2 The Long-Term Management Plan

This section discusses the existing mosquito management program, those programs found in neighboring jurisdictions (including programs developed specifically to address West Nile virus), Suffolk County mosquitoes, laws and regulations that bear on mosquito control, and aspects of the Long-Term Plan, including a mission statement for the Long-Term Plan, its goals and objectives, and a summary of its contents.

2.1 Existing Program

The following discussion of the existing SCVC program is based on the Task 4 report, *Current Operations*, prepared by CA (Cashin Associates, 2004a), as supplemented and updated by personal communications from Dominick Ninivaggi and Tom Iwanejko, SCVC, and Dr. Scott Campbell, SCDHS, in 2005 and 2006.

The current Suffolk County vector control program is conducted by two departments of County government.

SCVC is the division of SCDPW that is responsible for controlling mosquito populations that may be an infestation or public health threat in Suffolk County. SCVC has a staff of approximately 45 people, including the Division Superintendent, clerks, compliance and laboratory staff, and field crews. The Superintendent manages the Division. A principal environmental analyst, biologist, computer programmer and analyst, and lab technicians work under the Superintendent to organize information for quick decision making. The four field crews, made up of a foreman and four to eight equipment operators and laborers, execute the plans and decisions set forth by the Superintendent. The field crew are full-time, year-round employees of the Division.

SCVC operates out of the County Office Complex in Yaphank, a facility it shares with Arthropod-Borne Disease Laboratory (ABDL) (see below). The building contains offices for staff, a conference room, a kitchenette, and a garage for the repair of machinery. In addition, SCVC also has a free-standing garage used for storage of pesticides and equipment. At present SCVC is renovating a former pesticide mixing shed into a storage shed for the pesticides.

SCVC works with SCDHS to educate the public, identify health threats, and plan control measures. SCVC is answerable to the Commissioner and Chief Deputy and Deputy Commissioners of SCDPW, and ultimately to the County Executive and Suffolk County Legislature. SCVC conducts work under the authority of the NYS Public Health Law, Article 15, Sections 1500, 1501, 1502, and Section C8-4 of the Suffolk County Charter, and Part 380 of the Suffolk County Code.

The Legislature approves the SCVC Plan of Work and budget in November each year as part of the County budget. The SCVC Superintendent prepares the budget each year and submits it to the Commissioner of SCDPW in May. The budget is included with the overall SCDPW annual budget and is then sent to County Executive in June to be included in the County Budget, to be voted on in November by the Legislature. The SCVC 2005 budget was $2,750,935, broken down as:

- $1,986,273 for personnel services
- $46,800 for equipment (office equipment, calibration equipment, radio and communication, furniture, etc.)
- $704,500 for supplies and materials (books and research materials, computer software, pesticides which accounts for $370,000 of the $704,500, rental fees for office equipment, etc.)
- $13,362 for travel expenses.

The Plan of Work is a written description of the SCVC purpose, history, current operations, and goals for the following year, and into the future. The Plan of Work is prepared by the Superintendent and submitted to the Legislature in October for approval in November.

SCVC operations are based on the principles of Integrated Pest Management (IPM). Generally, IPM relies on a hierarchical approach to any pest problem, where addressing a problem early, using methods that have the least potential impact, and targeting efforts so as to address the specific pest as directly as possible are overall guides to best operating procedures. However, all

IPM programs are individualized to one degree or another to ensure that treatments used are most appropriate for the problem and setting.

SCVC relies on public education to reduce exposure to mosquitoes, surveillance to determine if mosquito problems represent a human health or public welfare problem, source reduction to remove breeding habitat (including water management, especially in salt marshes), larval control if required, and, if other measures have not been successful and the problem is deemed to be serious enough, adult control.

Typically, in fall, winter, and spring SCVC focuses operations on water management. At the current time, SCVC water management has been limited to maintaining the legacy grid ditch system. Millions of feet of ditches were installed in salt marshes and some upland wetlands in the 1920s and 1930s to control mosquito populations. Ditch maintenance consists of the removal of debris from and general regrading and refurbishing of the existing ditches so as to return hydraulic functions to the system. SCVC made small additions to the legacy ditch systems in the 1970s and 1980s, and an even smaller amount in the 1990s, to address areas of marsh supporting mosquito breeding, but no longer installs any new traditional ditches. Under the scaling back of the Plans of Work, beginning with the 2002 Plan of Work, ditch maintenance activities were also limited in extent compared to past activities. In 2005, the County Executive announced a moratorium on machine ditch maintenance. Other jurisdictions use other means to conduct water management to control mosquitoes. These other means are generally considered to be more progressive than ditch maintenance, and are generally known as Open Marsh Water Management (OMWM). SCVC has not generally adopted OMWM practices, primarily due to an inability to receive appropriate permits for such work. Ditch maintenance is expressly permitted under existing State regulations; NYSDEC staff has openly expressed concerns regarding potential impacts to marsh health under OMWM. In addition, there is concern that earlier, permitted OMWM demonstration projects were generally not adequately monitored and documented.

In spring, as mosquitoes emerge, SCVC undertakes its extensive surveillance program. Regular surveys of over 2,000 potential breeding locations are made, and, in conjunction with the ABDL, monitoring of 27 fixed New Jersey light traps and 27 fixed location CDC (Centers for Disease Control and Prevention) light and gravid traps is conducted. Additional CDC traps are added

throughout the season, with maximum weekly trap placements set outs approaching 80 at peak pathogen presence times. Inspectors are sent, within a day or two, to visit the location of every complaint call received (approximately 3,000 calls are logged each year). Approximately 10,000 catch basins are monitored, and those with standing water receive time-release methoprene briquets to suppress mosquito breeding there, and certain recharge basins are stocked with *Gambusia* fish (or, if water quality is too poor, treated with time-release methoprene or *Bacillus sphaericus* (Bs) briquets).

Beginning in spring, and continuing to September, larval control of mosquitoes, if justified by surveillance, is conducted in certain areas by contract helicopter and in others by hand applications of larvicides. Although the majority of acreage treated is in salt marshes, the focus of effort is on fresh water settings. Approximately 75 percent of the sites treated from 2000 to 2005 with larvicides were fresh water, upland locations (Table 2-1). *Bacillus thuringenesis var israelensis* (Bti) is typically used early in the season as the larvicide of choice. Methoprene is predominantly used in the middle of summer. Bti needs to be consumed to be effective, and so can only be used when younger larval instars are present. Methoprene is effective on all stages of larval mosquitoes. Sometimes a duplex formulation of Bti and methoprene is used. Bs formulations also are used, particularly in "permanent water" environments. Approximately 80 percent of the treatments from 2000 to 2005 in regulated fresh water wetlands were either Bti or Bs. Dominant methoprene use in catch basin treatments meant that the overall fresh water balance was 51 percent methoprene-based larvicides, and 49 percent bacterial products. For salt marshes, slightly more treatments contained methoprene (51 percent) than bacterial products (49 percent) (Table 2-2). Water management may also be carried out at locations with breeding problems, but in summer water management is only conducted at spot locations requiring simple actions, generally on an as-needed, emergency basis.

Table 2-1. Distribution of larvicide applications by habitat type, 2000-2005

	Treatments	Catch basins	Total
Fresh water	17,748	7,601	26,349
Salt water	8,373		8,373
Total	26,121	7,601	33,722

Table 2-2. Distribution of larvicide type by habitats, 2000-2005

	Methoprene-based products	Bti or Bs products
Applications to regulated fresh water wetlands	1,428	5,859
Applications to all fresh water sites	12,943	12,406
Applications to salt water habitats	4,305	4,068
All applications	17,248	16,474

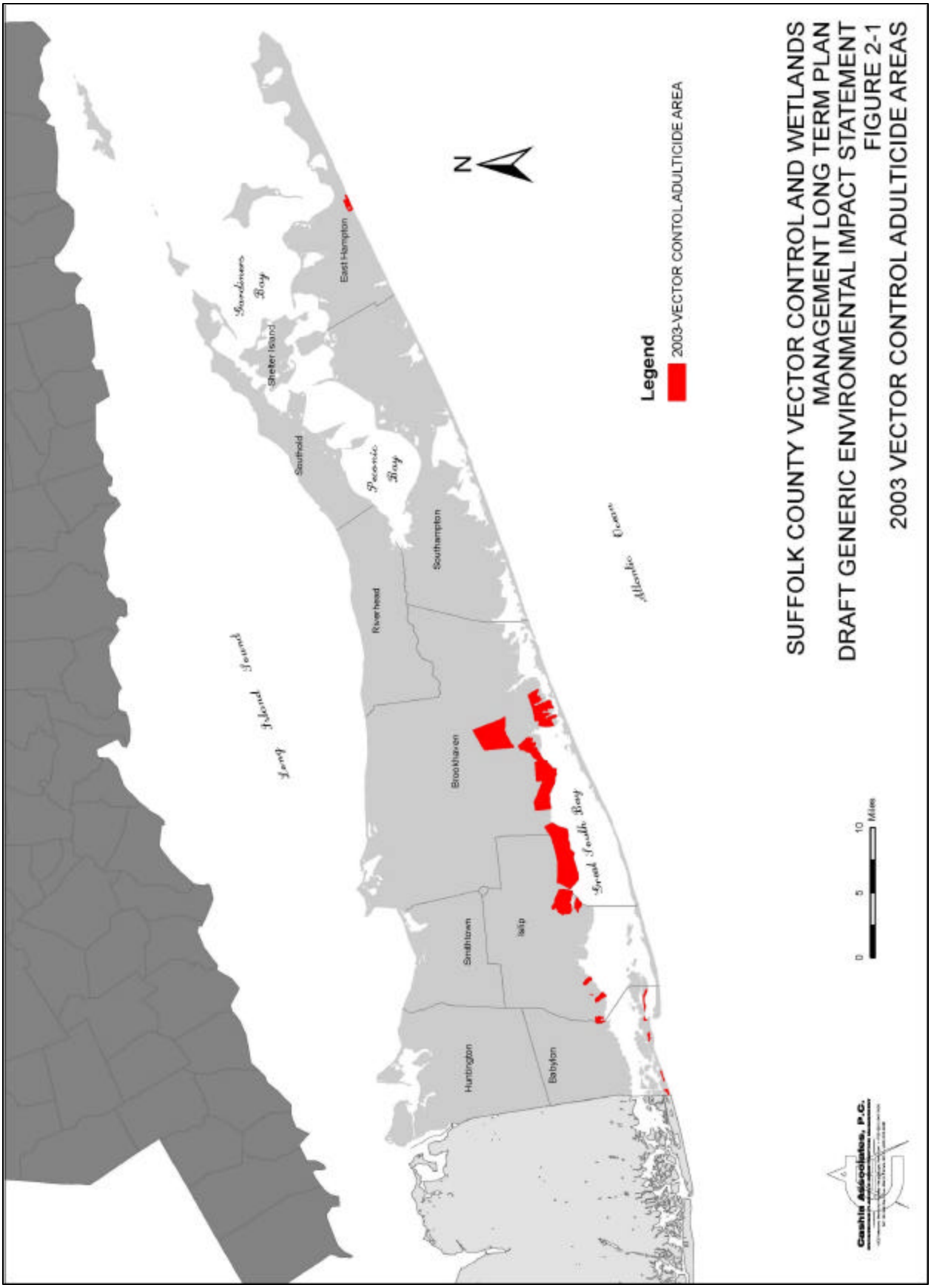
Adult control of mosquitoes is conducted when other means of mosquito control have proven to be ineffective, and to preserve human health and welfare. In certain communities on Fire Island, regular applications of adulticides have been scheduled following the onset of salt marsh mosquito infestations. This is because Federal policies at FINS do not allow SCVC to carry out water management or larval control except in the private communities. These applications are carried out using hand-held applicators beginning shortly before dusk. Over the past several years, sumithrin has been exclusively used as the pesticide for these applications.

All other adulticide applications are conducted on the basis of overt surveillance justifications.

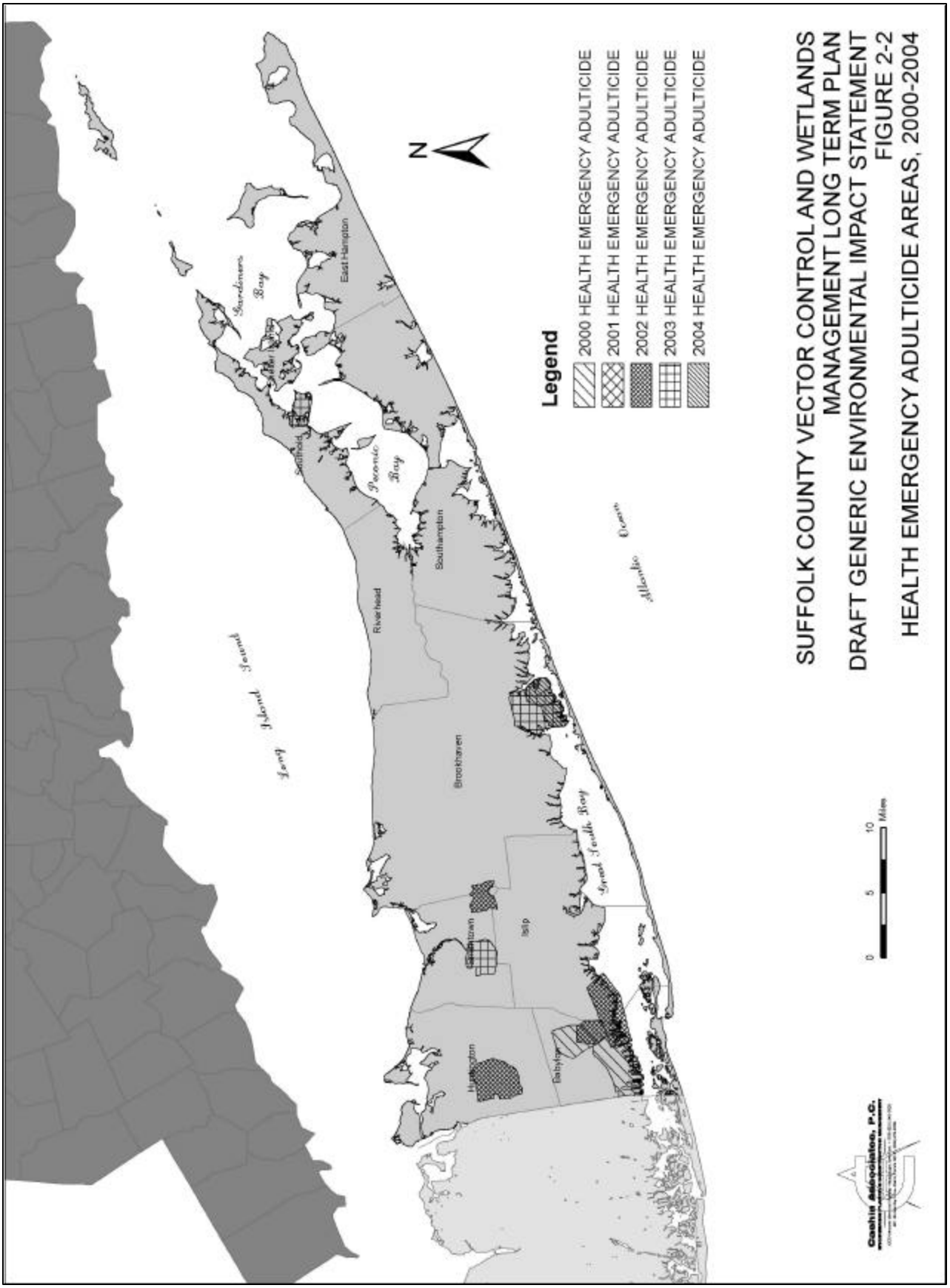
Control of large mosquito populations (called "vector control" by SCDPW for the past three or four years), which also reduces disease risks associated with these human vectors, is generally conducted by truck. Setbacks of 150 feet from wetlands are observed, and 100 foot setbacks from open water are also followed. Resmethrin has been used exclusively for the past several years for both truck and aerial applications. The areas where adulticiding was undertaken for vector control reasons (excluding the Fire Island communities within FINS) are quantified in Table 2-3. The areas adulticided for vector control purposes in 2003 (excluding the Fire Island communities within FINS) (which was the greatest year for adulticiding over the period 2001 to 2004, see Table 2-3) are shown in Figure 2-1.

Table 2-3. Acres Treated with Adulticide under Vector Control Determinations (FINS Communities not included)

Year	Vector Control Adulticide Acreage
2000	66,400
2001	27,600
2002	5,850
2003	34,650
2004	20,300


SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS
MANAGEMENT LONG TERM PLAN
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
FIGURE 2-1
2003 VECTOR CONTROL ADULTICIDE AREAS
Legend
2003-VECTOR CONTOL ADULTICIDE AREA
N
East Hampton
Southold
Riverhead
Southampton
Brookhaven
Smithtown
Islip
Huntington
Babylon
Shelter Island
Sag Harbor
Peconic Bay
Great South Bay
Atlantic Ocean
Long Island Sound
0
5
10
Miles
Cashin Associates, P.C.

Most disease monitoring is conducted by the ABDL (see below). Discovery of mosquito-borne human pathogens by surveillance results in an application being made by SCDHS to NYSDOH for a human health threat declaration by the NYSDOH Commissioner. Once that is received, all Suffolk County mosquito control activities come under the direction of the SCDHS Commissioner. Should further risks to human health be determined, the SCDHS Commissioner may declare a Human Health Emergency, and determine that adulticides need to be applied to reduce the risks of disease transmission to people. At that time, a coordinated review of the situation is undertaken with NYSDEC, and, if needed, waivers of certain regulations (such as the State fresh water regulations forbidding the application of pesticides over fresh water wetlands) may be requested. Most pesticide applications in a human health emergency are conducted by air (using a contract helicopter). Resmethrin has been the insecticide choice over the past several years. SCDHS consults with SCVC to determine the optimal application area. The cumulative applications made by Suffolk County for 2000 to 2004 under health emergencies are shown in Figure 2-2.


SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT LONG TERM PLAN
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
FIGURE 2-2
HEALTH EMERGENCY ADULTICIDE AREAS, 2000-2004
Legend
2000 HEALTH EMERGENCY ADULTICIDE
2001 HEALTH EMERGENCY ADULTICIDE
2002 HEALTH EMERGENCY ADULTICIDE
2003 HEALTH EMERGENCY ADULTICIDE
2004 HEALTH EMERGENCY ADULTICIDE
N
0
5
10
Miles
Long Island Sound
Gardiners Bay
Peconic Bay
Atlantic Ocean
East Hampton
Southold
Southampton
Riverhead
Brookhaven
Islip
Huntington
Babylon
Great South Bay
Cashin Associates, P.C.

SCVC is responsible for ensuring all permits and reports regarding pesticides use and other regulated activities are in order. The ABDL is responsible for filing for any appropriate State reimbursements.

SCDHS, as discussed above, is the other department of County government that has a major role in current vector control operations. SCDHS participates in several ways:

- The ABDL is responsible for mosquito identification and disease monitoring. SCVC provides some staff to assist in this, and the ABDL in turn supports SCVC population surveillance by overseeing specimen speciation of larval and adult samples collected by SCVC. Approximately 50 percent of the ABDL effort is devoted to mosquito control efforts. The ABDL is part of the SCDHS Division of Public Health.

- SCDHS public health educators conduct the organized outreach portion of the public education program. These educators are responsible for presenting materials to schools and other groups and organizations that request it. SCDHS is also responsible for updating the vector control portion of its County website webpage. These health educators are part of the Division of Public Health.

- The Commissioner of SCDHS is responsible for petitioning the NYSDOH Commissioner when a public health threat exists, for a formal declaration of such a threat. When the NYSDOH Commissioner does so declare, then the Commissioner of SCDHS assumes control of County vector control activities. SCVC is thus directed by SCDHS under Health Threat conditions.

- The Office of Ecology (Division of Environmental Quality) reviews the Annual Plan of Work. In addition, the Office of Ecology has played a key role in past marsh management projects undertaken by the County under various environmental restoration programs.

In order to determine changes associated with the proposed Long-Term Plan, measures of recent water management, larvicide use, and adulticide use have been compiled. Water management (ditch cleaning) is quantified in terms of feet of ditches cleaned, and larvicide and adulticide use

in terms of acres treated. Acreage is used for pesticide usage, as the formulations of different pesticides have different amounts of active ingredients, and the weights of total pesticides used (active and inert ingredients together) per acre can vary. Acreage treated is thought to measure the intensity of the programmatic effort best.

Linear feet of ditch cleaning is unlikely to be a meaningful measure once progressive water management techniques are adopted by the County. The most apt statistic for water management would be an acreage measure. The issue for the acreage measure would be whether to count all of a marsh if only part is treated, and if partial marsh measures are to be used, what bounds should be scribed around a treatment. A preferred measure would seem to be the acreage of the marsh that is intended to be affected by the action. The County will therefore report two statistics as a measure of water management. One will be the total acreage of marshes addressed through the program (this will be the sum of the total acreages of marshes), and, as a measure of program efficacy, the total acres of marsh actually altered. It is not possible to revisit past water management efforts and translate the linear feet measure to a commensurate acreage of treatment to create a single measure for past practices and future actions.

Table 2-4. SCVC Programmatic Efforts, 1999-2004

Year	Water Management (Linear Feet Ditch Cleaning)	Larval Control (Acres Larvicided)	Adult Control (Acres Adulticided)
1999	610,890	26,380	63,865
2000	515,664	31,961	68,480
2001	480,631	35,726	18,389
2002	165,580	32,515	29,248
2003	176,646	26,728	34,880
2004	124,434	31,428	22,880

2.2 Comparisons to Other Nearby Jurisdictions

The following information in Section 2.2 is based upon the Task 4 report, *Suffolk County Comparison with Other Northeast Operations* (CA-CE, 2004a), supplemented by other, explicitly referenced material.

The New Jersey Agriculture Experiment Station (NJAES) is mandated under Title 26 Chapters 3 and 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 mosquito control efforts, including five necessary components:

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

The evaluations here are based on these components. The criteria NJAES uses to evaluate New Jersey mosquito control programs are applied 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.

2.2.1 Westchester County

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 full-time workers, two conducting surveillance and five for control. During the summer months, as many as 40 additional staffers are made available from WCDH to assist with mosquito related activities. Budgetary figures were not made available, but funding has been relatively constant over the past three to four years. In 1984, Westchester County had discontinued an earlier program 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 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.

Surveillance

The surveillance component of the Westchester program is excellent but is limited to monitoring the mosquito vectors of WNV. Adult surveillance consists of operating CDC light traps 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 NYSDOH 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 is the case for 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 can guide control decisions.

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

The personnel that coordinate surveillance in Westchester County are well trained biologists and highly qualified.

Source Reduction

The source reduction component of the Westchester program consists of monitoring and treating catch basins to control *Culex* mosquitoes. Westchester County is not aggressive in efforts to gain access to private property for either inspection or control activities.

Westchester County does not have a water management program. It lacks the large pieces of equipment normally associated with water management, and does not conduct ditch maintenance. Westchester County does not sample its larval habitats (beyond catch basins) on a regular basis, and does not conduct active surveillance of potential bridge vectors.

Chemical Control

Larviciding catch basins is the only mosquito control measure conducted by Westchester 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 double orange spots. 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 permit issued by 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 years have been accomplished via a contractual arrangement with Clarke Environmental Mosquito Control (Roselle, IL). Future adulticide applications, if necessary, would be performed under a similar contractual arrangement.

Biological Control

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.

Education and Outreach

The Westchester mosquito control program has an excellent public education component. This is a direct result of having qualified personnel, including 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.

2.2.2 Nassau County

Mosquito control in Nassau County has a long history, beginning in 1915. Mosquito control activities were placed under a commission in 1929 (as allowed under State law) 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 IPM as conducted for mosquito control (often denoted as 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 pieces of 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 NCDH and some are mosquito inspectors employed by 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 competence and are deputized by the Commissioner of NCDH 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 flood water salt marsh mosquito broods. The urbanization of the upland areas of the county prevents fresh flood water 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.

Surveillance

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 in 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 human biting species. 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 42 collection sites, which create a 2.5-mile grid across 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 County has an extensive crow surveillance program operated out of the NCDH that is used by mosquito control personnel to pinpoint areas of WNV activity.

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:

- Mosquito trap counts
- WNV virus isolations from mosquitoes
- Dead crow reports
- Suspect human cases

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

Source Reduction

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 maintains 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.

Chemical Control

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 (10 to 15 percent of all of the salt marshes in the County). Larviciding is accomplished with a contract helicopter applicator, North Fork Helicopters, utilizing *Bti* in the early season and methoprene 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 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 residential areas south of the Southern State Parkway.

Normally, adulticiding is only done in areas contained by natural barriers. For example, *Ochlerotatus 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 NCDPW 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 10 backpack sprayers.

Any decision to apply adulticide chemicals is made by NCDH.

Biological Control

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.

Education and Outreach

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 is available.

2.2.3 New York City

New York City has a WNV control program, which is administered by the New York City Department of Health and Mental Hygiene (DOHMH), Environmental Health, Veterinary and Pest Control. The City formerly had a larger, more comprehensive program, dating back to the early 1900s. Some of the earliest, comprehensive ditching programs were conducted in New York City in the 1910s, for example. Budget crises in the absence of explicit mosquito-borne disease threats led to the phase-out and ultimate elimination of the program in the 1970s and 1980s (Cashin Associates, 2004b).

Surveillance

New York City performs surveillance activities for mosquito larvae and 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 to 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 sets additional traps to evaluate the efficacy of the control measures. Mosquito magnet traps are also used to survey and control adult mosquitoes at wastewater treatment plants.

Source Reduction

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 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 and containers, and

to locate and eliminate tire piles. DOHMH also aggressively enforces the health code that requires elimination of standing water from properties throughout the City.

Chemical Control

DOHMH conducts larviciding in accordance with permits issued by NYSDEC Region 2 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 aerially. 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 2001 DEIS for the New York City program determined there was a potential for impact by methoprene to non-target organisms, based on its mode of action. It was noted that some research found temporary reductions in populations of other aquatic dipterans, but no other impacts were cited. The determination in New York City was to restrict methoprene use to sewers and catch basins, where release to surface waters would not occur (NYC DOH, 2001). Reportedly, this decision was spurred by a refusal by NYSDEC Region 2 to issue a permit to the City for wider use of methoprene.

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

When warranted, the City will apply pesticides for adult mosquito control. The adulticide used from 1999 to 2003 was sumithrin, applied as in an ultra low volume (ULV) formulation. 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 for several years. If aerial applications were required, they would be performed by a private applicator under contract to the DOHMH.

Biological Control

New York City does not have a biological control component.

Education and Outreach

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 around the clock. 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, green grocer associations, day camps, and

community organizations. DOHMH works with the Department for the Aging 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, green grocer associations, day camps, and community organizations.

2.2.4 New Jersey

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 (commissions or agencies) 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 requires 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 source reduction components that range 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 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 PhD-, MS-, or MPH-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 three 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 to pass this course. Certification from Rutgers University is granted to those that can pass a rigorous written test and lab practicum. 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. The association of New Jersey agencies also holds an annual scientific meeting each spring.

Table 2-5 summarizes the classification of New Jersey programs. Table 2-5 makes cost comparisons among the better New Jersey programs, and the SCVC and Nassau County programs.

Table 2-5. Classes of New Jersey Mosquito Control Programs.

	Surveillance	**Source Reduction**	**Chemical Control**	**Biological Control**	**Education & Outreach**
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 nor professional education component in their program.

Table 2-6. Cost Comparison among Long Island and the Premier New Jersey Mosquito Control Programs

County	Area	Population	Operating Budget	Cost per Square Mile	Per Capita Cost
Suffolk	912 mi^2	1,500,000	$2,700,000	$2,960	$1.80
Nassau	287 mi^2	1,400,000	$1,200,000	$4,181	$0.86
Cape May	267 mi^2	665,000	$2,300,000	$8,614	$3.46
Monmouth	472 mi^2	650,000	$2,300,000	$4,873	$3.54
Middlesex	318 mi^2	775,000	$1,700,000	$5,346	$2.19
Ocean	640 mi^2	480,000	$1,600,000	$2,500	$3.33
Morris	479 mi^2	470,000	$2,300,000	$4,802	$4.89

2.2.5 Connecticut (State Program)

The Connecticut Mosquito Management Program is a state-level multi-agency program. The three main players are the Department of Environmental Protection (CTDEP), 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.

Surveillance

CAES does all of the mosquito surveillance and testing. Currently, it sets CDC light 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 observed habitats that support vectors of these diseases. Traps are run throughout the summer from June through October (or later, if samples indicate continued virus activity). Each trap is sampled every seven to 10 days. CAES collects, identifies and tests all the mosquitoes, by species in pools of up to 50 individuals each, for a number of viruses. It also completes the majority of larval identification, with CTDEP performing a portion, as well.

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

Source Reduction

CTDEP does OMWM for mosquito control as part of their larger Integrated Marsh Management 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 (600 acres per year if invasive plant control is included).

Chemical Control

Connecticut uses between 1,000 and 2,000 pounds of Bti and Bs per season along with methoprene briquets and granules in salt marshes and fresh water wetlands and flood water areas (mostly in response to complaint calls). The methoprene usage is a few hundred pounds per season. Currently, all applications are made by hand. Investigations are underway for the use of aerial larviciding of Bti, which may be utilized in the future depending on budget constraints. Each season, larval control is conducted in 500 to 1,000 acres of the 6,000 acres of state-owned coastal marshes.

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.

Table 2-7 lists the application rates reported by towns which had state permits for the application of methoprene (for 2003 and 2004). Some municipalities apply chemicals with themselves, 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 2-7. Connecticut State Methoprene Permits, in lbs of Altosid briquets, by Town

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

Adulticiding is generally not a function of the state mosquito control program. Sites that are treated include state parks along the coast, for control of salt marsh mosquitoes, using resmethrin by truck-mounted ULV. Aerial application of adulticides has not occurred since 1996, in response to EEE in the southeastern part of the state. Local municipalities may conduct adulticide activities, through private contractors.

Biological Control

The Connecticut 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.

Education and Outreach

The CTDEP, CAES and CDPH each have websites that contain information on mosquito control and also publish informational brochures. CAES and CTDEP also participate in periodic field days, and have displays at fairs and other public events. CTDEP has also developed Public Service Announcements that are broadcast on public access cable and has created local television and radio advertising spots.

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

2.3 West Nile Virus Response Plans

The introduction of WNV to North America, and its rapid spread across the US, led to the development of specific plans to respond to this new public health threat. The EISs prepared by Westchester County and New York City were, in fact, needed to address SEQRA issues associated with the creation of WNV Response Plans for those entities, not those for comprehensive mosquito control plans. The following section discusses some local WNV Response Plans, and also includes plans from California and British Columbia (these latter two plans are different in form and content from the others).

CDC

CDC is the Federal agency that has generally taken the lead to address issues associated with WNV (and mosquito-borne diseases in general), although USGS has also had a role in monitoring the spread of the infection across the US. CDC, in close cooperation with state and local health departments, monitors the potential sources and outbreaks of mosquito-borne diseases and provides advice and consultation on prevention and control of these diseases. It released a standard procedures manual for mosquito-borne diseases in 1993, which identified a generalized risk assessment methodology to be followed to determine appropriate reactions to findings indicating the presence of mosquito-borne diseases in an area (Moore et al., 1993). These guidelines were revised, expanded to include control measures, and made specific for WNV in 2001 (CDC, 2001), and updated further in 2003 (CDC, 2003). In these guidelines, CDC tends not to identify specific conditions that call for specific actions; rather, the documents describe a manner under which appropriate decisions may be made by responsible officials, actions that are to be found to be commensurate with disease risks and potential impacts from control.

CDC guidelines emphasize an integrated program to address mosquito problems, beginning with public communication and education, and relying on surveillance commensurate with the level of risk in a particular community. As the levels of apparent risk increase, surveillance and control measures increase accordingly. Source reduction, especially for standing water around a house, is an important means of preventing risks from reaching levels of concern. However,

larval and adult control can also be considered as means of addressing mosquito control needs (CDC, 2003).

Once multiple cases of WNV are confirmed in humans, or conditions favoring continued transmission to humans exist, the CDC recommendations include:

- Intensify emergency adult mosquito control program, repeating applications as necessary to achieve adequate control
- Enhance risk communication about adult mosquito control
- Monitor efficacy of spraying on target mosquito populations
- Consider a coordinated widespread aerial adulticide application if outbreak is widespread and covers multiple jurisdictions
- Emphasize urgency of personal protection through community leaders and media, and emphasize the use of repellent at visible public events.

(CDC, 2003)

New York State

In 2001, NYSDOH developed the New York State West Nile Virus Response Plan in coordination with CDC (NYSDOH, 2001)

Responses to disease threats are to be based on a tiered hierarchical approach, where as the perceived human health threat from WNV increased, the response taken could have an increased potential for collateral human health or environmental impacts (NYSDOH, 2001).

Table 2-8. NYSDOH Tiered Response to WNV Threats

Tier	Circumstances	Response
I	No historical or current evidence of virus No neighboring Health Unit with historical/current evidence of virus	Level 1 education campaign Enhanced passive human/bird surveillance Consider adult mosquito surveillance (species, distribution) Lower priority for lab testing Consider larval surveillance Consider local environmental assessments Consider local disease risk assessments
II	Historical evidence of virus Neighboring Health Units with historical evidence	Level 1 enhanced education program (general community & provider community) Local environmental assessments Local disease risk assessments Active human (if evidence in-unit)/bird surveillance Larval surveillance Larval habitat source reduction Larval control Adult surveillance and lab testing
III	Current virus isolation/evidence of infection in individual locations	Level 2/3 education program (general public & provider community) Active human/bird surveillance Larval surveillance Larval habitat source reduction Larval control Adult surveillance and lab testing Adult control, ground application
IV	Current virus isolation/evidence of infection in multiple locations	Level 2/3/4 education program (general public & provider community) Active human/bird surveillance Larval surveillance Larval habitat source reduction Larval control Adult surveillance and lab testing Adult control, ground application

When a current virus isolation/evidence of infection in individual locations is identified, or if current virus isolation/evidence of infection in multiple locations is identified, the following response actions take place:

- Education of the general public and provider community
- Active human/bird surveillance
- Larval surveillance
- Larval habitat source reduction

- Larval control
- Adult surveillance and lab testing
- Ground application of adulticides

Adulticiding is considered only when there is evidence of WNV epizootic activity at a level suggesting high risk of human infection (for example, high dead bird densities, high mosquito infection rates, multiple positive mosquito species including bridge vectors, horse or mammal cases indicating escalating epizootic transmission, or a human case with evidence of epizootic activity) and abundant adult vectors. Human population density is taken into consideration prior to applying adulticides. If the affected area is rural and there are few people, the cost and potential risks of an application may not be considerable to justify its use. That different communities have varying perspectives on the benefits of mosquito control is also taken into consideration when determining whether or not to spray (NYSDOH, 2001).

In and of itself, finding a WNV positive bird or mosquito pool is not sufficient evidence of an imminent threat to human health and therefore will not warrant the application of adulticides. Adulticides are only considered after careful consideration of the WNV risk to human health by taking into account multiple factors:

- documentation of the presence of WNV in the area
- the numbers and species of the vector populations
- the physiologic age of the vectors
- the density and proximity of human populations
- the time of year
- weather conditions
- physiography of and accessibility to the area where the vector is located
- rapidity of response required as determined by the seriousness of the pubic health threat

- potential impact of people and the environment

- the likelihood that vectors in nearby areas not subject to control measures will migrate to the treatment area, negating the effects of treatment.

Aerial applications are only conducted when necessary because of geographic considerations, and are limited to the immediate area where the vector population has been documented to exist and to adjacent areas considered at risk for imminent disease transmission (NYSDOH, 2001).

In New York State, mosquito surveillance and control activities are exempt from certain requirements of environmental law, rule and regulation (only during the season in which a public health emergency is declared). A public health emergency is determined by the presence of human vector-borne disease or the presence of disease-specific etiologic agents in a known or suspected vector, and by the substantiation by specific risk assessment activities described in 10NYCRR Part 44.51. When a public health emergency exists, authorizations are granted that can affect certain permit and regulatory requirements. However, these emergency authorizations are limited to the specific county (or other specific area affected by the emergency). A public health emergency has affects the following permit/regulatory decisions:

- Article 24/Part 663 Freshwater Wetlands Permits

- Article 25/Part 661 Tidal Wetlands Permits

- Special Wildlife Permits

- SEQRA

(NYSDOH, 2001)

Control activities that are undertaken following the declaration of a public health emergency would qualify as "emergency actions" and would be classified as a Type II action under SEQRA (6NYCRR Part 617.5(c)(33)) (NYSDOH, 2001).

Health emergencies can be declared by NYSDOH in response to requests from a county government. New York State categories the risk of human disease outbreak into five classes.

When human health is threatened, it is classified as "Probable." WNV reaches this level when quantitative measures indicate that epizootic activity is at a level suggesting high risk of human infection and abundant adult vectors. These measures include the following:

- High dead bird densities
- High mosquito infection rates
- Multiple positive mosquito species including bridge vectors
- Horse or mammal cases indicating escalating epizootic transmission
- Human case with evidence of epizootic activity

A public health emergency is defined as an "Outbreak in Progress." Emergency conditions, a higher level of concern, are defined as multiple confirmed human cases with conditions favoring transmission to humans continuing (NYSDOH, 2001).

New York City

To ensure a coordinated approach in managing mosquito-borne disease outbreaks in New York City, the DOHMH updates its WNV Response Plan each year in coordination with State and Federal agencies. According to the Plan, should when mosquito surveillance findings indicate that a substantial risk exists for WNV transmission to humans, adult mosquito control will be considered (NYCDHMH, 2004).

Whenever WNV is detected in an area in NYC, DOHMH will increase public education, breeding site reduction activities, and larvicide applications. A public notice would also be is released to notify the public of the recent findings. CDC light traps would be added to the area of concern if additional surveillance data is required and larval surveillance would be conducted in affected areas if needed. Furthermore, laboratory testing of mosquito pools would be given priority in bridge vector mosquito species (i.e. *Andes* spp., *Ochlerotatus* spp., *Cx. salinarius*) (NYCDHMH, 2004).

If surveillance indicators suggest that the level of WNV activity poses a threat to human health, additional measures would be taken. These measures may include ground application of adulticides to immediate areas of concern, aerial application of adulticides to broader areas (based upon surveillance data), and the recommendation of restricting and/or cancellation of outdoor evening activities or the closing of recreational areas. Indicators to implement these additional measures include:

- mosquito density and distribution
- mosquito species
- persistence of WNV activity
- weather
- time of year
- the proximity to human populations

DOHMH will make the necessary determination, based on its evaluation of these factors, if adulticide applications appear to be warranted (NYCDHMH, 2004).

If adulticides are necessary, DOHMH provides advance notice to the public and to health care providers. Adulticides applied would be in compliance with City, State, and Federal laws and regulations. Adulticides considered would include one of the following active ingredients:

- resmethrin
- sumithrin
- permethrin
- dibrom
- naled
- malathion

The public would receive notification of scheduled adulticide applications 24 hours in advance (NYCDHMH, 2004).

DOHMH monitors and assesses control activities for any potential environmental and health effects through several measures, including pre- and post-spray environmental sampling and addressing any pesticide exposure complaints (NYCDHMH, 2004).

Connecticut

CTDEP developed four public health action levels in the 2001 West Nile Virus Surveillance and Response Plan, recommended to be implemented in proportion to the threat of WNV infections in people. These four actions levels are:

1. Public health notification
2. Public health alert
3. Public health warning
4. Public health emergency

(CTDEP et al., 2001)

Larval source reduction through local abatement programs using target-specific agents in definable areas is used as the first line emergency response for mosquito control if disease is detected in humans or domestic animals. When a Public Health Emergency is proclaimed, actions taken include:

- An evaluation for the need for declaring a civil preparedness emergency
- Deployment of adulticides applied aerially or by ground, as decided by the Commissioner of CTDEP

(CTDEP et al., 2004)

The State of Connecticut does not adulticide, although specific towns may choose to use adulticides in times of need. During a public health emergency, adulticides may be applied without the approval of the municipal officials in the towns affected (CTDEP et al., 2004).

If WNV is confirmed in Connecticut, the Department of Public Health, in consultation with other state and local agencies, will evaluate the potential threat to human health. The threat to human health is parsed into four levels:

- Level 1 – Public Health Notification: declared when WNV is first detected and confirmed in a bird, mosquito or domestic animal.

- Level 2 – Public Health Alert: declared when WNV is confirmed in multiple horses or domestic animals; two or more dead crows are sighted per square mile in a week; two or more human-biting mosquito pools collected at one or more trap locations; or if detected in a person without any other indications of the presence of WNV in the area.

- Level 3 – Public Health Warning: announced when WNV is confirmed in a person with characteristic severe neurologic disease, and when in the judgment of the Commissioners of Environmental Protection and Public Health, evidence of the virus presents a serious risk to human health based upon high levels of WNV activity (e.g. two or more human-biting mosquito species in the area of concern test positive for WNV).

- Level 4 – Public Health Emergency: issued by the Commissioner of Public Health when WNV is confirmed in multiple persons with characteristic severe neurologic disease, and when conditions exist that favor the continued transmission of WNV to people.

(CTDEP et al., 2004)

New Jersey

The New Jersey WNV surveillance plan is coordinated among a number of state, local, and other entities, including:

- NJDEP, Office of Mosquito Control and Coordination

- NJ Department of Health and Senior Services (NJDHSS)
- NJ Department of Agriculture, Division of Animal Health
- Rutgers University
- the 21 county mosquito control agencies
- local health departments
- physicians and hospitals
- CDC
- other states in the region

(NJDHSS, 2004)

NJSMCC funds a virus surveillance program that measures the size of mosquito borne encephalitis virus vector populations during the summer season and tests specimens for virus on a weekly basis. Mosquito collections are made at permanent study sites by staff from NJAES. A wide range of assistance and support is provided by local mosquito control agencies in this effort. In addition, some county mosquito control agencies run sentinel chicken programs to identify areas where mosquito borne encephalitis virus is active, and monitor mosquitoes for virus to add information to that provided by the state. Analysis of the data collected by the state is compiled, and information on the status of mosquito borne encephalitis virus is dispersed to all mosquito control agencies in the state in a weekly summary throughout the encephalitis season. Decisions regarding the initiation of control of mosquitoes for public health reasons are made at the local level (NJDHSS, 2004).

Massachusetts

In 2005, the Massachusetts Department of Public Health (MDPH) released the *Massachusetts Arbovirus Surveillance and Response Plan* (DeMaria, 2005) This Plan updated the 2003 *Massachusetts Surveillance and Response Plan for Mosquito-borne Disease* (Timperi and

DeMaria, 2003). The Plan is intended to provide coordination among state agencies and local authorities tasked with responding to and preventing mosquito-borne disease. Outside of the scope of this Plan are activities conducted by local health boards to control mammal-biting mosquitoes. The Plan explicitly notes that control of vectors of disease reduces nuisance mosquito populations and provides public health benefits. However, the Plan notes that increases in risk of disease should cause refocusing and augmentation of local mosquito control efforts.

Extensive surveillance (fixed and supplemental trap sites focusing on EEE and WNV, State Reclamation and Mosquito Control Board trap sites, dead bird testing, potential trapping of live birds, and equine and human disease surveillance) is the basis for establishing a phased response approach to disease threats. Five risk categories were established for WNV (remote, low, moderate, moderate/high, and high) and EEE (remote, low, moderate, high, and critical) (DeMaria, 2005).

Remote risk for WNV is determined if there was no virus in the community or adjacent areas in the preceding year. Passive surveillance and source reduction of breeding are the recommended actions to address this stage (DeMaria, 2005).

Low risk is the status for areas anticipating WNV activity, based on past history, but without any disease indicators at this time. Surveillance would be more intense than for remote risk areas (including surveillance for equine and human illness); actions could include source reduction, and larval control to reduce bridge vectors, especially *Culex spp*. Outreach efforts should focus on risk reduction and personal protection, and schools should be required to file outdoor IPM plans (DeMaria, 2005).

Moderate risk is defined by sporadic detections of virus in birds and mosquitoes. Source reduction, larval control, surveillance, and outreach activities should all be increased (or initiated if not begun earlier). Adult control is not recommended based on findings of positive birds, without positive mosquito pools (DeMaria, 2005).

Moderate/high risk is caused by detections of virus prior to August, sustained detections of WNV, or an equine or human case. Responses include increased surveillance, multi-media

outreach efforts (focusing on personal protection), and potential live bird testing. The Department of Health will consult with local officials to determine if an outbreak is imminent. Ground-based adulticiding will be considered, with factors such as time of year, mosquito abundance, and population density/at-risk populations being weighed (DeMaria, 2005).

High risk is defined by more than one human case. Adult control should be intensified, and restrictions may be placed on outdoor activities by the Department of Health. Consultations will occur to determine if coordinated control responses, focusing on aerial applications of adulticide, are required (DeMaria, 2005).

For EEE, adulticide use is countenanced more quickly. Remote risk is defined by a lack of prior year detections, ho current horse or human cases, no EEE isolates prior to July 1, and limited current year detections of EEE. Surveillance and source reduction are in order (DeMaria, 2005).

Low risk is defined by previous year EEE detections above the 14 year mean levels or a horse case, or current EEE detections before July 1, or more than 10 current year detections in *Cs. melanura*. Responses include source reduction and ensuring schools have filed their outdoor IPM plans, but also include allowances for adult control of bridge vectors using truck applications (through the Reclamation and Mosquito Control Board) (DeMaria, 2005).

Moderate risk is determined when an area had a human case (or five equine cases) of EEE in the previous year, or if there has been a human case this year, 20 detections of EEE in *Cs. melanura*, or EEE detection in a human vector species. Increased larval and source control efforts are to be made, and ground-based adulticiding is recommended (DeMaria, 2005).

High risk comes with multiple cases of equine EEE or high isolation rates of EEE in Cs. melanura. The responses include larviciding and adulticiding using State resources, extensive multi-media public outreach including daily bulletins to affected areas, and the potential for "intensive" ground adulticiding (DeMaria, 2005).

Critical risk for EEE stems from more than one human case, more than 10 equine cases, or isolations of EEE in bridge vectors that are associated in time and space. Responses include the potential for state-funded aerial applications of adulticide, repeated ground applications of

adulticide, and the declaration of a state of emergency, including restrictions on outdoor activities per the Department of Health (DeMaria, 2005).

California

In 2004, the California Mosquito-borne Virus Surveillance and Response Plan was developed to provide a semi-quantitative measure of virus transmission risk that could be used by local agencies to plan and modulate control activities. Again, this plan does not specify actions for particular surveillance results, but rather suggests the factors that will affect decision-making. It sets three levels of concern that establish a range of responses, for three specific mosquito-borne diseases (Western equine encephalitis, St Louis encephalitis, and WNV) (CDHS et al., 2004).

The levels of concern are set based on the average conditions in a year for a range of surveillance factors. The factors vary for each disease, and the conditions associated with each factor that cause concern can differ for the different diseases. The factors are assessed on a scale of one to five, and then averaged to determine the level of concern.

There were eight factors to be considered for WNV. They were:

- environmental conditions (as defined by temperature, with higher seasonal temperatures increasing the assessment value)
- relative abundance of *Cx. pipiens* and *Culex tarsalis*
- virus isolation rates for those two species (expressed as MIR – minimum infection rates – per 1,000)
- sentinel chicken flock seroconversions (considered regionally and locally)
- dead bird infections (statewide and locally)
- equine cases
- human cases (statewide and locally)
- if virus is detected, the population density of the affected area

(CDHS et al., 2004)

Level I (normal) is defined by a mean score of 1.0 to 2.5. Emergency planning (Level II) is defined by a score of 2.6 to 4.0, and epidemic conditions (Level III) are defined by a score greater than 4.0 (CDHS, 2004).

Normal conditions would call for routine actions that include surveillance, public communication and education, and preparation for the potential to increase activity. When the need for emergency planning is determined, public education and the provision of information to health care providers should be enhanced. Epidemiological investigations of cases of equine or human disease need to be conducted. Surveillance of larvae, as well as control of larvae, should be increased. Adult mosquito surveillance should also be enhanced, and the number of mosquito pools tested for virus increased. Local control of adult mosquitoes can be performed, and commercial applicators are to be contacted in anticipation of large scale adulticiding. Candidate pesticides should be reviewed for availability and in terms of the susceptibility of local vector mosquito species (CDHS et al., 2004).

When surveillance factors add up to an epidemic status, a full scale media campaign is conducted. Active human cases detection and epidemiological investigations of cases of equine or human disease need to be conducted. Larval surveillance and treatment is continued. The geographical coverage of adult mosquito surveillance is broadened, and adult mosquito control is accelerated, if appropriate. Mosquito surveillance and control is initiated in geographical regions without an organized vector control program. Public health exemptions from FIFRA (40CFR 166) and emergency tolerance exemptions (40CFR 176) are to be requested. At this time, a declaration of a local emergency or general State of Emergency is considered and whether to activate a Standardized Emergency Management System plan at the local or state level is determined. Lastly, mosquito education and control programs are continued until mosquito abundance is substantially reduced and no additional human cases are detected (CDHS et al., 2004).

Health Canada

Health Canada developed mosquito control guidelines for Canadian municipalities to consider in light of WNV incursions into Canada. The focus of the guidelines was on the prevention of risks, through source reduction and public education, and the general development of an integrated program so as to avoid the necessity for adulticide applications. Nonetheless, communities considering mosquito control were advised to take necessary steps to permit themselves to apply pesticides. Although a quantitative trigger for nuisance control was given (25 human-biting adults in a New Jersey trap, averaged over three nights), the rationales necessary to justify control for human disease prevention were only discussed very generally (Ellis, 2004).

British Columbia

The British Columbia Center for Disease Control Division of Epidemiology Services (DES) investigates and evaluates the occurrence of communicable diseases. DES is responsible for the development, implementation, and evaluation of policies and programs for communicable disease prevention and control (BC Centre for Disease Control, 2004).

The Arbovirus Surveillance and Response Guidelines for British Columbia (2004) outlined five different response levels to help determine which monitoring and/or abatement activities may be required by a local municipality in the province. These levels are as follows:

- Level 0 – no confirmed WNV infection in a bird, animal or mosquito pool and WNV activity is unlikely
- Level I – no confirmed WNV infection in a bird, animal or mosquito pool and WNV is possible or the risk is unknown
- Level IIa – based on an assessment of risk following WNV detection in a jurisdiction in the previous year or in a neighboring jurisdiction in the current year
- Level IIb – based on an assessment of risk following WNV detection within a jurisdiction in the current year

- Level III – detection of a single or multiple human case(s) of WNV infection (with no history of travel to an area confirmed with WNV activity within 21 days of onset symptoms) in the current year within a jurisdiction

Implementation of larvae control measures are based on the advice of or as an order from the Medical Health Officer. Adulticides are used only if the Medical Health Officer declares a health emergency, and as a last resort (Vancouver City Council, 2003). As of 2005, the Province had determined that adulticides would only be applied after human cases had been detected (D. Tonjes, Cashin Associates, personal report on a presentation by the BC Ministry of Health at the 71st Annual Meeting of the American Mosquito Control Association, Vancouver, BC, April 3, 2005).

2.4 Mosquitoes of Suffolk County

Table 2-9 lists the 50 mosquito species found in Suffolk County. This list has been compiled through trapping and literature analyses by the director of the ABDL, Dr. Scott Campbell.

Not all of the mosquitoes on the list are of concern for people. Mosquitoes that do not impact people either through biting or disease association are sometimes labeled as scientific curiosities. However, even these mosquitoes can become of interest as conditions change. *Culiseta melanura* was once treated as a curiosity, of interest only because of its strange overwintering habitat in the roots of trees in swamps. Now this mosquito is subjected to intense surveillance, as it was realized that it plays an essential role in the amplification of EEE (CA-CE, 2004b).

Table 2-9. Mosquitoes of Suffolk County

	Reinert (2000)	**WRBU (2005)**
1	*Aedes cinereus*	*Aedes cinereus*
2	*Aedes vexans*	*Aedes vexans*
3	*Anopheles barberi*	*Anopheles barberi*
4	*Anopheles bradleyi*	*Anopheles bradleyi*
5	*Anopheles crucians*	*Anopheles crucians*
6	*Anopheles earlei*	*Anopheles earlei*
7	*Anopheles punctipennis*	*Anopheles punctipennis*
8	*Anopheles quadrimaculatus*	*Anopheles quadrimaculatus*
9	*Anopheles walkeri*	*Anopheles walkeri*
10	*Coquillettidia perturbans*	*Coquillettidia perturbans*
11	*Culex erraticus*	*Culex erraticus*
12	*Culex pipiens*	*Culex pipiens*
13	*Culex restuans*	*Culex restuans*
14	*Culex salinarius*	*Culex salinarius*

	Reinert (2000)	**WRBU (2005)**
15	*Culex territans*	*Culex territans*
16	*Culiseta annulata*	*Culiseta annulata*
17	*Culiseta inornata*	*Culiseta inornata*
18	*Culiseta melanura*	*Culiseta melanura*
19	*Culiseta morsitans*	*Culiseta morsitans*
20	*Culiseta silvestri minnesotae*	*Culiseta silvestri minnesotae*
21	*Ochlerotatus abserratus*	*Aedes abserratus*
22	*Ochlerotatus atropalpus*	*Aedes atropalpus*
23	*Ochlerotatus aurifer*	*Aedes aurifer*
24	*Ochlerotatus canadensis*	*Aedes canadensis*
25	*Ochlerotatus cantator*	*Aedes cantator*
26	*Ochlerotatus diantaeus*	*Aedes diantaeus*
27	*Ochlerotatus dorsalis*	*Aedes dorsalis*
28	*Ochlerotatus excrucians*	*Aedes excrucians*
29	*Ochlerotatus fitchii*	*Aedes fitchii*
30	*Ochlerotatus flavescens*	*Aedes flavescens*
31	*Ochlerotatus grossbecki*	*Aedes grossbecki*
32	*Ochlerotatus hendersoni*	*Aedes hendersoni*
33	*Ochlerotatus intrudens*	*Aedes intrudens*
34	*Ochlerotatus japonicus japonicus*	*Aedes japonicus japonicus*
35	*Ochlerotatus sollicitans*	*Aedes sollicitans*
36	*Ochlerotatus sticticus*	*Aedes sticticus*
37	*Ochlerotatus stimulans*	*Aedes stimulans*
38	*Ochlerotatus taeniorhynchus*	*Aedes taeniorhynchus*
39	*Ochlerotatus triseriatus*	*Aedes triseriatus*
40	*Ochlerotatus trivittatus*	*Aedes trivittatus*
41	*Orthopodomyia alba*	*Orthopodomyia alba*
42	*Orthopodomyia signifera*	*Orthopodomyia signifera*
43	*Psorophora ciliate*	*Psorophora ciliata*
44	*Psorophora columbiae*	*Psorophora columbiae*
45	*Psorophora confinnis*	*Psorophora confinnis*
46	*Psorophora ferox*	*Psorophora ferox*
47	*Psorophora howardii*	*Psorophora howardii*
48	*Toxorhynchites rutilus septentrionalis*	*Toxorhynchites rutilus septentrionalis*
49	*Uranotaenia sapphirina*	*Uranotaenia sapphirina*
50	*Wyeomyia smithii*	*Wyeomyia smithii*

Reinert, JF. 2000. New classification of the composite genus *Aedes* (Diptera: Culicidae: Aedini), elevation of subgenus *Ochlerotatus* to generic rank, reclassification of the other subgenera and notes on certain subgenera and species. *Journal of the American Mosquito Control Association* 16:175-188.

WRBU. 2005. *2001 Systematic Catalog of Culicidae*. Walter Reed Biosystematics Unit. www.mosquitocatalog.org/main.asp. Retrieved June, 2005.

There are two genus names for many mosquitoes, because Reinert reorganized mosquito classification in 2000, elevating the subgenus *Ochlerotatus* to full genus rank. This validity of this reorganization has recently been challenged, and the dispute has not been resolved.

Table 2-10 contains compiled New Jersey trap data for Suffolk County. Table 2-11 contains compiled CDC light trap data. Table 2-12 presents compiled gravid trap data. Trap data are biased samples of mosquito populations, in that not all mosquitoes species are attracted to these

traps, and of those species that are attracted, some are trapped at much greater frequencies than their natural abundance would indicate. The Suffolk County New Jersey traps, as shown in Figure 2-5 (presented later in this report) tend to be located close to salt marshes, and so tend to collect more mosquitoes that breed in those environments. Therefore, the overall distribution of species (as determined by SCVC) of 58 percent salt marsh species and 42 percent fresh water species, may not accurately describe the relative populations of those two major classifications. The Suffolk County CDC traps, as shown in Figure 2-6 (presented later in this report, and only showing the initial set outs for the season) tend to be located more inland, and so might be expected to collect more fresh water species than the New Jersey traps do. These data, biased as they are, illustrate typical means that mosquito control professionals employ to understand the populations and species affecting their areas of concern. They also show how fresh water and salt marsh habitats intermix, as all New Jersey traps attracted fresh water mosquitoes (the highest percentages of salt water mosquitoes were 93 percent, from Heckscher Park, and 91 percent for Orient), and only two traps did not attract any salt water mosquitoes (both from Manorville).

Table 2-10. Mosquitoes Found in New Jersey Light Traps in Suffolk County (2005)

Species	**Count**	**Percent**
Aedes cinereus	283	0.380
Aedes vexans	5,346	7.178
Anopheles barberi	5	0.007
Anopheles crucians	2	0.003
Anopheles punctipennis	334	0.448
Anopheles quadrimaculatus	598	0.803
Anopheles walkeri	0	0
Coquillettidia perturbans	5,824	7.819
Culex spp.	9,072	12.180
Culex pipiens	0	0
Culex restuans	0	0
Culex salinarius	0	0
Culex territans	95	0.128
Culiseta inornata	2	0.003
Culiseta melanura	544	0.730
Culiseta morsitans	0	0
Culiseta silvestri minnesotae	0	0
Ochlerotatus abserratus	108	0.145
Ochlerotatus aurifer	42	0.056
Ochlerotatus canadensis	361	0.485
Ochlerotatus cantator	3.291	4.419
Ochlerotatus excrucians	297	0.399
Ochlerotatus fitchii	1	0.001
Ochlerotatus japonicus japonicus	868	1.165
Ochlerotatus sollicitans	24.880	33.404
Ochlerotatus taeniorhynchus	5,758	7.731

Species	Count	Percent
Ochlerotatus triseriatus	87	0.117
Ochlerotatus trivittatus	115	0.154
Orthopodomyia signifera	1	0.001
Psorophora ciliate	6	0.008
Psorophora confinnis	0	0
Psorophora ferox	8	0.011
Psorophora howardii	0	0
Uranotaenia sapphirina	541	0.726

Table 2-11. Mosquitoes Found in CDC Light Traps in Suffolk County (2005)

Species	Count	Percent
Aedes cinereus	893	1.954
Aedes vexans	2,188	4.787
Anopheles barberi	1	0.002
Anopheles crucians	4	0.009
Anopheles punctipennis	2,047	4.479
Anopheles quadrimaculatus	642	1.405
Anopheles walkeri	0	0
Coquillettidia perturbans	8,051	17.615
Culex pipiens-restuans	4,225	9.244
Culex salinarius	0	0
Culex territans	22	0.048
Culiseta inornata	0	0
Culiseta melanura	2,659	5.818
Culiseta morsitans	0	0
Culiseta silvestri minnesotae	0	0
Ochlerotatus abserratus	204	0.446
Ochlerotatus atropalpus	1	0.002
Ochlerotatus aurifer	1,042	2.28
Ochlerotatus canadensis	8,097	17.715
Ochlerotatus cantator	1,851	4.050
Ochlerotatus dorsalis	0	0
Ochlerotatus excrucians	0	0
Ochlerotatus fitchii	0	0
Ochlerotatus flavescens	0	0
Ochlerotatus intrudens	0	0
Ochlerotatus japonicus japonicus	604	1.321
Ochlerotatus sollicitans	5,679	12.425
Ochlerotatus sticticus	0	0
Ochlerotatus stimulans	0	0
Ochlerotatus stimulans group	535	1.171
Ochlerotatus taeniorhynchus	5,481	11.992
Ochlerotatus triseriatus	242	0.529
Ochlerotatus trivittatus	150	0.328
Orthopodomyia alba	2	0.004
Orthopodomyia signifera	0	0
Psorophora ciliate	1	0.002
Psorophora confinnis	0	0
Psorophora ferox	150	0.328
Psorophora howardii	0	0
Toxorhynchites rutilus septentrionalis	0	0

Species	Count	Percent
Uranotaenia sapphirina	935	2.046
Wyeomyia smithii	0	0

Table 2-12. Mosquitoes Found in CDC Gravid Traps in Suffolk County (2005)

Species	Count	Percent
Aedes cinereus	10	0.072
Aedes vexans	3	0.022
Anopheles barberi	3	0.022.
Anopheles crucians	0	0
Anopheles punctipennis	6	0.043
Anopheles quadrimaculatus	15	0.109
Anopheles walkeri	0	0
Coquillettidia perturbans	22	0.0159
Culex pipiens-restuans	13,125	95.033
Culex salinarius	0	0
Culex territans	1	0.007
Culiseta inornata	0	0
Culiseta melanura	3	0.022
Culiseta morsitans	0	0
Culiseta silvestri minnesotae	0	0
Ochlerotatus abserratus	1	0.007
Ochlerotatus atropalpus	0	0
Ochlerotatus aurifer	0	0
Ochlerotatus Canadensis	63	0.456
Ochlerotatus cantator	4	0.029
Ochlerotatus dorsalis	0	0
Ochlerotatus excrucians	0	0
Ochlerotatus fitchii	0	0
Ochlerotatus flavescens	0	0
Ochlerotatus japonicus japonicus	410	2.969
Ochlerotatus sollicitans	84	0.608
Ochlerotatus sticticus	0	0
Ochlerotatus stimulans	0	0
Ochlerotatus taeniorhynchus	3	0.022
Ochlerotatus triseriatus	51	0.369
Ochlerotatus trivittatus	2	0.014
Orthopodomyia alba	0	0
Orthopodomyia signifera	0	0
Psorophora ciliate	0	0
Psorophora confinnis	0	0
Psorophora ferox	0	0
Psorophora howardii	0	0
Toxorhynchites rutilus septentrionalis	0	0
Uranotaenia sapphirina	5	0.036
Wyeomyia smithii	0	0

All mosquitoes require water to breed in. Because mosquito larvae are air-breathing organisms, they do not tolerate moving water, and so quiescent or standing water is where mosquito breeding occurs. Certain mosquitoes hatch at the end of winter, but in Suffolk County, the

predominant species of management concern are those that breed and hatch during warm weather. Some mosquitoes tolerate salt water, and so their larvae grow in pooled water on salt marshes (salt marsh mosquitoes). Others are found in natural fresh water environments, and still others have adapted to man-made settings, especially discarded objects that hold water, whether temporarily or permanently (CA-CE, 2004b).

Shallow still or slow-moving waters best suit mosquito larvae. This means marshes and swamps are favored habitats (CA-CE, 2004b). There they feed on food particles in the water column, concentrating on microbes, microinvertebrates, and general organic matter (Wallace and Merritt, 2004). Mosquito problems today are much less than they were formerly, primarily because we have destroyed so much of the original extent of wetlands in this country. Appreciation for these habitats has been generally fostered (and codified into law and regulation) over the past 50 years or so (Cashin Associates, 2006). This means that source reduction as a means of mosquito control is more carefully addressed than it used to be.

Female mosquitoes appear to only live long enough, under most conditions, to make one blood meal. They require blood to form eggs; nutritional requirements for all adult mosquitoes are provided by plant nectars (Spielman and D'Antonio, 2001). Sampling of mosquitoes in resting places in Queens County found that slightly less than one-quarter of the mosquitoes were gravid or had a recent blood meal (Apperson et al., 2002). Since the mosquito-borne diseases of current concern in Suffolk County are not vertically transmitted (from one generation of mosquito to another), mosquitoes must feed at least twice to potentially transmit a disease (Spielman and D'Antonio, 2001). This means only a minority of all mosquitoes in the population, generally-speaking, are capable to transmitting a disease. This is not the case for brooded mosquitoes (such as *Oc. sollicitans* and other flood water mosquitoes), as the brood ages. In such settings, the percentage of infected mosquitoes will increase dramatically even as the population numbers drop. However, overlapping generations make this an oversimplification of the risk factors. For non-brooded mosquitoes, the percentage of parous (previously-fed) mosquitoes tends to remain constant (Cashin Associates, 2005a).

The role of mosquitoes in the ecosystem is not clear. There is little literature on this issue. The maturation of larval, aquatic mosquitoes to adult, flying terrestrial insects clearly transfers some

organic material from the aquatic environment to the terrestrial one. No information was available regarding the relative importance of predation versus disease or other natural mortality to mosquitoes, so that it is difficult to assess whether this transfer proceeds into the greater food web or detrital system. Figure 2-3 is an example of how, even for salt marshes where mosquito production is maximized, general ecological descriptions see no need to include mosquitoes as an important or notable element.

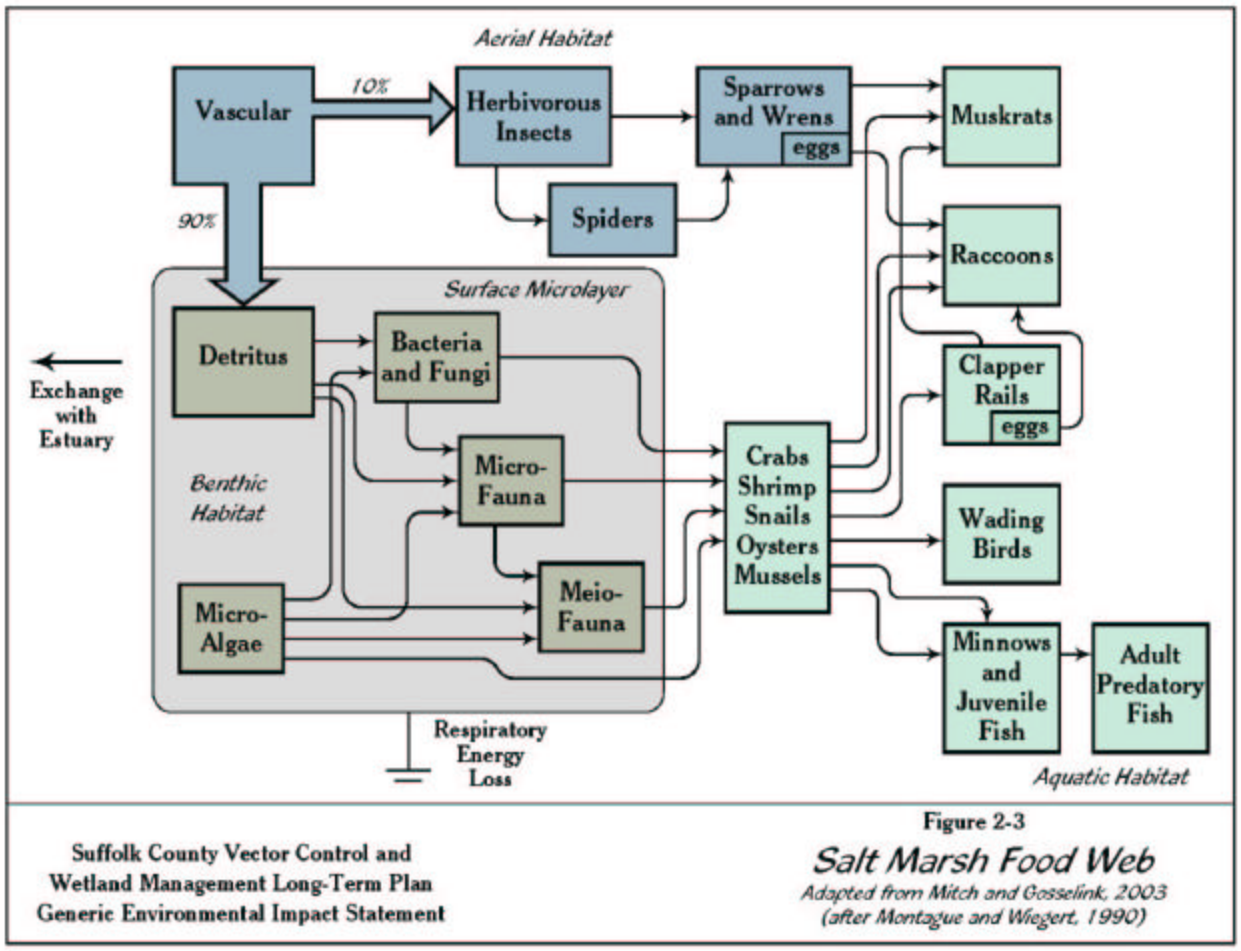


Figure 2-3
Salt Marsh Food Web
Adapted from Mitch and Gosselink, 2003 (after Montague and Wiegert, 1990)

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Research has been conducted to identify mosquito predators, as part of general control strategies. Larval predators include other mosquito larvae, aquatic invertebrates, and various fish (CA-CE, 2004b; CA-CE-2004c). Adult predators are less well defined. They appear to include larger insects, such as beetles and dragonflies; despite oft-repeated stories, birds and bats do not appear to be substantial predators (CA-CE, 2004b), although they can be important at specific times and places (generally, if mosquitoes are swarming). Mosquitoes are small, which generally makes

them insubstantial meals, and are famous for irregular, erratic flight paths (which makes consumption on the wing difficult). Reportedly, ants and other ground-based insects may be effective preying on resting mosquitoes.

Table 2-13 contains the list of 15 species of concern in the County. The mosquitoes have been classified in terms of their vector capability and/or impacts to quality of life. It is clear that it is difficult to separate the mosquitoes that serve as disease risks from those that are of concern for the spread of disease. This is partially because aggressive biting behavior is a characteristic that is likely to make a mosquito species a bridge vector, especially since birds constitute the major disease hosts for arboviruses. Mosquitoes that are aggressive also tend to be indiscriminant in their feeding habits, and so create opportunities, if they are capable of serving as a vector for a disease, of spreading that disease from birds to people due to their feeding habits (Turrell et al., 2005).

Table 2-13. Mosquito Species of Concern in Suffolk County (as determined by SCVC and SCDHS)

Species	**Vector Status**	**Other Issues**
Aedes vexans	Known WNV bridge vector Probable EEE bridge vector	Aggressive, SC's major fresh flood water mosquito
Anopheles punctipennis	Possible WNV bridge vector	Pesky, enters houses
Anopheles quadrimaculatus	Malaria vector	Moderately aggressive
Coquillettidia perturbans	EEE bridge vector	Aggressive human biter, breeds in emergent fresh marshes
Culex pipiens	WNV amplification vector Probable WNV bridge vector	Breeds near (containers, catch basins, other standing water) and enters houses
Culex restuans	WNV amplification vector	
Culex salinarius	WNV bridge vector	Irritating biter, breeds in brackish flood water (rare here)
Culiseta melanura	EEE amplification vector Probable WNV amplification vector	
Ochlerotatus canadensis	Probable EEE bridge vector Possible WNV bridge vector	Spring fresh water mosquito, extremely long lived, avid human biter
Ochlerotatus cantator		Spring salt water mosquito, moderately aggressive
Ochlerotatus japonicus japonicus	WNV bridge vector	Tree-hole (tire) mosquito, causes local biting complaints, moderately aggressive
Ochlerotatus sollicitans	EEE bridge vector Probable WNV bridge vector	SC primary pest species, extremely aggressive, salt water flood mosquito
Ochlerotatus taeniorhynchus		Aggressive salt water flood mosquito
Ochlerotatus triseriatus	Possible WNV vector LaCrosse encephalitis vector	Irritating pest, containers-tree holes-tires mosquito
Ochlerotatus trivittatus	Possible WNV vector	Aggressive fresh flood water (recharge basins) mosquito

Table 2-14 shows the same species, evaluated in terms of WNV transmission potential, per Turrell et al (2005). The differences are slight.

Table 2-14. WNV Transmission Potential for Mosquito Species of Concern in Suffolk County (per Turrell et al., 2005) (Scale of 0-4, with 4 being greatest potential)

Species	WNV Human Vector Potential
Aedes vexans	2
Anopheles punctipennis	na
Anopheles quadrimaculatus	na
Coquillettidia perturbans	1
Culex pipiens	2
Culex restuans	2
Culex salinarius	4
Culiseta melanura	0
Ochlerotatus canadensis	2
Ochlerotatus cantator	2
Ochlerotatus japonicus japonicus	4
Ochlerotatus sollicitans	1
Ochlerotatus taeniorhynchus	1
Ochlerotatus triseriatus	3

The following sections specify important information regarding these 15 key species. The information was primarily drawn from the Literature Search (Book 1) (CA-CE, 2004b) and Means (1979). Other references used are noted at the beginning of the discussion for each species.

Aedes vexans – The Inland Flood Water Mosquito

(O'Malley, 1990)

Aedes vexans is a medium-sized mosquito. It has white, narrow bands on some segments of the tarsi. The third, fourth, and fifth abdominal segments are dark-scaled, with white basal bands and a V-shaped notch posteriorly. The average life span of an adult is three to six weeks.

Ae. vexans is multivoltine, its eggs are desiccation tolerant, and its larvae will overwinter. Eggs are laid in sites subject to inundation by water. Hatching will occur as the result of a reduction in dissolved oxygen content. It takes six to eight days for larval development. Larval habitats include open, shallow grass filled depressions and woodland pools. It is mainly a fresh water mosquito; however, it will breed in salt marshes. Larvae are usually found between mid-April

and October depending upon climatic conditions. Adults are present June to late September. *Ae. vexans* has a flight range of five to ten miles from the breeding site.

This mosquito can cause serious disruptions to human activities. It will feed in shady places during the day, but is mostly active at dusk. Peak activity occurs 30 to 40 minutes after sunset. Females bite readily, but not very viciously. Females take blood from whatever hosts are available, and blood feeding begins on the second day after emergence. *Ae. vexans* is a primary vector of dog heartworm. It has also been shown to transmit EEE, Western equine encephalitis, and St. Louis encephalitis in the laboratory. EEE has been found in field collected specimens. *Ae. vexans* is also an identified bridge vector of WNV.

***Anopheles punctipennis* - The Over-wintering Mosquito**

(www.mosquito-va.org/anopheles_punctipennis.htm; www.uri.edu/research/eee/mosquito.html; www.snowcrest.net/mosquito/Mosquito%20Facts/local_mosquitoes.htm; www.co.rockland.ny.us/WNV/mosquitos/freshwater.htm)

Anopheles punctipennis is a large mosquito, known to fly great distances. It has elongated palps, equal in length to the proboscis. Another identifying characteristic is the distinct yellow markings located at the top and side of each wing. *An. punctipennis* larvae can be found in fresh water swamps, ditches, ponds, springs, pits, puddles, and artificial containers. Larvae preferentially are found in cool and clear water. The larvae will lie on the surface of the water with their bodies parallel to the surface. The greatest abundance of *An. punctipennis* occurs in early spring and late fall. It is present in the summer, but is much less abundant. Oftentimes, adult, inseminated females will overwinter in buildings, cellars, hollow trees, and other protected shelters.

An. punctipennis is a vicious biter, can have large impacts on people's activities, and enters houses readily. Females will usually attack after dusk, but will also bite during daytime in a wooded area or at their resting places. This mosquito rests during the day in dark moist shelters. *An. punctipennis* will feed on mammals and birds. It can be infected with malaria in the laboratory, although it is not considered to be a primary malaria vector. *An. punctipennis* was involved in the malaria epidemics during the late 1800s and early 1900s in northern California. It is a very good carrier of dog heartworm, and is a possible WNV bridge vector.

Anopheles quadrimaculatus – The Common Malaria Mosquito

(Kaiser, 1994; Levine et al., 2004; www.issg.org/database/species/ecology.asp?si=140&fr=1&sts; www.mosquito-va.org/anopheles_quadrimaculatus.htm)

Anopheles quadrimaculatus is a medium-sized mosquito, dark brown in color. The wings are entirely dark scaled, four mm in length, and have four distinct dark-scaled spots. *An. quadrimaculatus* larvae have widely spaced hairs on the head capsule. Larvae are typically found in sites with abundant rooted aquatic vegetation such as rice fields, irrigation ditches, fresh water marshes, lakes, ponds, and reservoirs. The typical larval period is 12 to 20 days and there can be seven to 10 generations per season. The flight range of *An. quadrimaculatus* is one mile or less.

An. quadrimaculatus is a significant pestiferous species. It feeds during the night and rests during the day. It is active for a short period after dusk and just before dawn. This mosquito is most active in the summer, and adult females will overwinter. *An. quadrimaculatus* primarily feeds on mammals. It is the primary vector for malaria in North America, especially in the eastern US. It has also been found to transmit St. Louis encephalitis, in the laboratory. It is an excellent host for dog heartworm and can transmit Cache Valley virus. Pools of *An. quadrimaculatus* have been found to be WNV positive in the US since 2001.

Coquillettidia perturbans – The Salt and Pepper Mosquito

(biomicro.sdstate.edu/Hildrethm/mosquito/sdmosquito.html#perturbans; www.cdc.gov/ncidod/dvbid/westnile/mosquitoSpecies.htm; www.mosquito-va.org/coquillettidia_perturbans.htm; www.agctr.lsu.edu/en/environment/insects/mosquitoes/common+names+of+important+mosquito+species+from+louisiana.htm)

Coquillettidia perturbans is a large, brown and pale speckled mosquito. It is most often identified by pale bands at the outer third of both the hind femur and the hind tibia. *Cq. perturbans* is univoltine, its eggs are desiccation intolerant, and its larvae are found in fresh water. Larvae will attach themselves to the roots of emergent vegetation, which makes larval surveillance and control difficult. This mosquito can overwinter in various stages of larval

development. Larval habitats include permanent ponds, lakes, and marshes. The larvae possess two large air bladders which allow them to store air while underwater for long periods of time.

Adults emerge during spring and summer. Adult females can be vicious biters and will bite during the day in shady, humid places. However, the majority of feeding takes place at dusk and after midnight. Typical hosts for *Cq. perturbans* include humans and other mammals, and birds. This species is a strong flier and will travel several miles searching for hosts. *Cq. perturbans* has been found to be a bridge vector for EEE, and pools have tested positive for WNV. It is attracted to light traps.

***Culex pipiens* – The Common House Mosquito**

(Andreadis et al., 2004; Kilpatrick et al., 2006; Molaei et al., 2006; www.pherobase.com/database/common-names-index-eng.html; www.rci.rutgers.edu/~insects/cxpip.htm; www.cbwinfo.com/Biological/Vectors/Culex.html; biomicro.sdstate.edu/Hildrethm/mosquito/Culexpipiens.html)

Culex pipiens is identified by the basal bands of its abdominal terga. Females have short palpi and a blunt, rather than pointed, abdomen. *Cx. pipiens* is multivoltine, and its eggs are desiccation tolerant. Larvae are found in polluted (organics-rich but fresh) water in cans, buckets, tires, bird baths, rain gutters, wading pools, storm drains, and catch basins. The presence of *Cx. pipiens* adults is an indicator of polluted water in the very immediate vicinity. It can thus be controlled by searching for and removing its larval habitats. This is the species that causes the most human discomfort in urban and suburban settings.

Adult females will overwinter, blood feed in the spring, and then lay eggs that produce the summer populations. *Cx. pipiens* continues breeding throughout the summer; population numbers gradually decline until the first frost. There is some controversy regarding its feeding habits. The standard model is that it prefers to feed on birds, but will bite humans, and other mammals, as well. Testing recently found that 93 percent of *Cx. pipiens* exclusively fed on birds (American robin being the primary blood donor), and four percent had mixed mammal-bird blood in their digestive tracts. Only one tested mosquito had bitten a human. Another report found, contrarily, that *Cx. pipiens* had a seven-fold increase in mammal feeding in late summer and early fall. The cause of the change was said to be robin dispersal and migration, disrupting normal feeding patterns.

The general state of opinion is that it is a primary vector of St. Louis encephalitis and the prime WNV vector in the northeast US (including Suffolk County) (although, based on the above, some experts disagree). *Cx. pipiens* is the most widely distributed mosquito in the world and can be found on every continent except Antarctica. Individual mosquitoes, however, do not travel far from breeding sites.

Culex restuans - The White Dotted Mosquito

(Ngo and Kramer, 2003; Ebel et al., 2005; Molaei et al., 2006; www.pherobase.com/database/common-names-index-eng.html; biomicro.sdstate.edu/Hildrethm/mosquito/Culexrestuans-modified.html; www.co.leon.fl.us/mosquito/mceduc/mosquitobiology/mosquito_species.asp; www.mosquito-va.org/culex_restuans.htm; www.fairfaxcounty.gov/hd/westnile/wnvpotential.htm; www-rci.rutgers.edu/~insects/rest.htm)

The abdomen of the *Culex restuans* mosquito has straight, pale-scaled basal bands. It may also be identified by its unbanded hindtarsomeres and proboscis. Larval habitats of *Cx. restuans* include edges of grassy swamps, sphagnum bogs, road side ditches, tires, buckets, catch basins, and septic seepage. Similarly to *Cx. pipiens*, this mosquito can often be controlled by seeking for and removing its breeding habitat. This species is most abundant in the spring and early summer. It is also present during the late summer and autumn, but is less numerous.

Cx. restuans is a night time biter that feeds almost exclusively on birds. Testing found that all meals taken by *Cx. restuans* had avian sources, with the American robin being the bird most frequently fed on. It will invade night time roosts, and bite sleeping birds. *Cx. restuans* has been shown to take multiple bloodmeals during each egg-laying cycle, which enhances its virus transmission capabilities, and may increase its importance as an amplification vector. In addition, sampling that speciates *Culex* light trap collections shows that the relative abundance of *Cx. restuans* far exceeds *Cx. pipiens*, suggesting that it is a significant element in the transmission cycling of WNV. Under certain circumstances, *Cx. restuans* may accept humans as a blood meal host, even to the point where it receives attention as a human pest. In most cases however, *Cx. restuans* is not attracted to humans and the species is not regarded as a significant impactor of people's lives. This species may transmit Western equine encephalitis, and EEE has occasionally been isolated from *Cx. restuans*. This mosquito is an important amplification

vector for WNV, due to its prey preferences. *Cx. restuans* are more readily trapped with properly baited gravid traps than with light traps. Its flight range is up to one or two miles.

Culex salinarius – The Unbanded Salt Marsh Mosquito

(Campbell, S., Director, Arthropod-Borne Disease Laboratory, SCDHS, unpublished data; Ngo and Kramer, 2003; Molaei et al., 2006; Zyzak et al., 2002; http://www.rci.rutgers.edu/~insects/sp11.htm; www.mosquito-va.org/culex_salinarius.htm; 64.233.161.104/search?q=cache:LclU-dvae1kJ:www.rci.rutgers.edu/~insects/sp11a.htm+Culex+salinarius&hl=en

Culex salinarius is a medium-sized mosquito. It can be distinguished from *Cx. pipiens* by its longer, more slender siphon. *Cx. salinarius* is multivoltine, and its larvae have some salt tolerance. They can be found in grassy pools, ditches, ponds, rain barrels, cattle tracks, and stump holes. Larvae are often found in fresh or brackish water that contains emergent and decaying vegetation. Larval populations tend to increase toward the end of summer and are frequently found in atypical habitats later in the season. Population numbers will peak after flooding, and rotting salt marsh vegetation functions as an oviposition attractant.

Adult populations build gradually from spring through summer and do not cease host seeking activities during the autumn. A late season population peak usually occurs which persists until cold weather brings about hibernation. *Cx. salinarius* will overwinter as inseminated, adult females; therefore, it exits hibernation in a parous state. *Cx. salinarius* will invade open water in Atlantic white cedar swamps directly above the subterranean crypts that support *Culiseta melanura*. Adults rest during the day, often in outbuildings and other similar shelters. They will host seek two to three hours after sunset. *Cx. salinarius* will readily enter houses and can be pestiferous. It is indiscriminate in host choices, readily biting birds and mammals (including humans). Testing found that slightly more than half its meals are from mammals (and it was found to feed on humans) and about a third are from birds (11 percent of the samples were a mix of bird and mammal blood). These mosquitoes are efficient vectors of St. Louis encephalitis and WNV (it was identified as the primary vector for WNV in Connecticut). *Cx. salinarius* has been shown to take multiple bloodmeals during each egg-laying cycle, which enhances its virus transmission capabilities, and may increase its importance as a bridge vector. This species is considered to be a good flier, with a flight range of up to five miles. Its prevalence in Suffolk

County may have been underestimated, as 2005 identification efforts aimed at discerning whether a Culex mosquito was actually *Cx. restuans*, *Cx. pipiens*, or *Cx. salinarius* found a much higher proportion of *Cx. salinarius* than was expected.

***Culiseta melanura* – The Black-tailed Mosquito**

(www.rci.rutgers.edu/~insects/sp25.htm; www.mosquito-va.org/culiseta_melanura.htm)

Culiseta melanura is a medium sized mosquito. It is easy to recognize in the larval stage by the long air tube and prominent antennae. Under the microscope, the unique bar-like comb scales are diagnostic; no other larva has a comb that is even remotely similar. Adult *Cs. melanura* are often mistaken as *Culex*.

Cs. melanura is multivoltine (three to four generations per year), its eggs are desiccation tolerant, and its larvae are found in fresh water. It is present year round. *Cs. melanura* overwinters as larvae. The larvae can be found in underground crypts in acid water bogs with a pH of 5.0 or lower. They are commonly found in Atlantic white cedar and red maple swamps in holes in the flooded root crypts of these trees.

This species is most common in the spring and summer. *Cs. melanura* prefers to feed on birds and is not attracted to mammals. It is the primary amplification vector for EEE, and may serve as an amplification vector for WNV. Control of this species is difficult for several reasons. Habitat access for larval control is very difficult, and, in addition, the swamps where larvae are found are often of regulatory concern due to co-existing rare-threatened-endangered species. Because of its key role in EEE transmission, adulticide use is often countenanced when EEE is found to be present. *Cs. melanura* are attracted to light traps. The typical flight range is less than one mile.

***Ochlerotatus canadensis* – The Woodland Pool Mosquito**

(www.mosquitomagnet.com/help/common/mosquito_sp.htm#10; www.mosquito-va.org/ochlerotatus_canadensis.htm;
biomicro.sdstate.edu/Hildrethm/Mosquito/OchlerotatusCanadensis.html;
www.co.rockland.ny.us/WNV/mosquitos/woodland.htm

Ochlerotatus canadensis adults are mostly dark brown. The wing scales are narrow and dark. The legs of *Oc. canadensis* have white double-banding on the tarsi. Narrow basal pale bands on the abdominal tergites are present. Larvae hatch in late winter and spring. Sometimes, a second brood may hatch in mid- to late fall. Its eggs are desiccation tolerant and larvae develop in temporary or semi-permanent shaded fresh water woodland pools containing fallen leaves, or in pools adjacent to wooded areas. *Oc. canadensis* will overwinter as an egg.

Adults emerge in April, May, and early June. This mosquito can live a long time, until late summer. It is a persistent biter, and will bite humans during the morning and evening hours when disturbed. *Oc. canadensis* are indiscriminate in host selection, biting mammals, birds, amphibians, and reptiles. *Oc. canadensis* does have a preference for mammalian blood, but also an affinity for turtles. This species has been identified as a probable EEE and a possible WNV bridge vector. It has been shown to transmit LaCrosse encephalitis and heartworm. *Oc. canadensis* is typically addressed using larvicides. However, when EEE is a concern, because of habitat overlap with *Cs. melanura* it is often a target for adulticide control. Its flight range is a quarter mile.

***Ochlerotatus cantator* – The Brown Salt Marsh Mosquito**

(64.233.161.104/search?q=cache:5x1dQvPzp6AJ:wrbu.si.edu/www/culicidae/culicinae/oc/och/cantator/cantator.html+Ochlerotatus+cantator&hl=en; www.rci.rutgers.edu/~insects/sp22.htm)

The maxillary palpus of a female *Ochlerotatus cantator* is less than half the length of either the antenna or proboscis. The postspiracular setae are present and the prespiracular setae are absent. The scales on the dorsal surface of the radial sector and media are narrow. It is multivoltine, its eggs are desiccation tolerant. Larvae are salt water tolerant. It will brood in the upland edge of a salt marsh in spring. Populations from the spring brood generally peak by mid-May and become mixed with those of *Oc. sollicitans*. Breeding, in lesser numbers, continues later in the season, but the larvae become distributed over a wider range of salt marsh habitat. Larvae can generally be found in both salty and brackish habitats well into the fall. *Oc. cantator* larvae resemble *Aedes canadensis* larvae.

Oc. cantator is a persistent biter and an aggressive human feeder. It mainly feeds in the evening, on mammals and birds, but will also bite during the day if its habitat is disturbed. It causes the

most problems for people at dusk. *Oc. cantator* has been determined to most probably not be a vector for EEE, and is not believed to be an effective transmitter of WNV, although it is possible that it serves a bridge vector. Control measures that are effective for *Oc. sollicitans* are effective for *Oc. cantator*. This species is attracted to light, and so is effectively caught in light traps (in fact, in many cases, the numbers of *Oc. cantator* in light traps give an over-estimation of the numbers that are actually biting people). *Oc. cantator* has a substantial range, and has been found 10 to 20 miles from larval habitats.

***Ochlerotatus japonicus japonicus* – The Japanese or Rockpool Mosquito**

(Sardelis et al., 2002; www.mosquito-va.org/ochlerotatus_japonicus.htm; www.mosquitomagnet.com/help/common/mosquito_sp.htm#11; www.co.rockland.ny.us/WNV/mosquitos/container.htm)

Adults are very large and easily identified by the eye. The coloration of this mosquito is black throughout, accented by three white leg bands on the hind legs, a gold lyre symbol on the mesonotum, and thin white bands across the abdomen. Larvae can be found in small-volume containers of relatively clean, clear water. They are most often recovered from artificial containers such as bird baths, buckets, plastic milk jugs, wheelbarrows, animal watering containers, and tires. They have also been collected from tree holes, rock pools, cement catch basins, and standing water in tire ruts. It overwinters as larvae. Larvae are present all year long.

Adults have been found from early April through late November. It is most active during the day, but will readily bite humans at night, too. It feeds on a wide array of mammals and birds. *Oc. japonicus japonicus* is an efficient vector of WNV; some believe its importance as a WNV vector is underestimated in the US. It is not known to be an EEE vector, although laboratory testing shows it is capable of doing so.. *Oc. japonicus japonicus* is an introduced and invasive species from Asia. This species is now widespread in Suffolk County. It shares many lifestyle characteristics with *Oc. triseriatus,* and is attracted to carbon dioxide (so that CDC light traps are effective means of surveillance). Its flight range is limited to about a tenth of a mile.

***Ochlerotatus sollicitans* – The Eastern Salt Marsh Mosquito**

Lesser, undated; www.mosquito-va.org/ochlerotatus_sollicitans.htm; biomicro.sdstate.edu/Hildrethm/Mosquito/OcSollicitans.html;

64.233.161.104/search?q=cache:tFxBHk15XKsJ:www.fairfaxcounty.gov/hd/westnile/wnvpotential.htm+Ochlerotatus+sollicitans&hl=en; www.mosquitomagnet.com/help/common/mosquito_sp.htm#13

Ochlerotatus sollicitans is a medium sized mosquito. It is usually identified by a pale-scaled band near the middle of its proboscis, a pale-scaled band on the middle of its first hindtarsomere, wide tarsal bands, and a pointed abdomen. This mosquito is similar in appearance to *Cx. tarsalis*. *Oc. sollicitans* is multivoltine, its eggs are desiccation tolerant, and its larvae are salt water tolerant. Larvae are mostly found in salt marshes, but can also be found in brackish swamps. It overwinters as an egg. Larvae and adults can be found April through October. This mosquito can occur in huge numbers. One production estimate is that each lunar tide (neap or full moon) in summer can result in one million mosquitoes per acre, as each female lays between 100 and 200 eggs at one time.

Oc. sollicitans is a persistent biter and will attack at any time, day or night. It rests in vegetation during the daytime, and will attack something invading its resting areas, even in sunlight. It is the primary cause of human discomfort in Suffolk County, especially on the south shore where large broods can sometimes make normal activities impossible to pursue. *Oc. sollicitans* feeds preferentially on humans and large animals, but also on small mammals and, sometimes, birds. It has been found to be a vector of EEE, WNV, and heartworm. Coastal mosquito control agencies are often tasked with ensuring this mosquito does not prohibit an outdoors lifestyle for residents near the shore communities, and to minimize its role as a bridge vector. *Oc. sollicitans* are strong fliers; typical published flight ranges are five to 10 miles, although some mosquitoes have been found up to 40 miles from larval habitats. It is strongly attracted to lights.

***Ochlerotatus taeniorhynchus* - The Black Salt Marsh Mosquito**

(www.cmmcp.org/species.htm, particularly D. Henley, East Middlesex Mosquito Control Project, W. Crans, Rutgers University, T. Deschamps and C. Best, Central Massachusetts Mosquito Control Project, the Massachusetts Entomologist group.)

Ochlerotatus taeniorhynchus is a medium to small sized mosquito. It is identified by white-tipped palps, white ring at middle of proboscis, white basal bands on abdomen and legs, and dark wing scales, and does not have a band at the middle of the first tarsal segment of the legs.

Oc. taeniorhynchus is multivoltine, and its eggs are desiccation tolerant. Larvae develop mostly in salt marshes, but also in fresh water pools. Larvae are also found in inland brackish-water swamps and pools; a particular habitat is in oil fields. Adults emerge six days after the eggs hatch. This mosquito is most abundant during summer and early fall following high tides and/or heavy rains. Eggs enter diapause in response to decreasing day length and water temperature in order to overwinter.

This species is a persistent biter and will attack birds and mammals day and night. It usually rests in vegetation during the day, unless disturbed. While capable of transmitting EEE and St. Louis encephalitis in the laboratory, *Ochlerotatus taeniorhynchus* is not believed to be a major vector of these diseases in nature. It is recognized as an important vector of dog heartworm and Venezuelan equine encephalitis, and appears to be capable of WNV transmission. It is a strong flier, and often migrates in large numbers. Its flight range is five to ten miles.

***Ochlerotatus triseriatus* – The Eastern Tree Hole Mosquito**

(www.mosquito-va.org/ochlerotatus_triseriatus.htm; biomicro.sdstate.edu/Hildrethm/Mosquito/OcTriseriatus.html; www-rci.rutgers.edu/~insects/sp9.htm

Ochlerotatus triseriatus is a medium sized mosquito. It is identified by pale-scaled stripes on the sides of the scutum, unbanded hindtarsi, few hairs on the scutum, and distinct bands on the abdomen.

It is multivoltine, and larvae are found in tree holes and artificial containers, mainly in shaded or wooded areas. Adults reach very high numbers (as many as 60,000 females per acre in mid-summer) in tire scrap yards. This mosquito has become more common in urban areas because it breeds so readily in discarded tires. *Oc. triseriatus* overwinters as an egg. As the weather cools, eggs switch into diapause and will not hatch even if flooded. Larvae are found May through September.

Oc. triseriatus flies and bites during the day in shaded or wooded areas. It is a persistent biter and bites a wide variety of mammals, including humans. Sometimes it feeds on birds, but its preference is for squirrels and chipmunks. This mosquito is the primary vector of LaCrosse

encephalitis, and is identified as a possible WNV vector. *Oc. triseriatus* is widely distributed throughout North America. Individual mosquitoes have a flight range of less than a mile.

***Ochlerotatus trivittatus* - No common name**

(biomicro.sdstate.edu/Hildrethm/Mosquito/Ochlerotatustrivittatus.html; www.rci.rutgers.edu/~insects/sp12.htm)

Ochlerotatus trivittatus is a medium sized mosquito. The scutum of this mosquito has a pair of submedian, pale-scaled stripes, separated by a dark strip in the middle. The abdomen has a distinctive triangular pattern. It is also characterized by unbanded legs, unbanded hindtarsi, a dark unbanded surface on the dorsum of the abdomen, and clear, unspotted wings. *Oc. trivittatus* also has two stripes of white scales separated by a narrow band of dark scales running down the top of the mesonotum.

Oc. trivittatus is multivoltine, and its eggs are desiccation tolerant. Larvae are found in fresh water habitats such as flooded woodlands, marshes, open pools, and woodland pools. They are especially common in recharge basins that retain water intermittently. Adults are present from June to September. It is a persistent and aggressive biter, and will bite in bright sun or open areas when its territory is invaded. However, it is most active in the evening. *Oc. trivittatus* prefers to feed on mammals (including humans). It is thought to be a potential vector of WNV, but not to be an EEE vector. Because its flight range is not great (a half mile or less), control efforts often focus on identification of and then elimination or treatment of larval habitat, especially recharge basins.

There are undeniable impacts to the quality of life from large numbers of aggressive biting mosquitoes. Many areas of the country are renowned for their uncomfortable insect problems. Suffolk County, especially along its shorelines, can be infested by large broods of *Ochlerotatus sollicitans*, the salt marsh mosquito. This species of mosquito is especially aggressive in its feeding on mammals, especially people. It is an opportunistic feeder, and although it prefers to seek hosts around dawn and dusk (crepuscular activity), it is one of the very few mosquitoes that will leave daytime resting places when disturbed to seek a blood meal. This means walking across a lawn in the summer sun when a brood is present can result in many bites in a very short period of time. The eggs of this species need to dry for several days after being laid, and only

hatch in water; therefore, higher lunar or storm tides trigger broods which hatch, develop, and mature at approximately the same time. This means that millions and millions of mosquitoes can leave a particular marsh at the same time, all seeking hosts to provide necessary blood meals, as the generation of eggs requires this input of proteins.

2.5 Environmental Settings of Interest for Mosquito Control

Mosquitoes are aquatic through their larval stages. Therefore, all mosquitoes need water in order to survive. The additional requirements of their larval life-style mean that the salt marshes and fresh water wetlands of Suffolk County are of special concern as potential environments for mosquito breeding. CA estimates there are 16,839 acres of vegetated salt marsh within the County, and NYSDEC has mapped 18,084 acres of fresh water wetlands. SCVC has established over 2,000 "breeding points" to monitor on a regular basis for potential control of mosquitoes. However, there are an estimated 100,000 storm water structures along roads in the County, and innumerable half-filled cans, wading pools, poorly-maintained gutters, and abandoned swimming pools, plus thousands of discarded tires, in backyards and throughout the woods, all of which can also serve as sites to breed mosquitoes. Sites as small as a deer hoof print to as large as 500 acres of salt marsh can serve as focus points for breeding problems, which makes for a daunting scope of work.

The wetlands of Suffolk County are discussed briefly in Section 3, and at much greater length in Section 5.

As adults, mosquitoes may disperse from their breeding locations, and so are found throughout Suffolk County. The County in general is discussed in Section 3, and specific sites used in the quantitative risk assessment for closer analysis are discussed in Section 4.

2.6 Legal Justification for Suffolk County Vector Control

New York State PHL authorizes agencies to investigate and ascertain the existence and causes of disease outbreaks, including vectors, and to take measures necessary to protect the public health. NYSDOH enforces compliance with the PHL. The powers and duties of NYSDOH are set forth in Article 2, §201 of the PHL. Among these are the supervision of local boards of health and health officers, (PHL §201[a]), supervision of the reporting and control of disease (PHL

§201[c]), controlling the pollution of waters of the state (PHL §201[l]), controlling and supervising the abatement of nuisances likely to affect public health (PHL §201[n]), and advising any local unit of government in the performance of their duties and regulate financial assistance granted by the state in connection with public health activities (PHL §201[o]).

PHL Article 15, sections 1520 et seq., authorizes a county to form a Mosquito Control Commission (MCC), and sets forth the powers and duties of said commission. The commission may use appropriate means to suppress mosquitoes, with the limitation that said measures "shall not be injurious to wildlife" (PHL sec. 1525[2]). In Suffolk County, mosquito control was a function of the Suffolk County MCC. That Commission is still referenced in the Suffolk County Charter (SCC), but is no longer active. Amendments to the County Charter in 1973 established the SCDHS. These amendments continued the existence of the Suffolk County Health District, noting therein that the Commissioner of the Department would be the chief administrative officer of the District, and that any reference of the New York State PHL to a local commissioner of health and/or a local department of health would be deemed to refer to the newly formed Department or its Commissioner, as appropriate. The Commissioner was to be a County Health Commissioner within the meaning of Article 3, Title III, of the PHL (SCC §C9-1, §C9-2; L.L No. 25 of 1973). Subsequently, vector control activities were the responsibility of the Division of Public Health in SCDHS.

However, in 1992, amendments to Sections C8-2 and C8-4 of the SCC established the SCVC as part of SCDPW and authorized the Division to "use every means feasible and practical" to suppress mosquitoes and other arthropods (SCC §C8-2, §C8-4; L.L. No. 16 of 1992). That Local Law also noted as follows:

> Although the authority for the county to establish a vector control program is contained within the New York State PHL, this law does not mandate that vector control activities be performed under the auspices of the local Health Department. However, in the event that an arthropod-borne disease is found to constitute a major public health threat, the DHS shall directly supervise vector control (L.L. No. 16 of 1992, Section1).

SCVC is responsible for controlling mosquito infestations that are of public health importance, pursuant to the powers granted to the County under the PHL. In the event of a vector control

emergency, "as defined" by the Commissioner of SCDHS, the direct supervision of vector control shall be by the SCDHS (SCC § C8-2[Y], L.L. No. 16 of 1992).

SCDHS is responsible for monitoring and prevention of human diseases, including those transmitted by mosquitoes, such as WNV and EEE. SCDHS monitors the blood supply, handles reports of WNV and EEE infected birds and horses, and responds to health emergencies through its Division of Public Health. In the event that an arthropod-borne disease is found to constitute a major public health threat, the vector control program would be under the control of SCDHS (SCC, §C8-2[y], L.L. No. 16 of 1992). SCDHS, Division of Environmental Quality, through its Office of Ecology, manages a number of water quality and restoration programs that involve wetlands managed by SCVC. The Office of Ecology is the program office for the PEP, and is the major County participant in the South Shore Estuary Reserve and the Long Island Sound Study.

According to the SCC, SCVC shall have

> charge and supervision for vector control throughout the County of Suffolk. The Department shall have the power and authority to enter without hindrance upon any or all lands within the county for the purpose of performing acts which in its opinion are necessary and proper for the elimination of mosquitoes and other arthropods, provided that such measures are not injurious to wildlife. In the event of a vector control emergency, as defined by the Commissioner of Health Services, the direct supervision of the vector control shall be by the Department of Health Services. (SCC §C8-2(Y).

The charter also specifies the powers of SCVC, and relates its responsibilities. SCVC

> shall use every means feasible and practical to suppress mosquitoes, ticks and other arthropods which are vectors of human disease requiring public action for their control. In carrying out its responsibility hereunder, the Division shall have the power and authority to enter without hindrance upon any or all lands within the county for the purpose of draining or treating the same and to perform all other acts which, in its opinion and judgment, may be necessary and proper for the elimination of mosquitoes and other arthropods, but such measures shall not be injurious to wildlife (SCC §C8-4(B) (1))

The responsibilities listed for SCVC include submitting an Annual Plan of Work to the Legislature each year, and various public noticing requirements, both for the truck and aerial applications, under a declared health emergency, and for vector control purposes.

2.7 Potential Legal and Other Constraints on the Long-Term Plan

2.7.1 General Constraints

The primary authority for a Federal government role in vector control is the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). USEPA has been granted broad authority to enforce FIFRA to regulate the testing, marketing, and use of pesticides. New York State has been delegated general authority for regulation of pesticides within its borders, subject to USEPA oversight. However, USEPA retains authority over the labeling of pesticides, perhaps the most important component of pesticide regulation. USEPA also has authority to enforce the federal Clean Water Act (CWA), the statute that was enacted to protect the waters of the nation from pollution. The CWA has recently been the focus of several lawsuits, including one against Suffolk County, in which it has been argued that vector control, even if carried out in compliance with other federal laws such as FIFRA, may still violate the CWA. Depending on the activities proposed in the County vector control program, a number of Federal agencies such as USACOE and NPS may be involved in permitting for the vector control program (CA-CE, 2005a).

Both the State and Federal governments have enacted programs to protect and guide development in coastal areas generally, and in certain specific areas of the waters of Long Island. The key piece of Federal legislation is the Coastal Zone Management Act (CZMA), which essentially is a grant program that encourages coastal states, including New York, to develop and implement Comprehensive Coastal Management Plans (CMPs). New York State has enacted a Waterfront Revitalization Law ("The Waterfront Law"), which in turn encourages local municipalities to establish their own waterfront revitalization programs. The Federal CZMA requires Federal agencies to carry out any activities within the state coastal zones (such as issuance of a permit) in a manner consistent with the policies of the state program. The New York State Waterfront Law requires the State, when issuing any permit or taking an action in the coastal area, to be consistent with the policies of The Waterfront Law, and also with any Local Waterfront Revitalization Program (LWRP). These consistency determinations may be a factor in the planning and implementation of the County's vector control program. (CA-CE, 2005).

NEPA and its New York State counterpart, SEQRA, require environmental review of actions, such as permit issuance, by Federal, or State or local agencies, respectively. The issuance of

Federal permits, such as the special use permits for FINS, may require environmental review pursuant to NEPA. Thus, although the goals of NEPA and SEQRA, to involve environmental considerations in agency decision-making and permitting, are similar, the environmental review of the vector control program will require attention to the different procedural requirements of each statute (CA-CE, 2005a).

It is anticipated that New York State, through NYSDEC, will be the main permitting authority for the County vector control program. NYSDEC issues permits for pesticide use, and maintains detailed requirements for applicator certification, pesticide registration, and recordkeeping and reports. It is anticipated that the pesticide applications required by the County vector control program may take place in the vicinity of wetlands. NYSDEC has strict permitting requirements for activities, including pesticide applications, which take place in the vicinity of fresh water and tidal wetlands, as well as a specific permitting program for the application of pesticides directly to surface waters (CA-CE, 2005a). Wetland regulations are discussed in detail below.

The PHL is enforced by NYSDOH. The PHL authorizes local agencies, such as Suffolk County, to investigate and take measures necessary to protect the public health. This includes authority to undertake vector control activities. SCDPW will be the County agency mainly responsible for the SCVC program. SCDHS retains responsibilities for monitoring and prevention of human diseases, including those of concern in the County vector control program. In the event that an arthropod-borne disease is found to constitute a major public health threat, the direction of the vector control program would be under the control of SCDHS (CA-CE, 2005a).

Suffolk County has enacted a "No-Spray" list, requiring advance notification, and in some cases, limitations on the application of pesticides within Suffolk County. This no-spray list will be a factor in determining when and where the County will apply pesticides, at least in the absence of a public health emergency (CA-CE, 2005a).

It is noted that a number of towns on Long Island retain ownership of bays and harbor bottoms and hold said lands for the benefit of town residents, as a public trust. In addition, a number of towns have wetlands codes which regulate activities within freshwater and tidal wetlands. A number of municipalities in Suffolk County have also enacted LWRPs, which may require consistency review for the issuance of certain permits (CA-CE, 2005a).

2.7.2 Pesticide Labels

Pesticide labels are important determinants of the allowable use of the product. Although the Long-Term Plan is deemphasizing the use of pesticides as a means of mosquito control, an IPM program for mosquito control will still require using these agents when other methods of control are not effective. This section is drawn from the analysis presented in CA-CE (2005c) unless specifically noted.

Introduction

FIFRA provides for federal control of the distribution, sale and use of pesticides. All label language must be approved by USEPA prior to a pesticide being sold or distributed in the US. The pesticide label is the primary document for conveying general and technical information from regulatory agencies and pesticide manufacturers to mosquito control agencies, the agricultural community, the commercial service industry, and the general public. It is the one source where scientific review, regulatory oversight, and public policy are interwoven to achieve a common objective: to clearly and precisely convey information on handling, storing, applying, and disposing of pesticides in a manner conducive to good health and environmental stewardship (Whitford et al., 2001).

Pesticides are developed by the manufacturer, registered with USEPA, and sold to the public with the assumption that users read, understand, and follow instructions found on the product label. Specific information on use, personal protective equipment, environmental precautions, and storage and disposal are found on the pesticide label. The purpose of the label is to provide clear directions to allow maximum product benefit while minimizing risks to human health and the environment. All research, testing, and regulatory processes ultimately are reflected through the language on the label (NYSDEC, 2003a).

Every pesticide label includes the statement, "It is a violation of federal law to use this product in a manner inconsistent with its labeling." This language obliges the purchaser or user of any pesticide to assume all legal responsibilities for the use of the product. Further, courts of law and regulators recognize the pesticide label is a binding contract that requires the person using the product to do as exactly as directed. Terms such as must, shall, do not, and shall not mean that

the user is responsible for specific actions when applying or handling the given product. Any departure from such directions is, in the eyes of the law, an illegal use of the pesticide (NYCDOH, 2001).

"Use" means more than just the application of the pesticide. Federal and state regulations define pesticide use to include handling, mixing, loading, storage, transportation, and disposal, as well as human and environmental exposure. This all-encompassing definition covers every activity that involves a pesticide - from purchase to container disposal. Many statements on the label result from rigorous scientific investigation and governmental regulatory decisions. Pesticide users must read, understand, and follow pesticide label directions to ensure effective pest control, personal safety, environmental protection and legal compliance (Whitford et al., 2001).

Every pesticide product must bear a label that contains the information specified in FIFRA and the regulations in 40 CFR §156.10. The contents of the label must clearly and prominently show the following:

- Name, brand, and trademark under which the product is sold
- Name and address of the producer, registrant, or person for whom the product was produced
- Product Registration Number
- Producing Establishment Number – referring to the final establishment at which the product was produced or finished
- Net Contents, as set forth below:
    - The net weight or measure of content shall be exclusive of wrappers or other materials and shall be the average content unless explicitly stated as a minimum quantity.
    - If the pesticide is a liquid, the net content statement shall be in terms of liquid measure at 68 degrees Fahrenheit (°F) (20 degrees Celsius [°C]) and shall be

expressed in conventional American units such as fluid ounces, pints, quarts, or gallons.

- If the pesticide is a solid or semisolid, viscous or pressurized, or is a mixture of liquid and solid, the net content statement shall be in terms or weight expressed as pounds and ounces.

- In all cases, net content shall be stated in terms of the largest suitable units, i.e. "1 pound 10 ounces" rather than "26 ounces."

- In addition to the required units specified, the net content may be expressed in metric units.

- Variation above minimum content or around an average is permissible only to the extent that it represents deviation unavoidable in good manufacturing practice. Variation below a stated minimum is not permitted. In no case shall the average content of the packages in a shipment fall below the stated average content.

- Warning or precautionary statements. Every pesticide product label must bear on the front panel the statement "Keep Out Of Reach Of Children." However, human hazard signals and precautionary statements will vary according to the product's toxicity to humans, as discussed under "Toxicity Categories."

- Ingredient Statement, which must contain the name and percentage by weight of each active ingredient, the total percentage by weight of all inert ingredients, and, if the pesticide contains arsenic in any form, a statement of the percentages of total and water-soluble arsenic calculated as elemental arsenic. Accepted common names are to be used followed by chemical name unless the common name is widely known. In cases where the pesticide formulation changes considerably over time (degradation), the following statement must be written on the label: "Not for sale or use after [date]." The product must meet all requirements on the label through that date. Inert ingredients may need to be listed if they pose a hazard to public health or the environment.

- Use Classification, indicating whether the product is for general use, restricted use, or both. If it is a restricted use product, specific directions must follow. Other information may be required if its use is restricted to certain applicators.

- Directions for use, which must be easily read and understandable by the average person who will use them. They may appear anywhere on the label providing they may be easily read. Directions may be omitted if:

    - The product is only to be used in manufacturing.
    - It will not come into the hands of the public
    - It has data sheets specifying products involved
    - It is determined that directions are not necessary to prevent unreasonable adverse effects on humans and the environment
    - It is only to be used by a physician
    - It is a drug regulated under the Federal Food, Drug, and Cosmetic Act (FFDCA)
    - It will only be used by formulators of pesticide

Safety Information

Child hazard warning. The front panel of every pesticide product label must bear the statement, "Keep Out Of Reach Of Children." USEPA may waive this requirement only in cases where the likelihood of contact with children is extremely remote, or when the product is approved for use on children.

A **signal word** must appear prominently on the front of the pesticide container, providing, in essence, a one-word summary of the product's potential toxicity to humans. The three signal words, in decreasing order of toxicity, are DANGER (highly toxic), WARNING (moderately toxic), and CAUTION (slightly toxic).

A signal word is assigned on the basis of laboratory tests conducted with that particular product. Data are compiled from animal studies on exposure through ingestion, inhalation, and dermal (skin and eye) absorption. The route of exposure which shows the highest human toxicity potential determines the signal word assigned to the label. For example, if laboratory test results indicate product XYZ to be moderately toxic if ingested, highly toxic if inhaled, and slightly toxic if absorbed through the skin or eyes, the signal word would be danger based on inhalation studies, and would be DANGER.

Hazards to humans and domestic animals. Precautionary statements indicating specific hazards, routes of exposure, and precautions to be taken to avoid human and animal injury are required on the label. For example:

- Harmful if swallowed, inhaled, or absorbed through the skin.
- Do not breathe vapors or spray mist
- Avoid contact with eyes, skin or clothing
- Handle concentrate in a ventilated area.

Specific precautionary statements are developed for each pesticide, based on testing results.

The **protective clothing and equipment statement** directs the applicator to reduce the potential for exposure by using protective clothing or equipment. Most pesticide labels contain very specific instructions concerning the type of clothing that must be worn during the handling and mixing processes.

Potential routes of exposure determine the types of protective clothing designated on the label. Generally, a long-sleeved shirt, long pants, and waterproof footwear are the minimum requirements. The label will state whether specific items such as respirators and chemical-resistant gloves, aprons, goggles, and boots are needed. Common label language includes:

- Wear full face shield, rubber gloves, apron, and waterproof footwear when pouring concentrate or when exposure to concentrate is possible, or

- Eye protection and chemically resistant gloves and footwear, a long-sleeved shirt, and long-legged pants or coveralls are recommended

The **Statement of practical treatment** (first aid) provides valuable information to persons at the scene of a pesticide poisoning. Some examples include:

- In case of contact with skin, wash immediately with plenty of soap and water
- If swallowed, call a physician or poison control center immediately
- Immediately wash eyes with water for at least 15 minutes and get medical attention
- After first aid is given, take victim to clinic or hospital
- If inhaled, remove victim to fresh air

The statement of practical treatment informs physicians and emergency responders of appropriate medical procedures for poisoning victims. For example, the statement might indicate to a physician:

- There is no specific antidote
- If the product is ingested, induce emesis or stomach lavage
- The use of an aqueous slurry of activated charcoal may be considered

Products labeled DANGER also bear a toll-free telephone number that physicians may use for further treatment advice. Emergency telephone numbers are provided on the Material Safety Data Sheet (MSDS). The pesticide distributor or manufacturer should be contacted for the MSDS.

Environmental Information

Environmental hazard statements are required to state the nature of potential hazards and appropriate precautions to avoid accident, injury, or damage if the product presents risks to non-target organisms or the environment. Potential hazards are determined by a series of tests that

evaluate a pesticide's toxicity to wildlife such as mammals, fish, birds, aquatic invertebrates, and pollinating insects. Statements might include label language such as:

- This product is highly toxic to bees
- This product is highly toxic to fish
- This product is toxic to aquatic invertebrates.

To reduce the risks, the label may direct measures such as:

- Do not allow drift to contact nontarget plants
- Do not apply directly to water or wetlands

If the pesticide has the potential to harm an endangered or threatened species or its habitat, statements will indicate where not to apply the pesticide or refer the user to an endangered species bulletin for further information. For example, the label might read:

- Use of this product in a manner inconsistent with the Pesticide Use Bulletin for Protection of Endangered Species is a violation of federal law
- Restrictions for the protection of endangered species apply to this product
- If restrictions apply to the area in which this product is to be used, you must obtain the Pesticide Use Bulletin for Protection of Endangered Species for that county

Statements on environmental impact may indicate that the product "…may travel through soil and can enter ground water," or "…has been found in ground water." The label instructions will tell how to reduce the impact on the environment, such as:

- This product may not be mixed, loaded, or used within 50 feet of all wells, including abandoned wells, drainage wells, and sink holes
- This product has been shown to leach under certain conditions. Do not apply to sand and loamy sand soils where the water table (ground water) is close to the surface.

Product Information

The **brand (trade) name** under which a pesticide product is sold always appears on the front panel and often is the most conspicuous part of the label.

The **name and address of the producer, registrant, or person for whom the product was produced** must be shown on the label. If the registrant's name appears on the label and the registrant is not the producer, it must be qualified by appropriate wording such as "Packed for…," "Distributed by…," or "Sold by…."

The **net weight or volume of the contents** of the formulated pesticide product is displayed prominently on the label or stamped on the container.

The product registration number appears on the label, preceded by the phrase "EPA Registration No." or "EPA Reg. No." The registration number identifies a specific pesticide product and signifies that federal registration requirements have been met. At a minimum, registration numbers consist of two sets of digits: e.g., 491-005. The first set of digits identifies the registrant. The second set represents the specific registration issued to the company by USEPA. Together, these numbers clearly identify the product.

The **establishment number** is preceded by the phrase "EPA Est." USEPA requires pesticide production sites to be registered with USEPA. A pesticide-producing establishment is assigned a USEPA establishment number that clearly identifies that location. All pesticides produced at that location must bear its USEPA establishment number on the label or container. Farm service centers that repackage bulk pesticides must be registered as pesticide-producing establishments and, as with all pesticide producers, must keep records of their pesticide production and file annual production reports.

The **ingredient statement** normally is found on the front panel of the label. It identifies the name and percentage of a pesticide product that affects the target pest. Chemical names often are complex; for example, *2-chloro-4-ethylamino-6-isopropylamino-s-triazine* is the active ingredient in the product *Atrex*. To aid communication, USEPA-approved common names may be substituted for chemical names.

Inert ingredients allow active ingredients to be formulated into many different products. As part of the formulation, they determine a product's handling properties and influence toxicity, release rates, residual activity, persistence, and methods of application. Also, there are no pest controlling claims for inert ingredients and, because product formulations are confidential, the total percent by weight of inert ingredients usually is the only information about inert ingredients found on the label.

The **formulation** of the product often appears on the front panel of the label, either near the brand name or in the general information section. Pesticides may be formulated into many products; currently, in the US, some 450 active ingredients are formulated into 25,000 different products. Information about the type of product formulation—granular, liquid flowable, dry flowable, microencapsulated, emulsifiable concentrate, etc—provides insight about application equipment, handling properties, and performance characteristics.

General-use versus restricted-use classification. USEPA may classify a certain pesticide product for restricted use due to the complexity of the designated use, concerns about environmental safety, or potential human toxicities. A restricted-use product may be bought and used only by a certified applicator or persons under the direct supervision of a certified applicator. A restricted-use statement appears conspicuously at the top of the front panel of the label to make this classification obvious. All restricted-use pesticides are identified by the following language:

> For retail sale to and use only by certified applicators or persons under their direct supervision, and only for those uses covered by the certified applicator's certification.

Pesticides that remain unclassified are referred to as "general use" pesticides and may be purchased by the public. Most pesticides used by homeowners are general use products. However, there is no positive statement on labels approving the chemical for homeowner use. Rather, it is the absence of the restricted use statement that allows for general use. Nothing that can be interpreted as a "general use statement" ever will appear on the product label.

The **physical and chemical hazard statements** identify a given pesticide's flammability or explosiveness. These statements show specific hazards and state conditions to be avoided, such as:

- Extremely Flammable
- Contents Under Pressure
- Keep away from fire, sparks, and heated surfaces
- Do not puncture or incinerate containers
- Exposure to temperatures above 130º F causes bursting

The **warranty** information is the manufacturer's assurance that the product conforms to the chemical description on the label and that it is fit for labeled purposes if used according to directions under normal conditions. The warranty does not extend to any use of the product contrary to label instructions, nor does it apply under abnormal conditions such as drought, tornadoes, hurricanes, or excessive rainfall.

Use Information

Misuse statements contain language such as, "It is a violation of federal law to use this product inconsistent with its labeling."

Storage and transportation statements may include the following:

- Store at temperatures above 32º F
- Do not contaminate feed, foodstuffs or drinking water
- Do not store next to feed or food, or transport in or on vehicles containing foodstuffs or feed
- For help with any spill, leak fire or exposure involving this material, call Chem Trek (800-424-9300)

Directions for use often comprise the bulk of a pesticide label. They must be adequate to protect the public from fraud and personal injury and to prevent unreasonable adverse effects on the environment. The instructions must provide guidance to the user on issues such as:

- pests controlled
- sites of application
- compatibility with other pesticides
- mixing or dilution rates
- application rates
- equipment needed for application
- timing and frequency of applications
- harvest intervals
- general information for successful results.

Directions for use may appear on any portion of the label. Because of the detail required for specific applications, use directions for common sites, pests, and applications may be grouped together under a general heading. Information specific to individual uses may be addressed under specific headings.

Container rinsing and disposal statements list proper procedures for handling pesticide containers and disposing of unused products. Federal, state, and local regulations often must be consulted to determine how to dispose of unused pesticide concentrates or diluted mixtures. Container disposal statements include the following:

- Triple rinse (or equivalent)
- Do not reuse container
- Offer for recycling or reconditioning

- Puncture and dispose of in a sanitary landfill
- Disposal by other procedures allowed by state and local authorities
- Improper disposal of excess pesticides, spray mixture, or rinsate is a violation of federal law
- If these wastes cannot be disposed of by use according to label instructions, contact your state pesticide or environmental control agency, or the hazardous waste representative at the nearest EPA regional office for guidance

While numerous pesticide labels still state that properly rinsed containers may be burned, almost every state has clean air laws that prohibit such disposal.

2.7.3 Regulations Affecting Wetlands

Wetlands regulation is a special subset of the rules that affect the Long-Term Plan.

New York State defines tidal wetlands as:

> those areas which border on or lie beneath tidal waters, such as, but not limited to, banks, bogs, salt marsh, swamps, meadows, flats or other low lands subject to tidal action, including those areas now or formerly connected to tidal waters …

specifically:

> all banks, bogs, meadows, flats and tidal marsh subject to such tides, and upon which grow or may grow some or any of the following: salt hay (*Spartina patens* and *Distichlis spicata*), black grass (*Juncus gerardi*), saltworts (*Salicornia spp.*), sea lavender (*Limonium carolinianum*), tall cordgrass (*Spartina pectinata* and *Spartina cynosuroides*), hightide brush (*Iva frutescens*), cattails (*Typha angustifolia* and *Typha latifolia*), groundsel (*Baccharis halmilifolia*), marsh mallow (*Hybiscus palustris*) and the intertidal zone including low marsh cordgrass (*Spartina alterniflora*).
>
> (ECL, Title 1, Section 25)

Fresh water wetlands are defined by New York State as:

> lands and waters of the state as shown on the freshwater wetlands map which contain any or all of the following:

a) lands and submerged lands commonly called marshes, swamps, sloughs, bogs, and flats supporting specific species of aquatic or semi-aquatic vegetation (as listed in Section 24-0107 of the Environmental Conservation Law);

b) lands and submerged lands containing remnants of any vegetation that is not aquatic or semi-aquatic that has died because of wet conditions over a sufficiently long period, provided that such wet conditions do not exceed a maximum seasonal water depth of six feet and provided further that such conditions can be expected to persist indefinitely, barring human intervention;

c) lands and waters substantially enclosed by aquatic or semi-aquatic vegetation as set forth in paragraph (a) of Section 24-0107 or by dead vegetation as set forth in paragraph (b) of Section 24-0107, the regulation of which is necessary to protect and preserve the aquatic and semi-aquatic vegetation; and

d) the waters overlying the areas set forth in (a) and (b) and the lands underlying (c).

(ECL, Title 1, Section 24)

The first law adopted to protect wetlands by regulating activities in and adjacent to wetlands was enacted by Massachusetts in 1963 and required a state permit for the filling or dredging of tidal wetlands (Adler, 1999). In 1965, Massachusetts passed a second wetlands law that extended its regulatory authority to fresh water wetlands (Town of Needham Conservation Commission, 2006). Similarly, Connecticut in 1969 (Dreyer and Niering, 1995) and New York in 1973 (Atlantic States Marine Fisheries Commission, 2004) passed laws that regulated activities in tidal wetlands. In 1972 Connecticut (Connecticut Association of Conservation & Inlands Wetlands Commissions, Inc., 2006) and New York in 1975 (NYSDEC, 2006) passed laws regulating activities in fresh water wetlands. While the federal government has not adopted a law that specifically protected and regulates activities in or near wetlands, many local municipalities under their zoning and land use powers have.

2.7.3.1 Federal Regulation

The Federal government regulates wetlands under the Federal Water Pollution Control Act (1972) ("The Clean Water Act" [CWA]), which covers all "waters of the United States" which

may have been or are used in interstate or foreign commerce. Wetlands are defined in accordance with three criteria:

- Hydrology
- Vegetation
- Soils

Wetlands are defined as "waters of the United States" (NYSDOS, 1997). This definition has received some modification through a 2001 Supreme Court decision (*Solid Waste Agency of Northern Cook County v. United States Army Corps of Engineers*), which limits the Federal government in its regulation of isolated wetlands that are not hydraulically connected to other waters. The discharge of dredge or fill material or the construction of any kind in a wetland requires a permit from the US Army Corps of Engineers, under the CWA (§404). The Federal government does not regulate "adjacent" areas near wetlands (NYSDOS, 1997).

The Federal government can also regulate wetlands under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403). Section 10 regulates navigable waters and includes activities such as beach nourishment, dredging, filling, and the construction of boat ramps, piers, pilings, and shore protection (NYSDOS, 1997).

In addition, President Bush established a federal policy of "no-net loss" of wetlands, on Earth Day, 2004 (www.whitehouse.gov/news/releases/2004/04/20040422-4.html).

The National Marine Fisheries Service has review responsibilities for actions involving activities seaward of the high tide line, and special responsibilities for designated Essential Fish Habitats, which may affect wetlands projects (NYSDOS, 1997).

The NYSDOS, through the Coastal Zone Management Act (1972), was delegated authority to address coastal zone problems, including environmental issues (which can include wetlands) (see below) (NYSDOS, 1997).

There are two Federal estuary programs that potentially affect the County's wetlands, the Long Island Sound Study (LISS) and the Peconic Estuary Program (PEP). Both are administered by USEPA.

The LISS Comprehensive Conservation and Management Plan (CCMP) (1994) identified habitat enhancement (including wetlands) as an important goal. Tracking reports on the progress of the CCMP implementation note with approval that Connecticut replaced its mosquito ditching maintenance practices with OMWM and that New York State has been phasing out its ditching practices. It was recommended that New York State continue to phase out mosquito ditching and implement OMWM to control mosquitoes and improve the value of wetlands by restoring wetland ponds and pools. Technical guidance in achieving the habitat restoration goals (LISS, 2003) listed twelve habitat types, five of which were specifically addressed. Tidal wetlands were included. The focus was on Connecticut marshes, but included those marshes found on Long Island. Seven specific impacts to marshes were identified as requiring restoration:

- grid (parallel)-ditching
- draining
- impoundments
- filling/burying
- phragmites invasion
- stormwater impacts
- sea level rise impacts

For each impact, preferred means of restoration were cited. OMWM was not specifically identified as a restoration means, although ditch plugs and pond creation were identified as useful means of restoring salt marshes. Although mosquito management was identified as a means of causing impairments to habitat, mosquito management was not included as an element to be addressed during restoration activities. No Suffolk County marsh was identified on the primary priority list for restoration.

The PEP CCMP (SCDHS, 2002) contains many brief mentions of mosquito control effects on the estuary. Mosquito control ditching was listed as a cause of habitat loss, fragmentation, and degradation of the marshes where it was conducted.

The CCMP recommends improved coordination between SCDHS, SCVC, other agencies and departments, and municipalities in maintaining existing mosquito ditches and developing coordinated planning efforts relating to mosquito control in wetlands. The Plan recommends that OMWM techniques be employed. OMWM helps to ensure that fish life that feed on mosquito larvae can survive and be present in areas where mosquitoes breed. A no new ditch policy was established, and it was urged that SCVC work cooperatively with all governments and government agencies in planning mosquito ditch maintenance. *Phragmites* control was also emphasized (SCDHS, 2002).

Policies have also been established by major federal landholders regarding management of wetlands. For instance, NPS generally (and FINS, specifically) has determined:

> The establishment and maintenance of ditches in Fire Island tidal marshes as a means of mosquito control are extremely disruptive to the natural evolutionary processes of the ecosystem. Furthermore, the effectiveness of the grid drainage system for mosquito control is generally believed to be of little, if any, value. Considering the National Park Service's mandate to preserve Fire Island's natural environment and the lack of knowledge of ditching effects, the maintenance of existing ditches will be terminated on all Park Service owned lands. Ditching activities on other lands within the legislated boundary of Fire Island Seashore should also be terminated with the exception of designated experimental sites. The cessation of ditching as a mosquito control method will remain in effect until its utility can be proven and its effectiveness is shown to outweigh the associated environmental degradation.
>
> (Fire Island National Seashore, 1977)

The NPS has also identified poor salt marsh quality and the potential for the need for more active salt marsh management as major issues for FINS. However, NPS has not yet determined what management might be permissible to address both an apparent need for marsh management and a general distaste for grid ditching and the maintenance of the grid ditch system (Milstead et al., 2004).

USFWS is a large landholder in east coast salt marshes. USFWS would also like to eliminate pesticide use in its refuges, but also maintain its policy of being a good neighbor to surrounding communities. Its perception is that this role includes preventing, as much as possible, mosquito

problems to exist due to breeding on the refuges. OMWM holds a promise of meeting these two goals, and, potentially, of providing collateral wildlife values enhancements.

Initial guidance had been offered that closed (ditch plug) systems and semi-open (sill systems) were preferable over open systems. The exception was the use of open systems to address *Phragmites* invasion. USFWS appeared concerned that open systems would serve to drain the water table excessively (Taylor, 1998). However, noting the lack of standardized information on OMWM benefits and potential impacts, the advisory was slightly altered in 1999 that determinations regarding OMWM projects be made at the specific refuge level (USFWS, 1999), pending the outcome of initial (Roman, 1998) and long-term (James-Pirri et al., 2001) projects. The initial evaluation, in Maine for ditch plugging, found shifts in vegetation toward *S. alterniflora* due to increased water levels, Bird responses were variable across the sites, but fish populations were either stable (at two sites) or significantly enhanced (at one site) (Adamowicz and Roman, 2002). The larger, longer project by James-Pirri et al., has only published interim data sets (James-Pirri et al., 2003); a project report was due in 2004, but has been delayed while undergoing review by USFWS and USGS (the project sponsors). Reportedly, USFWS will use the findings of the James-Pirri et al. study to determine the Region 5-wide response to OMWM proposals.

2.7.3.2 State Regulation

New York State has two different regulatory programs and sets of requirements for wetlands protection:

- one for fresh water wetlands as set forth under Article 24 of the ECL.
- one for tidal wetlands under Article 25 of the ECL.

Article 24 was adopted in 1975. Article 25 was adopted in 1973 but its implementing regulations did not become effective until 1977 (NYSDOS, 1997).

The regulations for fresh water wetlands are contained in 6 NYCRR Part 662, Part 663, Part 664, and Part 665. The implementing regulations for tidal wetlands are found in 6 NYCRR Part 661. Both laws and their regulations define wetlands based largely on vegetation. Both map regulated wetlands (New York State does not have jurisdiction over "unmapped" wetlands). Both identify

regulated activities (but almost any activity requires a permit), and set forth standards for permit issuance. The permitting process itself is governed under the NYSDEC Uniform Procedures Act (NYSDOS, 1997).

Two of the more significant differences between the two wetland laws and their regulations are:

- the Freshwater Wetlands Act (FWA) regulates activities within 100 feet of the edge of wetlands while the Tidal Wetlands Act (TWA) regulates activities within 300 feet of the edge of wetlands.
- the regulation of fresh water wetlands can be delegated to local municipalities provided the regulations are at least as restrictive as the regulations in effect pursuant to the FWA.

Ditch maintenance activities have been found to be acceptable under the TWA. Other forms of marsh management require further review, and generally are determined to require a permit. Suffolk County has applied for and received general permits for its marsh management activities, including replacement of in-kind water control structures and ditch maintenance.

The application of pesticides directly to any regulated body of water in New York (that is, "waters of the State") is considered an aquatic application. As such, it requires an NYSDEC Article 15 Aquatic Pesticides Permit. This regulation covers the application of any larvicide to standing water, except for water solely within artificial containers or other, isolated waters not considered "waters of the State." The County maintains such a permit (through SCVC). ULV adulticides are not applied directly to water, do not target the aquatic stage of mosquitoes, and so do not require an Article 15 permit.

The NYSDEC Article 24 regulations (6NYCRR Part 663) state that the application of a pesticide covered under an Article 15 permit also requires a separate Freshwater Wetlands permit. The County also maintains an Article 24 permit to allow for its fresh water wetland larvicide program. Application of adulticide within 100 feet of an NYSDEC regulated fresh water wetland area requires a permit. NYSDEC has indicated that ULV adulticide applications that take place 150 feet or more from fresh water wetlands will be considered out of Article 24 jurisdiction. The County therefore maintains such a setback on its vector control adulticide applications.

If an application of adulticide over a regulated fresh water wetland is deemed necessary, an emergency authorization can be requested from NYSDEC if NYSDOH has previously declared a Health Threat. The emergency request to NYSDEC needs to present the specific reason the application is needed, with maps delineating the application zone. Emergency actions required to respond to a public health threat are exempt from regulation under Article 24.

The NYSDEC Article 25 regulations (6NYCRR Part 661) state that the use or application of any pesticide, where otherwise authorized by law, does not require a permit. Thus, if a pesticide is registered in New York State and is applied per the label, a permit is not needed (except if the application is made to NYSDEC-owned lands, see below). Application of adulticides over tidal wetlands is generally avoided. If required due to a public health threat, such applications can be made without a specific permit if the product label specifically allows such use of the product over tidal marshes.

Application of pesticides to NYSDEC-owned lands requires NYSDEC permission. This permission had been received in the form of a sign-off on Article 15 permits for larvicide use. In March, 2006, SCVC received a letter stating this would no longer be the case, although NYSDEC had not yet determined how such permission might be granted (D. Ninivaggi, SCVC, personal communication, 2006).

NYSDEC implements several other programs that indirectly affect wetlands:

- Coastal Erosion Hazard Areas Program: actions that may affect mapped coastal erosion zones receive further regulation.
- Use and Protection of Waters (Stream Protection Program): regulates disturbances of stream beds, or excavation and fill of any navigable waterway.
- State Pollution Discharge Elimination Program: regulates discharges into surface water by industrial, commercial, and municipal sources, and some residential areas as well, including a ban on the discharge of untreated stormwater to wetlands.
- Water Quality Certification Program: under the CWA, New York was delegated the authority to regulate discharges to navigable waters.

- Endangered Species Program: regulates activities that might harm Federal or State listed endangered or threatened species.
- Natural Heritage Program: this program identifies occurrences of rare biota and amps natural communities, and is funded jointly with The Nature Conservancy.
- Wild, Scenic and Recreational Rivers System: designated systems receive extra protections.

(NYSDOS, 1997)

NYSDOS developed a State-wide Coastal Management Plan CMP, which was approved by the (Federal) Secretary of Commerce in 1982. The policies established in this plan are used by NYSDOS when it reviews Federal and State actions in the coastal zone, subjecting them to a single set of locally-determined criteria. There are now 13 criteria that must be complied with in these "consistency" reviews. NYSDOS can further delegate coastal management authority through the Local Waterfront Revitalization Program (LWRP) (see below) (NYSDOS, 1997).

Another element of the State CMP was the designation and mapping of Significant Coastal Fish and Wildlife Habitats. These sites are further protected, with the intent of preventing impairment. A goal is to restore any such habitats to improve them, where practical (NYSDOS, 1997).

In 1999, NYSDOS completed a management plan for Long Island Sound, designed to help spur implementation of the State CMP. The Long Island Sound CMP recognized four arenas for action:

- The developed coast
- The natural coast
- The public coast
- The working coast

Under the natural coast, protection and restoration of tidal and included fresh water wetlands was identified as a priority. One of the important impairments of the mid-Sound coast was ditches installed for mosquito control purposes. Invasive plants, presumably including *Phragmites*, were

also identified as a problem. Recommendation 11 of the Plan was to reach a net gain in quality and quantity of tidal wetlands, and no net loss for fresh water wetlands. The primary means of achieving the gains was to be reconstruction of lost physical features that would result in natural wetlands functioning. Sites for restoration were to be identified by LISS. In addition, 13 regionally important natural areas were identified, 10 of which lie at least partially in Suffolk County, and all but one of which have important wetland resources (Oyster Bay-Cold Spring Harbor, Lloyd Neck-Eatons Neck, Crab Meadow-Fresh Pond, Sunken Meadow-Nissequogue River, Stony Brook-Setauket, Mount Sinai, Wading River, Wildwood-Bating Hollow, Riverhead Bluffs [no wetlands], eastern islands [Plum Island, Great Gull Island, etc.], Fishers Island) (NYSDOS, 1999).

The South Shore Estuary Reserve (SSER), a planning effort under the direction of NYSDOS, determined that, in order to meet estuarine water quality objectives, stream corridors (especially fresh water wetlands along the streams) would need to be managed as described by New York State in its guideline to prevent non-point pollution, including sediment erosion, from stormwater (NYSDEC, 1996). The Comprehensive Management Plan also identified wetlands as key elements of the biological landscape, and called for increasing the quantity and quality of wetlands, especially tidal wetlands. The means of doing this were identified as primarily being:

- hydrological modification of formerly connected wetlands
- restoration of dredge spoil sites
- OMWM
- Establishing protective buffers
- Identifying existing high quality wetlands

(SSER Council, 2001)

NYSDOS and NYSDEC collaborated on the production of *Salt Marsh Restoration and Monitoring Guidelines* in 2000 (Niedowski, 2000). This apparently was the result of considerations of the Seatuck OMWM demonstration project in 1986 (see Lent et al., 1990), plus other pressures to develop a state guidance for salt marsh projects. The Guidelines do not appear

to have any regulatory authority, nor do they seem to be referred to by those proposing or enforcing the State regulations.

The document is intended to serve as a framework for New York salt marsh restoration activities, including planning, design, implementation, and monitoring for restoration projects sponsored by municipalities. The goal statements for habitat restoration in New York State are summarized as follows:

- To the greatest extent practicable, achieve functional, community, and/or ecosystem equivalence with reference sites when undertaking restoration.
- Restore critical habitats for priority fish, wildlife, and plant species, including those listed as threatened, endangered, and of special concern by Federal and State governments, and species of historical or current commercial and/or recreational importance in New York State.
- Plan and implement restoration initiatives using a regional perspective to integrate and prioritize individual restoration projects and programs.
- To the extent practical, use historical acreages, proportions, and/or spatial distributions to prioritize habitats from a state or regional perspective.
- To the extent practical, ensure where appropriate that historical acreages, proportions, and/or spatial distributions of priority habitats are restored and preserved.

Two desirable OMWM techniques described in the manual are closed systems and semi-tidal systems. According to the guidelines, closed systems should consist of shallow ponds and pannes ranging from two to 18 inches deep, sump ponds ranging from 30 to 36 inches deep, and pond radial, spur ditches approximately 30 inches deep. Ponds with gentle slopes are recommended in areas where mosquito breeding is evident. More shallow areas may be constructed in a pond for shorebird foraging areas. Excavated spoil resulting from pool and ditch creation is recommended to be used to raise the bottom of ditches, and for plugging ditches. The use of rotary ditching equipment is advised to minimize the impacts of spoil disposal. The semi-tidal systems are described as consisting of 30 inch deep ditches with sills that are only partially

tidal. A sump pond and connector ditch system is recommended for semi-tidal systems as well. Open systems are not discussed (Niedowski, 2000).

The New York State Department of General Services administers all State lands below high tide, and issues any grants, easements, or leases required for any private use of such lands (NYSDOS, 1997).

2.7.3.3 County Regulation

Suffolk County does not regulate wetlands. However, in the late 1970s, there was a fresh water wetlands law (Local Law 20-1976, Chapter 488 of the Suffolk County Code "Freshwater Wetlands") that referred to a Commissioner of Environmental Control, criteria and applications (W. Dawydiak, SCDHS, personal communications, 2005). It is not clear if the County ever implemented the law, which was repealed in 1993 by Local Law 16-1993.

2.7.3.4 Local Regulation

Nine of Suffolk County's 10 townships have local laws that regulate activities in wetlands; in some cases, the local laws regulate the adjacent area. The Town of East Hampton Trustees regulate wetlands, but this is not codified in the Town Code. The town laws typically describe the value of wetlands and the need to protect them, and then define prohibited activities, identify regulated activities, and set forth a permitting procedure for proposed activities in or adjacent to wetlands. The local laws may include standards for permit issuance. Wetlands are protected by denying a permit, or issuing a permit that contains conditions designed to minimize or mitigate impacts. Unlike New York State, which maps wetlands, the Towns do not map the wetlands, or they use the state maps.

Review of the nine Town Codes found the following:

Babylon

Chapter 108 Dredging

A permit is needed to remove any material from any waterway, watercourse, or upland abutting or adjoining a waterway or watercourse.

Chapter 128 Freshwater Wetlands

This law is very similar to the New York State FWA. A permit is needed for activities within 100 feet of a fresh water wetlands including:

- draining
- dredging
- excavating
- dumping
- filling
- erecting any roads or structures
- discharging pollutants or effluents

Public health activities are exempt.

Brookhaven

Chapter 81 Wetlands and Waterways

A permit is needed for activities within 150 feet of tidal and fresh water wetlands including:

- draining
- dredging
- excavating
- dumping
- filling
- erecting any roads or structures
- discharging pollutants or effluents

Huntington

Chapter 141 Streams, Watercourses & Wetlands

Article I Filling, Diversion, or Draining of Streams and Watercourse

A permit is needed to:

- fill or divert the course of streams, creeks, or watercourses
- divert any stream, watercourse, or creek from its natural course
- drain any pond or impoundment.

Chapter 141 Streams, Watercourses & Wetlands

Article II Freshwater Wetlands

The Town assumes the implementation of the New York State FWA.

Chapter 137 Marine Conservation

Article II Removal or Deposition of Material

A permit is needed to remove/place material on wetlands or watercourses owned by the Town.

Chapter 137 Marine Conservation

Article III Construction or Reconstruction

A permit is needed to construct or reconstruct a dam or impounding structure and docks, piers and pilings.

Islip

Chapter 67 Wetlands and Watercourse

A permit is needed to dig, dredge, excavate, or dump on tidal waters, tidal marshes, fresh water wetlands, coastal wetlands, tidal wetlands, and watercourses.

Riverhead

Chapter 107 Tidal and Freshwater Wetlands

A permit is needed to dig, dredge, excavate, or dump on tidal waters, tidal marshes, fresh water wetlands, coastal wetlands, tidal wetlands, and watercourses and within 150 feet of wetlands.

Shelter Island

Chapter 129 Wetlands

A permit is needed for dredging, disturbing, filling, or excavating in tidal and fresh water wetlands, and within 100 feet of a wetland.

Smithtown

Chapter 170 Freshwater Wetlands

Pursuant to the New York State FWA, the Town assumes the implementation of the Act.

Chapter 138 Dredging

A permit is needed to remove or deposit fill from any wetlands or watercourse.

Southampton

Article VII Regulating Dredging, Docks, Bulkheading and Channels (Board of Trustees)

A permit is required to dredge or deposit material on the bottom of any waters in the Town.

Chapter 325 Wetlands

A permit is needed undertake open water marsh management measures and to place, deposit, or dredge material in a tidal or fresh water wetland area, or within 200 feet of a wetlands boundary.

Southold

Chapter 97 Wetlands and Shorelines

A permit is needed to remove material from wetlands or to deposit or discharge material on tidal or fresh water wetlands

Town Trustees

Suffolk County has a special wetlands regulatory situation, which is the result of local history and practice. This is the establishment of town trustees, who in three cases are entirely separate from other elements of Town government.

In 1664, King Charles II granted all lands "from the west side of the Connecticut River to the east side of the Delaware River," including associated islands, to his brother, the Duke of York. Colonel Richard Nicolls was sent to ensure the Dutch (former rulers of this area) recognized this claim. It had been determined in English law that when the King conquered a kingdom, he could alter laws as he saw fit, and so Col. Nicolls imposed English law throughout the new territories on behalf of the King. In 1665, Col. Nicolls established the Duke's Laws, in consultation with the settlers of the area. The Duke's Laws also included the town patents. These designated several patentees, who could act on behalf of "themselves and their associates, the freeholders and inhabitants" as proprietors of the towns. The land grants included "havens, harbors, creeks, quarries, woodland, meadows, pastures, marshes, lakes, fishing, hawking, hunting and fowling" and established the Town. It also required that each purchase of land from the Indians would need approval from the Duke (or his governor). Generally, the lands were held as "tenants in common" where shares of the land were held by the original purchasing families, and could be inherited and otherwise transferred. The land grants extended to high water, and also to the mouths of protected bodies of water. It appears that "swamps" and "bogs" and "boggy meadows" referred to fresh water wetlands, "marsh" was low marsh, "foreshore" was the area between low and high tides, "salt meadow" was high marsh, and "thatch" and "creek thatch" was grass growing along streams. These terms were not used precisely at the time, but rather were determined through particular filings and court decisions (Kavanagh, 1980).

The Towns, and their time of foundations, are:

- Brookhaven (1655)
- Easthampton (*sic*) (1649) (Gardiners Island was separate, settled 1640)

- Huntington (1653) (included Babylon, not established until 1872)
- Islip (1710)
- Shelter Island (1649)
- Southampton (1640)
- Southold (1640) (including Riverhead, not established until 1792)

War flared up again in 1673; the King renewed his brother's charter in 1674. In 1683, the fourth English governor of New York, Colonel Thomas Dongan, arrived with instructions to call an assembly to reestablish the "good weal and government" of the colony. To improve on the collection of rents for the Duke, Col. Dongan rewrote the patents for the Towns between 1686 and 1688. This was also done to impose English and catholic authority on the colonists, reflecting the protestant upheavals that had been causing turmoil and civil war in England over the previous hundred years, and would lead to the loss of throne for James II within several years (Kavanagh, 1980).

Dongan quickly persuaded Brookhaven, Easthampton (*sic*), and Southampton to surrender their patents, and receive new ones. Southold, resisted, and operated under a patent issued by the second Governor, Major Edmund Andros. Smithtown and Shelter Island were private proprietary grants, and so did not require a patent (as was the case for Gardiners Island). Huntington was resistant, but acceded to the Governor, and agreed to a new patent in 1688 (Kavanagh, 1980).

Turmoil followed in 1689 with the Glorious Revolution that led to the reign of William and Mary and the deposition of James II. In 1691, Colonel Henry Sloughter was appointed governor, and held an assembly for "settling, quieting, and confirming" the various patents. Thus Shelter Island, Smithtown, Southold, and when incorporated, Islip (by virtue of patents issued to individual landholders) are "Andros Patent" towns, as the Andros patents they held were confirmed by Col. Sloughter. Brookhaven, Southampton, and Southampton are "Dongan Patent" towns, as their Dongan patents were also confirmed by Col. Sloughter. Huntington, on the other hand, had its Dongan Patent originally affirmed by the sitting governor during an unsettled time locally called the Leisler Rebellion (after the James II-appointed governor hanged by Col.

Sloughter when he took command of the colony). Col. Sloughter voided all laws and decisions made during the rebellion. Therefore, Huntington applied for a re-confirmation of its patent, and finally received one in 1694 from the new Governor, Benjamin Fletcher. Huntington thus has a "Fletcher Patent," which is of the same form and essentially the same content as a Dongan patent (Kavanagh, 1980).

All of the patents described and assigned land to the landholders, and, as described above, the Nicolls patents (which became Andros patents) also assigned certain rights to the landholders. The Dongan patents went further, however. They expanded the rights of the Towns to be equivalent to towns and boroughs in England, so that they could own and hold land in and of themselves, and sue and be sued. In addition, the Dongan patents created trustees for each Town to hold and manage all unappropriated land for the use and benefit of the freeholders of the towns. The scope of the trust was listed as:

> houses, messuages, tenements, buildings, mills, mill dams, fencing, enclosures, gardens, orchards, fields, pastures, woods, underwoods, trees, timbers, feedings and common pasture, meadows, marshes, swamps, plains, rivers, rivulets, waters, lakes, ponds, brooks, streams, beaches, quarries, creeks, harbors, highways and easements, fishing, hawking, hunting and fowling, mines and minerals (gold and silver mines excepted), and all franchises, profits, commodities, and heriditaments whatsoever to the … tract of land and premises…

This was due to the practice of having common lands for the use of all, and established a means for the ordering and management of those lands. The trustees were bound by previous land grants and use, and were to be elected annually. This meant that although the trustees had great power over the towns, the practice of holding town meetings meant that many aspects of governance were outside of their realm (Kavanagh, 1980).

When the State formed its constitution in 1777, it affirmed common law and acts of the colonial legislature, as well as colonial land charters and patents. It also took title to all unappropriated navigable waters and the lands under them (exclusive of lands already granted to New York City, Long Island towns, and certain individuals, by kings of England). Subsequent court cases determined the extent (and limits) of those preexisting arrangements. Generally, trustees were sometimes lax in maintaining public land title to wetland areas that were surrounded by uplands and so were easily utilized by surrounding landowners. They have tended to be more vigilant

with low marsh and foreshore areas, although historical use patterns led to many leaseholders to fill and otherwise destroy wetlands still under trustee ownership (Kavanagh, 1980).

At this time, towns maintaining separate town trustees are:

- East Hampton: nine trustees, two year terms

The Trustees own and/or manage waters, lands underwater and adjacent beaches. In discharging their duties as the owners and/or managers of the above, the Trustees have developed policies and regulations designed to improve water quality, increase the productivity of their holdings and protect public rights. These include regulating docks, controlling boat discharges, involvement in shellfish propagation and quality enhancement programs, and designating areas in their harbors for various activities, such as water ski, mooring, windsurfing, fish trap, and duck blind areas. They review, and must approve, all dredging projects. They review, and must approve, all bulkheads, revetments and other erosion control devices proposed to be constructed (or which may have an impact) on their lands. They have adopted rules governing beach driving and work with the Town Board to coordinate efforts toward more responsible beach use. The Trustees also own many upland parcels, numerous roads in all areas of Town, and many properties between the ocean and so-called oceanfront residences (Town of East Hampton, 2006).

- Southampton: five trustees, two-year terms

Duties of the trustees are to preserve public access to the water, uphold the traditions of a maritime community, advise the Town Board on coastal related issues, inform the public of the facts of coastal issues and policy, represent the best interest of the freeholders, maintain and protect surface water quality, regulate dock and bulkhead construction and impacts, promote sustainable harvest of commercial shellfish and finfish, provide a safe marine environment, and inspect all structures built on bay bottom (Town of Southampton, 2006).

- Southold: five trustees, four year terms

Duties of the trustees are the regulation of any activity along the shoreline of the Town and its inland wetlands, per Chapter 97 of Town Code, and to approve moorings (Town of Southold, 2006).

In the other patent towns, town trustees have become subsumed into the Town Boards. Nonetheless, Town Boards will often need to become the Town Trustees to settle certain issues. Trustee issues have been extensively litigated and are often subject to intense interest on the part of some community activists, even where the practice of trusteeship is largely ignored.

2.7.4 Constraints Imposed by Plans and Other Management Programs

In addition to the formal legal requirements that may affect County vector control programs, there are a number of management programs that may, at a minimum, influence how the Long-Term Plan is implemented. Guidance regarding mosquito control operations generally addresses the two broad areas employed to reduce these pests. These are pesticides and water management.

Overall, all authorities call for reductions in the use of pesticides. Pesticide usage is regarded as something that may increase potential risks to human health and the environment, whether or not the pesticides so used are being applied in an approved fashion. If pesticide use can be reduced with no loss in mosquito control, then potential risks to human health and the environment should be less. Thus, reductions in the number of applications and overall volume of pesticide usage are generally endorsed[1] (Cashin Associates, 2004c).

However, human health emergencies take precedence over the broader guidance to reduce pesticide applications. This is because mosquito-borne diseases represent clear and defined threats to human health and may result in fatal illnesses. The potential damage to human health and the environment from pesticides is generally not perceived to be as immediate as the risk posed by these diseases. Therefore, in situations where pesticide usage is believed to be capable of reducing the chance of human disease, pesticide use is (generally) recommended (Cashin Associates, 2004c).

[1] There are programmatic reasons for minimizing reliance of pesticides for mosquito control. One is that operational difficulties can thwart the planned application of pesticides (due to weather or logistical complications, for example). Secondly, IPM calls for the use of multiple means of control to reduce the development of resistance to particular pesticide formulations. Thirdly, particular pesticides may constitute limited markets, and overreliance on one or two chemicals may lead to the risk of the manufacturer stopping production and threatening the effectiveness of the pest control program.

Some documents, such as NPS guidance for FINS, are very specific about the graduated levels of responses that may eventually lead to pesticide use. Others have more general approaches to these kinds of guidance, usually supporting a hierarchical approach (IPM) where pesticide applications are the action of last resort. A notable exception to the general rule is the NYSDEC preference for larvicide applications instead of habitat modifications as the preferred means of controlling mosquito populations in freshwater wetlands (Cashin Associates, 2004c).

In general, Federal and State guidance call for specific decisions regarding vector control to be made at the local level. The Federal and State guidelines generally give a planning and decision-making framework that should be implemented, and so set the stage for any determinations that may lead to the declaration of an emergency or other incremental changes in the level of response required to address a vector problem. However, the final determinations as to when and exactly how to implement the framework are left to local decision-makers (Cashin Associates, 2004c).

Planning documents that directly discuss mosquito control tend to call for a reliance (or priority) on source control/source reduction measures. Therefore, water management is encouraged in many of these documents. Exceptions are mostly limited to areas where other public policies have established a priority for natural processes over active human management of the environment. Specific examples of these include NPS guidance for FINS, especially the wilderness areas, USFWS guidance for wilderness and unditched areas of national wildlife refuges, and the previously mentioned NYSDEC guidelines for fresh water wetlands (Cashin Associates, 2004c).

Those guidances that call for water management generally specify the use of OMWM. OMWM is a guild of techniques; these methods were developed to address perceived environmental impacts from the implementation and maintenance of wetlands ditching ("traditional water management"). Sometimes OMWM is applied as a restoration program, but, in the context of vector control, OMWM techniques are active means of source reduction that address mosquito development in wetlands (primarily by encouraging native fish to have greater access to mosquito breeding points, and so having the fish consume the larvae), and, at the same time, also

reduce traditional water management impacts to the environment by restoring water levels in the marshes (Cashin Associates, 2004c).

Traditional water management (marsh ditching) finds little favor in most of the reviewed documents. This is because traditional water management is thought to be overmanagement of the sensitive shoreline environment, and to result in the loss of key elements of the natural suite of wetlands habitats. Some of these key elements are marsh surface waters (ponds and pannes, important as for waterfowl habitat) and the distribution of wetland plants (which may affect overall diversity of the wetland) (Cashin Associates, 2004c).

OMWM is often cited as a replacement for traditional water management. All of the major surface water management plans for Long Island (the Long Island Sound Study, the PEP, and the South Shore Estuary Reserve) recommend the use of OMWM in some fashion as part of their overall management approaches. However, some of the reviewed management plans may not acknowledge the potential for OMWM to also require significant alterations to the in-place environment. For example, some plans explicitly support the use of OMWM, but also declare opposition to ditching and ditch maintenance. For mosquito control purposes, OMWM requires construction of fish reservoirs and access waterways to breeding areas, and may require long-term maintenance. Therefore, typical OMWM installations for mosquito control purposes may seemingly result in some conflicts with some goals and objectives of the guidance documents (Cashin Associates, 2004c).

Part of the confusion may arise from restorations of water levels in ditched marshes by building earthen plugs to mosquito control ditches. This technique is widely called OMWM. Vector control professionals believe that all true OMWM activities need to be designed to affect mosquito populations, and the construction of ditch plugs does not explicitly address this need, as it has been implemented in some situations (Cashin Associates, 2004c).

The Long-Term Plan therefore provides an opportunity to resolve aspects of certain management plans which, perhaps, have some apparent conflicts. Guidances that may need some refinement appear to be ditching prohibitions versus OMWM installations, and some preferences for ditch reversion in light of recommendations for pesticide use reductions (since water management is identified as an effective means of limiting pesticide applications) (Cashin Associates, 2004c).

Many of the Long Island habitat-oriented guidance documents do not discuss water-related goals in light of mosquito-borne disease control, even in this age of WNV. This is especially true of guidance oriented for inland areas (although fresh water mosquitoes appear to be important vectors for WNV). In part, this is due to the relatively low rank of fresh surface waters in the hierarchy of Long Island environmental concerns (Cashin Associates, 2004c).

A mosquito control program that relied on grid-ditch maintenance, or that primarily relied on chemical controls, would find itself in conflict with most of the reviewed documents. On the other hand, most of these policy statements support (at least implicitly) IPM-based programs that use OMWM as primary means of water management in salt marshes, and where adulticiding using pesticides is the last-resort option, used only in health emergencies (Cashin Associates, 2004c).

To specifically address issues associated with Coastal Zone Management, the approved and adopted LWRPs for Suffolk County were closely reviewed. The following six municipalities have the only approved and adopted LWRPs in Suffolk County:

- the Town of Smithtown
- the Town of Southold
- the Village of Greenport
- the Village of Head-of-the-Harbor
- the Village of Lloyd Harbor
- the Village of Sag Harbor

(NYSDOS, 2006)

The following notes specifics in each LWRP which could bear on vector control and wetlands management.

<u>Town of Smithtown</u>

There are no direct mentions of vector control. Indirect policies that may affect vector control and wetlands management include:

- Policy 25 states, "protect, restore and enhance natural and man-made resources."

- Policy 25B states, "prevent the irreversible modification of natural geologic forms and the removal of vegetation from dunes, bluffs and wetland areas."

- Policy 35B states, "wetland channels maybe altered only if the action results enhancing the viability of the wetland area."

- Policy 44 intends to preserve and protect tidal and freshwater wetlands and preserve the benefits derived from these areas.

Town of Southold

There are no direct mentions of vector control in the document, with the exception of one reference, when discussing Hashamomuck Pond, as ditching as a potential cause of loss of tidal connection, and therefore something that should be avoided. Indirect references to wetlands management and/or vector control activities include:

- Discussion of a restoration of 80 acres of diked agricultural land by the US Department of Agriculture, where tidal flow had been lost, on the east bank of West Creek;

- Policy 6.1, which states, "protect and restore ecological quality throughout the Town of Southold;"

- Policy 6.2, which states, "protect and restore Significant Coastal Fish and Wildlife Habitats," noting specifically that actions that destroy habitat values through physical alteration or significantly impair the viability of the habitat (causing a reduction in vital resources or change in environmental conditions beyond the tolerance range of important species) should be avoided;

- Policy 6.3, which states, "protect and restore tidal and freshwater wetlands," where restoration is defined as reconstruction of physical values, adjustment of adverse chemical characteristics, or the manipulation of biological characteristics back to some prior, preferred state;

- Policy 8.3.D, which states, "protect public health, public and private property, and fish and wildlife from inappropriate use of pesticides," by which would be achieved by implementation of Integrated Pest Management, avoidance of pesticide deposition into waterways, and general minimization of exposure of people, fish , and wildlife.

Village of Greenport

There are no direct mentions of vector control. Indirect policies that may affect vector control and wetlands management include:

- According to Policy 12, "activities or development in the coastal area will be undertaken so as to minimize damage to natural resources."

- Policy 44 aims to preserve and protect tidal and freshwater wetlands and preserve the benefits derived from these areas.

Village of Head of the Harbor

The LWRP does not specifically make mention of mosquito management or pesticide use within its boundaries. There are some policies which may or may not be compatible with marsh management.

- On page II-31, the extreme frailty of the Village's beaches, dunes, escarpments, and extensive tidal wetlands is discussed, and a need to protect these assets natural state as best as possible is recognized.

- Page II-52 discusses Village concerns regarding the preservation of its fresh water wetlands and tidal marshes.

- Under Policy 44, tidal and fresh water wetlands, as well as the benefits derived from them, must be preserved and protected.

- The report asserts that fish and wildlife habitats are within the wetlands and marshes of the village. Policy 7 states that "significant coastal fish and wildlife habitats…shall be protected, preserved, and…restored." Policy 7D states that reducing or eliminating these

areas for a "regional public purpose" is allowable, with the condition that there is creation of new habitat in a ratio of two to one.

Village of Lloyd Harbor

There are no direct mentions of vector control. Indirect policies that may affect vector control and wetlands management include:

- Policy 7 states, "coastal fish and wildlife habitats…shall be protected, preserved, and where practicable…restored so as to maintain their viability as habitats."
- Policy 12 requires that all activities in the coastal area must be undertaken so as to minimize damage to natural resources.
- Policy 24 addresses preventing impairment of scenic resources. This impairment includes irreversible modification of geologic forms.
- Policy 25 intends to "protect, restore or enhance natural and man-made resources which…contribute to the overall scenic quality of the coastal area."
- Policy 44 states its goal is to "preserve and protect tidal and freshwater wetlands and preserve the benefits derived from these areas."
- Chapter 137 of the Town of Huntington Code is discussed. This code section addresses Marine Conservation. It was established to protect and preserve the watercourses, coastal shorelines, tidal marshes and watersheds. This law also regulates the removal or deposition of soils within wetland areas of the Town.

Village of Sag Harbor

There are no direct mentions of vector control. Indirect policies that may affect vector control and wetlands management include:

- The Village Conservation Districts (CDs) are described. These were created to preserve the tidal and fresh water marshes found within any one or all of the CDs. The CDs

restrict use of the wetlands by permit. The major intent of the CDs is to preserve the water quality of natural areas.

- Policy 6.3 on page III-21 is intended to protect and restore tidal wetlands.

Generally, the only parts of the LWRPs that could conflict with the Long-Term Plan are those relating to wetland preservation. These programs generally intend to maintain and enhance wetlands with as little activity in them as possible. Although water management for vector control purposes is nowhere mentioned explicitly, it may be that the policies would be interpreted that water management could not occur unless it resulted in "improvements" to the wetlands. Alteration of a wetland can occur, even to the point of total destruction (see Head of the Harbor), although mitigation may be required. Pesticides of any kind were not discussed in these LWRPs.

2.8 Mission Statement of the Long-Term Plan

The Suffolk County Vector Control and Wetlands Management Long-Term Plan has two goals:

1) decrease risks to human health and impacts to public welfare from mosquitoes and mosquito management

2) simultaneously reduce impacts to the environment and increase potential ecological benefits associated with the selected management techniques

These goals will be achieved by adopting a progressive mosquito management approach based on the principles of IPM. It should be understood that not all mosquitoes in all situations need control. Where control is deemed to be required, the Long-Term Plan uses a hierarchical approach to mosquito management:

- scientific surveillance to determine the locations and types of mosquito problems

- source reduction, including the use of water management to modify habitat to minimize mosquito breeding if appropriate, is paramount

- when breeding occurs, larval control using products that have no human health effects and little environmental impacts will be undertaken

- if mosquitoes develop into adults, and an assessment of the problem finds that adult control is required, then products will be used that have little to no impact to people, have an acceptably small impact to non-target organisms, degrade quickly, and are effective at killing adult mosquitoes

Suffolk County currently follows this hierarchical approach in its mosquito control program. The County intends, through adoption of the Long-Term Plan, to reduce risks to its residents and improve overall County environmental quality through improvements in each of the major elements of IPM.

It is essential that professional, scientific surveillance of potential mosquito problems be undertaken. Without timely information of the highest quality, it is difficult to reach optimal decisions concerning mosquito control, and to generate public confidence in those decisions. Surveillance activities are intended to:

- describe the species and numbers of mosquitoes present in areas of concern

- accurately define the locus of mosquito activity

- set sampling results in historical, geographical, and seasonal contexts

- document the stage of the mosquito, if immature, or its parity, if adult (a parous mosquito has fed already)

- determine the presence of pathogens in host and sentinel species and mosquito vectors (including amplification and bridge vectors, if relevant)

Data collected in the field will be processed to information quickly, and, if possible, locally. It will then be disseminated to the proper officials in a format that will enable the information to guide control decisions regarding identified mosquito problems.

A mosquito problem is defined as a threat of disease and impacts to public welfare. Mosquitoes are identified as the most important vector of human disease, worldwide. Most of the human misery and death caused by mosquitoes is from the transmission of malaria. Fortunately, Suffolk County and the rest of the US managed to control this disease more than half a century ago. Although minor outbreaks of the disease still occur, the risks of malaria to Americans today are nearly non-existent. Similarly, other dread mosquito-borne diseases such as dengue fever and yellow fever are of only passing concern (Cashin Associates, 2005b).

The mosquito-borne diseases of concern in Suffolk County right now are encephalitic arboviruses. The two of most concern are EEE and WNV. Outbreaks of EEE, which can have fatality rates ranging from 35 to 75 percent, have occurred recently in New Jersey and Massachusetts (Cashin Associates, 2005b), and in Nassau County in 2005 (although, fortunately, there were no human cases associated with this outbreak) (NCDH, 2005). Although there has never been a diagnosed human case of EEE in Suffolk County, horses have died from the disease here as recently as 2003. In 1999, WNV was introduced into the country, with the first human cases and deaths occurring in Douglaston, Queens. WNV is found throughout the continental US, resulting in over 16,000 human cases with 665 deaths through 2004; four of the people who died were residents of Suffolk County. These encephalitides not only have the potential to kill otherwise healthy individuals, but non-fatal impacts can include neuro-invasive effects, which can be permanent (Cashin Associates, 2005b).

It is also clear that there are numerous other mosquito-borne diseases that currently are not found in the US. The immediate lesson of WNV in Suffolk County is that mosquitoes here have the capacity to transmit exotic pathogens and pose a significant disease threat. It is understood that the introduction of invasive mosquito-borne disease is not a question of "if," but rather a question of "when." This is because modern transportation has removed geographical isolation. Along with generating undeniable benefits, this facet of modern life also means that disease organisms are often only one airplane flight away (Cashin Associates, 2005c).

In temperate climates, human disease is the end-product of a long series of epidemiological events that build in intensity over a period of months. The development of human illness due to this progression can be aborted by careful actions taken to control the disease vectors. Almost

all public health plans recognize that waiting for disease to become evident in people means that control efforts begun at that time may be ineffective in preventing further human suffering. This is especially true for mosquito-borne diseases. Mosquitoes tend to be concentrated as immature organisms, and targeted control efforts using natural predators or narrow-spectrum agents are very effective; as adults, they tend to widely disperse, complicating efforts to alleviate the threat of harm, and often requiring the use of chemicals that may have wider non-target impacts (Spielman and D'Antonio, 2001).

Therefore, disease control efforts cannot begin when pathogens are circulating in adult mosquitoes. An integrated control program is required for efficient and proper control of endemic diseases such as WNV. Comprehensive surveillance can document areas that pose the greatest risk of disease amplification and transmission. Source reduction should be employed to reduce breeding opportunities for the amplification vectors (if possible) and for those bridge vectors that may eventually pose a risk to human populations. Similarly, larval control needs to be conducted prior to detection of the virus in adult mosquito populations, as larval population reduction efforts will not decrease the imminent risk posed by pathogen presence in amplification or bridge vectors. An integrated program such as this acknowledges that any need for adulticide applications signals failures in other, better means of disease suppression. Thus, because WNV will likely occur in multiple sites in the County every year (with its ultimate geographic distribution apparently the result of complicated interplay and feedback between weather and mosquito, avian, and viral population dynamics), mosquito control conducted for the purpose of preventing cases of human disease needs to be conducted generally across the County and throughout the season.

Nonetheless, Federal and State guidelines have established separate protocols for addressing increasing risks from WNV and other mosquito-borne diseases. These include guidance on how to increase vigilance prior to the introduction of the disease to the general area, and also discuss ways to consider managing increasing risk in a season when the pathogen is detected locally (CDC, 2003; NYSDOH, 2001). As part of the process, when imminent risk reaches a certain level, the County Commissioner of the Department of Health Services is authorized to petition for a State Department of Health declaration of a "health emergency." This declaration changes certain lines of local authority (making mosquito control explicitly the responsibility of the

Department of Health Services, for example) and allows certain State permitting procedures to be expedited more rapidly. But the declaration does not signal the initiation of local interest in mosquito-borne disease, nor the beginning of control efforts focused on pathogen transmission. These activities must be an essential part of County vector control activities throughout the year.

Mosquitoes impact public welfare not only by disease transmission, but also through subclinical effects of mosquito biting. Mosquitoes are known to be infected by other viruses, bacteria, and pathogens and parasites, such as worms of various kinds, some of which are implicated in human illness. The salivary fluids released when a mosquito bites typically cause welts, and can cause rashes and various allergic reactions. Thus, even in the absence of defined diseases circulating in mosquito populations, human-biting mosquitoes can adversely impact public health (Eldridge and Edman, 2000).

Surveillance programs, especially post-WNV introduction, are designed to detect early signs of pathogens, and to determine if health risks presented by disease require actions to reduce the chance of human illnesses. However, human-biting mosquitoes come into contact with blood when they bite. In areas where there is disease transmission risk, the distinction between mosquito control for public health protection and mosquito control for the relief of human discomfort (sometimes called nuisance control) becomes unclear. Nearly all human-biting mosquitoes in Suffolk County have some vector capability for the arboviruses that are the modern day health threats in the northeast US (see Turrell et al., 2005). Thus, control of these human-biting mosquitoes is undertaken to have some impact on the overall risk of disease. Actions taken to reduce the populations of human-biting mosquitoes in Suffolk County reduce the risk of disease transmission, and result in public health benefits beyond minimization of subclinical effects. In addition, there is an ancillary, but important, improvement in the quality of life for those who live, work, or recreate where these mosquitoes live. For parts of Suffolk County, especially in areas in close proximity to the south shore, high numbers of mosquitoes that are very persistent and fierce in their search for blood meals (these are largely spawned from local salt marshes) can make it impossible to spend any amount of time outside, in the absence of mosquito control programs.

Public health protection emphasizes monitoring for pathogens among amplification vector populations, and controlling important bridge vector populations through source reduction (especially water management for salt marsh species), larval control where source reduction is not possible or was not effective, and, if a health risk assessment deems it necessary, adult control. There is significant overlap between this approach and the alleviation of severe public welfare effects. Historically, Suffolk County significantly reduced mosquito populations, particularly along the south shore, through its ditch maintenance program augmented by regular use of larvicides (Campbell et al., 2005). The Long-Term Plan proposes to pursue more progressive marsh restoration management practices, which should reduce the need for larvicide applications immensely.

State and County Public Health Law (PHL) identify mosquito control and the reduction of mosquito habitat (such as standing water) as abatement of public health nuisance. A public health nuisance is, by definition, a condition that adversely affects public health (irrespective of whether it causes fatal disease or some sublethal impacts). In this case it is the recognition of health effects from an ectoparasite (mosquitoes are grouped as such with pests such as lice, fleas, and bedbugs). Under State law, health officers have a duty to address the effects caused by these to the public. The presence of pathogens in mosquitoes is not required for this definition of public health nuisance, as the law implicitly recognizes there are health concerns that extend beyond the transmission of diseases such as WNV and EEE.

The Long-Term Plan uses the term "vector control" to describe adulticide applications in the absence of a detected pathogen. In general, "vector control" is interchangeable with "public health nuisance control," as these instances of adult control take place under conditions where there is a low imminent public health threat of the outbreak of serious disease (such as WNV or EEE), where the risk to the public cannot be said to be zero, and where sublethal impacts also occur.

The mosquitoes of Suffolk County develop in both fresh and salt water environments. In order for pathogens of present-day concern to become prevalent enough to pose a major health threat, they need to be amplified through avian reservoirs by fresh water mosquito species (Turrell et al., 2005). The County, therefore, as it is allowed under regulations that protect important fresh

water natural resources, conducts surveillance and control programs to reduce overall health risks. For EEE, it is clear that other mosquito species are needed to spread disease to people, and some of the most able of these species breed in salt water settings (Cashin Associates, 2005g). For WNV, the cycling of the pathogen is less well understood, but quite a few fresh and salt water mosquitoes have been determined to be (or are suspected of being) human vectors. Therefore, the integrated control program that focuses on reducing these human-biting mosquito populations, in both fresh and salt water environments, clearly reduces overall risks of disease transmission.

Modern vector control efforts also have a focus on reducing impacts associated with controlling mosquitoes. The County will seek to implement progressive means of water management that will enable it to significantly reduce the places, application events, and overall amounts of and areas affected by larvicides that it currently applies. This greater degree of control is anticipated to reduce the places, application events, and overall amounts of and areas affected by adulticides used in the County (Wolfe, 1996). Adulticide usage will also be reduced through improvements in surveillance, and by optimizing applications (when required) through use of computerized flight and pesticide release controls. However, decisions to use adulticides are not necessarily determined by the number of mosquitoes; adulticides are often used to reduce any explicit health threat the mosquitoes may represent.

The pesticides considered for use by the County today have been shown to have little to no health effect on people, even when exposures are projected for entire lifetimes. They are formulated to have no acute effects on people, chronic effects have been generally found to be of little concern, and calculations of potential risks show they are unlikely to be the cause of any local cancer cases. This is because these chemicals are designed to affect insects, especially mosquitoes, and not people. Most are applied at low concentrations due to the relative fragility of the mosquito (compared to many hardier agricultural pests that require much higher dosages). These pesticides are made so that they degrade quickly in the environment, so that the amount of pesticide any person is exposed to, and the time period that an application can affect people, are both extremely small. These same traits limit impacts to non-target organisms present in the environment. Modeling shows that there is a small risk from some adulticides to specific organisms, although these impacts to particular species do not propagate to cause an overall

impact to the ecosystem (Cashin Associates, 2005d). Measurements of actual pesticide concentrations following applications in Suffolk County show that these models may use unduly conservative assumptions (Cashin Associates, 2005e), and therefore it is quite probable there may actually be no impact to the environment associated with the use of most modern mosquito control pesticides.

Progressive vector control practices can restore degraded or threatened wetlands, and so produce environmental improvements (Wolfe, 1996). Careful, scientific selection of appropriate, progressive water management techniques will result in healthier marshes County-wide, resulting in greater ecological diversity and productivity for our precious salt marshes and associated estuarine systems, in addition to reducing populations of mosquitoes. Suffolk County is embedded in the marine environment, and the waters that surround us are cherished and important to all. Improvements to water management procedures for mosquito control will lead to measurable enhancements of these natural resources. With cooperation from other local marsh managers and regulators, and by developing an overarching management strategy for wetlands in the County, Suffolk County anticipates conducting extensive restoration across its marshes over the next ten years. Much of the management will consist of simply letting the marshes be, if scientific analyses suggest that is the most appropriate action to take. However, approximately one-third of the County's marshes are candidates for more active management because they receive repeated applications of larvicide over the course of a season. The effect of conducting appropriate progressive water management at such sites will not only be less pesticide use in these marshes, but also improved ecological functioning of the restored areas (see the BMP Manual, Appendix C).

2.9 Objectives of the Long-Term Plan

Explicating a set of well-defined objectives for the Long-Term Plan provides the means for the interested public to understand how the ambitious Goals of the Plan will be achieved. The following are the objectives for the two goals.

Goal 1: Decrease risks to human health and impacts to public welfare from mosquitoes and mosquito management

Objective 1. The prevention of serious disease in residents of and visitors to the County, as practical, is of utmost importance.

Objective 2. Generally, problem populations of mosquitoes will be reduced where possible (when exceeding threshold/criteria described in Section 2.10.6, below) because large numbers of human-biting mosquitoes, in association with people and areas where mosquito-borne diseases have been detected, represent increases in overall health risks for those people. Enhancement of public welfare is an important auxiliary benefit. This objective relates to "Vector Control;" in the chance of a detected pathogen, this can also be considered "Public Health Nuisance Control."

Objective 3. To achieve these objectives, the County's program will follow the principles of IPM, seeking to address mosquito problems by means of appropriate controls applied at times of greatest effectiveness and least impact to human health and the environment.

Objective 4. A program of scientific surveillance will be employed, with the intent of accurately and specifically defining potential mosquito problems.

Objective 5. Source reduction will be the primary focus of mosquito control. A key element will be public education, outreach, and assistance for habitat reduction around homes and businesses. The second key element is the adoption of a program of Best Management Practices and, in appropriate areas, progressive and extensive water management projects, to be implemented in coordination with (and with approval from) local and State agencies, and with the participation of other stakeholders.

Objective 6. The use of biorational larvicides, specifically targeted towards the insects of concern, will allow for reduction of any identified mosquito problem prior to dispersal as adults, when control is more difficult.

Objective 7. The use of adulticides, when all other methods of control have been unsuccessful or when other control methods cannot be implemented, if Vector Control (Public Health Nuisance) thresholds are exceeded, or if emergency response conditions exist.

Objective 8. The mosquito control program will be guided by an appreciation for the overall management of risk to people, minimizing potential impacts to human health from disease and from control methods.

Other ancillary benefits of the Long-Term Plan are to facilitate enjoyment of the County's natural environments, and to support local businesses and enterprises that depend on tourism and recreation, as is possible while also attaining the specified objectives of the Plan.

Goal 2: Simultaneously reduce impacts to the environment and increase potential ecological benefits associated with the selected management techniques.

Objective 1. The County will adopt an overall plan for marsh management that will emphasize the need to preserve or increase acreage of wetlands, including vegetated wetlands, and to foster biodiversity and a mosaic of ecological communities. Vector control efforts will be accommodated within this framework, but will not necessarily be the primary determinant in marsh management decision-making. In salt marshes, most areas will either be subject to reversion or low impact Best Management Practices. In certain areas, the judicious employment of progressive water management will be continued, with the intent to increase overall habitat diversity, generated by an ecological setting composed of tidal creeks, ponds, low and high marsh, pannes, mudflats, salt shrub, associated freshwater wetlands, and adjacent beaches or sand berms (although every marsh may not have all habitats). This will provide a variety of microhabitats and ecotones, which should support appropriate plant and animal diversity, as measured by monitoring and project evaluations. Projects conducted under the Long-Term Plan will also seek to reduce invasive species, especially *Phragmites*, in the managed wetlands.

Objective 2. The aim of the water management program is to reduce the routine use of larvicides, ultimately resulting in significant reductions in the overall acreage where larvicides are applied each year. However, each marsh will be examined on a case-by-case basis, and major decisions of marsh management projects must be reviewed and approved by a Screening Committee. Biodiversity, vector control, and *Phragmites* control are all important marsh management goals. Each needs to be considered for all projects. For example, marsh restoration projects may be implemented for biodiversity purposes, with design elements that achieve net mosquito-neutral effects. Other projects will be considered because they will reduce mosquito

populations (and potentially also create environmental benefits). The initial list of priority salt marshes for consideration for progressive water management, however, is comprised of those sites where aerial applications of larvicides are currently used to treat mosquito breeding.

Objective 3. To ensure that water management projects achieve natural resource goals, the County intends to continue to rely on advisory groups such as the Technical Advisory Committee and the Wetlands Subcommittee to provide input and direction for the program, and to support the activities of the Wetlands Management Plan Screening Committee.

Objective 4. Where mosquito breeding occurs despite water management efforts, or where no such actions can be taken, biorational larvicides will be used to ensure that no (or, at worst, minimal) non-target impacts to the surrounding ecosystems.

Objective 5. If adult mosquito population control proves to be necessary, the County will use adulticide products that have no significant, long-term impacts to the environment.

Objective 6. The mosquito control program in general will be guided by an appreciation for the overall management of risk, minimizing potential impacts to the environment and natural systems and improving them where possible, while protecting human health and public welfare.

2.10 The Long-Term Plan: An Integrated Pest Management Approach

Mosquito control in the United States has evolved from reliance on insecticide application for control of adult mosquitoes to IPM programs. IPM programs focusing on mosquito control are sometimes referred to as Integrated Mosquito Management. IPM addresses mosquito problems through a hierarchical application of the following elements:

- Public education and outreach
- Scientific surveillance
- Source reduction/control (water management is a special subset of source reduction)
- Biocontrols (as a special subset of larval and adult control)
- Larval control

- Adult control (but only if necessary)

Adherence to the hierarchy addresses mosquito problems so that initial responses are limited in scope, but are selected to have the greatest impact at the most effective time, with the fewest environmental impacts. Actions further along in the hierarchy generally require more effort and organization to address, and may have more impacts, because the problem is being addressed in a more general fashion. Because adult mosquitoes are the most dispersed form of mosquitoes, and generally present more pathogenic potential, their control is more difficult and invites more complex solutions that can lead to greater potential impacts and more public concern and controversy. In terms of impacts ranging from costs, environmental effects, control of human disease, and public concern, it almost always preferred to address a potential mosquito problem through the hierarchy.

The following subsections address the proposed Long-Term Plan in line with the hierarchical, IPM approach sketched above. These sections are summaries of the Long-Term Plan (and associated Wetlands Management Plan). The Long-Term Plan has been attached as Appendix A, and the Wetlands Management Plan has been attached as Appendix B.

2.10.1 Public Education

Public education is a key element of the Long-Term Plan. Public education can:

- help people avoid mosquitoes and mosquito-borne disease;
- raise public awareness of the value of good housekeeping;
- ensure the public cooperation essential for Vector Control's operation;
- provide justification for the actions taken by the County on behalf of its citizenry to control mosquitoes and mosquito-borne disease; and
- avoid public demand for more pesticide applications than are truly necessary, out of excessive concern over mosquito-borne disease.

SCDHS is primarily responsible for public education on mosquitoes and mosquito-borne disease. The County will promote information on personal protection and avoidance by distributing brochures and giving presentations on its "Dump the Water" and "Fight the Bite" programs. Additionally, the Long-Term Plan Citizens Advisory Committee created a new pamphlet titled, "Mosquito Control and Prevention at Home" that it will distribute to libraries and at health fairs.

In addition to the SCDHS efforts, SCVC offers public assistance to help homeowners who have mosquito problems, by visiting the property and removing breeding areas. If the homeowner is not available during the site inspection, SCVC ground crews hang tags on the front door knob. The door hanger describes the reason for the inspection and lists any work done. It also provides basic information about mosquito control. The tag gives contact telephone numbers, and directs the homeowner to the SCVC website for more information.

Each year during the off-season, prior to the development of the coming year's brochure, field personnel from SCVC should interact with the health educators from SCDHS. This will allow transfer of information from the field to the educators regarding the kinds of persistent problems that are not being reduced through current education programs. In addition, field crews will be made aware of the current focus and ranges of materials used by the educators, which should enhance the field crews' education efforts, as well.

Another way in which SCDHS could improve public outreach is to participate in "Mosquito Awareness Week", which is an American Mosquito Control Association (AMCA) sponsored program that takes place at the start of the summer season. This program provides mosquito control professionals with a time frame that can be devoted to focusing the public's attention on the services SCVC provides.

The County should undertake an education program to persuade citizens not to inappropriately discard tires, but to manage them properly. Tires should not be stored out of doors. The County should conduct internal outreach so that Departments such as Parks and Public Works, in the course of other maintenance activities, understand the importance of removing littered tires when encountered. Although the Towns are the level of government responsible for zoning and waste management in the County, the County should determine if it can provide useful resources to allow Towns to address tire stockpile issues.

Irrigation can cause ponding on fields which generates mosquito breeding habitat. SCVC already maintains certain water management structures in agricultural areas to drain standing water. Targeted education through Cornell Cooperative Extension can reach this audience efficiently, and reinforce the already delivered message regarding best practices for irrigation conditions.

Another missing element is targeted outreach to commercial property owners and private homeowner associations to ensure that private storm water systems are properly maintained. In this instance, a well-worded insert in tax bills (or separate mailing utilizing County property data bases), identifying benefits to the County that include decreased flood impacts, improved public health, and avoidance of a label as a public health nuisance, may encourage neglected maintenance to be undertaken.

Similarly, SCVC, through SCDPW, needs to raise awareness in the County and in other municipal highway offices that poor maintenance of catch basins and other storm water systems not only exacerbates flooding problems and is not in compliance with USEPA Phase II regulations, but threatens public health. These underground facilities are prime *Cx. pipiens* habitat.

Areas that have historically experienced vector control adulticide treatments (roughly speaking, Babylon, Islip, and Brookhaven south of Sunrise Highway) should receive augmented, targeted education efforts. These efforts will focus on personal protections steps to minimize negative impacts from mosquitoes, such as wearing long-sleeved shirts and long pants, using repellents, and avoiding outdoor activities during peak mosquito times. In addition, the Commissioner of SCDHS will identify pertinent actions that residents should consider to reduce exposure to and impacts from any adulticide applications. Currently, the public notice for adulticide applications includes the following language:

> Steps you should take: Children and pregnant women should take care to avoid exposure when practical. If possible, remain inside or avoid the area whenever spraying takes place and for about 30 minutes after spraying. Close windows and doors and turn off air-conditioning units or close their vents to circulate indoor air before spraying begins. Windows and air-conditioning vents can be reopened about 30 minutes after spraying. If you come in contact with pesticide spray, protect your eyes. If you get pesticide spray in your eyes, immediately rinse them

> with water. Wash exposed skin. Wash clothes that come in direct contact with spray separately from other laundry. Consult your health care provider if you think you are experiencing health effects from spraying.
>
> Steps you may wish to take: Cover outdoor tables and play equipment before spraying or wash them off with detergent and water if exposed to pesticides during spraying. Bring laundry and small toys inside before spraying begins (wash with detergent and water if exposed to pesticides during spraying). Bring pet food and water dishes inside, and cover ornamental fishponds to avoid direct exposure.

Presentations at schools, to civic organizations, and other interested groups, and news releases to local newspapers will all be used to specially inform these citizens who are more likely to be exposed to mosquito bites and adulticide applications than other people living in Suffolk County. Targeted education and outreach efforts will similarly be undertaken if the FINS-specific mosquito control plan includes adulticide applications for vector control purposes.

The County websites for SCVC and SCDHS provide current information about upcoming spray events and general work of SCVC, and information about what the public can do to for protection from mosquitoes, and to help combat mosquitoes around their homes. The website also describes the various methods and products used by SCVC for mosquito control. Information regarding the dates and events taking place during "Mosquito Awareness Week" will also be made available on the SCDHS website with links to each of the brochures the used in the public education program.

Another recommendation for public outreach is to post efficacy reports on the SCVC website at the beginning, middle and end of the season. These reports will summarize the results of mosquito control efforts that were measured before, during and after aerial spray events. Reporting efficacy to the public will emphasize how SCVC operations are improving the quality of life in their community and throughout Suffolk County. Public support for vector control operations will aid the County in justifying the need for the formation of the new Mosquito Surveillance and Control unit, which will perform quality assurance and quality control functions.

No-Spray Registry

SCVC maintains a "no-spray" registry of residences where adult mosquito control is not desired. Citizens can sign up for this registry via the SCDPW website, or by calling the SCVC directly. When control is required to deal with a public health emergency, the Commissioner of Health Services can override the list. Even then, efforts are made to telephone list members prior to applications in their area.

In addition to this legally required registry, the SCVC maintains special listings of beekeepers and organic farms. Beekeepers are generally avoided or notified before treatments so that they can protect their hives. Because the commonly used SCVC adulticides are not registered for croplands, organic farms and all other croplands are excluded from spray areas to ensure label compliance. Organic farms are specially called out because many are small and in otherwise residential areas.

Notification

The SCDHS web site is used to post maps and will be used to post spray schedules. In addition, a list serve feature will be installed on the SCDHS website to allow citizens the choice to automatically be informed of spray events. For each adulticide application, over 150 faxes are sent to various officials and other interested parties. Newsday and News12 post spray schedules and maps and "No Spray" members are telephoned. Notifications are also broadcast over several local radio stations, posted on a call-in hotline, and on orange signs at the entrance of parks where applications are scheduled. The Suffolk County Board of Cooperative Educational Services (BOCES) is also notified, and it, in turn, notifies schools.

It is not appropriate to provide more than 24 hours notice in most cases, because beyond that time, weather forecasts do not have the necessary reliability to schedule the application events. Attempts to provide more than 24-hour notice can result in many spray operations being announced but then cancelled, which can be very confusing to the public.

In addition to these formal outreach operations, the Long-Term Plan envisions continuing its Citizens Advisory Committee as a means of having on-going dialog with involved members of

the public. This Committee has served an important role in the course of developing the Plan, and has routed useful and important information and viewpoints to planners and researchers.

SCVC has also had the opportunity to renew contacts with members of various state, federal, and local agencies and governments, and certain interested non-governmental organizations, through the Long-Term Plan. The Wetlands Subcommittee has been a key venue for these efforts. The Long-Term Plan requires that similar kinds of communications continue in order to achieve important aspects of the proposed Plan.

Website

The County mosquito website needs to be updated, and a means of regularly posting new and relevant information there must be established. The results of efficacy testing, for example, and the various annual and other reports that will be produced on a regular basis as a result of the Plan should be made available to the public, in addition to the material that is already posted there (information on WNV, the Long-Term Plan process, pesticide application notifications, and the "No Spray" registry, as well as annual reports from SCDHS).

Trigger for Public Education

Public education and outreach will be undertaken every year. Public outreach efforts will be increased as risks associated with disease transmission increase. Areas that typically receive vector control applications will be subjected to targeted, intense efforts to reduce the potential for impacts from either mosquito-borne disease or pesticide applications. The County will make a conscious effort to justify the mosquito control program better through greater analyses of its efforts and publication of these analyses in annual reports.

2.10.2 Surveillance

The mosquito surveillance program will have two separate functions:

- Sampling mosquito populations
- Sampling for mosquito-borne disease

Mosquito population surveillance also differentiates between sampling larval populations and adult populations. There are a few ways that these distinctions are not absolute, but they generally serve to define the surveillance program. Population surveillance is the responsibility of SCVC; disease surveillance responsibility belongs to the ABDL.

Larval Surveillance

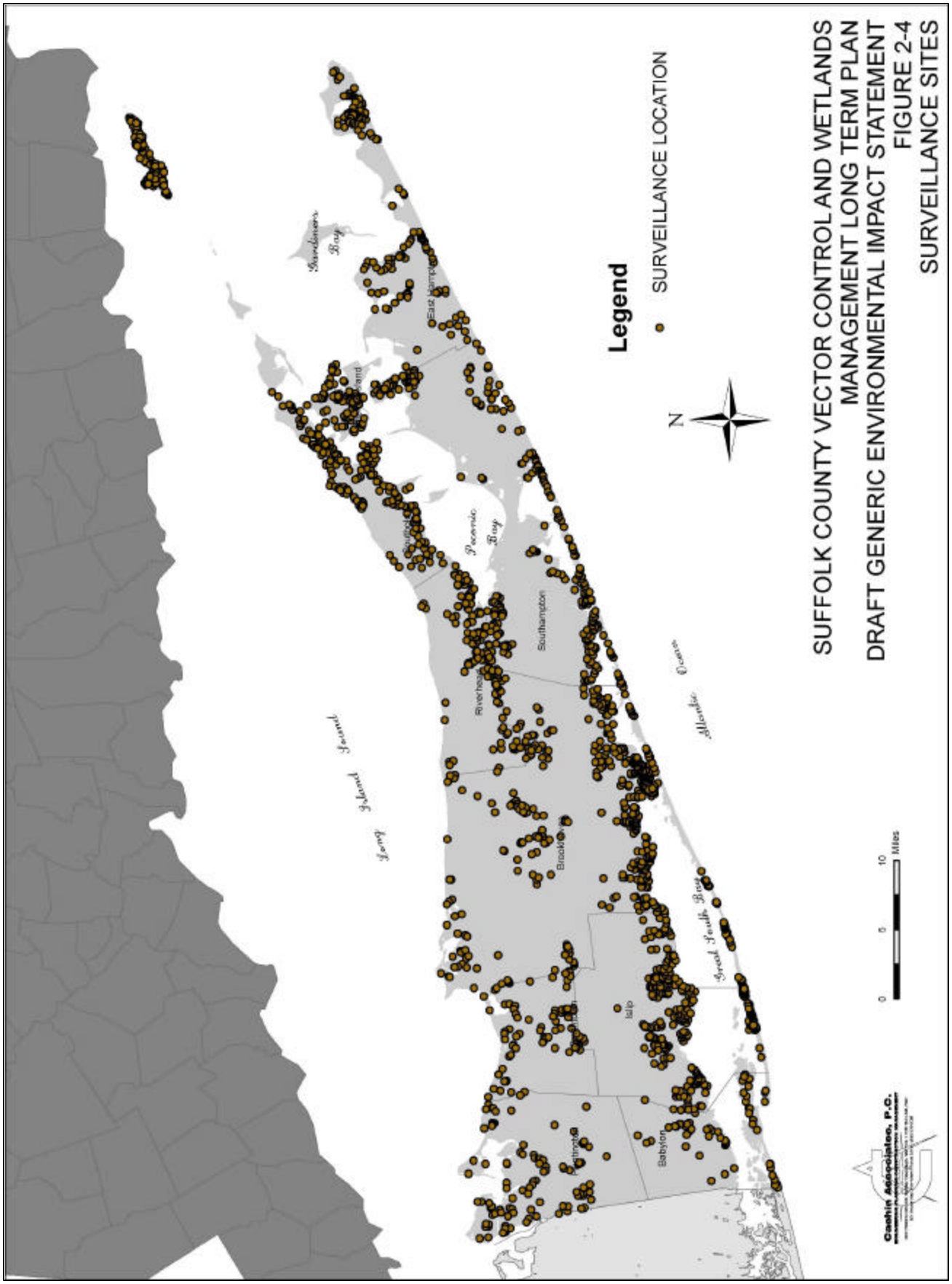
Teams of inspectors, consisting of three foremen with 11 field crews that each consist of two equipment operators or laborers, will continue to be assigned to geographic areas of the County to guarantee complete coverage of potential breeding habitats on a regular basis. The number of field crews assigned to each geographic area is dependent upon the number of wetlands located within each area (Table 2-15).

Table 2-15. Geographic Designations for Larval Surveillance and the Number of Field Crews per Area.

Geographic Area	# of field crews
south shore west	3
south shore east	4
north shore west	2
north shore east	2

Inspectors obtain samples from larval breeding areas, such as wetlands, primarily by dipping. Inspectors will quantify larval surveillance results in the field by counting the number of larvae per dip. They will also determine which of four larval stages are present. At times, other sampling methods will need to be employed to determine if specific species are present, or for specific media (such as with tires, or when sampling for *Cs. melanura* or *Coquilletidia perturbans*). Catch basin sampling will be accomplished using aquarium nets are attached to telescoping poles, and then rinsing the nets to wash the larvae into a bucket.

SCVC has identified over 2,000 breeding points throughout the County (see Figure 2-4). These are areas where problem mosquito populations have re-occurred. Each breeding location has been assigned a unique identifier, composed of letters (for the Town) and numbers, and has been mapped using GPS. To encourage consistent sampling, it tends to be monitored by the same inspector team.


SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS
MANAGEMENT LONG TERM PLAN
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
FIGURE 2-4
SURVEILLANCE SITES
Legend
SURVEILLANCE LOCATION
N
Miles
Southampton
Riverhead
Brookhaven
Babylon
Islip
Peconic Bay
Great South Bay
Long Island Sound
Atlantic Ocean
Cashin Associates, P.C.

Breeding locations are monitored on different schedules according to the type of mosquito problem that is usually associated with the particular site. Salt marshes that are candidates for aerial larviciding are monitored every Monday. Each field crew also is assigned a route of smaller salt marshes and fresh water sites that also tend to breed fairly regularly, which are monitored on a 10 day to two week cycle. Finally, there are certain locations that only support breeding under particular environmental conditions, and so are only monitored when the requisite trigger (very high tide or excessive rainfall, usually) has occurred. Higher tides and/or heavy rains often lead to widespread breeding, which can result in a need to monitor nearly all breeding sites throughout particular environmental settings, leading to personnel stresses.

Salt marshes will be sampled consistently, at sites chosen in the high marsh where mosquitoes breed. It is important to record presence/absence of larvae, the extent of the initiating tidal inundation, the dominant stage of the larvae, and the remaining water on the marsh. Brackish and fresh tidal marshes also need to be sampled similarly.

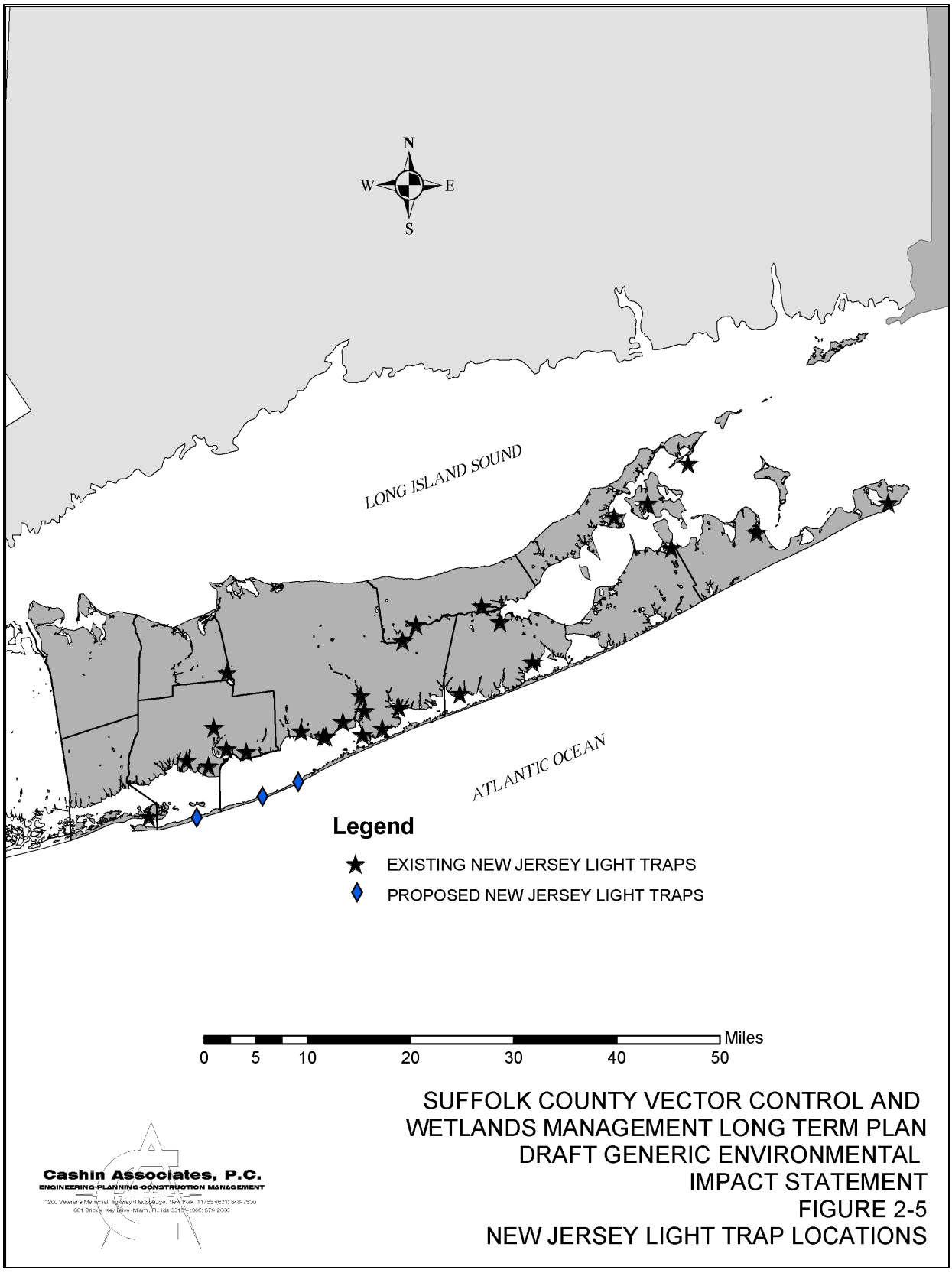
The County intends to increase the scope of its catch basin monitoring (from the current 10,000 to 40,000 to 50,000). Additional basins will be selected based on a history of viral activity in the surrounding area, the age of the system, if maintenance may have been deferred, and if the basins are located at the terminal end of drainage systems. The catch basins will be sampled beginning in late May or early June, and revisited and re-sampled, as resources allow, during the middle (July) and end of the season (September), for presence/ absence of larvae. It is also recommended that SCVC increase the number of recharge basins that are sampled.

The field crews will examine and determine the larval stages present in samples in the field. Collected larvae will be stored in glass sample jars. The samples will then be transported to the laboratory for species identification by an entomologist.

Adult Mosquito Population Surveillance

Populations of adult mosquitoes are monitored using New Jersey light traps and CDC light traps. New Jersey traps are generally named for surrounding hamlets (e.g., "the Oakdale New Jersey trap"), and are often maintained in the same location for years or even decades. The County

currently has 27 New Jersey light traps (see Figure 2-5), and the Long-Term Plan calls for augmenting this network with three additional trap locations on Fire Island.



CDC light traps are set in the evening and collected in the morning. CDC light trap samples analyzed for population purposes do not need to be preserved following collection. CDC traps are used for population monitoring when special problems have been identified, such as where the volume of complaints increases, or where there are other indications that a mosquito biting problem will not be detected by the fixed New Jersey trap network. The County also uses CDC traps extensively for pathogen detection (see below).

It is proposed that the County consider establishing identification stations – a single room within an existing municipal building, equipped to allow field technicians to identify mosquitoes to the species level. These are also called Field Identification Stations/Field Stations in other jurisdictions. Two candidate sites are Fishers Island and Riverhead.

Fire Island represents a special case where travel and other factors affect surveillance. To meet NEPA requirements, FINS has requested that the County prepare a FINS-specific plan. That plan will generally accord with the surveillance program outlined here and in the Long-Term Plan. The Fire Island population monitoring network currently is anticipated to be expanded by SCVC adding New Jersey light traps in Saltaire, Davis Park and Fire Island Pines.

CDC light traps are also good tools for testing the efficacy of adulticide applications, and the Long-Term Plan proposes to do just that. CDC traps should be optimally set within a proposed treatment area the night prior to the application. Traps should also be set post-application to determine the degree of population reduction caused by the treatment. Control locations should be identified so as to provide means of appropriately interpreting the trap data.

In certain locations (Bellport Village Brookhaven hamlet, East Patchogue, Mastic-Shirley, Oak Beach, and Oakdale), mosquito infestations prompting many biting complaints from residents are common. Formal landing rate sites should be created in these areas.

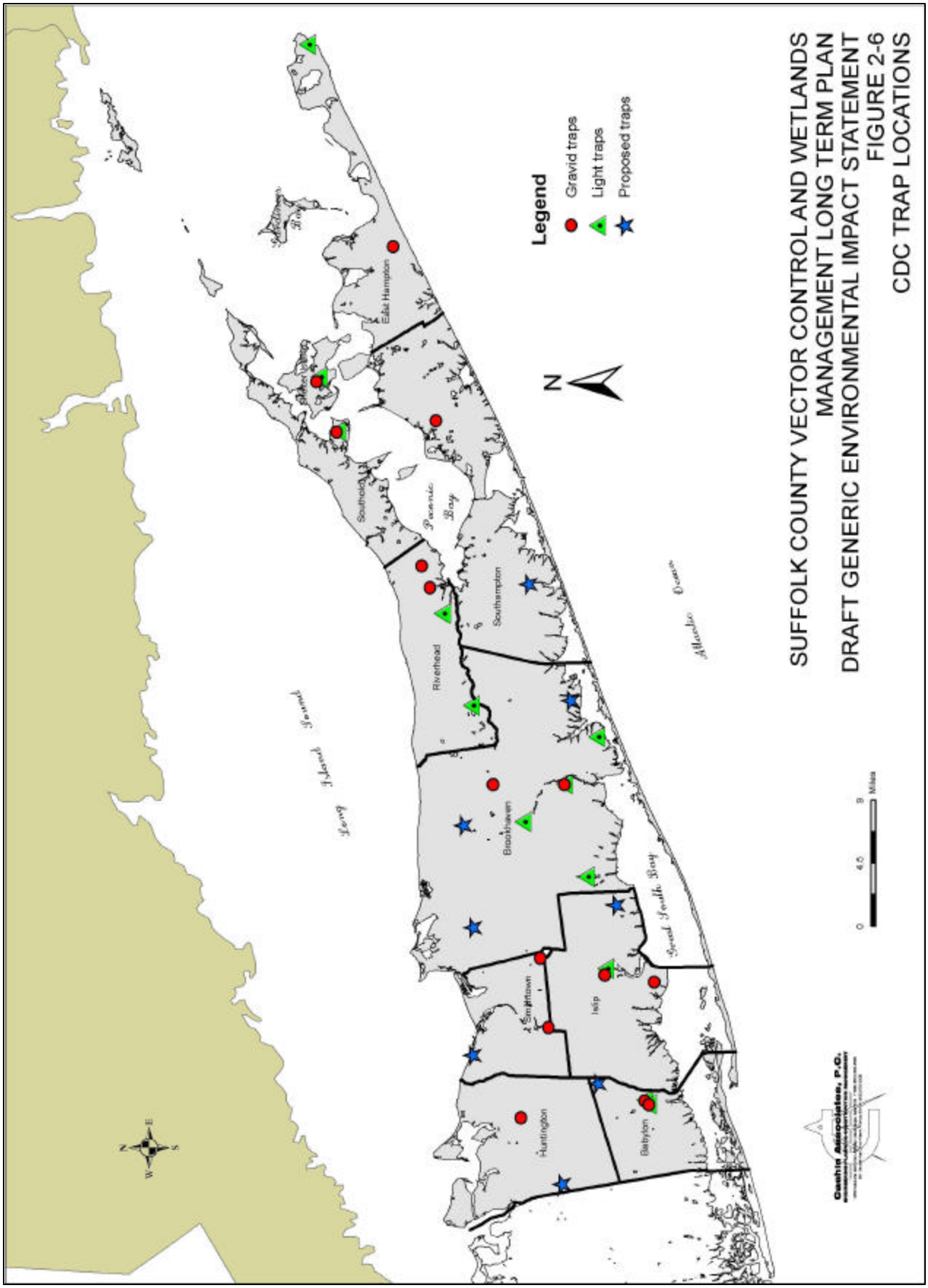
As part of the overall program for assessing adult mosquito populations, SCVC will seek to establish trap stations for background (ambient) levels of mosquitoes. This is a difficult task because there are few good candidate sites for such monitoring. Potential sites could include a FINS site and an upland portion of the William Floyd Estate. Background monitoring sites will only be established as resources allow, probably post-construction of new laboratory space.

Public complaints are a cornerstone of the County surveillance program as SCVC responds to complaints regarding biting adult mosquitoes, larval breeding, clogged culverts, flooded marshes/swamps, and other sources of stagnant water, received through the County's telephone complaint line. An inspector will visit the site within one to three days after receiving the complaint and submit a recommendation for action. Inspectors educate homeowners, determine the source of the problem, potentially adding the site to the mosquito breeding list. Complaint calls are logged by type. This permits maps to be prepared showing the timing and areas of complaints.

Disease Monitoring

Viral surveillance will continue to be conducted according to the latest CDC and NYSDOH guidelines and will likely continue to be primarily directed at EEE and WNV, with modifications to suit Suffolk County's unique environment. The large size of the County, coupled with resource limitations, has set some restrictions on where and how often traps can be placed or serviced. Travel times are often excessive. If SCVC or ABDL personnel living on the East End could begin a day's work by collecting traps near home (and servicing them at night on the way home), more traps could be set and serviced.

A major means of monitoring for virus activity is through CDC traps. Mosquitoes are identified and sorted by species in the laboratory. The pools are then separated with the number of mosquitoes in each pool being noted. Current DNA analyses can identify WNV. Other viruses must be cultured and analyzed by NYSDOH in Albany. CDC gravid traps are also used, and mostly collect *Culex* mosquitoes that have had a blood meal and are seeking a location to oviposit. As with CDC light traps, gravid traps are adaptively placed in areas with a history of viral activity or the sampled presence of viral indicators, such as viral positive birds. The trapped mosquitoes are collected, sorted, kept cool and tested as are samples from CDC light traps. Gravid traps are currently only used for WNV surveillance. The ABDL begins each season using s suite of 27 fixed CDC traps. Others are added throughout the season as pathogen presence or signals indicate. For the initial implementation of the Long-Term Plan, the ABDL proposes to increase the initial set out to 35 trap locations (see Figure 2-6).


SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS
MANAGEMENT LONG TERM PLAN
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
FIGURE 2-6
CDC TRAP LOCATIONS
Legend
Gravid traps
Light traps
Proposed traps
N
East Hampton
Southampton
Riverhead
Brookhaven
Islip
Huntington
Babylon
Smithtown
Long Island Sound
Peconic Bay
Great South Bay
Atlantic Ocean
0
4.5
9
Miles

The fresh water wetlands that are currently monitored by the County due to a history of viral activity are listed in Table 2-16 and Table 2-17. These wetland areas are monitored using CDC light and CDC gravid traps in fixed locations.

Table 2-16. Fresh water wetlands with a history of EEE.

Wetland Location	**Recent detections**
Riverhead	1990,1994,1996
Robert Cushman County Park, Manorville	1994,1996
Bayview, Southhold	1996
Camp Hero State Park, Montauk	1996, 2003
Shelter Island	1996
South Haven County Park	1996
Connetquot State Park	1997

Table 2-17. Fresh water wetlands with a history of WNV.

Wetland Location	**Year First Detected**
Belmont State Park	2000
Blydenburgh County Park	2000
Saltaire (Fire Island)	2000
Heckscher Park	2000
Canaan Lake	2000
Nesconset	2001
Watch Hill, Fire Island	2001
Smith Shores, Fire Island	2002
Meeting House Creek, Aquebogue	2002
William Floyd Estate	2003
Area adjacent to the County Jail, Riverhead	2004
Headwaters of the Carmans River, Yaphank	2004

SCDHS will revisit the County's fresh water wetlands that were last visited during an initial (1996) survey of potential EEE sites, as well as those that are not currently monitored, to determine if the ecology of these areas has matured sufficiently to support disease vectors by inventorying the types of vegetation present and looking for evidence of *Cs. melanura*. Sampling for *Cs. melanura* and other larvae should be performed and CDC light traps should be placed in the wetlands that have sufficiently matured to determine the population parameters of the mosquitoes currently inhabiting these areas, and be added to the list of fresh water wetlands that are currently monitored on a regular basis. Extra field personnel and equipment, such as vehicles, would be necessary to sample these additional areas as well as more laboratory space for processing the samples generated as the result of increased surveillance.

Sampling frequency for these set locations is once a week, absent any indications of viral activity. If these are signs of local amplification, the frequency of sampling can be increased.

To augment virus activity surveillance, the ABDL has 144 CDC light and gravid traps. The Early Action projects required the acquisition of 12 additional CDC light traps. This suite of traps will be used, should optimal personnel needs be met, to expand maximal weekly set outs from the current 80 to perhaps as many as 110. The additional set out sites will be chosen based on history of viral activity or the presence of viral indicators, such as the finding of birds with WNV in the area.

Fishers Island represents a particular issue for the County. The County currently conducts no viral sampling on Fishers Island, due to travel difficulties. An identification station there would not address the need for viral surveillance. Two possibilities are:

- detail a technician whose major summer responsibility would be to collect samples from the traps on Fishers Island and return them to the ABDL each week. This seems to be a poor allocation of limited resources.

- seek the services of a local pilot to fly from Fishers Island once per week to return samples, from May to October. This is possible as several of the residents own and pilot airplanes, and have expressed interest in supporting mosquito control efforts.

FINS conducts its own viral surveillance from a network of CDC light and gravid traps; samples from this network are managed by the ABDL for FINS on a cooperative basis, and the resulting data generated by NYSDOH is also shared. The Village of Saltaire also operates its own CDC light trap, due to a history of virus detections there.

The pools of mosquitoes generated by ABDL sampling are currently sent to NYSDOH for viral analysis. The County can send samples every day, but results are generally not available for at least three days. Expansion of the ABDL to Biosafety Level-3 laboratory (BSL-3) (see below) would allow for local processing of mosquito samples, with overnight (or faster) results possible.

SCDHS also remains in constant contact with NYSDOH to keep abreast of cases found elsewhere in the State as a gauge of possible threats faced here. SCDHS also maintains contacts

with local veterinarians and stables for equine cases, and with hospitals for human cases of meningitis or encephalitis.

Through 2004, SCVC and SCDHS, in conjunction with NYSDOH and CDC, monitored for WNV using indicators such as unusual bird deaths or the number of dead birds, primarily corvids. The ABDL has developed the capacity to conduct tests for WNV, which have been confirmed with NYSDOH. However, recent observations suggest this surveillance tool has failed, because fewer crows succumb to WNV than in the past, especially in the early part of the season. Therefore, the County needs to develop some other form of surveillance to detect the virus, because, unlike EEE, it does not magnify in well-defined habitats.

Other non-migratory bird species, such as house sparrows, may be useful as indicators of viral presence. Viral activity in avian populations can also be monitored by:

- Netting
- Sentinel chicken flocks
- Obtaining blood samples from hatch year birds (juveniles)

Suffolk County needs to determine which option is best to meet its needs. For many reasons, the most reasonable choice appears to netting non-migratory birds. If this is chosen as a necessary program element, it most likely will require additional resources to conduct the work.

In 2004, the ABDL acquired a machine known as the Rapid Analyte Measurement Platform (RAMP) to test dead birds for WNV. RAMP is not used for mosquito testing because the technique it employs is not as sensitive as the technique used by Taqman (a laser-coupled spectrophotometer, to perform a rapid version of the Polymerase Chain Reaction [PCR]), another County tool. Taqman detects WNV in mosquitoes or birds in less than one day. Taqman and RAMP are specialized for WNV testing, but the County has a need to test for EEE, since it has often been detected. Therefore, the County would like to conduct general viral surveillance to ensure that other arboviruses do not become established in the local mosquito population without detection. This requires the use of virus culturing and standard PCR. The laboratory has the capability to perform standard PCR, but culturing and processing viruses also requires that

laboratory be equipped and certified at BSL-3, and meet certain Homeland Security requirements. The Long-Term Plan envisions, that as part of an already planned laboratory upgrade, that the ABDL will be improved and certified to BSL-3 standards.

Until the laboratory has these certifications, the ABDL will improve the efficacy of sample processing and the speed with which results are obtained by sending batched samples to the state laboratory in Albany once per week early in the season (late May through July) when turn around time is not as critical. The ABDL will generally rely on the Taqman and RAMP analyses later in the season (August to October) when viral activity peaks and detecting viral presence in a short time period becomes critical. In addition, confirmation of WNV results and broader viral scans will be obtained by using daily (if necessary) shipments to the NYSDOH laboratory.

Mosquito Surveillance and Control Unit Upgrades

A unit within SCVC is the Mosquito Surveillance and Control Unit. This section should be asked to perform additional tasks under the Long-Term Plan, by adding a work unit, informally designated as the QA/QC (Quality Assurance/Quality Control) team.

Major tasks for the QA/QC team would include:

- special surveillance responsibilities such as early spring sampling for *Cs. melanura,* and seasonal sampling for *Cq. perturbans* and of tire stockpiles. *Cs. melanura* and *Cq. perturbans* cannot be sampled using standard dip techniques. Effective tire sampling also requires some specialized techniques.

- larvicide effectiveness measurements

- adulticide need testing, using CDC light traps

- in association with adulticide need testing, treatment efficacy measures should be made

- research and demonstration tasks, such as developing an alternative bird sampling methodology, in conjunction with ABDL personnel, to keep WNV surveillance robust

Data Management

Monitoring data for larval mosquitoes are recorded on paper forms and directly entered into hand-held GPS units. The forms are returned to the office each day, and information from the hand-held units is downloaded into the Vector Control Management System (VCMS) software database. It has been suggested that the County investigate replacing these useful devices and system because it is difficult to interface the VCMS information directly into a standard GIS system. The loss of specificity may result in some data entry and system inconvenience; and VCMS has provided good technical support that is unlikely to continue absent a vendor-sponsored system. However, the utility of direct entry of data into a GIS system should reap great rewards in data management, and eventual conversion of data into information useful for management decisions.

Computer terminals placed at individual stations throughout the laboratory will be used to enter data resulting from processing samples obtained from surveillance activities. These terminals will be linked to the County's GIS system in order to make the data accessible to all SCVC and SCDHS personnel as soon as possible. All service request and response information will continue to be entered into hand-held GPS units in the field for download into the main system at a later time.

The Superintendent and the Director of the ABDL currently analyze collected data, with assistance from an entomologist, a GIS specialist, and ABDL staff. The type of data collected and resource allocation limit the scope of statistical analysis currently performed on collected data.

At this time, the ABDL Director produces a summary of the season's findings and annual work plans summarize operations from the previous year. However, a comprehensive annual report, including in depth statistical analysis of laboratory and field data, should be produced detailing these results. This report could be posted on the County's website.

Trigger for Surveillance

Surveillance activities will begin when environmental conditions indicate that mosquitoes are hatching or leaving dormancy in the spring. Population monitoring will be conducted through a

combination of regular route servicing, and special efforts dictated by weather and tides. Sampling will also be initiated in situations where it seems that adulticiding may be necessary, as a final check to ensure that the vector control treatment parameters have been met. Pathogen monitoring will likewise be initiated each year when environmental conditions dictate vector species are propagating. Monitoring efforts will be stepped up as indicators of disease prevalence (dead birds, positive pools, animal or human cases) proliferate.

2.10.3 Source Reduction

Household and Institutional Source Reduction

Public education is the first step in realizing household source reduction. SCDHS has greatly expanded its role in educating the public about the public health importance of mosquito controls, and its educational outreach has been discussed above. It includes presentations to groups and schools, the "Fight the Bite" and "Dump the Water" programs, and using the Citizens Advisory Committee pamphlet, "Mosquito Control and Prevention at Home."

Tire disposal needs to be addressed, through the education program, and outreach to those who may be in positions to promptly remove tires from the environment, such as personnel in various Parks and Public Works departments. Similarly, outreach needs to be made to farmers, farm educators and advocates, and others involved in agricultural water use issues regarding over-irrigation of fields, perhaps through Cornell Cooperative Extension. Storm water management structure maintenance also needs to be emphasized, with municipal (including County and State) departments targeted, but also intending to reach those responsible for commercial properties and private homeowner associations.

The initiation of action by SCVC in household situations is often a complaint phone call. SCVC receives on the order of 3,000 phone calls for service per year. These are logged into the SCVC computer system, assigned to an inspection team on the basis of the geographical location of the complaint. Each complaint that is received is responded to within one to three days. The initial response is to go to the complainant's house. State law allows SCVC wide latitude with regard to investigating and reacting to mosquito problems, so even if the complainant is not home some investigation will be undertaken.

In all cases, an immediate assessment of the problem is made: are mosquitoes present, and, if so, what species are involved, and what is the source of the problem. The primary investigative tool is larval dipping in potential source area water. Samples of larvae are returned to the laboratory for complete evaluation of the problem; however, field crews are trained in larval identification, as well. The larval stages and, very often, species involved can be determined in the field. The follow-up laboratory identifications ensures that novel or unusual species are identified and noted, and as QA/QC for the field identifications.

Most often, the source of the problem is immediately obvious. Removing the water causing any problem will break the breeding cycle, so draining a water source is the best solution for a local household mosquito problem.

Sometimes that is not possible, as when the source of water is as large as a swimming pool or relatively unmanageable as a recharge basin. Ecologically isolated, artificial bodies of water such recharge basins can be treated by stocking *Gambusia* (mosquito fish). If the water quality is marginally acceptable, these fish will consume larvae even when there is a great deal of vegetative cover. SCDHS, through the ABDL, purchases these fish from commercial suppliers. This decision should be carefully considered, however, and ecological and operational factors weighed prior to stocking fish. The County should consider using species, such as the fathead minnow (*Pimephales promelas*) in place of *Gambusia*. Fathead minnows are also introduced species, but have proven themselves to be non-invasive (native species are not displaced when fathead minnows enter an ecosystem), according to NYSDEC. These would need to be raised, as is done in New Jersey. It is best if fish only be stocked in basins where they have been stocked before, and only after reconnaissance that shows there is no hydraulic exit from the basin (such as an overflow outlet) that could result in a release to ponds that may serve as fish-free environments.

When recharge basins are slow to drain, the basin owner should be asked to arrange for maintenance of the basin. A stop-gap measure, until maintenance can be arranged for, would be to apply larvicides to control breeding. Timed release formulations of larvicides such as Bti, Bs, or methoprene can be in order (see below). For purely artificial, non-ecological systems such as

an abandoned cistern or swimming pool, larvicide applications are an effective means of breaking the breeding cycle.

Once an inspection team has investigated a site, it will discuss its findings and actions with the homeowner, with the intention of teaching the homeowner, should the cause of the problem be self-inflicted, or the neighbor (or municipality or agency), should the source be nearby and identifiable. Pre-printed check-off cards are used when the involved landowners are not at home. These cards invite follow-up phone calls to explain the findings and actions taken, and to try to ensure that the problem does not reoccur through homeowner education.

Rarely, and only with extensive although potentially time-compressed investigation, would adulticiding be considered in response to homeowner complaints. A nexus of complaints can be an important surveillance tool. For example, some mosquitoes, such as the tree-hole (and tire) mosquito *Oc. japonicus*, can be difficult to capture in the most common surveillance traps, and their presence is usually uncovered by investigating biting complaints.

Each year during the off-season, prior to the development of the coming year's brochure, field personnel from SCVC should interact with the health educators from SCDHS. This will allow transfer of information from the field to the educators regarding the kinds of persistent problems that are not being reduced through current education programs. In addition, field crews will be made aware of the current focus and ranges of materials used by the educators, which should enhance the field crews' education efforts, as well.

It should to be noted that the County Administrative Code (Section A8-5) specifies that environmental improvements are one possible criterion to justify maintenance dredging. Public benefits must be demonstrated prior to allocation of County resources for maintenance dredging projects. Any future dredging proposal that cites vector control benefits as a public benefit will require separate review.

Water Management

The Wetlands Management Plan, together with its associated Appendix, the Best Management Practices manual, was appended in its entirety to the Long-Term Plan. Implementation of the Wetlands Management Plan is key for the County to achieve its ambitious goals.

The County recognizes the importance of healthy, good-functioning marshes. There are many factors that affect the health and functionality of a marsh. The current Wetlands Management Plan does not intend to address all of them, explicitly. Its overt scope is limited to immediate factors that affect and are affected by mosquito management, at this time. Within that somewhat limited scope, the Wetlands Management Plan clearly intends to make determinations regarding mosquito management in such a way that marsh health and functionalities are attended to. A major intent is that any work conducted on a marsh will be a restoration of environmental values to the marsh. This is because the enhancement of water quality and fish habitat values are the basic requirements for progressive water management to achieve mosquito control aims, by fostering killifish on the salt marsh in the areas where mosquito breeding had been occurring (Wolfe, 1996). However, the Wetlands Management Plan looks beyond those two goals and includes supporting larger ecological values in the course of implementing the available Best Management Practices (BMPs).

This larger goal can be achieved through cooperative project development. The County will only consider water management projects in a framework that includes active participation in the project development by the landowner/land manager, involved regulators, and other interested parties. Extensive procedures, informal for minor projects, but formalized for larger projects, have been established to achieve this end. These steps include the development of a County-wide, comprehensive management plan with the intent of improving and succoring marsh health throughout the County. The Screening Committee (see below) will be charged with developing the overall strategy and developing the conceptual models for program managers to work from (with administrative support from SCDHS).

The essence of the Wetlands Management Plan is that the County intends to continue to focus its program on water management. However, no longer will the standard treatment be maintenance of the legacy grid ditch system. Rather, the default choice for each marsh instead will be reversion – allowing natural processes to occur. If a mosquito problem is occurring, and action is warranted, then progressive water management will be conducted, following the procedures and processes outlined in the Wetlands Management Plan and its associated BMP Manual.

Implementation is expected to take 12 years to address the vector control and ancillary wetland management needs for all 17,000 acres of tidal wetlands in Suffolk County. It seems likely that until an overall County wetlands management strategy is developed by the Screening Committee, major marsh restoration projects will be limited to Wertheim National Wildlife Refuge. Some of the projects undertaken in the first three years that use "no to little impact" or "minor impact" Best Management Practices may exceed size thresholds (set at 15 acres) and so require Screening Committee consideration, as well.

Progressive water management will be considered for implementation at the 4,000 acres of tidal wetlands that have been identified as major mosquito breeding problem areas. The 4,000 acres were identified because they constitute the area occupied by the 46 marshes that currently receive regular aerial applications of larvicides to control mosquito breeding. The goals of this initiative are pesticide reduction by reducing or eliminating the need for such applications, and habitat enhancement, including maintaining or increasing biodiversity and *Phragmites* control. It is estimated that approximately 4,000 acres of tidal wetlands will undergo reversion, because of low mosquito breeding potential and/or distance from points of dense populations of people. In those areas, natural processes will gradually undo the construction of ditches across the marshes. In the long run, reversion is not necessarily ecologically optimal; other restoration options may need to be considered for purposes other than vector control, in the context of the overall comprehensive marsh management plan.

The remaining 9,000 acres will be assessed over the coming decade, with some being actively restored, and others subjected to reversion processes. The policy in these areas will be one of presumptive interim reversion (i.e., no ditch maintenance unless deemed necessary for ecological or mosquito control purposes). It is expected that less than four percent of the County's tidal wetlands (on the order of 500 acres) will be subject to ditch maintenance over the next decade.

These acreages overstate the extent of the proposed management actions. Mosquito breeding only occurs in the intermittently flooded portions of salt marshes – the high marsh. Unlike grid ditching, progressive water management is intended to alter only the portions of the marsh where mosquito breeding occurs. Primarily, progressive water management achieves mosquito control through predation by naturally occurring killifish. The essence of the technique, therefore, is to

provide habitat enhancement for these fish. This is generally achieved by providing access for the fish to breeding areas (sometimes by constructing shallow waterways to breeding loci, but also through pond construction), improving in-marsh water quality so that the fish can maintain themselves on the marsh (often by improving tidal circulation patterns), and by providing some refuges for the fish from their own predators (mostly through construction of some deeper sumps in ditches or other waterways, or in ponds) (Niedowski, 2000). Another common part of progressive water management projects is to eliminate breeding habitat altogether. This can be achieved by digging ponds in areas where mosquitoes breed, or by using the spoils from pond or waterway construction to smooth the often irregular surface of the high marsh. Mosquitoes commonly breed in shallow (two to four inch deep), small, isolated "potholes" formed as *Spartina patens* (the signature high marsh plant in New England class salt marshes) (Nixon, 1982). Smoothing spoils into these potholes eliminates these breeding locations, and reportedly allows for enhanced growth of *S. patens* (Shisler and Jobbins, 1977).

The Wetlands Management Plan represents a significant departure from seven decades of grid-ditch maintenance policy. Instead of committing to maintain the grid ditch network as a means of controlling mosquitoes, Suffolk County will instead apply more nuanced criteria to determine the best means of managing its salt marsh resources. For now, plans include a presumptive policy of reversion, where wetlands that pose no mosquito problems will remain untouched while long-term plans for restoration are developed and implemented. Existing water management systems (ditches, culverts, and other structures) will normally be either left alone, if not needed for mosquito control, or upgraded to BMPs as outlined in the Wetlands Management Plan. In some cases, implementation of BMPs is not immediately feasible due to lack of pre-project information or institutional factors such as landowner policies. Implementation of BMPs may also not be immediately feasible due to lack of resources. For instance, if major tidal flow restoration is desirable but is currently too expensive because it involves major road work, interim measures should be taken while these resources are sought if the alternative is a loss of habitat and/or an increased reliance on pesticides.

Assuming Long-Term Plan water management policies are implemented (especially open marsh water management), the general presumption will be against maintenance of ditch systems.

However, in limited circumstances, existing structures may be maintained on an interim basis, when the following conditions are met:

- Deterioration of or damage to structures resulting in a significant mosquito problem, as evidenced by larval and/or adult surveillance, serious enough to require control. An example would be a collapsed pipe that restricts tidal flow and results in a need to larvicide an area. Or:

- Failure to maintain the structures would result in the loss of resource values, such as fish passage or tidal flow, or loss of vegetation due to freshwater impoundment. Or:

- Failure to maintain the structures would result in a hazard or loss of property as a result of flooding.

Benefits to be expected from the work include:

- Maintaining or reconstructing the existing structures will improve water circulation or provide fish habitat sufficient to reduce the need for pesticide application.

- Maintaining the structures is compatible with habitat values that existed prior to the failure or deterioration of the structures.

- Maintaining the structure will prevent flooding or other hazards.

Constraints on any maintenance of a pre-existing ditch system include:

- The structures will be maintained essentially in-place and in-kind.

- Disruption of wildlife habitat due to construction will be minimized by limiting work areas and/or by using seasonal constraints.

- Listed species will not be adversely impacted.

- Interim maintenance will not lead to excessive drainage that would result in a loss of wetlands values.

- The action will not lead to increased or more direct conveyance of inputs from storm drains or other structures.

- The action will not preclude the implementation of BMPs when resources and/or institutional considerations allow.

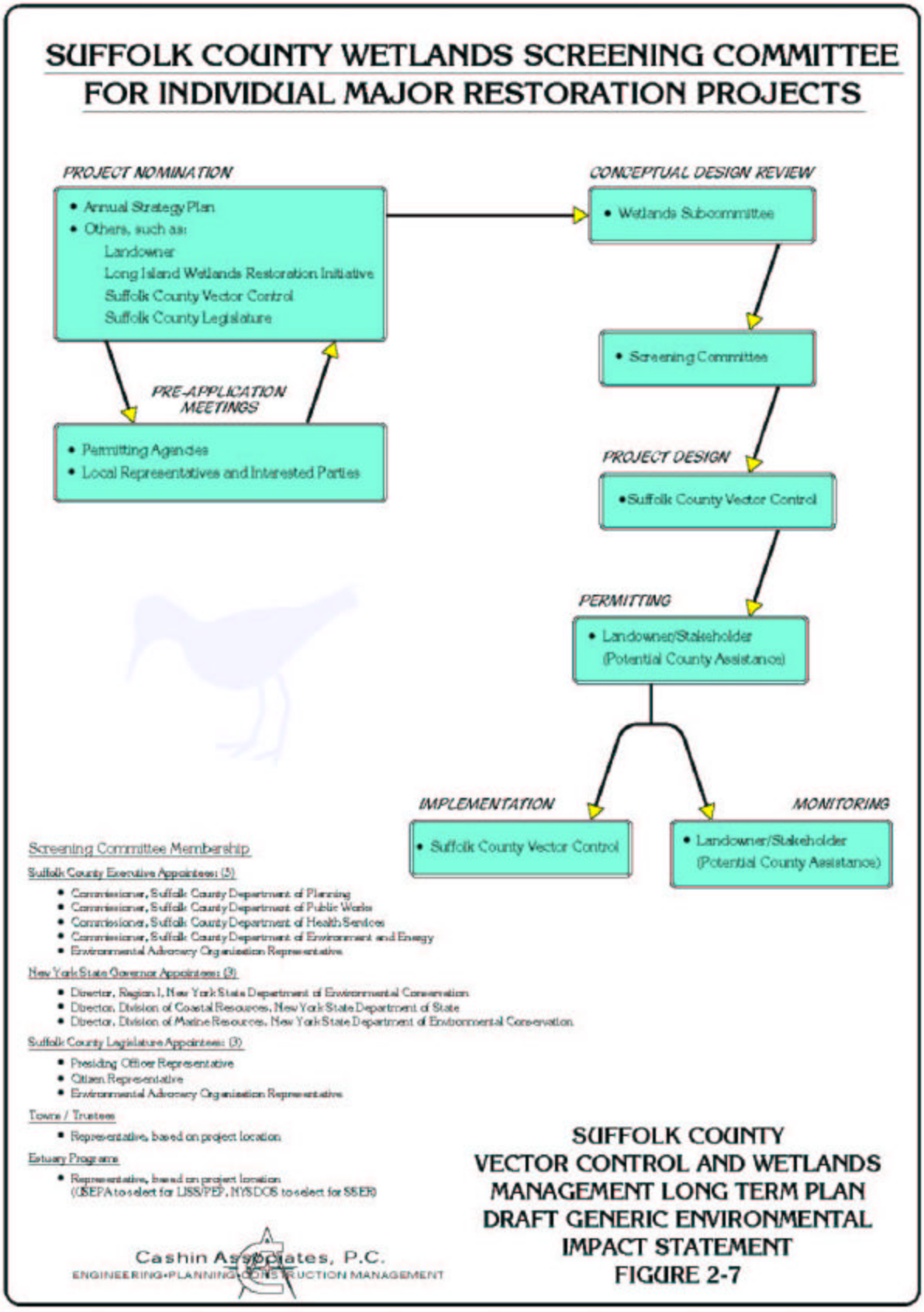
Given the above, it is expected that less than 50 acres per year will be subject to ditch network maintenance. All maintenance will be summarized in the annual water management reports, and will be conducted in accordance with a Memorandum of Understanding (MOU) with the SCDHS Office of Ecology and the Suffolk County Department of Environment and Energy (SCDEE).

The proposed policy change is predicated on the ability to conduct a broad variety of best management practices and, specifically, to implement the kinds of progressive water management that are often labeled as OMWM. All mosquitoes spend larval stages as aquatic organisms, and source reduction is an essential component of mosquito control as practiced through IPM. Source reduction through OMWM leads to impressive reductions in successful mosquito breeding, and so leads to major reductions in the number of applications and overall usage of pesticides. In addition, this kind of water management also increases overall marsh habitat diversity and wildlife values (Wolfe, 1996).

This holistic approach has been demonstrated for the first time on Long Island, as part of this Wetlands Management Plan, at the Wertheim National Wildlife Refuge. Permitting of this project was a major accomplishment, as a cooperative approach to project design allowed concerns raised by State regulators regarding potential impacts to existing important natural resource attributes of ditched marshes, and marsh loss in tidal settings, together with a lack of monitoring and documentation for past OMWM demonstration projects, to be addressed. The degree to which project plans addressed these concerns coupled with the first blush of success at the site in controlling mosquito breeding and enhancing natural resource values may allow NYSDEC to consider these options that might not have passed regulatory muster a short while ago. Continued cooperation between Federal and State agencies will be critical to ensure that projects similar to Wertheim will be implemented throughout Suffolk County.

The Wetlands Management Plan consists of seven sections, the first of which addresses goals and numerous objectives. In the second section, a framework for managing larger, more ambitious projects is discussed. A key feature is the creation a Screening Committee to review and approve the major projects (see Figure 2-7). Collaborative project selection, design, and implementation are emphasized throughout, with all stakeholders being involved so that through cooperative efforts appropriate projects will be identified and constructed. The scale and overall approach of the particular project will often need to be determined by local resource managers or the landowner, and then SCVC will assist in creating a design to achieve the desired ends. The involvement of the Screening Committee ensures that overall policies and major projects will accord with the needs and programs of regulator, local government, marsh managers, and other interested parties. It also allows for adjustments as the County-wide approach to marsh management is promulgated.

Section 2 also establishes a comprehensive reporting framework to ensure that interested and involved parties will be able to participate in and understand the progress of the developing progressive water management implementation. It includes annual reports with an associated ongoing implementation strategy, and triennial reports on attainment of goals, work completed, and new directions being entertained. These procedures were proposed to explicitly promote cooperative project (and overall policy) development, and ensure that stakeholders were involved in marsh management, as proposed under the auspices of mosquito management. In all cases, projects can (and in many cases, must) have factors other than mosquito control included in the overall project design, and to ensure ecological concerns are paramount in project consideration. Participation by interested parties in the design and approval processes is intended to ensure that appropriate care is taken in making these choices to ensure the overall health of the marshes being so managed.


SUFFOLK COUNTY WETLANDS SCREENING COMMITTEE
FOR INDIVIDUAL MAJOR RESTORATION PROJECTS
PROJECT NOMINATION
• Annual Strategy Plan
• Others, such as:
Landowner
Long Island Wetlands Restoration Initiative
Suffolk County Vector Control
Suffolk County Legislature
PRE-APPLICATION MEETINGS
• Permitting Agencies
• Local Representatives and Interested Parties
CONCEPTUAL DESIGN REVIEW
• Wetlands Subcommittee
• Screening Committee
PROJECT DESIGN
•Suffolk County Vector Control
PERMITTING
• Landowner/Stakeholder
(Potential County Assistance)
IMPLEMENTATION
• Suffolk County Vector Control
MONITORING
• Landowner/Stakeholder
(Potential County Assistance)
Screening Committee Membership
Suffolk County Executive Appointees: (5)
• Commissioner, Suffolk County Department of Planning
• Commissioner, Suffolk County Department of Public Works
• Commissioner, Suffolk County Department of Health Services
• Commissioner, Suffolk County Department of Environment and Energy
• Environmental Advocacy Organization Representative
New York State Governor Appointees: (3)
• Director, Region 1, New York State Department of Environmental Conservation
• Director, Division of Coastal Resources, New York State Department of State
• Director, Division of Marine Resources, New York State Department of Environmental Conservation
Suffolk County Legislature Appointees: (3)
• Presiding Officer Representative
• Citizen Representative
• Environmental Advocacy Organization Representative
Towns / Trustees
• Representative, based on project location
Estuary Programs
• Representative, based on project location
(USEPA to select for LISS/PEP, NYSDOS to select for SSER)
Cashin Associates, P.C.
ENGINEERING•PLANNING•CONSTRUCTION MANAGEMENT
SUFFOLK COUNTY
VECTOR CONTROL AND WETLANDS
MANAGEMENT LONG TERM PLAN
DRAFT GENERIC ENVIRONMENTAL
IMPACT STATEMENT
FIGURE 2-7

In section three, the 15 BMPs and four Interim Management/On-going Maintenance Actions are discussed (Tables 2-18 - 2-21). The actions are aimed at reducing mosquito populations utilizing methods that either minimizes potential environmental change, or maximizes the enhancement of particular natural resource values. Implementation of these BMPs is expected to reduce aerial larviciding approximately 75 percent from current levels (as measured by acres of marsh treated in a year, in comparison to a baseline of 30,000 acres), and to result in healthier, better functioning wetlands throughout the County. Implementation of progressive water management is also expected to reduce conditions under which the County needs to apply adulticides.

Table 2-18. Management Activities for Minimal or No Action

BMP	Action	Factors to Consider	Potential Benefits	Potential Impacts	Equipment to be used	General Compatibility With Tidal Wetlands 6 NYCRR Part 661
BMP 1.	Natural processes (reversion/no action)	- Default option - Land owner prefers natural processes to proceed unimpeded - Natural reversion is actively infilling ditches - No existing mosquito problem	- Return to pre-ditch hydrology - More natural appearance/processes - Requires no physical alterations	- Possible increase in mosquito breeding habitat, creation of problem - Loss of ditch natural resource values - Loss of tidal circulation - Phragmites invasion if fresh water is retained on marsh - Drowning of vegetation if excess water is held on marsh	Not applicable	NPN
BMP 2.	Maintain/repair existing culverts	- Flooding issues - Are existing culverts adequate for purpose? - Are existing culverts functioning properly?	- Maintain existing fish and wildlife habitats - Maintain tidal flow and/or prevent flooding	- Continue runoff conveyance into water bodies - Roads & other associated structures	- Hand tools (minor maintenance) - Heavy equipment for repair	GCp
BMP 3.	Maintain/ reconstruct existing upland/ fresh water ditches	- Flooding issues - Are existing ditches supporting flood control? - Are existing ditches needed for agricultural uses?	- Maintain existing fish and wildlife habitats and hydrology - Prevent or relieve flooding - Support turtle habitat - Provide fish habitat	- Continue runoff conveyance into water bodies - Perpetuate existing degraded conditions - Excess drainage	- Hand tools (minor maintenance) - Heavy equipment for reconstruction (rare)	NPN (6 NYCRR Part 663)

Please note that other jurisdictions besides NYSDEC may also regulate activities in wetlands.

Table 2-19. Management Activities for Minor Impacts

BMP	Action	Factors to Consider	Potential Benefits	Potential Impacts	Equipment to be used	General Compatibility With Tidal Wetlands 6 NYCRR Part 661
BMP 4.	Selective Maintenance/ Reconstruction of Existing Salt Marsh Ditches	- Local government issues and concerns resolution - SCDHS Office of Ecology review - Mosquito breeding activity - Land owners long-term expectations - Overall marsh functionality - Ditch maintenance is to be selective and minimized	- Enhance fish habitat - Maintain existing vegetation patterns - Maintain existing natural resource values - Allow salt water access to prevent/control Phragmites - Reuse pesticide usage	- Perpetuate ongoing impacts from ditching	- Hand tools (minor maintenance) - Heavy equipment for reconstruction	NPN
BMP 5.	Upgrade or install culverts, weirs, bridges	- Flooding - Flow restrictions - Associated marsh impacts - Cooperation from other involved departments	- Improve tidal exchange and inundation - Improve access by marine species - Increase salinity to favor native vegetation - Improve fish habitat & access	- Negative hydrological impacts - Changes in vegetation regime	- Heavy equipment required	GCp
BMP 6.	Naturalize existing ditches	- Grid ditches - Mosquito breeding activity - Landowner needs - In conjunction with other activities	- Increase habitat diversity - Increase biofiltration - Improve fish habitat and access by breaching berms	- Hydrology modification - Minor loss of vegetation - Possible excess drainage	- Hand tools (minor naturalization) - Heavy equipment for major	NPN/GCp
BMP 7.	Install shallow spur ditches	- Mosquito breeding activities - Standard water management not successful (continued larviciding)	- Increase habitat diversity - Allow higher fish populations - Improve fish access to breeding sites	- Drainage of ponds and pannes - Hydraulic modification - Structure not stable	- Preferably hand tools	NPN/GCp
BMP 8.	Back-blading and/or sidecasting material into depressions	- Mosquito breeding activities - Standard water management not successful (continued larviciding)	- Improve substrate for high marsh vegetation - Compensate for sea level rise or loss of sediment input - Eliminate mosquito breeding sites	- Excessive material could encourage Phragmites or shrubby vegetation - Materials eroded so that application was futile	- Heavy equipment required	NPN or GCp
BMP 9.	Create small (500-1000sq. ft) fish reservoirs in mosquito breeding areas	- Mosquito breeding activities - In conjunction with other water management - Natural resource issues	- Increase wildlife habitat diversity/natural resource values - Improve fish habitat - Eliminate mosquito breeding sites - Generate material for back-blading	- Convert vegetated area to open water with different or lower values	-Heavy equipment required	Status Undetermined

Please note that other jurisdictions besides NYSDEC may also regulate activities in wetlands.

Table 2-20. Management Activities for Major Impacts

BMP	Action	Factors to Consider	Potential Benefits	Potential Impacts	Equipment to be used	General Compatibility With Tidal Wetlands 6 NYCRR Part 661
BMP 10.	Break internal berms	- Water quality (poor) - Standing water (mosquito breeding) - Impacts on structural functions	- Allow access by marine species - Prevent waterlogging of soil and loss of high marsh vegetation - Improve fish access to mosquito breeding sites - Prevent stagnant water	- Changes in system hydrology - Excessive drainage of existing water bodies - Introduction of tidal water into areas not desired	- Hand tools (minor) - Heavy equipment (major)	Pip
BMP 11.	Install tidal channels	- Improve water quality - Tidal ranges and circulation - Increase salinity (invasive vegetation) - Natural resources enhancement	- Improve tidal exchange - Improve access by marine species - Increase salinity to favor native vegetation - Improve tidal inundation - Improve fish habitat	- Changes in system hydrology - Excessive drainage or flooding of uplands - Increase inputs from uplands into water body	- Heavy equipment	P
BMP 12.	Plug existing ditches	- Improve fish habitat - Tidal ranges and circulation - Prevent upland inputs - Natural resources enhancement	- Return to pre-ditch hydrology & vegetation - Reduce pollutant conveyance through marsh - Provide habitat for fish & wildlife using ditches - Retain water in ditch for fish habitat - Deny ovipositioning sites	- Changes in system hydrology - Reduce tidal exchange - Reduce fish diversity in ditches due to lack of access - Impoundment of freshwater could lead to freshening & Phragmites invasion - Possible drowning of marsh vegetation	- Heavy equipment	P
BMP 13.	Construct ponds greater than 1000 sq.ft.	- Landowner's needs - Water fowl habitat - Natural resources enhancement - Aesthetic improvements	- Increase habitat values for targeted species and associated wildlife - Improve habitat for fish - Eliminate mosquito breeding sites	- Changes in system hydrology - Convert vegetated areas to open water with different and possibly lower values	- Heavy equipment	P
BMP 14.	Fill existing ditches	- Landowner's needs - Aesthetic improvements - To restore pre-ditch hydrology - Vegetated areas	- Return to pre-ditch hydrology and vegetation - Reduced likelihood of pollutant conveyance through marsh - Create vegetated habitat to replace that lost by ditches or by other alterations - Deny mosquito breeding habitat by eliminating stagnant ditches	- Potential to create new breeding habitats if ditches are not properly filled or by making the marsh wetter - Loss of ditch habitat for fish, other marine species & wildlife using ditches - Loss of tidal circulation - Phragmites invasion if freshwater is retained on marsh - Drowning of vegetation if excessive water is held on marsh	- Heavy equipment	P
BMP 15.	Remove dredge spoils	- Increase wetland habitat	- Convert low-value upland to more valuable wetland habitats - Eliminate mosquito breeding sites	- Could result in new breeding sites if not carefully designed - Major change in local topography	- Heavy equipment	P

Please note that other jurisdictions besides NYSDEC may also regulate activities in wetlands.

Table 2-21. Interim Management/Ongoing Maintenance Actions

Interim Action	Action	Factors to Consider	Potential Benefits	Potential Impacts	Equipment to be used	General Compatibility with Tidal Wetlands 6 NYCRR Part 661
IMA 1.	Natural processes (No action reversion)	-Presumptive interim action	- Non-intervention in natural system	- Non-intervention in natural system	- Non-intervention in natural system	- Non-intervention in natural system
IMA 2.	Selective ditch maintenance (Standard Water Management)	- mosquito breeding activity - water quality (poor) - improve fish habitat	- Enhance fish habitat - Maintain existing vegetation pattern - Improve fish access to breeding sites - Increase fish and wildlife habitat diversity - Increase biofiltration - Improve fish habitat and access by breaching berms	- Perpetuate ongoing impacts from ditches - Hydrology modification - Minor loss of vegetation - Possible excess drainage of marsh surface	- Hand tools (Minor) - Heavy equipment (Major)	NPN
IMA 3.	Culvert repair/maintenance when tidal restrictions are apparent	- improve water quality - restore pre-restriction hydrology -mosquito breeding activities	- Maintain existing habitat - Maintain existing flows and/or prevent flooding	- Continue runoff conveyance into water bodies - Potentially inadequate water transmission	- Heavy Equipment	NPN
IMA 4.	Stop-gap ditch plug maintenance	- prevent upland inputs - increase wetland habitat - sustain fish and wildlife habitat	- Return to pre-ditch hydrology & vegetation - Reduce pollutant conveyance through marsh - Provide habitat for fish & wildlife using ditches - Retain water in ditch for fish habitat - Deny ovipositioning sites	- Reduce tidal exchange - Reduce fish diversity in ditches due to lack of access - Impoundment of freshwater could lead to freshening & Phragmites invasion - Possible drowning of marsh vegetation - Impermanent approach (likely to fail within 5 years)	- Heavy Equipment	GCp

Please note that other jurisdictions besides NYSDEC may also regulate activities in wetlands.

Tables 2-18 to 2-21 explicitly show that all proposed management actions in wetlands are permissible under existing regulations, albeit some may require a permit. FINS, on the other hand, as stated in section 2.7, at this time does not allow water management to occur within the National Seashore. The County is discussing with FINS how water management might be implemented in the Seashore to meet the goals of the Long-Term Plan and yet also to meet the natural resource preservation requirements in effect at FINS. As shown in Section 2.7, no other jurisdiction within Suffolk County has any explicit prohibition on water management, although several would prefer that permits or other permissions be acquired for pertinent projects.

Section 4 and Section 5 of the Wetlands Management Plan address plan implementation and resource needs of SCVC to undertake this Wetlands Management Plan, respectively. The need for streamlined and dedicated State processes is highlighted. Vector control program needs may be eligible for restoration grant opportunities, as well as the Suffolk County Water Quality Protection and Restoration Program (the Quarter Percent Sales Tax). Section 6 establishes a Timeline for reaching Wetlands Management Plan goals, including the identification of good candidates for certain kinds of projects over the first three year time period. In Section 7, the County's salt marshes are prioritized in terms of those requiring restoration to address mosquito management needs, sites that appear to be best suited for reversion, and those areas requiring closer study before determining overall management needs.

In New York State, fresh water regulations do not allow for much manipulation of the existing hydrology of the marshes. This means that there are very few options in terms of mosquito-related water management and restoration. Source reduction and larviciding are the main means of addressing mosquito problems associated with freshwater wetlands (see above and below for the implementation of those program elements). The Long-Term Plan includes a desire to participate, if possible, in ongoing State reconsiderations of the existing wetlands regulations and their implementation. In addition, the Long-Term Plan also recognizes that the ecological savvy available in many local resource agencies could be well-applied in reducing any potential impacts associated with SCVC operations. Therefore, SCVC is seeking to communicate with these local resource managers to determine sensitive species and environments that should be allowed for as it conducts its operations.

The development of the wetlands management portion of the Long-Term Plan, through the Wetlands Management Plan was the result of a tremendous amount of collaboration among agencies within the Wetlands Subcommittee of the TAC. It is also the result of an exhaustive literature review and comprehensive field work, which is reflected in Task 3 (Literature Review) and Task 7 (21 representative wetland areas, totaling over 2,000 acres, have been evaluated in detail). The first digital tidal wetlands map of all County wetlands has been produced, and other GIS information was gathered into one system. Monitoring of the potential impact of this management approach will be fostered by the development of remote sensing capabilities for the major vegetation types in Suffolk County salt marshes. This portion of the project has been slow to be implemented, but is expected to result in a cost-effective, efficient means of keeping track of some basic measures of wetlands health across the entire County, and at individual sites as well.

The entire Wetlands Management Plan (Appendix B), which includes the Best Management Practices Manual (Appendix C) discusses all of these considerations in much greater detail and specificity.

Source Reduction Summary

Table 2-22 summarizes source reduction efforts under the Long-Term Plan, by focusing on the species of concern identified in Tables 2-13 and 2-14.

Table 2-22. Source Reduction Summary

Species	Source Reduction Efforts	Other Issues
Aedes vexans	Upper salt marsh management	Fresh water habitat manipulation contrary to current State regulations
Anopheles punctipennis	Household efforts	Fresh water habitat manipulation contrary to current State regulations
Anopheles quadrimaculatus		Fresh water habitat manipulation contrary to current State regulations; prefers pristine settings, and so may involve R-T-E species
Coquillettidia perturbans		Fresh water habitat manipulation contrary to current State regulations; requires special sampling efforts
Culex pipiens	Household efforts, storm water structures	
Culex restuans	Household efforts, storm water structures	
Culex salinarius	Upper salt marsh management	
Culiseta melanura		Fresh water habitat manipulation contrary to current State regulations; habitat often associated with R-T-E species;

		requires special sampling efforts
Ochlerotatus canadensis		Fresh water habitat manipulation contrary to current State regulations
Ochlerotatus cantator	Salt marsh management	
Ochlerotatus japonicus japonicus	Container, tire management	
Ochlerotatus sollicitans	Salt marsh management	
Ochlerotatus taeniorhynchus	Salt marsh management	
Ochlerotatus triseriatus	Container, tire management	
Ochlerotatus trivittatus	Upper salt marsh management	Fresh water habitat manipulation contrary to current State regulations

It is evident from the table that source reduction efforts can reduce populations of many of the species of concern in the County. However, it is also clear that many actions that are allowed in other jurisdictions, such as draining breeding areas and otherwise manipulating fresh water environments, are not permitted under New York State regulations, in order to preserve these environments. In some cases, environmental benefits associated with this general rule are clear. In other cases, the benefits that may result from non-interference in these habitats are not as discernable. SCVC has interest in reported re-evaluations of New York State wetlands regulations that are said to be occurring within NYSDEC, and would be willing to participate in such efforts, as may be allowable.

Triggers for Source Reduction

Household and institutional source reduction measures will be initiated in several ways:

- The detection by field crews of standing water that supports breeding
- Determination that standing water could potentially support mosquito breeding
- Prophylactic measures to ensure that stormwater management structures, agricultural irrigation practices, and littered tires do not cause mosquito breeding opportunities

The presumptive activity with regard to County salt marshes under the Long-Term Plan is reversion. If, however, a treatable wetland is determined to present a mosquito breeding problem, water management following the Wetlands Management Plan and utilizing the Best Management Practices Manual will be initiated if the project is assessed as an appropriate action.

If consultation with the landowner and other involved parties determines that action is in order, and the proposed action is in accord with the Wetlands Management Plan and any other guidelines and regulations that such actions are subject to, then the procedures outlined above regarding project review will be initiated. Wetlands management projects may also be initiated for reasons other than mosquito control in this scenario, and SCVC involvement may be indicated to ensure that such projects do not lead to future mosquito breeding problems. If project reviews indicate that the proposed action meets all applicable guidelines and will address the mosquito problem without causing negative impacts to the wetland in question (as can best be determined, and with appropriate consultation outside of SCVC), SCVC in conjunction with the land manager will pursue the necessary regulatory procedures to gain permission for the action. The most applicable BMP or BMPs for the site will be determined, and the project will be undertaken. Monitoring, as required and as appropriate, will be conducted to ensure the project is successful in achieving its stated aims. SCVC will only undertake wetlands management projects following consultation and review with other involved and interested parties, including the appropriate Town natural resource division, and after explicitly reviewing ecological issues associated with the project.

All water management projects will be conducted in compliance with State regulations, and any necessary permits and approvals will be obtained prior to beginning work. All projects will be conducted with explicit project goals (determined prior to project initiation), and monitoring to ensure the goals are being met will be conducted (as well as any other required monitoring). Annual reports on water management activities will be prepared and disseminated.

2.10.4 Biocontrols

Biological control considerations include many mosquito predators, and would-be predators; the most commonly used biological control adjuncts are mosquito fish, *Gambusia*. Care must be taken in placing this species in areas where endemic fish or other species may be impacted. For that reason, the County has considered using native fathead minnows as an alternative. SCVC needs to ensure that it does not introduce fish into previously predator free environments that support amphibians and invertebrates that may be less noxious than mosquitoes (CA-CE, 2004c).

Another group of biocontrol agents with promise for mosquito control is predaceous copepods. Copepods are easy to rear and to deliver to the target sites in the field, and they generally perform well when used with pesticides. However, they have not been shown to provide the degree of control that comes with other biocontrols such as fish. Copepods must multiply to effectively attack mosquito larvae populations, leading to a lag time between inoculation and effective control. There is some County interest in developing a copepod program in Suffolk County as some species may be effective for long-term control in catch basins. In areas with seasonal rain patterns, brine shrimp have also shown promise as similar larval predators (CA-CE, 2004c).

Triggers for Biocontrol Use

Biocontrols will be very judiciously used. They will only be used when source reduction is not possible, but mosquito breeding needs to be addressed. In addition, other controls (species specific) will be used.

Fish will only be used in settings where they have expectations of survival (persistence of water and adequate water quality), and where native organisms will not be negatively impacted (as when there is a predator-naïve settings). Fish will only be used in settings where it is clear there is no opportunity for them to escape into broader ecosystems. In addition, in case this low probability event does occur, the County is to begin using organisms that are already widespread in County waters (where they appear to be causing no ecological impacts).

Copepods, if New Jersey research confirms their effectiveness, would only be used in underground drainage systems that are isolated from larger fresh water or salt water settings.

2.10.5 Larval Control

The Long-Term Plan proposes to use three biorational products as its primary larvicidal treatments. These three products, *Bacillus thuringenesis var israelensis* (Bti), *Bacillus sphaericus* (Bs), and methoprene, have been shown through the risk assessment to have no impacts to human health, and apparently no significant or substantial impacts to the environment (Cashin Associates, 2005d). These conclusions are supported by independent scientific

experiments conducted by the Long-Term Plan, discussed later in this document (see Section 6) and a rigorous review of the scientific literature (see Section 7).

It is a general objective of the Long-Term Plan to avoid the use of pesticides, whenever possible. It is a basic tenet of IPM that an excessive dependence on pesticides is not wise from a programmatic point of view. An excessive reliance on pesticides can make a program vulnerable to control failure. For instance, logistical problems or weather conditions may prevent the application of pesticide in all areas where they are needed and at the proper times. Development of resistance to pesticides to the targeted organisms can be a problem. In addition, if a widely used material is found to have unacceptable impacts, or if it becomes unavailable due to market forces, a program that is overly dependent on that material can find itself without viable options. Sound management principles dictate that pesticides must be just one part of a comprehensive control program.

These management principles result in a Long-Term Plan that emphasizes water management as a means of reducing larvicide applications. Scientific surveillance measures are the means of ensuring that larvicide applications are truly necessary. Surveillance data analysis to establish site-specific values for dipping results may allow for further reductions in larvicide applications.

Especially if progressive water management succeeds as the County anticipates it will, the focus of larviciding activities will increasingly be in fresh water environments. Approximately three-quarters of all larvicide applications occur in fresh water settings currently, although the greater scope of larvicide applications in salt marshes means that most of the acreage treated is in salt marshes. Since the range of source reduction actions is somewhat limited in fresh water settings, it is possible that the potential scope of larvicide applications in fresh water will remain approximately constant under the Long-Term Plan.

Fresh water wetlands require special consideration for any pesticide treatment. These environments are more diverse than salt water mosquito breeding sites (see Section 5 of this document), and have the potential to be more sensitive to perturbations. Most of the species of special concern in the County are found in or near fresh water wetlands. Therefore, the County will, over time, through consultation with State, County, and town natural resource staff and other interested parties, develop GIS determinations of the fresh water areas that require more

nuanced approaches to treatment decisions. A focus will be on the identification of vulnerable species, and to determine the points in their life histories that may make them more susceptible to potential impacts from vector control operations, and then to determine what modifications of vector control activities can be made to mitigate the potential impacts. For instance, because of special reproduction requirements for certain species, spring or early summer pesticide treatments may be counseled against. In other instances, early morning or evening applications may be preferred in order to avoid knock down of day-active insects by applications. These plans may become customized for particular settings. An expansion of GIS capabilities in the County may facilitate this approach. As inventories of the wetlands and the special habitat and other needs of important species are ascertained, special research conducted on behalf of the County may be able to craft modifications of its standard operating procedures to reduce the chances that any negative environmental impact will follow from treatments. As an important example of this, following consultation with NYSDEC, SCVC has removed all tiger salamander habitats from its larvicide list, to ensure that no possible impact from these pesticides to this rare species can occur.

Surveillance

All treatment decisions will be made on the basis of scientific surveillance to determine the need for the treatment. Appropriate surveillance requires sampling for the presence of larvae. Although standardized sampling methods have been developed (and discussed in the scientific and technical literature) for larval sampling of all kinds, the results of the testing are almost all sampler-dependent (CA-CE, 2004d).

SCVC has had good experience using a larval dipping index at Wertheim National Wildlife Refuge. Nonetheless, generally SCVC will continue to rely on absence/presence tests of larval habitats at this time. Qualitative assessments by samplers of relative population densities (none-some-many-throngs) will be used as a determinant of apparent populations. Samplers will also record actual numbers of larvae, as possible, per dip. For the identified breeding locations, data analysis of these numbers will be pursued, and it may be that site-specific triggers that appear to lead to reasonable reductions in larviciding frequencies can be developed over time. Samples will be collected for laboratory speciation, as well.

Until site-specific triggers are established, however, the determination of a need to control larvae will be the identification of a potential mosquito problem. This is determined by complaint history, close association with residential or recreational settings, or disease history or other risk factors, and the presence of human-biting mosquito larvae. The presence of human-biting mosquito larvae is a determination made most often by observations through sampling with identification of the larvae as a pest species by field crews, or by the subsequent laboratory analysis of the returned specimens.

Permanent and transient fresh water breeding habitats have been identified and catalogued by SCVC. The permanent water sites are visited on a regular basis. Transient water sites, which are not as extensive in Suffolk County due to the high permeability of the soils (generally) are sampled following significant rainfalls. History dictates the kinds of rains likely to produce breeding.

Mosquito Problem Identification

There are four types of areas where SCVC may apply larvicides. They are:

- catch basins and other, mostly underground, storm water control structures. Some 10,000 storm water structures have been identified as potential breeding problems by SCVC through surveillance work; surveillance efforts will be expanded to a total of approximately 40,000 to 50,000 sites. Where possible, maintenance records and plans of appropriate agencies will be accessed prior to the surveillance effort. If the basin shows signs of breeding, it and all connected basins will be treated to limit the risk of potential mosquito disease transmission. Open water systems, such as recharge basins, without histories of treatment will be assessed similarly to environmental sites identified in complaints.

- sites identified by complaints (mostly household-institutional sites). Most complaint call investigations are easily resolved by identifying household breeding sites, and remediating them. In some situations, the household mosquito source is too large, and in those instances, treatment with a larvicide may resolve the immediate problem, and allow time to investigate for long-term management of the underlying problem. In other complaint situations, the source of the troubling mosquitoes may appear to be an

environmental setting. If the site is not a known breeding site, then sampled larvae will be brought to the laboratory for official identification, and follow-up at the site shall be undertaken by senior level staff. Options available on this follow-up include minor water management to resolve a drainage or fish access issue, larvicidal treatment, or assignment to a follow-up surveillance list. The determination as to whether to treat the site will be through evaluation of ecological issues and the degree of seriousness of the problem. The senior staff will annotate the SCVC GIS with appropriate treatment trigger information, including quantitative or qualitative larvae presence factors, time of year, or other issues of note.

- breeding areas within marshes that are aerially larvicided. Sites that are considered for aerial applications of larvicides are those that are too large or inaccessible for ground application and breed mosquitoes consistently and persistently. There are approximately 4,000 acres of salt marsh that receive aerial larviciding at this time. A major focus of the water management plan is to substantially reduce this acreage. Until those projects have been undertaken, the sites will be monitored weekly by SCVC crews. Testing in the salt marsh will be on a presence/absence basis, with identification of the larval stage included to guide pesticide choices. Use of GPS equipment will allow for good determinations of the portion of the marsh that is breeding. Field observations regarding the intensity of breeding will also be useful for decision-makers. In addition, the state of the tide and the status of water on the marsh may be used in making treatment decisions. It may be that a careful analysis of treatment histories and subsequent adult mosquito infestations suggest that a certain amount of larvicide treatments can be eliminated for some of the marshes. Then analysis of larval survey records may help determine some kind of threshold value for each particular marsh, probably based on a mean number of larvae per dip.

- breeding areas that are not within marshes that are aerially larvicided. These are wetlands that do not require aerial treatments, either due to their small size or relatively minor mosquito problem. The kinds of mosquitoes that can be expected to be found at these sites have been well determined over time. Therefore, field crews can often make treatment decisions based on sampling results, and efficiently treat any problem that is brewing. Fresh water sites on this list are good candidates for reassessment of routine

treatment measures. It will be important to factor into the decision-making regarding such sites that the control of bridge vectors probably plays an important role in the prevention of EEE County-wide, and so it is unlikely that major breeding sites for known EEE vectors will be allowed to flourish without intervention. Nonetheless, as with the frequency of larviciding in certain salt marshes, some of these fresh water sites may be places where treatment patterns can be altered to ensure that there are no non-target impacts to important elements of the ecosystem.

Larval Treatment Selection

The choice of methods for larval control is based on several factors:

- Species of mosquito present
- Kind of habitat to be treated
- Stage of larvae present
- Efficacy of the considered treatment
- Residual effects (potency and duration)
- Potential environmental impacts of the considered treatment
- Resistance management

Species composition is important for gaining some understanding of breeding patterns. For example, if the larvae belong to a univoltine, brooding mosquito, generally long acting pesticides would be wasteful as there will be no further breeding once this episode passes. For multivoltine, steady-breeding mosquitoes, it is not important to know what stage is currently dominant, as breaking the breeding cycle is more important. For brooding, multivoltine mosquitoes such as *Oc. sollicitans*, knowing what stage the current brood is in becomes very important, so as to disrupt what may be a large emergence.

Bti and Bs need to be ingested to be effective. This limits their utility to Stage I, Stage II, and Stage III larvae. In the salt marsh, Bti seems most effective on stages I and II, when the marsh is

very wet, and when temperatures are relatively low. If these pesticides are considered for use, then they either need to be applied to situations where they will eventually choke off further breeding, or where most of the current mosquitoes will be directly affected by them (CA-CE, 2005b).

One reason for the County to use multiple larvicide products is to allow for resistance management. The County tends to alternate between Bti and methoprene in salt marshes, for example. Bti is effective with Stage I, Stage II, and Stage III larvae, so when development is slower in spring and later summer, Bti is preferred. Methoprene prevents larvae from developing, and is a contact pesticide; so it is effective for all stages of larvae, especially late stages. It is used when larvae are developing quickly, as the lag between detection of larvae in the marsh and treatment with Bti in summer could result in ineffective treatments, as no susceptible organisms would remain because they had all become Stage IV or later organisms. Reliance solely on methoprene could run a considerable risk of developing resistant mosquitoes, by eliminating all mosquitoes except those that methoprene does not kill. Bti uses five distinct toxins to kill mosquitoes; it is generally believed that so many toxic compounds will not allow for resistance to develop, and so from that standpoint Bti has advantages (CA-CE, 2005b). It has been SCVC's experience that using both these materials has resulted in a more effective program than would be possible if only one of either is used. By having Bti and methoprene available for use, SCVC is able to use each of them under the conditions where they are more likely to be effective.

The County will also use a duplex formulation of Bti and methoprene in summer when generations appear to be overlapping, or development is especially rapid. This can also aid in resistance management to either material should any occur, since it is unlikely that mosquitoes can develop resistance to both products simultaneously.

Selected Compounds

Bacillus thuringiensis israelensis (Bti)

Bti is a naturally occurring soil bacterium used as a microbial pesticide. These materials consist of bacterial spore, rather than live bacteria, and must be ingested by the larvae to be effective (CA-CE, 2005b).

Bti's selectivity in terms of its ability to target the larvae of certain insect species, particularly mosquito and black fly larvae, is attributable to a variety of factors. Bti produces five distinct types of endotoxins. Targeted insects are less likely to build up resistance to Bti because each of the five produced toxins varies to some degree in its mode of toxicity. Alkaline conditions in the larvae's gut, generally corresponding to a pH of seven or greater, are required to activate these endotoxins. Specific enzymes must also be present in the gut to cause activation. In addition, distinct chemical receptors must be present in the plasma membrane of the gut to encourage binding of the endotoxins. Mosquitoes that are most susceptible to Bti include species in the genera *Aedes* and *Psorophora*. *Anopheles* and *Culex* are also susceptible to Bti, but generally higher application rates are required (CA-CE, 2005b).

The length of time that Bti remains effective against insect larvae varies, depending primarily on the species and behavior of the larvae, environmental conditions, and water quality. In general, Bti is effective from one to seven days after application. Because Bti is used predominantly in aquatic settings, its response to light has not been extensively studied. However, UV light in the range of 300 – 400 nanometers (nm), falling within the wavelength range of sunlight, has been shown to inactivate both spores and endotoxins of Bt. Bti toxin can last for a few months in the soil and has an above-ground half-life of one to four days on plant surfaces. In aquatic environments, Bti has a tendency to bind to particulate matter in the water column and settle out on the bottom. When adsorbed to particulates in the water column, Bti is too large to be ingested by insect larvae. Once settled on the bottom, Bti is not available for consumption by targeted mosquito and black fly larvae which reside in the open water column or at the water's surface. Thus, the efficacy of Bti may be limited in aquatic systems with a large amount of particulate matter (CA-IC, 2005).

Bti, as is the case with Bt strains in general, does not colonize or cycle (reproduce and persist to infect subsequent generations of pests) in the magnitude necessary to provide continuing control of target pests. The bacteria may multiply in the infected host, but bacterial multiplication in the insect does not result in the production of abundant spores or endotoxins. Once larvae die, few or no infective units are released into the environment (CA-IC, 2005).

Bacillus sphaericus (Bs)

Bs, as with Bti, is a naturally occurring bacterium used as a microbial pesticide. Bs is found naturally in soil and aquatic environments. Commercial formulations utilizing Bs consist of living bacterium that produce spores. Granules that contain the Bs are mixed with water and other substances, and then sprayed from the air or from the ground (CA-CE, 2005b).

Bs spores produce two delta-endotoxins that are toxic specifically to mosquito larvae upon ingestion. Similar to the mode of action of Bti, Bs exerts toxicity through the release of the endotoxins upon ingestion by mosquito larvae, which results in the disruption of gut activity and ultimately leads to death. The selectivity of Bs is attributable to the fact that certain gut conditions (i.e., pH, enzymes, and chemical receptors) unique to mosquito larvae must be present to result in toxicity. Bs has been shown to be effective against many mosquito genera. All species of *Culex* larvae are considered susceptible to Bs, and many species of *Aedes*, *Psorophora*, *Coquillettidia*, and *Anopheles* are also very susceptible. However, susceptibility of species within these genera is variable. Studies of Bs clearly indicate that it is not infectious or pathogenic (CA-CE, 2005b).

The length of time that Bs remains effective against mosquitoes varies, depending primarily on the species and behavior of mosquito larvae, environmental conditions, and water quality. In particular, Bs appears to recycle in the cadavers of dead mosquito larvae. This means that, in general, the more larvae that are killed in the initial application, the longer the residual action. In general, Bs is effective for one to four weeks after application, although measures of effectiveness range from as little as 2.5 hours to more than 60 days. UV light in the range of 300 – 400 nm, falling within the wavelength range of sunlight, has been shown to inactivate both spores and endotoxins of Bs. Bs is less likely than Bti to adsorb to particulate matter and settle out of the water column. Therefore, it is considered to have generally higher efficacy against mosquito larvae in waters with a higher degree of particulates. As it occurs naturally, Bs does cycle and maintain itself in the environment; however, the insecticidal formulations currently in use do not cycle in salt water to infect subsequent generations of mosquito larvae (but will in fresh water) (CA-IC, 2005). Bs is relatively slow acting, compared to Bti. Larvae in a treated area may hatch, and develop through the first two larval stages prior to being controlled. For this

reason, once an area has been treated, it should not be re-treated unless stages III and IV are present. SCVC field crews have been specially trained to understand this effect in order to avoid unnecessary re-treatments.

Methoprene

Methoprene is a biochemical pesticide found in two formulations (methoprene and methoprene sustained release formula), and is an insect growth regulator that acts by interfering with maturation and reproduction in insects by mimicking the activity of natural juvenile insect hormone. This hormone in insects, secreted by glands near the brain, controls the retention of juvenile characteristics in larval stages. If present, it (or methoprene acting as an insect growth regulator) leads to a suppression of adult characteristics. Although applied at the larval stage, response to methoprene usually occurs in the last instars of the larval or nymph form, or pupae form. In the case of mosquitoes, larvae are the target stage, but the effect is not seen until lack of adult emergence (CA-CE, 2005b).

Methoprene degrades rapidly in sunlight, both in water and on inert surfaces. Within three days of application, 90 percent will degrade via photolysis and microbial metabolism; without microbial metabolism, photolysis will degrade 80 percent in 13 days. Overall, methoprene has a half-life ranging from 30 hours to 14 days, depending on environmental conditions. Higher temperatures and salinity lead to higher degradation rates. The effects of methoprene last up to a week, but it reaches undetectable levels in ponds within 48 hours of application. After four days, only one percent of the original application concentration will persist in the top two inches of soil. Methoprene is tightly adsorbed to soil and is rapidly broken down; therefore it is not likely to be transported to ground water. Methoprene sustained release formulation does not produce residual concentrations greater than those produced with the application of the liquid formulation (CA-IC, 2005). Sediment sampling associated with the Caged Fish experiment suggested that methoprene has a half-life in sediments of approximately one week (Cashin Associates, 2005e). Methoprene has been used by SCVC since 1995, and is particularly useful in the salt marsh, where Bti is not always effective.

Formulations and Uses

There are five basic Bti formulations available for use: liquids, powders, granules, pellets, and briquets. Liquids, produced directly from concentrated fermentation slurry, tend to have uniformly small (two to 10 micron) particle sizes, which are suitable for ingestion by mosquito larvae. Powders, in contrast to liquids, may not always have a uniformly small particle size. Clumping, which results in larger sizes and heavier weights, can cause particles to settle out of the feeding zone of some target mosquito larvae, preventing their ingestion by the typical filter feeding process used by these insects. Powders must be tank-mixed before application to an inert carrier or to the larval habitat. They must be mixed thoroughly to achieve a uniformly small consistency. Bti granules, pellets, and briquets are formulated from Bti primary powders and an inert carrier. Bti labels contain the signal word "CAUTION" (CA-CE, 2005c) SCVC will predominantly use liquid and briquette formulations.

Available commercial brands of Bti liquids include Aquabac XT, Teknar HP-D, and Vectobac 12AS. Labels for all three products recommend using four to 16 liquid oz. per acre in unpolluted, low-organic water with low populations of early instar larvae (clean water situations). The Aquabac XT and Vectobac 12AS (but not Teknar HP-D) labels also recommend increasing the range from 16 to 32 liquid oz. per acre when late third or early fourth instar larvae predominate, larval populations are high, water is heavily polluted, or algae are abundant (CA-CE, 2005c). Bti liquids will be applied by air or truck, with or without methoprene in a duplex formulation.

Bti briquets (donuts) are a mixture of Bti, additives, and cork. They are designed to float and slowly release Bti particles to the water body for extended periods of time. They apparently are attractive to raccoons because of their odor, and may sometimes be disturbed or carried off (other wildlife may also feed on them). Donuts may be staked in place to prevent wind from moving them from a site's littoral zone into open water. The use rate is one donut per 100 square feet in clean water and up to four donuts per 100 square feet in dirty water (CA-CE, 2005c). They are available for use in recharge basins, pools, and, potentially, catch basins, although the difficulties associated with highly organic water make these somewhat less preferred than either Bs or methoprene.

Corncob granules use a carrier that is dense enough to penetrate heavy vegetation. There are currently two popular corncob granule sizes used in commercial formulations. Aquabac 200G, Bactimos G, and Vectobac G are made with 5/8 mesh size grit-crushed cob, while Aquabac 200 CG (Custom Granules) and Vectobac CG are made with 10/14 mesh size grit cob. Aquabac 200 CG is available by special request. The 5/8 mesh size grit is much larger and contains fewer granules per pound. The current labels of all *Bti* granules recommend using 2.5 to 10 lbs. per ac. in clean water and 10 to 20 lbs. per ac. in dirty water situations (CA-CE, 2005c). SCVC uses these products to larvicide on Fishers Island.

VectoLex-CG is the trade name for a granular formulation of Bs (strain 2362). The product is formulated on a 10/14 mesh size ground corncob carrier. The VectoLex-CG label carries the "CAUTION" hazard classification. Bs is designed to be applied by ground (by hand or truck-mounted blower) or aerially at rates of five to 10 lbs. per ac. Use of the highest rate is recommended for dense larval populations. VectoLex WSP, a water-soluble pouch, is registered for use in catch basins, and is a recommended product for them. They are also used in fresh water habitats that hold their water, because the cycling of the bacteria provides additional control over time. Bs is not suitable for habitats that dry down, as the bacteria will perish (CA-CE, 2005c).

Altosid is the name of the methoprene product used in mosquito control and is applied as briquets (similar in form to charcoal briquets), pellets, sand granules, and liquids. The Altosid label carries the "CAUTION" hazard classification. The liquid and pelletized formulations can be applied by helicopter and fixed-wing aircraft (CA-CE, 2005c).

Altosid Liquid Larvicide (A.L.L.) and A.L.L. Concentrate**:** These two flowable formulations have identical components except for the difference in the concentration of active ingredients. A.L.L. contains five percent (wt./wt.) s-methoprene while A.L.L. Concentrate contains 20 percent (wt./wt.) s-methoprene. The balance consists of inert ingredients that encapsulate the s-methoprene, causing its slow release and retarding its ultraviolet light degradation. Use rates are three to four ounces of A.L.L. five percent and 0.75 to one ounce of A.L.L. Concentrate (both equivalent to 0.01008 to 0.01344 lb. AI) per ac., mixed in water as a carrier and dispensed by spraying with conventional ground and aerial equipment. A.L.L. Concentrate is recommended for aerial and truck applications (CA-CE, 2005c).

The Altosid Briquet was the first solid methoprene product marketed for mosquito control beginning in 1978. It is made of plaster (calcium sulfate), 3.85 percent (wt./wt.) r-methoprene, 3.85 percent s-methoprene (0.000458 lb. AI/briquet), and charcoal to retard ultraviolet light degradation. Altosid Briquets release methoprene for about 30 days under normal weather conditions. Application should be made at the beginning of the mosquito season and under normal weather conditions repeat treatments should be carried out at 30 day intervals. The recommended application rate is one briquet per 100 square feet in non-flowing or low-flowing water up to two feet deep. Recommended treatment sites include storm drains, catch basins, roadside ditches, ornamental ponds and fountains, abandoned swimming pools, construction sites, and other artificial depressions. Altosid also comes as a XR Briquet**,** made of hard dental plaster (calcium sulfate), 1.8 percent (wt./wt.) s-methoprene (0.00145 lb. AI/briquet), and charcoal to retard ultraviolet light degradation. Despite containing only three times the AI as the "30-day briquet," the comparatively harder plaster and larger size of the XR Briquet change the erosion rate allowing sustained s-methoprene release up to 150 days in normal weather (CA-CE, 2005c). Due to its long release characteristics which minimize the need for retreatments, the County will primarily use the XR Briquet, in appropriate situations..

Altosid Pellets were approved for use in April of 1990. They contain four percent (wt./wt.) s-methoprene (0.04 lb. AI/lb.), dental plaster (calcium sulfate), and charcoal. As with the briquets discussed above, Altosid Pellets are designed to slowly release s-methoprene as they erode. Under normal weather conditions, control can be achieved for up to 30 days. Label application rates range from 2.5 lbs. to 10 lbs. per ac. (0.1 to 0.4 lb. AI/ac.), depending on the target species and/or habitat. This formulation is effective in penetrating habitats with overhanging vegetation. It is also suitable for wetting-drying habitats, as not all of the product dissolves at once, and so it can provide residual impacts when the habitat wet again (CA-CE, 2005c).

Storm water structures should receive either Vectolex WSP pouches or Altosid briquets as a preferred treatment. If the recharge basin being treated appears to have clear water, treatment with Bti donuts is possible, and may indeed be preferred due to the general difficulty of inducing resistance with Bti.

Field crews will have equipment allowing treatment of any site with Bti, Bs, or methoprene. Treatment will depend on the combination of the stage(s) of the larvae, and environmental

conditions. Vectolex may be preferred in swampy situations, as it has greater penetration through undergrowth due to the weight of the pellets. The crew leader is responsible for carefully estimating the area of the application (based on dimensions of the application, so that 100 feet by 100 feet is one-quarter of an acre, for example), and determining the amount of product to be used. In-house and NYSDEC pesticide applicator training enable these calculations to be made in a manner consistent with the law and the appropriate label.

Aerial application decisions will be made based on surveillance data. As stated earlier, Bti is often used for early season applications, and methoprene is often the choice for middle of the summer. Applications should be made at very low altitudes to minimize drift.

Efficacy Measurements

The three major larvicide efforts could be included:

- Catch basins
- Non-aerial larvicide applications (routine monitoring responses, and complaint follow-up)
- Aerial applications

The QA/QC team will have access to application data so that testing is appropriate to the treatment.

Catch basin work is not time sensitive. An appropriate scale of work might be follow-up at a rate of 20 basins per month (tentatively, five basins in four general treatment areas) to dip for larvae to ensure:

1. Treated basins are not now breeding mosquitoes
2. Untreated basins are not now breeding mosquitoes

The intent of the work is to guide the future actions of the field crew to enhance efficiency and ensure that effective treatment is occurring.

Non-aerial larvicide application testing is time sensitive. These sites will need to be visited within a day or two of treatment to sample in a fashion appropriate to treatment. If Bti or Bs were applied, then dipping for larvae is the appropriate measure of success. Bti should kill larvae within 24 hours and so finding live larvae signals that the treatment was not completely successful. For Bs, the finding of stage I and II larvae does not indicate that this slow acting material is not working. Only the presence of stages III, IV and/or pupae indicate that a Bs treatment is no longer working. If methoprene was applied, or a duplex treatment was made, larvae or pupae should be sought for "fly-up" testing. The organisms can be brought back to the laboratory, and their development history traced. Failure to develop is a signal that the pesticide application was successful, although transfer to the laboratory sometimes results in failure to thrive (Cashin Associates, 2005f).

In either situation, the measurements will be more effective if similar, untreated wetlands are sampled concurrently to act as control sites. Again, because of the nature of the sampling methodology, it is unclear if the results can always be quantitatively compared.

A similar procedure should be followed to assay the effectiveness of aerial larviciding.

Optimal frequencies may be best determined once the program is established; as a coarse estimate, something in the vicinity of 20 sites for truck applications of larvicides, and two aerially larvicided marshes tested each month through the season, seems to be a minimal effort required to develop efficacy information.

Larval Control Triggers

Larval control will only be initiated on the basis of surveillance information. Primarily, the most important information will be the absence or presence of larvae. At the initiation of the Long-Term Plan, it seems likely that the only location where numerical triggers will be employed (based on dipping counts) will be Wertheim National Wildlife Refuge, where SCVC and USFWS determined a site-specific trigger for aerial larvicide applications. SCVC will make a concerted effort to quantify larval sampling data, and as resources allow, will analyze those data to determine if other triggers can be applied to other areas that are regularly treated. It needs to be acknowledged that although dipping data are quantitative, they are also relative and subjective, and usually are not replicable. This is the basis for the County's concerns regarding

general larval control triggers, as very careful and close analyses of data sets for particular settings need to be made to create appropriate values to manage larval populations well.

Some treatments can be made on field crew initiative, following complaint investigations. Others need to be made by more senior personnel (such as aerial larvicide determinations). The general intent of larval control is to prevent the generation of a mosquito problem (that is, a situation where adult mosquitoes affect human health risks or quality of life).

Table 2-21 lists the surveillance results weighed by decision-makers for the variety of larval habitats that may need larval control. Generally, the surveillance data are qualitative in nature (for instance, "much of the marsh" has larvae "present," which indicates a need for action). The choices for action are generally determined by the stage of larvae causing the problem.

Table 2-23. Larvicide Decision Table

Location	Surveillance Result	Quantitative?	Resultant Action
Aerially-larvicided salt marsh	Presence Area Present Stage	@ Wertheim NWR Potentially expandable	Stages I- II: Bti Older: methoprene
Other salt marshes	Presence Stage	No	Stages I- II: Bti Older: methoprene
Permanent Fresh Water Habitat	Presence Stage Environmental Considerations	Possible	Stages I- III: Bs Older: methoprene
Transient Fresh Water Habitat	Presence Stage Environmental Considerations	No	Stages I- III: Bti Older: methoprene
Catch Basins	Presence	No	methoprene time release
Recharge Basins	Presence Environmental Considerations	No	Stock fish Transient: Bti donuts Permanent: Bs Methoprene time release
Artificial (e.g., swimming pools)	Presence	No	Empty If not possible: Bti, methoprene

2.10.6 Adult Control

The decision to apply adulticides must be based on information drawn from scientifically-based surveillance activities. Having stated that, the decision will not be based on a single treatment threshold. Applying an adulticide to control mosquitoes is a decision based on the mosquito species, the numbers of mosquitoes present, the threat or presence of a human pathogen, the age

and history of the mosquito population of concern, and the time of year. In addition, historical and current trends in the mosquito populations, the current weather, the predicted weather, both short-range and over an extended period of time (seasonality), the environmental setting, and the people in the area where the pesticide will be applied also need to be factored into this equation. This discussion has been significantly expanded in Table 2-24, and presented as flow charts in Figures 2-8 and 2-9.. The assessment of these various factors form a risk determination by program managers, where potential benefits (and potential costs) of applying the pesticide are weighed against the probable costs (and potential benefits) of not applying the pesticide. The costs of not applying the pesticide are the only element described as probable, because at the time of application the present impacts of the mosquito population to human health and public welfare, is the most well-known factor under consideration. In addition to this complex set of variables, there is also, to a certain degree, the expressed preference of the community that may or may not receive the treatment. However, it should also be understood that firm criteria for vector control adulticide applications will include 25 human-biting mosquitoes per trap night when New Jersey trap data are available, or 100 human-biting mosquitoes when CDC trap data are available.

Table 2-24. Adulticide Decision Parameters

Type of Parameter		**Factor for Vector Control Applications?**	**Factor for Applications under Health Emergency?**	**Criteria**	**Comment**
Basic Surveillance Parameters	Number of mosquitoes	Yes	No	Counts in light traps significantly above norm; landing rates; complaints	Not a fixed value; somewhat species specific; ~ 25 per NJ trap, ~ 100 per CDC trap; landing rate 5+/min.; complaints invaluable where traps are not set; intend to set CDC traps before all non-Fire Island applications
	Species present	Yes	Yes	Light trap content analysis	Information on basic mosquito biology essential: Vector Control targets aggressive biters; Health Emergency targets specific (bridge) vectors; ; intend to set CDC traps before all non-Fire Island applications
	Complaints	Yes	Yes	Number/location of calls	Evaluate in historic context; complaints must be supported with appropriate surveillance data; complaints document extent of problem better than traps can
	Historical population trends	Yes	No	Surveillance data records	Data patterns often signal that problem is about to abate, or is likely to worsen
Species Specific Parameters	Aggressiveness of target species	Yes	Yes	Documented biting patterns of trapped mosquitoes	Aggressive biters indicate greater problem, increased likelihood for bridge vector participation
	Activity patterns of target species	Yes	Yes	Documented host seeking patterns, flight ranges of trapped mosquitoes	Guides actual control decision; e.g., evening vs. later at night; day-time flying may inhibit control; spot treatments only effective for short flight range species; large flight ranges require applications to cover larger, continuous areas to be effective
	Vector Potential	No	Yes	Infection rate, vector competence, % mammalian meals of trapped species	Establishes relative risk for species present
	CDC Vector Index	No	Maybe	MIR, trap counts for all potential vectors	CDC light trap counts * MIR, summed over all vector species; higher index correlates to more human infections following week; requires high mosquito/human infection rates for use; can use only with multiple trap data sets

Type of Parameter		Factor for Vector Control Applications?	Factor for Applications under Health Emergency?	Criteria	Comment
Species specific parameters, continued	Parity rates	Sometimes	Yes	Age (blood meal history) of biting population	For Health Emergency, high parity rates indicate majority of biters had prior blood meal – direct indication of increased Vector Potential; for Vector Control, an aging population, even if smaller, will be treated since it represents increasing vector potential
	Life Cycle Type	Yes	Yes	Trap analysis	Brooded mosquitoes eventually die off on own, continuous breeders build populations over season
Public Health Parameters	Bird testing	No	Yes	Presence/absence of virus	Provides early warning in terms of bird to bird transmission; documents active disease foci in County
	CDC mosquito pool testing	No	Yes	Presence/absence of virus	Amplification vectors provide early warning, document active disease foci in County; bridge vectors indicate virus present in human biting species, is signal that human health risk is imminent
	Veterinarian reports	No	Yes	Ill/dead target animals	Non-mammals provide early warning, document active disease foci in County; mammalian cases indicate virus present in bridge vectors, signal that human health risk is imminent
	Physician reports	No	Yes	Human cases	Realized human health threat
	Disease history	No	Yes	Number of human/ important animal cases in prior years	Indicates that local conditions are favorable for pathogen amplification and transmission
	Avian dispersal/migration patterns	No	Yes	Time of year regarding dispersal of hatch year birds and known migration periods	Identifies new areas for concern, signals need to control known bridge vectors
Climatic Parameters	Current weather	Yes	Yes	Temp = 65+ Wind < 10 mph No rain	Application time decision
	Short-term weather forecast	Yes	Yes	Presence of fronts & storms; barometric patterns	Application planning
	Time of year	Yes	Yes	Spring, Summer, & Fall activity patterns for trapped mosquitoes	Species-specific behavior; generally, cooler weather retards activity, warmer weather increases activity; virus presence not as significant when activity decreases

Type of Parameter		**Factor for Vector Control Applications?**	**Factor for Applications under Health Emergency?**	**Criteria**	**Comment**
Ecological Parameters	Environmental factors in target area	Yes	No	Environmentally sensitive settings (R-T-E species)	Prior mapping is essential to clearly identify all environmentally sensitive areas; usually addressed through NYSDEC; Town and other expert cooperation is sought
	Population	Yes	Maybe	Number of impacted people/population density	For Vector Control: no people means no problem; for Health Emergency, threat may be sufficient
	Application restrictions	Yes	In some settings	Farms; no-spray list; NYSDEC wetlands, wetlands buffers; open water buffers; FINS	Vector Control no-spray areas include crop areas, no-spray list, buffers – discontinuities may make application ineffective; FINS Health Emergency criteria are more stringent than County criteria

The purpose for controlling adult mosquitoes is always to prevent impacts to people from their presence. Suffolk County has a pesticide phase out law that sets a goal of limiting or eliminating pesticide use when possible. Adherence to this principle is an important element of the decision-making, and means that managers tend to avoid applications whenever the impacts from mosquitoes are not exceptional.

Mosquito adulticides must be used in residential areas to control mosquitoes that are biting people. This means that human exposure to the materials is inevitable, and efforts to minimize exposure to pesticides are prudent. In addition, it is at least theoretically possible that there are as yet unknown adverse impacts that could result from use of these materials, so that it is wise to place limits on their use.

Treatment Decisions

It must be emphasized that whenever adulticiding is being considered, it is in the context of IPM. In any situation where adult control is being considered, mosquito control has already been undertaken through public education, source reduction (including aggressive, progressive water management programs), and larviciding. Adulticiding is being considered as the last means of achieving protection of human health and public welfare. It is certainly not the management tool of first choice for Suffolk County.

There are two possible conditions for adulticiding to occur under. One is when a declared health emergency applies, and the other is for vector control purposes. In either case, a multivariate assessment of scientific surveillance information will drive the decision-making.

Typically adulticide treatments are differentiated between those that are undertaken for the protection of human health and those that are needed for public health nuisance abatement to provide for relief of human discomfort (vector control). As discussed earlier in Section 2.8, the planners of the County mosquito program have found it difficult to clearly separate mosquito control conducted for human health protection from that conducted for preservation of quality of life. This is especially difficult when considering the program as a whole, since many treatment decisions need to be made prophylactically under conditions where WNV (or another arbovirus) may eventually emerge as an imminent health threat. Differentiation between adult control for

vector control as compared to human health protection is also very difficult to do. Legally, it is simple, as vector control adulticiding does not occur on the basis of a public health emergency declaration by the Commissioner of SCDHS. However, mosquitoes that are controlled for human health protection (those which carry the greatest risk of disease transmission) tend to be very aggressive human biters. This means that reducing their numbers to reduce disease threats also reduces the level of discomfort experienced by people. This means that adult control for human health protection also provides quality of life benefits. Secondly, the conditions that cause the most discomfort to people in Suffolk County (large numbers of *Oc. sollicitans* mosquitoes in coastal communities) also contain a certain amount of disease risk and potential impacts to health, under all situations. It is clear that elimination of aggressive biting mosquitoes clearly improves public welfare for those in the afflicted areas. But vector control also provides a degree of protection of public health. Instead of being discrete, the separate kinds of treatments actually describes a continuum of control rationale, where neither a purely health protection event nor a purely nuisance control event can be considered likely to occur. But it is also true that every adulticide application is either a "vector control/public health nuisance control" treatment (made under the authority of SCVC) to primarily preserve quality of life (but also reducing potential human health impacts), or a "public health emergency" treatment (made under the authority of the Commissioner of SCDHS) to primarily reduce risks of human disease (but also reducing the quality of life impacts attributable to the adult mosquitoes, as well).

Under a declared health emergency, the benefits associated with pesticide use include disruption of transmission of disease. However, such adulticide treatments are not made wherever indications of disease are found, but rather where the risk factors indicate that the greatest possible risk is located. Under the WNV conditions that currently exist in the County, treating wherever indications of disease are found might mean treating most of the County each summer.

Control decisions are not made merely on the number of mosquitoes, or the amount of human biting that is occurring. These are important issues, but they are not definitive. Other information is required in order to determine if adult control is necessary:

- Species of mosquitoes present, from trap data
- Relative numbers of mosquitoes, by species, from trap data

- Population trends, from past data sets and control sites
- Aggressiveness of the mosquito population, inferred from trap data, based on species composition, based on complaint logs, and/or from landing rates
- Activity pattern of the species of concern (preferred feeding habits, resting habitats, etc.), from trap data
- Presence or absence of virus, from laboratory analysis of mosquitoes, dead birds (may no longer be realistic), sentinel birds, and/or wild avian surveillance, or the presence of human cases
- Analysis of the risk posed by the particular virus, based on professional judgment and CDC-NYSDOH guidance
- Parity of mosquitoes (percent of the population that has previously had a blood meal)
- Bird migration patterns
- Current weather and short-term weather forecasts
- Long-term weather trends (time of year considerations)

Not every decision can have (or needs to have) a complete information set, and sometimes decisions may be tentatively made and then confirmed based on very immediate data collection. The kinds of applications that have historically been made will be revisited in light of the Long-Term Plan decision process, to illustrate how the process should function.

There are several areas in the County, mostly along the south shore, that typically experience inundations by broods of salt marsh mosquitoes several times in a year. Knowledge of the mosquito broods comes to SCVC management in several ways:

- Reports from field crews prior to the outbreak, suggesting large numbers of larvae were present on the salt marsh (as a prelude to larviciding)

- Follow-up reports from field crews conducting larval surveillance on the marshes, indicating high numbers of biting adult mosquitoes on the marshes

- Increases in biting complaints from the community (these are logged and mapped by SCVC)

- Requests from elected officials (mayors, legislators and others) or community groups

- New Jersey light trap data, indicating increases in *Oc. sollicitans* numbers in the sentinel traps

All complaints are followed up. Therefore, field crews will be dispatched to the areas where complaints are being logged, and will confirm (or not) that an infestation has occurred (people with party or holiday plans have been known to try to arrange for prophylactic applications to ensure no mosquito disruptions). Informal landing rate tests across open fields are a good test for the presence of *Oc. sollicitans* during the day. If trap counts are excessive (25 biting adults per trap night, compared to a more usual zero to five count, in New Jersey light traps, and 100 mosquitoes per night in a CDC light trap), and mosquitoes have been confirmed, the general area where the infestation is occurring is mapped, based on complaints received and the follow-up visits by field crews. Since truck applications are the typical means of responding, the road network of the area is used to determine the potential boundary of the application. Weather forecasts will be accessed to determine if conditions seem to be acceptable for a potential application, and to ensure a cold front or other storm situation will not occur to eliminate the need for the application. It is also assumed that the time of year indicates that the infestation is not about to become less due to cooler temperatures, as might be the case in September or later in the season, or in May or early June (mosquito activity slows with decreasing temperature, and rises with increasing temperatures). Population trends for the particular area will be observed to ensure that typically these conditions do persist (most of the areas where such control treatments are considered are well-known to SCVC administrative staff). No-spray addresses and key environmentally sensitive areas are factored in, and then the application area is noticed, so that an application can occur the next evening.

At this time, the QA/QC team should locate a suitable area in or near the center of the application block, and set up a CDC light trap for confirmatory sampling. This trap would also be used for baseline data as a measure of treatment efficacy. Another trap, outside but near to and in a somewhat similar setting, could be established for a control site. In the morning, the two traps would be collected. The species and number of biting mosquitoes would be noted. A target for the decision to continue with application plans would be the presence of 100 or so biting mosquitoes in the CDC trap of interest. Anything substantially less than this, or a notable shift in the speciation of the trapped mosquitoes, requires reassessment of the application decision.

Assuming that the trap confirms the decision, and the weather is appropriate, the application will occur on the second evening. The next night, CDC traps would again be set, and the collected data used to calculate the efficacy of the application. The intent of the control program is to reduce targeted species' numbers by an order of magnitude (measured trap counts, as adjusted by the control results, would be expected to be 90 percent less than the original counts). These actions are intended to reduce impacts to the quality of life experienced in the neighborhood, and also to reduce disease risk by eliminating older mosquitoes from the available population. Breeding may also be slightly curtailed (but unless the marshes are also targeted, not enough of the salt marsh mosquito population will be killed to seriously impact overall breeding). Populations out on the marshes can only be successfully curtailed through effective water management and larvicide applications.

It is possible that areas outside of typical locations impacted by biting mosquito problems will appear to need treatment. In these cases, initiation of recognition of a problem will probably begin with complaint calls, and continue with follow-up on the calls. It is less likely a set New Jersey light trap will be set conveniently to assess the problem, and so the analysis may not proceed quite as quantitatively as described above. It is all the more important to analyze overall mosquito population trends for this season and previous seasons, in these cases, and to set the pre-application CDC light traps, and carefully analyze the data from those traps prior to confirming any application decision.

The decision-making process can be summarized by the following four criteria:

1. Evidence of mosquitoes biting residents (there is no problem unless people are affected):

   - Service requests from public - mapped to determine extent of problem
   - Requests from community leaders, elected officials

2. Verification of problem by SCVC (service requests must be confirmed by objective evidence):

   - New Jersey trap counts higher than generally found for area in question (at least 25 females of human-biting species per night).
   - CDC portable light trap counts of 100 or more.
   - Landing rates of one to five per minute.
   - Confirmatory crew reports from problem area or adjacent breeding areas.

3. Control is technically and environmentally feasible (pesticides should only be used if there will be a benefit):

   - Weather conditions predicted to be suitable (no rain, winds to be less than 10 mph, temperature to be 65ºF or above).
   - Road network adequate and appropriate for truck applications.
   - "No- treatment" wetlands, wetlands and open water buffers, and no-spray list members will not prevent adequate coverage to ensure treatment efficacy.
   - There are no issues regarding listed or special concern species in the treatment area.
   - Meeting label restrictions for selected compounds (such as avoiding farmland) will not compromise expected treatment efficacy.

4. Likely persistence or worsening of problem without intervention (pesticides should not be used if the problem will resolve itself):

- Considerations regarding the history of the area, such as the identification of a chronic problem area.

- Determination if the problem will spread beyond the currently affected area absent intervention, based on the life history and habits of the species involved.

- Absent immediate intervention, no relief from the problem can be expected (such as when proximity to uncontrolled sources such as Fire Island National Seashore wetlands will result in ceaseless migrations into the area).

- Crew reports from adjacent breeding areas suggest adults will soon move into populated areas.

- Life history factors of mosquitoes present – i.e., if a brooded species is involved, determining if the brood is young or is naturally declining.

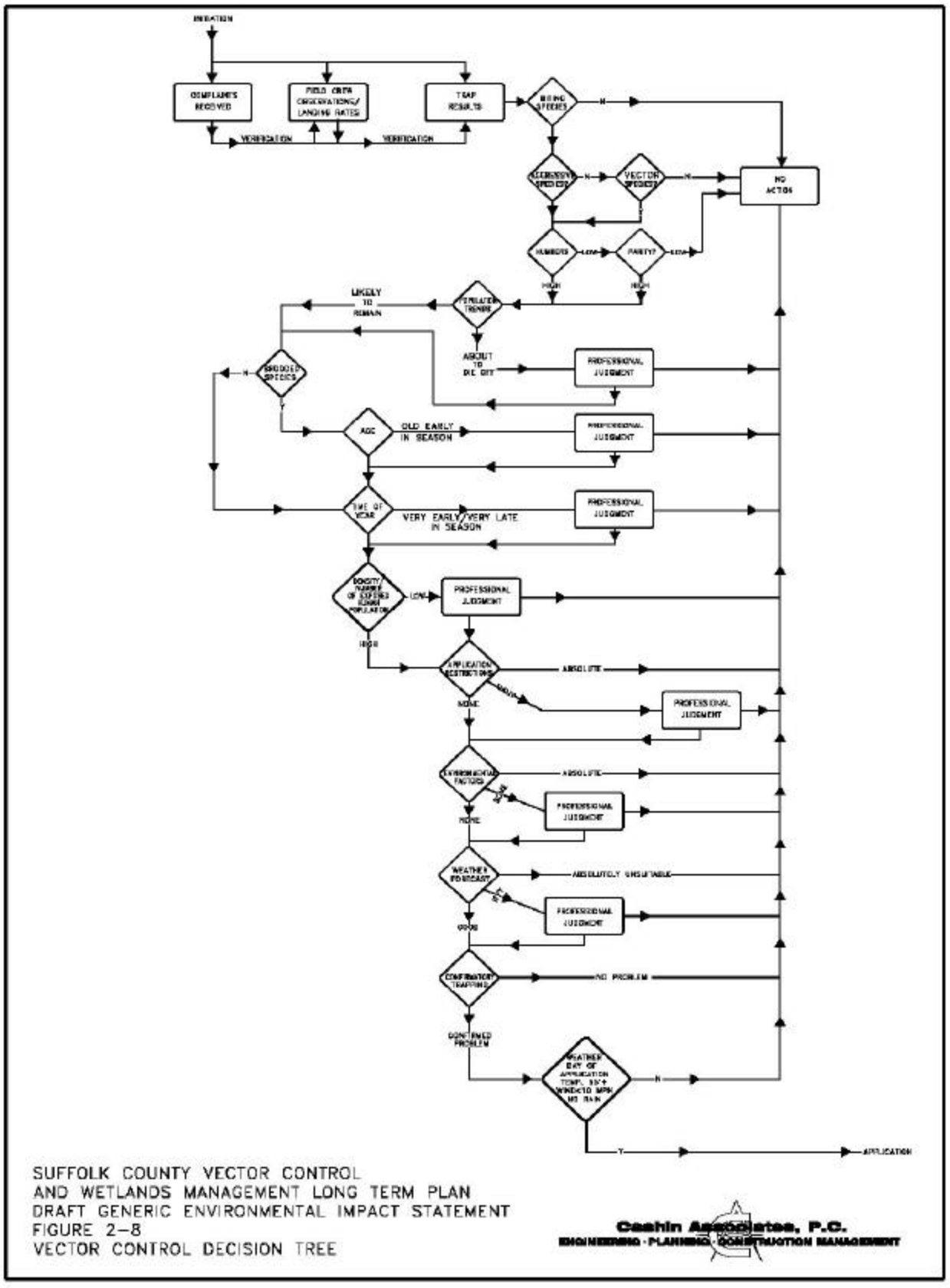
- Seasonal and weather factors, in that cool weather generally alleviates immediate problems, but warm weather and/or the onset of peak viral seasons exacerbate concerns.

- Determining, if the decision is delayed, if later conditions will prevent treatment at that time or not. Conversely, adverse weather conditions might remove most people from harm's way.

In essence, criteria 1 and 2 are necessary thresholds which must be met, prior to a treatment being considered. With enhanced surveillance, there will be rigorous, numeric validation of mosquito control infestation near a potentially affected population in all cases. Treatment will not occur unless criteria 1 and 2 are satisfied through a combination of surveillance indicators, although not all surveillance techniques may be feasible in every setting and situation.

Criteria 3 and 4 are "treatment negation" criteria. If certain conditions are met, treatment will not occur, even if treatment is otherwise be indicated by criteria 1 and 2. Careful records on criteria and thresholds (and related conditions) which trigger each treatment will be kept, for every adulticiding event.

Figure 2-8 illustrates the decisions that are made to reach a vector control application decision. The term "professional judgment" is used to show that the decision most often involves weighing the factors that appear to indicate that control is necessary in light of those factors that indicate control is not necessary.



SUFFOLK COUNTY VECTOR CONTROL
AND WETLANDS MANAGEMENT LONG TERM PLAN
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
FIGURE 2–8
VECTOR CONTROL DECISION TREE

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Fire Island Communities

Historically, SCVC has routinely applied adulticides as vector control treatments in certain of the Fire Island communities. As part of the application process for a special use permit for mosquito control in FINS, the County is meeting with NPS staff to determine mutually agreeable procedures for conducting operations in various settings, under various conditions. The structure and content of the Long-Term Plan are to be the guides for this site-specific plan. However, it is not yet known what conditions and at what locations adulticides may be applied in FINS at this time.

Declared Health Emergencies

Control decisions under a declared health emergency are different from those employed for a vector control decision. SCDHS has overall responsibility, is responsible for ensuring that the risk assessment has been properly conducted, and reviews the operational plan proposed by SCVC to meet the required risk reduction. The risk assessment first requires that mosquito-borne disease has been detected in the County. On rare occasions the identified mosquito problem has involved malaria; however, the modern mosquito-borne diseases of concern are arboviruses. The most prominent of these, and the ones most likely to be detected in the County, are WNV and EEE.

The County's disease management protocol is based on the NYSDOH four-tiered WNV response strategy. It differs is some minor respects from that overall approach, but essentially follows the overall strategy. Table 2-25 summarizes the NYSDOH WNV response strategy (presented earlier as Table 2-7).

Table 2-25. NYSDOH Four-Tiered WNV Strategy

Tier	Circumstances	Response
I	No historical or current evidence of virus No neighboring Health Unit with historical/current evidence of virus	Level 1 education campaign Enhanced passive human/bird surveillance Consider adult mosquito surveillance (species, distribution) Lower priority for lab testing Consider larval surveillance Consider local environmental assessments Consider local disease risk assessments
II	Historical evidence of virus Neighboring Health Units with historical	Level 1 enhanced education program (general community & provider community)

	evidence	Local environmental assessments Local disease risk assessments Active human (if evidence in-unit)/bird surveillance Larval surveillance Larval habitat source reduction Larval control Adult surveillance and lab testing
III	Current virus isolation/evidence of infection in individual locations	Level 2/3 education program (general public & provider community) Active human/bird surveillance Larval surveillance Larval habitat source reduction Larval control Adult surveillance and lab testing Adult control, ground application
IV	Current virus isolation/evidence of infection in multiple locations	Level 2/3/4 education program (general public & provider community) Active human/bird surveillance Larval surveillance Larval habitat source reduction Larval control Adult surveillance and lab testing Adult control, ground application

Because WNV and EEE have been historically detected in Suffolk County, the County essentially begins each mosquito season in Tier II of the NYSDOH tiered approach.

Over the period 2000 to 2004, the signal of WNV presence in birds was finding dead crows that tested positive for virus. It appears that nearly all susceptible crows have died from the disease, or, in any case, the survivors and their off-spring do not readily perish from WNV, at least as often as they used to. This means that new sentinels must be developed. Whatever method is selected (see the Surveillance section, above), testing of these samples could continue to occur in-house, with some samples sent to NYSDOH in Albany for confirmation and more inclusive general viral scans.

If no alternative bird surveillance tool is developed, the County will need to step up its use of CDC light and gravid traps, collecting more samples, more frequently, and from many more locations. Currently, CDC light traps are set at fixed stations in areas where EEE and WNV have reoccurred, and more are set to investigate bird deaths and positive bird samples. Gravid traps are also set to particularly target *Cx. pipiens* (for WNV surveillance). Absent bird deaths to target sampling, means of generally conducting surveillance across the entire County will need to be established. This will require some method of increasing the density in both time and space

of the CDC trap network. Increasing the number of CDC trap samples collected is very labor intensive, both in terms of managing the traps (set-outs and sample collections) and in processing the collected samples. The nature of mosquito-borne disease is also that a low infection rate in mosquitoes can result in very high infection rates in target species, so that sampling mosquito pools is not very efficient at identifying areas where infectious agents are present and circulating. For these reasons, identification of alternate bird sampling methodologies is preferable.

If surveillance reveals the presence of WNV (birds or mosquito pools), the County will petition to the State Commissioner of Health for a declaration of a Health Threat. This allows the County to apply for reimbursement of certain expenses in SCDHS relating to mosquito control, and places SCVC formally under the direction of the Commissioner of SCDHS. It is also a necessary first step prior to any declaration of a Health Emergency. This also moves the County to Tier III of the NYSDOH tiered response strategy.

A health threat declaration will also be sought in sampling results from *Cs. melanura* pools shows that EEE is amplifying in bird populations. This is signaled by detection of a *Cs. melanura* positive pool from samples sent to Albany for analysis.

The declaration of a health threat will also be accompanied by stepped-up public education and outreach, through SCDHS press releases and web site publications. These are intended to draw attention to the heightened state of concern regarding mosquito-borne disease. In addition, SCDHS will contact its physician and hospital reporting network, and touch base with local veterinarians. This ensures that any human or sentinel animal cases of mosquito-borne disease are promptly reported.

Detections of clusters of positive WNV pools for *Cx. pipiens* would signal the potential for adulticide control. In that case, the presence or absence of potential bridge vectors would be an important consideration, especially if the bridge vectors tended to have a higher parity rate. For flood water mosquitoes, a determination as to whether a brood was waning naturally, and need no control for numbers to be of little concern, would also be a factor, although not necessarily a compelling one. With bridge vectors, older mosquitoes are much more dangerous than young mosquitoes, so a large population of virgin mosquitoes is much less risky than a small population entirely populated by blooded mosquitoes (CDC, 2003). Time of year is important, as it has

been suggested that *Cx. pipiens* changes its feeding habits after the first week of August or so, and feeds more regularly on humans (Kilpatrick et al., 2006). This makes it a more dangerous mosquito, especially as the species (in general) transitions from bird feeding to human feeding (increasing the potential to pass virus along). In late summer, as night temperatures drop, *Oc. sollicitans* begins feeding more commonly during the day (Means, 1979). This makes control harder, as the mosquito is less likely to be flying when the insecticide would be applied. Thus, late summer-early fall adulticiding is less common for *Oc. sollicitans* vector control purposes. These conditions move the County to Tier IV of the NYSDOH tiered strategy.

Another factor considered in control decisions is the size of population (and its composition, if greatly different from the County as a whole) in the near vicinity of the problem. Generally, the more people potentially exposed to the disease threat, the greater the likelihood of an adulticide application. If positive results occur in a bridge vector pool, then this too signals a potential need for adult control (CDC, 2003). If the virus were to be detected in *Oc. sollicitans*, especially, given its very aggressive biting habits and generally large numbers, concerns would be raised. The age of the brood, the time of year (control is more difficult late in the year when the mosquitoes fly at night as less often), and weather patterns (mosquito activity can be reduced by colder weather, or heat can make them more active) all need to be factored into the decision.

For EEE, the threat of a bridge vector brood near a cycling center is a strong impetus towards declaration of a health emergency. Generally, Suffolk County has focused on EEE control in the near vicinity of the amplification area. Information gathered through the Long-Term Plan project provides support for the benefits of controlling *Oc. sollicitans* in all areas when EEE threatens, especially where coastal red maple or Atlantic white cedar swamps occur. *Oc. sollicitans* has been persuasively portrayed as the most dangerous and most effective potential vector for EEE. The need to control *Oc. sollicitans* and other bridge vectors generally was underscored through discussions of the potential for dispersing young birds to carry the virus to anywhere along their migration route from natal swamps (where they may have contracted EEE) (Cashin Associates, 2005g). Any dead horses, or dead farmed pheasants or emus, would also signal the need for a health emergency declaration to address EEE, as all of these quickly succumb to the disease. Disease in horses is of special concern, as it signals presence of the virus in a bridge vector.

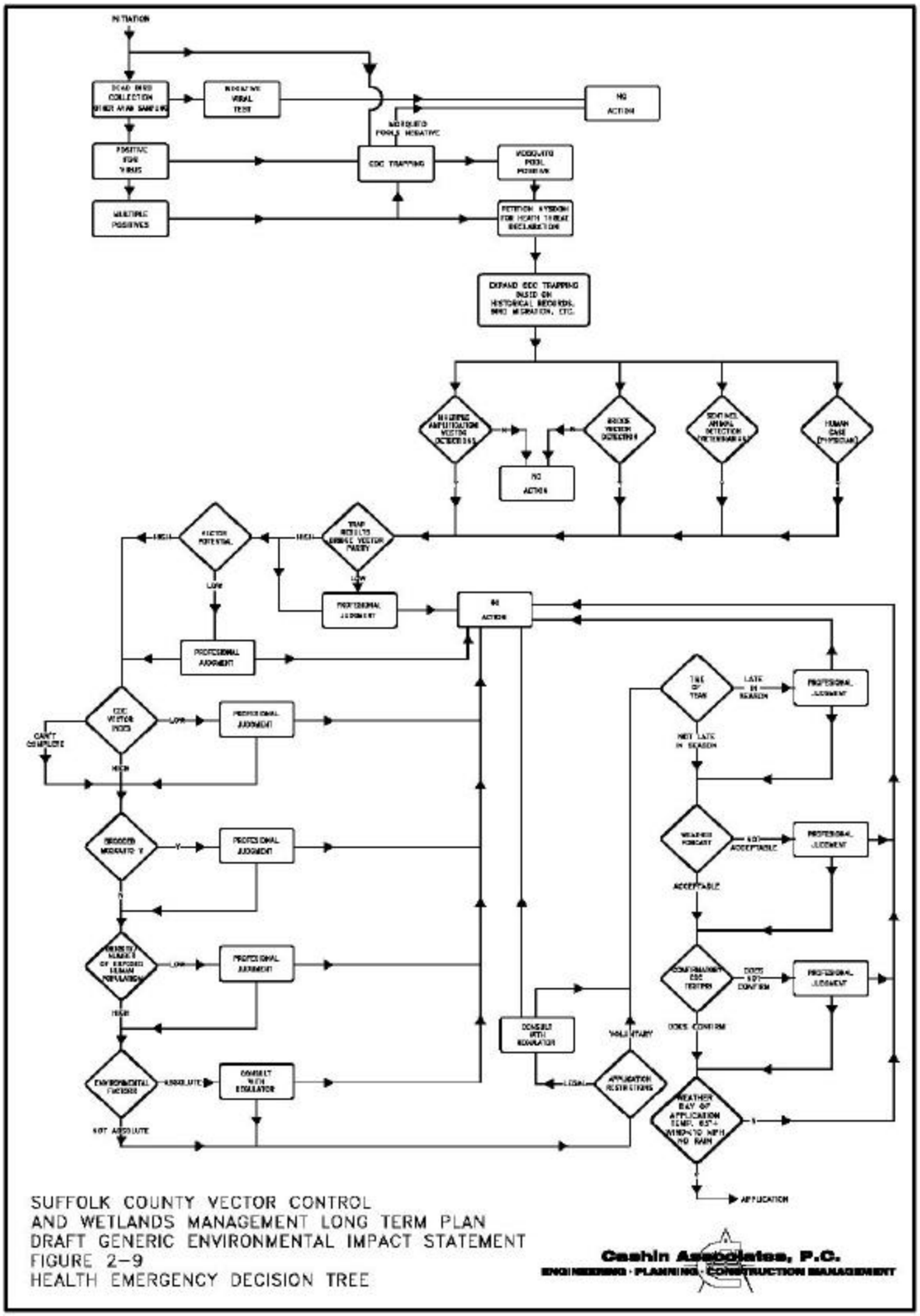
Working with SCVC, SCDHS would determine the best application zone, and determine the most appropriate application approach, based on the target mosquito. Hitherto, Suffolk County has focused its control efforts on bridge vectors, meaning that applications are conducted primarily right after sunset, when nearly all important mosquito species are active. Where *Cx. pipiens* is clearly the mosquito of concern, the timing of an application may be retarded to effectuate a better control on this later-flying mosquito. The target area will be based on surveillance data, tempered by natural features (although a waiver from fresh water setbacks will be received for any disease threat application, major bodies of water serve as natural barriers to mosquito migration and so there is no need to apply pesticides over them needlessly) and label restriction areas such as croplands, if they can be avoided. Notices will be filed, and the expedited NYSDEC permit waiver process pursued. Generally, staff from NYSDEC will make themselves available on very short order to enable a coordinated consultation regarding the proposed application zone to address sensitive species and habitat concerns.

Similarly to vector control applications, the QA/QC team will set out a minimum of two sets of CDC light traps. Not only will these traps serve as efficacy measures for the treatment to follow, but sampling the trapped populations for species and parity can reinforce (or cause re-evaluation) of the application decision. Parous mosquitoes of concern should be present to cause the application to move forward – although it should be understood that at any given time approximately 50 percent of a *Cx. pipiens* population is parous (Cashin Associates, 2005a). Pools from the traps will also be tested for virus presence, although if State facilities are used the results will not be received in a decision-timely manner. Efficacy will be at least partially determined if parity is lower after the application, and, if pathogens were detected in pools before the application, they are not detected in pools after the application event.

It must be understood that all decisions to apply adulticides in Suffolk County are made in the context of an IPM system. Adulticide applications are always the last, least desired control measure. Great efforts will have been made to avoid their use, beginning with public education, source reduction (including water management), and larval control steps. The decisions are not made arbitrarily, but in light of collected data from a surveillance system that has been bolstered from one described as among the best in the country. Adulticiding will only be undertaken to avoid worse consequences, in full knowledge of the benefits and risks associated with the action.

These considerations mean that the County decisions clearly comply with all Federal and State guidelines issued to help managers make the best possible choices under difficult conditions.

Figure 2-9 illustrates the decision-making process followed when adult control is being considered as a Health Emergency measure.


INITIATION
NO ACTION
EDC TRAPPING
EXPAND EDC TRAPPING INSIDE ON HISTORICAL RECORDS, BIRD MIGRATION, ETC.
NO ACTION
PROFESSIONAL JUDGMENT
NO ACTION
PROFESSIONAL JUDGMENT
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PROFESSIONAL JUDGMENT
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PROFESSIONAL JUDGMENT
CONSULT WITH ENTOMOLOGIST
CONSULT WITH ENTOMOLOGIST
APPLICATION
SUFFOLK COUNTY VECTOR CONTROL
AND WETLANDS MANAGEMENT LONG TERM PLAN
DRAFT GENERIC ENVIRONMENTAL IMPACT STATEMENT
FIGURE 2-9
HEALTH EMERGENCY DECISION TREE
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Selected Pesticides

Pesticides selected by Suffolk County for adulticide control under the Long-Term Plan are all suited for ULV treatments, have no to little detectable human health impacts, and have relatively insignificant ecological impacts (Cashin Associates, 2005d). The ecological impacts are further mitigated by the relatively small area that pesticides are applied over, and the distinct probability that the model (which is based primarily on laboratory testing) overestimates the concentrations of pesticides actually delivered to aqueous environments by several factors, based upon testing conducted in association with this project (Cashin Associates, 2005e). That being the case, it is clear that a model recalibrated with empirical data would confirm the findings of the Caged Fish study, and find little to no impacts to the ecosystem.

In addition to ULV applications, malathion is approved for thermal fogging. Malathion, permethrin, and sumithrin are also approved by NYSDEC for hand-held applications (CA-CE, 2005b).

Resmethrin is to be the primary material for truck and aerial ULV applications. This is based on its record of effectiveness, and the results of the risk assessment (which showed that impacts to human health or the environment were unlikely). Its rapid degradation in the environment provides a margin of safety in avoiding adverse impacts (Cashin Associates, 2005d).

Sumithrin is to be the primary material for hand-held applications, as the label for this product (Anvil) allows for use with small aerosol droplets, while resmethrin (Scourge) does not, currently (CA-CE, 2005b). Because of the similar risk profile found for sumithrin compared to resmethrin (Cashin Associates, 2005d), sumithrin would be an acceptable alternate if resmethrin was not available.

Permethrin had higher ecological risks associated with its use (Cashin Associates, 2005d), and also has label setback requirements that make it less practicable for use in shoreline settings. However, permethrin is a widely produced product, and so is likely to remain available if the other three pyrethroids were not (CA-CE, 2005b).

Natural pyrethrum did not receive as extensive a review as the other pyrethroids. It appears to have a similar risk profile (Cashin Associates, 2005d). It degrades very rapidly, giving it a

margin of error with regard to potential risks. Its labels also allow for application over crops, which is not the case for other pyrethroids. It is expensive (as compared to other pyrethroid products), and is sometimes not readily available (CA-CE, 2005b).

Malathion is of a different chemical class than the pyrethoids (as an organophosphate), which means if pyrethroid resistance became an issue, it would be useful to have as an approved product. It also is labeled for thermal fogging, which is a useful application technique in some settings (underground structures or tire piles) (CA-CE, 2005b). It is technically more difficult to use as a ULV product, and the risk assessment indicated it has higher risks with regard to potential human health or ecological impacts than the other products (Cashin Associates, 2005d). Malathion is identified in the Long-Term Plan only as a specialty tool, for instances where the other pesticides would not be effective or cannot be used.

Pyrethroids

The pyrethroids are synthetic pyrethrin-like materials widely used for insect control. Pyrethrins are natural pesticides harvested from some chrysanthemum plants (mainly *Chrysanthemum cinerarnaefolium*). Chemically, pyrethroids are esters of specific acids (e.g., chrysanthemic acid, halo-substituted chrysanthemic acid, 2-(4-chlorophenyl)-3-methylbutyric acid) and alcohols (e.g., allethrolone, 3-phenoxybenzyl alcohol) (CA-IC, 2005).

Pyrethrins and pyrethroids have a similar mode of action — they work on the nerve axons by keeping open sodium channels used to propagate signals along a nerve cell. Initially, they cause nerve cells to discharge repetitively; later, they cause paralysis. These pesticides affect both the peripheral and the central nervous systems. When applied alone, pyrethroids may be swiftly detoxified by enzymes in the insect. Thus, some pests will recover unless the effect is augmented. To delay the enzyme action so a lethal dose is accomplished for pest control, a synergist (e.g., piperonyl butoxide) is generally added to pyrethroid formulations to improve efficacy (CA-IC, 2005).

Pyrethroids are generally favored above malathion as adulticides. This is because the degradation of pyrethroids in the environment is so swift as to make it extremely difficult to

cause any human or environmental impacts, and yet the pesticides still retain efficacy in killing targeted mosquitoes (CA-CE, 2005b).

Resmethrin

Resmethrin is the preferred pyrethroid, and is generally the adulticide of choice for the Long-Term Plan because of its effectiveness and chemical properties. The risk assessment concluded, at the concentrations resmethrin might be applied in Suffolk County, that no significant health or ecological effects would follow from its use. Resmethrin was identified as potentially impacting night-flying insects, although this appears to result from use of honey bees as the sentinel flying insect based on information availability. Honey bees appear to be more susceptible to impacts from pesticides than other large insects, and so their use may overstate risks (Cashin Associates, 2005d). The effect is likely to be short-lived: sampling in California found that following some reduction in insect populations after adulticide events, the populations rebounded in a matter of days (Jensen et al., 1999). In addition, to further mitigate the potential for any impacts, the Caged Fish study reported much lower concentrations of resmethrin in the water column than were used by the risk assessment model (Cashin Associates, 2005e). The lower concentrations are apparently due to quick environmental degradation of the compound, which was not completely factored into the risk assessment method. In addition, the generally small area of the County that might be affected by resmethrin use should be considered. In 2003, when pesticide applications exceeded recent mean amounts, approximately five percent of the land area of the County was treated, accounting for approximately 12 percent of the County's shoreline. In addition, it is anticipated that the gradual implementation of more progressive water management techniques could lead to a reduction in the need to apply pesticides for mosquito control purposes.

Sumithrin

Sumithrin (sumethrin, phenothrin) is currently used in hand-held adulticide applications (current NYSDEC interpretations of the resmethrin label do not allow resmethrin to be used in hand-held applications) (CA-CE, 2005b). This use would continue under the Long-Term Plan.

Sumithrin is a broad spectrum pyrethroid insecticide registered for use against mosquitoes in swamps, marshes, and recreational areas. The risk assessment concluded, at the concentrations sumithrin might be applied in Suffolk County, that no significant health or ecological effects would follow from its use. As with all of the pesticides, the risk assessment found there might be impacts to night-flying insects. As discussed above, this appears to result from use of honey bees as the sentinel flying insect based on information availability (Cashin Associates, 2005d).

Permethrin

One potential problem with resmethrin and sumithrin is that they are relatively low volume production pesticides. This means if the manufacturer discontinues the product for any reason, the program may be without alternatives that have been reviewed and determined to meet its needs. Therefore, two alternative pyrethroid/pyrethrin products have been identified as meeting the needs of the County, including permethrin.

Permethrin is a broad spectrum pyrethroid insecticide which is used against a variety of insect pests. There are four isomeric forms, two cis- and two trans-, of technical permethrin. Product formulations can vary greatly in isomeric content (CA-IC, 2005).

The risk assessment concluded, at the concentrations permethrin might be applied in Suffolk County, that no significant health or ecological effects would follow from its use. However, as with all of the insecticides that were modeled, the potential for impacts to night-flying insects was found to exist, based on the bee model (discussed above). In addition, permethrin was found to have the potential to impact aquatic invertebrates. Sophisticated ecological modeling found that the loss of certain invertebrates would not have any greater ecological impacts (i.e., the effects did not propagate up the food chain). Additionally, longitudinal modeling suggested rapid recovery for any affected species, so that full ecological recovery would be expected by spring following any application the previous year. These results are somewhat expected, given that permethrin is not persistent in the aquatic environment and does not bioaccumulate to any significant degree (Cashin Associates, 2005d).

Pyrethrum

To add to the selection of pesticides available for County use, and to ensure the County has a product that is registered for use in agricultural areas should treatment there be required,

pyrethrum has been added to the list of approved products. It is somewhat costly, however, and can be difficult to acquire during high demand periods.

Pyrethrum is a natural, botanical pesticide that is an extract of flowers from certain chrysanthemum species. The flowers are either dried or powdered, or their oils are extracted with solvents. The resulting pyrethrum extract or powder is composed of individual pyrethrins; including pyrethrin I and pyrethrin II, cinerins and jasmolins, which are the components that have insecticidal properties. Most of the pyrethrin pesticide products that are available also contain a synergist, such as PBO (CA-CE, 2005b).

Pyrethrum was not as closely investigated as the other three pyrethroids. However, indications are that it is somewhat less toxic than the synthetic pyrethroids. This suggests that, at the concentrations it would be applied in Suffolk County, no significant health or ecological effects would follow from its use (Cashin Associates, 2005d).

PBO

PBO is a derivative of piperic acid and, as discussed, is generally utilized as a chemical synergist in pyrethroid formulations. Pyrethroid products containing PBO are used to control mosquitoes in outdoor residential and recreational areas, as well as indoors to control insects such as fleas, ticks, and ants. Formulations of pyrethrins containing PBO are also used as a pediculicide to control body, head and crab lice (CA-IC, 2005). PBO, at the modeled concentrations, was found by the risk assessment not to have any significant human health or environmental impacts (Cashin Associates, 2005d).

Malathion

Organophosphate pesticides consist of a broad class of chemicals used primarily in insect and pest control. Malathion is a nonsystemic broad-spectrum organophosphate chemical that is used in agriculture and horticulture applications. Malathion contains approximately five percent impurities consisting largely of reaction byproducts and degradation products. As many as 14 impurities have been identified in technical-grade malathion, including isomalathion and malaxon (CA-IC, 2005).

Malathion possesses a relatively low acute toxicity compared to other organophosphates. The risk assessment concluded, at the concentrations that malathion might be applied in Suffolk County, that no significant health or ecological effects would follow from its use. However, as with all of the insecticides that were modeled, the potential for impacts to night-flying insects was found to exist, based on the bee model (discussed above). In addition, malathion was found to have the potential to impact aquatic invertebrates – a slightly greater potential than was found for permethrin. Sophisticated ecological modeling, based on the permethrin impacts which were similar in scope, found that the loss of certain invertebrates would not have any greater ecological impacts (i.e., the effects did not propagate up the food chain). Additionally, longitudinal modeling suggested rapid recovery for any affected species, so that full ecological recovery would be expected by spring following any application the previous year. These results are somewhat expected, given that malathion is not persistent in the aquatic environment and does not bioaccumulate to any significant degree (Cashin Associates, 2005d).

It should be understood that public perception of the toxicity of malathion is based largely on work conducted on agricultural pest control applications. The label rates for malathion for use as a mosquito control pesticide are lower than for its use against general agricultural pests. Mosquitoes are more sensitive to pesticides than most other insects. This means that malathion is applied for mosquito control at much lower concentrations than it is for agricultural pest control, and so any potential impacts are much less as well (Mount, 1996).

Formulations

Scourge 18-54 will be the resmethrin product used by the County. Product labels contain the signal word "CAUTION" (CA-CE, 2005b). The product will be applied either by ground or aerial ULV at label rates.

Anvil 10+10 will be the sumithrin product used by the County. It has a label that contains the signal word "CAUTION" (CA-CE, 2005b). Sumithrin will be applied primarily through hand ULV applications, although it may also be used for ground or aerial ULV uses.

Commercially available permethrin products include Permanone, and Aqua Reslin, but as the patent has expired, brands are proliferating (CA-CE, 2005b). The County has not yet selected a

preferred provider. Permethrin labels may contain either the signal word "WARNING" or "CAUTION," depending on the formulation (CA-CE, 2005b). Permethrin is not a primary use adulticide for the County, but rather will be used if other pyrethroids become unavailable.

Commercially available pyrethrum products include Pyrocide, and Pyrenone (CA-CE, 2005b). The County has not yet selected a preferred product. Product labels contain the signal word "CAUTION." Formulations generally contain five percent pyrethrins with PBO at a one to five ratio. They are applied as a ULV application, and are expensive compared to other products (CA-CE, 2005b), and sometimes are difficult to obtain because demand outstrips supply. Pyrethrum will be used for resistance purposes, and over agricultural areas, if required.

Fyfanon will be the malathion product used by the County. It is one of the most widely used adulticides in the country, primarily because of its lower cost compared with other approved adulticides. The label contains a "CAUTION" warning indicating that it is only a slightly toxic material. Malathion is generally used against all mosquito species of concern, primarily as a ground ULV application, needing no mixing or dilution. For thermal fog applications, malathion is diluted six to eight oz. /gal. with a suitable oil carrier, and applied at up to 40 gal./hr. with a vehicle speed of 5 mi./hr., or multiple thereof. Malathion can be applied using ULV aerial application techniques (CA-CE, 2005b). Malathion will primarily be used for resistance purposes, or if thermal fogging is necessary.

Application Methods

The County uses three application methods, with variations associated with several of the different means. In all instances to address resistance concerns, and to achieve the best possible results, the County will apply the pesticides at the maximum rate allowed by the product label.

There are some general constraints on all application events. Low temperatures inhibit mosquito activity; SCVC has set 65 degrees F as the minimum for operations. Winds cannot exceed 10 mph, as mosquito activity is lower when conditions are windy, and the pesticides will disperse too quickly. Mosquitoes are not as active in the rain, and rain will remove pesticides from the atmosphere, making the application pointless. Therefore, rain is counterindicative for applications.

On Fire Island, where vehicle access is difficult, a golf cart type platform is used to hand haul a London Aire Colt Hand Portable ULV Aerosol Generator to apply adulticides. This is an ultra-low volume (ULV) treatment. Hand applications are only conducted as vector control treatments. Health emergency applications over Fire Island would most probably be conducted by helicopter, as the scope of the event would almost certainly exceed one community.

It should be noted that applying adulticides by aircraft is one way that the County's virus response plan differs from NYSDOH guidelines. State guidelines suggest using trucks to apply pesticides (NYSDOH, 2001); Suffolk County prefers aerial applications in response to Health Emergencies (see below for a discussion of some of the factors that bear on this decision).

The planned hand-held application will be discussed by managers and applicators prior to the applicators leaving SCVC offices. The application route will be specified, along with any setbacks, no-spray properties, and other areas that will not be treated. The specific path to be followed will not be mapped, but will depend on operator judgment (resort communities present special problems such as parties and other congregations that need to be adjusted for in the field). Prior to initiating treatment, the crew would conduct spot larviciding as needed, and also conduct a landing rate survey to ensure *Oc. sollicitans* mosquitoes are still present, and any other confirmatory sampling that may be required under the FINS-specific plan that is being developed.

The protocol to ensure label compliance requires a "walking pace," estimated to be approximately two mph. A two-man crew will conduct work, one ensuring that the applicator functions properly, and the other noting the route that was being followed, and anticipating obstacles and areas requiring the applicator to be shut down, including pedestrians or people out of doors. It is SCVC policy not to spray where people may receive direct exposures. Spraying begins at dusk, or sometimes a little before (sumithrin, the preferred insecticide for hand-held applications, degrades readily and rapidly in sunlight, and so such applications are less effective in daylight).

The hand-held routes are not performed with GPS equipment, and so the application route needs to be filed with GIS staff for mapping. Enhancement of SCVC equipment to allow GPS tracking of these sometimes intricate routes would be beneficial.

Setbacks from salt water are currently set at 100 feet. Setbacks from fresh water wetlands are set at 150 feet. These setbacks were negotiated with NYSDEC as a means of addressing perceived needs to regulate adulticide applications that fall within the 50 feet regulated buffer surrounding NYSDEC-mapped fresh water wetlands, and to similarly abide by label restrictions regarding applications directly to water. The specific modeling results associated with the risk assessment, and the risk assessment computation of ensuing impacts, provide a means to reconsider these bounds. SCVC should initiate discussions with NYSDEC staff at its earliest opportunity to determine if the setbacks need to be increased to provide more protection to the aquatic communities, or reduced to provide more complete control, especially in what may be key buffer area adult mosquito habitat.

On the mainland, essentially all vector control efforts are conducted using truck applications. Almost all air applications would require receiving a waiver from fresh water wetlands regulations, which NYSDEC has not been willing to issue for non-health emergency adulticide efforts, pending completion of this EIS. Even with the formulation of the EIS, the County sees no immediate need to abandon truck applications as the predominant means of applying vector control treatments. Aerial applications are most efficient when used over wider areas; many vector control applications are made over relatively restricted areas. Where tree canopies tend to be closed (as in some residential areas), truck applications can be more effective. Aerial applications, in the areas SCVC treats most often for vector control purposes, would necessarily result in treating wetlands. Although the risk assessment found there is likely to be no to little impact to aquatic communities from the application of resmethrin (Cashin Associates, 2005d), County policy dictates that pesticide use be minimized.

SCVC pickup trucks are fitted with London Fog Model 18-20, ULV truck mounted aerosol generators that are equipped for adulticiding with an Adapco Monitor III GPS tracking and computer logger for ground-based adulticiding. The equipment is calibrated prior to the beginning of the season. Droplet spectrums are rechecked periodically. For mosquitoes such as *Oc. sollicitans* and *Ae. vexans*, the nozzle angle is set at 45 degrees to create a lower pesticide cloud. Should applications for canopy-dwelling mosquitoes (such as *Cx. pipiens* and *Cs. melanura*) be desired, the angle of the nozzle will be increased to 60 degrees from horizontal.

Maps of the target area will be generated by GIS prior to staff leaving SCVC offices. The maps will have no-spray lines, setback boundaries, and buffers surrounding other areas of concern clearly marked with strong colors to ensure the notations are discernable within the truck at night. SCVC tries to be sensitive for individual community needs. For example, spraying in Westhampton Beach was rerouted to avoid exposure for worshippers walking to synagogue one Friday.

The operation requires two people. One will operate the truck and application machinery. The other will be responsible for route maintenance and avoidance of obstacles, including timely warning of pedestrians or people in yards (it is SCVC policy not to spray people in the outdoors).

Spraying usually will begin at dusk, or sometimes a little later, and will continue for several hours to complete the route. This is for several reasons:

- Resmethrin, the Long-Term Plan preferred insecticide, including for truck applications, degrades rapidly under daylight conditions, and so efficacy would be lost through daylight applications.

- Most mosquito species, especially *Ae. vexans* and *Oc. sollicitans*, are most active at that time.

- Waiting for dark tends to minimize pedestrians and other outside venturers.

Pre-dawn applications target the same mosquito species, but often would be conducted at temperatures that are too low to meet current operational requirements. Thus, it is proposed that almost all applications occur in the evening. Mosquitoes active later in the night, such as *Cx. pipiens* and *Cs. melanura*, could be targeted by having the application start several hours later (around 10 pm).

The vehicle must be moving at least seven mph for the sprayer to operate (that allows for proper dispersion of the spray cloud), and will cease operations if 20 mph is exceeded. The target speed is 10 mph. The sprayer is computerized, and so will calculate the release rate necessary to meet label limits. The sprayer also generates a GIS map of the route it followed, including on/off sites. It calculates the amount of pesticide applied. This information is downloaded on

completion of the application, and is verified by the field crew prior to finalization by data management staff.

Setbacks from salt water are currently set at 100 feet. Setbacks from fresh water wetlands are set at 150 feet. SCVC will discuss the utility of setbacks from salt water and fresh water wetlands with NYSDEC in light of the risk assessment modeling and ecological risk calculations.

Some of the ground-based application events are under Health Emergency conditions. For those events, SCVC has almost always received a waiver from fresh water wetlands restrictions, and need not abide by the voluntarily assumed setbacks for either fresh or salt water. As a practical matter, setbacks often ensue in any case due to the relationship between roads and waterways (roads seldom follow waterways without a buffer of some kind, and very often a residential lot is a very substantial buffer). In addition, SCVC voluntarily adheres to measures requested by NYSDEC to limit environmental impacts, even when not required to by law, provided that can be done without compromising effectiveness. For Health Emergency applications, no-spray list restrictions need not apply, if waived by the Commissioner of SCDHS. Although this is not required by law, SCVC attempts to contact no-spray list members in an area targeted for an emergency treatment, in order to allow these individuals to take protective measure such as staying indoors, if they so choose.

Aerial applications are almost always under Health Emergency conditions. This is because it is generally impossible to set helicopter swaths to abide by the NYSDEC setbacks, and because many vector control treatments can be more limited in area than those conducted with a focus on addressing arbovirus presence.

The area selected for treatment is defined differently for each application mode.

- Hand held applications (strictly on Fire Island) cover the entire residential area in each community, excepting housing in buffers (for wetlands, open-water, and no-spray addresses), and the specific addresses on the no-spray list.

- The general area for a truck application for vector control purposes is generally defined by the locus of complaints. Complaints, while not sufficient to cause an adulticide application, are the most efficient means of defining areas with higher mosquito biting

rates. Once a general area of interest has been defined, the application area is refined by including modifiers such as mandatory and voluntary setbacks (such as those around wetlands, open water, and no-spray list members), no-spray list addresses, environmentally-sensitive areas, farms, and other areas that should not be treated. The area road network also factors into the application area determination. This is because issues such as large distances between streets, so that the application will not cover contiguous areas and so be less effective, may determine areas that it is not worthwhile to apply pesticides over. The tentative application determination is reviewed with SCDHS (typically, the ABDL director) for concurrence, and is used as a basis for public noticing. Application areas may continue to be refined until just before the run begins, although early determinations have the benefit of resulting in better route maps for the applicators.

- Health Emergency application areas are determined by SCDHS staff in consultation with SCVC. A focus of the determination is the extent of viral presence. The area to be treated also is set based on assumptions regarding the ranges of the potential human vectors. Complaints are sometimes referenced, as these can help identify areas where bridge vectors are especially active. Consultations with FINS, if required, can further define the application area. NYSDEC is routinely involved in the application area determination because there will generally need to be a permit granted for waiver of NYSDEC Freshwater Wetlands regulations. Practical considerations that need to be addressed regarding the capabilities of the helicopter that will apply the pesticides usually lead to a final application area determination. The practical considerations include (but are not limited to) the amount of pesticide that can be loaded onto the aircraft, the area that can be covered, and the geometry associated with making turns and applying pesticide in swaths. With the Adapco Wingman system operating, the actual final route followed by the aircraft will be determined in the air, due to real-time feedback from the model, based on area weather observations and project placement of the released pesticide. The Wingman model may also prove to be useful in developing efficient application area determinations.

The County uses a helicopter for aerial applications. It is a 3,200 lb. aircraft with an 18 foot six inch radius rotor operated by North Fork Helicopters, Ltd., of Cutchogue. The helicopter is

fitted with two Beecomist nozzles nine feet from the centerline, oriented straight back. They have a flow rate of 25.2 oz/min. Prior to 2005, the applications means was by 300 foot swath released from 75 feet to 150 feet above the canopy at 70 mph. Modeling results indicated that off-target drift could be minimized by applying a 600 foot swath at 35 mph. It has been subsequently determined that in most situations, it will not be possible to slow the helicopter to 35 MPH for flight safety reasons. In addition, concerns were raised that slower speeds could increase droplet deposition, which could lead to greater non-target impacts. Instead, off-site drift will be reduced through the use of the Adapco Wingman system. Because the aerosols are intended to be composed of droplets so small they tend to remain suspended (they are brought to the ground more by turbulence than gravitational effects), drift caused by winds sometimes means the maximum pesticide concentrations do not occur in the center of the target area (Mount, 1996). This can be addressed through dispersion modeling, and leads to purposeful upwind offsets to bring the pesticide fully into the target area. To optimize this process, SCVC has acquired a state-of-the-art in-aircraft navigational-modeling system, produced by Adapco (the Wingman system). This system provides instantaneous course corrections to the pilot based on real time ground and balloon weather information generated in (or near to) the application zone.

The Adapco system has demonstrated its effectiveness (based on unpublished company data) at optimizing pesticide delivery so that little to no pesticide is wasted. The Adapco system maintains the desired application concentration in the area where mosquitoes have been identified as being. This means that it is efficient for its intended purpose, and necessarily minimizes drift, as is possible given the application method. This means the least amount of pesticide as is possible (for a given application rate over a particular area) will be used.

The general flight pattern will be set with the pilot at the application area prior to loading pesticides into the helicopter, although the final route will depend on the on-board modeling output. The Adapco system, similar to the GPS guidance system in use at this time, will produce flight paths with on/off markings, and compute the amount of pesticide applied. The Adapco Wingman system ground module can also be used as a means of setting the proposed application area by forecasting an optimal swath pattern, given estimated weather. The timing of application events will follow those set for truck applications, above.

The use of the Adapco system, which will optimize any required applications, in concert with the advances in surveillance to ensure applications are only made when truly needed, and the intended reduction in mosquito populations of greatest concern through the use of progressive water management, are all expected to result in less use of adulticides over the life of the Long-Term Plan.

Resistance Concerns

All pesticide uses have an inherent risk of generating resistance in the target species. Resistance is minimized by using appropriately high enough concentrations of pesticide. Resistance can also be minimized by alternating pesticides applied in order to reduce the potential of repeated use of only one formulation to select against that formulation. The probability of a mosquito being less sensitive to two different insecticides is reduced in comparison to the chances of being less sensitive to one, especially if they have different modes of action (CA-CE, 2005b).

The formulators of the Long-Term Plan believe that the Caged Fish experiment justifies a reliance on resmethrin as an adulticide. Reliance on one compound does raise resistance concerns. These are mitigated by the few adulticide applications made by SCVC over the course of a year, and by the small area impacted by adulticide events. This allows for a great many adult mosquitoes to reach maturity without contact with resmethrin. These mosquitoes will serve as a reservoir of genes to ensure that resistance does not become a dominant trait in Suffolk County mosquito populations.

However, this informal check on resistance is not sufficient. Therefore, SCVC should develop an improved resistance monitoring program. This kind of work is very specialized, and needs to be exceedingly precise and refined. This is because learning that the County has developed a sizable population of resistant mosquitoes would mean that it would be difficult to implement measures to relax selection and allow the return of susceptible mosquitoes. Good resistance monitoring determines if a problem is developing, and allows actions to be taken so that all pesticide tools can continue to be effective in achieving desired ends. New Jersey has an especially sophisticated program facilitated by Rutgers University Mosquito Research and Control Unit, and it is recommended that the County enter into a program with that group. The

larger mosquito management companies (such as Clarke Mosquito Control) also offer such services.

Efficacy Testing

In order to explicitly validate the County's adulticide program, the County should perform efficacy tests in association with every adulticide application. Two CDC light traps would be set prior to every application, one in a control area, and one in the middle of the target zone. The samples from the night before would then be compared to samples from the night after. Adjustments to the data sets would be made based on the control site results. The focus of the results would be on reductions in numbers of mosquitoes, and, when a health emergency has been declared, reductions in the parity and infection rates for the target species.

SCVC also maintains a colony of *Cx. pipiens* in the laboratory. These mosquitoes are more usually used for laboratory investigations of such issues as pesticide effectiveness. However, mosquitoes can be put into cages, and set outside at appropriate or important sites to document adulticide application effectiveness. The results are generally recorded as the percent of exposed mosquitoes that succumb over a two or three hour interval. Caged mosquito testing is much more labor intensive than trap tests. The information generated by cage testing only bears on the immediate effectiveness of the application, and so is either very specific to the application, or is limited to the immediate time frame of the application (depending on one's point of view). Additionally, trap data have applicability for other aspects of mosquito control work. In sum, SCVC would conduct relatively few cage tests in any seasons (one or two are likely to be standard).

Each aerial application efficacy result set should be released within a week or so of the application. Results should also be released on an annual basis for the program as a whole. The individual events could be discussed in detail at that time.

Triggers for Adult Control

Adult control occurs under two sets of circumstances. One is for vector control (predominantly to address quality of life impairments). The second is under a Health Emergency (predominantly to address potential impacts to human health). The triggers for each are based on different multi-

variate analyses of a host of surveillance data and environmental and historical trends and patterns. Table 2-26 (presented earlier as Table 2-24) states the factors and their general use.

Table 2-26. General Adulticide Decision Parameters

Type of Parameter		**Factor for Vector Control Applications?**	**Factor for Applications under Health Emergency?**	**Criteria**	**Comment**
Basic Surveillance Parameters	Number of mosquitoes	Yes	No	Counts in light traps significantly above norm; landing rates; complaints	Not a fixed value; somewhat species specific; ~ 25 per NJ trap, ~ 100 per CDC trap; landing rate 5+/min.; complaints invaluable where traps are not set; intend to set CDC traps before all non-Fire Island applications
	Species present	Yes	Yes	Light trap content analysis	Information on basic mosquito biology essential: Vector Control targets aggressive biters; Health Emergency targets specific (bridge) vectors; ; intend to set CDC traps before all non-Fire Island applications
	Complaints	Yes	Yes	Number/location of calls	Evaluate in historic context; complaints must be supported with appropriate surveillance data; complaints document extent of problem better than traps can
	Historical population trends	Yes	No	Surveillance data records	Data patterns often signal that problem is about to abate, or is likely to worsen
Species Specific Parameters	Aggressiveness of target species	Yes	Yes	Documented biting patterns of trapped mosquitoes	Aggressive biters indicate greater problem, increased likelihood for bridge vector participation
	Activity patterns of target species	Yes	Yes	Documented host seeking patterns, flight ranges of trapped mosquitoes	Guides actual control decision; e.g., evening vs. later at night; day-time flying may inhibit control; spot treatments only effective for short flight range species; large flight ranges require applications to cover larger, continuous areas to be effective
	Vector Potential	No	Yes	Infection rate, vector competence, % mammalian meals of trapped species	Establishes relative risk for species present
	CDC Vector Index	No	Maybe	MIR, trap counts for all potential vectors	CDC light trap counts * MIR, summed over all vector species; higher index correlates to more human infections following week; requires high mosquito/human infection rates for use; can use only with multiple trap data sets

Type of Parameter		Factor for Vector Control Applications?	Factor for Applications under Health Emergency?	Criteria	Comment
Species specific parameters, continued	Parity rates	Sometimes	Yes	Age (blood meal history) of biting population	For Health Emergency, high parity rates indicate majority of biters had prior blood meal – direct indication of increased Vector Potential; for Vector Control, an aging population, even if smaller, will be treated since it represents increasing vector potential
	Life Cycle Type	Yes	Yes	Trap analysis	Brooded mosquitoes eventually die off on own, continuous breeders build populations over season
Public Health Parameters	Bird testing	No	Yes	Presence/absence of virus	Provides early warning in terms of bird to bird transmission; documents active disease foci in County
	CDC mosquito pool testing	No	Yes	Presence/absence of virus	Amplification vectors provide early warning, document active disease foci in County; bridge vectors indicate virus present in human biting species, is signal that human health risk is imminent
	Veterinarian reports	No	Yes	Ill/dead target animals	Non-mammals provide early warning, document active disease foci in County; mammalian cases indicate virus present in bridge vectors, signal that human health risk is imminent
	Physician reports	No	Yes	Human cases	Realized human health threat
	Disease history	No	Yes	Number of human/ important animal cases in prior years	Indicates that local conditions are favorable for pathogen amplification and transmission
	Avian dispersal/migration patterns	No	Yes	Time of year regarding dispersal of hatch year birds and known migration periods	Identifies new areas for concern, signals need to control known bridge vectors
Climatic Parameters	Current weather	Yes	Yes	Temp = 65+ Wind < 10 mph No rain	Application time decision
	Short-term weather forecast	Yes	Yes	Presence of fronts & storms; barometric patterns	Application planning
	Time of year	Yes	Yes	Spring, Summer, & Fall activity patterns for trapped mosquitoes	Species-specific behavior; generally, cooler weather retards activity, warmer weather increases activity; virus presence not as significant when activity decreases

Type of Parameter		**Factor for Vector Control Applications?**	**Factor for Applications under Health Emergency?**	**Criteria**	**Comment**
Ecological Parameters	Environmental factors in target area	Yes	No	Environmentally sensitive settings (R-T-E species)	Prior mapping is essential to clearly identify all environmentally sensitive areas; usually addressed through NYSDEC; Town and other expert cooperation is sought
	Population	Yes	Maybe	Number of impacted people/population density	For Vector Control: no people means no problem; for Health Emergency, threat may be sufficient
	Application restrictions	Yes	In some settings	Farms; no-spray list; NYSDEC wetlands, wetlands buffers; open water buffers; FINS	Vector Control no-spray areas include crop areas, no-spray list, buffers – discontinuities may make application ineffective; FINS Health Emergency criteria are more stringent than County criteria

Vector control treatment decisions are made by SCVC. The predominant intention of conducting a vector control treatment is to reduce inordinate impacts to quality of life, although necessarily reductions in risks to human health will also be accomplished. Vector control applications will almost always be limited to areas where salt marsh mosquitoes have become infested (almost always only on the south shore). Criteria for conducting a vector control treatment include:

1. Evidence of mosquitoes biting residents (there is no problem unless people are affected):

    - Service requests from public - mapped to determine extent of problem
    - Requests from community leaders, elected officials

2. Verification of problem by SCVC (service requests must be confirmed by objective evidence):

    - New Jersey trap counts higher than generally found for area in question (at least 25 females of human-biting species per night).
    - CDC portable light trap counts of 100 or more.
    - Landing rates of one to five per minute.
    - Confirmatory crew reports from problem area or adjacent breeding areas.

3. Control is technically and environmentally feasible (pesticides should only be used if there will be a benefit):

    - Weather conditions predicted to be suitable (no rain, winds to be less than 10 mph, temperature to be 65ºF or above).
    - Road network adequate and appropriate for truck applications.
    - "No- treatment" wetlands, wetlands and open water buffers, and no-spray list members will not prevent adequate coverage to ensure treatment efficacy.
    - There are no issues regarding listed or special concern species in the treatment area.

- Meeting label restrictions for selected compounds (such as avoiding farmland) will not compromise expected treatment efficacy.

4. Likely persistence or worsening of problem without intervention (pesticides should not be used if the problem will resolve itself):

- Considerations regarding the history of the area, such as the identification of a chronic problem area.

- Determination if the problem will spread beyond the currently affected area absent intervention, based on the life history and habits of the species involved.

- Absent immediate intervention, no relief from the problem can be expected (such as when proximity to uncontrolled sources such as Fire Island National Seashore wetlands will result in ceaseless migrations into the area).

- Crew reports from adjacent breeding areas suggest adults will soon move into populated areas.

- Life history factors of mosquitoes present – i.e., if a brooded species is involved, determining if the brood is young or is naturally declining.

- Seasonal and weather factors, in that cool weather generally alleviates immediate problems, but warm weather and/or the onset of peak viral seasons exacerbate concerns.

- Determining, if the decision is delayed, if later conditions will prevent treatment at that time or not. Conversely, adverse weather conditions might remove most people from harm's way.

In essence, criteria 1 and 2 are necessary thresholds which must be met, prior to a treatment being considered. With enhanced surveillance, there will be rigorous, numeric validation of mosquito control infestation near a potentially affected population in all cases. Treatment will not occur unless criteria 1 and 2 are satisfied through a combination of surveillance indicators, although not all surveillance techniques may be feasible in every setting and situation.

Criteria 3 and 4 are "treatment negation" criteria. If certain conditions are met, treatment will not occur, even if treatment is otherwise be indicated by criteria 1 and 2. Careful records on criteria and thresholds (and related conditions) which trigger each treatment will be kept, for every adulticiding event.

The need for health emergency treatments is determined through the NYSDOH tiered approach to risk assessment for mosquito-borne disease. Table 2-27 (presented earlier as Table 2-7 and 2-25) describes the NYSDOH decision-making structure.

Table 2-27. NYSDOH Four-Tiered WNV Strategy

Tier	Circumstances	Response
I	No historical or current evidence of virus No neighboring Health Unit with historical/current evidence of virus	Level 1 education campaign Enhanced passive human/bird surveillance Consider adult mosquito surveillance (species, distribution) Lower priority for lab testing Consider larval surveillance Consider local environmental assessments Consider local disease risk assessments
II	Historical evidence of virus Neighboring Health Units with historical evidence	Level 1 enhanced education program (general community & provider community) Local environmental assessments Local disease risk assessments Active human (if evidence in-unit)/bird surveillance Larval surveillance Larval habitat source reduction Larval control Adult surveillance and lab testing
III	Current virus isolation/evidence of infection in individual locations	Level 2/3 education program (general public & provider community) Active human/bird surveillance Larval surveillance Larval habitat source reduction Larval control Adult surveillance and lab testing Adult control, ground application
IV	Current virus isolation/evidence of infection in multiple locations	Level 2/3/4 education program (general public & provider community) Active human/bird surveillance Larval surveillance Larval habitat source reduction Larval control Adult surveillance and lab testing Adult control, ground application

Historical occurrences of EEE and WNV mean Suffolk County begins each season in Tier II.

If evidence of circulating pathogens are detected (positive mosquito pools, dead birds, animal or human illness), the Commissioner of SCDHS petitions the Commissioner of NYSDOH for a Health Threat determination. Receiving this moves the County into Tier III. If evidence of viral amplification continues, and it is clear that bridge vectors make the potential for transmission to people possible (due to factors such as population, parity, and/or detection of virus), a qualitative risk assessment is conducted that factors in historical patterns, current weather, seasonal factors, population density and expectations, and professional judgment regarding the overall risk of disease and the potential to reduce that risk through an adulticide application. If, in the professional judgment of the Commissioner of SCDHS, the disease risk can be sufficiently mitigated by insecticide use, then a Health Emergency application will be made.

These decisions are tempered by the County policy regarding minimization of pesticide use, and by the understanding that unwarranted human and ecological exposure to pesticides should be avoided (the general finding of minimal risk to people or the environment from the County's preferred adulticide agent, resmethrin, notwithstanding).

2.10.7 Administration

Organization

SCVC works closely with SCDHS to ensure ongoing health related surveillance input for SCVC decisions are made. SCDHS operates the ABDL at the Yaphank facility and is also responsible for medical surveillance, environmental monitoring, community outreach and public education, while the SCVC concentrates its efforts on mosquito control. An additional cooperative relationship exists between SCVC and SCDHS and NYSDOH to alert the County of statewide occurrences of WNV and EEE.

In the future, it is recommended that SCVC concentrate its resources on surveillance activities that involve assessing the population density and distribution of larval and adult vectors, while SCDHS continues to monitor and locate disease activity in mosquitoes and sentinel animals such as birds. Mosquito population surveillance (New Jersey traps, larvae, complaints, special traps set in problem areas) is intimately associated with the control operation and should be funded by SCDPW and be primarily a SCVC responsibility. While both SCVC and the ABDL will

continue to be involved with mosquito surveillance, SCVC surveillance staff should be organized as a work unit that collects and receives New Jersey trap collections, larval samples from the SCVC crews, and conducts special larval and adult collections designed to manage the control effort. The ABDL will employ more technically demanding sampling methods, such as cold chain, which involves keeping specimens cold to prevent viral degradation.

In order to implement the recommendations of this Long-Term Plan, it is expected that significant additional resources of both personnel and equipment will be approved by the County to improve vector control practices in accordance with the findings of this study. SCDPW and SCDHS have prepared specific proposals detailing the number and titles of new personnel required to implement this program. The actual creation and filling of these proposed positions, however, is dependent upon the County budget process.

Administration

The Vector Control Superintendent will be responsible for the overall administrative supervision and the supervision of mosquito management actions. Because of intense regulatory scrutiny, the Superintendent will particularly administer aerial larvicide and all adulticiding operations. There will be expanded responsibilities for this position as the operations of SCVC become more technically complex. New oversight by various committees and cooperative outreach to towns and other government agencies will also increase the workload. The expanded mandate with respect to wetlands management will be an additional set of new responsibilities. The end of the Long-Term Plan project should facilitate the time and efforts necessary to deal with these new expanded duties.

SCVC will use Long-Term Plan to assist in the preparation of Annual Plan of Work. The Plan of Work is a written description of SCVC's purpose, history, current operations, and goals for the following year and the future. The Plan of Work is prepared by the Superintendent and submitted to the Legislature in October for approval in November. The Legislature approves SCVC plan of work each November as part of the County Budget.

General administrative support for SCVC will come from the SCDPW Administration and will include duties such as payroll, purchasing, etc. This unit will take service requests and handle

other public contact, and support litigation response by providing files and other pertinent information. Given the increased activities proposed for SCVC, there will be a need for additional administrative staffing. The existing staff includes one Purchasing Technician and one Clerk Typist.

Technical Services and Compliance

The Technical Services and Compliance unit will coordinate and approve all data collected by the SCVC, while providing technical support for the other units. This unit will oversee all SCVC activities for environmental compliance and ensure that all required reports are prepared. This unit will also be responsible for some of the technically demanding tasks of SCVC, such as equipment calibration and adulticiding. All data collected by SCVC must be made immediately available to the ABDL. To accomplish this, SCVC will task its Programmer/Analyst and other staff with developing improved data systems to facilitate rapid collection and dissemination of adult and larval data over the network. Access to these data will be given to the ABDL.

There is a need for a highly trained and experienced Principal Environmental Analyst to handle these tasks and oversee day-to-day operations, since it is not possible for the Superintendent to perform these tasks and also handle administrative duties. Given the high visibility of the program, the extensive set of laws and regulations that pertain to it, and the high likelihood of continuing litigation, maintaining proper data systems and oversight to maintain and document compliance is a critical activity. At the current time, the Technical Services and Compliance unit consists of:

- one Principal Environmental Analyst
- one Programmer/Analyst
- one Biologist (this position will be moved to a new Natural Resources Unit, if created)

A GIS specialist will be required to: receive data from field crews and integrate it into the overall system and to assist the Mosquito Surveillance and Control and Natural Resource units in acquiring GIS/GPS data and provides information for reports.

Mosquito Surveillance and Control

The Mosquito Surveillance and Control unit will be reorganized and upgraded to process more information to guide control decisions and evaluate the control efforts. This unit will guide the larval control program. It will determine the need for adult control and refer that task to Technical Services and the Superintendent for action. Existing staffing is not sufficient to provide trapping data in all locations where adulticiding occurs. Greater follow-up and a new quality control effort are to be implemented will also require additional resources. Similarly, as more information is to be provided to the public to support the program, this information must be compiled and put in a useful format. This information would also be used in determining the need for additional control if pathogens are present. This unit could assist the ABDL in viral surveillance during peak times and emergencies, but these duties would normally be transferred out of SCVC to the ABDL. The information gathered would also be used for compliance reports. ABDL data should be made available to SCVC, to the extent permitted by medical confidentiality laws. Collection of field samples should be coordinated between SCVC and the ABDL to avoid duplication of effort.

The Mosquito Surveillance and Control unit currently consists of:

- one Vector Control Supervisor
- one Vector Control Aide
- one Laboratory Technician (vacant)
- one Auto Equipment Operator (seasonal)

Natural Resources

The Natural Resources unit, which is a newly proposed unit, will be responsible for the implementation of an expanded, far more sophisticated, progressive water management program. This will require more attention to natural resource issues and more detailed project planning, documentation, and evaluation. In particular, even the most minor maintenance actions will require more documentation, and simple culvert replacements and upgrades will require

engineering-level drawings. Survey skills will be necessary, at a minimum, and complex projects may require sophisticated engineering design. Engineering skill may also be required for SCVC input into USEPA Phase II Stormwater Management actions. Even if other agencies have available resources to perform project monitoring, SCVC will need to guide and evaluate these efforts.

Field Crew and Water Management

The Field Crew and Water Management unit will perform the daily technical tasks such as water management and pesticide application for SCVC. This unit will also conduct larval surveillance, assist with adult surveillance, and respond to service requests. Thus, this unit will represent the working component of the program, while serving as its sentinel.

Existing staffing for this unit is:

- five Vector Control Labor Crew Leaders
- one VC Supervisor (temporary for Fishers Island)
- two Temporary Labor Crew Leaders (Fishers Island)
- one Vector Control Aide
- three Construction Equipment Operators
- three Heavy Equipment Operators
- 18 Auto Equipment Operators (including two currently vacant positions)
- four Laborers (including one currently vacant position)

Arthropod-Borne Disease Laboratory (SCDHS)

The ABDL presently operates using a combination of SCDHS and SCVC staff to conduct viral and population surveillance. This practice creates a situation whereby the same staff members collect information related to the control aspect of the program as well as information for the

disease aspect of the program. This results in programmatic competition for limited staff time. The ABDL and SCVC both need increased resources, and especially staff, to implement the draft management recommendations. Given the high priority of viral surveillance, resources are often not available to provide data and analysis directly related to the control program. In addition, the lines of supervision, control and budget are complex and not conducive to optimal use of resources. Under the proposed organization, the ABDL would be clearly tasked with viral surveillance and would control all resources needed to conduct that work. This would allow assignment of SCVC staff for activities critical to that unit, and relieve the ABDL of tasks more directly related to the control program than to disease surveillance. When the ABDL identifies viral activity, the information can be easily combined with that collected by SCVC to guide response measures. In fact, increased and more sophisticated surveillance by SCVC on vector populations should lead to a more targeted response to viral activity.

SCVC staff will manage its workload to allow it to assist with viral surveillance, if needed, during the peak viral season (August and early September). However, peak viral season historically has coincided with the times when the demands on SCVC staff associated with the complexities involved in adulticide planning, permitting, and follow-up have also peaked. If this seasonal pattern continues under the Long-Term Plan, it would limit SCVC's ability to provide assistance. ABDL staffing levels should not be based on an assumption that SCVC staff will be available for all peak viral surveillance workloads. During times of a declared public health threat, all surveillance and control resources will be controlled by SCDHS, as outlined in the County Charter. High priority viral sampling may have to take priority over other surveillance. SCDHS will be required, of course, to continue to ensure that all aspects of the Long Term Plan are complied with, to the maximum extent practical.

Staff from this unit will report to SCVC on a daily basis, but may report to the ABDL during emergencies.

The existing staff of the ABDL and their corresponding duties are:

- One Laboratory Director: Responsible for overall administration and supervision of laboratory.

- Four Biologists: Performs dead bird testing using the RAMP system as well as assist with infectious agent surveillance and testing.

- One Laboratory Technician: Assists with testing of infectious agents.

- One Program Aide: this staff member serves as the Health Safety Officer, performs budgetary tasks and attains the necessary permits for laboratory function.

As a supplement to the existing positions listed above, significant new staffing resources will be needed to implement the proposed management plan recommendations for the ABDL. The department has a specific proposal for consideration during the county budget process. All sampling, testing, and analysis for the presence and distribution of mosquito-borne pathogens should be transferred to a stand-alone ABDL with full capabilities to conduct this work. Staffing level and other resources, such as vehicles, must be sufficient to provide this capability. The level of resources will depend to some extent on how much testing will be done in-house. Data from this effort would be combined with SCVC data on vector populations, plus human surveillance conducted by SCDHS, to assess the risk of mosquito-borne disease and to determine if measures beyond general vector control (such as special adulticiding) are required. Resource sharing between SCVC and ABDL is possible and necessary. Examples include deploying and recovering traps. There are, nonetheless, advantages to a more formal division of labor between SCVC and the ABDL. The current situation has the same staff collecting information related directly to control and information for virus survey. This can lead to competition for limited staff time. Since virus sampling has the highest priority, data collection related to the need for and the evaluation of control efforts may not be completed. The best way to ensure more data is collected to assess the need for control and to evaluate any control efforts, while not decreasing pathogen sampling, is to provide the resources that allow the two programs to operate independently.

In summary:

- It makes organizational sense for SCVC to collect and manage the data it needs for its day-to-day control operation.

- It makes organizational sense for SCDHS to survey for human pathogens.

- Most of SCVC's effort is preventative and conducted based on the abundance and distribution of vectors, rather than in direct response to pathogens, and so is conducted prior to and independent of the detection of pathogens.

- SCVC's sampling needs are directed mostly toward those areas where mosquitoes are most abundant, while the ABDL is most concerned with determining where pathogens may be present.

- Vector sampling is time-critical, in that daily control decisions depend on it.

- The samples collected for monitoring purposes by SCVC do not require being kept in cold storage after collection, as those collected by the ABDL for viral detection do.

- A division of labor between the sampling programs allows each one to operate in a manner that optimizes its efforts.

The current level of coordination between the ABDL and SCVC regarding adulticide decisions when there is no declared health threat appears adequate. The standard e-mail notices for the adulticide operations should include a brief description of the surveillance indicators for the operation, a practice that has begun this season. During a declared health threat, adulticide decisions are controlled by SCDHS as required by the County Charter. It has been standard practice at these times for SCDHS to delegate control decisions based on mosquito population levels to the SCVC Superintendent. Decisions regarding applications in direct response to viral findings and human disease risk have been made by SCDHS, with technical input from SCVC.

The County currently has a capital project in progress to upgrade SCVC facilities and the ABDL. Upgrading the laboratory will provide it with the BSL-3 certification required to become fully autonomous. Obtaining this certification would allow samples to be processed in-house, decreasing the amount of time required to obtained results significantly. The BSL-3 certification would also provide the ABDL with the ability to test samples for all types of mosquito-borne viruses, such as EEE. Under the current scenario, sending samples to Albany is a necessity because the state laboratory tests for all types of mosquito-borne viruses, such as EEE and St.

Louis Encephalitis, while the Taqman and RAMP methods only detect WNV. Testing for all types of mosquito-borne viruses ensures that field detection systems and laboratory detection systems are working, and that unexpected arboviruses do not pass unnoticed. SCVC and the ABDL should share lab facilities, wherever these facilities ultimately are built, to avoid duplication and facilitate coordination.

Professional Education

Continuing education provides professional staff with the opportunity to gather information on current and novel mosquito control techniques. Professional education for mosquito control workers includes:

- pesticide training programs
- short courses in mosquito control
- "Right to Know" training for hazardous substances
- attendance at state, regional and national mosquito control conferences

Pesticide applicators are required to acquire 18 hours of continuing education every three years in order to maintain licensing. Formal courses offered in the immediate area that would be of value to SCVC and ABDL personnel include species identification short courses taught at both Rutgers and Cornell. Travel restrictions make attendance at these courses difficult. Although Cornell is located in-state, the distance from the County means overnight stays are a necessity. The Rutgers courses can be commuted to, but constitute out-of-state travel, which is currently restricted by County policy.

Specifically, the productivity of SCVC staff and the existing mosquito control program would benefit by allowing additional travel. Two regional meetings should be attended by two additional professional staff, such as an entomologist and biologist. There should be regular participation in additional regional (Northeastern Mosquito Control Association, Mid-Atlantic Mosquito Control Association, and New Jersey Mosquito Control Association, as examples) and national meetings (CDC annual WNV conference, AMCA national and Washington meetings,

and the Society of Vector Ecologists, as examples) by the Superintendent. Suffolk County should also participate in the Associated Executives of Mosquito Control in New Jersey, an organization of superintendents and other key mosquito control officials that meets on a monthly basis. The Associated Executives provides a forum for officials with similar issues and problems to share information. It helps prevent "re-inventing the wheel" by more than one agency, saving time and money for all concerned. Technical staff should also attend professional training offered at Rutgers and/or Cornell in mosquito biology and identification to improve their mosquito identification and sampling skills. Such training will be especially valuable for field technicians responsible for retrieving traps from distant locations, such as the north shore, and utilizing proposed identification stations.

2.10.8 Other Elements of the Long-Term Plan

The remaining sections of the Long-Term Plan (sections discussing Technology Assessment, Adaptive Management for the Long-Term Plan, Resource Commitments by the County to the Plan, and Implementation Recommendations) have not been summarized for inclusion in this document. They are, however, available in their entirety in the Long-Term Plan, attached as Appendix A.

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