

Vector-borne Disease Update: Advancing Strategies for Tomorrow's Challenges

To: Chair and Members of the Board of Health

Meeting Date: April 3, 2024

Report No. **BH.01.APR0324.R10**, Pages: 17

Prepared By: Phil Wong, Director, Health Protection
Bo Cheyne, Environmental Health Specialist
Michael Coburn, Public Health Inspector

Approved By: Christopher Beveridge
VP, Health Protection & Emergency Preparedness

Submitted By & Signature: *Original signed document on file.*
Dr. Nicola J. Mercer, MD, MBA, MPH, FRCPC
Medical Officer of Health & CEO

Recommendations

It is recommended that the Board of Health receive this report for information.

Key Points

1. Impact of Climate Change on Tick Populations

- Rising temperatures and extended warm seasons in Ontario contribute to larger tick populations, heightened activity levels, and expanded geographical range.
- Ticks are venturing into regions where they were previously rare, as indicated by Wellington-Dufferin-Guelph Public Health (WDGPH) surveillance data.

2. Surveillance and Tick Disease Incidence

- In 2023, the passive surveillance program received 202 tick submissions, 90 of which were identified as blacklegged ticks, the primary vector for Lyme disease, as well as Anaplasmosis, Babesiosis, and Powassan Virus.
- Local and provincial Lyme disease incidence rates are increasing. The Infectious Disease Program documented 20 human cases of Lyme disease, approximately twice the annual amount reported from 2018 to 2020.

3. Innovations in Tick Surveillance and Public Education

- WDGPH introduced an online, mobile-friendly tick submission process in 2023 to enhance the efficiency and completeness of data collection and entry.

- Future initiatives include the development and deployment of educational signs in local parks and trails to promote awareness and use of the online tick submission tool.
- The online submission process has improved WDGPH reach and facilitated improved management of tick-related data and public health responses.
- Developing Zoonotic and Vector-borne Disease public dashboard with live and historic data sets including tick surveillance measures.

4. Impact of Climate on Mosquito Populations

- Predicted warmer and wetter weather is likely to enhance mosquito population growth.
- Environmental changes necessitate stronger surveillance systems to monitor mosquito species that could carry emerging illnesses such as Eastern Equine Encephalitis.

5. Surveillance and West Nile Virus Incidence

- In 2023, three mosquito pools in the region tested positive for West Nile Virus.
- No human cases of West Nile Virus were reported to WDGPH in 2023.

6. Innovations in Mosquito Surveillance and Public Education

- WDGPH is forming a partnership with Conestoga College to pilot a new technology utilizing environmental DNA (eDNA) sampling of standing water for 2025.
- eDNA technology improves understanding of local mosquito vector populations and promptly identifies potential new and emerging mosquito-borne disease vectors.
- WDGPH will be publishing a Zoonotic and Vector-borne Disease public dashboard with live and historic data sets including mosquito surveillance and control measures.

Background

Vector-borne and zoonotic diseases are caused by viruses and bacteria that are transmitted to humans from animals. In the case of vector-borne diseases, the pathogen is transmitted through a “vector” like a mosquito or tick. The *Health Protection and Promotion Act*, specifically *Ontario Regulation 199/03*, and Ontario Public Health Standards outline the requirements that public health units have a robust vector-borne program.

Mosquito Surveillance and Control Program

West Nile Virus (WNV) is transmitted through the bite of an infected mosquito. WNV symptoms are typically mild and flu-like, although a small percentage of infected persons can develop life-threatening-illnesses, including meningitis or encephalitis. Exposure to WNV can be prevented by reducing mosquito breeding sites (i.e., standing water) and taking steps to prevent mosquito bites (e.g., wearing long sleeves and pants, applying mosquito repellent, etc.).

WDGPH’s WNV control efforts include a combination of surveillance activities and the targeted application of larvicide(s). The program is also supported by municipal bylaw enforcement who respond to standing water complaints. Larvicide applications are designed to target mosquito vector populations that transmit WNV. Larvicide is applied to potential breeding sites where species that transmit WNV have been identified through surveillance. Candidate breeding sites

include locations where standing water cannot be eliminated, for example, municipal catch basins, stormwater management ponds, and roadside ditches.

Surveillance activities include the collection and identification of larval and adult mosquitoes and the testing of adults for the presence of WNV. The presence of the mosquito species that transmit WNV (i.e. *Culex Pipiens*) determines when and where larvicides are applied. Additionally, the presence of vector species and adult mosquitoes testing positive for WNV can help inform which geographic areas might be at higher risk and where further control measures, or targeted education, might be required.

The surveillance program for WNV vectors is part of a broader vector surveillance program that monitors other mosquito species of interest, including the vector for Eastern Equine Encephalitis (EEE). EEE is a serious illness with a high fatality rate. It is transmitted from birds to humans (or other hosts like horses) through specific mosquito species. Although only four human cases have been documented in Ontario, human cases are more common in the United States including states that border Ontario.^{1,2} As part of enhanced surveillance for EEE that began in 2011 in Ontario, equine cases (cases in horses) have been reported and EEE-positive mosquito vectors have been detected in other parts of Ontario. Public health units continue to include EEE surveillance and testing as part of ongoing mosquito surveillance work.

The objective of the WNV program is to reduce the risk of infections by preventing the breeding of vector species. Key indicators that support monitoring the WNV program are positive pools (mosquito pools that are positive for the virus) and human cases. Indicator data for the WNV program is shared in the discussion section.

Tick Surveillance Program

WDGPH's tick-borne disease program focuses on surveillance for blacklegged ticks, tracking human cases of tick-borne disease through case investigations, as well as public education.

Lyme disease is the most common vector-borne disease in North America.³ It is caused by the bacterium *Borrelia burgdorferi* and is transmitted to humans through the bite of an infected blacklegged tick. Early symptoms can include fever, headache, muscle and joint pain, fatigue, and a characteristic skin rash. If left untreated, the infection can spread to joints, the heart and nervous system and cause serious and chronic illness. To transmit Lyme disease, an infected blacklegged tick must be attached to a person and actively feeding for at least 24 hours. Consequently, key prevention strategies include avoiding tick bites by using insect repellent and covering up, checking for ticks, and safely removing ticks as soon as possible, and implementing strategies to reduce tick habitats.

Blacklegged ticks can also carry and transmit other tick-borne diseases, including anaplasmosis, babesiosis, and the Powassan virus. Although these diseases remain rare, they were each classified as a Disease of Public Health Significance in 2023, reportable to WDGPH for surveillance and education under the Health Protection and Promotion Act. This

classification enables more effective surveillance of emerging diseases, which in turn supports prevention and risk management. There are two tick surveillance methods used by WDGPH:

Passive surveillance involves tracking and identifying ticks submitted by the public. Data collected can potentially inform local programming and active surveillance. Additionally, as part of the identification service, when a tick is identified as a blacklegged tick by a Public Health Inspector, individuals are advised to consult a healthcare provider for clinical advice on whether to begin treatment with antibiotics.

Active surveillance uses a method called tick dragging to collect ticks from their habitats. Collected ticks are identified and tested for the presence of pathogens. The tick-dragging process consists of dragging a white cloth over and around vegetation in the habitats of targeted tick species. Locally, active surveillance is conducted jointly with the Ontario Veterinary College at the University of Guelph. Active surveillance is used to update Public Health Ontario (PHO)'s [Ontario Lyme Disease Map](#) (figure 1a-b) showing the estimated risk areas of Lyme disease across Ontario. Figure 1 shows the estimated risk areas in 2017 and 2023. In 2017, Wellington-Dufferin-Guelph was not part of the risk areas identified by PHO. Risk areas have quickly grown throughout Ontario and in 2023 estimated risk areas overlap with the southeastern and northeastern edges of Wellington-Dufferin-Guelph. It is important to note that infected blacklegged ticks can still be found outside of the estimated risk areas shown on the map.

The expanding estimated risk areas can be attributed to rising temperatures and longer warm seasons leading to more abundant tick populations as well as increased tick activity levels and range in Ontario. Ticks are expanding into regions where they were once uncommon and are expected to continue to expand northward.⁴

Figure 1a. Ontario Lyme Disease Map Estimated Risk Areas in 2017.

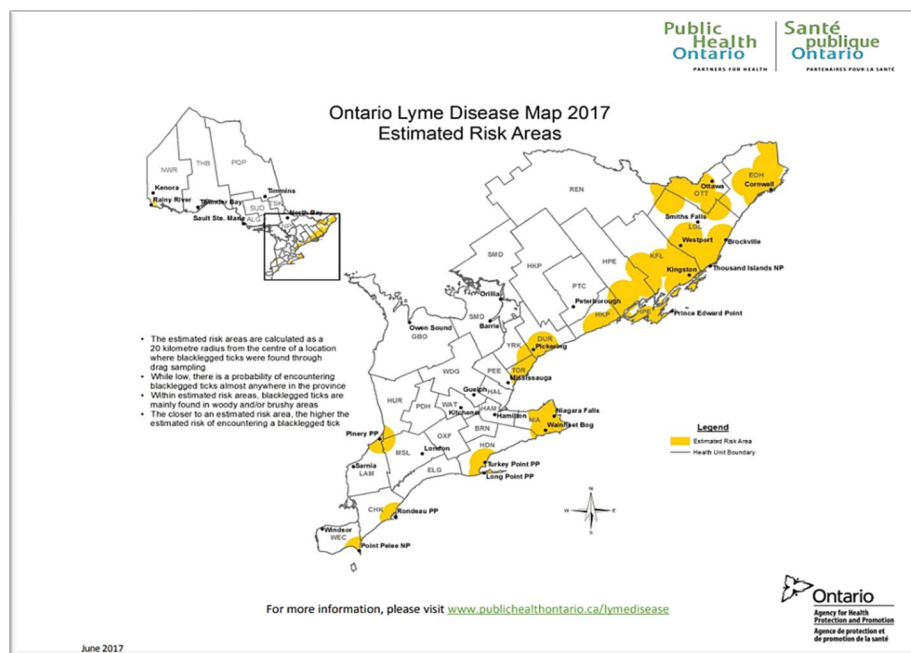
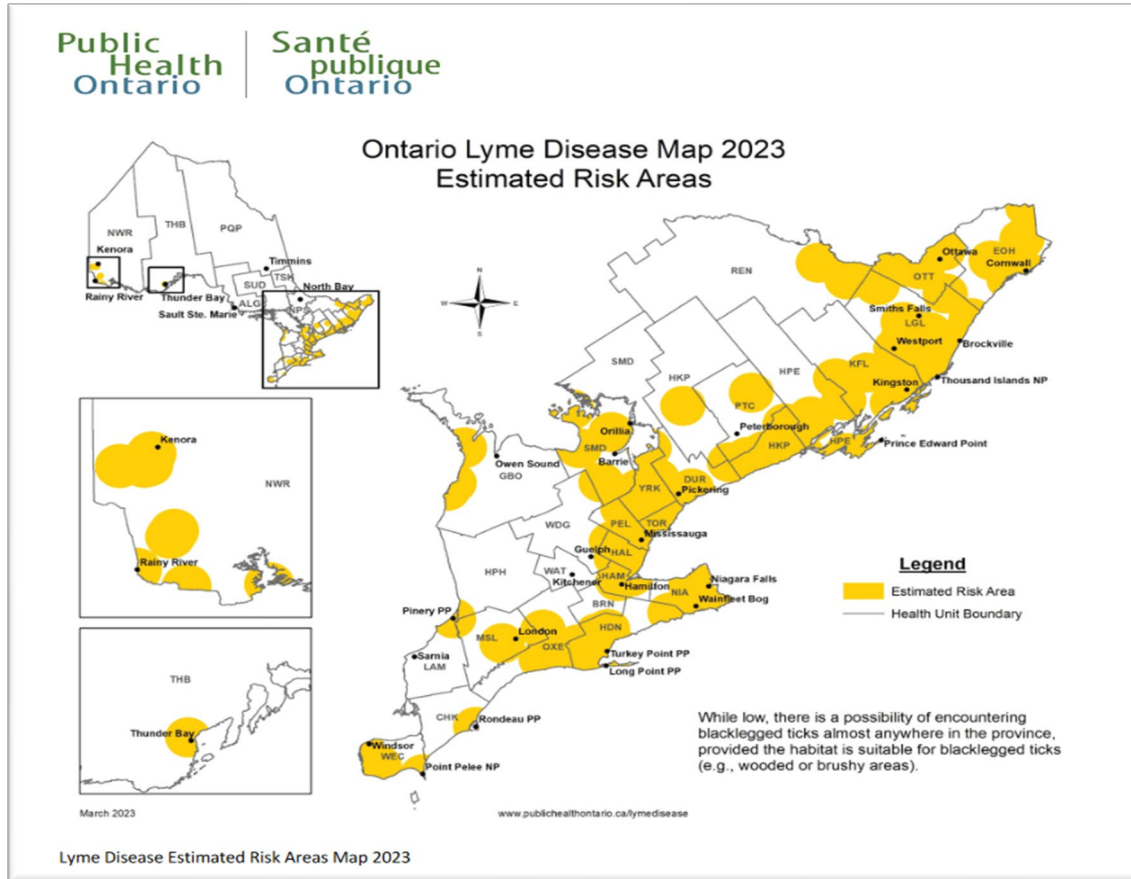


Figure 2b. Ontario Lyme Disease Map Estimated Risk Areas in 2023.



Source: Public Health Ontario 2017 [Ontario Lyme Disease Map 2017 Estimated Risk Areas](#); Public Health Ontario 2023 [Ontario Lyme Disease Map 2023: Estimated Risk Areas](#). Accessed February 8, 2023

Discussion

Mosquito Surveillance Key Findings

The number of positive mosquito pools (samples) has remained low over recent years ranging between 0-3 positive pools each year. Local human infections of WNV have also remained low, fluctuating between 0-1 case annually (Table 1). WNV is very likely underreported since most people experience mild flu-like symptoms. Having said that, it is reasonable to suggest that trends indicate local WNV risks remain low.

Table 1: WNV vector surveillance data and human cases counts of WNV reported in Wellington-Dufferin-Guelph, 2018-2023

Year	Mosquito pools* positive for WNV	Human cases**
2018	2	0
2019	0	1
2020	0	1
2021	1	1
2022	0	0
2023	3	0

*A pool is a group of mosquitoes belonging to the same species collected through mosquito trapping.

**Data source: The integrated Public Health Information System (iPHIS). Extracted February 13, 2024

In 2023, the mosquito vector species that transmits EEE was not identified in any of the traps submitted for identification and testing. Continuing to test for this vector, as well as other emerging mosquito-borne diseases, will become increasingly important as patterns of mosquito populations are influenced by the warmer and wetter conditions that climate change is bringing.

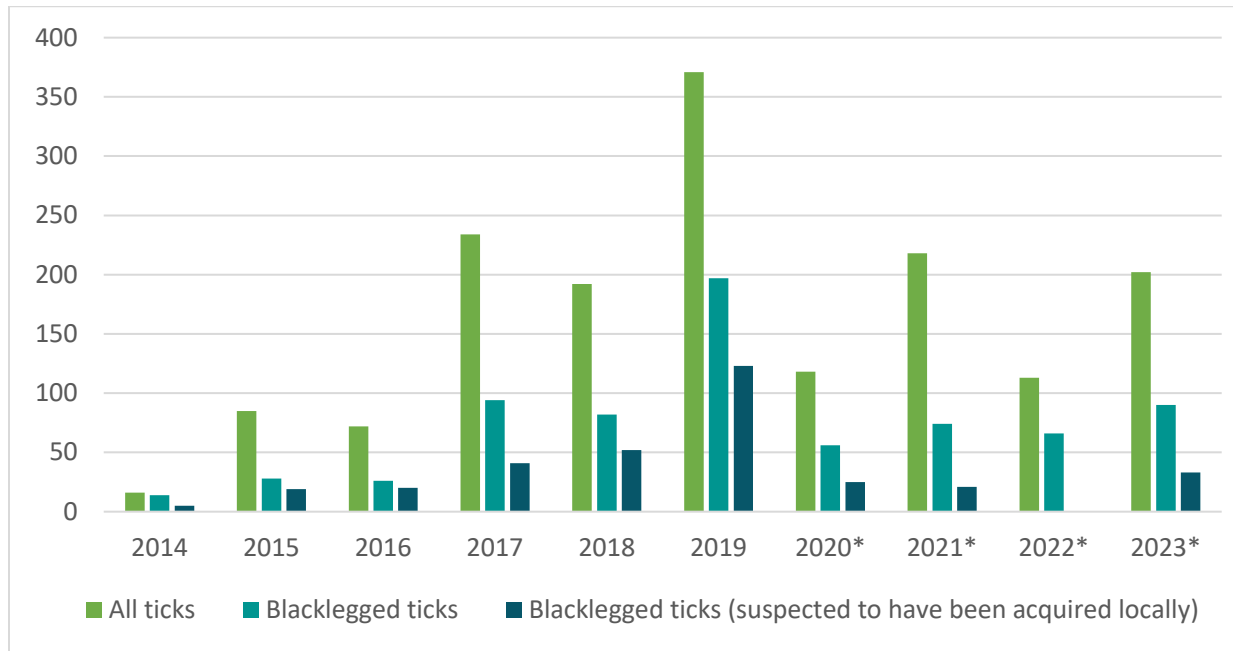
Additional details from the surveillance and control activities completed under the WNV program in 2023 are provided in Appendix A.

Passive Tick Surveillance Key Findings and Program Updates

Passive tick surveillance began in 2011 and initially, submissions remained low (Figure 2). In 2019, a large spike in submission was observed both locally and provincially. This sudden increase was likely partly attributable to broadly increasing public awareness from education campaigns. Although the total number of ticks submitted through passive surveillance has fluctuated over the years, on average about half of the ticks submitted are blacklegged ticks and about half of the blacklegged ticks submitted are suspected to have been acquired locally.

Surveillance capacity was impacted to varying degrees between 2020 and early 2023 due to the COVID-19 pandemic. Consequently, during that time, data collection sometimes did not include a suspected acquisition location (i.e., where the tick may have been picked up), and reported numbers for locally acquired ticks are likely underestimated. This was true for all ticks received in 2022 and early 2023 until the online form was launched in May 2023. Consequently, values reported for locally acquired ticks are likely underreported between 2020 and early 2023.

Figure 3. Passive surveillance for Blacklegged ticks in Wellington-Dufferin-Guelph, 2014-2023

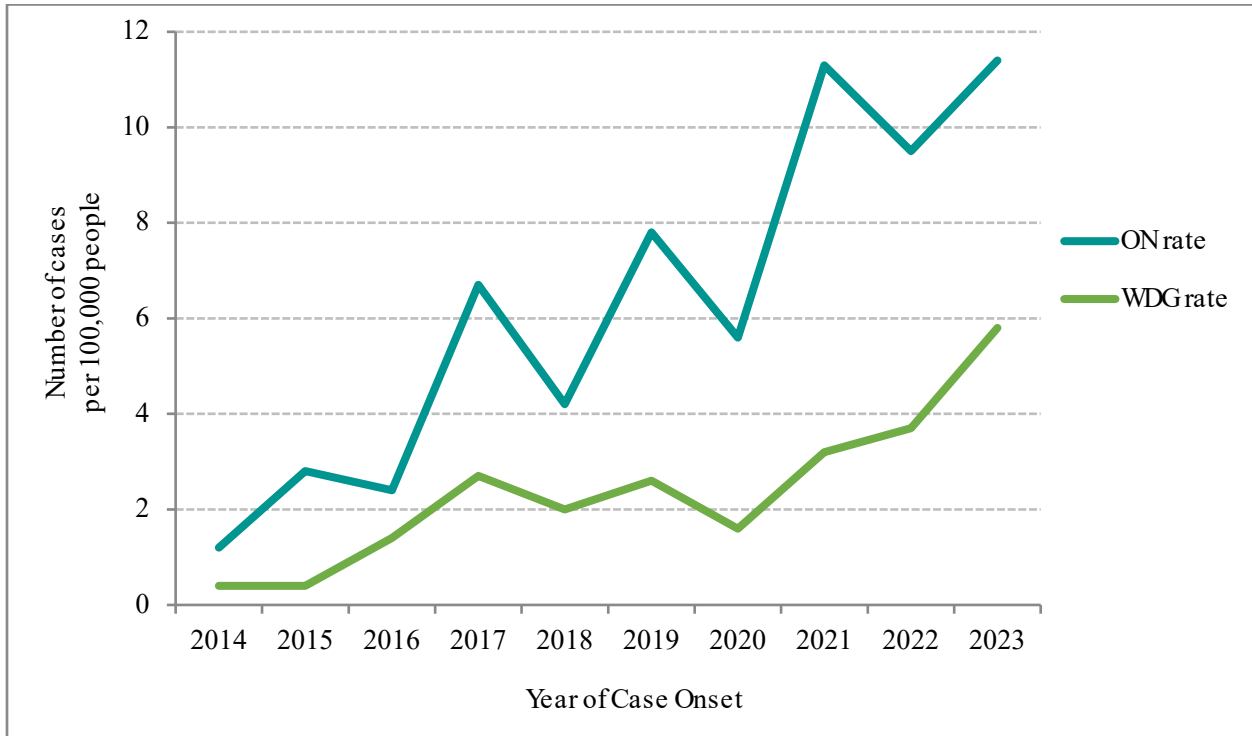


*Surveillance capacity was impacted between 2020 and early 2023. Between 2020 and 2022, many of the ticks submitted did not have data collected on where the tick was acquired and numbers for blacklegged ticks *acquired locally* is underestimated. This remained the case in early 2023 until the new online form was launched in late May. Consequently, 2023 values reported for *locally acquired* ticks is also underreported, as data collected in 2023 prior to launch of online form did not include suspected acquisition information.

Human Cases of Lyme Disease

Local human cases of Lyme disease have been trending upward over recent years (Table 2), consistent with trends being observed at the provincial level. Local case counts from the past six years are shown in Table 2 and Figure 3. Although case numbers are small, they are increasing and are expected to continue to increase. Public Health Agency of Canada notes that while some of these increases being observed could be attributed to increasing awareness both among the public and among healthcare providers, the risk of human infection is also increasing due to climate changes that are contributing to the expansion of the range of blacklegged ticks.⁵

Figure 3: Incidence Rates of Laboratory-Confirmed Lyme Disease in Ontario and Wellington-Dufferin-Guelph, 2014-2023



Data Source: Integrated Public Health Information System, Public Health Ontario Infectious Disease Query. Extracted Feb 20, 2024

Table 2: Human Cases of Lyme Disease reported in Wellington-Dufferin-Guelph, 2018-2023

Year	Human Cases of Lyme Disease
2018	8
2019	11
2020	7
2021	12
2022	17
2023	20

Data source: The integrated Public Health Information System (iPHIS). Extracted February 13, 2024

It is important to note that, over the years, cases reported locally often did not include a suspected exposure site and consequently, many may have been acquired outside of Wellington-Dufferin-Guelph. However, cases reported in 2023 nearly always included a suspected exposure site or notes suggesting a few potential exposure sites. A few points of interest from human cases reported in 2023 include:

- Twenty cases were reported in 2023. An increasing trend from the last five years.
- Case investigation notes suggest that:
 - In about half (11 cases) of reported cases, the suspected exposure site was local (within Wellington-Dufferin-Guelph)
 - In 8 of the 20 reported cases, the suspected exposure site was a residential property.
 - Two reported cases may have been occupational exposures.

Online Submission Process for Tick Identification

Tick identification services to support passive surveillance have been in place since 2011. In 2017, WDG Public Health saw a notable increase in the number of tick submissions and since that time tick submissions have remained high. Although switching from receiving specimens submitted in person to receiving photos via email did reduce some of the labour involved, it continued to demand significant staff time to complete. Collecting information from the client about where and how the tick was acquired, documenting the identification results, and responding was labour intensive as it often involved several email exchanges and manual data entry. To help manage the large volume of tick submissions, improve the process flow for this service, and broaden the range and accessibility of the service an online system for submitting photos of ticks was launched in 2023.

The new digital mobile-friendly submission process was designed to improve data collection and improve reach within the WDG community. The new system includes a public-facing online form where submitters upload photos of their tick and answer questions about where they suspect the tick was acquired and how (i.e., the type of outdoor activity they were engaged in). Once the Inspector completes an identification, an automated email response to the submitter is triggered. The response includes the result of the identification and corresponding guidance.

The online submission form was launched at the end of May last year. Consequently, most tick submissions in 2023 were received through the new online process. Key findings from the first year of using the new process include:

- Most submitted ticks were either blacklegged ticks or American dog ticks, which remains in line with trends seen in previous years.
- Most blacklegged ticks submitted were:
 - reported to have been found attached to a person.
 - identified as an adult female tick.
 - engorged (indicating the tick had likely been attached and feeding).

- Based on submitter-reported data:
 - just over half of both ticks and blacklegged ticks were suspected to have been acquired locally; and
 - roughly 25% of ticks acquired locally were suspected to have been picked up while spending time on a residential property, usually the submitters own property.

Passive surveillance data is typically not robust enough to draw conclusions about patterns of tick populations due to potentially unreliable location data as noted above. Nonetheless, some of the information collected could help inform local programming and health promotion activities. For example, last year a new educational resource was added to WDG Public Health’s [Ticks and Lyme Disease webpage](#). This resource was developed by the National Collaboration Centre for Environmental Health (titled [Ticks in a Changing Climate](#)) and includes a section with advice to property owners on ways to reduce tick habitats. Given that a significant portion of tick submissions came from clients who suspect they acquired the tick at their home property, future educational campaigns will promote this resource and related messaging further.

Public Education – Some ticks carry harmful bacteria!

After a soft launch in the spring, the online submission form was actively promoted in the fall through social media (Table 3 and Figure 4) and will be further promoted in a larger campaign in 2024. The number of unique users who visited the WDGPH Ticks and Lyme Disease webpage was up this year, nearly double the number of users who visited the site last year.

Table 3: Media and Public Education Data for Ticks in WDG 2022

Webpage	Users ^b	Social media posts (Total across all platforms ^a)	
		Impressions ^c	Engagement ^d
Webpage – Ticks and Lyme Disease	2794	n.a.	n.a.
Social Media Ads (see Figure 4)	n.a.	6,607	132

^a Platforms include Facebook, and X (Twitter)

^b Users – The number of unique users who visited the page

^c Impressions – The number of times content was displayed to users

^d Engagement – number of times users engaged with content (includes clicks on the post link, reactions, shares, comments, saves, and story tapbacks)

Figure 4. An example of a social media ad promoting WDG Public Health’s new online tick photo submission form



As part of this year’s campaign, we are connecting with local partners, like the Grand River Conversation Authority, to explore designing and posting educational signage at local trails and parks. The key goal of the signs will be to raise awareness about:

- the risks posed by ticks, and
- the importance of promptly removing ticks and having a tick identified (the signs will include a QR code linking to the new online tick submission form).

Next Steps: One Health

As discussed above, surveillance activities under the WNV program also include identifying other mosquito species of interest, including the mosquito vectors that transmit EEE. Monitoring for these emerging vectors plays a critical role in a robust vector-borne disease program. This is even more critical in the face of a changing climate that will favour the proliferation of mosquito populations.

Consequently, tools that support and enhance mosquito species identification play a critical role in delivering comprehensive surveillance programs. However, currently accepted methodologies for species identification are highly labour-intensive and expensive. An emerging and promising technology that could support monitoring efforts involves collecting environmental DNA (eDNA), genetic material obtained directly from environmental samples like water, and testing samples for the presence of targeted species. Through a collaboration with Conestoga College, WDG Public Health will be supporting a local pilot project that will assess eDNA methods for the

detection of targeted mosquito species. This work is expected to start in 2025 pending federal grant approval.

Embracing an integrated system approach, WDGPH is set to deepen its educational outreach on zoonotic and vector-borne diseases within the context of the One Health framework, which recognizes the intricate connections between human, animal, and environmental health. This approach will enhance awareness of how climate change exacerbates the spread and impact of these diseases. In the coming year, we plan to enrich the web content to provide comprehensive information for both healthcare experts and the public, underscoring the critical links to climate change. This effort highlights the importance of cross-disciplinary collaboration and data transparency and illustrates these connections through an interactive Zoonotic and Vector-borne Disease dashboard and other relevant resources. This tool will visualize local trends and surveillance data, showcasing the efforts undertaken by the organization to monitor and control these diseases.

Health Equity Implications

When offering services to the public, it is important to consider how different clients who need the service may experience barriers to accessing the service.

During the planning phase of the Online Tick Submission Process, it was recognized that some individuals would experience barriers to accessing this new online service. The online tick form not only requires a device to complete the form but also an email address to receive follow-up messages. To address these barriers, a pilot process was set up to support those individuals. Clients could opt to travel to a WDG Public Health office with a tick specimen and ask for in-person support from a Public Health Inspector. Using their agency cell phone, the Inspector would support the client by helping to take a photo of the tick and complete the online form. The public-facing online form includes a “*For staff use only*” field where the Inspector can make a note that the submission was staff-supported. This provides an opportunity to flag that the follow-up method likely needs to be modified to meet the needs of the client (for example a phone call instead of an automated email reply). When completing the internal identification form, the inspector has options built into the form to ensure clients without an email address receive follow-up through a communication method that meets their needs. According to 2023 data, this alternative pilot process was used six times. In 2024, this process is being reviewed for improvement opportunities. For example, during the pilot, staff at reception asked whether they could potentially also support clients who visit a WDGPH office with a tick specimen. As part of the planned review, we will further explore this suggestion and the feasibility of training staff at reception to support clients who experience barriers to accessing the online tick identification service.

To effectively apply a health equity lens to vector-borne disease surveillance programs at WDG Public Health, it is essential to design health education initiatives that are inclusive and accessible to all community members, regardless of their socioeconomic status or educational

background. This entails developing health promotion materials and messages that are easily understandable across diverse literacy levels and available through multiple formats, not solely digital platforms. Recognizing the digital divide – the gap between those who have ready access to computers and the internet, and those who do not – is crucial in ensuring that vital health information reaches everyone, including those in remote or underserved areas.

To achieve this, initiatives could include printed materials in community centers, libraries, and clinics; interactive workshops and community talks in multiple languages. Additionally, partnering with local community organizations and leaders can enhance outreach efforts and ensure messages are culturally relevant and trusted. By incorporating these strategies, WDGPH can ensure its tick and mosquito surveillance programs do not inadvertently contribute to health disparities but instead promote health equity by ensuring all community members have the information and resources they need to protect themselves from tick and mosquito-borne diseases. This comprehensive population health approach acknowledges and addresses the barriers to accessing health information and services, paving the way for healthier communities across Wellington County, Dufferin County, and Guelph.

Conclusion

Climate change brings longer and hotter seasons, mosquito populations will become more abundant and stick around for longer each year, increasing the risk of virus transmission and supports the expansion of new vector species not previously present. Similarly, the expansion of suitable habitats for Blacklegged ticks is facilitated by milder winters and extended periods of warmth. This leads to an extended activity season for ticks and expansion into new regions, heightening the probability of human exposure to tick-borne diseases.

Keeping up with a changing landscape and addressing the complex interplay between climate change and vector-borne diseases requires a One Health and continuous improvement approach. Robust surveillance systems, effective vector control measures, evidence-informed public awareness campaigns, and strategic partnerships form a crucial foundation of a comprehensive strategy to mitigate the escalating risks associated with Vector-borne Diseases. WDGPH continues to identify initiatives to further strengthen this program and prepare for the future. The online tick submission process launched last year supports managing higher volumes of tick submissions while strengthening local data collection. Concurrently, the eDNA pilot project will form an important first step toward innovating mosquito surveillance work to ensure the early detection of emerging vectors and diseases.

The interconnections between the environment and public health cannot be overstated, making collaboration with municipalities, academia, and human and animal health paramount to build comprehensive strategies and programs that are adaptable to changing conditions, ensuring community health and resilience in the face of a warming planet.

Ontario Public Health Standards

Foundational Standards

- Population Health Assessment
- Health Equity
- Effective Public Health Practice
- Emergency Management

Program Standards

- Chronic Disease Prevention and Well-Being
- Food Safety
- Healthy Environments
- Healthy Growth and Development
- Immunization
- Infectious and Communicable Diseases Prevention and Control
- Safe Water
- School Health
- Substance Use and Injury Prevention

2024-2028 WDGPH Strategic Goals

More details about these strategic goals can be found in [WDGPH's 2024-2028 Strategic Plan](#).

- Improve health outcomes
- Focus on children's health
- Build strong partnerships
- Innovate our programs and services
- Lead the way toward a sustainable Public Health system

References

1. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Public health data request: Human cases of Eastern Equine Encephalitis Virus (EEEV) in Ontario: 2012-2023. Toronto, ON: King's Printer for Ontario; 2024.
2. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Eastern equine encephalitis: history and enhanced surveillance in Ontario. Toronto, ON: Queen's Printer for Ontario [Internet]. 2014 [cited 2024 Feb 7]. Available from: <https://www.publichealthontario.ca/-/media/documents/E/2014/eeev-report.pdf>
3. 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 [Internet]. 2016 [cited 2024 Feb 7]. Available from : https://www.publichealthontario.ca/-/media/Documents/Lab/lyme-disease-prevention-technical.pdf?rev=edabb26ea99f41dfa6c247b8878d2aab&sc_lang=en
4. National Collaborating Centre for Environmental Health. Ticks in a changing climate [fact sheet]. Vancouver, BC: NCCEH [Internet]. 2023 [cited 2024 Feb 8]. Available from: <https://ncceh.ca/resources/evidence-reviews/ticks-changing-climate>.
5. Public Health Agency of Canada. Lyme disease surveillance report: Annual Edition, 2019 [Internet]. 2023 [cited 2024 Feb 8]. Available from : <https://www.canada.ca/content/dam/phac-aspc/documents/services/publications/diseases-conditions/lyme-disease-surveillance-report-2019/LD-REPORT2019-ENG-Final.pdf>

Appendices

Appendix A - 2023 Mosquito Control Activities

Larvicide treatments are applied by trained technicians certified by the Ministry of Environment, Conservation and Parks (MECP). Larvicide helps reduce or eliminate mosquito populations that transmit WNV and other mosquito-borne diseases. Larvicide is applied to identified breeding sites where standing water cannot be eliminated or is more difficult to control, including municipal catch basins, stormwater management ponds and roadside ditches, and where vector species have been identified through surveillance. Table A1 shows the number of treatments within the WDG region in the 2023 season.

Treatments and inspections 2023	
Roadside catch basins treatments	25,920 roadside catch basins, plus 25 Environmentally Sensitive Area (ESA) catch basins each received 4 treatments between June 5 th , 2023, and August 30 th , 2023 74 backyard catch basins, plus 114 regionally owned catch basins (in parks) each received one treatment during same period
Stagnant surface water inspections and treatments	Of the 1729 site inspections that were conducted, 105 of these sites were identified as vector species breeding areas and treated between June 5 th , 2023, and September 25 th , 2023 0.142 hectares of stagnant surface-waters were treated

Table A1: Mosquito Control data from 2023 season in WDG Region

Standing water complaints within the City of Guelph are supported by the City of Guelph's Standing Water By-law (By law Number (2003) – 1719). Complaints outside the City of Guelph are addressed by local By-law Enforcement.

2023 Mosquito Surveillance Summary

Surveillance activities in 2023 included collecting both adult and larval life stages of the mosquito species such as *Culex restuans* and *Culex pipiens*, which are considered *vector species* known to transmit WNV. Mosquitoes collected in the WDGPH surveillance program are identified, and viral analysis is conducted for the presence of WNV.

Table A2: Mosquito Surveillance Data from 2023 season in WDG Region

Surveillance 2023	
Mosquito trapping	16 trap site locations selected 208 traps were submitted for analysis
Mosquito pools (samples)	4,411 adult mosquitoes collected 43% of adults identified were vector species 23% of adults identified were potential bridge vector species 34% of adults identified were of no public health concern 203 adult mosquito pools sent for WNV-testing 3 pools tested positive for the presence of WNV 0 pools tested positive for the presence of EEE*

*The mosquito vector species for EEE, *Culiseta melanura* was not identified in any of the traps submitted for identification and testing.