



APPENDIX C

SCVC Comparison with Other Northeast Operations



*Suffolk County
Vector Control &
Wetlands
Management
Long Term Plan &
Environmental
Impact Statement*

**TASK 4 SUFFOLK COUNTY VECTOR CONTROL
COMPARISON WITH OTHER NORTHEAST
OPERATIONS**

Prepared for:

**Suffolk County Department of Public Works
Suffolk County Department of Health Services
Suffolk County, New York**

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April 2005

**SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT
LONG - TERM PLAN AND ENVIRONMENTAL IMPACT STATEMENT**

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LIST OF ABBREVIATIONS AND ACRONYMS

<i>Bs</i>	<i>Bacillus sphaericus</i>
<i>Bti</i>	<i>Bacillus thuringiensis israelensis</i>
CAES	Connecticut Agricultural Experiment Station
CDC	Centers for Disease Control
CDEP	Connecticut Department of Environmental Protection
CDPH	Connecticut Department of Public Health
CO ₂	Carbon dioxide
DFTA	Department for the Aging
DOHMH	Department of Health and Mental Hygiene
DPW	Department of Public Works
EEE	Eastern Equine Encephalitis
GIS	Geographical Information System
GPS	Global Positioning System
IMM	Integrated Mosquito Management
MMD	Mass Medium Diameter
NCDH	Nassau County Department of Health
NCDPW	Nassau County Department of Public Works
NJAES	New Jersey Agricultural Experiment Station
NJDEP	New Jersey Department of Environmental Protection
NJSMCC	New Jersey State Mosquito Control Commission
NYPD	New York Police Department
NYSDEC	New York State Department of Environmental Conservation
OMWM	Open Marsh Water Management
PCR	Polymerase Chain Reaction
RAMP	Rapid Analyte Measurement Platform
SCDHS	Suffolk County Department of Health Services
SCDPW	Suffolk County Department of Public Works
SCVC	Suffolk County Vector Control
UConn	University of Connecticut
ULV	Ultra-Low Volume

WCDH Westchester County Department of Health
WNV West Nile virus

1. Introduction

The purpose of this report is to provide a comparison between the operations of the Suffolk County Department of Public Works (SCDPW), Division of Vector Control and other mosquito control operations in the immediate northeast region. In order to accomplish this, site visits and interviews were conducted with the operating agencies in Nassau County and Westchester County as well as the Suffolk County agency itself. Additional information regarding the operations of mosquito control agencies in New Jersey was provided via the input of Dr. Wayne J. Crans of the New Jersey Agricultural Experiment Station (NJAES) at Rutgers University. Information on the Connecticut State program was provided by Roger Wolfe, Mosquito Management Coordinator for the Connecticut Department of Environmental Protection (CDEP). New Jersey is regarded as a model for mosquito control because of Title 26 enabling legislation designed by John B. Smith at the turn of the last century. Smith, a biologist at Rutgers University who was also trained as a lawyer, drew up the set of laws to assure that mosquito control decisions are based on science. New Jersey is the only state where mosquito control is mandated at the county level with university input on an annual basis. This effectively links the applied aspects of mosquito control with current advances in science to assure that environmental issues are properly addressed.

The NJAES is mandated under Title 26 Chapters 3 & 9 of the New Jersey Health Statutes to review the Plans and Estimates of New Jersey's 21 County Mosquito Control Programs on an annual basis and provide written comments to individual County Boards of Chosen Freeholders by December 1 of each year. To facilitate the process, guidelines have been developed that set standards for mosquito control operations to promote valid comparisons of the mosquito control efforts in the state.

NJAES looks for five necessary components in mosquito control work plans:

1. Surveillance
2. Source Reduction
3. Chemical Control
4. Biological Control

5. Education.

The evaluations in this report are based on these components. This report outlines the criteria NJAES uses to evaluate New Jersey mosquito control programs and then applies those criteria to the New York programs of Nassau and Westchester Counties, and New York City, selected mosquito control programs in the state of New Jersey, and the Connecticut State program. Additional pertinent criteria are also reviewed. The evaluations are also used to compare the jurisdictions to operations in Suffolk County.

2. Components of a Responsible Mosquito Control Program

2.1. Surveillance Component

Mosquito management must begin with a surveillance initiative to document pest and vector species, which provides justifications regarding control decisions. Although more than 60 mosquito species are native to the northeastern United States, approximately 15 species function as serious threats to human health and well being. A number of mosquitoes in the northeast do not feed on human blood; these targeted by species are classified biological curiosities in terms of mosquito management, and should not be targeted by mosquito control operations. Others have extremely limited flight ranges so that they rarely bite humans even though they do host seek for blood. Thus, species-specific records need to be developed prior to considering control of any kind. Records should also be maintained that delineate the composition of mosquito populations before and after management to determine the effectiveness of control operations, and to justify their costs and potential environmental impacts. Surveillance programs should have components addressing larvae, adults, and mosquito-borne pathogens. To accomplish these goals, qualified staff with ongoing training must be in place, both to implement surveillance programs and also to evaluate the surveillance data. Thus, mosquito control is more than a profession that goes well beyond pest control, but is a professional undertaking. Resource allocations must include laboratory space equipped with up to date scientific equipment, to support surveillance that will determine the scope of control aspects of the program.

2.2. Source Reduction Component

Source reduction (e.g. the alteration or elimination of larval habitat) is the most effective method for long-term relief from mosquito infestation. A responsible source reduction effort should be in place before chemicals of any kind are considered to reduce mosquito populations. Source reduction can be as simple as the removal of used tires and the cleaning of rain gutters by property owners. Source reduction can also entail extensive regional water management projects to eliminate mosquito-breeding habitats. Source reduction activities should be undertaken to eliminate or substantially reduce the need for applications of insecticides in habitats that chronically produce mosquitoes. When properly designed, source reduction initiatives maintain, rather than eliminate wetlands habitats and enhance them for wildlife utilization. Mosquito

control is often blamed for having a negative impact on the environment, but properly designed source reduction activities can enhance wetland features.

Source reduction activities are generally divided into Sanitation, Freshwater Wetlands Management, and Saltmarsh Water Management. Source reduction practiced by responsible mosquito control agencies includes a broad scope of activities that range from simple sanitation to major water management programs. Wetlands management generally requires permits from county, state, or federal governments. As a result, qualified staff are required to recognize problems, design solutions, address regulatory requirements, and implement meaningful source reduction projects.

2.3. Chemical Control Component

When surveillance has documented a problem, and sanitation or water management do not provide feasible solutions, NJAES supports the use of chemicals to control immature and/or adult mosquito populations. The chemicals used by mosquito control agencies must comply with state and federal regulations and be applied according to label restrictions. In New Jersey, recommendations for pesticides used in mosquito control are provided annually by researchers at NJAES, and the recommendations are available for any mosquito control agency on request. All pesticide applicators and operators must be licensed by the state and receive ongoing training on a yearly basis. Larviciding (applying chemicals to kill the immature stages of mosquitoes by ground or aerial treatments) is more effective than focusing on adults because the immature stages can be targeted at the breeding habitat before populations have had a chance to disperse. Applications of larvicides impact less acreage than adulticiding operations because treatments are made to relatively small areas where larvae are concentrated as opposed to wider regions after adult populations have dispersed. Biorational larvicides including *Bacillus thuringiensis israelensis* and *Bacillus sphaericus* (bacterial larvicides) and methoprene (an insect growth regulator) should be used whenever possible, although temephos (an organophosphate) and petroleum oils are feasible in many situations. Adulticiding is the use of chemicals to reduce adult mosquitoes by ground or aerial applications. Adulticides are commonly applied as an Ultra-Low Volume (ULV) spray using small amounts of active ingredient dispensed through equipment that must be properly maintained and calibrated.

2.4. Biological Control Component

Biological control is the utilization and/or manipulation of natural agents to aid in the control of pest and vector species. Biological control efforts support the concept of integrated pest management and are advantageous because they are generally host-specific for mosquito control with limited impacts on non-target species. As a result, biological control practices often include creating or enhancing habitat that supports organisms that impact mosquito populations. Although many biological control initiatives for mosquito control are still in the experimental stages of development, NJAES believes that every mosquito control program should be exploring available options. Predacious fish have been shown to effectively reduce mosquito larvae in many mosquito breeding habitats and represent an effective biological control agent for use in virtually all mosquito control programs, regardless of size or budget. Predacious fish, typically *Gambusia* species, can be reared and stocked in mosquito breeding habitats as an alternative to using larvicides. When native fish populations are known to exist, well designed water management projects enhance biological control by creating habitat that encourages native fish to function better in terms of natural predation. Although individual county mosquito control agencies can raise and release their own fish, state sponsored regional programs are encouraged to provide predator fish species for field release. In 1990, the State of New Jersey established a state-wide mosquitofish program with a specific protocol for distribution and use. While originally designed for *Gambusia affinis*, the program now offers other fish species for mosquito control including the fathead minnow, the freshwater killifish, and two species of native sunfish.

2.5. Educational Component

Mosquito control agencies should have programs of public education and continuing education as ongoing activities of their work plans. Public education must be initiated by the mosquito control agency to teach mosquito biology to the public and encourage citizens to utilize prevention techniques. Examples include: bullet list fact sheets and brochures, classroom lectures at schools, slide shows, films and videos on mosquitoes and their control and exhibits at state and county fairs. Responsible mosquito control agencies interact with civic leaders, politicians, and professionals on a regular basis to eliminate crisis management, which typically

relies too heavily on pesticides. Properly designed public education programs reduce homeowner pesticide applications and encourage support for organized mosquito control.

Continuing education encompasses programs for operational workers to instill or refresh knowledge related to practical mosquito control procedures. All too often, the importance of continuing education is overlooked and under utilized in job training at mosquito control facilities. Mosquito control is a profession that is based on science and the latest advances in mosquito control technology cannot be obtained without a proper educational component. Examples of continuing education for mosquito control workers include: bullet list pesticide training programs, mosquito control short courses, and “Right to Know” training for hazardous substances. The most important form of continuing education for the professional staff that direct the surveillance, water management and administrative components of the operation is attendance at state, regional and national mosquito control conferences. Interaction with peers at scientific conferences promotes professionalism and ongoing training that cannot be obtained in any other venue.

3. Mosquito Control Programs in the Northeast

3.1. Westchester County, New York

The Westchester program for mosquito control is located in the Westchester County Department of Health (WCDH), Division of Environmental Health Services, and is operated out of the District Office in New Rochelle, NY. Mosquito control activities are conducted by seven fulltime workers, two conducting surveillance and five for control. During the summer months, as many as 40 additional staff are made available from the Health Department to assist with mosquito related activities. Budgetary figures were not available at the time of the interview but funding has been relatively constant over the past three to four years. Westchester County discontinued an earlier program in 1984 that was run out of Fordham University and directed toward ticks as well as mosquitoes. The current program was restructured in 2000 as a direct result of the 1999 outbreak of West Nile virus (WNV) in the New York metropolitan area. The Westchester County program is evolving but operates as a WNV control program and, as a result, lacks a number of components necessary for comprehensive mosquito control.

3.1.1. Surveillance Component

The surveillance component of the Westchester program is excellent but is limited to monitoring the mosquito vectors of WNV. Adult surveillance consists of operating Center for Disease Control (CDC) traps baited with carbon dioxide (CO₂) three times each week together with gravid traps baited with an oviposition attractant at 10 locations in the county, from mid-May to mid-October. The specimens are identified to species, pooled under cold chain conditions, and sent to the New York State Department of Health laboratories in Albany for virus tests. The information is ultimately entered into the Health Information Network and expertly analyzed, in house, to compile meaningful species lists, infection rates and vector population trends. As with most small mosquito control programs, the surveillance data are compiled after the fact and are used to document overall seasonal trends. As a result, very little information is provided by this surveillance effort to drive control aspects of the program and no system is in place to generate data on the day-to-day fluctuations in mosquito population levels that are needed to make responsible control decisions.

Larval surveillance in the Westchester program includes a comprehensive catch basin evaluation program, beginning in March and April that is focused in the most densely populated areas of the county. The program has compiled a data set of overall larval habitats in their county, but inspections of floodwater and permanent water habitats are not an ongoing activity.

The personnel that coordinate surveillance in Westchester County are well trained biologists and highly qualified to run the program. This means staff is in place if the County decides to expand its program beyond WNV surveillance to a more comprehensive approach to mosquito control.

3.1.2. Source Reduction Component

The source reduction component of the Westchester program consists of monitoring and treating catch basins to control *Culex* mosquitoes and is coordinated by WCDH. Westchester County is not aggressive in efforts to gain access to private property for either inspection or control activities. The large pieces of equipment normally associated with mosquito control activities are not available to establish a water management component at the present time. Teams of inspectors sampling larval habitats on a county-wide basis are not a part of this program. Ditch maintenance, while feasible, is also not an activity in the current work plan. The existing program is directed primarily toward WNV transmission and its amplification vectors. Adding monitoring and control of likely bridge vectors to this program would require additional staff, additional equipment, and a completely revised work plan.

3.1.3. Chemical Control Component

Larviciding catch basins is the only mosquito control measure conducted by the county. Of the approximately 65,000 catch basins located on public land in the county, 55,000 are treated with ALTOSID® XR Briquettes, which are designed to provide up to 150 days of larval control in water. Treatments are done from approximately mid May to the end of June. During that time approximately 10 certified applicators work every week, each treating an average of 200 catch basins per day. The treatment is accomplished with a two-man crew, one being the driver who is responsible for marking maps with treatment sites, and the second being the applicator. Once treated, the catch basin is marked with a single orange spot on the grate. Catch basins that cannot be treated because they are full of sediment, and therefore do not retain water, are marked

with a double orange spot. There are approximately 5,000 additional catch basins on county roads that are treated by county Department of Public Works (DPW) personnel.

There are an estimated 45,000 additional catch basins located on private properties such as malls, housing developments and office complexes that are not treated because the treatment permit issued by the New York State Department of Environmental Conservation (NYSDEC) Region 3 only allows the treatment of catch basins on public land.

In the event of a health emergency, WCDH does have the authority to treat mosquito breeding sites on private property if the proper permits are obtained.

WCDH does not have any equipment to perform adult mosquito control. Adulticide operations in the past were accomplished via a contractual arrangement with Clarke Environmental Mosquito Control from Roselle, IL. Future adulticide applications, if necessary, would be performed under a similar contractual arrangement.

3.1.4. Biological Control Component

The Westchester program for mosquito control does not have a biological control component. Their mosquito control efforts rely on pesticides for larval control with a strong public education component.

3.1.5. Educational Component

The Westchester mosquito control program has an excellent public education component. This is a direct result of having qualified personnel, and the public health educators through WCDH. The Westchester staff maintains a website, develops public service announcements, participates in school visitations, and maintains a presence at health fairs. Funds are limited for ongoing professional education, particularly for allowing staff personnel to attend conferences beyond the regional level.

3.2. Nassau County, New York

Mosquito control in Nassau County has a long, rich history, beginning in 1915. Mosquito control activities were established under a commission in 1929 and were placed within the Department of Public Works in 1948. The current program for mosquito control is a cooperative effort between the Nassau County Department of Public Works (NCDPW) and the Nassau

County Department of Health (NCDH). This combination was implemented in 1996, and integrates Integrated Mosquito Management (IMM) technology with public health science. Sanitarians from the health department provide a cadre of trained biologists to assure that mosquito control is based on science. Inspectors, vehicles, and large mosquito control equipment are housed within the NCDPW portion of the operation.

The Nassau County mosquito control program has 20 full time employees and an annual budget of approximately \$1,200,000. Some of the personnel are sanitarians employed by the NCDH and some are mosquito inspectors employed by the NCDPW exclusively for mosquito control. All 20 employees are cross-trained to conduct surveillance, larviciding, and species identification. All personnel are tested for mosquito control and are deputized by the health commissioner to perform mosquito control enforcement activities. The county's relatively high population density results in an emphasis on urban mosquito control. The county, however, has significant salt marsh habitat along its coast that must be regularly monitored for floodwater salt marsh mosquito broods. The urbanization of the upland areas of the county limits fresh floodwater species from occurring in large numbers. Urbanization promotes high *Culex* production, with catch basins and water retention facilities, such as recharge basins, generating the largest populations.

3.2.1. Surveillance Component

The Nassau County surveillance program includes larval surveillance, adult surveillance, and virus surveillance components. Urbanization in Nassau has eliminated many mosquito species through habitat loss. As a result, species-specific identification is relatively simple to implement for responsible mosquito control, requiring relatively little laboratory space for taxonomic efforts.

Much of Nassau County's surveillance effort is towards breeding habitat that is surrounded by water that must be surveyed by boat. Mosquito inspectors must be able to distinguish non-breeding marsh that is inundated regularly by tide from high marsh habitat that is capable of producing regular broods of salt marsh mosquitoes. Because of the narrow window between egg hatch and adult emergence in salt marshes, larval inspections focus on detection of mosquitoes in very early instars. Virtually all mosquito species produced on tidal salt marshes function as

major biting pests. Under these conditions, inspectors can determine the need for control without having to identify most collections to species. This allows the county to field-train their inspectors without insisting on a complete range of species identification skills.

Culex mosquitoes are the primary focus for mosquito control in upland areas of Nassau County. Approximately 70,000 catch basins and 600 retention basins are monitored on a regular basis. *Culex* larvae are unique enough to be recognized in the dipper. As a result, *Culex* from stagnant water collections can be controlled on the basis of presence without having to wait for species confirmation from the laboratory.

For adult mosquitoes, the Nassau County program operates seven New Jersey light traps from May to October. The data are used primarily to estimate the size of their mosquito populations, as collections are usually not identified to species. Nassau County runs an intense adult surveillance effort to monitor the mosquito vectors of WNV. CDC light traps and gravid traps are operated regularly at more than 42 collection sites representing 2.5-mile sampling intervals within the county. The specimens are identified to species and pooled for virus tests by NCDH sanitarians. The samples are then sent to Albany with a seven-day turn around time for virus results. Results from the WNV surveillance effort are used to develop a summary of female mosquitoes trapped by species each year. Nassau has an extensive crow surveillance program operated out of the NCDH that is used by mosquito control personnel to pinpoint areas of WNV activity. This surveillance effort is as comprehensive as any in the nation.

The Nassau County program responds to citizen complaints and uses the information as an important aspect of its surveillance component. All complaints are logged and assigned to an inspector for follow-up action. Once inspections are completed, property owners are advised of the action and provided with mosquito literature whenever possible.

The surveillance activities of the Nassau County program provide the following triggers that are used to justify control:

1. Mosquito trap counts
2. WNV virus isolations from mosquitoes
3. Dead crow reports

4. Suspect human cases

Prior to the adoption of an active WNV surveillance component, control activities were driven largely by complaints.

3.2.2. Source Reduction Component

The Nassau County program uses source reduction to eliminate mosquito breeding at every level of mosquito production. Inspectors eliminate standing water breeding sources whenever possible during routine complaint investigations. Salt marsh mosquito management involves a program of ditch maintenance to reduce standing water that produces mosquito larvae. Nassau has approximately 1,000 miles of existing ditches, and can maintain 200 miles per year if there are no operational problems. The county has a fleet of 12 specialized vehicles to support this water management component. The Nassau County source reduction component ranks among the best in the northeast, although it relies on ditch maintenance rather than more progressive water management techniques.

3.2.3. Chemical Control Component

There are approximately 70,000 catch basins in the county. Those that are known mosquito larva producers are treated with ALTOSID XR® Briquettes in the spring. These briquettes are intended to provide up to 150 days larval control. If re-treatment is needed during the summer, smaller ALTOSID BRIQUETTES® are used.

On average, the county larvicides approximately 2,000 acres of salt marsh per week, which represents one-fifth to one-sixth of the salt marsh in the county. Larviciding is done with a contract helicopter applicator, North Fork Helicopters, utilizing *Bacillus thuringiensis israelensis* (*Bti*) (VECTOBAC® granule) in the early season and methoprene (ALTOSID LARVICIDING LIQUID®) later in the season. Approximately 34,000 acres of salt marsh treatments are made annually.

Surveillance triggers may justify the need for adult mosquito control. The Vector Control unit has four London Fogger 18-20 ULV sprayers that are mounted on F350 pickups in August and left on the trucks until the end of the season. Resmethrin (Scourge) is used for truck applications. Adulticide applications are generally restricted to State parks and for salt marsh

mosquito control. Salt marsh mosquitoes are normally only treated for in areas south of the Southern State Parkway.

Normally, adulticiding is only done in areas contained by natural barriers. For example, *Oc. Sollicitans* is not normally treated north of the Southern State Parkway. State parks that require adulticiding are treated by NCDPW Vector Control. The trucks used for treatment are driven by DPW inspectors, with a sanitarian riding in the truck to observe the area for citizens and other reasons to interrupt treatment, and to navigate for the driver.

The NCDPW Vector Control Division has 14 pickup trucks and 12 pieces of mechanized equipment. It also has 8 BIRCHMEIER™ and 2 MURYAMA™ backpack sprayers.

Any decision to apply adulticide chemicals is made by NCDH.

3.2.4. Biological Control Component

The Nassau County program realizes the value of introducing fish for mosquito control but maintains a very modest biological control component. Several varieties of predacious fish have been introduced over the years to storm water recharge basins that hold water year round. Most of their efforts involve maintaining habitat for native killifish in salt marsh habitats. Ditch maintenance can encourage survival of native fish.

3.2.5. Educational Component

Nassau County has developed a proactive program for public awareness in mosquito control that reaches a broad range of citizen groups. It provides pamphlets, press releases, and television public announcements with informative messages on mosquitoes, mosquito-borne diseases and elimination of mosquito breeding habitats. Close cooperation between NCDPW and NCDH makes this possible, as the education outreach connects health interests with the applied side.

Continuing education for the mosquito control workers in the county is not emphasized or supported. The county does have an excellent planning regime for the program that encourages teleconferences with state, city and county participants. Some funding to participate in regional and national conferences exists, but is minimal considering the size of the program.

3.3. New York City

The New York City's West Nile Virus program is administered by the New York City Department of Health and Mental Hygiene (DOHMH), Environmental Health, Veterinary and Pest Control.

3.3.1. Surveillance Component

New York City performs surveillance activities for mosquito larvae, adults, and WNV. Larval surveillance provides information on expected adult mosquito density and can indicate areas where efforts to eliminate mosquitoes at their source should be targeted. Adult mosquito surveillance and viral testing provide early predictive information about the potential for a disease outbreak.

Mosquitoes are collected weekly from mosquito traps at 53 permanent locations throughout New York City. In 2003, a total of 145,112 adult mosquitoes belonging to 34 species were tested for the presence of WNV infection. Five mosquito species, *Aedes albopictus*, *Culex pipiens*, *Cx. restuans*, *Cx. salinarius*, and *Cx. territans* were infected with WNV. Of the 7,679 mosquito pools tested, 275 were tested positive for WNV:

- 42 in the Bronx; 37 in Brooklyn
- 11 in Manhattan; 62 in Staten Island
- 123 in Queens.

Cx. pipiens was identified as the primary enzootic vector of WNV from 1999-2003 based upon the number of positive pools.

Mosquitoes are collected using DOHMH miniature light and gravid traps on a weekly basis. Each trap collection is sorted by species of mosquitoes collected. Information on the location, collection data, trap type and the total number female mosquitoes is recorded. Extra trapping may be conducted to collect day-biting mosquitoes using omni directional Fay Prince traps and mosquito magnets. In the event that pesticides are applied for adult mosquito control, DOHMH will set traps more frequently to evaluate the efficacy of the control measures. Mosquito magnet traps are also used to survey and control adult mosquitoes at wastewater treatment plants.

3.3.2. Source Reduction Component

DOHMH devotes considerable resources to a citywide effort to prevent mosquito breeding, through the aggressive elimination of standing water. Through its public information campaign, DOHMH urges residents to reduce breeding sites around their homes and commercial properties and to report potential mosquito breeding sites. It collaborates with elected officials, other City agencies and large property owners to eliminate standing water in empty lots, tire piles and other containers. DOHMH also aggressively enforces the health code that requires elimination of standing water from properties throughout the City.

3.3.3. Chemical Control Component

DOHMH conducts larviciding in accordance with permits issued by the NYSDEC in catch basins, sewage treatment plants, and areas of permanent standing water. Approximately 135,000 catch basins are inspected and treated at least twice each season by hand application. In areas that are inaccessible by ground vehicles, larvicide may be applied aurally. The larvicides most commonly used in New York City are VectoLex (*Bacillus sphaericus* [Bs]), VectoBac (*Bti*), and/or Altosid (methoprene). Catch basin applications are performed by a private contractor during the summer season. Beginning in May, larvicide is applied at wastewater treatment plants, parks, and other surface waters, if larval breeding is determined to exist.

The DOHMH has acquired a helicopter that will be operated by New York Police Department (NYPD) pilots to perform aerial application of larvicides, as necessary. Currently, aerial larviciding is done under contract by a private applicator.

When warranted, the City will apply pesticides for adult mosquito control. The adulticide used during the last four seasons in New York City is sumithrin (ANVIL®). This product is applied as an ULV application. Applications are generally made with truck-mounted ULV delivery systems. Each spray truck is equipped with a Global Positioning System (GPS) that records the location and time of each spray event. In addition to the driver, who is the certified applicator and employed by the DOHMH, typically each truck has a navigator to assist the driver with safety issues and read maps. While spraying, each truck is preceded by a NYPD vehicle that broadcasts a warning, in two languages, that the area is about to be sprayed for mosquito control. For quality assurance purposes, a private contractor, independent of the pesticide applicator,

provides guidance and assists with the technical elements of pesticide application so that operations are conducted according to plan and pursuant to applicable regulations.

Information is released 24 hours in advance of scheduled spray events through the media, the DOHMH web site and WNV Information Line, and pertinent City and community organizations. There have not been any aerial adulticide applications recently. If aerial applications were required, they would be performed by a private applicator under contract to the DOHMH.

3.3.4. Biological Control Component

The City, at this time, does not have a biological control component to their program.

3.3.5. Educational Component

In 2000, DOHMH launched a public education campaign to increase awareness of WNV. This campaign highlighted the need for New Yorkers to take personal protective measures against mosquito bites and to eliminate mosquito breeding sites around their homes. With the theme *Mosquito-Proof NYC*, a poster campaign in English and Spanish appeared from May to October in New York City's mass transit system. Similar messages were also aired on television and radio. DOHMH developed 16 fact sheets and made information available in 17 languages to community boards, elected officials, schools, community-based organizations, and the general public. In subsequent years, DOHMH staff has made hundreds of presentations to various community gatherings.

DOHMH receives standing water and dead bird reports via the New York City's Citizen Service Center (311) and DOHMH's enhanced Web site (nyc.gov/health). Callers can receive comprehensive information about WNV, including updated information about adulticiding schedules by dialing 311. The Citizen Service Center provides callers with a live operator 24 hours a day, 7 days a week. DOHMH also provides information on WNV through its web site (nyc.gov/health/wnv) in the form of fact sheets, press releases, adulticiding schedules, and maps. This information is regularly faxed to City agencies, elected officials, community boards, the Department of Education, hospital, nursing homes, associations of green grocers, day camps, and community organizations. DOHMH works with the Department for the Aging (DFTA) for distribution of WNV literature and insect repellents to the senior citizens at social gatherings and formal meetings.

Adulticiding information is made available through DOHMH's web site and phone line, regular news broadcasts, scheduled advertising times on local radio, print media, and web sites of news organizations. Information is released at least 24 hours in advance through the media, DOHMH web site and Citizen Service Center (311), and to hospital emergency departments, pertinent City agencies, elected officials, community boards, the Department of Education, nursing homes, associations of green grocers, day camps, and community organizations.

3.4. New Jersey Mosquito Control Programs

New Jersey mosquito control programs fall into four tiers:

1. Autonomous Mosquito Control Commissions with programs that rank among the best in the nation
2. Mosquito Control Agencies in other units of county government that have maintained excellent programs
3. Mosquito Control programs (Commission or Agency) that have lost staff, lost budget and are in danger of reverting to pest control operations
4. Mosquito Control agencies with model programs conducted by limited staff that require more support to reach their full potential.

Annual budgets in New Jersey range from \$2,300,000 to less than \$200,000. The autonomous commissions have a maximum budget that is based on tax rateables. Few reach the maximum allowed but pressure put on county boards of Chosen Freeholders (aided by intervention by New Jersey Department of Environmental Protection [NJDEP] and NJAES) can result in higher funding levels when appropriate. All of the autonomous commissions and most of the agencies have a surveillance component that includes larval, adult, and virus surveillance programs. Virtually all of the better programs have a source reduction component that ranges from coordinated tire recycling efforts to major water management programs. The poorer programs rely heavily on chemical control because they lack a comprehensive water management component. Coastal counties, regardless of size, engage in Open Marsh Water Management (OMWM) for salt marsh mosquito control, augmented by funding from the state in many cases.

Meetings called by NJDEP and NJAES with county officials have generated significant upgrades in several of the poorer programs in recent years.

The Cape May County Mosquito Extermination Commission and the Monmouth County Mosquito Extermination Commission stand out as New Jersey's premier mosquito control programs. Both have Ph.D., M.S., or M.P.H degreed individuals directing the surveillance and water management aspects of the programs. Both have full-time pilots on staff and own helicopters. The Cape May County program has an accredited Biosafety Level 3 (BSL-3) laboratory on site for research and virus testing purposes. The Monmouth County program is developing a BSL-3 laboratory at Rutgers University that is staffed entirely by Monmouth County personnel.

The Middlesex County Mosquito Extermination Commission, Ocean County Mosquito Extermination Commission, and Morris County Mosquito Extermination Commission rank almost as high. Their mosquito control efforts are comparable to the premier programs, but lack the facilities and personnel needed to conduct laboratory research. Bergen County, Atlantic County, and Essex County had Mosquito Commissions that were abolished, with responsibilities transferred to county Departments of Public Works. Although each has been able to maintain a viable program, improvements can be made. Two obvious issues are:

1. Obtaining permission to leave the county and attend regional and national meetings.
2. Replacement of retiring staff with individuals lacking appropriate qualifications.

Both represent threats to maintenance of the mission and application of the science needed to run a responsible mosquito control initiative.

Regardless of size or funding, the New Jersey mosquito control community has resources provided by the New Jersey State Mosquito Control Commission (NJSMCC) and Rutgers University that are not available in other northeast US jurisdictions. NJSMCC operates the New Jersey State Airspray Program as a service to counties that can document the need for larviciding or adulticiding over significant mosquito breeding acreage. NJSMCC uses capital funds to support an equipment program that provides equipment ranging from rotary ditchers and long-reach cranes to ULV sprayers and microscopes to any mosquito control agency in the state that

secures permits to conduct large scale mosquito control projects. NJSMCC supports a cooperative Biocontrol Program with New Jersey Fish and Game to supply insectivorous fish to any mosquito control agency that can document the need. NJSMCC funds Rutgers University to coordinate a virus surveillance program, and reimburses the New Jersey State Department of Health for all virus tests conducted on specimens collected by mosquito control agencies in the state.

Rutgers University offers a 14-week course in Mosquito Identification and Habitat Recognition. The certification program taught at Rutgers includes 3 major teaching components:

1. Lectures on basic mosquito biology
2. Laboratory identification of larvae and adults to species
3. Eight all-day field trips to representative mosquito breeding habitats.

A properly identified larval and adult collection is required. Certification from Rutgers University is granted to those that can pass a rigorous written test and lab practicum at the end of the course. Rutgers University reviews the annual plans and estimates of the New Jersey programs and provides scientific input for budget reform in terms of constructive criticism to the legislators that fund each program. Most importantly, the New Jersey mosquito control community has been meeting monthly at Rutgers University since the 1930s to exchange ideas, receive scientific updates, and compare notes on the best way to accomplish mosquito control properly.

3.5. Connecticut State Program

The Connecticut Mosquito Management Program (MMP) is a state-level multi-agency program. The three main players are the Department of Environmental Protection (CDEP), the Department of Public Health (CDPH) and the Agricultural Experiment Station (CAES). Additional assistance is also obtained from the Department of Agriculture (for domestic animal testing) and the University of Connecticut (UConn) for pathology work on birds and animals.

3.5.1. Surveillance Component

The CAES does all of the mosquito surveillance and testing. Currently, they place carbon dioxide baited traps and gravid traps at 91 locations throughout the state. Additional traps will

be placed if virus activity is observed. The trap sites were chosen based on historic virus activity (EEE and WNV) and/or habitats that support vectors of these diseases. Traps are run throughout the summer from June through October, or later if samples indicate virus activity. Each trap is sampled approximately once every seven to ten days. The CAES collects, identifies and tests all the mosquitoes, by species in “pools” of up to 50 individuals each, for a number of viruses. They also do the majority of larval identification, with CDEP performing a portion as well.

The CDPH performs human and avian surveillance. They have an agreement with the CDEP Wildlife Division to hire couriers to collect and deliver dead birds from the local health departments to the state laboratory. They have microbiologists and epidemiologists on staff that commit up to 50 per cent of their time to WNV/EEE work. They also fund laboratory technical assistance at UConn as well as supplies, equipment and transportation.

3.5.2. Source Reduction Component

CDEP does OMWM for mosquito control as part of their larger Integrated Marsh Management (IMM) program of source reduction and restoration/enhancement of degraded wetland. This includes not only OMWM, but tidal flow restoration, culvert replacement, fill removal and similar operations. Approximately 200 to 300 acres of water management is performed per year, with that number increasing to 600 acres if invasive plant control is included.

3.5.3. Chemical Control Component

Connecticut uses between 1,000 and 2,000 pounds of Bti and Bs per season along with methoprene (Altosid) briquets (30 and 150-day) and methoprene granules (30-day) in salt marshes and freshwater wetlands and floodwater areas (in response to complaint calls). The methoprene usage is a few hundred pounds per season. Currently, all applications are done by hand. Investigations are underway for the use of aerial larviciding of Bti, which may be utilized in the future depending on budget constraints. The larviciding is done on the 6,000 acres of state-owned coastal marsh that is routinely inspected. Generally, 500 to 1,000 acres of the marshes are treated in a season.

Catch basin treatments are not performed at this time at the state level unless there is a public health emergency and the larviciding of catch basins is needed in addition to adulticiding. There

are, however, a number of towns and private applicators that treat catch basins as part of their local programs, generally with methoprene briquets (Altosid).

Table 1 lists the application rates reported by towns which had state permits for the application of methoprene, for the calendar years 2003 and 2004. Some municipalities apply chemicals with their own forces, but the majority contract out this service to private applicators. The state does not issue permits for the application of biological larvicides, such as Bti and Bs, and does not maintain records on the use of these agents at the local level.

Table 1 - CT Methoprene Permits

TOWN	2003 (lbs)	2004 (lbs)
Bethel	205	200
Bridgeport	177	
Brookfield	177	
Monroe	18	18
New Haven	1381	1381
New London	145	145
Ridgefield	280	280
Shelton	225	225
Weston/Westport	347	
Wilton	275	275

Note: Values are for pounds of Altosid Briquets (methoprene), not active ingredient

Very little adulticiding is done at the state level. Sites that are treated include state parks along the coast for salt marsh mosquito control. All applications are by truck-mounted ULV, with resmethrin (Scourge®) being the chemical of choice. Aerial application of adulticides has not occurred since 1996 in response to EEE in the southeastern part of the state.

3.5.4. Biological Control Component

The Connecticut State program does not have a biological control component, but they will provide technical assistance to homeowners who wish to use mosquito fish in aquatic gardens.

3.5.5. Educational Component

The CDEP, CAES and CDPH each have websites that contain information on mosquito control and also publish informational brochures. The CAES and CDEP also participate in periodic field days, and have displays at fairs and other public events. CDEP has also developed Public

Service Announcements that go out on public access cable and has done local television and radio spots.

The CDEP Wetland Habitat and Mosquito Management Program also provides technical assistance to municipalities and the public on mosquito control. They respond to complaint calls and provide recommendations to abate mosquito problems to local health departments, public works departments, and licensed private applicators.

4. Outside Review of Suffolk County Department of Public Works Division of Vector Control

The Suffolk County Vector Control Program (SCVC) operates under New York State Public Health Law and Article 15 of the Suffolk County Charter. Its responsibility is to control mosquito infestations that threaten public health or create social or economic problems for county residents. The Division has their offices in Yaphank with a staff of 50 full time employees. The total operating budget is approximately \$2,700,000.00 at the present time.

SCVC works closely with the Suffolk County Department of Health Services (SCDHS), which operates an Arthropod-Borne Disease Laboratory at the Yaphank facility. This relationship assures ongoing health related surveillance input for SCVC vector control decisions. Additional cooperative working relationships exist between SCVC and the New York State Department of Health.

Suffolk County has a population of 1,500,000 within a land mass of 912 mi². The county ranges from urban through suburban to rural in terms of population density, which increases the range of mosquito habitats that must be monitored. Salt marsh floodwater, fresh floodwater and permanent swamp mosquito breeding habitats must be dealt with in addition to a wide variety of habitats that produce domestic mosquito species. A total of 42 different mosquito species have been identified since the program was developed to combat malaria during the 1930s.

Suffolk County has an ongoing threat from mosquito-borne diseases that includes EEE as well as WNV. Although WNV has received considerable publicity in recent years, EEE must be closely monitored because Suffolk has all of the ingredients for transmission to humans. Significant *Culiseta melanura* habitat (the amplification vector) is present at a number of inland foci that must be monitored for evidence of virus activity. Coastal salt marshes produce large populations of *Oc. sollicitans*, an extremely efficient vector of this virus and a documented bridge vector to humans. Inland areas have habitat for *Cq. perturbans*, a secondary bridge vector for the virus, that requires specialized larval surveillance techniques. Monitoring efforts for both EEE and WNV are required over the course of every mosquito breeding season.

4.1 Surveillance Component

SCVC directs considerable resources towards surveillance. A large proportion of its permanent staff positions have surveillance obligations to assure that surveillance data guides the control decisions. The wide variety of mosquito breeding habitats in Suffolk County requires an in-depth larval surveillance component. Teams of inspectors are assigned to geographical areas of the county to guarantee complete coverage of potential breeding habitats on a regular basis. Records are kept on a wide variety of parameters that make up each of the breeding sites that the inspection team is responsible for. Larval surveillance results are quantified by the inspectors in the field to give an overview of population density prior to the initiation of larval control. SCVC identifies a large proportion of the field material collected by its inspectors to species and has laboratory space devoted specifically to that activity. Very few mosquito control agencies in the northeast have surveillance programs of this scope.

Adult surveillance is accomplished by identifying trap catches from 27 permanent NJ light trap stations in the county. The adult surveillance data set is analyzed by location, trap night, species, and male to female ratios in the collections as well as the percentage of saltmarsh or freshwater species that are represented in the data set. Year-to-year as well as week-to-week comparisons can be made to provide a complete picture of how current populations deviate from long-term means. Such surveillance ranks among the best in the nation.

Virus surveillance is directed against a broad scope of lesser known mosquito-borne arboviruses as well as the primary risk targets, EEE and WNV. As with most virus surveillance programs in the northeast, bridge vectors are sampled with CDC traps baited with CO₂. *Culex* species that function as amplification vectors are captured in gravid traps baited with an oviposition attractant. Specimens for virus testing are sorted and identified to species at the Arthropod-Borne Disease Laboratory. The specimens are pooled and sent to Albany for tests. Turn around time for this process poses a problem for SCVC. Virus surveillance results can be up to two weeks old by the time they are received, suggesting that in-house testing would provide substantial improvements. The Arthropod-borne Disease Laboratory is experimenting with the Rapid Analyte Measurement Platform (RAMP) system to test specimens in house to shorten turn around time. It is also developing a system to use Polymerase Chain Reaction (PCR) to become

completely independent but needs more staff to make this aspect of the cooperative program fully operative.

SCVC uses a number of additional surveillance tools to broaden the scope of information that goes into their vector control decisions. Over the years these have included landing rates, bite counts, resting boxes, and sentinel chickens, as well as an integrated Geographical Information System (GIS) to map complaints into the overall surveillance database and track the responses.

4.2 Source Reduction Component

The SCVC comprehensive program for water management ranges from simple sanitation to broad scale water management programs. A work force of 40 individuals is utilized for this aspect of the work. Hand labor aspects of their program include hand ditch maintenance, de-snagging, and stream clearance projects. SCVC does not have an organized tire removal initiative.

SCVC has an inventory of high-tech water management equipment for major projects that includes two amphibious rotary ditchers and a Bombardier GT-300 multipurpose track vehicle fitted with a dump body to facilitate moving spoil. The program also maintains a low ground pressure excavator that permits water management in sensitive areas with minimal disturbance to wetlands habitats. The superintendent of this program has a background in water management, which provides SCVC with the expertise needed for water management planning as well as the implementation of projects. The program uses GIS as well as GPS technology to maximize their resources to the areas where water management is most beneficial. A biologist and GIS technician are on staff to assure that the source reduction component operates efficiently. The water management staff ranks among the best on a national scale.

One shortfall in the SCVC source reduction component is the inability for this program to utilize its water management expertise where the benefits are most needed. There is opposition to water management in areas of salt marsh within the county that chronically breed mosquitoes. In some cases, SCVC is prevented from cleaning grid ditches that should have been replaced by OMWM years ago. It is not good mosquito control policy to allow ditches to re-vegetate without a system in place to eliminate breeding habitat produced by the resulting stagnation of water flow. The situation is compounded by the fact that larval control is not permitted on federal lands on Fire

Island and the William Floyd Estate. This unfortunate set of circumstances forces SCVC to rely on adulticiding to reduce annoyance and vector potential from broods of salt marsh mosquitoes that emerge at regular intervals during the course of the mosquito season.

4.3 Chemical Control Component

During the summer, SCVC conducts a weekly survey of over 100 wetland breeding sites, mostly salt marsh, that are too large for ground application of larvicides. Based on the results of that survey, decisions are made as to which areas are to be treated and with what material. A contract helicopter makes the application, usually the day after the survey, using material provided by SCVC. The decision to treat, and the material to use, is based on the presence of larvae, tidal stage, degree of flooding, time of year, and larval stages present. In general, liquid Bti is preferred when first and second instars are detected early in the season, and when the marshes are well flooded. Third and fourth instars, and all stages in mid-summer, are treated with methoprene (ALTOSID® LIQUID CONCENTRATE). When all larval stages are present, both larvicides may be used in a tank mix. There are about 3000 acres of breeding habitat in the aerial larvicide program, and these major areas account for approximately 90 percent of all larvicide treatments.

In 2004, more acres were treated with *Bti* than with methoprene. The location and time of all applications is recorded on a GPS and the information is downloaded and permanently stored. The attention to detail and success of the aerial salt marsh larviciding program contributes greatly to minimizing the number of adult mosquitoes that move inland. The net result is less use of adulticides and lower risk of disease transmission to people and equines.

In addition to the aerial larviciding program, inspection crews carry larvicide products in backpack and hand held sprayers on their vehicles. The products available for use are *Bti* liquid, ALTOSID® Liquid Larvicide, VectoLex® Granules, and ALTOSID® XR Briquets (that are applied to catch basins). Approximately 5,000 of the estimated 100,000 catch basins in the county are treated. Inspection crews only apply larvicides if larvae are present.

If adults emerge, and the surveillance program indicates that they may pose a threat to the human population, adulticiding programs may be utilized. Ground adulticiding is performed by the field crew on an overtime basis. The equipment used are truck-mounted London Fogger ULV

sprayers that dispense approximately one ounce of formulated insecticide per acre. These sprayers are equipped with Monitor III™ systems which monitor the amount of pesticide being applied at all times, and, with the attached GPS, keep an accurate record of the time and location of all applications. Resmethrin (SCOURGE® 18-54) is the adulticide typically applied, with sumithrin (ANVIL® 10+10) used secondarily. The amount of active pyrethroid applied per acre is in the range of 0.0017 to 0.007 pounds of resmethrin per acre for the pesticide SCOURGE® 18-54 or 0.0012 to 0.0036 pounds of sumithrin for the adulticide ANVIL® 10+10. The sprayers are calibrated to dispense very precise amounts of pesticide. Accurate records of the type of pesticide used, the amounts used, and the location of the treated areas are maintained and forwarded to state regulators. In 2004, there were two aerial adulticide applications. There were three applications in 2002 and 2003.

Periodically, SCVC and outside organizations examine the spray equipment to ensure it is applying the proper amount of pesticide and is generating the correct droplet size as specified on the label. The droplet size spectrums for these two products are: ANVIL® 10+10 – Mass Medium Diameter (MMD) of five to 25 microns, and SCOURGE® 18-54 a MMD of eight to 20 microns. SCVC has its own DC-III droplet analysis unit, which is used for both ground and aerial ULV applications. They also have the ability to do slide analysis for droplet size. These droplets sizes ensure optimum movement through the flying adult mosquito population and ensure the droplets will impinge on the flying mosquitoes. The relatively small droplet size also tends to protect larger insects because the low amount of insecticide per droplet will not normally have any effect on larger insects, birds or mammals. These two insecticides are the same products used by adjoining and neighboring mosquito control agencies.

4.4 Biological Control Component

SCVC does have a fish-stocking program. Natural populations of *Gambusia affinis* are found in some areas of the county and the fish are often moved to areas where they can have an impact on mosquito breeding habitat. The Arthropod-Borne Disease Laboratory at the Yaphank facility assists in this portion of the program by obtaining the necessary permits. Stocking is conducted by field crews, most often on the basis of complaints. In 2004, SCVC stocked ponds in Lindenhurst, Amagansett, Bellport, Flanders, Amityville, and Brookhaven.

4.5 Educational Component

SCVC maintains an advanced public outreach program. Inspectors deal directly with property owners when they respond to resident complaints. SCDHS has taken the lead role in public education, and has an educator on staff to coordinate the effort. Sanitarians are used to enforce property cleanups of mosquito breeding problems when they are needed. Public education includes distribution of pamphlets, media exposure, and presentations to citizen groups. SCDHS also has a web site with a wide variety of information on mosquito control. One major public education component is public notification and the no-spray registry. Public notification is a major undertaking that includes no-spray maps, media posted spray schedules, a 24-hour hot line, and the county's reverse E911 system.

SCVC is less advanced in the continuing education component of their program. In-house training for pesticide license recertification renewals is coordinated through Cornell University. Attendance at scientific meetings by professional staff is less well supported.

4.6 Comparison of SCVC with other Mosquito Control Programs in the Northeast.

Table 2 compares aspects of the SCVC program with Nassau and Westchester County programs and 16 of New Jersey's 21 mosquito control commissions/agencies. Table 3 compares these programs on the basis of IPM components, and Table 4 offers a comparison of budgeted funds expended per square mile of area and per person in the respective counties. Table 4 indicates that Suffolk County, although operating a well-respected mosquito control program, expends less per land area, and per person, than many of the New Jersey programs.

In terms of the New York programs, SCVC is superior by the criteria NJAES uses to evaluate professionalism in mosquito control. The Westchester county program is essentially a WNV control program and lacks many of the components needed to drive a responsible mosquito control effort. Although the program is evolving, it cannot compare with the balanced SCVC approach to mosquito control. Nassau County has an excellent mosquito control initiative, tailored to mosquito control in an area of high population density. As with Suffolk County, the Nassau County program is situated within the DPW but has an excellent working agreement with its Health Department which provides services to the citizenry that could not be otherwise

provided. The urban setting allows it to focus on a smaller range of pests and vectors, which makes its' job simpler than that of SCVC in terms of habitats that require monitoring. Nassau, like Westchester, does not have extensive tidal wetlands near major population centers as are present in Suffolk County. Nassau County is much smaller than Suffolk County in terms of land area, which minimizes travel for both surveillance and control. The Nassau County program has allowed the NCDH to assume much of the science, allowing the mosquito unit to focus on and excel in the applied aspects of mosquito control. Technologically, SCVC is proactive while Nassau relies heavily on its Health affiliate to provide technological skills. SCVC personnel appear better qualified, better trained, and more diverse than their Nassau counterparts. Surveillance complements the Nassau County program but does not drive its overall control efforts. SCVC has one of the best surveillance programs in the country and stands out in that regard. The working relationship that SCVC has with SCDHS allows it to conduct research to support its mission, which is rare in most mosquito control programs.

In comparison with the NJ programs, SCVC ranks high but does not lead. SCVC certainly has a more complete program than any NJ county that has a mosquito control program in DPW setting. The SCVC program exceeds any NJ agency program by a very wide margin. Its close affiliation with Health Services is one important reason, but overall the level of professionalism in the SCVC program allows them to provide services well beyond the norm.

To the credit of Suffolk County, SCVC would be ranked higher by NJAES criteria than six of NJ's eight autonomous commissions. The SCVC surveillance program provides a model that few NJ programs can match. SCVC understands mosquito control and the integration of components that provide for responsible mosquito management. The SCVC budget is also a factor because it gives it the tools to excel. However, the counties of Cape May and Monmouth in New Jersey have developed better programs with lower budgets for several important reasons.

The political structure in Cape May and Monmouth Counties, using commissions, promotes better expenditures of funds. Monetary decisions are made by citizens that are appointed as commissioners, and who also have input from a University. The political structure of a commission allows the commissioners to hire trained professionals when needed, rather than have training develop on the job. Rutgers University has instilled the concept that mosquito

control should be based on science. This allows the hiring of students trained in mosquito biology at the Masters and Ph.D. levels. Virtually all of NJ's commissions and a large proportion of the agencies have adopted that philosophy, allowing for a high level of professional support. It is not uncommon to see individuals with Masters degrees in biological or administrative positions. New Jersey's programs almost all have better continuing education programs, promoting participation in state and regional meetings to encourage technical proficiency, which directly upgrades the quality of programs. The lack of such support is a significant deficiency for SCVC.

Suffolk County once led the northeast with their excellent source reduction component. The quality of equipment available to the program shows that water management is taken seriously. NJAES, however, would point out two serious shortcomings in the current SCVC source reduction component:

1. The lack of an organized tire reduction program
2. The inability to engage in meaningful water management to reduce populations of salt marsh mosquitoes on federal lands.

The fact that SCVC does not have an organized tire pickup program at the present time should be addressed. Tires provide breeding habitat for the major mosquito vectors of WNV. SCVC should take the lead in a meaningful tire removal initiative to show the general public how simple sanitation contributes to mosquito control and reduction in disease potential. Most mosquito control agencies in the country engage in this relatively simple form of source reduction for mosquito control. The public relations benefits alone make this a worthwhile activity that can be achieved at relatively low cost.

An inability to address major breeding areas in proximity to residential areas is an obvious deficiency for a mosquito control program. There is no obvious solution to this situation, which is caused by federal policies long established and validated nationwide for national parklands and designated wilderness areas.

In addition, the problems SCVC is having enacting OMWM in salt marshes seriously interferes with its ability to provide responsible mosquito control. Well-designed water management

projects are essential for mosquito management and should be integrated into the SCVC effort. New Jersey's coastal counties have all developed well funded, progressive OMWM programs that have significantly reduced pesticide usage and eliminated chronic breeding habitats. Suffolk County is currently caught in controversy that is increasing rather than decreasing its reliance on pesticides. NJAES would issue harsh criticism to those who oppose water management programs, and would insist that a solution be found. Suffolk County has the potential to have one of the best mosquito control programs in the country. The funding levels are more than adequate to achieve that status if the few drawbacks could be overcome.

Table 2 - Comparison of Selected Mosquito Control Agencies in the Northeast

County	Land Area	Population	Full Time Employees	Seasonal Employees	Approximate Operating Budget
New York State Programs					
Suffolk	912 mi ²	1,500,000	50		\$2,700,000.00
Nassau	287 mi ²	1,400,000	20	6	\$1,200,000.00
Westchester	500 mi ²	925,000	7	4	(Not Available)
Premier NJ Programs ¹					
Cape May	267 mi ²	665,000	18	13	\$2,300,000.00
Monmouth	472 mi ²	650,000	25	12	\$2,300,000.00
Middlesex	318 mi ²	775,000	20	7	\$1,700,000.00
Ocean	640 mi ²	480,000	15	12	\$1,600,000.00
Morris	479 mi ²	470,000	24	3	\$2,300,000.00
Remaining NJ Programs ²					
Bergen	246 mi ²	885,000	27		\$1,300,00.00
Atlantic	567 mi ²	255,000	11	3	(Not Available)
Essex	127 mi ²	780,000	23	As Needed	\$1,900,000.00
Warren	365 mi ²	103,000	7	4	\$ 600,000.00
Camden	221 mi ²	515,000	15		\$ 675,000.00
Mercer	226 mi ²	360,000	10	0	\$ 540,000.00
Salem	338 mi ²	65,000	8	1	\$ 520,000.00
Hunterdon	430 mi ²	126,000	2	3	\$ 150,000.00
Gloucester	328 mi ²	250,000	9	0	
Passaic	195 mi ²	500,000	15		\$ 680,000.00
Sussex	535 mi ²	144,000	4	2	\$ 250,000.00

¹ Ranked by NJAES criteria

² Figures not included for Union, Somerset, Burlington, Cumberland and Hudson Counties in New Jersey

Table 3. Comparison of SCVC with Other Programs in the Northeast in Terms of IPM Components

PROGRAM	Surveillance	Source Reduction	Chemical Control	Biological Control	Educational
New York Programs					
SCVC	Larval, adult and virus surveillance are among the best in the nation with excellent cooperation with SCDH. Most importantly, SCVC uses the information to make responsible control decisions.	Maintains an inventory of high tech equipment for use on major water management projects. Possesses the ability to excel at the national level in this category. Opposition to management on salt marshes increases the need for chemical control and detracts from how SCVC would be ranked in this category.	Well equipped to conduct meaningful chemical control. Has developed a meaningful list of triggers to assure that all control decisions are justified. Ranks among the best in the northeast in this important category.	Maintains an adequate fish stocking program based on confirmed complaints. Would not be considered a leader in this area without increasing their efforts markedly.	Maintains an advanced public outreach program with an educator on staff. Good in-house training but limited support for professional education of most of the staff. Limited attendance at scientific meetings detracts from the programs image at the national level, and limits up-to-date access to knowledge of many SCVC key personnel.
Nassau	Strong larval, adult and virus surveillance conducted in cooperation with NCDH.	Excellent source reduction at every level of mosquito production.	Well equipped to conduct meaningful larval and adult control.	Limited primarily to maintaining habitat for native killifish in salt marsh habitats.	Proactive program for public awareness. Limited support for professional education of most staff.
Westchester	Limited to WNV. Not used to drive control aspects.	Limited to monitoring catch basins. Lacks equipment to conduct water management.	Limited to larviciding catch basins. No equipment for adult control.	None in place.	Excellent public education component. Limited funds for professional education of all but the key staff.

New Jersey Programs	Surveillance	Source Reduction	Chemical Control	Biological Control	Educational
Autonomous Commissions with Premier Programs	Exceptionally strong larval, adult and virus surveillance with dedicated space and staff for each component.	Excellent source reduction at every level of mosquito production, with well a trained water management specialist in charge.	Exceptionally strong chemical control component with both aerial and ground equipment, relying heavily on surveillance data to trigger responsible control decisions.	Take full advantage of the State Biocontrol Program. Promote biological control as a part of their public relations activities.	Excellent public relations component with a Biologist usually in charge. Funds are made available for professional education and professional staff are routinely sent to scientific conferences.
Agencies in Units of County Government with Excellent Programs	Good larval, adult and virus surveillance with dedicated space and staff for each component.	Excellent source reduction at every level of mosquito production, often relying on State Equipment Program to complete necessary tasks.	Utilize larval and adult control components of their program responsibly. Make frequent use of the State Airspray Program for many control activities.	Routinely use the state Biocontrol Program to stock mosquito eating fish.	Maintain a good program of public education. Provide in-house professional education, but rarely send their staff to any out-of-state educational meetings.
Agencies with Model Programs that require more support	Excellent larval, adult and virus surveillance using staff with other responsibilities.	Lack both personnel and equipment to conduct meaningful water management projects.	Maintain a modest program of larval and adult control. Recruit administrator and biologists frequently and rely heavily on seasonal help.	Incorporate a Biocontrol component into their program, primarily for public relations purposes.	Maintain a modest public education program. Routinely provide key staff with funds to attend educational meetings.
Programs in danger of reverting to Pest Control Operations	Little or no larval surveillance, modest adult surveillance. Information is rarely available to help make responsible control decisions. Work often performed by poorly trained seasonals.	Most do not engage in the source reduction aspects of mosquito control.	Rely too heavily on the chemical control component to keep mosquito populations manageable.	Rarely engage in biocontrol aspects of mosquito control even though the service is available.	Have neither a public education or professional education component in their program.

Table 4. Comparison of SCVC with Other Programs in the Northeast in Terms of Cost

County	Land Area	Population	Approximate Operating Budget	Approximate Cost per Square Mile	Approximate Cost per Person
New York State Programs					
Suffolk	912 mi ²	1,500,000	\$2,700,000.00	\$2,960	\$1.80
Nassau	287 mi ²	1,400,000	\$1,200,000.00	\$4,181	\$0.86
Westchester	500 mi ²	925,000	(Not Available)		
Premier NJ Programs					
Cape May	267 mi ²	665,000	\$2,300,000.00	\$8,614	\$3.46
Monmouth	472 mi ²	650,000	\$2,300,000.00	\$4,873	\$3.54
Middlesex	318 mi ²	775,000	\$1,700,000.00	\$5,346	\$2.19
Ocean	640 mi ²	480,000	\$1,600,000.00	\$2,500	\$3.33
Morris	479 mi ²	470,000	\$2,300,000.00	\$4,802	\$4.89
Remaining NJ Programs					
Bergen	246 mi ²	885,000	\$1,300,00.00	\$5,285	\$1.47
Atlantic	567 mi ²	255,000	(Not Available)		
Essex	127 mi ²	780,000	\$1,900,000.00	\$14,960	\$2.44
Warren	365 mi ²	103,000	\$ 600,000.00	\$1,644	\$5.83
Camden	221 mi ²	515,000	\$ 675,000.00	\$3,054	\$1.31
Mercer	226 mi ²	360,000	\$ 540,000.00	\$2,389	\$1.50
Salem	338 mi ²	65,000	\$ 520,000.00	\$1,538	\$8.00
Hunterdon	430 mi ²	126,000	\$ 150,000.00	\$349	\$1.19
Gloucester	328 mi ²	250,000			
Passaic	195 mi ²	500,000	\$ 680,000.00	\$3,487	\$1.36
Sussex	535 mi ²	144,000	\$ 250,000.00	\$467	\$1.74