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Executive Summary

The following report provides information about the transmission and health effects of the vector-borne diseases of concern in Peel Region, as well as details and results of surveillance and risk reduction activities undertaken in 2010.

Since 2000, the Region of Peel has conducted a program to monitor the risk of West Nile Virus (WNV) transmission to humans through surveillance and to reduce it through control efforts and education. In 2009, the Ontario Ministry of Health and Long-Term Care (MOHLTC) reduced funding to health units by over 20 per cent and changed its funding structure by expanding the WNV program to include additional vector-borne diseases. Consequently, larval surveillance activities in Peel were shortened by one month and the WNV Prevention Plan was enhanced to include two other vector-borne diseases of concern in Ontario: Lyme disease and Eastern equine encephalitis (EEE).

The ideal conditions for the spread of WNV from mosquitoes to humans are achieved during periods of prolonged, hot weather. The occurrence of these conditions is likely to increase in frequency in the coming years as a result of climate change. Unlike the past two years, the summer of 2010 was relatively dry, with lower than normal levels of precipitation. Although the temperatures were high enough to increase the viral replication rate in mosquitoes, the dry conditions were not conducive for mosquitoes to breed and increase their population. This was demonstrated through mosquito surveillance statistics in 2010 which indicated a 28% decrease in WNV mosquito activity from the 2009 season. In 2010, an estimated 46,163 mosquitoes were collected from 31 permanent, fixed monitoring traps throughout Peel Region between June 13 and October 2, 2010. *Aedes vexans* was the most abundant mosquito species captured in 2010 (38.3%). Fourteen batches tested positive in 2010; 12 of the 14 positive batches (86%) were found to contain the *Culex* species. There were no human cases of WNV reported in the Region of Peel or any of its neighbouring municipalities in 2010.

Mosquito larvae surveillance was undertaken at 2,274 potential mosquito breeding sites in Peel Region in 2010. Ditches, culverts and field pools comprised over three quarters of the sites with larvae present. A total of 5,036 mosquito larvae were identified; the majority (61%) were of the *Culex* species.

To help control the number of vector mosquitoes in Peel, a larviciding program aimed at source reduction was conducted in 2010. Over 368,000 roadside catch basins in Peel Region were treated with a total of 252 kg of Altosid® Pellets, 988 pouches of Vectolex® Water Soluble Pellets, and a total of 2,149 briquets of Altosid® XR Briquets were used to treat non-roadside catch basins located on Region of Peel owned properties and in public parks. Furthermore, 460 surface water sites received a total of 636 larvicide treatments.

In 2010, Peel conducted passive tick surveillance. One deer tick submitted by a resident tested positive for Lyme; however this tick was collected from an endemic area outside of Peel Region. There was no EEE activity in Peel in 2010, despite three cases of EEE among horses in Ontario. There were no human cases of EEE in Ontario in 2010.

1. Introduction

A vector-borne disease is a disease that is transmitted to humans or animals by an insect or other arthropod. In Ontario, mosquitoes and ticks are the two most common vectors of human disease; West Nile Virus (WNV) and Lyme disease are the two most common diseases in humans resulting from the transmission of infection by vector. In recent years another vector-borne disease called Eastern Equine Encephalitis (EEE) has emerged. Although much less common, EEE is a serious viral disease that can be transmitted by mosquito to both humans and horses. To date, there have been no human cases of the EEE virus reported in Ontario; however the virus has been detected in mosquitoes and horses. Due to concern that regional environmental change is making it more favourable for these vector populations to increase, there is mounting pressure on health units in Ontario to develop surveillance programs for EEE.

Public health units in Ontario have carried out WNV surveillance activities since 2000. In 2009, the program underwent some considerable changes. The provincial government reduced the budget allocated to health units by 23% relative to 2007, and changed its funding structure by expanding the WNV program to include additional vector-borne diseases including Lyme disease and EEE. The Ontario Ministry of Health and Long-Term Care (MOHLTC) also announced that it would cease funding the dead bird surveillance program, so Peel Public Health stopped collecting dead birds in 2009.

As a result of these funding and program changes, larval surveillance activities began June of 2009 and 2010 instead of May, and the Region of Peel WNV Prevention Plan was enhanced to include surveillance of Lyme disease and EEE in addition to WNV. The program name was changed from the West Nile Virus Surveillance program to the Vector-Borne Disease (VBD) Surveillance program. These changes impact the comparability of surveillance data from 2009 and 2010 to surveillance data from earlier years when the scope of the program was more narrow.

Temperature and weather in Peel also have a direct impact on the surveillance results from year to year. The habitat, survival and replication cycles of many vector species are determined by temperature. Warmer and wetter summers are conducive to greater mosquito activity. Increasing future temperatures associated with climate change could increase the survival and replication rates of mosquitoes and ticks and expand the geographical range of survival. This in turn may contribute to a higher incidence of vector-borne disease in the future in areas which currently have little vector-borne disease activity, making it prudent for public health officials to continue surveillance activities for such diseases.

This ninth annual report provides information about the transmission and health effects of the vector-borne diseases of concern in Peel Region, as well as details and results of surveillance and risk reduction activities in 2010. Detailed explanations about the processes and methods are not described because they have been articulated in previous reports (see <http://www.peelregion.ca/health/vbd/index.htm> for previous reports). Any changes in the program impacted the interpretation of the data are explained.

2. West Nile Virus

West Nile Virus, a virus transmitted primarily through the bite of infected female mosquitoes, was first detected in North America in 1999 when an outbreak was experienced in New York City. Since then, WNV has rapidly spread across all other continental U.S. states and the majority of Canada's provinces.

In early spring, the amplification of WNV begins after infected adult mosquitoes overwinter and/or infected migratory birds return to the region. *Culex pipiens* and *Culex restuans*, two mosquito species that feed primarily on birds, are the main vectors for the virus in Ontario and have been estimated to be responsible for up to 80% of WNV human infections in the north-eastern United States, an environment similar to Peel Region.¹

Infected mosquitoes feed on birds and the virus is transmitted back and forth resulting in an increase in the number of birds and mosquitoes infected. Later on in the season, typically late July, there is a "spill over point" where the virus bridges out of the mosquito-bird cycle via bridge vectors. The bridges are mosquito species, like *Aedes vexans*, that feed on humans and other mammals in addition to birds. Although *Culex* mosquitoes continue to be the primary vectors throughout the season, these bridge vectors are also a concern in late summer.

The species type of WNV vector mosquitoes varies with geography. For example, the species responsible for the 2007 increase in human cases in the Canadian prairie provinces, *Culex tarsalis*, is not found in significant abundance in Ontario.

WNV was first detected in birds and mosquitoes in Peel in 2001. Locally acquired human illness from WNV first occurred in Peel Region in 2002. Twenty-one of 37 cases required hospitalization. In 2002, there were two deaths in Peel due to WNV infection; these have been the only WNV-related deaths to occur in Peel.

According to the literature, an estimated one in five people who are bitten by a mosquito infected with WNV will develop symptoms. The incubation period is estimated to be three to 14 days with symptoms lasting on average three to six days. Most people who are infected have either no symptoms or mild illness, such as WNV fever. WNV fever is characterized by a sudden onset of fever, often accompanied by malaise, headache, nausea, vomiting, anorexia, eye pain, myalgia and less commonly, rash and/or swollen lymph nodes. These mild cases are typically classified as West Nile Virus Non-Neurological Syndrome (WN Non-NS).²

In about one percent of infected individuals, WNV can cause more severe illness including severe neurological disease which can result in hospitalization. Cases of the more severe disease typically are classified as West Nile Virus Neurological Syndrome (WNNS) and symptoms include muscle weakness and a change in mental status.² Long-term health effects of WNV infection are possible but are less well understood. They can include physical (long-term muscle weakness and paralysis, fatigue and headache), cognitive (depression, confusion, and memory loss) and functional effects (difficulty with meal preparation and shopping).²

Ontario Regulation 199/03³ (Control of West Nile Virus), under the *Health Protection and Promotion Act*, requires that the local Medical Officer of Health (MOH) conduct a risk assessment of the conditions pertaining to WNV in their health unit. The risk assessment relies on surveillance of human and mosquito infections. This guides the MOH with respect to appropriate WNV risk reduction activities, including the need for mosquito reduction measures.

Provincial regulation also requires the MOH to record, investigate and report any adverse or unintended human health effects attributed to mosquito reduction actions and to report any non-human environmental adverse effects to the Ministry of Environment and/or other relevant local or provincial authorities. WNV is both a reportable and communicable disease under Regulations 558/91⁴ and 559/91⁵, respectively, requiring physicians and laboratories to report human cases to the local MOH.

The goal of the WNV component of the Region of Peel’s Vector-Borne Disease Prevention Plan is to minimize the impact of WNV with a regional surveillance program involving humans and mosquitoes. The surveillance program guides the integrated pest management activities which include mosquito larvae reduction and prevention and public education and community outreach activities.

2.1. Human Case Surveillance

The human case surveillance program is intended to detect cases of WNV in Peel. All probable or confirmed cases identified by hospitals and physicians are reported to the local public health department. The MOHLTC has developed case definitions and diagnostic test criteria (refer to Appendix A).⁶

Peel Public Health staff investigate all reported probable and confirmed cases of WNV among Peel residents. Demographic and medical information including symptoms and risk factors (e.g. travel history, blood products recipient) are collected and entered into the integrated Public Health Information System (iPHIS).

2.1.1. Human Surveillance Program - 2010

In 2010, there were no confirmed human cases of WNV in Peel Region. Table 1 presents the number of human cases of WNV in Peel from 2002 to 2010. In 2002, 57 probable and confirmed cases of WNV were reported (based on the case definitions at that time). If the present day definition were applied to the 2002 cases, there would have been 18 confirmed cases in 2002.

Table 1: Number of Probable and Confirmed Human Cases by Municipality, Region of Peel, 2002 – 2010.

Year	Region of Peel	Mississauga	Brampton	Caledon
2002	57	52	5	0
2003	10	10	0	0
2004	0	0	0	0
2005	3	2	1	0
2006	2	0	2	0
2007	1	1	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0

2.1.2. Comparison with Other Health Units

Across Ontario, there was one confirmed WNV human case in 2010, compared to three in 2009, four in 2008 and 15 in 2007. The confirmed case in Ontario in 2010 was in Durham Region.

2.1.3. Comparison with Other Provinces

In 2010, there were five human cases and no deaths from WNV in Canada, compared to eleven cases and no deaths in 2009, 38 cases and no deaths in 2008, and 2,355 cases and two deaths in 2007. In 2010, the positive human cases were in the provinces of British Columbia, Alberta, Saskatchewan and Ontario. One case was reported as WNNS and the other four cases as WN Non-NS. No deaths were reported.⁷

2.2. Adult Mosquito Surveillance

WNV circulates between mosquitoes and birds when a female mosquito feeds on the blood of a WNV-infected bird. Once the virus has incubated in the mosquito, it can be passed to another host (e.g., bird, human) through the saliva of the mosquito. Mosquito surveillance programs serve to monitor the mosquito population both for their abundance and the species present. Certain species of mosquitoes are more likely to transmit WNV to humans, with some species being more efficient transmission vectors than others. Therefore, it is important to monitor their occurrence in order to assess the potential risk to human health. In Ontario, the species of particular interest due to their WNV transmission risk continues to be the *Culex* species.

Historically, *Culex* species have consistently been responsible for the majority of the WNV-positive mosquito batches in Peel Region. Once again in 2010, 12 of the 14 WNV-positive mosquito batches were due to the *Culex* species. For more information about the methodological details associated with species identification, sorting and viral testing, refer to the 2006 West Nile Virus report.⁸

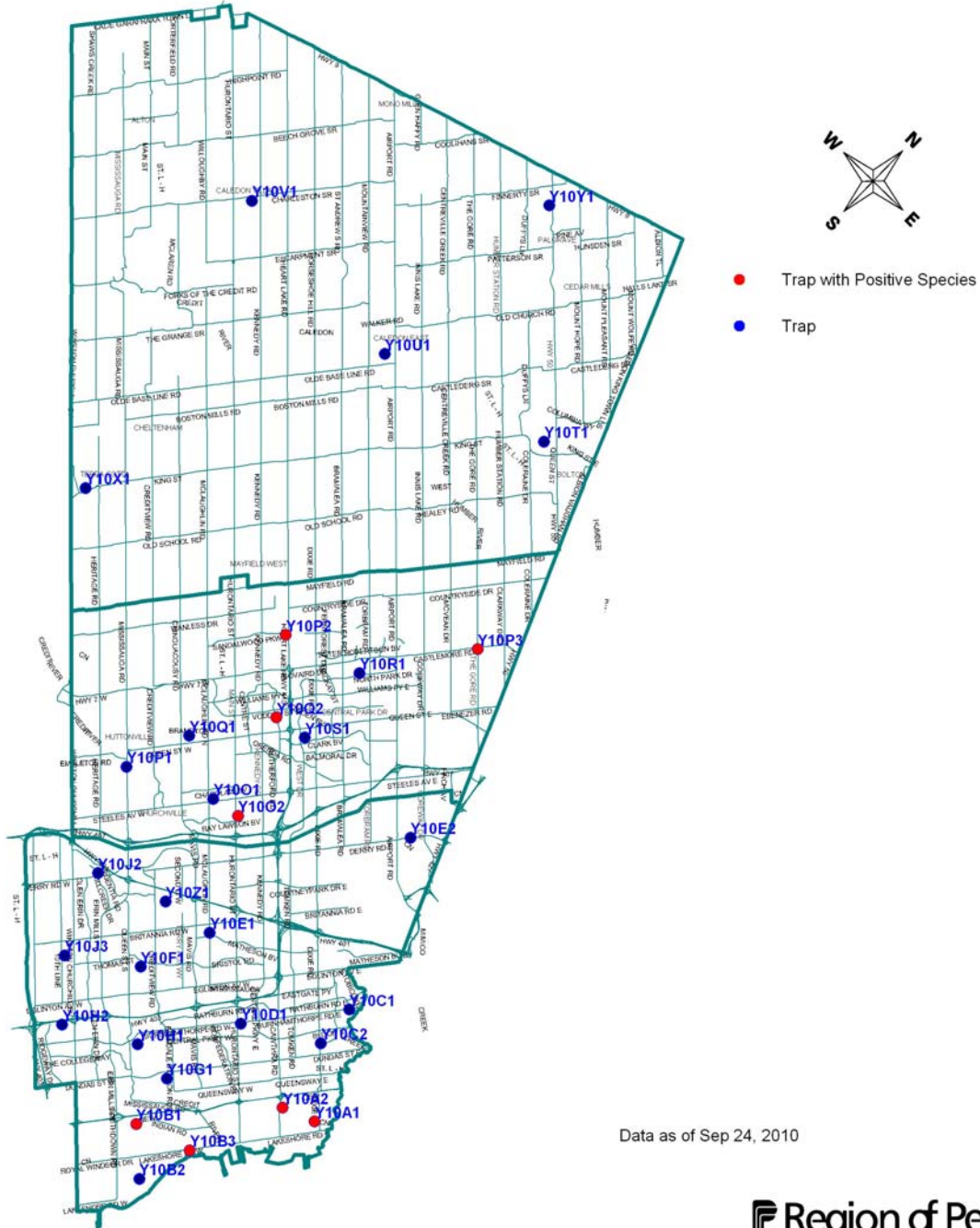
2.2.1. Adult Mosquito Surveillance Program – 2010

Map 1 shows the locations for the fixed adult mosquito traps set in Peel Region in 2010. Thirty-one fixed CDC (Centre for Disease Control) light traps were distributed by Regional ward, with a minimum of one trap per ward across Peel: 17 in the City of Mississauga, nine in the City of Brampton and five in the Town of Caledon.

Map 1: Map of Mosquito Trap Location, by Municipal Ward, Region of Peel, 2010.

West Nile Virus - Mosquito Trapping

Peel - Year 2010 (Week 24 - 39)



Data as of Sep 24, 2010



Table 2 presents the estimated number of mosquitoes collected by species in 2010**. The number of specimens identified refers to all species whose identification was confirmed, up to approximately 200 specimens per trap, any others were not identified. An estimated 46,163 mosquitoes were collected between June 13 and October 2 of 2010. The total number of mosquitoes collected in 2010 represents a 28% decrease from 2009 when 64,393 mosquitoes were collected and identified.

Table 2: Estimated Number of Female Adult Mosquitoes Collected and Identified by Species, Region of Peel, 2010.

Vector Species*	All Peel	Brampton	Caledon	Mississauga North	Mississauga South
<i>Cx pipiens/restuans</i>	7,442	4,083	333	932	2,094
<i>Cx salinarius</i>	2	2	0	0	0
<i>Cs melanura</i>	2	2	0	0	0
<i>Ae vexans vexans</i> [†]	17,722	8,186	1,456	3,644	4,436
<i>An punctipennis</i>	980	359	175	204	242
<i>An walkeri</i>	2	1	0	1	0
<i>An quadrimaculatus</i>	244	61	126	20	37
<i>Oc japonicus</i>	1,721	206	21	346	1,148
<i>Oc tirseriatus</i>	1,089	182	57	384	466
<i>Oc tivittatus</i>	3,593	791	560	339	1,903
<i>Oc stimulans</i>	346	44	183	62	57
<i>Oc canadensis</i>	829	645	142	3	39
Non-Vector Species*	All Peel	Brampton	Caledon	Mississauga North	Mississauga South
<i>Ae cinereus</i>	25	13	4	1	7
<i>Cq perturbans</i>	11,676	3,375	3,664	1,438	3,199
<i>Cs morsitans</i>	4	0	3	1	0
<i>Oc black-legged</i>	220	66	31	47	76
<i>Oc broad-banded</i>	96	6	70	4	15
<i>Oc excrucians</i>	6	1	4	0	1
<i>Oc provocans</i>	7	0	7	0	0
Males (not identified)	3,791	1,008	212	778	1,793
Extra's	157	54	6	29	69
Total Mosquitoes	46,163	18,077	6,842	7,455	13,789
% Peel Total	100%	39.2%	14.9%	16.1%	29.8%

Source: totals provided to the Region of Peel from Cosray Labs, 2010.

*The common abbreviations for genus are as follows: *Aedes* (Ae.), *Anopheles* (An.), *Culex* (Cx.), *Culiseta* (Cs.), *Coquillettidia* (Cq.), *Ochlerotatus* (Oc.), *Stegomyia* (St.), *Psorophora* (Ps.) and *Uranotaenia* (Ur.)

[†]38 specimens of *Ae. vexans nipponii* (a subspecies of *Ae. vexans vexans*) were found and included in this total.

Over the 16 weeks of the 2010 season, 11 mosquito vector species and 1 subspecies were identified. As in previous years, *Ae. vexans* was the most abundant mosquito species identified in 2010. *Ae. vexans* comprised 38.3% (17,722 / 46,163) of the total mosquitoes captured in 2010, despite a smaller accumulation of rainfall in 2010 than 2009. Other mosquito species identified in 2010 included *Cq. perturbans* (25.3% of the species abundance) and *Cx. pipiens/restuans* (16.1% of the species abundance). *Oc. japonicus*, a highly competent WNV-

** These totals are based on the results provided to the Region of Peel by Cosray Labs, 2010.

vector that is becoming more established in Ontario, accounted for 3.7% of the total species captured in 2010 (1,721 / 46,163). The lack of rainfall during the 2010 season may have caused *Culex* numbers to drop slightly from 8,800 identified species in 2009 to just over 7,400 in 2010. However, July and August temperatures were high and may have contributed to increased WNV replication as *Cx. pipiens/restuans* made up 12 of the 14 WNV-positive mosquito batches during the 2010 season (discussed further later in the report).

Of the total number of mosquitoes collected, most were collected in Mississauga (45.9%), 29.8% in South Mississauga and 16.1% in North Mississauga, followed by Brampton (39.2%) and Caledon (14.9%). The species distribution varied across municipalities. The most prevalent species captured in Mississauga and Brampton was *Aedes vexans* with 38.0% and 45.3% species abundance, respectively. In Caledon, the most prevalent species collected was *Cq. perturbans* with 53.6% species abundance.

Oc. japonicus continues to increase in actual counts and trapping events. As illustrated in Figure 2, the number captured in Peel has increased each year since 2002. Laboratory studies indicate that *Oc. japonicus* is a very efficient vector of WNV. *Oc. japonicus* is an invasive mosquito, native to Asia. It was first identified in North America in New Jersey in 1998. Since then, it has spread rapidly throughout most of eastern North America. Several batches were positive for WNV in the United States in 2000, 2001, and 2002.⁹ In 2007, the first WNV positive batch of *Oc. japonicus* was reported in Ontario, in Chatham-Kent.¹⁰ Peel had positive *Oc. japonicus* batches reported in 2009 and 2010.

The total number of *Oc. japonicus* species captured in 2010 represents a 29.9% increase over the total number captured in 2009. Of the total *Oc. japonicus* species captured in Peel Region in 2010, 86.8% (1,494 / 1,721) were captured in Mississauga, 11.9% (205 / 1,721) were captured in Brampton, and 1.2% (21 / 1721) were captured in Caledon. The percentage of *Oc. japonicus* species captured in Peel Region relative to other species has also increased annually. In 2010, *Oc. japonicus* represented 3.7% of the total species captured, relative to 2.2% in 2009, 0.76% in 2008, and less than 0.4% each year between 2002 and 2007. The abundance of the *Oc. japonicus* species in Peel Region has increased by 89% since 2007.

Figure 2: *Oc. japonicus* abundance (based on actual counts), Region of Peel, 2002-2010.

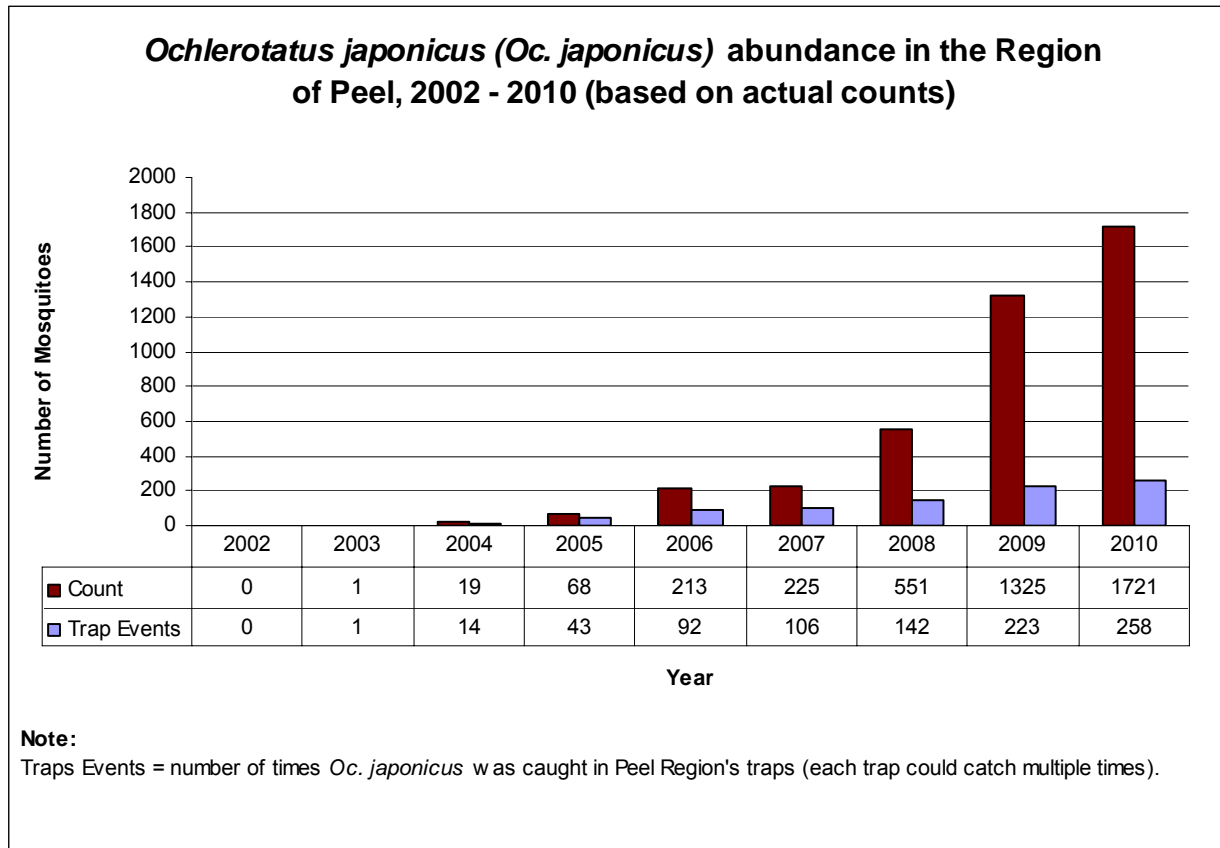


Table 3 presents the number of WNV-positive mosquito trapping events for 2002, 2008, 2009 and 2010 by area municipality. In 2010, there were 14 events where a mosquito trap tested positive, compared to 4 in 2009 and 21 in 2008. In 2010, eight of the positive trap events occurred in Mississauga and six of the positive trap events occurred in Brampton. Since the beginning of the WNV surveillance program in the Region of Peel, 2002 remains to be the year with the highest number of positive trapping events (128).

Table 3: Number of Positive Trapping Events by Municipality, Region of Peel, 2002, 2008-2010.

Year	Region of Peel	Brampton	Caledon	Mississauga	Date of First Positive Event
2010	14	6	0	8	July 25, 2010
2009	4	0	0	4	August 26, 2009
2008	21	11	0	10	July 29, 2008
2002	128	22	0	106	June 20, 2002

Figure 3 compares the annual number of positive mosquito batches per week for the 2002 baseline year and 2008-2010. The year to year onset and peak of WNV-positive mosquito batches vary. This is likely due to a range of factors including weather (temperature and rainfall) and the effectiveness of the multifaceted prevention program in reducing breeding sites on public and private property, and larviciding catch basins and surface water on public property.

The first positive trapping event in 2010 occurred during the week of July 28 in Mississauga and the last positive batch in 2010 occurred during the week of September 28 in Brampton.

Figure 3: WNV Positive Mosquito Batches by Week of Collection, Region of Peel, 2002, 2008-2010.

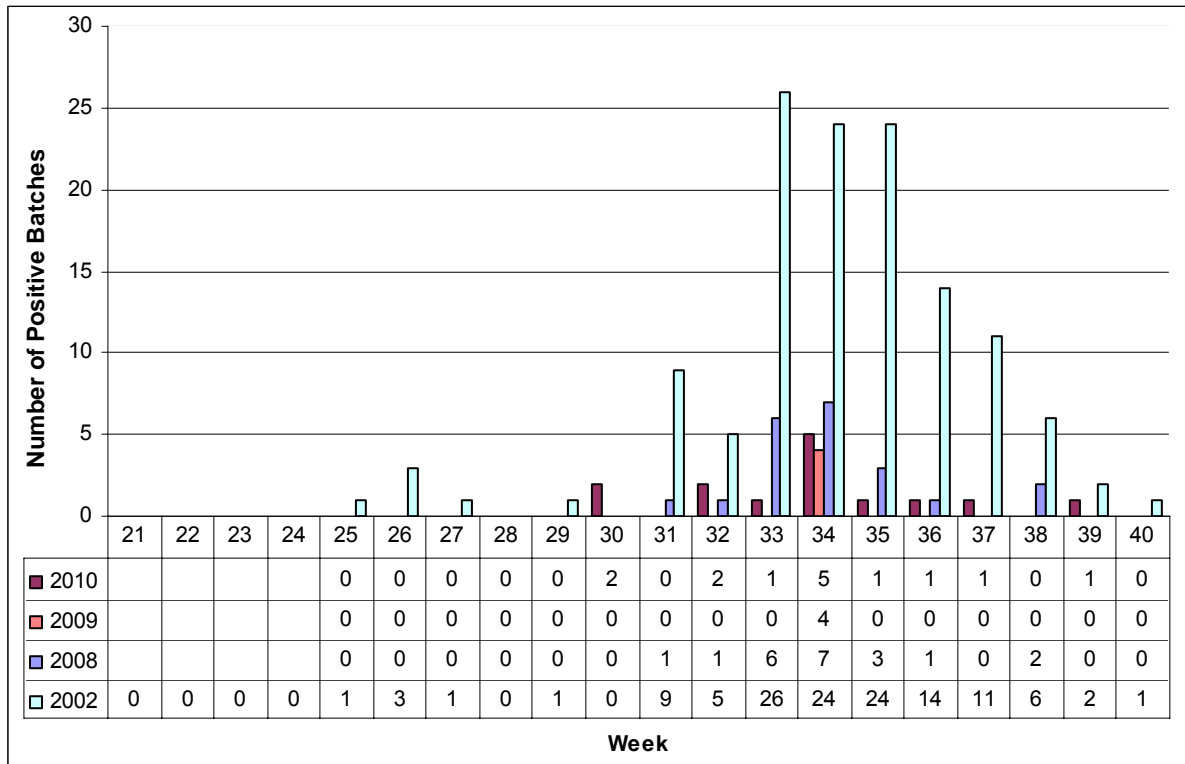
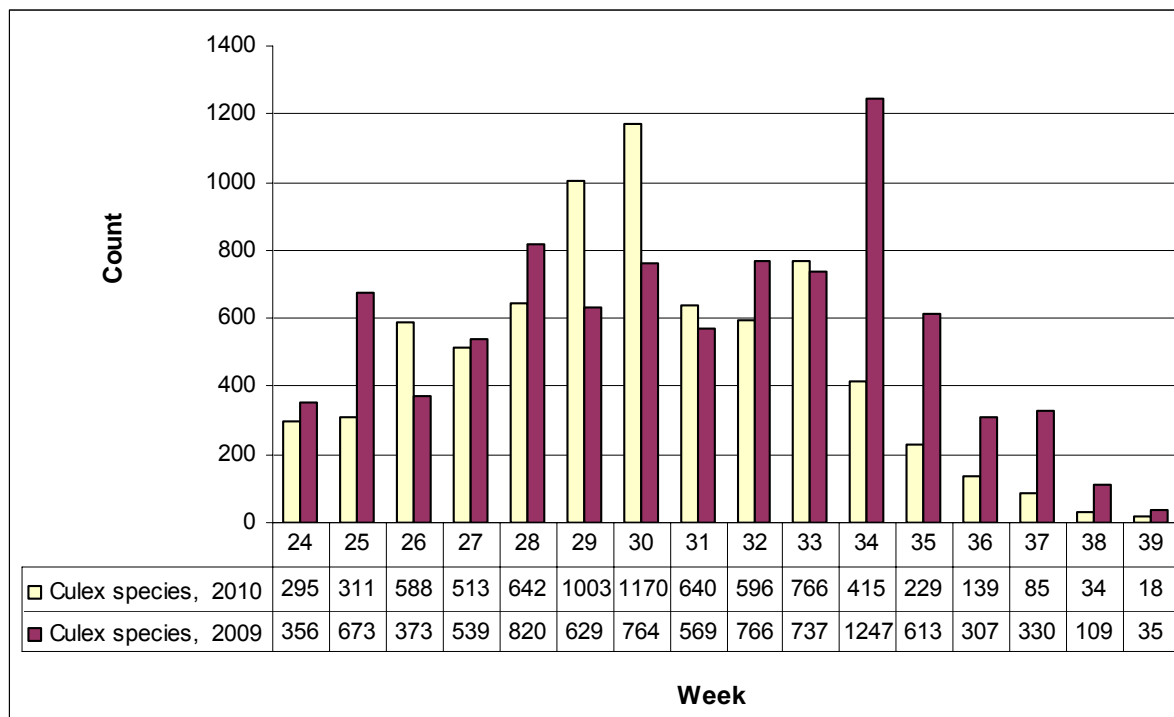


Figure 4 presents an annual comparison of the number of female *Culex* mosquitoes in 2009 and 2010.

Figure 4: *Culex* abundance in the Region of Peel, 2009 and 2010 (based on actual counts).



The absolute number of the *Culex* species captured in 2010 was lower than the previous two years. The relative percentage of *Culex* species to all species captured remained high, accounting for 16.1% of species abundance in Peel Region. Table 4 presents an annual comparison of the number and percentage of *Culex* mosquitoes in all batches and the number and percentage of all *Culex* positive batches for 2008-2010 and the 2002 baseline year. Similar to previous years, 2010 showed a high percentage of positive batches containing *Culex* species (85.7%). The two other positive batches consisted of *Ae. vexans* and *Oc. japonicus* mosquitoes.

Table 4: Total Number and Percentage of *Culex* Mosquitoes in all Batches and Positive Batches, Region of Peel, 2002, 2008-2010.

Year	Mosquitoes in All Batches			Positive Mosquito Batches		
	Total Number of Mosquitoes	Number of <i>Culex</i> Mosquitoes	% of <i>Culex</i> in all Batches	Total Number of Batches	Total Number of <i>Culex</i> Positive Batches	% <i>Culex</i> in all Positive Batches
2002	24,269	7,278	30.0%	128	98	76.6%
2008	78,214	8,431	10.8%	21	20	95.2%
2009	64,393	8,862	13.8%	4	1	25.0%
2010 ¹	46,163	7,442	16.1%	14	12	85.7%

¹ Source: Cosray Labs – 2010 Final Report

2.2.2. The Minimum Infection Rate

The minimum infection rate (MIR) is used as an indicator of the prevalence of WNV transmission intensity, and therefore the risk for human disease. The MIR is the number of positive batches of mosquitoes of a given vector species divided by the total number of mosquitoes of a given vector species that were tested for the presence of the virus, expressed per 1,000.

Tables 5 and 6 present the MIR's for the *Culex* species and for non-*Culex* species (*Ae. vexans* and *Oc. japonicus*) respectively, grouped by municipality in Peel Region in 2010. Higher MIR's are usually indicative of greater WNV activity among a given species but can be unreliable when the sample size is less than 1000.

As shown in Table 5, the MIR's for the *Culex* species were consistently and considerably higher throughout the Region of Peel than 2009. The MIR for the *Culex* species in Peel in 2010 was about 15 times higher than 2009. The MIR increased in 2010 due to a high number of positive batches of *Culex* in 2010 relative to previous years. The highest MIR for the *Culex* species was observed in Mississauga at 3.82.

Table 5: Minimum Infection Rates* of *Culex* Species by Municipality, 2007-2010

Municipality	Vector Species	2010 Number Tested	2010 Positive Batches	2010 MIR*	2009 MIR*	2008 MIR*	2007 MIR*
Mississauga	<i>Culex pipiens/restuans/species</i>	2,094	8	3.82	0.25	2.12	0.40
Brampton	<i>Culex pipiens/restuans/species</i>	4,083	4	0.98	-	2.01	0.73
Caledon	<i>Culex pipiens/restuans/species</i>	333	-	0.00	-	0.00	-
Peel Region	<i>Culex pipiens/restuans/species</i>	6,512	12	1.84	0.12	1.99	0.50

*The Minimum Infection Rate (MIR) is calculated as the number of positive batches of infected mosquitoes of a given species divided by the total number of mosquitoes of a given vector species that were tested for the presence of the virus, expressed by 1,000.

As shown in Table 6, two positive mosquito batches were attributed to non-*Culex* species in Peel Region in 2010. As observed during the 2009 season, the highest MIR in 2010 was for a non-*Culex* mosquito species.

Table 6: Minimum Infection Rates* of non-Culex Species in Each Municipality, Region of Peel, 2008-2010.

Municipality	Vector Species	2010 Number Tested	2010 Positive Batches	2010 MIR*	2009 MIR*	2008 MIR*
Mississauga	<i>Ae. vexans</i>	4,436	-		0.34	0.14
	<i>Oc. japonicus</i>	1,148	-		0.99	
Brampton	<i>Ae. vexans</i>	8,186	1	0.12		-
	<i>Oc. japonicus</i>	206	1	4.85	-	
Caledon	<i>Ae. vexans</i>	1,456	-			-
	<i>Oc. japonicus</i>	21	-		-	
Peel Region	<i>Ae. vexans</i>	14,078	1	0.07	0.20	0.08
	<i>Oc. japonicus</i>	1,375	1	0.73	0.84	

*The Minimum Infection Rate (MIR) is calculated as the number of positive batches of infected mosquitoes of a given species divided by the total number of mosquitoes of a given vector species that were tested for the presence of the virus, expressed by 1,000.

2.2.3. Adult Mosquito Surveillance in Other Ontario Health Units

Table 7 lists the results of the mosquito testing programs in Ontario health units in 2010. Nine of the 36 health units reported WNV positive mosquito batches in 2010. Toronto reported the greatest number of batches, 19 (34% of total), followed by Peel Region, 14 (25% of total) and Windsor-Essex County, 10 (18% of total). Of the health units adjacent to Peel Region, Toronto and Halton reported positive WNV mosquito batches in 2010.

Table 7: WNV Mosquito Surveillance Statistics by Health Unit, Ontario, 2010.¹¹

Health Unit	Total Positive Batches	Percent of Total
Algoma Health Unit	0	0%
Brant County Health Unit	0	0%
Chatham-Kent Public Health Division	1	2%
Durham Region Health Department	1	2%
Eastern Ontario Health Unit	0	0%
Elgin-St. Thomas Health Unit	0	0%
Grey-Bruce Health Unit	0	0%
Haldimand-Norfolk Health Unit	0	0%
Haliburton-Kawartha-Pine Ridge District Health Unit	0	0%
Halton Region Health Department	4	7%
Hamilton-Public Health & Community Services Dept.	1	2%
Hastings & Prince Edward Counties Health Unit	0	0%
Huron County Health Unit	0	0%
Kingston, Frontenac and Lennox & Addington Health Unit	0	0%
Lambton County Community Health Services Department	0	0%
Leeds, Grenville and Lanark District Health Unit	0	0%
Middlesex-London Health Unit	2	4%
Niagara Regional Public Health Department	1	2%
North Bay Parry Sound Health Unit	0	0%
Northwestern Health Unit	0	0%
Ottawa Public Health and Long-Term Care Branch	0	0%
Oxford County	0	0%
Peel Regional Health Department	14	25%
Perth District Health Unit	0	0%
Peterborough County-City Health Unit	0	0%
Porcupine Health Unit	0	0%
Renfrew County and District Health Unit	0	0%
Simcoe - Muskoka District Health Unit	0	0%
Sudbury and District Health Unit	0	0%
Thunder Bay District Health Unit	0	0%
Timiskiming Health Unit	0	0%
Toronto Public Health	19	34%
Waterloo Region Public Health	3	5%
Wellington-Dufferin-Guelph Health Unit	0	0%
Windsor-Essex County Health Unit	10	18%
York Region Health Services Department	0	0%
ONTARIO TOTAL	56	

Neighbouring municipalities are highlighted in yellow.
 Source: Ontario Ministry of Health and Long-Term Care

2.2.4. Adult Mosquito Surveillance Across Canada

Table 8 presents the national mosquito surveillance data by province/territory. A total of 85 WNV positive mosquito batches were reported in three provinces in Canada (Saskatchewan, Manitoba and Ontario), in 2010. Ontario had the greatest number with 56 positive batches. The significant fluctuation from year to year may be attributable to changes in weather conditions.

Table 8: WNV Mosquito Surveillance Statistics by Province and Territory, Canada, 2010.

Province/Territory	No. confirmed positive mosquito batches
Newfoundland and Labrador	0
Prince Edward Island	0
Nova Scotia	0
New Brunswick	0
Quebec	0
Ontario	56
Manitoba	20
Saskatchewan	9
Alberta	0
British Columbia	0
Yukon Territory	0
Northwest Territories	0
Nunavut	0
Canada – Total	85

Source: Public Health Agency of Canada ¹²

2.3. Larval Mosquito Surveillance

Larval surveillance is used to determine the location, species and population densities of mosquitoes, and is vital for predicting adult emergence and establishing optimal times for larval reduction measures.

In 2010, seasonal staff surveyed a variety of aquatic habitats for the presence of mosquito larvae from June to September. Aquatic habitats are defined as potential mosquito breeding sites using breeding site information collected in previous years and by stagnant water complaints (received through the Environmental Health Contact Centre or on-line reporting form). Details on the methods used for larval surveillance can be found in the Region of Peel 2006 WNV report.

Larval surveillance was conducted at 2,274 potential mosquito breeding sites on publicly owned lands across the Region in 2010. Table 9 provides a breakdown of the distribution of surface water site monitoring by municipality in 2010 relative to previous years. In 2010, over half (52%) of the potential breeding sites monitored were in Mississauga, 21% in Brampton, and 27% were in Caledon. The higher number of surface water sites identified and monitored by Peel Public Health in Mississauga is consistent with the higher mosquito activity and number of positive mosquito trapping events in Mississauga.

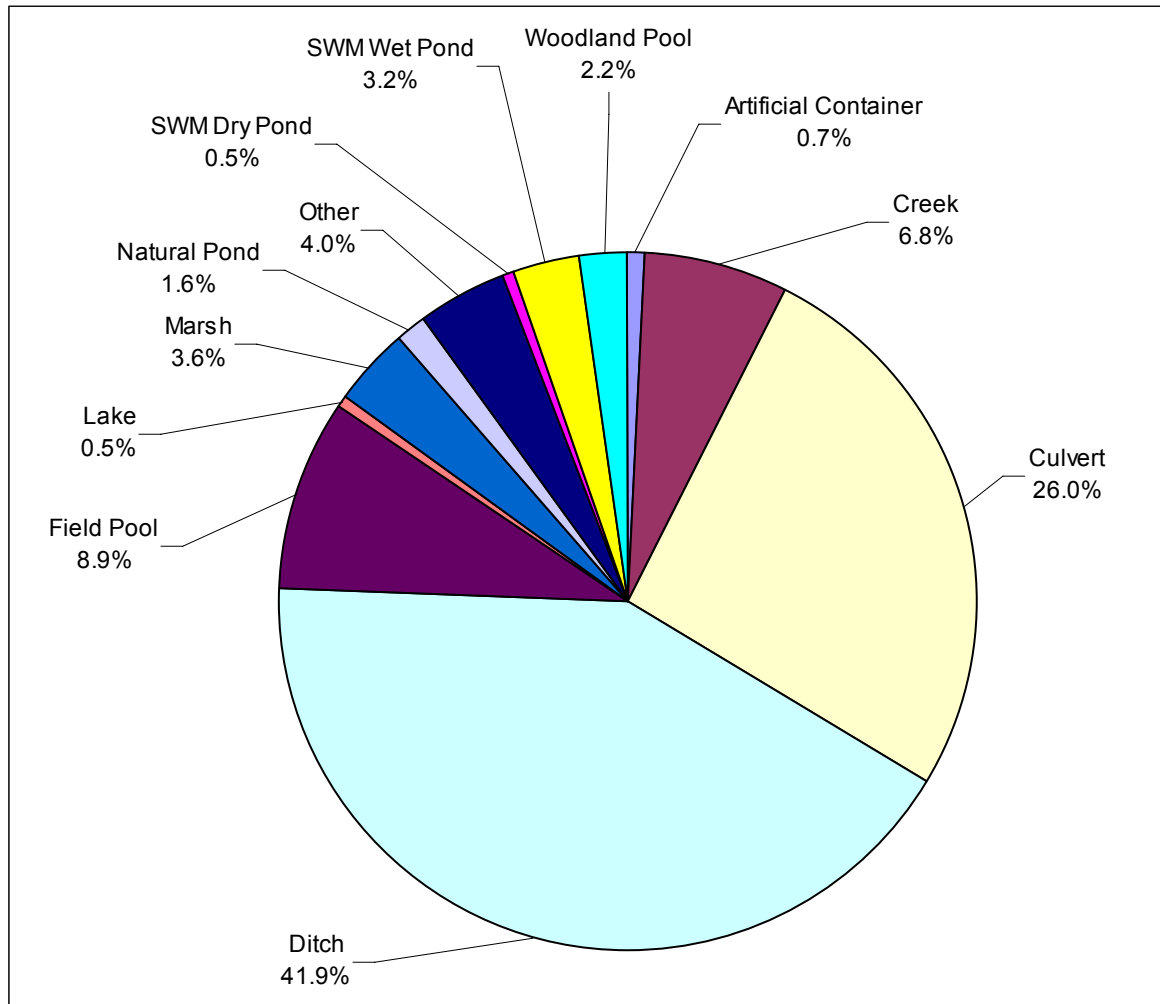
Table 9: Number of Surface Water Sites Monitored by Municipality, Region of Peel, 2002, 2008-2010.

Year	Peel Region	Mississauga	Brampton	Caledon
2002	278	152	106	20
2008	3,479	1,904	784	791
2009	2,073	1,206	426	441
2010	2,274	1,186	478	610

Note: Monitoring season ran from May - September in 2002 and 2008, and June - September in 2009 and 2010.

Figure 5 presents the larval surveillance results by breeding site type (habitat) in Peel Region in 2010. Ditches (42%), culverts (26%) and field pools (9%) comprised over three quarters of sites with larvae present (76.8%). These are also the locations that are most difficult to contain mosquito populations using control measures because of their relative abundance and effectiveness at holding standing water.

Figure 5: Type of Sites Found to Contain Mosquito Larvae - Region of Peel, 2010



Note: SWM refers to storm water management

2.3.1. Species Identification – Larval Analysis

In 2010, seasonal staff identified 5,036 mosquito larvae from June to September. There were significantly fewer species identified through larval surveillance in 2010 due to the shorter season; ten different species of larvae were identified in 2010 relative to 14 in 2009 and 21 in 2008. The majority (61%) were of the *Culex* species, *pipiens* and *restuans*, the primary WNV vectors, as well as *Culex territans*, a non-WNV vector. This figure is similar to the percentage of larvae identified as *Culex* species in the three previous years, 61% in 2009 and 2008, and 60% in 2007.

Ae. vexans, a confirmed WNV bridge vector in Ontario, accounted for 26% of larvae identified in 2010; *Oc. japonicus* accounted for less than two percent of larvae identified.

2.4. Larval Mosquito Reduction

A major part of the Region of Peel WNV Prevention Program is aimed at reducing the number of vector mosquitoes. This is done by eliminating or altering mosquito breeding habitats (source reduction) to make them less conducive to mosquito breeding, and by applying pesticides to common habitats during the larval stage of development to impede their development into viable adult mosquitoes.

Public education is used to increase awareness about the importance of reducing mosquito breeding sites by removing standing water around homes; however, education alone is not sufficient to effectively reduce vector populations. It is very difficult and cost-prohibitive to eliminate all breeding sites because very little water is required for most female mosquitoes to lay their eggs, particularly in the case of the *Culex* species. Therefore, a complementary larviciding program is necessary to control mosquito populations. It is easier, more efficient and cost effective to control mosquito populations by treating at the larval stage with larvicides before adult mosquitoes emerge and become more widely dispersed.

The most common breeding sites for mosquito vectors include roadside catch basins, ditches, discarded tires, unused swimming pools and containers left outdoors. These sites are conducive to promoting the emergence of multiple mosquito species because of standing or slow-moving water and decaying organic matter which serves as food for the larvae. Special attention and effort is directed towards monitoring catch basins and surface water breeding sites.

Catch basin networks are extensive in urban and suburban environments. They retain a small amount of water and organic matter in the form of sediment that collects in the sump of the catch basin. The majority of catch basins in Peel Region have been found to contain larvae. Surface water breeding sites are many in number and type and can change from year to year requiring a systematic approach to their surveillance and treatment.

Habitat modification, which includes altering the habitat to eliminate standing water, can also reduce the potential to breed mosquitoes. Peel Public Health staff work with municipal departments to pursue all effective measures to achieve this outcome.

2.4.1. Larvicides

Since 2003, mosquito larviciding has been a key component of Peel Public Health's vector management strategy, in particular for the abatement of mosquitoes in the extensive network of storm-water catch basins and in surface waters located on municipal properties.

Methoprene, a synthetic insect growth regulator, interferes with mosquito larvae development. It has been approved by Health Canada's Pest Management Regulatory Agency (PMRA) for mosquito larviciding. It is effective against the *Culex* species, degrades rapidly in water and is low in toxicity for non-target species. A study by the Ministry of the Environment (MOE) found that methoprene did not harm streams, rivers and drinking water in treated areas and that it was effective in reducing mosquito larvae.¹³

In catch basins, contractors for Peel Public Health use either methoprene pellets/briquets (Altosid®) or *Bacillus sphaericus* (VectoLex® WSP – water soluble pouches). Methoprene pellets were used in the majority of roadside catch basins. Methoprene briquets were used in non-roadside catch basins such as those located in public parks and Region of Peel-owned or operated buildings. *Bacillus sphaericus* was used in catch basins draining into Environmentally Sensitive Areas (ESAs). Surface water treatment involved the use of *Bacillus thuringiensis var. israelensis* (VectoBac 1200L or 200G). *Bacillus sphaericus* has a longer residual effect than *Bacillus thuringiensis var. israelensis* and is effective in environments with high organic matter.

Pestalto Environmental Health Services Inc. was contracted by Peel Public Health to carry out larviciding of catch basins and surface water sites across the Region. Permit applications were prepared by Peel Public Health staff, in consultation with Pestalto, and submitted to the MOE. Three permits were issued in 2010 by the MOE to allow treatment for the following site types: catch basins, surface water and sensitive areas. Notices of larviciding were placed in local newspapers before application began.

2.4.2. Catch Basin Treatment

Table 10 summarizes the catch basin treatment activities across Peel Region in 2010. Between June and August, a total of 367,272 roadside catch basins were treated with 257.09 kg of Altosid® pellets, and 988 roadside catch basins were treated with Vectolex® water soluble pellets (WSP). A total of 2,149 Altosid® XR briquets were also applied to non-roadside catch basins located in or along parks, private backyards (107), day cares (10), government buildings (491), social housing (20) and long-term care facilities (32) in Peel Region.

Table 10: Summary of Catch Basin Treatments, Region of Peel, 2010.

Location	Product	Phase	Start Date	End Date	Quantity	Treatments
Roadside	Altosid® Pellets	1	Jun-07	Jun-24	63.05 kg	90,073
	Altosid® Pellets	2	Jun-28	Jul-15	63.86 kg	91,227
	Altosid® Pellets	3	Jul-19	Aug-05	64.78 kg	92,541
	Altosid® Pellets	4	Aug-09	Aug-25	65.40 kg	93,431
	Vectolex® WSP	1	Jun-01	Jun-03	247 pouches	247
	Vectolex® WSP	2	Jul-05	Jul-05	247 pouches	247
	Vectolex® WSP	3	Jul-22	Jul-26	247 pouches	247
	Vectolex® WSP	4	Aug-11	Aug-11	247 pouches	247
Non-Roadside	Altosid® XR Briquets	1	Jun-01	Jul-30	2,149 briquets	2,149
Total			Jun-01	Sep-11	----	370,409

Source: Pestalto, 2010¹⁴

2.4.3. Surface Water Treatment

Monitoring mosquito larval habitats to assess the presence and abundance of mosquito larvae was conducted using a standard sized plastic dipper following the sequential sampling method. On each surveillance visit the standing water site was given a pool rating based on the total number of larvae observed. Larval samples were collected and identified by Peel Public Health seasonal staff. If vectors were identified then the larval habitats were referred to Pestalto for treatment.

Unlike previous years when the pattern of sites monitored varied in each municipality, in 2010 the majority of sites monitored were ditches and culverts in all three municipalities. Ditches and culverts accounted for 56.1%, 73.2% and 86.7% of sites monitored in Mississauga, Brampton and Caledon, respectively (Table 11). In 2010, 460 surface water sites across Peel Region received a total of 636 larvicide treatments (Table 12).

Table 11: Number of Surface Water Sites Monitored, Region of Peel, 2010.

Site Types	Mississauga	Brampton	Caledon	Total Sites Treated
Artificial Container	11	6	-	17
Creek	125	22	8	155
Culvert	348	114	129	591
Ditch	317	236	400	953
Field Pool	166	15	22	203
Lake	10	1	-	11
Marsh / Wetland	20	16	46	82
Natural Pond	21	15	1	37
Other	65	27	-	92
Storm Water Management Pond	66	17	1	84
Woodland Pool	37	9	3	49
Total	1,186	478	610	2,274

Table 12: Standing Water Surveillance Visits and Treatments in Peel Region, 2010.*

Site Type	Sites	Surveillance Visits	Area Treated (m ²)	Sites Treated	Treatments
Artificial Container	3	8	367	3	8
Ditch	605	780	14,241	372	505
Field Pool	40	54	2,102	34	44
Pond	13	25	40,619	13	25
Storm Water Management Pond	13	20	9,281	11	17
Wetland	10	13	8,450	8	11
Woodland Pool	25	32	3,905	19	26
Total	709	932	78,965	460	636

* Activities were conducted by Pestalto personnel.

2.5. Risk Assessment Summary

Each year, from mid-June to October, Peel Public Health's West Nile Virus Working Group carries out a weekly risk assessment based on surveillance information collected during that week to identify the risk of human infection in Peel. The working group consists of staff from various programs including Environmental Health, Communications, Epidemiology, and Communicable Disease. Various surveillance factors that influence the risk of WNV infection are evaluated. The factors included are:

- Seasonal temperatures
- Adult mosquito vector abundance
- Virus isolation rate in vector mosquito species
- Human cases of WNV
- Local WNV activity (equine, mosquito)
- Time of year
- WNV activity in proximal urban or suburban regions

Each surveillance factor is assigned a weighted score based on the observations of the previous week. The WNV Mosquito Adulticiding Risk Assessment form is completed weekly (Appendix C) and when the risk assessment level exceeds a value of three, a decision tree process is invoked whereby increased surveillance and the possibility of adulticiding are considered.

2.6. Public Education and Outreach

2.6.1. Health Promotion and Education

The prevention and reduction of WNV risk requires the involvement of many sectors. Engaging individual residents is integral in preventing human infections, particularly in advocating personal protective measures and the elimination of breeding sites on private property.

Peel Public Health has developed various educational resources about personal protective measures and individual and household activities to prevent or discourage the breeding of mosquitoes. The resources included flyers, fact sheets, posters, mailers and newspaper advertisements. All the materials are available on the Region of Peel website at <http://www.peelregion.ca/health/westnile/resources/>.

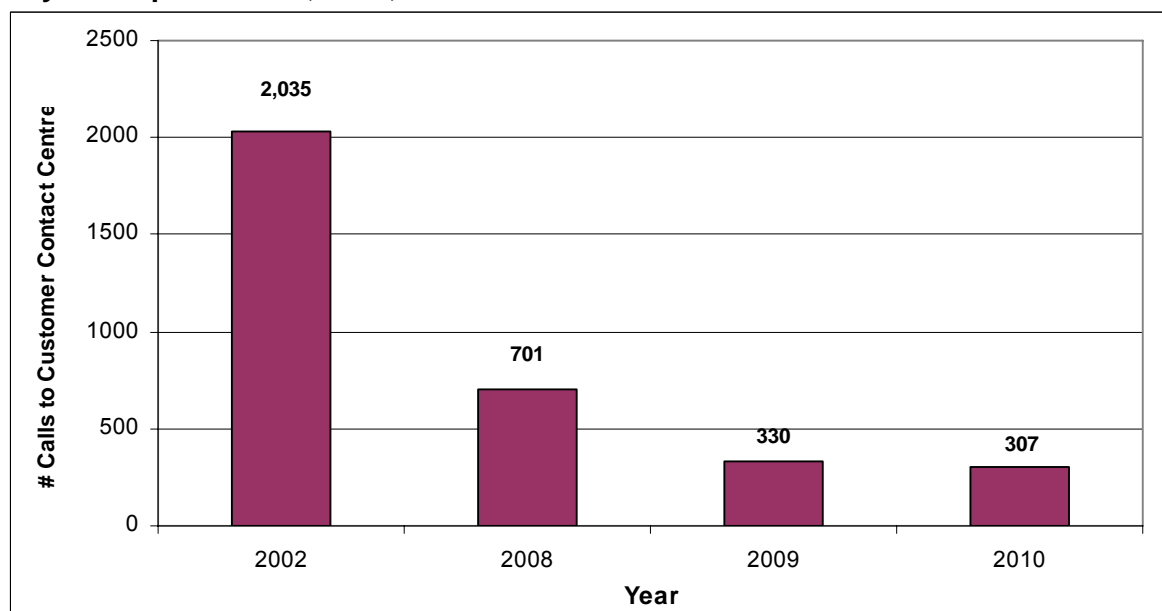
As in previous years, Peel Public Health staff hand delivered WNV educational flyers to households located nearby an area where a mosquito batch tested positive. In 2010, this meant 16,354 flyers were distributed to households located nearby an area where eight trap locations were found to be positive. Peel Public Health staff were also available to conduct stagnant water surveys on residential properties in areas where WNV was detected. The VBD team also participated in community displays. Health promotion items including fridge magnets, mosquito swatters and temporary tattoos were distributed at these events.

2.6.2. West Nile Virus Calls

The Region of Peel Customer Contact Centre is the first level of contact for WNV related inquiries, complaints and reports. WNV inquiries that were of a complex nature were forwarded to the Environmental Health Contact Centre. Peel residents were requested to call the Region with their stagnant water complaints and when there were any questions related to prevention and protection against WNV. The number of calls can be used as a crude indicator of public engagement and concern about WNV when compared over a number of years.

In 2010, Peel Region received a total of 307 calls (Figure 6). The number of calls received has decreased every year since 2003 when 8,142 calls were received; this was the year that the Region first conducted a larviciding program. The fewest number of calls occurred in 2010. In part this can be attributed to the cessation of dead bird surveillance in 2008 and the program starting one month later in the season than the years prior to 2009.

Figure 6: Number of WNV related calls to the Customer Contact Centre, Region of Peel, May 1 – September 30, 2002, 2008 - 2010.



2.6.3. Visits to the Website

In addition to providing public education, Peel Public Health's VBD website posts surveillance results, updates larviciding activities, provides public access to the VBD Prevention Plan, and annual technical reports dating back to 2002. Between January 1 and November 19, 2010 there were a total of 8,222 visits to Peel Public Health's VBD website. Monthly visits to the website peaked during August and September. From April 2010 onwards, the total number of visits to the website averaged at about 24 per day. More than 80% of visitors to the website visited more than once. The total number of visits to the VBD website is up slightly from 2009 (7,138), consistent with the addition of information to the website for vector-borne diseases other than WNV (i.e., Lyme disease and EEE). Accordingly, the webpage with the greatest number of visits in 2010 was for information on Lyme disease (1,562 visits).

3. Lyme Disease

Lyme disease was first recognized in the United States in 1975, following an outbreak of juvenile rheumatoid arthritis near the community of Lyme, Connecticut. The first reported case in Canada occurred in 1984.

Lyme disease is an illness caused by the bacterium, *Borrelia burgdorferi*, which can be spread through the bite of certain types of ticks. This bacterium is transmitted to ticks when they feed on infected animals and then to humans through the bites of the infected ticks. In Ontario, the disease is spread by the black-legged tick (*Ixodes scapularis*), also known as the deer tick. Lyme disease is the most common tick-borne disease in North America.

Lyme disease must be reported to the local health unit as it is both a reportable and communicable disease under the *Health Protection and Promotion Act*. The standard investigation includes confirming the diagnosis, collecting demographic data, determining location of exposure and investigating possible epidemiological links among cases. This is accomplished by completing the Ministry of Health and Long-Term Care Lyme Disease Human Case Investigation Report which is entered into the integrated Public Health Information System (iPHIS). To date, there has not been a confirmed human case that was locally acquired within Peel.

The first sign of infection is usually a circular rash called erythema migrans (EM). This rash occurs in approximately 70-80% of infected persons and begins at the site of a tick bite after a delay of three to 30 days.¹⁵ The rash gradually expands over a period of several days, reaching up to 30 cm across. The center of the rash may clear as it increases in size, resulting in a bull's-eye appearance. Patients may also experience symptoms of fatigue, chills, fever, headache, and muscle and joint aches, and swollen lymph nodes. In some cases, these may be the only symptoms of infection.

If not treated the infection may spread to other parts of the body within a few days to weeks, producing a variety of symptoms. The symptoms include loss of muscle tone on one or both sides of the face, severe headaches and neck stiffness due to meningitis, shooting pains that may interfere with sleep, heart palpitations and dizziness due to changes in heartbeat, and pain that moves from joint to joint. Many of these symptoms will resolve, even without treatment.¹⁵

After several months, approximately 60% of patients with an untreated infection will begin to have intermittent bouts of arthritis, with severe joint pain and swelling. Large joints are most often affected, particularly the knees.¹⁵

Most cases of Lyme disease can be cured with antibiotics, especially if treatment occurs early in the course of illness. However, a small percentage of patients with Lyme disease have symptoms that last months to years after treatment with antibiotics. These symptoms can include muscle and joint pains, arthritis, cognitive defects, sleep disturbance, or fatigue. The cause of these symptoms is not fully understood.

Table 13 shows the number of Peel residents that have been diagnosed with Lyme disease since 2001.

Table 13: Lyme Disease Cases in the Region of Peel, 2001- 2010

Year	Cases
2001	1
2002	2
2003	2
2004	3
2005	3
2006	8
2007	5
2008	18
2009	1
2010	2

There are areas in Ontario that are considered high risk for Lyme disease because the bacteria have consistently been found in black-legged ticks from these areas. These areas include the north shore of Lake Erie including the Long Point area, Rondeau Provincial Park, Turkey Point and the St. Lawrence Islands National Park.¹⁶ There are concerns that changes of climatic conditions such as warmer seasons could lead to conditions that are favourable for the establishment of black-legged tick populations in many parts of the province. It should be noted that ticks can be spread by birds, in particular songbirds that feed off the forest floor. Because these birds are migratory, there is the potential for new populations of the black-legged ticks to spread across the province. As a result, Peel Public Health undertook an active tick surveillance pilot project in 2009. Active surveillance involves collecting ticks in their natural habitat for identification and testing.

In August of 2009, Peel Public Health's VBD team received a Conservation Areas Access Permit from the Credit Valley Conservation Authority (CVCA) to conduct active black-legged tick surveillance study on CVCA lands. Access was granted for this work in the Rattray Marsh and Meadowvale Conservation Areas. The sites were chosen because of the suitability of habitat, host abundance and potential for dispersal by other hosts like migratory birds.

Drag sampling, which consists of dragging a white flannel cloth over and around vegetation and leaf litter where ticks may be waiting for a passing host, was undertaken at the two sites throughout September 2009. This sampling did not yield a single black-legged tick or any other tick species. These two habitats were classified as non-endemic for black-legged ticks. However, both sites have the combination of environmental factors to allow new populations of black-legged ticks to become established. Migrating birds or deer could introduce ticks harbouring *B. burgdorferi* to these two sites at some point in the future.

In 2010, Peel Public Health did not conduct active tick surveillance but did conduct passive tick surveillance by examining ticks brought into Peel Public Health offices by the public. Eight tick samples were submitted to Peel Public Health. Specimens associated with human contact were submitted to the Central Public Health Laboratory (CPHL) in Toronto for species confirmation. There were three ticks identified as black-legged ticks which were sent to the Public Health Agency of Canada's (PHAC) National Microbiology Laboratory in Winnipeg for Lyme disease testing. In 2010, Peel received one lab report from PHAC indicating that a tick was positive for *Borrelia burgdorferi*. It should be noted that all the black-legged tick specimens submitted by Peel residents were collected from endemic areas outside of Peel Region.

Active surveillance including tick dragging would have been undertaken by Peel Public Health if passive tick surveillance revealed an established black-legged tick population, or a positive tick or human case of Lyme disease had been acquired locally.

4. Eastern Equine Encephalitis

Eastern equine encephalitis (EEE) is a viral disease of wild birds that is transmitted to horses and humans by mosquitoes. Of the North American mosquito-borne diseases, EEE appears to be the most severe human pathogen; approximately 33% of people who develop EEE die of the disease, and many survivors have long-term health effects.¹⁷

In Ontario, outbreaks of EEE have occurred sporadically among horses, but no human cases have ever been confirmed. The lack of verified human cases of EEE in Ontario is not entirely understood, since human cases have repeatedly been reported in several states bordering the province. In 2010, three horse cases were reported in the province, two in Simcoe County and one in Bruce County.

The first incidence of the virus being found in Ontario mosquitoes occurred in September 2009, when mosquito pools in Wahta Mohawk Territory in the Muskoka region tested positive. In early September 2010, two more mosquito pools from this First Nations community tested positive for EEE. An additional positive EEE mosquito pool was found in the North Bay Parry Sound District Health Unit in mid September.

Many species of mosquitoes can become infected with EEE virus. However, the most important mosquito species in maintaining the bird-mosquito transmission cycle is *Culiseta melanura*, whose preferred habitat is shaded freshwater hardwood swamps. *Culiseta melanura* larvae have never been collected by the VBD team. This may be due to the fact that *Culiseta melanura* larvae are difficult to collect using the standard mosquito dipper methods. This species develop in dark or low light intensity areas such as holes beneath tree roots and stumps, and the underside of root systems of aquatic plants in fresh-water swamps and marshes.

Adult mosquito surveillance conducted over the last several years has found this species present in Peel but in very low numbers (Table 14). In 2010, Peel Public Health continued to monitor the prevalence and distribution of *Culiseta melanura* using the region-wide adult mosquito CDC light trap network. Two *Culiseta melanura* were collected in Peel light traps in 2010; both tested negative for the EEE virus.

Table 14: *Culiseta melanura* found in CDC light traps in the Region of Peel, 2003, 2008 and 2010.

Year	Week	Trap ID	Quantity	Location	Municipality
2010	25	R1	1	Professor's Lake North Park & Bramalea Rd	Brampton
2010	39	P3	1	Fire Station The Gore Rd & Castlemore Rd	Brampton
2008	40	T1	1	Bolton Deer Valley Rd & King St	Caledon
2003	38	E1	1	Sugar Bush Bristol Rd & McLaughlin Rd	Mississauga

In 2010, the VBD team enhanced the *Culiseta melanura* monitoring program by conducting a resting site collection pilot project. *Culiseta melanura*, like most mosquito species, are relatively inactive during the daylight hours and rest in such natural sites as dense vegetation, animal burrows, caves, and tree holes or man-made structures such as culverts. Artificial resting sites are used in monitoring mosquito populations by collecting mosquito species that congregate in diurnal resting places. Artificial resting sites are normally made of heavy plywood which makes them difficult to transport and store. Peel elected to use moulded fibre tree nursery pots as artificial resting sites as they yielded equivalent results to plywood resting boxes in a study conducted in Massachusetts by the Harvard School of Public Health.¹⁸

Fibre nursery tree pots made of recycled rubber tree products were purchased for the study. The pots were 23 cm high with a 28 cm open end that tapered down to a 20 cm closed end (Figure 7). The pots were painted black on the outside and either red or black paint on the inside. The black exterior is highly attractive to mosquitoes searching for a shaded resting site. The addition of colour inside the pots is not to attract more mosquitoes but may make it easier to identify mosquitoes collected in the resting site.

Figure 7: Fibre nursery tree pot



Peel Public Health received permission from the Toronto Region Conservation Authority to conduct the *Culiseta melanura* study in the Heart Lake Conservation Area in north Brampton (Figure 8). The site was selected as it is a permanent wooded swamp with underwater tree root systems the type of site preferred by *Culiseta melanura*.

Figure 8: Swamp at Heart Lake Conservation Area



A total of twelve tree pots were set up in the forested area around the perimeter of the swamp from July 12th – Sept. 15th, 2010. Six pots were painted black and six pots were painted red and black. The pots were placed on the ground in shaded habitats so that direct sunlight did not to enter any portion of the artificial resting sites during the morning or early afternoon hours. The pots were checked in early afternoons on a daily basis on week days for most of the period. The numbers of mosquitoes found in these individual artificial resting sites varied from 0 to 30 during the season. Mosquito numbers were found to peak in mid-August and decline significantly by mid-September. There was no difference in mosquito numbers in the all black resting pots and in the black/red pots. Only non-anophelene mosquitoes were collected and brought back to the Peel VBD team field office for identification. No *Culiseta melanura* were collected in the study but two *Culiseta morsitans* were collected. *Culiseta morsitans* also have a habitat preference for swamps in wooded areas.

In 2011, the VBD program will continue to use artificial resting sites to improve surveillance sensitivity for *Culiseta melanura*.

5. Conclusion

The ideal conditions for the spread of WNV from mosquitoes to humans are achieved during period of prolonged, hot weather. The occurrence of these conditions is likely to increase in frequency in the coming years as a result of climate change. Unlike the past two years, the summer of 2010 was relatively dry, with lower than normal levels of precipitation. Although the temperatures were high enough to increase the viral replication rate in mosquitoes, the dry conditions were not conducive for mosquitoes to breed and increase their population. Mosquito surveillance activities in 2010 showed a marked decrease in WNV activity in Peel Region compared to the previous years. In 2010, the total number of mosquitoes collected and identified in Peel was 28% lower than 2009, and the lowest recorded in Peel since the year 2002 when the first locally acquired human cases occurred in Ontario.

In 2010, 14 batches of mosquitoes tested positive for WNV, 12 of which were *Culex* species. The number of WNV positive mosquito batches in 2010 was higher than in 2009, but lower than 2008. It is evident that WNV activity fluctuates widely from year to year based on the meteorological conditions of precipitation and temperature, the abundance of vector mosquito populations, as well as a number of other factors.

Although there were no human cases of WNV reported in Peel Region or any of its neighbouring municipalities in 2010, there is no indication to suggest that the spread of WNV has stopped. While WNV activity varies annually, it is reasonable to assume that the disease has established itself in North America and Peel Region.

Increasing temperatures associated with climate change could increase the survival and replication rates of vector mosquitoes and may contribute to higher incidence of disease in the future. The information collected from various surveillance activities in Peel Region continues to be valuable in assessing and minimizing the risk of human WNV infection to Peel residents. This information helps to assess the need for enhanced mosquito control systems. Furthermore, climate change could also expand the habitat and infectivity of other disease-carrying insects, and thereby increase the potential for transmission of diseases such as Lyme disease and EEE in Peel. It is thus prudent to continue surveillance programs for these other vector-borne diseases as well.

In 2010, an enhanced pilot program of *Culiseta melanura* surveillance was implemented in Peel Region based on the fact that the EEE virus was found in Ontario mosquitoes in 2009. In 2011, the VBD program will continue this program to improve the surveillance sensitivity for *Culiseta melanura* in Peel, and will also continue surveillance, public education and larval mosquito reduction activities essential to the WNV component, consistent with past seasons and other jurisdictions.

References

- ¹ Centres for Disease Control and Prevention (2010). West Nile Virus Activity in the United States. Available at: <http://cdc.gov/ncidod/dvbid/westnile/Mapsincidence/surv&control10IncidbyState.htm>
- ² Centres of Disease Control and Prevention (2007). West Nile Virus Infection: Information and Guidance for Clinicians. Available at: <http://cdc.gov/ncidod/dvbid/westnile/clinicians/>
- ³ Ontario Ministry of Health and Long-Term Care. Health Protection and Promotion Act, Ontario Regulation 199/03: Control of West Nile Virus. Available at: http://www.e-laws.gov.on.ca/html/reggs/english/elaws_reggs_030199_ev001.htm
- ⁴ Ontario Ministry of Health and Long-Term Care. Health Protection and Promotion Act, Ontario Regulation 558/91: Specification of Communicable Diseases. Available at: http://www.e-laws.gov.on.ca/html/reggs/english/elaws_reggs_910558_e.htm
- ⁵ Ontario Ministry of Health and Long-Term Care. Health Protection and Promotion Act, Ontario Regulation 559/91: Specification of Reportable Diseases. Available at: http://www.e-laws.gov.on.ca/Download?dDocName=elaws_reggs_910559_e
- ⁶ Ontario Ministry of Health and Long-Term Care. Provincial Surveillance for West Nile Virus (VNV). Ontario WNV Human Case Definition, Version: July 4, 2005.
- ⁷ Public Health Agency of Canada. 2010 Human Case Surveillance. Available at: <http://www.phac-aspc.gc.ca/wnv-vwn/mon-hmnsurv-eng.php>
- ⁸ Region of Peel Public Health. 2006 West Nile Virus in the Region of Peel. Available at: <http://www.peelregion.ca/health/westnile/resources/reports.htm#control06>
- ⁹ Scott, J. (2004). Ochlerotatus japonicus (Theobald) Rutgers Entomology. Available at: <http://www.rci.rutgers.edu/~insects/ocjap.htm>
- ¹⁰ Ontario Ministry of Health and Long-Term Care. West Nile Virus 2007: Mosquito Surveillance. Available at: http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_07/wnv_mosquit_oes.html
- ¹¹ Ontario Ministry of Health and Long-Term Care. West Nile Virus 2010: Mosquito Surveillance. Available at: http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_10/wnv_mosquit_oes.html
- ¹² Public Health Agency of Canada. West Nile Virus National Surveillance Report. Available at: http://www.phac-aspc.gc.ca/wnv-vwn/pdf_nsr-rns_2010/wnvnr_201042-eng.pdf
- ¹³ Region of Peel Public Health (2005). 2004 West Nile Virus in the Region of Peel.
- ¹⁴ Pestalto (2010). Mosquito Abatement Program for the Reduction of West Nile Virus Vectors 2010 Final Report. Pestalto Environmental Services Inc. October 2010.

¹⁵ Centres for Disease Control and Prevention. Lyme Disease Symptoms. Available at: http://www.cdc.gov/ncidod/dvbid/Lyme/ld_humandisease_syptoms.htm

¹⁶ Public Health Agency of Canada. Ticks and Lyme Disease. Available at: <http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php>

¹⁷ Canadian Cooperative Wildlife Health Centre. The Eastern equine encephalitis virus. Available at: http://www.ccwhc.ca/wildlife_health_topics/arbovirus/arboeee.php

¹⁸ Harvard School of Public Health. Comparison of light weight, portable fibre pots to plywood resting boxes for sampling adult mosquitoes. Available at: <http://www.nmca.org/Nmca94-4.htm>

Appendices

Appendix A

Provincial Surveillance for West Nile Virus – Case Definitions

Provincial Surveillance for West Nile Virus (WNV)

Section A: Case Definitions

The current Case Definitions were drafted with available information at the time of writing. Case Definitions and Diagnostic Test Criteria are subject to change as new information becomes available.

1) West Nile Virus Neurological Syndrome (WNNS):

Clinical Criteria:

History of exposure in an area where WN virus (WNV) activity is occurring¹ OR history of exposure to an alternative mode of transmission² AND onset of fever

AND NEW ONSET OF AT LEAST ONE of the following:

- encephalitis (acute signs of central or peripheral neurologic dysfunction)
- viral meningitis (pleocytosis and signs of infection e.g. headache, nuchal rigidity)
- acute flaccid paralysis (e.g. poliomyelitis-like syndrome or Guillain-Barré-like syndrome³)
- movement disorders (e.g., tremor, myoclonus)
- Parkinsonism or Parkinsonia like conditions (e.g., cogwheel rigidity, bradykinesia, postural instability)
- other neurological syndromes as defined in the note below

¹ History of exposure when and where West Nile Virus transmission is present, or could be present, or history of travel to an area with confirmed WNV activity in birds, horses, other mammals, sentinel chickens, mosquitoes, or humans.

² Alternative modes of transmission, identified to date, include: laboratory-acquired; in utero; receipt of blood components; organ/tissue transplant; and, possibly via breast milk.

³ A person with WNV-associated acute flaccid paralysis may present with or without fever or mental status changes. Altered mental status could range from confusion to coma with or without additional signs of brain dysfunction (e.g. paralysis, cranial nerve palsies, sensory deficits, abnormal reflexes, generalized convulsions and abnormal movements). Acute flaccid paralysis with respiratory failure is also a problem.

Note: A significant feature of West Nile viral neurologic illness may be marked muscle weakness that is more frequently unilateral, but could be bilateral. WNV should be considered in the differential diagnosis of all suspected cases of acute flaccid paralysis with or without sensory deficit. WNV-associated weakness typically affects one or more limbs (sometimes affecting one limb only). Muscle weakness may be the sole presenting feature of WNV illness (in the absence of other neurologic features) or may develop in the setting of fever, altered reflexes, meningitis or encephalitis. Weakness typically develops early in the course of clinical infection. Patients should

be carefully monitored for evolving weakness and in particular for acute neuromuscular respiratory failure, which is a severe manifestation associated with high morbidity and mortality. **For the purpose of WNV Neurological Syndrome Classification, muscle weakness is characterized by severe (Polio-like), non-transient and prolonged symptoms.** Electromyography (EMG) and lumbar puncture should be performed to differentiate WNV paralysis from the acute demyelinating polyneuropathy (Guillain-Barré syndrome). Lymphocytic pleocytosis (an increase in WBC with a predominance of lymphocytes in the cerebrospinal fluid [CSF]) is commonly seen in acute flaccid paralysis due to WNV.

Other emerging clinical syndromes, identified during 2002 included, but were not limited to the following: myelopathy, rhabdomyolysis (acute destruction of skeletal muscle cells), peripheral neuropathy; polyradiculoneuropathy; optic neuritis; and acute demyelinating encephalomyelitis (ADEM). Ophthalmologic conditions including chorioretinitis and vitritis were also reported. Facial weakness was also reported. Myocarditis, pancreatitis and fulminant hepatitis have not been identified in North America, but were reported in outbreaks of WNV in South Africa. “Aseptic” meningitis without encephalitis or flaccid paralysis occurring in August and September when WNV is circulating may be due to non-polio enteroviruses circulating at the same time. This should be considered in the differential diagnosis.

[Sejvar J et al. JAMA (2003) Vol.290 (4) p. 511-515, Sejvar, J. et al. Emerg Infect Dis (2003) Vol 9 (7) p.788-93 and Burton, JM et al Can. J. Neurol. Sci. (2004) Vol.31 (2) p.185-193]

Suspect WN Neurological Syndrome Case:

Clinical criteria IN THE ABSENCE OF OR PENDING diagnostic test criteria (see below) AND IN THE ABSENCE of any other obvious cause.

Probable WN Neurological Syndrome Case:

Clinical criteria AND AT LEAST ONE of the probable case diagnostic test criteria (see below).

Confirmed WN Neurological Syndrome Case:

Clinical criteria AND AT LEAST ONE of the confirmed case diagnostic test criteria (see below).

2) West Nile Virus Non-Neurological Syndrome (WN Non-NS):

Clinical Criteria:

History of exposure in an area where WN virus (WNV) activity is occurring¹ OR history of exposure to an alternative mode of transmission²

AND AT LEAST TWO of the following⁵:

- fever,
- myalgia⁶,
- arthralgia,
- headache,
- fatigue,
- lymphadenopathy,
- maculopapular rash

¹ History of exposure when and where West Nile Virus transmission is present, or could be present, or history of travel to an area with confirmed WNV activity in birds, horses, other mammals, sentinel chickens, mosquitoes, or humans.

² Alternative modes of transmission, identified to date, include: laboratory-acquired; in utero; receipt of blood components; organ/tissue transplant; and, possibly via breast milk.

⁵ It is possible that other clinical signs and symptoms could be identified that have not been listed and may accompany probable case or confirmed case diagnostic test criteria. For example, gastrointestinal (GI) symptoms were seen in many WNV patients in Canada and the USA in 2003 and 2004.

⁶ Muscle weakness may be a presenting feature of WNV illness. **For the purpose of WNV Non-Neurological Syndrome classification, muscle weakness or myalgia (muscle aches and pains) is characterized by mild, transient, unlikely prolonged symptoms that are not caused by motor neuropathy.**

Suspect WN Non-Neurological Syndrome Case:

Clinical criteria IN THE ABSENCE OF OR PENDING diagnostic test criteria (see below) AND IN THE ABSENCE of any other obvious cause.

Probable WN Non-Neurological Syndrome Case:

Clinical criteria AND AT LEAST ONE of the probable case diagnostic test criteria (see below)

Confirmed WN Non-Neurological Syndrome Case:

Clinical criteria AND AT LEAST ONE of the confirmed case diagnostic test criteria (see below)

3) West Nile Virus Asymptomatic Infection (WNAI)⁷:

Probable WN Asymptomatic Infection Case:

Probable case diagnostic test criteria (see below) IN THE ABSENCE of clinical criteria

Confirmed WN Asymptomatic Infection Case:

Confirmed case diagnostic test criteria (see below) IN THE ABSENCE of clinical criteria

⁷ This category could include asymptomatic blood donors whose blood is screened using a Nucleic Acid Amplification Test (NAT), by Blood Operators (i.e. Canadian Blood Services or Hema-Quebec) and is subsequently brought to the attention of public health officials. The NAT that will be used by Blood Operators in Canada is designed to detect all viruses in the Japanese encephalitis (JE) serocomplex. The JE serocomplex includes WN virus and 9 other viruses, although from this group only WN virus and St Louis encephalitis virus are currently endemic to parts of North America. Blood Operators in Canada perform a supplementary WN virus-specific NAT following any positive donor screen test result.

Section B: West Nile Virus Diagnostic Test Criteria:

Probable Case Diagnostic Test Criteria:

AT LEAST ONE of the following:

Detection of flavivirus antibodies in a single serum or CSF sample using a WN virus IgM ELISA ⁸ without confirmatory neutralization serology (e.g. Plaque Reduction Neutralization Test [PRNT]) OR
A 4-fold or greater change in flavivirus HI titres in paired acute and convalescent sera or demonstration of a seroconversion using a WN virus IgG ELISA ⁸ OR
A titre of $\geq 1:320$ in a single WN virus HI test, or an elevated titre in a WN virus IgG ELISA, with a confirmatory PRNT result OR [Note: A confirmatory PRNT or other kind of neutralization assay is not required in a health jurisdiction/authority where cases have already been confirmed in the current year]
Demonstration of Japanese encephalitis (JE) serocomplex-specific genomic sequences in blood by NAT screening on donor blood, by Blood Operators in Canada.

⁸ Both CDC and commercial IgM / IgG ELISAs are now available for front line serological testing. Refer to appropriate assay procedures and kit inserts for the interpretation of test results.

Note: WNV IgM antibody may persist for more than a year and the demonstration of IgM antibodies in a patient's serum, particularly in residents of endemic areas, may not be diagnostic of an acute WN viral infection. Seroconversion (by HI, IgG ELISA or PRNT assays) demonstrates a current WNV infection. Therefore, the collection of acute and convalescent sera for serologic analysis is particularly important to rule out diagnostic misinterpretation early in the WNV season (e.g. May, June) and to identify initial cases in a specific jurisdiction. However, it should be noted that seroconversions may not always be documented due to timing of acute sample collection (i.e. titres in acute sera may have already peaked). If static titres are observed in acute and convalescent paired sera, it is still possible⁹ the case may represent a recent infection. To help resolve this, the use of IgG avidity testing⁹ may be considered to distinguish between current and past infection. The presence of both IgM antibody and low avidity IgG in a patient's convalescent serum sample are consistent with current cases of viral associated illness. However test results that show the presence of IgM and high avidity IgG are indicative of exposures that have occurred in the previous season. Immunocompromised individuals may not be able to mount an immune response necessary for a serological diagnosis. West Nile Virus diagnostic test criteria for these individuals should be discussed with a medical microbiologist.

⁹ Early in infection the immune system generates antibodies that bind relatively weakly to viral antigen (low avidity). As the infection proceeds, an increasing percentage of newly generated IgG antibody displays higher binding affinity to virus antigen and thus avidity also rises (Note: avidity is usually measured based upon the ability of IgG to dissociate from antigen preparations after incubation with a solution of urea). As long as high avidity IgG is not yet detected in the serum it can be assumed that the individual was exposed to the viral agent during a recent exposure. With respect to WNV infection it has not been precisely determined when (i.e. post-exposure) high avidity antibodies reach levels in serum that can be accurately detected by

serological assays (there may be significant variation depending on the individual). However, it has been shown that greater than 95% of sera collected from individuals exposed to WNV 6-8 months previously will have IgG antibodies that bind strongly to viral antigen and will give high avidity scores using both IFA and ELISA testing formats. **Note: Avidity testing will not replace confirmatory neutralization testing, non-WNV flavivirus IgG antibody (Eg. dengue, SLE, etc.) may bind to the antigen preparations used in avidity assays.**

Confirmed Case Diagnostic Test Criteria:

It is currently recommended that health jurisdictions/authorities use the Confirmed Case Diagnostic Test Criteria to confirm index cases (locally acquired) in their area each year; for subsequent cases, health jurisdictions/authorities could use the Probable Case Diagnostic Test Criteria to classify cases in their area as “confirmed”, **for the purposes of surveillance**. Throughout the remainder of the transmission season health jurisdictions/authorities may wish to document PRNT antibody titres to West Nile Virus in a proportion of cases, to be determined by that health jurisdiction/authority, in order to rule-out the possibility of concurrent activity by other flaviviruses. [For further information on diagnostic testing algorithms for West Nile Virus, see the section entitled Laboratory Specimen Diagnostic Testing Algorithm in Appendix 4 of the National Guidelines for Response to West Nile Virus.]

AT LEAST ONE of the following:

A 4-fold or greater change in WN virus neutralizing antibody titres (using a PRNT or other kind of neutralization assay) in paired acute and convalescent sera, or CSF. OR
Isolation of WN virus from, or demonstration of WN virus antigen or WN virus-specific genomic sequences in tissue, blood, CSF or other body fluids OR
Demonstration of flavivirus antibodies in a single serum or CSF sample using a WN virus IgM ELISA ^{8,9} , confirmed by the detection of WN virus specific antibodies using a PRNT (acute or convalescent specimen). OR
A 4-fold or greater change in flavivirus HI titres in paired acute and convalescent sera or demonstration of a seroconversion using a WN virus IgG ELISA ^{8,9} AND the detection of WN specific antibodies using a PRNT (acute or convalescent serum sample).

⁸ Both CDC and commercial IgM / IgG ELISAs are now available for front line serological testing. Refer to appropriate assay procedures and kit inserts for the interpretation of test results.

Note: WNV IgM antibody may persist for more than a year and the demonstration of IgM antibodies in a patient’s serum, particularly in residents of endemic areas, may not be diagnostic of an acute WN viral infection. Seroconversion (by HI, IgG ELISA or PRNT assays) demonstrates a current WNV infection. Therefore, the collection of acute and convalescent sera for serologic analysis is particularly important to rule out diagnostic misinterpretation early in the WNV season (e.g. May, June) and to identify initial cases in a specific jurisdiction. However, it should be noted that seroconversions may not always be documented due to timing of acute sample collection (i.e. titres in acute sera may have already peaked). If static titres are observed in acute and convalescent paired sera, it is still possible⁹ the case may represent a recent infection. To help resolve this, the use of IgG avidity testing⁹ may be considered to distinguish between current and

past infection. The presence of both IgM antibody and low avidity IgG in a patient's convalescent serum sample are consistent with current cases of viral associated illness. However test results that show the presence of IgM and high avidity IgG are indicative of exposures that have occurred in the previous season. Immunocompromised individuals may not be able to mount an immune response necessary for a serological diagnosis. West Nile Virus diagnostic test criteria for these individuals should be discussed with a medical microbiologist.

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Early in infection the immune system generates antibodies that bind relatively weakly to viral antigen (low avidity). As the infection proceeds, an increasing percentage of newly generated IgG antibody displays higher binding affinity to virus antigen and thus avidity also rises (Note: avidity is usually measured based upon the ability of IgG to dissociate from antigen preparations after incubation with a solution of urea). As long as high avidity IgG is not yet detected in the serum it can be assumed that the individual was exposed to the viral agent during a recent exposure. With respect to WNV infection it has not been precisely determined when (i.e. post-exposure) high avidity antibodies reach levels in serum that can be accurately detected by serological assays (there may be significant variation depending on the individual). However, it has been shown that greater than 95% of sera collected from individuals exposed to WNV 6-8 months previously will have IgG antibodies that bind strongly to viral antigen and will give high avidity scores using both IFA and ELISA testing formats. **Note: Avidity testing will not replace confirmatory neutralization testing, non-WNV flavivirus IgG antibody (Eg. dengue, SLE, etc.) may bind to the antigen preparations used in avidity assays.**

Appendix B

Week Codes - 2010 - West Nile Virus

Week # (Sun to Sat)	2010
1	Jan 3 - Jan 9
2	Jan 10 - Jan 16
3	Jan 17 - Jan 23
4	Jan 24 - Jan 30
5	Jan 31 - Feb 6
6	Feb 7 - Feb 13
7	Feb 14 - Feb 20
8	Feb 21 - Feb 27
9	Feb 28 - Mar 6
10	Mar 7 - Mar 13
11	Mar 14 - Mar 20
12	Mar 21 - May 27
13	May 28 - Apr 3
14	Apr 4 - Apr 10
15	Apr 11 - Apr 17
16	Apr 18 - Apr 24
17	Apr 25 - May 1
18	May 2 - May 8
19	May 9 - May 15
20	May 16 - May 22
21	May 23 - May 29
22	May 30 - Jun 5
23	Jun 6 - Jun 12
24	Jun 13 - Jun 19
25	Jun 20 - Jun 26
26	Jun 27 - Jul 3

Week # (Sun to Sat)	2010
27	Jul 4 - Jul 10
28	Jul 11 - Jul 17
29	Jul 18 - Jul 24
30	Jul 25 - Jul 31
31	Aug 1 - Aug 7
32	Aug 8 - Aug 14
33	Aug 15 - Aug 21
34	Aug 22 - Aug 28
35	Aug 29 - Sep 4
36	Sep 5 - Sep 11
37	Sep 12 - Sep 18
38	Sep 19 - Sep 25
39	Sep 26 - Oct 2
40	Oct 3 - Oct 9
41	Oct 10 - Oct 16
42	Oct 17 - Oct 23
43	Oct 24 - Oct 30
44	Oct 31 - Nov 6
45	Nov 7 - Nov 13
46	Nov 14 - Nov 20
47	Nov 21 - Nov 27
48	Nov 28 - Dec 4
49	Dec 5 - Dec 11
50	Dec 12 - Dec 18
51	Dec 19 - Dec 25
52	Dec 26 - Jan 1

Appendix C – 2010 WNV Risk Assessment

Assessment week:

Date completed:

Completed by:

Surveillance Factor	Assessment	Benchmark	Assigned Value
1. Seasonal temperature	1	Two week mean daily temperature below normal (>2°)	
	3	Two week mean daily temperature at or near normal (±2°)	
	5	Two week mean daily temperature above normal (>2°)	
2. Adult mosquito vector abundance Determined by trapping adults, identifying them to species, and comparing numbers to those previously documented for an area	2	Vector abundance well below average (<50%) (or <25% of 2002 data)	
	4	Vector abundance below average (50%-90%) (or 25%-50% of 2002 data)	
	6	Vector abundance average (90%-150%) (or 50%-75% of 2002 data)	
	8	Vector abundance above average (150%-300%) (or 75%-150% of 2002 data)	
	10	Vector abundance well above average (>300%) (or >150% of 2002 data)	
3. Virus isolation rate in vector mosquito species MIR = $\frac{\text{\# of Positive Cx. Pools}}{\text{\# of Cx. Mosquitoes Tested}} \times 1000$ Tested in pools of 50. Expressed as minimum infection rate (MIR) per 1000 female mosquitoes tested (or 10 pools). A single positive pool with < 500 total <i>Culex</i> cannot score higher than 6.	2	MIR*1000 = 0	
	6	MIR*1000 = > 0 - 5	
	8	MIR*1000 = > 5 - 10	
	10	MIR*1000 = > 10	
4. Human Cases of WNV (Probable and Confirmed)	1	No human cases in province or neighbouring US states	
	2	≤ 10 human cases in neighbouring US states, and none in province	
	3	One human case acquired in province or 11-99 in neighbouring US states	
	4	Multiple human cases acquired in province, or ≥ 100 in neighbouring US states	
	5	One or more human cases acquired in region/area	
5. Local WNV activity (do not score if bird testing has stopped, unless benchmark factor is met for a score of 5)	1	No WNV in horses, or mosquitoes in the province	
	3	One or more positive mosquitoes or horses in the province	
	5	One or more positive mosquito batches or horses in Peel Region during week of assessment	
6. Time of Year (score only if virus activity detected in region/area)	1	Before June 15 or after September 15	
	3	Between June 15 and July 15, or between September 1 and September 15	
	5	Between July 15 and September 1	
7 Proximity to urban or suburban regions (score only if virus activity detected in region/area)	1	Virus activity in remote areas	
	2	Virus activity in rural areas	
	3	Virus activity in small towns	
	4	Virus activity in suburban/urban areas	
	5	Virus activity in suburban/urban areas with positive mosquito traps and previous infection rates >5 per 100,000 for a previous season	
Risk Assessment Level		Total	
		Divide total by 7 if summing surveillance factors 1-5 Divide total by 9 if summing surveillance factors 1-7 Divide total by 6 if summing surveillance factors 1-4 Divide total by 8 if summing surveillance factors 1-4 and 6,7 Average	