.4 Signs and Symptoms

The majority of humans infected with WNV will be asymptomatic or only have mild symptoms (non-neurological), such as a fever or rash. Other cases may progress to neurological symptoms such as encephalitis. The extent and severity of symptoms varies from person to person. (PHAC, 2012b)

When infected with WNV illness humans will develop symptoms within two to 15 days after being bitten by an infected mosquito. Mild symptoms of West Nile Virus include fever, headache, body aches, mild rash, or swollen lymph glands. A few people will experience a more severe form of West Nile Virus infection called encephalitis (swelling of the brain). Severe symptoms of encephalitis include rapid onset of headache, high fever, stiff neck, nausea, vomiting, drowsiness, confusion, muscle weakness, and/or paralysis. (PHAC, 2012b)

While people of any age or health status can contract WNV, the overall risk for serious infection does increase with age. Those with weakened immune systems are also at greater risk for serious health effects caused by WNV infection. Studies indicate that some people who develop serious symptoms of WNV can recover completely, while others may experience prolonged health problems. Those prolonged health problems can include: memory problems, confusion, depression, fatigue, headache, muscle weakness, and difficultly with functionality, such as preparing meals, or shopping. (PHAC, 2012b)

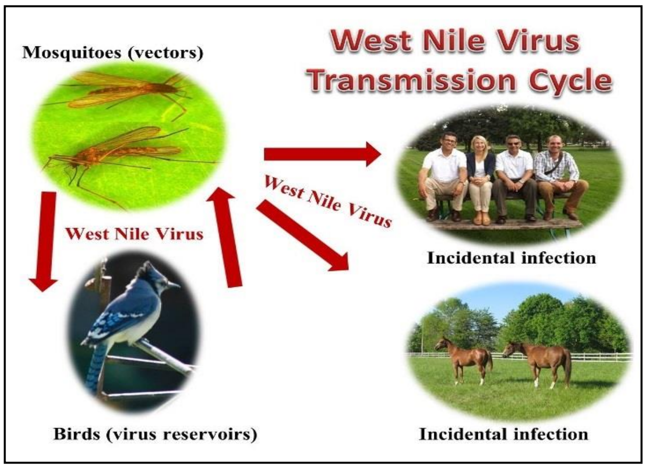


Figure 1-2: West Nile Virus transmission cycle.

1.5 Conclusions and Recommendations

The Vector-Borne Disease (VBD) Program uses an Integrated Pest Management (IPM) approach to monitor, identify and control vector mosquito larvae within Middlesex-London. A calculated and detailed approach to monitoring local mosquito populations helps to decrease the burden of vector-borne illness to residents in the community.

In order to reduce the burden of illness to residents of Middlesex-London, the 2013 VBD Program focused on:

- Human surveillance:
  - WNV human cases: 2 confirmed 1 probable.
- Public education.
- Adult mosquito trapping and viral testing:
  - 4 WNV-positive traps detected.
- Dead bird surveillance and WNV testing:
  - 9 WNV-positive birds detected.
- Weekly surveillance of standing water and identification of mosquito larvae.
- Control of vector mosquito larvae in standing water located on public property.
- Surveillance mapping of adult mosquito trap locations, and standing water sites.

West Nile Virus is one of the three vector-borne diseases monitored in Middlesex-London. The MLHU continues to monitor for other vector-borne diseases, such as Eastern Equine Encephalitis (EEE), and Lyme disease.

The identification of WNV-positive human cases, mosquito traps and birds each season has demonstrated that WNV has established itself in the region. For over 10 years, WNV-positive data has confirmed the continued need for a WNV surveillance and control program to reduce the transmission of illness to local residents.

Chapter 2: Lyme Disease

2.1 Introduction

Lyme disease (LD) is the most common vector-borne disease in North America and in Ontario. Infection is caused by the bacteria known as *Borrelia burgdorferi*, which is transmitted to humans through the bite of an infected tick (Wormser et al., 2006). In Ontario this bacterium is transmitted by the blacklegged tick (*Ixodes scapularis*), also known as the deer tick [**Figure 2-1**]. The LD bacterium is in commonly found in mice and deer in Ontario. While human LD infection can include mild symptoms, if the illness is left untreated, more severe symptoms and long term effects can develop. This is why local surveillance and education is necessary; to protect residents and prevent tick bites not only in Middlesex-London but also while travelling to other locations. Lyme disease is a growing concern as more human infections are occurring and there continues to be an increase in the distribution of blacklegged ticks throughout Ontario. (MOHLTC, 2011b)

Blacklegged ticks can be found across Canada. This can be attributed to tick larvae and nymphs attaching to birds that migrate from endemic and established areas within the United States and some parts of Canada. Since the blacklegged tick is able to be easily transported across North America, it is important to identify the population dynamics and monitor the geographic distribution, as it changes with climate and migration trends.

Due to the changing habitats and migration patterns of host species, populations of blacklegged ticks can fluctuate by region. In order to better understand the distribution of blacklegged ticks and the level of risk associated with Lyme disease, it is important to define the populations present in Ontario. In Ontario, local tick populations are classified into three categories: 'adventitious', 'established' and 'endemic'. These three terms are used to describe the level of risk within certain geographic regions of Ontario, depending on the number of blacklegged ticks and LD cases reported from within that region. (MOHLTC, 2011b)

Ontario regions with an 'endemic' blacklegged tick population have identified blacklegged ticks in all life cycle stages, over multiple years. In ‘endemic’ regions, both ticks and small mammals in the area have tested positive for *Borrelia burgdorferi.* Regions with an 'established' blacklegged tick population have identified a number of blacklegged ticks over multiple years, however, these ticks have not tested positive for *Borrelia burgdorferi.* Active tick surveillance is conducted in regions classified as 'endemic' or 'established’.

Figure 2-1: Blacklegged tick (*Ixodes scapularis*) identified in the MLHU’s Strathroy laboratory.

‘Adventitious’ tick populations are regions where blacklegged ticks are found only sporadically. Middlesex-London has an adventitious tick population, as tick dragging has not identified any blacklegged ticks, however, there have been blacklegged ticks submitted to the Health Unit from within Middlesex-London. An 'adventitious' tick population means that both passive and active surveillance are conducted within the region, depending on the total number and species of ticks that are submitted to the Health Unit. The risk of acquiring LD within a region classified as having an 'adventitious' blacklegged tick population is low, however, it is possible. (OAHPP, 2012)

Throughout this report, the MLHU will discuss all three classifications of blacklegged tick populations. Based on local classifications and risk assessments, the MLHU will advise residents through educational messages to protect themselves while outdoors, especially in endemic and established regions, where the risk for LD infection is greater. The greatest risk for acquiring Lyme disease in Canada occurs in areas where populations of blacklegged ticks are established or endemic, and where there is evidence that these ticks are transmitting Lyme disease to local mammals. If an area is classified as established or endemic, humans may incidentally become infected with LD through a bite. These locations are termed ‘Lyme endemic or established areas’ as defined by Health Canada. (Russell, 2011)

In Ontario, endemic and established regions with blacklegged ticks include Long Point, Turkey Point, Wainfleet Bog, Rondeau Provincial Park, Point Pelee National Park, Prince Edward Point National Wildlife Area and the St. Lawrence Islands National Park in the Thousand Islands region of eastern Ontario. It is difficult to define precise boundaries of tick populations since the species continues to expand into neighbouring regions. (MOHLTC, 2011b)

The current knowledge of established blacklegged tick populations, based on active surveillance in the field, is detailed in the map identified as **Figure 2-2**, which identifies the distribution of established and endemic blacklegged tick populations in Ontario. Research suggests that tick populations and Lyme endemic areas currently occur in a limited area of Canada; however, surveillance indicates that established populations are beginning to expand their geographic scope. Since blacklegged ticks feed on migratory birds, deer and other small animals, they can easily be transported throughout the province. The potential for expansion of tick populations is likely, and makes it difficult to define the geographic limits of this species from year to year. (PHAC, 2013b)

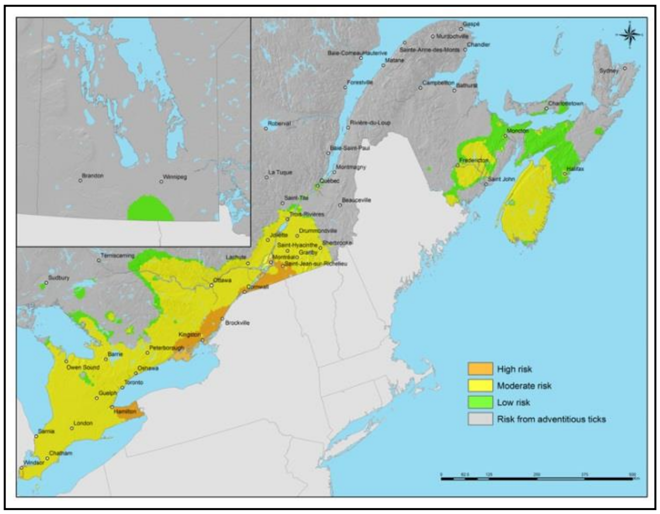


Figure 2-2: "A map showing areas predicted to be at risk for emergence of Lyme endemic areas in eastern and (inset) central Canada," by Public Health Agency of Canada, 2013a. This map is a copy of an official work and has not been produced in affiliation with the Government of Canada.

2.2 Tick Life Cycle

The two year life cycle of the blacklegged tick begins when eggs are laid in the spring and hatch as larvae in the summer. Larvae feed on mice, birds, and other small animals in summer and early fall. Larvae may become infected with the Lyme disease bacterium when feeding on these animals. Once a tick becomes infected, it stays infected for the duration of its life and can transmit the bacteria to other hosts. After this initial feeding, the larvae molt into nymphs and then become inactive until the following spring. Nymphs seek a blood meal to fuel their growth into adults. Nymphs feed on small rodents, birds, dogs, and other small mammals in late spring and early summer. Nymphs will also feed on humans, and if infected with the Lyme disease bacterium, they can transmit the disease to humans at this time. Nymphs molt into adults in the fall. In the fall and early spring, adult ticks feed on large animals, such as deer, and mating also occurs at this time. Adult female ticks will also feed on humans. In the spring, adult female ticks will lay their eggs on the ground, completing the two-year life cycle. (OAHPP, 2012) [**Appendix A** and **Figure 2-3**].

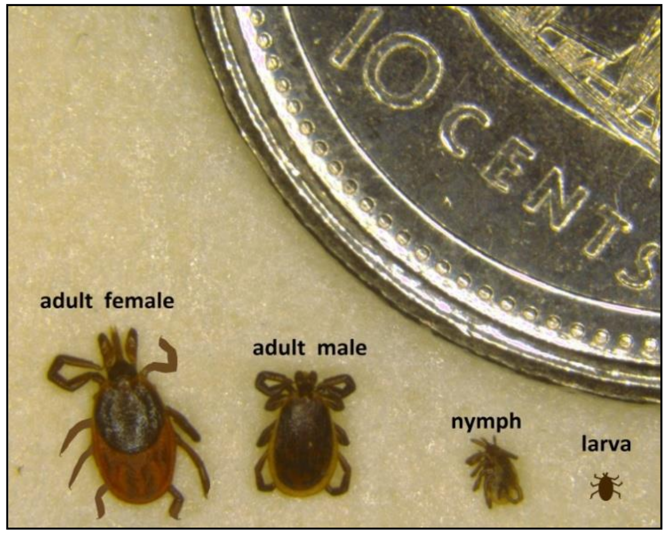


Figure 2-3: Life stages of the blacklegged tick.

2.3 Transmission of Lyme disease

Lyme disease is transmitted to humans after an infected blacklegged tick feeds on a person for at least 24 hours. It takes this 24 hour period for LD bacterium to transfer from the tick's salivary glands into the bloodstream of its host. In order to prevent infection it is important to check for ticks and remove them immediately if found. (OAHPP, 2012)

2.4 Symptoms and Treatment

There are a number of broad symptoms associated with LD in humans, making it difficult to diagnose. These symptoms can occur in three stages and patients often do not show all symptoms. Many symptoms of LD can also occur with other diseases, which can make LD challenging to diagnose. Symptoms usually begin within three days to one month after being bitten by an infected tick. The first sign of infection is usually a circular rash called erythema migrans (EM), commonly known as the "bull's-eye" rash [**Figure 2-4**]. This rash varies in size and occurs in 70% to 80% percent of cases. (PHAC, 2013b) During the initial stage of infection, symptoms may include; fatigue, chills, fever, headache, muscle/joint pain and swollen lymph nodes.

If left untreated, the symptoms may progress to the second stage of infection, which can last for several months. Symptoms during the second stage of infection may include; multiple skin rashes, heart palpitations, arthritis and/or arthritic symptoms, extreme fatigue, general weakness, and central or peripheral nervous system disorders. The third stage of infection can cause recurring neurological problems and arthritis and can last for a just few months or years. Most cases of LD can be successfully treated with antibiotics; however, if left untreated, LD can seriously affect the joints, heart and nervous system, resulting in chronic health problems. (OAHPP, 2012; PHAC, 2013c)

2.5 Lyme disease Reporting

Lyme disease was first recorded in Canada in 1979, by a biologist who had been working in Long Point, Ontario; now a known endemic region for blacklegged tick populations. Although 1979 may be the first documented case of LD in Ontario, it is difficult to establish an early history of the disease since many cases of LD in Canada have not been well documented in the past. Lyme disease has become important in recent years as health units are beginning to see blacklegged tick populations expand throughout the province. (Artsob, 2010) Lyme disease is a nationally reportable disease in Canada. This means that all medical professionals must report cases of LD to the Public Health Agency of Canada. It is believed that LD cases will increase as populations of blacklegged ticks increase and expand due to warming climates and migration patterns of host species northward. So far, the monitoring of LD cases and blacklegged ticks in Ontario has been effective in detecting the prevalence of LD. (PHAC, 2010)

2.6 Lyme disease in Middlesex-London

The Middlesex-London Health Unit combines both passive and active tick surveillance. This surveillance approach is used because there have only been a few blacklegged ticks submitted from within Middlesex-London, and to date, all have tested negative for LD, classifying the region as ‘adventitious’.

The most common species of tick found in Middlesex-London is the dog tick (*Dermacentor variabilis*); this species is not known to transmit Lyme disease [**Figure 2-5**]. Passive tick surveillance relies on submissions from the public as well as physicians, veterinarians, and helps to determine if LD vectors are present in Middlesex-London. All submissions are identified in the MLHU's Strathroy laboratory, and if a blacklegged tick is identified it is sent to the London Public Health Laboratory for species confirmation and then to the National Microbiology Laboratory of Canada to determine if the tick is positive for Lyme disease.

Figure 2-4: “Bulls eye rash,” by J.Gathany, 2007; Provider: Centers for Disease Control and Prevention, *Public Health Image Library (PHIL).*

If a blacklegged tick is submitted and/or identified from within Middlesex-London, the Health Unit will utilize active surveillance and perform tick dragging in the area. Multiple tick submissions from the same geographic area may also prompt the MLHU to monitor tick populations closely. The VBD Team performed tick dragging in several areas throughout the region after blacklegged ticks were found and submitted for identification.

In 2013, 145 ticks were submitted to MLHU. This is an increase from 87 ticks submitted in 2012 and 76 submitted in 2011. Submissions were made from April 30, 2013 to November 8, 2013. Once again, dog ticks (*Dermacentor variabilis*), a non-vector species, were the most common type of tick submitted to the MLHU.

The following is a breakdown of tick species identified by the MLHU in 2013:

- 125 (86%) *Dermacentor variabilis* (dog tick), a non-vector species.
- 8 (6%) *Ixodes scapularis* (blacklegged tick), vector species for the Lyme disease bacterium in Ontario.
- 12 (8%) identified as species other than blacklegged or dog ticks, all of which are non-vector species for Lyme disease. [**Figure 2-6**]

Of the eight blacklegged ticks identified, six were acquired from Grand Bend, Ontario, and two were acquired locally in London, Ontario. Currently the MLHU has only received Lyme disease testing results from five of the eight blacklegged ticks submitted to the National Public Health Laboratory. All results so far have been negative; the MLHU is awaiting LD test results from the additional three blacklegged ticks submitted in 2013.

In 2013, there were no Lyme disease human cases contracted from within Middlesex-London. All confirmed and probable cases of LD reported to the Health Unit were travel related. Overall there were four confirmed human cases and one probable human case reported to the MLHU. The four confirmed human cases were travel-related and cases exposed to ticks while travelling in the United Kingdom, Poland, Georgia and New York State. The probable case was exposed to a tick in Florida, U.S. Three of the confirmed cases (U.K, Poland, Georgia) were a strain of European Lyme disease that can only be contracted in Europe.

Figure 2-5: Dog tick (*Dermacentor variabilis*) identified in the MLHU's Strathroy laboratory.

2.7 Conclusions and Recommendations

The VBD Team continued passive surveillance based on public tick submissions and conducted some active surveillance by dragging in areas in where the blacklegged ticks were observed. The MLHU will continue to monitor for blacklegged ticks in order to inform the public of the regional incidence of tick populations in Middlesex-London.

Based on tick surveillance in 2013, the following recommendations have been made:

- Continue local tick surveillance. Although the incidence of LD-carrying ticks in Middlesex-London remains low, nearby regions have established or endemic blacklegged tick populations. Tick populations continue to expand and migrate by way of host movement; therefore, potential hosts may carry ticks from these neighbouring regions into Middlesex-London.

- Maintain LD surveillance and education to provide residents with protection information, tick removal strategies and information on how to properly identify the signs and symptoms of LD. Informative materials and presentations will continue to enhance public education strategies to bring awareness to Lyme disease prevention methods for those who travel to endemic regions.

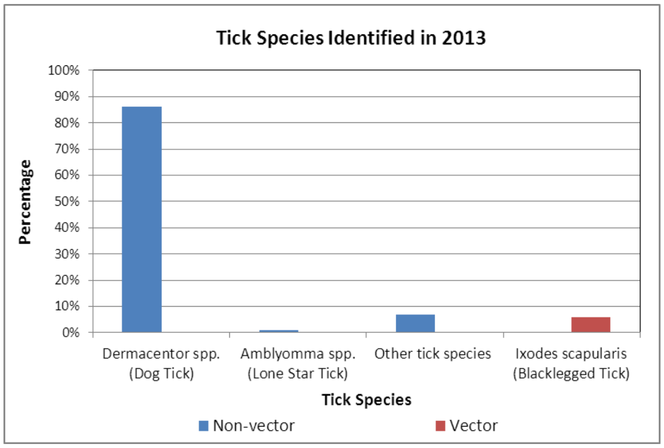


Figure 2-6: Breakdown of tick species identified in MLHU's Strathroy laboratory in 2013.

Chapter 3: Eastern Equine Encephalitis

3.1 Introduction

Eastern Equine Encephalitis (EEE) has been present in horse populations in Ontario since 1938 (MOHLTC, 2011b). In recent years, EEE activity has been detected in horses and mosquitoes in Ontario, Quebec and Nova Scotia, with no human cases reported to date (MOHLTC, 2011a). Eastern Equine Encephalitis is classified as an *alphavirus* from the family Togaviridae. Eastern Equine Encephalitis most often circulates through a bird-mosquito-bird cycle of transmission, with the mosquito species *Culiseta melanura* acting as the main vector for amplification within avian populations. *Coquillettidia perturbans, Aedes vexans, Aedes albopictus, Culex salinarius*, and *Ochlerotatus canadensis* have also been identified as mosquito bridge vectors for the transmission of EEE to animals and humans. (MOHLTC, 2011a)

3.2 Transmission of Eastern Equine Encephalitis

The transmission of EEE occurs between birds and mosquitoes. Mosquitoes are known as bridge vectors because they can bite an infected bird and possibly spread the disease to humans through a bite. Humans can become incidentally infected by EEE vector mosquitoes carrying the illness, and consequently become dead-end hosts [**Figure 3-1**].

While West Nile Virus (WNV) has typically been associated with urban areas, the EEE transmission cycle is associated with more rural and suburban settings, which provide the ideal habitat for EEE's main vector, *Culiseta melanura* (MOHLTC, 2011a). These ideal habitats are characterized by low-lying areas and swamps dominated by hardwood trees, where the mosquitoes will lay eggs in small pools of standing water containing high organic content, created and protected by the root system of surrounding trees. (MOHLTC, 2011a)

3.3 Symptoms and Treatment

In the past, EEE has predominately affected equine populations, however, the presence of EEE-positive mosquito pools in Ontario in recent years has increased the possibility of human infection. Human infection can involve very general symptoms, to severe symptoms of encephalitis, however, a majority of infections will be asymptomatic. If general symptoms do occur, they may include: fever, chills, muscle pain and/or weakness. General symptoms do not involve the nervous system and can last for two weeks. Although it is rare, some people infected with EEE can develop a more severe form of illness called encephalitis.

Symptoms of encephalitis include: sudden onset of severe headache, fever, drowsiness, loss of appetite, vomiting, or coma. (MOHLTC, 2011a)

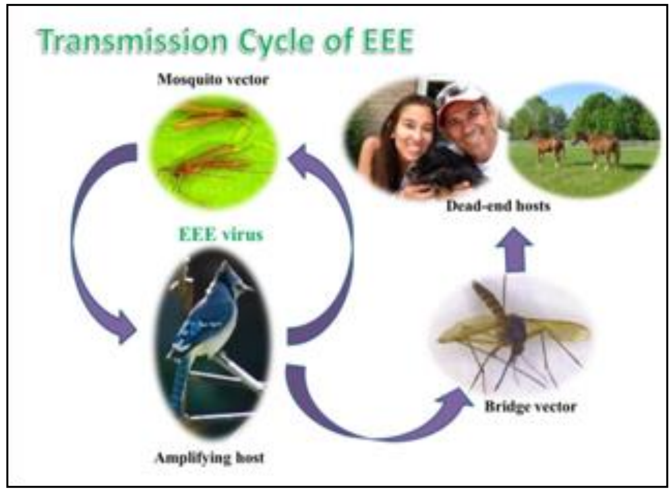


Figure 3-1: The transmission cycle of Eastern Equine Encephalitis (EEE).

Approximately one third (33%) of all patients who develop encephalitis will die from the disease or suffer permanent mental and physical side effects. Of those who recover, many are left with long term health problems, which can include intellectual impairment, personality disorders, seizures, paralysis or coma. There are currently no vaccines to protect humans against EEE, and no anti-viral medications available. (MOHLTC, 2011a).

3.4 Incidence of Eastern Equine Encephalitis

There have been no known EEE human cases reported to date within Canada, however, in the last few years, surveillance data from Ontario health units and the First Nations Inuit Health Branch has detected the virus in some adult mosquito specimens. Due to this finding, local health units have continued surveillance to monitor for the disease, even though the risk of human infection is very low. (MOHLTC, 2011b) Within Middlesex-London there were no EEE-positive mosquito pools and only two specimens of *Culiseta melanura* collected in adult traps. Adult mosquito trapping has also identified the presence of other EEE-vector species. In 2013, of the 22,052 adult mosquitoes identified by GDG Environnement 44% were vector species for EEE, this is compared to 31% in 2012, 51% in 2011 and 48% in 2010. The EEE-vectors identified in 2013 were: *Aedes vexans vexans, Cs. melanura, Cx. salinarius, Cq. perturbans* and *Oc. canadensis*. Guidelines set out by Public Health Ontario (PHO) outline EEE surveillance protocols and the EEE Adult Mosquito Testing Order of Preference.

These guidelines recommended priority species for EEE testing, which included: *Cs. melanura, Oc. canadensis, Cq. perturbans* and *Ae. vexans vexans*. By testing a variety of potential EEE vectors, the MLHU's service provider, GDG Environnement, performed 237 EEE viral tests. All viral tests were negative. There were also no human or equine cases of EEE reported from Middlesex-London. (GDG, 2013) In 2013, there was one EEE-positive mosquito trap and one positive horse reported from Ontario. The EEE positive trap was identified from the Eastern Ontario Health Unit. The EEE-positive horse was reported by the Simcoe-Muskoka District Health Unit. (OAHPP, 2013b)

In the past several years, the United States (U.S.) has reported an increase in EEE cases. In 2010, the U.S. saw some of its highest numbers of EEE, and in 2012 there were 12 human cases and 477 EEE-positive mosquito pools recorded (CDC, 2011; USGS, 2012). In 2013, the U.S. saw even fewer EEE cases, reporting only five human cases, none of which were reported from states bordering southern Ontario. This year 407 EEE-positive mosquito pools were reported, 53 from New York State; 22 from Vermont and 24 from New Hampshire, however, once again, no EEE cases were reported from states bordering southern Ontario. (USGS, 2013a)

3.5 Conclusions and Recommendations

Since several mosquito vectors that have the potential to carry and transmit WNV also have the potential to transmit EEE, the MLHU's vector control program will continue to collect and test those species of concern. Regular surveillance, mosquito identification and viral testing will remain an important aspect of the Middlesex-London Health Unit's (MLHU) Vector-Borne Disease Program.

Based on surveillance results from the 2013 season the following recommendations have been made:

- Although EEE has never been detected in Middlesex-London, the MLHU should continue to follow the PHO guidelines to monitor and test for the potential emergence of this disease.

- The MLHU should maintain partnerships with other health units in the province as well as with mosquito control organizations in the U.S., in order to share information regarding emerging trends, disease prevalence, and track the distribution of EEE-positive activity throughout North America.

Chapter 4: Dead Bird Surveillance

4.1 Introduction

Dead bird surveillance is used to provide an early indication that West Nile Virus (WNV) activity is present within the community. Residents of Middlesex-London actively participated in dead bird surveillance, by informing the Health Unit through online forms or by telephone. Crows and Blue Jays have been identified as the primary bird of concern for WNV identification. The Canadian Cooperative Wildlife Health Centre (CCWHC) has identified that birds from the Crow family (Corvids) have the ability to become infected with WNV more easily, and if infected, this bird species has been found to have high death rates (CCWHC, 2013).

4.2 Dead Bird Collection

The Vector-Borne Disease (VBD) Team receives reports and responds to dead bird concerns on a daily basis. Once a dead bird report is received, the VBD Team attempts to investigate the concern within two business days. All dead bird calls are triaged to VBD staff working in the area of the reported bird, and the appropriate team member retrieves the bird. Only species of WNV concern (Crows and Blue Jays) are picked up for testing. Birds must also be in fresh condition in order to obtain an accurate test result.

Once the bird is retrieved it is brought to the Strathroy laboratory for WNV testing using RAMP (Rapid Analyte Measurement Platform) technology. This technology is designed to detect the presence of WNV from the saliva of dead birds collected within the community. The RAMP kit is a testing method to obtain WNV-positive results quickly and easily in the Strathroy laboratory. Having an in-house RAMP testing kit allows the MLHU to obtain immediate test results and better inform the community where WNV-positive activity is present. The MLHU confirms WNV-positive test results with the CCWHC to ensure the accuracy of in-house RAMP tests.

4.3 Results

The first dead bird report was received on April 16, 2013. Overall a total of 128 dead bird concerns were reported to the MLHU. This is a decrease compared to the number of dead birds reported in 2012 [**Figure 4-1**]. Twenty (20) birds met the testing requirements and were collected by VBD staff this year. In total, nine birds were confirmed positive for WNV [**Appendix B**].

When a WNV-positive bird is identified, the information is reported to the public to encourage personal protection and source reduction. Additionally, the MLHU responds to all WNV-positive results by heightening standing water surveillance and treatments to reduce vector mosquito populations.

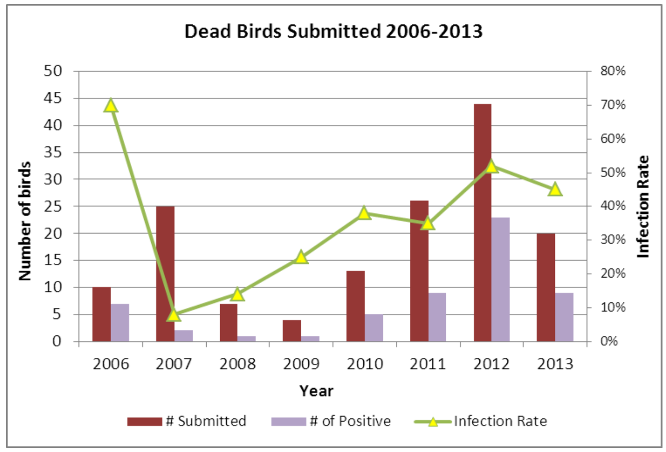


Figure 4-1: Dead bird submissions and WNV-positive birds identified, 2006 to 2013.

4.4 Discussion

The VBD Team has received reports of dead crows and blue jays since 2006. Trends indicate that WNV is still present within the community and that public submissions are an important in monitoring local viral activity. Each season, the rate of dead bird infection has been in the rage of 30%, indicating that the virus remains present in avian populations and continued surveillance and testing is required to mitigate the transmission of disease to humans and local mosquito populations. [**Figure 4-1**]

Nine of twenty reported birds were confirmed positive for WNV in the Strathroy laboratory in 2013. This is a decrease compared to 2012 when 23 WNV-positive birds were identified. This decrease in WNV-positive results can be attributed to the high viral activity in 2012, throughout Middlesex-London and Ontario, with numbers close to the outbreak year of WNV in 2001. Following increased viral activity in 2012, the MLHU heightened mosquito surveillance and control measures, targeting *Culex pipiens*. A focus on reducing local vector mosquitoes contributed to a decrease in mosquito bridge vectors, which are species that prefer to bite both birds and humans. By reducing bridge vectors, which transmit the virus bird-to-bird, fewer dead birds are often identified as WNV-positive, since fewer mosquitoes are present to transmit the virus. Areas identified by WNV-positive birds prompted increased mosquito surveillance and control efforts to reduce the vector mosquito populations.

Following the identification of a WNV-positive bird, the MLHU will set up hotspot traps to determine if WNV has spread to local mosquito populations. No hotspot adult mosquito traps were identified as WNV-positive this year.

This indicated that WNV activity had decreased from the previous year, and that WNV may have only been contained in the bird specimen, rather than in local mosquitoes, where the potential to transmit illness to humans would exist.

When a WNV-positive bird is identified it is also important that the MLHU inform residents through media releases. These messages remind the community to protect against mosquito bites by wearing insect repellent, avoiding outdoors at dawn and dusk when mosquito biting is most common and continuing to report dead birds to the Health Unit. Once again residents of Middlesex-London were very involved in the dead bird reporting program.

4.5 Conclusions and Recommendations

Maintaining the dead bird surveillance program allows the MLHU to:

- Provide advanced warning to residents regarding the presence of WNV in the community.
- Strengthen knowledge and understanding of WNV trends in bird species.
- Increase surveillance and control efforts in areas where WNV activity has been detected.
- Increase adult mosquito trapping and viral testing in areas identified by WNV-positive bird specimens.

It is important to keep residents informed and updated on local VBD activity as it encourages community participation in dead bird reporting to help identify WNV in the community.

Chapter 5: Larval Mosquito Surveillance

5.1 Introduction

The objective of larval surveillance is to identify vector mosquito larvae in standing water in order to initiate control measures to reduce the burden of WNV illness to residents of Middlesex-London. The Middlesex-London Health Unit (MLHU) requires data collected from larval surveillance to initiate control measures as part of an Integrated Pest Management (IPM) approach to reduce vector mosquito species and the transmission of WNV to residents of Middlesex-London.

5.2 Larval Identification Results

In 2013, larval surveillance began in March to get an early start on identifying mosquito larvae in standing water pools created by snowmelt. Previous year's surveillance data has indicated that spring vector mosquito lifecycles can begin in early March under favourable conditions. Weekly larval surveillance was conducted at a sample of standing water sites throughout the spring. The first larvae were collected on April 25, 2013 (Week 17). In 2012, the first larvae were identified on March 12. The identification of mosquito larvae came six weeks later than the first identification of larvae in 2012.

The first species collected in 2013 was *Ochlerotatus stimulans*, the same species collected for the first time in 2012. Once the first vector mosquito larvae were identified, weekly monitoring of all standing water sites commenced. Within Middlesex-London *Ochlerotatus stimulans* are the most common type of "spring" vector mosquito species. This vector mosquito species can transmit West Nile Virus (WNV), however, it is not considered a highly competent vector in the transmission of WNV.

Overall, 16,702 mosquito larvae were identified. Of those identified, 11,794 (71%) were vector species, and the remaining 4,908 (29%) were non-vectors. **Figure 5-1** shows a comparison of vector and non-vector species for the past four years. For the second year in a row, the highest numbers of mosquito larvae were identified in week 23 (June 2 to June 8). This same week produced the most larvae in 2012. This year a second spike was observed in week 28 and 29 (July 7 to July 20), when over 2200 mosquito larvae were identified in two weeks.

5.3 Discussion

Since 2002, the Middlesex-London Health Unit has been performing larval surveillance. This practice has been effective in identifying vector mosquito species throughout Middlesex-London, in order to initiate control measures and reduce WNV transmission in Middlesex-London.

Since the VBD Program was implemented, it has expanded to monitor more standing water sites, gaining a better understanding of larval breeding habitats, including improved surveillance strategies. These enhancements have led to an increase in the variation of larval mosquito species identified. In 2013, 12 different mosquito species were identified.

In 2013, *Culex pipiens* was the most abundant vector species identified, representing twenty-two percent (22%) of the all larvae identified. The second most abundant vector identified was *Culex restuans*, representing seventeen percent (17%). *Culex pipiens* and *Cx. restuans* remain the primary vectors for WNV in Ontario. These species have been identified as the most competent vectors for WNV. This means that they have the ability to transmit WNV more easily to human populations than other mosquito species. The MLHU focuses surveillance and control efforts these species due to their high numbers identified in standing water and catch basins each season.

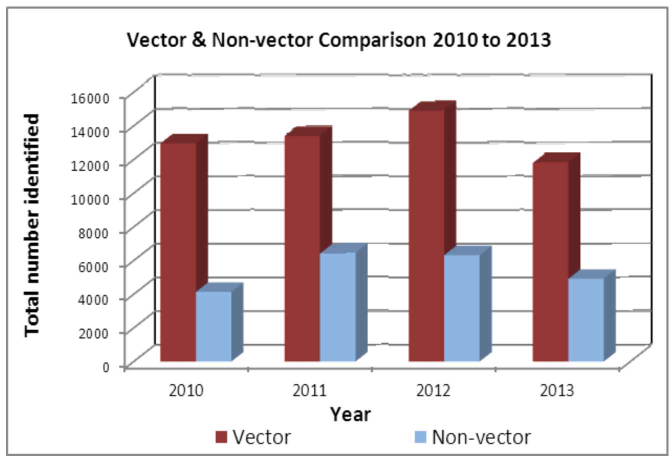


Figure 5-1: Vector and non-vector larval species comparison, 2010 to 2013.

Vector Discussion

The MLHU does not initiate treatment until competent larval mosquito vectors are identified, such as *Culex pipiens*, *Culex restuans* or *Aedes vexans*. In week 20, these three WNV vectors were the first species of the season to be collected. The first treatments were conducted in Week 20 following the identification of these species. In Ontario, *Culex pipiens* and *Cx. restuans* continue to be a target for larval surveillance and control efforts. (MOHLTC, 2010) Ministry guidelines dictate the surveillance and control of these species for several reasons.

Culex pipiens and *Cx. restuans* are targetted because they prefer to bite both birds and humans (increasing the likelihood for WNV transmission to humans).

These species have the ability to transmit the WNV pathogen better than other mosquito species, their population numbers which remain steady and present in Ontario each year, and finally, because of the evidence and historical data which indicates they are the main species that test WNV-positive each year (MOHLTC, 2010).

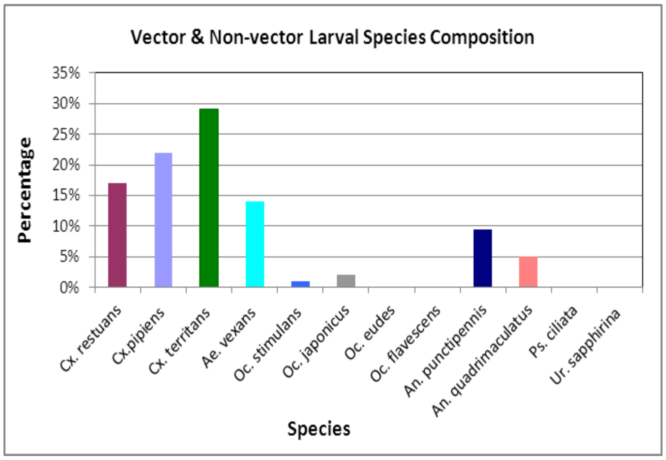


Figure 5-2: Vector and non-vector larval species composition, 2013.

Culex pipiens (22%) and *Culex restuans* (17%) were the most abundant vectors identified in larval form [**Figure 5-2**]. In 2012, populations of *Cx. pipiens* and *Cx. restuans* increased by 5%. In 2013, *Cx. pipiens* decreased by 37% and *Cx. restuans* increased by 13%, compared to 2012. As a result of their abundance in both Middlesex-London and Ontario over the past 10 years, these species have been the focal point for larval control. Since both of these species have been the target of surveillance and control efforts each year, the MLHU has noted an overall decrease in their populations since 2005. The decrease can be attributed to the VBD control program targeting these species specifically, due their capability to transmit WNV.

The third most abundant vector identified was *Aedes vexans* (14%). Since many of the rural sites the MLHU monitors, are grassy ditches or field pools bordering wooded areas, the MLHU often finds this species during early spring surveillance, and following rainfall events. Twenty-five percent (25%) of all *Ae. vexans* identified this year were collected in Week 23 (June 2 to 8). Compared to the week before (week 22), *Ae. vexans* populations increased by 85%. This spike can be attributed to the approximately 100 millimetres of precipitation recorded the week prior. Increased precipitation in Week 21 and 22 contributed to higher water levels, making *Ae. vexans* habitats more favourable. The MLHU continued to control this species because it is a vector for both WNV and Eastern Equine Encephalitis (EEE). *Aedes vexans* remains present in Middlesex-London, due to the amount of habitat to support this species throughout the region.

Aedes vexans can transmit both WNV and EEE, so it will remain a species that is monitored closely by the MLHU each season.

In 2013, *Ochlerotatus japonicus* larvae decreased for the first time. This species was observed in various habitats such as Storm Water Management Facilities (SWMFs), ditches, and woodland pools within Environmentally Sensitive Areas (ESAs). It has been reported that *Oc. japonicus* has become established in southern Ontario since 2001, and that the species is expanding throughout the province. The MLHU continues to monitor for *Oc. japonicus* as the species can breed in a variety of habitats; both natural and artificial. (Theilman & Hunter, 2006) Due to this species ability to adapt to artificial habitats, such as catch basins and Storm Water Management Facilities, the VBD Team will continue to monitor and control *Oc. japonicus* larvae.

Figure 5-3: *Culex territans* larvae.

Non-Vector Discussion

Culex territans was the most abundant non-vector species identified in 2013 [**Figure 5-2**]. Like *Culex pipiens* and *restuans*, *Culex territans* larvae can be found in artificial containers and other small bodies of water [**Figure 5-3**]. The usual habitat for *Cx. territans* seems to be large permanent marshes, with extensive vegetation, especially those covered with duckweed. Female *Cx. territans* seek blood meals from cold blooded amphibians and reptiles which populate marshes and woodlands. (Wood et al., 1979) Since this species continues to be considered a non-vector, the MLHU does not perform a larvicide treatment when this species is found at standing water sites in Middlesex-London.

The MLHU continued to closely monitor standing water sites in Parkhill this season. Surveillance in Parkhill began in March. In the past a high number of the non-vector species *Ochlerotatus blacklegged* have been identified from Parkhill. In 2013, the MLHU did not identify any samples of *Oc. blacklegged* larvae, which was the nuisance non-vector species observed in high numbers in 2011.

Overall in 2013, 382 larval samples were collected from standing water sites on public property within Parkhill. The amount of larvae collected in Parkhill comprised only 2% of the total number of mosquito larvae collected in 2013.

5.4 Storm Water Management Facilities

Storm Water Management Facilities (SWMFs) are temporary ponds that gather rainfall and surface water runoff to help reduce flooding and property damage. Excess rainfall and surface runoff are directed into a receiving body of water, which becomes known as the SWMF as water collects in the receiving forebay and cell. The landscape and structural design of SWMFs helps to slow and filter storm water runoff following heavy rain events to properly trap sediments, retain pollutants and avoid erosion, prior to the water being released back into natural waterways. (City of London, 2013, October)

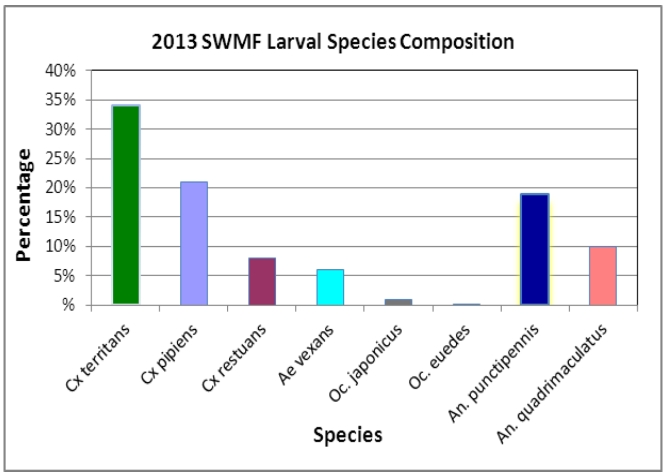


Figure 5-4: SWMF larval species composition, 2013.

While guidelines exist for the proper design and function of Middlesex-London's Storm Water Management Facilities, these structures do have the potential to become an ideal breeding habitat for mosquito larvae, since the purpose of these structures is to retain water for a period of time.

The combination of still water with emergent vegetation found along the banks of SWMFs can provide shelter for mosquito larvae, protecting it throughout the stages of its life cycle. Each SWMF may have several components such as a forebay, cell, channel and/or plunge pool; therefore multiple sites can be present at each SWMF location. **Appendix C** lists the SWMFs monitored in 2013.

In 2013, a total of 1,630 visits were made to SWMFs, comprising 34% of all standing water monitoring visits. Overall 4,001 larvae were identified from SWMFs. The most abundant species identified in SWMFs was the non-vector species *Cx. territans* (34%). *Culex pipiens* (21%) was the second most common species [**Figure 5-4**].

Figure 5-5: Storm Water Management Facility (SWMF), monitored by the MLHU, located in Dorchester.

The VBD Team observed a 44% decrease in the number of mosquito larvae identified from SWMFs this year. Additionally, the most abundant species identified from SWMFs was the non-vector species *Cx. territans* (34%), whereas in 2012, the most abundant species was *Cx. pipiens* (33%). An overall decrease in mosquito larvae found in all SWMFs can be attributed to several factors; first, the City of London has begun to remediate certain SWMFs, clearing the ponds of heavy peripheral vegetation, which in previous years has supported larval mosquito breeding. For example, the Mornington SWMF which consisted of a forebay and cell underwent significant remediation in 2012. Second, new SWMFs are being designed differently, with efforts to reduce peripheral vegetation, which can assist in the reduction of mosquito habitat. SWMF's will remain a focus for larval mosquito surveillance because they are the most commonly treated site type each year. The monitoring of these sites is important to effectively control vector mosquitoes, especially because SWMFs are often located within residential neighbourhoods and urban centres [**Figure 5-5**]. Since older, more naturalized SWMFs can breed higher amounts of vector mosquito larvae, it is important that the MLHU continue to identify and treat these urban structures. Surveillance of Middlesex-London's SWMFs will ensure that most vector mosquitoes breeding in these structures are effectively eliminated.

5.5 Environmentally Significant Areas

Each year the MLHU continues to identify a high number of vector mosquito larvae in Environmentally Significant Areas (ESAs). West Nile Virus positive activity has also been identified from these locations in past seasons. Continued surveillance and treatment of peripheral pools in ESAs is essential to reduce vector mosquito emergence and WNV illness to local populations. Environmentally Significant Areas consist of wetlands, meadows, and forests that contain diverse plant and animal life. Many ESAs are home to endangered plants, significant wildlife species and rare landforms. (UTRCA, 2005a) This season the MLHU continued to monitor peripheral pools and standing water located in ESAs, for vector mosquito larvae. Environmentally Sensitive Areas located in Middlesex-London are predominantly found near urban, heavily populated areas that are frequently used for recreation during the spring and summer. A total of 3,656 mosquito larvae were identified in ESAs, a 20% increase from 2012. Over one quarter of the species identified in ESAs were *Cx. pipiens* and *Cx. restuans*.

Westminster Ponds

At approximately 200 hectares, Westminster Ponds is the largest ESA in London and is also designated as a Provincially Significant Wetland. This natural site located in the centre of London provides a great variety of natural habitats. (UTRCA, 2005b) The wetland habitats located in Westminster Ponds are associated with lowland areas around the margins of the ponds and include deciduous swamp, peat bog, and cattail marsh. The ponds and the mixture of habitats make this site an excellent place for wildlife, even mosquitoes. (City of London, 2013, November) Overall 63 treatments were performed in Westminster Ponds. On average, 41 treatments are performed within Westminster ponds each year.

Sifton Bog

Sifton Bog is a Provincially Significant Wetland and Canada's most southerly large acidic bog, which makes it an important place for research and education. It consists of bog wetlands as well as the peripheral pools of the bog. The 40-hectare site is known to accumulate large amounts of standing water following rainfall and snow-melt since its original formation was the result of a melted glacial till, forming the 'kettle lake' nearly 14,000 years ago. The pond supports unique groups of plants adapted to the bog environment. (City of London, 2013, November) Permits issued by The Ministry of Environment allow treatment of only the peripheral pools, not the kettle lake or the bog itself. Sifton Bog did not hold as much standing water as it has in past. This contributed to fewer mosquito larval identifications and fewer treatments compared to surveillance data recorded for this site in past years. In 2013, six treatments were performed in Sifton Bog.

Figure 5-6: Larval monitoring performed in March to check for early spring mosquito species.

5.6 Conclusions and Recommendations

Environmentally Sensitive Areas can play a role in vector mosquito breeding within Middlesex-London. These locations are unique, protected environments that serve the Middlesex-London community as a place for activity and leisure year-round. In addition to protecting human health by monitoring standing water in local ESAs, it is important that the MLHU work closely with local partners in order to respect the work being done to maintain protected plant and animal species.

Based on larval surveillance in 2013, the following recommendations have been made:

- Continue with earlier larval monitoring [**Figure 5-6**]. Early larval monitoring will assist the MLHU in making decisions surrounding control strategies to reduce WNV in the community each season.

- Continue to monitor populations of *Culex pipiens and Culex restuans*, as they remain the most competent vector species and have been identified as WNV-positive in adult mosquito traps. A comprehensive control program targeting these species will assist with reducing WNV transmission to residents.

Chapter 6 : Adult Mosquito Surveillance

6.1 Introduction

In order to effectively monitor for vector-borne diseases, the Middlesex-London Health Unit (MLHU) must monitor adult mosquito populations in Middlesex-London on a weekly basis. The information gathered from mosquito trapping, species identification and viral testing allows the MLHU to assess the status of vector-borne diseases within Middlesex-London and identifies specific communities that require increased surveillance and control efforts.

6.2 Adult Mosquito Surveillance in Middlesex-London

Trapping of adult mosquitoes commenced on June 5, 2013 and was conducted for 17 weeks, ending on October 2, 2013. A total of 23 traps were set up on a weekly basis throughout the City of London and Middlesex County.

- 15 terrestrial traps (4 to 6 feet off the ground) were used.
- 8 canopy traps (13 to 20 feet off the ground) were used.

All traps are distributed across Middlesex-London [**Appendix D**]. Canopy traps were used to study the variation and biting preferences of adult mosquitoes at heights greater than 10 feet (trapping mosquito species that fly at heights for biting birds). The locations of the mosquito traps were chosen based on geographic distribution, proximity to vulnerable populations and/or previous year's viral activity trends.

Adult mosquito trapping followed the MLHU's standard procedures:

- Collect adult mosquitoes with battery-operated miniature light traps.
- Bait traps with carbon dioxide (dry ice).
- Set traps up to operate for the duration of one night (15 to 20 hours in total).
- Retrieve samples the following day, package, and send to the service provider for identification and viral testing.

Once traps are received by the service provider, mosquitoes are counted, identified and tested for West Nile Virus (WNV) or Eastern Equine Encephalitis (EEE). Following identification and viral testing, the MLHU was informed of all results.

In 2013, 65,409 mosquitoes were collected in adult mosquito traps and 21,864 specimens were identified by GDG. A total of 21 different mosquito species were identified in Middlesex-London over a period of 17 weeks. Of the 21 different species identified, 13 were vector species. (GDG, 2013) Overall, 972 pools representing 10,831 specimens were tested by GDG for WNV and/or EEE. All testing followed Public Health Ontario's Testing Order of Preference guidelines.

The EEE testing order focused on the primary enzootic vector *Culiseta melanura, Ochlerotatus canadensis, Coquillettidia perturbans*, and *Aedes vexans*. The EEE testing order of preference tests species that are considered to be 'high-risk' in Ontario due to their ability to carry and transmit EEE. Overall 237 EEE viral tests were performed, all of which were negative. (GDG, 2013)

The WNV Testing Order of Preference focused on the primary WNV vectors; *Cx. pipiens/restuans, Cx. salinarius, Oc. japonicus* and *Cx. tarsalis*. The most frequently tested species were *Culex pipiens/restuans*. The other species tested most often were *Aedes vexans*, *Ochlerotatus canadensis* and *Ochlerotatus trivitattus*. (GDG, 2013) There were 735 WNV tests conducted, resulting in four WNV-positive traps [**Appendix B**].

Three terrestrial traps and one canopy trap were confirmed WNV-positive. The WNV-positive traps were all located within the City of London. The first positive terrestrial trap was detected on July 18, 2013; this was the same week that positive activity was first detected in the 2012 season. The remaining WNV-positive traps were detected on September 5, 2013 (1 terrestrial trap) and September 12, 2013 (1 terrestrial trap, 1 canopy trap). The vector ratio from the four positive traps averaged 93% percent. This means that most of the mosquitoes collected in each of the four traps were vector species capable of transmitting WNV. (GDG, 2013) Upon detection of WNV-positive activity, the MLHU informed local news outlets and the community with a media release. Hotspot traps were then set up in the areas where WNV-positive activity was identified in order to monitor additional mosquito populations and the distribution of WNV. Heightened standing water surveillance and control was conducted in areas identified as having WNV-positive activity.

6.3 Terrestrial Trap Surveillance

In 2013, 88% of all mosquitoes collected were from terrestrial traps (57,468). In total, 17,472 specimens were identified from the collection; ~86% vector species, ~14% non-vector species. This year's vector composition decreased by 10% from 2012. This decrease can be attributed to an effective mosquito control program, reducing adult vector mosquitoes by targeting *Culex pipiens/restuans* in larval form. Once again, the most abundant vector was *Ae. vexans* (36%) and *Oc. trivittatus* (17%). These are the same two species that were the most common in 2009, 2010, 2011 and 2012. [**Table 6-1**; **Figure 6-1**]

Table 6-1: Mosquito species composition in terrestrial traps. Non-vector species in bold; *vectors of both WNV and EEE.

Species	Number Identified (Terrestrial)	Percent
Culex pipiens/restuans	1132	6%
*Aedes vexans**	6316	36%
An. punctipennis	693	4%
*Cq. perturbans**	387	2%
An. quadrimaculatus	228	1%
Oc. stimulans	851	5%
Oc. triseriatus	155	1%
Oc. trivittatus	2877	17%
*Oc. canadensis**	1553	9%
Oc. japonicus	368	2%
*Culiseta melanura**	1	0.1%
*Culex salinarius**	1	0.1%
Aedes/Ochlerotatus	458	3%
Oc. broadbanded	32	0.2%
Ae. cinereus	27	0.2%
Oc. provocans	10	0.2%
Oc. blacklegged	2349	13%
Other	34	0.2%
Total	**17,472**	**100%**

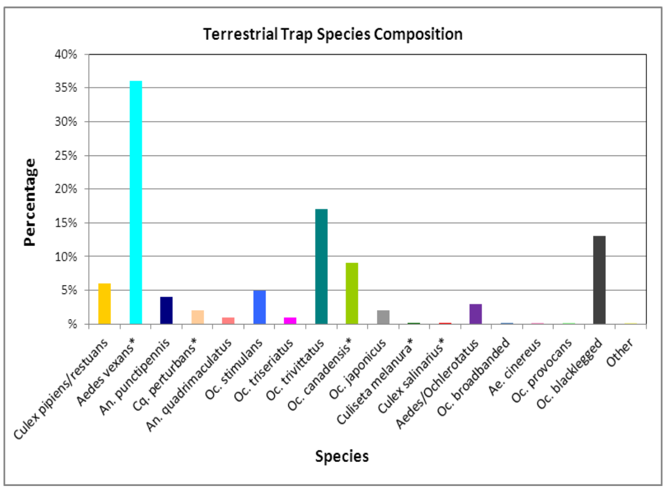


Figure 6-1: Species composition in terrestrial traps, 2013.

In 2013, EEE vector species represented 47% of all mosquitoes identified, a slight increase from 31% in 2012. However, a decrease from 2011 and 2010, when over 50% of mosquitoes identified in terrestrial traps were vectors.

In the past traps H and H-A located in Parkhill have yielded the highest counts of mosquitoes. In 2011, Trap H collected 95,997 mosquitoes, accounting for 71% of all mosquitoes collected that season. In 2012, a decrease of nearly 94,000 mosquitoes was observed with only 1,738 mosquitoes collected that year. In 2013, 30,648 mosquitoes collected from traps H and HA. Once again this year a very low vector composition was identified. Trap H yielded 45% vector species, and trap H-A 48% vector species. This vector composition is very low when compared to other traps which had vector compositions of 86% to 100% vector species.

6.4 Canopy Trap Surveillance

Canopy trap surveillance is a unique aspect of the VBD Program, in addition to regular terrestrial mosquito trapping. Canopy traps are mosquito traps set up at heights of 13 to 20 feet for the duration of one night. Canopy traps are used to analyze species composition, biting preferences and identify viral activity in adult mosquitoes that fly at heights greater than 10 feet and prefer to bite birds. This is an important aspect of adult mosquito trapping because mosquitoes that prefer to bite birds often contribute to the transmission of WNV and amplification of the virus in the bird population. This type of biting preference can have an impact on human health when a greater number of vector mosquitoes bite birds and become infected with WNV. When more mosquitoes are infected with WNV, it increases the likelihood of transmission to humans.

This year 7,941 mosquitoes were collected from eight canopy traps located throughout Middlesex-London. This is a 68% increase in mosquitoes collected from canopies in 2012. In total ~84% of mosquitoes in canopy traps were vector species, and ~16% were non-vectors [**Figure 6-2; Table 6-2**]. This is a decrease in the number of vector mosquitoes observed in canopies from 2012, when ~91% were vector species. The number of WNV-positive canopy traps also decreased this year. In 2013 only one WNV-positive canopy trap was reported, whereas in 2012, seven canopy traps were WNV-positive. When mosquito species are confirmed positive at heights favourable for biting birds, there is an increased likelihood of WNV transmission to humans.

Middlesex-London observed a decrease in WNV-positive mosquito traps and also a decrease in WNV human cases in 2013. Despite noting an increase in the overall number of mosquitoes collected in canopies, the MLHU observed decreased viral activity in these traps. *Culex pipiens/restuans* (27%) were the most abundant vector species identified in canopy traps, followed by *Ochlerotatus trivittatus* (19%) and *Aedes vexans* (16%) [**Figure 6-2; Table 6-2**]. It should be noted that a significant increase from 2012 to 2013 was observed in the identification of all of these species. *Culex pipiens/restuans* increased by 33%, *Aedes vexans* by 85% and *Oc. trivitattus* increased by 55%. Another significant increase was *Oc. canadensis*, which increased by 99% in 2013. The most notable increases in populations of *Ae. vexans*, *Oc. canadensis* and *Oc. trivitattus* can be attributed to excess rainfall in 2013, which triggered emergence of these floodwater species (GDG, 2013). The spike in *Oc. trivitattus* can be closely linked to the intense rain events with an average increase of 211 millimetres from 2012.

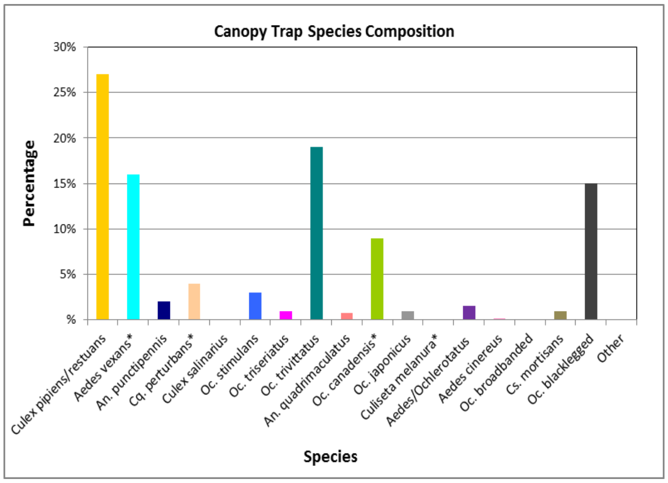


Figure 6-2: Species composition in canopy traps, 2013

Table 6-2: Mosquito species composition in canopy traps. Non-vector species in bold; *vectors of both WNV and EEE.

Species	Number Identified (Canopy)	Percent
Culex pipiens/restuans	1206	27%
*Aedes vexans**	683	16%
An. punctipennis	91	2%
*Cq. perturbans**	171	4%
Culex salinarius	1	0%
Oc. stimulans	136	3%
Oc. triseriatus	34	1%
Oc. trivittatus	850	19%
An. quadrimaculatus	33	0.8%
*Oc. canadensis**	397	9%
Oc. japonicus	39	1%
*Culiseta melanura**	1	0%
Aedes/Ochlerotatus	69	1%
Aedes cinereus	8	0.2%
Oc. broadbanded	1	0%
Cs. mortisans	45	1%
Oc. blacklegged	623	15%
Other	4	0%
Total	**4392**	**100%**

6.5 Discussion

A combined total of 65,409 mosquitoes were collected from terrestrial and canopy traps. This was an increase from the 18,464 mosquitoes trapped in 2012. Overall terrestrial traps collected 13,080 more mosquitoes than canopy traps, however, certain species were collected in canopies in higher numbers. In total, terrestrial traps collected ~86% vector species and canopy traps collected ~84% vector species. When comparing the terrestrial and canopy vector mosquito composition, a larger percentage of *Culex pipiens/restuans* are identified in canopy traps.

The increased vector ratio in canopies can be attributed to the biting preferences of the species, which are to bite both humans and birds. Finding this species in high numbers in canopies confirms the species preference to bite birds resting in tree branches. This species continues to be a primary vector for transmission of WNV to humans.

This year the MLHU observed a 72% increase in the number of mosquitoes collected. Mosquito populations spiked twice in 2013; the first spike was observed from week 25 to 26 (June 16 to June 29) and the second from week 29 to 30 (July 14 to July 27). Over these four weeks 53% of all mosquitoes captured in 2013 were collected. This averages approximately 8,500 adult mosquitoes collected each week. (GDG, 2013) Cooler average temperatures led to fewer positive mosquitoes this season, despite an increase in viable habitats created by an overall increase in precipitation. (GDG, 2013) In 2012, there was less precipitation, however, a greater number of degree days, accounting for fewer mosquitoes, but increased viral activity.

Each week adult mosquito traps collected 86% to 100% vector species, with the exception of traps located in Parkhill, which collected fewer vector mosquito species than other trap locations. Traps located in Parkhill (three in total) collected an average of 52% vector species, whereas other traps in Middlesex-London collected an average of 90% to 100% vector species. Those traps with a higher number of vector species have the potential to test positive more frequently than those with lower vector mosquito counts.

Of the four WNV-positive mosquito traps identified this season, the average vector composition was 85%. Many traps had a vector composition of 90% or greater. The MLHU set up four hotspot mosquito traps following the confirmation of WNV-positive mosquito traps, birds and human cases. In total hotspot traps only collected 94 mosquito specimens, and no positive traps were confirmed in 2013. Mosquitoes identified in hotspot traps were 100% vector species.

In 2013, GDG Environnement performed 237 viral tests for EEE based on Public Health Ontario's Guidelines and EEE Testing Order of Preference, which focused on the primary enzootic vector *Culiseta melanura*, and three others; *Ochlerotatus canadensis*, *Coquillettidia perturbans*, and *Aedes vexans*. The EEE testing order of preference focuses on species that are considered to be 'high-risk' vectors in Ontario by their ability to carry and transmit EEE. (MOHLTC, 2011a) Once again very low numbers of *Cs. melanura* were identified in Middlesex-London this year. Only two adult mosquito *Cs. melanura* were collected this season. According to adult mosquito trapping data very few Cs. melanura have been identified, their populations are not dispersed throughout the region, and at this point they appear to be concentrated in one small area of Middlesex-London.

In total, only 21 specimens of *Cs. melanura* have ever been collected to date, all of which have been collected from Trap S and Can 12, located at Sifton Bog in west London.

A significant decrease (76%) was observed in *Cq. perturbans*. This is often a very difficult species to target in larval control measures due to the species' modified siphon, which is shaped like a hook, and attaches to underwater stems and roots of emergent or floating vegetation. With the modified siphon, this species receives its oxygen through the plant, not needing to rest at the water's surface to respire like other larval species with a regular siphon. It is therefore more difficult to find and target this species in larval form, since they spend a lot of time below the water's surface. (Brothers, 2005) Since *Cq. perturbans* are a vector for EEE, this decrease is an important step in reducing the number of EEE vector species present in Middlesex-London.

For the second year the non-vector species *Ochlerotatus blacklegged* was identified in lower numbers. In 2013, 2,972 *Oc. blacklegged* were identified, and only 18% of those mosquitoes were identified from traps located in Parkhill. In 2011 high numbers of this nuisance mosquito species was collected in traps in Parkhill, however, since a third trap was added, in addition to several remediation projects within the town, the populations of *Oc. blacklegged* have continued to decline each year. The MLHU has now identified more *Oc. blacklegged* species in the traps located in London rather than in the three traps located in Parkhill. Following initial remediation efforts in Parkhill in 2011, work continued throughout 2012 and 2013 to clear areas of standing water within the town. The MLHU also worked to identify new sites and monitor all sites located on public property in order to reduce vector mosquito populations and support ongoing efforts in North Middlesex.

6.6 Conclusions and Recommendations

Adult mosquito surveillance was an important aspect of the MLHU's effort to identify and reduce the impact of WNV transmission to local residents. Despite an increase in the number of adult mosquitoes collected, the MLHU observed a decrease in WNV activity due to environmental conditions breeding more floodwater mosquito species, which aren't as competent in transmitting WNV to humans.

Following adult mosquito surveillance in 2013 the following recommendations have been made:

- Continue to collect adult mosquitoes and perform WNV testing in order to identify and communicate infectious disease trends to residents in Middlesex-London and educate people on how to protect themselves against bites and vector-borne diseases when positive activity is identified.

Chapter 7: Human Surveillance of Vector-Borne Diseases

7.1 Introduction

The objective of human surveillance is to understand the epidemiology of vector-borne diseases within the human population. The collection of epidemiological data, which includes the incidence, prevalence, source and cause of the infectious disease, assists in determining biological and environmental risk factors for acquiring the infection. West Nile Virus (WNV), Lyme disease (LD), and the encephalitic symptoms caused by Eastern Equine Encephalitis (EEE) are classified as both Reportable Diseases and Communicable Diseases under the *Health Protection and Promotion Act*. Physicians are required to report suspected, probable, and confirmed cases to the local Medical Officer of Health, who must then report the probable and confirmed human cases to the Infectious Diseases Branch of the Ministry of Health and Long Term Care. (MOHLTC, 2009a)

7.2 Human Surveillance of West Nile Virus

Using data from mosquito, bird and human surveillance, local WNV trends are used to develop comprehensive surveillance and control plans, to reduce vector-borne disease transmission and protect human health within the community. Human surveillance of reportable diseases, such as WNV, allows the MLHU to continually develop and update strategies to help aid in the reduction of vector-borne diseases. As WNV activity continues to be present within Middlesex-London, it is important to track the number of cases on a year-to-year basis in order to understand the changing dynamics of WNV infection and what can be done to mitigate the risk to local residents.

In the event of a human WNV diagnosis in Middlesex-London, the MLHU's Infectious Disease Control Team will begin an investigation into the case. Preliminary actions include notifying the MOHLTC through the Integrated Public Health and Information System (iPHIS) and a comprehensive assessment of the case's travel history, recent blood donation history and a review of symptoms. Following initial actions, results are reviewed with the patient. Results are forwarded to the Ministry of Health and Long Term Care (MOHLTC) where they once again review the blood donation history of the patient. Canadian Blood Services is also notified of any human, mosquito, bird, and sometimes equine WNV cases, which provides a more complete picture of the presence of WNV in a community.

Background

The Public Health Agency of Canada's (PHAC) WNV case definition is used by healthcare providers to diagnose WNV in humans. Case definitions are continually updated to reflect additional information concerning the signs and symptoms of the disease.

West Nile Virus Infections are classified into three infection types:

- West Nile Virus Neurological Syndrome (WNNS),
- West Nile Virus Non-Neurological Syndrome (WN-Non-NS), and
- West Nile Virus Asymptomatic Infection (WNAI).

West Nile Virus Neurological Syndrome and WN-Non-NS cases may be classified as suspected, probable, or confirmed, and WNAI cases as probable or confirmed. Both clinical symptoms and laboratory findings are based on blood work, and must be interpreted in order to reach a diagnosis. Specific criteria must be met in order to classify a case as suspected, probable, or confirmed.

The clinical and laboratory criteria for WNV diagnosis and case classification are based on Public Health Agency of Canada's National Surveillance for West Nile Virus case definitions. These definitions are outlined in **Appendix E**. (MOHLTC, 2009c; PHAC, 2008b)

Results

The number of reported cases of WNV-related illness decreased this season. In 2013, there were two confirmed cases and one probable case of WNV reported. In 2012, there were seven WNV cases reported from Middlesex-London. In 2011, the MLHU reported one confirmed WNV-positive human case and one probable WNV human case. In 2010 and 2009, WNV illness remained low at both the national and provincial levels.

In Ontario, 49 human WNV cases were reported in 2013, a decrease from 2012, when 252 human cases reported. In 2011, 72 human cases were reported. The last time Ontario saw greater than 10 human cases was in 2006 and 2007, which were outbreak years for WNV at both the national and provincial level. (PHAC, 2013d; OAHPP, 2013b)

This year, Canada's WNV cases decreased significantly from 2012, with 107 reported clinical cases in 2013 (PHAC, 2013d). In 2012 there were 428 clinical cases (PHAC, 2013e). In 2011, 101 human cases were reported in Canada (PHAC, 2013e).

The United States (U.S.) reported a decrease in WNV human cases as well, with 2,374 cases in 2013, compared to 5,387 in 2012. In the states that border southern Ontario, Michigan reported 36 cases, Ohio reported 24 cases and New York reported 26 cases, a decrease from over 100 cases reported from each respective state in 2012. (USGS, 2013b)

Human WNV infection confirmed from regions south of the Ontario's border can pose a concern for the MLHU, as the identification of WNV human cases and positive mosquito activity in bordering regions can have an effect on local mosquito populations through travel and tourism, migration of avian specimens, and/or through the displacement of mosquito vectors in artificial and shipping containers moving in and out of the country.

Discussion

A WNV-positive human case is identified when a person visits a physician and symptoms of a WNV infection are identified. The health care provider then submits a blood sample to Public Health Laboratory. The first test performed is the IgM Enzyme-Linked Immunosorbent Assay (ELISA), which, if positive, is run once more to rule out false positive results. These two tests may then be followed by a Plaque Reduction Neutralization Test (PRNT) to confirm the diagnosis. If the IgM ELISA tests are positive, the patient is advised that they are a 'Probable' WNV case. The ELISA results are available within 24 hours, while the PRNT confirmation testing takes an additional seven days. (MOHLTC, 2009c; PHAC, 2008b)

Upon laboratory confirmation of WNV, the Health Unit conducts interviews with the patient to determine exposure information. Following the confirmation of WNV human cases the MLHU contacted clients for follow up to review the client's age, risk factors and history, including any hobbies and/or activities which may have been case for exposure to WNV.

In response to WNV human case confirmation the MLHU heightened standing water surveillance and control as well as set up additional hotspot adult mosquito traps in the community. Adult mosquito surveillance and dead bird testing indicated the presence of WNV within Middlesex-London. In 2013, the MLHU identified nine WNV-positive dead birds and four WNV-positive mosquito traps. The identification of WNV activity within Middlesex-London indicates the continued need for WNV adult mosquito monitoring and viral testing, including the control of vector mosquito larvae, in order to reduce the associated risks for human WNV transmission.

West Nile Virus Conclusions

Although the number of reported WNV cases declined, the increase in human cases at the local, provincial and national level in 2012 indicates that there is still a risk for WNV infection. Despite fewer cases, it is still important to monitor local human, mosquito, and bird populations in order to avoid a year such as 2012. Human infection typically occurs by mid-summer or towards the end of the year, once the virus has amplified within local bird and mosquito populations. Human surveillance is important to understand the epidemiology and clinical course of infection in local populations. A comprehensive West Nile Virus monitoring program not only monitors for the human incidence, but also considers the transmission within local bird and mosquito populations. Additionally, a comprehensive education campaign will also take preventative action to reduce the risk of WNV, prior to human infection.

A combination of human, mosquito and bird surveillance provides a thorough understanding of the presence of WNV in a community, serving to protect residents through field surveillance, public education, and additional control measures when required.

7.3 Human Surveillance of Lyme disease

Background

Lyme disease (LD) in Ontario is caused by the bacterium *Borrelia burgdorferi* and is transmitted through the bite of an infected *Ixodes scapularis* tick species, commonly known as the blacklegged or deer tick. (MOHLTC, 2011b)

Lyme disease can have serious symptoms, however, it is a bacterial infection, so it may be treated by antibiotics. Symptoms become increasingly worse if an infection remains undiagnosed and/or untreated. (PHAC, 2013b)

There are three stages of an LD infection. Not every person infected with LD experiences symptoms at each stage, and patients typically only experience the latter stages of infection if it remains untreated.

- **Stage 1:** A circular, or "Bulls-Eye", rash called an erythema migrans (EM) is indicative of the initial infection. This occurs in approximately 70-80% of cases 3 days to 1 month after infection at the site of the bite. Flu-like symptoms may also be experienced. (PHAC, 2013b)

- **Stage 2:** This stage may last up to several months and include: central and peripheral nervous system disorders, multiple skin rashes, arthritis and arthritic symptoms, heart palpitations, and extreme fatigue and general weakness.

- **Stage 3**: This stage may last several months to years, and include chronic arthritis and neurological symptoms or adverse fetal affects in pregnant women.

In order to diagnose Lyme disease in Ontario, a health care practitioner must first evaluate a patient's clinical symptoms and risk of exposure to infected ticks. A blood test may be ordered by a practitioner in order to detect the presence of antibodies for *Borrelia burgdorferi* by means of two IgM/IgG ELISA tests performed simultaneously. (MOHLTC, 2009d; MOHLTC, 2011b)

Results

In 2013, there were four confirmed human cases and one probable human case of Lyme disease reported to the MLHU. All four confirmed cases were travel-related and were exposed to ticks while travelling in the United Kingdom, Poland, Georgia and New York State. The probable case was exposed to a tick in Florida, U.S. Three of the confirmed cases (U.K, Poland, Georgia) were a strain of European Lyme disease that can only be contracted in Europe.

Discussion

Although the risk of acquiring Lyme disease remains low in Middlesex-London, residents can acquire LD from an infected tick anywhere in Ontario, especially when travelling to known endemic regions. This is because ticks can travel on migratory birds or mammals. Although Middlesex-London does not have an established blacklegged tick population, there are endemic areas within 100 kilometers, in Norfolk County and Windsor-Essex County. The MLHU performed tick dragging as part of a passive tick surveillance program. Tick dragging was performed in an area of northwest London after two blacklegged ticks were submitted to the MLHU. Tick dragging also occurred after a high number of ticks were submitted by the public from Melbourne, Glencoe, Lambeth, and Strathroy. No ticks were collected from any of the drags that were performed in 2013.

Lyme disease Conclusions

It is important that the MLHU continue to implement public education strategies that outline personal protection measures, tick removal techniques and how/where to submit a tick, in addition to early LD symptom identification, in order to prevent and/or detect the early signs of LD.

The MLHU must also continue to perform tick dragging when blacklegged ticks are submitted and in areas identified as having a high number of tick submissions, or in areas where residents reported a high number of tick sightings or tick bites.

7.4 Human Surveillance of Eastern Equine Encephalitis

Background

In the past, Eastern Equine Encephalitis (EEE) has predominately affected equine populations; however, the presence of EEE-positive mosquitoes in Ontario in recent years has increased the possibility of human infection. Human infection can involve very general symptoms, to severe symptoms of encephalitis, however a majority of infections will be asymptomatic. (MOHLTC, 2011a)

Approximately one third (33%) of all patients who develop encephalitis will die from the disease or suffer permanent mental and physical side effects. There are currently no vaccines to protect humans against EEE, and no anti-viral medications available. (MOHLTC, 2011a).

Eastern Equine Encephalitis most often circulates through a bird-mosquito-bird cycle of transmission, with the mosquito species *Culiseta melanura* acting as the main vector for amplification within avian populations. *Coquillettidia perturbans, Aedes vexans vexans, Aedes albopictus, Culex salinarius,* and *Ochlerotatus canadensis* have also been identified as potential vectors for EEE. (MOHLTC, 2011a)

Results

This year a few EEE vector species were identified in Middlesex-London, however, no mosquitoes tested positive for the virus, and there were no reported cases of EEE in horses or humans.

Currently the risk for EEE human infection in Middlesex-London is low, although Ontario has reported some positive veterinary cases and mosquito traps in recent years. The presence of EEE in the United States supports the need for continued surveillance of EEE vector mosquitoes in Middlesex-London. Due to the high rate of human mortality among those infected with EEE, in addition to the continued presence of EEE in bordering states, it is important to keep focus on surveillance of EEE and maintain an education program to prevent human infection. The MLHU continues to follow Public Health Ontario guidelines to monitor for the presence of EEE vector mosquito species, and test those species if they are identified in local adult mosquito traps. By testing a variety of potential EEE vectors, the MLHU's service provider, GDG Environnement, performed 237 EEE viral tests. All viral tests were negative.

Discussion

In 2012, the U.S. saw a high level of EEE-positive activity, reporting human cases, positive mosquitoes, birds, and veterinary cases. In 2013, these numbers decreased, however, five human cases were still reported, none of which were from states bordering southern Ontario. (USGS, 2013a)

Although there were no human cases of EEE reported in Ontario, the report of a single human case is still significant. Since the prognosis for those infected with EEE is poor, it is important to maintain continued surveillance for EEE vector species. Since EEE activity continues to be reported in the U.S., the MLHU must continue to follow Public Health Ontario guidelines to monitor for the disease.

7.5 Conclusions and Recommendations

Human surveillance of vector-borne diseases is an important aspect of the MLHU's Vector-Borne Disease Program. Confirmation of positive WNV, EEE or LD activity in an area puts the general public on alert. Doctors and healthcare providers may also be alerted in order to look for associated signs and symptoms in patients. Human surveillance also provides more clues to Health Unit staff about who may be at risk for the serious health effects that vector-borne diseases can cause. In addition, it provides information to help ensure the safety of the blood supply in Canada. Every time a WNV case is confirmed, the patient is interviewed in detail and asked if they have recently given blood. Canadian Blood Services is contacted in order to ensure that the blood supply remains safe and protected.

Chapter 8: Mosquito Control

8.1 Introduction

Controlling vector mosquito larvae in standing water is an important aspect of the Middlesex-London Health Unit's (MLHU) Integrated Pest Management (IPM) approach. Control of vector mosquito larvae helps to reduce the transmission of West Nile Virus (WNV) and Eastern Equine Encephalitis (EEE) in Middlesex-London. Reducing vector mosquito species before they reach the adult and/or biting stage of development is a key component to reduce the spread of infection to humans as well. The MLHU's control strategy aims to manage vector mosquito larvae while remaining economically and environmentally conscious. Together, the MLHU and its mosquito control service provider, The Canadian Centre for Mosquito Management (CCMM) employ the IPM approach which includes careful collection, identification and planning prior to performing a larvicide treatment. This IPM approach ensures that only those mosquito species that can harm human health through the transmission of vector-borne diseases are controlled.

The control of vector mosquito larvae in standing water and catch basin structures is an effective step in minimizing the amplification of WNV in nature, and can help to reduce the spread of infection to human populations. Larviciding, or controlling, mosquitoes in the larval stage is an effective preemptive control strategy to reduce human infection. Controlling vector populations of mosquito larvae, in advance of them reaching the adult stage of development has been a key component of the MLHU's response to reducing the transmission of West Nile Virus. (CCMM, 2013)

8.2 Products and Application

All staff involved in the application of pesticides hold either a Pesticide Technician licence or an Exterminators licence, both of which are provincially regulated by the Ministry of the Environment (MOE) and issued in accordance with the *Pesticides Act* under the Pest Management Regulatory Agency of Canada (PMRA).

The Vector-Borne Disease Program continued to use larvicides applied directly to water; these larvicides are classified as "Class 2" by the Pest Management Regulatory Agency of Canada. The PMRA requires that Class 2 pesticides be applied by trained and licenced personnel. *Bacillus thuringiensis israelensis* (*B.t.i.*) was the primary larvicide used. This larvicide is biologically safe and target specific, meaning that it only affects mosquito larvae when applied to standing water for a treatment. *B.t.i.* contains an acidic bacterium that causes a lethal reaction in the alkaline environment of the mosquito larva's gut. When ingested by mosquito larvae, the specimen becomes unable to feed, resulting in death.

Figure 8-1: MLHU staff measuring larvicide.

All staff applying *B.t.i* carefully follow the application charts and industry guidelines in order to apply only measured amounts of this product relative to the treatment area identified by the presence of vector mosquito larvae [**Figure 8-1**]. The residual life of *B.t.i.* lasts for approximately 48 hours, a shorter period of time than other products on the market, making this larvicide safe for use in Environmentally Significant Areas (ESAs), with little to no impact on surrounding non-target aquatic invertebrates and plant life. AquaBac® 200G, VectoBac® 200G, and VectoBac® 1200L contain *B.t.i.* as the active ingredient. VectoLex® CG and VectoLex® WSP (Pouches), contain *Bacillus sphaericus* (*B.s.*) as an active ingredient. The MLHU and CCMM used products containing *B.t.i.* and *B.s* for the treatment of standing water located in ditches, woodland pools, ponds, storm water management facilities, and some catch basins (Health Canada, 2011) Catch basins are primarily treated with Altosid® Pellets or Briquets, which are methoprene products, however when a catch basin flows into an ESA, *B.s* products are utilized.

Methoprene is an insect growth regulator, which was first registered for use in Canada in 1977. This product works by disrupting the lifecycle of mosquitoes. When applied to the water methoprene products prevent the development of a mosquito beyond the larval stage. methoprene's mode of action is non-toxic and studies show that it is not persistent in the environment, degrading rapidly when applied to water and when exposed to sunlight and microorganisms. Health Canada's PMRA assesses the human health and environmental impact of pesticide control products approved for use in Canada. Laboratory tests have found that methoprene products have a very low toxicity with no lasting adverse effects on invertebrates or non-target aquatic organisms when products are used in accordance with label directions. (Health Canada, 2010)

CCMM utilized Altosid® products to treat vector mosquito larvae found in catch basins in Middlesex-London and sewage lagoons within Pollution Control Plants. Both CCMM staff and the MLHU's VBD Team obtained a Mosquito/Biting Fly Exterminator licence prior to applying larvicide products. In preparation for 2013 surveillance, all VBD and service provider staff participated in detailed health, safety and field training sessions, in addition to focused in-class training provided by an Ontario Pesticide Specialist. Staff field training consisted of larval dipping techniques and treatment demonstrations highlighting safe handling and use of pesticides in the field. In addition, practical examinations were administered to test the team's ability to understand the safe application of larvicides to standing water.

8.3 Standing Water Treatments

Standing water located on public property was monitored for potential mosquito breeding by the MLHU and CCMM. Standing water sites established as part of the mosquito surveillance schedule can exist on public property, a considerable distance from roadways. Global Positioning System (GPS) coordinates represent geographic locations. GPS coordinates are mapped allowing staff to easily locate standing water sites. These sites were monitored on a weekly basis and larvicide treatments were conducted when moderate to high counts of vector mosquito larvae were identified [**Figure 8-2**]. In 2013, 744 treatments were performed at 229 sites. This treatment total is exclusive of treatments conducted at Environmentally Sensitive Areas (ESAs) and Pollution Control Plants (PCPs). These numbers indicate that 17% of monitoring visits included treatment, and that 62% of sites monitored were treated one or more times. Larvicide was applied to 16.38 hectares of standing water located on public property [**Table 8-1**]. The scope of surface-water surveillance and control included the municipalities of Adelaide-Metcalfe, London, Lucan Biddulph, Middlesex Centre, Newbury, North Middlesex, Southwest Middlesex, Strathroy-Caradoc and Thames Centre. Most treatments were conducted at sites located in London, Strathroy and Parkhill. Overall there was a 29% decrease in treatments compared to 2012. Last year a high number of treatments were performed as a result of increased viral activity, after 17 WNV-positive adult mosquito traps were identified in Middlesex-London. (CCMM, 2013)

As a follow up to positive activity, the MLHU always heightens standing water surveillance, and as a result, increased treatments are performed when vector mosquito larvae are identified more frequently in standing water located on public property. The MLHU observed a significant increase in the number of frequently treated sites (10 or more times), from 34 in 2011 to 55 frequently treated sites in 2012. Since a decrease in the total number of treatments was observed this year, a decrease was also observed in the number of frequently treated sites.

In 2013, 23 sites were treated 10 or more times. The combined total of sites monitored, including all surface water, ESA and Pollution Control Plants was 248, with a total of 857 treatments were conducted at these sites.

Storm Water Management Facilities

Storm Water Management Facilities (SWMFs) were the most frequently treated site type [**Table 8-1**]. These structures require more control due to their proximity to urban populations and design features, which are favourable to vector mosquito breeding. Many naturalized SWMFs breed higher amounts of vector mosquito larvae, because these older structures tend to have more vegetation and less wave action, creating a warm, still, nutrient-rich environment for mosquito egg-laying and breeding.

This year seven of the 23 most frequently treated sites were SWMFs, and 44% of all treatments were conducted at this site type [**Appendix F**]. Surveillance data indicates that this site type remains an important area for surveillance and control, especially as SWMFs continue to naturalize and develop favourable vegetation for larval mosquito breeding.

Figure 8-2: Treatment notification sign posted following larvicide application to standing water.

Table 8-1: Number of treatments performed by site type in 2013, excluding ESAs and PCPs.

Site type	Number of treatments	Area treated (ha)
Ditch	111	0.1993
Field Pool	85	1.5427
Pond	38	0.8473
Storm Water Management Facility	331	9.9524
Woodland Pool	179	3.8406
Total	**744**	**16.38**

Environmentally Significant Areas

Twelve sites were monitored as Environmentally Significant Areas (ESAs) in Middlesex-London from May 16, 2013 to September 26, 2013. In total 93 treatments were performed in the peripheral bodies of standing water ESAs, totaling 4.76 hectares of surface waters treated.

In order to perform treatments in ESAs each year the MLHU and CCMM must apply and receive a pesticide permit from the Ministry of the Environment, which allows for the application of mosquito larvicides to standing water located in ESAs in Middlesex County and the City of London. This year permits allowed for the application of VectoBac® 200G, a *Bacillus thuringiensis israelensis* product, and VectoLex® CG, a *Bacillus sphaericus* (*B.s*) product. (CCMM, 2013)

8.4 The Canadian Centre for Mosquito Management Inc. (CCMM) Activities

Catch Basin Treatments

Catch basins can provide one of the single most significant breeding sites for urban *Culex pipiens/restuans* mosquito populations. These species are the primary vectors for WNV in Ontario. Catch basins are designed to trap water, and often, this water remains stagnant for an extended period of time, allowing organic matter to collect, and mosquitoes to develop. Due to the design of catch basins, standing water creates a highly organic environment, ideal for *Culex* breeding, especially in large urban centres. It is imperative that the Health Unit identify these sites and that timely application of larvicide to municipal catch basins begins to ensure the success of a WNV management program. (CCMM, 2013; **Figure 8-3**) Early control measures ensure a significant reduction in *Culex pipiens/restuans* populations, which contributes to decreased WNV transmission.

In 2013, catch basin treatments began in early June and ended in August [**Appendix G**]. In three rounds, an average of 29,368 catch basins were treated using Altosid® Pellets, for a total of 88,103 roadside basins treated overall. The three treatment rounds were spaced out to achieve optimal control at the most critical times identified for mosquito development in artificial structures. The early stages of catch basin larviciding are considered imperative to reduce the emergence of early spring mosquitoes. Eliminating early spring mosquitoes slows the amplification of WNV in summer months. The final round of catch basin treatment is conducted to reduce the number of overwintering mosquitoes, which would emerge and could potentially transmit WNV the following season. (CCMM, 2013)

In total 64.5kg of Altosid® Pellets were used to treat a total of 88,103 roadside catch basins. An additional 371 catch basins were treated this year compared to 2012. Thirty (30) VectoLex® Pouches that contain *B.s* as the active ingredient were used to treat roadside catch basins that had outflows into Environmentally Significant Areas (ESAs). The ESA basins were located in Kilworth, Glencoe and Strathroy, and each was treated with VectoLex® during each of the three rounds of applications. In addition, 939 Altosid® XR Briquets were applied to non-roadside catch-basins, including: catch basins located in rear yards of residential properties [99]; catch basins located in municipal green-spaces [260]; and catch basins located on properties, including government buildings, social housing units, long-term care facilities, etc, [580]. The application of Altosid® Pellets and Briquets is an effective treatment strategy for the control of mosquitoes in the highly organic environment of catch basins. These formulations provide long-lasting residual activity, which is important in the control of *Culex* populations, since these mosquitoes have multiple, continuous and overlapping generations.

Catch basin larviciding is established on the basis of thorough pre-treatment larval inspections. In May of 2013, a minimum of 30 catch basins are sampled at various intervals in order to initiate the first round of catch basin control treatments. The first round of catch basin treatments was initiated on June 3, 2013 and was based on the compilation of pre-treatment surveillance findings. (CCMM, 2013)

Figure 8-3: CCMM staff performing a catch basin treatment.

Each season, quality control checks are performed in order to ensure the effectiveness of all larvicide treatments. Effectiveness is confirmed by sampling the standing water or catch basin site following treatment and measuring the number of mosquitoes that have or have not completed their life cycle at the specific treatment site. Overall Altosid® Pellets averaged 96.3% control during each of the three rounds of application to roadside catch basins. In non-roadside catch basins, control was 100% effective for up to 63 days post-treatment (CCMM, 2013).

8.5 Pollution Control Plants

The City of London has seven pollution control plants (PCPs) that are monitored by CCMM staff in partnership with City of London. Every 21 days CCMM and city staff visit the PCPs to control mosquito larvae using Altosid® Granules in off line waste water holding tanks. The first application was June 4, 2013, and the abatement program continued until August 6, 2013. A total of 20 applications were made to five municipal pollution control plants within the City of London. CCMM staff applied 7.28kg of Altosid® to 0.797 hectares of surface waters located in sewage lagoons. Each treatment was accompanied by both a pre- and post-treatment inspection to ensure the effectiveness of larvicide applications. For each treatment, the success of the control was monitored and on no occasion was re-treatment necessary. (CCMM, 2013)

8.6 Source Reduction

While the treatment of standing water with larvicide is an effective method to temporarily reduce larval mosquito populations, the MLHU also encourages permanent elimination through source reduction. Source reduction is the removal of standing water to eliminate suitable environments for mosquitoes to lay eggs; therefore emergence is prevented, larvicide treatments are no longer required. Source reduction has greater efficacy and results in permanent control The removal of standing water sites requires collaboration between the MLHU and local community partners. This season remediation efforts in Parkhill continued, to clear areas of standing water and encourage water flow. Continued collaboration with city and municipal partners is important to effectively identify areas of standing water and try to reduce artificial or man-made habitats that may allow standing water to collect and vector mosquito larvae to breed.

8.7 Adulticiding

Adulticiding is an additional tool that a health unit can use to reduce WNV illness to humans (OAHPP, 2013a). This year the MLHU did not utilize adulticiding as a component of the VBD control program, however, other important components of WNV management were employed, such as, mosquito and human surveillance, source reduction, larviciding and public education (OAHPP, 2013a). In the event that WNV-positive activity poses a significant risk to human health, and the control measures in place did not adequately prevent amplification of WNV, the Medical Officer of Health for Middlesex-London would determine if adulticiding would be a necessary course of action to prevent human infection. This decision would be based on the results of a local risk assessment, which would take into account: standing water surveillance data; the presence of WNV in humans, adult mosquitoes and birds; and the efficacy of control methods already in place. (OAHPP, 2013a)

8.8 Conclusions and Recommendations

The MLHU's vector mosquito control program strives to reduce the number of vector mosquitoes in Middlesex-London, in order to reduce human WNV infection. With extensive weekly surveillance of standing water, control treatments on vector species, three rounds of catch-basin larviciding, and source reduction on private property, the MLHU successfully reduced viral activity and the overall burden of illness to local populations. Not only was a decline in WNV-positive mosquitoes and birds observed, but also a decrease in WNV human infections.

To maintain effective control of vector mosquito populations, the following recommendations should be considered:

- Maintain the current catch basin treatment program to reduce the breeding of WNV vector species *Culex pipiens* and *Culex restuans*. The current catch basin treatment schedule ensures effective control of vector species at three optimal times for mosquito breeding. Maintenance of this current treatment schedule would ensure that vector species are managed to reduce WNV transmission to local populations. (CCMM, 2013)

- Maintain surface water surveillance and treatment. Weekly monitoring of standing water located on public property is essential to effectively reduce vector mosquito emergence. Effective monitoring of current sites, and new sites, is important to manage vector mosquito populations and reduce the overall burden of WNV infection to the public.

Chapter 9: Complaints, Comments and Concerns

9.1 Introduction

The Middlesex-London Health Unit (MLHU) continued to monitor, record and respond to complaints, comments and concerns (CCCs) received from the public in 2013. Initial intake of inquiries was handled by a VBD field technician and then triaged to seasonal Vector-Borne Disease (VBD) staff. When standing water related concerns are received, appropriate actions are taken to resolve and eliminate the area of concern as soon as possible. Concerns were received by phone, email, or in person, and documented in a protected complaints database. In some cases, the assistance of Public Health Inspectors (PHIs) and/or local community partners was required to assist the VBD Team in resolving standing water issues on public and/or private property.

9.2 Results

In 2013, the VBD Team received and responded to a total of 309 CCCs (including dead bird and tick reporting) [**Appendix H**]. This is a slight decrease from 364 received in 2012. For the past three years the number of CCCs has been in this range [**Figure 9-1**]. The MLHU encourages residents to call and report any standing water, West Nile Virus (WNV), dead bird or tick-related concerns, in addition to calling to inquire about personal protection methods and/or advice on how to prevent mosquito and tick bites.

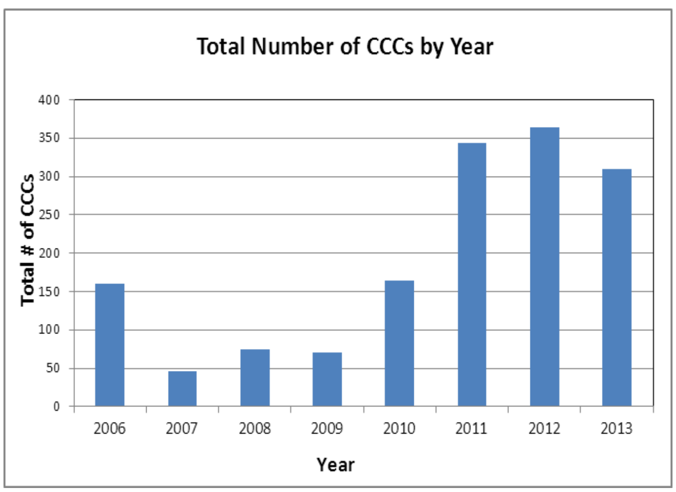


Figure 9-1: Comparison of total Complaints, Comments and Concerns (CCCs) by year.

9.3 Overview of Complaints

Dead bird reports were the highest recorded public concern, comprising 41% of all CCCs [**Figure 9-2**]. Dead bird reporting assists the MLHU with identifying WNV-positive birds. The early detection of WNV-positive birds allows the VBD Team to set up extra hotspot traps and prepare for the possibility of WNV-positive mosquitoes. Dead bird reporting assisted with the identification of 9 WNV-positive birds in 2013, allowing the MLHU to notify the public of WNV in the community, prior to the identification of WNV-positive mosquitoes. Over the past five seasons the MLHU has observed an increase in the number of dead bird and tick reports. Tick reporting has increased most significantly, from 42 tick reports in 2010, to 118 in 2013 [**Figure 9-2**]. From the 118 tick reports this year, 145 specimens were submitted, a 71% increase from 2012.

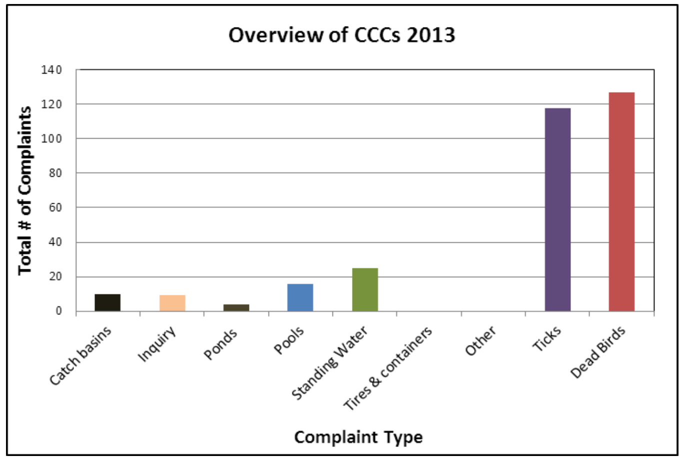


Figure 9-2: Frequency of Complaints, Comments and Concerns (CCCs), 2013.

Many swimming pool and standing water concerns were reported, together comprising over 10% of all CCCs in 2013. It is important to note that the number of standing water and pool concerns often fluctuates from year to year. Factors that affect each season's total reported standing water concerns are: precipitation levels, temperatures and the amount of local news coverage, including media releases issued by the MLHU. Media releases often generate increased awareness of the MLHU's WNV prevention efforts leading to more concerns from residents. The reporting of standing water concerns can also be attributed to the MLHU's public education efforts; which encourage residents to reduce standing water around the home in order to eliminate mosquito breeding. Additionally, the increased number of tick submissions observed can also be attributed to the MLHU's increased public education efforts to promote protection against Lyme disease (LD), encouraging the public to prevent tick bites and submit ticks to the Health Unit. In the past, the MLHU has also observed an increase in catch basin concerns. The number of catch basin concerns has increased since 2007. In an effort to reduce this type of concern, the MLHU created a new system to communicate with homeowners once their backyard catch basin had been treated. This system included notification left at the home following treatment, and also a follow up call to confirm receipt of the notification of treatment with the homeowner.

This new method of communication was discussed and implemented by the service provider who performed the work. The MLHU also noted an increase in calls regarding catch basins treatment requests from residents interested in participating in the backyard catch basin program. This trend can be attributed to public education and the distribution of promotional and educational materials throughout Middlesex-London to encourage participation in reducing mosquito populations on private property.

9.4 Discussion

Once again the MLHU observed an increase in dead bird and tick-related concerns. This increase was also observed in 2011 and 2012. In 2012, the MLHU observed a 30% increase in reports of dead birds and a 15% increase in the number of tick reports/submissions. A slight decrease was observed in dead bird reporting, however, a 27% increase was observed in tick reports and LD-related inquiries.

Swimming pool, standing water and other CCC calls were received most often following the release of media statements. Media releases not only report local viral activity, but encourage the public to identify areas of standing water around the home and neighbourhood. Dissemination of WNV messaging in the media, targeting the public to take action and prevent the spread of WNV, has been effective in encouraging residents to call the MLHU and report pool and standing water concerns more frequently. Although the goal is to reduce these instances, it is important to note that the public understands and can identify the structures that cause mosquito breeding, and are taking action to report these concerns when identified.

In the past a significant amount of time and effort has been dedicated to addressing ongoing concerns in the town of Parkhill in North Middlesex. Since 2011, the MLHU has worked closely with local municipal and Conservation Authority officials to monitor mosquito populations and continue to support remediation efforts. In addition to observing fewer adult mosquitoes in Parkhill in 2012 and 2013, the MLHU has also received fewer CCC calls from residents of Parkhill.

In 2013, there were no significant trends to report from Parkhill. In 2013, the MLHU continued to monitor local mosquito populations and support the Municipality of North Middlesex in its two aerial applications to its town property. In addition, meetings were attended to discuss ongoing efforts and actions to ensure mosquitoes do not reach the levels observed in 2011. North Middlesex and the Ausauble Bayfield Conservation Authority (ABCA) will continue with remedial efforts to ensure Cameron Gillies Drain continues to flow.

The MLHU will continue to work closely with community partners in North Middlesex to ensure that the standing water located on public property is monitored and controlled to effectively reduce the breeding of vector mosquito larvae in Parkhill. The MLHU will continue to address public concerns to ensure that residents of Parkhill are aware of how to reduce standing water, prevent mosquito breeding, protect against mosquito bites, and understand the work the MLHU does to monitor and reduce standing water throughout Middlesex-London.

9.5 Community Partnerships

The MLHU maintained strong community partnerships with a variety of local organizations. Working closely with community partners the MLHU was able to reduce reported standing water, address public concerns and participate in education to reduce mosquito and tick bites. The MLHU continued to support the Municipality of North Middlesex and the Ausauble Bayfield Conservation Authority in their remediation efforts at standing water sites located in Parkhill. In addition, a weekly larval mosquito monitoring and treatment schedule in Parkhill, including conducting adult mosquito trapping and viral testing was maintained. In 2013, the MLHU observed fewer adult *Ochlerotatus blacklegged* species, and continued to performed treatments to standing water, when vector mosquito larvae were identified.

By responding to complaints, comments and concerns, the VBD Team is able to educate residents at the time of a call or visit, and ultimately impact the burden of illness through discussion, demonstration, education and remediation efforts, which are all included in the process of addressing a public concern or inquiry.

The VBD Team will remain in contact with community partners in order to inform them of the work the MLHU performs in the region, in addition to supporting ongoing remediation efforts to clear waterways and reduce mosquito breeding on both town and conservation authority lands.

9.6 Conclusions and Recommendations

Since the MLHU continues to observe over 300 CCC reports each year, the continued response to public concerns and inquiries remains an important part of the VBD Program. If increased public reporting of VBD concerns continues, the VBD Team will require continued staff dedication to respond to and resolve CCC reports within two business days.

As a result of VBD CCC investigations, the VBD Team is able to educate and inform the public to prevent and protect against mosquito and tick bites, and ultimately reduce the transmission of vector-borne diseases within Middlesex-London.

After an analysis of 2013 complaints, comments and concerns, the following recommendations have been made:

- Continue to develop public education strategies, engage residents and encourage CCC reporting. Improve strategies to reduce overall burden of illness by maintaining consistent messaging, encouraging homeowners to eliminate mosquito breeding around the home and report VBD concerns to the MLHU for investigation.

- Continue to investigate concerns and inquiries regarding, not only standing water, but any locale that poses an immediate or potential threat to human health. This includes the investigation of areas identified as having a high number of ticks.

- Continue to cultivate strong relationships with local/municipal governments, city developers, and Public Health Inspectors and community partners. Community partnerships are effective in addressing and resolving public concerns, including permanent remediation efforts.

Chapter 10: Weather Trends and Special Projects

10.1 Introduction

The changing climate will play an important role in the increment of vector-borne disease impact on humans. Monitoring the weather can provide public health professionals with risk indicators to prepare for the impact that changing climates may have on vector-borne diseases. Vector-borne disease activity can be affected by fluctuations in temperature, humidity, rainfall, and sea level rise. Both mosquitoes and ticks are cold-blooded insects that are susceptible to environmental changes. The impact of vector-borne diseases is dependent on several environmental factors; increased temperature, humidity, drought, precipitation and rainfall, all of which may become present as a result of climate change. (Patz and Ueijo, 2008) The Vector-Borne Disease (VBD) Team reviews weather trends and Accumulated Degree Days (ADD) to better understand the environmental factors and temperatures that favour larval mosquito development, West Nile Virus transmission, and small mammal, bird and tick migration throughout southern Ontario.

10.2 Weather Trends in Middlesex-London

The MLHU monitors weather and its effect on tick populations. Some research has indicated the potential for blacklegged tick populations to move further north as temperatures increase. Currently, no established blacklegged tick populations have been identified in Middlesex-London, however, the MLHU is closely monitoring local populations in the event temperature change effects host migration and current endemic boundaries.

In 2013, the mean temperatures in Middlesex-London were cooler than normal for the entire season [**Figure 10-1**]. Typically, warmer temperatures accelerate mosquito development, as a warmer spring will speed up the development of larvae in small snowmelt pools, causing adults to emerge sooner thus creating a longer mosquito season and potentially increased viral activity. This was not the case in 2013, as temperatures were cooler for most of the summer, except for September, when the monthly mean temperature was 0.2 degrees Celsius warmer. A warmer fall will allow adult mosquitoes to live longer, especially *Culex* populations. (GDG, 2013) Rainfall also played a significant role in mosquito development, as the amount of rain received in 2013 was much greater compared to the normal, and the 2012 rainfall amounts. In 2013, a total of 687.9 millimetres (mm) of rainfall was recorded, and in 2012, 427.4mm was recorded. This year, rain fell steady from April to September, with August recording the least amount of precipitation. In 2013, eight precipitation events with greater than 20mm were recorded and two major spikes were observed in early spring and late fall. (GDG, 2013) [**Figure 10-2]**

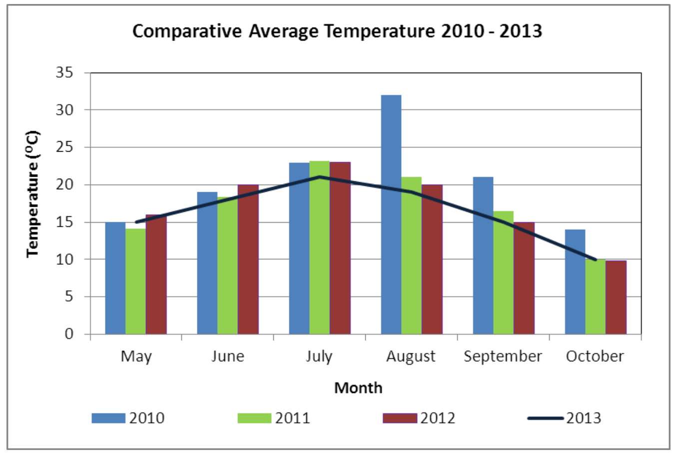


Figure 10-1: Comparison of average monthly temperature, 2010-2013.

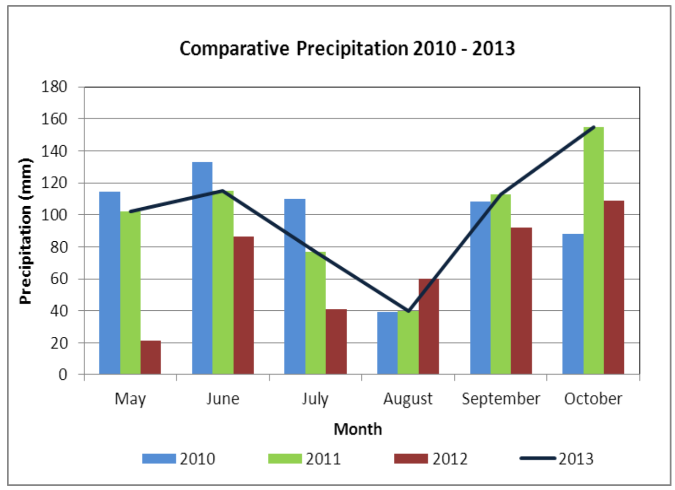


Figure 10-2: Comparison of precipitation, 2010-2013.

10.3 Weather Trends and West Nile Virus

Weather plays a role in the habitat preferences, generational longevity and virus-carrying capabilities of mosquitoes. Higher temperatures will increase the development of mosquitoes and the viral amplification in vector mosquitoes (OAHPP, 2013a). In the case of WNV, a certain amount of heat and time are required to incubate the virus within the mosquito, prior to causing a risk to humans. It has been found that with high temperatures, a greater number of vector mosquitoes will become infected at higher levels in a shorter amount of time (GDG, 2013). Additionally, seasons with a higher number of Accumulated Degree Days earlier in the year have been found to have a greater risk of WNV-positive mosquito and human cases. (OAHPP, 2013a)

The relationship between weather and mosquito-borne infections can be explained through the Accumulated Degree Day (ADD) model. The combination of time and temperature required for mosquito development is expressed in units called degree days. Degree days are the sum of daily differences between the mean temperature, and a determined temperature threshold. (GDG, 2013) In Ontario, a degree day is recorded for each time a temperature is measured above the threshold of 18.3 degrees Celsius. Positive mosquito traps can appear in as few as 30 consecutive ADD, and positive human cases usually appear once 180 to 200 consecutive ADD are observed. (OAHPP, 2013a)

In 2013, 279 degree days were recorded from May 1 to September 30. Overall, two blocks of consecutive ADD occurred this season. First, 152 consecutive ADD were recorded from June 21 to July 23. Second, 53 ADD were recorded from August 17 to September 2.Following the first set of consecutive degree days in 2013, the MLHU identified the first WNV-positive trap on July 17. Prior to this first positive trap, 119 consecutive degree days were recorded. The MLHU had anticipated WNV-positive traps later in the summer.

Since Public Health Ontario has noted that as few as 30 consecutive ADD are required to support WNV-positive mosquito traps, the observation of 53 ADD in early September helped to indicate the coming positive traps, which were confirmed on September 4 and September 11, 2013. The pattern of ADD observed this season foreshadowed when traps were more likely to be found WNV-positive.

Figure 10-3, compares the decrease in ADD observed in 2013, compared to the number of consecutive degree days identified in 2012. In 2013, four WNV-positive traps were identified and three WNV-positive human cases were reported. Compared to 2012 the MLHU observed fewer ADD this year, and as a result, decreased viral replication and WNV-positive mosquito traps. In 2012, a block of 235 consecutive degree days were observed from June 27 to August 16. These ADD accounted for increased viral activity in 2012, when 17 WNV-positive traps were identified, in addition to 7 WNV-positive human cases. [**Figure 10-3**]

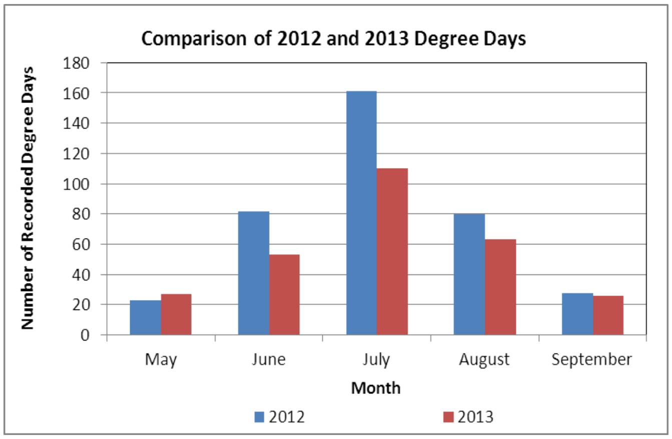


Figure 10-3: Comparison 2012 and 2013 degree days recorded in Middlesex-London.

10.4 Weather Trends and Eastern Equine Encephalitis

Eastern Equine Encephalitis (EEE) activity has been identified throughout North America in recent years. Since some outbreak years of EEE have been recorded in states bordering Ontario, the environmental conditions associated with this emerging vector-borne disease have been monitored following these outbreaks. Similar to WNV, EEE is transmitted through an enzootic cycle involving birds, mosquitoes, and humans are infected through bridge vectors. Bridge vectors are mosquitoes that feed on infected birds and then on humans. The MLHU monitors for EEE through mosquito surveillance, the same way WNV surveillance is conducted. It is important to note that there are different vectors for EEE and different weather conditions that favour the presence of EEE vector species. (MOHLTC, 2011a)

Climate conditions and rainfall have been found to play an important role in predicting EEE activity. In the U.S. EEE activity has been associated with higher rainfall. Significant correlations in Massachusetts, Michigan and New Jersey have been drawn between the occurrence of excess rainfall and flooding, and outbreaks of EEE-positive human and equine cases. Rainfall patterns play a particularly important role in EEE monitoring and surveillance, as precipitation helps to jump start and support the development of EEE vector species, *Culiseta melanura* and *Aedes vexans*. (MOHLTC, 2011a) High rainfall activity contributed to increased populations of spring larval mosquito species. In 2013, an increased number of spring species, including the EEE vector, *Aedes vexans* was observed in Middlesex-London. Rainfall in excess of 20mm has been shown to trigger population cycles of *Ae. vexans*. Based on analysis of rainfall in Middlesex-London in 2013, the amount of precipitation did have an impact on spring mosquito species, and in particular, increased populations of *Ae. vexans* that were captured this year. (GDG, 2013) The most Ae. *vexans* (nearly 25% of all identified *Ae. vexans* in 2013) were collected in Week 23 (June 2 to 8) this season. This spike was preceded by 96mm of precipitation recorded in Week 22. Week 22 provided nearly five times the amount of rainfall required to trigger populations of this species.

The MLHU also collected a high number of *Ae. vexans* in adult mosquito traps early in the season as well. Due to increased numbers of this species and higher than average precipitation in 2012, the MLHU monitored *Ae. vexans* closely, since this is a species that acts as a vector for both WNV and EEE. In total, 286 pools of *Ae. vexans* were tested for both WNV and EEE. This species comprised the largest group of mosquito specimens tested this year, yielding no positive results.

Although rainfall has been found to support *Cs. melanura* populations, once again in 2013 very low numbers of this species were identified. No *Cs.*

melanura larvae were identified and only two adult mosquitoes were identified and tested, both of which were negative for EEE. Despite the presence of EEE vector species in Middlesex-London, no EEE-positive mosquito traps, or veterinary or human cases ever recorded indicates that EEE is very low risk in Middlesex-London at this time.

10.5 Weather Trends and Larval Surveillance

In 2013, the first vector species was collected at the end of April, six weeks later than the first vector specimen collected in 2012. Cooler average temperatures contributed to the identification of mosquito larvae later in the season this year. Despite cooler temperatures delaying the first identification of mosquito larvae, increased precipitation affected the levels of spring floodwater species emerging this year. A significant increase in *Aedes vexans* was observed and can be attributed to increased precipitation, which supported the development of this species. Increased rainfall has been known to encourage egg hatches in grassy ditches and woodland pools.

In 2013, two major spikes in precipitation were observed; the first in early spring, and the second in the fall [**Figure 10-4**]. In the months of April and May 181mm more precipitation was recorded than in 2012. This allowed for a spike in the identification of spring species, such as *Ae. vexans* and *Oc. stimulans*. The most *Ae. vexans* identified were 551 specimens in week 23. Just one week prior, in week 22, over 100mm of precipitation was recorded, accounting for the spike in these populations. The only *Oc. stimulans* that were identified were collected from weeks 17 to 20, with the most (180 specimens) collected in week 20 following 35mm of precipitation in week 19.

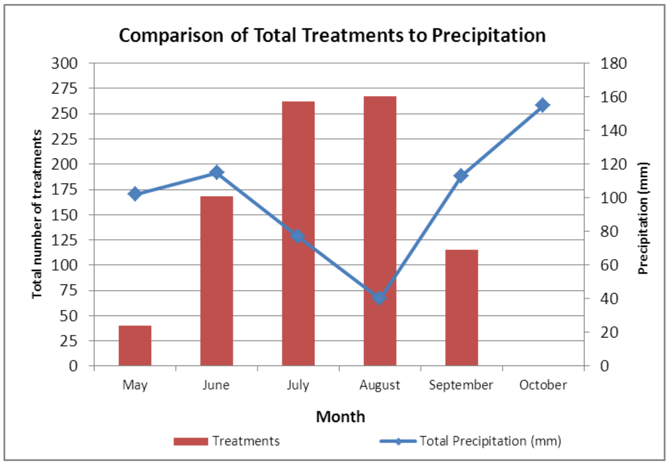


Figure 10-4: Comparison of larvicide treatments to precipitation recorded in Middlesex-London, 2013.

10.6 Weather Trends and Tick Surveillance

Currently in Ontario, there are several areas, concentrated in southern Ontario which have been identified as having established blacklegged tick populations. While these areas remain low in number at present, several climate change studies indicate the changing spatial pattern of tick populations.

Warming climates have been studied to understand and predict host migration patterns, which may affect the emergence of new tick populations or the expansion of established tick populations in Ontario. Literature indicates that blacklegged tick populations are becoming established where the climate is warmer, as more suitable environmental conditions support blacklegged tick populations. Specifically, climate warming may be a key facilitator in supporting the expansion of blacklegged ticks in Canada. (Ogden, Lindsay, Morshed, Sockett & Artsob, 2009) Temperatures in Middlesex-London have not increased significantly over the past four years. However, 2013 experienced cooler than average temperatures. Thus it is important to monitor local weather data and understand the implications of climate warming, as this may have an effect on local tick populations.

Literature has indicated that projected changes in climate will effect tick distribution and Lyme disease transmission in North America. In particular, climate models have been used to identify habitat suitability variations that may occur as a result of climate change in coming years. (Brownstein, Holford, & Fish, 2005) Warming climates may create previously uninhabitable territory for blacklegged ticks, increasing reproductive ability, biting rates and shortening the incubation period of LD, if the tick is infected (Patz, Epstein, Burke & Balbus, 1996)

Since blacklegged ticks have been identified as being highly dependent on climate patterns (Lindsay et al, 1995), research suggests that warming temperatures will alter the current distribution of this vector species (Brownstein et al., 2005). In Canada, climate change scenarios demonstrate a high probability of blacklegged tick establishment in other areas of Ontario by 2020 (Lindsay et al., 1995).

Climate trends indicate an increase in suitable areas for blacklegged ticks to move further northward in Canada, as warming temperatures will provide the necessary conditions to support populations of this species. (Brownstein et al., 2005) This movement northward into Canada may result either by systemic advancement from the U.S., by movement on mammal hosts, or by adventitious introduction from avian hosts (Klich Lankester, & Wu, 1996).

As climates continue to change from year to year, it is evident that changing temperatures, will begin to affect vector-borne diseases in future seasons. At this point, the MLHU has not observed significant increases in average temperatures to support the expansion of blacklegged tick populations into Middlesex-London.

While established blacklegged tick populations do exist within 100 kilometers of Middlesex-London, it is important that the MLHU continue to monitor local temperatures and tick populations in order to understand local conditions and habitat suitability. The MLHU also works closely with Public Health Ontario and Dr. Curtis Russell to understand weather factors in order to better assess and monitor the geographic distribution of blacklegged ticks in Ontario.

10.7 Weather Trends and Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) typically hold larger amounts of standing water due to bog-like conditions and tree cover, which provide shade and little sunlight to dry large woodland pools and ponds of standing water. Often, due to the ESA's ability to maintain large pools of standing water for a period of time, increased mosquito larval breeding is observed in these areas. Mosquito breeding leads to an increased number of treatments in these areas, if the larvae identified are vector mosquitoes. A 20% increase in mosquito larvae was observed in ESAs, however, the majority of the species identified was *Culex territans*, a non-vector species. Since 2010, Sifton Bog has become dryer each season; retaining very little standing water and therefore producing lower levels of mosquito larvae. This was true once again in 2013, as MLHU staff observed very little standing water at the bog, and only performed six treatments. Although increased precipitation was observed throughout Middlesex-London, Sifton Bog did not retain any of the rainfall long enough to allow for larval mosquito breeding.

10.8 Weather Trends and Adult Mosquito Surveillance

Cooler temperatures and fewer Accumulated Degree Days (ADD contributed to decreased viral activity in 2013. The ADD model assists in the preparation for WNV-positive activity each season. Accumulated Degree Days allowed the MLHU to anticipate WNV-positive activity, since a certain number of ADD act as a guideline for detection. Positive mosquito traps can appear in as few as 30 ADD, and a risk for positive human infection exists when 180 to 200 consecutive ADD are observed (OAHPP, 2013a). Overall 119 ADD were observed prior to the first WNV-positive mosquito trap detected on July 17. The MLHU anticipated WNV-positive traps later in the summer following a second block of ADD observed from August 17 to September 2. The remaining WNV-positive traps were detected on September 4 (1 trap) and September 11, 2013 (2 traps). [**Figure 10-5**]

The MLHU observed a 72% increase in the number of adult mosquitoes collected in 2013, compared to 2012. This increase can be attributed to increased precipitation, significant rain events. The first event was observed from June 16 to June 29, and the second significant rain event occurred from July 14 to July 27. Over these four weeks 53% of all adult mosquito specimens were collected, averaging approximately 8,500 adult mosquitoes collected each week. (GDG, 2013) Increased precipitation helped to hatch spring floodwater species, and increased the number of adult mosquitoes emerging following major rain events. Although more adult mosquitoes were collected this season, fewer ADD were observed, keeping viral activity lower. Since temperatures were cooler there were fewer positive mosquitoes, despite the increase in viable habitats and adult mosquito hosts. (GDG, 2013)

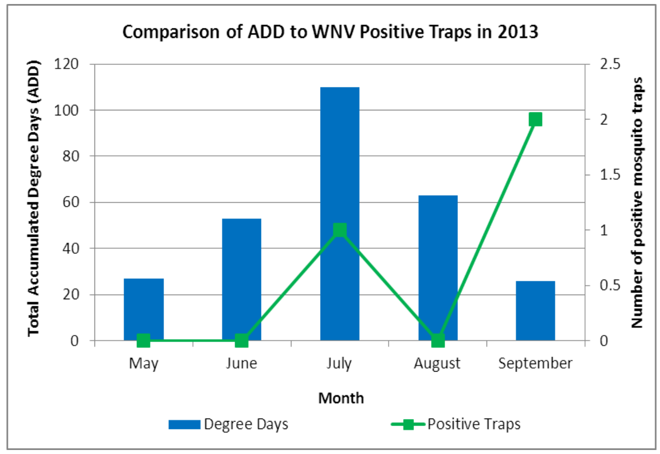


Figure 10-5: Comparison of Accumulated Degree Days (ADD) to WNV-positive traps detected in Middlesex-London, 2013.

10.9 Weather Trends and Seasonal Complaints

Typically precipitation plays a role in the nature of public concerns represented each year, as a winter with increased snowfall or a spring with heavy precipitation may promote spring floodwater mosquito species and/or pools of standing water in neighbouring yards and private properties. Despite a significant increase in precipitation in 2013, the number of standing water complaints did not coincide with the rain events observed in Middlesex-London. Last year the first concern was reported to the MLHU on March 2, 2012. The first concern of the year was reported on April 26, 2013.

This year tick submissions increased once again. A mild winter and warmer temperatures in the fall extended the typical time frame that ticks are submitted in, beginning earlier in the season and lasting later into the fall. The first tick submission was April 30, 2013. Tick submissions typically begin once warm spring temperatures arrive following snowmelt in late March or early April, however, due to this season's mild winter, ticks were present in grassy fields and wooded areas earlier than usual. Ticks were steadily submitted to the Health Unit throughout the spring, summer and fall, with the last tick submission on November 8, 2013.

10.10 Weather Trends and Mosquito Control

There are several aspects of weather which may affect the MLHU's control program. First, if a season brings warmer temperatures, it can accelerate the development of mosquito larvae, increasing vector mosquito populations, and requiring more larvicide treatments. A season with cooler temperatures can prolong the maturation of certain larval mosquito species, therefore necessitating fewer larvicide treatments. Precipitation and significant rain events at certain points in a season can also affect the development of floodwater mosquito species, hatching several generations of floodwater or spring species when heavy rain events occur.

Each spring, mosquitoes require a certain amount of precipitation to jump start their life cycle and/or maintain their populations throughout summer months. Precipitation assists mosquito production by providing floodwaters to hatch eggs laid on dry banks, or maintain development in stagnant water where eggs may be laid in summer months. Cooler than average temperatures and increased precipitation played a role in 2013's decreased viral activity and spike in populations of spring floodwater species, including a significant increase in *Ae. vexans* populations. Large rain events in June hatched large populations of spring floodwater species and *Ae. vexans*, prompting the need for treatment to reduce early vector mosquito populations. Often, rainfall in excess of 20mm will trigger population cycles of *Ae. vexans* (GDG, 2013). In May and June, an excess of 105mm of precipitation was recorded, contributing to a spike in vector populations. The first treatment occurred in week 20, when large numbers of *Oc. stimulans* and *Cx. restuans* were identified; both vector species. Just prior to week 20, 34mm of precipitation was recorded in Middlesex-London.

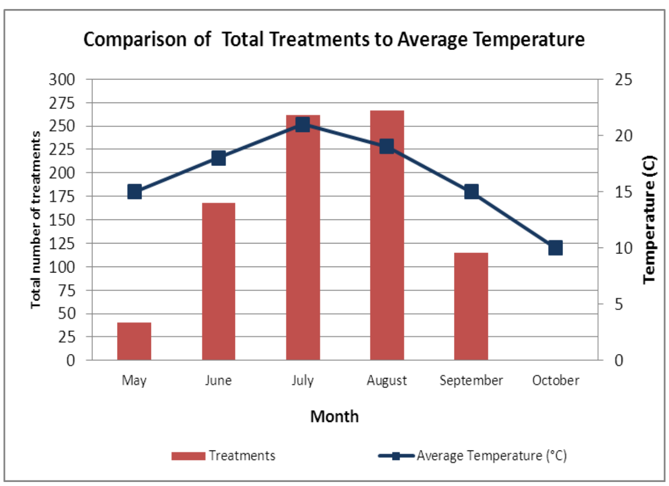


Figure 10-6: Total larvicide treatments compared to average temperature, 2013.

Although heavy spring rains contributed to the development of spring vector species, prompting the first treatment, cooler than average temperatures in 2013 kept the total number of treatments lower than previous years. In 2013, 857 treatments were performed [**Figure 10-6**]. Cooler temperatures prolonged development stages of mosquito larvae. In cooler weather, mosquito larvae do not move through life cycles as quickly, therefore requiring fewer treatments by the MLHU. [**Figure 10-6**]

10.11 Conclusions and Recommendations

Mosquito breeding habitats can be supported by certain weather conditions; precipitation, flooding, humidity and drought. Each year the variability of weather conditions can facilitate certain trends in larval mosquito development and contribute to the amplification of vector-borne diseases in Middlesex-London. This year cooler temperatures and steady rainfall contributed to fewer treatments and a decrease in viral activity.

After analysis of 2013 weather trends the following recommendations have been made:

- Understand changing climates and the implications it may have on the spread of vector-borne diseases.
- Monitor the weather conditions that favour mosquito development and viral production.
- Continue to record and analyze temperatures, Accumulated Degree Days, precipitation and drought conditions to better prepare for the impact that temperatures changes may have on local mosquito and tick populations.

Chapter 11: Public Education

11.1 Introduction

The Vector-Borne Disease (VBD) Team continued public education efforts focused on personal protection against tick and mosquito bites, including how to identify the symptoms of Lyme disease (LD) and how to submit a tick to the Health Unit. Educational materials were distributed to stakeholders at community events and residents were encouraged to 'Reduce and Repel' insect bites. Participation at local community events allowed residents to engage with VBD staff by asking questions, and learning about proper protection methods, tick removal strategies and Health Unit locations that accept ticks for submission.

11.2 Educational Resources

Educational messages in 2013 continued to encourage residents to 'Reduce and Repel' mosquito and tick bites. Brochures were distributed to residents, which contained basic information about West Nile Virus (WNV), preventing mosquito breeding and protecting against mosquito bites. The Health Unit's Lyme disease brochure was distributed to increase awareness about LD and to educate the public on how to protect against tick bites, how to identify the symptoms of LD and how to submit a tick. The VBD Team also liaised with Public Health Nurses on the Chronic Disease Team to contribute an informative article to the Middlesex County Trails Guide. This guide was created in partnership with several Health Unit service areas, Middlesex-County and its community partners. The VBD Team wrote an article on Lyme disease and West Nile Virus, including the signs and symptoms of the disease and tips on how to prevent insect bites. No print advertisements were purchased by the VBD Program this year. In the past advertisements were featured in the City of London Garbage Collection Calendar and on public transportation.

11.3 Media

In 2013, the VBD Team participated in several media interviews regarding WNV and LD. Many of these interview requests were made after the Health Unit issued media releases confirming positive WNV activity in Middlesex-London. Following the confirmation of WNV-positive birds, mosquitoes and human cases, residents, especially in areas where WNV was identified, were encouraged to protect against mosquito bites, reduce areas of mosquito breeding around the home and avoid the outdoors when mosquito biting is most active, at dawn and dusk. Local media coverage was a useful tool for the VBD Team to spread its personal protection messages to a large audience, especially following the confirmation of positive activity.

11.4 Web-Based Education and Social Media

In 2013 the Middlesex-London Health Unit's (MLHU) website underwent redevelopment, in order to provide the public with updated, accurate public health information in a clear, concise manner. All Vector-Borne Disease Program web pages were redeveloped, and now feature more information on WNV, LD and Eastern Equine Encephalitis (EEE), signs, symptoms, prevention methods and how to report concerns or submissions to the VBD Team. The public can now access relevant health information on mosquito monitoring, treatment activities, LD prevention, and tick submission within Middlesex-London. The public can also submit general questions, report standing water concerns and/or dead bird submission information through an online reporting featured on the website.

The Health Unit's communication department assisted the VBD Team by promoting 'Reduce and Repel' messages through the Health Unit's Twitter account. VBD-related tweets were used to quickly update residents on WNV-positive activity in a given area. Twitter also featured general information on protecting against mosquito bites, and sharing important information from media releases about WNV confirmed activity in Middlesex-London communities [**Figure 11-1**].

Figure 11-1: Tweets featuring VBD messages on the MLHU's Twitter account.

11.5 Community Events

In 2013, the VBD Team participated in several local events to enhance public education and network with community partners. The VBD Team presented information to a variety of audiences this season.

Information sessions conducted by the VBD Team included:

- Presentations to the Early Years Team within Family Health Services, sharing information to provide nurses with VBD protection information.
- Presentations to new moms at several MLHU 'Well Baby/Child Clinics' held in Dorchester, Strathroy, Glencoe, Parkhill and Mount Brydges.
- Presentation to Thames Valley District School Board Environmental (TVDSB) Educators.
- Provision of information at a West Nile Virus fair hosted by students at Jack Chambers elementary school in London.
- Presentations to elementary school students at Evelyn Harrison Public School in London, sharing information on the mosquito life cycle, and how to identify and remove standing water.

Information sessions included tips on protecting infants and young children from WNV and LD, including alternative insect repellent options, how to check for and remove ticks, and how to reduce mosquito breeding around the home. Information and resources shared with students focused on reducing mosquitoes and protecting against bites. School presentations were well received by both students and teachers, as many participants acquired brochures and had questions about protection information.

Throughout the summer months, the VBD Team donated educational materials to local community groups and participated in several events which included:

- Strathroy Turkeyfest [**Figure 11-2**]
- Fanshawe Dragon Boat Festival
- Glencoe Fair
- Children's Water Festival (materials only)
- Children's Make a Wish Foundation Golf Tournament (materials only)

At these events, the public was given an opportunity to inquire about WNV, LD, and EEE. Mosquitoes were on display to show the public what they look like and encourage residents to check around the home. All promotional materials featured the 'Reduce and Repel' logo as the VBD Team encouraged the community to reduce standing water and repel tick and mosquito bites. In addition, public education events allowed the VBD Team to have meaningful dialogue and engage with residents in order to: answer questions, confirm proper protection methods, explain proper removal of ticks, and advise on the locations to submit any ticks removed from humans. The VBD Team has placed more emphasis on educating the public about LD. Educational messages that the Lyme disease campaign focused on were:

- Encouraging the public to be aware of Lyme disease and use protection when travelling to endemic areas.
- Wear insect repellent to avoid tick bites.
- Check for ticks after outdoor exposure in grassy or wooded areas.
- Learn how to remove ticks.
- Know how to properly identify signs and symptoms of LD.
- Know how to submit ticks to the Health Unit for identification and testing.

Figure 11-2: Educational displays at Strathroy Turkeyfest.

11.6 Research and Evaluation

In 2013, the VBD Team worked to implement effective communication messages that supported increased LD prevention knowledge. This initiative was based on the results from the 2012 Rapid Risk Factor Surveillance System (RRFSS) survey. The Lyme disease survey responses provided the MLHU with baseline data about levels of awareness, perceived risk, risk behaviours, and use of protective measures related to LD. This information was valuable to the MLHU when planning public education initiatives for 2013, and provided a baseline for the measurement of changes in these behaviours over time.

Survey responses were analyzed following the final block of questions and results. Initial results indicated the following findings:

- Educational initiatives should be targeted toward males, aged 20-44 years of age and parents; these population groups were less likely to have heard about Lyme disease and more likely to travel in grassy or wooded areas.
- There is a need to promote awareness of personal protection methods to prevent tick bites.
- There is a need to increase messages and awareness for tick submission and testing if a tick is found attached to the skin.
- More time should be spent creating and sharing LD communication messages to support increased protective behaviour, knowledge of LD signs and symptoms, and the importance of submitting a tick for testing.

The results of RRFSS are used to make informed modifications to the delivery of the Lyme disease program and to better reach target populations implicated in the data. RRFSS allowed the MLHU to understand the knowledge base and typical protective behaviours of local residents. This basic understanding of the public's LD-awareness levels and protection behaviours better allowed the MLHU to plan, educate, and evaluate methods to prevent the transmission of LD in Middlesex-London. By focusing on LD communication and education campaigns, the MLHU can work to raise awareness and improve protective practices, ultimately reducing the burden of illness to residents. The findings of the MLHU's RRFSS survey also coincide with similar findings in evaluating the effectiveness of LD communication and education interventions. Literature indicates that public health education and communication campaigns have not effectively reached population groups yet to: encourage proper protective behaviours, prevent tick bites and increase overall awareness of LD.

Studies on personal protective behaviours indicate that even when instructed to protect against ticks and check for ticks after being outdoors in endemic regions, people are still not likely to protect themselves, check for ticks or know the signs and symptoms of LD to look for. In fact, it has been found that although people may be aware of LD, possessing some knowledge, it did not improve their likelihood to protect against tick bites when in an outdoor, wooded or grassy area.

An important aspect of LD prevention is to observe increased uptake of protective behaviours, therefore, it is important to monitor and improve these behaviours if survey outcomes do not indicate that the common practice of protective behaviours are followed. (Mobray, Amlot & Rubin, 2012) Considering the outcomes of the MLHU's RRFSS survey, and additional studies that have concluded the uptake of personal protective behaviors still remains low, it is important that the MLHU continue to focus on LD education and communication strategies in future seasons. With enough knowledge and awareness, personal protective behaviours should follow. However, the knowledge base and awareness of LD must first be present in order to influence further behaviours to protect against tick bites and LD transmission.

11.7 Conclusions and Recommendations

The VBD Program will continue to work with the public to ensure that vector-borne disease messages are understood and effectively reach all populations in Middlesex-London.

Based on the analysis of public education initiatives in 2013, the following recommendations have been made:

- Continue to advance the LD education campaign, ensuring that residents are aware of tick submission and identification, and practice personal protection against bites.
- Continue to participate in community events. This is one of the most cost-effective ways to reach a large audience, directly answer questions, and dispel common protection myths.
- Make use of social media, such as Twitter, to promote protection methods and report VBD information to the public. Social media is a cost-effective method to engage the public and disseminate educational messages to large audiences.
- Continue to share information and resources at events. By keeping colleagues and community partners informed and educated, the VBD Team can extend the scope of protection and prevention knowledge, improving the overall health and well-being of the Middlesex-London community.

Chapter 12: Conclusions and Program Analysis

12.1 Final Conclusions

Over the past 12 years of vector mosquito surveillance, the MLHU has developed comprehensive surveillance, control and public education strategies to prevent the transmission of West Nile Virus (WNV), Eastern Equine Encephalitis (EEE) and Lyme disease (LD). At the conclusion of season the MLHU analyzes results and trends to make informed program plans for the following season.

The following conclusions have been drawn for the 2013 season:

West Nile Virus:

- WNV activity was once again identified in Middlesex-London; with three human cases, four positive mosquito traps, and nine positive birds.
- Overall in 2013 there was a significant decline in viral activity both in Middlesex-London and across Ontario. In 2012 a high number of WNV-positive human cases and adult mosquito traps were identified in both Middlesex-London and Ontario.

The MLHU will continue to monitor for the presence of WNV in vector mosquito populations to reduce transmission of the virus to humans. Local risk assessments, adult mosquito trapping and viral testing, dead bird testing, control measures, and public education are important components of the WNV program that will help to reduce disease transmission.

Lyme disease:

- 145 ticks were submitted to the Strathroy laboratory for identification.
- Eight ticks were identified as blacklegged ticks, two of which were acquired within Middlesex-London.
- Four confirmed human cases and one probable human case of LD were reported to the MLHU, all cases were travel related.
- Tick dragging was conducted throughout Middlesex-London; no ticks were identified.

The MLHU observed an increase in tick submissions. Although the incidence of LD and blacklegged ticks within Middlesex-London remains low, the MLHU is starting to see increased submissions. This trend could be occurring because of Middlesex-London's close proximity to regions where there are established blacklegged tick populations. Residents who travel to these areas for camping and leisure activities may be acquiring ticks during their visit and submitting them to the MLHU upon their return.

The MLHU must maintain a LD surveillance and education program in order to provide residents with protection information, tick removal strategies and information on how to identify the signs and symptoms of LD. Education materials will continue to enhance public education strategies to bring awareness to Lyme disease prevention methods for those who travel to endemic regions. Passive tick surveillance and dragging will continue in order to closely monitor local tick populations.

Eastern Equine Encephalitis:

- 237 EEE viral tests were performed on EEE vector species collected in adult traps. All specimens tested negative.

Although the incidence of EEE remains low in Middlesex-London, the MLHU will continue to follow the Public Health Ontario guidelines to test species for EEE.

Dead Bird Surveillance:

- 128 dead birds were reported to the MLHU, 20 were suitable for testing.
- Nine birds tested positive for WNV in the Strathroy laboratory.

The MLHU will continue to accept dead bird submissions and perform WNV testing. The identification of WNV-positive dead birds provides important information to the MLHU, and an early indicator that WNV may be present in a certain area of the community. Information collected from dead bird reporting and testing allows the MLHU to increase surveillance in areas identified by WNV-positive birds, educate the public, and issue media releases encouraging residents to protect against mosquito bites.

Larval Mosquito Surveillance:

- 71% of all larval identified were vector species, 29% were non-vectors.
- *Culex restuans* and *Culex pipiens* were the most abundant vector species identified.
- A spike in spring floodwater species was observed, as heavy spring and summer rain events supported increased populations of *Aedes vexans*.

Surveillance of mosquito larvae is an important aspect of the MLHU's VBD Program. The MLHU continues to identify vector mosquito larvae each season, requiring larvicide treatments to reduce the amplification of vector-borne diseases in Middlesex-London.

The MLHU will maintain its current larval surveillance schedule to reduce WNV and EEE in local mosquito populations.

Storm Water Management Facilities (SWMFs):

- 1,630 visits were made to SWMFs, comprising 34% of all standing water monitoring visits.
- SWMFs were the most frequently treated site type in Middlesex-London.

The MLHU will continue to monitor SWMFs, as this site type often breeds the most vector mosquito larvae each season.

It is also important to closely monitor SWMFs as they naturalize (age), allowing more vegetation and organic content to develop around the periphery, and create a more favourable habitat for larval mosquito breeding.

Environmentally Sensitive Areas (ESAs):

- 3,656 mosquito larvae were identified from samples collected within ESAs, a 20% increase from 2012.
- The most abundant species identified in ESAs was the non-vector species, *Culex territans. Culex territans* comprised 48% of all larvae identified in ESAs.
- Despite increased rainfall, Sifton Bog did not retain a large amount of standing water, producing fewer mosquito larvae and, as a result, limited treatments.

The MLHU will maintain surveillance and treatment of vector mosquito species within ESAs. Since ESAs possess ideal conditions to support mosquito larval development, it is imperative that MLHU staff thoroughly monitor these areas.

Adult Mosquito Surveillance:

- 65,409 adult mosquitoes were collected in both terrestrial and canopy traps.
- 85% of all adult mosquitoes identified were vector species, capable of transmitting WNV and/or EEE.
- The MLHU observed an increase in the number of mosquitoes collected, however, a decrease in viral activity was noted.
- Four WNV-positive mosquito traps were confirmed this year. Three were WNV-positive terrestrial traps, and one was a WNV-positive canopy trap.

Overall viral activity remained low in Middlesex-London, despite a spike in adult mosquito populations. Since some WNV-positive activity was identified in both canopy and terrestrial traps, the MLHU should continue adult mosquito surveillance to identify and report on population dynamics and WNV-positive activity in Middlesex-London.

Human Surveillance:

- There were two confirmed human cases and one probable human case of WNV reported. All cases had possible exposure in Middlesex-London.
- There were four confirmed human cases and one probable human case of LD reported. All cases were travel related.

Human surveillance of West Nile Virus and Lyme disease is important to understand the clinical course of infection that these vector-borne diseases can take. With a combination of human, mosquito, tick, and bird surveillance, the MLHU has developed a comprehensive program to monitor for the presence of WNV, LD and EEE in the community

Although the risk of acquiring Lyme disease is currently low in Middlesex-London, it is possible to acquire LD from an infected tick in Ontario, and abroad. The number of blacklegged ticks observed in Middlesex-London and surrounding regions has increased each year, therefore, residents need to take particular caution to protect against tick bites and check for ticks when travelling to endemic regions or when spending time in grassy fields or wooded areas.

The MLHU will continue to monitor emerging tick populations in Middlesex-London and from nearby regions. It is important to continue to check local tick populations through tick dragging, and educate residents on how to protect against tick and mosquito bites, know the signs and symptoms of WNV and LD, and how to report or submit a tick to the Health Unit for identification. All of these efforts improve the MLHU's ability to assess local risk factors, and keep the community informed on the presence of vector-borne diseases each season.

Mosquito Control:

- 857 treatments were performed at 248 sites monitored by the MLHU and its service provider.
- 23 of 248 sites were frequently treated 10 or more times.
- 44% of all treatments were conducted at Storm Water Management Facilities (SWMFs), covering a treatment area of approximately 10 hectares.

- 20 applications of Altosid® Granules were made to standing water located in the City of London's pollution control plants.

The MLHU will continue to monitor larval mosquito populations in standing water located throughout Middlesex-London and perform larvicide treatments when vector mosquito larvae are identified. The MLHU will continue to follow Public Health Ontario's guidelines to reduce vector mosquito populations in larval form in order to mitigate the risk of WNV infection to local residents.

The MLHU will continue to encourage source reduction and site remediation as an alternative to larvicide a treatment. The MLHU observed ongoing remediation efforts at sites located in Parkhill, and several SWMFs throughout the City of London. In the past, the MLHU has observed a significant decrease in larval mosquito breeding following the clearing of peripheral vegetation in site remediation efforts.

Catch Basin Treatment:

- A total of 88,103 roadside catch basins were treated.

- 939 Altosid® XR Briquets were applied to non-roadside catch-basins, which included; catch basins located in backyards of residential homes [99]; catch basins located in municipal green-spaces [260]; and catch basins located on properties including government buildings, social housing units, and long-term care facilities, etc. [580].

Catch basin treatment is imperative in order to effectively manage local vector mosquito populations. Since the most competent WNV vectors *Culex pipiens* and *Culex restuans* prefer to breed in artificial structures, such as catch basins, it is important to continue calculated treatment plans for these structures in order to reduce the emergence of these species. Treatment of catch basins provides successful reduction of vector mosquito larvae, which have the potential to emerge and amplify WNV in the community.

Complaints, Comments and Concerns (CCCs):

- The MLHU received and responded to a total of 309 VBD-related concerns.

- Dead bird reporting was the most frequent concern, representing 41%.

- A 27% increase was observed in the number of tick reports received.

The MLHU will continue to support and promote public participation in the VBD program to prevent insect bites, mosquito breeding and the spread of vector-borne diseases.

The MLHU must continue to participate in education events to share protection and prevention messages with the public. Lyme disease education remains important as an increasing number of ticks, including blacklegged, are submitted from Middlesex-London residents each year.

2013 Weather Trends:

- Middlesex-London experienced cooler temperatures and increased rainfall allowing standing water to collect, creating a spike in *Aedes vexans* populations.

- 152 consecutive degree days were observed prior to the first WNV-positive mosquito trap confirmed on July 17, 2013.

- The MLHU received an increased number of tick submissions later in the year due to warmer temperatures in September and October.

It is important to monitor local weather and Accumulated Degree Days (ADD) in order to understand and prepare for WNV-positive activity in the community. When ADD are observed, the MLHU can heighten surveillance and treatment activities in areas of concern, and prepare the public for the possibility of positive viral activity by heightening public education messages and encouraging protection methods.

The MLHU will continue to monitor weather patterns as warming climates have been found to affect tick populations and host migration. If warming climate temperatures were to be observed for several years, tick populations may increase further in Ontario, and/or migration patterns of host species may change, establishing blacklegged tick populations in new regions of the province.

With careful attention to the weather, changing climates, and a commitment to tick dragging, the MLHU continues to closely monitor local tick populations to understand and report on the presence of blacklegged ticks in Middlesex-London.

Public Education:

- Lyme disease materials and WNV brochures to 'Reduce and Repel' mosquitoes were distributed at community events. Key messages focused on protection when travelling to tick endemic regions, wearing insect repellent to avoid bites, checking for ticks after outdoor exposure and knowing the Health Unit locations to submit a tick for identification.

- The VBD Team worked with other service areas to provide information to colleagues at the Health Unit.

- Lyme disease education remained a priority, as tick submissions continued to increase.
- The VBD Team continued to support North Middlesex in ongoing remediation efforts in Parkhill.
- The MLHU continued to engage residents through social media. Twitter allowed the VBD Team to share messages and update residents when WNV-positive birds and mosquitoes were identified.

The MLHU must continue to evaluate and enhance public education strategies to make informed decisions regarding public health strategies, vector-borne disease prevention and how to increase public engagement.

12.2 Program Analysis

Each season the VBD Team strives to continually improve its quality of service and decrease the burden of illness to residents of Middlesex-London.

- The MLHU works to continually improve the accuracy of adult mosquito collection and viral testing. Since the shape and population density of Middlesex-London has grown in recent years, the MLHU will closely review the locations of adult traps in 2014 and make adjustments as necessary. New standing water sites will also be added to the surveillance schedule as residents move closer to ponds, wooded areas and SWMFs on the outskirts of municipal and city limits, through the creation of new developments and the expansion of our communities.
- The VBD Program should continue to focus on Lyme disease education, as demonstrated by RRFSS results and increasing tick submissions each season. A focus on personal protection when travelling to endemic regions is also an important aspect of future educational messaging.
- The VBD Team should continue a multi-faceted public education campaign. In 2014, the MLHU would like to reach more residents to educate, engage and share information to decrease the overall burden of illness in Middlesex-London.

12.3 Final Comment

Although populations of blacklegged ticks have not become established in Middlesex-London, it is important that the MLHU continue local tick surveillance, dragging and risk assessments. Tick submissions have increased each year, requiring closer surveillance in future seasons. Program plans for the 2014 will include enhancing LD knowledge in Middlesex-London.

Each year the VBD Program conducts local risk assessments to reduce the exposure of insect bites and vector-borne diseases to residents of Middlesex-London. A comprehensive surveillance, control and public education-focused program will continue to reduce the burden of vector-borne disease-related illness to residents of Middlesex-London, while spending time outdoors, within the community and abroad.

Reference List

Artsob, Dr. H. (2010). Lyme disease: a tick transmitted bacterial disease of growing importance in Canada. *National Collaborating Centre for Infectious Diseases,* Purple Paper (17), 1-5.

Brothers, D.R. (2005). New distributional records of *Coquillettidia perturbans* (Walker) (Diptera, Culicidae) in Idaho. *Journal of Vector Ecology*, 30(1).163-4.

Brownstein, J., Holford, T., & Fish, D. (2005). Effect of climate change on Lyme disease risk in north America. *Eco Health Journal Consortium*, 2(1), 38-46.

Canadian Centre for Mosquito Management Inc. (CCMM). (2013). Middlesex-London Health Unit 2013 final report.

Canadian Cooperative Wildlife Health Centre (CCWHC). (2013). *West Nile Virus*. Retrieved from http://www.ccwhc.ca/west_nile_virus.php

Centers for Disease Control and Prevention. (2005). *Arboviral Encephalitides*. Retrieved from http://www.cdc.gov/ncidod/dvbid/arbor/arbdet.htm

Centers for Disease Control and Prevention. (2010). *Eastern Equine Encephalitis virus (EEEV*). Retrieved from http://www.cdc.gov/EasternEquineEncephalitis/index.html

Centers for Disease Control and Prevention. (2011). Epidemiology & geographic distribution. In *Eastern Equine Encephalitis*. Retrieved from http://www.cdc.gov/easternequineencephalitis/tech/epi.html

Centers for Disease Control and Prevention. (2013). *West Nile Virus*. Retrieved from http://www.cdc.gov/westnile/transmission/

City of London. (2012, October). *Storm water management facilities*. Retrieved from http://www.london.ca/residents/Sewers-Flooding/stormwater/Pages/Stormwater-Management-Facilities.aspx

City of London. (2013, November). *Wetlands in the city*. Retrieved from http://www.london.ca/residents/Environment/Natural-Environments/Pages/Wetlands.aspx

Darsie Jr., R.F., & Ward R.A. (Eds.). (2005). *Identification and geographical distribution of the mosquitoes of North America, north of Mexico*. Gainesville, FL: The University Press of Florida.

Environment Canada. (2013). Daily data report. In *National climate data and information archive*. Retrieved from www.climate.weatheroffice.gc.ca

Feemster R.F., Wheeler, R.E., & Daniels, J.B. (1958). Field and laboratory studies on equine encephalitis. *New England Journal of Medicine*, 259(3), 107-13.

Gathany, J. (Photographer), & Centers for Disease Control and Prevention (Provider). (2007). *Public Health Image Library (PHIL)*. [Photograph] Retrieved from http://phil.cdc.gov/phil/home.asp

Githeko, A.K., Lindsay, S.W., Confalonieri, U.E., & Patz, J.A. (2000). Climate change and vector-borne diseases: a regional analysis. In *Bulletin of the World Health Organization*, 78(9), 1136 -1147. Retrieved from http://www.who.int/bulletin/archives/78(9)1136.pdf?ua=1

Groupe de Gestion Environnement (GDG). (2013). Report on mosquito surveillance and detection of West Nile Virus and Eastern Equine Encephalitis virus for the Middlesex-London Health Unit.

Health Canada. (2011). Bti - *Bacillus thuringiensis* subspecies *israelensis*. In *Consumer product safety*. Retrieved from http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/bti/index-eng.php

Health Canada. (2010). Use of methoprene in mosquito control programs. In *Consumer product safety*. Retrieved from http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_factfiche/methoprene/index-eng.php

Klich, M., Lankester M.W., & Wu, K.W. (1996). Spring migratory birds extend the northern occurrence of blacklegged ticks. *Journal of Medical Entomology*, 33, 581-585.

Letson G.W., Bailey, R.E., & Pearson, J. (1993). Eastern Equine Encephalitis (EEE): A description of the 1989 outbreak, recent epidemiologic trends, and the association of rainfall with EEE occurrences. *American Journal of Tropical Medicine and Hygiene*, 49(6), 677-85.

Lindgren, E., Talleklint, L., & Polfeldt, T. (2000). Impact of climatic change on the northern latitude limit and populations density of disease transmitting European tick *Ixodes ricinus*. *Environmental Health Perspectives*, 108, 119-123.

Lindsay, L.R., Barker, I.L., Surgeoner, G.A., McEwan, S.A., Gillespie, T.J., & Robinson, J.T. (1995). Survival and development of *Ixodes scapularis* under various climatic conditions in Ontario, Canada. *Journal of Medical Entomology,* 32,143-152.

Lindsay, R., Artsob, H., & Barker, I. (1998). Distribution of *Ixodes pacificus* and *Ixodes scapularis* re concurrent babeseisus and Lyme disease. *Canada Communicable Disease Report*, 24,121-122.

Martens, W.J., Miessen, L.W., Rotmans, J., Jetten, T.H., & McMichael, A.J. (1995). Potential impact of global climate change on malaria risk. *Environmental Health Perspectives*, 103, 458-464.

Mobray, F., Amlot, R., & Rubin, G.J. (2012). Ticking all boxes? A systemic review of education and communication interventions to prevent tick-borne disease. *Vector-Borne and Zoonotic Diseases*, 12(9), 817-825.

Ministry of Health and Long Term Care (MOHLTC). (2009a). Appendix A: Disease specific chapters, West Nile Virus. In *Infectious diseases protocol*. Retrieved from http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/wnv_chapter.pdf

Ministry of Health and Long Term Care (MOHLTC). (2009b). Appendix A: Disease specific chapters, Lyme disease. In *Infectious diseases protocol*. Retrieved from http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/lyme_disease_chapter.pdf

Ministry of Health and Long Term Care (MOHLTC). (2009c). Appendix B: Provincial case definitions for reportable diseases, West Nile Virus. In *Infectious diseases protocol*. Retrieved from http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/wnv_cd.pdf

Ministry of Health and Long Term Care (MOHLTC). (2009d). Appendix B: Provincial case definitions for reportable diseases, Lyme disease. In *Infectious diseases protocol*. Retrieved from http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/lyme_disease_cd.pdf

Ministry of Health and Long Term Care (MOHLTC). (2011a). *Eastern Equine Encephalitis virus surveillance and management guidelines*. Toronto, Canada: Queens Printer for Ontario, 2011.

Ministry of Health and Long Term Care (MOHLTC). (2011b). *Lyme disease surveillance and management guidelines*.

Ministry of Health and Long Term Care (MOHLTC). (2010). *West Nile Virus preparedness and prevention plan, Ontario 2010*.

Ogden, N.H., Lindsay, R.L, & Morshed, M., Sockett, P. & Artsob, H. (2009). The emergence of Lyme disease in Canada. *Canadian Medical Association Journal,* 180(12), 1221-1224.

Ontario Agency for Health Protection and Promotion- OAHPP (Public Health Ontario). (2013a). *Guide for public health units: Considerations for adult mosquito control*. Toronto, ON: Queen's Printer for Ontario; 2013.

Ontario Agency for Health Protection and Promotion- OAHPP (Public Health Ontario). (2012). *Technical report: Update on Lyme disease prevention and control*. Toronto, Ontario. Retrieved from http://www.publichealthontario.ca/en/eRepository/PHO%20Technical%20Report%20-%20Update%20on%20Lyme%20Disease%20Prevention%20and%20Control%20Final%20030212.pdf

Ontario Agency for Health Protection and Promotion- OAHPP (Public Health Ontario). (2013b). *Vector-borne disease surveillance reports*. Retrieved from http://www.publichealthontario.ca/en/ServicesAndTools/SurveillanceServices/Pages/Vector-Borne-Disease-Surveillance-Reports.aspx

Patz, J., & Ueijo, C. (2008). Climate change and vector borne disease: update on climate effects on Lyme disease and West Nile Virus in North America. In *Institute of Medicine*, *Vector-borne diseases: Understanding the environmental, human health and ecological connections*. Washington, DC: The National Academies Press.

Patz, J.A., Epstein, P.R., Burke, T.A., & Balbus, J.M. (1996). Global climate change and emerging infectious diseases. *Journal of the American Medical Association*, 275(3), 217-223.

Patz, J.A., Githeko, K., McCarty, J.P., Hussein, S., Confalonieri, U., & de Wet, N. (2003). Climate change and infectious diseases: climate change and human health, risks and responses. In *World Health Organization: Climate Change* (chap.6). Retrieved from http://www.who.int/globalchange/publications/climatechangechap6.pdf

Public Health Agency of Canada. (2013a). *A map showing areas predicted to be at risk for emergence of Lyme endemic areas in eastern and (inset) central Canada* [Image]. Retrieved from http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php

Public Health Agency of Canada. (2012a). General information. In *West Nile Virus*. Retrieved from http://www.phac-aspc.gc.ca/wn-no/gen-eng.php

Public Health Agency of Canada. (2008a). History. In *West Nile Virus*. Retrieved from http://www.phac-aspc.gc.ca/wn-no/hist-eng.php

Public Health Agency of Canada. (2013b). *Lyme disease and other tick borne diseases: Information for health professionals*. Retrieved from http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php

Public Health Agency of Canada. (2013c). *Lyme disease frequently asked questions*. Retrieved from http://www.phac-aspc.gc.ca/id-mi/lyme-fs-eng.php

Public Health Agency of Canada. (2013d). *National surveillance for West Nile Virus (WNV)*. Retrieved from http://www.phac-aspc.gc.ca/wnv-vwn/index-eng.php

Public Health Agency of Canada. (2008b). *National surveillance for West Nile Virus section a: Case definitions*. Retrieved from http://www.phac-aspc.gc.ca/wnv-vwn/hmncasedef-eng.php

Public Health Agency of Canada. (2012b). Symptoms, diagnosis and treatment. In *West Nile Virus*. Retrieved from http://www.phac-aspc.gc.ca/wn-no/symptom-eng.php

Public Health Agency of Canada. (2013e). West Nile Virus, monitor: Human surveillance (2008-2012). In *West Nile Virus: Maps and stats*. Retrieved from http://www.phac-aspc.gc.ca/wnv-vwn/mon-hmnsurv-archive-eng.php#a2008_12

Public Health Agency of Canada. (2006). West Nile Virus transmission cycle. In *West Nile Virus*. Retrieved from http://www.phac-aspc.gc.ca/wn-no/transmission-eng.php

Reeves, W.C., Hardy, J.L., Reisen, W.K., & Milby, M.M. (1994). Potential effect of global warming on mosquito-borne arboviruses. *Journal of Medical Entomology*, 31, 323-332.

Russell, Dr. C. (Producer). (2011). *Ticks and Lyme disease in Ontario* [PowerPoint] Public Health Ontario (PHO): Enteric, Zoonotic and Vector-Borne Diseases Branch. Toronto, Ontario.

Theilman, A., & Hunter, F. (2006). Establishment of *Ochlerotatus japonicus* (Diptera: Culicidae) in Ontario, Canada. *Journal of Medical Entomology*, 43(2), 138-142.

Upper Thames River Conservation Authority (UTRCA). (2005a). *Living with natural areas: A guide for citizens of London*. Retrieved from http://www.thamesriver.on.ca/Wetlands_and_Natural_Areas/images/London_Living_with_natural_areas.pdf

Upper Thames River Conservation Authority (UTRCA). (2005b). *Westminster ponds/pond mills environmentally significant area master plan update 2005*. Retrieved from http://www.thamesriver.on.ca/wetlands_and_natural_areas/Westminster_Update/westminster_report.pdf

United States Geological Survey (USGS). (2013a). Eastern equine encephalitis. In *Disease maps*. Retrieved from http://diseasemaps.usgs.gov/eee_us_human.html

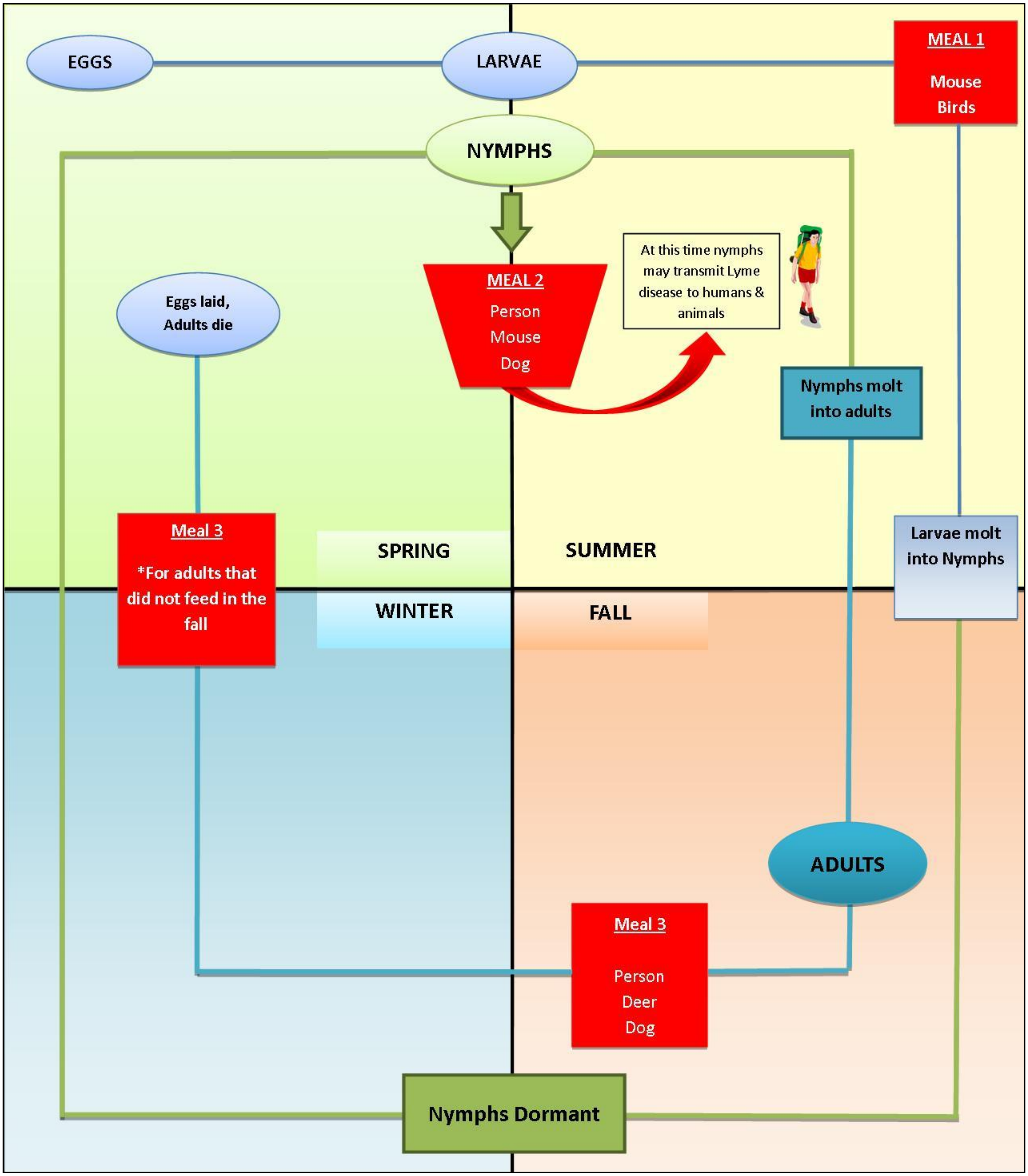
United States Geological Survey (USGS). (2012). Eastern equine encephalitis. In *Disease maps*. Retrieved from http://diseasemaps.usgs.gov/eee_us_human.html

United States Geological Survey (USGS). (2013b). West nile virus. In *Disease maps.* Retrieved from http://diseasemaps.usgs.gov/wnv_us_human.html

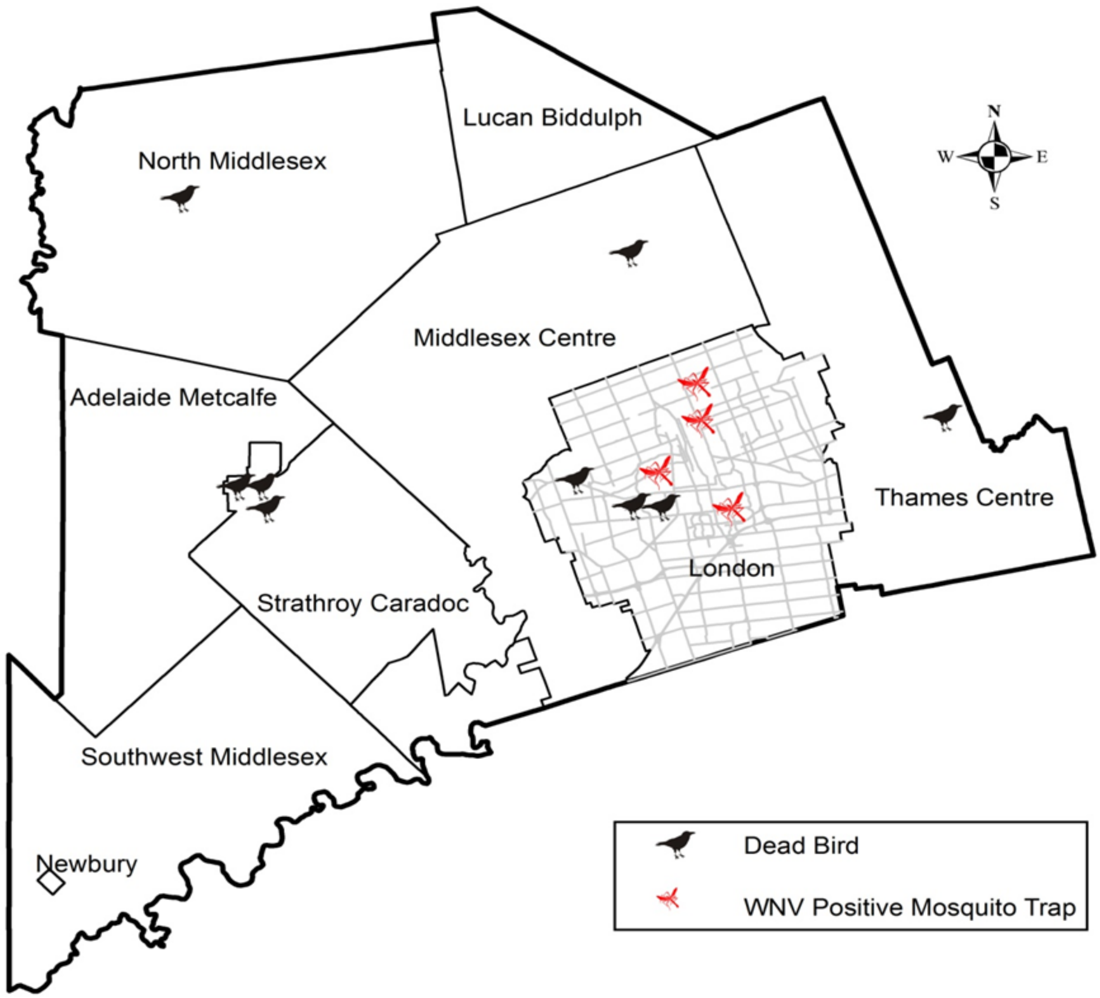
Wood, D.M., Dang, P.T., & Ellis, R.A. (Eds.) (1979). *The insects and arachnids of Canada.* Ottawa, Ontario: Canada Communication Group Publishing.

Wormser, G.P., et al. (2006). The clinical assessment, treatment, and prevention of Lyme disease, human granulocytic anaplasmosis, and babesiosis: clinical practice guidelines by the Infectious Disease Society of America. *Oxford Journals*. 43(9),1089-1134. Retrieved from http://cid.oxfordjournals.org/content/43/9/1089.long

Appendix A: Two Year Lifecycle of the Blacklegged Tick (*Ixodes scapularis*)



Appendix B: 2013 West Nile Virus Positive Birds and Mosquito Traps



Appendix C: Storm Water Management Facilities Monitored in 2013

Site Name	Component	Larvae Collected	Most Common Vector Species Identified (in order by most frequently identified)
Adelaide North	F	62	*Cx. pipiens, Cx. territans, An. punctipennis, An. quadrimaculatus*
Applegate	F, C	88, 129	*Cx. territans, An. punctipennis, An. quadrimaculatus*
Barry's Bay	F	53	*Cx. pipiens, Cx. territans , An. punctipennis, An. quadrimaculatus*
Beattie Street	C, Ch	37, 129	*Cx. pipiens, Cx. territans, An. quadrimaculatus, An. punctipennis,*
Corlon	F, C	25, 24	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis,*
Cranbrook	F, C	0, 4	*Ae. vexans, An.punctipennis,*
Crestwood	F, C	77, 48	*Cx. pipiens, Cx. restuans, Ae. vexans, An. quadrimaculatus*
Dorchester	F1, F2, C	0, 0, 1	*An. punctipennis*
Duncarin	F, C	95, 75	*Cx. pipiens, Cx. territans, An. punctipennis, An. quadrimaculatus*
Fanshawe Ridge North	F, C	51, 31	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis*
Hunt Club	F, C, Ch	25, 6, 60	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis, An. quadrimaculatus*
Innovation Park	C	24	*Cx. pipiens, Cx. territans, An. punctipennis, An. quadrimaculatus*
Jack Nash	F	301	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis*
Lowe's	F, C	30, 116	*Cx. pipiens, Cx. restuans, Cx. territans, Ae. vexans*
McNay Drain	F	7	*Cx. territans, An. punctipennis*
Meadowcreek	F, C	24, 22	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis*
Meadowlilly Woods	F, C	8, 0	*Cx. territans, An. quadrimaculatus*
Meander Creek	F	184	*Cx. pipiens, Cx. restuans, Cx. territans, Ae. vexans*
Meander Creek Park	F1, F2, C	184, 28, 46	*Cx. pipiens, Cx. restuans, Cx. territans, Ae. vexans, An. punctipennis*
Medway Valley Heritage Forest	F	45	*Cx. restuans, Cx. territans, Ae. vexans. An. punctipennis*
Meredith Drive	F, C	28, 20	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis*
Mornington	F, C	155, 63	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis*
North Lambeth	F, C	87, 58	*Cx. pipiens, Cx. territans, An. punctipennis, An. quadrimaculatus*
Oakridge Crossing	F	40	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis*
Pinecomb Drain	F	29	*Cx. pipiens, Ae. vexans, An. punctipennis*
Pinecourt	F, C	113, 9	*Cx. pipiens, Cx. restuans, Cx. territans, An. quadrimaculatus*
Pond Mills	F, Ch	106, 58	*Cx. pipiens, Cx. restuans, Cx. territans, Ae. vexans, An. punctipennis*
River Road	F	45	*Cx. pipiens, Cx. restuans, Cx. territans, An. quadrimaculatus*
South River	F, C	89, 0	*Cx. Pipiens, Cx. restuans, Cx. territans, Ae. vexans*
South Wenige	F,C	53, 50	*An. punctipennis, An. quadrimaculatus, Cx. territans, Cx. pipiens,*
South Wenige 2	F, C	45, 15	*Cx. pipiens, Cx. territans, An. punctipennis, An. quadrimaculatus*
Summercrest	F, C	66, 99	*Cx. territans, An. punctipennis, An. quadrimaculatus*
Summercrest 3	F, C	84, 44	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis*
Summerside	F, C	7, 13	*Cx. pipiens, Cx. territans, An. punctipennis*
Talbot Village	F, C	86, 39	*Cx. Pipiens, Cx. restuans, Cx. territans, An. quadrimaculatus*
Ted Earley Park	C, Ch	7, 17	*Cx. territans, Cx. restuans, An. punctipennis*
Third Street	F	124	*Cx. pipiens, Cx. territans, Ae. vexans, An. punctipennis*
Thornhead	F, C	0, 37	*Cx. territans, Ae. vexans, An. punctipennis*
Turnberry	F,C	73, 7	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis, An. quadrimaculatus*
Upland Hills	F1, F2, C	0, 115, 59	*Cx. pipiens, Cx. restuans, Cx. territans, An. punctipennis, An. quadrimaculatus*
Warbler Woods	F	28	*Cx. pipiens, Ae. vexans*
White Oak	F,C	11, 15	*Cx. pipiens, Cx. territans, Ae. vexans, An. punctipennis*
Wilton Grove Road	F	31	*Cx. territans, An. punctipennis, An. quadrimaculatus*
Zebro	F	53	*Cx. pipiens, Cx. territans, An. punctipennis, An. quadrimaculatus*

***An additional 4 SWMFs were monitored this season, however, no samples were collected from these sites.**

F= forebay C= Cell Ch= channel

Cx.= Culex *Ae.= Aedes* *An.= Anopheles*

Appendix D: Adult Mosquito Trap Names and Locations

Trap Name	Trap Type	Location	Total Mosquitoes Collected	Number of Positive Mosquito Pools
Trap A (Dorchester)	Terrestrial	Dorchester	827	-
Can 5 (Dorchester)	Canopy	Dorchester	533	-
Trap J (Glencoe)	Terrestrial	Glencoe	3315	
Trap H (Parkhill)	Terrestrial	Parkhill	23265	-
Trap H-A (Parkhill)	Terrestrial	Parkhill	7394	-
Can 10 (Parkhill)	Canopy	Parkhill	2900	-
Trap I (Strathroy)	Terrestrial	Strathroy	2921	-
Trap G (Lambeth)	Terrestrial	London	1314	-
Trap O (Exmouth)	Terrestrial	London	1249	-
Trap L (Glenora)	Terrestrial	London	2046	***1 Positive mosquito pool***
Trap D (Greenway)	Terrestrial	London	317	***1 Positive mosquito pool***
Can 3 (Greenway)	Canopy	London	198	-
Trap F (Upper Thames)	Terrestrial	London	3169	-
Can 6 (Upper Thames)	Canopy	London	560	-
Trap N (CC Mews)	Terrestrial	London	3219	-
Can 7 (CC Mews)	Canopy	London	2449	-
Trap C (Dearness)	Terrestrial	London	2395	
Can 2 (Dearness)	Canopy	London	491	***1 Positive mosquito pool***
Trap Q (Warbler Woods)	Terrestrial	London	1037	-
Trap S (Sifton)	Terrestrial	London	2295	-
Can 12 (Sifton)	Canopy	London	521	-
Trap M (Huron Conservation Area)	Terrestrial	London	2526	***1 Positive mosquito pool***
Can 8 (Huron Conservation Area)	Canopy	London	289	-
UU-12	Hotspot	London	5	-
WW-12	Hotspot	London	1	-
XX-12	Hotspot	London	72	-
ZZ-12	Hotspot	London	16	-

Trap Type	Description
Terrestrial	Adult mosquito trap set 4 to 6 feet off the ground, also known as a “ground trap”.
Canopy	Adult mosquito trap set up on a rope and pulley system attached to a large tree branch, raised 13 to 20 feet off the ground.
Hotspot	Adult mosquito trap set up within a 2km radius of any WNV-positive bird, mosquito or human case reported to the MLHU.

Appendix E:
Criteria for Diagnosis and Classification of West Nile Virus Cases

Clinical Criteria for Diagnosis of WNV

(with excerpts from Public Health Agency of Canada's National Surveillance for West Nile Virus, Case Definitions, 2008, and the Ministry of Health and Long Term Care's West Nile Virus Infectious Disease Protocol, 2009c)

West Nile Virus Neurological Syndrome (WNNS) Diagnostic Criteria

- History of exposure in an area where WNV activity is occurring **OR**
- History of exposure to an alternative mode of transmission (i.e. lab-acquired, in utero; receipt of blood components, organ/tissue donation; possibly via breast milk)

AND

- Onset of fever

AND recent onset of at least one of the following:

- Encephalitis, viral meningitis, acute flaccid paralysis, movement disorder, Parkinsonism or Parkinsonism-like disorders, or other neurological symptoms (as defined by the PHAC)

West Nile Non-Neurological Syndrome (WN-Non-NS) Diagnostic Criteria

- History of exposure in an area where WNV activity is occurring **OR**
- History of exposure to an alternative mode of transmission

AND at least two of the following:

- Fever, myalgia, arthralgia, headache, fatigue, lymphadenopathy, or maculopapular rash

West Nile Virus Asymptomatic Infection (WNAI) Diagnostic Criteria

- **There is an absence of clinical criteria in WNAI

Laboratory Criteria for Diagnosis of WNV

Probable Case Laboratory Criteria:

At least **one** of the following:

- Detection of flavivirus antibodies in a single serum or CSF sample using a WN virus IgM ELISA without confirmatory neutralization serology (e.g. Plaque Reduction Neutralization Test -PRNT) **OR**
- A 4-fold or greater change in flavivirus HI titres in paired acute and convalescent sera or demonstration of a seroconversion using a WN virus IgG ELISA **OR**
- A titre of > 1:320 in a single WN virus HI test, or an elevated titre in a WN virus IgG ELISA, with a confirmatory PRNT result **OR**
  [Note: A confirmatory PRNT or other kind of neutralization assay is not required in a health jurisdiction/authority where cases have already been confirmed in the current year]
- Demonstration of Japanese encephalitis (JE) serocomplex-specific genomic sequences in blood by NAT screening on donor blood, by Blood Operators in Canada

Confirmed Case Laboratory Criteria:

At least **one** of the following:

- A 4-fold or greater change in WN virus neutralizing antibody titres (using a PRNT or other kind of neutralization assay) in paired acute and convalescent sera, or CSF **OR**
- Isolation of WN virus from, or demonstration of WN virus antigen or WN virus-specific genomic sequences in tissue, blood, CSF or other body fluids **OR**
- Demonstration of flavivirus antibodies in a single serum or CSF sample using a WN virus IgM ELISA, confirmed by the detection of WN virus specific antibodies using a PRNT (acute or convalescent specimen) **OR**
- A 4-fold or greater change in flavivirus HI titres in paired acute and convalescent sera or demonstration of a seroconversion using a WN virus IgG ELISA AND the detection of WN specific antibodies using a PRNT (acute or convalescent serum sample)

Case Classification of WNV

WNNS and WN-Non-NS Case Classification Criteria

Suspect

- Clinical criteria AND absence or pending laboratory criteria AND absence of any other obvious cause

Probable

- Clinical Criteria AND at least one of the probable case laboratory criteria

Confirmed:

- Clinical criteria AND at least one of the confirmed case laboratory criteria

WNAI Case Classification Criteria

Probable:

- Probable case laboratory criteria AND absence of clinical criteria

Confirmed:

- Confirmed case laboratory criteria AND absence of clinical criteria

Appendix F:
Standing Water Sites Treated 10 or More Times in 2013

>15 Treatments	Site Name	Component
CCMM021	Edward Baker Park	Field Pool
HULONESA05	Westminster Ponds Zone 3	Woodland Pool
HULONESA07	Westminster Ponds Zone 5	Woodland Pool
HULON085	Huron Conservation Area	Woodland Pool & Ditch
15 Treatments		
CCMM006	Colonel Talbot Road	Ditch
HULON031	Jack Nash Terrace SWMF	Forebay
14 Treatments		
CCMM072	Watson Street Park	Woodland Pool
HUTC002	The Mill Pond, Dorchester	Pond
13 Treatments		
HULON002	Storey Book Gardens Frog Pond	Pond
HULON049	Stoney Creek Valley	Pond
HULONESA06	Westminster Ponds Zone 4	Woodland Pool
12 Treatments		
CCMM040	West Lions Park	Woodland Pool
HUTC007	Turnberry SWMF, Dorchester	Forebay
HUTC008	Turnberry SWMF, Dorchester	Cell
11 Treatments		
HULON054	Mornington SWMF	Forebay
HULON069	Egleton Woods	Woodland Pool
10 Treatments		
HULON037	Sunningdale Road Pond	Pond
HULON050	Meander Creek Park SWMF	Forebay
HULON056	Enterprise SWMF	Forebay
HULON087	Ted Earley SWMF	Forebay
HUMC001	Weldon Park, Arva	Field Pool
HUSWM004	Industrial Road, Glencoe	Ditch
HUTC001	Catherine Street, Dorchester	Field Pool

Appendix G: 2013 Catch Basin Flyer

MIDDLESEX-LONDON HEALTH UNIT

CATCH BASIN TREATMENT 2013

Why treat catch basins?

Catch basins are a significant breeding site for mosquitoes including *Culex pipiens*, a West Nile Virus mosquito vector (a species known to carry the virus). Treating catch basins will prevent larvae from maturing into adult mosquitoes and will reduce the risk of amplification and spread of the virus into the human population.

How will I know if the catch basins in my area have been treated?

Each catch basin will be assigned a colour based on the treatment status (see table below). Canadian Center for Mosquito Management Inc. will treat catch basins in every urban center in the Middlesex-London region approximately 3 times between June and September. The method of control used will depend on the area. Catch basins within 50m of an outfall to water bodies such as streams, lakes and wetlands are considered sensitive and will be treated with the biological larvicide, *Bacillus sphaericus* water soluble pouches. If the catch basin is not near an outfall, the pesticide methoprene will be used for treatment. Treatment will involve the use of 30-day methoprene Pellets for most public catch basins. A 120-day methoprene Briquet will be used in rear yard catch basins, park catch basins and other areas that may be difficult to access. Dry catch basins will not be treated. For further information, please contact the Middlesex-London Health Unit, Strathroy office at (519) 245-3230.

TREATMENT COLOUR CODES	
Purple	Treatment #1
White	Treatment #2
Orange	Treatment #3
Pink	Sensitive Area
Brown	Methoprene Briquet

Appendix H: Overview of 2013 Standing Water Concerns and Inquiries