Detroit Water and Sewerage Department

Wastewater Master Plan

DWSD Project No. CS-1314

Potential Mosquito Reduction Activities For DWSD Sewerage Facilities

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Table of Contents

1. Purpose and Scope 1

2. West Nile Virus 1

3. Control of Mosquitoes 2

4. Findings 3

5. Conclusions 4

6. References 4

Potential Mosquito Reduction Activities For DWSD Sewerage Facilities

1. Purpose and Scope

West Nile Virus and other mosquito borne diseases affect many people each year. Michigan had the second highest numbers of human cases of West Nile Virus (WNV) in the United States in 2002 (614 cases) (1). A majority of those infected in Michigan lived in southeast Michigan. Mosquitoes also transmit dog heartworm to dogs, and Eastern Equine Encephalitis and WNV to horses.

The scope of this technical memorandum is to describe the West Nile Virus disease cycle and identify methods and controls that DWSD could employ that would reduce or prevent mosquito breeding areas in DWSD facilities.

2. West Nile Virus

There is no cure for West Nile virus. The numbers of human cases and deaths from WNV in southeast Michigan coupled with a lack of a cure give urgency to preventing WNV. The Wayne County Department of Public Health, West Nile Virus (A Mosquito Borne Disease) booklet (2) and the Michigan Mosquito Control Manual (3) give detailed information about WNV and mosquito control.

The *Culex* species of mosquito is the species most involved in the transmission of mosquito borne diseases in Michigan. The *Culex* species is associated with these diseases; WNV, dog heartworm, Eastern Equine Encephalitis and St. Louis Encephalitis (3).

The *Culex* mosquito feeds on birds and mammals (people). Birds are the reservoir of WNV. The female mosquito transmits the virus from birds to birds and to humans through mosquito bites. One female mosquito can carry 1 million WNV. Humans are dead end hosts of the WNV cycle, which means that they do not transmit the virus to birds or mosquitoes.

Culex mosquitoes prefer to lay eggs in stagnant water that contains organic material. The *Culex* mosquito population increases in hot dry weather. This is because more stagnant pools are created in dry weather, which provides still water for the eggs to hatch. In addition the virus multiplies more rapidly in the mosquito in hot weather. The female *Culex* mosquito lays its eggs in rafts several times a year. The breeding cycle generally occurs in April, June and August. The mosquito grows from egg to adult in about 10 days.

The adult mosquito has a flight range of about 1 mile but generally stays near where it hatches if there are blood meals available. It rests in the tops of trees at night. The adult *Culex* mosquito has been found to over winter in New York City (7), southeast

Michigan and Windsor, Canada in manholes and other protected areas. The virus survives in the over wintering mosquitoes. In addition, birds that remain in the area over the winter may also carry the virus through the winter (7).

WNV has been detected in at least 138 species of birds. Crows and blue jays are more susceptible to the virus and reporting dead crows and blue jays is important in the surveillance of the disease. Dead crows and blue jays should be reported to the local health agency. An association has been found between the reporting of dead birds and the first human WNV infections. Generally, there is a three-week period between the first reported dead bird in an area and a human case of WNV.

3. Control of Mosquitoes

Control of mosquitoes is best addressed by an integrated pest management program (IPM). An IPM is "An ecological approach to pest management in which all available techniques are consolidated into a unified program so that pest populations can be managed to avoid economic damage and minimize adverse effects to humans and the environment." (5) An IPM includes the following:

- Surveillance - numbers and locations of mosquitoes, mosquito breeding areas, disease activity
- Source Reduction - tire drives, eliminating stagnant water
- Education - information to the public on eliminating rain catchers, stagnant water
- Larviciding - application of various methods to eliminate mosquito larvae
- Adulticiding - spraying to kill adult mosquitoes

This technical memorandum (TM) does not develop an IPM. The actions taken by DWSD should be part of a community's IPM. The following recommendations should help reduce mosquitoes and the risk of mosquito borne diseases. Early intervention to reduce the mosquito population through larviciding and source reduction interrupts the amplification of the virus in birds. Reducing amplification reduces the risk to humans. Larviciding is the control of mosquito larvae through the application of insecticides, hormones or a bacterial agent.

Mosquito control programs in other communities use a variety of insecticidal controls. These include:

- *Bacillus thruingiensis israelensis* (Bti), a bacteria that kills mosquito larvae. The bacteria are supplied in powders or briquettes.
- *Bacillus sphaericus*, another bacteria, but it is not as effective against the *Culex* mosquito.

These bacteria are non-toxic to humans and have little impact on plants or animals. New York City uses VectoLex (Bacillus sphaericus), VectoBac (Bacillus thuringiensis var. israelensis, Bti) and / or Altosid (methoprene) to control mosquito larvae (7, p.22) Table 1 provides the names of insecticides that are available for larviciding, the cost per catch basin, residual time and mode / action of the insecticide. Larviciding

requires approval from the Water Division, Michigan Department of Environmental Quality, 517-373-1320. Additional information on pesticide use, risk and safety can be found in reference 3.

Table 1. Insecticide Costs

Insecticide	Cost	Rate	Cost/CB
Abate® 5% PG	$9.99/lb	10 lb/ac	$.15
Abate®	$302/gal	1.5 oz/ac	$.01
VectoLex® CG	$4.75/lb	20 lb/ac	$.11
VectoLex® WSP	$50/100 pk	871 pk/ac	$.50
VectoLex® WDG	$39.25/lb	1.5/ac	$.07
Altosid® Pellets	$24.09/lb	10 lb/ac	$.27
Altosid® Briquets	$360/400 bqt	871 bqt/ac	$.90
Larviciding Oils	$4.49/gal	5 gal/ac	$.03

4. Findings

West Nile virus was found in Detroit, and Wayne, Macomb, St. Clair and Oakland counties in 2002. According to the Centers for Disease Control and Prevention, Suggested Guidelines for Phased Response to West Nile Virus Surveillance Data, areas that have had West Nile virus should apply larvicides to locations identified by an entomologic survey. (6) Larviciding could involve many DWSD structures. Identification of the areas that should be larvicided could be determined by the Detroit City Health Department. DWSD personnel can help in the gathering of information by reporting dead crows and blue jays to the local health department.

A study in southern California found mosquitoes in many different stormwater BMP structures (4). The study found that technologies that maintained permanent standing water, such as sumps or basins, provided an excellent habitat for mosquitoes. BMPs that drained rapidly rarely had mosquitoes. Examples of BMPs that drained rapidly are; biofiltration swales and strips, Austin-type sand media filters, infiltration basins and trenches, extended detention basins. (4, p.9) If structures drain in 72 hours, they are not a significant source of mosquitoes (4, p.11).

Excluding mosquitoes has also been effective in reducing mosquito larvae. A below ground sump was mosquito proofed in California by sealing off all entry ports with foam seals on the lids and fine mesh nets on the effluent pipe (4, p.11).

To reduce the mosquito population in the DWSD sewerage system, the following actions are recommended:

1. Generally good housekeeping that minimizes access of mosquitoes to the inside of buildings will prevent mosquitoes access to water or wastewater that is needed for laying eggs.
2. Provide information on WNV source reduction tips and other helpful information for homeowners in the DWSD water bills that are sent during April to August.
3. Develop educational material for DWSD employees to familiarize them with larviciding, methods to prevent breeding of mosquitoes, personal protection

measures and value of reporting to local health departments the location of dead crows and blue jays that they might come across.

4. Apply larvicides to catch basins that hold water in April, July and August. There are larvicides that are effective for 150 days. If one of these is used, one application might be enough for the year. New York City applies larvicide twice a year to 150,000 catch basins (7, p.20).

Examples of what New York City and other communities have included in their IPM are;

1. Eliminating standing water where possible. Examples include keeping water from accumulating in equipment, appurtenances, tires, containers, gutters, and standing water in plant containers.
2. Cutting weeds along building foundations and fence lines to eliminate resting places for mosquitoes.
3. Install mosquito magnet traps to survey and control mosquitoes at the wastewater treatment plant. (7, p.19)
4. Inspecting CSO and stormwater outfalls for buildup of debris or sediment. Removal of debris and sediment will eliminate standing water, which is an ideal breeding place for mosquitoes.
5. Under consideration is a modification of the design of catch basins that could reduce or eliminate catch basins as mosquito breeding sources. The modification is intended to eliminate standing water in catch basins. If this becomes an industry standard it would be worth considering for mosquito reduction efforts.

5. Conclusions

The DWSD sewerage system provides suitable habitat for mosquitoes to reproduce. With the presence of West Nile virus and other mosquito borne diseases in the southeast Michigan area, actions that DWSD can take to reduce mosquitoes can reduce the risk of humans to contract these mosquito borne diseases.

DWSD can assist with WNV control by maintaining general good housekeeping at facilities, providing educational material to the public and DWSD employees, larviciding catch basins, and cooperating with community IPMs for mosquito control.

6. References

1. CDC Office of Communication, www.cdc.gov/od/oc/media/wncount.htm website, West Nile Virus Update Current Case Count, March 27, 2003.
2. Wayne County Department of Public Health, West Nile Virus (A Mosquito Borne Disease) Revised 03/03.
3. Michigan Mosquito Manual, Michigan Department of Agriculture, Michigan Mosquito Control Association, revised 9/2002, available on line at www.mimosq.org.
4. Stormwater Features, The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs, Metzger, Marco, Dean F. Messer, Catherine L. Beitia, Charles M. Myers and Vicki Kramer, www.forester.net/sw_0293_dark_.html

5. WNV Abatement Options, Michigan Mosquito Control Association, power point presentation, 4/14/03, Washtenaw County West Nile Prevention Seminar.
6. Centers for Disease Control and Prevention, Suggested Guidelines for Phased Response to West Nile Virus Surveillance Data, http://www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-pr-2001.pdf
7. New York City Department of Health, 2002 Comprehensive Mosquito Surveillance and Control Plan