malaria

plague

yellow fever

tularemia

west nile virus

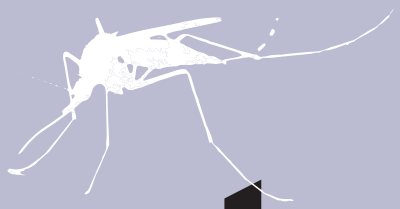
eastern equine encephalitis

lyme disease

chikungunya

zika virus

dengue fever



Vector-Borne Diseases

DURHAM REGION

HEALTH DEPARTMENT

durham.ca

Annual Report 2017

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Vector-Borne Diseases Program Annual Report 2017

Executive Summary

In 2003, the Ontario Ministry of Health and Long-Term Care (MOHLTC) mandated that all public health units (PHUs) in the province develop and implement a West Nile virus (WNV) control program to "prepare for, prevent, or mitigate the risk, if possible, of contracting WNV illness".

While the program was originally focused on the threat posed by the 2002 outbreak of WNV in Ontario, the program has now expanded to address the threats to human health posed by mosquitoes that may be carrying the Eastern Equine Encephalitis (EEE) and Zika viruses and by blacklegged ticks that may be carrying the bacteria that causes Lyme disease (LD). The program will continue to expand, as necessary, in response to potential threats from other Vector-Borne diseases of concern, including, but not limited to, chikungunya, dengue fever, malaria, plague, tularemia, and yellow fever.

This report will focus on Durham Region's surveillance, vector control, and health promotion activities related to WNV, EEE and LD. The report will also provide information and highlight ongoing surveillance activities related to the other Vector-Borne diseases of concern.

A local Durham Region West Nile Virus Response Committee (DRWNVRC) was created under the authority of Regional Council to coordinate WNV response activities in Durham Region. The DRWNVRC is comprised of regional, municipal, conservation authority, and provincial representatives. The committee receives technical advice from the MOHLTC and Public Health Ontario (PHO), as well as the Ontario Ministries of Agriculture, Food and Rural Affairs (OMAFRA), Environment and Climate Change (MOECC), and Natural Resources and Forestry (MNRF).

In 2001, the DRWNVRC developed the *Durham Region West Nile Virus Response Plan,* in compliance with the requirements of the provincial *West Nile Virus Preparedness and Prevention Plan,* to effectively respond to the occurrence of WNV in Durham Region. The plan was first implemented in the spring of 2002 in response to WNV epidemiology during 2001.

The goal of the Response Plan is to provide an effective response to the presence of WNV in the Region. Its objectives are as follows:

- to limit the impact of WNV on human health
- to reduce the availability of larval mosquito development sites
- to educate the public about personal protective measures against mosquitoes

- to provide accurate and timely information on WNV to health professionals, the public, and the media
- to employ the principles of Integrated Mosquito Management (IMM) to reduce the risk that vector mosquitoes may pose to humans.

The Response Plan outlines the coordinated actions that are to be taken to protect the life and health of the citizens of Durham Region in response to the threat of WNV. It applies to Durham Region Health and Works Departments as well as all 8 Durham Region municipalities. The plan is a working document and, as such, is subject to updates and revisions as required.

Durham Region's response to WNV activity is organized into four levels, with the roles of the various stakeholder agencies being delineated for each response level. In 2017, Durham Region Health Department (DRHD) operated the Vector-Borne Disease Program at a Level 4 response level, which corresponds to one or more confirmed human cases of WNV being identified in the Region.

In 2003, in accordance with the requirements of the provincial *West Nile Virus Preparedness and Prevention Plan*, the DRWNVRC created a *Durham Region West Nile Virus Vector Control Plan* that lays out the specific measures to be implemented to reduce the number of WNV vector mosquitoes in Durham Region and thereby reduce the risk of exposure for Durham Region residents. The 4 major components of the Vector Control Plan now include: Adult Mosquito Surveillance; Larval Mosquito Surveillance and Control; Monitoring of Human Health Effects / Complaints; and Communication / Public Education.

Over the past few years, the DRWNVRC has evolved in response to the establishment of blacklegged tick populations in the Region and the increasing incidence of LD amongst Durham Region residents. Due to the change in scope, the committee has been renamed the Durham Region Vector-Borne Disease Response Committee (DRVBDRC).

During the 2013 WNV season, DRHD participated in a working group, overseen by PHO. The working group developed a guidance document designed to assist PHUs to determine their need to institute adult mosquito control measures during any WNV season. The document, *Guide for Public Health Units: Considerations for Adult Mosquito Control*, was developed in response to Ontario experiencing, in 2012, the second highest number of WNV human cases and positive mosquito pools since the virus was first identified in Ontario in 2002.

Between 2001 and 2008, DRHD also conducted wildlife (dead bird) surveillance. During that period, a total of **52** WNV-positive birds were identified in Durham Region, with positive birds being found in each of the **8** local municipalities. However, because WNV was found to be present in the Ontario bird population annually, from 2001 to 2008, the MOHLTC discontinued its funding for dead bird surveillance in 2009. While DRHD no longer conducts active dead bird surveillance, it will continue to refer public requests for

testing of birds to the Canadian Cooperative Wildlife Health Centre (CCWHC), subject to a risk assessment.

The majority of the surveillance activities prescribed by the Vector Control Plan are conducted by DRHD staff, while any control activities are performed by a licensed pest control operator (PCO) under contract to the Region. During the 2017 WNV season, the contracted, licensed, PCO was the Canadian Centre for Mosquito Management Inc. (CCMM).

Larval mosquito surveillance generally begins each year in early May. The larval mosquito component of the Vector Control Plan consists of weekly monitoring of surface water sites on public property in relation to the potential for these sites to support larval mosquito development.

A roadside catch basin monitoring and larviciding program has also been active since 2003. Historically, **3** rounds of catch basin larviciding have been conducted in Durham Region by a licensed PCO, with the first treatment round beginning in early-to-mid June, and subsequent treatment rounds occurring in July and August. A 21 day residual period is maintained between each round of treatment.

Catch basins on selected Durham Region properties, including long-term care homes, child care centres, and Regional housing, are larvicided once per season using a methoprene briquette formulation which provides an extended residual effect.

Adult mosquito surveillance (trapping and testing) was first implemented in late 2002, and has been undertaken every year since. Surveillance begins mid-June, and continues until mid to late September, depending on climate conditions. Traps are set up at predetermined locations throughout the Region. The locations are determined using the following criteria: site security, historical data (e.g., previous positive surveillance results), proximity to human populations, ease of access, and geographical distribution. Adult mosquitoes are trapped one day each week during the trapping period, and the captures are sent to an accredited laboratory where they are enumerated, identified by species, and tested for WNV.

Historically, in addition to conducting adult mosquito surveillance for WNV, DRHD has subjected any adult *Culiseta melanura* species captures to testing for the EEE virus (EEEV). The virus is known to be maintained in a cycle between *C. melanura* mosquitoes and birds. However, in 2011, in response to an increase in EEEV activity in the United States, the MOHLTC asked PHUs to modify their adult mosquito surveillance protocols to include species that may act as vectors/bridge vectors for the transmission of EEEV to humans. Accordingly, DRHD implemented the modified surveillance protocols during each of 2011, 2012, and 2013. However, after finding no EEEV-positive mosquito pools during any of those years, DRHD, in consultation with PHO, reverted to traditional surveillance protocols in 2014.

Human case surveillance, for WNV, EEE, LD, and the other Vector-Borne diseases of concern, is conducted by DRHD staff. The number of human cases of each disease,

reported to DRHD by health care providers, is entered into the integrated Public Health Information System (iPHIS) data base and transmitted to the MOHLTC.

The accumulated surveillance data is used to assist DRHD to determine areas where additional vector surveillance and control activities (e.g., standing water site surveillance, adult mosquito trapping, mosquito larviciding) may have to be implemented.

DRHD investigates complaints regarding stagnant water, on regional and municipal land, in accordance with divisional policies and procedures. In consultation and cooperation with local municipalities, privately owned standing water sites are individually assessed to determine the need for treatment and or remediation. This assessment includes dipping for the presence of mosquito larvae. If WNV vector larvae are present, a Section 13 Order, pursuant to the *Health Protection and Promotion Act* (HPPA), is issued to the owner(s) of the private property, requiring remediation of the mosquito development site. Where remediation is not possible, other vector control activities, such as the application of larvicide, may be implemented.

DRHD also investigates complaints of human exposures to blacklegged ticks in relation to the potential for this species to carry and transmit *Borrelia burgdorferi,* the bacterium that causes LD. Any ticks submitted to DRHD, which have been associated with human contact, are sent to the National Microbiology Laboratory (NML) for identification. Once identified, all blacklegged ticks are further analyzed for the presence of *B. burgdorferi.* When specific geographic areas are identified as potential tick habitats, DRHD works with property owners to provide LD information, to conduct active tick surveillance, and/or to determine if properties can be remediated to reduce the risk of human contact with ticks.

Each year, Durham Region's WNV communication plan is updated with an aim to increasing community awareness of WNV and the personal precautions that can be taken to prevent transmission. The communication plan provides standing water prevention and personal protection information through a variety of means including the Durham Region website (durham.ca), local media (i.e., TV, radio, newsletters and newspapers), billboard and poster advertisements (i.e., shopping malls, arenas), and community events (e.g., health and safety fairs). In 2015 a weekly summary report on Vector-Borne diseases activities was developed and this is now distributed to community stakeholders throughout each WNV/LD season.

A communication plan for LD was first developed in 2010. Since then, the Durham Region website has been updated annually to include information about endemic areas for LD in Ontario, disease transmission, and personal protective measures to avoid tick bites.

WNV and LD presentations are provided to community groups upon request, and various health promotion items have been produced and utilized at community events and health fairs including an interactive LD game. Between 2011 and 2017, various community groups were targeted for distribution of the LD information including:

Durham Region elementary schools, a provincial park, golf courses, horticultural societies, garden centres, riding stables and doctor's offices. As well, a number of WNV and LD articles were developed and distributed via various Regional and other agency newsletters.

The WNV communication plan has been evaluated regularly since 2002 using the Rapid Risk Factor Surveillance System (RRFSS) WNV modules. Since 2011, RRFSS has also been used to survey Durham Region residents regarding their awareness of LD and their use of personal protective measures to reduce exposures to ticks. RRFSS results are detailed later in this paper.

Program Successes:

- WNV activity in mosquitoes, equines, and humans has been very low since the inception of WNV surveillance and control activities in Durham Region.
- Durham Region has experienced just **23** confirmed or probable human WNV cases between 2002 and 2017. There were **3** confirmed human cases of WNV reported in 2017.
- **One** case of equine WNV was reported in 2017 in an unvaccinated horse that was rescued and brought into the Region in 2017.
- Few equine cases of EEE have been reported in Durham Region and, to date, no human cases of EEE have ever been reported in Ontario.
- The establishment of the DRWNVRC (now DRVBDRC) has served to streamline stakeholder communications and coordinate public education and vector control measures within the Region.
- The establishment of a partnership between municipal by-law departments and DRHD for the investigation of stagnant water complaints on private property has worked well. As per the agreement between DRHD and local municipal by-law enforcement officers, outlined in the Notice of Required Action (distributed annually to municipalities), municipal staff are the first to respond to investigate stagnant water complaints on private property. Where compliance is not achieved within 48 hours, complaints are forwarded to DRHD for follow-up action.
- Between 2003 and the fall of 2017, **592** stagnant water complaints on private property were investigated by DRHD staff. This number does not include complaints that were investigated by municipal by-law enforcement staff and where compliance was achieved without further action by DRHD.
- In most instances, property owners have complied promptly with DRHD requests to remediate sources of standing water (e.g., pool, pond, bird bath, land depression). In instances where compliance was not immediately achieved, a Section 13 Order, under the HPPA, was issued.

- During the 2017 WNV season, **13** new standing water Orders were issued; **8** Orders to residential property owners requiring them to eliminate mosquito breeding sites in standing water on their properties (swimming pools, ornamental ponds, etc.), and **5** Orders to our licensed PCO to larvicide standing water sites on private properties when owners failed to address mosquito breeding concerns. Since 2003, a total of **107** Orders have been written.
- While most properties are promptly remediated once an Order is issued, **33** charges to property owners for "fail to comply with an Order of a PHI" have been laid since 2003. For 2017, DRHD laid **4** such charges. Convictions have been registered for **2** of the charges and a court case is pending for the other **2**.
- Active surveillance for blacklegged ticks has been conducted in various wooded or grassy locations within Durham Region since 2010. No ticks were found during active surveillance until the fall of 2013 when 19 blacklegged ticks were found in south Whitby. Since then blacklegged ticks have been found in a number of wooded or grassy locations across Durham Region.
- In the fall of 2014, blacklegged ticks, positive for *Borrelia burgdorferi*, were found during active surveillance activities in the Rouge Valley, Pickering. Since positive blacklegged ticks were found there again in 2015 and 2017, this area appears to contain an established tick population resulting in the Rouge Valley being designated a "risk area" for Lyme disease by PHO.
- In the fall of 2016, **8** ticks were found at **3** different locations (in Durham Forest, Uxbridge; near the Waterfront Trail, Clarington; and in Darlington Provincial Park, Clarington). All of the ticks tested negative for *Borrelia burgdorferi* as well as the other pathogens that blacklegged ticks can carry. **None** of the ticks tested positive for *B. burgdorferi* bacteria.
- In the fall of 2016, tick signs, warning the public of the presence of blacklegged ticks, and the precautions they should take to avoid exposures, were posted at the entrances to the Lynde Shores Conservation area (Whitby), and the Rouge Valley (Pickering) where populations of blacklegged ticks have become established.
- In the fall of 2017, in relation to DRHD active surveillance findings and public concerns about the number of ticks found in the Durham Forest, tick signs were provided to the Lake Simcoe Region Conservation Authority (LSRCA). The LSRCA has advised that these signs will be posted at all the trailheads in Durham Forest in the spring of 2018.
- **4** confirmed human cases of malaria were reported in Durham Region in 2017. In all 4 cases, travel to or residence in an endemic country was a risk factor.
- There were **0** reported cases of plague, tularemia, or yellow fever in Durham Region in 2017.

Program Challenges:

- Increased workload as a result of continually increasing numbers of surface water sites and catch basins.
- Lack of consistency at the municipal level in relation to the maintenance and remediation of municipally and privately owned storm water management ponds (SWMPs). Although there are guidelines and best practices for the maintenance and design of SWMPs, it is not clear who enforces or oversees adherence to the relevant guidelines.
- Remediation of municipally-owned larval mosquito development sites such as ditches. While remediation of surface water sites that are larval mosquito development sites is always the preferred option, the financial reality is that these sites may take many years to be remediated. Furthermore, it is not feasible to remediate all surface water sites that are larval mosquito development sites.
- Remediation of derelict pools, ornamental ponds and/or other water features on private properties where the property has been abandoned by the property owner(s). In these instances, tracking the responsible property owners (i.e., individuals, financial institutions, property management firms, etc.) to enforce remediation of the standing water, can often involve considerable time and staff resources.
- Inconsistent and, in some cases, inadequate municipal property standards by-laws related to standing water on private property (i.e., derelict pools, ponds, etc.). Since not all local municipalities have such by-laws, it has been necessary to establish a partnership with all 8 local municipal by-law enforcement departments whereby they conduct the initial investigation of stagnant water complaints on private property, but refer outstanding issues to DRHD staff when the issue cannot be resolved within 48 hours. With as many as **75** complaints regarding stagnant water occurring on private property each year, this can involve a considerable amount of DRHD staff resources.
- There has been a significant increase in the VBD Program workload in the past few years related to:
    - A substantial increase in the number of ticks submitted by the public and/or healthcare providers for identification and testing (passive tick surveillance for LD). In 2017, **176** ticks were submitted to DRHD versus **83** in 2016.
    - An increase in the need for active tick surveillance activities related to passive tick surveillance patterns.
    - An increase in the number of areas where blacklegged tick populations have become established as demonstrated by active tick surveillance results. During 2017, blacklegged ticks were found in **5** of the **9** areas where active surveillance was conducted.

- An increase in the number of laboratory and healthcare provider reports of suspect human cases of LD and WNV. In 2017 there were **40** confirmed and **8** probable cases of Lyme disease reported as compared to **16** confirmed and **8** probable cases reported in 2016.

- The identification of confirmed and probable human cases of WNV and LD is often problematic due to:
  - Challenges interpreting laboratory results. In particular, false negative or inconclusive blood test results for LD are common based on timing and the nature of the infection / infective agent.
  - Incomplete information from patients and healthcare providers regarding mosquito and tick exposure histories, symptoms, diagnosis and treatment.
- Providing timely information relating to LD risk areas, LD symptoms, and protective measures to prevent tick bites to health care providers and the public.
- The current Lyme assays (EIA and Western Blot) used by the Public Health Ontario Laboratory (PHOL) do not test for the European strains of LD (*Borrelia garinii* and *Borrelia afzelii).* Testing for European strains must be specifically requested. Therefore, it is difficult to identify these cases and it is important to investigate and determine whether patients have visited or resided in Europe and been potentially exposed to a tick(s) while there. In most years a small number of the total reported cases of LD in Durham Region are cases associated with the European strains of the bacteria.

Program Results (2013-2017)

West Nile Virus (WNV)

Overview:

WNV is maintained in nature in a transmission cycle that occurs between mosquitoes and birds. Mosquitoes become infected when they feed on the blood of a bird infected with the virus and they can then pass the virus on to other birds. The virus can be transmitted to humans and other mammals by mosquitoes that choose to feed on both birds and mammals. These mosquitoes are known as “bridge vectors”. Humans and other mammals (e.g., horses) are only incidental or “dead end” hosts and are generally incapable of transmitting the virus further. In rare instances, WNV has been transmitted within the human population through blood transfusions, organ or tissue transplants, and via breast milk.

WNV is endemic in many areas of the world including Africa, Europe, the Middle East, West Asia, South America, and throughout North America.

Currently, of the over **60** species of mosquitoes identified in Ontario, only **13** are known to be WNV vectors.

Most people infected with WNV will not develop any symptoms. When symptoms do develop, they appear within 3-15 days following the bite of an infected mosquito. They can range from mild fever, headache, and flu-like illness to severe neuro-invasive disease (meningitis, encephalitis or poliomyelitis) with rapid onset of symptoms including severe headache, high fever, stiff neck, muscle weakness, convulsions, paralysis, or coma. Severe WNV symptoms are more likely to occur in the elderly, the very young, and those with suppressed immune systems. There is no specific treatment for WNV once symptoms develop, and victims can only be provided with supportive care. In rare cases, WNV can result in death. However, most people do recover fully over time.

There is no human vaccine for WNV, so preventative measures are based on vector control and the use of personal precautions against mosquitoes.

Equine Surveillance

Summary:

In 2017 in Ontario, **21** equine cases of WNV were reported by OMAFRA. Only **1** of the cases occurred within Durham Region. This is a significant increase over the 2 equine WNV cases reported in Ontario in 2016.

Vector Surveillance

Adult Mosquito Surveillance

Summary:

In 2011, the MOHLTC provided PHUs with new criteria for viral testing of adult mosquito captures so as to include vectors for EEEV as well as WNV. DRHD instituted the new order of preference for viral testing in 2011 and utilized it during each of the 2011, 2012, and 2013 WNV seasons. After finding no EEEV-positive pools in any of those 3 years, DRHD, in consultation with PHO, reverted back, in 2014, to the 2010 order of preference for testing of adult mosquitoes as follows:

1. *Culex pipiens/restuans*
2. *Culex salinarius*
3. *Ochlerotatus japonicus*
4. *Culex tarsalis*
5. *Aedes vexans vexans/Aedes vexans nipponi*
6. *Ochlerotatus triseriatus*
7. *Anopheles punctipennis*
8. *Ochlerotatus trivittatus*
9. *Anopheles walkeri*
10. *Ochlerotatus stimulans*
11. *Anopheles quadrimaculatus*
12. *Ochlerotatus Canadensis*

Note: Durham Region's EEE surveillance results are included under a separate section entitled Eastern Equine Encephalitis (EEE) found later in this report.

In 2017, adult mosquito surveillance consisted of a network of up to **14** trap sites distributed over **7** of the 8 local municipalities. A total of **174** traps were set over a **15 week period** extending from CDC week 24 (w/o June 12) to week 38 (w/o September 18).

A total of **13,426** adult mosquitoes were captured during the 2017 season. This is more than the total captured in 2016 (9,347) but less than the numbers captured in 2014 (14,495) or 2015 (20,092).

Aedes vexans vexans was the most dominant mosquito species captured in Durham Region in 2017, representing **26%** of total captures. *A. vexans* vexans is a confirmed WNV bridge vector.

The second most prevalent species of mosquito captured in Durham Region was *Coquilletidia perturbans,* representing **21%** of total captures. While *Cq. perturbans* is not generally considered to be an efficient WNV vector, it is thought that it may still play a role in WNV transmission to humans due to its relative abundance and aggressive nature.

The third most prevalent species captured was *Culex pipiens/restuans* at **17%** species abundance. This species group is of particular concern since both *C. pipiens* and *C. restuans* are known to be efficient vectors of WNV in Ontario.

Species abundance numbers for the *Culex pipiens-restuans* group have remained relatively stable over the past few years, ranging from 15% in 2015 to 20% in 2016.

A total of **455** pools of mosquitoes were tested in 2017 using RT-PCR. **Ten** of the 455 pools tested positive for WNV. The 10 WNV-positive mosquito pools were comprised of *Culex pipiens/restuans* (8 pools), *Aedes vexans vexans* (1 pool) and *Ochlerotatus japonicas* (1 pool). In comparison, there were 10 WNV-positive mosquito pools identified in 2016; 0 in each of 2014 and 2015; and 15 in 2013.

2017

Trapping season: weekly basis, from **CDC week 24-38**

traps: **174**

mosquitoes captured: **13,426**

viral pools tested for WNV: **455**

WNV-positive pools: **10**

% *Culex pipiens/restuans* in the capture population: **17%**

% Bridge vectors in the capture population: **50%** (*Aedes vexans vexans* 26%)

% Non-vectors in the capture population: **33%** (*Cq. perturbans* 21%)

2016

Trapping season: weekly basis, from CDC week 24-39

traps: 199

mosquitoes captured: 9,347

viral pools tested for WNV: 374

WNV-positive pools: 10

% *Culex pipiens/restuans* in the capture population: 20%

% bridge vectors in the capture population: 67% (Cq. Perturbans: 53%, *Aedes vexans*: 14%)

2015

Trapping season: weekly basis, from CDC week 24-38

traps: 175

mosquitoes captured: 20,092

viral pools tested for WNV: 440

WNV-positive pools: 0

% *Culex pipiens/restuans* in the capture population: 15%

% bridge vectors in the capture population: **79%** (*Cq. perturbans*: 30%, *Aedes vexans*: 29%, *Ochlerotatus trivittatus*: 7%, other: 13%)

2014

Trapping season: weekly basis, from CDC week 26-37

traps: 136

mosquitoes captured: 14,495

viral pools tested for WNV: 357

WNV-positive pools: 0

% *Culex pipiens/restuans* in the capture population: 9%

% bridge vectors in the capture population: 83% (*Cq. perturbans*: 53%, *Aedes vexans*: 15%, *Ochlerotatus stimulans*: 13%, other: 2%)

2013

Trapping season: weekly basis, from CDC week 24-38

traps: 175

mosquitoes captured: 15,980

viral pools tested for WNV: 320

WNV-positive pools: 15 (from 4 different municipalities)

% *Culex pipiens/restuans* in the capture population: 33%

% bridge vectors in the capture population: 53% (C*q. perturbans*: 44%, *Aedes vexans*: 9%)

Larval Mosquito Surveillance

Summary:

As of 2017 a total of **405** standing water (sw) sites, including SWMPs, field or woodland pools, ditches, and other such areas, have been identified in Durham Region. Every year, these sw sites are monitored by WNV students on a weekly basis, from the beginning of May to the end of September. The number of standing water sites in Durham Region has increased in each of the past 5 surveillance years. When high counts of larval mosquitoes are observed, standing water sites are treated with larvicide, by the Region's licensed PCO, until 0 larvae are found for 3 consecutive weeks.

2017

Total # of sw sites monitored: **405**

Total # of sw site inspections (PCO staff and WNV students): **3,999**

Total # of larvicide treatments (when live mosquito larvae were found): **966**

2016

Total # of sw sites monitored: 401

Total # of sw site inspections (PCO staff and WNV students): 3,365

Total # of larvicide treatments: 684

2015

Total # of sw sites monitored: 395

Total # of sw site inspections: 4,282

Total # of larvicide treatments: 625

2014

Total # of sw sites monitored: 384

Total # of sw site inspections: 3,936

Total # of larvicide treatments: 852

2013

Total # of sw sites monitored: 365

Total # of sw site inspections: 4,517

Total # of larvicide treatments: 1,119

Human Case Surveillance

Summary:

- **In 2017 there were 3 confirmed human case of WNV reported in Durham Region.** In contrast, 1 confirmed and 1 probable case were reported in each of 2016 and 2015.
- The Public Health Agency of Canada (PHAC) has reported **155 clinical human cases of WNV for Ontario in 2017*.** This is a significant increase from the 46 cases reported in 2016, 33 cases in 2015, 10 cases in 2014, and 53 cases in 2013.
- **For Canada, PHAC reported 190 clinical human cases of WNV in 2017*.** This is an increase from the 100 cases reported in 2016, the 78 cases reported in 2015, and 21 cases reported in 2014.
- **In the United States, the US Centers for Disease Control and Prevention (CDC) reported 2,002 human cases of WNV in 2017, including 121 deaths≠.** For 2016 there were 2,149 cases; in 2015 there were 2,175 cases; and in 2014 there were 2,205 human WNV cases reported.

Note:

* *As of December 9, 2017 for Ontario and Canada statistics, link:* http://healthycanadians.gc.ca/diseases-conditions-maladies-affections/disease-maladie/west-nile-nil-occidental/surveillance-eng.php#s1

≠ *As of January 9, 2018 for USA statistics, link:* https://www.cdc.gov/westnile/statsmaps/preliminarymapsdata2017/disease-cases-state.html

2017

3 confirmed cases of WNV were reported in Durham Region.

2016

1 confirmed and 1 probable case of WNV were reported in Durham Region.

2015

1 confirmed and 1 probable case of WNV were reported in Durham Region.

2014

0 confirmed or probable cases of WNV were reported in Durham Region.

2013

3 confirmed cases of human WNV were reported in Durham Region. Two of the 3 cases experienced neurological complications while the other had milder symptoms. No deaths were reported.

Table 1: Summary of Reported Confirmed and Probable Human Cases of WNV (2013-2017)

Year	# of Reported Confirmed Human WNV Cases	# of Reported Probable Human WNV Cases
2017	**3**	**0**
2016	1	1
2015	1	1
2014	0	0
2013	3	0

Vector Control Measures:

Monitoring and Treatment of Roadside Catch Basins Summary:

Pre-treatment surveillance of **65** roadside catch basins commenced mid-May 2017 and then roadside catch basin treatments were initiated on June 5 (CDC week 23) in response to an increase in the numbers of *Culex* larvae found.

Product used: Altosid (methoprene) pellets which are designed to release effective levels of methoprene insect growth regulator for up to 30 days under typical environmental conditions.

Three rounds of roadside catch basin larviciding treatments were conducted in 2017, with the first round of treatment commencing June 5, 2017, and the third round ending

August 5, 2017. A 21 day residual period was incorporated between each treatment round.

During 2017, the total number of roadside catch basins treated was **159,306** (approximately 53,000 catch basins during each round of treatment).

Larvicide treatments occurred in all 8 Durham Region municipalities: Pickering, Ajax, Whitby, Oshawa, Clarington, Scugog, Uxbridge, and Brock.

Monitoring and Treatment of Backyard Catch Basins and Catch Basins located on Regional Property Summary:

Selected catch basins, located on regionally-owned properties (including long-term care homes, child care centres, and regional housing), received larvicide treatments.

Backyard catch basins (i.e., municipally-owned catch basins located on private, residential properties) were treated upon request by the property owner, and based on a risk assessment.

A total of **390** regionally-owned catch basins were treated in 2017. In addition, **82** backyard catch basins were treated. These treatments were scheduled to coincide, where possible, with the first round of roadside catch basin larviciding.

Product used: Altosid (methoprene*)* briquettes, designed to release effective levels of methoprene insect growth regulator over a period up to 150 days in mosquito breeding sites.

Table 2: Summary of Catch Basin Treatments (2013-2017)

Year	# of Roadside Catch Basins Larvicided	# of Backyard and Regionally-Owned Catch Basins Larvicided
2017	**159,306**	**472**
2016	154,743	482
2015	161,799	392
2014	161,595	386
2013	157,855	404

Monitoring and Treatment of Standing Water Sites Summary:

The program involves routine monitoring of chronic standing water sites including municipally-owned SWMPs, ditches, field pools, etc. As noted above, under the heading Larval Mosquito Surveillance, DRHD and licensed PCO field staff combined to conduct a total of **3,999 standing water site inspections** during the 2017 WNV season, resulting in **966 larvicide applications**.

DRHD also responds to public complaints regarding standing water in privately-owned swimming pools, ornamental ponds, ditches, field pools, etc. A total of **28** new standing water complaints were registered in 2017.

Thirteen new standing water Orders were issued, **8** to property owners and **5** to our licensed PCO, requiring remediation or treatment of the complaint sites.

Product Used: Vectobac (Bacillus thuringiensis israelensis) (Bti)

Treatment of standing water sites with Bti is dependent upon a risk assessment that takes into account the number and type (species) of larvae found, the time of year, the potential for timely site remediation, and WNV surveillance data obtained from Durham Region and other PHU jurisdictions.

Risk thresholds are as follows:

- For SWMPs ≥30 larvae in ≤10 dips to prompt an initial larviciding treatment. Thereafter, larviciding is initiated if any mosquito larvae are present;
- For derelict pools and ornamental ponds, > 0 larvae based on close proximity to human population and relative ease of remediation; and

- For ditches, field pools, etc. the potential for timely site remediation and risk assessment criteria are assessed.

Table 3: Summary of Standing Water Site Treatments (2013-2017)

Year	# of Standing Water Sites Routinely Monitored	Total # of Site Visits	# of Standing Water Sites Requiring Treatment	% of Standing Water Sites Requiring Treatment	# of Treatment Events
2017	**405**	**3,999**	**227**	**56%**	**966**
2016	401	3,365	155	39%	684
2015	395	4,282	185	47%	625
2014	384	3,936	163	42%	852
2013	365	4,517	226	62%	1,119

Table 4: Summary of Standing Water Complaint Investigations, Requests for Service, and PHI Responses (2013-2017)

Year	# of Complaint Investigations	# of Requests for Service	# of PHI Responses
2017	**28**	**0**	**8**
2016	10	3	6
2015	29	5	10
2014	34	9	13
2013	26	23	15

Health Promotion and Public Communications

Table 5: 2017 West Nile Virus and Lyme Disease Communications Campaign

Messaging	Media Type	# of items
Pesticide Notification	"Metroland" Newspapers (1/4 pg. b&w ads) Brock Citizen Oshawa/Whitby/Clarington This Week Pickering/Ajax News Advertiser Port Perry Star Uxbridge Times Journal "Independent" Newspapers (1/4 pg. b&w ads) Brooklin Town Crier Durham Citizen Orono Weekly Times Oshawa Express Scugog Standard Uxbridge Cosmos	8 Metroland ads - 205,750 impressions 6 ads - N/A impressions
"Fight the Bite" and LD Advertisements	Durham Sports HQ; 1/2 page colour ad; bonus article	1 ad + 1 article - N/A impressions
"Fight the Bite" and LD bathroom posters	New Ad Media Classic 13"x17" bathroom stall posters and digital posters from; June x 4 weeks + Sept. x 4 weeks Various restaurants throughout Durham Region Medical Clinics (Walmart) – in Whitby / Oshawa/Pickering/Ajax	22 posters – 31,200 impressions each 62,400 Total
"Fight the Bite" and LD Mobile App	Cross platform ads (mobile, desktop) for each message on The Weather Network from; May x 4 weeks + July x 4 weeks	1 ad each – 155,000 impressions each 310,000 Total
"Fight the Bite" and LD Web Advertisement	Metroland Media Group (durhamregion.com) Leaderboard and Big Box, Mobile Geofencing July x 4 weeks + Sept. x 4 weeks)	1 ad each – 111,000 impressions each 222,000 Total

Messaging	Media Type	# of items
"Fight the Bite" and LD web ads	Parentsource.ca ads - Big box ad (300x300pixels); June x 4 weeks + Sept. x 4 weeks	1 ad each ads - N/A impressions
"Fight the Bite" and LD digital ads	Medical wait room digital LCD screen ads in Oshawa, Whitby, Ajax, Pickering and Uxbridge; May x 4 weeks + Aug. x 4 weeks	30-60 second digital ads x 13 locations across Durham – 47,388 impressions each 94,776 Total
"Fight the Bite" Banner Bug Display	Community Events Regional Headquarters (5 days in each of 4 months – May, June, July, August)	20 display days - N/A impressions
"Let's Target Lyme Disease" Banner Bug Display	Community Events Regional Headquarters (5 days in each of 4 months – May, June, July, August)	20 display days - N/A impressions
"Fight the Bite" Health Promotion Materials	Community Information Regional Headquarters, Environmental Health Week (5 days) Durham District School Board Safety Day (1 day) Uxbridge Fair (1 day) Port Perry Fall Fair (2 days) Orono Fair (2 days)	Distribution of >2,000 promotional items over 11 display days - N/A impressions

Total trackable impressions: 894,926 (West Nile – 447,463; Lyme 447,463)

Response to Public Inquiries – Environmental Help Line Summary:

In 2017 the total number of public inquiries regarding Vector-Borne diseases increased dramatically, largely due to increasing public concerns around ticks and LD. **The number of inquiries related to ticks and LD has risen from 7 in 2013 to 82 in 2017.**

For the first time in 2016 there were calls to the Help Line regarding Zika virus and Zika virus testing. At that time an inquiry category was added to track these calls.

In 2012, an inquiry category was added to track increasing public concerns related to ticks and LD.

Table 6: 2017 Environmental Help Line Inquiries – Vector-Borne Diseases

Topic	# Telephone Calls
General information WNV	40
General information LD	82
Stagnant Water	27
Promotional Material Provided	1
Referrals	1
Zika Virus Inquiries	2
Total	**153**

Table 7: 2016 Environmental Help Line Inquiries – Vector-Borne Diseases

Topic	# Telephone Calls
General information	14
Stagnant Water	25
Promotional Material Provided	0
Referrals	3
LD / Tick Inquiries & Complaints	69
Zika Virus Inquiries	4
Total	115

Table 8: 2015 Environmental Help Line Inquiries – Vector-Borne Diseases

Topic	# Telephone Calls
General information	26
Stagnant Water	27
Promotional Material Provided	1
Referrals	0
LD / Tick Inquiries & Complaints	56
Total	110

Table 9: 2014 Environmental Help Line Inquiries – Vector-Borne Diseases

Topic	# Telephone Calls
General information	22
Stagnant Water	80
Promotional Material Provided	0
Referrals	1
LD / Tick Inquiries & Complaints	14
Total	117

Table 10: 2013 Environmental Help Line Inquiries – Vector-Borne Diseases

Topic	# Telephone Calls
General information	44
Stagnant Water	27
Promotional Material Provided	0
Referrals	4
LD / Tick Inquiries & Complaints	7
Total	82

Notes:

- *In 2017 "General Information" calls were divided into calls related to WNV and those related to LD*
- *In 2016 a new category, "Zika virus Inquiries" was created to track calls from the public and healthcare providers related to Zika virus infection and transmission*

Eastern Equine Encephalitis (EEE)

Overview:

Like WNV, The EEE virus (EEEV) is spread by the bite of infected mosquitoes. EEEV is maintained in nature in a cycle between *Culiseta melanura* mosquitoes and avian (bird) hosts in freshwater, hardwood swamps. The United States Department of Agriculture (USDA) reports that EEEV has been isolated from at least 27 different mosquito species in the USA.

While *Cs. melanura* is the primary vector for EEEV it is not an important vector with regards to transmission of EEEV to humans because it feeds almost exclusively on birds. Rather, "bridge vectors" (i.e., mosquitoes that feed on both birds and mammals), and in particular some *Aedes*, *Coquilletidia,* and *Culex* species, are responsible for transmission of EEEV to humans.

EEEV can cause serious infection in horses with case fatality rates ranging from 50-90% in symptomatic animals. Equine cases of EEE have been reported throughout North America, particularly in Eastern Canada, in a number of US states, and in Mexico. Fortunately, an EEEV vaccine is available for horses. Emus and ostriches are also highly susceptible to EEEV infection.

While most humans infected with EEEV will remain asymptomatic, serious infections, involving encephalitis (inflammation of the lining of the brain) may occur. Severe symptoms can include sudden onset of headache, high fever, chills, and vomiting, followed by disorientation, seizures, and coma. Human case fatality rates range from 30-70%, and survivors often suffer long-term neurological effects.

From 2011 to 2013, the MOHLTC asked PHUs to conduct increased surveillance for EEEV in response to the increase in viral activity in mosquitoes, birds, horses and humans in several US states and the province of Quebec in 2010. Enhanced surveillance for EEEV was discontinued in 2014 as there was found to be negligible EEEV activity in the vector species tested.

Surveillance Results Summary:

In response to an increase in EEEV activity in mosquitoes, birds, horses, and humans in several US states and the province of Quebec between 2008 and 2010, the MOHLTC asked PHUs to conduct increased surveillance for EEEV and they introduced a new order of preference for viral testing of adult mosquitoes in 2011. DRHD implemented the requested viral testing preferences in 2011, 2012, and 2013 (see above).

No EEEV-positive mosquitoes were identified in Durham Region during any of the 2011, 2012, or 2013 surveillance seasons and, despite increased surveillance, only 1 EEEV-

positive mosquito pool was identified in Ontario within that period (a single positive pool of *Coquillettidia perturbans* in Eastern Ontario in 2013)[+].

No *Culiseta melanura* mosquitoes were identified from any of the 174 adult mosquito traps set in 2017. However, a newly established species of mosquito, *Culex erraticus*, was collected (12 specimens). This species has been implicated as an EEEV vector and the collected specimens were tested for both WNV and EEEV. **No** EEEV-positive mosquito pools were identified in 2017.

No cases of equine EEE were reported in Durham Region between 2009 and 2016.

For Ontario, PHO reported **1** EEEV-positive mosquito pool in Huron County and OMAFRA reported **2** cases of equine neurological disease in 2017. In comparison, there were 0 equine cases in 2016, 5 in 2015 and 24 in 2014 [¥].

In the USA, for 2017, the USDA reported **81** equine cases of EEE[∞]. US equine EEE case statistics are of concern in Ontario because many of the equine cases reported in recent years have occurred in bordering states such as Michigan and New York.

No human cases of EEE were reported in Ontario in 2017.

In the USA, in 2016, the CDC reported **7** human cases of EEE. At the time this report was printed no statistics for 2017 were available [≡].

[+] *Source: Public Health Ontario, Eastern Equine Encephalitis Virus - History and Enhanced Surveillance in Ontario, 2014, link:* https://www.publichealthontario.ca/en/eRepository/Eastern_Equine_Encephalitis_Virus_Report_2014.pdf

[¥] Source: Ontario Ministry of Agriculture, Food, and Rural Affairs - Equine Neurological Disease Surveillance 2017. Data last updated October 30, 2017, link: http://www.omafra.gov.on.ca/english/livestock/horses/facts/nhd_surv2017.htm

[∞] *Source: United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) - 2017 Equine Case Reports of Eastern Equine Encephalitis. Data last updated December 5, 2017, link:* https://www.aphis.usda.gov/animal_health/downloads/animal_diseases/2017_eee_report.pdf

[≡] *Source: Centers for Disease Control and Prevention (CDC) - Eastern Equine Encephalitis, Epidemiology and Geographic Distribution.* https://www.cdc.gov/easternequineencephalitis/tech/epi.html

Table 11: Summary of Equine Cases of EEE - Ontario and USA (2013-2017)

Year	# Equine Cases of EEE Reported in Ontario (OMAFRA)	# Equine Cases of EEE Reported in the USA (USDA)
2017	**2**	**81**
2016	0	118
2015	5	70
2014	24	136
2013	1	192

Enhanced Adult Mosquito Surveillance (2011-2013)

2013

mosquito pools tested for EEEV: 128

EEE-positive mosquito pools detected: 0

2012

mosquito pools tested for EEEV: 230

EEE-positive mosquito pools detected: 0

2011

mosquito pools tested for EEEV: 337

EEE-positive mosquito pools detected: 0

Equine Surveillance (2013-2017):

2017

equine EEE cases reported in Durham Region: **0**

equine EEE cases reported in Ontario: **2**

2016

equine EEE cases reported in Durham Region: 0

equine EEE cases reported in Ontario: 0

2015

equine EEE cases reported in Durham Region: 0

equine EEE cases reported in Ontario: 5

2014

equine EEE cases reported in Durham Region: 0

equine EEE cases reported in Ontario: 24

2013

equine EEE cases reported in Durham Region: 0

equine EEE cases reported in Ontario: 1

Human Case Surveillance

2017

No human cases of EEE were reported in Durham Region

Note: To date, there has never been a human case of EEE reported in Ontario

Lyme Disease

Overview:

LD is an infection caused by a spirochete of the genus *Borrelia*. Worldwide, there are several species of *Borrelia* that can cause disease. However, to date in Ontario, the only species of concern is *Borrelia burgdorferi.* The infection is transmitted to humans via the bite of an infected tick. In Ontario, *Ixodes scapularis* (the blacklegged tick / deer tick) is the primary vector of LD.

LD is the most common Vector-Borne disease in North America, and, in 2010, it became a nationally reportable disease in Canada. PHAC has stated that there is a low risk of encountering ticks infected with the LD agent in most of Canada although the risk is increasing in eastern Canada. The risk for exposure to the disease is highest in regions where the ticks that transmit LD are known to be established. However, surveillance data indicates that small numbers of blacklegged ticks can be introduced into widely separated areas of Canada by migratory birds, posing some risk that individuals in other areas may also be exposed to infected ticks.

Passive Tick Surveillance

DRHD accepts tick specimens, submitted by members of the public or health care providers, that have been found and/or feeding on human hosts. These specimens are sent for identification by the PHOL. If they are identified as *Ixodes scapularis* ("blacklegged"/"deer") ticks, they are then forwarded to the National Microbiology Laboratory (NML) in Winnipeg to determine if they are carrying *Borrelia burgdorferi,* the bacterium that causes Lyme disease.

The number of ticks submitted annually to DRHD has increased dramatically from 2013 to 2017. A summary of passive tick surveillance results, 2013 to 2017, is included in Table 12.1.

Active Tick Surveillance

Active surveillance for blacklegged ticks ("tick dragging") has been conducted, in likely tick habitats within Durham Region, since 2010. For the first time, in the fall of 2014, blacklegged ticks, positive for *Borrelia burgdorferi*, were found during active surveillance activities. These findings resulted in a joint media release being issued by DRHD, Toronto Public Health, and York Region Community and Health Services, warning the public to take precautions against ticks when spending time outdoors in and around wooded areas. In addition, an updated *FAX About Lyme Disease* was distributed to all Durham Region health care providers advising them to consider LD as a possible

diagnosis for patients with related symptoms and/or whose lifestyle and travel histories may have resulted in them being exposed to ticks.

More LD-positive ticks were found in Durham Region between 2015 and 2017 and each year the number of established tick populations appears to be increasing within the Region.

Active tick surveillance was conducted at **9** different sites within Durham Region during 2017. Active surveillance sites are determined based on information obtained from passive surveillance (i.e. sites where the public has indicated they had exposure to blacklegged ticks).

A total of **21 blacklegged ticks were found during active surveillance at 5 different sites in Durham Region in 2017. Six of those 21 ticks were found to be positive for *Borrelia burgdorferi*.** Five of the 6 positive ticks were found in the Rouge Valley (Pickering), a known "risk area" for LD. The other positive tick was 1 of 7 ticks found at a conservation area in north Ajax. Further surveillance during 2018 will assist in determining if this is a new "LD risk area".

PHO defines "estimated LD risk areas"***** as locations where blacklegged ticks have been identified or are known to occur and where humans have the potential to come into contact with infected ticks. In the fall of 2016, signage was posted at the entrances to the Lynde Shores Conservation Area and the Rouge Valley, warning the public that blacklegged tick populations have become established in these areas.

In the fall of 2017 signage was provided to the Lake Simcoe Region Conservation Authority in relation to public concerns about the number of ticks being found on the various trails throughout the Durham Forest, Uxbridge. Further signage will be provided as new "estimated Lyme disease risk areas" are identified within Durham Region.

***** Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario). Technical Report: Update on Lyme disease Prevention and Control, Second Edition, Toronto, ON: Queen's Printer for Ontario; 2016, link: http://www.publichealthontario.ca/en/eRepository/Technical_report_update_on_Lyme_disease_prevention_and_control.pdf

Human Case Surveillance

LD became a reportable disease in Ontario in 1988 and a nationally notifiable disease in 2010. Because of this, DRHD routinely conducts human LD case investigations whenever laboratory testing, ordered by health care providers, is received and if results indicate that a patient has had a positive reaction to one or both tiers of LD testing. Confirmed and probable cases of LD are defined based on the patient's history of residence in or visit to a LD risk area plus a combination of clinical and laboratory evidence.

While the risk of contracting LD within Durham Region is currently low, the potential for infection is likely to increase subject to deer, small rodent, and bird migration patterns across the north shore of Lake Ontario. In addition, changing climatic conditions may contribute to an expansion of the distribution of ticks that carry LD.

In 2010, in an effort to increase public awareness about the risk of LD, DRHD developed a communication plan that included the provision of LD information on the Durham Region website and the development of an LD brochure and "Banner Bug" display. Since then, the annual communication campaign has expanded to include digital advertising in medical offices and malls, signage at golf courses and restaurants, and web-based ads via various media outlets.

From 2011 to 2013, DRHD staff distributed LD brochures to a number of target groups (i.e., school boards, horticultural societies, campers and hikers, etc.) as well as providing information and displays at a number of community events. The LD "Banner Bug" display was used at a number of community events and for LD presentations. An interactive LD trivia game was developed for use during presentations and at events to attempt to increase awareness amongst school-aged groups.

Between 2014 and 2016, LD information pamphlets were distributed to a number of target groups including all horticultural societies, all garden centres, all golf courses and all medical offices within Durham Region

Passive Tick Surveillance Summary:

In 2017, **176** tick specimens were submitted to DRHD for identification and potential testing. **One hundred and seventeen** of the **176** specimens were identified as blacklegged ticks, while the other specimens were identified as follows: **42** *Dermacentor variabilis* ("dog tick"); **7** *Ixodes cookei* ("woodchuck / groundhog tick"); **3** *Amblyomma americanum* ("Lone Star tick") or other *Amblyomma species*; **3** *Rhipicephalus sanguineus* ("brown dog tick") and **4** other tick species.

Eighty of the 117 blacklegged ticks identified were reported to have been acquired locally in Durham Region. The other 37 were acquired from various geographic areas outside Durham Region.

As of March 2, 2018, **18** of the 117 blacklegged ticks identified were found to be positive for *Borrelia burgdorferi*, the agent responsible for LD. Of the 18 positive ticks, **9** were reported to have likely been acquired within Durham Region. The other **9** were reported to have been acquired elsewhere.

The number of tick specimens submitted annually to DRHD, for identification and potential testing, has increased six-fold since 2013 (i.e., from 28 to 176).

*Note: As of March 2, 2018, test results for **9** blacklegged tick specimens, submitted in 2017, had not been received from NML. **Two** of these specimens were reported to have not likely been acquired within Durham Region, but the other **7** likely were.*

2017

 # ticks submitted for identification and potential testing: 176

- Breakdown of tick identification results:
    - Blacklegged tick (*Ixodes scapularis)* **117**
    - Woodchuck tick (*Ixodes cookei*) **7**
    - Dog tick (Dermacentor variabilis) **42**
    - Lone star tick (*Amblyomma americanum*) **3**
    - Brown dog tick (*Rhipicephalus sanguineus)* **3**
    - Other tick species **4**

ticks reported acquired as a result of travel outside of Durham Region: **37**

ticks reported to have been locally acquired: **103**

locally-acquired, blacklegged ticks: **80**

blacklegged ticks testing positive for *Borrelia burgdorferi*: **18 (as of March 2, 2018)**

of locally-acquired, blacklegged ticks testing positive for *B. burgdorferi*: **9 (as of March 2, 2018)**

2016

ticks submitted for identification and potential testing: 83

- Breakdown of tick identification results:
    - Blacklegged tick (*Ixodes scapularis)* 57
    - Woodchuck tick (*Ixodes cookei*) 2
    - Dog tick (Dermacentor variabilis) 13
    - Lone star tick (*Amblyomma americanum*) 1
    - Other tick species 1

ticks reported acquired as a result of travel outside of Durham Region: 32

ticks reported to have been locally acquired: 51

locally-acquired, blacklegged ticks: 39

blacklegged ticks testing positive for *Borrelia burgdorferi*: 4

of locally-acquired, blacklegged ticks testing positive: 1

2015

ticks submitted for identification and potential testing: 84

- Breakdown of tick identification results:
    - Blacklegged tick (*Ixodes scapularis)* 60
    - Woodchuck tick (*Ixodes cookei*) 5
    - Dog tick (Dermacentor variabilis) 17
    - Lone star tick (*Amblyomma americanum*) 2
    - Other tick species 0

ticks reported acquired as a result of travel outside of Durham Region: 30

ticks reported to have been locally acquired: 30

locally-acquired, blacklegged ticks: 30

blacklegged ticks testing positive for *Borrelia burgdorferi*: 5

of locally-acquired, blacklegged ticks testing positive: 2

2014

ticks submitted for identification and potential testing: 35

- Breakdown of tick identification results:
    - Blacklegged tick (*Ixodes scapularis)* 18
    - Woodchuck tick (*Ixodes cookei*) 3
    - Dog tick (Dermacentor variabilis) 12
    - Other tick species 1

ticks reported acquired as a result of travel outside of Durham Region: 21

ticks reported to have been locally acquired: 14

locally-acquired, blacklegged ticks: 12

of locally-acquired, blacklegged ticks testing positive: 0

2013

ticks submitted for identification and potential testing: 28

- Breakdown of tick identification results:
    - Blacklegged tick (*Ixodes scapularis)* 12

- Woodchuck tick (*Ixodes cookei*) 2
- Dog tick (Dermacentor variabilis) 8
- Other tick species 6

ticks reported acquired as a result of travel outside of Durham Region: 20

ticks reported to have been locally acquired: 8

locally-acquired, blacklegged ticks: 5

of locally-acquired, blacklegged ticks testing positive: 0

Table 12.1: Passive Tick Surveillance Results (2013-2017)

Year	# Ticks Submitted	# of Blacklegged Ticks Identified	# of LD-positive Blacklegged Ticks Acquired Within Durham (as of March 2, 2018)	# of LD-positive Blacklegged Ticks Acquired Outside Durham (as of March 2, 2018)
2017	**176**	**117**	**9**	**9**
2016	83	57	1	3
2015	84	60	2	3
2014	35	18	0	2
2013	28	12	0	2

Active Tick Surveillance Summary:

Active tick surveillance ("tick dragging") has been conducted in Durham Region each year since 2010.

No ticks were found during active surveillance activities until the fall of 2013 when 19 blacklegged ticks were found in south Whitby.

In the fall of 2014, 7 blacklegged ticks were found during active tick surveillance at 3 different sites as follows: 1 tick at Lynde Shores Conservation Area in south Whitby, 4 ticks in the Rouge Valley in south Pickering, and 2 ticks on the Seaton Hiking Trail in north Pickering. Three of the 4 blacklegged ticks found in the Rouge Valley (Pickering) subsequently tested positive for *B. burgdorferi*. This was the first time that any blacklegged ticks, found within Durham Region, have tested positive for the bacteria that causes Lyme disease.

In October of 2015, 12 ticks were found as follows: 10 ticks in the Rouge Valley, south Pickering, and 2 ticks at Lynde Shores Conservation Area, south Whitby. No ticks were found at other surveillance locations. Four of the 10 ticks found in the Rouge Valley

tested positive for *B. burgdorferi*. The other 6 ticks from the Rouge Valley and the 2 ticks found at Lynde Shores Conservation Area all tested negative for the bacteria.

In the fall of 2016, 8 blacklegged ticks were found at 3 separate sites within Durham Region: in Durham Forest (Uxbridge), on the waterfront trail near the Darlington Nuclear Plant (Clarington), and in Darlington Provincial Park (Clarington). None of the ticks tested positive for *B. burgdorferi* bacteria or any other pathogens of concern. While active surveillance was conducted at a number of other sites, no ticks were found.

"Get Tick Smart" signs were posted at the entrances to the Rouge Valley (south Pickering) and Lynde Shores Conservation Area (south Whitby) in the fall of 2016, to warn the public that blacklegged tick populations have become established in these areas.

Active tick surveillance was conducted in the spring and fall of 2017. In total, active tick surveillance was conducted at **9** separate sites throughout Durham Region. Surveillance site selections were based on information gathered via passive surveillance. Overall, for 2017, **21** blacklegged ticks were found at **5** of the 9 sites as follows: 6 in the Rouge Valley, Pickering; 6 in Durham Forest, Uxbridge at the Main Tract and Walkers Woods; 2 at Lynde Shores CA, Whitby; and 7 at Greenwood CA, Ajax.

Six of the 21 ticks found in 2017 tested positive for *Borrelia burgdorferi* including 5 of the 6 ticks found in the Rouge Valley and 1 of the 7 ticks found at the Greenwood CA.

2017

ticks found through active tick surveillance in Durham Region: **21** at 5 separate sites

blacklegged ticks identified: **21**

LD-positive blacklegged ticks identified: **6**

2016

ticks found through active tick surveillance in Durham Region: 8 at 3 separate sites

blacklegged ticks identified: 8

LD-positive blacklegged ticks identified: 0

2015

ticks found through active tick surveillance in Durham Region: 12 at 2 separate sites

blacklegged ticks identified: 12

LD-positive blacklegged ticks identified: 4 (all from the same site)

2014

ticks found through active tick surveillance in Durham Region: 7 at 3 separate sites

blacklegged ticks identified: 7

LD-positive blacklegged ticks identified: 3 (all from one of the 3 sites)

2013

ticks found through active tick surveillance in Durham Region: 19 at a single site

blacklegged ticks identified: 19

LD-positive blacklegged ticks identified: 0

Table 12.2: Active Tick Surveillance Results (2013-2017)

Year	# of Ticks Found	# of Blacklegged Ticks Identified	# of LD-positive Blacklegged Ticks Identified
2017	**21$^{\Omega}$**	**21**	**6$^{\alpha}$**
2016	8	8	0
2015	12$^{£}$	12	4^{ŧ}
2014	7$^{\infty}$	7	3$^{\neq}$
2013	19	19	0

$^{\Omega}$ *Note: the 21 ticks were found at 5 separate sites within Durham Region*

$^{\alpha}$ *Note: the 6 LD-positive ticks were found at 2 separate sites within Durham Region*

$^{£}$ *Note: the 12 ticks were found at 2 separate sites within Durham Region*

^{ŧ} *Note: all 4 LD-positive ticks were found at the same site within Durham Region*

$^{\infty}$ *Note: the 7 ticks were found at 3 separate sites within Durham Region*

$^{\neq}$ *Note: all 3 LD-positive ticks were found at the same site within Durham Region*

Human Case Surveillance Summary:

DRHD observed a dramatic increase in the number of LD test results received in 2017 as compared to 2016 and previous years.

The PHOL performs tests for antibodies to *B. burgdorferi* using a two-tier test method as recommended by the Canadian Public Health Laboratory Network. Initially, specimens

are tested for total antibodies using a *Borrelia* (Lyme) IgM/IgG ELISA. A specimen that is either reactive or indeterminate by ELISA will be further tested for IgM and IgG specific antibodies using a western blot (WB) assay.

In all instances where patients react to either the ELISA or both the ELISA and WB testing, the PHOL forwards the test results to the local PHU as per the requirements under the *Health Protection and Promotion Act*.

DRHD investigates all "reactive" test results to attempt to determine if individuals represent a "confirmed" or "probable" case of LD based on prescribed MOHLTC definitions.

In 2017, there were **40** confirmed and **8** probable human cases of LD identified in Durham Region (as of January 12, 2018), as compared to 16 confirmed and 8 probable human cases identified in 2016.

Twelve of the 40 confirmed and **4** of the 8 probable cases reported that their tick exposures most likely occurred within Durham Region.

One of the 40 confirmed cases was positive for *Borrelia garinii,* one of two European strains of *Borrelia* that are known to cause Lyme disease.

Between 2013 and 2017, a total of **82** confirmed human cases of LD were reported in Durham Region. In addition, **28** probable human cases were reported in that period.

2017

human cases of LD reported In Durham Region: **40** confirmed, **8** probable (as of January 31, 2018)

2016

human cases of LD reported In Durham Region: 16 confirmed, 8 probable (as of January 24, 2017)

2015

human cases of LD reported In Durham Region: 11 confirmed, 4 probable

2014

human cases of LD reported In Durham Region: 9 confirmed, 3 probable

2013

human cases of LD reported in Durham Region: 6 confirmed, 5 probable

Table 13: Summary of Reported Human Cases of Lyme Disease (2013-2017)

Year	# of Confirmed Human Cases Reported	# of Probable Human Cases Reported
2017	**40**	**8**
2016	16	8
2015	11	4
2014	9	3
2013	6	5

Other Vector-Borne Diseases of Concern

Malaria

Overview:

Malaria is an acute, flu-like illness caused by one of four species of parasite of the genus *Plasmodium*: *Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale,* and *Plasmodium malariae.*

Malaria is most commonly transmitted to humans through the bite of an infected female *Anopheles* mosquito. When an *Anopheles* mosquito ingests blood from a malaria-infected person, malaria parasites develop in the mosquito and migrate into the mosquito's salivary glands. When the infected mosquito bites another human, malaria can be transmitted to that individual. In rare instances the malaria parasite can also be transmitted by transfusion with infected blood, by shared needle use, or by a mother to her unborn child.

Symptoms of malaria include fever and flu-like symptoms such as headache, nausea, vomiting, muscle pain or spasms, chills, and malaise. Acute infection can cause enlargement of the spleen and make the liver tender.

The severity of the illness varies depending on which species of the malaria parasite is responsible for the infection. Of the 4 parasite species, *P. falciparum* is responsible for the most serious illness, including seizures, coma, kidney failure, and respiratory failure, which can lead to death.

If identified early and treated appropriately, almost all malaria cases can be completely cured. However, even short delays in diagnosis can make treatment more difficult and less successful.

Malaria is endemic (i.e., constantly occurring) in most of Sub-Saharan Africa and New Guinea; in large areas of South Asia, Southeast Asia, Oceania, Haiti, Central and South America; and in parts of Mexico, the Dominican Republic, North Africa, and the Middle East.

According to PHAC, there are roughly 400 reported travel-related cases of malaria in Canada each year, and it is estimated that up to 50% of cases are never reported. Measures to prevent malaria infection include personal precautions to avoid mosquito bites, and the use of effective anti-malarial medications. No vaccine is available.

Surveillance Results:

2017

Four confirmed cases of malaria were reported in Durham Region in 2017.

P. falciparum was identified as the agent responsible in 3 of the 4 cases while *P. vivax* was responsible for the 1 other case.

Travel to or residence in an endemic country was a known risk factor in all 4 cases.

2016

Six confirmed cases of malaria were reported in Durham Region in 2016.

P. falciparum was identified as the agent responsible in 4 of the 6 cases while *P. vivax* and *P. ovale* were each responsible for 1 of the other 2 cases.

Travel to or residence in an endemic country was a known risk factor in all 6 cases.

2015

Six confirmed cases of malaria were reported in Durham Region in 2015

P. falciparum was identified as the agent responsible in 5 of the 6 cases. The specific disease agent was not identified in the 6th case.

Travel to or residence in an endemic country was a known risk factor in the 5 cases. No details were available with respect to travel /residence or exposure in the other case.

2014

Nine confirmed cases of malaria were reported in Durham Region in 2014

P. falciparum was identified as the agent responsible in 2 of the cases, and *P. vivax* in another 3 cases. The responsible agent was not identified in 4 of the cases.

Travel to or residence in an endemic country was a known risk factor in 3 of the cases. There was no information available with respect to travel /residence in the other 6 cases.

2013

Durham Region had 12 confirmed cases of malaria reported during 2013

P. falciparum was identified as the agent responsible for 6 of the cases while *P. vivax* accounted for the other 6.

In all but 2 cases, travel to or residence in an endemic country was a known risk factor. No information with respect to travel/residence was available for the other 2 cases.

Table 14: Summary of Human Cases of Malaria (2013-2017)

Year	# of Cases	# Cases with Travel or Residence in an Endemic Country as a Known Risk Factor	Responsible Organism
2017	**4**	**4**	**3 - *P. faciparum* / 1 - *P. vivax***
2016	6	6	4 - *P. falciparum* / 1 - *P. vivax* / 1 - *P. ovale*
2015	6	5	5 - *P. falciparum* / 1 - unspecified
2014	9	3	2 - *P. falciparum* / 3 - *P. vivax* / 4 - unspecified
2013	12	10	6 - *P. falciparum* / 6 - *P. vivax*

Plague

Overview:

Plague is an infectious disease caused by the bacteria *Yersinia pestis.* It can affect both animals and humans. Plague is transmitted between animals and humans by the bite of infected fleas, direct contact with infected rodents, inhalation, and rarely, ingestion of infective materials. While there have been many outbreaks of plague in human history, outbreaks are rare today.

There are three different types of illness that the plague infection can cause. They are bubonic, pneumonic, and septicemic plague. All forms of plague begin with flu-like symptoms including fever, chills, muscle pain, weakness, and headache. Symptoms can also include nausea, vomiting, diarrhea, and abdominal pain.

Bubonic plague is the most common form of the plague. Infection results from the bite of an infected flea that has fed on an infected rodent, such as a rat. Bubonic plague infection affects the lymph nodes, causing swelling and pain.

Pneumonic plague is the least common but most deadly form of plague. It can be spread through airborne droplets released through coughs or sneezes, or contact with infected body fluids. It can also be spread through contact with clothing, or bed linens that have been contaminated with infected body fluids.

Septicemic plague can result from either bubonic or pneumonic plague.

Rapid diagnosis and treatment of plague is essential to reduce complications and fatality. Effective treatment methods enable almost all patients to be cured if diagnosed in time. Several antibiotics can effectively treat plague along with supportive therapy. While there is a vaccine to protect people who are at high risk of exposure to the disease, the vaccine is not available for general public use.

Because plague is usually transmitted from animals to humans via rodents or their fleas, in areas where plague is established in wildlife populations, people should avoid contact with the habitats where infected rodents or fleas might reside.

Surveillance Results 2013 - 2017

No human cases of plague were reported in Durham Region

Note: Human cases of plague are very rare in Canada. The last reported case occurred in 1939.

Tularemia

Overview:

Tularemia is an infection that is caused by the bacteria *Francisella tularensis.* It is endemic throughout North America, and many parts of Europe as well as the Soviet Union, China, and Japan.

The reservoirs for tularemia in North America include rodents, rabbits, muskrats, and beavers. The organism can also be carried by various hard ticks. Tularemia can be spread from animals to humans, although this is not common. Human infection usually results from direct contact with infected live animals, animal hides, or uncooked meat, but may also occur as a result of a tick bite, or inhalation of contaminated dust from animal environments (e.g., cages, barns, etc.).

The clinical signs of tularemia infection in animals are not always obvious, and will vary depending on the susceptibility of the animal species to the bacteria, the virulence of the bacteria, and the source of the infection

There are two types of tularemia: Type A and Type B. Type A tularemia usually causes more serious illness in people.

The onset of disease in humans is usually sudden, with cases experiencing flu-like symptoms including: high fever, chills, general body aches, headache, and nausea. An ulcer often develops on the skin or mouth at the site of introduction of the organism, and there may be swelling and pain in the lymph glands.

Symptoms of infection vary according to the means by which the *F. tularensis* bacterium is introduced into the body. Ingestion of the organism can produce pharyngitis, abdominal pain, diarrhea, and vomiting, while inhalation can result in pneumonia, and

introduction into the eyes can result in painful and productive conjunctivitis. Symptoms usually appear three to five days after exposure to the bacteria, but can take up to 14 days to appear.

While both types of tularemia can usually be successfully treated with antibiotics, in rare cases tularemia can be fatal.

Surveillance Results 2013 - 2017

No human cases of tularemia were reported in Durham Region

Yellow Fever

Overview:

Yellow fever is caused by a virus that is transmitted to humans by the bite of an infected mosquito. Yellow fever derives its name from the yellowing of the skin and eyes (jaundice) that occurs when the virus attacks the liver.

The primary vector of yellow fever virus is *Aedes aegypti* but other *Aedes* species in Africa and the *Haemagogus* species in South America also play a role in transmission. Non-human primates (e.g. monkeys, great apes) can also be infected with the yellow fever virus, and these animals serve as a reservoir for the virus in rural and jungle areas.

Yellow fever is endemic (always present) in many tropical areas of South America and Africa. Canadians travelling to endemic areas may be at risk of contracting the virus.

Symptoms of yellow fever usually take 3-6 days to appear in infected individuals, and may include sudden onset of fever, headache, joint pain, loss of appetite, abdominal pain, vomiting, and dehydration. Most patients recover after this stage. However, in severe cases, the disease can lead to shock, internal bleeding, jaundice (yellowing of the skin and eyes), and organ failure. This occurs in about 15% of patients.

The case-fatality rate for those who develop severe yellow fever disease is 20-50%. Once symptoms develop there is no specific treatment, and the only option is supportive care.

A yellow fever vaccine is available to prevent infection. First time recipients of the vaccine must be vaccinated at least 10 days before travelling to endemic areas for the vaccine to be effective. In addition to vaccination, personal protective measures against mosquitoes are recommended for persons travelling to endemic regions.

PHAC indicates that mosquito control has played a major role in preventing transmission of yellow fever in North America and Europe.

Surveillance Results:

2017

No human cases of yellow fever were reported in Durham Region.

2016

No human cases of yellow fever were reported in Durham Region.

2015

No human cases of yellow fever were reported in Durham Region.

2014

One human case of yellow fever reported in Durham Region. This case was reported to have been related to travel to Guyana.

2013

No human cases of yellow fever were reported in Durham Region

Zika Virus

Overview:

Zika virus was first identified in humans in 1952 in the Zika forest of Uganda. Since then, outbreaks of disease have been recorded in Africa, Asia, the Americas and the Pacific.

Zika virus is generally transmitted to humans via the bite of an infected mosquito. The vectors of Zika virus are *Aedes* mosquitoes (i.e., *Ae. aegypti* and *Ae. albopictus*). These mosquitoes also transmit the dengue and chikungunya viruses.

In addition to the primary means of transmission, it is now known that the Zika virus can be transmitted sexually from one partner to another via semen or vaginal fluids and that a pregnant woman infected with Zika virus can transmit the virus to her fetus during pregnancy or at the time of birth resulting in the potential for severe birth defects. Zika can also potentially be transmitted via blood transfusions, and via laboratory and healthcare setting exposures.

Most people infected with Zika virus experience mild symptoms including: fever, rash, joint pain, conjunctivitis, muscle pain, and headache. Some have no symptoms. However, during a large outbreak of Zika virus that was identified in Brazil in the spring of 2015, researchers identified an association between Zika virus infection and Guillain-Barré syndrome. In addition, it was found that Zika virus infection during pregnancy can

cause microcephaly and other severe birth defects. Microcephaly is a condition in which a baby has a head size much smaller compared to other babies of the same age and sex. Head size is an important measure of a child's brain growth. Researchers are still attempting to determine the full range of potential health problems Zika virus may cause.

There is no vaccine for Zika virus so the best way to prevent Zika virus transmission is to protect against mosquito bites using appropriate clothing, insect repellents, and barriers such as window screens and mosquito netting. Sexual transmission can be prevented with condom use or abstinence from sex after potential exposures to the virus.

Currently the risk of acquiring Zika virus within Canada is extremely low as it is thought that the Canadian climate is not conducive to the survival of and proliferation of *Aedes aegypti* and *Aedes albopictus* mosquitoes. However, PHAC is planning to enhance mosquito surveillance within Canada in future to allow for the detection of species that could transmit the virus.

Surveillance Results:

As of December 1, 2017, **544** travel-related cases and **4** sexually transmitted cases of Zika virus infection have been reported in Canada since cases started being detected in October 2015. A total of **37** cases have been reported amongst pregnant women in Canada and 2 newborns with Zika-related anomalies have been reported [≠].

[≠] Source: Public Health Agency of Canada (PHAC), Surveillance of Zika Virus, link: http://www.healthycanadians.gc.ca/diseases-conditions-maladies-affections/disease-maladie/zika-virus/surveillance-eng.php

Program Evaluation Durham Region - Rapid Risk Factor Surveillance System (RRFSS) Results

Note: No new data was available for 2017 at the time this report was printed.

The RRFSS is an ongoing telephone survey of adults aged 18 years and older, conducted by the Institute for Social Research at York University, on behalf of DRHD and other participating Ontario PHUs. Since 2001, a sample of at least 100 Durham Region residents has been surveyed on a monthly basis regarding knowledge, attitudes and risk behaviours of importance to public health. Questions related to WNV were included in the Durham Region RRFSS survey from 2002 to 2005, and in 2008, 2010, 2012, 2014, and 2016. Data collection for WNV did not take place in 2006, 2007, 2009, 2011, 2013 or 2015. In 2011, new modules were added to RRFSS to measure awareness and perceived risk of LD and the use of personal protective measures. The LD questions were included in the Durham Region RRFSS survey in 2011, 2012, 2013, and 2015. The RRFSS results provide data for evaluation of DRHD initiatives to increase public awareness and encourage behaviours that reduce the risk of contracting WNV and LD.

Data Notes:

95% Confidence Interval (CI): Percentages are expressed in the form of the point estimate ± the 95% CI around the estimate. The true or actual percentage falls within the range of values, 95 out of 100 times. A wide CI reflects a large amount of variability or imprecision. Usually, CIs are narrower when a large number of residents are surveyed. In bar charts, the 95% CI is represented by an error bar (I) at the top of each bar.

Significant Difference refers to a difference between two estimated percentages that is not likely due to chance. If the 95% confidence intervals of two estimates do not overlap, there is considered to be a significant difference between the estimates.

Household Weights are applied when calculating the estimates to adjust for the unequal probability of respondent selection based on the number of adults in the household.

WNV

During the summer of 2016 (May-August), over 615 Durham Region adults aged 18 and older were surveyed regarding awareness of WNV and use of personal and household protective measures to reduce exposure to mosquitoes and mosquito bites.

WNV Awareness

In 2016, **97%** (±2%) of adults in Durham Region had heard of WNV and **83%** (±4%) knew that WNV is passed on to people by mosquitoes. In 2014, when these questions were last asked, 98% (±1%) had heard of WNV and 89% (±3%) knew that mosquitoes were the means of transmission. This slight decrease since 2014 does not represent a significant change in awareness.

WNV Personal Protective Behaviours - Use of Clothing & DEET

2016

During the summer of 2016, **37%** (±5%) of Durham Region residents reported covering up with long sleeves, pants, and socks all or most of the time to protect themselves from being bitten by mosquitoes and about **13%** (±4%) of residents used a DEET-based insect repellant all or most of the time.

Main Reasons for Not Covering Up More Often (among residents who did not cover-up all or most of the time), Durham Region, May - August 2016

Table 15: Response Rate for Not Covering Up More Often

Response	Rate
Not Enough Mosquitoes Out	39% (±6%)
Not Worried About Being Bitten by Mosquitoes	23% (±6%)
Didn't Go Where Mosquitoes Are	17% (±5%)
Too Hot to Cover Up	16% (±5%)
Other Reasons	5%* (±2%)

Main Reason for Not Using DEET More Often (among residents who did not use DEET all or most of the time), Durham Region, May - August 2016

Table 16: Response Rate for Not Using DEET

Response	Rate
Not Enough Mosquitoes Out	36% (±5%)
Not Worried About Being Bitten by Mosquitoes	15% (±4%)
Didn't Go Where Mosquitoes Are	22% (±5%)
Don't Like Using Chemicals Like DEET	21% (±5%)
Other Reasons	6%* (±3%)

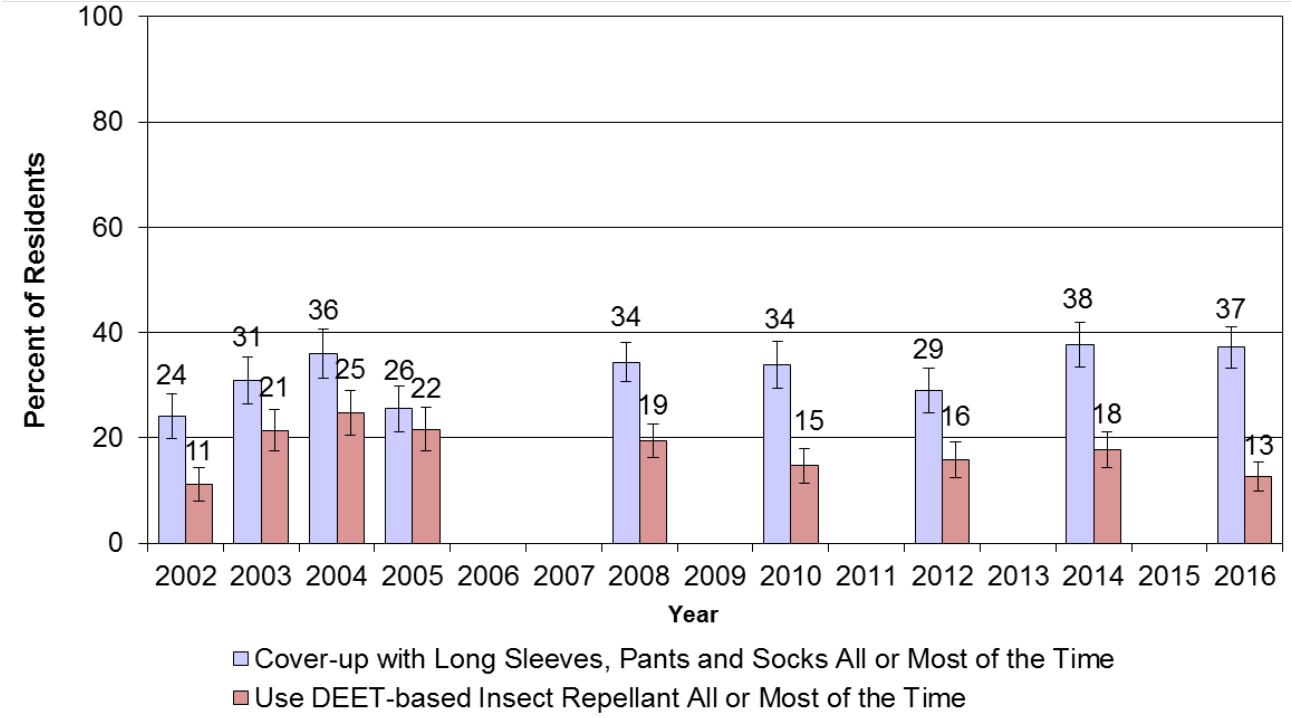
**Interpret with caution due to high variability*

Trend 2002 - 2016

The percentage of residents who cover-up with long sleeves, pants, and socks all or most of the time to protect themselves from being bitten by mosquitoes was similar in 2016 (37% ±5%) compared to 2014 (38% ±4%). There have been regular annual fluctuations over the more than ten years of data collection, such as the significant increase between 2012 (29% ±4%) to 2014 (38% ±4%).

Use of DEET-based insect repellant increased from 11% (±3%) in 2002 to a peak of 25% (±4%) in 2004. From 2008 onwards, it has since declined; ranging between 13% and 19%.

Graph 1: WNV Personal Protective Behaviours, Adults (18+), Durham Region, 2002-2016



WNV Household Protective Behaviours - Removal of Standing Water & Use of Window/Door Screens

2016

During the summer of 2016, **92%** (±3%) of Durham Region households did not have containers outside where water collected and stayed for more than 7 days: 75% (±4%) did not have containers that collected water and 17% (±3%) reported having containers where water could collect but was not allowed to stay for more than 7 days at a time. Only 8% (±2%) of households reported having containers where water collected and stayed for more than 7 days.

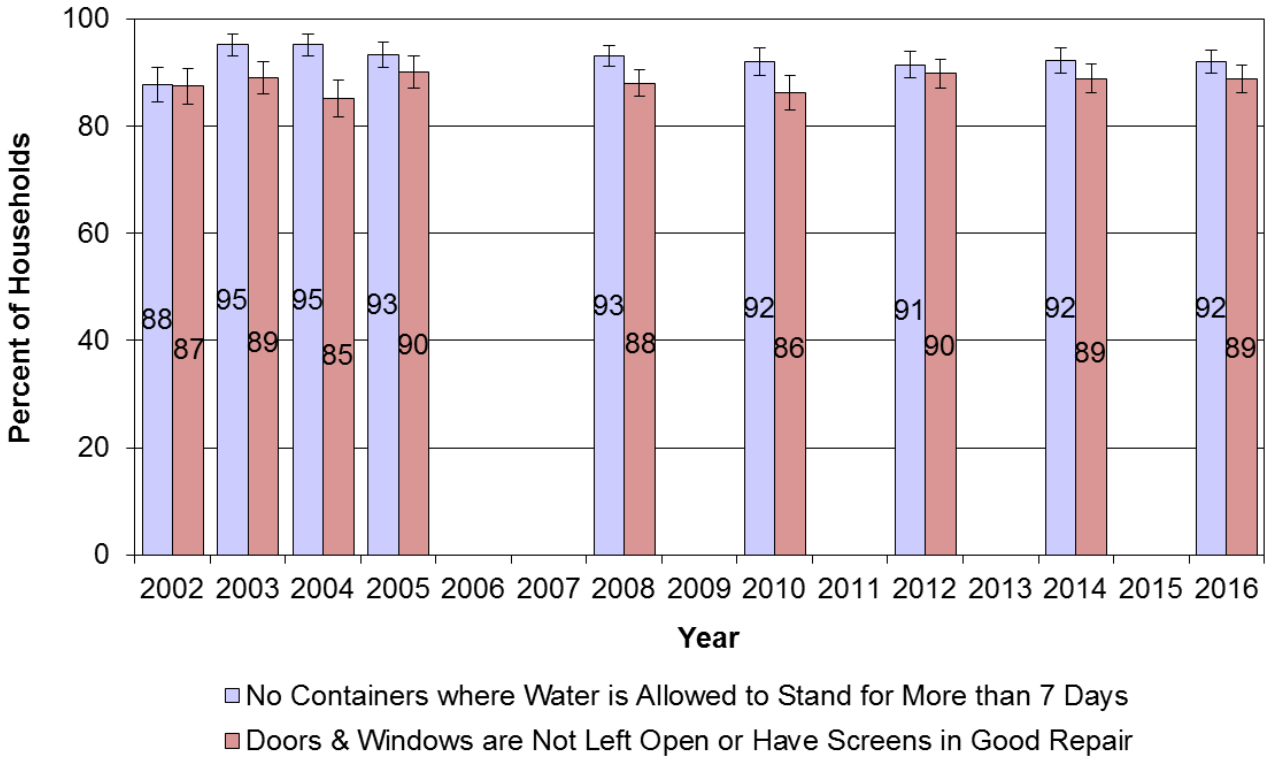
Most households (**89%** ±3%) had all door and window screens in good repair or did not leave doors and windows open: 67% (±4%) reported having screens with no holes or tears and 22% (±3%) did not leave doors and windows open. Ten per cent (10% ±2%) of households had screens in need of repair or had windows and doors without screens.

Trend 2002 - 2016

The percentage of households with no containers outside where water is allowed to collect and stand for more than 7 days increased significantly from 88% (±3%) in 2002 to 95% (±2%) in 2003 and 2004 and has since remained relatively steady ranging from about 91% to 93% of households.

The percentage of households with screens in good repair or where doors and windows are not left open has remained relatively steady since 2002 ranging from about 85% to 90% of households.

Graph 2: WNV Household Protective Behaviours, Durham Region, 2002-2016



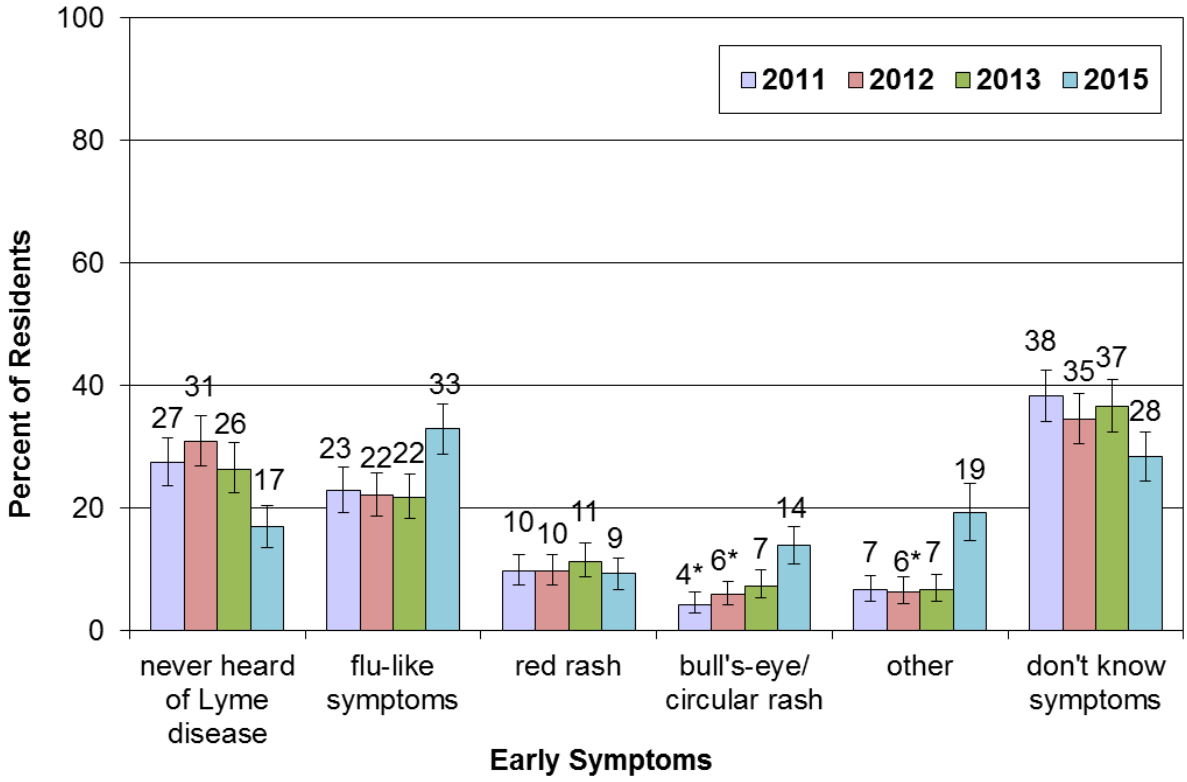
LD

During 2011, 2012, 2013, and 2015, approximately 600 Durham Region adults were surveyed each fall regarding their awareness and perceived risk of LD and their use of personal protective measures during the past summer to reduce exposure to ticks.

LD Awareness

In 2015, 83% (±4%) of adults in Durham Region had heard of LD and more than half (58% ±4%) knew that people get LD from ticks. These results are significantly higher compared to 2012 or 2013. Awareness of the early symptoms of LD varied: 33% (±4%) mentioned general flu-like symptoms including fatigue, fever or chills, muscle or joint pain, or swollen lymph nodes, 9% (±3%) mentioned a red rash and only 14% (±3%) specifically described a circular "bull's-eye" rash. The number of residents who were able to identify flu-like symptoms and a bull's eye rash has significantly increased from 2013 compared to 2015. There was also a statistically significant decrease in the number of residents who haven't heard of LD.

Graph 3: Awareness of Early Symptoms of LD, Adults (18+), Durham Region, 2011-2013, 2015



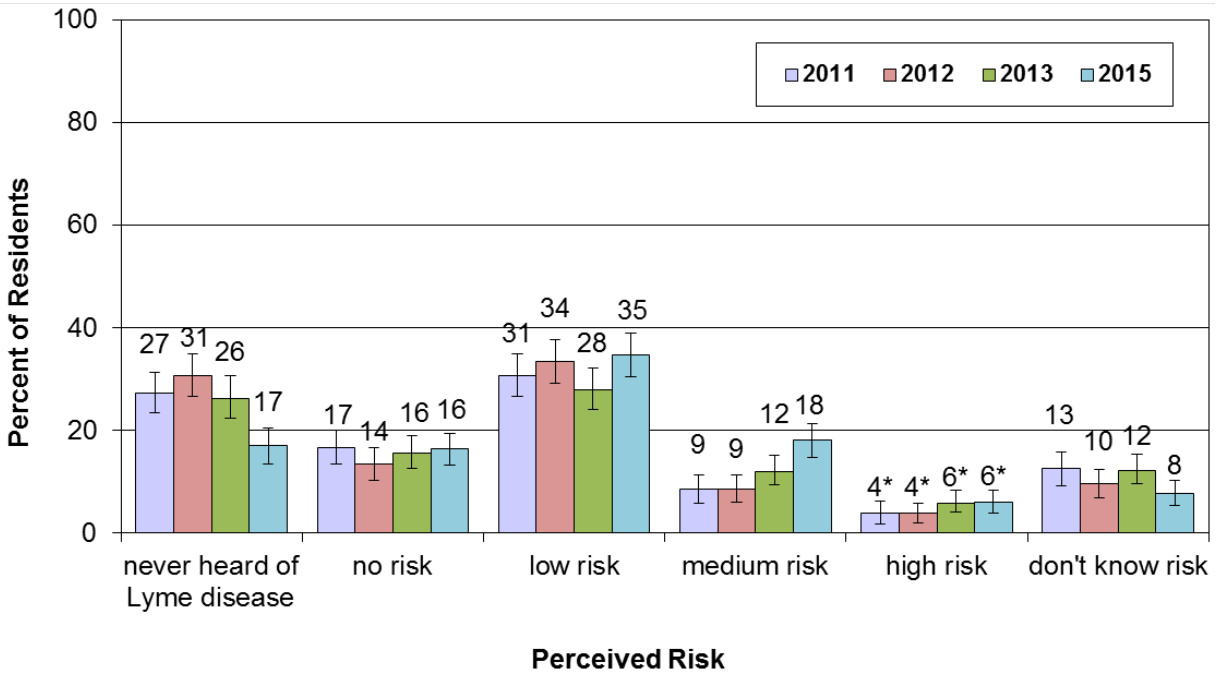
**Interpret with caution due to high variability.*

Among those who had heard of LD, **41%** (±5%) indicated that they would remove a tick attached to their skin by pulling it out with tweezers or some other tool. This did not change significantly from previous years. Using tweezers is the method recommended for safe tick removal. **Fifteen** per cent (15% ±4%) indicated that they would go to a hospital, clinic, doctor, or other health care service. Other methods mentioned by respondents were applying heat, salt or alcohol (9%* ± 3%) or pulling, brushing or flicking with your hand (17% ±3%). These methods are not recommended. Less than half of residents (46% ±5%) knew that ticks could be sent for Lyme disease testing.

LD Perceived Risk

Most Durham Region residents did not consider themselves to be at much risk of contracting LD during the fall of 2015. Those who had never heard of LD (**17%** ±4%) would not be aware of any risk and a further **51%** (±4%) considered themselves at low or no risk of getting LD. Another **24%** (±3%) felt they were at medium or high risk and **8%** (±3%) could not identify their level of risk. This pattern showed no significant changes from previous years.

Graph 4: Perceived Risk of Getting Lyme Disease, Adults 18+, Durham Region, 2011-2013, 2015



**Interpret with caution due to high variability.*

LD Personal Protective Behaviours

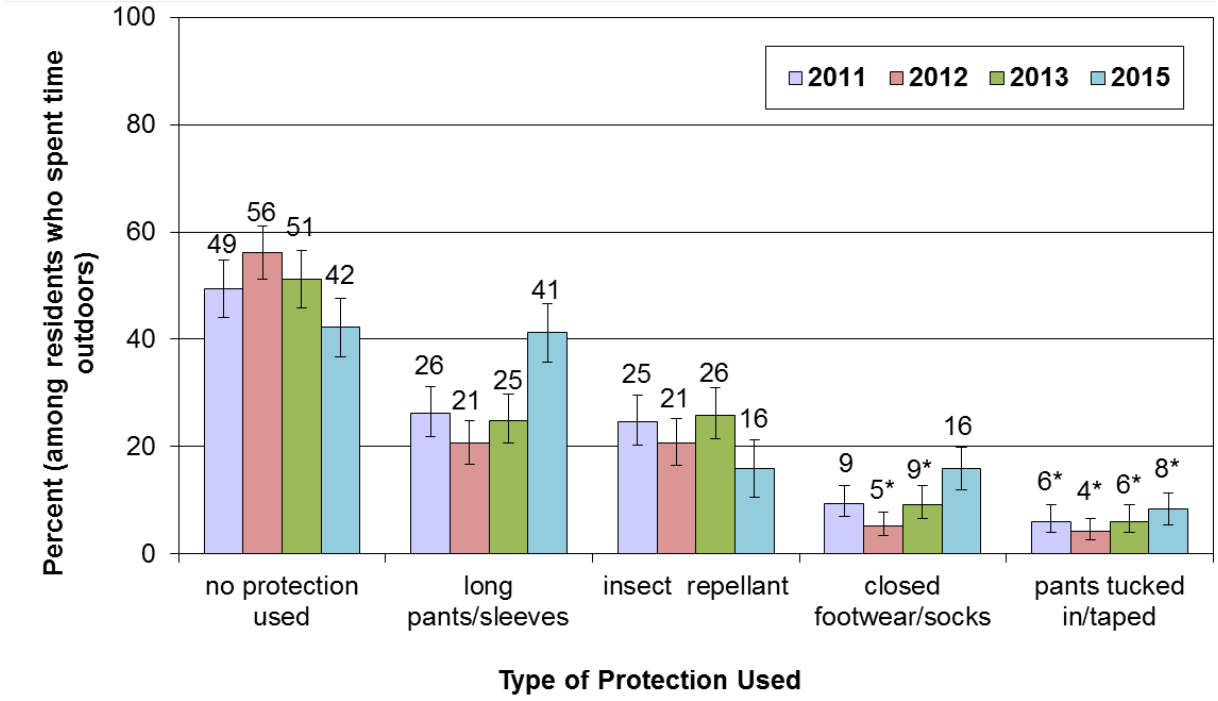
During the fall of 2015, three quarters (**67%** ±5%) of Durham Region adults aged 18 and over spent time outdoors in grassy fields or wooded areas. Among these residents, 36% (±5%) protected themselves every time or most of the time, 15% (±4%) protected themselves only sometimes or rarely and half (50% ±6%) never took steps to protect themselves from tick bites while in these areas. This pattern showed a significant increase from 2015 compared to previous years.

The most common methods of tick protection used were wearing long pants and sleeves (**41%** ±5%) and/or wearing closed footwear and/or socks (**16%** ±4%). Using insect repellant was mentioned by **12%** (±3%) of residents, and only **4%*** (±2%) specifically mentioned using DEET. **Eight per cent** (8%* ±3%) said they tucked in or taped the bottom of their pants. The number of Durham residents who wore long pants

and sleeves when spending time outdoors in grassy fields or wooded areas significantly increased from 2013 compared to 2015.

After being outside, only **25%** (±5%) checked themselves for ticks every time or most of the time, **10%*** (±4%) sometimes or rarely and over two thirds (**65%** ±6%) never checked themselves. There has been a significant increase in use of protective methods since 2013.

Graph 5: Type of Tick Protection Used by Adults (18+) who Spent Time Outdoors in Grassy Fields or Wooded Areas, Durham Region, 2011-2013, 2015



**Interpret with caution due to high variability.*

Overall Summary / Conclusions

West Nile Virus

Surveillance activities have revealed that WNV has been present in one or more of the adult mosquito, wildlife, or human populations, within Durham Region, since 2002.

Each year since 2002, in order to control the spread of WNV, the DRHD has instituted a Vector Control Plan which includes control measures such as adult mosquito surveillance, larval mosquito surveillance, the monitoring of human health effects / complaints, as well as a public awareness campaign focusing on source reduction, and personal protective measures.

For several years, the Vector Control Plan included an active avian (dead bird) surveillance component. However, this surveillance was discontinued in Durham Region in 2009, resulting in no birds being collected and submitted for testing by the DRHD since that time. General public inquiries and atypical avian fatalities are still referred to CCWHC for their follow-up, which may include bird pick-up and testing.

One equine case of WNV was reported in Durham Region in 2017, and OMAFRA reported 21 cases of equine WNV in Ontario (OMAFRA website last updated October 30, 2017).

Every year, beginning 2003, DRHD has contracted a licensed PCO, and licensed laboratory, to assist in the delivery of the Vector Control Program. For the 2017 season, CCMM was tasked with providing larvicide treatments to control Durham's larval mosquito population, while Entomogen Inc. was tasked with laboratory identification and testing of adult mosquitoes.

With regard to larval mosquito surveillance, DRHD and CCMM field staff combined to conduct a total of **3,999** inspections at identified standing water sites (including SWMPs, ditches, field pools, etc.) throughout Durham Region. These inspections resulted in **966** larvicide applications to standing sites where live mosquito larvae were identified.

Adult mosquito surveillance (trapping) was conducted in Durham Region between CDC weeks 24 (w/o June 12, 2017) and 38 (w/o September 18, 2017). The surveillance program consisted of a network of up to **14** trapping stations distributed over **7** of 8 local municipalities. Over the 15 week capture period a total of **174** traps were set, and **30** different mosquito species or species groups were identified. Of the 30 species, **12** are representative of WNV vector or bridge vector species.

A total of **13,426** adult mosquitoes were captured during the 2017 season. This is higher than the number captured during 2016 (9,347), but lower than the 2015 (20,092) and 2014 (14,495) seasons.

WNV vectors, primarily *Culex pipiens/restuans,* represented **17%** of total adult mosquito captures in Durham Region in 2017. Bridge vectors represented 50% of total captures and non-vector species made up the remaining 33% of captures. *Aedes vexans vexans* was the predominant bridge vector species and overall it was the dominant adult mosquito species captured in 2017, at **26%** of all captures.

A "degree-day" analysis was conducted for the 2017 season, by Entomogen Inc., from weather data collected at the Environment and Climate Change Canada, Oshawa Water Pollution Control Plant station. Based on an accumulated degree day model, used by PHO, Entomogen has indicated that the rate at which WNV replicates within adult female *Culex pipiens/restuans* depends on the ambient temperatures. Below an average daily temperature of 18.3^{o}C WNV does not appear to incubate in the mosquito. A total of 380 accumulated degree days would have been required for 50% of infected *Culex pipiens/restuans* mosquitoes to have tested positive for WNV. Since there were only 145 accumulated degree days observed in Durham Region in 2017, Entomogen concluded that there were "insufficient heat units in 2017 for amplification of the virus in *Culex spp. m*osquitoes".[^]

In 2017, a total of **455** pools of captured mosquitoes were tested for the presence of WNV using the RT-PCR method. Of the 455 pools tested, **10** were positive for WNV. *Culex pipiens/restuans* mosquitoes were responsible for 8 of the 10 WNV-positive pools, while the other 2 WNV-positive pools were comprised of *Aedes vexans vexans* and *Ochlerotatus japonicus* mosquitoes.

Durham Region had **3** confirmed human cases of WNV reported in 2017. This is higher than in 2016 where there was 1 confirmed and 1 probable case reported.

As of December 9, 2017, for the 2017 WNV season, PHAC reported **155** clinical human cases of WNV in Ontario and **190** clinical cases for all of Canada.[¥] There were more than triple the clinical human cases in 2017 in Ontario as compared to 2016 (46 cases) and almost twice as many cases in Canada (100 cases in 2016).

In the USA, as of January 9, 2018, a total of 2,002 cases of human WNV, including 121 deaths, were reported by the CDC. Of these, 1,339 (67%) were classified as neuro-invasive disease (such as meningitis, encephalitis, or acute flaccid paralysis) and 663 (33%) were classified as non-neuro-invasive disease.[+] Human WNV case numbers in the USA have generally been dropping since 2012 when 5,674 cases and 286 deaths were reported.

[^]Source: Entomogen Inc., West Nile Virus Mosquito Surveillance Report and Notes on Eastern Equine Encephalitis Virus Mosquito Testing, 2017-The Regional Municipality of Durham

[¥]*Source: Public Health Agency of Canada (PHAC), Surveillance of West Nile Virus, link: http://healthycanadians.gc.ca/diseases-conditions-maladies-affections/disease-maladie/west-nile-nil-occidental/surveillance-eng.php#s1*

[+]Source: Centers for Disease Control and Prevention, West Nile Virus Disease Cases and Presumptive Viremic Blood Donors by State-United States, 2017 (as of January 9, 2018), link: https://www.cdc.gov/westnile/statsmaps/preliminarymapsdata2017/index.html

Eastern Equine Encephalitis

An increase in EEE activity in bordering US states and in Quebec prompted the MOHLTC to request that PHUs enhance their adult mosquito surveillance for EEE vector mosquitoes for each of the 2011, 2012, and 2013 surveillance years. After finding no EEEV-positive mosquito pools in any of those surveillance years, DRHD, in consultation with PHO, reverted to traditional surveillance protocols for the 2014 WNV season. **No** EEEV-positive pools were identified in any of 2014, 2015, 2016, or 2017.

Culiseta melanura mosquitoes are the primary vectors of EEEV in Ontario. While no *C. melanura* mosquitoes were collected in 2017, a newly established species, *Culex erraticus*, was collected. The literature suggests that this species is an EEEV vector in the USA. Therefore Entomogen tested these mosquitoes for the presence of both WNV and EEEV. No EEEV-positive pools were identified.

No equine cases of EEE were reported in Durham Region during 2017, but as of October 30, 2017 OMAFRA reported **2** equine cases in Ontario. In comparison, 0 equine cases were reported in Ontario in 2016, 5 in 2015, 24 in 2014, and 1 case in 2013.[≠]

In 2017, **81** equine cases of EEE were reported in the USA (as of December 5, 2017). In comparison, 118 equine cases were reported in 2016, 70 cases in 2015, 136 cases in 2014, and 192 cases in 2013.[∞]

No human cases of EEE were reported in Durham Region in 2017 and, to date, no human cases have ever been reported by PHO/MOHLTC in Ontario.[α]

As of the date of this report, no data was available with regard to human cases of EEE in the USA in 2017. The CDC reported 7 human cases (with 3 fatalities) in 2016, 6 in 2015, 8 in 2014, and 8 in 2013.[¥]

[≠] Source: Ontario Ministry of Agriculture, Food and Rural Affairs, Equine Neurological Disease Surveillance 2017, Cases of Equine Neurological Disease in Ontario – 2017, last updated October 30, 2017, link: http://www.omafra.gov.on.ca/english/livestock/horses/westnile.htm

[∞] Source: United States Department of Agriculture, Animal and Plant Health Inspection Service (APHIS), 2017 Equine Case Reports of Eastern Equine Encephalitis reported to the ArboNET reporting system as of December 5, 2017, link https://www.aphis.usda.gov/animal_health/downloads/animal_diseases/2017_eee_report.pdf

[α] Source: Ontario Agency for Health Protection and Promotion (Public Health Ontario).Vector-Borne diseases 2016 summary report. Toronto, ON: Queen's Printer for Ontario; 2017, link: https://www.publichealthontario.ca/en/eRepository/Vector-Borne_Diseases_Summary_Report_2016.pdf

[¥] Source: United States Centers for Disease Control and Prevention (CDC), Eastern Equine Encephalitis - Epidemiology and Geographic Distribution, link: https://www.cdc.gov/easternequineencephalitis/tech/epi.html#casesbystate

Lyme Disease

In 2010, the MOHLTC and PHUs initiated a campaign to increase public awareness of LD in response to an increase in the number of established populations of blacklegged ticks in the southern part of the province.

For the past number of years, the number of ticks submitted to DRHD for identification and potential testing for LD (passive surveillance), has been steadily increasing. Tick specimens, removed from human hosts, may be submitted either by the public or by their health care providers. In 2017, a total of **176** tick specimens were submitted. In comparison, 83 ticks were submitted in 2016, 84 ticks in 2015, 35 ticks in 2014, and 28 in 2013.

One Hundred and Seventeen (117) of the **176** ticks submitted in 2017 (66%) were confirmed to be blacklegged ticks (*Ixodes scapularis*). **One hundred and three** (103) of the 117 blacklegged ticks were reported to have likely been acquired within Durham Region. To date, **18** of the total 117 blacklegged ticks identified (15%) have tested positive for *Borrelia burgdorferi* with **9** of the **18** positive ticks likely acquired within Durham Region.

Tick test results for 20 *Ixodes scapularis* (blacklegged tick) specimens remained outstanding at time of printing this report. Therefore, further *Borrelia burgdorferi* – positive ticks, acquired within and outside of Durham, may still be identified.

DRHD has conducted active tick surveillance (tick dragging), in likely tick habitats across Durham Region, since 2010. For the first time, in the fall of 2013, blacklegged ticks were found at 2 separate sites in Whitby. Subsequently, in 2014 and 2015, blacklegged ticks, positive for *B. burgdorferi*, were collected during active surveillance in the Rouge Valley in Pickering. No positive ticks were found during active surveillance at any sites in 2016.

During 2017, a total of **21** ticks were found at **5** separate sites in Durham Region. All 21 ticks were identified as blacklegged ticks. **Six** (6) of the 21 ticks tested positive for *Borrelia burgdorferi*.

The human case surveillance data for Durham Region indicates that there were **40** confirmed and **8** probable human cases of LD reported in Durham Region in 2017. This is a significant increase over the 16 confirmed and 8 probable cases reported in 2016.

Confirmed and probable LD cases are defined within the MOHLTC *Infectious Diseases Protocol*.[q]

Twelve of the 40 confirmed cases of LD reported they were most likely exposed to a tick within Durham Region ("locally acquired"). The other 28 confirmed cases reported travel to or residence in an endemic/risk area as a risk factor for LD exposure. Of the **8** probable LD cases, **4** reported that they most likely were exposed to a tick within Durham Region.

[q] Source: Ontario Ministry of Health and Long-term Care Infectious Diseases Protocol, Appendix B: Provincial Case Definitions for Reportable Diseases, Disease: Lyme Disease, Revised April 2015, link: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/infdispro.aspx

Currently, the risk of acquiring LD within Durham Region remains low. However, as a result of the recent passive and active tick surveillance findings, active surveillance activities will continue to be enhanced in likely tick habitats in 2018 and steps will be taken to increase public and healthcare provider knowledge about Lyme disease and personal precautions to avoid tick exposures.

Other Vector-Borne Diseases of Concern

Historically, human cases of malaria, plague, tularemia and yellow fever have been rare in Durham Region. There were **4** confirmed cases of malaria reported in Durham Region in 2017. In contrast, there were 6 cases in each of the 2016 and 2015 surveillance years. In all cases where exposure details were available, travel to or residence in an endemic area was listed as a risk factor for exposure.

There were **0** cases of tularemia or yellow fever reported in Durham Region in 2017 and there have been **no** cases of plague reported anywhere in Canada since 1939.

DRHD received a number of inquiries about Zika virus during both 2017 and 2016. Information about Zika virus transmission, personal precautions to avoid transmission, and viral testing is provided on the Durham Region website.

Outlook / Plans for 2018

DRHD will:

- Maintain an effective vector surveillance (adult and larval mosquito) program for WNV and EEEV.
- Maintain a passive surveillance program for blacklegged ticks (*Ixodes scapularis*).
- Enhance the active surveillance program for blacklegged ticks.
- Maintain effective human surveillance programs for WNV, EEE, LD, malaria, plague, tularemia, and yellow fever.
- Where possible, investigate reports of equine cases of WNV and EEE. Maintain an effective control program for WNV vector populations (i.e., *Culex pipiens/restuans*) in municipal and private catch basins, and in open water sites such as SWMPs, sewage lagoons, and ditches, beginning May/June, and continuing through to the end of September.
- Maintain an effective control program for *Aedes vexans vexans* and other secondary vector species via monitoring of and, where necessary, larviciding of ditches, temporary pools, etc., from early May through to the end of September.
- Maintain effective and timely communications with municipal representatives to promote the upkeep and/or remediation of municipal properties.
- Maintain a 48 hour response to public complaints regarding potential mosquito breeding sites on public and private property (i.e., derelict swimming pools, ornamental ponds, backyard catch basins, and other areas of standing water).
- Enhance partnerships with local municipal by-law departments in respect to the investigation of stagnant water complaints.
- Maintain an effective and comprehensive public communication campaign designed to educate the community regarding WNV and the need for source reduction, vector control, and personal protective measures against mosquitoes. In the absence of a vaccine or cure for infections caused by WNV, the cycle of transmission must be interrupted to prevent outbreaks. The promotion of personal protective measures through public education is an important step in combatting both WNV and EEE.
- Continue to develop and improve an effective and comprehensive public communication campaign designed to educate healthcare providers and the community regarding LD and the need for personal protective measures against ticks.
- Develop and implement a communication campaign designed to educate healthcare providers and the public regarding Zika virus, with respect to the need

for personal protective measures against mosquitoes when travelling and the need to prevent sexual transmission of the virus to women who are pregnant or who may be planning a pregnancy.

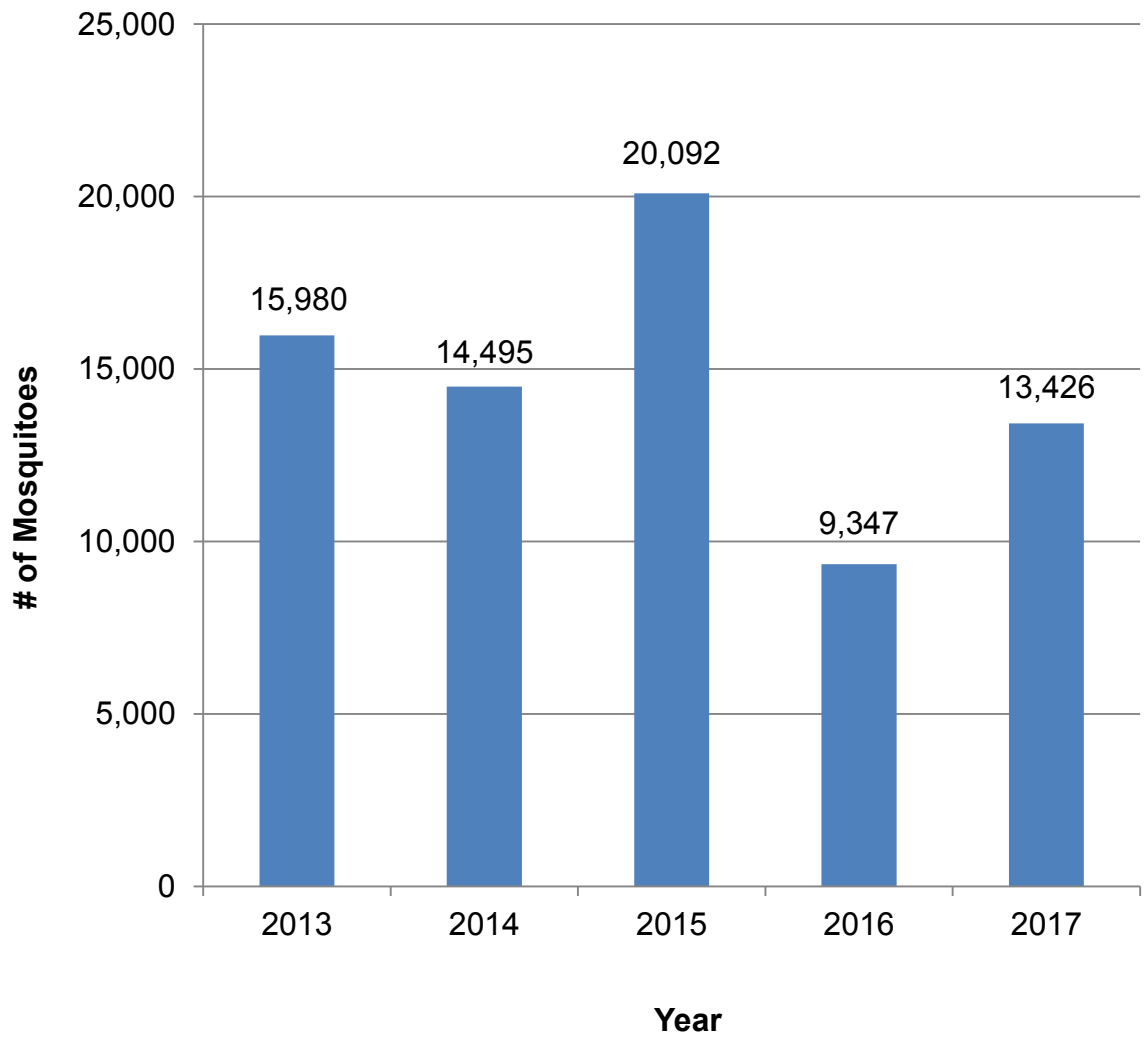
- Continue to use a RRFSS survey module to measure WNV personal and household protective behaviours.
- Continue to use a RRFSS survey module to measure public awareness about LD.

Appendix A

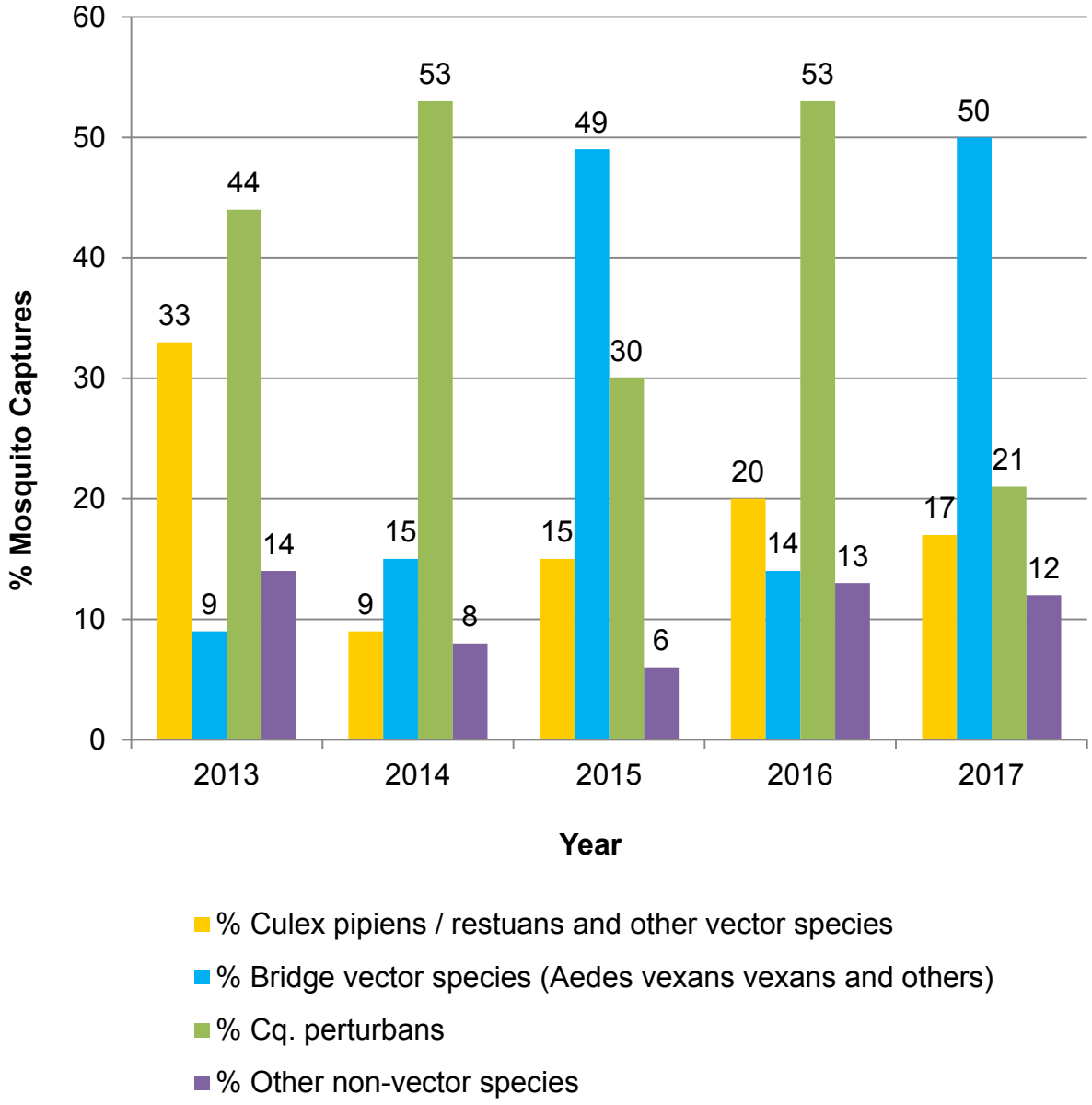
Graphs of West Nile Virus, Eastern Equine Encephalitis, and Lyme Disease / Tick Surveillance Results (2013 - 2017)

West Nile Virus

Graph 6: Adult Mosquitoes Captured Per Year – Durham Region (2013-2017)

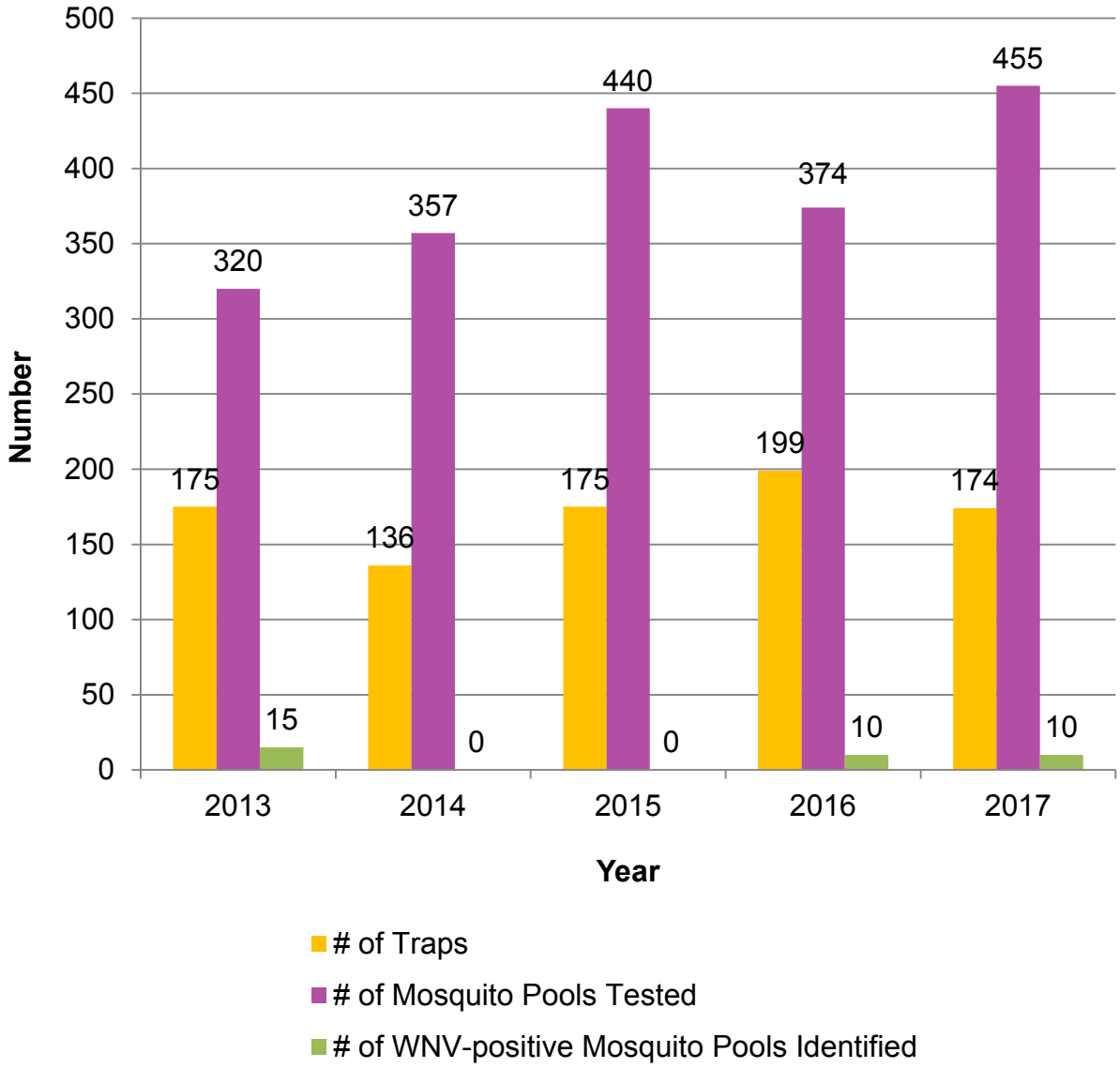


Graph 7: Mosquito Species Distribution - Durham Region (2013-2017) (% based on adult mosquito captures)

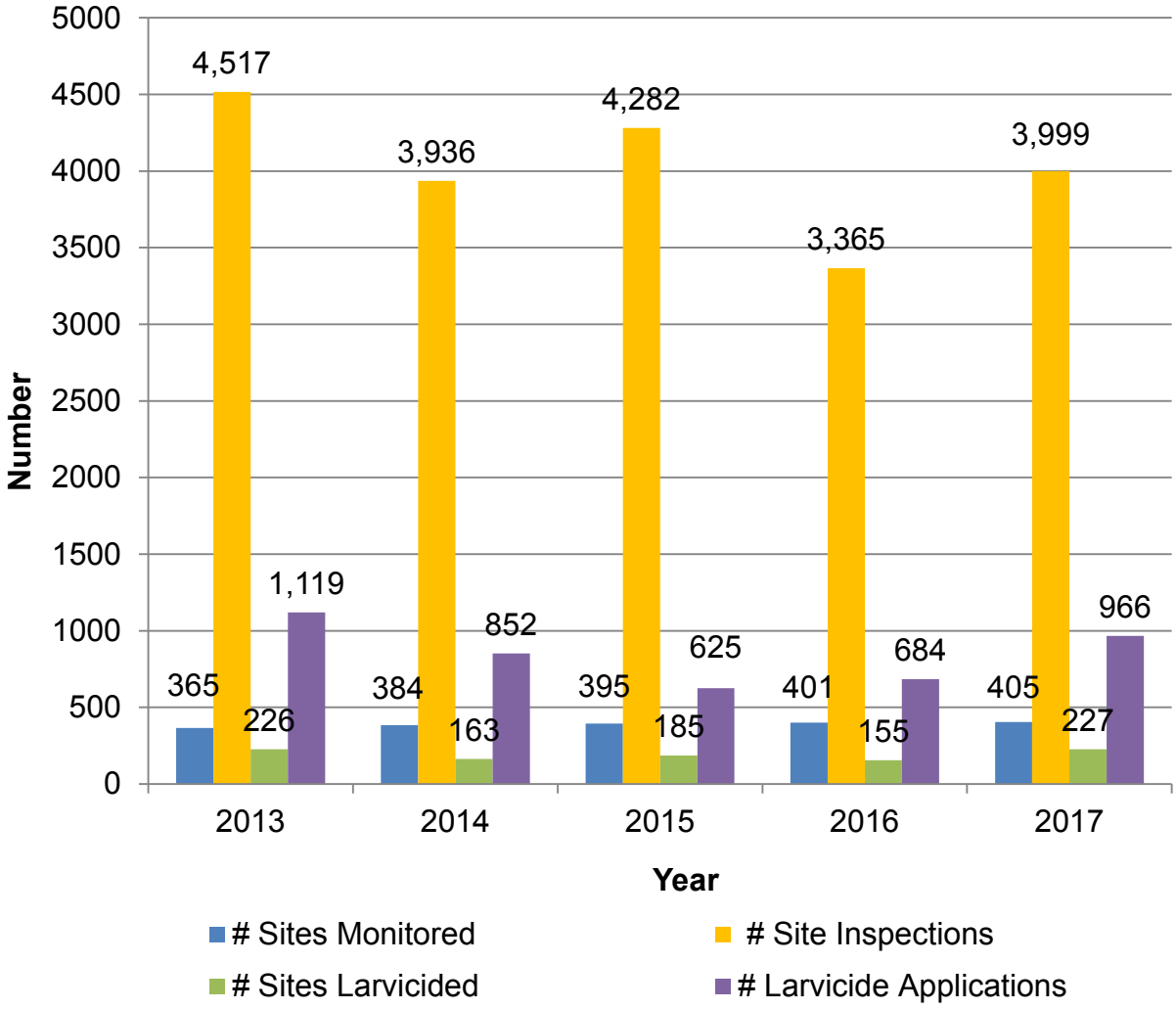


Note: While *Cq. perturbans* is not considered to be an efficient WNV vector or bridge vector, it is thought that it may still play a role in WNV transmission to humans due to its relative abundance and aggressive nature.

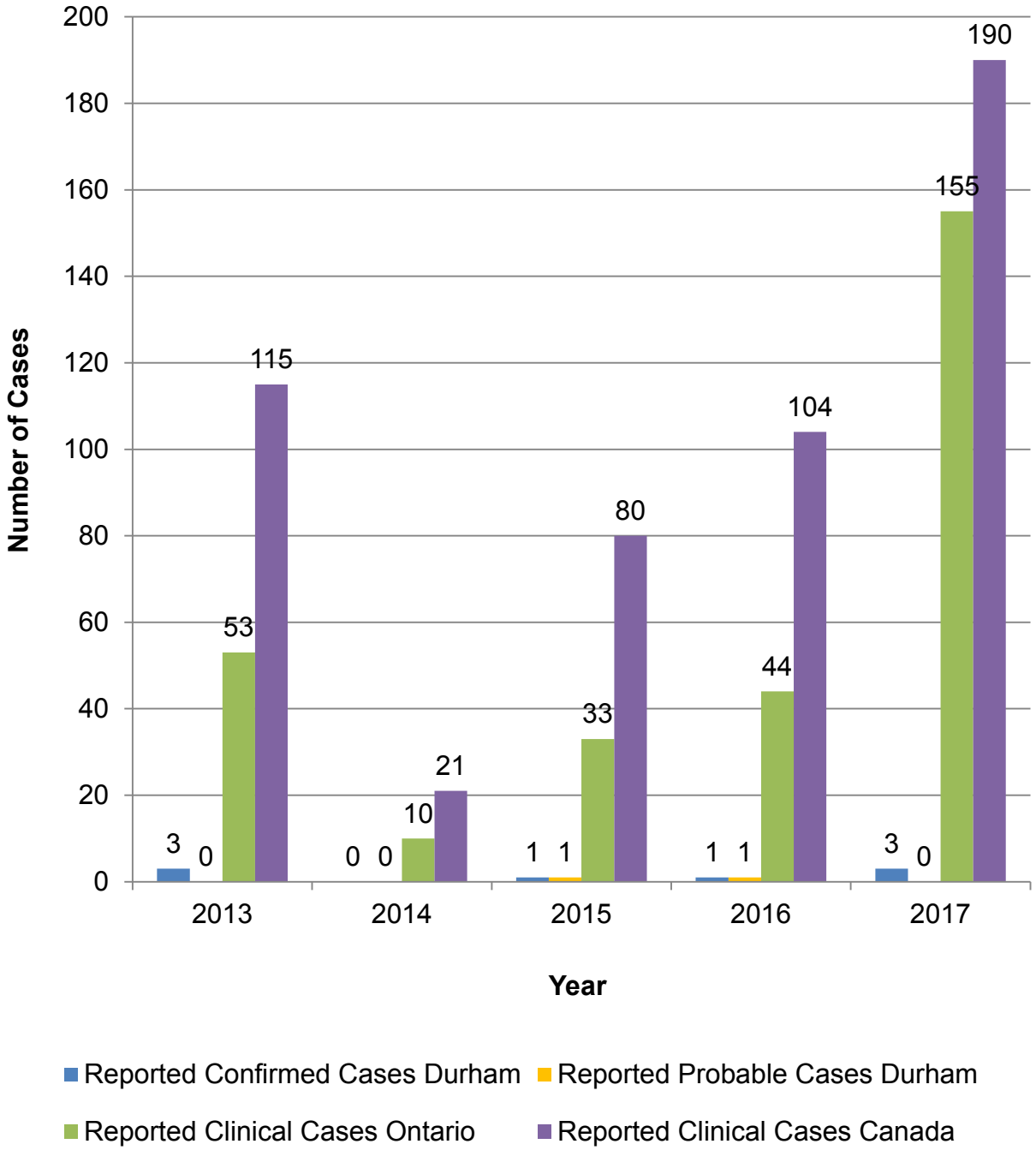
Graph 8: Results of Adult Mosquito Trapping – Durham Region (2013-2017)



Graph 9: Results for Standing Water Site Surveillance - Durham Region (2013-2017)

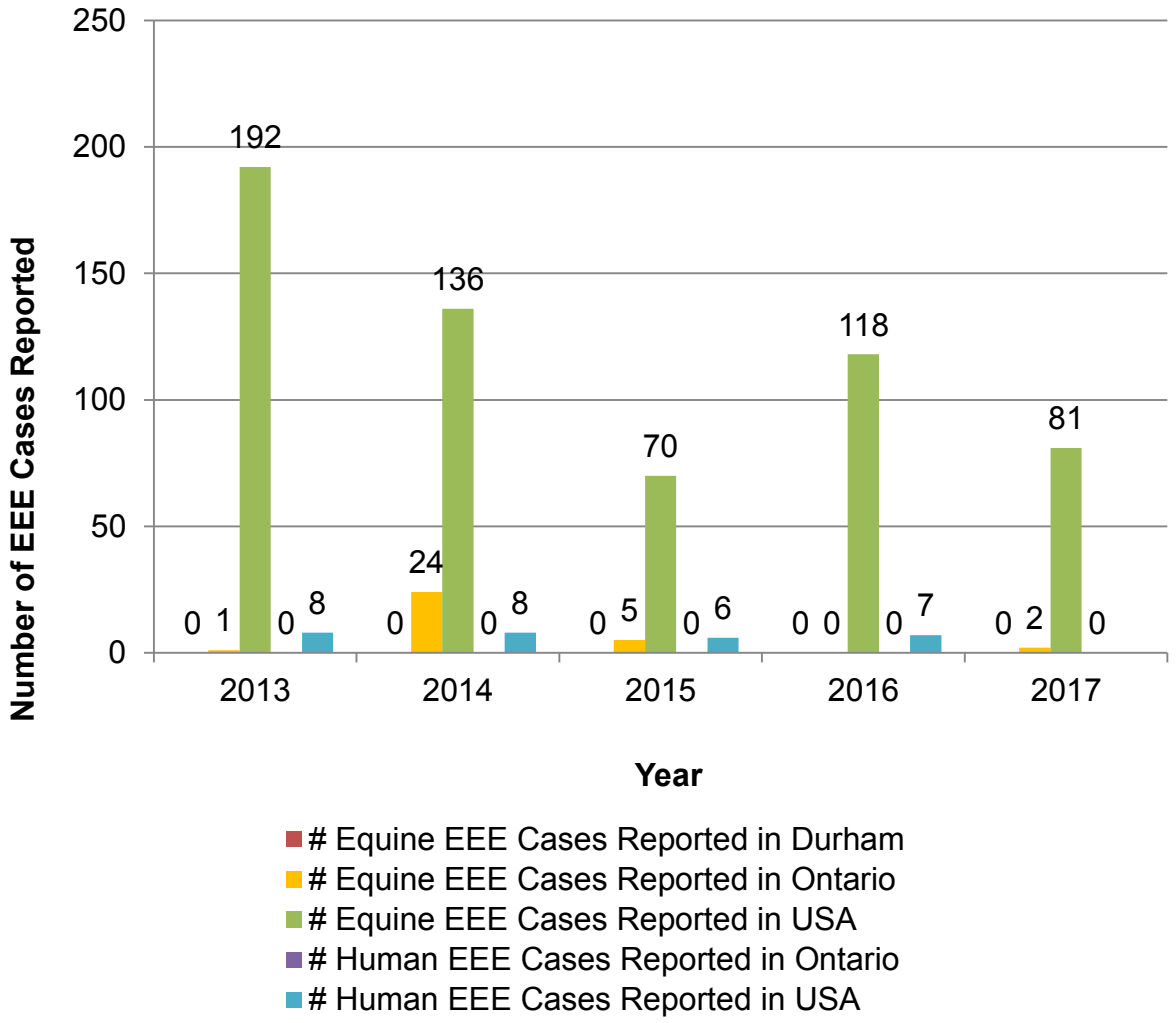


Graph 10: Reported Human Cases of WNV – Durham Region, Ontario, Canada (2013-2017)



Eastern Equine Encephalitis

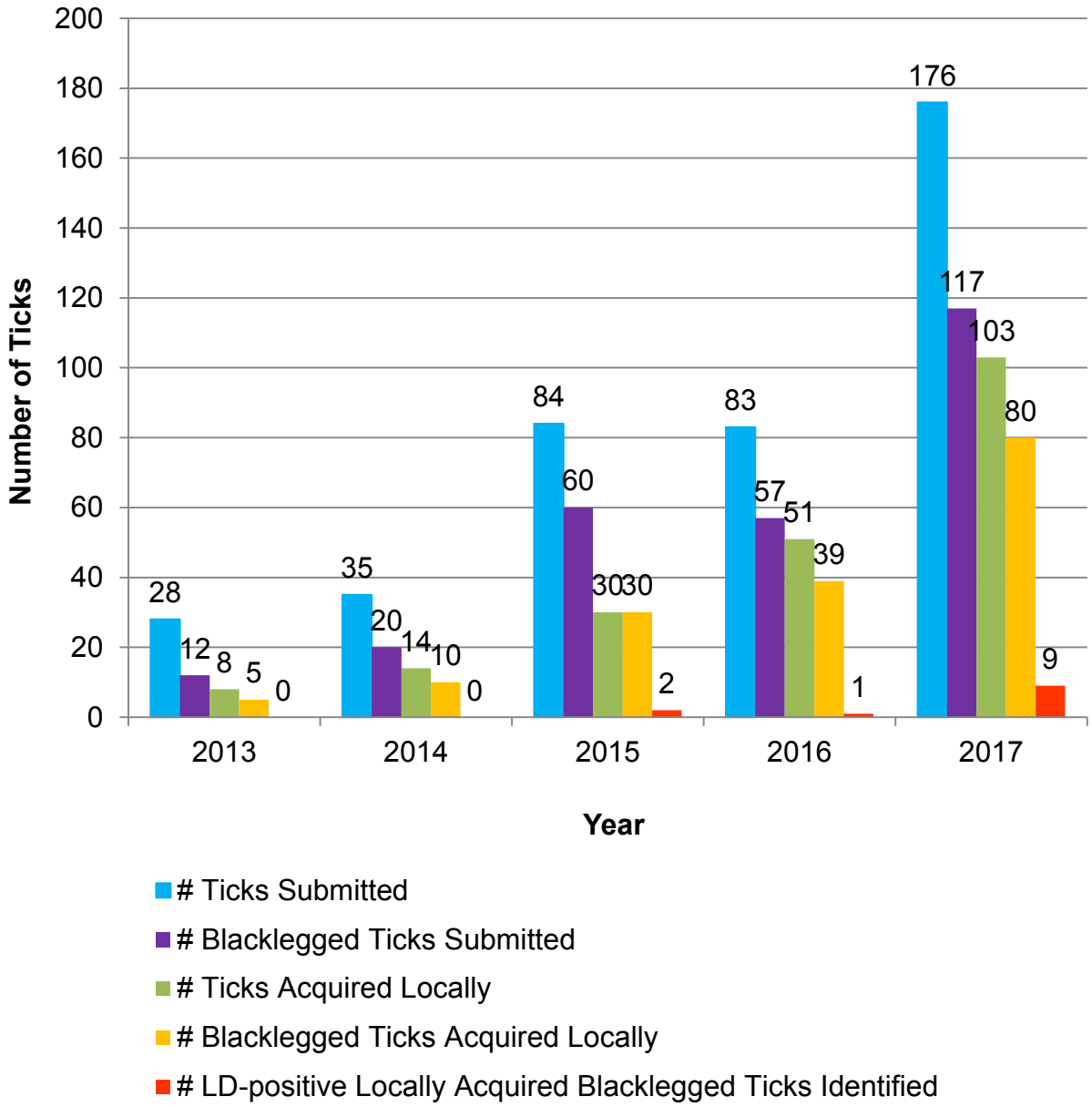
Graph 11: Eastern Equine Encephalitis Surveillance Results – Durham Region, Ontario, USA (2013-2017)



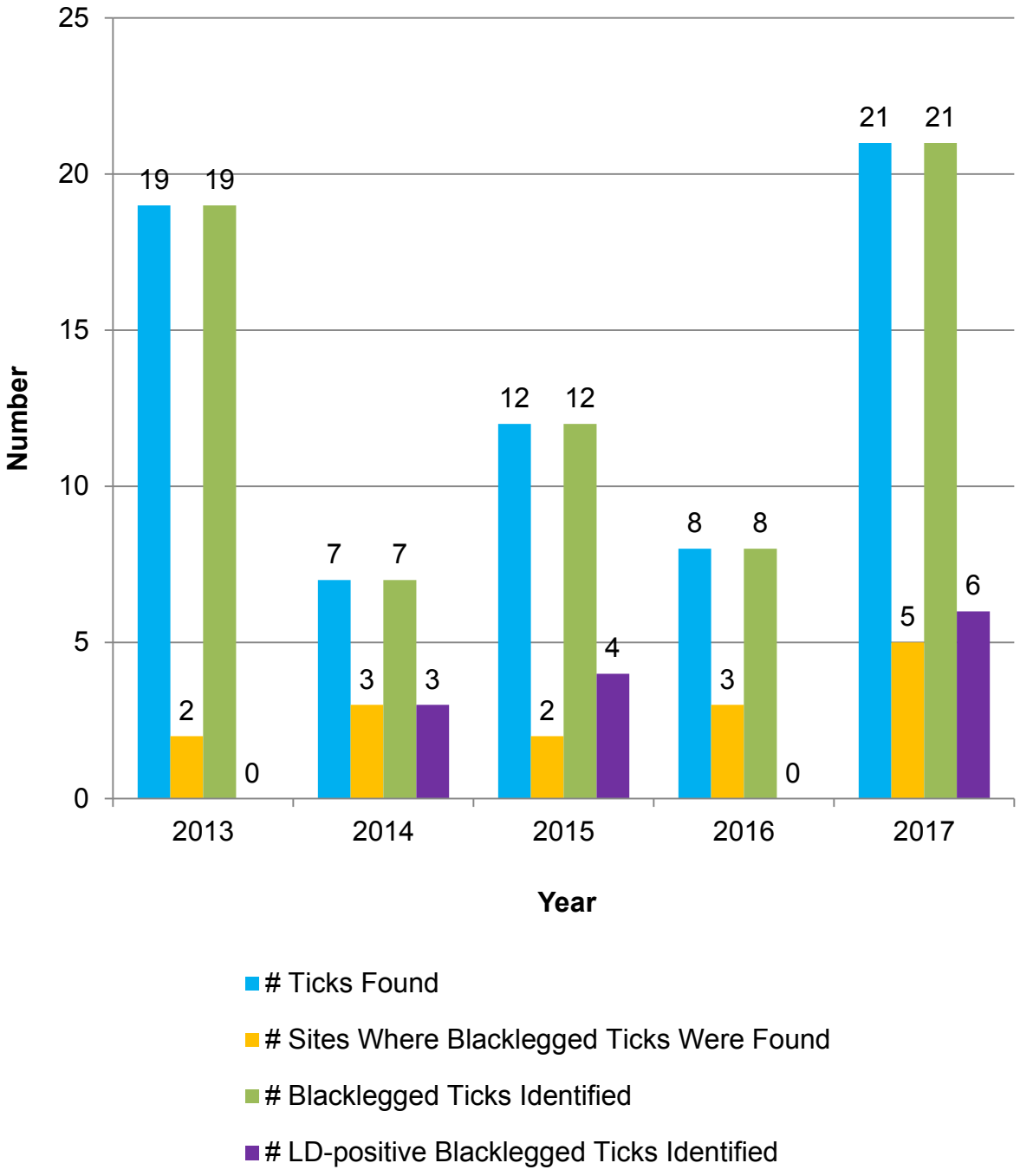
Note: The # of human EEE cases in USA for 2017 was not reported as of March 2, 2018

Lyme Disease / Ticks

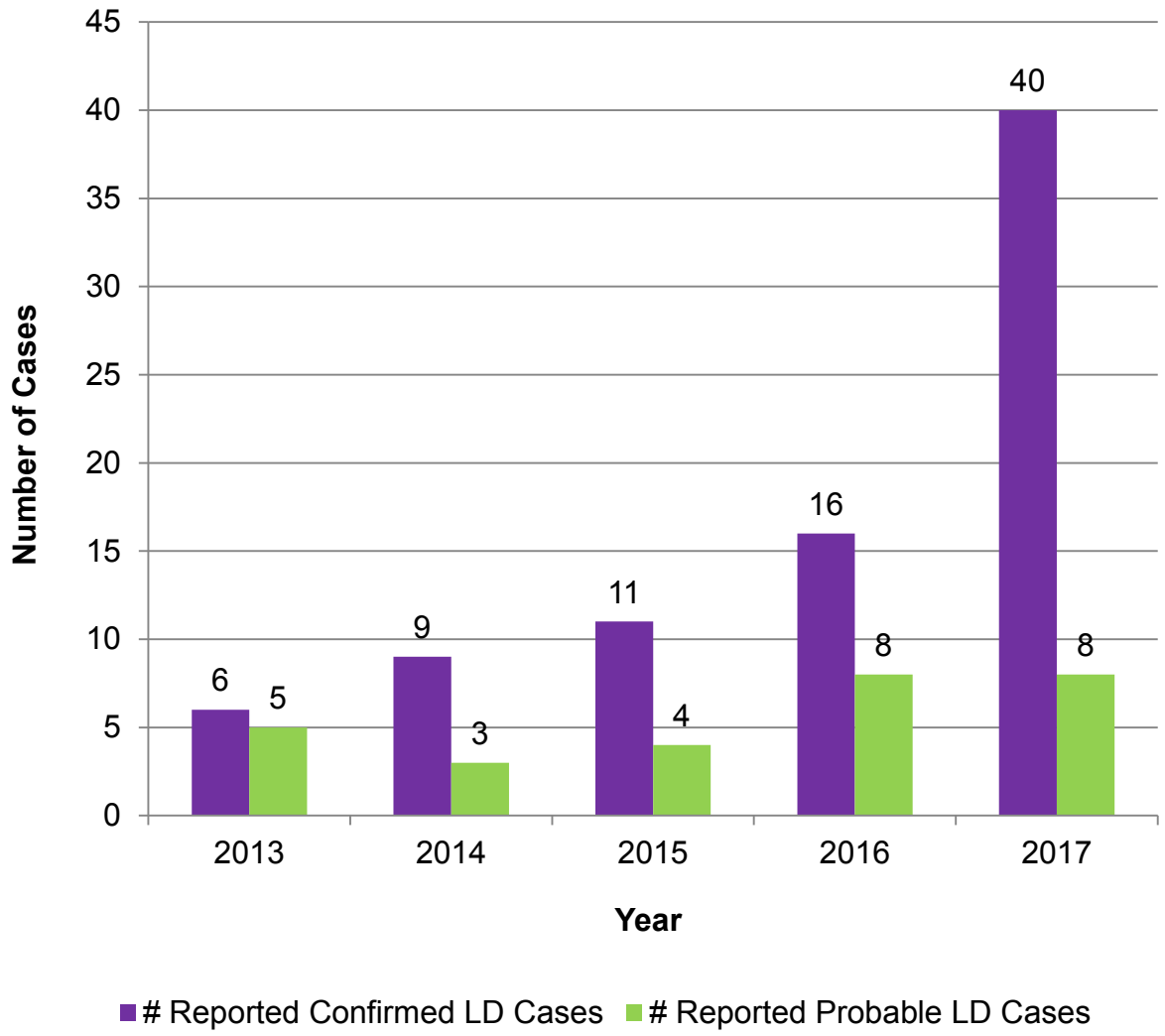
Graph 12: Results of Passive Tick Surveillance - Durham Region (2013-2017)



Graph 13: Results of Active Tick Surveillance - Durham Region (2013-2017)



Graph 14: Reported Human Cases of LD - Durham Region (2013-2017)



DURHAM REGION

HEALTH DEPARTMENT

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Environmental Help Line
1-888-777-9613
durham.ca