

Table of Contents

List of Figures..... ii

List of Tables.....iii

List of Maps..... iv

Executive Summary 1

Introduction.....5

Human Case Surveillance7

Dead Bird Surveillance 10

Adult Mosquito Surveillance 16

Larval Mosquito Surveillance..... 30

Larval Mosquito Reduction 32

Risk Assessment Summary..... 36

Public Education and Community Outreach 37

Conclusions..... 42

References 44

Appendices..... 46

List of Figures

Figure 1 Number of Dead Birds Reported to Environmental Health Contact Centre, Region of Peel, 2002-2008..... 11

Figure 2 Comparison of average capture of *Culex pipiens-restuans* since 2006, Region of Peel, 2002, 2006-2008 20

Figure 3 *Ochlerotatus japonicus* (*Oc. japonicus*) abundance (based on actual counts), Region of Peel, 2002 – 2008 21

Figure 4 WNV Positive Mosquito Batches by Week of Collection, Region of Peel, 2002, 2006-2008 22

Figure 5 Average Number of *Culex* Species per Trap Event by Week, Region of Peel, 2002, 2006-2008..... 24

Figure 6 Types of Sites Found to Contain Mosquito Larvae, Region of Peel, 2008 31

Figure 7 Surface Water Site Types Treated, Region of Peel, 2008..... 35

Figure 8 Number of Calls to the Customer Contact Centre, Region of Peel May 1 - September 30, 2002, 2006-2008 38

Figure 9 Average temperature and precipitation in the Region of Peel, 2006-2008 40

Figure 10 Potential for Replication of WNV in Mosquitoes, Region of Peel, 2005-2008.....41

List of Tables

Table 1	Number of Human Cases by Municipality, Region of Peel, 2002-2008..	8
Table 2	Number of Human Cases and Deaths by Province, Canada, 2007-2008	8
Table 3	Number of Dead Bird Reports for Target Species by Municipality, Region of Peel, 2002, 2006-2008	11
Table 4	Date and Location of First Positive Target Bird, Region of Peel, 2002, 2006–2008	12
Table 5	Annual Comparison of the Total Number of WNV Positive Birds, Region of Peel, 2002, 2006-2008.....	12
Table 6	WNV Test Results Among Birds Submitted to the Canadian Cooperative Wildlife Health Centre, by Health Unit, Ontario, 2008	15
Table 7	Estimated Number of Female Adult Mosquitoes Collected and Identified by Species, Region of Peel, 2008	19
Table 8	Number of Positive Trapping Events by Municipality, Region of Peel, 2002, 2006-2008	21
Table 9	Total Number and Percentage of Female <i>Culex</i> Mosquitoes in all Batches and all Positive Batches, Region of Peel, 2002, 2006-2008...	23
Table 10	Minimum Infection Rates* of <i>Culex</i> Species in Each Municipality, Region of Peel, 2006-2008	25
Table 11	Minimum Infection Rates of non- <i>Culex</i> Species in Each Municipality, Region of Peel, 2007 and 2008.....	26
Table 12	Mosquito Surveillance Statistics by Health Unit, Ontario, 2008.....	27
Table 13	Mosquito Surveillance Statistics by Province and Territory, Canada, 2008	28
Table 14	Number of Surface Water Sites Monitored by Municipality, Region of Peel, 2002, 2006-2008.....	30
Table 15	Summary of Catch Basin Treatment, Region of Peel, 2008.....	34
Table 16	Summary of Surface Water Treatment by Municipality, Region of Peel, 2006-2008.....	35
Table 17	Number of Surface Water Sites Treated, Region of Peel, 2008.....	36
Table 18	Proportion of Residents who Protected Themselves from Mosquitoes All or Most of the Time During the Month Prior to Interview, Region of Peel, 2002, 2006–2008	37

List of Maps

Map 1 West Nile Virus - Bird Surveillance (Crows & Blue Jays), Region of Peel, 2008 (Week 20-40) 13

Map 2 Location of Mosquito Traps by Municipal Ward, Region of Region, 2008 17

Executive Summary

West Nile Virus (WNV) is a mosquito-borne disease which poses potential health risks to humans. While WNV was first detected in North America in 1999, WNV activity in Peel Region first occurred among birds and mosquitoes in 2001. During the following year (2002), the greatest number of confirmed human cases in Peel Region occurred, including two deaths.

Since 2003, the Region of Peel has conducted a program to monitor the risk of WNV transmission to humans through surveillance and to reduce it through control efforts and education. WNV surveillance activities in 2008 in Peel Region showed an increase from 2007 in WNV activity among mosquitoes and birds. Despite this increase, there were no human cases of WNV in Region of Peel in 2008. In keeping with the Region of Peel WNV Prevention Plan, this seventh annual report presents the results of the 2008 surveillance program.

Research shows that the ideal conditions for the spread of WNV from mosquitoes to humans are achieved during periods of prolonged hot, wet weather.¹ The occurrence of these conditions is likely to increase in frequency in the coming years as the result of climate change.² The summer of 2008 was one of the wettest on record, with more than double the amount of rainfall compared to 2007, but the temperatures were cool. So, although the wet weather provided ideal conditions for mosquitoes to breed and increase their population, the temperature was not high enough to increase the viral replication rate in mosquitoes. Therefore, the chance for transmission of the virus from mosquitoes to humans was lowered. Similar to the situation seen in Peel Region, there was an increase in WNV vector activity in Ontario in 2008, but a decrease in the number of human cases over the same period. Across Canada, the number of human cases decreased 98% in 2008, compared to 2007.

Information collected through adult and larval mosquito and human surveillance activities continues to be valuable in assessing the risk of WNV to residents of Peel Region. Surveillance information is used to assess the need for enhanced mosquito reduction activities such as larviciding and adulticiding. The monitoring of bird mortality and testing dead birds for the presence of WNV is no longer considered valuable because of a downward trend in submissions from the public and will not be included in the 2009 program. Public education and community outreach continue to be used to reduce personal exposure and eliminate breeding sites on private property.

Human Case Surveillance

There were no human cases of West Nile Virus (WNV) reported in Peel Region in 2008. There was one human case in 2007 and two in 2006. In Ontario, there were no deaths and only three reported human cases of WNV in 2008.

Nationally, the number of human WNV cases decreased dramatically compared to the previous year. In 2008, 36 human cases were reported across Canada compared to 2,353 in 2007, a 98% reduction in the number of cases.

Saskatchewan saw the largest reduction in the number of cases from 1,422 cases in 2007 to 19 in 2008. In the United States, 1,370 human WNV cases and 37 deaths were reported to the Centers for Disease Control and Prevention in 2008.³

Dead Bird Surveillance

In 2008, the observed downward trend in calls to the Environmental Health Contact Centre to report dead birds continued in 2008. This decrease in calls has also been reported among many other health units in Ontario. In 2008, there was a 28% decrease in the number of dead birds (all species) reported to the Environmental Health Contact Centre compared to the previous year. In total 297 dead birds were reported in 2008 compared to 415 in 2007 (there had been a 60% decrease in calls in 2007 compared to the previous year).

Of the dead bird related calls received by the Environmental Health Contact Centre, 62% were from residents with birds found in the City of Mississauga, 26% were from residents with birds found in the City of Brampton and 12% were from residents with birds found in the Town of Caledon.

Fifteen birds tested positive for WNV in Peel in 2008 - 11 in Mississauga, 3 in Brampton and 1 in Caledon, an increase of 650% over 2007.

The first bird to be tested positive in Peel happened on August 4, 2008, a little less than one week after the first positive mosquito batch was detected in Peel.

Of the 35 dead birds submitted for testing to the Canadian Cooperative Wildlife Health Centre (CCWHC) from Peel in 2008, 15 birds tested positive for WNV (42%) - 11 in Mississauga, 3 in Brampton and 1 in Caledon. The proportion of positive birds was higher in Peel than the provincial and national average (19% and 12% respectively).

Adult Mosquito Surveillance

Surveillance of mosquito populations in 2008 showed a marked increase in WNV activity over the previous year. This increase may be attributable to the wet summer weather which served as ideal conditions for mosquito breeding. In 2008, there were 602.6 mm of rain compared to 275.4 mm in 2007 and 412.8 mm 2006.

Mosquitoes were collected weekly from 31 permanent, fixed-location traps throughout Peel Region. A total of 78,214 female adult mosquitoes were collected in Peel Region. The first positive trapping event in 2008 occurred on July 29 in

Brampton, this was one month earlier than in 2007. Nationally, three provinces reported positive mosquito batches (Ontario, Saskatchewan, Manitoba).

Thirteen permanent traps had positive mosquito batches in 2008, for a total of 21 positive mosquito batches (11 in Mississauga, 10 in Brampton, and 0 in Caledon). Ninety-five per cent, or 20 of 21 WNV positive batches in Peel Region were found to contain *Culex* species. The abundance of the *Culex* species more than doubled in 2008 to 16% from 7% the previous year. Of the nine health units reporting positive batches in Ontario, Peel Region had the highest number of positive mosquito batches.

In 2008, 22 different mosquito species were found in Peel Region. The *Culex* species, *Culex pipiens* and *Culex restuans*, are associated with a greater risk of WNV transmission. *Culex* species accounted for 16% of the total species found in 2008. The abundance of the *Culex* species more than doubled in 2008 from the previous year (16% vs 7%).

The relative abundance of *Ochlerotatus japonicus* in 2008, an efficient WNV vector, remained stable at under 1%. However, as seen with other mosquito types, the actual number and trapping events related to this species nearly doubled in 2008 over the previous year. As seen in 2007 in Ontario, *Ochlerotatus japonicus* tested positive for WNV.

Larval Surveillance

Mosquito larval surveillance was undertaken at 3,479 potential breeding sites in Peel Region. Mosquito larvae were found at 67% of the sites monitored (2,501 of 3,749); 2% of all sites had only vector larvae present.

Ditches and culverts were the most common habitat where larvae were found (34% and 22% respectively).

In 2008, a total of 2,501 mosquito larvae were identified. Sixty-one per cent of the larvae identified were *Culex pipiens* and *Culex restuans*. The abundance of these two types of mosquitoes can be attributed to amount of rain in 2008 and the fact that they breed primarily in man made containers and culverts which are difficult to empty or treat. Larvae were first found in week 20 (May 11 to 17) and the highest number were found in week 31 (July 27 to August 2).

Larval Mosquito Reduction

As in previous years, Peel's larval mosquito reduction activities involved several approaches. Four rounds of methoprene (Altosid®) pellets were applied to a total of 341,393 roadside catch basins between mid-June to the beginning of September (approximately 86,675 treated per round). Limited post-treatment monitoring indicated that the methoprene pellets were 100% effective in controlling mosquito

larvae. An additional 2,467 non-roadside catch basins on Peel-owned and/or operated properties, private backyards and public parks were treated with methoprene briquets which would be effective for up to 86 days.

Vectolex® (*Bacillus sphaericus*) was used in 2,564 catch basins that drain to Environmentally Sensitive Areas.

A total of 436 surface water sites were treated with Aquabac 200G (*Bacillus thuringiensis var. israelensis*). Some locations required multiple treatments because of the persistent prevalence of mosquitoes found at those sites. Across the Region, ditches, culverts, field and woodland pools were the types of surface water sites most often larvicided.

Climate Change Impacts on West Nile Virus

Milder winters followed by prolonged summer droughts and heat waves could favour the further spread of West Nile Virus through changes in mosquito populations.² The increased temperatures associated with climate change could increase the survival and replication rates of vectors like mosquitoes in Peel Region and may contribute to higher incidence of disease.² Longer summers will also extend the period associated with higher risk behaviours allowing people to engage in outdoor leisure and work related activities for longer periods.

Conclusion

In 2008, the wet summer conditions contributed to increased numbers of mosquitoes which resulted in more positive mosquito batches being reported. However, because it remained fairly cool, which reduced the opportunity for the virus to be replicated in mosquito populations, the increased number of mosquito vectors was not associated with any human cases. While WNV activity, as measured by the three main surveillance methods, will vary from year to year depending on the weather conditions, it is reasonable to assume that the disease has established itself and will continue to spread further throughout North America as the effects of climate change become more pronounced.

The *Culex* species continues to be the predominant species responsible for the majority of WNV positive mosquito batches in Peel Region. Therefore, targeted mosquito vector reduction focussing on the *Culex* species should continue.

The results from the 2008 WNV surveillance program, along with predicted climate change trends, suggest that the 2009 Vector-Borne Disease Prevention Plan (formerly the West Nile Virus Plan) should continue to focus on mosquito surveillance and reduction, public education and community outreach during times when the virus has been found in affected neighbourhoods.

Introduction

West Nile Virus (WNV), a virus transmitted primarily through the bite of infected 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 the continent to other US states and many Canadian provinces including Ontario, Quebec, Manitoba, Saskatchewan and Alberta.

In early spring, the amplification of WNV begins after infected adult mosquitoes overwinter and/or infected migratory birds return to a 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.³ They 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 the *Culex* species continue to be the primary vector throughout the season, these bridge vectors are also a concern in late summer.

The species type of WNV vector mosquito will vary with geography. For example, the species responsible for the 2007 increase in human cases in the prairie provinces and the central United States, *Culex tarsalis*, is not found in significant abundance in Ontario.

In 2001, WNV was first detected in birds and mosquitoes in Peel Region. Locally acquired human illness of 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, which have been the only deaths to occur in Peel due to this cause.

According to the literature, an estimated one in five people who are bitten by a mosquito infected with WNV will develop symptoms. Most people who are infected have either no symptoms or mild illness such as West Nile fever. In about one per cent of infected individuals, WNV can cause severe illness resulting in hospitalization. Even people with milder illness find that it can take months to feel well again.

Ontario Regulation 199/03 (Control of West Nile Virus),⁴ 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 primarily on surveillance of human, bird* and mosquito infections. This guides the MOH with respect to appropriate WNV risk reduction activities, including the need for mosquito reduction measures.

* Surveillance of birds will be discontinued starting in 2009.

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 558/91⁵ and 559/91⁶, respectively, requiring physicians and laboratories to report human cases to the local MOH.

The goal of the Region of Peel's WNV Prevention Plan is to minimize the impact of WNV with a regional surveillance program involving humans, birds 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.

This seventh annual West Nile Virus in the Region of Peel report presents the surveillance data and information on the risk reduction activities for 2008. This report follows the 2008 WNV Prevention Plan which was adopted by Peel Council.⁷ The 2008 surveillance information was compiled, analyzed and compared to previous years' information where appropriate. Larval reduction, public education and community outreach activities were also reviewed.

The scope of the 2008 report has been narrowed. In previous years, the annual report provided the detailed results of the Region of Peel program plus details on the surveillance activities at the provincial, national and Great Lakes states level. This report provides information about the local, provincial and national levels; however, will not repeat details that have been articulated in previous reports and that have not changed from year-to-year. Rather, the reader is directed to those reports for more detail (visit <http://www.peelregion.ca/health/westnile/> and click on resources, then reports and Plans).

In addition, detailed explanations of process and methods will not be repeated because they are established elements of the program. Any changes in the program will be noted.

Human Case Surveillance

An estimated one in five people who are bitten by a mosquito infected with WNV will develop symptoms. Most people who are infected have either no symptoms or mild illness, such as West Nile fever. The incubation period is estimated to be three to 14 days with symptoms lasting on average three to six days. Cases are classified as West Nile Virus Neurological Syndrome (WNNS) or West Nile Virus Non-Neurological Syndrome (WN Non-NS).

WNV fever is described as a sudden onset of fever that is often accompanied by malaise, headache, nausea, vomiting, anorexia, eye pain, myalgia and less commonly, rash and/or swollen lymph nodes. This is typically classified as WN Non-NS.⁸

In about 1% of infected individuals, WNV can cause serious illness including severe neurological disease which is classified as WNNS. Additional symptoms among those with severe disease include muscle weakness and a change in mental status.⁸

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).⁸

The human case surveillance program for WNV is intended to detect illness in Peel Region. All probable or confirmed cases identified by hospitals and physicians are reported to the local public health department. The Ministry of Health and Long-Term Care (MOHLTC) has developed case definitions and diagnostic test criteria (refer to Appendix A).⁹

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).

Human Surveillance Program - 2008

In 2008, there were no confirmed human cases of WNV in Peel Region.

Table 1 presents the number of human cases of WNV in Peel Region from 2002 to 2008. In 2002, 57 probable and confirmed cases of WNV were reported based on the case definitions at the time. However, the case definition has changed since 2002. If the present day definition was applied there would have been 18 confirmed human cases in 2002. Two WNV-related deaths occurred in 2002. No WNV-related deaths have occurred in Peel Region in subsequent years.

Table 1 Number of Human Cases by Municipality, Region of Peel, 2002-2008

	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

[†]In 2002, there were a total of 112 cases with laboratory and/or clinical evidence of WNV infection; 57 cases were classified as probable or confirmed. In subsequent years, only confirmed cases were reported as a result of changes in disease classifications. If the present day classifications were applied there would have been 18 confirmed human cases in 2002.

Comparison with Other Ontario Health Units

Across Ontario, there were four confirmed WNV human cases in 2008 compared to 15 in 2007 and 42 in 2006.¹⁰ Four of the 36 health units reported human cases in 2008. York Region was the closest health unit to Peel reporting human cases.

Comparison with other Provinces

In 2008, there were a total of 38 cases and no deaths compared to 2,355 human cases of WNV and 2 deaths across Canada in 2007. Table 2 presents the cases and deaths by province.

Table 2 Number of Human Cases and Deaths by Province, Canada, 2007-2008

Province/Territory	2008		2007	
	Cases*	Deaths	Cases*	Deaths
Newfoundland and Labrador	0	0	0	0
Prince Edward Island	0	0	0	0
Nova Scotia	0	0	1 ^{***}	0
New Brunswick	0	0	0	0
Quebec	0	0	2 ^{***}	0
Ontario	4	0	15	2
Manitoba	13	0	576	0
Saskatchewan	19	0	1,422	0
Alberta	1 ^{***}	0	320	0
British Columbia	1 ^{***}	0	19 ^{**}	0
Yukon	0	0	0	0
Northwest Territories	0	0	0	0
Nunavut	0	0	0	0
TOTAL	38	0	2,355	2

* sum of probable and confirmed: WNNS + WN Non-NS + Unclassified/Unspecified

** all cases likely related to travel outside the province / territory

*** All cases likely related to travel outside the province/territory

Sources: Public Health Agency of Canada, 2008 and the Ontario Ministry of Health and Long-Term Care (2008)

A nationwide temporal analysis of human cases was conducted for the six year period, 2003 to 2008. There is a consistent pattern in the time of year when cases were reported. Over this period, the lowest number of human cases was reported in Canada in 2008.

Saskatchewan and Manitoba experienced the highest number of human WNV cases in Canada in 2008 (19 and 13 cases, respectively), but the number of cases reported was dramatically lower than 2007.

Dead Bird Surveillance

The sudden appearance of dead birds was thought to be the first indicator of the presence of WNV in an area. The corvid species which includes crows and blue jays among other birds are particularly sensitive to the effects of WNV and are the most likely to die once infected. Therefore, the Region of Peel maintained the dead bird surveillance program during the 2008 season.

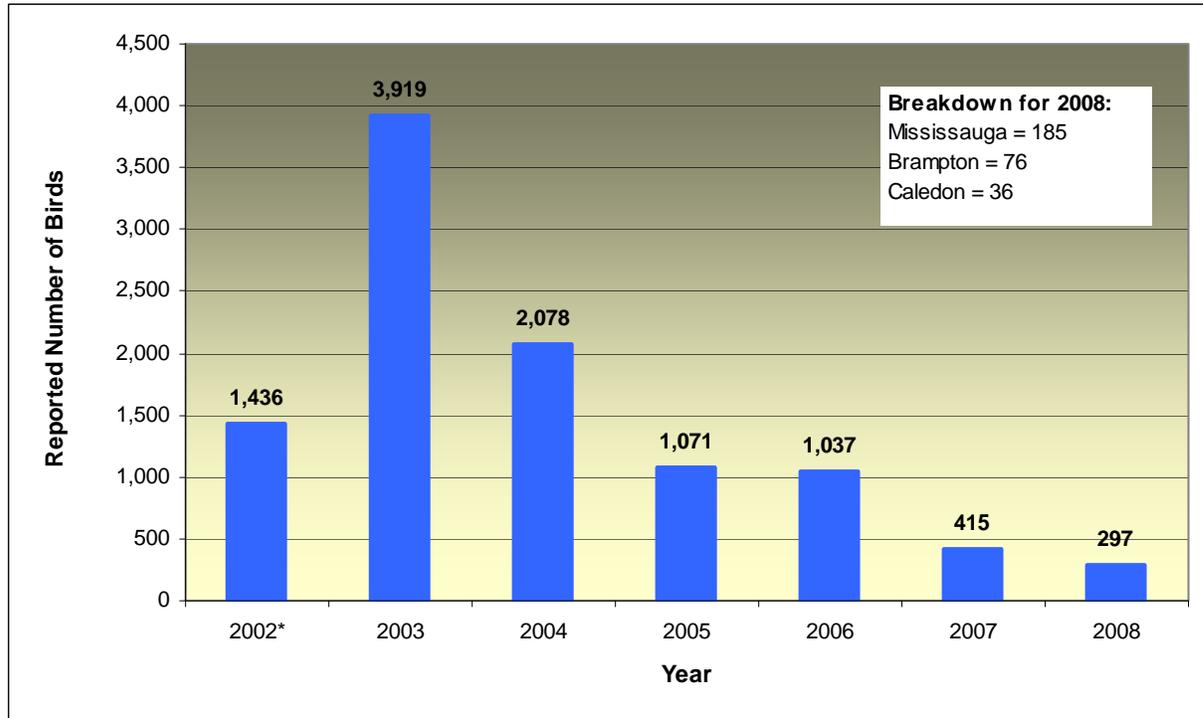
Telephone calls reporting dead birds were received by the Region of Peel Customer Contact Centre on weekdays and by staff at the Environmental Health Contact Centre on Saturdays and statutory holidays. The dead bird surveillance program started in 2000 with the inclusion of only crows but changed in 2004 to include both crows and blue jays. A private pest control company was contracted by Peel Public Health to pick up dead target birds for testing.

Testing of dead birds for WNV was conducted by the Canadian Cooperative Wildlife Health Centre (CCWHC) located in Guelph, Ontario. Not every target bird was suitable for testing due its physical condition at the time of reporting. Also, the bird testing program was suspended by the CCWHC once the virus had been established after at least one submitted bird from all three municipalities in Peel Region had tested positive. Therefore, not every dead target bird reported was tested. Reports of other dead birds species were noted and mapped but Peel Public Health did not collect or test these birds for WNV.

The total number of dead birds (all species) reported in 2008 was the fewest since the start of Peel's bird surveillance program in 2000. There were 297 dead bird calls to the Environmental Health Contact Centre in 2008, as shown in Figure 1. This represents a 92% decrease in dead bird reports since the 2003 peak of 3,919.¹¹ The decrease in the number of reports may be due to several factors including a general population decline of birds, especially those species sensitive to WNV that may have been significantly impacted in previous years.

Sixty-two per cent of the dead birds reported were located in Mississauga. The majority were found in two locations, one south of Highway 401 and another small cluster in the northeast community of Malton. Twenty-six per cent of the dead birds were located in Brampton and 12% were located in Caledon.

Figure 1 Number of Dead Birds Reported to Environmental Health Contact Centre, Region of Peel, 2002-2008



*All dead bird reports are assumed to be crows.

Table 3 shows the number of dead bird reports for the target species, crows and blue jays, for 2002, 2006, 2007 and 2008. There were 1,436 dead crows reported in 2002 in comparison to 86 dead crows and blue jays in 2008.

Fifty-six per cent of the calls reported target bird in 2008. The greatest number of reported birds were from Mississauga (56%) followed by Caledon (24%) and Brampton (20%).

Table 3 Number of Dead Bird Reports for Target Species by Municipality, Region of Peel, 2002, 2006-2008

	2002*	2006†	2007†	2008†
Brampton	485	36	14	17
Caledon	48	30	23	21
Mississauga	903	46	22	48
Total	1,436	112	59	86

* Target Birds were crows only

† Target Birds were crows and blue jays

Source: Region of Peel, 2008

As shown in Table 4, the first WNV-positive bird in 2008 was reported on August 4, 2008 (week 32) in the City of Brampton. It was reported one week after the first positive mosquito.

Table 4 Date and Location of First Positive Target Bird, Region of Peel, 2002, 2006–2008

Year	Date	Location
2002	May 19, 2002 (week 21)	Mississauga
2006	July 31, 2006 (week 31)	Brampton
2007	August 17, 2007 (week 33)	Brampton
2008	August 4, 2008 (week 32)	Brampton

In 2008, 15 target birds submitted for testing were found to be infected with WNV. Most were found in Mississauga (11), 3 were found in Brampton, and 1 in Caledon. Table 5 shows that 43% of the birds submitted for testing in 2008 were infected with WNV.

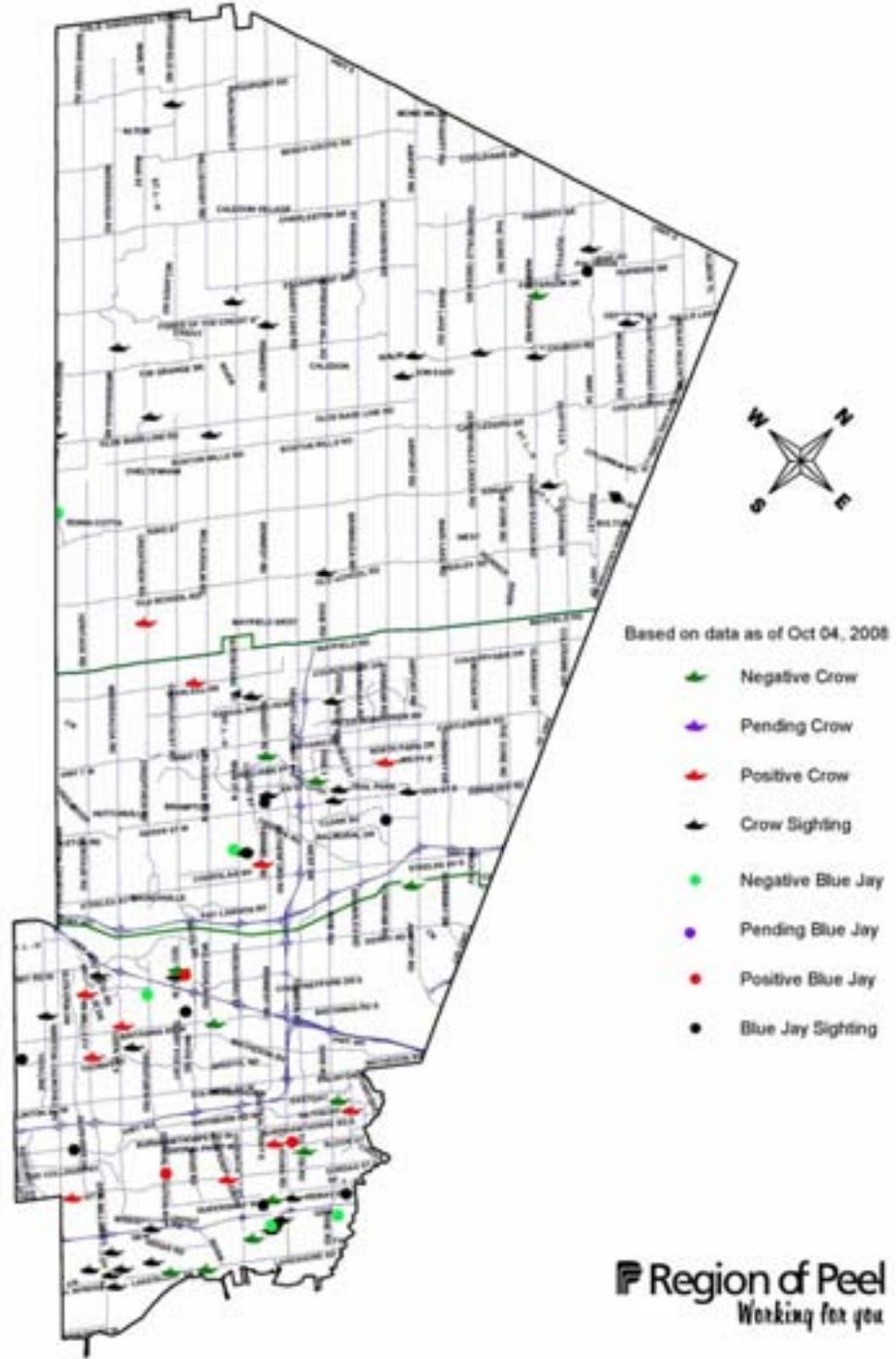
Table 5 Annual Comparison of the Total Number of WNV Positive Birds, Region of Peel, 2002, 2006-2008

Year	# of birds tested	# of positive birds	Per cent positive
2002	71	20	28.2
2006	27	11	40.7
2007	29	2	6.9
2008	35	15	42.9

Sources: CCWHC, 2008; Region of Peel, 2008

Map 1 shows the geographical distribution of the target birds and their viral status (positive, negative, pending or sighting). In Mississauga and Caledon, reports of dead target birds were relatively evenly distributed, whereas in Brampton they tended to cluster mostly around the centre of Brampton.

Map 1 West Nile Virus - Bird Surveillance (Crows & Blue Jays), Region of Peel, 2008 (Week 20-40)



Bird Surveillance in Other Ontario Health Units

Table 6 presents the data collected by the Canadian Cooperative Wildlife Health Centre (CCWHC) on the number of birds tested and the results within each Ontario health unit in 2008. In 2008, 150 birds tested positive for WNV in Ontario, a 47% increase compared to 79 in 2007.¹⁴

Table 6 also presents the number of birds submitted and the number of birds tested positive. A higher proportion of birds tested in Peel were found to be infected with WNV (43%), compared to Ontario as a whole.

Bird Surveillance to be Discontinued in 2009

The Province has decided to cease funding the program and concentrate efforts on mosquito surveillance, effective 2009.

Table 6 - WNV Test Results Among Birds Submitted to the Canadian Cooperative Wildlife Health Centre, by Health Unit, Ontario, 2008

Health Unit	Total Submitted	Not Tested	Negative	Total Positive
ALGOMA PUBLIC HEALTH	18	0	18	0
BRANT COUNTY HEALTH UNIT	6	0	3	3
CHATHAM - KENT PUBLIC HEALTH SERVICES	6	0	5	1
DURHAM REGION HEALTH DEPARTMENT	47	0	39	8
EASTERN ONTARIO HEALTH UNIT	28	1	20	7
ELGIN - ST. THOMAS HEALTH UNIT	1	0	0	1
GREY - BRUCE HEALTH UNIT	18	2	14	2
HALDIMAND - NORFOLK HEALTH UNIT	8	0	7	1
HALIBURTON, KAWARTHA, PINE RIDGE DISTRICT HEALTH UNIT	29	0	26	3
HALTON REGION HEALTH DEPARTMENT	40	0	22	18
HAMILTON PUBLIC HEALTH & SOCIAL SERVICES	44	3	27	14
HASTINGS & PRINCE EDWARD COUNTIES HEALTH UNIT	26	0	23	3
HURON COUNTY HEALTH UNIT	16	0	14	2
KINGSTON, FRONTENAC, LENNOX & ADDINGTON PUBLIC HEALTH	24	0	24	0
LAMBTON COUNTY HEALTH SERVICES DEPARTMENT	15	0	11	4
LEEDS, GRENVILLE & LANARK DISTRICT HEALTH UNIT	25	0	23	2
MIDDLESEX - LONDON HEALTH UNIT	6	0	5	1
NIAGARA REGION PUBLIC HEALTH DEPARTMENT	52	0	38	14
NORTH BAY PARRY SOUND DISTRICT HEALTH UNIT	22	0	14	8
NORTHWESTERN HEALTH UNIT	13	0	13	0
OTTAWA PUBLIC HEALTH	46	0	33	13
OXFORD COUNTY - PUBLIC HEALTH & EMERGENCY SERVICES	10	0	9	1
PEEL PUBLIC HEALTH	35	0	20	15
PERTH DISTRICT HEALTH UNIT	12	0	11	1
PETERBOROUGH CITY - COUNTY HEALTH UNIT	33	0	29	4
PORCUPINE HEALTH UNIT	16	0	16	0
RENFREW COUNTY & DISTRICT HEALTH UNIT	16	0	13	3
SIMCOE MUSKOKA DISTRICT HEALTH UNIT	28	0	24	4
SUDBURY & DISTRICT HEALTH UNIT	46	0	43	3
THUNDER BAY DISTRICT HEALTH UNIT	17	0	16	1
TIMISKAMING HEALTH UNIT	12	0	11	1
TORONTO PUBLIC HEALTH	13	0	10	3
WATERLOO REGION PUBLIC HEALTH	32	0	27	5
WELLINGTON - DUFFERIN - GUELPH PUBLIC HEALTH	21	1	19	1
WINDSOR - ESSEX COUNTY HEALTH UNIT	6	0	5	1
YORK REGION PUBLIC HEALTH SERVICES	14	0	12	2
Total:	801	7	644	150

Bird Surveillance across Canada

A total of 1,217 birds were submitted for testing from five provinces. Approximately 12% of all the birds submitted across Canada tested positive for WNV - almost double the percent positive over the previous year (6.5%). Only Ontario submitted birds which tested positive for WNV.

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 are associated with WNV transmission 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 human health risk. In Ontario, the species of particular interest due to their WNV transmission risk continues to be the *Culex* species.

Historically, the *Culex* species have consistently been responsible for the majority of the WNV-positive mosquito batches in Peel Region. Once again in 2008, all but one of the WNV-positive mosquito traps were due to the *Culex* species. Therefore, it is imperative to continue to decrease the vector abundance of the *Culex* species in particular. The WNV Prevention Plan needs to continue to focus on reducing the number of *Culex* mosquitoes and the *Culex* species abundance should continue to be reviewed in the weekly WNV risk assessment. However, other mosquito species are also WNV vectors. While reducing the abundance of the *Culex* species remains a priority for the Region of Peel, monitoring the abundance and WNV potential of various species remains very important in order to mitigate any risk in an informed manner

For more information about the methodological details associated with species identification, sorting and viral testing, refer to the 2006 West Nile Virus in the Region of Peel report.¹² (Follow this link to view the 2006 Report - <http://www.peelregion.ca/health/westnile/resources/reports.htm#report2006>)

Map 2 shows the locations for the fixed traps set in Peel Region in 2008 by municipal ward. Thirty-one fixed CDC light traps were distributed by Regional ward, with a minimum of one trap per ward across Peel: 17 in the City of Mississauga, 9 in the City of Brampton and five in the Town of Caledon.

Map 2 Location of Mosquito Traps by Municipal Ward, Region of Peel, 2008

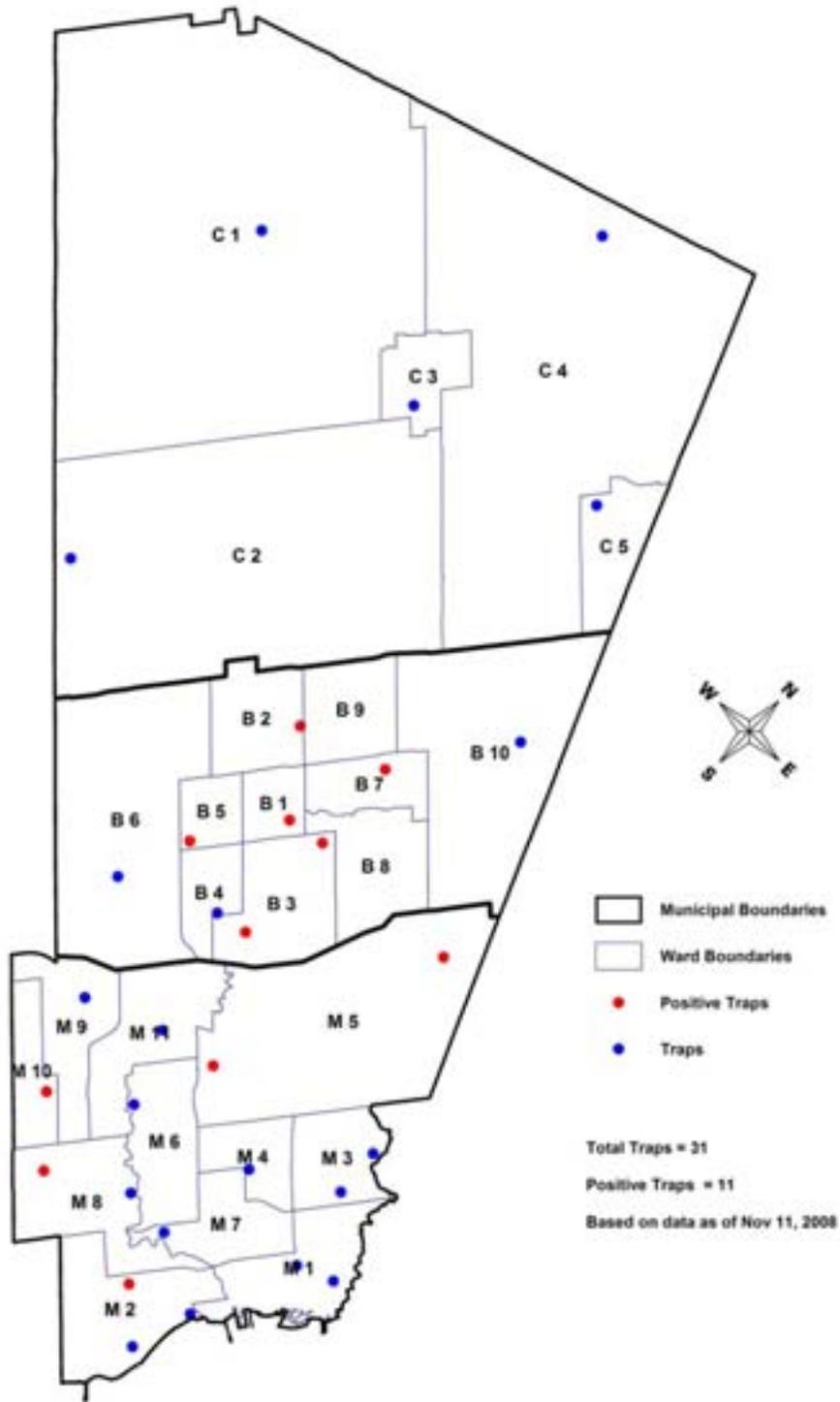


Table 7 presents the estimated number of mosquitoes collected by species[†]. These estimates are based partially on actual counts, where the pool size was less than 50 mosquitoes, and partially on estimating methods when the pool size exceeded 50 mosquitoes.¹³ An estimated 78,214 mosquitoes were collected and identified by species. This represents a 21% increase over 2007 when almost 65,000 mosquitoes were collected.

In 2008, *Aedes vexans* was the dominant mosquito species representing 40.5% of the total mosquitoes captured during the season. Last year, the dominant species was *Cq. perturbans* (58.8% of total).

Other mosquito species detected in 2008 included *Cq. perturbans* (13.8% species abundance), and *Oc. stimulans-excrucians* (8.8% species abundance). Vector mosquitoes, *Culex* species, accounted for 16% of the total species found. The *Culex pipiens-restuans* group is one of the most efficient primary vectors of WNV in Ontario.¹⁴ Approximately one per cent of the mosquitoes were unclassifiable and were placed in an “other species” grouping.

Of the total number of mosquitoes collected, most of them were collected in the Brampton (44%) and Mississauga (43%), followed by Caledon (13%). In 2007, the majority of total mosquitoes collected were in Mississauga (58%), followed by Brampton (30%) and Caledon (12%).

The species distribution across the municipalities varied. The most prevalent species captured were *Aedes vexans* and *Culex pipiens/restuans* (40.1% and 47% in Mississauga respectively and 49% and 18% in Brampton respectively). In Caledon, the most prevalent species collected was *Ochlerotatus stimulans* (41.1%) and *Oc. Canadensis* (22.6%).

[†] These totals are based on the results of weekly reports provided to the Region of Peel by GDG Environment Ltd, 2008.

Table 7 Estimated Number of Female Adult Mosquitoes Collected and Identified by Species, Region of Peel, 2008*

Species	Brampton	Caledon	Mississauga	Peel	% of Total
<i>AE. VEXANS VEXANS</i>	16,737	1,242	13,694	31,673	40.5
<i>CX. PIPIENS/RESTUANS</i>	6,202	430	5,830	12,462	15.9
<i>CQ. PERTURBANS</i>	2,374	381	8,033	10,787	13.8
<i>OC. STIMULANS</i>	1,277	4,270	1,362	6,910	8.8
<i>OC. CANADENSIS</i>	3,368	2,350	259	5,977	7.6
<i>OC. TRIVITTATUS</i>	2,546	749	1,853	5,149	6.6
<i>AN. PUNCTIPENNIS</i>	518	247	831	1,597	2.0
<i>OC. TRISERIATUS/HENDERSONI</i>	214	105	812	1,131	1.5
<i>AEDES/OCHLEOROTATUS SPECIES</i>	320	253	180	753	1.0
<i>OC. JAPONICUS</i>	49	15	531	595	0.8
<i>OC. BLACK LEGGED</i>	192	90	43	325	0.4
<i>AE. CINEREUS</i>	137	97	56	291	0.4
<i>AN. QUADRIMACULATUS</i>	76	81	27	184	0.2
<i>OC. BROAD-BANDED</i>	89	40	37	165	0.2
<i>OTHER SPECIES</i>	18	2	72	92	0.1
<i>CULEX SPECIES</i>	33	3	20	56	0.1
<i>ANOPHELES SPECIES</i>	15	9	5	29	0.0
<i>OC. PROVOCANS</i>	3	10		13	0.0
<i>CULISETA MORSITANS</i>		10	2	12	0.0
<i>AN. WALKERI</i>	3	8		11	0.0
<i>AN. QUADRIMACULATUS / WALKERI</i>		1		1	0.0
<i>CULISETA MELANURA</i>		1		1	0.0
Total Mosquitoes ⁺	34,172	10,395	33,647	78,214	100.0

Source: sum of weekly reports provided to the Region of Peel from GDG, 2008

*estimates based on CDC light trap surveillance data

⁺does not equal 100% due to rounding

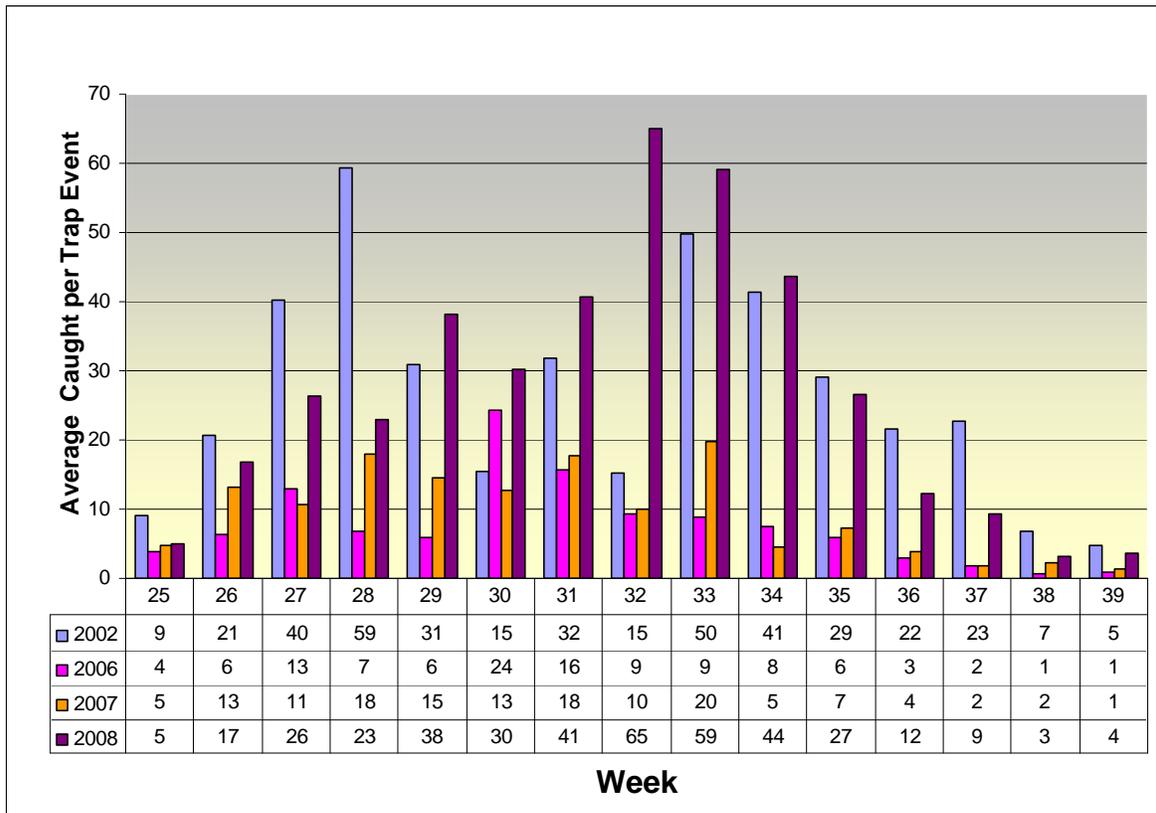
WNV vector mosquitoes of particular interest for Ontario highlighted in green

During the 2008 season, 22 mosquito species or species groups were identified. The most abundant captures occurred during the week of August 03-09 when the average adult mosquito capture per trap reached 525. In 2006 and 2007, peak abundance was reached earlier during the season - July 20-26 (average of 485.9 adults per trap) and July 6-12 (average of 510.6 adults per trap) respectively. *Oc. stimulans-excrucians* adults were found in the most abundance during the early part of the season followed by *Coquillettidia perturbans* and a shift in dominance to *Aedes Vexan*. The *Culex pipiens-restuans* group (the main vectors of WNV) was

present throughout the sampling period. It was found in higher numbers than in the three previous years. The abundance of adult mosquito populations was higher in 2008 (average 157.7 adults per trap) than in 2007 and 2006 (average of 129.9 and 149.1 adults per trap respectively). The group *Culex pipiens-restuans* was also nearly three times more abundant in 2008 than in 2007.

Figure 2 shows the average number of *Culex* mosquitoes collected per trapping event for each week. In 2008, an increase in the average number of *Culex* per trap (more than 10) started on week 26 (June 22 – 28) through to week 36 (Aug 31 – Sept 06) peaking the first week of August (week 32) at 60 per trap, the highest level ever recorded in Peel. Overall, the average number of *Culex* per trap in 2008 was the same as 2002, the benchmark year where the number of *Culex* per trap averaged 27 per trap.

Figure 2 Comparison of average capture of *Culex pipiens-restuans* since 2006, Region of Peel, 2002, 2006-2008



As illustrated in Figure 3, *Ochlerotatus japonicus* (*Oc. japonicus*) continues to increase in actual counts and trapping events. Laboratory studies indicate that *Oc. japonicus* is a very efficient vector of WNV. Several batches were positive for WNV in the United States in 2000, 2001, and 2002.¹⁵ In 2007, the first WNV positive *Oc. japonicus* was reported in Ontario (Chatham-Kent).¹⁶ In 2008, the City of Toronto reported a positive batch. As illustrated in Figure 3, the actual number of *Oc.*

japonicus captured in 2008 more than doubled from 225 in 2007 to 551 in 2008. The percentage of *Oc. japonicus* relative to other species also increased to 0.76% compared to previous years which remained around 0.4%.

Figure 3 *Ochlerotatus japonicus* (*Oc. japonicus*) abundance (based on actual counts), Region of Peel, 2002 – 2008

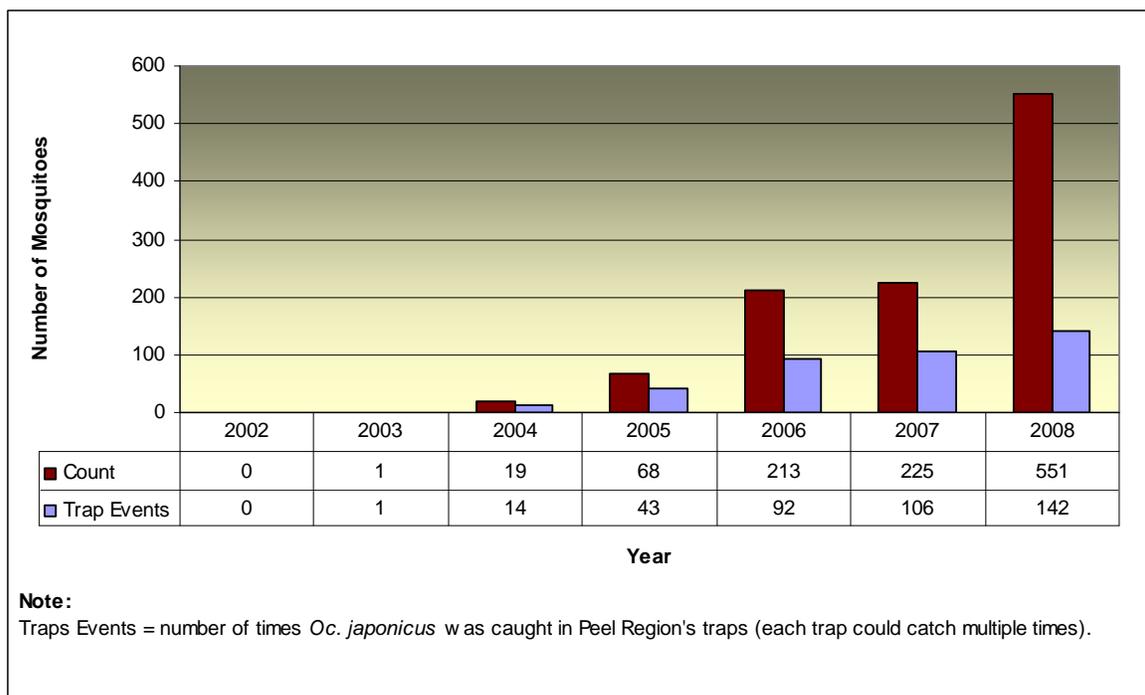


Table 8 presents the number of WNV-positive mosquito trapping events for 2002, 2006, 2007 and 2008 by area municipality. In 2008, there were 21 separate events where a mosquito trap tested positive compared to 3 in 2007 and 14 in 2006. Mississauga had 10 positive trapping events and Brampton had 11 in 2008. 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 8 Number of Positive Trapping Events by Municipality, Region of Peel, 2002, 2006-2008

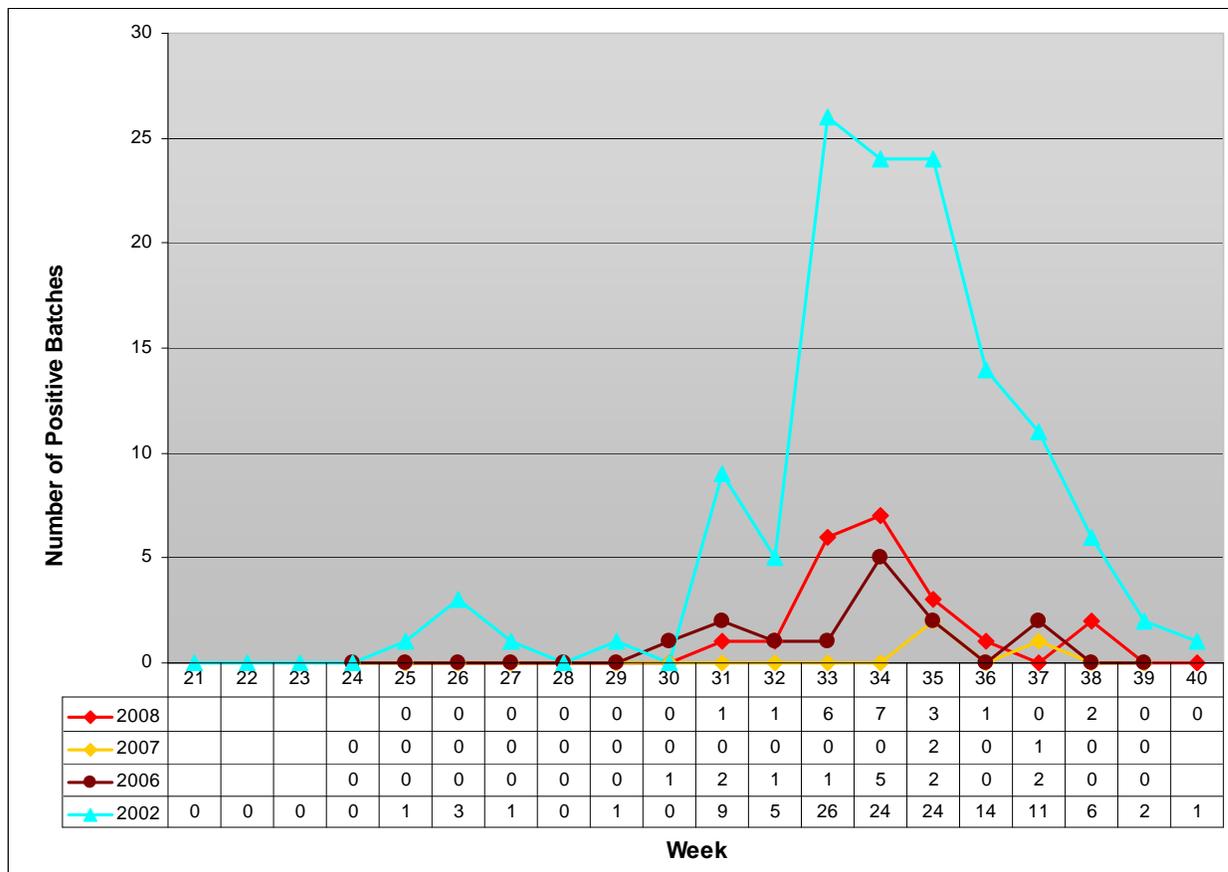
Year	Region of Peel	Mississauga	Brampton	Caledon	Date of First Positive Event
2002	128	106	22	0	June 20, 2002
2006	14	10	4	0	July 25, 2006
2007	3	1	2	0	August 28, 2007
2008	21	10	11	0	July 29, 2008

Figure 4 compares the yearly total number of positive batches per week for the 2002 baseline, 2006-2008. Based on previous years' data, batches found with positive mosquitoes are likely to occur anytime after June. There are occasions

when no positive mosquitoes are found at sites during the weeks tested. The year to year onset and peak of WNV-positive mosquito batches vary, likely due to a range of factors including weather (temperature and rainfall) and the effectiveness of the multifaceted prevention program involving reduction of breeding sites on public and private property and larviciding catch basins and surface water on public property.

The first positive trapping event in 2008 occurred on July 29th in Brampton, one month earlier than 2007 but a similar timeframe to previous years. The last positive batch occurred during the week of September 14-20.

Figure 4 WNV Positive Mosquito Batches by Week of Collection, Region of Peel, 2002, 2006-2008



Culex spp. mosquitoes are of particular interest because they have been the predominant species which carries WNV in Peel Region. Table 9 presents an annual comparison of the number of female *Culex* mosquitoes. In 2008, the absolute number of mosquitoes (all species) captured increased significantly over all other years. Similarly, the absolute number of *Culex* species captured was the highest ever recorded. The relative percentage of *Culex* species to total mosquitoes captured was 10% in 2008.

Most significantly, 2008 showed the highest percentage of positive batches containing *Culex* species. The remaining positive batch consisted (20 of 21 of all positive batches, 95%), *Aedes vexans* mosquitoes. *Aedes vexans* also act as bridge vector, biting both animals and birds, and are a confirmed WNV vector in Ontario.

Table 9 Total Number and Percentage of Female *Culex* Mosquitoes in all Batches and all Positive Batches, Region of Peel, 2002, 2006-2008

Year	All Batches			Positive Mosquito Batches		
	Total Number of mosquitoes	Number of <i>Culex</i> mosquitoes	% <i>Culex</i> in all batches	Total Number of mosquitoes	Number of <i>Culex</i> mosquitoes	% <i>Culex</i> in all positive batches
2002 [‡]	24,269	7,278	30.0%	128	98	76.6%
2006 [§]	71,099	3,627	5.1%	14	12	85.7%
2007 ^{**}	64,450	4,482	7.0%	3	2	66.7%
2008 ^{††}	78,214	8,431	10.8%	21	20	95.2%

* Source: 2006 West Nile Virus in the Region of Peel, 2007

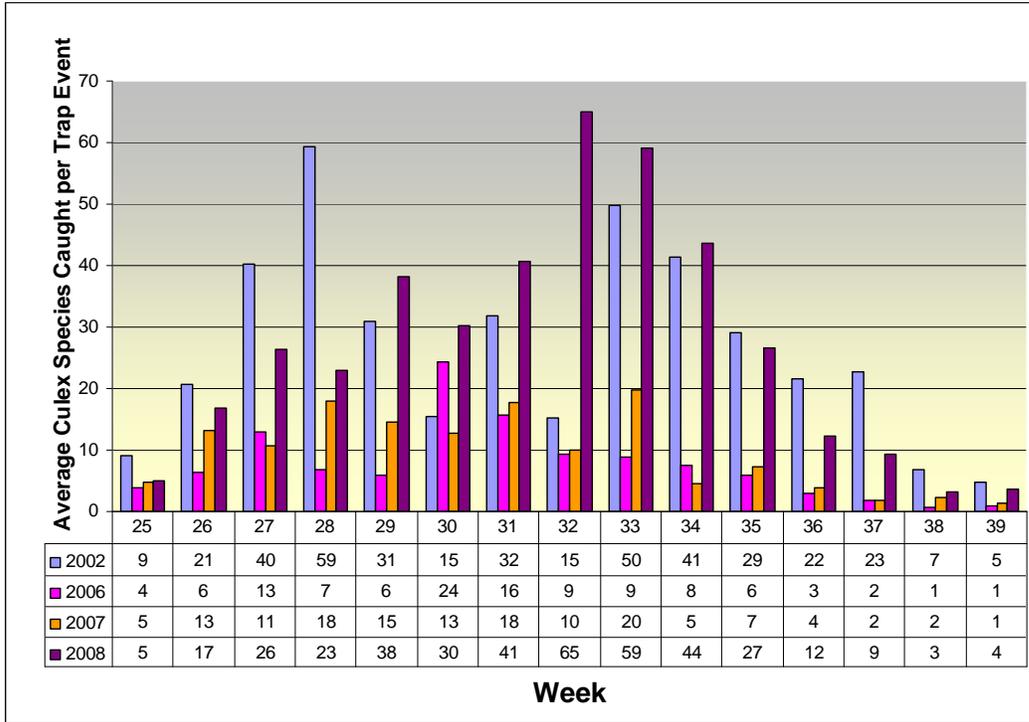
* Source: 2006 West Nile Virus in the Region of Peel, 2007

* Source: 2007 West Nile Virus in the Region of Peel, 2008

* Source: GDG, 2008

Figure 5 illustrates the average number of *Culex* mosquitoes collected per trapping event for each week. In 2008, an increase in the average number of *Culex* per trap started on week 26 through to week 36, peaking the first week of August (03-09) at 60 per trap, the highest level ever recorded in Peel.

Figure 5 Average Number of *Culex* Species per Trap Event by Week, Region of Peel, 2002, 2006-2008



The Minimum Infection Rate (MIR)

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 infected 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 1,000.¹⁷

Table 10 presents the MIR for the *Culex* species, grouped by municipality in Peel Region. Higher MIRs are usually indicative of greater WNV activity among a given species but can be unreliable when the sample size is less than one thousand. In 2008, the MIRs were much higher throughout the Region than in 2007 but not as high as in 2006. The highest MIR was for Mississauga at 2.12. The MIR increased in 2008 due to the high number of positive batches compared to 2007.

As shown in Table 11, one positive mosquito batch in 2008 was attributed to non-*Culex* species. The MIR for the City of Mississauga was 0.14 for *Ae. vexans* (1/6,993), compared to 0.08 for Region of Peel as a whole (1/13,204).

Table 10 Minimum Infection Rates* of *Culex* Species in Each Municipality, Region of Peel, 2006-2008

Municipality	Vector Species	2008 Actual # Tested	2008 Positive Batches	2008 MIR*	2007 MIR*	2006 MIR*
Mississauga	<i>Culex pipiens/restuans</i>	4725	10	2.12	0.40	3.47
Brampton	<i>Culex pipiens/restuans</i>	4976	10	2.01	0.73	4.27 [†]
Caledon	<i>Culex pipiens/restuans</i>	368	0	0.00	-	-
Peel	<i>Culex pipiens/restuans</i>	10,069	20	1.99	0.50	3.41

* 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 per 1,000. Caledon

[†] MIRs based on numbers < 1000 are more likely to be unstable than those based on numbers > 1000 .

Table 11 Minimum Infection Rates of non-*Culex* Species in Each Municipality, Region of Peel, 2007 and 2008

Municipality	Vector Species	2008 Actual Number Tested	2008 Positive Batches	2008 MIR*	2007 Actual Number Tested	2007 Positive Batches	2007 MIR*
Mississauga	<i>Ae. vexans</i>	6993	1	0.14	1,287	-	-
Brampton	<i>Ae. vexans</i>	5369	-	-	1,700	1	0.59
Caledon	<i>Ae. vexans</i>	842	-	-	271	-	-
Peel	<i>Ae. vexans</i>	<i>13204</i>	1	0.08	3,258	1	0.31

* 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 per 1,000.

Adult Mosquito Surveillance in Other Ontario Health Units

Table 12 lists all results of the mosquito testing programs in Ontario health units and highlights those health units adjacent to Peel Region.¹⁶ Eight of the 36 health units reported positive mosquito batches. Peel Region reported the greatest number of positive batches, 21 (34% of total), followed by Toronto, 17 (27% of total) and Windsor-Essex County, 10 (16% of total). Of the health units adjacent to Peel Region, Toronto, Halton and York reported positive mosquito batches in 2008.

Table 12 Mosquito Surveillance Statistics by Health Unit, Ontario, 2008

Health Unit	Total Positive Batches	Percent of total
Algoma Health Unit	0	0%
Brant County Health Unit	1	2%
Chatham-Kent Public Health Division	0	0%
Durham Region Health Department	0	0%
Eastern Ontario Health Unit	0	0%
Elgin-St. Thomas Health Unit	0	0%
Grey-Bruce Health Unit	0	0%
Haldimand-Norfolk Health Unit	1	2%
Haliburton-Kawartha-Pine Ridge District Health Unit	0	0%
Halton Region Health Department	6	10%
Hamilton-Public Health & Community Services Dept.	4	6%
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	0	0%
Niagara Regional Public Health Department	0	0%
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%
Region of Peel Health Department	21	34%
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	17	27%

Waterloo Region Public Health	0	0%
Wellington-Dufferin-Guelph Health Unit	0	0%
Windsor-Essex County Health Unit	10	16%
York Region Health Services Department	2	3%
ONTARIO TOTAL	62	

Source: Ontario Ministry of Health and Long-Term Care, 2008

- Rows shaded in yellow are the municipalities adjacent to the Region of Peel

Adult Mosquito Surveillance Across Canada

Table 13 presents the national mosquito surveillance data by province/territory. A total of 122 positive batches were reported from three provinces, compared to 1,682 in 2007, a 93% decrease from the number found in 2007. Ontario had the greatest number with 62 positive batches. The significant decrease in positive batches across Canada between 2007 and 2008 is attributable to changes in weather conditions.

Table 13 Mosquito Surveillance Statistics by Province and Territory, Canada, 2008

Province/Territory	No. Confirmed positive mosquito batches
Newfoundland and Labrador	0
Prince Edward Island	0
Nova Scotia	0
New Brunswick	0
Quebec	0
Ontario	62
Manitoba	41
Saskatchewan	19
Alberta	0
British Columbia	0
Yukon Territory	0
Northwest Territories	0
Nunavut	0
Canada – Total	122

Source: Public Health Agency of Canada, 2008. Ontario Ministry of Health and Long-term Care

Asian Tiger Mosquito (*Stegomyia albopicta*)

The Asian tiger mosquito (species *Stegomyia albopicta*) is a vector for a number of viruses including WNV, Eastern Equine Encephalitis and Dengue Fever. In 2005, the Ministry of Health and Long-Term Care (MOHLTC) included the Asian tiger mosquito in their WNV Preparedness and Prevention Plan as a species to identify and be included in viral testing.¹⁸

The Asian tiger mosquito was found in Peel Region in 2005. In 2006, the MOHLTC sponsored a special study, the purpose of which was to determine the abundance of the Asian tiger mosquito in the three Ontario health units that trapped the species in 2005. This study used a different trap, the Omni-Directional Fay-Prince trap, which is designed to attract specific species including the Asian tiger mosquito.

In 2008, 4 Omni-Directional Fay-Prince traps were used in Peel Region to monitor for the Asian tiger mosquito. The mosquitoes captured in these traps were not sent to the external laboratory for identification and therefore the capture counts are not reflected in the counts from the CDC light traps. Species identification for mosquitoes trapped in the Omni-Directional Fay-Prince trap was conducted in-house by a trained public health inspector. No Asian tiger mosquitoes were trapped in 2007 or 2008 in Peel Region.

Larval Mosquito Surveillance

Larval surveillance is useful in guiding WNV prevention and reduction activities. It is used to determine the location, species and population densities of mosquitoes. Larval surveillance activities are vital for predicting adult emergence and establishing optimal times for implementation of larval reduction measures.

From early May to early September, seasonal staff surveyed a variety of aquatic habitats for the presence of mosquito larvae. These potential breeding sites were identified by referring back to breeding site information collected in previous years and by stagnant water complaints received through the Environmental Health Contact Centre or on-line reporting form. Refer to the 2006 WNV in the Region of Peel report for details on the methods used for larval surveillance.¹⁹

In 2008, larval surveillance was undertaken at 3,479 potential mosquito breeding sites on publicly owned lands in Peel Region. Table 14 breaks down the number of surface water sites monitored by municipality and compares this to previous years. The total number of sites monitored across Peel Region increased in 2008 largely because of record rainfall. Overall 55% of the sites were in Mississauga, 22% in Brampton, and 23% in Caledon.

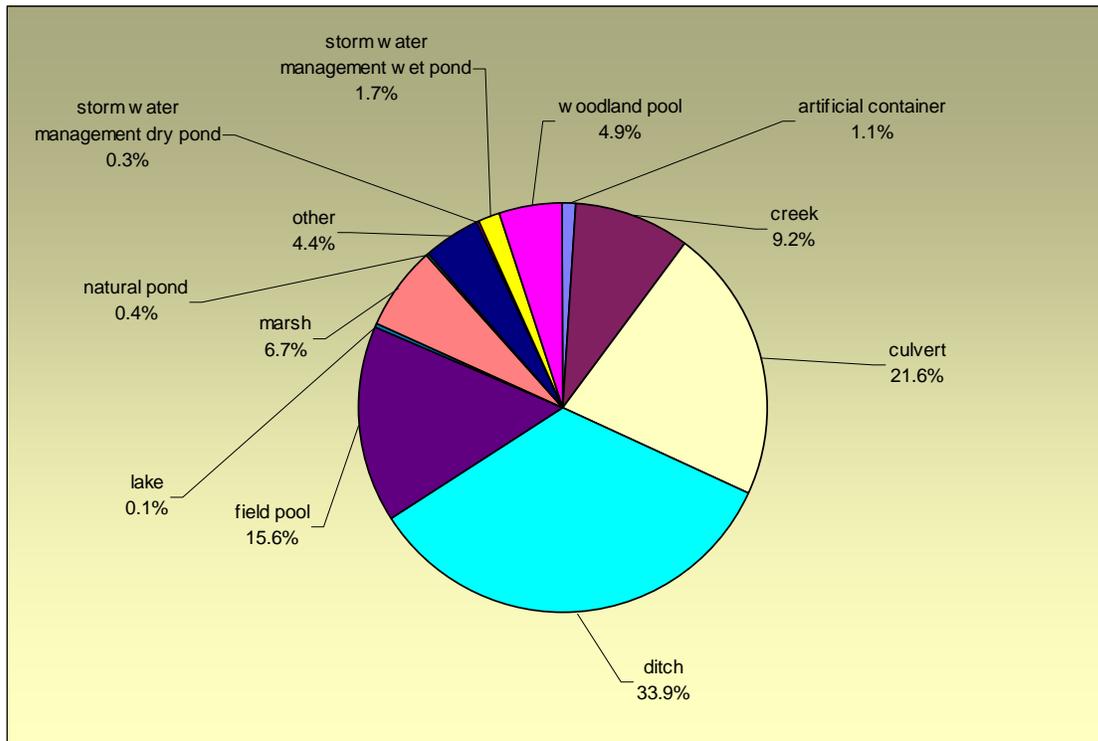
Table 14 Number of Surface Water Sites Monitored by Municipality, Region of Peel, 2002, 2006-2008

Year	Region of Peel	Mississauga	Brampton	Caledon
2002	278	152	106	20
2006	2,233	1,567	392	274
2007	2,400	1,689	451	260
2008	3,479	1,904	784	791

In 2008, mosquito larvae were found at 72% (2,501 of 3,479) of the breeding sites monitored in Peel Region compared to 20% (468 of 2,400) in 2007.

Figure 6 presents the larval surveillance results by breeding site type (habitat) in Peel Region. Ditches, culverts and field pools make up the greatest proportion (71%) of sites with larvae present. 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 6 Types of Sites Found to Contain Mosquito Larvae, Region of Peel, 2008



Species Identification – Larval Analysis

In 2008, a total of 2,501 mosquito larvae were identified from mid-May to the beginning of September. This represents a 30% increase from 2007 (1,927).

Twenty-one different species of larvae were identified; 61% (1,519) were the two *Culex* species, *pipiens* and *restuans*, the primary WNV vector. This figure is similar percentage of the identified larvae from these two species in 2007 (60%), up from 56% in 2006.

Aedes vexans is a confirmed WNV bridge vector in Ontario. Table 7, showed that this species represented 40% (31,673) of specimens captured and was the dominant species in the Region.

Larval Mosquito Reduction

A major part of the Region of Peel WNV Prevention Program is to conduct activities to reduce the number of vector mosquitoes. This goal can be achieved by preventing the emergence of mosquitoes by eliminating or altering habitats (source reduction) to make them less conducive to mosquito breeding and by pesticide treatment at the larval stage to impede their development into viable adult mosquitoes.

Source reduction is important and the Region of Peel's public education and outreach program highlights the need for eliminating stagnant water. However, 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, the prevention plan relies heavily on the larviciding program.

The purpose of the larviciding program is to reduce mosquito abundance, especially the *Culex* species. 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.

Habitats of importance, because of their potential to become mosquito breeding sites, include roadside catch basins, ditches, discarded tires, unused swimming pools and containers left outdoors. These breeding sites are conducive to promoting the emergence of multiple mosquito species because of standing or slow-moving water and the presence of 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 such as ditches, culverts, and ponds.

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.

Larvicides

In 2003, in response to an emerging threat, the Region of Peel Health Department developed a fully integrated program of surveillance, public education, and vector

management. Mosquito larviciding remains a key component of this vector management strategy, and in particular 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. This is supported by results of raw and treated drinking water testing which found no detectable levels of methoprene in a Region of Peel location in July 2005.²⁰ The Ministry of the Environment (MOE) also found that methoprene did not harm streams, rivers and drinking water in treated areas and that it was effective in reducing mosquito larvae.²¹

In catch basins, the Region of Peel uses 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 (ESA). Surface water treatment involved the use of *Bacillus thuringiensis var. israelensis* (Aquabac 200G). *Bacillus sphaericus* has a longer residual effect than *Bacillus thuringiensis var. israelensis* and is effective in organic environments.

The Canadian Centre for Mosquito Management Inc. (CCMM), on contract with the Region of Peel, carried out the larviciding of catch basins and surface water sites. Permit applications were prepared by Peel Public Health staff, in consultation with CCMM, and submitted to the MOE. Three permits were issued in 2008 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.

Catch Basin Treatment

Table 15 summarizes the catch basin treatment activities across Peel Region in 2008. The number of catch basins treated per round can vary due to a number of factors including catch basin cleaning (vacuuming), construction and new subdivisions being added to the program.

Roadside municipal catch basins were treated four times from mid-June to the end of August. Approximately 240 kg of Altosid® Pellets were applied to 341,522 catch basins in Peel Region in 2008 with on average 85,393 treated per round.²² This represents a slight decrease in the amount of pellets used in 2007. Peel Public Health conducted quality assurance monitoring of roadside catch basins. Altosid®

Pellets were found to be on average 93% effective in controlling mosquito larvae in 2008.

Altosid® Briquets were mostly applied early on in the season because of their extended period of residual activity. Altosid® XR Briquets were applied to 2,467 non-roadside catch basins (one application per catch basin). Non-roadside catch basins included those located in, along or on: municipal green-spaces (1,732); Region of Peel-owned or operated sites, such as government buildings, social housing units, day cares and long-term care facilities (608); rear yards of residential properties (97); provincial highways (30).

Two applications of VectoLex® water soluble pellets (WSP) were used in 1,282 catch basins in Mississauga (932), Brampton (284), and Caledon (66).

Table 15 Summary of Catch Basin Treatment, Region of Peel, 2008

Treatment Round	Number of Catch Basins Treated			Cycle Dates
	Altosid® Pellets	Altosid® XR Briquets	VectoLex WSP	
1	85,393	2,456	1,282	June 9 th – June 29 th
2	85,393	3	0	June 30 th – July 20 th
3	85,393	2	1,282	July 21 st – Aug 10 th
4	85,393	6	0	Aug 11 th – Aug 31 st
Total	341,572	2,467	2,564	

Source: The Canadian Centre for Mosquito Management Inc., 2008

Surface Water Treatment

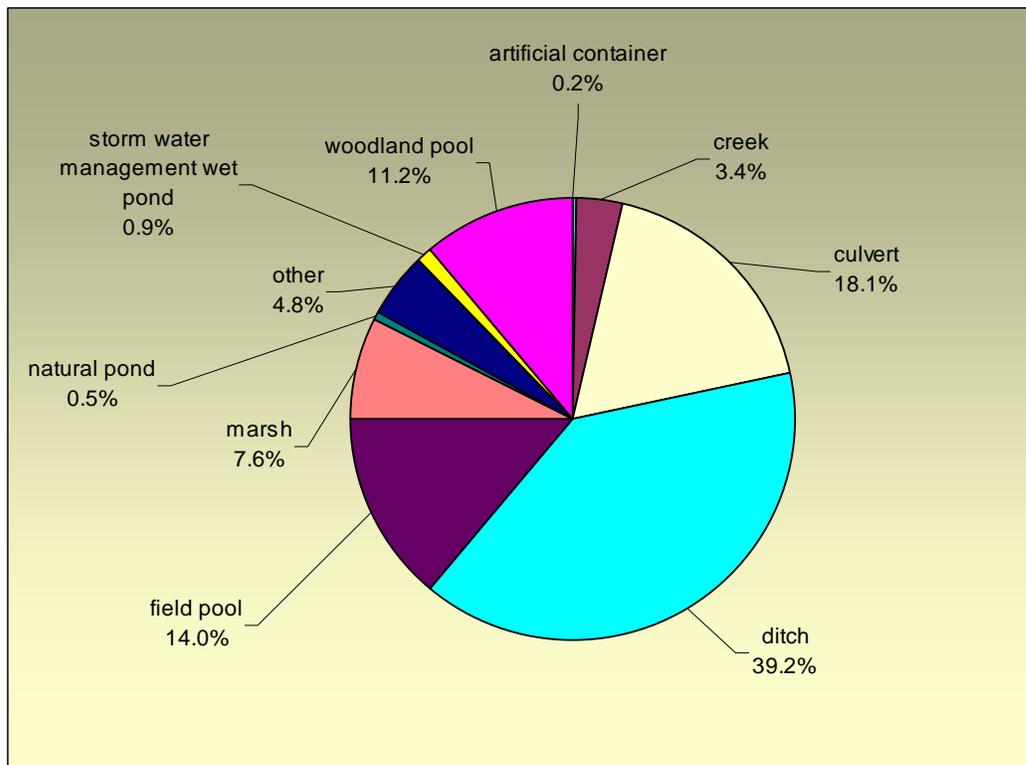
In 2008, 436 surface water sites received a total of 504 treatments with *Bacillus thuringiensis var. israelensis* (Aquabac 200G) from May 10 – September 29 covering 1.72 hectares of stagnant surface-waters.²³ This is nearly double the number of sites treated compared to any other year since the larviciding program was established (Table 16). This increase is due to increases in the number of sites treated in the City of Mississauga and Caledon. Sixty-nine per cent of the sites treated were in Mississauga, 21% in the Town of Caledon, and 10% in the City of Brampton.

Table 16 Summary of Surface Water Treatment by Municipality, Region of Peel, 2006-2008

Year	Total Sites Treated	Mississauga Sites Treated	Brampton Sites Treated	Caledon Sites Treated	Total Treatments (include multiple treatments at the same location)
2006	201	88	72	41	249
2007	221	136	64	21	253
2008	436	301	45	90	504

As illustrated in figure 7, across Peel Region, ditches (40%), culverts (18%), field pools (14%) and woodland pools (11%) were the surface water sites most often larvicided (39%, 18%, 14%, and 11% respectively). This varied from 2007 when ditches represented 35% of surface sites treated with woodland pools the second most common site at 16%. There were 19 surface-water applications made to three areas that the Ministry of Natural Resources considers environmentally sensitive areas.

Figure 7 Surface Water Site Types Treated, Region of Peel, 2008



The pattern of sites applied with larvicide varied in each municipality. In Mississauga and Brampton ditches and culverts accounted for a little over half of the total surface sites treated in each municipality (Table 17). In Caledon, 73% of the sites treated were ditches and marshes. No storm water retention ponds were treated in Caledon or Brampton.

Table 17 Number of Surface Water Sites Treated, Region of Peel, 2008

Site Types	Mississauga Sites Treated	Brampton Sites Treated	Caledon Sites Treated	Total Sites Treated
Artificial container	0	1	0	1
Creek	15	0	0	15
Culvert	60	9	10	79
Ditch	108	15	48	171
Field pool	54	7	0	61
Marsh	10	5	18	33
Natural pond	2	0	0	2
Other	19	2	0	21
Storm water management wet pond	4	0	0	4
Woodland pool	29	6	14	49
TOTAL	301	45	90	436

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 relative risk of human infection in the Peel Region. 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 (bird, 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.

Public Education and Community Outreach

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.

Seasonally, mid-June through mid-October, questions regarding mosquito protection measures are asked as part of the Rapid Risk Factor Surveillance System. This survey helps Peel Public Health staff understand the knowledge, attitudes and behaviours of Peel residents associated with WNV.

Table 18 illustrates the proportion of Peel Region residents that protected themselves from mosquitoes all or most of the time for 2002 and 2006 to 2008.²² Preliminary 2008 data indicate that 25% covered up with clothing, and 14% used a DEET-based (*N,N*-diethyl-3-methylbenzamide) repellent.

The proportion of respondents who reported covering up with clothing differed significantly over the four years examined, with the most frequent use of this strategy in 2006. The proportion of respondents who used insect repellent with DEET differed significantly over the four years examined, with this strategy being employed more in 2006 compared to other years. One possible reason for the similarity in the 2007 and 2008 figures may be due to do with the cancellation of a mass media campaign sponsored by the Province last year.

Table 18 Proportion of Residents who Protected Themselves from Mosquitoes All or Most of the Time During the Month Prior to Interview, Region of Peel, 2002, 2006–2008

Method of Protection	2002		2006		2007		2008	
	Per Cent	n						
Covered up with clothing	26.8	491	34.9	381	25.6	368	24.7	397
Used repellent with DEET	11.5	489	19.1	381	13.7	368	13.5	400
Used repellent without DEET	NA	--	5.8*	371	7.9*	363	6.5*	399

Notes: Data were collected May 11 to October 9, 2002, June 12 to October 11, 2006, June 12 to October 22, 2007 and June 14 to October 19, 2008. The proportion of respondents who covered up with clothing differed significantly ($p < 0.01$) over the four years examined, with the most frequent use of this strategy in 2006. The proportion of respondents who used insect repellent with DEET differed significantly ($p < 0.05$) over the four years examined, with this strategy being employed more in 2006 compared to other years.

* Use estimate with caution.

NA = Not applicable. Data were not collected for this question in 2002.

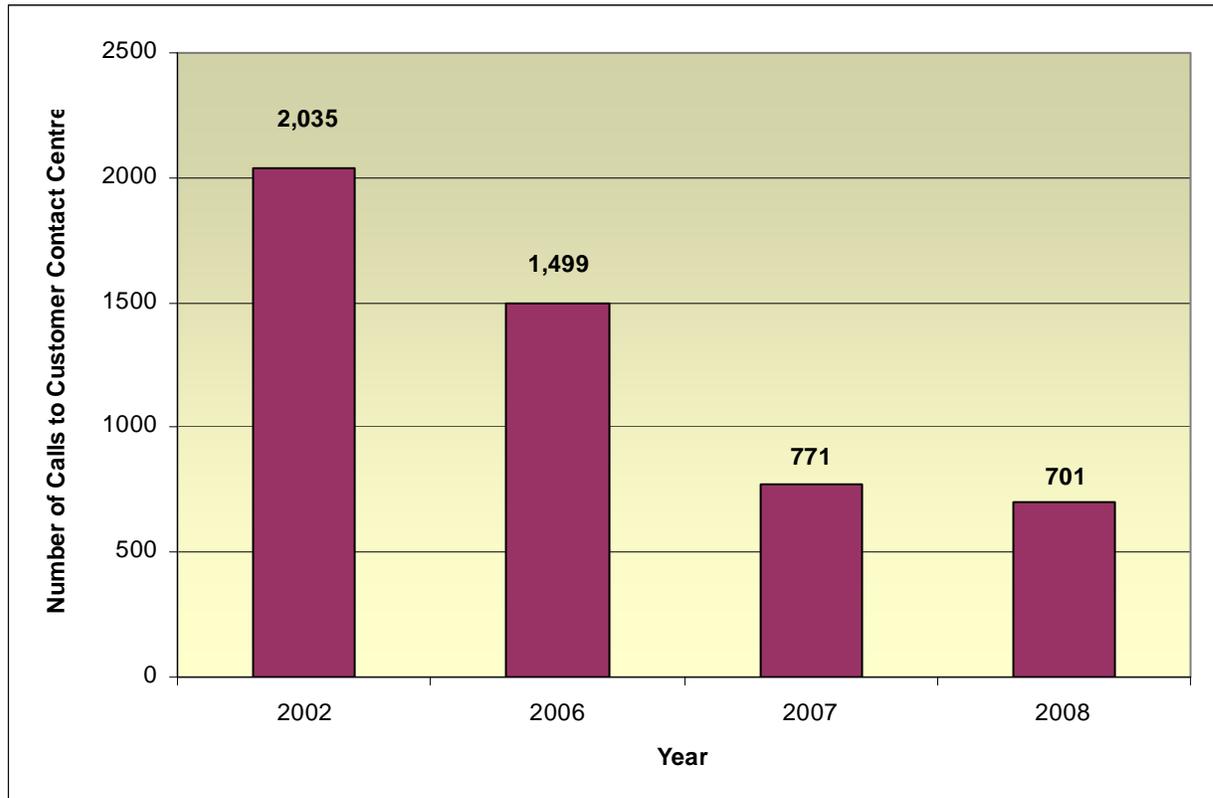
DEET - *N,N*-diethyl-3-methylbenzamide

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, dead bird reports and when there were any questions related to prevention and protection against WNV. The number of calls may be used as an indicator of public engagement and concern when compared over a number of years.

In 2008, a total of 701 calls were received, which included both stagnant water complaints and dead bird reports (Figure 8). The number of calls received decreased every year with 2008 having the fewest number of calls since first starting to accept calls in 2002 – a decrease of 53% compared to 2006 and 66% of 2002.

Figure 8 Number of Calls to the Customer Contact Centre, Region of Peel May 1 - September 30, 2002, 2006-2008



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

Visits to the Website

The total number of visits to the WNV website in 2008 was 7,602. This is down 35% from 2007 (11,678). Monthly visits to the website peaked at 1,485 in June.

Climate Change Impacts on West Nile Virus

Climate change may have been a factor in the spread of West Nile Virus in North America. Milder winters followed by prolonged summer droughts and heat waves favour the spread and establishment of West Nile Virus through changes in mosquito populations.² The increased temperatures associated with climate change could increase the survival or replication rates of vectors like mosquitoes (in Peel) and may contribute to higher incidence of disease.² Longer summers will also extend the period associated with higher risk behaviours allowing people to engage in outdoor leisure and work related activities for longer periods.²

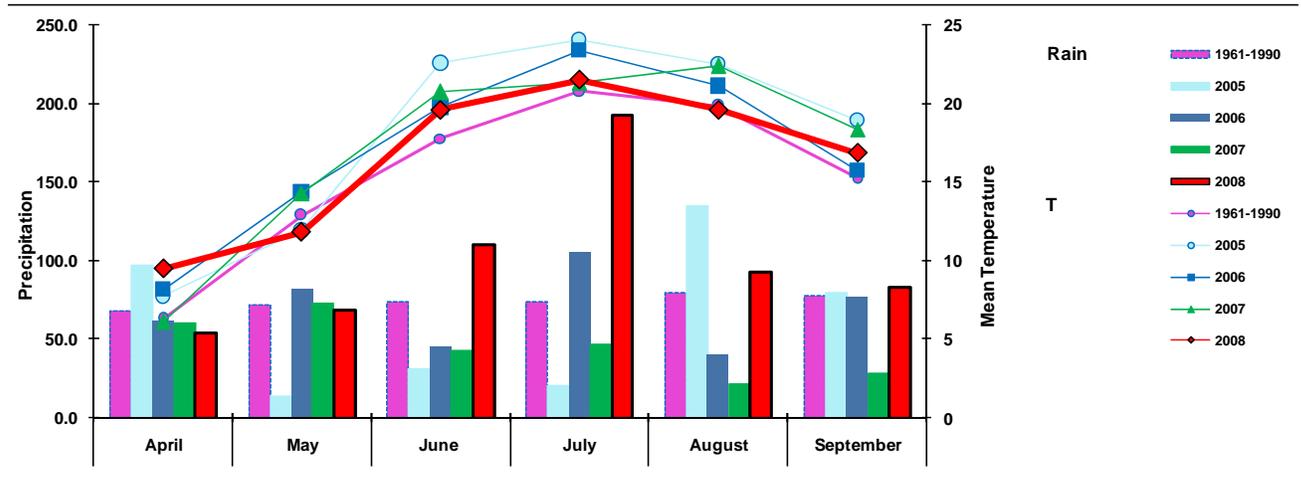
Degree-days, or the sum of daily differences between mean temperature and the temperature at which mosquitoes can begin to breed (14°C), were closely monitored throughout the 2008 season. It has been shown that WNV amplification in mosquitoes (extrinsic incubation period) is proportional to the total number of degree-days.²⁴ A high number of degree-days will increase the initial spread of the virus into the bloodstream of mosquitoes and shorten the extrinsic incubation period (EIP).^{‡‡}

^{‡‡} The extrinsic incubation period means the interval between the acquisition of an infectious agent by a vector and the vector's ability to transmit the agent to other susceptible vertebrate hosts.

In plain terms, this means that with high temperatures, infected mosquitoes will develop a higher amount of virus in the blood in a shorter time. Reisen and colleagues (2006) have estimated that for WNV and *Culex tarsalis*, the temperature threshold for WNV development in mosquitoes is 14°C and that the EIP is estimated at 109 degree-days. These values have not been formally established for *Culex pipiens-restuans*, but can serve as a good baseline.

Environment Canada has been collecting weather data at the Pearson International Airport for many years. The running total of degree-days over 14°C was accumulated for every day since the start of the 2008 season. As shown in Figure 9, the average monthly temperatures above 14°C in 2008 was the lowest over the past four years.

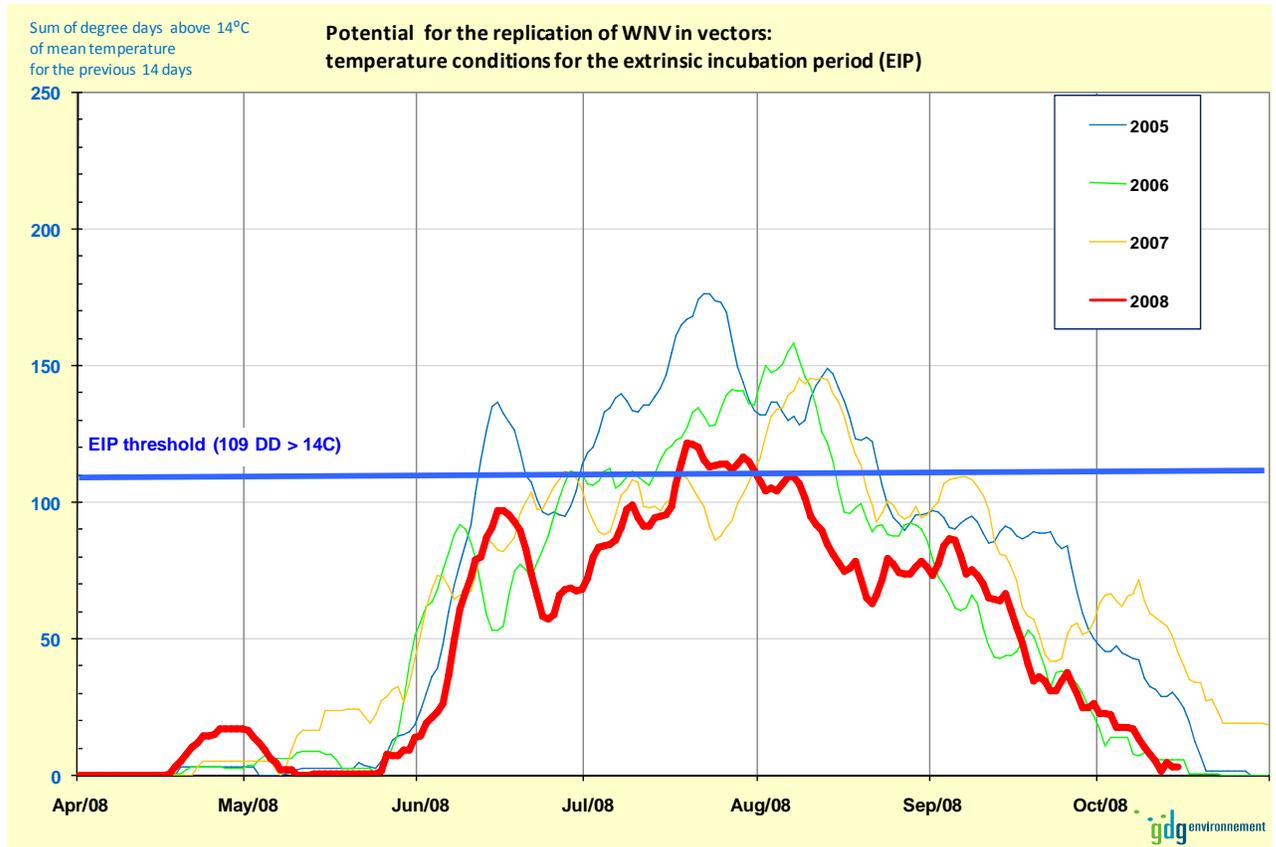
Figure 9 Average temperature and precipitation in the Region of Peel, 2006-2008



Source: GDG Environnement Ltée, 2008 Report on Mosquito Surveillance and Detection of West Nile Virus for the Region of Peel.

Hence, as Figure 10 shows, the threshold for replication of the WNV in mosquitoes in 2008 was reached for a short period in July (the last two weeks) - the warmest period in that summer. But, conditions were more favourable for the replication of WNV in mosquitoes in 2005, 2006, and in 2007.

Figure 10 Potential for Replication of WNV in Mosquitoes, Region of Peel, 2005-2008



Source: GDG Environnement Ltée, 2008 Report on Mosquito Surveillance and Detection of West Nile Virus for the Region of Peel.

Conclusions

Surveillance of birds and mosquitoes in 2008 showed an increase in West Nile Virus (WNV) activity in Peel Region and across Ontario. However, this did not translate into any human cases of WNV in Peel and only three across the Province - the lowest rate of human cases recorded since the virus was first detected in 2001. This past summer was one of the wettest on record but cool, with more than double the amount of rainfall compared to 2007. Research has found that ideal conditions for the spread of WNV from mosquitoes to humans are during times of prolonged hot, wet weather¹, conditions that are likely to increase in frequency in the coming years due to climate change.² So, though the wet weather provided ideal conditions for mosquitoes to breed and increase their populations, it did not appear to be hot enough to increase the viral replication rate of mosquitoes. Therefore, the chance for transmission of the virus from mosquitoes to humans was less likely. Like in Peel, there was an increase in WNV vector activity in Ontario and the rest of Canada (with the exception of the Prairie Provinces), but a decrease in human cases over the same period.

The spread of WNV in Canada may be attributed to the effects of climate change. Milder winters followed by prolonged summer droughts and heat waves, as has been witnessed recently in Canada, favour the spread and establishment of WNV through changes in mosquito populations.² The increased temperatures associated with climate change could further increase the survival or replication rates of vectors like mosquitoes and may contribute to higher incidence of disease.² Longer summers will also extend the period associated with higher risk behaviours allowing people to engage in outdoor leisure and work related activities for longer periods.

A number of factors influence the risk of human WNV infection requiring the implementation of multiple surveillance and risk reduction strategies to minimize the risk of human WNV infection.

There is no information suggesting that the spread of WNV has stopped. While WNV activity, as measured in the three main surveillance systems, will vary from year to year, it is reasonable to assume that the disease has established itself in North America and Peel Region.

The information collected from the various surveillance activities continues to be valuable in assessing and minimizing the risk of human WNV infection to Peel residents. This information is helpful in assessing the need for enhanced mosquito reduction systems which include larviciding and increased promotion of breeding site elimination.

The surveillance systems implemented in Peel Region suggest that prevention and reduction activities are resulting in reduced risk of human WNV infection in Peel Region. Given that the *Culex* species was predominantly responsible for the WNV

mosquito pools in Peel Region in 2008 and in previous years, targeted mosquito vector reduction focussing on the *Culex* species should continue.

Public education and community outreach are also important components of the program, particularly in preventing personal exposure and in eliminating breeding sites on private property. The education program has been successful in building awareness of the WNV risks and prevention. Peel Public Health will continue to work with the Ministry of Health and Long-Term Care, the local municipalities and conservation authorities to identify strategies to promote taking personal protection measures against mosquito bites.

The results of the 2008 WNV program suggest that WNV prevention strategies should continue to focus on surveillance, mosquito reduction, and public education and community outreach in 2009.

References

- ¹Cornel, A. J., Jupp, G., Blackburn N. K. (1993) Environmental temperature on the vector competence of *Culex univittatus* (Diptera: Culicidae) for West Nile Virus, *Journal of medical entomology* vol. 30, 2, pp. 449-456. Entomological Society of America, Lanham, MD, US.
- ²Séguin, Jacinthe and Berry, Peter (2008). *Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity*. Health Canada.
- ³Centers for Disease Control and Prevention. 2008 West Nile Virus Activity in the United States. Downloaded on January 13, 2009 from: http://www.cdc.gov/ncidod/dvbid/westnile/surv&controlCaseCount08_detailed.htm
- ⁴ Ontario Ministry of Health and Long-Term Care, Health Protection and Promotion Act Ontario Regulation 199/03: Control of West Nile Virus.
- ⁵ Ontario Ministry of Health and Long-Term Care, Health Protection and Promotion Act Ontario Regulation 558/91: Specification of Communicable Diseases
- ⁶ Ontario Ministry of Health and Long-Term Care, Health Protection and Promotion Act Ontario Regulation 559/91: Specification of Reportable Diseases
- ⁷Region of Peel Public Health. West Nile Virus (WNV) Prevention Plan 2008. (2007).
- ⁸Centers for Disease Control and Prevention. (2002) West Nile Virus (WNV) Infection – Information for Clinicians. 2002 August 20. Available from: http://www.cdc.gov/ncidod/dvbid/westnile/resources/fact_sheet_clinician_082102_0802.pdf
- ⁹Ministry of Health and Long-Term Care (2005). Provincial Surveillance for West Nile Virus (WNV). Ontario WNV Human Case Definition, Version: July 4, 2005.
- ¹⁰Ministry of Health and Long-term Care (2008). West Nile Virus 2008: Human Surveillance. Available at http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/WNV_08/WNV_humans.html
- ¹¹Canadian Cooperative Wildlife Health Centre (2008). 2008 CCWHC Provincial Reports. Available at: <http://wildlife1.usak.ca/> – downloaded January 29, 2008.
- ¹²Ontario Ministry of Health and Long-term Care, West Nile Virus (2008) Vector Surveillance Report CDC Week 36 September 2 – September 8.

¹³GDG Environment Ltd. (2008). Report on Mosquito Surveillance and Detection of West Nile Virus in the Region of Peel. 2008 Final Report.

¹⁴Turell, M. J., M. L. O'Guinn, D. J. Dohm, and J. W. Jones. "Vector Competence of North American Mosquitoes (Diptera: Culicidae) for West Nile Virus." *J Med Entomol JT - Journal of Medical Entomology*. 38, no. 2 (2001): 130-134.

¹⁵Scott, J.J. *Ochlerotatus japonicus* (Theobald) Rutgers Entomology.
<http://www.rci.rutgers.edu/~insects/ocjap.htm>.

¹⁶Ontario Ministry of Health and Long-Term Care (2008). Public Information: West Nile Virus 2008: Mosquito Surveillance. Available at:
http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/WNV_06/WNV_mosquitoes.html - downloaded January 29, 2008.

¹⁷Kulasekera, Varuni L. et. al. (2001),* West Nile Virus Infection in Mosquitoes, Birds, Horses, and Humans, Staten Island, New York, 2000. in *Emerging Infectious Diseases*. Vol. 7, No. 4. Jul–Aug. CDC

¹⁸Ontario Ministry of Health and Long-Term Care (2005). West Nile Virus Preparedness and Prevention Plan (June 23, 2005 – Public Health Division)

¹⁹Region of Peel Public Health. West Nile Virus (WNV) Prevention Plan 2006. (2007).

²⁰Baker, S. (Personal communication) (2005). email from Stacey Baker, Ontario

²Region of Peel Public Health (2005). 2004 West Nile Virus in the Region of Peel.

²²The Canadian Centre for Mosquito Management Inc. (2008) Mosquito Larval Abatement Program for the Control of West Nile Virus in the Region of Peel: 2008 Final Report.

²³Region of Peel Public Health (2008). Rapid Risk Factor Surveillance System. Preliminary Data.

²⁴Reisen, W. K., Y. Fang, and V. M. Martinez. (2006) "Effects of Temperature on the Transmission of West Nile Virus By *Culex tarsalis* (Diptera : Culicidae)." *Journal of Medical Entomology* 43, no. 2: 309-317

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), or
- viral meningitis (pleocytosis and signs of infection e.g. headache, nuchal rigidity), or
- acute flaccid paralysis (e.g. poliomyelitis-like syndrome or Guillain-Barré-like syndrome)³ or
- movement disorders (e.g., tremor, myoclonus) or
- Parkinsonism or Parkinsonia like conditions (e.g., cogwheel rigidity, bradykinesia, postural instability) or
- 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,⁶
- myalgia ,
- 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:

<p>Detection of flavivirus antibodies in a single serum or CSF sample using a WN virus IgM ELISA⁸ without confirmatory neutralization serology (e.g. Plaque Reduction Neutralization Test [PRNT]) OR</p>
<p>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 ELISA⁸ OR</p>
<p>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]</p>
<p>Demonstration of Japanese encephalitis (JE) serocomplex-specific genomic sequences in blood by NAT screening on donor blood, by Blood Operators in Canada.</p>

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 possible the case may represent a recent infection. To help resolve this, the use of IgG avidity testing 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 possible the case may represent a recent infection. To help resolve this, the use of IgG⁹ avidity testing 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.**

Appendix B

Week Codes - 2008 - West Nile Virus

Week # (Sun to Sat)	2008
1	Dec 30 - Jan 05
2	Jan 06 - Jan 12
3	Jan 13 - Jan 19
4	Jan 20 - Jan 26
5	Jan 27 - Feb 02
6	Feb 03 - Feb 09
7	Feb 10 - Feb 16
8	Feb 17 - Feb 23
9	Feb 24 - Mar 01
10	Mar 02 - Mar 08
11	Mar 09 - Mar 15
12	Mar 16 - Mar 22
13	Mar 23 - Mar 29
14	Mar 30 - Apr 05
15	Apr 06 - Apr 12
16	Apr 13 - Apr 19
17	Apr 20 - Apr 26
18	Apr 27 - May 03
19	May 04 - May 10
20	May 11 - May 17
21	May 18 - May 24
22	May 25 - May 31
23	Jun 01 - Jun 07
24	Jun 08 - Jun 14
25	Jun 15 - Jun 21
26	Jun 22 - Jun 28
27	Jun 29 - Jly 05

Week # (Sun to Sat)	2008
28	Jly 06 - Jly 12
29	Jly 13 - Jly 19
30	Jly 20 - Jly 26
31	Jly 27 - Aug 02
32	Aug 03 - Aug 09
33	Aug 10 - Aug 16
34	Aug 17 - Aug 23
35	Aug 24 - Aug 30
36	Aug 31 - Sep 06
37	Sep 07 - Sep 13
38	Sep 14 - Sep 20
39	Sep 21 - Sep 27
40	Sep 28 - Oct 04
41	Oct 04 - Oct 11
42	Oct 11 - Oct 18
43	Oct 19 - Oct 25
44	Oct 26 - Nov 01
45	Nov 02 - Nov 08
46	Nov 09 - Nov 15
47	Nov 16 - Nov 22
48	Nov 23 - Nov 29
49	Nov 30 - Dec 06
50	Dec 07 - Dec 13
51	Dec 14 - Dec 20
52	Dec 21 - Dec 27
1	Dec 28 - Jan 03

Appendix C 2008 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 birds, horses, or mosquitoes in province	
	2	One or more positive crows/blue jays or mosquitoes in province	
	3	One to three positive crows/blue jays locally	
	4	Multiple positive crows/blue jays (>3) or an equine case locally	
	5	A rapid increase in dead bird (crow and blue jay) sightings or 2 or more equine cases in the specific and local area.	
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	1	Virus activity in remote areas	
	2	Virus activity in rural areas	
	3	Virus activity in small towns	

region/area)	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 style="text-align: right;">Average	