

LARVAL MOSQUITO REDUCTION

Objective:

To reduce the abundance of adult mosquitoes of the *Culex* species through the use of Integrated Mosquito Management (IMM) practices.

Background:

All mosquitoes begin their life in water. This offers an opportunity to reduce the number of mosquitoes in an efficient way before the adult mosquitoes emerge and become widely dispersed.

Although approximately 40 species of mosquitoes are found in Peel, only a few are important in the transmission of WNV. *Culex pipiens* and *Culex restuans* are the most important mosquito species in the transmission of WNV. Since 2001, *Culex* mosquitoes have been responsible for the vast majority of positive mosquito batches in Peel, and in the last two years, all of the positive batches have been attributed to *Culex* mosquitoes. They are usually found in urban and suburban areas. They breed quickly and use standing or slow-moving water containing decaying organic materials in which to lay their eggs. Prime breeding sites include roadside catch basins, ditches, discarded tires left outdoors, poorly maintained swimming pools, clogged rain gutters and eaves troughs, covers on unused swimming and plastic wading pools, containers left outdoors to collect water, and other collections of stagnant water that last for a week or more. 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 these mosquitoes can be prevented by either eliminating 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. An Integrated Mosquito Management approach is recommended which makes use of a range of larval control strategies as appropriate to the situation.

Where *Culex* mosquito breeding cannot be effectively reduced by other means, larvicides will be employed. The larvicides that will be used in Region of Peel will be *Bacillus sphaericus* (Bs), *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. 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 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. 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 high in organic material. Sustained release formulations are available so that the application in catch basins will only be necessary every three weeks.

Bti is a biological pesticide which kills mosquito larvae before they develop into adults. Like methoprene, Bti has been extensively used, studied and regulated. However, it is also less effective and more difficult to use, particularly in catch basins. Bti will be used in surface water breeding sites where impacts on species other than mosquitoes are more of a concern.

In 2005, the Pest Management Regulatory Agency approved the use of the biological larvicide *Bacillus sphaericus* (Bs) in Canada for use in controlling mosquito larvae. The Ministry of Environment permitted the use of this larvicide in both catch basins and surface water breeding sites. The active ingredients in *Bacillus sphaericus* and Bti are naturally occurring soil bacteria. Both products have a similar mode of action: larvae ingest the larvicide, consisting of Bti or Bs spores. The bacteria damage the gut of the mosquito larvae, causing the larvae to starve to death. *Bacillus sphaericus* provides mosquito control over a period of time, while Bti, although fast acting does not provide extended control. *Bacillus sphaericus*, unlike Bti, is effective in controlling mosquito larvae in high inorganic environments like catch basins. In 2005, *Bacillus sphaericus* was used in Peel to treat catch basins that drain directly into sensitive sites as well as some selected surface water sites. *Bacillus sphaericus* will continue to be used for these purposes in 2006.

The Region of Peel's Integrated Mosquito Management (IMM) program appears to be effective in reducing the number of *Culex* mosquitoes. In 2005, five per cent of female mosquitoes collected in adult traps were *Culex* compared to eight per cent in 2004, 13 per cent in 2003. In 2002, prior to the implementation of IMM mosquito control measures *Culex* represented 30 per cent of females captured.

Based on the importance of *Culex pipiens* and *Culex restuans* in the transmission of WNV, the Region of Peel Mosquito Control Task Force has identified the following habitats in Peel (in order of priority from highest to lowest) and recommended control strategies:

Habitat	Recommended Control Strategy
Roadside Catch Basins in urban and suburban areas	Larvicide with methoprene – use <i>Bacillus sphaericus</i> or other methods for those that drain directly into environmentally sensitive areas
Artificial Containers on Public Property	Ensure existing sanitation and waste removal on public property and place an emphasis on removing garbage that promotes mosquito breeding
Artificial Containers on Private Property	Educational campaign for small breeding sites. Education, enforcement of property standards or public health legislation if necessary for significant breeding sites on residential or commercial/industrial properties
Roadside Ditches	Site by site assessment – physical alteration if feasible or larvicide if significant mosquito breeding site
Storm water management ponds (wet)	Site by site assessment, with habitat modification or larviciding if significant breeding site
Natural Areas <ul style="list-style-type: none"> • Swamps and marshes • Creeks and floodplains 	Site by site assessment, with improvement of natural controls. Bti or <i>Bacillus sphaericus</i> will be considered if mosquito breeding is significant and not controlled by other means

Roadside Catch Basins

Roadside catch basins are the major habitat in urban and suburban areas for *Culex pipiens* and *Culex restuans*, the main vectors of WNV. While each catch basin is small in and of itself, collectively they represent a large area of mosquito breeding habitat, free of natural predators.

To mitigate WNV, Peel Public Health will hire a licensed applicator to treat approximately 85,000 catch basins (roadside storm drains) using the larvicide methoprene with the cooperation of other departments in the Region of Peel, the City of Brampton, the City of Mississauga and the Town of Caledon. Treatment of catch basins is a core part of WNV reduction programs in southern Ontario. Since catch basins are designed to hold water and do so for long periods of time, the only option for reducing mosquito numbers in a large number of catch basins is to larvicide. Methoprene is the recommended agent due to its effectiveness against mosquitoes, low anticipated effects on non-target organisms and the availability of formulations that provide sustained control for at least three weeks. Catch basins which drain directly into environmentally sensitive areas such as Rattray Marsh or Cawthra Park will be treated with the biological larvicide

Bacillus sphaericus (Vectolex). Alternatives such as flushing with water or vacuuming catch basins have been found to be ineffective tools for control as larvae are found within a matter of days after a vacuuming or flushing.

Peel Public Health will ensure the catch basin larviciding program is in compliance with Ministry of the Environment regulations and guidelines.

As was done in previous years, the Medical Officer of Health will issue an Order to each local municipality directing them to assist in and facilitate the application of larvicides to catch basins and other breeding sites on public property.

Artificial containers

Artificial containers are objects such as tires, buckets, and unused swimming pools etc. that collect rainwater. Besides other sanitation concerns, they are ideal mosquito breeding sites for certain species due to the lack of predators and may be especially productive when they are in a heavily vegetated area. On public lands there are already programs for waste removal and some volunteer programs exist to clean up parks and ravines. Peel Public Health will work with municipal departments and volunteer groups to ensure that existing sanitation and waste removal on public property (including green areas such as parks, cemeteries, golf courses) places emphasis on removing garbage that promotes mosquito breeding.

A large percentage of the land area in Peel is privately owned. Prime breeding sites here include discarded tires left outdoors, clogged rain gutters, unused swimming pools and plastic wading pools and pots and pans containing stagnant water. Every residential and commercial property owner should regularly inspect their property and buildings to determine if conditions are conducive to mosquito breeding and endeavour to eliminate those conditions. The public education campaign in 2006 will continue to highlight the need for Peel property owners to eliminate potential mosquito-breeding sites on private property. Municipal or regional staff will become aware through regular service delivery or by public complaint of significant collections of stagnant water lasting more than a week (e.g. - unused swimming pools, large collections of tires or other refuse). Clean up will be accomplished through property owner education, or failing that, through enforcement of existing property standards by-laws or public health legislation. If required, Peel Public Health will assess for the presence of mosquito larvae. Small accumulations of stagnant water, such as in a birdbath or children's toys left outside, will be dealt with by education alone.

Roadside Ditches

Peel Public Health found a number of roadside ditches that contained vector mosquito larvae in 2005. Last year roadside ditches received more larvicide treatments than any other surface water breeding site in Peel. The most effective way to prevent breeding is to eliminate the stagnant water through improved grading and drainage. This can be an expensive venture and should only be

undertaken if the site is large and likely to be a problem on a continual basis. Municipal roadside ditches that hold water for longer than seven days in the summer months will be referred to the local roads departments for assessment and remediation plans will be considered within existing ditching programs. In the meantime, ditches containing mosquito larvae will be treated with Bti or *Bacillus sphaericus*.

Storm Water Management Ponds

Storm water management ponds are highly visible due to their size and location. Larval surveillance revealed that these sites do not support significant numbers of mosquito larvae. If larvae were found in ponds that constantly held water, it was generally only in small isolated areas that were surrounded with heavy vegetation. In ponds that were designed to hold water for only short periods of time, larvae were located in recessed areas that did not drain properly. In 2005, isolated areas of 13 storm management ponds received treatment: 12 in Mississauga and one in Brampton. In 2004, only three storm water management ponds had vector mosquito larvae in significant numbers to warrant larviciding. The increase in the number of storm water management ponds treated in 2005 can likely be attributed to the hot summer temperatures. The temperatures of these large bodies of water were at levels that were conducive for mosquito breeding most of the summer.

As in previous years, storm water management ponds will be monitored for mosquito larvae. If significant mosquito breeding is found at a site despite the use of other measures, Bti or *Bacillus sphaericus* will be used as part of an integrated mosquito management approach.

Natural Areas

Natural areas such as swamps, marshes, creeks and their floodplains serve as breeding sites for mosquitoes of many different species, the majority of which are not responsible for the amplification of WNV in the environment. However, areas where there are temporary pools are believed to be the most important. Areas of open or flowing water do not make good mosquito breeding habitats. Natural areas present special challenges and concerns for mosquito control. Any intervention in these areas must take care not to unnecessarily disrupt the existing ecosystem. And while many mosquitoes are present, many may not be important vectors of WNV. For example, the large number of *Aedes* mosquitoes that emerge in the spring are thought to play little if any role in WNV transmission.

The approach to mosquito control in natural areas in the Region of Peel for 2006 will involve assessment of breeding sites and larval monitoring to determine numbers and species important to WNV transmission. Response will be based on these assessment results and may involve improving natural controls, altering water flows if it does not damage the natural ecosystem and application of Bti or *Bacillus sphaericus* if other measures are insufficient to control mosquito

breeding. In environmentally sensitive areas such as Rattray Marsh or Cawthra Woods, Peel Public Health will follow the special process that has been developed by the Ministry of Natural Resources. It involves key provincial and federal agencies to provide recommendations on how to manage each specific site so as to minimize the impacts on rare and sensitive species present there.

Planned Activities:

- Public education materials will ask residents and property owners to eliminate mosquito breeding sites on private property.
- Peel Public Health will work with municipal departments and volunteer groups to ensure that existing sanitation and waste removal on public property (including green areas such as parks, cemeteries, golf courses) places emphasis on removing garbage that promotes mosquito breeding (e.g. tires, pails, etc).
- Reports of stagnant water on private property will be assessed as per usual practice by property standards officers. Small sites will be dealt with through education. Significant potential breeding sites which are not cleaned up will be assessed by Peel Public Health for mosquito breeding, and if significant, pursued through local property standards by-laws or public health legislation, as appropriate.
- Peel Public Health will consider enhancing natural biological controls in storm water management ponds such as stocking them with fathead minnows, if the Ministry of Natural Resources provides assistance in verifying that the site is suitable for biological control.
- Peel Public Health and other agencies will identify areas of stagnant water associated with surface grading problems, road construction, clogged sewers and catch basins and obstructed waterways that are serving as mosquito-breeding habitats. These areas will be assessed on a site specific basis as they are identified and may be treated with larvicide. Remediation will be performed if possible.
- The larvicide methoprene will be applied to approximately 85,000 roadside catch basins in Brampton, Mississauga, and in the towns, villages and rural subdivisions of Caledon. It is anticipated that this will consist of four applications starting in June and ending in late August. In 2004 and 2005, catch basins in green spaces of municipal parks were included in the larviciding program as were catch basins on properties owned and/or managed by the Region of Peel. Applications will continue to be conducted at these locations in 2006.
- Backyard catch basins will be only be treated upon the request of the homeowner. A consent form must be signed by the homeowner prior to

treatment. Methoprene will be the larvicide used to treat backyard catch basins.

- In catch basins draining directly into environmentally sensitive areas, the biological larvicide *Bacillus sphaericus* will be used.
- Peel Public Health, in collaboration with local conservation authorities and parks departments, will monitor natural areas for mosquito larvae. Where possible, natural controls will be enhanced. Larvicide (Bti) and or *Bacillus sphaericus* will be applied on a site specific basis if sufficient numbers of mosquitoes implicated in the transmission of WNV are found, in compliance with Ministry of the Environment and Ministry of Natural Resources requirements.

ADULT MOSQUITO REDUCTION

Objective:

To reduce the abundance of adult mosquitoes in areas of elevated risk to human health from WNV through the judicious use of pesticides.

Background:

The application of chemicals to kill adult mosquitoes by ground or aerial application is called adulticiding. Adulticiding would only be considered in Peel if there was a significant risk to human health. Adulticides are typically applied as an Ultra-Low-Volume (ULV) spray, where small amounts of insecticide are dispersed either by truck-mounted equipment or from fixed-wing or rotary aircraft. For effective adult mosquito reduction, the fine ULV droplets must drift through the habitat and come in contact with flying mosquitoes. Adulticiding is usually the least efficient mosquito control technique since adult mosquitoes are widely dispersed and the pesticide has to make contact with the mosquito in order to kill it. Nevertheless, adulticiding, based on surveillance data, can be an extremely important part of any Integrated Mosquito Management (IMM) program. If an outbreak of WNV in people is occurring or imminent, it means that large numbers of WNV-infected adult mosquitoes are likely present. This risk can only be mitigated in the short term through adult mosquito reduction.

During the WNV season, Peel Public Health's West Nile Virus Working Group will conduct a weekly risk assessment based on surveillance information to identify the relative risk of human infection in Peel. Prior to any decision to apply adulticides, this working group will consider a number of factors in the context of mosquito and WNV biology to assess the level of risk to human health:

- Dead bird distribution and density – this helps to assess the amount of WNV in an area and its location. A large die-off of crows from WNV suggests that human cases may occur in the next few weeks.
- Mosquito species distribution, density and trends – to see if mosquito populations are those known to transmit WNV and if they are present at a high or low level.
- The level of WNV present in mosquitoes – the presence of WNV in a high proportion of mosquitoes, especially those known to bite humans is of greatest concern.
- Density and proximity of human populations to positive findings of WNV.
- The time of year – human cases of WNV typically are greatest in the last two weeks of August and the first two weeks of September. Therefore,

indications of high WNV activity prior to this time are of much greater concern than those after it.

- Weather – certain conditions are necessary in order for adulticides to be applied effectively. Some forecasts may predict conditions that would result in a rapid decline in mosquito numbers making adulticiding unnecessary.
- The distribution of human cases in Peel and in other jurisdictions in the current year compared to past experience.

Because of the large number of factors, the decision to adulticide will be made on a case by case basis by the local Medical Officer of Health. This decision is made more difficult by having only three years of experience in which human cases of WNV occurred in Peel. However, every effort will be made to target this intervention to specific areas of risk and not an entire city or the entire Region and only when deemed necessary.

Adulticiding would be conducted using a truck-mounted unit. Aerial application is not being considered at this time. The adulticiding agent of choice will be malathion.

Planned Activities:

- Adulticiding decisions will be made on a case by case basis according to the level of human risk of WNV.
- Peel Public Health is planning to use malathion if necessary for adult mosquito control. Peel Public Health will annually review the availability, health impact and effectiveness information of pesticides. Any product will be applied in compliance with local, provincial and federal laws and regulations.
- The public will be notified of adulticide locations and schedules in advance, which will allow sufficient time to take any necessary precautions to reduce pesticide exposure (see Public Education and Community Outreach).
- Information will be released at least 48 hours in advance through the media, the Peel Public Health Web site, Health Line Peel and pertinent municipal and community organizations and the Ontario Regional Poison Control Centre in accordance with MOE requirements.
- Hospitals and the Ontario Regional Poison Control Centre will be notified regarding the adulticiding schedule. Information on the pesticide that will be used will be provided to the public, physicians and other health care providers.

- Elected officials will be notified immediately once the Medical Officer of Health has made the decision to adulticide.
- Adult mosquito reduction measures will be scheduled when mosquitoes are active and when weather conditions are conducive to its success.
- Peel Public Health will monitor and assess control activities for any potential environmental and health effects through several measures which may include pre- and post-spray environmental sampling and addressing pesticide exposure complaints received by Peel Public Health.