Nassau County
Mosquito Control Plan
2009

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Prepared for:

NASSAU COUNTY DEPARTMENT OF PUBLIC WORKS
and
Nassau County Department of Public Health

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List of Abbreviations and Acronyms

CDC	Centers for Disease Control
EEE	Eastern Equine Encephalitis
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information System
GPS	Global Positioning System
IPM	Integrated Pest Management
MCP	Mosquito Control Plan
NCDOH	Nassau County Department of Health
NCDPW	Nassau County Department of Public Works
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
SWB	Stormwater Recharge Basin
ULV	Ultra-Low Volume
USFWS	U.S. Fish and Wildlife Service
WNV	West Nile Virus

1 Introduction

The Nassau County Department of Public Works (NCDPW) and the Nassau County Department of Health (NCDOH) work together to suppress mosquito populations through mosquito surveillance and control. Both departments are committed to utilizing the Integrated Pest Management (IPM) approach, which focuses on long-term suppression or prevention with a minimal impact on the environment and on non-target organisms.

IPM control measures emphasize prevention and promote the most environmentally benign measures such as water management and physical control methods, and natural and biological controls, including larvicides targeted to specific areas. Pesticides that kill adult mosquitoes on contact (also called adulticides) are used only when a public health threat is imminent and other control measures have proved insufficient.

Subject to the commitment made in the Nassau County Mosquito Control Program Generic Environmental Impact Statement, this Mosquito Control Plan (MCP) will be reviewed annually to manage the mosquito problem in the county. The Plan will be evaluated each year based on mosquito surveillance reports, the prevalence of disease, the impact of previous control measures, and lessons learned from other programs in the region. Historic data on mosquito surveillance and mosquito-borne disease cases in Nassau County can be found in Appendix A.

2 Background Information

Mosquito control began in Nassau County in 1915 as a response to mosquito-borne malarial outbreaks.[1] Kerosene and No. 2 fuel oil were used to coat bodies of standing water, suffocating the mosquito larvae and reducing the adult mosquito populations. The malarial threat was under control by 1920, but the practice of spraying oil on standing water continued for mosquito nuisance control. In the 1930s, after the formation of a Mosquito Commission in Nassau County, ditching became an effective way of draining salt marshes to reduce mosquito-breeding areas. In 1948, the NCDPW took over mosquito control in Nassau County. At that time existing control measures were improved by mechanizing ditching procedures, using spray trucks, and using new mosquito-control products. When the NCDH joined the Mosquito Control Program in 1996, surveillance activities were greatly enhanced, as were analytical and virus-testing abilities.[2]

In 1999, with the outbreak of West Nile Virus (WNV), Nassau County expanded its mosquito control program using IPM principles. IPM promotes the use of non-chemical means to control pests wherever possible. Contact pesticides (adulticides) are used only if other methods of control fail and the risk of mosquito-borne disease reaching the human population outweighs the impacts of pesticide application.

[1] Nassau County. *Mosquito Surveillance and Control Report*. 2005.
[2] Nassau County. *Nassau County Mosquito Control Program 2002 Plan of Work*. 2002.

3 Public Health Concerns

Mosquitoes carry many diseases that can affect human, livestock, and wildlife populations. Fortunately, many of the worst diseases, including yellow fever and dengue fever, are not present in the United States. The threat of locally-transmitted malaria was minimal in Nassau County following the control measures in the 1920s. It was not until WNV appeared in Nassau County and other parts of the United States in 1999 that mosquito-borne disease again posed a significant human health threat.

In general, the populations most susceptible to mosquito-borne illnesses are children under the age of 15 and adults over the age of 50. The most effective way for a person to reduce their risk of WNV and other mosquito-borne disease is through the prevention of mosquito bites. Wearing long pants and sleeves, applying insect repellent while outdoors, and keeping screens on all open windows and doors while indoors are some simple, but effective methods of preventing mosquito bites.

3.1 West Nile Virus

WNV is a mosquito-borne viral disease that can cause serious illness and, in some cases, death. However, the chances of a person becoming ill with WNV are small. Most people who are infected with the virus will not exhibit any symptoms. Approximately 20% of the people who become infected will develop a fever with mild to moderate flu-like symptoms that usually last from three days to a week but can last several months. In most cases these symptoms will go away without treatment. In severe WNV cases, encephalitis (swelling of the brain) or meningitis (inflammation of the brain and spinal cord) can occur and be fatal. Approximately 1 in 150 people infected with the virus will develop these severe symptoms[3] Children and the elderly are more at risk of developing the severe form of WNV than the rest of the general population. There is no vaccine or medication that can treat WNV. Hospital care for severe cases consists of administering intravenous fluids, assistance breathing if needed, and help preventing secondary illnesses such as pneumonia.[4]

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[3] New York State Department of Health. (2007). *West Nile Virus*. Retrieved July 2009, from http://www.health.state.ny.us/diseases/west_nile_virus/

[4] Essig, MG. *West Nile Virus – Topic Overview*. Retrieved July 2009, from http://health.yahoo.com/infectiousdisease-overview/west-nile-virus-topic-overview/healthwise--uf4421.html

3.1.1 WNV Cases

WNV was first reported in North America in 1999 and has spread across the United States. Since 2000, there have been more than 254 cases and 26 deaths in New York State alone.[5]

Nassau County historically has had high incidences of human WNV cases compared with other counties in New York State (Table 3-1). The higher incidence of WNV is likely due to the fact that much of Nassau County is suburban, where human population densities are high and artificial containers are common. Standing water collects in swimming pools, bird baths, rain gutters, old tires, children's toys and other objects and these pools provide prime breeding ground for mosquitoes.

Table 3-1 Cumulative Human West Nile Virus Cases by New York County (2005 to 2008)

	2008	2007	2006	2005
Bronx County	1	2	1	3
Kings County	3	6	0	3
Nassau County	20	2	5	12
New York County	1	1	1	1
Niagara County	0	0	1	0
Onondaga County	0	0	1	0
Queens County	5	7	2	5
Richmond County	5	2	8	2
Rockland County	0	1	0	0
Suffolk County	9	0	2	9
Wayne County	0	0	1	0
Westchester County	2	1	2	3
Total	**46**	**22**	**24**	**38**

Source: U.S. Geological Survey. (2005-2008). West Nile Virus Maps. Retrieved July 2009 from http://diseasemaps.usgs.gov/wnv_historical.html.

3.1.2 WNV Transmission Cycle

In the United States, wild birds, primarily crows and jays, are the main reservoir or source of WNV. However, the virus is actually spread by certain species of female mosquitoes. Only females require a blood meal because of the nutritional demands of making eggs; male mosquitoes do not bite. Mosquitoes become infected with WNV when they feed on infected birds. The virus enters the bloodstream of the mosquito and circulates for a few days, settling in the salivary glands. When the infected mosquito bites an animal or a human, the virus enters the host's bloodstream, potentially causing serious illness.

3.1.3 Mosquito Species

There are approximately 70 different mosquito species in New York State. Sixteen of these species have been associated with WNV in Nassau County but only

[5] New York State Department of Health. (2007). *West Nile Virus*. Retrieved July 2009 from http://www.health.state.ny.us/diseases/west_nile_virus/

a few are common carriers that bite humans. Appendix B indicates the number of female mosquito species trapped in 2008. Of the 23 species trapped in 2008, two species, *Culex pipiens* and *Culex restuans*, tested positive for WNV.

Culex pipiens and *Culex restuans* are the predominant species that carry WNV in Nassau County. Both species can tolerate a wide range of breeding habitats and are often found in larval form in natural stagnant pools, in artificial containers where water has collected, and in still catch basins. They also can develop in water that is clean or high in organic content or even highly polluted. Therefore, most bodies of standing water are possible breeding sites for these vector species.[6,7]

3.2 Eastern Equine Encephalitis

In addition to WNV, eastern equine encephalitis (EEE) is a mosquito-borne virus that presents a threat to the health of humans, horses, and other large mammals. Mosquitoes become infected with EEE when they feed on birds that are infected with the virus. Infected mosquitoes transmit the disease to other animals when they feed on horses, humans, and other mammals. Horses and humans are not a source of infection for EEE and cannot transmit the disease.

There has never been a human case of EEE in Nassau County. The last human case in New York State was diagnosed in 1983, but states in the northeastern U.S. have seen EEE in the human population in 2004, 2005, 2006, and 2007.[8] A vaccine is available to protect horses, but there is no vaccine for humans. The last case of EEE detected in Nassau County was in a horse in 2005.

EEE symptoms in humans usually appear within 5 to 15 days after the bite of an infected mosquito. Symptoms range from a mild flu to inflammation of the brain, coma, and death. Like WNV, some people who contract the virus will not develop any symptoms. The most susceptible populations are children and the elderly. For people who develop the most severe symptoms, where infection of the central nervous system occurs, fever, muscle pains, and headache can be quickly followed by seizures or a coma. The most dangerous condition of the virus is encephalitis, or swelling of the brain. EEE is one of the most pathogenic mosquito-borne diseases in the U.S., with a reported case fatality rate of 30% to 70%. It is estimated that 35% of the people who survive EEE will have mild to severe disabilities. Like WNV, there is no specific treatment for EEE. Treatment focuses on reducing fever and swelling in the brain.[9]

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6 Crans, WJ. (2007). *Culex pipens* Linnaeus. Retrieved July 24, 2009 from Rutgers University Center for Vector Biology, http://www.rci.rutgers.edu/~insects/pip2.htm.

7 Crans, WJ. (2007). *Culex restuans* Theobald. Retrieved July 24, 2009 from Rutgers University Center for Vector Biology, http://www.rci.rutgers.edu/~insects/rest.htm.

8 US Center for Disease Control. (2008). *Confirmed and Probable Cases of Eastern Equine Encephalitis, United States, 1964-2007, By State*. Retrieved July 2009 from www.cdc.gov/ncidod/dvbid/Arbor/pdf/EEE_DOC.pdf

9 New York State Department of Health. (2006). *Eastern Equine Encephalitis*. Retrieved July 2009 from http://www.health.state.ny.us/diseases/communicable/eastern_equine_encephalitis/fact_sheet.htm.

4 Mosquito Biology

4.1 Mosquito Life Cycle

Mosquitoes have four distinct stages in their life history: the egg, larva, pupa, and adult. Adults feed on plant materials; only females feed on the blood of birds or mammals to provide the nourishment needed for their eggs to develop. Adults mate and the females lay eggs in water or in damp soil that may become inundated. The eggs hatch into larvae, which look wormlike and feed on microorganisms, including algae. They grow and molt through four stages and undergo a metamorphosis during which they become pupae, the non-feeding stage where the wings develop internally. The pupae emerge as adults to complete the life cycle.

The larvae, also known as "wrigglers," and the pupae, sometimes called "tumblers," require a water habitat. Although the larvae live and get their food in the water, they must come to the surface for air or obtain air from the underwater portions of aquatic plants.

4.2 Mosquito Season

The mosquito life cycle depends on temperature and moisture. Warm, wet conditions are most hospitable to mosquito breeding and larvae development. As such, warm weather storms in the spring, summer, and fall foster mosquito breeding, as do above-average tidal height, which can induce salt marsh mosquito eggs to hatch.

Duration of the mosquito life cycle is species-specific. Some species can take as little as four days to complete a life cycle, while others develop over a period as long as several weeks. The accumulation of water in any object or natural depression that contains some organic matter for even a few days can serve as a breeding site for mosquitoes.

Although mosquitoes are usually active from early spring until freezing weather, Nassau County's mosquito control program operates throughout the year. The busiest time is from May until October, but mosquito larvae have been found as late as November. Mosquitoes sometimes survive the winter as adults in residences, street drains, and other warm/moist places, emerging on mild days.

4.3 Mosquito Habitats

Mosquito larval development occurs in most aquatic habitats except fast-moving water and the open water of lakes, seas, and oceans. Habitat types are permanent pools; transient water; floodwater; artificial containers (e.g., tires and un-maintained swimming pools) and natural containers such as holes in tree stumps. Different species of mosquitoes prefer certain types of aquatic habitat for breeding and development and can be categorized based on this preference.

Mosquitoes preferring permanent pools are generally found in bodies of still, fresh water, such as permanent, shallow, or marginal ponds, lakes, and smaller impoundments. Transient habitats include waters found in storm drains, roadside ditches, clogged streams, and puddles. Floodwater mosquito species prefer areas that are intermittently inundated with water.

Both permanent and transient habitats for mosquitoes are present in Nassau County. The tidal marshes on the county's north and south shores also provide extensive areas of floodwater habitat. Artificial containers and holes in trees are extremely common in all residential areas of the county. Swimming pools, bird baths, rain gutters, old tires, pails, cans, children's toys, or any object that can collect and hold water may serve as a breeding site.

5 Mosquito Surveillance

Nassau County is committed to applying the IPM principles to all of its pest control activities. Accordingly, the cornerstone of the county's mosquito control program is surveillance. Treatment strategies based on surveillance are best because they work with the latest information on the mosquito population. All treated areas are revisited following treatment in order to monitor the efficacy of that strategy.

Monitoring the larval and adult stages of the mosquito population is an integral part of an effective IPM program. Two methods of monitoring actual and/or potential mosquito populations are "dipping" for larvae and "trapping" adult mosquitoes with CDC (Centers for Disease Control) light traps, gravid traps, and New Jersey light traps.

5.1 Dipping

The most effective means of controlling mosquito populations is to limit their ability to breed, thereby decreasing the future population size. In order to reduce their breeding potential, the NCDPW identifies likely breeding sites and checks to see if there are mosquito larvae developing in the water. This process is called dipping.

The results from the dipping surveys determine if control measures are necessary and what measures to take to reduce mosquito populations. When larvae are present, physical control methods and/or the appropriate larvicide may be applied. IPM practices call for using pest control products only when mosquito larvae are identified, so dipping plays an important role in minimizing the use of pesticides.

5.1.1 Dipping Methodology

"Dipping" for larvae is the sampling technique used to estimate the number of larvae present in standing water and the type of mosquito breeding. A dipper consists of a long pole with a cup on the end. Larvae are collected, counted, and, when feasible, identified to the species level and larval stage.

5.1.2 Dipping Frequency

Dipping surveys are conducted on the South Shore marshes every Monday from May through November. Other areas are dipped based on citizen complaints.

5.2 Trapping

Trapping provides important and detailed information about mosquito populations. Through this process:

- The adult mosquito population throughout the county at any given time is estimated.
- Specific areas with high mosquito populations are identified.
- The genus and species of the mosquitoes are identified.
- Mosquitoes are tested for diseases, particularly WNV and EEE.
- The effectiveness of control methods are assessed.

After trapping, the mosquitoes are delivered to the NCDH laboratory for identification and enumeration. The mosquitoes are pooled together by species and shipped to the New York State Department of Health lab for analysis.

5.2.1 Trapping Methodology

Nassau County uses three different kinds of traps: CDC light traps, gravid traps, and New Jersey light traps.

5.2.1.1 CDC Light Traps

CDC light traps use a combination of light (battery-operated) and carbon dioxide to attract mosquitoes. Carbon dioxide comes from the sublimation of dry ice, which is simply frozen carbon dioxide. At ambient air temperatures, dry ice converts directly to gaseous carbon dioxide. CDC traps are placed at designated trap sites throughout the season.

5.2.1.2 Gravid Traps

"Gravid" refers to the female mosquito when she is heavy with eggs. Generally, a blood meal is required to provide the nourishment necessary to develop and deposit her eggs. Gravid mosquitoes are considered to have a higher probability of carrying disease because they are more likely to have taken a blood meal.

A gravid trap consists of a tray containing standing water and a high amount of organic matter, which is necessary to nourish mosquito larvae once they emerge from their eggs. Just above the water level in the tray is a cylinder with a battery-driven fan. As mosquitoes fly into the tray to deposit their eggs on the putrid water, the fan sucks the mosquitoes into a collection bag. Gravid traps are more effective later in the season when mosquitoes have obtained blood meals; therefore fewer gravid traps are set than CDC traps.

5.2.1.3 New Jersey Light Traps

New Jersey light traps attract mosquitoes solely by light and are suitable for monitoring the large numbers of salt marsh mosquitoes found on the shores of Nassau County. New Jersey light traps are somewhat limited because they require an electrical outlet rather than batteries. New Jersey traps also tend to damage the mosquito specimens, which makes species identification difficult, so the county uses New Jersey traps only to estimate mosquito populations without particular attention to the species.

5.2.2 Trapping Frequency

Mosquitoes are collected from 42 trap sites on a two-week rotating schedule (see Figure 5-1). Two traps (one light trap and one gravid trap) are left overnight at predetermined locations and the contents are collected the following morning. Supplemental mosquito traps are sometimes placed in additional surveillance locations where positive mosquito pools have been found or additional monitoring is desirable.

5.2.3 Numeration and Identification

After trapping, the mosquitoes are delivered to Wadsworth Center, the New York State Department of Health laboratory in Albany, New York. At the laboratory, the female mosquito pools are tested for WNV and other viruses Results are returned to the Nassau County Department of Health and forwarded to the NCDPW.

The NCDOH evaluates the number of positive results in each mosquito pool and the number of adjacent positive mosquito pools. Multiple positive results in neighboring pool sites may indicate the need for additional control methods. The positive sites are examined, and appropriate control methods (see Section 8) are then implemented as necessary.

5.3 Permanent Surveillance Locations

5.3.1 Stormwater Recharge Basins

Stormwater recharge basins (SWBs), commonly called sumps, are designed to return surface water runoff to the groundwater table. There are approximately 795 SWBs in Nassau County, and 612 are managed by the county. The remaining 208 are managed by local municipalities. Some SWBs become a dumping ground for old tires and debris that collect rainwater and serve as ancillary breeding sites for mosquitoes. The NCDPW removes these items from the SWBs on a regular basis.

At times SWBs can retain water long enough that mosquitoes can breed and larvae can develop. Certain SWBs are known to drain slowly and, thus, they often contain standing water. The NCDPW maintains a pre-treatment list of 77 SWBs that are often wet and hospitable for mosquito development (Appendix C). SWBs are treated with larvicides when the results from dipping surveys show the presence of larvae.

5.4 Additional Surveillance Locations

5.4.1 Boat Surveys

There are more than 100 bodies of land (meadows, marshes, fields, islands) on the south shore bays of Nassau County. Most of these bodies of land are under water at high tide and therefore are not suitable mosquito breeding grounds. However, the few islets that do remain wholly or partially above a typical high tide are capable of breeding the golden salt marsh mosquito (*Ochlerotatus sollicitans*) and other salt marsh mosquito species. Populations of these mosquito species are periodically monitored by boat.

5.4.2 Salt Marsh Surveys

Salt marsh areas, especially those on the south shore of Nassau County, are potential breeding sites for mosquitoes. High tides and heavy rains can cause areas not normally covered by daily tidal activity to flood, hatching mosquito eggs within minutes of contact with the water. Therefore, at the beginning of each week during mosquito season, the marsh areas are surveyed and larvicide is applied where necessary.

5.4.3 Upland Surveys

In addition to the salt marsh surveys, many upland stream, drain, pond, and freshwater marsh surveys are made. Upland locations are surveyed when complaints from the public are received by the NCDPW. Catch basins, stormwater recharge basins, and abandoned swimming pools in the area are then checked for larvae.

5.5 Use of Geographic Information System (GIS) Mapping

The county maintains an advanced GIS system to map the viral activity in the county and compare it with areas where WNV has been identified. Maps generated from laboratory positive identifications and historical data are useful in the decision-making process. The NCDPW and the NCDOH correlate pools that have tested positive and consider proximity to one another, sensitive areas, and previous occurrences of WNV when determining where to apply pesticide treatments and the type of chemicals to use.

GIS is also used to record the areas covered in each aerial treatment of the south shore marshes. The helicopter used by the NCDPW is equipped with Wingman, a global positioning system (GPS) software that tracks the areas that have been sprayed in each application of larvicide or adulticide. After each session the GPS data is entered into the NCDPW's GIS database.

Insert Figure (page 1 of 2)

5-1 Mosquito Trap Locations

Figure 5-1 page 2 of 2

6 Host Surveillance

As noted above, birds such as American crows (*Corvus brachyrhynchos*) and blue jays (*Cyanocitta cristata*) have been implicated as a source or reservoir of WNV. Although most birds are sick for only a few days and fully recover with immunity to a new infection, crows are likely to die from the disease. For this reason, one element of the mosquito control program is to record information on dead birds and to test some birds for WNV.

The locations of birds that test positive for WNV are considered in the county's mosquito control strategy each year. However, birds are difficult hosts to map because they can travel long distances. Birds are less important in making treatment decisions than the results of mosquito pool testing.

6.1 Bird Surveillance Methodology

Residents of Nassau County can report dead birds by calling either the NCDOH phone number or the state-wide dead bird hotline (see Appendix E).

The NCDOH records information on dead birds reported in citizen phone calls and sends some of the dead birds to New York State laboratories for testing. The number of birds tested per year is limited by state laboratory quotas, so the NCDOH focuses on priority species such as the American crow when determining which specimens to send for testing.

6.2 EEE Host Surveillance

Although rarer than WNV, EEE is important to monitor because it presents a grave threat to the human and equine populations of Nassau County. It is difficult to capture the local mosquito species that are capable of carrying EEE because they are not drawn to conventional trapping methods, so the county considers dead horses as potential cases of EEE and investigates whenever one is reported.

7 Larval Control

7.1 Control Methods

7.1.1 Physical Controls

Modification of Habitat

Approximately 1,000 miles of drainage ditches were constructed up through the 1950s in order to reduce salt marsh mosquito populations as well as to improve drainage along the shoreline of the south shore barrier islands and islets (Figure 7-1). The natural forces of wind, rain, tides, and major storms continually influence the marsh topography, resulting in new and altered mosquito breeding areas, and so the county occasionally maintains (restores) the drainage ditches. Well-maintained ditches provide habitat for killifish, which feed on mosquito larvae, facilitate tidal water movement, and also create a suitable habitat for waterfowl. Nassau County inspects and maintains all existing ditches; however, there are no immediate plans by the NCDPW to undertake new drainage ditching in the next few years.

7.1.2 Natural Controls

Many saltwater fish eat mosquito larvae. Killifish are naturally present in large numbers in the bays and ditches of the south shore. In the past, the NCDPW has introduced several varieties of small top-feeding freshwater fish, including mosquitofish (*Gambusia*), to some stormwater recharge basins that hold water year-round. However, the New York State Department of Environmental Conservation (NYSDEC) no longer allows the introduction of *Gambusia* to waterways in Nassau County because it is a non-native species.

The NCDPW also manages vegetation overgrowth in and around SWBs by cutting back plant life around the basins listed on the pre-treatment list. Other overgrown SWBs are managed throughout the summer, as needed.

7.1.3 Chemical Controls (Larvicides)

7.1.3.1 Types of Larvicides

Nassau County uses four larvicides to control mosquito populations:

- **Vectobac, BTI (*Bacillus thuringiensis* var. israeliensis)** is a naturally occurring soil bacterium that is eaten by the larvae, infecting and killing them. It is available in granular form or in a doughnut-shaped briquette. It is target-

specific to mosquitoes but does not kill the pupal stage because pupae do not eat.

- **Vectolex CG (*Bacillus sphaericus*)** is also a naturally occurring bacterium that infects mosquito larvae. It persists well in the organic-rich environments favored by the Culex genus of mosquitoes. It too is ineffective against the non-feeding pupae.

- **Altosid (Methoprene)** is an insect-growth regulator that prevents mosquito larvae from changing into adults. It is sometimes called a juvenile hormone because it keeps the insects in a juvenile state. It is applied in a briquette form for manually treating SWBs and other sites requiring long-acting control. One briquette is used per 100 square feet of surface area up to two feet in depth. The two varieties of briquettes are each effective for 50 or 150 days. A liquid variety is also available for treatment of sites with limited accessibility.

- **Agnique** is a non-toxic, liquid larvicide that is sprayed by hand on suburban mosquito pools. It spreads an invisible mononuclear film over the water, reducing the surface tension, making it difficult for larvae and pupae to attach to the surface. The film also drowns the larvae and pupae by blocking their breathing tubes.

7.1.3.2 Larvicide Application Methods

- **Hand Application.** Larvicide briquettes are applied to small, easily accessible standing water bodies that are considered prime mosquito development sites, including those on the pre-treatment list and those with complaints (e.g. swimming pools and street catch basins). Pre-treated areas include storm water recharge basins where mosquito populations may or may not be present. These areas are checked weekly by NCDPW. They are dropped into the water and left to dissolve. Sites that require larvicide treatment and are too remote for direct briquette application are treated with liquid larvicide applied with a 48-ounce hand sprayer that has the capacity to spray over vegetation and into more isolated water bodies.

- **Helicopter and Aerial Application.** The NCDPW has a contract with a private company for spraying larvicide by helicopter if high larval populations are predicted for non-populated, inaccessible marsh areas. The helicopter sprays these large areas with a suitable larvicide, usually a liquid formulation of Altosid. Aerial larvicide application occurs around 6:00 a.m. Locations sprayed include the marshy areas of Jones Beach, Lido Beach, and a number of islets and hummocks on the south shore of Nassau County. Decisions as to when and where to treat are based upon the salt marsh surveys, tidal conditions, and boat surveys. The helicopter is not used on a regular basis. It was used 10 times in 2008 at the locations shown in Figure 7-2.

Insert Figure (page 1 of 2)

7-1 Location of Aerial Historic Drainage Ditching

TBD

Figure 7-1 page 2 of 2

All liquid applications are limited to mild weather conditions with wind speeds of 10 mph or less, and spraying is prohibited in rain.

7.2 Criteria and Procedures

7.2.1 Identifying Locations of Concern

The pre-treatment list (Appendix C) catalogues the stormwater recharge basins that require treatment regardless of larval activity because these basins are known to be hospitable environments for mosquito breeding. Aside from the sites on this list, areas of concern are identified by the NCDPW through a combination of dipping surveys, historical data on mosquito and virus activity, and complaints from the public.

The process of identifying water bodies requiring larval control is not formulaic because the hydrologic environment and the mosquito population can transform or shift each year, necessitating a variation in treatment regimen. The most important factor to consider when designing a larvicide plan is the results of dipping, since this reveals the number of larvae in the water and their developmental stage. In the past, larvicide has been applied to sites where dipping shows a high number of mosquito larvae in late developmental stages and the hydrological setting is considered favorable for further development.

7.2.2 Determining Appropriate Control Methods

Once the areas of concern are identified, larvicide treatment methods are determined based on the size of the water body, its accessibility, and the developmental stage of the larvae. The preferred larvicide is a briquette because it is easy to apply.

If an area of concern is not suitable for briquette application, the 48-ounce hand sprayer can be used, with a liquid larvicide suitable for the developmental stage of the larvae.

Larvicide is applied aerially when mosquito larvae are in late stages of development across a large area. Aerial application of larvicide is suitable for the south shore marshes because this is a sizeable area, largely unpopulated, with much potential for mosquito development. The helicopter sprays a liquid variety of larvicide.

7.2.3 Limitations of Application

NYSDEC prohibits the aerial application of larvicide or adulticide within 500 feet of the breeding areas of threatened species between April 1 and August 31 (see Appendix D for a list of the species of concern and a catalogue of locations where they are known to breed)

8 Adult Control

8.1 Control Methods

8.1.1 Physical Controls

Physical controls largely do not apply to adult mosquito populations because they fly and cannot be contained easily.

8.1.2 Natural Controls

Adult mosquitoes have some natural predators such as dragonflies and bats, but as they are difficult to introduce successfully, Nassau County does not pursue this option.

8.1.3 Chemical Controls (Adulticides)

Adulticides are applied when WNV is present in consecutive trap locations or is found to be in an extensive area where larviciding is not enough to contain viral activity. The number of mosquitoes infected with WNV is not the primary determining factor for applying adulticides. There is no correlation between viral activity and population size.

Adult mosquitoes are sensitive to a number of contact pesticides. The adulticide of choice for mosquitoes is a product called "Scourge" (resmethrin 4.14% and piperonyl butoxide 2.42%, in organic solvent).

8.1.3.1 Types of Adulticides

Scourge (resmethrin and piperonyl butoxide) is an adulticide that kills mosquitoes upon contact. The product is released as a fine mist in areas where mosquitoes are known to be active. It is the only adulticide used in Nassau County

8.1.3.2 Adulticide Application Methods

- **Hand Application.** Adulticides are not applied by hand.

- **Spray Truck Application.** The NCDPW uses the truck-mounted fogging unit called the Guardian 95ES to apply adulticide to areas outside the south shore marshes. The Guardian is an ultra-low volume (ULV) generator mounted on the back of the pickup truck and is calibrated so that the fog flows at approximately 4 feet high and evaporates before it reaches the ground. Driven at a constant 5 miles per hour (mph) rate, this method can treat large

areas on either side of a roadway. The equipment is outfitted with a GPS device that tracks the areas covered with adulticide and also monitors the speed of the vehicle to assure it is constrained to allowable speeds. If the truck exceeds permissible speeds for fog application, the Guardian unit automatically shuts down.

- **Helicopter and Aerial Application.** Larvacides are applied by helicopter only on the south shore marshes. Wingman technology is used to track the mosquito pools that have been treated with each aerial application.

All liquid applications are limited to mild weather conditions, with wind speeds of 10 mph or less, and spraying is prohibited in rain. The spray nozzle used in both truck and helicopter application is calibrated so that the liquid released evaporates before the droplets reach the ground.

8.1.3.3 Adulticide Application Regulations

Adulticides are applied in accordance with product labeling and NYSDEC regulations. Adulticides are not applied within 150 feet of freshwater wetlands, except for an emergency response to a viral breakout, which would be issued by the New York State Department of Health (NYSDOH). Furthermore, adulticides are not applied where runoff is directed into bays or other bodies of water.

Adulticides are not applied directly to water or wetlands in order to avoid any potential contact with aquatic organisms. Waterbodies could be subject to drift of runoff from adulticides. However, amounts entering the water are not expected to exceed U.S. Environmental Agency (EPA) limits because the county uses ULV application techniques and the adulticides applied rapidly biodegrade.

All state and federal threatened and endangered species habitats are avoided during adulticide application. Habitat information is provided by NYSDEC and coordination with NYSDEC minimizes impacts on threatened and endangered species. U.S. Fish and Wildlife Service (USFWS) access restrictions and county setback restrictions are followed.

8.2 Criteria and Procedures

8.2.1 Identifying Locations of Concern

Areas of concern for adulticide treatment are determined based on a combination of factors, the most important being the prevalence of WNV in mosquito populations, the size of positive populations, and the proximity of these populations to humans. The NCDOH considers the viral presence determined in mosquito trap analyses, human cases of WNV, nuisance complaints, and the dipping surveys, which can indicate the size of the future WNV- carrying mosquito population.

These components are geographically correlated with GIS software to reveal whether or not the areas positive for the virus are contiguous. If positive mosquito pools are adjacent, the NCDOH assumes that WNV activity is continuous

across the area and has the potential to spread to the surrounding mosquito populations.

8.2.2 Determining Appropriate Control Methods

Methods of control are determined based on the size and accessibility of the area of concern. Inland areas are sprayed with the truck-mounted Guardian fogger as well as aerial helicopter or airplane at targeted locations during times of health emergencies.

8.2.3 Implementation of Controls

8.2.3.1 Public Notification

The Nassau County Health Department is required to provide 24 hours' notice to legislators and the public before any adulticide application. In addition, the NCDOH updates its website with notices of spraying and encourages local news outlets to publicize spraying activity.

8.2.3.2 Time and Duration

Spraying must be conducted at times of low wind (less than 10 mph) and during sunset hours because mosquitoes are most active at dusk and the product breaks down quickly in bright sunlight.

8.2.3.3 Frequency

Adulticide spraying is only initiated when WNV activity is present in a percentage of the mosquito population large enough to present a threat to humans. There is no threshold percentage of positive mosquitoes that, when reached, warrants adulticiding because the decision to adulticide is based on a combination of this and other factors. Variables such as proximity to human populations, pervasiveness of positive mosquito pools in the county, and time of year are also incorporated into the decision to spray.

After one treatment application, the traps are monitored to determine whether the virus was eliminated from the mosquito population. Future adulticide treatments are determined from virus presence in the trapped mosquitoes.

9 Regulatory and Permitting Requirements

9.1 Pesticide Training and Certification

New York State requires all pesticide applicators to hold a Commercial Pesticide Certification of category 5B, Aquatic Insect and Miscellaneous Aquatic Organisms Control and Public Health Control Certification of category 8 in order to apply pesticides. This certification is valid for three years following initial receipt, and it necessitates that all holders pursue 16 credits of continuing education. Nassau County pesticide applicators attend certification classes hosted by another county because there is no instructor on staff.

9.2 NYSDEC Aquatic Pesticide Permits

Nassau County holds Aquatic Pesticide Permits authorizing the use of seven varieties of larvicide. Aerial pesticides are applied by a private contractor who holds a NYSDEC permit of aerial pesticide application.

10 Public Education and Community Outreach

The purpose of a public education program is threefold:

- To increase public awareness of mosquito-borne diseases, mosquito breeding locations, and simple preventive measures that can be taken to reduce mosquito populations and minimize impacts on human health.
- To provide information regarding routine mosquito control activities in Nassau County.
- To provide timely and accurate information in the event of a WNV public health threat and subsequent pesticide treatments.

10.1 Nassau County and New York State Mosquito-Related Resources

The phone number of the Nassau County Department of Health (NCDOH) (516-572-1211) is the contact point for information on WNV activity. The department's website has a page detailing the threat that WNV presents to the county, including recommendations on how to prevent infection (http://www.nassaucountyny.gov /agencies/Health/westnile.html). It also outlines the mosquito surveillance activities of the NCDPW. Throughout the mosquito season, citizens can also visit the website to see a map of the county with towns highlighted where mosquitoes have tested positive for WNV. It also contains links to NYSDOH and the CDC for further information on WNV.

Mosquito-control activities are directed by the NCDPW, so all inquiries regarding application of larvicides or pesticides should be directed to the NCDPW (516-572-1166). Citizens are directed to contact the NCDPW to report an incident of pooled water or mosquito nuisance.

Reports of dead birds in the county are managed by NYSDOH, which hosts a dead bird hotline to receive calls regarding dead birds (516-572-1211).

Appendix E lists NCDPW, NCDH, and NYSDOH hotline numbers for reporting and obtaining information on WNV and mosquito activity, dead birds, stagnant water locations, and mosquito control activities.

10.2 Community Notifications

Legislation passed in 2009 (Nassau County Legislature Amendment to Local Law No. 30-2000, Section 2) outlines notification procedures NCDOH must follow for any planned adulticide spraying. It requires that the NCDOH notify members of the County Legislature when the department submits a request to the NYSDOH to apply aerial adulticide. Major news outlets must be notified 24 hours in advance of any planned aerial adulticide spraying. Notice must also be posted on the NCDOH website at least 24 hours in advance of any spraying activity. Information released must include the timing, duration, location, and method (i. e. aerial or truck) of spraying; as well as name of pesticide to be used, health concerns of this pesticide, safety recommendations for residents, and the NCDOH contact information (phone and website).

In the case of adulticide application that is cancelled and rescheduled, the legislator, media, and public must still be notified 24 hours in advance of any spraying.

The NCDOH has publicized spraying dates and locations on local sources such as News 12, the Long Island Newsday newspaper, and local radio stations. Media companies are not required to disseminate information regarding spraying, but are encouraged to do so.

In the event of a public health emergency due to an outbreak of WNV, NCDOH notifies media outlets and publishes information on the Nassau County website.

10.3 Complaints, Requests, and Inquiries

Concerns about WNV in the community are received by the NCDOH and are followed up with information on WNV. The following simple methods of avoidance should be taken by county residents to avoid mosquito bites:

- Wear long sleeves, socks, and pants when outside;
- Apply insect repellant;
- Keep all doors and windows closed;
- Maintain screens on doors and windows; and
- Remove standing water on residential property (e.g. tires filled with water).

Mosquito-nuisance inquires are received by the NCDPW. All complaints and inquiries received are logged and assigned for follow-up. Follow-up procedures for mosquito nuisance complaints generally involve a visit to the complainant's home, inspection of a specific situation or, more often, a neighborhood survey. Surveys include but are not limited to streams, ponds, marshes, drainage ditches, standing water, swimming pools, artificial containers, street drains, and nearby stormwater recharge basins. Property owners are notified if home when the visit occurs. Otherwise a visit notice and informational pamphlets are left at the residence. If appropriate, treatment is made by hand with a suitable larvicide. If a major breeding area is identified, follow-up inspections are scheduled. Following an inspection, conditions and control efforts are logged.

11 Annual Control Plan Review

11.1 Current and Historical Viral Activity

11.1.1 WNV

Mosquito Pools

Human cases

Birds Cases

Mammal Cases

11.1.2 Other Viruses

11.2 Changes to the Mosquito Control Plan from the Previous Year

Any changes made to the Mosquito Control Plan will be noted in this section the following year. There are none to report at this time.

11.3 Overall Plan Effectiveness

All components of the Mosquito Control Plan are reviewed every year to determine the overall effectiveness of mosquito control and surveillance in Nassau County.

11.4 Recommendations and Improvements

Recommendations and improvements stem from the Mosquito Plan review process and will be incorporated into the plan on a yearly basis. None have been reported at this time.

A Historic Mosquito Surveillance and Mosquito-Borne Disease Data for Nassau County

Table A-1 Historic Mosquito Surveillance and Mosquito-Borne Disease Data for Nassau County

	2003	2004	2005	2006	2007	2008
Human Cases	17	0	12	3	2	20
Number of Areas Larvicided by Hand	1,576	1,153	1,513	787	576	1,284
Number of Aerial Larvicide Treatments	17	16	10	9	9	10
Number of Aerial Adulticide Treatments	0	0	2	0	0	1
Number of Sites Dipped	4,098	4,302	5,285	2,673	2,219	2,207
Number of Mosquito Pools sent to Wadsworth Lab (NYSDOH Lab) for Testing	596	696	473	485	466	428
Number of Positive Mosquito Pools	29	15	70	44	30	57

Source: Nassau County. Mosquito Surveillance and Control Report. 2005.

B Mosquito Species Found in Nassau County

Table B-1 Female Mosquito Species Trapped in 2008

Species	Number	Percent
Culex pipiens/restuans	10,884	56.94%
Aedes vexans	1,741	9.11%
Ochlerotatus sollicitans	1,597	8.26%
Aedes albopictus	1,257	6.58%
Ochlerotatus canadensis	1,103	5.77%
Ochlerotatus trivittatus	610	3.19%
Ochlerotatus japonicus	396	2.07%
Ochlerotatus cantator	316	1.65%
Coquillettidia perturbans	263	1.38%
Anopheles quadrimaculatus	252	1.32%
Ochlerotatus triseriatus	135	0.71%
Anopheles punctipennis	100	0.52%
Psorophora ferox	85	0.44%
Uranotaenia sapphirina	10	0.05%
Culex salinarius	5	0.03%
Culiseta melanura	3	0.02%
Culex territans	2	0.01%
Aedes cinerius	1	0.01%
Anopheles crucians	1	0.01%
Orthopomodia signifera	1	0.01%
Toxorhynchites rutilus septentrionalis	1	0.01%
Anopheles barberi	1	0.01%
Ochlerotatus excrucians	1	0.01%
Unidentifiable	369	1.93%
Total Female Mosquitoes	**19,116**	**100.00%**
Total Traps	**833**	
Mosquitoes per Trap	**22.9**	
Total Different Species	**23**	

C Stormwater Basin Pre-Treatment Locations in Nassau County

Table C-1 Nassau County Mosquito Control Pre-Treatment Locations

Northwest Nassau		
Code #	**SWB#**	**Address**
K21	123	193 Rockaway Av, Garden City
F18	91	63 Tanners Rd, Lake Success
B13	200	29 Wood Road, Great Neck (NW Corner of Parkwood Pool Lot)
B,C13	572	32 Carriage Road, Kings Point
E8	293	7 Woodland Dr., Sands Point
K16	44	87 Deepdale Pkwy, Roslyn Heights
K16	560	37 Carriage Rd, Roslyn Estates
K17, 18	134	1024 Willis Av, Albertson
L17	18	93 Oakridge La, Albertson
L17	151	20 Hilldale Rd, Albertson
L18	61	2 Bengyfield Dr, East Williston
M18	82	289 Roselle St, East Williston
M17	71	10 Schoolhouse Lane, Albertson (outlying area, not lake)
M16, 17	101	157 Parkway Dr, Albertson
P12	192	720 Northern Blvd, Old Brookville
K15	307	51 Intervale, Roslyn Estates
J14	327	47 The Serpentine, Roslyn Estates
L12, 13	597	Nassau Fine Arts Museum, Wm. Cullen Bryant Preserve, N/O Northern Blvd, Roslyn Harbor
N13	579	10 Tara Dr, East Hills
Southwest Nassau		
Code #	**SWB#**	**Address**
D25	122	238-27 115th Terrance, Elmont
F24	351	292 Travis Ave, Elmont
D25	117	2627 Ludlum Ave, Elmont
G22	121	30 Tunnel St, Floral Park
Northeast Nassau		
Code #	**SWB#**	**Address**
N18	118	202 Guinea Woods Rd, Old Westbury
N, P16	585	31 Foxhollow Lane, Old Westbury
M8	469	56 Knot Drive, Glen Cove
N5	547	20 Lattingtown Ridge Ct, Lattingtown
V9	206	301 Ross Lane, East Norwich
Y7	534	41 Woodland Dr, Oyster bay Cove
BB11	474	7 1st Street, Woodbury
CC11	306	1 Stratford Ave, Avery Rd, Woodbury
Y10	241	755 Syosset-Cold Spring Harbor Rod, Syosset
Z10	575	176 Belican Ct, Syosset
Z11	309	188 Syosset-Woodbury Rd, Syosset
Y11	270	7 Miller Blvd, Ira Rd, Syosset
Y11	88	17 4th Place, Ira Rd, Syosset
S3	603	10 Transwinds Dr, Bayville
U10	586	17 Serentine Lane, Muttontown

Table C-1 Nassau County Mosquito Control Pre-Treatment Locations

Northeast Nassau (continued)		
Code #	**SWB#**	**Address**
W, X12	Private	E/O Pondview Drive, Muttontown
V15	138	308 Nimitz St, Jericho
W18	234	204 10th Street, Hicksville
U18	128	136 Charlotte St, Duffy's Ave, Hicksville
R19	315	902 Linden Ave, Westbury
Y20	412	669 Ivy Ct E, Hicksville
AA16	346	74 Central Park Drive, Plainview, Permanent Water by North Culvert, Extensive floodplain on N & S ends, needs 400+ briquettes
AA17	330	75 Herhard Rd, Plainview
BB13	478	81 Harvard Dr, Plainview
BB15	460	60 Skyline Dr, Plainview
BB16	Private	96 Palo Alto Dr, Plainview
BB15, 16	370	29 Washington Ave, Plainview
CC, DD15	372	1670 Old Country Rd, Plainview
BB17	297	110 Briarwood Drive, Plainview
Z17	223	53 Warwick Pl, Plainview
Z18	312	51 Floral Ave, Plainview
Southeast Nassau		
Code #	**SWB#**	**Address**
EE33		Tobay Beach Parking Lot, Ocean Parkway, Jones Island
EE25	300	8 Ashwood Pl, Massapequa
DD25	489	217 Philadelphia Ave, Massapequa Park
DD26	488	369 Pennsylvania Ave, Massapequa Park
CC21	467	43 Conklin St, Farmingdale
X20	34	28 Polaris Lane, Levittown
W20	23	115 Azalea Lane, Levittown
W20	43	60 Pelican Rd, Levittown
V20	42	6 Pintail Lane, Levittown
U24	85	2027 Central Dr, East Meadow
T23	353	292 Maple Ave, East Meadow
BB18	382	15 West Park Dr, Old Bethpage
To Monitor on a Monthly Basis		
Code #	**SWB#**	**Address**
D9	366	54 Barkers Point Rd, Sands Point
H19	462	82 Shelburne Lane, Manhasset Hills
J18	292	1029 Ceder Dr S, Manhasset Hills
G13	408	138 Bournedale Rd N, east end of Rd, Plandome Heights
J18	415	2 Hamilton Dr, Roslyn Estates
L11	349	700 Motts Cove Rd, Roslyn Harbor
N19	139	304 Mallard Rd, Carle Place - use liquid Altosid
M10	215	55 Todd Dr N, Glen Head
S2	562	3 Spruce Court, Bayville
W12	569	96 Stirrup Lane, Muttontown
CC11	332	4 Maple Dr, Woodbury
AA17	261	87 Morton Blvd, Plainview - use liquid Altosid

Table C-1 Nassau County Mosquito Control Pre-Treatment Locations

To Monitor on a Monthly Basis (continued)		
Code #	**SWB#**	**Address**
CC21	86	69 Jefferson Pl, Farmingdale
CC20	281	1 Jerome Dr, Farmingdale
U23	272	545 Tremont Pl, East Meadow (culvert)
R22	537	134 Glen Curtis Blvd, Uniondale
N29	500	2170 Maple St, Baldwin

Source: SWB Pre-Treatment. November 15, 2007. Nassau County Department of Public Works.

D

Species of Concern for Aerial Larvicide Treatment in Nassau County and Breeding Locations with Aerial Pesticide Application Restrictions in Nassau County

Table D-1 Bird Species of Concern for Aerial Larvicide Treatment in Nassau County

Common Name	Scientific Name	Status
American oystercatcher	*Haematopus palliatus*	
Black skimmer	*Rynchops niger*	NYS Special Concern
Black-crowned night heron	*Nycticorax nycticorax*	
Cattle egret	*Bubulcus ibis*	
Common tern	*Sterna hirundo*	NYS Threatened
Forster's tern	*Sterna forsteri*	
Gull-billed tern	*Sterna nilotica*	
Glossy ibis	*Plegadis falcinellus*	
Great egret	*Ardea alba*	
Great blue heron	*Ardea herodias*	
Little blue heron	*Egretta caerulea*	
Least tern	*Sterna antillarum*	NYS Threatened
Piping plover	*Charadrius melodus*	NYS Endangered
Roseate tern	*Sterna dougallii*	NYS Endangered
Snowy egret	*Egretta thula*	
Tricolored heron	*Egretta tricolor*	
Yellow-crowned night-heron	*Nyctanassa violacea*	

Source: New York State Department of Environmental Conservation, Division of Solid and Hazardous Materials. Article 15 Permit to Use an Aquatic Pesticide. 2008.

Table D-2 Breeding Locations in Nassau County with Aerial Pesticide Application Restrictions

Site Name	Town/Borough	Quad
Bannister Island	Hempstead	Lawrence
Big Crow Island	Hempstead	Freeport, Jones Inlet
Big Hassock	Hempstead	Lawrence
Black Banks Hassock	Hempstead	Lawrence
Boormans Island	Hempstead	Lawrence, Lynbrook
Cinder Island Group	Hempstead	Jones Inlet
Cuba Island Group	Hempstead	Freeport
Deep Creek Meadow	Hempstead	Jones Inlet
East Channel Islands	Hempstead	Lawrence
East Crow Island	Hempstead	Jones Inlet
False Channel Marsh	Hempstead	Jones Inlet, Freeport
Garrett Marsh	Hempstead	Lawrence
Goose Island	Hempstead	Amityville
Green Sedge Cedar Island Group	Hempstead	Lawrence
Hewlett Hassock	Hempstead	Lawrence
Ingraham Hassock	Hempstead	Jones Inlet
Jones Island	Hempstead	Jones Inlet
Lawrence Marsh	Hempstead	Lawrence
Line Island Group	Hempstead	West Gilgo Beach
Long Meadow Island	Hempstead	Jones Inlet
Meadow Island	Hempstead	Jones Inlet
Neds Island	Hempstead	Amityville
Neds Meadow	Hempstead	Freeport
Olivers Island	Hempstead	Freeport
Parsonage Island Group	Hempstead	Jones Inlet
Pine Marsh	Hempstead	Jones Inlet
Sanford Island	Hempstead	West Gilgo Beach
Smith Meadow	Hempstead	Jones Inlet, Freeport
West Meadow Island	Hempstead	Lawrence
Tobay Marsh Islands	Hempstead	West Gilgo Beach

Source: New York State Department of Environmental Conservation, Division of Solid and Hazardous Materials. Article 15 Permit to Use an Aquatic Pesticide. 2008.

E Hotline Numbers for the Nassau County Mosquito Control Program

Table E-1 Hotline Numbers for the Nassau County Mosquito Control Program

	Hotline	Department
WNV Activity	(516) 572-1211	Nassau County Department of Health
Dead Bird Reports		
Mosquito Nuisance Complaints	(516) 572-1166	Nassau County Department of Public Works
Stagnant Water Concerns		
Mosquito Control Activities		