EXECUTIVE SUMMARY

Introduction

West Nile Virus (WNV) is a virus transmitted primarily through the bite of infected mosquitoes. The virus is relatively new to North America, having made its first known appearance in the summer of 1999 during an outbreak in New York City. Since then, West Nile virus has spread rapidly across the continent. In 2004, WNV human, bird, equine or mosquito activity was reported in five Canadian provinces (Quebec, Ontario, Manitoba, Saskatchewan and Alberta) and all of the continental United States with the exception of Washington State.

In 2001, WNV was detected for the first time in Peel Region in birds and mosquitoes. The following year locally acquired human cases occurred for the first time in Peel Region. In 2003, Peel Public Health developed a WNV Prevention Plan. The goal of this plan was to minimize the impact of WNV through region-wide surveillance that directed integrated pest management based mosquito reduction activities at a level commensurate to the risk of human illness. In 2004, Peel Public Health's WNV Prevention Plan continued to follow the blueprint developed the previous season. Surveillance activities and a mosquito larvae reduction program continued to be conducted in all of the three local municipalities in Peel Region.

This report is the third report in which WNV surveillance information has been compiled and published by Peel Public Health. The previous reports dealt with surveillance information collected in 2002 and 2003. This report describes the findings of our surveillance program in 2004. Comparisons between findings from the 2002 and 2003 WNV seasons are provided when appropriate. In addition, activities relating to the larval reduction program are reviewed. Analyses of these data sources will assist in evaluating Peel Public Health's West Nile Virus surveillance and reduction programs.

Dead Bird Surveillance

In total, 110 dead crow or blue jay sightings were reported to Peel Public Health in 2004, of which 60 were tested and 16 were found positive. Thirty-two per cent of the crows (13/41) and 16% of blue jays (3/19) tested positive. In addition, a hawk that was submitted for study purposes tested positive for the virus.

All three municipalities reported positive dead birds in 2004. Five positive crows were found in Caledon, four in Brampton and four in Mississauga. Two positive blue jays were found in Mississauga and one in Caledon. The positive hawk was found in Mississauga.

The increase in positive birds from 12 in 2003 to 17 in 2004 can be attributed to Peel continuing to submit carcasses throughout the entire WNV season. In previous years the agency that conducted the testing, the Canadian Cooperative Wildlife Health Centre, suspended submissions from a health unit when four positive birds were identified in a jurisdiction, and resumed receiving samples in the fall.

Adult Mosquito Surveillance

Mosquitoes were collected weekly from mosquito traps at 30 permanent and two temporary locations throughout Peel. A total of 53,556 female mosquitoes comprised of 38 species were identified in Peel in 2004; however, as in previous years only a small number were likely to be important in the transmission of the virus to humans. Three species from the genus *Culex* accounted for all four positive mosquito batches. Two positive batches were found in both Brampton and Mississauga. As in previous years, no positive mosquito batches were found in Caledon.

In 2004, calculations showed that the West Nile Virus infection rates in the *Culex* species were lower when compared to 2003 and 2002 data. The analysis of trapping results demonstrated lower proportions of *Culex* mosquitoes were collected than in previous years. This may be due to larval reduction measures which targeted primarily *Culex* mosquitoes.

Larval Mosquito Surveillance

Larval surveillance served many important functions. It was used to determine the specific aquatic habitats that supported mosquito populations throughout Peel. When specimens were identified and counted, the information was used to determine species composition and vector abundance in an area. The information was also used to project the optimal times to conduct larval reduction measures. In 2004, approximately 2,300 breeding sites were surveyed: 75% in Mississauga, 17% in Brampton and 8% in Caledon. Ditches, culverts, field and woodland pools were the site types where mosquito larvae were found most frequently.

A total of 20 different species were identified from the 12,981 larvae specimens collected. Approximately 76% of those collected were from the *Culex* species: *Culex pipiens* were the most predominant species accounting for 52% and *Culex restuans* accounted for 24% of the mosquito larvae collected and identified.

Larval Mosquito Reduction

The larval mosquito reduction program in 2004 involved several approaches, some of which were more efficacious than others.

Four rounds of methoprene pellets were applied to the roadside catch basins in Peel, with the number of treatments totalling 297,110.

An additional 1,863 methoprene pellet treatments were conducted to catch basins on Peel owned and/or operated properties, one catch basin in a public park and 37 backyard catch basins.

A random sample of catch basins was evaluated and results showed that methoprene pellets were effective in reducing the emergence of viable adult mosquitoes, with an efficacy rate of over 90%.

A total of 1,463 Altosid® Briquets (methoprene ingots) were applied to catch basins in public parks, on Peel owned or operated properties, and in private back yards. Preliminary results from a joint study with the MOE determined that a one-time application of briquets was not as effective as expected, with efficacy rates of 45-75% lasting for a total of 60 days, rather than the 150 days stated by the manufacturer.

One hundred and fifty-one catch basins that drained directly into sensitive areas were treated by the Larvasonic® device that uses ultrasound to kill the mosquito larvae. This device was found to have an efficacy of approximately 91%.

A total of 226 Bti (Bacillus thuringiensis israelensis) applications were performed at 138 surface water sites throughout Peel. Bti is a biological pesticide which kills mosquito larvae before they develop into adults. There was an increase in the number of surface water sites treated in 2004 compared to 2003. The increase in the total number of sites treated can be attributed to an enhanced referral process, as some sites were referred for treatment prior to larval species identification. The efficacy of Bti was determined to be between 76-100%, based on pre- and post-treatment larval counts.

Peel Public Health undertook a pilot project to attempt to biologically reduce mosquito larvae in a storm water management pond in Caledon. This site supported WNV vector mosquito larvae in 2003 and was larvicided on two occasions in 2003. In May 2004, Peel Public Health stocked this site with fathead minnows. In late July, an increase of larval activity was noted which coincided with a reduction of fathead minnows being observed in the shallow waters. Tests by the local conservation authority revealed that the majority of the adult fish had died, likely because of over abundance of aquatic vegetation which led to low levels of dissolved oxygen. Since the fish were not present the entire season the efficacy of using fathead minnows could not be ascertained.

The efficacy studies indicated that pellets, Bti, and Larvasonic® were effective in controlling mosquito larvae, while the briquet efficacy study indicated that the residual effect of this product may only last for 60 to 70 days instead of 150 days.

Human Surveillance

Human surveillance for West Nile Virus in 2004 showed that the level of WNV activity in humans was much lower than in previous years. Locally acquired human illness occurred for the first time in Peel in 2002, with 112 residents having laboratory evidence of WNV (55 suspect cases, 20 probable cases and 37 confirmed cases, including two deaths). In 2003, there were 10 residents in Peel who had laboratory evidence of WNV infection, nine of whom were confirmed as having West Nile Fever (WNF) and one having a diagnosis of West Nile Neurological Manifestations (WNNM). There were no deaths in 2003 from WNV. In 2004, there were no residents of Peel Region who had laboratory evidence of WNV infection stemming from the 2004 WNV season.

Conclusion

Surveillance information collected during the 2004 mosquito season showed a reduction in West Nile Virus activity in Peel compared to 2002 and 2003. The number of positive mosquito batches and human cases declined substantially over the last three years. However, the number of positive birds in Peel did increase from 12 in 2003 to 17 in 2004. This can be attributed to Peel continuing to submit carcasses throughout the entire 2004 WNV season. In previous years the agency that conducted the testing, the Canadian Cooperative Wildlife Health Centre, suspended submissions from a health unit when four positive birds were identified in a jurisdiction; later in the fall they would permit additional submissions.

Although approximately 40 species of mosquitoes are found in Peel only a few are important in the transmission of WNV. The vectors most responsible for the bird – mosquito amplification cycle in Peel are members of the genus *Culex*. Because of their importance, *Culex* species numbers were analysed comparing adult mosquito trap data for 2002, 2003 and 2004. The analysis of trapping results demonstrated that *Culex* mosquitoes accounted for 30% of the mosquitoes collected in 2002, 13% in 2003 and 8% in 2004. The downward trend in *Culex* mosquito activity can be attributed to the larviciding program undertaken in both 2003 and 2004 which was primarily directed at the reduction of *Culex* mosquitoes. Other factors that may have impacted *Culex* numbers were breeding site source reduction and weather conditions.

An analysis of the West Nile Virus infection rates in *Culex* mosquitoes was also conducted. The calculations showed that the West Nile Virus infection rates in *Culex* mosquitoes have declined in each of the past three years. When there is a lower prevalence of WNV in the mosquito population, there is a lower risk of humans contracting the disease. In 2004, Peel had no reported human cases; this can be attributed primarily to the low infection rates in Peel's mosquito population.

Analysis of the West Nile virus program data indicates that information collected from bird and mosquito surveillance is valuable in identifying the presence of the virus in a community and can serve as an "early warning system" of the risk to human health. This information can also be used to enhance mosquito reduction activities and public education.

It is appropriate that Peel's 2005 West Nile Virus Prevention Plan continues to focus on surveillance, mosquito reduction and education activities. Source reduction and larviciding should continue to focus on *Culex pipiens* and *Culex restuans* mosquitoes, the main vectors of WNV in Peel.

Introduction

WNV is a mosquito-borne virus that first made its appearance in the North America during the summer of 1999, when an outbreak occurred in New York City. Since that time WNV has spread across the continent. In 2004, the virus was found in five Canadian provinces (Quebec, Ontario, Manitoba, Saskatchewan and Alberta) and all of the continental United States with the exception of Washington State.[1]

In 2001, WNV was detected for the first time in Peel Region in birds and mosquitoes. The following year locally acquired human illness occurred for the first time in Peel. There were 112 residents of Peel who had laboratory evidence of WNV infection from the 2002 season (55 suspect cases, 20 probable cases and 37 confirmed cases, including two deaths).[2] The vast majority of these confirmed cases were in Mississauga (34), the remaining three confirmed cases were Brampton residents, and there were no reported cases in Caledon. Most of these cases occurred in August and September. The first reports of human cases in 2002 were preceded by a sharp increase in crow deaths in late July and early August. By the end of the year Peel Public Health documented over 1,400 dead crows in the region. Other indicators of extensive WNV activity in Peel during 2002 included positive tests for WNV in 20 crows and 128 mosquito batches.

In 2003, there were only 10 human cases and no deaths reported in Peel. Four of the 10 cases required hospitalization: 9 cases presented predominantly with fever and one case presented with WNV neurological manifestations. In 2003, the onset date for the first human case was August 13th. Mississauga continued to be the area in Peel with the highest WNV risk as all the cases of WNV in people were Mississauga residents. The number of positive mosquito batches dropped dramatically to 24 in 2003. Sixteen positive batches were collected from traps in Mississauga and the remaining eight positive batches were located in Brampton. The first positive batch was not collected until July 24. A total of 12 crows tested positive for WNV in 2003. Brampton and Mississauga each had five positive crows reported and there were two positive crows found in Caledon. The first positive crow was found on July 4 in Caledon.

WNV Transmission Cycle

Evidence suggests that WNV remains in an area over the winter in infected adult mosquitoes and/or birds. Hence, a small number of infected mosquitoes and/or birds are present within the region during the early spring months. At this time, the virus begins its amplification cycle. In Peel, two mosquito species that feed primarily on birds, *Culex pipiens* and *Culex restuans,* are the main enzootic vectors of the WNV. As these mosquitoes species feed on birds, the virus is transmitted back and forth between the vector (mosquitoes) and the reservoir host population (birds) allowing an increasing number of birds and mosquitoes to become infected. If environmental conditions are optimum for transmission, the virus amplifies to a theoretical point of "spill over". At this point in the amplification cycle, the virus bridges out of the enzootic, bird-mosquito cycle via bridge vectors. Bridge vectors are mosquito species such as *Aedes vexans* and *Coquillettidia perturbans* that readily feed on humans and other mammals in addition to birds. It is at this point in the season, generally from late July to early autumn, that the transmission to humans is most likely to occur. Recent evidence suggests that *Culex* mosquitoes may play a larger role in the transmission of WNV to people than previously thought.[3]

West Nile Virus Legislation

In 2003, the Government of Ontario enacted Ontario Regulation 199/03, "Control of West Nile Virus." Under Ontario Regulation 199/03 (Appendix A), the local Medical Officer of Health (MOH) is required to conduct a risk assessment of the conditions pertaining to West Nile Virus (WNV) in the Health Unit. The risk assessment identifies the probability of human infection from West Nile Virus using surveillance information based upon human cases, birds, mosquito and equine infections as well as a number of other pertinent information elements. Conducting the risk assessment in accordance with the Regulation offers guidance to the MOH regarding appropriate WNV reduction activities, and if needed, provides a review of appropriate mosquito reduction activities (i.e., larviciding or adulticiding) and their effective application. The Regulation requires the local municipality to undertake those measures necessary for mosquito reduction when directed to do so by the Medical Officer of Health.[4]

The Medical Officer of Health is also required under Ontario Regulation 199/03 to record, investigate, and report any confirmed, likely adverse or unintended human health effects attributed to mosquito reduction actions, and to report any non-human environmental adverse effects to the Ministry of the Environment and/or other relevant local or provincial authorities.[4]

In 2003, the Ministry of Health and Long-Term Care (MOHLTC) amended legislation regarding WNV to make it both a reportable and communicable disease under Ontario Regulation 558/91 (Appendix B) and 559/91(Appendix C). Physicians and laboratories must report human cases of WNV to the local Medical Officer of Health.

In 2003, Peel Public Health developed a WNV Prevention Plan. The goal of this plan was to minimize the impact of WNV through region-wide surveillance that directed integrated pest management based mosquito reduction activities at a level commensurate to the risk of human illness. In 2004, Peel Public Health's WNV Prevention Plan continued to follow the blueprint developed the previous season. Surveillance activities and a mosquito larvae reduction program continued to be conducted in all of the three local municipalities in Peel Region.

During the summer of 2004, Peel Public Health's West Nile Virus Working Group carried out a weekly risk assessment based on surveillance information collected that week to identify the relative risk of human infection in Peel Region. Analyses were undertaken based on week of collection. The numbers used throughout this report to describe the weeks of the year in 2004 can be found in Appendix D. The WNV Working Group was made up of representatives from the Office of the Medical Officer of Health, Communicable Disease Division, Environmental Health Division, Epidemiology and Communications Services. The risk assessment protocol (Appendix E) looked at several surveillance factors, including: seasonal temperature; abundance of vector mosquitoes; minimum mosquito infection rates; positive birds; positive mosquito batches; presence of human cases in neighbouring provinces or US states; local/provincial WNV activity in birds, horses, and mosquitoes; time of year; and proximity of WNV activity to urban or built up areas in Peel. Based on the risk assessment the Medical Officer of Health could consider intensifying WNV prevention activities to reduce the risk of human infections of WNV in Peel Region.

This report is the third report in which WNV surveillance information has been compiled and published by Peel Public Health. The previous reports dealt with surveillance information collected in 2002 and 2003. This report describes the findings of our surveillance program in 2004. Comparisons between findings from the 2002 and 2003 WNV seasons are provided when appropriate. In addition, activities relating to the larval reduction program are reviewed. Analyses of these data sources will assist in evaluating Peel Public Health's West Nile Virus surveillance and reduction programs.

Dead Bird Surveillance

Introduction

The sudden die-off of crows in New York City in the summer of 1999 was not immediately connected to the appearance of a virus that had never been seen before in North America. It wasn't until weeks after human cases of encephalitis appeared that the illnesses were diagnosed as West Nile Virus. Since that time, the sudden appearance of dead birds in the early summer has signalled the possible presence of West Nile Virus (WNV). Testing of dead birds, especially crows, has been used as an indicator of the presence of WNV in a community and the risk of human infection. Since August 2001, a dead bird testing positive for WNV has been the first indicator that the virus was present in Peel (Table 1).

Table 1: Date and Location of First Positive Crow, Region of Peel, 2001-2004

Year	Date	Location
2001	August 10, 2001	Mississauga
2002	May 19, 2002	Mississauga
2003	July 4, 2003	Caledon
2004	July 6, 2004	Brampton

While over 200 North American native bird species have been infected with WNV, the corvid bird species (crows, jays, and ravens) have been found to most likely die from the virus.[5] Crows (Figure 1) in particular will demonstrate an almost 100% mortality rate once infected with WNV. Crows continue to be the bird species of choice for most dead bird surveillance programs in Canada and the USA. In addition to crows, blue jays (Figure 2), the other main corvid species found in Peel, were submitted for testing in 2004. Blue jays were included in the provincial dead bird surveillance program, in part due to low crow population

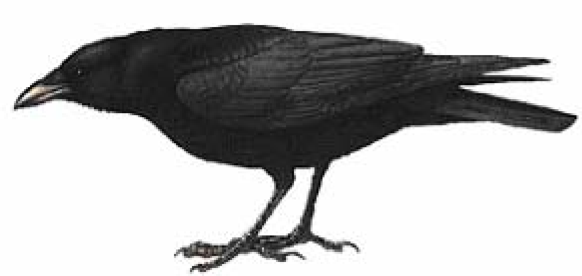


Figure 1: American Crow

Source: Canadian Cooperative Wildlife Health Centre
http://wildlife.usask.ca/WestNileAlertHTML/WestNileAlertBirdPage.htm

levels in some parts of Ontario. The agency that conducted the viral testing in the province, the Canadian Cooperative Wildlife Health Centre (CCWHC), also requested the submission of hawk carcasses for study purposes. Crows, blue jays, and hawks are particularly useful, since they have high mortality rates when infected with WNV, are conspicuous and easily recognized by the public, and are relatively common where they are naturally present. The submission of dead birds for testing for WNV has been a reliable surveillance tool for determining the presence of WNV in our community.

Methods

As part of Peel Public Health's 2004 WNV education program, members of the public were asked to report dead crows to the health department. The public also contacted the health department to report other dead bird species. When the public identified the location of a dead crow, blue jay or hawk, Animal Control Services staff in Brampton, Caledon, and Mississauga were dispatched to pick up the carcass. Information such as location, species of bird and date of the call was entered into a geographic information system. Peel Public Health staff sent the carcasses that were suitable for analysis to the CCWHC in Guelph for viral testing.

Figure: 2 Blue Jay

Source: Canadian Cooperative Wildlife Health Centre
http://wildlife.usask.ca/WestNileAlertHTML/WestNileAlertBirdPage.htm

In previous years, the CCWHC would stop accepting dead bird submissions for a period of time from a health unit once a total of four positive birds had been identified in that particular area of the health unit. Testing would not resume until sometime in the fall to observe the seasonal extent of the WNV infection in birds. In 2004, Peel Public Health arranged for continued bird testing during the entire dead bird surveillance season by paying an additional fee for each extra bird tested. This was recommended in the 2003 West Nile Virus Prevention and Control Plan Evaluation Report.[6] This provided additional surveillance data to assist in monitoring WNV activity in Peel Region throughout the season.

The CCWHC conducted a rapid test of dead birds for WNV using a VecTest®. The first four WNV positive birds from a given health unit found to be positive using the VecTest® underwent further confirmatory testing using the Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) test.
For 2004, dead birds were collected and submitted from early May to the end of October. Crows and other corvid species which were not fit for testing and other

non-corvid species were recorded as sightings and also entered into the geographic information system data base.

Results

In 2004, the first WNV-positive bird in Ontario was a blue jay found on May 7th in Grey Bruce Health Unit near the town of Hanover.[7] At least one positive bird was reported in every health unit in Ontario with the exception of the Kingston, Frontenac and Lennox and Addington Health Unit.[8] A total of 1,403 target species birds were tested in Ontario for the presence of the virus at the CCWHC laboratory.[8] In the target species group, 250 birds were found to be positive (217 crows; 32 blue jays; and one raven).[8] The positive hawk found in Peel was not included in the provincial totals as hawks are not one of primary target testing species for WNV testing. A comparison of the number of WNV positive target species birds found in all Ontario health units in 2004 is shown in Table 3. Only Toronto, with 18 positive birds, had higher numbers than Peel.

Table 2: Dead Bird Test Results by Health Unit, Ontario, 2004

Health Unit	Total Submitted	Tested	Not Tested	Total Positive
Algoma	39	36	3	9
Brant	18	18	0	5
Chatham - Kent	22	22	0	6
Durham	54	52	2	8
Eastern Ontario	28	28	0	3
Elgin - St. Thomas	16	16	0	4
Grey - Bruce - Owen Sound	20	20	0	3
Haldimand - Norfolk	9	9	0	6
Haliburton - Kawartha	43	43	0	6
Halton	48	48	0	13
Hamilton - Wentworth	42	42	0	7
Hastings, Prince Edward	69	68	1	7
Huron County	24	24	0	4
Kingston, Frontenac	38	38	0	0
Lambton	24	23	1	5
Leeds, Grenville, Lanark	36	36	0	1
Middlesex - London	17	17	0	6
Muskoka - Parry Sound	45	45	0	10
Niagara Area	63	59	4	4
North Bay	53	49	4	8
Northwestern	57	57	0	8
Ottawa - Carleton	38	38	0	6
Oxford County	27	26	1	5
Peel Regional	60	60	0	16
Perth District	26	26	0	5
Peterborough	38	35	3	9
Porcupine	53	51	2	3
Renfrew District	45	44	1	9
Simcoe County	51	50	1	5
Sudbury	60	59	1	5
Thunder Bay	45	45	0	13
Timiskaming	23	23	0	2
Toronto	49	49	0	18
Waterloo	20	19	1	4
Wellington - Dufferin - Guelph	35	31	4	5
Windsor - Essex County	21	21	0	11
York Regional	84	76	8	11
Total	1,440	1,403	37	250

CCWHC last update 2004-11-19
Source: Canadian Cooperative Wildlife Health Centre
http://wildlife1.usask.ca/ccwhc2003/portal/provReports.php

Over half the positive birds that tested positive in Canada for the virus in 2004 were found in Ontario (Table 3). Four other provinces (Quebec, Manitoba, Saskatchewan and Alberta) had positive birds found within their provincial boundaries.[7] These five provinces also had positive bird activity in 2003. Two provinces (New Brunswick and Nova Scotia) that had positive birds in 2003 did not have any confirmed positive birds in 2004.[7]

Table 3
Dead Bird Test Results by Province, Canada, 2004

Province/Territory	No. tested	No. of confirmed positive dead birds
Newfoundland and Labrador	85	0
Prince Edward Island	105	0
Nova Scotia	455	0
New Brunswick	509	0
Quebec	866	112
Ontario	1,403	250
Manitoba	316	16
Saskatchewan	364	29
Alberta	670	9
British Columbia	1,437	0
Yukon Territory	11	0
Northwest Territories	10	0
Nunavut	2	0
Canada - Total	6,233	416

Source: Public Health Agency of Canada
http://dsol-smed.phac-aspc.gc.ca/wnv/map600_e.phtml

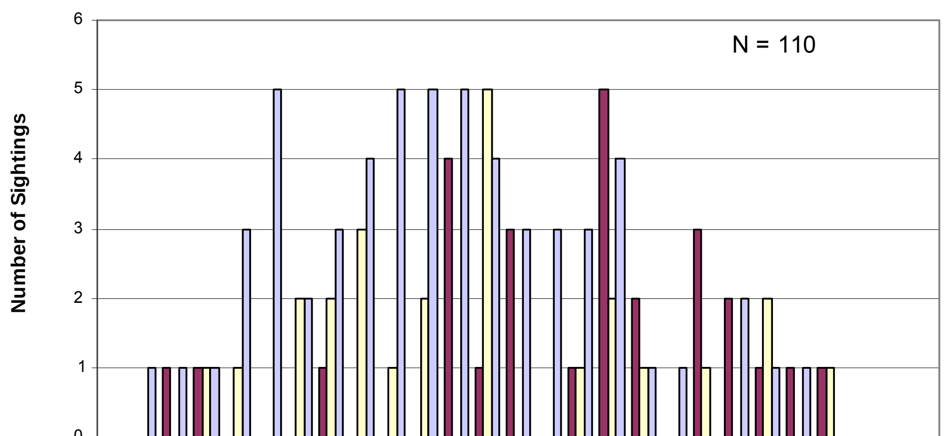
A total of 2,086 calls concerning dead birds were received from the public by Peel Public Health in 2004. These calls resulted in 1,832 bird sightings other than blue jays or crows being reported. A combined total of 110 confirmed blue jays or crows (Figure 3) were reported with a total of 60 carcases from two species being submitted to the CCWHC for testing. The dead bird surveillance program ran from May 10 to October 31, 2004. In Peel, 32% (13/41) of the crows and 16% of blue jays (3/19) submitted for testing proved positive for WNV. In addition, 33% of hawks (1/3) were positive. This brought the Peel total to 17 positive birds -16 from the primary target species and one hawk.

Peel's first positive bird was a crow found in Brampton on July 6 (Week 27) and the last positive bird was another crow found in Mississauga on September 22

(Week 38). In 2003, a crow found on July 4 in Caledon was the initial positive bird in Peel. A crow found in Mississauga on May 19, 2002 was the first WNV infected bird found in Canada during that year.

All three municipalities reported positive dead birds in 2004. Five positive crows were found in Caledon, four in Brampton and four in Mississauga. Two positive blue jays were found in Mississauga and one in Caledon. The positive hawk was found in Mississauga.

Figure 3: Target Bird Sightings by Municipality, Region of Peel, 2004



	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
Mississauga (27)	0	0	1	1	0	0	0	1	0	0	0	4	1	3	0	1	5	2	0	3	2	1	1	1	0	0	0
Brampton (25)	0	0	0	1	1	0	2	2	3	1	2	0	5	0	0	1	2	1	0	1	0	2	0	1	0	0	0
Caledon (58)	0	1	1	1	3	5	2	3	4	5	5	5	4	3	3	3	4	1	1	0	2	1	1	0	0	0	0

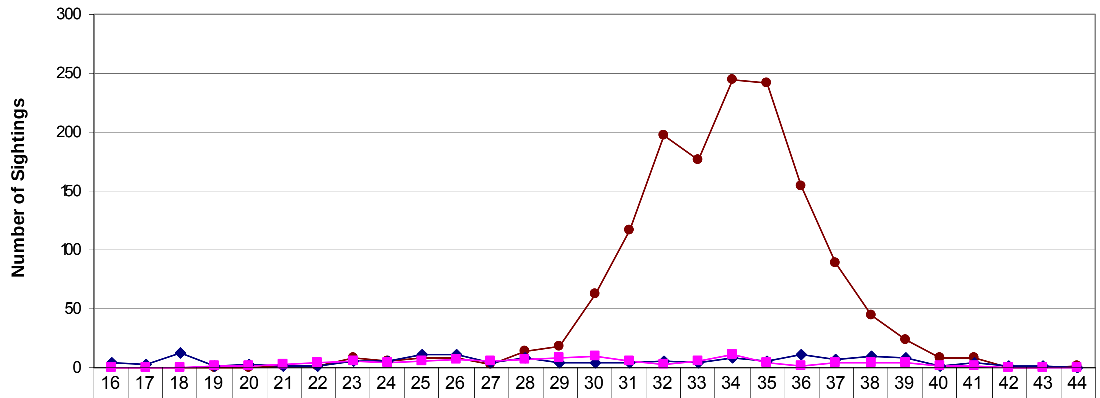
Week

Note: "2004 target birds include crows and blue jays"

In 2002, a sharp increase of dead crow sightings began in the third week of July (Week 30) and peaked during the last two weeks of August (Weeks 34 and 35) with nearly 250 sightings in each of these two weeks (Figure 4). Contrary to the findings from 2002, there were no large increases or peaks seen in the dead bird surveillance numbers in 2003 or 2004 (Figure 4). In 2004, the CCWHC expanded the target species that they would test from Southern Ontario health units to include blue jays. In 2004, the combined number of dead blue jay and crow sightings in Peel totalled 110 (33 blue jays and 77 crows). Despite the inclusion of blue jays in the 2004 dead bird surveillance program, the number of target dead bird sightings decreased from the 150 reported in 2003 and the 1,436 reported in 2002 when only dead crows were noted as sightings (Table 4). The reduction of the number of sightings was probably a result of two factors: lower WNV activity in Peel in 2004; and the fact the two main corvid populations in Peel (blue jays and crows) have not fully recovered from the large die-off in 2002 when there was a high level of WNV activity in Mississauga and Brampton. This is supported by local observations of low crow and blue jay numbers in

Brampton and Mississauga. A study in an area in Illinois that had high WNV activity in 2002 estimated as much as 82% of the crow population died in 2002, largely as result of WNV.[9]

Figure 4: Target Bird Sightings by Week, Region of Peel, 2002, 2003 & 2004



Week	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
2002	0	0	0	0	0	1	2	9	5	8	8	3	14	18	63	116	197	176	245	242	154	89	44	23	8	9	0	0	1
2003	4	3	13	1	3	1	1	5	5	11	11	4	8	4	4	4	6	4	9	5	11	7	10	8	2	4	1	1	0
2004	0	0	0	1	2	3	4	5	4	6	7	6	7	9	10	6	3	5	11	4	1	4	4	4	2	2	0	0	0

Week

1,435 - crows reported in 2002
150 - crows reported in 2003
110 - crows and blue jays reported in 2004

Table 4: Number of Dead Crows by Municipality, Region of Peel, 2002-2004

Year	Peel	Mississauga	Brampton	Caledon
2002	1,436	903	485	48
2003	150	59	37	54
2004	77	14	21	42

Locations of the crow and blue jay sightings by Forward Sortation Area (FSA - the first three digits of the postal code) are shown in Figure 5. In 2004, over 50% of the target dead bird sightings occurred in the Town of Caledon, despite Caledon having only five per cent of Peel's human population. Caledon crow and blue jay numbers were not impacted to the same degree as those in the other two local municipalities as the surveillance data revealed lower levels of WNV activity in Caledon in 2002, 2003 and 2004.

Densities of dead crows and blue jays reported per square kilometre were mapped by FSA and are shown in Figure 6. In 2004, the highest densities were found in L6S located in the central area of Brampton and L4Y and L5K located in south Mississauga. This distribution follows the same general pattern as 2002 and 2003 when only crow sightings were mapped. In 2002, the highest crow densities were almost 10 crow sightings per square kilometre; the highest crow density in 2003 was one crow per square kilometre. This year, even with crow and blue jay sightings combined, the highest density per square kilometre was substantially less than one bird per square kilometre. This is consistent with high crow mortality in Mississauga and Brampton in 2002 and 2003 depleting the local population.

Figure 5: Locations of Dead Crow & Blue Jay Sightings by Forward Sortation Area (FSA), Region of Peel, 2004

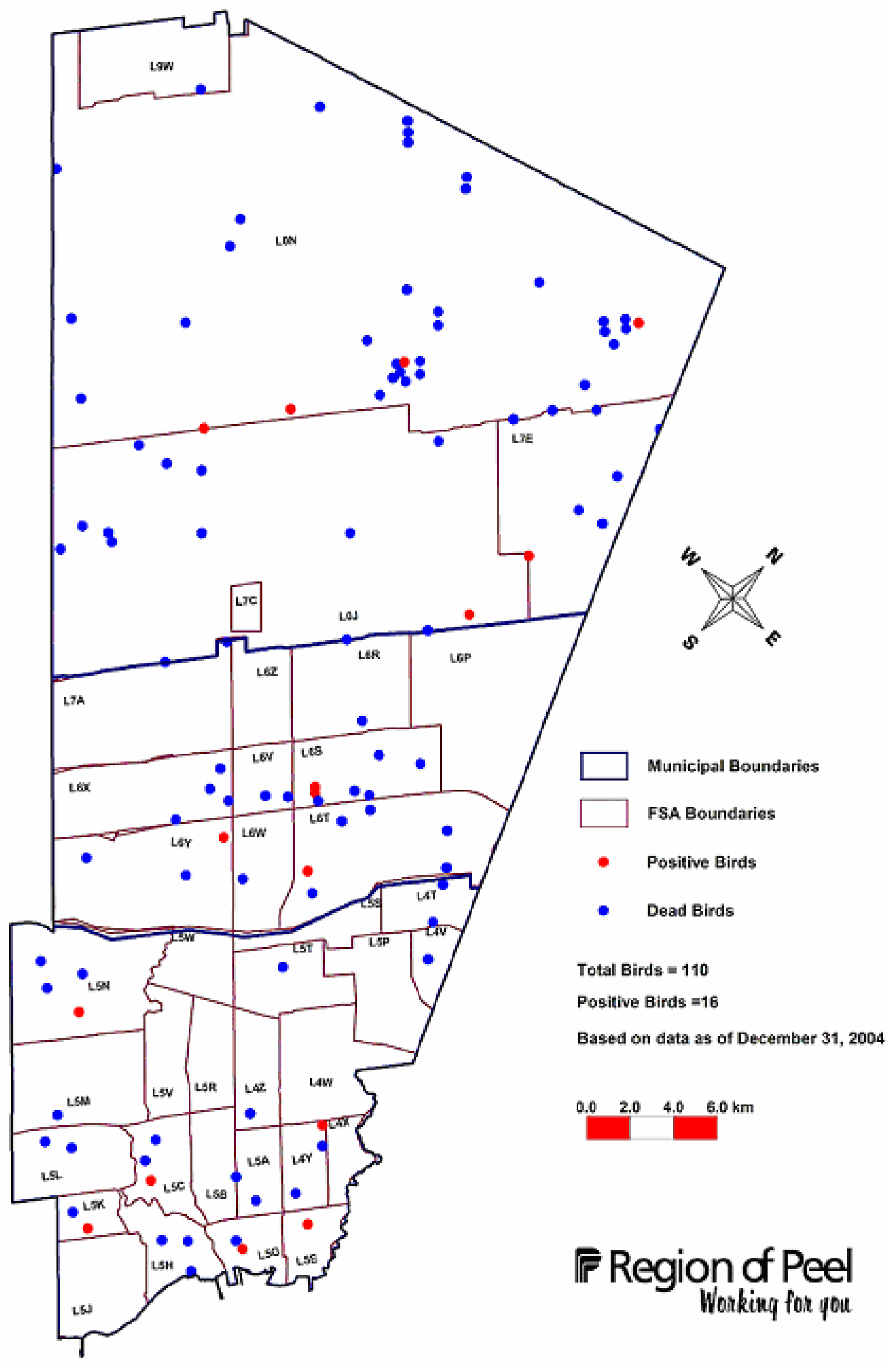
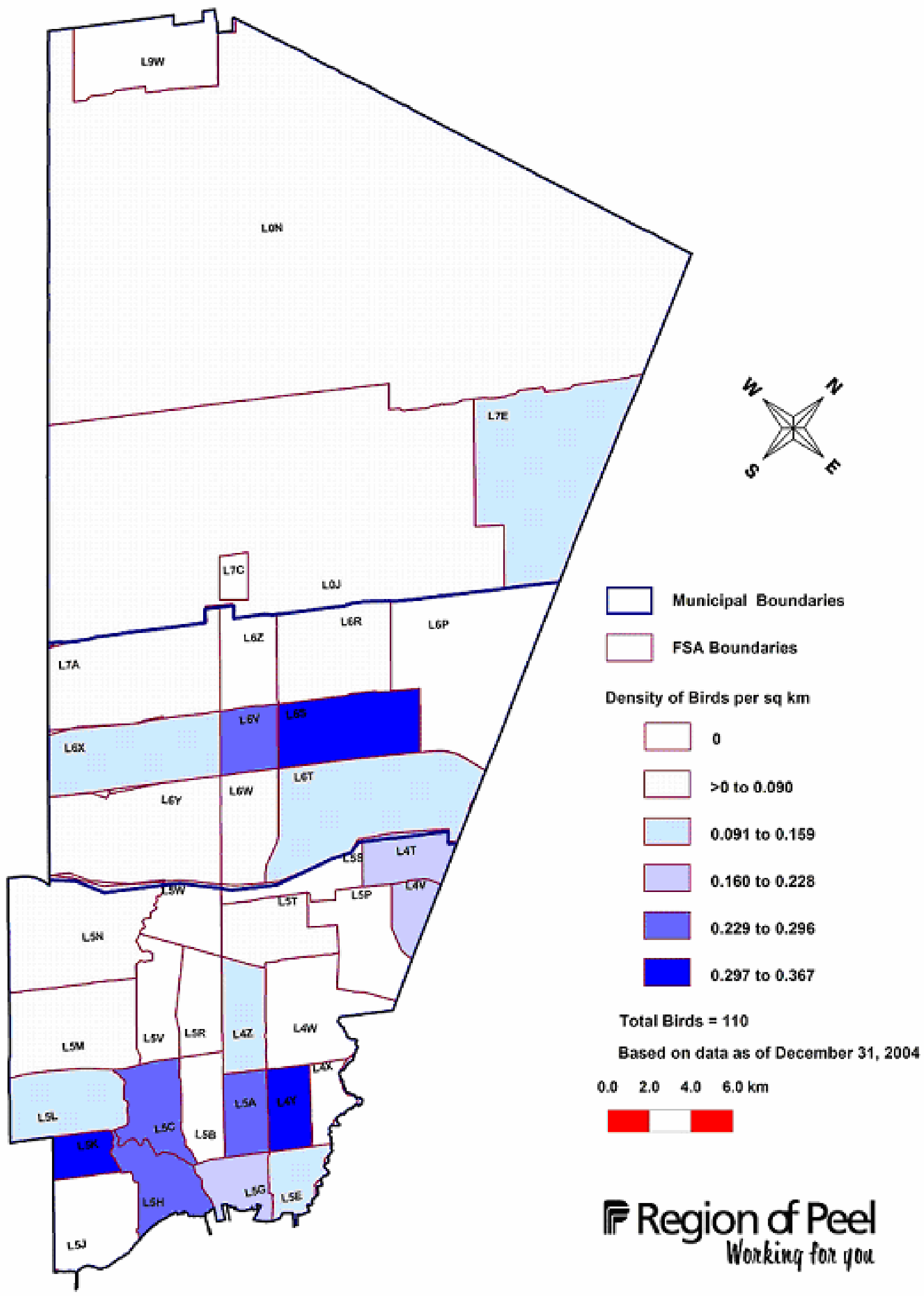


Figure 6: Density of Dead Crows & Blue Jays
Reported by Forward Sortation Area (FSA), Region of Peel, 2004



Summary

The earliest indicator of WNV activity in a jurisdiction is by the detection of the virus in birds. This surveillance information can serve as an early warning of risk to human health. Dead bird surveillance is an important part of Peel's WNV monitoring program.

In 2004, a crow found in Brampton on July 6th was Peel's first positive bird. The previous year a crow found on July 4th in Caledon was the initial positive bird in Peel. A crow found on May 19, 2002 in Mississauga was the first WNV infected bird found in Canada during that year.

In total, 110 dead blue jays or crow sightings were reported to Peel Public Health in 2004, of which 60 were tested and 16 were found positive. Thirty-two per cent of the crows (13/41) and 16% of blue jays (3/19) tested positive. In addition, 33% of hawk carcasses (1/3) submitted were positive for the virus.

The increase of WNV positive birds from 12 in 2003 to 17 in 2004 can be attributed to Peel continuing to submit bird carcasses throughout the entire WNV season for the first time in 2004. In previous years, the CCWHC would suspend testing from a health unit when four WNV positive birds were identified in a jurisdiction; later in the fall they would permit additional submissions.

Adult Mosquito Surveillance

Introduction

The West Nile Virus survives by circulating between bird and mosquito populations. A female mosquito can acquire the infection by obtaining a blood meal from a WNV-infected bird. After a suitable incubation period, it can then pass the infection by injecting its virus laden saliva into another host (bird, horse, human or other animal) when it takes another blood meal.[10] Once in the new host, the virus multiplies and is able to infect another female mosquito. The virus can also survive over winter in adult female mosquitoes or eggs. When these mosquitoes take a blood meal or the eggs hatch in early spring, a new cycle of WNV transmission can begin.[10]

The purposes of mosquito surveillance programs are: to monitor mosquito populations associated with WNV; to determine the level of WNV activity among these species; and to use this information to make decisions regarding the risk of transmission to humans and the need to implement mosquito reduction plans.

Methods

In 2004, Peel Public Health used two types of traps to capture live adult mosquitoes. The first type of trap was the Center for Disease Control (CDC) miniature light trap (Figure 7) which uses carbon dioxide and light to attract host-seeking adult female mosquitoes looking for a blood meal. The second type of trap used was the gravid trap (Figure 8) in which nutrient-rich stagnant water (infusion media) is used to attract gravid female mosquitoes (egg-carrying) searching for a suitable site in which to lay their eggs.

Figure 7: CDC Mosquito Light Trap

Source: Photo taken by Peel Public Health WNV Team

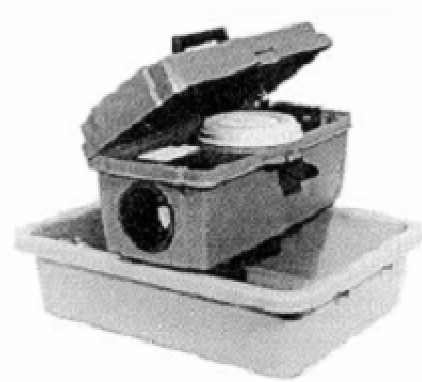


Figure 8: Mosquito Gravid Trap

Source: Photo Courtesy of Central Massachusetts Mosquito Control Project
http://cmmcp.org/

Thirty-two CDC traps were deployed in 30 fixed and two temporary locations across Peel from June 14 to September 29, 2004. Adult mosquito traps were located as shown in Figure 9. There were 16 mosquito trapping sites in Mississauga, nine in Brampton and five in Caledon. Two “Hot Spot” CDC light traps were located in Brampton where positive birds were found.

Adult mosquitoes were usually collected once per week at a trap site, refrigerated, and transported alive by Peel Public Health staff to the Department of Biological Sciences at Brock University in St. Catharine’s, Ontario.

In order to ensure the delivery of mosquito specimens to Brock in a timely manner and to assist in other surveillance activities, Peel Public Health leased a truck for a period of six months. Twice a week (Tuesday and Thursday afternoons), a student transported adult mosquitoes in coolers packed with freezer packs. The leasing of this truck is a result of one of the recommendations in the 2003 WNV Prevention and Control Plan Evaluation Report.[6]

At Brock, the trap contents were frozen until such time as they could be examined. At that point, the contents were evenly spread out on a dry ice platform in order to keep them frozen. Large insects (moths, caddis flies, etc.) were removed and then a section of the sample was chosen at random. With the use of a magnifying glass, female mosquitoes were individually removed by the sorter until a count of 100 was reached.[2] The entire sample of mosquitoes was then counted and separated into males (which feed on nectar and do not take blood meals) and remaining females, which were classified as “extras”. The 100 females were separated into species, recounted and then “pooled” or batched by species, date of collection and location for testing. Batches typically contained 50 or less adult female mosquitoes.[2]

When species could not be distinguished, they were either classified as a group (e.g. *Culex pipiens/restuans*) or to the level of genus (e.g. *Culex spp.*). Some mosquitoes ended up being classified as “unidentifiable females” because the specimens were either unusable due to the natural aging process, or damaged during collection, shipping or storage.[2]

Counts of sampled female mosquitoes by species, unidentifiable females, males, extras and total mosquitoes, along with their corresponding date collected and site identification number were entered into a database by staff at Brock University; this information was then posted on the Brock website. Testing for WNV was done by Brock University and positive batch test results were sent electronically to health units often within one week. The results were posted on the Peel WNV website.

The above procedures were somewhat different than those used in 2002. For example in 2002, a number of traps were set out twice per week at the same site, resulting in a higher number of trapping events. In addition, Brock University identified all female mosquitoes by species in 2002, rather than taking a portion of the mosquitoes and sampling them as was done in 2003 and 2004. All viral testing of female mosquitoes was conducted at Brock University in 2003 and 2004, whereas in 2002, some of the testing was done at Health Canada's National Microbiology Laboratory in Winnipeg, Manitoba.

Estimates of the total number of mosquitoes for a particular species were derived using the actual number of adult female mosquitoes that had been separated into species as a proportion of the total number of mosquitoes (excluding males). In the tables and charts of this section of the report, certain analyses are based on actual numbers while others are based on estimated numbers of mosquitoes, and are notated accordingly.

Five gravid mosquito traps were used on a trial basis in 2004. The gravid traps were set up once per week at trap sites in Brampton and Caledon from mid-July until early October. The mosquitoes captured in the traps were refrigerated and transported to our in-house mosquito lab in Brampton. The specimens were then frozen prior to being identified by Peel Public Health staff. The mosquitoes that were collected were counted and separated into species. Viral testing of the mosquitoes captured in the gravid traps was not undertaken.

Results

In Peel, approximately 55,800 mosquitoes were trapped over the course of the 2004 season, of which 53,556 were identified as female mosquitoes of various species (Table 5). The total number of mosquitoes trapped in 2004 exceeds the totals for 2002 (41,000) and 2003 (43,500). The increase in mosquito numbers is directly related to the increase in the number of permanent and temporary traps used during the 2004 season. Twenty permanent and three temporary traps were deployed in 2003 while 30 permanent and two temporary traps were used in 2004. Adult females from 38 mosquito species were collected in Peel traps in 2004 (Table 5). As in previous years, *Coquillettidia perturbans* and *Aedes vexans* were the most common mosquito species.

There were 70 WNV positive mosquito batches identified in Ontario in 2004[11] (Table 6). Toronto had the highest number of WNV positive mosquito batches with 31. In 2002, there were 598 WNV positive mosquito batches in the province and 135 in 2003.[11]

In 2004, there was a substantial reduction of WNV positive mosquito batches in Canada (Table 7). In 2004, there were 176 WNV positive mosquito batches in the country compared to 579 in 2003 and 663 in 2002.[12] The WNV positive mosquito batches were located in five provinces: Quebec, Ontario, Manitoba, Saskatchewan and Alberta.[12]

Table 5: Estimated Number of Female Adult Mosquitoes Collected by Species and Municipality, Region of Peel, 2004

Species Name	Brampton	Caledon	Mississauga	Peel
Coquillettidia perturbans *	1,456	286	18,350	20,092
Aedes vexans vexans	3,674	309	5,092	9,075
Aedes /Ochlerotatus spp. **	2,204	2,431	1,537	6,172
Ochlerotatus stimulans	1,876	1,509	1,026	4,411
Ochlerotatus canadensis	1,893	1,716	139	3,748
Ochlerotatus triseriatus	149	102	2,288	2,539
Culex pipiens/restuans	997	116	1,333	2,446
Ochlerotatus trivittatus	810	50	226	1,086
Culex pipiens	435	36	294	765
Culex restuans	250	92	349	691
Ochlerotatus excrucians	219	200	81	500
Anopheles punctipennis	177	56	223	456
Culex spp.	208	9	186	403
Aedes vexans/cantator	116	9	179	304
Anopheles quadrimaculatus	153	27	17	197
Aedes cinereus	79	65	18	162
Ochlerotatus triseriatus/hendersoni	3	3	94	100
Ochlerotatus dorsalis	57	8	8	73
Ochlerotatus fitchii	7	54	3	64
Aedes vexans nipponi	18	2	41	61
Ochlerotatus japonicus	0	0	45	45
Culiseta morsitans	16	19	3	38
Culex territans	9	1	23	33
Anopheles earlei	14	4	1	19
Anopheles walkeri	15	2	1	18
Anopheles spp.	6	6	5	17
Ochlerotatus euedes	0	7	0	7
Psorophora ferox	0	0	6	6
Ochlerotatus riparius	0	4	1	5
Culex salinarius	3	0	1	4
Culiseta inornata	4	0	0	4
Ochlerotatus abserratus	0	3	0	3
Ochlerotatus cantator	1	0	2	3
Uranotaenia sapphirina	1	0	2	3
Anopheles perplexans	0	1	1	2
Ochlerotatus provocans	0	2	0	2
Culiseta spp.	0	1	0	1
Orthopodomyia alba	1	0	0	1
Total Mosquitoes * **	**14,851**	**7,130**	**31,575**	**53,556**

* includes 2 mosquitoes classified as C*q. perturbans* (pale legs) (not a species type)

** includes 428 mosquitoes classified as *Ochlerotatus* black-legged and 2968 mosquitoes classified as *Ochlerotatus* broad-banded (not a species type)

*** includes adult female mosquitoes, "Unidentifiable Females" and "Extras", but excludes "Males" that were counted

Table 6: Mosquito Surveillance Statistics by Health Unit, Ontario, 2004

Health Unit	Total Positive Batches
Chatham - Kent Public Health Division	3
Durham Region Health Department	2
Halton Region Health Department	5
City of Hamilton - Public Health & Community Services Dept.	8
Hastings & Prince Edward Counties Health Unit	1
County of Lambton Community Health Services Department	2
Middlesex - London Health Unit	2
County of Oxford	1
Regional Municipality of Peel Health Department	4
Perth District Health Unit	2
Timiskaming Health Unit	1
Toronto Public Health	31
Windsor - Essex County Health Unit	7
York Region Health Services Department	1
Ontario Total	**70**

WNV mosquito surveillance statistics are provided individually to the MOHLTC by Ontario's 37 regional health units. Surveillance statistics are current as of 5:00 p.m. EST Monday through Friday.

Data as of January 4, 2005
Source: Ontario Ministry of Health and Long -Term Care
Available from URL: http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_04/wnv_mosquitoes.html

Table 7: Mosquito Surveillance Statistics by Province, Canada, 2004

Province/Territory	No. Confirmed Positive Mosquito Pools
Newfoundland and Labrador	0
Prince Edward Island	0
Nova Scotia	0
New Brunswick	0
Quebec	21
Ontario	70
Manitoba	54
Saskatchewan	30
Alberta	1
British Columbia	0
Yukon Territory	0
Northwest Territory	0
Nunavut	0
Canada Total	**176**

Data as of January 4, 2005
Source: Health Canada
Available from URL:
http://www.phac-aspc.gc.ca/wnv-vwn/pdf_sr-rs/2004/situation_report_102604_mp.pdf

Peel also experienced a reduction of WNV positive mosquito batches in 2004. This year, only four positive batches were found in Peel, two each in Mississauga and Brampton. The first WNV positive mosquito batch in Ontario was found in Peel on July 15 (Week 28) near the Queen Elizabeth Way and Cawthra Road. The last recorded WNV positive batch in Peel was found on August 19 (Week 33) in the area of Queen Street E and Dixie Road in Brampton. As in previous years, no positive mosquitoes were found in Caledon. In 2003, there were 24 positive batches of mosquitoes identified in Peel and 128 in 2002.

A temporal analysis of the WNV positive mosquito batches is shown in Figure 10. Since the numbers of positive batches were low, there was no large peak in the number of batches collected in any one week as was the case in 2002. The highest number of positive batches collected in a given week was in Week 33 (August 15 - August 21) when two positive batches were identified.

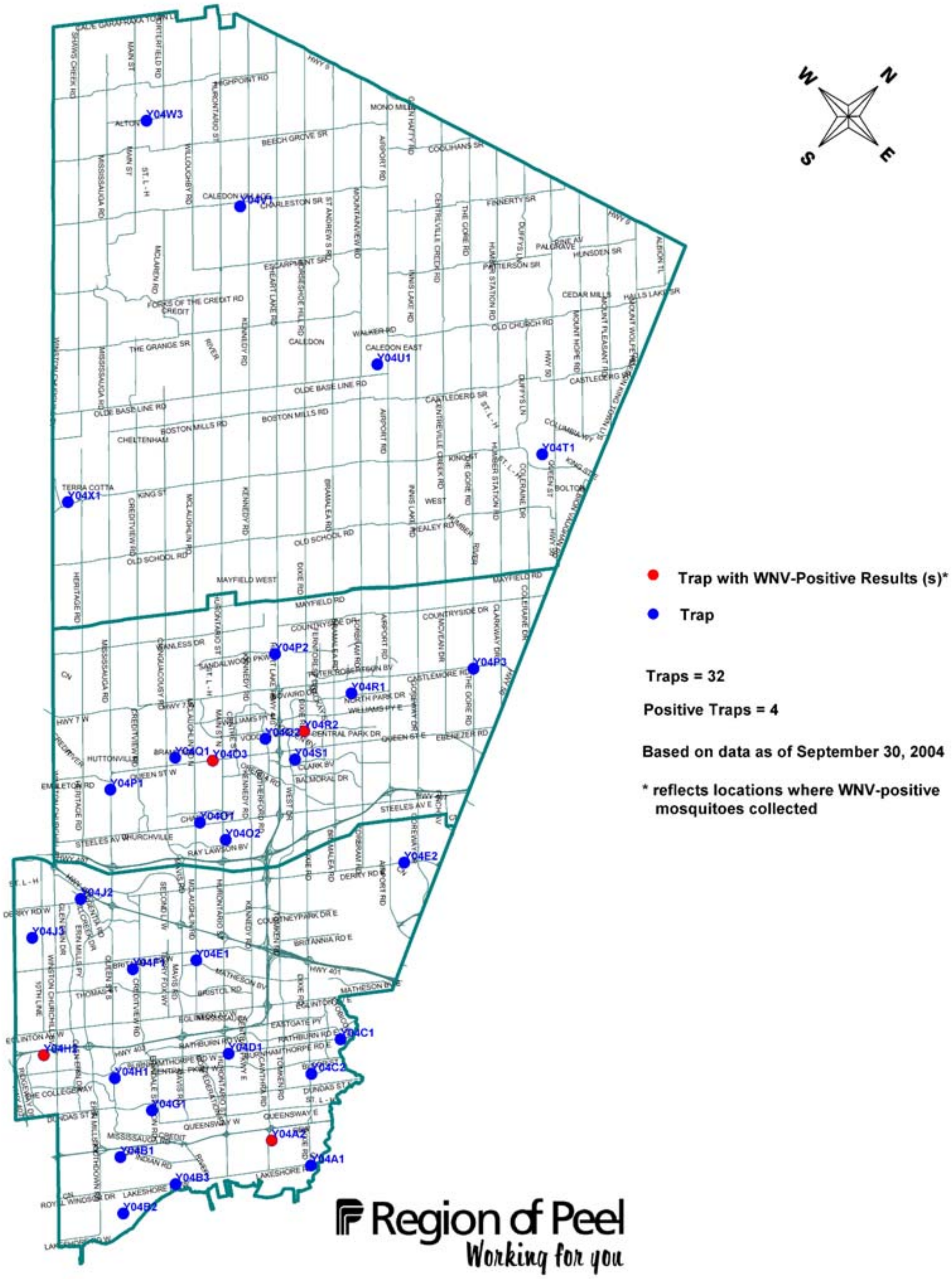
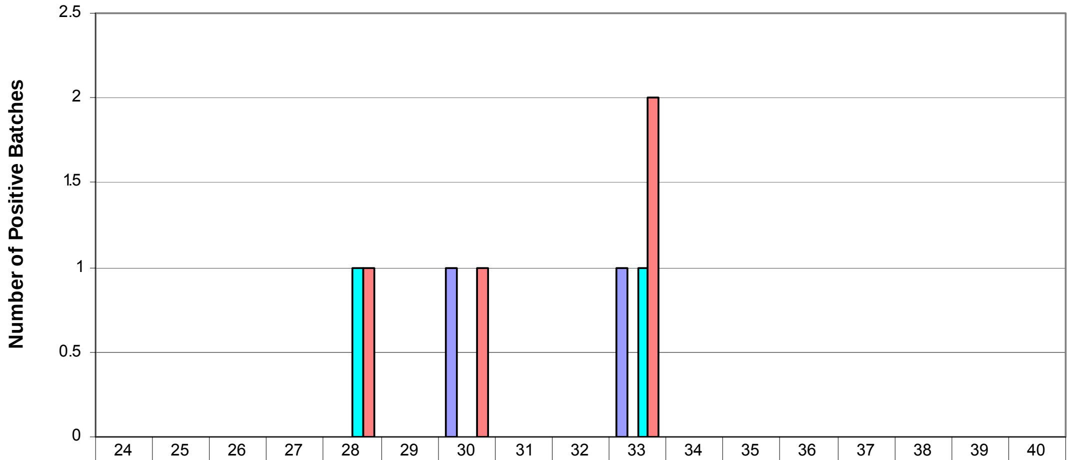

W
N
S
E
Trap with WNV-Positive Results (s)*
Trap
Traps = 32
Positive Traps = 4
Based on data as of September 30, 2004
* reflects locations where WNV-positive mosquitoes collected
Region of Peel
Working for you

Figure 10: WNV - Positive Mosquito Batches by Week of Collection and Municipality, Region of Peel, 2004



	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Brampton	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
Caledon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mississauga	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Peel Total	0	0	0	0	1	0	1	0	0	2	0	0	0	0	0	0	0

Week

Note: No WNV-positive mosquito batches were found in Caledon in 2004

Peel had four positive species identified in 2003 and 11 in 2002. Only three species or groups of mosquitoes were found to be WNV positive in Peel in 2004. The *Culex* group of mosquitoes accounted for all the positives this year. The WNV positive mosquitoes were *Culex restuans*, *Culex pipiens*/*restuans* and *Culex spp.* mosquitoes which were not able to be identified as specific *Culex* species. *Culex* mosquitoes accounted for 8% of the total female mosquitoes collected, but represented 100% of the positives.

The minimum infection rate (MIR) is used as an indicator of the prevalence of WNV, transmission intensity and thus the risk to human disease.[2] MIRs of WNV in certain species, expressed as the number infected per 1,000 mosquitoes tested, are shown in Table 8. Higher MIRs are usually indicative of greater WNV activity among a given species, but can be unreliable based on sample size.[13]

In 2004, the only MIR on a sample of more than 1,000 mosquitoes in Peel was observed among *Culex pipiens*/*restuans* (0.97 per 1,000). The MIR for *Culex spp*. was 2.95 and 1.71 for *Culex restuans*. These results are based on samples of less than 1,000 mosquitoes and are more likely to be unreliable.

The MIRs from 2004 are lower than those from 2003 and much lower than those noted in 2002. This suggests a lower prevalence of WNV in the mosquito population and thus a lower risk of humans contracting the disease. In 2004, Peel had no reported human cases; this is entirely consistent with low infection rates in Peel's mosquito population.

Table 8: Minimum Infection Rates by Mosquito Species and Municipality, Region of Peel, 2004

Municipality	Vector Species	Actual Number Tested	Positive Batches	MIR *
Mississauga	*Culex pipiens/restuans*	1,102	1	**0.91**
	Culex restuans	307	1	3.26 †
Brampton	*Culex spp.*	164	1	6.10 †
	Culex pipiens/restuans	861	1	1.16
Caledon	*(none) ***			
Peel	*Culex spp.*	339	1	2.95 †
	Culex pipiens/restuans	2,061	2	**0.97**
	Culex restuans	584	1	1.71 †
All Species Total		18,036	4	

* 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 species that were tested for the presence of the virus, expressed per 1,000
** 14 different species from Caledon were tested (254 batches; 1,685 specimens), but none were WNV-positive
† MIRs based on numbers < 1000 are more likely to be unstable than those based on numbers ≥ 1000 (bolded)

The gravid trap was used on an experimental basis in limited numbers as it incorporated new design features from previous gravid traps. The initial findings indicate that these traps were labour intensive and did not capture sufficient numbers of gravid mosquitoes of the *Culex* species. The WNV team will conduct a short study in 2005 and compare the older style and new design gravid traps using a new recipe for the infusion media in both traps. The infusion media is designed to simulate the smell of stagnant water the gravid female mosquitoes prefer for egg laying.

Comparison of 2002, 2003 and 2004 Mosquito Trap Data

Although approximately 40 species of mosquitoes are found in Peel, only a few are important in the transmission of WNV. The vectors most responsible for the bird-mosquito amplification cycle in Peel are members of the genus *Culex*. The larviciding program targets *Culex* mosquitoes because of their role in the spread of the disease in the environment.

Table 9 shows numbers of female *Culex* mosquitoes collected and positive mosquito batches in Peel in 2002, 2003 and 2004. In 2002, it is estimated that *Culex* mosquitoes accounted for 30% of mosquitoes collected in Peel traps. A total of 77% (98/128) of WNV positive batches in 2002 were attributed to *Culex* mosquitoes. In 2003, 13% of the mosquitoes collected in Peel traps were *Culex*: they represented 96% (23/24) of WNV positive mosquito batches. The percentage of *Culex* species captured in Peel traps dropped to 8% in 2004 and accounted for 100% (4/4) of the WNV positive mosquito batches.

Table 9: Comparison of Female Culex Mosquitoes by Year, Region of Peel, 2002-2004

Year	Female Mosquitoes Collected			Positive Mosquito Batches		
	Total Number	Number of Culex	% Culex	Total Number	Number of Culex	% Culex
2002	24,269	7,278	30%	128	98	77%
2003	41,212	5,326	13%	24	23	96%
2004	53,556	4,305	8%	4	4	100%

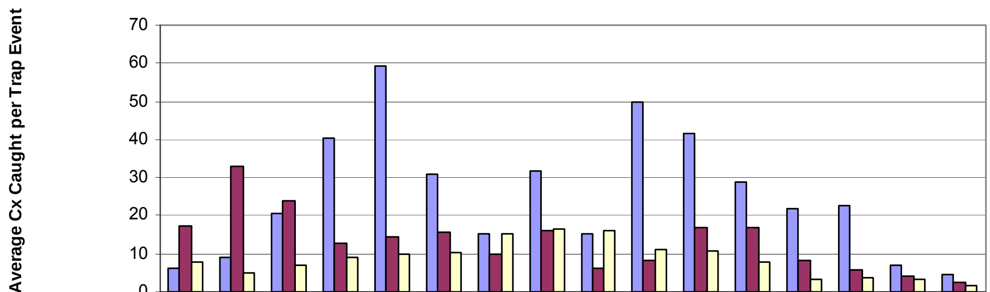
One of the factors reviewed at the weekly risk assessment by the WNV Working Group was vector abundance. *Culex pipiens*, *Culex restuans*, *Culex pipiens*/*restuans* and *Culex spp*. were incorporated into these measurements. Since the number of traps in the adult mosquito surveillance program increased each year, the method employed to determine vector abundance was to review the average *Culex* captured per trap event on a weekly basis (Figure 11). With the exception of weeks 24, 25, 26 and 32, vector abundance was higher each week in 2002 than during comparable weeks in 2003 or 2004. In 2002, during weeks 27-29 and 33-37, the trap averages were much higher than in the two years that followed. The average number of *Culex* per trap event from week 24-39 was 25.1 in 2002, 12.9 in 2003 and 8.6 in 2004.

A further analysis was undertaken of the relative abundance of *Culex* mosquitoes that were collected in the 13 traps that were located at the same sites during the same time period in each of 2002, 2003 and 2004 (Figure 12 and Table 10). As a proportion of total mosquitoes, *Culex* mosquitoes were lower every week in which mosquitoes were captured in 2004 than in 2002, with the exception of week 30 when the numbers of *Culex* captured were identical. In 2004, weeks 30, 31 and 32 were the only weeks in which the proportion of *Culex* mosquitoes exceeded 2003 trap counts.

Table 10 compares the top 12 mosquito species collected from the 13 common trap sites from 2002 to 2004. This shows the number of *Culex* that were ranked in the top 12 species count decreased from 2,644 in 2002 to 1,816 in 2003 to 1,121 in 2004 at the selected sites (note that *Culex* species were not included in the top 12 species in 2004).

The downward trend in *Culex* mosquito activity could be attributed to the 2003 and 2004 larviciding program which primarily directed at the reduction of *Culex* mosquitoes. Other factors that may have impacted *Culex* numbers were breeding site source reduction and weather conditions.

Figure 11: Proportion of Culex Species per Trap Event by Week, Region of Peel, Week 24-39, 2002 to 2004

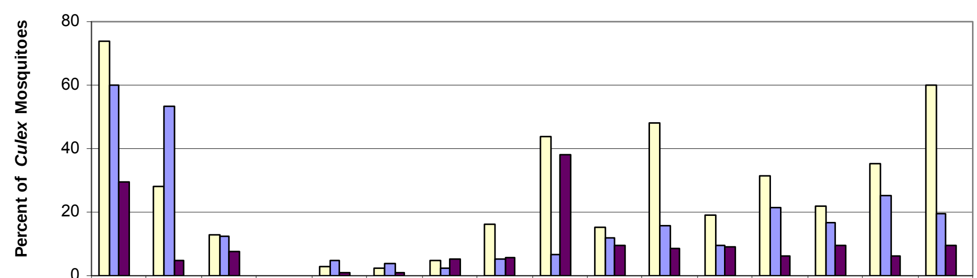


Week	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
2002 Average Culex/Trap event	6.33	9.08	20.58	40.33	59.31	30.90	15.36	31.85	15.20	49.85	41.42	29.00	21.62	22.73	6.82	4.67
2003 Average Culex/Trap event	17.32	32.77	23.91	12.64	14.54	15.57	9.71	15.92	6.23	8.42	16.71	16.76	8.28	5.72	4.31	2.34
2004 Average Culex/Trap event	7.67	4.93	7.13	8.90	9.94	10.32	15.19	16.39	16.03	10.97	10.59	7.81	3.47	3.91	3.16	1.78

Week

*NOTE: The *Culex* species used were *Culex pipiens, Culex pipiens/restuans, Culex restuans,* and *Culex spp.*

Figure 12: Proportion of *Culex* Species* to Total in Selected Sites
Region of Peel, 2002, 2003 and 2004**



Week	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
2002	74	28	13	0	3	2	5	16	44	15	48	19	31	22	35	60
2003	60	53	12	0	5	4	2	5	6	12	16	9	21	16	25	19
2004	29	5	8	0	1	1	5	6	38	10	8	9	6	9	6	10
Site Count	1	3	3	0	3	7	9	13	3	13	12	13	11	12	12	12

Week

* The selected *Culex* species include *Culex pipiens*, *Culex restuans*, *Culex pipens/restuans* and those not able to be identified *(Culex spp.)*
** A maximum of thirteen trap sites were common in both 2002, 2003 and 2004.
For 2002, the average count per week for each site was used. For 2003 and 2004, estimated counts were used to calculate the average.

Table 10: Comparison of the Top 12 Mosquito Species Collected from Common Trap Sites and Time Periods, Region of Peel, 2002, 2003, and 2004

2002				2003				2004			
Rank 2002	Species (Actual)	Average Actual Number 2002*	Per Cent	Rank 2003	Species (Estimated)	Average Estimated Number 2003**	Per Cent	Rank 2004	Species (Estimated)	Average Estimated Number 2004**	Per Cent
1	*Coquillettidia perturbans*	4,147	38.8	1	*Cq. perturbans*	11,991	58.0	1	*Cq. perturbans*	14,608	66.4
2	*Aedes vexans*	2,301	21.5	2	*Ae. vexans*	3,646	17.6	2	*Ae. vexans vexans*	3,708	16.8
3	*Culex pipiens/restuans*	1,173	11.0	3	*Oc. canadensis*	1,423	6.9	3	*Oc. trivittatus*	756	3.4
4	*Culex spp.*	610	5.7	4	*Cx. pipiens/restuans*	1,284	6.2	4	*Cx. pipiens/restuans*	709	3.2
5	*Culex pipiens*	604	5.7	5	*Ae./Ochlerotatus spp.*	568	2.7	5	*Ae./Oc. Spp.*	529	2.4
6	*Aedes vexans/cantator*	445	4.2	6	*Oc. trivittatus*	319	1.5	6	*Oc. canadensis*	453	2.1
7	*Aedes/Ochlerotatus spp.*	319	3.0	7	*Oc. stimulans*	237	1.1	7	*Cx. pipiens*	286	1.3
8	*Culex restuans*	257	2.4	8	*Cx. restuans*	216	1.0	8	*Oc. triseriatus*	269	1.2
9	*Ochlerotatus excrucians*	177	1.7	9	*An. punctipennis*	195	0.9	9	*Oc. Broad-banded* †	187	0.8
10	*Ochlerotatus trivittatus*	175	1.6	10	*Cx. spp.*	169	0.8	10	*An. punctipennis*	147	0.7
11	*Ochlerotatus canadensis*	120	1.1	11	*Cx. pipiens*	147	0.7	11	*Cx. restuans*	126	0.6
12	*Ochlerotatus triseriatus*	93	0.9	12	*Ae. vexans/cantator*	98	0.5	12	*Oc. stimulans*	111	0.5

* 2002 data are based on average, actual numbers collected per trap event at 13 common trap sites
** 2003 and 2004 data are based on average, estimated numbers collected per trap event at the same trap sites
† not a true species

Summary

The adult mosquito surveillance program was used to monitor the seasonal abundance of mosquito populations and the detection of the virus.

Mosquitoes were collected weekly from mosquito traps at 30 permanent and two temporary locations throughout Peel. An estimated total of 53,556 female mosquitoes comprising 38 species were identified in Peel in 2004; however, as in previous years, only a small number were likely to be important in the transmission of the virus to humans. Three species from the genus *Culex* accounted for all four positive batches. Two positive batches were found in both Brampton and Mississauga. As in previous years, no positive mosquito batches were found in Caledon.

In 2004, the MIR calculations showed that the infection rates in the *Culex* species were lower when compared to 2003 and 2002 data.[2] The analysis of trapping results demonstrated lower proportions of *Culex* mosquitoes were collected than in previous years. This may be due to larval reduction measures that were undertaken in Peel which primarily targeted *Culex* mosquitoes.

Larval Mosquito Surveillance

Introduction

Mosquitoes go through complete metamorphosis. The lifecycle of the mosquito has four distinct developmental stages: egg, larva, pupa and adult (Figure 13). Mosquitoes lay their eggs on top of stagnant water or damp soil that will be flooded with rain or melting snow. The first three stages of development occur in an aquatic environment. The adults emerge from the pupae and take flight shortly after emergence.

Only the female mosquito requires a blood meal and bites animals - warm or cold blooded - and birds. Stimuli that influence biting (blood feeding) include a combination of carbon dioxide, temperature, moisture, smell, color and movement. Male mosquitoes do not bite, but feed on the nectar of flowers or other sources of sugar. The acquisition of a blood meal (protein) is essential for egg production, but generally both male and female mosquitoes are nectar feeders. The females will seek blood meals from mammal, avian or amphibian sources, depending on the feeding preferences of that mosquito species.

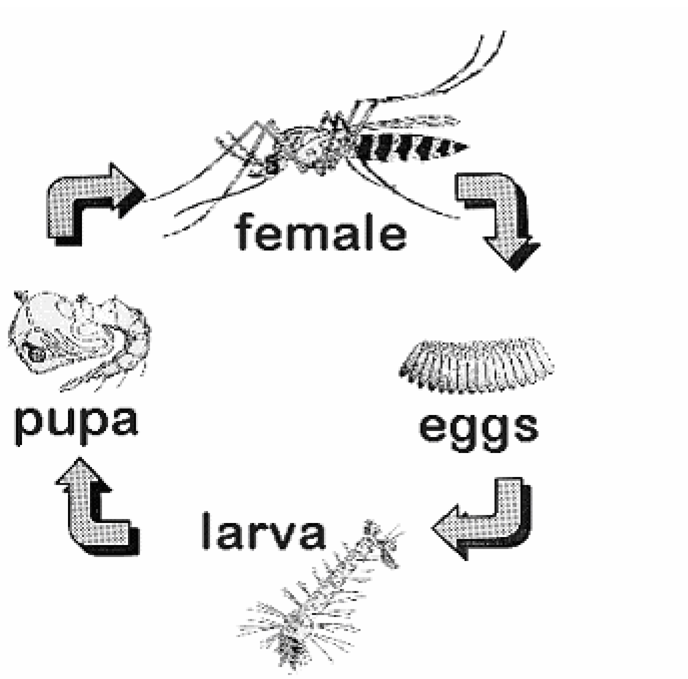


Figure 13: Mosquito Life Cycle

Source: Courtesy of Rutgers State University Web page
http://www.rci.rutgers.edu/~insects/lcycle.htm

Larval surveillance results are important in guiding and implementing appropriate prevention and reduction activities. They are used to determine the location, species and population densities of vector mosquitoes. Larval surveillance activities are vital for predicting adult emergence and establishing optimal times for application of larval reduction measures.

Larval surveillance was undertaken at approximately 2,300 potential mosquito breeding sites on publicly owned lands in Peel in 2004.

Methods

Stagnant Water Surveillance

Seasonal staff surveyed a variety of aquatic habitats for the presence of mosquito larvae from early May to late October. Staff identified mosquito breeding sites by referencing historical breeding site information collected in 2002 and 2003. In addition, stagnant water complaints received from the public assisted in identifying additional sites. In 2004, the public were able to report stagnant water sites using an on-line reporting form. This was recommended in the WNV evaluation report.[6] The larval sampling procedure involved collection of larvae in a standard aquatic dipper (Figure 14). A standardized larval sampling method was used to quantify larvae density and the breeding sites were ranked as nil, low, medium or high density. This information was entered into a handheld computer in the field. Other data captured were the type and dimensions of the breeding site and the date of the inspection. The exact latitude and longitude of the potential breeding site was recorded using a Global Positioning System (GPS) unit and entered into the breeding site data base.

Figure 14: Standard Mosquito Dipper

Source: Photo taken by Peel Public Health WNV Team

Larval Mosquito Identification

Breeding sites were continually surveyed and sampled for mosquito larvae. Field samples were sent to one of our in-house mosquito laboratories for species identification by trained Peel Public Health staff. In order to expedite mosquito larvae identification, laboratories were set up in our offices in Mississauga and Brampton in 2004. The number of larvae that were collected was dependent on the number and frequency of the dips taken and the larval activity at the time of the breeding site survey. The number of specimens collected was completely random but likely provided a good indication of larval activity throughout the Region. Laboratory identification results were used to determine species distribution, habitat preferences, abundance and seasonal occurrence and were a valuable tool in guiding larval reduction measures.

A geographic information system (GIS) was used to maintain all larval surveillance data. Maps identifying the location of all the potential breeding sites were generated using a mapping software program. These maps were also used to identify the sites that contained larvae and more importantly the sites that supported WNV vector larvae. This information was used to determine the types of habitats where larvae were found as well as the distribution of the different mosquito species in Peel.

Results

In 2004, a total of 2,296 potential breeding sites were surveyed for the presence of larvae (Figure 15). Mississauga had 75% (1,726) of the total sites, 17% (383) were found in Brampton and 8 % (187) in Caledon. The proportion of breeding sites surveyed by municipality is consistent with the 2003 figures. The distribution of these sites is influenced in part by stagnant water complaints received from Peel residents and by historical information of the types of habitat that support larvae.

Mosquito larvae were found in 32% (728 of 2,296) of the breeding sites that were monitored in Peel. Vector larvae (larvae of a species found to have tested positive for WNV in Canada) were identified in 27% (627 of 2,296) of these locations.

Larval surveillance results by municipality and habitat type are shown in Figures 16 to 18. As in 2003, man-made structures, such as ditches and culverts were the most frequent types of sites in which larvae were found in Peel (Figure 19). Mosquito larvae were also frequently found in the naturally-occurring woodland pools and field pools. These naturally occurring sites are generally not a concern by mid-summer as they tended to dry up. The storm water management (dry and wet) ponds which are highly visible due to their size and location generally did not support significant numbers of mosquito larvae.

In 2004, three storm water management (SWM) ponds required treatment: two in Caledon and one in Brampton. These sites were treated as a result of moderate to high counts of vector larvae being found in these locations. Although a number of natural ponds or marshes were found to have larvae present, none required treatment as the larvae found at these sites were generally not WNV vectors.

Figure 15: Surveyed Locations of Mosquito Breeding Sites, Sites with Larvae and Vector Larvae*, Region of Peel, 2004

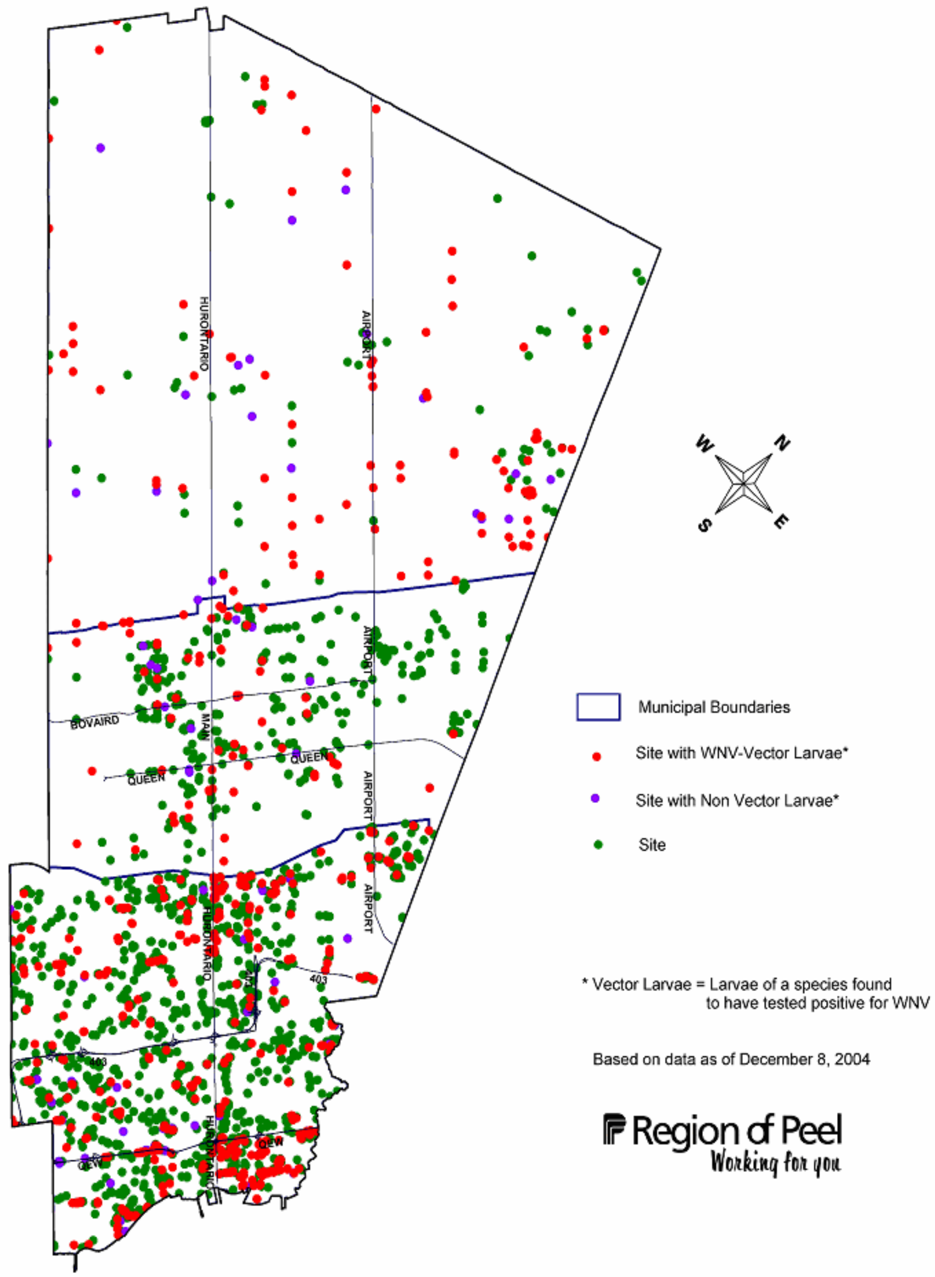
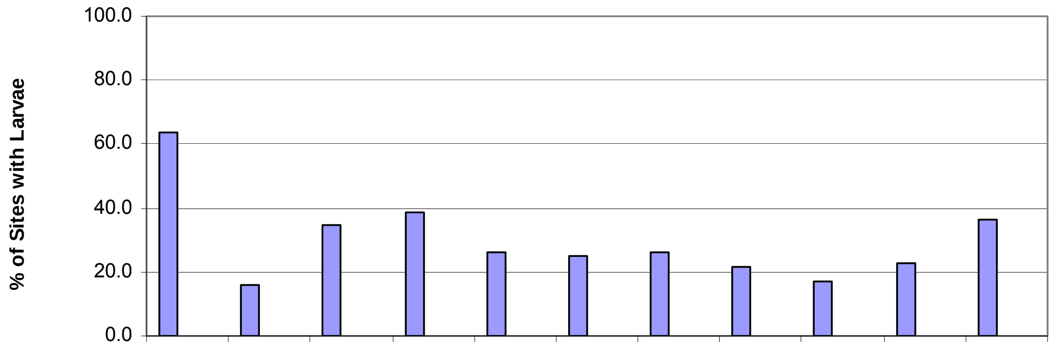


Figure 16 : Proportion of Potential Surface Water Mosquito Breeding Sites with Larvae, by Type of Site, Mississauga, 2004

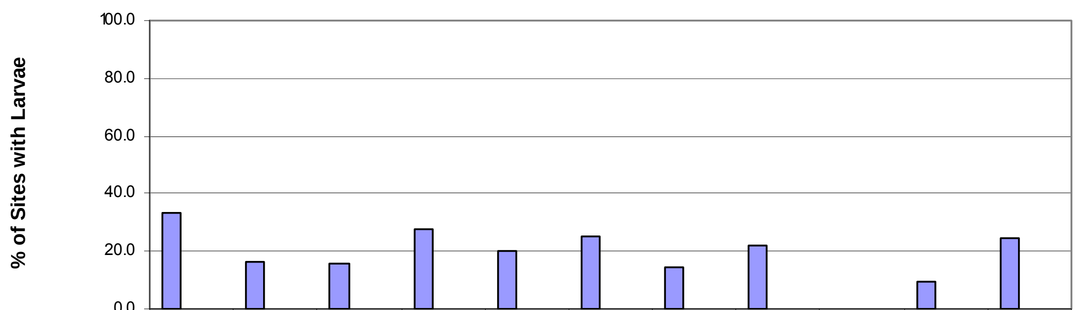


	Artificial Container	Creek	Culvert	Ditch	Field Pool	Marsh	Natural Pond	Other	SWM Dry Pond	SWM Wet Pond	Woodland Pool
% Sites with Larvae	63.6	16.0	34.5	38.8	26.3	25.0	26.3	21.6	17.2	22.9	36.3
# Sites With Larvae	14	25	110	173	94	19	5	38	5	8	33
Total Sites	22	156	319	446	357	76	19	176	29	35	91

Site Description

Note: Catch Basins (n=158) are excluded from this chart as they were primarily checked for the presence of standing water and not for the presence of larvae. 'Other' – tree holes, plants, plant leaves and other natural container microhabitats.

Figure 17 : Proportion of Potential Surface Water Mosquito Breeding Sites with Larvae, by Type of Site, Brampton, 2004

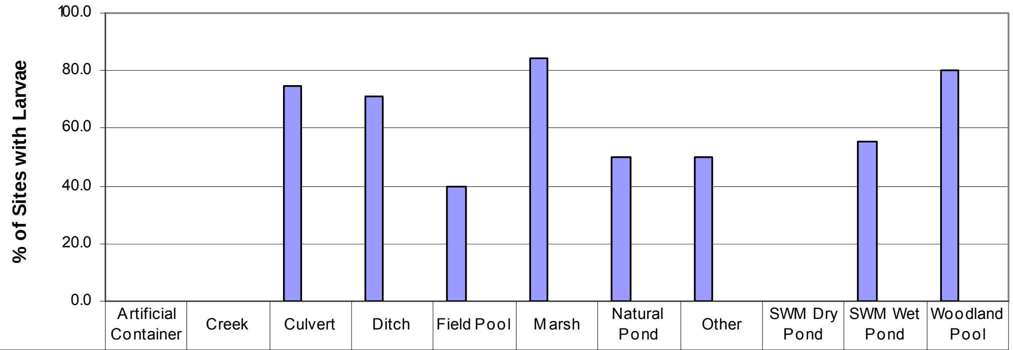


	Artificial Container	Creek	Culvert	Ditch	Field Pool	Marsh	Natural Pond	Other	SWM Dry Pond	SWM Wet Pond	Woodland Pool
% Sites with Larvae	33.3	16.7	16.0	27.8	20.0	25.0	14.3	22.2	0.0	9.4	24.4
# Sites With Larvae	1	8	4	35	6	2	3	6	0	5	10
Total Sites	3	48	25	126	30	8	21	27	1	53	41

Site Description

Note: Catch Basins (n=16) are excluded from this chart as they were primarily checked for the presence of standing water and not for the presence of larvae. 'Other' – tree holes, plants, plant leaves and other natural container microhabitats.

Figure 18 : Proportion of Potential Surface Water Mosquito Breeding Sites with Larvae, by Type of Site, Caledon, 2004

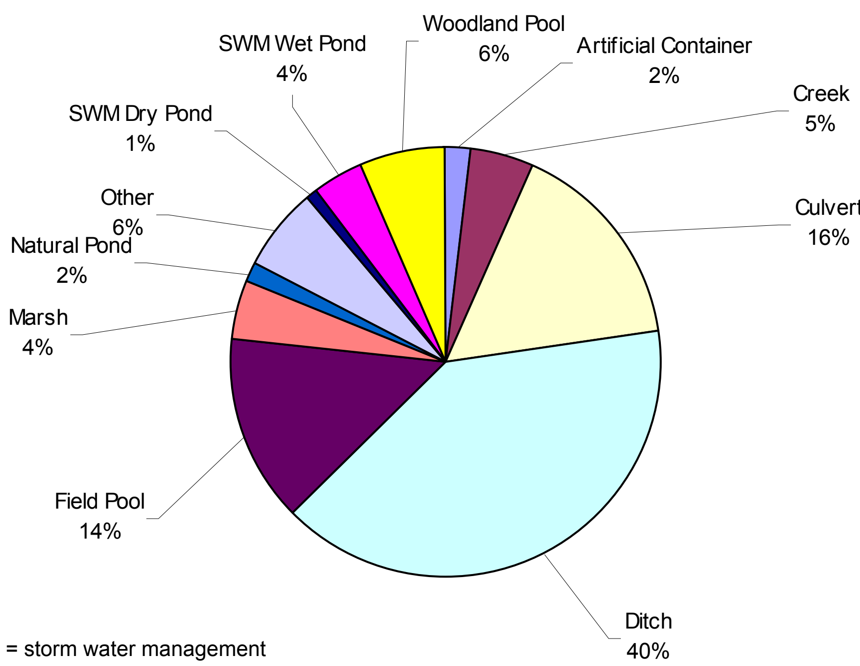


	Artificial Container	Creek	Culvert	Ditch	Field Pool	Marsh	Natural Pond	Other	SWM Dry Pond	SWM Wet Pond	Woodland Pool
% Sites with Larvae	0.0	0.0	75.0	70.8	40.0	84.6	50.0	50.0	0.0	55.6	80.0
# Sites With Larvae	0	0	3	80	4	11	3	3	0	15	4
Total Sites	0	2	4	113	10	13	6	6	1	27	5

Site Description

Note: There were no catch basins surveyed in Caledon. 'Other' – tree holes, plants, plant leaves and other natural container microhabitants.

Figure 19 : Types of Sites Found To Contain Mosquito Larvae, Region of Peel, 2004



SWM = storm water management

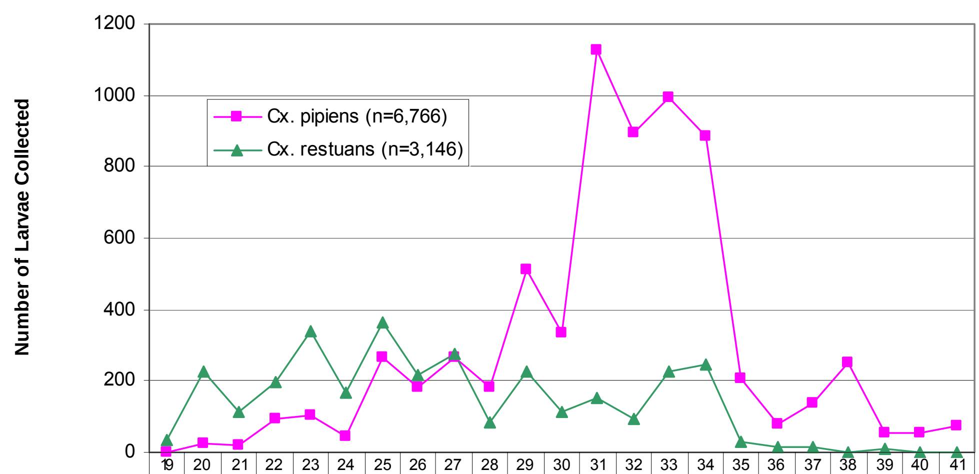
val Mosquito Identification Results

A total of 12,981 mosquito larvae were identified from mid-May to late October. Twenty different species were identified; of those, 76% were of two *Culex* species: *Culex pipiens* accounted for 52% and *Culex restuans* accounted for 24% of the larvae that were identified in 2004.

As in previous years, the *Culex restuans* larvae appeared earlier in the season and was the predominant *Culex* species in May and June (Figure 20). *Culex restuans* larvae numbers peaked in week 25 (June 13 - June 19) the same week as the peak occurred in 2003. However, the peak this year was not as pronounced as in 2003.[2] A crossover occurred in early July when the number of *Culex pipiens* larvae submissions started to exceed the *Culex restuans* submissions. The *Culex pipiens* numbers continued to rise and peaked in week 31 (August 1 - 7), which was one week earlier than the peak noted in 2003.[2] Over the course of the mosquito season, there were about twice as many *Culex pipiens* larvae found as there were *Culex restuans*. In 2003, there were approximately the same numbers of larvae from each of these species identified in Peel. An analysis of more than two years of larval surveillance data will be needed to determine the average ratio of *Culex pipiens* to *Culex restuans* in Peel's surface water sites.

After week 35 (August 29 –September 4), a noticeable decline in the number of larvae that were collected was observed. This can be attributed to the loss of the majority of the seasonal staff who were responsible for larvae collections.

Figure 20: Numbers of *Culex pipiens* and *Culex restuans* Larvae by Week of Collection, Region of Peel, 2004



Week	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
Cx. pipiens (n=6,766)	0	25	21	92	102	42	264	183	267	180	511	334	1124	893	993	884	206	77	136	250	56	52	74
Cx. restuans (n=3,146)	35	228	115	197	338	167	362	216	275	83	228	113	151	92	226	245	30	15	14	2	11	2	1

Week

Includes data from Catch Basins
Cx = Culex

Summary

Larval surveillance has many important functions. It was used to determine the specific aquatic habitats that supported mosquito populations throughout Peel. When specimens were identified and counted, the information was used to determine species composition and vector abundance in an area. The information was also used to project the optimal times to conduct larval reduction measures. In 2004, approximately 2,300 breeding sites were surveyed: 75% in Mississauga, 17% in Brampton and 8% in Caledon. Ditches, culverts, field and woodland pools were the site types where mosquito larvae were most frequently found.

A total of 20 different species were identified from the 12,981 larvae specimens collected. Approximately 76% of those collected were from the *Culex* species: *Culex pipiens* were the most predominant species accounting for 52% and *Culex restuans* accounted for 24% of the mosquito larvae collected and identified.

Larval Mosquito Reduction

Introduction

The most efficient and cost effective method of reducing mosquito populations is targeting the larval stage and the sites where they can develop. This offers an opportunity to reduce the number of mosquitoes in an efficient way before the adult mosquitoes emerge and become widely dispersed. Once mosquitoes become flying adults, reducing mosquito populations is more difficult and expensive.

A larval reduction program was first undertaken in Peel in 2003. This program was expanded and enhanced in 2004. The purpose of this program was to reduce the abundance of WNV vector mosquitoes, in particular the *Culex* species.

Although 38 species of mosquitoes were found in Peel in 2004, only a few are capable of transmitting WNV. *Culex pipiens* and *Culex restuans* are the most important mosquito species in the local transmission of WNV. They are one of the most common mosquitoes found in urban and suburban areas. They breed quickly and use standing or slow-moving water containing decaying organic matter to lay their eggs. Prime breeding sites include roadside catch basins, ditches, discarded tires left outdoors, unused swimming pools and containers left outdoors to collect water. Catch basins are an especially important environment since the majority of catch basins inspected in Peel have been found to contain mosquito larvae. This is supported by findings in other nearby jurisdictions.

Breeding of mosquitoes can be prevented by either eliminating breeding sites containing stagnant water (source reduction), changing the environment to be less hospitable for mosquito breeding, or treating the water with larvicide to prevent mosquitoes from developing. Habitat modification can include changing the physical environment or introducing predators. In 2004, Peel conducted a study by stocking a pond with fathead minnows to determine if the fish would be effective in reducing mosquito larvae. Peel Public Health staff also worked with municipal departments in identifying mosquito breeding sites on public property that could be remediated or modified. Peel Public Health's educational material provided homeowners with guidelines to reduce mosquito breeding sites on residential property.

Where *Culex* or other vector mosquito species could not be effectively reduced by other means, larvicides were employed. The larvicides that were used in Peel were *Bacillus thuringiensis* var. *israelensis* (Bti) and methoprene (Altosid®).

Methoprene is a synthetic insect growth regulator which interferes with the development of mosquito larvae into adults.[4] It has been widely used over a period of many years, and its effectiveness and environmental impact have been extensively studied and documented. It has been investigated and approved by the federal Pest Management Regulatory Agency (PMRA) for mosquito larviciding in Canada. Methoprene has very little non-target species toxicity, and poses no risk to the health of mammals, including humans. It degrades rapidly in water, particularly in the presence of sunlight. In 2003, the Ontario Ministry of the Environment (MOE) conducted WNV monitoring studies in conjunction with the University of Western Ontario, Ryerson University, the City of Toronto, Peel Region, Halton Region, Environment Canada and local conservation authorities. Previous studies suggested that methoprene, once it leaves storm sewers and enters the environment, will break down in a short period of time. The 2003 WNV monitoring studies confirmed that the larvicides used to reduce mosquitoes did not harm streams, rivers and drinking water in treated areas and that the pesticides were effective in reducing mosquito larvae. Overall, these studies collected and analyzed approximately 1,200 water samples.[14]

In 2004, methoprene was the only larvicide which the MOE would permit to be used to treat catch basins.[15] Methoprene has a number of features which makes it the preferred larvicide for catch basins. It is highly effective against the mosquitoes found in catch basins (*Culex pipiens* and *Culex restuans*) and works well in water containing high organic matter. Four applications of methoprene pellets were applied to approximately 75,000 roadside catch basins in Brampton, Mississauga, and in the towns, villages and rural subdivisions of Caledon. In 2004, catch basins located in the green spaces of municipal parks were included in the larviciding program as were catch basins on properties owned or managed by Peel. Methoprene briquets which received temporary registration by the PMRA in 2004 were used primarily in the park catch basins. A single application of briquets was undertaken in these catch basins as the label indicated they were to provide season long control of mosquito larvae. Peel Public Health participated in a study with the MOE to determine the effectiveness of the briquets. The final results of the study were not available at the time this report was written.

Catch basins which drained directly into environmentally sensitive areas such as Rattray Marsh or Cawthra Park were treated by a device called a 'Larvasonic®'. The Larvasonic® generates acoustic energy which causes trauma to the internal organs of the larvae resulting in their death.

In addition to catch basins, Peel's larval reduction program includes the treatment of surface water breeding sites that are located on public lands. In 2004, a total of 138 surface water breeding sites were treated in Peel. Decisions to larvicide these sites were based on larval surveillance activities and response to stagnant water complaints. The MOE only permitted the larvicide Bti (Bacillus thuringiensis israelensis) to be used on surface water.[15] Bti is a biological pesticide which kills mosquito larvae before they develop into adults. Like methoprene, Bti has been extensively used, studied and regulated. It is more selective for mosquito larvae than methoprene, and so has less impact on other insect species. However, it is also less effective and more difficult to use, particularly in catch basins. Bti breaks down quickly in the environment and needs to be reapplied regularly to obtain adequate mosquito reduction.

Peel Public Health developed a computerized program to track the mosquito breeding sites throughout the Region. This program was used to guide both larval surveillance and larval reduction activities.

Methods

Prior to the initiation of the larviciding program, permit applications were prepared by the WNV team and submitted to the MOE for review and approval. Four permits were issued for Peel's larviciding program. A permit was issued to allow three applications of Altosid® pellets (methoprene) to the roadside catch basins (Figure 21) and to apply Altosid® XR Briquets (methoprene) to catch basins located in parkland and on Peel owned and/or operated properties. An amended permit was issued to allow a fourth round of Altosid® pellets to be applied to the roadside catch basins. Another permit was issued allowing the use of Bti larvicide (Vectobac® or Aquabac™) at surface water sites located on public lands. A permit specific to the treatment of stagnant pools located in the Rattray Marsh and Cawthra Woods was also issued. These two sites are designated as protected wetlands by the Ministry of Natural Resources and required a special approval process and separate permit. Bti was the only larvicide permitted for use in wetlands.

Pestalto Environmental Products Inc. was contracted by Peel to provide the mosquito larval reduction services. The contract involved locating and mapping catch basins and surface water breeding sites, monitoring larval activity prior to the larvicide application, applying the larvicide and collecting larvae or pupae samples to determine larvicide efficacy. In 2004, Peel Region staff was provided larviciding treatment information on a daily basis through "real-time" access to data on Pestalto's website database.

Pestalto applied four rounds of Altosid® pellets (methoprene) to the municipal roadside catch basins in Peel during 2004. These catch basins were larvicided at approximately 21 day intervals. Each catch basin received 0.7 grams of pellets as per the MOE permit requirement.[15] Teams of two people treated the catch basins. One person was responsible for driving the truck and the other was responsible for the application and marking the catch basin grate with a non-permanent paint. A coloured dot was painted on each catch basin grate to identify that larvicide was applied. A designated colour represented each round of application (round 1-blue, round 2-white, round 3-orange and round 4-green). The catch basin colour coding scheme was implemented as a result of a recommendation in the 2003 WNV evaluation report.[6]

Catch basins that were treated with briquets received one application and were marked with red dot.

Catch basins that drained directly into sensitive areas were treated by the Larvasonic® device that uses ultrasound to kill the mosquito larvae rather than using Altosid® pellets.[16] Sensitive area catch basins were marked with a yellow dot.

Larval surveillance conducted by Peel Public Health staff resulted in a number of stagnant surface water sites being referred to our licensed applicator, Pestalto Environmental Products, for larviciding. The applicator applied granular Bti products to sites that contained moderate to high densities of larvae as per the MOE guidelines. They primarily used the Bti product Aquabac™ 200G, but used a similar product, Vectobac® 200G at one site.[16]

The application of Bti was carried out using two methods. The first involved the use of a calibrated grass seed spreader (Figure 22). This was used to distribute the product evenly over a large surface area. The second method involved manual application. The product was measured using a graduated cylinder and measuring spoons and scattered by hand evenly over a water surface. This method was used on small water bodies such a culverts or tire tracks. A public notification sign (Figure 23) was posted at each surface water site immediately before the application and for at least 48 hours after the application as per the MOE permit requirements.

Results

Catch Basin Treatments

Round one of the roadside catch basin program began on June 14th and was completed by July 2. A total of 72,484 catch basins were treated during this round.[16]

Round two began on July 5th and was completed on July 23rd. A total of 75,831 catch basins were treated in round two.[16]

Round three commenced on July 26th and finished on August 13th. In round three a total of 74, 774 were larvicided.[16]

Round four began on August 16th and was completed on September 3rd. A total of 74,021 catch basin received treatment in this round.[15]

Figure 21: Catch Basin Grate

Source: Photo taken by Peel Public Health WNV Team

The variation between the numbers of catch basins treated each round was primarily due to Pestalto not treating catch basins in the zones where catch basin vacuuming was being undertaken.

A total of 209 kilograms of Altosid® pellets was used to treat the catch basins in Peel Region. This total includes 1,863 treatments of catch basins located on Peel owned and operated properties, one catch basin in a public park and 37 in private backyards.[16]

A total of 1,463 Altosid® XR Briquets (methoprene ingots) was applied to catch basins: 1,284 in public parks, 72 on Peel owned or operated properties, 33 on highways and 74 to private back yards.[16] Back yard catch basins were treated upon the request of the home owner and required a signed consent form prior to the application.

Figure 22: Surface Water Larviciding Application using Bti

Source: Photo taken by Peel Public Health WNV Team

One hundred and fifty-one catch basins were treated with the Larvasonic® device. These catch basins required treatment numerous times over the summer as the Larvasonic® did not provide any residual activity.

Figure 23: Public Notification Sign

Source: Photo taken by Peel Public Health WNV Team

Surface Water Site Treatments

In 2004, 138 surface water sites received a total of 226 Bti treatments in Peel.[16] Mississauga had 96 sites of which 32 had more than one treatment; Brampton had 16 sites of which six received more than one application; Caledon had 26 sites of which 13 received additional applications.[16] In 2003, 68 surface water sites received a total of 131 larvicide treatments in Peel.[17] The increase in the total number of sites treated can be attributed to a quicker referral process, as some sites were referred for treatment prior to larval identification. In addition, the historical site data gathered in 2002 and 2003 assisted staff in identifying sites that had previously supported larvae.

As noted in 2003, the man-made structures such as ditches and culverts were the site types that were larvicided most frequently (Figures 24 to 27). In 2004, sites were treated under the wetland permit for the first time. Two woodland pools were treated in Cawthra Woods in late June.

Figure 24: Surface Water Site Types Treated, Region of Peel, 2004

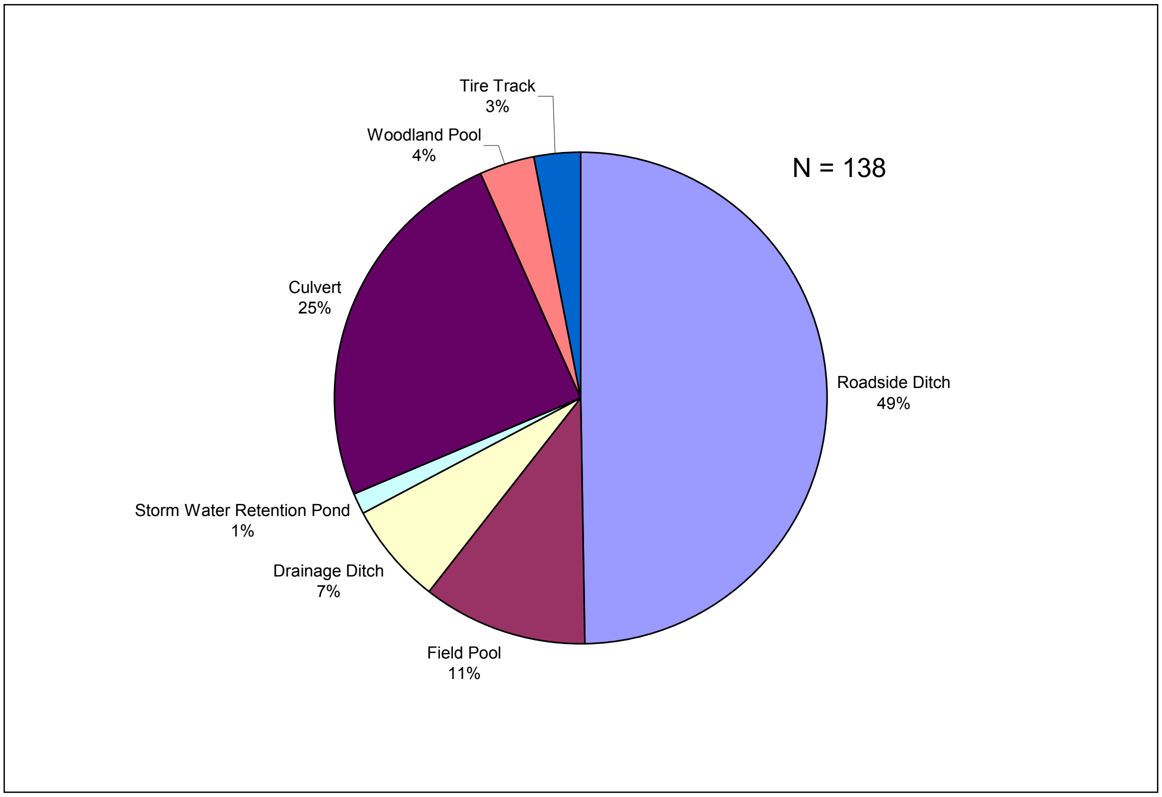


Figure 25: Surface Water Site Types Treated in the Municipality of Mississauga, Region of Peel, 2004

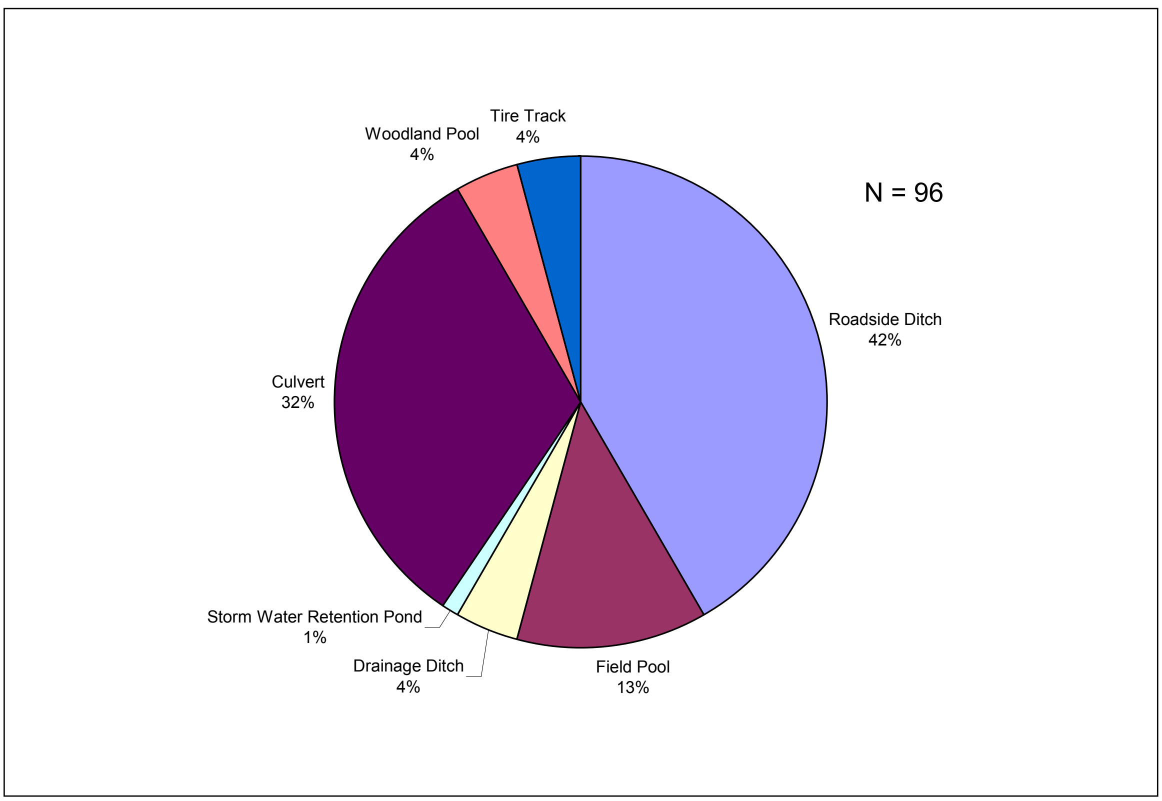


Figure 26: Surface Water Site Types Treated in the Municipality of Brampton, Region of Peel, 2004

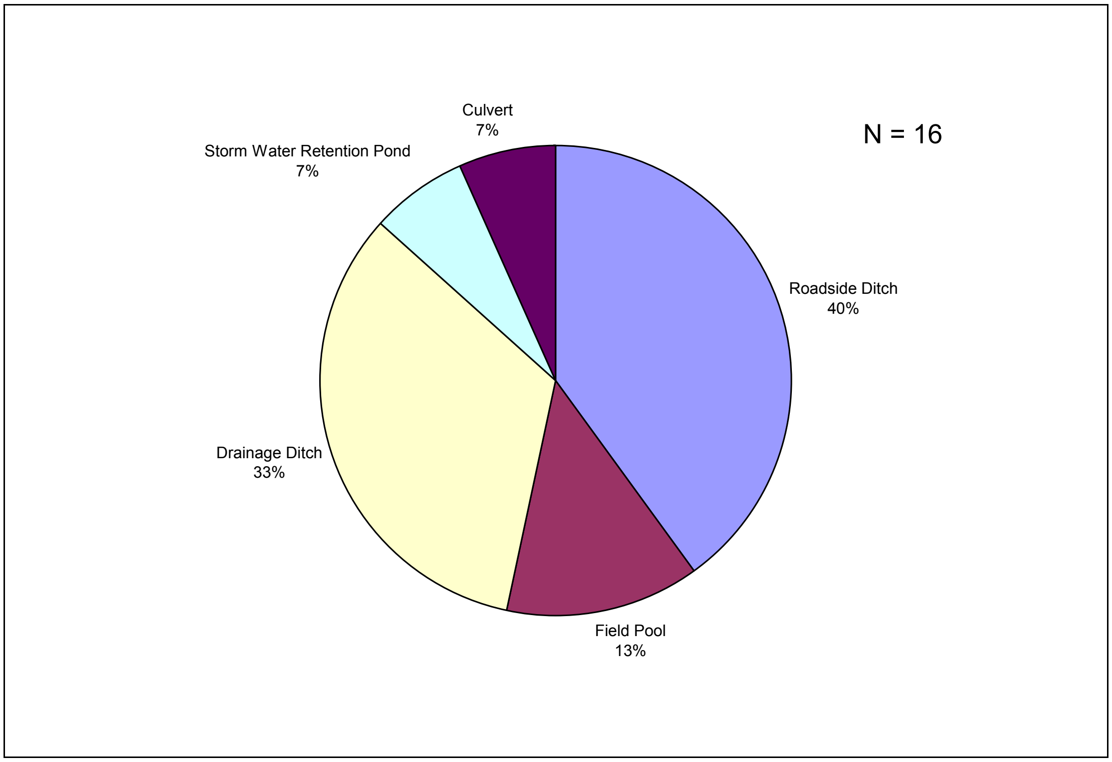
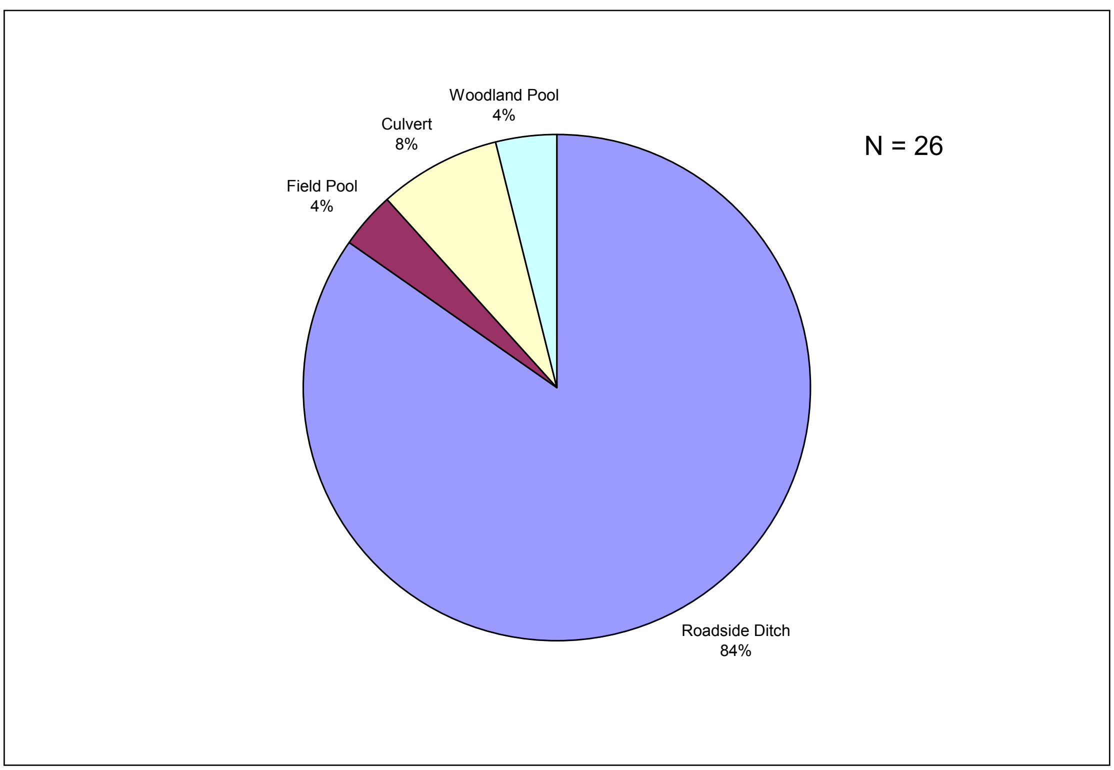


Figure 27: Surface Water Site Types Treated in the Municipality of Caledon, Region of Peel, 2004



Effectiveness of Treatments

A random sample of 35 catch basins located throughout Peel was monitored by Pestalto to determine the efficacy of the Altosid® pellets. The MOE monitoring protocol requires that mosquito pupae and water be collected at approximately seven day intervals following the application of the pellets. The pupae are kept in mason jars and observed daily to see if viable adults successfully emerge over a period of 30 days. The post-treatment pupal monitoring indicated this product's efficacy rate was over 90% and was particularly effective in the first 21 days after application. [16]

Peel Public Health and MOE staff carried out a joint study to determine the efficacy of methoprene briquets. The federal PMRA issued a temporary registration for methoprene briquets. The label advised that the briquets would effectively reduce mosquito larvae for up to 150 days. [18] If the briquets did remain effective for 150 days then catch basins would only need to be treated once during the summer. The need to only treat catch basins once during the summer promised savings in manpower over the pellets which need to be added to catch basins three or four times. The study was intended to determine the actual residual activity and efficacy of these briquets in catch basins.

A MOE report of this study will be provided at a later date once the results have been reviewed in detail. Based on the initial data provided by this study, it appears that the ingots did not provide effective efficacy for 150 days. The results indicate that catch basins treated with the briquets had emergence rates varying between 45% to 75% (average 60%) and that the briquets were effective for approximately 60 days.[19]

Several factors could have adversely affected the efficacy of the briquets. Rainfall in the summer of 2004 exceeded normal summer rainfall level.[20] This could have affected its dissolution properties making it effective for only 60 days instead of 150 days. The increased rainfall could also have flushed the briquets out of the catch basins, as they were not able to be recovered from the catch basins at the end of the study. Lastly, many catch basins contained upwards of two feet of leaves at their base. Burial of the briquets in this organic matter may have reduced their ability to dissolve. These are just theories based on the preliminary data and further investigation will be needed.

The efficacy of the Larvasonic®, which was used in catch basins that drain directly into sensitive wetlands, was also monitored. Pestalto used the standard MOE mosquito larval sequential sampling protocol to determine pre- and post-treatment counts in each of the 151 catch basin where the device was used. [16] The results revealed that mortality occurred more rapidly with larvae in the later stages of development, compared to larvae in the earlier growth stages. However, these larvae in the earlier stages of development eventually died when they matured. Thus, the overall efficacy of the Larvasonic® was approximately 91%.[16]

The efficacy of the Bti granular products used to treat stagnant surface water sites was also conducted by Pestalto. Pre- and post-treatment counts from 10 treatment sites were used to illustrate the effectiveness of Bti. Vectobac® 200G provided 100% control at the one site it was applied in Peel. [16] Aquabac™ 200G was found to reduce mosquito larvae numbers by an average of 76.5% in the nine selected efficacy monitoring sites. [16]

Biological Control

Fathead Minnow Project

Peel Public Health stocked a storm water management pond at the Caledon Wellness Centre in Bolton with fathead minnows (Figure 28) in an attempt to reduce mosquito larvae in the pond. In 2003, Peel Public Health staff identified WNV vector larvae in this pond. That year, the pond was treated with the biological larvicide Bti on two occasions.

The Ministry of Natural Resources determined that the fathead minnow is the best species to stock in storm water management ponds. This native species is abundant, widely distributed, an omnivorous feeder and is salt and temperature tolerant. Fathead minnows have been shown to consume 100-160 mosquito larvae a day in a laboratory environment. [21]

The storm water management pond was stocked in late May with 1,440 fathead minnows. The pond was monitored on a weekly basis. Initial monitoring results revealed that the minnows appeared to be controlling the larvae. In late July, larval surveillance at the pond indicated an increase in the number of mosquito larvae. The increase in larval activity in the pond coincided with a reduction of fathead minnows being observed in the shallow waters. Tests conducted by the Toronto Region Conservation Authority (TRCA) revealed that the majority of the adult minnows had died. This was attributed to low levels of dissolved oxygen in the pond. An overabundance of aquatic vegetation in the pond was the likely cause of the oxygen depletion. In late August, vector mosquito larvae were found at this site and it was larvicided with Bti by Pestalto.

Although this study was unsuccessful, Peel Public Health will consider stocking fathead minnows in the future if a more suitable site can be located. Peel Public Health may need assistance from other government agencies such as TRCA and MNR (Ministry of Natural Resources) in determining whether a particular breeding site is suitable for biological control.

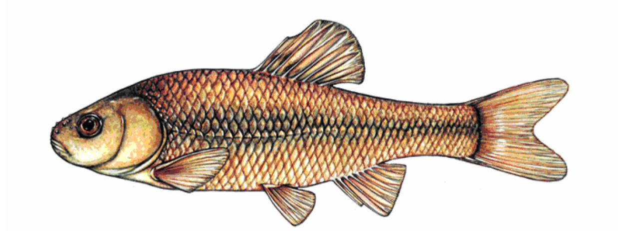


Figure 28: Fathead Minnow

Source: illustration by Ted Walke, PFBC
www.fish.state.pa.us

Summary

The 2004 larval mosquito reduction program involved several approaches, some of which were more efficacious than others.

Four rounds of methoprene pellets were applied to the roadside catch basins in Peel, with the number of treatments totalling 297,110. [16]

An additional 1,863 methoprene pellet treatments were conducted to catch basins on Peel owned and operated properties, one catch basin in a public park and 37 backyard catch basins. [16]

A random sample of catch basins was evaluated and results showed that methoprene pellets were effective in reducing the emergence of viable adult mosquitoes, with an efficacy rate of over 90%.[16]

A total of 1,463 Altosid® Briquets (methoprene ingots) were applied to catch basins in public parks, on Peel owned or operated properties, and in private back yards. [16] Preliminary results from a joint study with the MOE determined that a one-time application of briquets was not as effective as claimed, with efficacy rates of 45-75% lasting for a total of 60 days, rather than the stated 150 days.[19]

One hundred and fifty-one catch basins that drained directly into sensitive areas were treated by the Larvasonic® device that uses ultrasound to kill the mosquito larvae.[16] This device was found to have an efficacy of approximately 91%.[16]

A total of 226 Bti applications were performed at 138 surface water sites throughout Peel. The efficacy of Bti was determined to be between 76-100%, based on pre- and post-treatment larval counts. [16]

Peel Public Health undertook a pilot project to attempt to biologically reduce mosquito larvae in a storm water management pond in Caledon. This site supported WNV vector mosquito larvae in 2003 and was larvicided on two occasions in 2003. In May, Peel Public Health stocked this site with fathead minnows. In late July, an increase of larval activity was noted which coincided with a reduction of fathead minnows being observed in the shallow waters. Tests by the local conservation authority revealed that the majority of the adult fish had died, likely because of over abundance of aquatic vegetation led to the low level of dissolved oxygen. Since the fish were not present the entire season the efficacy of using fathead minnows could not be ascertained.

The efficacy studies indicated that pellets, BTI, and Larvasonic® were effective in reducing mosquito larvae while the briquets efficacy study indicated that the residual effect of this product may only last for 60 to 70 days instead of 150 days.

Human Case Surveillance

Introduction

The intention of human case surveillance is to quickly detect human illness due to West Nile Virus (WNV). Locally acquired human illness occurred for the first time in Peel in 2002, when there were 112 residents with laboratory evidence of the virus (55 suspect cases, 20 probable cases and 37 confirmed cases, including two deaths).[2] Many cases required hospitalization and intensive care. In 2003, there were 10 residents in Peel who had laboratory evidence of WNV infection, nine of whom were confirmed as having West Nile Fever (WNF) and one having a diagnosis of West Nile Neurological Manifestations (WNNM). There were no deaths in 2003 from WNV. Each of the 10 cases reported onset of symptoms in August or September of 2003.[2] An additional 56 residents were assessed but either had a previous infection (49) or it was determined that they did not meet the case definition (7).[2]

While most human WNV infections are without symptoms, about one in five people (20%) develop a less severe illness referred to as West Nile fever.[22] The incubation period is estimated to be three to 14 days, with symptoms lasting approximately three to six days. West Nile Fever (WNF) 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.[22]

Less than one percent of cases (approximately one case in 150) will develop severe neurological disease, with encephalitis being reported more often than meningitis. Additional symptoms among those with severe disease include muscle weakness and a change in mental status. Other symptoms include seizures, optic nerve involvement, cranial nerve abnormalities, paralysis and ataxia (difficulty coordinating movement or body functions).[22]

As there is no cure for WNV; treatment is supportive in nature and involves hospitalization, administering of intravenous fluids, providing respiratory support and preventing secondary infections for patients with severe disease.[22]

Modifiable risk factors for WNV include known travel in an area previously identified as having WNV activity, acquiring the infection through occupational exposure[23], or having received blood, blood products or organ transplants from an infected donor. As a result of these known risk factors, the Canadian Blood Services have screened all donations of blood for WNV since July 1, 2003.[24]

Methods

As of May 1, 2003, West Nile Virus Illness was specified as a Reportable and Communicable Disease under the Health Protection and Promotion Act (Appendix C). In 2004, there were two substantive changes to the WNV case definition. The first was the removal of the 2003 WNV human surveillance investigation category term “possible” from the case definitions. This left “suspect”, “probable” and “confirmed” as levels of confirmation for the diagnosis of WNV. The second change to the case definition was the omission of fever as a required clinical criterion of the West Nile Fever case classification.

Peel Public Health developed and faxed a Health Professionals Update (HPU) to physicians in the Region of Peel on June 21, 2004. This document contained an overview of the WNV experience in Peel in 2003, as well as reporting and diagnostic testing instructions for physicians.

All suspect WNV cases identified by hospitals and physicians were reported to the Public Health department. WNV was suspected in any adult presenting with fever and rash when WNV was present in the community.

Once a blood sample was taken from the patient it was submitted to the Ministry of Health and Long-Term Care (MOHLTC) Central Public Health Laboratory (CPHL) in Toronto. The first test performed on a blood sample was the Immunoglobulin M (IgM) Enzyme-Linked Immunosorbent Assay (ELISA), which, if positive, was run a second time to rule out false positive results. These two tests were followed by PRNT (Plaque Reduction Neutralization Test) to confirm diagnosis in the first three cases within each public health jurisdiction. ELISA test results were available within 24 hours, while the PRNT confirmation testing took an additional seven days.

Peel Public Health staff investigated all suspect probable and confirmed cases among residents in Peel. Standardized medical information including demographics, symptoms, risk factors (such as travel history or having received blood products) and test results were entered into the Reportable Diseases Information System (RDIS) by the Peel Surveillance Unit. The clients will be mapped according to postal code at a later date.

Results

On August 2, 2004 a woman in the Windsor-Essex area was the first person to be reported with a WNV illness in Ontario; this was also the first case in Canada.[25] Ontario had a total of four probable and 10 confirmed cases in 2004 (Table 11).[26] One of the confirmed cases was a 59 year old female from York Region that died of the disease. This case was travel-related as the case contracted the virus while travelling to Florida in July. Toronto had the highest number of confirmed cases in the province with six.

Table 11: Human Case Surveillance for West Nile Virus (WNV) by Health Unit, Ontario, 2004

Health Unit	Probable Cases*	Confirmed Cases**
Chatham-Kent	1	0
Elgin-St.Thomas	0	1‡
Niagara	0	1
Ottawa	1	0
Toronto	0	6‡
Windsor-Essex	1	2
York Region	1***	0
TOTAL	**4**	**10**

*Probable cases refer to patients with two positive IgM ELISA (enzyme-linked immuno sorbent assay) tests
**Confirmed cases refer to patients with two positive ELISA tests AND either a positive confirmatory PRNT (plaque-reduction neutralization test) OR three previous cases have been confirmed by PRNT in the same health unit this year
‡ May have been exposed during travel
***Travel case

Data as of January 5, 2005
Source: Ontario Ministry of Health and Long-Term Care
Available from URL:
http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_04/wnv_humans

In 2004, there were 30 cases reported throughout the country (Ontario 14, Saskatchewan 10, Manitoba 3, Alberta 2, Quebec 1). There were no deaths associated with the individuals that contracted the virus in Canada.[25]

In 2004, there were approximately 120 suspect cases, 0 probable, and 0 confirmed cases for WNV in the Region of Peel. WNV was subsequently ruled out as a cause of acute illness for the 120 suspect WNV cases in Peel. In 2003, there were 10 confirmed human cases in Peel. These results were much lower than the 112 residents with laboratory evidence of WNV identified in 2002, 37 of whom were "confirmed" and 20 were classified as "probable" cases (Table 12).

Table 12: Number of Human Cases* by Municipality, Region of Peel, 2002-2004

Year	Peel	Mississauga	Brampton	Caledon
2002	57	52	5	0
2003	10	10	0	0
2004	0	0	0	0

*Note: Cases include both probable and confirmed.

Summary

Human illness due to WNV acquired in Peel occurred for the first time in 2002, with 112 residents having laboratory evidence of WNV (55 suspect cases, 20 probable cases and 37 confirmed cases, including two deaths).[2] In 2003, there were 10 residents of Peel who had laboratory evidence of WNV infection stemming from the 2003 season, nine of whom were confirmed as having West Nile Fever and one having a diagnosis of West Nile Neurological Manifestations.

There were no residents of Peel Region who had laboratory evidence of WNV infection stemming from the 2004 season. There were 120 Peel residents that were assessed in 2004. They either had a previous infection with WNV or a closely related virus or it was determined that they did not meet the WNV case definition.

Human surveillance for West Nile Virus in 2004 showed that the level of WNV activity in humans was much lower than in previous years. The efforts of hospital-based active WNV human surveillance have resulted in frequent routine diagnostic testing of patients with symptoms of WNV during the summer months when mosquitoes are prevalent.

Other Animal Surveillance

Peel Public Health relies mainly on the testing of crows and mosquitoes to determine the presence and location of the WN virus in Peel Region. Evidence of WNV infection has been found in many wild and domestic animals, including dogs, cats, and squirrels. However, the risk of these other species developing clinical disease from the infection appears to be very low. While many other animal species can become infected with the virus, only results on infected horses are collected and reported by Health Canada. In horses the disease is severe, with up to 30% of horses infected with the virus either dying or having to be euthanized.[27] As part of the provincial West Nile Virus surveillance system, the Ontario Ministry of Agriculture and Food works with the Canadian Food Inspection Agency, Health Canada, veterinarians, and private laboratories in the collection of data on WNV-infected horses. The tracking of infected horses is another resource tool local health units can use for locating the virus in Ontario and across Canada. Peel experienced its first WNV-infected horse in 2003 when a horse in the Inglewood area of Caledon tested positive. [28] There were no WNV-positive horses found in Peel during 2004. [29]

In Ontario, there has been steady decline in the number of presumed or confirmed cases in horses since 2002, when there were 101 presumed or confirmed cases reported. [30] A total of nine confirmed cases for 2004 were documented (Table 13). This represents a significant decline from 2003 when there were 41 presumptive or confirmed horses in Ontario. [28]

Table 13: Horse Surveillance for West Nile Virus by Health Unit, Ontario, 2004

Region	Date of First Case	Date of Last Case	Status
County of Brant	October 12	October 12	1 confirmed
County of Elgin	October 4	October 4	1 confirmed
Region of Durham	October 12	October 12	1 confirmed
County of Lambton	September 30	September 30	1 confirmed
District of Nipissing	August 20	September 13	3 confirmed
District of Muskoka	September 8	September 8	1 confirmed
District of Sudbury	August 26	August 26	1 confirmed

Total: 9 confirmed

Data as of January 5, 2005
Source: Ontario Ministry of Agriculture and Food
URL: http://www.gov.on.ca/OMAFRA/english/livestock/horses/facts/wnv_surv2004.htm

Across Canada, a total of 13 confirmed cases of WNV illness in horses were recorded in 2004, with nine cases in Ontario and four cases in Alberta.[31] The low level of WNV illness in horses across Canada may be due to the use of a vaccine to protect horses from the disease which has been available since September 2001. The vaccine available for use on horses is not licensed for use on other species. These low numbers may be due to the decreased testing for WNV in horses as veterinarians are more experienced in recognizing WNV clinical symptoms in addition horse owners may be reluctant to pay for testing.

Conclusion

Surveillance information collected during the 2004 mosquito season showed a reduction in West Nile Virus activity in Peel compared to 2002 and 2003. The number of positive mosquito batches and human cases declined substantially over the last three years. However, the number of positive birds in Peel did increase from 12 in 2003 to 17 in 2004. This can be attributed to Peel continuing to submit carcasses throughout the entire 2004 WNV season. In previous years the agency that conducted the testing, the Canadian Cooperative Wildlife Health Centre, suspended submissions from a health unit when four positive birds were identified in a jurisdiction; later in the fall they would permit additional submissions.

Although approximately 40 species of mosquitoes are found in Peel only a few are important in the transmission of WNV. The vectors most responsible for the bird – mosquito amplification cycle in Peel are members of the genus *Culex*. Because of their importance, *Culex* species numbers were analysed comparing adult mosquito trap data for 2002, 2003 and 2004. The analysis of trapping results demonstrated that *Culex* mosquitoes accounted for 30% of the mosquitoes collected in 2002, 13% in 2003 and 8% in 2004. The downward trend in *Culex* mosquito activity can be partially attributed to the larviciding program undertaken in both 2003 and 2004 which was primarily directed at the reduction of *Culex* mosquitoes. Other factors that may have impacted *Culex* numbers were breeding site source reduction and weather conditions.

An analysis of the West Nile Virus infection rates in *Culex* mosquitoes was also conducted. The calculations showed that the West Nile Virus infection rates in *Culex* mosquitoes have declined in each of the past three years. When there is a lower prevalence of WNV in the mosquito population, there is a lower risk of humans contracting the disease. In 2004, Peel had no reported human cases; this can be attributed primarily to the low infection rates in Peel's mosquito population.

Analysis of the West Nile virus program data indicates that information collected from bird and mosquito surveillance is valuable in identifying the presence of the virus in a community and can serve as an "early warning system" of the risk to human health. This information can also be used to enhance mosquito reduction activities and public education.

It is appropriate that Peel's 2005 West Nile Virus Prevention Plan continues to focus on surveillance, mosquito reduction and education activities. Source reduction and larviciding should continue to focus on *Culex pipiens* and *Culex restuans* mosquitoes, the main vectors of WNV in Peel.

There are no indications that the spread of the disease has stopped. At this point it is reasonable to assume that the disease has established itself in North

America and will return to Peel at some level in 2005. How much human illness will occur in 2005 is impossible to predict given our limited experience with WNV.

REFERENCES:

1. Centers for Disease Control and Prevention. Division of Vector–Borne Infectious Diseases. Background: Virus History and Distribution. [cited 2004 Nov 19]. Available from: http://www.cdc.gov/ncidod/dvbid/westnile/background.htm

2. Region of Peel. West Nile Virus in the Region of Peel 2003. 2004 [cited 2004 Dec 1]. Available from: http://www.peelregion.ca/health/westnile/resources/reports.htm#report2003Ontario

3. Kilpatrick AM, Kramer LD, Campbell SR, Alleyne EO, Dobson AP, Daszak P, West Nile Virus Risk Assessment and the Bridge Vector Paradigm. Emerging Infectious Diseases. [serial on the internet]. 2005 March [cited 2005 Mar 4], 11(4). Available from: http://www.cdc.gov/ncidod/EID/vol11no03/pdfs/04-0364.pdf

4. Ministry of Health and Long-Term Care. West Nile Virus Preparedness and Prevention Plan for Ontario. May 28, 2004. [cited 2004 Nov 22]. Available from: http://www.health.gov.on.ca/english/public/pub/ministry_reports/wnv_plan_2004/wnv_plan_2004.pdf

5. Centers for Disease Control and Prevention. Division of Vector–Borne Infectious Diseases. Vertebrate Ecology [cited 2004 Nov 22]. Available from: http://www.cdc.gov/ncidod/dvbid/westnile/birds&mammals.htm

6. Region of Peel. West Nile Virus Prevention and Control Plan Evaluation Report (unpublished report). March 2004.

7. Health Canada. West Nile Virus: Canada. Dead Bird Surveillance Results of 2004 Program, Dead Bird Test Results by Province. [cited 2004 Nov 16]. Available from: http://www.phac-aspc.gc.ca/wnv-vwn/pdf_sr-rs/2004/situation_report_091104_db.pdf

8. Canadian Cooperative Wildlife Health Centre. West Nile Virus Provincial Reports [cited 2004 Nov 19]. Available from: http://wildlife1.usask.ca/ccwhc2003/portal/provReports.php

9. Yaremych SA, Warner RE, Mankin PC, Brawn JD, Raim A, Novak R, et al. West Nile Virus and High Death Rate in American Crows. Emerging Infectious Diseases. [serial on the internet]. 2004 April [cited 2004 Dec 9], 10(4). Available from: http://www.cdc.gov/ncidod/EID/vol10no4/03-0499.htm

10. Centers for Disease Control and Prevention. Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention and Control, 2003 [cited 2004 Nov 16]. Available from: http://www.cdc.gov/ncidod/dvbid/westnile/surv&control.htm#surveillance

11. Ontario Ministry of Health and Long-Term Care. Public Information: West Nile Virus 2004 - Mosquitoes.[cited 2004 Dec 8]. Available from: http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_04/wnv_mosquitoes.html

12. Health Canada. West Nile Virus: Canada. Mosquito Surveillance: Results of 2004 Program, Mosquito Test Results by Province [cited 2004 Nov 24]. Available from: http://www.phac-aspc.gc.ca/wnv-vwn/pdf_sr-rs/2004/situation_report_102604_mp.pdf

13. Nasci R, White D, Stirling H, Oliver J, Daniels T, Falco R, et al. West Nile Virus Isolates from Mosquitoes in New York and New Jersey, 1999. Emerging Infectious Diseases [serial on the internet]. 2001 July-August. [cited 2004 Dec 10]. Available from: http://www.cdc.gov/ncidod/eid/vol7n04/nasci.htm

14. Ontario Ministry of the Environment. Summary Report of Activities to Control West Nile virus 2003. [cited 2005 Jan 5]. Available from: http://www.ene.gov.on.ca/envision/gp/4637e.htm

15. Ontario Ministry of the Environment. Permit Applicant Guide for Municipalities and Health Units: Controlling Mosquito Larvae for the Prevention and/or Control of the West Nile virus. April 2004.

16. Pestalto Environmental Products Inc. Mosquito Abatement Program for Vector Reduction of West Nile Virus: Final Report for the Regional Municipality of Peel 2004. December 2004.

17. Pestalto Environmental Products Inc. Mosquito Abatement Program for Vector Reduction of West Nile Virus: Final Report for the Regional Municipality of Peel 2003. December 2003.

18. Wellmark International, S.IL. Altosid Specimen Labels. [cited 2005 Jan 7]. Available from: http://www.altosid.com/

19. Ontario Ministry of the Environment. Methoprene Briquet Efficacy Trials– Region of Peel-(unpublished report). October 2004.

20. Environment Canada. Canadian Climate Normals 1971-2000 [cited 2005 Feb 11]. Available from: http://climate.weatheroffice.ec.gc.ca/climate_normals/results_e.html

21. Ontario Ministry of Natural Resources. Fact Sheet - Fish Stocking to Control West Nile Virus. June 2004.

22. Centers for Disease Control and Prevention. West Nile Virus (WNV) Infection - Information for Clinicians. 2002 August 20. [cited 2004 Feb 18]. [1 screen]. Available from: http://www.cdc.gov/nicdod/dvbid/westnile/resources/fact sheet clinician 082102 0802.pdf

23. Centers for Disease Control and Prevention. Laboratory-Acquired West Nile Virus Infections – United States, 2002. MMWR [serial on the internet]. 2002 Dec 20. [cited 2004 Feb 4] 51/50:1133-35. Available from: http://www.cdc.gov/mmwr/pdf/wk/mm5150.pdf

24. Canadian Blood Services. West Nile Virus (WNV): Update. 2004 February [cited 2004 Feb 26]. Available from: http://www.bloodservices.ca/centreapps/internet/uw v502

25. Health Canada. West Nile Virus: Canada. Human Surveillance: Results of 2004 Program, Human Test Results by Province [cited 2004 Dec 20]. Available from: http://www.phac-aspc.gc.ca/wnv-vwn/pdf_sr-rs/2004/situation_report011104_hm.pdf

26. Ontario Ministry of Health and Long-Term Care. Health Care Professionals. West Nile Virus 2004 - Humans. [cited 2004 Dec 22]. Available from: http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_04/wnv_humans.html

27. Ontario Ministry of Agriculture and Food. West Nile Virus Threat to Ontario Horses. [cited 2005 Jan 6]. Available from: http://www.gov.on.ca/OMAFRA/english/livestock/horses/facts/infothreat.htm

28. Ontario Ministry of Agriculture and Food. West Nile Virus Equine Surveillance 2003. [cited 2004 Nov 23]. Available from: http://www.gov.on.ca/OMAFRA/english/livestock/horses/facts/wnv_surveillance.htm

29. Ontario Ministry of Agriculture and Food. West Nile Virus Equine Surveillance 2004. [cited 2004 Nov 23]. Available from URL: http://www.gov.on.ca/OMAFRA/english/livestock/horses/westnile.htm

30. Ontario Ministry of Agriculture and Food. West Nile virus Equine Surveillance 2002. [cited 2004 Nov 23]. Available from URL: http://www.health.gov.on.ca/english/providers/program/pubhealth/westnile/wnv_02/wnv_horses.html

31. Health Canada. West Nile Virus Canada. Domestic Animal Surveillance: Results of 2004 Program, Test Results by Province [cited 2004 Dec 1]. Available from: http://www.phac-aspc.gc.ca/wnv-vwn/pdf_sr-rs/2004/situation_report_101904_da.pdf

LIST OF APPENDICES

APPENDICES

Appendix A

Health Protection and Promotion Act
Loi sur la protection et la promotion de la santé

ONTARIO REGULATION 199/03

Amended to O. Reg. 322/04

CONTROL OF WEST NILE VIRUS

This Regulation is made in English only.

Determination if action required

1. A medical officer of health shall make a determination whether action is required by a municipality to decrease the risk of West Nile Virus to persons either inside or outside the health unit served by the medical officer of health, based upon a local risk assessment in accordance with the document entitled *West Nile Virus Preparedness and Prevention Plan for Ontario*, published by and available from the Ministry of Health and Long-Term Care, dated May 28, 2004. O. Reg. 231/03, s. 1; O. Reg. 322/04, s. 1.

Notice to municipality

2. (1) Where the medical officer of health has determined that action is required, he or she may give notice to the municipality of the required action. O. Reg. 199/03, s. 2 (1).

(2) In determining required actions under subsection (1), the medical officer of health shall have regard to,

(a) the document mentioned in section 1; and

(b) the generally accepted practices in the field of public health with regard to decreasing the risk of West Nile virus to persons. O. Reg. 199/03, s. 2 (2).

Must comply

3. A municipality shall comply with any requirements set out in the notice. O. Reg. 199/03, s. 3.

What may be required

4. Action required under this Regulation may include, without being limited to,

(a) requirements respecting source reduction measures;

(b) requirements respecting surveillance;

(c) requirements respecting public awareness campaigns about personal protection;

(d) requirements respecting the control measures for larviciding and adulticiding set out in Table 1; and

(e) requirements respecting the time within which the action shall be taken. O. Reg. 199/03, s. 4.

TABLE 1
LARVICIDING AND ADULTICIDING IN ONTARIO — WEST NILE VIRUS RESPONSE

"Triggers" based on surveillance of WNV positive humans, birds, mosquito pools or mammals (horses)

Current-Year WNV findings in Health Unit or municipality	Last Year's WNV findings in Health Unit or municipality	Preparatory Status (Larval surveys, mosquito trapping, mapping, training, etc.)	Larviciding ACTION	Adulticiding ACTION
No West Nile virus found yet	No West Nile virus found; virus found in adjacent Health Unit(s)	Not yet done	Do the preparatory work, then larvicide where indicated	Not indicated
No virus found yet	Virus found	Not yet done	Do the preparatory work, then larvicide where indicated	Not indicated
No virus found yet	Virus found	Done last year and under way this year	Larvicide where indicated	Not indicated
Virus found in non-human (dead bird, mosquito pool or mammal) — isolated or as a "hot spot"	Virus found or not found	Done or under way this year	If a "hot spot" and larvae are present, larvicide around this "hot spot" (if not too late in the season)	Adulticide a 3-km "Zone" ONLY IF there are high-risk indicators of transmission to humans*
Human case(s) — one or a few in a space-time "cluster"	Virus found or not found	Done or under way this year	Larvicide around the case or cluster if larvae are present (and if not too late in season)	Adulticide a 3-km radius Zone around the case or cluster
Human cases continue to occur; continued high-risk indicators*	Virus found or not found	Done or under way this year	Larvicide widely where larvae are found (if not too late in season)	Adulticide 3-km Zones — may be contiguous or overlapping

Note: Public education efforts and non-pesticide means of mosquito source reduction should be in place, and increased as increasing evidence of virus is found (especially human cases) in the current year.

* High-risk indicators of transmission to humans: increasing dead bird sightings; high mosquito infection rates; abundant bridge vector populations; increasing mammal (horse) cases; proximity of mosquito breeding sites to human populations (especially large population centres) and weather conditions that favour mosquito breeding.

1. These are minimum activity standards. Medical Officers of Health may increase the Zone size to be treated or take additional mosquito control actions, if justified by scientific data or recommendations.

2. Medical Officer of Health will maintain a means to record, investigate, and report any confirmed or likely adverse or unintended human health effects attributed to mosquito control actions, and will report any non-human environmental adverse effects that he or she knows about to the Ministry of the Environment and/or other relevant local or provincial authorities.

O. Reg. 199/03, Table 1.

taken from:
http://www.e-laws.gov.on.ca/DBLaws/Regs/English/030199_e.htm

Appendix C

Health Protection and Promotion Act
Loi sur la protection et la promotion de la santé

ONTARIO REGULATION 559/91

Amended to O. Reg. 96/03

SPECIFICATION OF REPORTABLE DISEASES

This Regulation is made in English only.

1. The following diseases are specified as reportable diseases for the purposes of the Act:

Acquired Immunodeficiency Syndrome (AIDS)

Amebiasis

Anthrax

Botulism

Brucellosis

Campylobacter enteritis

Chancroid

Chickenpox (Varicella)

Chlamydia trachomatis infections

Cholera

Cryptosporidiosis

Cyclosporiasis

Cytomegalovirus infection, congenital

Diphtheria

Encephalitis, including,

i. Primary, viral

ii. Post-infectious

iii. Vaccine-related

iv. Subacute sclerosing panencephalitis

v. Unspecified

Food poisoning, all causes

Gastroenteritis, institutional outbreaks

Giardiasis, except asymptomatic cases

Gonorrhoea

Group A Streptococcal disease, invasive

Group B Streptococcal disease, neonatal

Haemophilus influenzae b disease, invasive

Hantavirus pulmonary syndrome

Hemorrhagic fevers, including,

i. Ebola virus disease

Appendix B

Health Protection and Promotion Act
Loi sur la protection et la promotion de la santé

ONTARIO REGULATION 558/91

Amended to O. Reg. 97/03

SPECIFICATION OF COMMUNICABLE DISEASES

This Regulation is made in English only.

1. The following diseases are specified as communicable diseases for the purposes of the Act:

Acquired Immunodeficiency Syndrome (AIDS)

Amebiasis

Anthrax

Botulism

Brucellosis

Campylobacter enteritis

Chancroid

Chickenpox (Varicella)

Chlamydia trachomatis infections

Cholera

Cytomegalovirus infection, congenital

Diphtheria

Encephalitis, primary viral

Food poisoning, all causes

Gastroenteritis, institutional outbreaks

Giardiasis

Gonorrhoea

Group A Streptococcal disease, invasive

Haemophilus influenzae b disease, invasive

Hemorrhagic fevers, including,

i. Ebola virus disease

ii. Marburg virus disease

iii. Other viral causes

Hepatitis, viral,

i. Hepatitis A

ii. Hepatitis B

iii. Hepatitis D (Delta hepatitis)

iv. Hepatitis C

Influenza

Lassa Fever

Legionellosis

Leprosy

Listeriosis

Lyme Disease

Malaria

Measles

Meningitis, acute,

i. bacterial

ii. viral

iii. other

Meningococcal disease, invasive

Mumps

Ophthalmia neonatorum

Paratyphoid Fever

Pertussis (Whooping Cough)

Plague

Pneumococcal disease, invasive

Poliomyelitis, acute

Psittacosis/Ornithosis

Q Fever

Rabies

Respiratory infection outbreaks in institutions

Rubella

Rubella, congenital syndrome

Salmonellosis

Severe Acute Respiratory Syndrome (SARS)

Shigellosis

Smallpox

Syphilis

Transmissible Spongiform Encephalopathy, including,

i. Creutzfeldt-Jakob Disease, all types

ii. Gerstmann-Sträussler-Scheinker Syndrome

iii. Fatal Familial Insomnia

iv. Kuru

Trichinosis

Tuberculosis

Tularemia

Typhoid Fever

Verotoxin-producing E. coli infections

West Nile Virus Illness,

i. West Nile Virus Fever

ii. West Nile Virus Neurological Manifestations

Yellow Fever

Yersiniosis

O. Reg. **558/91**, s. 1; O. Reg. 204/95, s. 1; O. Reg. 380/01, s. 1; O. Reg. 431/01, s. 1; O. Reg. 80/03, s. 1; O. Reg. 97/03, s. 1.

2. Omitted (revokes other Regulations). O. Reg. **558/91**, s. 2

taken from:
http://www.e-laws.gov.on.ca/DBLaws/Regs/English/910558_e.htm

ii. Marburg virus disease
iii. Other viral causes
Hepatitis, viral,
i. Hepatitis A
ii. Hepatitis B
iii. Hepatitis C
iv. Hepatitis D (Delta hepatitis)
Herpes, neonatal
Influenza
Lassa Fever
Legionellosis
Leprosy
Listeriosis
Lyme Disease
Malaria
Measles
Meningitis, acute,
i. bacterial
ii. viral
iii. other
Meningococcal disease, invasive
Mumps
Ophthalmia neonatorum
Paratyphoid Fever
Pertussis (Whooping Cough)
Plague
Pneumococcal disease, invasive
Poliomyelitis, acute
Psittacosis/Ornithosis
Q Fever
Rabies
Respiratory infection outbreaks in institutions
Rubella
Rubella, congenital syndrome
Salmonellosis
Severe Acute Respiratory Syndrome (SARS)
Shigellosis
Smallpox
Syphilis
Tetanus

Transmissible Spongiform Encephalopathy, including,

i. Creutzfeldt-Jakob Disease, all types

ii. Gerstmann-Sträussler-Scheinker Syndrome

iii. Fatal Familial Insomnia

iv. Kuru

Trichinosis

Tuberculosis

Tularemia

Typhoid Fever

Verotoxin-producing E. coli infection indicator conditions, including Haemolytic Uraemic Syndrome (HUS)

West Nile Virus Illness,

i. West Nile Virus Fever

ii. West Nile Virus Neurological Manifestations

Yellow Fever

Yersiniosis

O. Reg. **559/91**, s. 1; O. Reg. 205/95, s. 1; O. Reg. 129/96, s. 1; O. Reg. 381/01, s. 1; O. Reg. 432/01, s. 1; O. Reg. 81/03, s. 1; O. Reg. 96/03, s. 1.

2. Omitted (revokes other Regulations). O. Reg. **559/91**, s. 2.

taken from:
http://www.e-laws.gov.on.ca/DBLaws/Regs/English/910559_e.htm

Appendix D

WEST NILE VIRUS WEEK CODES FOR 2004
Week includes dates from Sunday to Saturday

Week Number	Dates Included
18	May 2 - May 8
19	May 9 - May 15
20	May 16 - May 22
21	May 23 - May 29
22	May 30 - June 5
23	June 6 - June 12
24	June 13 - June 19
25	June 20 - June 26
26	June 27 - July 3
27	July 4 - July 10
28	July 11 - July 17
29	July 18 - July 24
30	July 25 - July 31
31	Aug 1 - Aug 7
32	Aug 8 - Aug 14
33	Aug 15 - Aug 21
34	Aug 22 - Aug 28
35	Aug 29 - Sept 4
36	Sept 5 - Sept 11
37	Sept 12 - Sept 18
38	Sept 19 - Sept 25
39	Sept 26 - Oct 2
40	Oct 3 - Oct 9
41	Oct 10 - Oct 16
42	Oct 17 - Oct 23
43	Oct 24 - Oct 30
44	Oct 31 - Nov 6

Appendix E

2004 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 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 *Culex* 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 or mosquitoes in province	
	3	One to three positive crows locally	
	4	Multiple positive crows (>3) or an equine case locally	
	5	A rapid increase in dead bird (crow) 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 region/area)	1	Virus activity in remote areas	
	2	Virus activity in rural areas	
	3	Virus activity in small towns	
	4	Virus activity in suburban/urban areas	
	5	Virus activity in suburban/urban areas with positive mosquito traps and previous infection rates >5 per 100,000 for a previous season	
Risk Assessment Level		Total	
		Divide total by 7 if summing surveillance factors 1-5 Divide total by 9 if summing surveillance factors 1-7 Divide total by 6 if summing surveillance factors 1-4 Divide total by 8 if summing surveillance factors 1-4 and 6,7 Average	

Appendix F

Definition of Terms

Ataxia: difficulty coordinating movement or body functions

Encephalitis: inflammation of the brain

Host: an animal or plant having received a parasite which then resides within the animal or plant

Hot Spot: in WNV programs, a collection of two or more local positive findings among dead birds, mosquito pools or mammals, as opposed to an isolated finding

Malaise: bodily discomfort, especially without development of a specific disease

Meningitis: inflammation of the lining of the brain or spinal cord

Myalgia: muscle soreness or pain

Sighting: a report of a dead crow received from the public with species being confirmed by animal control authorities at time of carcass pick-up

Vector: carrier of disease or infection from one organism to another

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