COUNTY OF SUFFOLK

STEVEN BELLONE
COUNTY EXECUTIVE

DEPARTMENT OF ECONOMIC DEVELOPMENT AND PLANNING
DIVISION OF PLANNING AND ENVIRONMENT

COUNCIL ON ENVIRONMENTAL QUALITY

TOM GULBRANSEN
CHAIRPERSON
CEQ

MEMORANDUM

TO: Interested Parties/Involved Agencies

FROM: John Corral, Environmental Projects Coordinator *JC*

DATE: October 15, 2020

RE: Proposed Vector Control 2021 Annual Plan of Work

Enclosed please find the 2021 Annual Plan of Work for the Suffolk County Vector Control and Wetlands Management Long Term Plan which has been submitted to the Council on Environmental Quality (CEQ) for review. Pursuant to Title 6 NYCRR Part 617 and Chapter 450 of the Suffolk County Code, the CEQ must recommend a SEQRA classification for the action and determine whether it may have a significant adverse impact on the environment which would require the preparation of a Supplement to the Generic Environmental Impact Statement for the Suffolk County Vector Control and Wetlands Management Long Term Plan.

The Council would like to know your environmental concerns regarding this proposal and whether you think a Supplement to the Generic Environmental Impact Statement or a determination of non-significance is warranted. This project will be discussed at the **October 21, 2020** CEQ meeting. If you are unable to attend the meeting to present your views, please forward any recommendations or criticisms to this office prior the date of the meeting. **If the Council has not heard from you by the meeting date, they will assume that you feel that the action will not have significant adverse environmental impacts and should proceed accordingly.**

JC/cd
Enc.

cc: Ken Zegel, Chief – Office of Ecology, Principal Public Health Engineer
Suffolk County Department of Health Services
Andrew P. Freleng, Chief Planner
Department of Economic Development and Planning

COUNTY OF SUFFOLK

STEVEN BELLONE
SUFFOLK COUNTY EXECUTIVE

DEPARTMENT OF PUBLIC WORKS

JOSEPH T. BROWN, P.E.
COMMISSIONER

ERIC M. HOFMEISTER
DEPUTY COMMISSIONER

DARNELL TYSON, P.E.
CHIEF DEPUTY COMMISSIONER

PHILIP A. BERDOLT
DEPUTY COMMISSIONER

MEMORANDUM

TO: Amy M. Ellis
Clerk of the Suffolk County Legislature

FROM: Joseph Brown, P.E.
Commissioner of Public Works

DATE: September 30, 2020

RE: **Division of Vector Control 2021 Annual Work Plan**

Pursuant to Article VIII, Section C8-4, B(2) of the Suffolk County Administrative Code, enclosed please find a copy of the 2021 Annual Plan of Work for the Division of Vector Control for distribution to all members of the Legislature. This Annual Plan is consistent with the Findings of the Vector Control and Wetlands Management Long Term Plan and GEIS as approved by the Legislature in Resolution 285-2007 on March 20, 2007 and signed by the County Executive on March 22, 2007. As such, no further compliance under SEQRA is required.

A resolution for approval of the 2021 Plan of Work will be submitted to the Legislature by the County Executive's Office.

Thank you for your cooperation.

Attachments: Plan of Work, EAF, Long Term Plan Resolution with Findings
cc: Lisa Black, Chief Deputy County Executive
Natalie Wright, Commissioner, Economic Development & Planning
Darnell Tyson, P.E., Chief Deputy Commissioner of Public Works
Eric Hofmeister, Deputy Commissioner of Public Works
Phil Berdolt, Deputy Commissioner of Public Works
Thomas Iwanejko, Vector Control Superintendent
John Corral, CEQ

Short Environmental Assessment Form
Part 1 - Project Information

Instructions for Completing

Part 1 – Project Information. The applicant or project sponsor is responsible for the completion of Part 1. Responses become part of the application for approval or funding, are subject to public review, and may be subject to further verification. Complete Part 1 based on information currently available. If additional research or investigation would be needed to fully respond to any item, please answer as thoroughly as possible based on current information.

Complete all items in Part 1. You may also provide any additional information which you believe will be needed by or useful to the lead agency; attach additional pages as necessary to supplement any item.

Part 1 – Project and Sponsor Information

Suffolk County Department of Public Works

Name of Action or Project:
Vector Control 2021 Annual Plan of Work

Project Location (describe, and attach a location map):
Throughout Suffolk County

Brief Description of Proposed Action:
2021 Vector Control Annual Plan of Work for the County's ongoing mosquito control program, to be conducted pursuant to the Vector Control and Wetlands Management Long Term Plan and GEIS (the Long Term Plan).

Name of Applicant or Sponsor:	Telephone: 631-852-4270
Suffolk County Dept of Public Works - Vector Control	E-Mail: Tom.Iwanejko@suffolkcountyny.gov

Address:
335 Yaphank Ave

City/PO:	State:	Zip Code:
Yaphank	NY	11980

	NO	YES
1. Does the proposed action only involve the legislative adoption of a plan, local law, ordinance, administrative rule, or regulation? If Yes, attach a narrative description of the intent of the proposed action and the environmental resources that may be affected in the municipality and proceed to Part 2. If no, continue to question 2.	☐	☑
2. Does the proposed action require a permit, approval or funding from any other government Agency? If Yes, list agency(s) name and permit or approval: NYSDEC Article 15 & 24 Permits are in place as is Clean Water Act NOI w DEC	☐	☑

3. a. Total acreage of the site of the proposed action? _____ acres
   b. Total acreage to be physically disturbed? n/a acres
   c. Total acreage (project site and any contiguous properties) owned or controlled by the applicant or project sponsor? n/a acres

4. Check all land uses that occur on, are adjoining or near the proposed action:

☑ Urban ☑ Rural (non-agriculture) ☑ Industrial ☑ Commercial ☑ Residential (suburban)

☑ Forest ☑ Agriculture ☑ Aquatic ☐ Other(Specify):

☑ Parkland

	NO	YES	N/A
5. Is the proposed action,			
a. A permitted use under the zoning regulations?	☐	☐	☑
b. Consistent with the adopted comprehensive plan?	☐	☑	☐

	NO	YES
6. Is the proposed action consistent with the predominant character of the existing built or natural landscape?	☐	☑

	NO	YES
7. Is the site of the proposed action located in, or does it adjoin, a state listed Critical Environmental Area? Sites vary, but adhear to NYSDEC specified permited locations and applications. If Yes, identify: _____	☐	☑

	NO	YES
8. a. Will the proposed action result in a substantial increase in traffic above present levels?	☑	☐
b. Are public transportation services available at or near the site of the proposed action?	☑	☐
c. Are any pedestrian accommodations or bicycle routes available on or near the site of the proposed action?	☑	☐

	NO	YES
9. Does the proposed action meet or exceed the state energy code requirements? If the proposed action will exceed requirements, describe design features and technologies: _____	☑	☐

	NO	YES
10. Will the proposed action connect to an existing public/private water supply? If No, describe method for providing potable water: _____	☑	☐

	NO	YES
11. Will the proposed action connect to existing wastewater utilities? If No, describe method for providing wastewater treatment: _____	☑	☐

	NO	YES
12. a. Does the project site contain, or is it substantially contiguous to, a building, archaeological site, or district which is listed on the National or State Register of Historic Places, or that has been determined by the Commissioner of the NYS Office of Parks, Recreation and Historic Preservation to be eligible for listing on the State Register of Historic Places?	☑	☐
b. Is the project site, or any portion of it, located in or adjacent to an area designated as sensitive for archaeological sites on the NY State Historic Preservation Office (SHPO) archaeological site inventory?	☑	☐

	NO	YES
13. a. Does any portion of the site of the proposed action, or lands adjoining the proposed action, contain wetlands or other waterbodies regulated by a federal, state or local agency?	☐	☑
b. Would the proposed action physically alter, or encroach into, any existing wetland or waterbody?	☐	☑
If Yes, identify the wetland or waterbody and extent of alterations in square feet or acres: _____ All pesticide applications and wetland restoration activities are carried out under multiple NYSDEC Article 15, 24 and 25 permits for the actions applicable to each permit.		

14. Identify the typical habitat types that occur on, or are likely to be found on the project site. Check all that apply:

☑ Shoreline ☑ Forest ☑ Agricultural/grasslands ☑ Early mid-successional

☑ Wetland ☐ Urban ☑ Suburban

	NO	YES
15. Does the site of the proposed action contain any species of animal, or associated habitats, listed by the State or Federal government as threatened or endangered?	☐	☑
16. Is the project site located in the 100-year flood plan?	☐	☑
17. Will the proposed action create storm water discharge, either from point or non-point sources? If Yes,	☐	☑
a. Will storm water discharges flow to adjacent properties?	☐	☐
b. Will storm water discharges be directed to established conveyance systems (runoff and storm drains)?	☐	☐
If Yes, briefly describe: _____		
18. Does the proposed action include construction or other activities that would result in the impoundment of water or other liquids (e.g., retention pond, waste lagoon, dam)? If Yes, explain the purpose and size of the impoundment: _____	☑	☐
19. Has the site of the proposed action or an adjoining property been the location of an active or closed solid waste management facility? If Yes, describe: _____	☑	☐
20. Has the site of the proposed action or an adjoining property been the subject of remediation (ongoing or completed) for hazardous waste? If Yes, describe: _____	☑	☐

I CERTIFY THAT THE INFORMATION PROVIDED ABOVE IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE

Applicant/sponsor/name: Thomas Iwanejko Date: 9/30/2020

Signature: _____ Title: Superintendent

PRINT FORM

SUFFOLK COUNTY
SHORT ENVIRONMENTAL ASSESSMENT FORM
6 NYCRR Part 617
State Environmental Quality Review

Part 2 – Impact Assessment (To be completed by Lead Agency)

	No, or small impact may occur	Moderate to large impact may occur
1. Will the proposed action create a material conflict with an adopted land use plan or zoning regulations?	☒	☐
2. Will the proposed action result in a change in the use or intensity of use of land?	☒	☐
3. Will the proposed action impair the character or quality of the existing community?	☒	☐
4. Will the proposed action have an impact on the environmental characteristics that caused the establishment of a Critical Environmental Area (CEA)?	☒	☐
5. Will the proposed action result in an adverse change in the existing level of traffic or affect existing infrastructure for mass transit, biking or walkway?	☒	☐
6. Will the proposed action cause an increase in the use of energy and fail to incorporate reasonably available energy conservation or renewable energy opportunities?	☒	☐
7. Will the proposed action impact existing public/private water supplies?	☒	☐
8. Will the proposed action impact existing public/private wastewater treatment utilities?	☒	☐
9. Will the proposed action impair the character or quality of important historic, archaeological, architectural or aesthetic resources?	☒	☐
10. Will the proposed action result in an adverse change to natural resources (e.g., wetlands, waterbodies, groundwater, air quality, flora and fauna)?	☒	☐
11. Will the proposed action result in an increase in the potential for erosion, flooding or drainage problems?	☒	☐
12. Will the proposed action create a hazard to environmental resources or human health?	☒	☐

SUFFOLK COUNTY
SHORT ENVIRONMENTAL ASSESSMENT FORM
6 NYCRR Part 617
State Environmental Quality Review

Part 3 – Determination of Significance

The Lead Agency is responsible for the completion of Part 3. For every question in Part 2 that was answered "moderate to large impact may occur", or if there is a need to explain why a particular element of the proposed action may or will not result in a significant adverse environmental impact, please complete Part 3. Part 3 should, in sufficient detail, identify the impact, including any measures or design elements that have been included by the project sponsor to avoid or reduce impacts. Part 3 should also explain how the lead agency determined that the impact may or will not be significant. Each potential impact should be assessed considering its setting, probability of occurring, duration, irreversibility, geographic scope and magnitude. Also consider the potential for short-term, long-term and cumulative impacts. Attach additional pages as necessary.

☐ Check this box if you have determined, based on the information and analysis above, and any supporting documentation that the proposed action may result in one or more potentially large or significant adverse impacts and an environmental impact statement is required. (Positive Declaration)

☐ Check this box if you have determined, based on the information and analysis above, and any supporting documentation that the proposed action will not result in any significant adverse environmental impacts. (Negative Declaration)

Name of Lead Agency	Date
Print or Type Name of Responsible Officer in Lead Agency	Title of Responsible Officer
Signature of Responsible Officer in Lead Agency	Signature of Preparer (if different from Responsible Officer)

2021

SUFFOLK COUNTY

DEPARTMENT OF PUBLIC WORKS

DIVISION OF VECTOR CONTROL

ANNUAL PLAN OF WORK

Vector Control crews installing coir logs to aid filling of mosquito ditches as part of a wetland restoration project at Gardiner County Park in West Islip

Suffolk County Vector Control

Mission

Suffolk County Vector Control seeks to protect public health and welfare by reducing disease incidence and impacts caused by mosquitoes and ticks in an environmentally sensitive approach.

Governance

The Suffolk County Department of Public Works, Division of Vector Control is responsible under the County Charter to 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 §C8-4(B). The Division's responsibility is to control infestations of mosquitos, ticks and other arthropods that significantly threaten public health, or create social or economic problems for the communities in which they occur. The Division meets its responsibilities in consultation with the Suffolk County Department of Health Services (SCDHS) and appropriate federal, state and local agencies.

Executive Summary

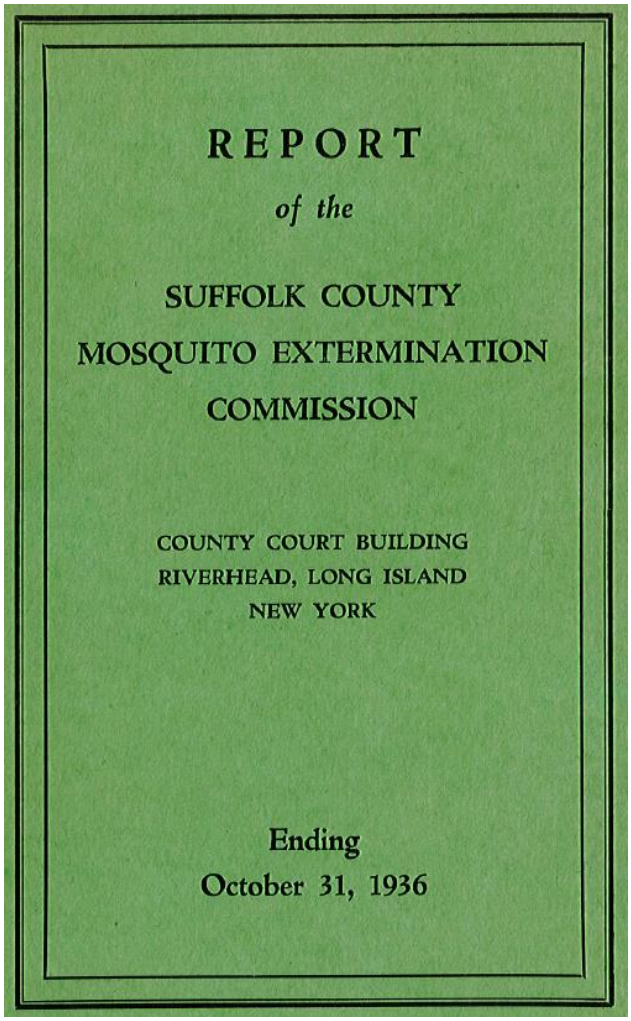
The Suffolk County Department of Public Works – Vector Control Division seeks to control mosquitoes and ticks of public health importance using integrated management techniques in an environmentally sensitive manner. Protection of Suffolk County resident and visitor's health who appreciate our picturesque towns and villages is carried out using best practices which are least impactful to the environment. This report reviews SCVC accomplishments for 2020 and presents its operational plans for 2021.

Using an integrated holistic approach need not only incorporate control or 'spraying' of the insect; but an understanding of the insect's life cycle and when and how to best to target the pest. The components of a successful integrated pest management (IPM) plan include biology of the species and its habitat, population surveillance and various control strategies using best practices during each stage of the insect's development. SCVC continues to monitor its control program and adopt new materials and techniques that best control the pest species in an environmentally judicious way.

The 2021 Vector Control Plan of Work has been developed to give the reader an improved understanding of the overall Suffolk County mosquito and tick control program. The Plan includes a summary of the 2020 season and issues of discussion that deserve mention. In addition, the 2021 Plan of Work will address future program goals during the upcoming year. This format returns to the early roots of Suffolk County's mosquito control program where an Annual Report was released that included a historical overview of the its yearly operations.

Background

Suffolk County has a long history of mosquito control efforts that first began under the United States Department of Agriculture (USDA) in 1900 with experimental projects for malaria and salt marsh mosquito control. Additional control efforts were often undertaken by owners of large estates and resorts located along the coastline seeking control of salt marsh mosquitoes through private ditch construction. Demand for a structured mosquito control program grew in Suffolk as effective levels of mosquito control were seen in Nassau County, New York City and New Jersey through both wetland filling and the ditching of marshes. In 1933, a countywide mosquito control program began under the Suffolk County Emergency Work Relief Bureau, which provided jobs during the Great Depression. The Suffolk County Mosquito Extermination Commission was later created in 1934 to unite the individual town and private mosquito control efforts under a central agency. A significant increase in mosquito control efforts was further funded under the Federal Works Project Administration (WPA) in 1937 employing over 650 workers to assist the Suffolk County Mosquito Extermination Commission. It was during the years of 1933-1938 that the majority of our 9.5 million feet of mosquito ditches were created throughout Suffolk through these agencies. Mosquito control continued in Suffolk County through the Mosquito Control Commission from 1934 to 1974. The Commission consisted of the Mosquito Control Superintendent, a Board of Directors and included one representative from the Suffolk County townships through the Chair of the Board of Supervisors, as an ex-officio member of the Commission.


REPORT
of the
SUFFOLK COUNTY
MOSQUITO EXTERMINATION
COMMISSION

COUNTY COURT BUILDING
RIVERHEAD, LONG ISLAND
NEW YORK

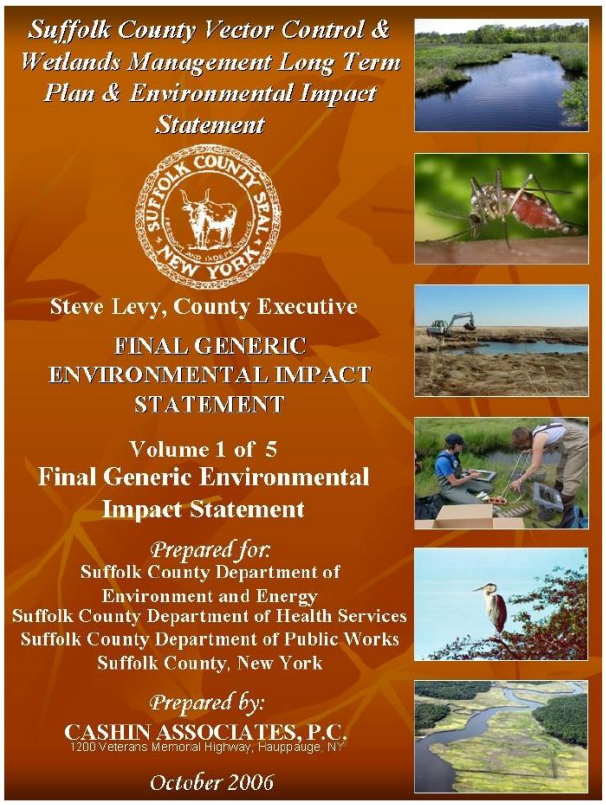
Ending
October 31, 1936

In 1974, the Suffolk County Charter was amended to transfer the mosquito control functions and authority from the Mosquito Control Commission to the Suffolk County Department of Health Services, Division of Public Health, Bureau of Vector Control. During 1992, due to budget deficits, the county legislature transferred Vector Control from Health Services to the Department of Public Works, Division of Vector Control where the program continues to reside today.

Annual Plan of Work Requirements

The Suffolk County Charter and New York State law requires an annual Vector Control plan of work for the succeeding year be submitted by resolution for legislative approval each year. This Plan of Work has been prepared pursuant to and in compliance with the Vector Control and Wetlands Management Long Term Plan and Generic Environmental Impact Statement (the Long Term Plan). The Long Term Plan was approved by the County Legislature as Resolution 285-2007 on March 20, 2007 and signed by the County Executive on March 22, 2007. The 2021 Annual Plan of Work is therefore governed by State Environmental Quality Review Act (SEQRA) Regulation 617.10(d)(1) which provides the following: "When a final generic EIS has been filed under this part (1) no further SEQR compliance is required if a subsequent proposed action will be carried out in conformance with the conditions and thresholds established for such actions in the generic EIS or its findings statement." This issue is also discussed in the Findings, appended hereto, pages 7 and 58. The 2015 Plan of Work added the use of a new active ingredient, prallethrin, which required a modification of the Long Term Plan. In accordance with the Findings, a SEQR review of prallethrin was conducted in order to allow the use of the new active ingredient. This review was completed with the issuance of a Negative Declaration as CEQ Resolution 34-2014 and the modification of the Long Term Plan approved by the Legislature as Resolution 706-2014.

This Annual Plan complies with the reporting requirements in Executive Order 15-2007 (Suffolk County Vector Control Pesticide Management Committee) and Resolution 285-2007 (which adopted the Findings Statement for the Long-Term Plan). The reporting requirements of Resolution 285-2007 are satisfied within this Annual Plan, and the Pesticide Management Committee submits a report to CEQ independently to satisfy Executive Order 15-2007.



Mosquito Control - IPM

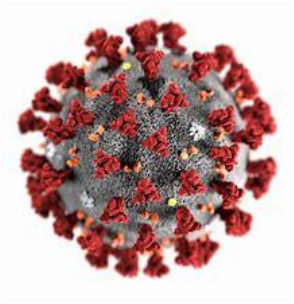
The Vector Control Division employs an integrated control program also referred to as integrated pest management or IPM. Control measures are employed in a hierarchical manner that emphasizes prevention of the pest species and is guided by an active surveillance program to ensure that control measures are only directed to address a clear need. Control proceeds from long-term, environmentally sound measures such as wetland management, to use of biological controls, use of highly specific larvicides, and only incorporates chemical control for adulticiding if other measures prove to be either insufficient or not feasible. This integrated approach is recognized as the most effective and environmentally sound manner in which to conduct a mosquito control program.

Because mosquitoes are of high public health importance, the Division works closely with SCDHS Arthropod Borne Disease Laboratory (ABDL). The ABDL concentrates its efforts on surveillance for mosquito-borne pathogens, primarily the arboviruses West Nile Virus (WNV), Zika and Eastern Equine Encephalitis (EEE). The Vector Control Division conducts laboratory work that concentrates on estimating populations of mosquito adults and larvae identification. The Division also conducts laboratory work related to special projects designed to improve the control program and to evaluate the impacts of wetlands management. The results of this surveillance are used to guide and evaluate the Division's ongoing control work.

During times of a declared public health threat, the Division comes under the operational control of SCDHS. However, these declarations are infrequent and are issued by the New York State Health Commissioner as was the case in 2019 with the finding of EEE in Manorville.

The New York State Department of Health (NYSDOH) provides important support to the program by analyzing mosquito samples for pathogens, providing technical advice and guidelines and determining when a public health threat declaration is required. NYSDOH also provides significant assistance with public education, as well as financial aid for vector surveillance and control. Because mosquito control involves work in environmentally sensitive areas and the use of pesticides, environmental compliance and protection are important components of the program. The Division is heavily regulated and subject to inspection under a series of New York State Department of Environmental Conservation (DEC) permits, as well as regulations pertaining to the use of pesticides and licensing of applicators. Close contact is maintained with DEC, United States Fish and Wildlife Services (USFWS), EPA and other agencies throughout the year to ensure that all work is conducted to a high environmental standard.

COVID-19 (SARS-CoV-2) Impacts on SC Vector Control



The finding of COVID-19 has had serious impacts on everyone, including Vector Control's program. The timing of the virus' arrival in Suffolk County occurred as Vector's field crews were busy working on a wetland restoration project. All field work was stopped on the project in mid-March and crews were told to remain on-call for new assignments. Within days, SC Fire Rescue and Emergency Services (FRES) reached out to Public Works seeking assistance and Vector's crews readily stepped up to help. Vector Control field staff assisted the SC Fire Marshal's Office to collect donated personal protective equipment (PPE) for redistribution to hospitals, nursing homes and other critical need programs throughout Suffolk. Office staff were tasked with assisting in making Covid notifications to residents who tested positive for the virus, contact tracing of potential exposures and other related tasks as required. Assistance at FRES continued till May 4th when Vector's staff resumed mosquito control operations. Vector Control's public health protection services from arthropod-borne diseases such as West Nile and EEE is designated as an essential service.

2020 Climate Summary and Impacts to Mosquito Populations

Climate can impact mosquito numbers in vast ways. From a lite summer rain storm that fills containers and causes an emergence of backyard mosquitoes to a hurricane that floods marshes and forests that result in massive floodwater mosquito emergences. Warm, dry summers can result in WNV ramping up with spillover to humans, while wet cool spring weather may favor swamp dwelling mosquitoes and result in EEE findings. Each year is unique, much like the winter snow storm events, with planning for the coming mosquito season is near impossible. An isolated shower in one part of Long Island may never impact other areas, but the lasting effects of that isolated shower may result in mosquitoes in the community for several weeks. Each year the Vector Control program can only prep for an average mosquito season and must respond accordingly as the season progresses. The following summary shows the climatic conditions leading into the 2020 summer season and how these events helped shape this year's mosquito season.

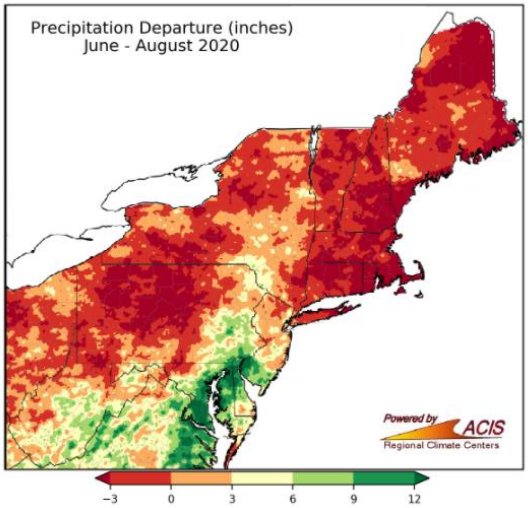
<u>Spring 2020 (March – May)</u>

The spring of 2020 was significantly drier than normal and mixed in terms of temperature. The total precipitation during the March to May Spring period was 9.99 inches which is 20% less (-2.57 inches) than the 30-year average of 12.56 inches. The March precipitation was 0.24 inches below normal while the 1.22 inches of precipitation during May was a significant 2.56 inches below normal.

The mean temperature for March was significantly above normal while the mean temperatures for April and May were both a bit below the normal 30-year averages for each month.

Summer 2020 (June – August)

The summer of 2020 was drier and considerably warmer than normal (Fig 1). The total precipitation was 9.96 inches, which is approximately 15% less than the 30-year average of 11.68 inches. The driest month was June with a large precipitation deficit of 2.71 inches. August was also on the dry side with a precipitation deficit of 0.73 inches. Precipitation was actually above normal during July with a surplus of 1.72 inches which is around 50% above normal. The above normal precipitation at Islip MacArthur Airport during July was due to patchy local thunderstorms that did not affect the county equally.



The mean temperatures for each of the three summer months were above the 30-year normal for the summer. July experienced temperatures that were significantly above normal. The average July temperature of 77.7 degrees F was a 3.8 degrees F above the normal July average temperature of 73.9 degrees F.

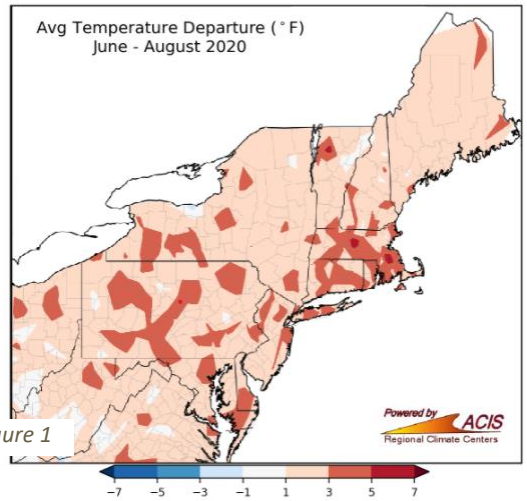


Figure 1

It should be noted that certain areas on the eastern end of Long Island had considerably less precipitation during the summer of 2020 which was noted by abnormally dry soil conditions in the agricultural areas on the east-end.

Overall Season - Spring and Summer 2020

Generally the six month period of March through August of 2020, in Suffolk County New York, was warmer and drier than normal. The months of May and June were very dry with a precipitation deficit of well over 5 inches at the airport. July was the wettest month with a precipitation surplus of 1.72 inches at the airport but these wet conditions were not noted in all sections of Suffolk County. Most areas east of the Islip MacArthur airport experienced less rainfall during July. As is very common during the summer months the western areas of Suffolk County received more rainfall than central and eastern sections.

Above normal summer temperatures were evident in all three summer months of 2020. With the six month spring/summer season experiencing above normal temperatures, with only April coming in 2.0 degrees cooler than normal and May averaging 0.9 degrees below normal.

Weather Impacts on Mosquito Control and Disease

Rainfall summary for the spring and summer of 2020 was quite different from the wet spring in 2019. The dry conditions were prime for West Nile virus amplification during May-June (Figure 2), a crucial time for virus development. We have found above average temperatures during

May and June, with below average precipitation events in Suffolk County to significantly increase West Nile development. While we had dry conditions during the summer of 2020, the April and May average temperatures were below normal, delaying WNV development and resulting in a low season for WNV positive mosquito pools and human cases in Suffolk County.

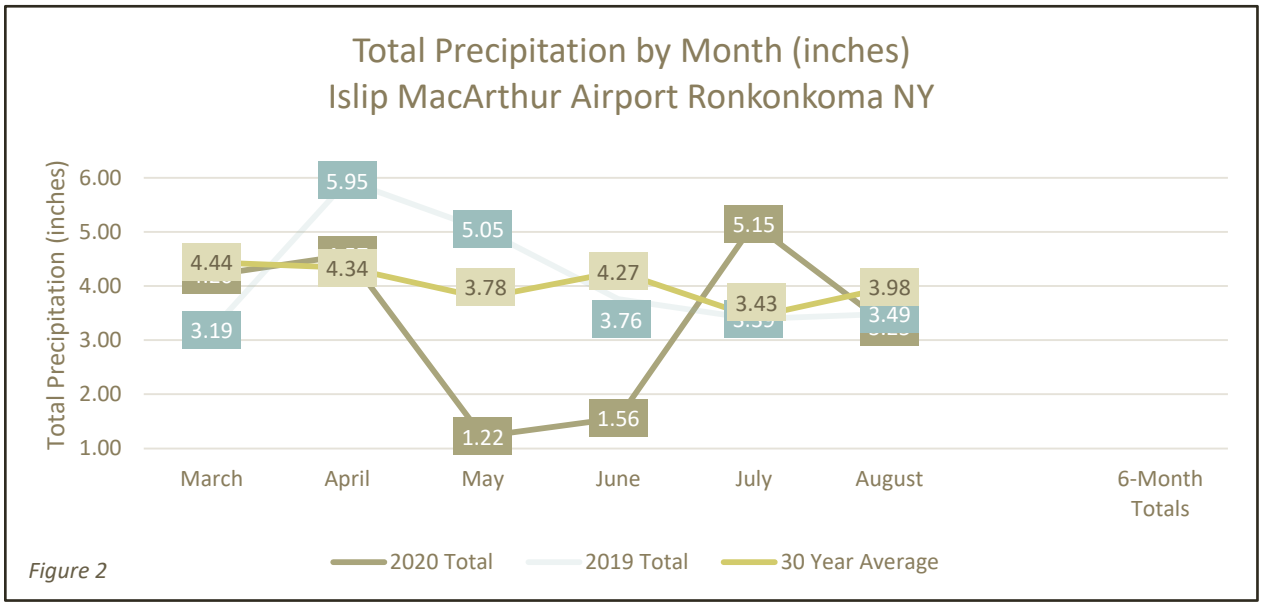


Figure 2

The dry spring weather, and drop in groundwater levels from 2019's elevated levels greatly impacted on our Eastern Equine Encephalitis (EEE) findings. EEE virus is predominately found in the red maple/cedar swamps that are the breeding ground for the *Culiseta melanura* mosquito. Melanura larvae develop in the root crypts under these trees in freshwater swamps, and their numbers are tied closely to fluctuating water levels. Because the larvae overwinter in these swamps, a wet winter/spring with high water levels in the swamps can cause these mosquitoes to emerge in great numbers in the spring. Dry winters, or areas with draw-down of impounded water (managed dams) over the winter can greatly reduce the numbers of *Culiseta melanura*.

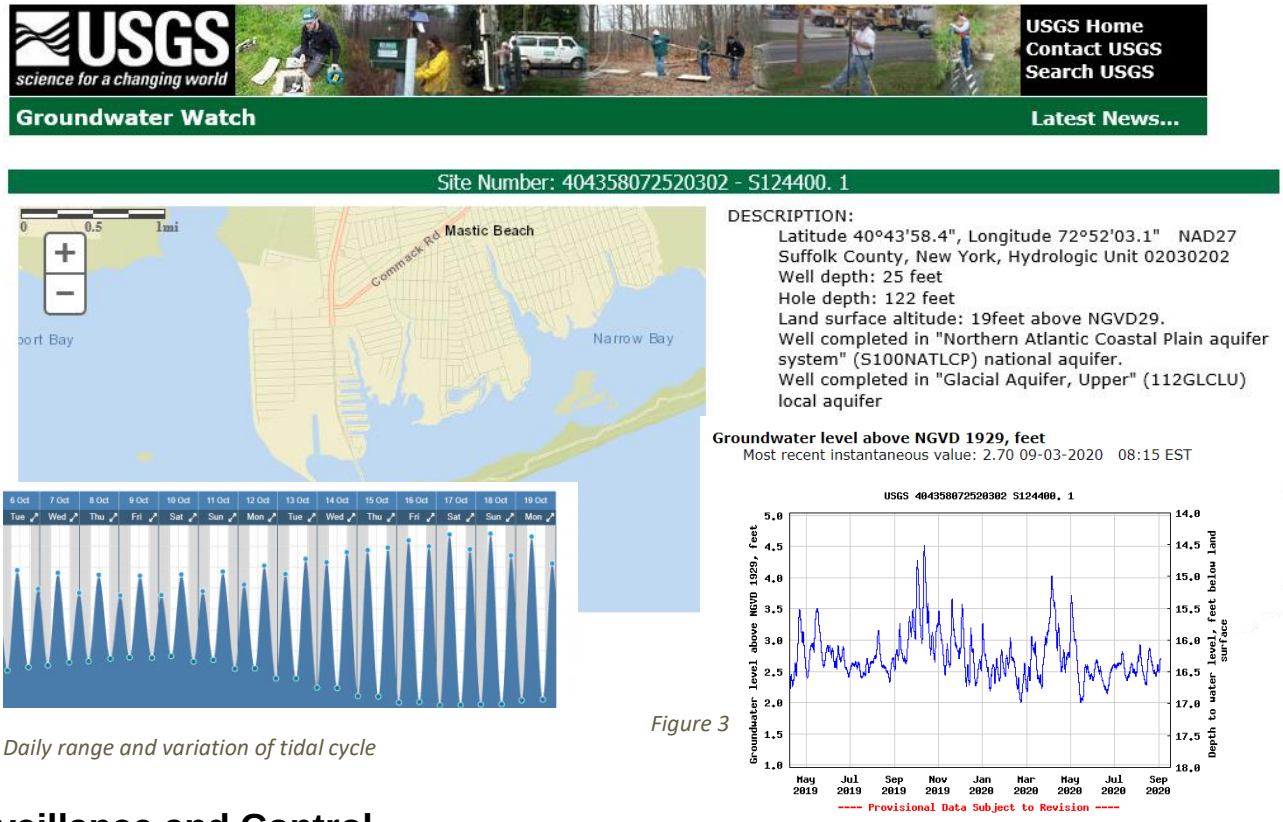
Early reports of EEE virus findings in our neighboring States and upstate NY were concerning that 2020 would be a repeat of our 2019 EEE findings. Dry spring conditions in 2020, a low water table and a relatively dry winter/spring season resulted in low numbers of *Culiseta melanura* mosquitoes and greatly reduced potential for EEE findings here in Suffolk. While EEE can be a health concern through the first hard frost, trap data and cooler September conditions should minimize EEE findings for 2020.

USGS Groundwater Monitoring, Tides and Potential Mosquito Impacts

The 2020 mosquito season continued to trend as a relatively low year for much of Suffolk County, similar to our 2019 findings. A comparison to New Jersey's 2020 mosquito control program summary shows that NJ had salt marsh mosquitoes at or above their expected average levels, differing greatly from Suffolk's findings. While we did conduct aerial mosquito larval control of our salt marshes six times over the 2020 season, there were multiple weeks that did not produce extensive mosquito larvae in the salt marshes requiring aerial treatment. Spring moon

tides (full and new moon tides) for Great South Bay were generally lower during the summer for 2020 and did not flood the marshes as extensively. Peak tides for 2021 show the trend may shift next year to the summer months and could result in the return of significant numbers of salt marsh mosquitoes.

Groundwater levels during the summer of 2020 were below normal as seen from a USGS groundwater well at Smith Point in Shirley (Fig 3), which is in close proximity to several SCVC treated salt marshes. The prolonged low water table did help dry down the marshes, but spring tide events over the summer also trended below normal and may not have flooded the marshes long enough to support mosquito development. The combination of a low water table and reduce tidal flooding hastened the marshes draining and reducing the amount of standing water on the marsh required for larval development. The Groundwater well data also supports the observed absence of EEE activity in Suffolk County during 2020, with the low water table and drought-like conditions resulting in a less conducive environment for *Culiseta melanura* larval development in the freshwater swamps.



Daily range and variation of tidal cycle

Figure 3

Surveillance and Control

The Suffolk County Health Department's Arthropod Borne Disease Lab (ABDL) conducts surveillance for mosquito-borne viruses that pose a risk to human health. Activities performed include mosquito trapping and species identification for testing of mosquitoes and birds for disease, determining local areas of high risk, and providing surveillance information to assist SCVC in making control decisions. Efforts focus on WNV and EEE, which are the most common mosquito-borne viruses and pose the greatest public health risk in Suffolk County; but also includes monitoring for Zika and other introduced diseases.

West Nile

Virus isolations of what eventually was determined to be West Nile virus were first identified in NYC during the summer of 1999. Shortly after NYC's findings of WNV, including several human cases and deaths, Suffolk County also began to find isolations in mosquitoes and human cases of the disease. Virus isolations of mosquitoes carrying West Nile virus, reports of dead birds and human cases of WNV, has become an annual part of Suffolk County's Vector Control program. Vector Control in consultation with Suffolk County and NYS Health Departments reviews each year's virus isolations and on a weekly basis reviews risk to human health. The first years of WNV found clusters of mosquito isolations and human cases, but over the last several years WNV isolations and human cases have become more dispersed and haven't clustered in 'hot spots'.

Prevention is the key component to the limiting the number of human cases of WNV. Public education and larval source reduction or elimination of breeding sites is key to reducing risk. In addition, early larvicide of historic WNV breeding sites such as catch basins in high risk areas, and treatment of abandoned swimming pools and recharge basins/sumps help limit the number of *Culex* mosquitoes that amplify the virus. A major part of breeding source reduction involves community outreach and education to engage the help of the public. Preventing the mosquito larvae from emerging into adults is the easiest and most environmentally-sound way to reduce the number of mosquitoes that may transmit West Nile virus in Suffolk County. Larval habitats or breeding sources for WNV include stagnant water in artificial and natural containers: tires, birdbaths, tin cans, clogged gutters, puddles, pot holes, tree holes and to a more limited extent marshlands and other wetland habitats.

The need for responding to a Health Threat is determined under the New York State Department of Health West Nile Virus Response Plan and the County's Zika Action Plan, adapted for local conditions by staff experts at Vector and Health Services. Because of the persistent presence of WNV in the County, the County perpetually begins each year in Risk Category 2. The New York State Department of Health has determined that there is an ongoing threat to the public health from West Nile Virus, and no longer declares health threats each year. The determination of when the threat of west Nile rises to the level that requires adulticiding is made by the County Vector Control staff in consultation with the Health Commissioner and ABDL staff. As additional pathogenes including EEE, Zika, Dengue, Chikugunya viruses and malaria become established in the US; the CDC, NYS Health and Suffolk continually reevalute the risk to County residents. Currently, only travel related cases of Zika, Malria, Chikungunya and Dengue have been repoted in Suffolk County, but Health ABDL continues to monitor mosquitoes that have shown competence to carry these diseases. As of September 30th 2020 there have been no confirmed human cases of WNV infection in Suffolk County this year, although several potential cases are still being tested. Suspect WNV cases can take several weeks to be confirmed, but data suggests that 2020 will be regarded as a moderate to low WNV risk year.

The need for adulticiding in response to WNV varies greatly from year to year. An analysis of Suffolk County's WNV history during the years 2000-2020 indicates that most years, (12 of 20) the number of human cases of WNV was low, 0-4 cases. Under such conditions, the WNV human transmisson risk level is low, even when WNV is found in the County. In these low risk years, determining exactly where and when to adulticide is nearly impossible with limited data. As a result, in low years, area wide adulticiding is usually not warranted due to the difficulty in

delinating specific areas to target. High risk years are caused largely by environmental conditions favorable to virus amplification in birds and mosquitoes, such as a warm spring and a hot dry summer weather. These conditions manifest themselves in late June and early July through higher than normal numbers of positive mosquito samples and calculated infection rates. WNV history also demonstrates that, in years when WNV activity is higher than normal, human cases are more likely to occur in certain parts of the County than other areas. In years with early indicators of high risk, adulticiding targeted to these high risk areas can measurably reduce the risk of human transmission and is therefore warranted. When a high risk year is identified, these WNV applications generally take place in late July and August during peak tranmission. Responding to early indications of high risk is important, because adulticiding should occur before peak human transmisson occurs in the first 2-3 weeks of August. Waiting to see transmission results in actual human cases is not appropriate because by the time cases are detected, transmission has been ongoing for several weeks and it may be too late to prevent further transmission. Whenever a virus isolation or human case is identified, Vector Control crews are sent to scout the area and treat locations of standing water, including catch basins and recharge basins/sumps for mosquito larvae.

As indicators of risk of transmisson to humans accumulate, Vector Control and Health determines when control measures are best suited to the situation and which areas should be targeted for maximum benefit. The Commissioner of the SCDHS generally makes the final determination of the need for adult control in reponse to pathogens if a public health threat is declared. This strategy is consistent with the goal in the Findings to reduce the use of pesticides by a targeted tiered approach.

To ensure adulticides are used only when there is a clear need and a likely benefit, the criteria for conducting an adulticide treatment will include:

1. Evidence of high numbers of mosquitoes biting residents and visitors (Vector Control):

- Service requests from public - mapped to determine extent of problem.
- Requests from community leaders, elected officials.
- New Jersey trap counts higher than generally found for area in question (at least 25 females of human-biting species per night).
- Centers for Disease Control (CDC) portable light trap counts of 100 or more.
- Confirmatory crew reports from the problem area or adjacent larval habitat, with landing rates of over one biting mosquito per minute over a five minute period.

2. Higher than normal risk of human disease transmission that can be reduced by adulticiding (Health Threat):

- Indications of a higher than normal year for WNV activity County-wide as determined by such measures as infection rates and/or the number or proportion of positive mosquito samples, especially by late July or early August. In a year with normal or below normal levels of WNV activity, adulticiding is generally not indicated.
- In a high risk year, adulticiding may be warranted when there are indications of higher than normal levels of WNV risk (such as the number of positive mosquito samples, infection rates, vector species populations and history of human transmission) in particular areas. Adulticiding priority will be given to those parts of the County where WNV cases have occurred in multiple years and at high densities compared to the rest of the County.

- Zika, Dengue and other mosquito-borne disease responses will occur when positive mosquitoes are found in traps or local transmission by mosquitoes is suspected due to aquired cases without travel history.
- Adulticiding will be strongly considered if EEE is detected during July, August or September when human transmission is most likely.
- Adulticiding in reponse to other pathogens (such as dengue, chikungunya, malaria or other emerging pathogens) will be considered on a case-by case basis based on the vector ecology of the pathogen involved.

3. Control is technically and environmentally feasible:

- A target area can be clearly defined based on geographic features and the distribution of vector species and other risk factors.
- Weather conditions are predicted to be suitable for ULV application when mosquitoes are active. Aerial applications in response to WNV are particularly dependent on weather conditions, and near-ideal conditions of low wind combined with high temperatures and humidity are needed for truly effective results.
- The road network is adequate and appropriate when truck applications are considered.
- Legal restrictions on the treatment of wetlands, open water buffers, and no-spray list members in the treatment zone will not create untreated areas that would 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 will not compromise expected treatment efficacy.

4. Likely persistence or worsening of problem without intervention:

- Considerations regarding the history of the area, such as the identification of a chronic problem area for biting mosquitoes or a history of virus transmission.
- Seasonal cycles of pathogen activity, such as whether or not the treatment is in time to prevent WNV transmission or whether it is too late and most transmission has already occurred.
- Determination if the problem will spread beyond the currently affected area absent intervention, based on the life history and habits of the species involved.
- Crew reports from adjacent larval habitats 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.
- 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, will later conditions prevent treatment at that time or not. Conversely, adverse weather conditions might reduce the threat of disease transmission.

Criteria 1 or 2 are necessary thresholds which should be met prior to a treatment being considered. While criteria 3 and 4 are factors that would determine the extent of the treatment or capability to meet the the goals of the control plan. Treatment will not occur unless criteria 1 or 2 are satisfied through a combination of surveillance indicators, although not all surveillance techniques may be feasible in every setting and situation. The County is not aware of any new data, studies or reports which contravene the research, reports and Findings of the Long Term

Plan with respect to adulticide treatment guidelines or thresholds. Therefore, those Findings remain valid and guide this Annual Work Plan.

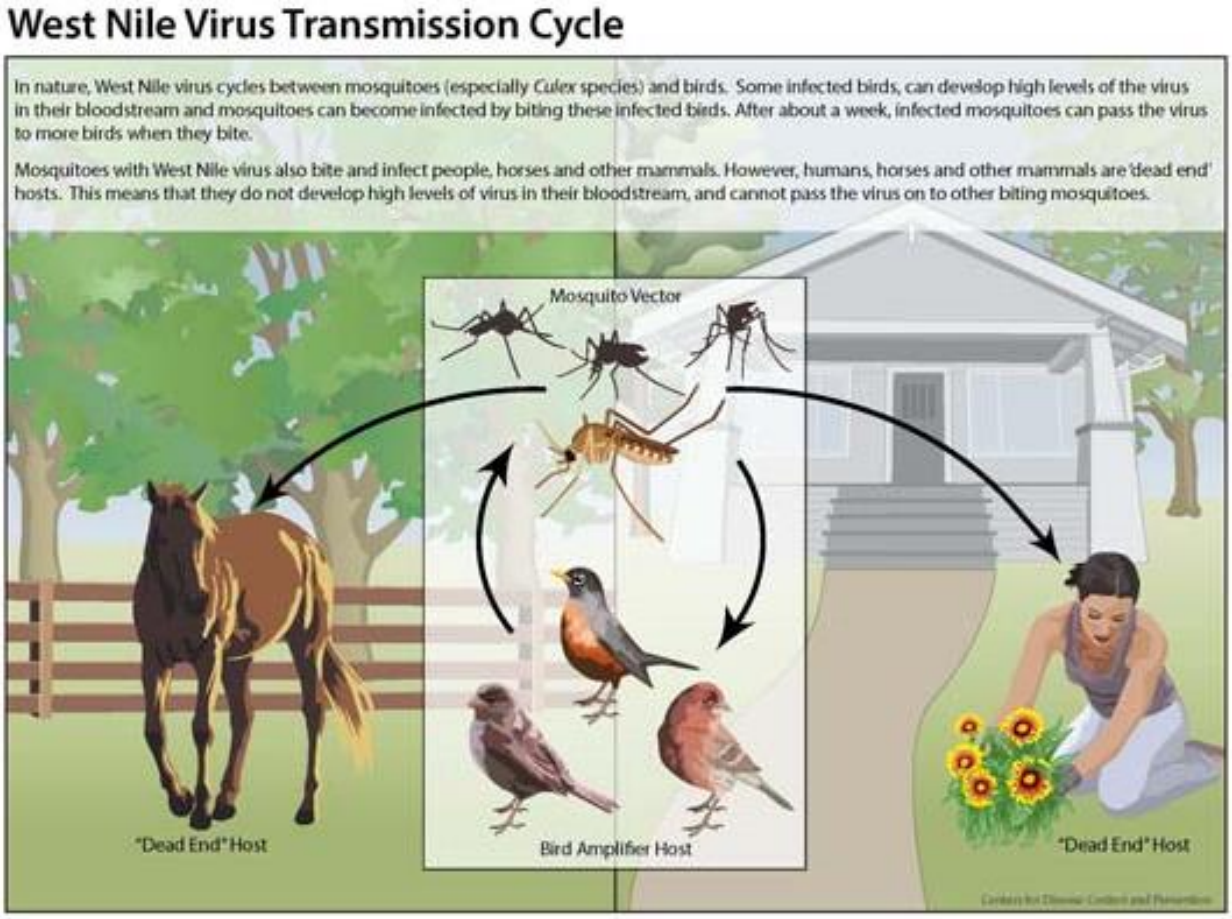


Figure 4. From CDC

Some key recommendations for preventing WN virus in humans include:

- People, especially those 50 and older or those with underlying health conditions, should take special care to prevent WN virus because they are more susceptible to severe WN virus symptoms
- Know the symptoms of diseases to receive early treatment
- If outside at dusk or dawn, or if mosquitoes are biting during the day, wear long pants, long-sleeved shirts and socks
- Consider the use of an EPA and DEC approved insect repellent containing: 2-undecanone, DEET, picaridin, IR3535, or oil of lemon eucalyptus according to the label's directions
- Make sure doors and windows have tight-fitting screens. Repair or replace screens that have tears or holes
- Reduce the number of mosquitoes in your area by getting rid of containers with standing water that provide breeding places for the mosquitoes.

The CDC encourages surveillance programs to routinely incorporate a more informative index of relative virus activity, with the virus infection rate mosquito-based evaluation of local virus activity patterns. At the county level or below, weekly tracking of mosquito minimum infection rate (MIR) can provide important predictive indicators of transmission activity levels associated with elevated human risk. The graph below (Fig. 5) shows the 2020 WNV season started 3 weeks behind the highest WNV years and had a late peak (CDC week 35). 2020 MIR rates declined rapidly in the late season (2020 data shown in graph only reported to week 37) as rain and cool temperatures broke WNV cycling. 2010 and 2012 were high risk years for WNV due to the early findings, large number of mosquito positive isolations and the number of reported human cases.

Disease Risk – MIR based on the number of WNV isolations each [CDC] week

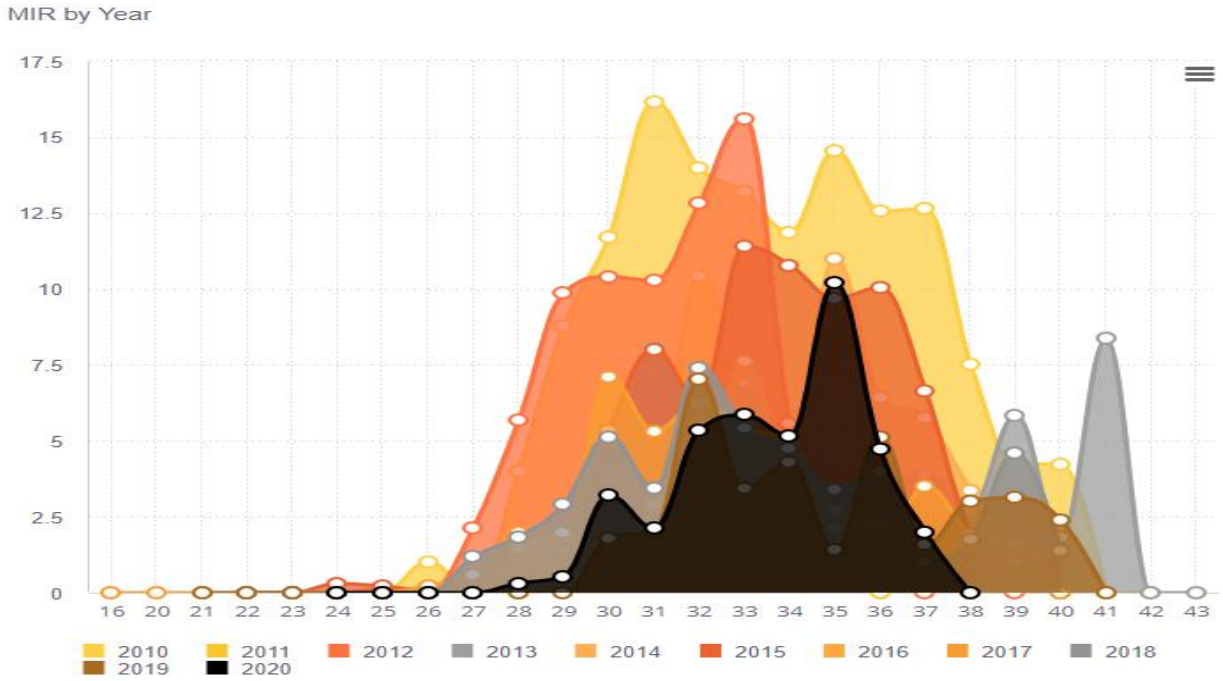


Figure 5 SC Health

Eastern Equine Encephalitis

Eastern equine encephalitis (EEE) virus is transmitted by a mosquito bite and that can cause severe infections (encephalitis) in humans with approximately a 30% mortality rate. Most at risk are children, especially those under age 15. The CDC states that symptoms of EEE infection (EEE, involving encephalitis, an inflammation of the brain) begin with the sudden onset of headache, high fever, chills, and vomiting. The illness may then progress into disorientation, seizures, and coma. Approximately a third of patients who develop EEE die, and many of those who survive have mild to severe permanent brain damage. In 2019 the EEE virus was again found in mosquitoes from the Manorville/Calverton area of Suffolk County in two traps near red maple swamps. This area is exceptionally conducive to the main mosquito that carries EEE - *Culiseta melanura* and the area has a long history of EEE virus isolations. This area was historically cranberry bogs with impoundments to control water levels adjacent to the Peconic

Figure 6 Culiseta melanura Red Maple Swamp Habitat for EEE

River. The old cranberry bogs have been displaced by the red maple swamps with the flooded root crypts the *Culiseta* mosquito inhabits (Fig. 6).

No mosquito pools, human or horse cases have been reported in 2020 (to date) for Suffolk County, while neighboring states of Massachusetts has reported human cases and in NJ there have been horse cases. While the risk of EEE virus extends to the first hard frost, SC Health mosquito traps have continued to be free of EEE virus findings well into late September 2020.

Mosquito-borne Viruses and Species Monitoring

There have been 51 species of mosquitoes documented in Suffolk County, with each unique species having its own habitat requirements and disease transmission potential. The following table shows some of the most common mosquito species in Suffolk County and the potential diseases they can transmit. Concern mounts for human health risk when species habitats and disease potential overlap.

Such is the case in EEE where freshwater swamps are the most likely locations for virus amplification and transmission to occur. If the swamp is in close proximity to a salt marsh, the disease risk to local residents increases significantly due to crossover of the virus to more aggressive human biting species with greater flight ranges. This list only covers some of the most common diseases found locally, with new introductions of mosquitoes and diseases occurring frequently now with globalization and rapid travel to previously isolated regions of the world. The following are just a few of the known arthropod-borne diseases with potential to spread into the United States and/or Suffolk County: Dengue, Malaria, Zika, Yellow Fever, Rift Valley, Murray Valley, Chikungunya, Japanese and Western Equine Encephalitis (Table 1).

Some common mosquito species in Suffolk County and the diseases they can carry and potentially transmit locally:

Scientific Name / Common Name	Diseases Transmitted	Habitat
Aedes albopictus - Asian Tiger mosquito (ATM)	*CHIK, ZIKA, WNV*	*Container, Tarp, Tire*
*Aedes canadensis W*oodland pool mosquito	*EEE, JCV, LAC, WNV*	*Swamps*
Aedes sollicitans Eastern Salt marsh mosquito	*EEE, DHW, WNV*	*Salt marsh*
Aedes triseriatus Eastern tree hole mosquito	*LAC, WNV*	*Treehole*
Aedes vexans Common floodwater mosquito	*WNV, EEE, DHW*	*Woodland puddles*
Anopheles mosquito species	*MAL, WNV*	*Pond edge, streams*
Coquillettidia perturbans Cattail mosquito	*EEE, WNV*	*Ponds*
Culex pipiens Northern house mosquito	*WNV, EEE, SLE, DHW*	*Containers*
Culex restuans	*WNV, EEE*	*Various fresh*
Culex salinarius Salt-marsh Culex	*EEE, WNV, SLE*	*Brackish swamps*

Culiseta melanura	*EEE, WNV*	*Red maple Swamp*

CHK – Chikungunya	WNV – West Nile virus
DHW – Dog Heartworms	ZIKA – Zika virus
EEE - Eastern equine encephalitis	SLE – Saint Louis encephalitis
JCV – Jamestown Canyon virus	MAL – Malaria
LAC – La Crosse encephalitis	

Table 1

Service Requests:

Residents and visitors can report mosquito issues directly to Vector Control. Request can include notifying us of high numbers of adult mosquitoes, reporting a location of standing water for breeding, catch basin or recharge basin/sump check, reporting abandoned swimming pools and for drainage issues that impact mosquito breeding. Service requests are completed as promptly as possible, usually in under a week depending on the volume of requests, staffing and weather conditions. To report an issue, residents can call the office at (631) 852-4270 Monday through Friday from 8am to 3:30pm, dial 311, send an e-mail to SCVector@SuffolkCountyNY.Gov or via the web: https://dpw.suffolkcountyny.gov/vectorcomplaint/ The information is logged into the database and is sent to the field crews to investigate the issue. For 2020, we received 1054 service requests (Fig 7); an increase from the 955 we responded to in 2019. Staff also received several hundred phone call and e-mail/web requests for adult spraying or 'fogging' not included in these service request totals.

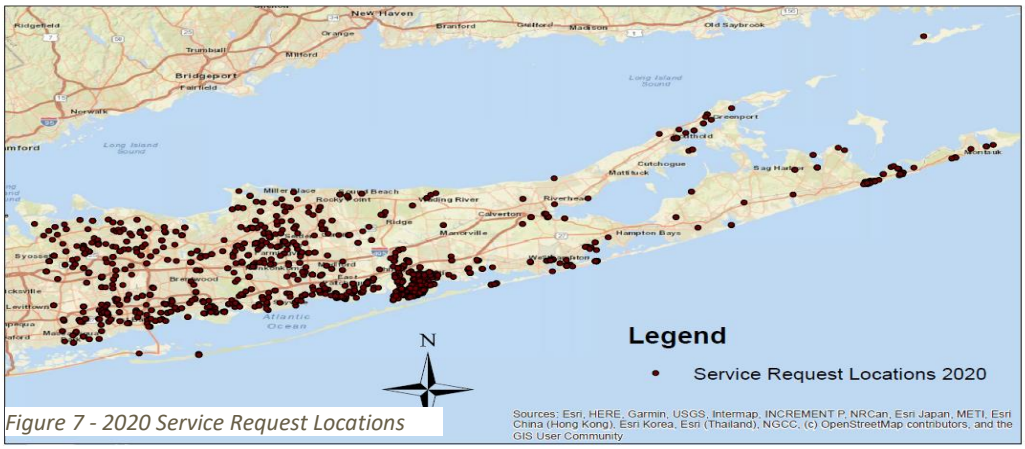


Figure 7 - 2020 Service Request Locations

E-mail and web app requests continue to serve the residents best, as these service requests can be sent 24/7 directly to the office.

Public Education:

Vector Control staff continue to give presentations to community associations and commercial pest control applicators on mosquito and tick issues including the expanding Asian Tiger mosquito and tick surveillance and control. Education of homeowners also occurs when field crews conduct inspections of private property advising residents on steps they can take around their home to reduce mosquito and tick encounters (Fig 8). If no one is home

during an inspection, crews will leave an educational flyer on mosquito control to help inform residents. Health Services staff also holds informative meetings on mosquito and tick issues, post to social media and updates the County website with information and findings on mosquito borne diseases, including steps homeowners can take and updating postings for mosquito spray events. While Covid restrictions have severely limited these types of events, requests for online presentations are becoming the new norm. E-mail and web service requests sent to us also have an automatic e-mail response informing the sender of steps they can take to combat mosquitoes around their home.

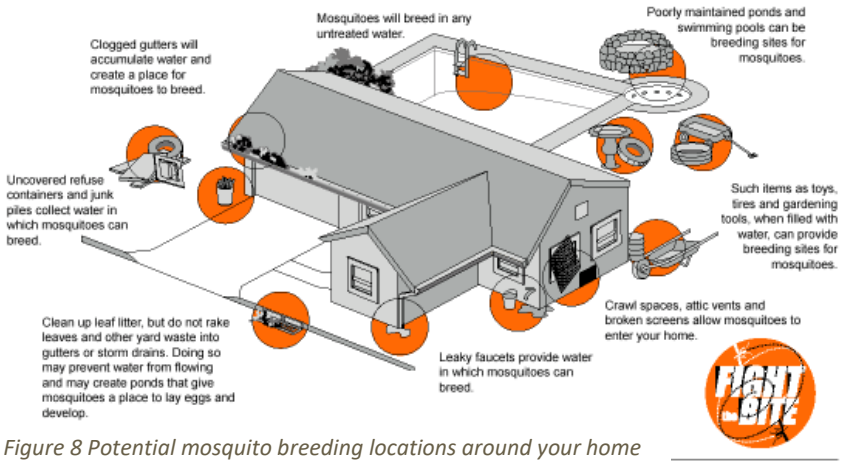


Figure 8 Potential mosquito breeding locations around your home

Surveillance

Spring tides and exceptional rainfall events are key factors driving floodwater mosquito populations and need to be understood to plan successful control. Spring tides occur around full and new moon events and can cause tidal flooding of salt marshes. These events often flood the upper fringe marsh where salt marsh mosquitoes are most common. Storm events with excessive precipitation/rain are also a trigger for freshwater flood mosquitoes. Low depressions in the forest floor can hold eggs dormant for long periods of time between rain events that trigger the eggs to hatch. These floodwater species can be quite aggressive but generally do not travel far from their breeding locations so the impact is more localized compared to salt marsh emergences. Most freshwater floodwater mosquitoes can carry several diseases of public health importance, so monitoring and control of these species is also of concern to SCVC crews.

Adult Mosquito Population Monitoring:

Of the 51 species of mosquitoes in Suffolk County, only a limited number cause issues with disease transmission or generate calls for mosquito control services to Vector Control. Without exception, the salt marsh mosquitoes are the most aggressive and prolific species in generating request for spraying to control biting mosquitoes. While these mosquitoes can be a considerable nuisance, they also can carry risk of disease transmission to humans and heart worm parasites to pets. Three salt marsh mosquito species made up 80% of the adult mosquitoes collected in our 31 NJ type light traps located throughout Suffolk. The remaining 20% of adult mosquitoes consisted of 27 species including freshwater/swamp, container and treehole breeding mosquitoes.

Aedes sollicitans: The mosquito of greatest turmoil to residents of coastal regions of Suffolk County is the *Aedes sollicitans* mosquito. This aggressive species breeds prolifically in the upper reaches of salt marshes and can travel several miles seeking out a blood meal from an animal or human. A salt marsh can produce millions of these mosquitoes, generally appearing 7-10 days after a lunar tide (full or new moon) event. Of our local waterbodies, the Great South Bay produces the majority of the *A. sollicitans* mosquitoes due to local tidal amplitude causing puddles/pannes on the salt marsh where this species lays its eggs. Eggs that are laid in the marsh

Figure 9

by the female mosquito and can lay dormant for weeks, months or even years awaiting the next flood tide event to generate a new hatch. The aerial larvicide program in Suffolk County targets this species due to large acreage tracks of salt marshes where this mosquito lives. The following graph shows the 2020 *Aedes sollicitans* weekly population counts as compared to the 5 year average. From the graph we see salt marsh mosquitoes were down significantly compared to the 2014-2019 weekly mean for all traps (Fig 9).

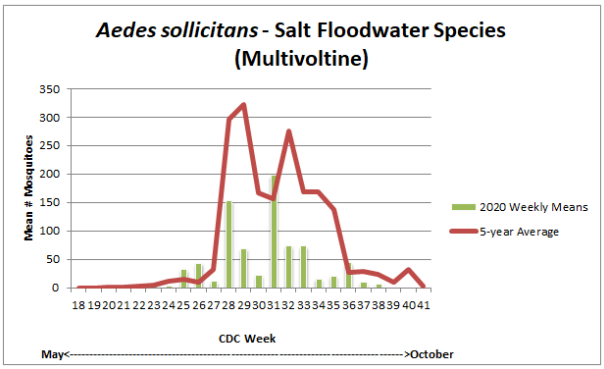


Figure 9

Culex pipiens/restuans complex: The *Culex* species of mosquitoes are container species with a strong link to West Nile virus cycling and potential transmission to humans. One of our predominant habitats for *Culex* mosquitoes includes catch basins that hold water for extended periods. Treatement of catch basins with larvicide in areas with active or historic WNV isolations and human cases is carried out in the early mosquito season in these hot spot locations. Larviciding the basins assists in breaking the WNV cycle and keeping mosquito populations low. In 2020, *Culex* numbers in our traps were well below average due to the drought like conditions that kept most catch basins dry through the season (Fig 10).

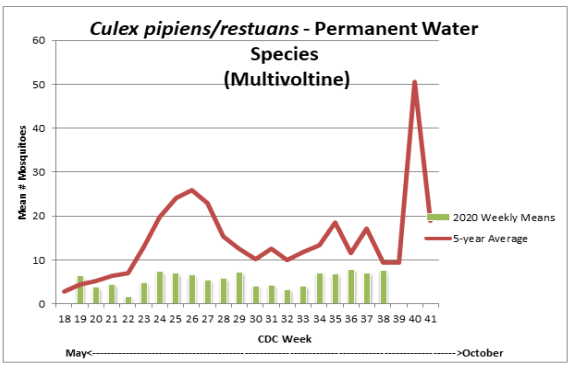


Figure 10

The Asian Tiger Mosquito (ATM) *Aedes albopictus*: is a prolific, aggressive, daytime biting mosquito that adapted rapidly to Suffolk County. This species is from Asia and now can be found throughout Suffolk County and has become a severe concern in areas that never before had to deal with mosquito issues. The ATM is a container breeder and a fierce daytime biter. The ATM usually will bite the ankles, legs and feet if not covered. Because this species breeds in buckets, tarps, bird baths and any small water holding container, having Vector Control check every yard on a regular basis would be impossible. Instead, public education directed to homeowners is the best way to remind residents to 'Dump the water' especially after rain events. This mosquito does not travel far, typically under 300 feet from where it emerged and generally will not cross open areas including roads. Residents with ATM issues should seek out the source in their yard, or try to determine if a neighboring property is the source. The ATM season peaks late summer and can continue their aggressive attack to the first frost. The 2020 data shows ATM numbers have tracked well below the seasonal average for most weeks, with a peak emergence after heavy rains in August due to Tropical Storm Isaias (Fig 11). Late season service requests for ATM control have been below past year's requests for September when populations often peak.

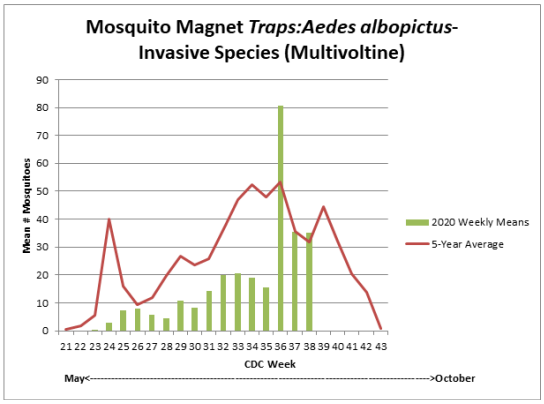


Figure 11

Resistance Monitoring:

Pesticide resistance is of great concern, so for the past several years we have begun monitoring resistance in several of our primary species of concern. In 2016 we began by using CDC bottle assays of our adulticide pesticides Anvil 10+10 ULV (sumithrin), Duet (sumithrin and prallethrin) and Scourge (resmethrin) of *Aedes sollicitans, A. albopictus A. taeniorrhynchus* and *Culex pipiens* (Fig 11).

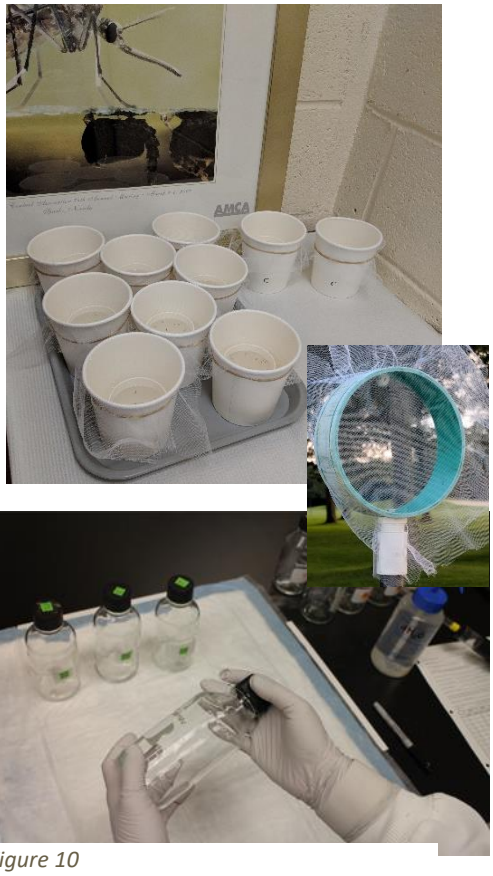


Figure 10

Starting in 2019, we started resistance monitoring of our two primary larvicide products; Bti and Methoprene. Larvicide resistance tests, using Bti and Methoprene were performed on *Culex pipiens* (northern house mosquito) the primary vector of concern for West Nile virus by Vector in 2019. For 2020 we had larvae tested independently against our larvicides by the Northeast Regional Center for Excellence in Vector-Borne Diseases (NEVBD). No resistance was found in tested populations of the *Culex pipiens* mosquito larvae tests during 2019 and 2020. There have been several recent reports of *Culex* resistance to *Bacillus sphaericus* (Bsph) (now renamed *Lysinibacillus sphaericus*) from other mosquito districts in the US. Vector Control will continue to monitor use of this material for possible resistance locally and will only use Bsph in rotation with other larval control materials to avoid building resistance to the bacterial toxin in Bsph. When used in combination with Bti, mosquitoes have been shown to become more susceptible to the Bti through synergistic effects with the *Bacillus sphaericus* bacteria.

Larval Control:

All field personnel conduct larval control during the active mosquito season. Most crews conduct ground larviciding, while a heavy equipment crew also assists in helicopter larvicide applications. This component is conducted during the active mosquito season of May 1 to October 15. Larval control is required when water management has not been able to completely prevent mosquito production or is not appropriate for the site. Ground crews visit known larval habitats, check for the presence of larvae, obtain larval specimens for identification in the laboratory and will apply larvicide when required. Field crews also eliminate larval habitats by unclogging culverts, dumping or removing containers or otherwise removing standing water. While the acreage of these sites is often small, their proximity to residential areas makes them important sources. Ground crews also respond to complaints from the public. The Division's most intense efforts are directed to the major salt marshes and large wetland complexes, which require use of the helicopter due to their substantial acreages. These large marshes are surveyed weekly, or after extreme flood tides. If larvae are discovered, a contract helicopter applies

larvicide as directed by Vector Control. For salt marshes and similar habitats, either Bti (Bacillus thuringiensis israelensis), Altosid (methoprene), or a combination of materials are applied, based on larval stage, temperature, and weather conditions.

For 2020, crews perform approximately 6,000 inspections of larval sites. Checked and treat as required 9,829 catch basins in communities with past history of West Nile virus positive pools or human cases. Vector Control crews also investigated 182 abandoned swimming pools that were reported from the public and municipal agencies to be inspected by Vector staff.

Treated approximately 9,960 acres with the biorational larvicides: Bacillus thuringiensis israelensis (Bti), Bacillus sphaericus or methoprene. Material applied depends on mosquito stage of development, weather, coastal tides and virus findings [See table of pesticide usage on the last page of the Plan]. Improvements to the aerial larval control program through incorporating the product VectoPrime FG, a granule with a Bti/methoprene mix allowed for better targeted application sites with reduced drift issues compared to the liquid droplet products. The granules also allow applications over upland vegetated transition zones, where tree canopy cover makes liquid applications to water below the tree canopy difficult. VectoPrime FG is also a fast acting, non-residual product that does not persist in the environment. Cost per acre is more expensive using the VectoPrime FG, but savings are anticipated in the reduced need for follow-up adult control (ULV fogging) and through improved targeting of the larval breeding sites resulting in less material usage.

For 2020, VectoMax FG was also introduced to the larvicide program for freshwater locations. VectoMax FG is a combination product of Bti and *Bacillus sphaericus* two bacterial products that is best suited for semi-permanent waterbodies where potential for extended control is anticipated through natural recycling of the *B. sphaericus* bacteria. The cost of the material and high application rate make use of VectoMax ideal for remote locations where crews may have difficulty making more frequent site inspections, such as Fishers Island, Shelter Island and Fire Island.

The equipment to be used for larval control includes various trucks for crew transportation, samplers such as dippers and mosquito traps, truck-mounted hydraulic sprayers, backpack sprayers and granular blowers, plus specially-equipped helicopters for larvicide applications on areas too large or inaccessible for ground treatment. All pesticide applications use USEPA and NYSDEC registered materials and are conducted under appropriate Article 15 Protection of Waters and Article 24 Freshwater Wetland DEC permits and in accordance with label directions and other relevant State and Federal laws.

The Division has developed technical guidelines for larval surveillance and control that determine where and when larvicides are used and what materials are best selected for a

particular situation. These guidelines emphasize the use of bacterial products when possible and reserve methoprene for those situations where bacterial products alone are unlikely to be as effective. As per the Findings for the Long Term Plan and Executive order 15-2007, the Pesticide Management Committee has reported on the results of its review of literature on methoprene and potential impacts, as well as on research sponsored by the County. The Committee found no significant new concerns regarding the use of methoprene. The County is committed to implementing a Pesticide Reduction Action Plan, which will seek to further accelerate pesticide reduction. As part of this Pesticide Reduction Action Plan, the County will continue to work with technical experts to further refine protocols related to larval monitoring and larvicide usage, consistent with the Long-Term Plan and GEIS. The County is not aware of any new data, studies or reports which contravene research, reports and Findings of the Long Term Plan with respect to larval treatment guidelines or thresholds. Therefore, those Findings are still valid, and govern this Annual Plan. In 2019, the County contracted with SUNY Stony Brook researchers to undertake a pesticide literature review for the products used by the Vector Control program. This review will encompass any new findings since 2010 when the last literatre review was completed. Release of the final SUNY Stony Brook methoprene literature review was delayed due to Covid, but Stony Brook has stated its review it will be ready for attachment with the Plan and presented at the CEQ and Legislature meetings.

Adult Control:

Vector Control will conduct adult treatment, spraying or 'fogging' when infestations are severe and widespread and/or necessary to respond to the presence of mosquito-borne pathogens. Community-wide requests for adult control were limited in 2020, with the notable exception of the communities of Mastic, Mastic Beach and South Shirley that border the Fire Island National Seashore and William Floyd Estate. While marshlands within the neighboring US Fish and Wildlife Refuge at Wertheim allow for regulated mosquito control activities under a special use permit, the National Park Service does not allow Vector Control to treat their land holdings, except under tiered conditions for virus response. This creates unique hardships on the neighboring communities to these Fire Island Seashore lands from immense numbers of biting mosquitoes migrating into these areas. The extreme numbers of biting mosquitoes results in the need for repeated adult ULV spraying of adjoining residential areas. Many parts of the Mastic Beach community are also within NYSDEC mapped freshwater wetlands restricting our ability to undertake adult control treatments for residents living within areas adjacent to these wetlands.

Adult control can be deemed to be necessary under two separate operational scenarios in the GEIS. One is defined as a "Vector Control" (public health nuisance) application, the other is defined as "Health Emergency" application. Vector Control adulticide applications are made to reduce excessive numbers of human biting mosquitoes that could impact public health and quality of life by their biting activities. These high populations also represent potential vectors if a pathogen is present or appears in the area. Health Emergency applications are made when an unacceptably high risk of disease transmission to humans is detected, based on the ongoing

presence of pathogens in mosquitoes. In either case, pesticide use decisions are only made on the basis of scientifically-determined surveillance data.

The Long-Term Plan proposed a general reliance on resmethrin, a synthetic pyrethroid, as the primary adulticide pesticide. However, the Federal and State re-registration for resmethrin products was recently terminated by the manufacturer and this material can no longer be used for mosquito control. Sumithrin, a similar pyrethroid, was proposed by the Long Term Plan to be the primary back-up to resmethrin, and the primary pesticide for hand-held applications. Sumithrin has now become the Division's primary adulticide material. Sumithrin, like resmethrin has been found to be an effective pesticide for mosquito control, can be used for ultra-low volume (ULV) applications for truck and aerial delivery, undergoes rapid decay in the environment, and, as discussed below, has few identified non-target effects when applied as proposed under the Long-Term Plan. The Division has also begun use of Duet, with the Long Term Plan modified to include Duet and its active ingredients, sumithrin and prallethrin. Duet is similar to the Division's primary sumithrin product, Anvil, in that both products contain sumithrin and the synergist piperonyl butoxide (PBO). However, in addition to 5% sumithrin and 5% PBO, Duet also contains 1% prallethrin. This amount of prallethrin is not sufficient to control mosquitoes, but it does induce them to fly, a phenomenon known as "benign agitation". Benign agitation causes mosquitoes that are resting to fly so that they will encounter the aerosol droplets and increase the likelihood mosquitoes would be exposed to a lethal dose of sumithrin. Duet has been shown to be particularly effective against mosquitoes that tend to rest during the optimal time of the day for aerosol treatment, that is, at night. The primary use for Duet will be against the Asian Tiger mosquito (ATM), *Aedes albopictus* and may be used for control of other active daytime species including salt marsh mosquitoes. The ATM is an introduced species that inhabits containers and tends to bite during the daytime, making it a significant biting pest that is difficult to control because it is less active at night.

The Long-Term Plan also identifies two other pyrethroids, permethrin and natural pyrethrins, as potential adulticide compounds. Neither is preferred, as permethrin is a widely available product that is manufactured for many homeowner pest and farm uses that may have caused increase mosquito resistance to the material. Natural pyrethrins are identified as a potentially useful compound because its label allows for use over agricultural areas, and while the pesticide is organic, pyrethrin can cause allergic reactions to sensitive individuals and non-target impacts, including toxicity to fish and aquatic invertebrates.

In addition to the pyrethroids, malathion, an organophosphate pesticide, was identified as a potential adulticide. Malathion would only be considered for use under very specialized conditions, such as in Zika response if a thermal fogging application was required, emergency daylight applications were called for, or if resistance testing indicated pyrethroid applications would be ineffective in meeting the goals for public health protection.

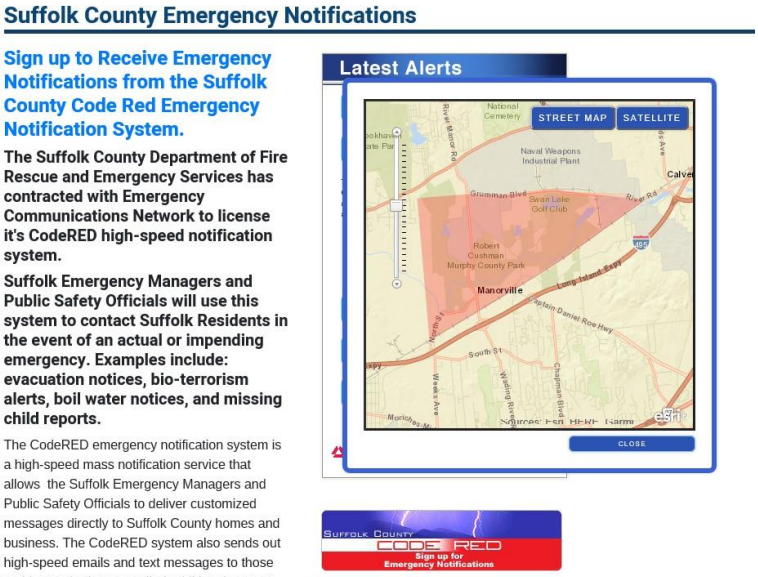
All of these pesticides are EPA and NYSDEC registered, applied at the label rates, used in the best way of achieving effective mosquito control and to avoid development of pesticide

resistance. The adulticides included in this Annual Plan have been fully evaluated in the GEIS for the Long-Term Plan, and this Annual Plan is fully consistent with the attached Findings Statement. Vector Control continually reviews available pesticides and alternatives, including emerging materials and application techniques for the most environmentally suitable control methods.

PUBLIC NOTIFICATION AND THE "NO-SPRAY" REGISTRY:

In 2000, the County passed new laws to improve required public notification for adult mosquito control. As a result, there is now an increased use of the media and extensive outreach to local officials. The Health Services and Vector Control websites are used to post spray notices and maps of the treatment area. For each adulticide application, over e-mails and faxes are sent to various officials and other interested parties. Newsday and News12 often post spray schedules and maps but are not consistent in covering spraying events. Health has begun posting spraying updates to social media including Facebook and Twitter. It is important to recognize that adulticide applications are very sensitive to the weather, especially aerial applications. The need to inform the public needs to be balanced with the need to conduct operations promptly, within weather windows and before the problem spreads and more acreage needs treatment. It is usually not appropriate to provide more than 24 hours' notice in most cases, because beyond that time, weather forecasts are not very reliable. Attempts to provide more than 24-hour notice often result in aerial spray operations being announced and then cancelled. These cancellations are confusing to the public and difficult to reschedule. Despite these difficulties, the County provides 48-hour notice for aerial adulticide applications whenever possible for non-virus response.

In addition to the previous public notification procedures, the County has implemented a County law, passed in 2010, requiring the use of its "Code Red" automated calling and messaging system to provide more thorough public notice for adulticiding. This system allows automated phone calls to be placed to all landline telephones in an area designated for treatment. These messages provide basic information about the operation, such as spray hours, and refer the recipient to additional sources of information. The system ensures that nearly everyone in the area knows about the operation. Use of the



Code Red system has been very successful and provides a new level of public information for the program. Residents can also register their cellphones or e-mail addresses to receive the Code red updates through FRES.

The Division also maintains a "no-spray" registry of residences where adult mosquito control is not desired. During ground applications the application unit is shut off 150 feet prior to passing such a residence and not turned on until 150 feet after. This registry represents an effort to balance the desires of those residents who want control of adult mosquitoes with those who oppose the use of pesticides. In 2020, the "no-spray" registry listed 212 properties, including 36 for health concerns, 28 beekeeper hive locations and 28 were organic farms locations including backyard gardens and 118 opposed to pesticide use. When control is required to deal with a public health threat, the Commissioner of SCDHS can override the list. Even then, list members are contacted prior to applications in their area through the Code Red system or called directly. In addition to this legally required registry, the Division maintains on the list beekeepers and organic farms who register. Beekeepers' properties are generally avoided and beekeepers are notified via Code Red before treatments so that they can take any additional actions they may deem necessary to protect their hives. In addition, several steps are taken to avoid impacts to bees including timing of applications to the evening hours when bees are not foraging. Vector also uses mosquito control materials least likely to impact bees and through adjustment of spray equipment and technique using an ultra-low volume (ULV) droplet size that will impact mosquitoes, but not injure larger bodied insects, including bees. Certified organic farms are avoided and a buffer zone around the farm is included.

The County also provides public notification for aerial larviciding. An e-mail notice of the marshes to be treated by helicopter is sent each week to Legislators, local governments and other interested parties. In addition, a list of marshes to be treated is posted each week on the County Web site and on the Health Department's social media pages.

Mosquito Surveillance and Research:

All control mosquito operations are based on information obtained from surveillance and research. This is a cooperative effort between Vector Control staff in the Department of Public Works and the Arthropod Borne Disease Laboratory in the Department of Health Services. Knowledge of mosquito populations, species composition and arbovirus activity is used to guide and evaluate control measures. Arbovirus surveillance allows the Division, in cooperation with the County and State Health Departments, to gauge the potential for disease transmission and to take appropriate action.

New Jersey Light Trap

Mosquito population surveillance: Larval and adult mosquito surveys are analyzed each year for species abundance and location. These surveys are necessary for locating infestations, directing control efforts and evaluating the effectiveness of those efforts. The mosquito species that breed in various locations are determined from larval samples. Adult mosquitoes in residential areas are estimated from a network of approximately 31 New Jersey style light traps in fixed locations throughout the County. New Jersey traps provide staff with ongoing population trends and are compared with service requests in a community to assist in determining the need for adult mosquito spraying. In 2020, over 41,000 mosquitoes from these traps were identified to species and counted (Fig 12). This tedious work is conducted by the Vector Control mosquito entomologist. In addition, Vector maintains an array of specialized Mosquito Magnet type traps to monitor seasonal cycles and long term trends in populations of the introduced exotic, container-breeding species *Aedes japonicus* and *Aedes albopictus* (The Asian Tiger Mosquito).

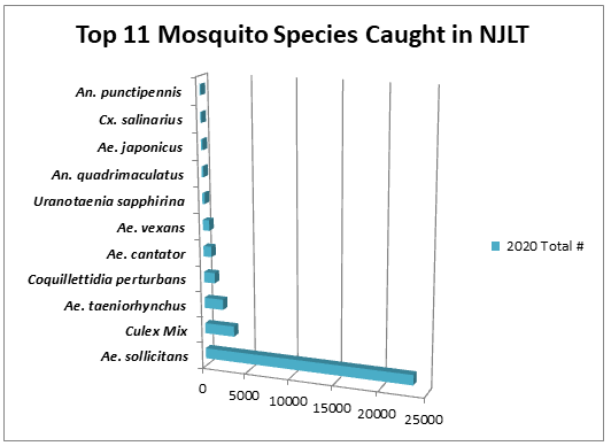


Figure 12

Arbovirus surveillance in mosquitoes: Viral surveillance is conducted primarily by the ABDL and will be directed primarily at the main pathogens, WNV, Zika and EEE. Surveillance is conducted according to the latest CDC and State DOH guidelines, modified for Suffolk County's unique environment. To monitor virus activity, ABDL staff set CDC light traps and gravid traps on a weekly or rotating basis at various locations throughout the County. These sites are chosen based on their history of viral activity or the presence of viral indicators such as the finding of birds with WNV in the area. The ABDL collects and process approximately 50,000 live, adult mosquitoes annually for viral analysis (Fig 13). Mosquitoes collected are sorted by species, frozen, and sent to Albany for arbovirus analysis in the State DOH laboratory.

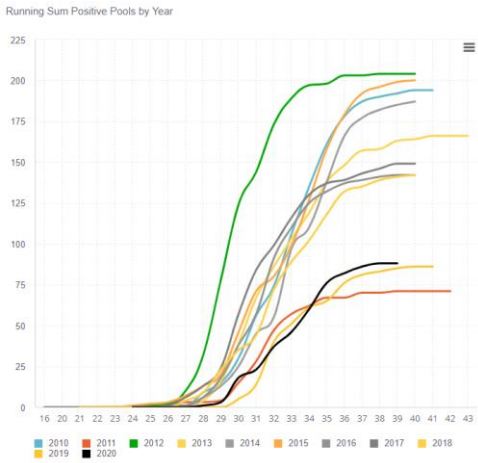


Figure 13 Total WNV Positive Mosquito Pools by Year

Human, avian and other surveillance: SCDHS, State DOH, DEC and CDC monitor other WNV and EEE indicators such as unusual bird deaths or the number of dead birds sighted in an area. The presence of WNV-positive birds is an indicator of virus activity in an area, and ABDL picks up selected dead birds for WNV testing. ABDL conducts a rapid RNA test (the RAMP test) to check for WNV in dead birds. There are also indications that the number of dead bird sightings in an area is a surrogate indicator of risk. SCDHS and NYS also monitor hospitals, blood banks and outreach to physicians to quickly detect human cases of Zika, WNV and other emerging vector borne illnesses.

Efficacy monitoring: While the Division has always monitored the effectiveness of the control program in a variety of ways, there has been an increased effort in this area, based on trial work

to develop methods conducted in 2007. In particular, trapping of adult mosquitoes before and after adulticide events is conducted using carbon dioxide baited CDC light traps, NJ traps or reviewing service request logs. In addition, indicators of virus activity before and after treatment are followed to be sure the desired effect is achieved. The number of adult mosquitoes in New Jersey type traps compared to historic averages (Fig 14) and the number of service requests in a community are key indicators of the overall success of the larval control program.

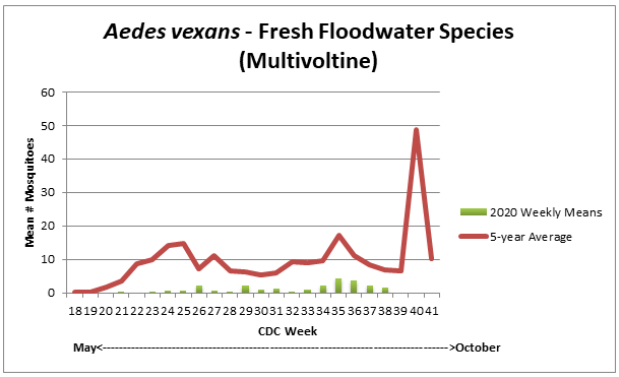


Figure 14

Special surveys and field investigations: Vector's Control staff conduct special surveys to determine the source of mosquito problems when these turn up in places where they are not expected. Special surveys of problems that appear early in a season can allow larval crews to prevent further trouble through the summer. Given the somewhat unpredictable ways mosquitoes can cause problems for residents of and visitors to the County, it is important that the Division retain a flexible ability to investigate issues as they are identified.

Support for Wetlands Restoration/Stewardship activities: Vector Control continues to provide support for monitoring and other investigations related several wetland restoration activities. In particular, Division staff assist in the ongoing monitoring of the Integrated Marsh Management (IMM) projects at Wertheim and Seatuck National Wildlife Refuges. In addition, the Division will assist the Wetlands Stewardship Program in identifying and evaluating prospective sites for future IMM projects, particularly those that will help meet Long Term Plan goals for pesticide use reduction. With the completion of the Wetlands Stewardship Strategy and the availability of grant funding, this component of the program will continue in 2021 with several grant funded restoration projects.

COOPERATIVE EFFORTS AND OUTREACH:

Other provisions of the Work Plan notwithstanding, Vector Control may participate in research, monitoring, and demonstration projects in cooperation with other levels of government such as the State, Towns or Federal agencies such as the US Fish and Wildlife Service or Army Corps of Engineers. These activities may be subject to separate DEC permitting and SEQRA compliance, and to CEQ and Wetlands Stewardship Committee review as well.

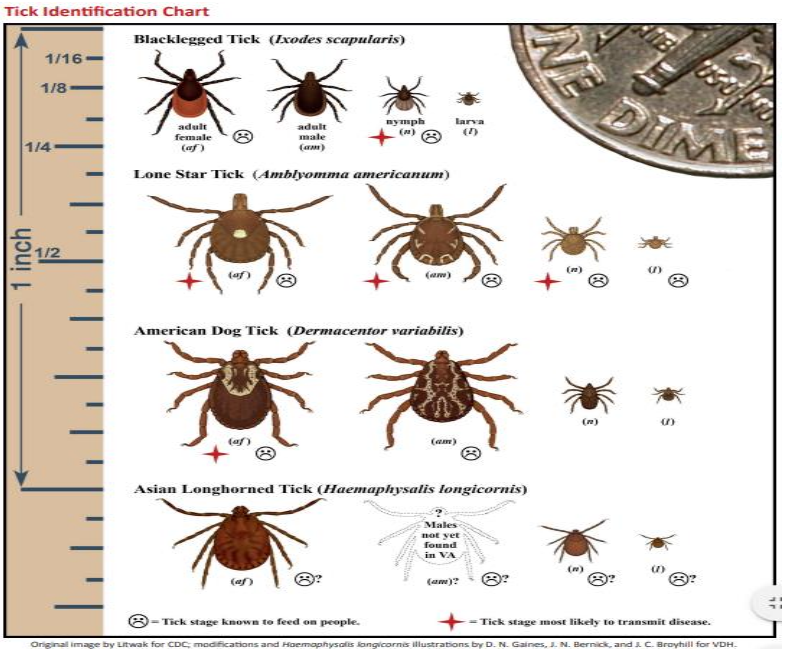
Vector Control will also continue to work with the various local governments, including the cooperative effort with East Hampton Town to provide a framework to develop, plan and construct wetland restoration projects that will restore wetland functions and values, and lead to a reduction in pesticide use, while still protecting human health and quality-of-life through reduced mosquito numbers.

TICK RESEARCH SURVEILLANCE AND CONTROL:

On October 17, 2013, the County approved Resolution 797-2013 requiring this Plan of Work to include a section on the "steps being taken to reduce the incidence of tick-borne diseases in Suffolk County". Accordingly, the 2021 Plan of Work includes a section on current tick surveillance, research and control activities. For 2021, these steps will continue to be focused on planning, information gathering, outreach, technical assistance, and small scale tick control trials and as such will be Type II actions under SEQRA Section 617.5 (c) (20), (21) and (27). In 2013, the Division began work under Resolution 797-2013 to determine how the County might best be able to reduce the impact of tick-borne diseases. This was a follow-up to the Tick Management Task Force (TMTF) report that was submitted to the Legislature in May of 2008 in response to Resolution 1123-2006. In addition, Resolution 132-2014 created the Tick Control Advisory Committee (TCAC) to advise Vector on tick control planning. Any large scale effort to reduce the number of ticks on a countywide landscape, such as those described by the TMTF, would have the potential for adverse impacts on the environment and would need full SEQRA review. While no large scale control efforts can be undertaken prior to an environmental review of tick control under SEQRA, and potentially an EIS tick control supplement to the plan, several interim actions are underway.

The development of a Tick Control Plan and environmental review, therefore, is a major effort that has yet to be funded. In 2015, the County took the first step and created a new tick entomologist position for tick-related surveillance activities. This full time entomologist is devoted to tick research and control and has been a major step forward in understanding the tick issues in Suffolk. Re-establishment of the TCAC under Resolution 1668-2016 is also assisting the County to develop a plan of action and identify the resources needed going forward to fully develop a County-wide environmentally sound tick control plan.

In 2021, Vector Control will continue to work on developing a County-wide tick control plan with the limited resources available. Current studies on tick control efforts are restricted to research activities that do not require full environmental review under SEQRA. Vector is also working to improve the technical basis for control efforts and provide practical information to the various public and private entities currently undertaking localized tick control programs. These cooperative efforts can help leverage the County's limited resources through partnership and collaborative efforts, including our involvement in the Shared Services program.



Tick Seasonal Activity Surveillance

Bi-weekly site surveillance, initialized in 2015, has continued through 2020 to more accurately track seasonal activity, population density, species distribution, and environmental characteristics which drive tick activity within the County. Due to Covid-19, there was limited ability for early season surveillance efforts. Collaborative surveillance with New York State Parks has continued from 2018 through 2020 in tracking the efficacy of the State's 4-poster programs at Connetquot, Wildwood, Heckscher and Robert Moses State Parks. This additional data has bolstered the surveillance network within the County at no additional burden on County resources.

A clear species gradient has been observed across the County with western locations having higher densities of deer ticks, while Lone star tick densities increase in an eastward direction. This species gradient aligns with environmental conditions more supportive to one species or the other. The collected tick activity data collected for *I. scapularis* and *A. americanum* nymphs and adults (Fig 15) will be updated periodically.

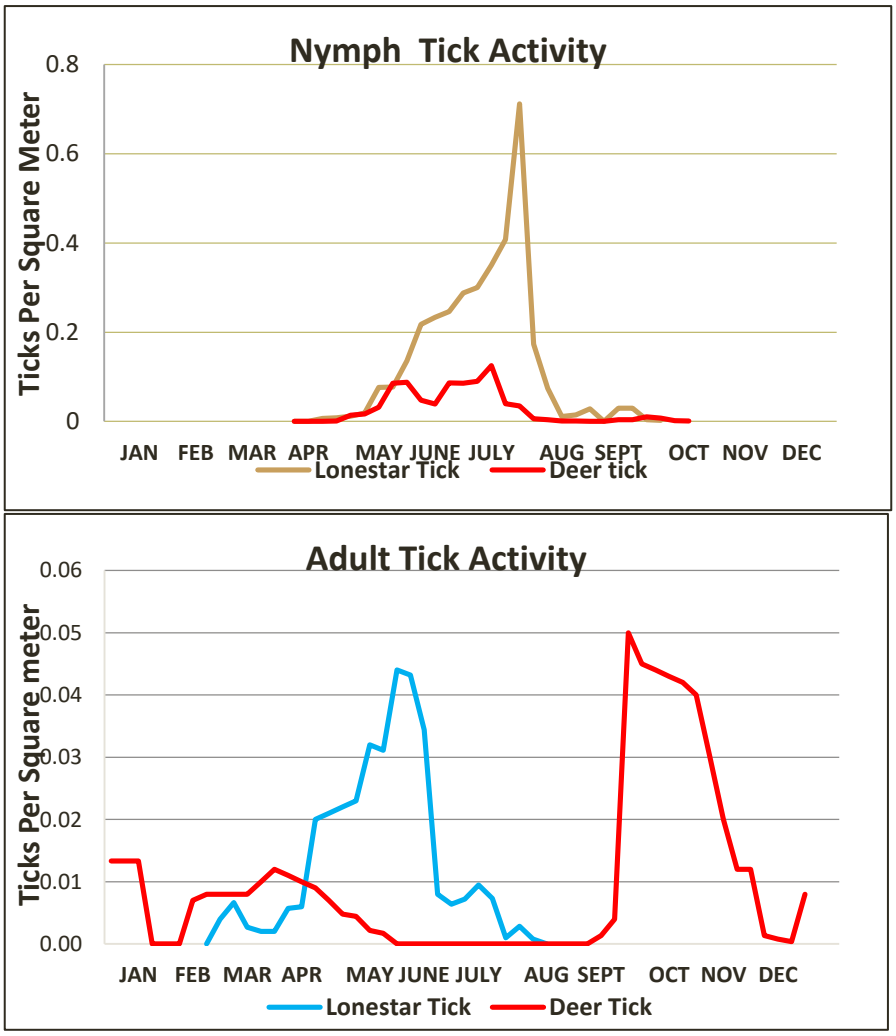


Figure 13

Asian Longhorned Tick Surveillance Efforts

The invasive Asian longhorned tick has now been found at several locations in Suffolk County. This species has been documented to feed on a wide range of animals, including occasionally on humans. Vector staff acquired reference samples in 2018 of this tick to aide in confirmation of species identification. Larvae and nymphs were collected from an Ocean Beach location, nymphs were collected off of a white-tailed deer from the William Floyd Estate in Mastic Beach and a single adult female was collected in Lloyd Harbor. At this time we have yet to encounter multiple tick stages at a single location, which would confirm an established breeding

population. It is likely, as our surveillance efforts increase, we will encounter established populations within small localities throughout the County.

Technical Advice and Guidance on Tick Mitigation

Vector staff continue to provide technical advice and guidance for landowners, government agencies, municipalities and civic groups that are conducting tick control or are considering doing so. These activities will continue to provide further opportunities to learn what techniques local entities are interested in adopting, currently using, or which may be useful to the County and other entities.

Advisory Committees and Working Groups

We continue to work with the Tick Control Advisory Committee (TCAC) to explore tick control strategies and potential funding opportunities. Most importantly, the TCAC will allow for the continued input and feedback from stakeholders needed to gauge what options might be feasible and acceptable for implementation at each local level. This is a significant task, since each of the available control options have their own unique local benefits and drawbacks. Public acceptance of various tick control options may also vary considerably across Suffolk County.

In 2019, the Tick Advisory Group (TAG) was organized through the Northeast Regional Center for Excellence in Vector-Borne Diseases (NEVBD). This working group was established to provide advice to local towns and villages seeking guidance on tick surveillance and management related efforts as part of the SuffolkShare Public Health Partnership. Vector Control staff also participate on the Tick Working Group (TWG) organized through NEVBD due to a growing need for guidance on tick surveillance, disease, tick control, outreach and education for the broader northeast regional community. Due to Covid-19 these two committees have met much less frequently, but discussions are underway to resume the groups' efforts.

We continue to reach out to local and nationally recognized tick experts for their advice and input on research and control strategies. Staff attend regional seminars and conferences to discuss emerging diseases, introduced species and new developments. These efforts have already proven very helpful in gaining knowledge that may not be published but is highly valuable and have allowed the fostering of mutually beneficial collaborations and potential funding sources.

Non-County Funding Awards and Grants

For a third year, Vector Control was awarded a student internship though CCE and Cornell University which greatly enhanced tick related efforts with no County costs. There is an opportunity to continue this program for a student internship award for 2021. Students in the program actively assist in all phases of the tick research program and develop an independent poster project to be presented to their advisors upon return to Cornell University. Due to Covid-19 related concerns in 2020, we implemented protective strategies and protocols which allowed the internship to move forward following Covid-19 safety protocols.

In collaboration with Cornell University's Northeast Regional Center For Excellence in Vector-Borne Diseases and the Suffolk County Cornell Cooperative Extension the joint proposal: "Novel Evaluation of Control and Prevention Strategies for Ticks and Tick-Borne Diseases" was awarded a three year grant supported by the Deployed Warfighter Protection Research Program (DWFP), a Department of Defense sponsored research grant administered by the Armed Forces Pest Management Board (AFPMB). This collaborative research effort will include evaluating numerous tick management strategies, products, and application methods along with developing guidelines for management initiatives to reduce tick-borne disease incidence (Fig 16). Vector Control's role will be evaluating several natural oil and traditional acaricide/pesticide products that have potential application for use in Suffolk County. Resulting data will directly assist with the design of and choice of acaricide products and application methods for developing best management practices in a tick control program. This funding allows Vector to purchase required equipment for the development of the Tick Laboratory facility at Vector Control.

Chart of Tick Species and Tick-borne Diseases

Illness or Condition	Vector Tick Species	Tick Stage(s) Transmitting Disease	Minimum Feeding Time for Disease Transmission
Acquired Red Meat Allergy	Lone Star Tick	Larva, Nymph, Adult	Unknown
Anaplasmosis	Blacklegged Tick	Nymph, Adult	24 Hours
Babesiosis	Blacklegged Tick	Nymph, Adult	36 hours
Borrelia miyamotoi Disease	Blacklegged Tick	Larva, Nymph, Adult	24 Hours
Ehrlichiosis	Lone Star Tick	Nymph, Adult	24 Hours
Heartland Virus	Lone Star Tick	Nymph, Adult	Unknown
Lyme Disease	Blacklegged Tick	Nymph, Adult	36 Hours
Powassan Virus	Blacklegged Tick	Nymph, Adult	15 minutes
Rickettsia parkeri Disease	Gulf Coast Tick	Adult	Unknown
	Lone Star Tick	Larva, Nymph, Adult	
Rocky Mountain Spotted Fever	American Dog Tick	Adult	2-20 hours
	Brown Dog Tick	Nymph, Adult	
	Lone Star Tick	Larva, Nymph, Adult	
Southern Tick Associated Rash Illness (STARI)	Lone Star Tick	Nymph, Adult, ?	Unknown
Tularemia	American Dog Tick	Adult	Unknown
	Lone Star Tick	Nymph, Adult	

Figure 14 Virginia Department of Health

Capital Request – Capital Project No. 8739 Tick Control Plan

The prevention of tick-borne diseases in the County is a difficult and complex issue. It is particularly difficult because the biology of these vectors and their associated diseases are significantly linked to deer overpopulation, expansion of their range and limited management opportunities in a densely populated suburban landscape. In addition, tick control technology suitable for large scale application is not as well developed as mosquito control techniques. A proper plan with concurrent SEQRA compliance would require additional resources to undertake an EIS, beyond those currently available to Vector. However, tick-borne diseases and the adverse impacts ticks have on the ability of County residents to utilize the outdoors, and even their own property, are important issues that need continued investigation.

Beginning in 2018, capital funds were requested for the review of best management practices and to initiate a County Park based pilot program to inform and further develop a Tick Control Plan and related State Environmental Quality Review Act (SEQRA) environmental review. In addition, the resulting Tick Control Plan could be utilized by other municipalities through the SuffolkShare Public Health Partnership. Capital Program 8739 was passed by the Legislature in November of 2019 and provided funding for phase 1 of the pilot program. Due to financial difficulties arising from Covid-19, funds were not released for 2020. We will continue to move forward on plans for developing the Tick Pilot Project and environmental review.

Field Efficacy Trials

Continued field testing of 25(b) Exempt and traditional tick control products has continued to yield novel information on the efficacy of these products when applied to park like environments (Fig 17). In addition, we have identified a more realistic total level of control that 25(b) Exempt products can provide when used for tick control. Environmental conditions appear to play a direct role in the overall efficacy of these products as does the activity of the tick population during the time of application. These products also were found to have no effective residual action on ticks.

Control rate comparison between two natural oil products (in green) and two commonly used traditional tick control pesticides based on field testing.

Control Product	Deer Tick		Lonestar Tick	
	Nymphs	Adults	Nymphs	Adults
Essentria IC3	43%	8%	46%	42%
Cedar Safe	55%	32%	54%	29%
Maverik Perimeter	83%	79%	69%	97%
Talstar Granular	92%	73%	28%	51%

Arena setup for field efficacy trials.

Figure 15

2021 Suffolk County Tick Control Advisory Committee

Recommendations to Vector Control

Suffolk County Government continues to support county efforts of addressing ticks and tick-borne illnesses by funding two entomologist positions and two capital programs for tick-borne pathogen surveillance and tick management. The Suffolk County Legislature directed the creation of a "Tick Control Advisory Committee (TCAC) to advise the Division of Vector Control in developing a successful plan to reduce tick-borne illnesses in Suffolk County." The development and funding of the plan should be noted as demonstration of an increased

commitment to the challenge of reducing tick-borne illness, which can be built upon in future years. To this end, the TCAC has developed the following recommendations to guide and support Suffolk County Division of Vector Control with their yearly Plan of Work to reduce tick-borne illnesses in Suffolk County.

The Tick Control Advisory Committee recommends the following for the 2021 Vector Control Plan of Work:

- Collaborate with Suffolk County Department of Health Services for a countywide program addressing tick management and tick-borne pathogens
- Collaborate with other agencies, local governments and committees when necessary
- Continue participation in the Suffolk County Shared Services Initiative (i.e. SuffolkShare Public Health Partnership) which is a partnership of more than 100 local governments that cooperate on data sharing, providing or bartering goods or services, joint procurement, coordinating activities and collaborative problem solving
- Include language that supports a commitment to studying and implementing tick and host management techniques
- Support and maintain dedicated staffing to effectively address tick and tick-borne diseases
- Continue the commitment and efforts for developing integrated strategies for managing tick populations through the County Park Pilot Program
- Provide data to enable policy makers the ability to properly prioritize budgetary decisions
- Continue focus on the Asian longhorned tick with concern on residents, pets, wildlife and livestock
- Share information and best practices with interested parties including county elected officials and municipalities
- Maximize efforts in education and public outreach, using public messaging (e.g. public service announcements) especially the at-risk populations
- Maximize efforts in research whenever possible and to collaborate with municipal and private efforts that undertake research that benefits committee and county objectives
- Continue to conduct new and replicate field trials on efficacy testing of minimum risk, conventional and other pesticides
- Continue to conduct tick surveillance and surveillance at bi-weekly surveillance sites
- Seek funding wherever possible to increase resources for staff, equipment and other necessary items
- TCAC should remain active and continue to assist Vector Control as it addresses the reduction of tick-borne illnesses in Suffolk County

These recommendations are based on Vector Control having sufficient staff and resources to undertake the tasks listed above. Vector Control is committed to continue working with the TCAC and seeking out best management practices for the control of ticks and tick-borne disease in Suffolk County.

Water Management and Wetland Restoration

Water Management:

Field personnel conduct this component from January 1 to April 30, and October 1 to December 31. Water management during the winter months is a functional way to reduce the need for pesticide applications during the summer, by keeping mosquito ditches and creeks free of blockages. The Division expects to conduct water management in each of the County's ten towns, as needed. Highest priority is assigned to larval habitats where adult mosquito infestations have the greatest potential for negative impact. In particular, areas that had virus isolations or showed unexpectedly high infestations in 2020 will have high priority over the coming winter. Water management activities will be carried out in such a manner so that the primary goal of the work will be to protect the health of the marsh, while also reducing mosquito numbers.

Water management minimizes mosquito production through maintaining or improving systems of tidal channels, ditches, culverts and other structures that drain off surface water and/or allow access to potential larval habitats by predatory fish. In some cases, the current ditch system has become an important component of the wetland as it exists today, and maintenance of the system is necessary to maintain tidal flow, fish habitat, or existing vegetative patterns. Much of this is maintenance work that may not require a permit, but is nonetheless conducted after consultation with the New York State Department of Environmental Conservation (DEC) to ensure consistency with conservation of the wetland. More extensive work to rehabilitate wetlands in a manner that restores and preserves resource values while also reducing mosquito production is now underway under the umbrella term Integrated Marsh Management (IMM). In accordance with the Long Term Plan, all water management activities are conducted with appropriate notification to and oversight by the Council for Environmental Quality (CEQ), as outlined in the Findings Statement of the Suffolk County Legislature that was adopted by Suffolk County Resolution 285-2007.

The Wetlands Stewardship Committee completed its work in establishing standards for wetlands Best Management Practices (BMP's) and a Wetlands Stewardship Strategy was issued by Executive Order 01-2015 on July 13, 2015. With that Strategy in place, plans for 2021 include continuing work on several grant sponsored marsh restoration projects. These are projects that restore and enhance the natural resource values of the wetlands while also reducing or eliminating the need for pesticides to control mosquitoes. All work is planned in partnership with the landowner and NYSDEC, USFWS and other natural resources agencies and undergoes SEQRA/CEQ review as required.

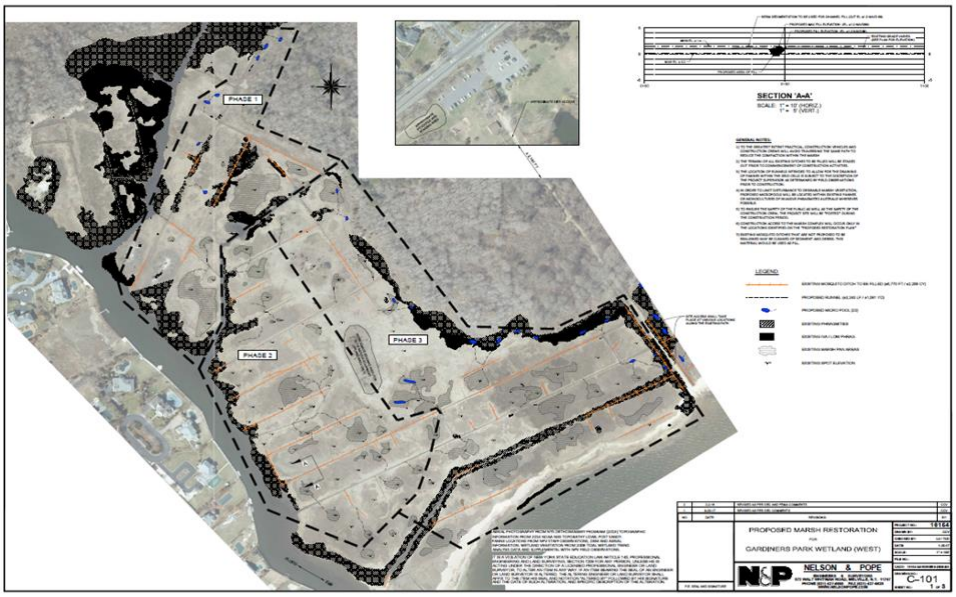
Integrated Marsh Management - Wetland Restoration Projects:

National Fish and Wildlife Foundation (NFWF) Sandy Resiliency Wetland Restoration Grant:

This $1,310,000 NFWF grant with a County match of $688,849 was awarded for Coastal Resiliency via Integrated Salt Marsh Management. The goals of the project include coastal resiliency and wetland restoration, with natural mosquito control through habitat adaption and killifish access as secondary goals. Work on the marsh restoration project at Gardiner SC Park east and the larger west side was over 90% completed in spring 2020 when Covid shut down work on the project. Beginning in October 2020, crews will complete the remaining work at Gardiner Park. Wetland restoration at West Sayville County Park and Timber Point NYSDEC wetlands are scheduled for winter 2020-2021 using funds secured through the NFWF grant. The DEC permits for each project has been secured, with an allowance for ongoing field modifications with DEC approval for greater ability to meet project goals.

Suffolk County Community College student interns were previously hired as consultants to monitor site conditions including vegetation, mosquito breeding, water quality and fish usage of the marshes. Due to Covid restrictions for hiring the SCCC interns, Vector Control staff continued monitoring the sites during 2020; although at a reduced capacity.

The Nature Conservancy (TNC) was retained to help assemble a team of coastal wetland experts who reviewed the project plans and gave guidance on wetland restoration projects undertaken in their jurisdictions. These wetland scientists gave field visits to their sites and/or presentations on projects from work on marshlands including restoration work in CT, DE, NJ, RI and NYC. A key component of this project was the Regional Technical Workgroup (RTW) Report of saltmarsh restoration practitioners across the Sandy-impacted region which provides a forum for the exchange of ideas, experiences and best practices regarding saltmarsh restoration. TNC submitted the final report of recommendation to the County in the spring of 2020.



Summary of Work on the Gardiner NFWF Project: From October 2019 to March 2020 marsh restoration work was undertaken at Gardiner County Park in West Islip under the NFWF Coastal Resiliency grant. The marsh had been historically grid-ditched and was undergoing marsh loss along the bay front and had extensive panne formation. Without the ditches being maintained on a regular basis, large segments of the marsh became severely waterlogged and the marsh edge developed into prime mosquito breeding habitat. The waterlogged marsh has additional deleterious effects on overall marsh health, including the impounded water causing die-back of marsh vegetation. To reduce mosquito breeding habitat, foster a healthier marsh environment and return the marsh to a more "natural" state, IMM (Integrated Marsh Management) was implemented at Gardiner County Park. Integrated Marsh Management is "a comprehensive approach to ecological restoration and mosquito control", and had been used successfully by the county to restore 95 acres of Wertheim National Wildlife Refuge marshlands in Shirley. Due to vegetation and wildlife use of the salt marsh over the summer months, NYSDEC imposes a season winter work window (October 15 – March 30) when the restoration activities can occur.

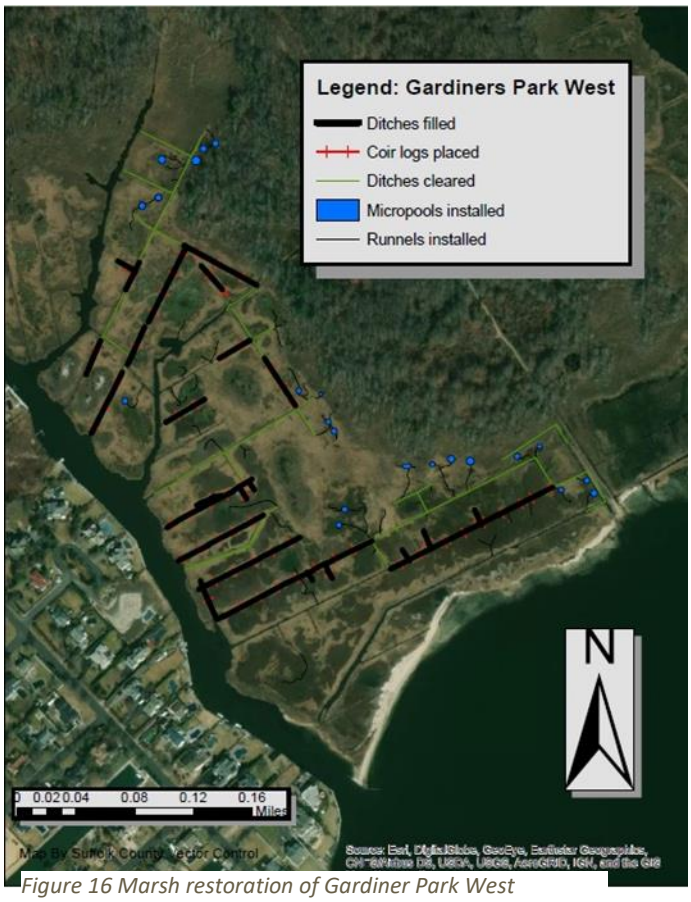


Figure 16 Marsh restoration of Gardiner Park West

A Watershed Designed for Proper Tidal Exchange – Single Channel

Prior to the restoration there were multiple interconnected 'grid' ditches that drained to the bay, which decreased effectiveness for tidal exchange in the marsh. A single, well planned tidal channel serving a watershed allows ponded floodwater to leave the marsh during low tides, and during high tides greater exchange and nutrient cycling to the marsh (Fig 18).

This is due to the increased hydrological pressure of the single channel, which is even more pronounced in the micro-tidal environment of the Great South Bay. To correct for the tidal exchange, some existing ditches were cleaned and new tidal channels were created. To create one primary drainage channel in each "phase" connecting 'grid' ditches were filled. Small micro-channels or runnels were installed to connect pools of standing water in marsh pannes to the new drainage channel. Installation of runnels allows surface water in the pannes to drain during low tides to reduce marsh vegetation die-back in the flooded areas. At the Gardiner marsh, due to sea level rise and panne formation, large sections of the marsh were being lost at an exorbitant rate.

Left; Marsh surface prior to drainage channel and runnels, Right Surface after drainage channel and runnels installed, note all the new vegetation growing in previously flooded pannes. Bottom; Filling of ditches with coir logs and covered with marsh peat.

Increased tidal exchange is when more water comes onto, and leaves the marsh every low/high tide cycle. When supplemented with runnels, a host of benefits is brought to the marsh including:

Removal of consistent stagnant water: There were many areas that had consistent stagnant water. These areas had the capacity to be mosquito breeding habitat, and prevented new vegetative growth. By removing the stagnant water, mosquito habitat is removed and new vegetative growth can begin.

Increased Sediment deposition: As the tide comes in it brings along with it sediment, very fine particulate matter made of sand, eroded rocks and organic matter. This sediment would normally then also go out with the marsh, but as the tide goes out sediment is blocked by vegetation, and the sediment gets caught on the marsh. Over time this sediment gradually becomes the marsh surface, and increases elevation of the marsh. As such, a healthy marsh's elevation level will constantly rises due to sediment deposition. If a marsh cannot accrete sediment at a rate equal to or greater than sea level rise it will be subject to erosion. This is why proper drainage, tidal exchange and removal of stagnant water are so important. Removal of stagnant water allows new vegetation to grow, which in turn gathers more sediment and "builds" the marsh faster.

With improved tidal exchange, a greater volume of sediment is brought onto the marsh to be deposited.

With sea-level-rise as a continuing threat, it is important to ensure our marshes keep up with the rising tides. If our marshes accrete material slower than sea level rises, we will lose an important ecosystem that provides us with many benefits such as storm protection, erosion protection and habitat for protected species. Based on a collaboration done by Suffolk County Vector Control and Stony Brook University, Gardiner Park marshes were not keeping pace with sea level rise and include panne formation and loss of marsh edge (Fig 19).

Figure 19 Comparison of Gardiner Park marsh edge loss along Great South Bay from 2012 to 2020.

Filling of historic ditches

Pre-existing ditches that would disrupt the new planned drainage pattern were filled with a combination of reuse of material from the local marsh, and coir logs. Coir logs are fibrous biodegradable logs made out of coconut fiber. Once a ditch was slotted to be filled, the coir log was staked into the ditch and marsh material from cleaned tidal creeks was placed on top of the coir log. Coir logs will degrade over time, but will give vegetation time to grown over the ditch, restoring a resilient marsh environment.

Extensive sampling was done prior to the start of the project to ascertain where the mosquitos were breeding. In areas with the heaviest breeding, micro-pools were installed. Micro-pools are small ponds, less than 10 feet by 10 feet with shallow runnel connecting the pond to a tidal creek. The goal of these micro-pools is to both remove the area where mosquitos breed, and provide a habitat for fish who then hunt mosquito larvae. Weekly pre and post-project sampling shows that throughout the entirety of 2019 no mosquito larvae were found in Phase 1 section of Gardiner Park, while hundreds of larvae were found in this same marsh in prior years to the restoration work.

From Left to right: 1. Coir logs placed inside a pre-existing ditch. 2. Material taken from cleaned out ditches being placed on top of a coir log to fill a ditch. 3. Excavator cleaning tidal creek and placing the sediment for transport to fill a ditch. 4. Cleaning a tidal creek. All machines are rated for amphibious use and have less than 2-psi and are less damaging to the marsh surface than someone walking on it.

Below: A finished fish micro-pool with a shallow connecting runnel.

Federal Emergency Management Agency (FEMA) Sandy Resiliency Wetland Restoration Grant:

This federally funded project again has the goals of coastal resiliency and wetland restoration, with natural mosquito control through habitat adaption and killifish access as secondary goals. The Smith Point Marsh in Shirley is approximately 90 acres of wetlands to be restored using the same techniques as the NFWF projects. All NYSDEC and ACOE permits are in place for the implementation phase and NEPA review completed. FEMA/NYS DOHS have successfully secured funds for restoration, and the County and FEMA grant funding agreement was finalized so that the field work can begin on the restoration. This project is scheduled to begin in 2021, after work on the NFWF projects have been completed.

Indian Island Wetland Restoration Grant:

NYS DEC funding has been extended for restoration of this dredge spoil filled former wetland. Restoration would reconnect the site for regular tidal exchange and assist in natural mosquito control by use of native predacious killifish. The site is now regularly treated by Vector Control via aerial larvicide. DEC and County agencies continue to review and revise restoration plans dealing with dredge material and the overall scope of the project.

Beaverdam Creek

The Beaverdam Creek County Park in Brookhaven Hamlet is being studied for the re-establishment of a wetlands complex at a dredge spoil impacted marsh. This project is a cooperative undertaking between several County agencies and the Post Morrow Foundation. SC Parks is lead agency on this project, but with Vector staff involvement in the planning. Vector Control marsh equipment would be used to restore the dredge filled site to a tidal wetland. Preliminary site plans were drafted and are under review. SC water quality program is funding the consultants and the restoration work would be undertaken by County staff. The goal of this restoration project is to return tidal circulation to a diked marsh that is a mostly phragmites and several low areas that breed salt marsh mosquitoes. A tidal creek will be created through the dike to allow for the return of salt marsh vegetation, phragmites control and a reduction in mosquitoes by allowing killifish access to the low areas of the site.

Mastic Beach

A USDA/NRCS grant of $795,000 was awarded to DPW for demolition of three homes destroyed during Sandy and restoration of impacted wetlands on these properties. Funding agreements between Suffolk and USDA are being finalized, with assistance from Parks. Work on environmental permits and demolition agreements should begin in 2021, with wetland restoration anticipated in 2022. There are 25 adjoining parcels the County DEEP program is actively purchasing and once the acquisitions are complete restoration can commence.

Due to the Covid-19 pandemic, all of our wetland restoration projects have been delayed. Staff reassignments for assisting in Covid response by Suffolk County and NYSDEC has limited our

ability to hold meetings and field visits. We do however remain committed to continuing with this essential work on restoring our marshes for coastal resiliency and reducing pesticide usage.

Accabonac Cooperative Project 2017-2020:

Summary of the 2020 season saw continued reduction in pesticide use at Accabonac Harbor through the cooperative project (Fig 20). Data collected in 2020 confirms many previously identified hot spots for mosquito breeding along the west side of the harbor in the marsh's upland fringe, which was treated on five dates over the 2020 summer season.

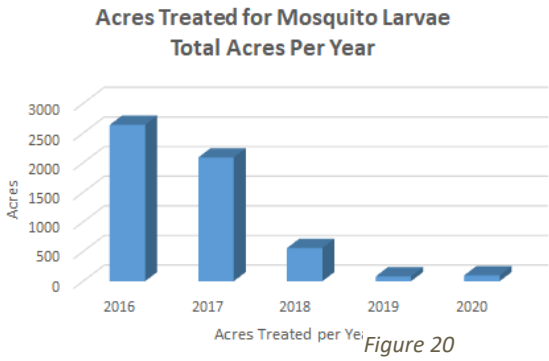


Figure 20

A joint project was initiated between Suffolk County Vector Control (SCVC), East Hampton Town Trustees (EH) and the Nature Conservancy (TNC) in 2017 with the goal to reduce pesticide applications to Accabonac Harbor. The basis of the pesticide reduction program was to undertake a more targeted approach to mosquito larvicide treatments through detailed GIS mapping of mosquito breeding locations. In 2017, a pilot project covering 5 weeks was initiated and focused on 2 spray blocks in the southern section of Accabonac Harbor. The 2017 trial allowed the partners to see if this method could be a feasible approach to achieve the end goal of cutting pesticides applied. Due to the success the group achieved in the 2017 trial where spray blocks were reduced greatly in size, the program was expanded for 2018 and continued through 2020 due to the success of the program. The survey team collects several thousand GIS data points over the summer, identifying positive dip locations. Dip data taken by the team includes GIS location (lat/long), larval stage (1-4 & pupae) and total number of each stage, count of pupae present and any notes of the sampler. Information collected by the team was sent to Vector Control for review. Vector staff GIS map the larval distribution and review the dip data for a treatment decision. If treatment was necessary, a revised map would be sent to the helicopter pilot to adjust the spray blocks at Accabonac Harbor to only target those 'hot spots' identified within the treatment block (Fig 21).

Figure 21 'Hot Spots'

Data from the EH team continues to allow Vector to cut the spray blocks dramatically. The reduction of treatment block acres allows the County cost savings from less pesticide applied and reduced helicopter flight hours treating the site. The identified points by the team showed breeding was predominantly along the upper marsh edge moving the applications further away from the harbor water's edge (Fig 22).

Figure 22 Dip Locations

The next step is for TNC, EH and Vector to take the mosquito data, aerial imagery and other data sources and develop wetland restoration plans where natural mosquito control via killifish and

habitat modifications, such as runnels, can further reduce or eliminate the need for pesticide applications at Accabonac Harbor.

APPENDIX Description of Pesticide Materials SCVC 2021:

The mosquito larval control products to be used in 2021 and the conditions under which they are used are described as follows:

Altosid Liquid Larvicide Concentrate (methoprene, EPA 2724-446) – Aerial application to tidal and freshwater marshes.

Altosid Liquid Larvicide (methoprene, EPA 2724-392) – Ground application to tidal and freshwater marshes, as well as other temporarily flooded areas.

Altosid Pellets (methoprene, EPA 2724-448) – Ground application to intermittently or permanently flooded areas such as freshwater swamps, catch basins, drainage areas and recharge basins, provided that they are not fish habitats.

Altosid XR-G (methoprene, EPA 2724-451) – Ground or aerial application to tidal wetlands; ground application to intermittently flooded freshwater areas; aerial application in freshwater areas in response to Eastern Equine Encephalitis (EEE) or West Nile Virus (WNV) with required separate approval by NYSDEC.

Altosid XR Briquets (methoprene, EPA 2724-421) – Catch basins and other drainage or artificial structures that are not fish habitats, swimming pools.

Aquabac 200G (Bti, EPA 62637) – Ground application to intermittently flooded freshwater and tidal areas.

Sphaeratax SPH (50G) (B. sphaericus, EPA 84268-2) – Ground application to freshwater and brackish areas that hold stagnant water such as ditches, impounded marshes, swamps, puddled areas, sewage lagoons; late season application to catch basins.

Valent BioSciences VectoBac 12 AS (Bti, EPA 73049-38) – Aerial application to tidal and freshwater marshes; ground application to intermittently flooded areas such as tidal and freshwater marshes.

Summit B.t.i. Briquets (Bti, EPA 6218-47) – Catch basins, ground depressions, artificial sites.

Fourstar Briquets 90 (Bti plus B. sphaericus, EPA 83362-3) – Catch basins, ground depressions, artificial sites, swimming pools

Valent VectoPrime FG (Bti and methoprene EPA 73049-501) – Ground and aerial application to tidal and freshwater marshes, as well as other temporarily flooded areas.

Valent VectoBac WDG (Bti EPA 73049-56) – Ground and aerial application to tidal and freshwater marshes, as well as other temporarily flooded areas.

Valent VectoMax FG (B. sphaericus and Bti, EPA 73049-429) - Ground and aerial application to freshwater marshes, as well as other semi-permanent flooded sites.

Valent VectoMax WSP (B. sphaericus and Bti, EPA 73049-429) –Catch basins, swimming pools and other small flooded areas of standing water.

Any new larvicide material to be considered for incorporation into the 2021 program can only include the three active ingredients: Bti, B. sphaericus and methoprene as approved in the Long Term Plan and GEIS and would be used under a NYSDEC permit. New active ingredient pesticide materials would require SEQRA review and be included as a supplement to the GEIS.

Vector Control Pesticide Labels and SDS:

Pesticide labels and SDS safety sheets for all materials in use by Vector Control are posted on the Suffolk County Government website under Public Works – Vector Control at:

https://suffolkcountyny.gov/Departments/Public-Works/Vector-Mosquito-Control/Vector-Online-Form

2021 Suffolk County Vector Control Program Summary:

Ticks: Vector Control will continue to work on developing tick control strategies and will follow the TCAC recommendations for developing the tick control program in Suffolk. Work continues on developing a potential pilot project at a County Park and environmental review control strategies and review of emerging research.

Education/Outreach: In cooperation with SC Health, Vector Control will continue to work on public education on tick and mosquito issues, avoidance and control options for residents, commercial applicators and municipalities within Suffolk.

Resistance Testing: Vector Control will continue to monitor and test mosquito populations for pesticide resistance and will continue to work with the Northeast Regional Center for Excellence in Vector-Borne Diseases (NEVBD) Pesticide Resistance Lab. Resistance testing of ticks will be investigated in cooperation with work being developed by the NEVBD. Investigate alternatives to pesticides currently in use for resistance management.

Public Notification: Vector Control will continue the use of Code Red for adult spraying alerts, work with Health on press releases and social media messages, County website updates and phone hotline.

Pesticide Reduction: Vector Control is fully committed to implement pesticide reduction strategies whenever possible. Work on wetlands management and Integrated Marsh Management (IMM) with cooperators will continue, as IMM is the best management practice for reducing aerial larvicide applications to the greatest acreage consistently. Pesticide reduction

through IMM not only greatly benefits the environment, but saves the County financially in reduced pesticide material requirements and in staff time checking and treating these sites.

Virus Response: Vector Control will continue to work closely with SC Health in safeguarding residents from mosquito-borne viruses including WNV, EEE and working on the control of tick-borne pathogens.

Adult and Larval Mosquito Control: Pesticides employed for adult and larval mosquito control will only be used if they are EPA and NYSDEC registered. Crews must follow label conditions and any applicable NYS permits for application. All active ingredients (AI) will match those reviewed and approved for use in the Vector Control Long Term Plan/GEIS unless a supplemental study is undertaken for new AI.

The Suffolk County Department of Public Works – Division of Vector Control
2021 Plan of Work was prepared by:
Thomas Iwanejko - Superintendent of Vector Control

Special thanks to the following Suffolk County staff for their assistance in compiling data and information used for this report:

Department of Public Works – Vector Control
Moses Cucura – Tick population, control and project summary
Malgorzata (Margaret) Kawalkowski – Mosquito population data and summaries, resistance updates
Joseph Montesano – Wetland restoration activity summary for Gardiner County Park
Dr. Ilia Rochlin – Status updates for grant wetland restoration projects

Economic Development and Planning
Frank Castelli – Weather summary
Jonathan Sokol – Weather graphs

Health ABDL - Dr. Scott Campbell – Mosquito-borne virus data, TCAC updates

Suffolk County Vector Control Pesticide Acreage Estimates for 2020

Pesticide	Active Ingredient	EPA#	Amount used	Units	Amount in use units	Units	Dose (units / acre)	Air/Ground Application	Total 2020 Acreage	Change in Acres +/- from 2019
Ground Larvicide										
Altosid 5%	Methoprene	2724-392	1.7	GL	217.6	fl	4	Ground	54.40	-586
Altosid pellets	Methoprene	2724-448	18	LB	18	lbs	5	Ground	3.60	-44
Altosid XRG	Methoprene	2724-451	0	LB	0	lbs	5	Ground	0.00	-32
Bti briquets - Summit	Bti	6218-47	203	EA	203	ea	435	Ground	0.47	-2
Fourstar 90 briquets	Bti/*B.sphaericus*	83362-3	180	EA	180	ea	435	Ground	0.41	-6
VectoBac 12AS	Bti	73049-38	17.314	GL	2216.192	fl	16	Ground	138.51	-750
Aquabac 200G	Bti	62637-3	387.99	LB	387.99	lbs	10	Ground	38.80	-195
VectoPrime FG	Bti/Methoprene	73049-501	2210.08	LB	2210.08	lbs	4	Ground	552.52	458
Spheratax 50G	*B.sphaericus*	84268-2	267.5	LB	267.5	lbs	15	Ground	17.83	-302
VectoMax FG	Bti/*B.sphaericus*	73049-429	1049.03	LB	1049.03	lbs	15	Ground	69.94	70
VectoMax WSP	Bti/*B.sphaericus*	73049-429	1359	EA	1032	ea	871	Ground	1.56	2
Altosid XR briquets	Methoprene	2724-421	7594	EA	7594	ea	218	Ground	34.83	-6
Ground Larvicide Total Acres:								Ground Total	912.87	-1,394
Aerial Larvicide:										
VectoPrime FG	Bti/Methoprene	73049-501	34840	LB	34840	lbs	4	Aerial	8,710.00	5
VectoMax FG (*EEE Site*)	Bti/*B.sphaericus*	73049-429	5040	LB	5040	lbs	15	Aerial	336.00	336
Duplex Altosid 20% &	Methoprene	2724-446	0	GL	0	fl	0.75	Aerial	0.00	-1,750
Duplex VectoBac 12AS	Bti	73049-38	0	GL	0	fl	18	Aerial	0.00	
Aerial Larvicide Total:								Aerial Total	9,046.00	-1,409
Total Larvicide Acreage:								Total Larval	9,958.87	-2,804
Adulticide:										
Anvil 10+10	Sumithrin	1021-1688-8329	64	GL	8192	fl	0.6	Ground/Air	13,653.33	-491
Duet	Sumithrin+Prallethrin	1021-1795-8329	0	GL	0	fl	0.75	Ground	0.00	0
Mavrik Perimeter (Tick)	Tau-fluvalinate	2724-478	0.5	GL	65.0	fl	21.78	Ground	3.00	3
Adulticide Acreage:								Adulticide:	13,656.33	-488

Note: Mavrik Perimeter was applied on behalf of Parks Department to control ticks at the Flight 800 Memorial at Smith Point SC Park.

Review of Recent Literature on the Safety of Methoprene as a Tool for Vector Control

Anne McElroy, Bruce Brownawell, J. Kirk Cochran and Evan Horowitz
School of Marine and Atmospheric Sciences
Stony Brook University
October 1, 2020

Introduction:

History and Scope of Project

In May 2019 Suffolk County contacted faculty in the School of Marine and Atmospheric Sciences soliciting interest in a proposal for an independent review of recent literature since 2010, covering toxic effects, environmental fate, and current uses of all the pesticide products, both natural and synthetic, approved for use as part of their Long-Term Plan most recently revised in 2014. Based on their experience working with the County and Sea Grant and other non-governmental agencies in marsh ecosystems, and in evaluating the toxicity and environmental fate of pesticides used for vector control. Professors Bruce Brownawell, Kirk Cochran and Anne McElroy, with the assistance of Prof. Cochran's MS student Evan Horowitz agreed to take on the task and produce a series of reports reviewing the literature appearing since 2010 on the following pesticides used by Suffolk County for vector control, including:

a. Methoprene
b. Sumithrin and Prallethrin (Duet)
c. Piperonyl butoxide (PBO)
d. Deltamethrin
e. *Bacillus thuringiensis israelensis* (Bti)
f. *Bacillus sphaericus* (Bs)

In conducting this review, the Stony Brook team was charged to focus on the environmental risk associated with actual use of these pesticides for mosquito control as it applies to use in Suffolk County, and not on laboratory studies where potential toxicity or elucidating mechanisms of action were the main questions being addressed. Neither were human health impacts, nor efficacy against target organisms to be addressed. This constitutes a completed draft of our first report on the juvenile hormone mimic Methoprene.

Literature Search Methods

Primary searches were conducted within the Web of Science using Methoprene OR Altosid (the latter term is more common than the 100s of other trade names/product formulations that contain Methoprene for pest control). To obtain related work, for most papers, (especially those cited more than 10 times) we also examined more recent papers that cited them, allowing us to find additional papers missed by the search engine. As we read the papers, we also obtained previously published papers that

appeared to have key information. Although the focus of our search was on material published since 2010, in order to not potentially miss key papers published previously but not included in previous literature reviews, we also searched on papers published since 1975. Using these terms, the Web of Science search yielded 1419 papers published since 1975, with 560 published since 2010.

A number of additional papers were located using the Google Scholars search engine that yields a greater number of potential matches and includes reports, theses and dissertations, and papers not indexed by the Web of Science. To limit these searches the search term Methoprene was combined with other terms including "nontarget, assessment, environmental fate, toxicity, ecotox* (note * is a wild card indicator allowing hits with any additional letters in the word), bees, Mellifera (the genus of honey bees), and review." Similar searches with the same search terms were conducted just using the general Google browser. Finally, to better ensure we did not miss papers on Methoprene transformation products we searched methoxycitronel* and citronellic, which would target known Methoprene transformation products 7-Methoxycitronellic acid, Methoxcitronellal, and Citronellic acid along with Methoprene acid and Methoprene epoxide. These searches did not yield additional papers we had not already located.

Based on their abstracts, references were narrowed down to those likely to be pertinent to the scope of this project, and full PDFs obtained for further analysis. Electronic copies of all the PDFs we obtained will be made available to Suffolk County. Relatively few papers were found that directly related to the scope of this project. The most detailed concerned environmental fate of Methoprene deployed in catch basins or sprayed on marsh surfaces (5 references). Others (6 references), in some cases the same studies also evaluated effects on non-target organisms. Most useful were several large reviews examining ecological risk associated with use of Methoprene and in some cases other juvenile hormone mimics (4 references), including risk assessments on their use by other countries including Canada, Australia and the EU. This report discusses in some detail a total of 15 relatively recent papers.

In going forward, it is important to note that the potential risk of adverse effects must be considered in light of anticipated environmental concentrations and exposures. Therefore, we will first discuss environmental occurrences and then go on to discuss evaluation of effects on individual species, or ecosystem level effects. Also, as evidenced by the large number of papers published prior to 2010, much of the seminal work on Methoprene fate and occurrences was published previous to the period being evaluated in this review. One of the primary advances of the more current literature is the use of analysis methods with much lower detection limits and selectivity afforded by advanced mass spectrometry methods, providing more detailed information on environmental fate.

Background on Methoprene

Methoprene belongs to a group of compounds termed biorational pesticides commonly used as larvicides in mosquito control programs. This group includes active toxin ingredients, *Bacillus thuringiensis israelensis* (Bti) and *Lysinbacillus sphaericus* (Ls – formerly known as *Bacillus sphaericus or* Bs – to be reviewed in another report) and *Saccharaopolspora sinose* (Spinosad), as well as Methoprene. Unlike these other biorational pesticides, Methoprene acts as a juvenile hormone analogue (JHA) or insect growth regulator (IGR), inhibiting molting of mosquito pupae into the flying adult stage. There are other synthetic biorational insecticides available, but there is little evidence that they are used in any appreciable quantities for mosquito control, either because they are not permitted in some areas, presumably because they are considered to be less environmentally safe given less favorable toxicity profiles to non-target invertebrates or vertebrates (as reviewed by Lawler et al., 2017; Ramasedshadri et al., 2012; Bellini et al., 2014).

Methoprene is marketed under a large number (100s) of different trade names, but is typically applied as a spray (either by hand or air plane) or in time release pellets or briquets which release product over the course of weeks to months. Methoprene exists in two forms, an R and S isomer, with the S isomer having the most insecticidal properties. Most commercial formulations only include the S form. In addition to Altosid products Suffolk County recently began using a new product, VectoPrime FG, containing a granular formulation of Bti along with Methoprene that can be sprayed aerially or applied to the ground (Suffolk County Department of Public Works Division of Vector Control 2019).

Discussion of Recent Literature:

Environmental Occurrences

We found five papers published since 2010 that made measurements in surface waters and catch basins to which Methoprene had been applied as briquets, pellets or aerially sprayed (Baker and Yan 2010; Butler et al., 2010; Kuo et al., 2010; Sternberg et al., 2012; and Tonjes et al., 2018). The first two of these papers also report levels of Methoprene transformation products. Tonjes et al. (2018) critically review much of the previously published work on Methoprene levels in treated waters, and reviews on Methoprene and other mosquito larvicides by Lawler (2017) and Ramaseshadri (2012) also distill what is known about expected concentrations of Methoprene or concentration ranges of environmental relevance that can be used for risk assessments. Lawler states that applications of Methoprene using different approaches are designed to produce approximately10 µg/L (referred to hereafter as ppb), and perhaps likely much less, of Methoprene from either direct liquid addition or sustained release. The conclusions from a much earlier U.S. EPA fact sheet (2001) appear to remain valid after our review of recent papers. That EPA review states that one might expect the high range of environmental exposures to be less than or equal to 4 ppb. This is consistent with the updated review presented in Tonjes et al. (2018 discussed below) as well as the highest levels measured by Stony Brook University (SBU) or USGS in ponds and marshes underneath aerial sprays conducted in Suffolk County (Zulkowsky et al., 2005;

Abbene et al. 2005; Tonjes et al., 2018). In fact, in older and even recent papers, the preponderance of measurements of Methoprene in treated waters are less than or equal to analytical method detection limits that varied between <0.001 to 0.2 ppb. In this regard, we point to a 2007 water quality assessment and guidelines for Methoprene published by Canada that is relatively detailed in terms of environmental exposure and risks to nontarget organisms (Canadian Council of Ministers of the Environment 2007). This document was not discussed in the 2010 literature review by Suffolk County (Suffolk County Vector Control Management Committee 2010).

In studies with Methoprene briquets or pellets added to ponds and storm water catch basins measured concentrations tend to be undetectable in most (50-98%) of water samples analyzed. One reason for this variation corresponds to large differences in method detection limits, with studies conducted with higher detection limits (0.2-0.4 ppb) reporting less than 10% of samples with detectable concentrations. Most of the remaining detections are well under 1-4 ppb in catch basin and related shallow pond studies. For example Butler et al. examined concentrations in storm water catch basins from 2 areas in Rhode Island and only detected Methoprene in 1 out of 36 samples at a level of 0.5 ppb, (Butler et al. 2010). That said, some of these papers report isolated samples with much higher concentrations for example: 112-848 ppb (Baker and Yan 2010). Although Sternberg et al. (2012) reported 92% of their samples fell below the 0.14 ppb detection limit, concentrations of 11-18 ppb were detected in three samples. However, in all but one case this was thought to be due to accidental sampling of small portions of the briquettes themselves. In another study where pump station samples contained low to undetectable levels of Methoprene after initial treatment (4 of 10 samples at 0.04 – 0.14 ppb) two extraordinarily high values of 122 and 622 ppb were observed in underground concrete inspection ports (Kuo et al. 2012). It is important for risk assessment purposes to understand these extreme outlier concentrations, however little effort has been put into the papers to provide information about the specifics of those samples that might limit possible explanations, such as water volume to briquette ratios; water depth or prior drying or condition of broken up briquets mentioned in at least one study, and the potential to possibly include small portions of briquets in the water samples collected.

Greater attention should be paid to conditions that can lead to concentrations much greater than 10 ppb in surface waters (the upper end of what Methoprene products are reportedly designed to provide). An important question to consider is whether it is even plausible for concentrations much in excess of 100 ppb to exist in many of the systems being studied. Specifically are the samples collected and analyzed reflective of ambient water conditions? Or may they be accidently sampling small fragments of briquette/pellets in these often shallow and sometimes small volume sampling sites? Fragments might even be created by disturbing the briquettes themselves during sampling as has been alluded to in several papers (Sternberg et al. 2012; Kuo et al. 2012). The paper by Baker and Yan (2010) included the highest reported measurements of Methoprene (848 ppb) in a study using one briquette per 5500 liters of storm basin water. For illustrative purposes, if one assumes one briquette weighs 25 g and was added to 5500 liters of water, this would represent an

addition of 95 ppb Methoprene if it all dissolved in water. This calculation indicates that the value of 848 ppb is unreasonable, especially given that Methoprene is known to have a short half-life in surface water and was added in a slow release formulation. The Baker and Yan (2010) results seem to have been strongly influenced by the presence of leaf litter and detritus. Indeed part of their study design was to compare catch basins that had been cleaned with those that had not. They reported both much higher levels in the uncleaned basins, as well as lower emergence of mosquitos, suggesting that the detrital material served as a continuing source of Methoprene after a single yearly treatment of 1 briquet per basin. Furthermore, these basins were repeatedly sampled, over the course of a 105 day study, and the extremely high levels were not persistent, supporting our interpretation that they may have inadvertently sampled small pieces of the briquets in some cases. The high variability between basins observed on any given day also supports this interpretation. If risk assessments are to consider worst case scenarios for Methoprene exposure to aquatic ecosystems, as well as all data for concentration measurements in the literature, it may prove useful to further consider (either through modelling or experimentally) what the real limits on water concentrations under different conditions are likely to be (e.g. weathering of time release formulations and water to pesticide treatment ratios that can vary in time and space), prior to including unrealistically high values in risk assessment calculations.

The method of analysis can also influence results. Two recent papers (Sternberg et al. 2010 and Butler et al. 2010) quantified Methoprene using gas chromatography GC) with flame ionization detection (FID), and most of the papers report extracting whole water samples from detritus (and organism) rich catchment basins or ponds. GC-FID analysis is much less selective than GC-MS-based approaches (which also provide lower detection limits). Whole water extracts, particularly with detritus and living organisms contain many compounds that may interfere with analysis by potentially creating interferences that can create peaks at the same retention time as Methoprene. Such peaks can result in false positives even with the more sensitive GC-MS-based methods. Indeed issues related to analytical methods were found to compromise a report on detections of Methoprene and a number of little used and non-persistent pesticides in adult lobsters collected by the State of Connecticut by one laboratory. When re-analysis by a second lab failed to confirm results, a detailed analysis of quality assurance and quality control (QA/QC) was done, as well as a rigorous side by side comparison of tissue amended with known concentrations of Methoprene. Analysis of new lobster samples using GC-MS-MS run by both laboratories failed to detect any of the pesticides, including Methoprene in any lobster tissues (Krol et al., 2016). The methods eventually used to quantify pesticide concentrations in lobster tissue are described in Provatis et al. (2014). We and others have found that for some analytes it is especially critical to either further purify extracts prior to MS-MS analysis or at least evaluate whether more than one MS-MS transition is used to verify positive detections. When considering water column concentration measurements, particularly those from organic-rich storm water catch basins, it is probably safe to generalize that methods

employing GC without mass spectrometry (mentioned as EPA Method 616 in some papers) on unfiltered water samples will be associated with the least reliable results.

A recent paper by Tonjes et al. (2018) reports on a time series of surface water and sediment measurements of Methoprene in samples collected hours to weeks following aerial spraying of Altosid over two Long Island salt marshes in Suffolk County (Timber Point and Johns Neck) feeding into Great South Bay. Two separate laboratories conducted analysis on water samples sometimes collected at the same times and locations. USGS analyzed filtered air-water interface samples, and SBU typically analyzed whole water samples collected just below the water surface. This study followed up on similar work on Long Island where marsh, freshwater pond and coastal seawater samples had been studied after local spray events. Not surprisingly, the very highest concentrations (still only ~1 ppb) were measured in samples collected 90 minutes or less after spraying, with highest levels observed in interface water samples. Despite very low detection limits (0.0005 using HPLC-MS, or 0.005 ppb utilizing GC-MS), there were a large number of non-detects reported for water samples collected more than 0.5-24 hours after spraying. These data indicate that in local waters adjacent to regions sprayed and often previously sprayed with Altosid, Methoprene concentrations remained low, likely due to a combination of degradation and tidal mixing leading to rapid dilution.

Limited time series analysis of Methoprene in sediments collected from marsh ditches indicated stable concentrations ranging from 9 to 28 ng/g (ppb) dry weight indicating slow loss over a couple weeks' time with inventories in the upper 5 cm that were much less those predicted based on aerial application rates. Methoprene was not detected in marsh sediment samples taken from a similar marsh on the north shore of Long Island where Methoprene was not sprayed (Flax Pond salt marsh). As reviewed in Tonjes et al. (2018), results from this work were consistent with other results from studies conducted on use of liquid Methoprene sprayed onto both marshes and fresh water ecosystems. The results of the SBU and USGS labs reported in Tonjes et al. (2018) were also consistent with the earlier work these groups had done on Long Island salt marshes, fresh water ponds and coastal waters (Abbene et al. 2005, Zulkosky et al. 2005). These studies reported data following aerial spraying at 7 sites, some studied after multiple spraying events. Most samples collected within minutes to hours after the sprays had undetectable Methoprene concentrations (<0.005 ppb). When there were detections (4 of 11 events), only one sample collected in the Carmans River (9 ppb measured approximately 0.5 hr after spraying) had measured concentrations above 0.9 ppb. For the most part, that summary is consistent with earlier measurements reported in other parts of the U.S.

The data discussed above refer only to measurement of Methoprene. Several of these studies also measured Methoprene metabolites which was a concern raised in the most recent literature review conducted by Suffolk County on Methoprene in 2010 Kuo et al. (2010) conducted additional derivatization steps to determine Methoprene' s main transformation products as well as parent Methoprene in catch basins around Vancouver Island that were treated with Methoprene briquets. Samples were analyzed prior to treatment, during an initial precipitation after treatment and again after 150 days.

They also analyzed a few samples within the below-ground catch basins in selected inspection chambers that had been treated. After initial treatment, Methoprene was detected in 4 of 10 samples at 0.04 – 0.14 ppb while its metabolite Citronellic acid was reported at 0.07 ppb in only one sample (detection limits as low a 0.02 ppb for Methoprene and 0.05 ppb for transformation products (Methoprene acid, Citronellic acid and 7-Methoxycitronellic acid). In another sample where high levels of Methoprene (122 ppb) were reported, Methoprene acid was also detected at 1.74 ppb. In yet another sample with extremely high levels of Methoprene (622 ppb), both Methoprene acid (20 ppb) and Citronellic acid (0.05 ppb) were also detected. In the Kuo et al. (2010) study levels of metabolites were always much lower by at least half and usually more than a factor of 10 below levels of the parent compound Methoprene. In contrast, Baker and Yan (2010) using GC-Time-of-Flight (Tof) MS reported higher levels of the Methoprene metabolites Methoprene acid and Methoxycitronellal (0.02 ppb) as compared to 0.005 ppb for Methoprene in another study of catch basins. The wider availability of advanced MS and LC-MS techniques allowing simultaneous analysis of parent compound and metabolites should begin to shed more light on the relative persistence of Methoprene metabolites, and if warranted, toxicological studies on these compounds should also be conducted. The assumption is that metabolites are not as toxic as the parent compounds, but this is not always true and should be determined experimentally.

To summarize data on exposures it is worth noting that scenarios of catch basins with limited sunlight, and intermittent flows, the presence of detrital material, with pesticide application via friable time release briquets may yield much higher and variable estimates of ambient Methoprene concentrations as compared to spray applications of Methoprene onto salt marshes subject to high irradiance, and routine flushing. In the well flushed marshes or coastal waters there is little evidence of either high concentrations or persistence of Methoprene.

Effects on non-target organisms:

The recent review paper published by Lawler in 2017 provides an excellent analysis of data on the ecological risks associated use of Methoprene as a larvicide. She compares risks associated with Methoprene to those of several other biorational pesticides including Spinosad and those containing Bti and Ls. A major point in her review is that ecorisk must be evaluated within the context of realistic environmental exposures. Briefly her review finds that Methoprene has been determined in numerous studies to be among the safest pesticides and that environmental concentrations typically are in the 2-5 ppb range. She concludes, as most others before her have, that these exposures typically would be expected to have minimal if any impact on most species of non-target organisms. Although she acknowledges that laboratory testing indicates that some species of zooplankton, larval stages of some other invertebrates and small Diptera (non-target insects) may experience some toxicity, she points out that in studies of natural populations exposed to Methoprene applied as directed by the manufacturer, either no or limited short term effects have been observed in all but small Dipteran species.

Several recent studies identified in our literature search are discussed below beginning with those which attempted to quantify ecosystem level effects. All tried to tie environmental concentrations to measures of effects. In general, studies of real field applications provide important environmental relevance, but are often poorly controlled. In contrast, laboratory studies, while better controlled, cannot duplicate the conditions of the field with respect to sunlight, moisture, presence of biotic and abiotic material in the test system and influence of other macro and micro-organisms on the fate of the test compound and direct and indirect effects on the test species. That said, in a reasonably well-designed study there are usually important insights to be gained.

Butler et al. (2010) conducted an evaluation of non-target effects of Methoprene in a three-part study examining concentrations and community level effects in real catch basins in the field after a simulated rain event, and in experiments using natural communities introduced to similarly sized artificial catch basin mesocosms in the laboratory. Two types of natural catch basin systems were examined in the field. In a first experiment, two interconnected catch basins drained into Pt Judith Pond in RI. Both were treated with 3.5 g of Altosid (4.24% active ingredient- AI) and one week later, at the time estimated to have maximum released concentration, a rain event was simulated by flooding the first catch basin with 5,000 L of water from a fire hose. Replicate subsurface water samples were taken at the outlet to the catch basins and 30 m away in Pt Judith Pond. Sampling was repeated one hour later. Methoprene was detected at a concentration of 0.5 ppb only in the first sample collected from the first catch basin where it was added. All other measurements were below the minimum detection limit of 0.18 ppb, indicating either significant degradation or dilution of the product.

A second experiment conducted by Butler et al. (2010) examined potential community level effects in a study in where 30 catch basins along several residential streets were sampled. Community samples were taken before Methoprene addition to about half the catch basins and one and 2 months after addition. Abundance and diversity were calculated down to the lowest identifiable taxa. Statistical analysis revealed no significant effects due to Methoprene treatment. A third experiment evaluated changes in a natural benthic community transplanted to mesocosms set up to represent catch basins in the laboratory. The mesocosms were 25 percent of the size of the catch basins on the street, with a benthic community of organisms collected from catch basins that had not been treated with Methoprene for at least 2 years used to seed the populations in each of the mesocosms. Community structure was evaluated in samples taken before Methoprene treatment (0.6 g/mesocosm at approximately the same surface area to dose used in the field study) and again 6 weeks later. The entire experiment was run twice. Here too, no effects due to Methoprene were observed, even though concentrations of Methoprene in the mesocosms ranged from 6 to 15 ppb. Although this entire study yielded mostly negative results, the three related studies conducted by Butler et al. (2010) carefully examined both concentrations and community level responses, and finding none, concluded that Methoprene applied to catch basins at recommended levels neither contaminates local receiving waters with direct input from treated catch basins, nor has measurable effects on the catch basin

communities. Although clear in its conclusions, this study would have benefited from the use of more sensitive GC or LC-MS methods, and additional chemical sampling in the community effects portion of the study.

Another recent comprehensive study examining efficacy, environmental concentrations and toxicity to juvenile coho salmon (*Oncorhynchus kisutch*) of Mosquito Dunks and Bits (Bti)-VectoLex WSP and VectoLex CG (Ls), and Methoprene either as Altosid briquets (catch basin study) or in Aquaprene XL (coho salmon toxicity study) was conducted over a three year period in Seattle by Sternberg et al. (2012). The efficacy of round top and grated basins was also examined. Water was sampled for active product before pesticide application and 1, 3 and 5 weeks post treatment apparently both in the basins and in pipes draining from the basins into local receiving waters. Efficacy was measured by counting pupae after the Bti and Ls treatments and counting adult emergence from pupae sampled after Methoprene treatments. This study was very ambitious, but the description of the results was somewhat cursory, making it difficult to really evaluate how well the study was done.

The Steinberg et al. (2012) study quantified Methoprene in catch basin waters and reported non-detectable concentrations (<0.14 ppb) in 93% of samples from the basins sampled with a maximum concentration of 13 ppb detected 5 weeks post addition in 2006. Sampling done in 2008 yielded similar results, this time with detectable concentrations in 2 of 45 samples collected with a maximum value of 11.4 ppb, although the discussion indicated they may have picked up a piece of the briquet in their sample. Despite the lack of detectable Methoprene concentrations, data on adult emergence indicated effective concentrations of the product were present. Coho toxicity experiments were done in the laboratory in vessels dosed using the maximum concentrations directed for application (although even nominal concentrations used were not given) with fish added 7 days after pesticide addition and followed for 96 hrs thereafter. Exposures were done with each pesticide by itself and in pairwise mixtures with Bti and LS. No mortality was observed in response to any of the pesticides evaluated, and for Methoprene analysis of water samples taken from the tanks were all below limits of detection (0.14 ppb). Despite the limited data description, as presented in the paper, the results of this study are consistent with previous studies failing to demonstrate toxic responses to larvicides in fish species (see review by Lawler et al. 2017).

Sublethal effects of Methoprene or exposure to Agnique MMF (a product that creates a surface film) on the tadpole shrimp (*Triopps Newberryi* Packard) were evaluated by Su et al. (2014). Tadpole shrimp are used as a method of biological mosquito control, so toxicity to the shrimp could boost mosquito populations. Potential effects were evaluated both in controlled laboratory dose/response studies and in field trials. Lab studies used technical grade Methoprene while field studies used commercial grade Altosid. No effects on growth, longevity or fecundity were observed in shrimp exposed to 1, 5 and 10 mg/L (hereafter termed ppm) technical grade Methoprene, concentrations, 90-900 times higher than EC90 (effective concentrations for 90% of the population) against *Culex quinquefascitus* mosquitos determined in laboratory studies

(0.583 ppm). Field trials using with Altosid liquid larvicide (5% Methoprene AI) applied at 0.3-12. L/ha to earthen ponds (equivalent to 1-4 times of the label rates or approximately 5, 10 or 190 ppm also had no measurable effects on tadpole shrimp. Agnique was more toxic with effects observed even at recommended application levels. The combination of laboratory matched to field studies under more natural conditions was a strength of this study as was their choice of sublethal endpoints tied to growth and reproduction. This study demonstrated that co treatments of Methoprene as a chemical biorational pesticide and introduction biological predators (tadpole shrimp) of mosquitos are compatible treatments.

Pauley et al. (2015) conducted a comprehensive study examining gray treefrog (*Hyla versicolor*) populations in model pond communities with and without predation evaluating Mosquito Dunks, Mosquito Bits (both Bti formulations), and Mosquito Torpedoes which contain Methoprene. Effects on the communities of pond macroinvertebrates were also assessed. To put their study in context they then conducted a survey to assess use of these pesticides in ponds under the control of local managers including golf courses, and parks and recreation departments in Iowa, Kansas, and Missouri and home owners in Nebraska. Growth, survival and development of tadpoles was assessed in pond mesocosms with and without the predatory insect, dragonfly larvae. The pond mesocosms contained aged tap water, dried detritus from an oak hickory forest, plankton collected from natural ponds, a concentrated sample of mosquito larvae, with 5 snails and 2 snail egg masses also added as natural competitors, but were closed to introduction of other species. Larvicide products were added 14 days after introduction of tadpoles based on manufacturer's instructions. Torpedos contain 8.62% (0.659 g) Methoprene providing a slow release reported to be effective for up to 60 days. Tadpole metamorphs were captured daily and taken to lab for analysis until complete resorption of tail when they were measured and then sacrificed.

Results of this study were complicated and difficult to explain. The presence of dragonfly larvae had a strong impact, which was also associated with significantly enhanced the toxicity associated with exposure to the Methoprene torpedos, yet exposure to Methoprene alone produced no toxic effects. Effects on invertebrate populations were also assessed. Copepod abundance was not influenced by pesticides, although Cladoceran abundance was influenced by both predators and pesticides in complex ways. In the absence of predators Methoprene reduced invertebrate populations. The authors suggested that behavioral responses may have contributed to enhanced toxicity of Methoprene observed only in the presence of the dragon fly larvae. In reviewing this paper, Lawler et al. (2017) hypothesized instead that the complex responses might be due to alterations in predatory prey abundance. Due to potential interactive effects of selective removal of important prey species due to pesticide application, further more well controlled work of this type may be warranted.

The potential of other stressors to enhance the toxicity of pesticide exposure was examined in a laboratory study investigating the effects of co exposure to low dissolved

oxygen concentrations (hypoxia) and elevated carbon dioxide concentrations (hypercapnia) on growth and survival in larval and juvenile oysters (*Crassostrea virginica*) and hard clams (*Mercenaria mercenaria)* (Garcia et al. 2014). This study compared a wide range of pesticides used for mosquito control including the pyrethroids Permethrin and Resmethrin, an organophosphate (Naled) and Methoprene determining LC50s were determined after 4 day and 21 day exposures in experiments with pesticides concentrations ranging from 1-10 ppm. Acute (4 day) LC50s ranged from 1.59 to >10 ppm with clams being more sensitive than oysters, with chronic (21 day) exposure generally increasing toxicity dropping the lowest LC50 by a factor of 2.5. Sublethal effects were also quantified with some compounds leading to reducing swimming activity after 4 days and reduced growth at 21 days. Methoprene was found to be the lest toxic of the compounds tested for oysters with 4 day LC50s all reported as >10 ppm the highest dose tested. Chronic exposure was more toxic, with the 21 day L50 for Methoprene reported as 1.32 ppm the second most toxic of the pesticides tested. Larval and juvenile clams were more sensitive with the 4 and 21 day LC50s or Methoprene reported at 2.81 and 0.68 ppm respectively, making Methoprene again the second most chronically toxic pesticides tested. Juvenile oyster swimming activity and clam growth were all negatively affected by Methoprene and the other pesticides often at concentrations much lower than the those causing mortality. The combined effect of hypoxia and hypercapnia were only assessed with Resmethrin in larval clams. Both stressors enhanced toxicity due to Resmethrin exposure.

An important aspect of the Garcia et al. (2014) study is that the investigators then went on to put their laboratory data into a risk assessment framework by calculating a hazard quotient (HQ) comparing concentrations observed in the environment with their toxic thresholds determined in the laboratory. If the quotient is <1 safety is assumed, and conversely if environmental concentrations are at or exceed concentrations known to cause toxicity (HQ equal to or >1), adverse effects are more likely. Assuming standard application rates for Scourge 18+54 (Resmethrin), Permanone 30-30 (Permethrin), Trumpet E (Naled) and Altosid (Methoprene) applied to a 1 ha pond 30 cm deep, Garcia et al. (2014) calculated an effective concentration and compared that to the lowest 4 day LC50 in the most sensitive list stage evaluated. In this study the HQs calculated for all four pesticides were less than 0.02, indicating that when used as directed, adverse effects in larval and juvenile clams or oysters are unlikely. Prior to this study data on early life stages was lacking. Garcia et al. (2014) took a comprehensive approach to evaluating not only potential acute but also chronic toxicity. More importantly they put their results in context with expected real world exposures, and thus their work represents a model for future research on non-target species. The potential for interactions with other environmental stressors such as hypoxia and ocean acidification was another strength of this study, and something that along with the stress of increased temperature deserves further analysis.

It is worth mentioning a field study published by Russel et al. (2009) that was not included in the previous review of Methoprene conducted by Suffolk County in 2010. The focus of this study, evaluating potential effects on non-target invertebrates of typical applications of Methoprene and Bti in marsh systems generally comparable to those

found in Suffolk County, makes it worth discussing. The Russel et al. study was conducted in Queensland Australia, enumerating the composition and abundance of 15 taxa non-target aquatic and terrestrial arthropods in two salt marsh systems spaced about 30 km apart. The study evaluated 2 pesticides, Bti (Vectobac 1.2 L/hectare) and Methoprene (Altosid 0.36 L/hectare). In one system (Coomera Waters, Methoprene was administered one month before Bti, and in the other Garden Island, Bti was administered about 3 months before Methoprene. In each case invertebrate samples were collected 1,5,8, and 20 days after spraying. Although Methoprene exposure was associated with minor changes in species composition or abundance, results were transient, and usually not observed at both experimental sites.

Finally we note a comprehensive review of all published toxicology studies compiled by the Canadian Council of the Ministers of the Environment (2007). Their compilation of 47 published values reported the lowest concentration with significant chronic effects on a non-target organism to be 10.1 ppb observed in 10 and 20 day LC50 studies with *Chironomous stigmaterus* and *Brachydeutera argentata*. Multiplying this value by a safety factor of 0.05, they derived a Target Organism Management Value of 0.53 ppb, a Water Quality Guideline to be protective of 95% of all freshwater aquatic species with the exception of the target species (in this case mosquito larvae). This value was rarely exceeded for very long in any assessments of Methoprene under standard field applications conditions discussed in this review, therefore even by this most conservative measure, it appears that Methoprene, when used as directed, would be expected to represent only a minimal risk to non-target organisms.

Conclusions:

A literature search focusing on publications since 2010 yielded only 15 studies highly relevant to the use of Methoprene for vector control in Suffolk County. There has been no new fundamental knowledge related to Methoprene use and safety appearing during this time period. Improved analytical specificity and sensitivity provides a better measure of environmental levels than available in the past, yet still indicates that concentrations in water are low and rapidly diminish after application, with half lives in hours (particularly in well flushed areas) to days. Analysis of sediment samples in marshes after spraying indicate half lives in weeks, with no evidence of build up even after repeated applications. Occasional reports of extremely high values, orders of magnitude higher than expected, are rare and likely reflect Methoprene associated either with the original time-release product or with detrital material, and are not representative of environmental exposures. Recent studies investigating or reviewing effects on non-target organisms and populations either failed to detect effects associated with application, or, if found, the effects were short lived and inconsistent between sampling sites. In cases where effects were observed in the laboratory, these occurred at concentrations well above measured or predicted concentrations in the environment in most species, except for Dipteran insects and some sensitive Crustacean species. Several recent reviews, including large risk assessments conducted by Canada and New Zealand, as well as approved uses in the European Union, support the use of biorational pesticides in general and Methoprene in particular,

finding it to be among the safest pesticides available for control of mosquito populations.

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SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT

LONG - TERM PLAN

GENERIC ENVIRONMENTAL IMPACT STATEMENT
STATEMENT OF FINDINGS

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Adopted March 22, 2007

SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT

LONG - TERM PLAN

GENERIC ENVIRONMENTAL IMPACT STATEMENT
STATEMENT OF FINDINGS

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STATEMENT OF FINDINGS
SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT
LONG-TERM PLAN

Preparation/Submission Date:	February 1, 2007
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Lead Agency:	County of Suffolk Suffolk County Legislature William H. Rogers Building 725 Veterans Memorial Highway Smithtown, NY 11787
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Location:	Countywide, but excluding the Orient Point Mosquito Control District and Fire Island National Seashore

A. Introduction

The subject action is the Suffolk County Vector Control Wetlands Management and Long-Term Plan (herein the Long-Term Plan; October, 2006). This Statement of Environmental Findings has been prepared in accordance with the environmental review requirements of the State Environmental Quality Review Act (SEQRA), as set forth in 6 NYCRR Part 617 and Chapter 279 of the Suffolk County Charter. This statement of findings has been prepared to demonstrate that:

1. the procedural requirements of SEQRA have been met;
2. the proposed Long-Term Plan was selected from among the reasonable alternatives as the choice that minimized potential impacts; and
3. as required by 6 NYCRR Section 617.11(d), consistent with social, economic and other essential considerations from among the reasonable alternatives available, the action is one that avoids or minimizes adverse environmental impacts to the maximum extent practicable. Adverse environmental impacts will be avoided or minimized to the maximum extent practicable by incorporating as conditions to this Statement of Findings those mitigative measures that were identified as practicable.

B. Overview

Purpose/Goals

Suffolk County has developed this Long-Term Plan to control mosquitoes (protect public health), reduce pesticide usage, and manage and protect wetlands. A major goal is to reduce larviciding by 75 percent, as measured in acres treated, over 12 years; currently, 4,000 acres of tidal wetlands are routinely larvicided. Another key goal is to continue to reduce adulticiding. In recent years, less than two percent of Suffolk County has received non-emergency adulticide treatments.

Description of Action

The Long-Term Plan enhances integrated pest management, including increased surveillance (including pre-adulticide, and post-adulticide efficacy), operational improvements (e.g., catch basin larviciding), and expanded public education/outreach. Strict numeric mosquito criteria will

be used to justify every non-Health Emergency adulticide treatment. The use of technology has also been optimized. For example, the Adapco Wingman spray technology is used to minimize pesticide usage, and geographic information systems have been improved.

Wetlands management will be critical in reducing larvicide usage. As part of the program, no new ditches will be created, and routine use of machine ditch maintenance has ceased. During the first three years, implementation of the Long-Term Plan will focus on low-impact water management without significant changes to the wetland ecology. Wetlands functions and values will be the paramount objective for all wetland management projects.

In the longer term, a Wetlands Stewardship Committee strategy will address the assessment and management needs of all 17,000 acres of tidal wetlands in Suffolk.

At a minimum, the Long-Term Plan will be updated on a triennial basis, with the first update due in 2010. The triennial report will contain detailed information on effectiveness of implementing a broad variety of recommendations related to public health, vector control, and water management (see Appendix 1 for format and examples of specific indicators). Any significant changes to the Plan may be subject to further environmental review (see section G).

Impact Analysis

A comprehensive environmental review was conducted for the potential impacts of the Long-Term Plan. As discussed in Section F, there is no data or analysis which documents that implementation of the Long-Term Plan will have any potentially significant adverse impacts (with the possible exception of adulticide impacts to non-target insects which are believed to be minor and can be mitigated, as well as Wetlands Best Management Practices 5 through 15, which would be subject to additional environmental review if proposed). Successful implementation of the Plan will, however, result in significant beneficial impacts (e.g., pesticide reduction).

Potential environmental impacts were reviewed for all aspects of the program, through exhaustive literature searches, local experiments (including collection of extensive monitoring data) and demonstration projects, and a comprehensive, quantitative risk analysis. Vector control and water management programs, and impacts, were evaluated for numerous jurisdictions.

The pesticides analysis results can be summarized as:

- Human health: negligible impacts (acute, chronic, or carcinogenic) from any larvicide or adulticide agent.
- Ecological impact: no significantly increased risks for impacts for mammalian, avian, or reptilian wildlife from any pesticide. Possible risks for aquatic impacts were associated only with the adulticides permethrin and, potentially more so, malathion. However, models indicate that the increased risk for invertebrate impacts does not propagate up the food chain, and a sophisticated ecosystem model showed recovery to be complete by the following spring.

Bees are the standard for understanding agricultural pesticide impacts to flying insects and, based on theoretical potential effects to bees, all adulticides posed a potential risk to non-target flying insects. However, vector control adulticides are generally not applied when bees are flying (day time). No study has attributed significant impacts to insect populations from vector control adulticides at the concentrations and methods in which they are applied. Also, the literature suggests that effects of transient stressors on insect populations are fleeting, with populations recovering within days. Mitigation measures contained in the Long-Term Plan are expected to minimize any potential impacts to non-target flying insects.

The water management impact assessment found that there should be no significant impacts from careful, site-specific application of the selected Best Management Practices. For the first three years of the Long-Term Plan (through early 2010), implementation of the Long-Term Plan will focus on low impact Best Management Practices (BMPs 1-4, including de minimis ditch maintenance and maintenance/repair of existing culverts). Any other BMPs (including BMPs 5-15) will automatically trigger additional environmental review.

The Long-Term Plan involves a new approach to the management of Suffolk County's coastal marshes, and there will be no new ditch construction, no routine ditch maintenance of the overall grid ditch system, and minimal, limited machine ditch maintenance (expected to be annually limited to 50,000 linear feet, affecting less than 50 acres of marsh) in conjunction with projects where it is necessary to preserve or enhance important ecological functions in tidally restricted areas.

Mitigation

Mitigation is discussed in detail in Section F. Mitigation is summarized as follows, in terms of integrated pest management, water management, and pesticide usage.

Integrated Pest Management

The Long-Term Plan mitigates potential impacts because it enhances many aspects of the current Integrated Pest Management approach, including:

- Public outreach will be bolstered. In particular, there will be targeted education efforts in areas that have a greater probability of receiving adulticide applications.
- Surveillance efforts (pre-spray and post-spray efficacy) will increase, including increasing the number of traps used and the number of set-outs made. New Jersey Light Traps will increase from 27 to 30, and CDC trap-nights are expected to increase from 80 to 105 trap nights per week, at peak). Surveillance results will be better communicated to the public as a means of justifying program decisions.
- Current efforts to reduce mosquito breeding in catch basins and other storm water systems will be increased. Catch basin monitoring will increase, with the goal of increasing from 10,000 to 40,000 inspections per year.
- Focus will be increased on reducing the number of tires that litter the County. These sites serve are key habitats for important disease vectors, and so these efforts clearly reduce the risks of disease transmission.
- Biocontrol use will be mitigated through the use of disease-free, native fish, whenever possible (although the use of disease-free fathead minnows is also a possibility), and through strict observance of restrictions to ensure fish do not escape to other water bodies and do not threaten endangered species or significant habitats.

Wetlands Management

Water management was the cause of many comments from interested parties. It is of prime importance that wetlands management be organizationally and functionally separated from vector control. To mitigate potential effects from any wetlands management project, the following measures will be instituted.

- For the first three years of the Long-Term Plan (through early 2010), implementation of the Long-Term Plan will focus on low impact Best Management Practices (BMPs 1-4, including de minimis ditch maintenance and maintenance/repair of existing culverts).
- Any other BMPs (including BMPs 5-15) will automatically trigger additional environmental review. While BMPs 1-4 will be generally classified as Type II Actions, they may be subject to further SEQRA review if deemed necessary by DEE and/or CEQ. BMPS 5-15 will be deemed Unlisted or Type 1 Actions to ensure appropriate SEQRA review.
- A Wetlands Stewardship Committee, chaired by the Suffolk County Department of Environment and Energy, will be a key part of the Long-Term Plan, and this Committee will provide recommendations on all projects using BMPs 10-15, and can review any other project its membership wishes to consider.
- In 2010, the first triennial report will include recommendations from the Wetlands Stewardship Committee strategy; at that point, any Long-Term Plan modifications may be subject to further environmental review (see section G).
- The Long-Term Plan now emphasizes marsh health and preservation in design, implementation, and assessment of all wetlands management projects.
- All necessary permits will be acquired, which will require a great deal of formal project reviews.

Pesticide usage

Pesticide impacts are mitigated in several ways, as follows.

- Implementation of the long-term plan is expected to result in decreasing need to use larvicides (an eventual 75 percent reduction is a Long-Term Plan goal).
- Precise triggers (trap counts or landing rates) are required to be met before any Vector Control adulticide applications.
- Efficacy testing will be a significant element of the Long-Term Plan, and these data should provide justification for the pesticide use that does occur.

- Use of the Adapco Wingman technology will optimize aerial adulticide applications (maximize mosquito control while minimizing pesticide usage)
- Continued consultation with New York State Department of Environmental Conservation (NYSDEC) and other resource agencies will ensure that all pesticide applications avoid impacts to endangered species and minimize impacts to settings of particular concern, whether through the use of setbacks, adjustments in application timing, or avoidance of specific areas.
- The plan report now appears to want to lessen such buffers, which right now are 100-150 feet. CEQ feels the buffers are necessary, though if more nuanced applications are proven to avoid non-target impact/drift, CEQ will be willing to consider such evidence as part of the long term strategy.

It is important to emphasize that the Long-Term Plan will be an adaptively managed Plan. The Steering Committee and the advisory committees (Citizens and Technical) are expected to continue to function, and issues can continue to be addressed, even if they arise or are realized after this iteration of the Plan has been completed.

Further Environmental Review

The triggers for further environmental review which are specified herein constitute the minimum conditions under which additional environmental review would be initiated. At any time, the County could commence additional environmental review based on substantial new technical information.

Further environmental reviews (see Section G) are possible under at least two circumstances: adoption of the Annual Plan of Work, and in relation to wetlands management projects. Both are summarized below.

Annual Plans of Work

On an annual basis, the Council on Environmental Quality will review Annual Plans of Work and make a recommendation with respect to the State Environmental Quality Review Act to the Suffolk County Legislature. Annual Plans of Work that comply with the form and content of the Long-Term Plan generally should not require further environmental review. If an Annual Plan

of Work diverges from the Long-Term Plan, whether in terms of the scope of particular elements, or in terms of specific products or approaches to vector control, then all or part of the Annual Plan may be subject to further environmental review, at the determination of the Suffolk County Legislature and/or other involved agencies.

In general, annual plans need to focus on the use of surveillance to determine where mosquito problems exist, and to primarily employ source reduction tools to reduce the impact of mosquitoes on people. The implementation (over time) of the techniques for wetlands management developed in the Best Management Practices manual, as outlined in the Wetlands Management Plan may be a source reduction tool.

Specific triggers for additional SEQRA reviews have been detailed. These triggers include:

- failure to include public education and outreach steps to educate residents and visitors on the means that are available to avoid mosquito bites and diseases associated with mosquitoes
- inadequate mosquito population or disease surveillance
- failure to commit to respond to all mosquito complaints using personnel appropriately trained to identify and mitigate sources of mosquito problems
- failure to use the review processes outlined in the Wetlands Management Plan for wetlands management projects
- proposed use of a non-native biocontrol organism not already resident in Suffolk County natural environments
- proposed use of a larvicide other than Bacillus thuringenesis var israelensis (Bti), Bacillus sphaericus, or methoprene
- proposed use of an adulticide other than resmethrin, sumithrin, permethrin, natural pyrethrins, or malathion
- identification of a preferred adulticide agent other than resmethrin or sumithrin
- use of BMPs 5-15.

Wetlands Management

Most wetlands management projects will be subject to further environmental review. Projects utilizing Best Management Practices 1 through 4, as determined by DEE, (none to Minimal Impacts) will not, unless unusual site-specific conditions are cause for concern; all others will.

The triggers for further environmental review which are specified in the FGEIS and below in Section G constitute the minimum conditions under which additional environmental review would be initiated. At any time, the County and/or the Council on Environmental Quality could commence additional environmental review based on substantial new technical information.

C. Procedural Requirements

Suffolk County Department of Public Works (SCDPW) prepared an Environmental Assessment Form (EAF) for the development of a Vector Control and Wetlands Management Long-Term Plan and submitted the EAF to the Council on Environmental Quality (CEQ) on May 2, 2002. On May 15, 2002, the CEQ issued a recommendation for a Positive Declaration to the Suffolk County Legislature. The Legislature issued the Positive Declaration at its meeting on August 6, 2002.

A draft Scoping document was prepared by Suffolk County Department of Health Services (SCDHS). The draft Scope was circulated for public review beginning August 7, 2002. A public Scoping hearing was held on September 10, 2002, at the Suffolk County Legislative Building in Hauppauge. This hearing was conducted by the CEQ, acting on behalf of the County Legislature, as authorized by Chapter 279 of the Suffolk County Administrative Code.

The CEQ held open the public Scoping record until September 25, 2002, in order to afford the opportunity for additional written comments regarding the scope of the DGEIS. All written comments received through that date, as well as minutes and summaries from the various meetings conducted as part of the Scoping process, were collected together and published by the County.

The Final Scope was published August 1, 2003, and was adopted by the Legislature by Resolution 1122 on December 16, 2003. The resolution was signed by County Executive Robert Gaffney on December 18, 2003.

A Draft Generic Environmental Impact Statement (DGEIS) for the Suffolk County Vector Control and Wetlands Management Long-Term Plan was submitted to CEQ on May 3, 2006. It was accepted as complete by CEQ at its May 17, 2006 meeting. At that meeting, CEQ set a 60 day comment period (through July 17, 2006) and also announced that two public hearings would be held. Public hearings were thus held, on Thursday, June 29, 2006, from 6 to 9 pm, at the Maxine S. Postal Legislative Auditorium, Riverhead, and on Thursday, July 6, 2006, from 10 am to 1 pm in the Rose A. Caracappa Legislative Auditorium, Hauppauge, before members of CEQ, with CEQ Chair Dr. R. Lawrence Swanson presiding.

At the CEQ meeting held on August 9, 2006, CEQ determined that the comments received in writing and at the hearings were substantive in nature, and forwarded a recommendation to the Legislature that it cause to have a Final Generic Environmental Impact Statement (FGEIS) prepared. The Legislature, at its meeting on October 17, 2006, passed resolution 1103-2006 authorizing the preparation of a FGEIS. The resolution was signed by County Executive Steve Levy on October 20, 2006.

The FGEIS was received by CEQ on November 9, 2006. The FGEIS Supplement was sent to the CEQ on January 4, 2006. All documents were forwarded to the Legislature for review and consideration together with comments from CEQ, and considered at the January 29, 2007 meeting of the Environmental, Planning and Agriculture Committee (EPAC) of the Suffolk County Legislature. These findings incorporate the direction from the Legislature.

To the extent that these Findings may contain measures (e.g., mitigation) which are not already explicitly in the Plan, the Plan is deemed to be amended to incorporate these Findings. If any provisions in the Findings are potentially inconsistent with the Plan, the provisions of the Findings are deemed to prevail.

D. Long-Term Plan Overview

Introduction

On August 6, 2002, the Suffolk County Legislature adopted a "Positive Declaration" on the County's proposed Vector Control and Wetlands Management Long-Term Plan. The Legislature subsequently appropriated funding to conduct the program, resulting in SCDPW (as fiscal manager) and SCDHS (as project manager) preparing and issuing a Request for Proposals (RFP) for the preparation of a Long-Term Vector Control and Wetlands Management Plan together with any associated environmental reviews.

An open and public process was undertaken to generate a Long-Term Plan and to perform the environmental impact assessment of the Long-Term Plan. Elements of public participation and input included:

- Formation of project committees such as the Technical Advisory Committee (TAC), the Citizens Advisory Committee (CAC), the Wetlands Subcommittee, and the Monitoring Subcommittee. These formally constituted committees (the TAC and CAC) and more informal groups provided venues and means for comment and review of project work products, and for feedback and input on the development of the Long-Term Plan to be made.
- Reviews of various project work products by nationally recognized technical experts (organized by the TAC).
- The Best Management Practices Manual and Wetlands Management Plan were released in draft form for public review in July 2005. The Long-Term Plan was released for public review in September 2005. On the basis of received public comments, the Long-Term Plan and the associated Wetlands Management Plan and Best Management Practices Manual were revised, and released in draft form again in December 2005. At that time, a draft version of the DGEIS was also released for public comment and review.
- Following the receipt of comments, the County once again revised the Long-Term Plan, the Wetlands Management Plan, and the Best Management Practices Manual. These documents, together with a revised DGEIS, were formally submitted to the CEQ on May 3, 2006.

- Following the public comment period on the DGEIS, the Long-Term Plan, the Wetlands Management Plan, and the Best Management Practices Manual were again revised, with the updated versions released in October 2006. On November 9, 2006, the FGEIS was delivered to CEQ, as a response to comments made on the DGEIS.

Therefore, it is clear that the Long-Term Plan and its associated environmental reviews are the product of an open and very public process, one in which several substantial revisions have been made following extensive public input to generate draft plans and analyses. The Plan was revised several times, on a voluntary basis, by the County.

In addition, Suffolk County commissioned its consultant, Cashin Associates, PC, and its team of subconsultants to conduct extensive fieldwork and local data collection, including local experimentation and environmental characterizations. These efforts included:

- Designing, permitting, constructing, and monitoring a progressive water management project at Wertheim National Wildlife Refuge, in conjunction with US Fish and Wildlife Service (USFWS) and the County.
- Designing, permitting, and conducting the Caged Fish experiment of larvicide and adulticide impacts under environmentally relevant conditions, documenting all aspects of the applications and subsequent fate and transport, and testing for biological effects, in conjunction with the County and the US Geological Survey (USGS).
- Identifying and characterizing 21 local wetlands (Primary Study Areas) to serve as a basis for determining environmental impacts associated with water management.
- Identifying and characterizing four sentinel areas of the County to allow for careful modeling of the risks to human health and the environment from proposed pesticide applications.
- Conducting an assessment of the potential for mosquito control ditches to convey land-based pollutants to the surrounding estuaries.
- Testing for changes in invertebrate communities at five pairs of salt marshes from extended exposure to mosquito control larvicide formulations.

- Determining the long-term vegetation characteristics at two south shore salt marshes, and relating changes in vegetation patterns to extrinsic environmental changes, such as ditching, changes in land use, major storms, and similar factors.
- Monitoring turtle use of upland mosquito ditches near Napeague Harbor, and surveying for their presence in three similar settings.
- Surveying additional stormwater control structures beyond those identified by preliminary County assessments for the potential to breed mosquitoes that might impact human health.
- Testing innovative mosquito control formulations and devices in County environments.
- Constructing a Geographical Information System (GIS) database of local vector control information along with other relevant County environmental data sets.
- Designing and preparing to implement a test of remote sensing capabilities to ascertain vegetation geographical patterns and temporal trends in County salt marshes.

This information was released to the public through 27 separate publications associated with the Literature Search, additional reports connected with other tasks of the project, construction and maintenance of a project website where all relevant information, publications, and presentations were posted, professional presentations at local, national, and international meetings, and through production and dissemination of a project specific newsletter.

Nuisance versus Disease

The Long-Term Plan attempted to distinguish between mosquito control conducted to control nuisance, and mosquito control conducted to prevent human health impacts. However, such a distinction proved to be impracticable. The Plan was successful, however, in describing approaches geared to "Vector Control" (control in the absence of a detected pathogen; synonymous, for purposes of the Long-Term Plan, with the term "Public Health Nuisance Control"), as differentiated from actions associated with "Emergency Response."

It is noted the Long-Term Plan approach is consistent with Public Health Law. The law reflects the position that a severe infestation of mosquitoes that results in large numbers of people receiving many bites is clearly not a "healthy" situation, even if no specific disease is transmitted. State and County Public Health Law describe a mosquito infestation as a "public health nuisance," whether or not pathogens have been detected. A public health nuisance is, by definition, a condition that can adversely affect public health.

It is not possible to distinguish specific mosquito control steps for human health protection from all other mosquito control actions. For instance, West Nile virus (WNV) occurs and reoccurs across nearly all the County in most years. Nearly all human-biting mosquitoes found in the County have the potential to transmit WNV. Source reduction, wetlands management, larval control efforts, and wetland management techniques can reduce the potential for infection by reducing the pool of mosquitoes that can transmit disease. However, since female adult mosquitoes that have fed at least once are the only mosquitoes that carry WNV, the application of these techniques that limit the production of adult mosquitoes necessarily occurs prior to the mosquitoes becoming infected.

WNV impacts in the County are believed to be much less than they might in the absence of such control measures. Modeling suggests that West Nile virus incidence rates could be an order of magnitude higher in the absence of vector control (i.e., potentially tens of deaths, and hundreds of serious illnesses, annually). It is quite probable that other factors, such as the composition of the County's mosquito population, also impacts the infection rate here. However, the control program also has a role in shaping the mosquito population, so that again it is difficult to separate out clearly the impact of the control program from other factors. The terminology used for control of adult mosquitoes may appear to support a distinction between nuisance and disease control, but that is not so. "Health Emergency" adulticide applications are made when the Commissioner of the SCDHS, acting under authority granted by the New York State Department of Health, determines that immediate risks to human health need to be reduced, by reducing adult mosquito populations in a certain area because there is a particularly high risk of transmission of disease to humans. The implication is that other applications are not made to reduce health risks. However, the Long-Term Plan has accurately designated these other kinds of adulticide applications "Vector Control" applications (i.e., control vectors with potential to adversely affect public health, prior to detection of WNV or other pathogens). The terminology is intended to

underline that all human-biting mosquitoes in the County are potential vectors of disease (most often, WNV), and that the reduction of large numbers of these mosquitoes will reduce overall disease risks. This clear connection between the reduction of large numbers of human-biting mosquitoes and decreases in disease risk is the reason that all aspects of the County control program are seen to be part of an overall disease control effort. It is true that alleviation of impacts to residents' and visitors' quality of life does follow from adulticide applications, and this is an important benefit of the program. This brief discussion focuses on West Nile virus. As discussed in the Long-Term Plan and GEIS, an integrated vector control program is credited to manage risks from other diseases and Eastern Equine Encephalitis.

Content of the Vector Control Long-Term Plan

Those aspects of the Vector Control portion of the Long-Term Plan were developed as an implementation of Integrated Pest Management. Integrated Pest Management is a means of addressing pest problems that uses a hierarchical approach where those activities that have greater impact on the organisms but potentially have fewer environmental or human health risks are assayed first, and where actions taken are commensurate with the problem.

The scope of the Long-Term Plan includes all of Suffolk County. However, Orient Point Mosquito Control District is responsible for vector control in that portion of the County. In addition, implementation of mosquito control in Fire Island National Seashore will require completing a separate permit application and environmental review process, and, due to its status in the national park system, may require some additional considerations that do not apply to the remainder of Suffolk County.

The hierarchical elements of the Vector Control component of the Long-Term Plan are:

- Public education and outreach

  Public education and outreach is central to the effectiveness of the Long-Term Plan. The Long-Term Plan will re-enforce existing efforts that allow residents and visitors to avoid being bitten by mosquitoes, and that address mosquito breeding problems determined through responses to citizen complaints. The Long-Term Plan calls for expansion of general public outreach through program presentations, brochures, and web site maintenance, and will target the areas of the County, predominantly along the south shore, where adulticide

applications have been made more frequently. Specific efforts to improve catch basin maintenance and to address tire litter are expected to provide dividends in terms of reductions of disease risks. The County will maintain its "Do Not Spray" registry and will expand its efforts to educate Suffolk County residents regarding specific elements of the vector control program.

- Scientific surveillance

A central tenet of Integrated Pest Management is that information is necessary in order to determine appropriate actions. The Vector Control Long-Term Plan surveillance program is intended to generate necessary information in sufficient quantity and in a timely manner so that the activities of the vector control program are optimized. Surveillance generally determines two parameters concerning the local mosquito population. One is number and speciation, generally called population surveillance. The second is pathogen presence, which is generically called disease monitoring.

Population surveillance looks to assess larval and adult populations. Larval populations are determined at set stations, where crews collect samples with laboratory confirmation of numbers and speciation. Crews also seek for breeding sites in response to citizen complaints. The County will maintain its existing larval population sampling efforts, and endeavor to respond to all complaints within three days. Adult populations are assessed through trapping, primarily. The fixed New Jersey trap network will be expanded by three under the Long-Term Plan, and, if adult control is proposed, special population sampling using CDC light traps will be undertaken prior to any application to ensure numerical triggers are exceeded. In addition, post application sampling will be conducted to measure efficacy. In some circumstances, landing rates will be used either in place of trapping or as an adjunct to trapping efforts.

Disease surveillance generally uses CDC gravid or CDC light traps. The initial set out of CDC traps will be expanded to 35 weekly set outs, and will be proportionately increased as the season progresses. The County will continue to send its pools of potentially infected mosquitoes to the State Department of Health for testing, although the Long-Term Plan recommends the construction of a Bio-Safety Level 3 laboratory in Suffolk County so that testing may occur more quickly and be conducted on more potential pools than is currently

possible. Dead birds will continue to be collected, tested for WNV presence locally, and tested for a larger range of pathogens at the State laboratory.

Generally, SCVC will assume responsibility for population surveillance, and the Suffolk County Department of Health Services Arthropod-Borne Disease Laboratory (ABDL) will be responsible for disease surveillance. SCVC and the ABDL will continue to work closely together and share responsibilities to ensure that the primary mission of public health protection is adequately supported.

A discussion of surveillance results will be included in Annual Plans of Work. Detailed reporting and analysis of surveillance data will be included in each Triennial Report.

- Source control

Source control means to eliminate conditions conducive to mosquito breeding. This is a focus of public outreach efforts. It is also the most effective method of mosquito control conducted in response to public complaints. The County already has a strong program to encourage residents to take steps to drain standing water from containers near houses, to ensure pools are properly maintained, and to replace water in birdbaths at frequent intervals. The County will expand these efforts by addressing issues such as used tire management and catch basin maintenance with other local governments, and will expand the storm water facility maintenance program to private concerns such as shopping centers or apartment complexes. These efforts are especially important as the house mosquito (*Culex pipiens*) is believed to be the prime vector for WNV in Suffolk County (other mosquitoes are also significant risk factors for WNV transmission, as well).

- *Wetlands Management*

The Long-Term Plan reconfirms the existing County commitment to abandon ditching as a means of wetlands management for mosquito control, and to avoid machine ditch maintenance except in the most limited of circumstances. In the longer run, the Long-Term Plan has identified the utilization of more progressive wetlands management in salt marshes (as defined in the Best Management Practices Manual) as one element in increasing effective control of mosquitoes and decreasing the potential for environmental impacts associated with vector control. Potential reductions of 75 percent in larvicide use, reductions in adulticide

use, and improvements in important salt marsh ecological functions are all thought to result from careful and considered application of the Best Management Practices in select coastal marshes in the County.

Concerns raised by interested and involved parties have resulted in much more thorough review and appraisal of wetlands management as a means of vector control. For the first three years of the Long-Term Plan, only minor and relatively no impact projects will be considered by the County (see Figure 1, Figures 2-3, and Figure 6). Any project that is usually more likely to have potentially significant impacts or major impacts (Best Management Practices 5 to 15; Figures 4-5) will be subject to additional review under SEQRA. In addition, any project involving machine maintenance of existing ditches, structures, waterways, or other features associated with wetlands will be noticed to CEQ, either through submission of a copy of the permit application for the project, or submission of a project description detailed enough to serve as a NYSDEC permit application.

- Biocontrols

Biocontrols are not a major facet of the County program. This is largely due to the potential for environmental impacts from the invasive and aggressive *Gambusia* fish which has served the County as its primary biocontrol for several decades, and so the necessity to restrict biocontrols to settings where the fish will almost certainly not impact natural water bodies. In addition, many settings where biocontrols would serve good purposes for mosquito control are ecologically sensitive, often because they are largely predator-free. The Long-Term Plan proposes to substitute fathead minnows (*Pimephales promelas*) for *Gambusia*, as the minnow as been identified as a more benign species should it escape to natural water bodies. The County will also follow developments in other jurisdictions regarding other promising organisms that are shown to consume mosquitoes, such as certain freshwater copepods (potential biocontrols for catch basins). However, the County will be very cautious in implementing biocontrol use, to ensure that sensitive environments are not disrupted through the introduction of predator species.

- Larval control

The Long-Term Plan reaffirms the County commitment to only using pesticides when scientifically-collected information supports its use, in the context of Integrated Pest

Management principles. Surveillance data regarding the species and stages of immature mosquitoes along with information on the time of year and conditions at the prospective treatment site will be used to determine if use of one of two bacterial pesticides, *Bacillus thuringiensis var israelensis* (Bti) or *Bacillus sphaericus* (Bs), or the insect growth hormone mimicker methoprene, is appropriate. At times, the County may use a "duplex" treatment of Bti and methoprene, as well. Application rates will always be at label maximums. This insures maximum effectiveness for the application, and is important to reduce the development of resistance in treated populations. For regularly sampled locations, the primary determinant of the need to larvicide will be "presence/absence" over an appropriate subset of sampling points. The Long-Term Plan also identifies the potential to develop numerical triggers through analysis of data sets as augmented by continuing sampling, through the creation of a GIS (Geographical Information System) database of historical sampling results as part of the Plan development process. The County will continue to apply larvicides by helicopter to marshes that have large expanses of breeding, although it is anticipated that implementation of the Wetlands Stewardship Strategy (to be developed by the Wetlands Stewardship Committee under the direction of SCDEE) will help to significantly reduce larviciding needs. Other larvicides will be applied by field crews in response to surveillance data generated by citizen complaints or regular surveillance of smaller breeding locations. To check *Culex pipiens* populations further, the County will expand its surveillance of catch basins to some 40,000 (or more) sites each year. Time release formulations of methoprene, or, sometimes, Bs, will be used to prevent the emergence of adult mosquitoes at these sites.

The Long-Term Plan requires the establishment of an efficacy program and also sampling to determine if resistance is being generated in treated populations.

- Adult control

Control of adult mosquitoes is the least favored means of mosquito control. Adulticide use signals the failure of all other potential treatment means, and is the last option for program managers. The County always endeavors to minimize its use of adulticide products.

Adult control can be deemed to be necessary under two separate operational scenarios. One is defined as a "Vector Control" (public health nuisance) application; the other is defined a

“Health Emergency” application. In either case, pesticide use decisions are only made on the basis of scientifically-determined surveillance data.

Vector Control adulticide applications are made to reduce large numbers of human biting mosquitoes. 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 per minute over a five minute period.
    - 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.
- 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.

Vector Control applications will normally be made by truck. Necessary public notices will be issued in a timely manner (normally, at least 24 hours pre-application), and appropriate precautions will be made to meet NYSDEC restrictions on applications, and to avoid "No Spray" properties (including all farms).

The need for Health Emergency treatments is determined by the New York State Department of Health West Nile Virus Response Plan for mosquito-borne disease. Because of the persistent presence of WNV in the County, the County perpetually begins each year in Tier II. As indicators of pathogen presence accumulate (positive dead birds, positive pools of mosquitoes), the Commissioner of the SCDHS will petition the Commissioner of the State Department of Health to declare a Health Emergency. If the petition is granted, and the risk assessments made by SCDHS indicate that risks to the residents of an area of the County are no longer tolerable, the Commissioner will declare a Health Emergency. In conjunction with NYSDEC and SCVC, SCDHS will determine the optimal treatment area to reduce risks of disease transmission to people. An application will be made to NYSDEC for NYSDEC to issue an Emergency Authorization to permit adulticide applications that might otherwise violate the State Freshwater Wetlands Regulations. Appropriate required public notices will be issued. Pre-application mosquito sampling will be conducted (for efficacy determinations). If, as is almost always the case for Health Emergency applications, an aerial application is proposed, a helicopter using the Adapco Wingman guidance system will be used to optimize the delivery of the pesticide.

Efficacy measurements will be made following every adulticide application. The Long-Term Plan also calls for the establishment of resistance testing for the more commonly used compounds.

The Long-Term Plan proposed a general reliance on resmethrin, a synthetic pyrethroid, as the adulticide pesticide. Resmethrin has been found to be an effective pesticide for mosquito control, can be used for ultra-low volume applications for truck and aerial delivery, undergoes rapid decay in the environment, and, as discussed below, has few identified non-target effects when applied as proposed under the Long-Term Plan. Sumithrin, a similar pyrethroid, is proposed to be the primary back-up to resmethrin, and the primary pesticide for any hand-held applications (the resmethrin label is currently interpreted as not permitting hand-held applications). The Long-Term Plan also identifies two other pyrethroids, permethrin and natural pyrethrins, as potential adulticide compounds. Neither is preferred; however, permethrin is a more widely available product that is manufactured by more than one company, and so may continue to be available under conditions when the patented, less-widely used pyrethroids may not be. Natural pyrethrins are identified as a potentially useful

compound because its label allows for use over agricultural areas. In addition to the pyrethroids, malathion, an organophosphate pesticide, was identified as a potential adulticide. Malathion would be used under very specialized conditions, such if thermal fogging were needed, daylight applications were called for, or if resistance testing indicated pyrethroid applications would be ineffective in meeting the goals of the application. All of these pesticides would be applied at the maximum label rate, as that is the best way of achieving effective mosquito control and is helpful in avoiding the development of pesticide resistance.

Each year, SCVC will prepare and submit to CEQ and the Legislature a report on its pesticide use in the previous calendar year. The report will document actions taken to minimize the use of pesticides. It will summarize any notable scientific findings regarding the pesticides used by the program. The report will also identify any research or product development that may lead to selections of alternatives to the compounds selected by SCVC over that time period. The report will also review the thresholds used for Vector Control application consideration, and determine if those thresholds were appropriate to achieve the goals of protecting public health and the environment.

Wetlands Management component of the Long Term Plan

The Long-Term Plan establishes a Wetlands Stewardship Committee. The Suffolk County Department of Environment and Energy (SCDEE) will chair the committee. NYSDEC permits and reviews will be required for nearly every project. No project requiring a NYSDEC permit will be allowed to proceed without explicit review and approval of SCDEE, meaning that permit applications and Wetlands Stewardship Committee considerations will not begin without SCDEE vetting of the proposed project. Any project that is usually more likely to have potential for major impacts (Best Management Practices 10-15), or any other project, using Best Management Practices 5 through 9 that the Wetlands Stewardship Committee membership determines to need review, will undergo the review and recommendations of the Wetlands Stewardship Committee of the project goals, design, and impact assessment. Any project requiring a NYSDEC permit will be noticed to CEQ. Thus, any project except for the most minor will undergo extensive scrutiny and analysis prior to any alteration of the marsh.

If the DEE adopts any of the BMPs 2-4 as part of [their] its stewardship strategy, then "Maintenance as define in BMPs 2-4 needs further clarification [classification].

a) No material alteration of marsh hydrology, tidal circulation characteristics, vegetation or animal populations shall occur as part of any maintenance activity.

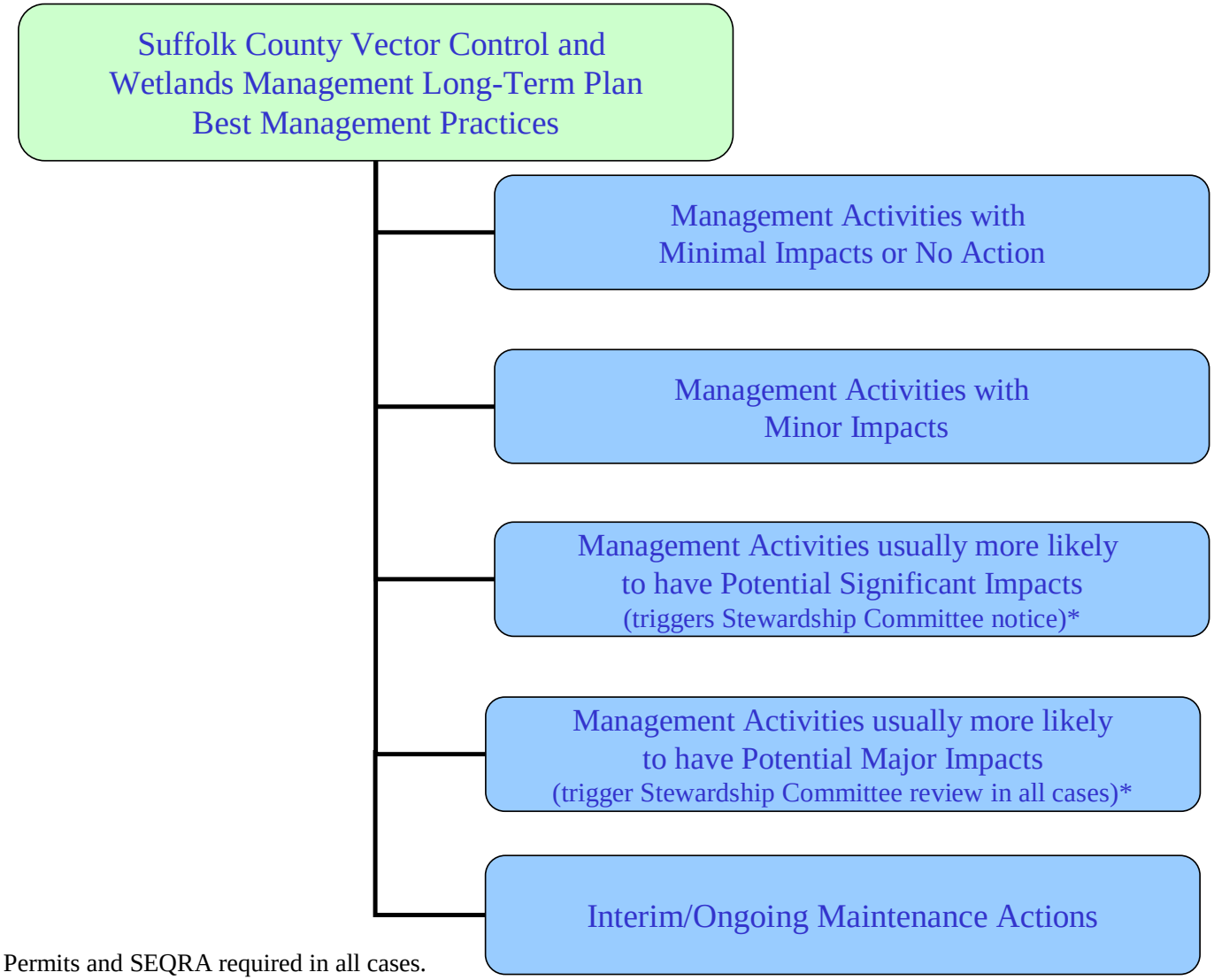
b) Maintenance should involve only existing water features in a marsh and cannot be used to expand any feature in length, width or depth.

c) Suffolk County can remove blockages/obstructions in a ditch or impairments to tidal flow in accordance with conditions identified in the FGEIS.

d) Maintenance cannot expand a ditch network.

e) Maintenance shall avoid enhancement of storm water conveyance.

Figure 1. Overall Hierarchy of Proposed Best Management Practices



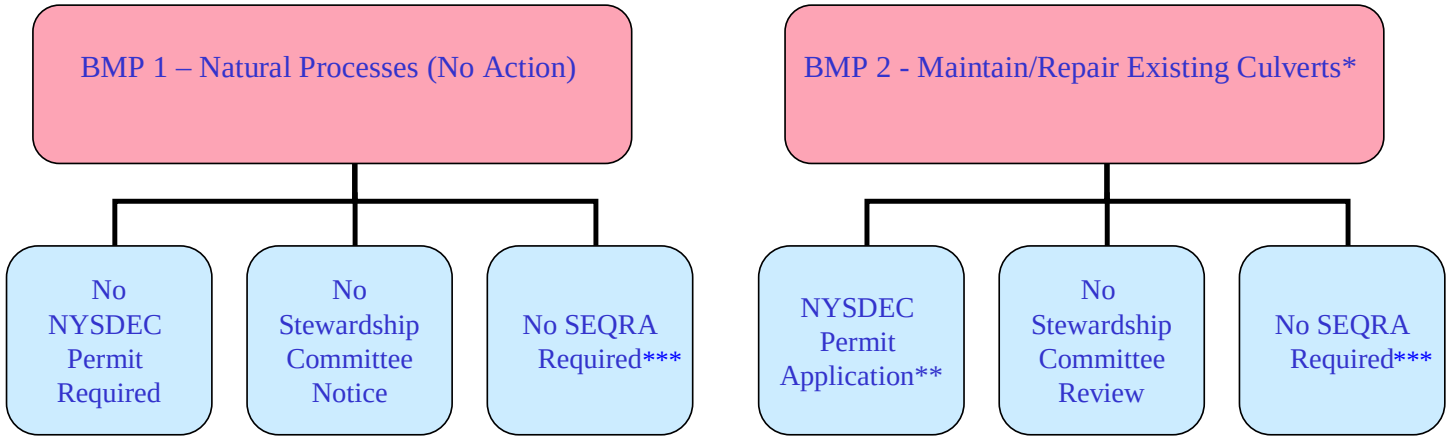
* DEC Permits and SEQRA required in all cases.

Figure 2. Review Process for Management Activities with No or Minimal Impacts

S.C. Vector Control and Wetlands Management Long-Term Plan

Review Process for Wetlands Activity

NO ACTION & MINIMAL IMPACT



* Replacement in-kind with substantially identical culvert.

** Notice will also be sent to Town and Trustee jurisdictions.

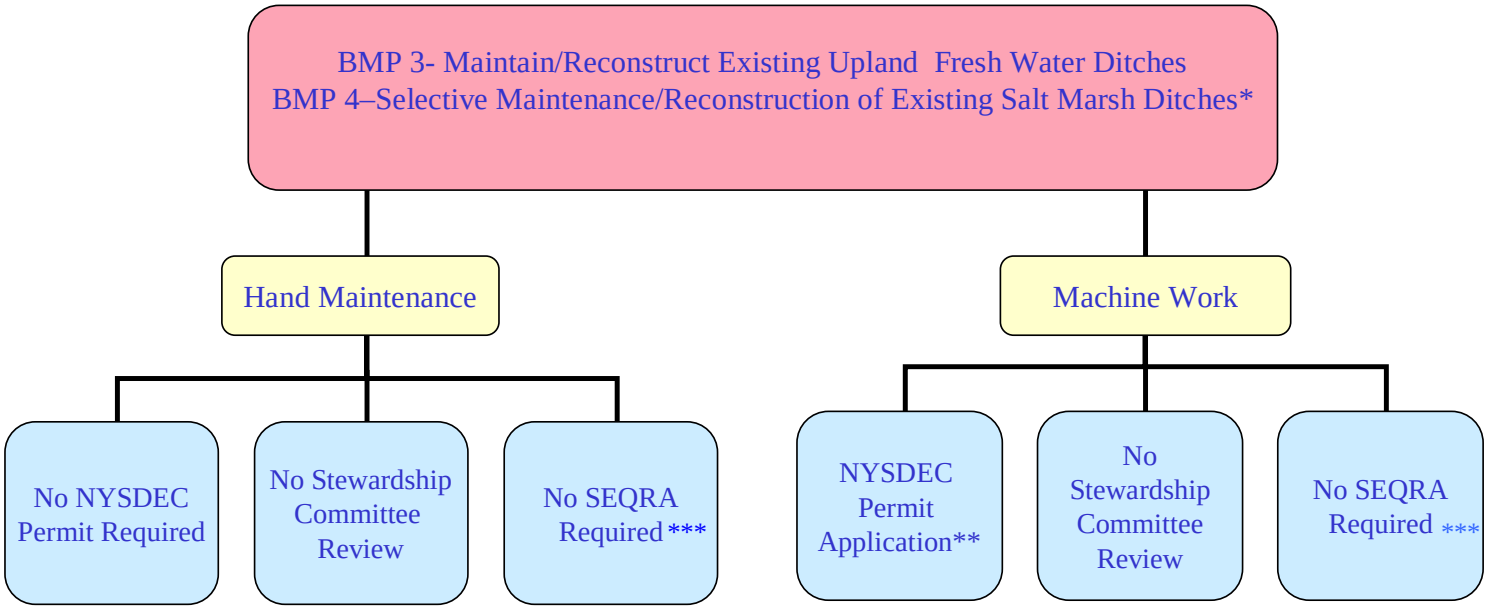
*** BMP 1-4 may require SEQRA review if deemed appropriate by DEE/CEQ.

Figure 3. Review Process for Management Activities with Minor Impacts

S.C. Vector Control and Wetlands Management Long-Term Plan

Review Process for Wetlands Activity

MANAGEMENT ACTIVITIES WITH MINOR IMPACTS



* Minimal machine maintenance when required for critical public health or ecological purpose (50,000 feet/year, 50 acres maximum, 1 acre minimum).

** Notice will also be sent to Town and Trustee jurisdictions.

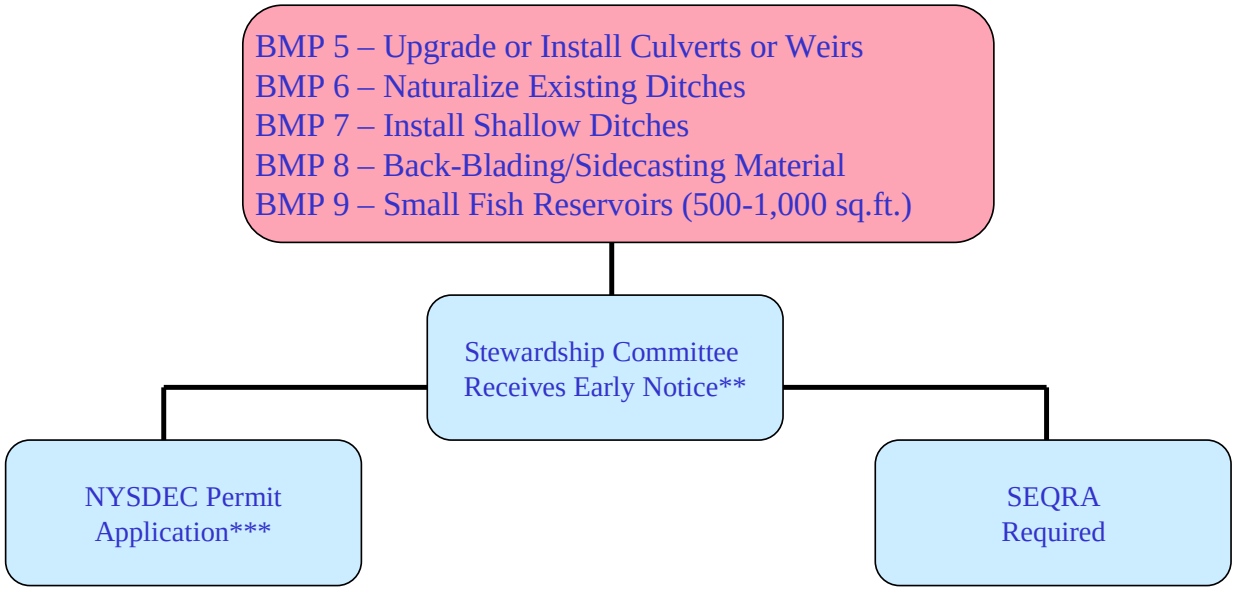
*** BMP 1-4 may require SEQRA review if deemed appropriate by DEE/CEQ.

Figure 4. Review Process for Management Activities with the Potential for Significant Impacts

S.C. Vector Control and Wetlands Management Long-Term Plan

Review Process for Wetlands Activity

MANAGEMENT ACTIVITIES USUALLY MORE LIKELY TO HAVE POTENTIAL SIGNIFICANT IMPACTS*



* In former plan drafts, BMP's 5-9 were designated "minor impacts" unless they affect 15 or more acres. In the current plan all are deemed usually more likely to have "potential significant impacts," irrespective of size. Impacts may be beneficial not necessarily adverse.

** Stewardship Committee can submit comments to project sponsor and/or SEQRA lead agency prior to project approval. Stewardship Committee meetings can also occur, as needed.

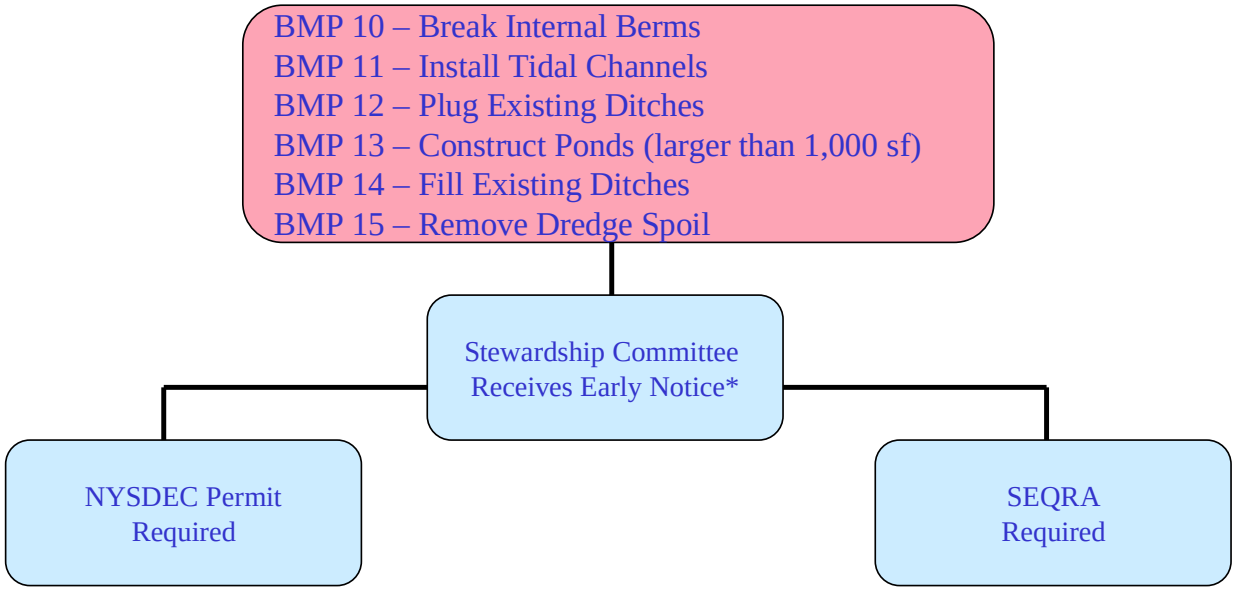
*** Notice will also be sent to Town and Trustee jurisdictions.

Figure 5. Review Process for Management Activities with the Potential for Major Impacts

S.C. Vector Control and Wetlands Management Long-Term Plan

Review Process for Wetlands Activity

MANAGEMENT ACTIVITIES USUALLY MORE LIKELY TO HAVE POTENTIAL MAJOR IMPACTS*



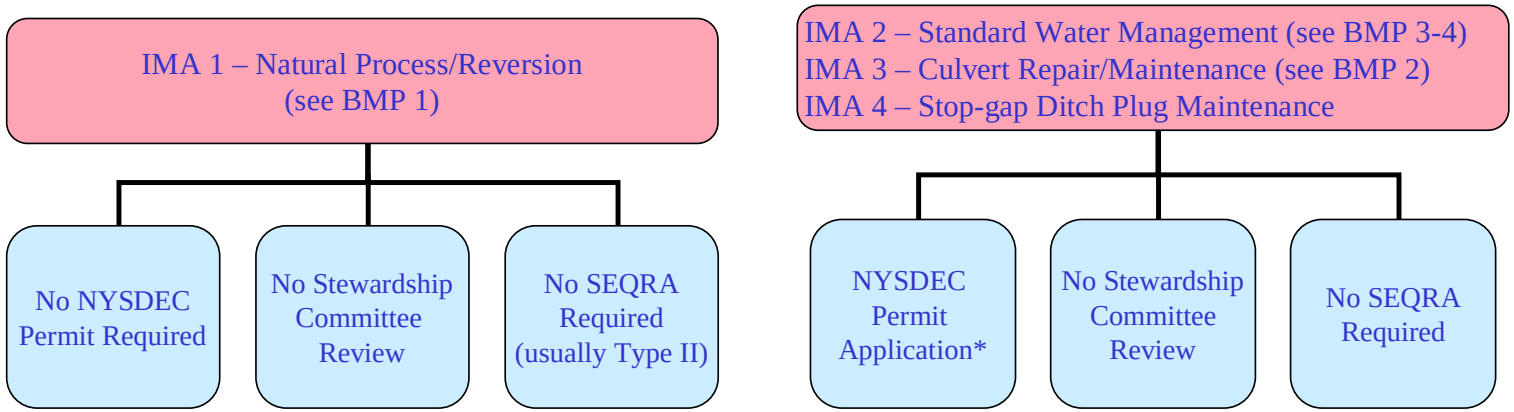
* Includes representation from local jurisdictions.

Figure 6. Review Process for Interim Management/Ongoing Maintenance Activities

S.C. Vector Control and Wetlands Management Long-Term Plan

Review Process for Wetlands Activity

INTERIM MANAGEMENT/ONGOING MAINTENANCE ACTIVITIES (IMA)



* Notice will also be sent to Town and Trustee jurisdictions.

In addition, over the first three years of the Long-Term Plan, the Stewardship Committee is charged with developing more rigorous indicators for marsh health for Suffolk County, and using them to assess marsh health and develop a strategy to manage all of the counties 17,000 acres of salt marsh (not just the 4,000 acres of vector control concern). SCDEE will oversee the development of this strategy. Marsh health (functions and values) and the preservation of marshes are to be paramount considerations in evaluating any potential project.

The Wetlands Stewardship Committee is envisioned in the Long-Term Plan to have the following composition:

Estuary programs:
- Long Island Sound Study (LISS) representative
- Peconic Estuary Program (PEP) representative
- South Shore Estuary Reserve (SSER) representative

State
- New York State Department of Environmental Conservation (NYSDEC) Region I
- NYSDEC Bureau of Marine Resources
- New York State Department of State (NYSDOS)

County
- County Legislature
- County Executive
- Suffolk County Department of Health Services (SCDHS)
- Suffolk County Department of Public Works (SCDPW)
- Suffolk County Department of Environment and Energy (SCDEE) (chair)
- Suffolk County Department of Planning
- Suffolk County Department of Parks
- Council on Environmental Quality (CEQ)

Local
- Town representative (based on project location)
- Trustee's representative (based on project location)

Non-governmental Organizations
- Two appointed by County Legislature
- Two appointed by County Executive

Any agency or entity that initiates a project that is before the committee, cannot vote on that project.

Appendix 2 more completely describes the functions of the Wetlands Stewardship Committee.

The Long-Term Plan identified priority sites for consideration of wetlands management (approximately 4,000 acres of salt marshes), and also identified other sites where no marsh

management for vector control purposes appeared to be appropriate (also approximately 4,000 acres). The Long-Term Plan, in the context of the Integrated Marsh management program developed by the Wetlands Stewardship Committee under the direction of SCDEE, proposes to assess the priority sites and the remaining 9,000 acres of other coastal marshes over the next 12 years or so to determine whether marsh management (possibly with a vector control element) is appropriate.

Other important Long-Term Plan elements

SCVC and the Arthropod Borne Disease Lab (ABDL) have redefined areas of operation under the Long-Term Plan, with SCVC focusing on population dynamics and control, and the ABDL concentrating on disease surveillance and determination of the need for adulticide treatment to reduce health risks. Each division has been slightly reorganized, and the County has committed to providing the personnel necessary for the organizations to meet their duties under the Long-Term Plan. The Long-Term Plan also emphasizes the need for continuing professional education to maintain the current top-notch standing of these organizations and to support continuing review and reporting on program elements.

The Long-Term Plan is not envisioned to be a static document. Means for continuing adaptive management are outlined in the Plan, including, obviously, incorporation of the findings of the Wetlands Stewardship Committee into the Wetlands Management element of the Plan. In addition, to meet the need for continuing evolution of the Long-Term Plan, and also to meet important public outreach goals, the production of a Triennial Report has been proposed. Its outline is attached as Appendix 1 to this Findings Statement.

E. Reasonable Alternatives Considered

In accord with the requirements of SEQRA, the environmental review of the Long-Term Plan considered reasonable alternatives to the Long-Term Plan.

- No Action (continue the existing program)

  SEQRA requires that a "no action" alternative be considered. If no changes were made to the existing situation, then the existing mosquito management program would be continued.

  The existing program is an Integrated Pest Management program, but the Long-Term Plan has identified ways that it could be improved. The ways that the existing program would be improved include:

  - An expanded and improved education program
  - An expanded surveillance program
  - Potential construction of a local BioSafety Level 3 laboratory
  - Improved GIS capabilities for data management
  - Improved source reduction, including an emphasis on tire management and storm water facility maintenance
  - Implementation of a more ecologically sound and yet more effective water management program
  - Selection of a better biocontrol agent than *Gambusia* fish
  - Proposed implementation of numerical triggers for larviciding
  - Establishing goals for larvicide reductions through more effective water management
  - Purchase and installation of the Adapco system for aerial adulticide applications
  - Establishing clear and precise numerical triggers for Vector Control treatments
  - Creating pesticide efficacy programs
  - Establishing resistance testing

- Establishing clear distinctions for the complementary roles of SCVC and the ABDL
- Creating mechanisms by which the Long-Term Plan can be modified as needs dictate

Thus, the No Action alternative is clearly inferior to the Long-Term Plan.

- No Mosquito Control

A considered alternative was one where no mosquito control was to be conducted. This alternative was found to be insufficiently protective of human health. A model of WNV prevalence in the theoretical absence of mosquito control found that tens of deaths might occur each year, with more than one hundred additional cases requiring hospitalization. In addition, because careful implementation of progressive water management can augment important salt marsh functionalities, potential ecological benefits would be lost. Human health and environmental impacts from pesticide use (see Section F below), which would be avoided under this alternative, were not found to be of the same magnitude as the potential human health impacts from disease. The potential for ecological impacts from water management are mitigated by processes established for programmatic and project level reviews (see Section D above and Section F below).

- Alternative IPM approaches

Various permutations of the overall Long-Term Plan approach were considered. They included:

- No water management at all

  This is to adopt a marsh reversion policy for all marshes throughout the County. The environmental analysis suggested that, for certain marshes, allowing ditches to infill could increase mosquito breeding. In addition, for certain marshes, allowing the ditches to infill would reduce tidal circulation, and therefore lead to reduced functioning as a salt marsh. Therefore, having no water management at all would lead to potentially greater human health impacts because of increased mosquito breeding, and decreases in important ecological functions.

- Selective ditch maintenance

Experiences in other jurisdictions suggests that there are water management alternatives that potentially are more effective as mosquito control means, have potentially fewer environmental impacts, and should augment certain marsh functionalities such as fish production and water bird use of the marsh. This suggests that ditch maintenance is an inferior means of conducting water management.

- Ditch maintenance of all ditches

This alternative is based on the notion that structures should be maintained as they were constructed to be. However, it is clear that not all ditches are needed for mosquito control purpose. It is also likely that some ditches have had negative environmental impacts on certain marshes. Therefore, a universal policy of ditch maintenance is also an inferior means of mosquito control and of marsh management.

- Alternative larvicide compounds

Three alternatives were considered: ethoxylated fatty alcohols, Temphos, and Golden Bear Oil. Temphos clearly has the potential for greater ecological impacts to non-target aquatic invertebrates compared to Bti, Bs, and methoprene. The other two compounds are not as well studied. However, they appear to have the potential for non-target organism impacts, and do not appear to meet operational needs for SCVC. Therefore, these three compounds were evaluated to be inferior choices.

- No larvicide use in fresh water settings, with no methoprene use in salt water settings

Based on efficacy data, it is clear that mosquito breeding would be increased under this choice. The County has found that increased mosquito populations increase risks of disease transmission. Therefore, selecting this alternative would increase the risk of human disease. The analysis was not able to quantify the increase in risks, however. Selection of this alternative is based on the environmental benefits of reduced larvicide use outweighing the increase in human health risks. Although no use of pesticides is risk free, the quantitative risk analysis found that the proposed Long-Term Plan use of Bti, Bs, and methoprene should result in no changes to ecological conditions, as the modeling

suggested the exposure of organisms to these pesticides would be below thresholds where impacts were found to occur. Therefore, it is likely that no discernable environmental benefits would ensue, and so the risk increase to human health is likely to be much greater than (and incommensurate with) any potential ecological benefits. In fact, significantly increased adulticide usage could occur as a result. This makes this alternative inferior to the Long-Term Plan.

- Alternative adulticide compounds

Four alternatives were considered: naled, fenthion, chloripyrifos, and deltamethrin. Qualitative risk assessments were conducted of these compounds. Naled, fenthion, and chloripyrifos are organophosphate pesticides. US Environmental Protection Agency studies suggest they are likely to have more non-target impacts than the pyrethroids selected for the Long-Term Plan. They thus represent inferior choices to resmethrin and sumithrin (the preferred Long-Term Plan adulticides). Deltamethrin is also a synthetic pyrethroid. The qualitative analysis of deltamethrin suggested it should have ecological and human health impacts that are similar to the selected pyrethroids. Because no information surveyed suggested it would have lower impacts than the selected pyrethroids, it was not selected as an alternative that should be preferred over the Long-Term Plan choices.

- Use of Mosquito Magnets in Davis Park

Mosquito Magnets and other mosquito traps have been found to be effective in some testing. However, local tests conducted under the Long-Term Plan did not find that they deterred mosquitoes from reaching a target area. Therefore, establishing an array of such traps across the barrier beach to reduce infiltration of mosquitoes to the community was thought to be technically flawed.

- Adulticide only for Health Emergencies

Four study areas were considered for the quantitative risk assessment. Two areas (Dix Hills, with one application, and Manorville, with two applications) were evaluated under Health Emergency scenarios. Mastic-Shirley (10 applications) was evaluated for a mix of Health Emergency and Vector Control applications, and Davis Park (14 applications)

was evaluated for Vector Control applications only. Increasing the number of applications did not increase risks above impact thresholds for most of the scenarios and compounds evaluated. Potential impacts to terrestrial insects were found under all scenarios and for all pesticides (see Section F below). Potential impacts to aquatic invertebrates were found for the higher use scenarios for permethrin and malathion, but not for resmethrin and sumithrin. More sophisticated ecological modeling suggested that any permethrin impacts would be of short duration, and would not affect ecological conditions in the following season (these results were thought to be valid for malathion, as well). The only potential risk found to be greater than threshold limits for human health was found for the highest potential release of malathion in Davis Park, and this risk increase could be mitigated by washing the exposed vegetables (a "community gardener" scenario was modeled for all risk assessment areas, even though it was understood that conditions on Fire Island do not allow for extensive vegetable gardens). Thus, only under the highest use scenario with the highest potential exposure concentration was there even a suggestion that Vector Control applications might lead to greater impacts than Health Emergency applications. Thus, the risk assessment generally found the potential for increased risks associated with Health Emergencies and Vector Control applications to be similar (and negligible). Therefore, there would be only slight risk benefits to be achieved by eliminating Vector Control applications. The analysis by the County, however, finds that increased numbers of mosquitoes tends to increase risks of disease transmission. Therefore, there is a risk benefit for human health from decreased disease risks when Vector Control applications are made. Therefore, eliminating Vector Control applications would not only decrease quality of life, but it would increase human health risks, and provide only negligible risk advantages. This made it an inferior alternative.

- Adulticide only after human illness

This programmatic choice is logically flawed. For one, adulticides are used to avoid human illness. In this scenario, the illness has already occurred. Secondly, it needs to be understood that there is often a week or more lag between the time of infection and diagnoses of illness. Because mosquitoes often have high mortality rates (especially for brooded mosquitoes), the mosquitoes that may have been responsible for the illness may

already be dead when the illness is determined. Therefore, it will often be the case that treatment decisions will be made for reasons other than the targeted mosquitoes having caused illness. If so, those treatment criteria could be used prior to the onset of illness. Because the mosquitoes that caused illness are not likely to still be present, it is clear that eliminating mosquitoes that caused people to become ill is not the direct cause of the proposed adulticide application. This means other criteria must be used to determine where and when the application will be made. If other criteria are used, then these self-same criteria could have been applied prior to the onset of illness, with the effect of potentially preventing impacts to human health. In nearly all mosquito control situations with a virus like WNV that has a long lag between induction of illness and diagnosis of the disease, and where brooded mosquitoes are important to the risk of transmission, past human cases are a poor criterion on which to base mosquito control decisions, and the more important criteria that measure current risks from virus presence are not affected by incidences of disease. Therefore, disease occurrence in humans is a suboptimal trigger for treatment.

- No adulticiding

Information collected in the impact assessment suggests that adulticiding is effective at killing adult mosquitoes. If virus is circulating in these mosquitoes, their deaths will decrease risks to people from mosquito-borne disease. The analyses carried out on adulticide applications suggest that no significant increases in risks to the environment or human health result from judicious use of these pesticides. Therefore, avoiding the use of adulticides does not result in significant risk reductions. On the contrary, it could result in significant risk increases for mosquito-borne disease impacts.

F. Long-Term Plan Potential Significant Impacts and Identified Mitigation

Introduction

Suffolk County, through its consultant, Cashin Associates, and the team of subconsultants assembled by Cashin Associates, has conducted a most thorough and complete evaluation of potential impacts of the proposed Long-Term Plan. As detailed above in Section C, the overall approach to this project provided for a robust feedback system whereby initial findings were commented on and criticized, leading to revised and improved programs and analyses of the proposed programs. Not only were traditional methods of environmental analysis used (such as the literature search and modeled risk analysis), but local and unique experiments, assessments, and demonstration projects were undertaken to strengthen the development of the project and its environmental impact analysis.

Several elements are key to the findings regarding the proposed Long-Term Plan. These are:

- The 27 volume literature search
- The quantitative risk assessment of potential ecological and human health impacts of the proposed Long-Term Plan pesticides, using four exemplar areas of the County with different application scenarios, conducted by Integral Consulting.
- The Caged Fish experiment of fate and transport and potential impacts to sentinel organisms for methoprene and resmethrin under operational conditions in salt marsh ditches, under the direction of Professor Anne McElroy, Stony Brook University.
- The Wertheim National Wildlife Refuge demonstration of progressive water management practices and their potential to create environmental benefits and meet mosquito control needs, with the cooperation of USFWS.
- A model of potential human health impacts from WNV in the absence of local mosquito control, based on serological data collected in New York, Ohio, and Ontario.

Hundreds of samples of air, water, sediment, and biota were taken, with samples analyzed to the low part-per-trillion level, the lowest known detection limit ever attained. Numerous other efforts from this three-year study contributed to the conclusions reached here.

The contributions of volunteers were extremely important, and shaped the results presented here. These volunteers included citizens and government and academic professionals from outside of the project, who served on the various committees and who analyzed project output and draft and provisional documents.

Impacts and Mitigation

The following specifies potentially significant impacts that may be incurred with the adoption of the Long-Term Plan by the Suffolk County Legislature, and also identifies mitigation of these potential impacts.

- Education and Outreach

The Long-Term Plan identified the potential for impacts associated with counseling the public to use DEET to avoid mosquito bites. Although it is not clear that any health impacts result from the use of DEET, the Long-Term Plan repeats the advice of the State Department of Health and urges the public to use caution when applying DEET to skin, and to ensure label directions are followed. Any potential impacts associated with DEET use are mitigated by reductions in disease risk associated with its effective deterrence of mosquito bites.

- Source Reduction

Collection of littered tires can increase waste management requirements, and the maintenance of storm water structures can also generate somewhat problematic materials. The scope of these problems, in light of waste management as a whole County-wide, is not great. The impact of problems associated with these waste streams is mitigated by the potential for improved mosquito management, especially in the reductions of risks to human health.

- Water Management

The Long-Term Plan identifies 15 Best Management Practices and four Interim Management/Ongoing Maintenance Activities (Tables 1 through 5) that could be conducted in coastal marshes to further mosquito control purposes. The following five tables summarize the possible impacts associated with each, and also identify mitigation for each potential impact (identified in the Tables as “Potential Benefits”).

Table 1. Management Activities with No or Minimal Impacts

BMP	**Action**	**Factors to Consider**	**Potential Benefits**	**Possible 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

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

NPN = Uses Not Requiring a Permit
GCp = Generally Compatible Use- Permit Required

Table 2. Management Activities with Minor Impacts

BMP	**Action**	**Factors to Consider**	**Potential Benefits**	**Possible Impacts**	**Equipment to be used**	**General Compatibility With Tidal Wetlands 6 NYCRR Part 661**
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? - Perpetuate existing degraded conditions - Excess drainage	- Hand tools (minor maintenance) - Heavy equipment for reconstruction (rare)	NPN, GCp (6 NYCRR Part 663)
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 (lack of habitat diversity)	- Hand tools (minor maintenance) - Heavy equipment for reconstruction	NPN, GCp

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

NPN = Uses Not Requiring a Permit
GCp = Generally Compatible Use- Permit Required

Table 3. Management Activities Usually More Likely to Have Potential Significant Impacts

BMP	Action	Factors to Consider	Potential Benefits	Possible Impacts	Equipment to be used	General Compatibility With Tidal Wetlands 6 NYCRR Part 661
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, P, PiP
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	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	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	Usually NPN or GCp; could be PiP or I
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	PiP

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

NPN = Uses Not Requiring a Permit
GCp = Generally Compatible Use- Permit Required
P = Permit Required
PiP = Presumptively Incompatible Use- Permit Required
I = Incompatible Use

Table 4. Management Activities with the Potential for Major Impacts

BMP	Action	Factors to Consider	Potential Benefits	Possible 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	PiP
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	PiP or I
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	PiP
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	PiP or I
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	PiP

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

PiP = Presumptively Incompatible Use- Permit Required

I = Incompatible Use

Table 5. Interim Management/Ongoing Maintenance Actions

Interim Action	**Action**	**Factors to Consider**	**Potential Benefits**	**Possible 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, GCp
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	GCp
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.

NPN = Uses Not Requiring a Permit
GCp = Generally Compatible Use- Permit Required

Extensive experience in other jurisdictions such as New Jersey and Connecticut, suggests that careful site selection and professional implementation of these Best Management Practices tends to minimize the potential for negative impacts and increase the potential for benefits to accrue.

In addition to these efforts to mitigate impacts, Suffolk County will take the following actions to ensure that projects do not result in unwanted and unexpected negative environmental impacts:

- All water management projects are to be conducted on the basis that marsh health and marsh preservation are the primary project concern.
- All projects using Best Management Practices 5 to 15 (listed in Tables 3 and 4) will be subject to initial review through SCDEE and also will be subject to further environmental review.
- All projects will receive NYSDEC permits, as required, and undergo State environmental reviews, as required. Any project requiring a NYSDEC permit will be noticed to CEQ.
- The Long-Term Plan calls for the creation of a Wetlands Stewardship Committee. The Committee will be chaired by SCDEE. This Committee, as discussed in Section D, (and further outlined in Appendix 2) will be responsible for developing a definition of marsh health, and to use that definition to develop a County-wide marsh management plan that will be the basis of an Integrated Marsh Management program. The Integrated Marsh Management program will address all County marsh management needs, including those associated with vector control. The Wetlands Stewardship Committee will also be required to review and make recommendations on all projects that use Best Management Practices 10 to 15, and Best Management Practices 5-9 that the membership of the Committee determines requires further review.
- For the first three years of the Long-Term Plan, the County will only conduct water management projects that have the potential for minimal environmental impacts.
- All wetlands management projects will be developed, reviewed, and assessed on site-specific basis.

- Projects that do not meet goals and objectives after implementation will be subject to remedial activities to mitigate any potential impacts.

- Biocontrols

The Long-Term Plan identified potential impacts of the introduction of fish into certain fresh water habitats as a potential impact associated with the use of biocontrols. This is because certain predator-deficient environments allow for the development of aquatic invertebrates, insects, and amphibians. Some of the insects that can flourish in these environments are mosquitoes. Thus, it can seem to be worthwhile, from a mosquito control standpoint, to introduce mosquito larvae predators to reduce emergent populations. This would likely have negative impacts on other species, however. Therefore, the County will mitigate this potentially negative impact by limiting fish releases generally to locations where they have been used before. In addition, any expansion of fish releases will only occur after the locations have been reviewed and determined not to provide these kinds of "vernal pool" or "coastal plain pond"-type environments, and that any connected waters that the fish might migrate to also do not constitute such environments. This will be done for natural waters, and also for the various artificial waterways (such as recharge basins) that sometimes appear to need treatment.

- Larval Control

Comments were received on the County's proposed use of methoprene and its potential for environmental impacts. The comments tended to focus on two areas:

1) The County ignored important scientific findings in making its analysis
2) The County did not correctly interpret a study conducted in Minnesota

There is no study that was evaluated as part of the Long-Term Plan which suggested that methoprene, as used in vector control applications in Suffolk County (as per NYSDEC-approved label requirements), has significant adverse ecological impacts. To the contrary, the Long-Term Plan's comprehensive risk assessment found that methoprene has no such impacts. Therefore, these findings do not recognize these comments and potential impacts as being substantiated. No commenters have refuted the specific technical materials in the

DGEIS or the FGEIS. Some commentators have recommended that, as a matter of policy, methoprene should be eliminated from the County's vector control program, without scientific documentation of adverse impacts. The commentators have made the recommendation based on speculation that, in the future, scientists may document adverse methoprene impacts in our salt marsh. This basis of speculation is clearly contrary to SEQRA.

Michael Horst has published research regarding impacts of methoprene on various crustaceans since 1999. He has found serious impacts, especially to larval stages of crabs and lobsters. The following summarizes the findings of this environmental assessment with regard to Dr. Horst's research:

- Methoprene is applied in wetland areas, not where larval crabs and lobsters used by Dr. Horst are found. Blue claw crabs hatch offshore and only arrive in estuaries when they are close to being fully developed. It is unlikely any are present in salt marshes in larval forms. Lobsters hatch offshore, develop offshore, and live offshore. A modeling exercise, made to estimate the maximum amount of pesticides that could have been in Long Island Sound when the 1999 lobster die-off occurred, found the maximum amount of methoprene that could be present in the near offshore waters of the sound was measured in the parts per quadrillion, and the lowest concentration linked to effects are in the parts per billion.
- Dr. Horst tends to overestimate the concentration of methoprene that could be present in salt marsh ponds, ditches, and streams, and in estuarine waters, according to all other researchers in the field. He also finds effects that, sometimes, others cannot duplicate.
- Dr. Horst has identified effects from methoprene that other researchers have not found, and have not looked for. This is because he is concerned about impacts from methoprene effects on endocrine systems of organisms. It is possible that pesticides (and other chemicals) that affect endocrine systems are not being correctly evaluated. However, the work in this field is preliminary, and cannot and should not be used to draw conclusions regarding any environmental impacts, based on only a few, limited laboratory studies.

To more specifically illustrate problems with the methoprene research cited by commentators, Dr. Horst's 1999 research with crab larvae used concentrations up to 500 times higher that those levels present in real-world vector control applications. Dr. Horst's more recent work in 2005 with lobster larvae suggested that there was increased mortality in Stage II lobster larvae in experiments conducted utilizing concentrations of 1 to 2 ppb methoprene continuously during a 72 hour exposure. These results were not confirmed in concurrent Stony Brook University analyses.

In any case, one ppb methoprene exposures maintained continuously for 72 hours is an extremely unrealistic exposure. The Caged Fish Study, conducted as part of the Long-Term Plan, with independent verification by USGS, clearly demonstrated that the concentrations required to cause impacts found by the Horst laboratory do not persist in the water column. Nominal concentrations of methoprene rapidly decrease to near or below detection limits of 5 ng/L (0.005 ppb); most of this reduction occurs within two hours of application. In addition, the quantitative risk assessment found, with comfortable margins of error, that risks of ecological impact do not increase to any significant level when methoprene is applied as is anticipated under the Long-Term Plan. Field sampling of salt marshes around Suffolk County also found no differences in the presence or absence of keystone marsh species with the use or not of methoprene in the marshes.

Some have placed great reliance of reports from researchers in Minnesota that appear to show impacts from methoprene use in fresh water marshes. The Hershey group's studies, published in 1997 and 1998, looked at six years of data collected from 1989 to 1994. The research indicated that methoprene use was correlated with relative reductions in insect populations and diversity (primarily in the chironomids), compared to control sites (but note that all populations actually increased in numbers and diversity over the study period; the treatment site populations grew more slowly than the control site populations did). However, sampling of the same marshes in 1997 and 1998 found the effect was gone, although insecticide use was continued. These reports are interpreted by many, including Suffolk County, as indicating that methoprene was not the primary cause of the change in the marsh insect populations.

In summary, the Hershey results do not document potential adverse impacts of methoprene, particularly in terms of Suffolk County's vector control setting. Scientifically, the Minnesota results are equivocal. The results relied on by Hershey impacts were apparently anomalous, as variations in chironomid populations occurred only in later years of the study, with no apparent causal explanation. Confounding factors such as meteorological variations may have been the root of observed impacts on chironomids. Significantly, Hershey's results were not reproduced in subsequent studies and years (i.e., no impacts, despite continuing pesticide use). Finally, it is important to emphasize that, even though the Hershey study was rigorously evaluated, it is substantially irrelevant to the Suffolk County vector control program. Hershey's work was performed exclusively in fresh water systems, while Suffolk's use of methoprene is focused predominantly on salt marshes. As such, Hershey dealt with different use patterns and ecological settings than those present in Suffolk County.

Aerial applications of larvicides appear to have the potential to cause impacts to certain bird species. Aircraft, especially when flown low over a marsh, have been observed to startle resting and nesting birds, causing them to take flight. Research on the impacts of startling such birds at one or two week intervals, as can occur due to repeated applications of larvicide across a season, is sparse, and so the impacts to any such species is based on speculation.

This potential impact is mitigated in two ways through the Long-Term Plan. One is by identifying important populations, and then altering application techniques to avoid any startling. This is already the practice of SCVC when piping plover nesting sites may be in potential flight paths. SCVC has requested that local experts work more closely with it to identify any significant populations or environments that may be impacted by its operations; although the focus of this effort is on fresh water settings, the same experts may be useful in identifying at risk populations in salt marshes, and the times when they are most sensitive to disturbance. Secondly, it is hoped that full implementation of progressive water management across the salt marshes will lead to a reduction in aerial larviciding. This has been the experience in neighboring jurisdictions where these procedures are used regularly.

Generally, the potential for impacts from the use of larvicides will be mitigated by the proposed large-scale reduction in applications, as the need for such applications is reduced.

Another overall mitigation is the benefit to human health resulting from disease risk reductions when potential vector populations are reduced.

As mentioned above, potential impacts associated with larval controls in fresh water settings are going to be further mitigated by encouraging information exchange between experts with knowledge of at risk organisms or settings, and SCVC. As each party understands habitat needs of the organisms, and proposed treatments by SCVC, it is anticipated that alterations can be made in the means SCVC uses to control mosquitoes to minimize the potential for impacts. These alterations could be shifts in the time of day that applications are made, to avoidance of treatments for certain settings at certain times, to more studied selection of treatments and times or applications to optimize mosquito control while minimizing the opportunities for impacts to occur. SCVC has, for example, worked closely with NYSDEC to avoid treating any tiger salamander habitats at times when impacts might affect breeding, or development and emergence of young. This is true although there do not appear to be any reasons to believe larvicide applications directly affect amphibians.

The quantitative risk assessment, the scientific literature in general, and local field work all found no potential impacts from the use of the biorational larvicides selected by the County under its proposed application means. Nonetheless, the County will seek to minimize its use of pesticides in the program. This is for several reasons:

- Minimizing pesticide use complies with spirit of the County pesticide phase-out law
- Minimizing pesticide use complies with Integrated Pest Management, where other means of pest control are preferred to the use of pesticides
- Reliance on pesticides for mosquito control can lead to suboptimal control. Resistance might develop, weather or other factors may impede the delivery of the pesticide, or the application may fail to impact the targeted population as expected (for a number of reasons). Thus, the pesticide may not achieve the expected efficacy.
- The potential exists for impacts due to accidents or misapplications.
- All studies, experiments, and calculations involve some uncertainties; in the case of much of the work with mosquito control pesticides, there are certainly a number of

factors and conditions that have not been completely studied and understood. Therefore, there is still a potential for impacts from the use of these products.

Therefore, the County will continue to seek to reduce its use of these compounds wherever and whenever it is feasible to do so.

- Adult Control

In the course of modeling helicopter releases of adulticides, RTP Environmental discovered there was drift of the pesticides from the release point so that at least some of the material was deposited outside of the target zone. To mitigate this potential impact, the County purchased an Adapco Wingman system. This is a coupled weather station-modeling-aircraft guidance system, where real-time meteorological data are used to model potential draft patterns of released ultra-low volume pesticides, and flight patterns are instantaneously generated to optimize the delivery of the pesticides to the target zone. This modeling system was installed on the contract helicopter used by the County in late 2005.

The quantitative risk assessment found at the point in the model grid where pesticides concentrations were greatest in Davis Park, that some elevated risks for human health for a receptor called the "community gardener" are possible (the community gardener receptor was studied in all settings, although it is not feasible for someone on Fire island to have a large, extensive vegetable garden). A community gardener is someone who eats all of their vegetables and fruit in summer from home-grown produce (15 percent of all annual produce ingestion) and works in the garden. Such an individual receives a higher dose of pesticides from residues ingested on the vegetable and from dermal contact with contaminated plants. The exposure modeled is a chronic, non-cancerous toxicity associated with malathion only. The risk can be mitigated by washing produce. It is also mitigated because malathion is not a preferred pesticide for the Long-Term Plan, and exposures associated with the pyrethroids (including resmethrin and sumithrin) do not exceed concentrations of concern. Public education efforts will help to mitigate risks associated with home-grown produce ingestion.

The quantitative risk assessment determined that there could be impacts to night-flying insects based on air dispersion model output concentrations compared to significant concentrations that could cause effects on bees (see Table 6 and Table 7).

Table 6. Bee Risk Quotients, Study Area Maximum Average Pesticide Concentrations

Pesticide	Davis Park	Dix Hills	Manorville	Mastic-Shirley (aerial)	Mastic-Shirley (truck)
Permethrin	200	8	9	20	90
Resmethrin	90	4	4	8	40
Sumithrin	100	5	6	10	60
Malathion	200	30	20	50	100

(PBO effects included)

Table 7. Bee Risk Quotients, Study Area Mean Pesticide Concentrations

Pesticide	Davis Park	Dix Hills	Manorville	Mastic-Shirley (aerial)	Mastic-Shirley (truck)
Permethrin	7	3	2	7	2
Resmethrin	3	1	1	3	1
Sumithrin	4	2	1	4	1
Malathion	20	20	9	30	8

(PBO effects included)

A number of key factors may act to mitigate and in some cases entirely remove the potential for risks to honeybees and other non-target insects:

- Actual risks would be most likely to occur when insect activity coincides with the application timing, with risks being largely mitigated for daytime insects if spraying were to occur at night.
- Additional habitat preferences, activity patterns, and behavior could result in lower risks for certain non-target insects than those predicted in this evaluation. For example, many insects are active on the ground and may be below vegetation, which may intercept applied adulticides. Many insects, such as crickets, beetles, ants, and millipedes, spend a portion of their life cycle underground. If this period does not temporally coincide with the spray season, the potential for exposure could be significantly mitigated. Some flying insects, such as certain moths and dragonflies, rest at nighttime underneath plants or other structures, and therefore would be less likely to be exposed during nighttime applications. Certain insects may actively avoid sprayed areas, and it has been shown that permethrin has a strong repellant effect on honeybees, for example.
- Verification of the air modeling data showed that under "normal" atmospheric conditions, there was typically a three to one difference between predicted PBO values and measured PBO values; with unusual atmospheric conditions, the agreement was less good (an average of 14:1). The model overpredicts the pesticide concentrations. Conservatively, it seems reasonable to assert a slight overprediction

of three to five times on the basis of the air modeling, which suggests that under most atmospheric conditions resmethrin has little potential for impact to bees, using the study area mean concentrations as a basis for understanding impacts. The same would follow for sumithrin; similar conclusions follow for at least two of the permethrin results.

- Exposures and risks are predicted based upon instantaneous conditions, precluding the incorporation of degradation of adulticides. However, adulticides are generally not persistent in terrestrial environments. Because of the difficulty in measuring resmethrin concentrations in the field, it was conservatively assumed that the resmethrin to PBO ratio would remain constant. However, deposition samples collected on solid media and aqueous samples collected within 30 minutes of the pesticide applications all found that the resmethrin had significantly decreased in concentration relative to PBO. This strongly suggests that the degradation of resmethrin may reduce the predicted concentrations enough so that the concentration of concern for bees is not achieved under most conditions.

The combination of degradation of resmethrin and overprediction by the air modeling makes it conceivable that the predicted concentrations are at least an order of magnitude greater than may actually occur. This suggests there is not likely to be a potential impact for resmethrin to flying insects under the more conservative assumptions in Table 6 for any of the aerial application scenarios. Because sumithrin has been found to behave similarly to resmethrin in laboratory experiments, it may be that it, too, degrades very quickly relative to PBO. If that were the case, then aerial applications of sumithrin would likewise be of much less concern, even under the more conservative modeling scenario.

In very broad terms, the toxicity of an insecticide dose is proportional to the size of the affected insect. The pesticides used under the Long-Term Plan are intended to be toxic to mosquitoes. Therefore, insects of similar or smaller sizes are likely to be affected if they are also exposed to the pesticide. Table 8 lists the orders of flying insects found in the New York metropolitan area that are of similar or smaller size compared to mosquitoes.

Table 8. Orders of flying insects that contain many/certain insects that are generally similar in size or are smaller than mosquitoes (0.15 inches)

Order	Notes	Order Exemplars
Diptera	Some classify this order as larger than mosquitoes (mosquitoes belong to Diptera)	True flies – black flies, midges, fruit flies, houseflies, mosquitoes
Ephemeroptera	Often attracted to lights; short-lived; Paleoptera; some classify this order as larger than mosquitoes	Mayflies
Homoptera	Important herbivores	Aphids, scale insects, leaf hoppers, cicadas
Mecoptera	Seldom common; insect predators	Scorpion flies
Proscoptera	Many wingless; effective dispersers (often first colonizers of islands)	Bark lice
Strepsiptera	Only males fly; insect parasites	
Thysanoptera	Often destructive to plants	Thrips
Zoraptera	Termite-like; rare; winged individuals may be dispersal form	

There has only been one test of pyrethroid application impacts on flying insects; in that experiment, both the control and test sites experienced declines in populations, and both recovered within a week. Another test using a different class of adulticide also found recovery of the insect population within a week. This suggests that any effects on non-target organisms are likely to be short-lived; since the mechanism for recovery is likely to be in-migration, one caveat, thus, is that the treatment area sizes should be minimized.

Acute and chronic impacts to aquatic invertebrates were predicted for malathion under many evaluated scenarios, and for permethrin in one case through the quantitative risk assessment. No elevations in risk that are likely to cause impacts were predicted for the use of resmethrin or sumithrin. A sophisticated aquatic ecosystem model developed by the US Environmental Protection Agency was used to test whether permethrin use might result in ecological impacts (permethrin, rather than malathion, was tested because pyrethroids were identified as the preferred adulticide, and so testing a pyrethroid for impacts was deemed to be of greater value in predicting any ecological impacts from implementing the Long-Term Plan). The model found short-term declines in populations for a variety of organisms following modeled exposure to permethrin. However, all but one population recovered within several months of the cessation of applications, and the slower recovery of the remaining population did not lead to any ecological changes in the modeled system.

Mitigation of these potential impacts includes:

- Measurement of effects may be based on overpredictions of deposited concentrations (see just above)
- Pyrethroids, as represented by resmethrin, appear to degrade very rapidly (testing of pesticides in association with the Caged Fish experiment was only able to detect resmethrin in the water column immediately following applications)
- Historically, applications have only been made to small portions of the County. In 2003, which had more adulticide use of any year since 1999, only six percent of the County received an adulticide application. This means that any potential impacts are extremely limited in terms of geographical extent.

More generally, the County will also seek to mitigate potential impacts to those areas that commonly receive one (or more) Vector Control adulticide application in a season. Targeted outreach will stress the importance of avoiding exposure to mosquitoes, and in taking mitigating steps if exposure cannot be avoided. The Commissioner of SCDHS will also craft an advisory detailing the means that SCDHS recommends (or suggests) to minimize risks for potential impacts from exposure to adulticides. Washing of home-grown vegetables in areas where adulticides may be used more often will be an important outreach topic.

The small area of the County impacted by adulticides in any one year is a general mitigation of impacts. In addition, the strict compliance of SCVC with defined, numerical application triggers may reduce the number of applications, and will mitigate any public perceptions that applications are made on the basis of ambiguous criteria. Finally, implementation of progressive water management steps should provide more effective larval control than has been achieved using larvicides and ditch maintenance, which may decrease the need for adulticide applications.

The use of adulticides also provides ancillary benefits. Adulticide applications reduce risks for mosquito-borne disease and also reduce impacts to quality of life. This is because efficacy data clearly shows adulticides are effective means of reducing mosquito populations, although these populations may recover within several weeks in conditions allow. The collection of efficacy data in association with adulticide applications will allow the County to

clearly justify this element of the program. If the efficacy data do not support claims of population reductions, then the County will need to reexamine its use of this control tool.

The County will mitigate the overall impacts of its use of pesticides through an annual review. Elements of this review will include documenting the use of pesticides in the previous year, analysis of any relevant scientific findings on the products in use, and considered evaluation of alternatives in light of any new information (research or product development) since the previous year's report. The report will also discuss the application thresholds used to determine if Vector Control applications should be made, and determine if adjustments need to be made in light of human health and environmental considerations.

- Adaptive management

Suffolk County has made a public commitment to adaptively managing the Long-Term Plan. This is a clear mitigation of any impact associated with the Long-Term Plan. If the above analysis did not adequately identify a potential impact, or if some potential impact was overlooked in the environmental analysis, the ability to adjust the program to meet changed circumstances allows the Long-Term Plan to be modified. The list of issues to be addressed in the Triennial Plan, attached as an appendix to this Findings Statement, makes clear Suffolk County's determination to carefully assess the effectiveness and potential impacts of the Long-Term Plan.

G. Requirements for Further Environmental Reviews

Potential further environmental reviews for actions taken under the Long-Term Plan relate to at least two types of actions:

- adoption of the Annual Plan of Work by the County Legislature
- reviews of water management projects and BMPS 5-15

The triggers for further environmental review which are specified herein constitute the minimum conditions under which additional environmental review would be initiated. At any time, the County and/or the Council on Environmental Quality could commence additional environmental review based on substantial new technical information.

The adoption of these Findings by the Legislature (as Lead Agency) means the Legislature is satisfied that the potential impacts of the Long-Term Plan have been adequately reviewed. From this perspective, if an Annual Plan of Work complies substantively with the Long-Term Plan, then potential impacts of that annual plan will have been adequately considered, as well, and the Annual Plan of work would be deemed a Type II Action pursuant to SEQRA.

The primary criterion for determining if an Annual Plan of Work is not substantively in accord with the Long-Term Plan should be the annual plan's compliance with the overall approach of the Long-Term Plan, and, where specified, a failure to use particular actions, or a major deviation from an important specific set of actions. In general, annual plans need to focus on the use of surveillance to determine where mosquito problems exist, and to primarily employ source reduction tools to reduce the impact of mosquitoes on people. An important source reduction tool must be implementation (over time) of the techniques for water management developed in the Best Management Practices manual, as outlined in the Wetlands Management Plan. Any plan that proposes to manage mosquitoes without surveillance or to not use water management as a means of obtaining long-term control of mosquito problems will require additional environmental review.

Other criteria that would lead to additional environmental review of an annual plan would be:

- failure to include public education and outreach steps to educate residents and visitors on the means that are available to avoid mosquito bites and diseases associated with mosquitoes
- Inadequate mosquito population or disease surveillance
- failure to commit to respond to all mosquito complaints using personnel appropriately trained to identify and mitigate sources of mosquito problems
- failure to use the review processes outlined in the Wetlands Management Plan for water management projects
- proposed use of a non-native biocontrol organism not already resident in Suffolk County natural environments
- proposed use of a larvicide other than *Bacillus thuringenesis var israelensis* (Bti), *Bacillus sphaericus*, or methoprene

- proposed use of an adulticide other than resmethrin, sumithrin, permethrin, natural pyrethrins, or malathion
- identification of a preferred adulticide agent other than resmethrin or sumithrin

Environmental reviews may consist of a negative declaration if no significant environmental impacts will result (6 NYCRR §617.10(d) (3)) or a supplemental environmental impact statement if one or more significant adverse environmental impacts was not adequately addressed (6 NYCRR §617.10(d) (4)). Use of an expanded EAF may be appropriate when a negative declaration is proposed.

The adoption of these Findings by the Legislature (as Lead Agency) means the Legislature is satisfied that the potential impacts of the Long-Term Plan have been adequately reviewed. From this perspective, the classification of allowable water management actions (as described in the Best Management Practices manual) as "no to little" potential impacts, "minor" potential impacts, "usually more likely to have potentially significant" impacts, and "usually more likely to have major" potential impacts will have been accepted, and the descriptions of the potential for impacts (and the mitigation steps to avoid impacts) will have been deemed to be adequate.

Nonetheless, on a project by project basis, the following criteria need to be considered to determine if additional environmental reviews are warranted:

- the techniques to be employed have been classified as having the potential for potentially significant or major environmental impacts (BMPs 5-15)
- consultation with local authorities or review by the Wetlands Stewardship Committee finds there is a potential for environmental impacts under the proposed course of action
- review by the CEQ finds there is a potential for environmental impacts under the proposed course of action

Environmental reviews may consist of a negative declaration if no significant adverse environmental impacts will result (6 NYCRR §617.10(d) (3)) or a supplemental environmental impact statement if one or more significant environmental adverse impacts was not adequately addressed (6 NYCRR §617.10(d) (4)). In light of the extensive reviews of the techniques to be employed for water management in the GEIS and associated documents, use of an expanded

EAF to cite relevant sections of the GEIS or to report on local data collection efforts that justify the project may be appropriate if a negative declaration is proposed.

The triggers for further environmental review which are specified above constitute the minimum conditions under which additional environmental review would be initiated. At any time, the County could commence additional environmental review based on substantial new technical information.

Appendix 1 to the Statement of Findings: Contents of the Triennial Report

The following outline is intended to provide a preliminary overview of issues which will be analyzed to form the basis of the Triennial Report. The outline includes indicators (where available) which will be used to measure success. The content and format of the Triennial Report will be contingent on Steering Committee and Wetlands Stewardship Committee input which will be sought at the early stages of report preparation.

1) Executive Summary

The Executive Summary will provide an overview of the following issues, which will be addressed in detail in subsequent report sections.

- Public health (viral surveillance, human disease)
- Vector control (pesticide usage, water management, surveillance, etc.)
- Education/outreach
- Wetlands Stewardship Program – Accomplishments and Plans
- Potential Plan Updates and Amendments

2) Public Health

- Viral surveillance results
- Human health (cases and deaths from mosquito-borne diseases)

3) Vector Control Long-Term Plan Implementation

The report will integrate results from the Department of Public Works, Division of Vector Control and Department of Health Services, Division of Public Health.

A. Public Education and Outreach

Current Program:

- Recommend avoidance of the outdoors at dawn and dusk.
- Consider use of personal repellants (DEET, Bite Blocker, Picaridin, Oil of Lemon Eucalyptus).
- Maintain home environments that do not foster mosquito breeding.
- Distribute Publications such as “Fight the Bite” and “Dump the Water.”
- Maintain County Web Site
  - Post spray events
  - Link to no spray list

Long-Term Plan Recommendations:

- Establish tire management education program to eliminate mosquito breeding habitat. Encourage other county departments and municipalities responsible for routine sanitation or maintenance activities to properly dispose of tires.
- Conduct farmer irrigation outreach-targeted education through Cornell Cooperative Extension.
- Encourage private storm water system maintenance.
- Conduct tailored outreach to municipal highway departments regarding storm water structures as mosquito habitat.

- Emphasize personal responsibility for reducing impacts from mosquitoes (avoiding mosquitoes whenever possible, wearing long-sleeves and pants, and using repellents).
- Improved efficacy reporting. Results made available to the public via the web and annual reports.
- Post efficacy reports on the SCVC website. Reports will summarize the results of mosquito control efforts measured before, during and after aerial spray event.
- Maintain the Citizens Advisory Committee.
- Create a listserv for adulticide application notifications.
- Integrate new web site into existing county site.
- Revise public notice/guidance.
- Participation in "Mosquito Awareness Week."
- Targeting specific communities (recommended in DGEIS comment period).
- Focusing on educating school-aged children (recommended in DGEIS comment period).

Indicators of Success

- Degree to which current program and Long-Term Plan recommendations are implemented. Implementation will be quantified, where possible. E.g.:
  - Partnerships established with towns for tire management plans.
  - Public education workshops which have been conducted.
  - Brochures and fact sheets disseminated to public.
  - Number of efficacy reports posted.
  - Programs targeted at specific communities and school-aged children.

B. Scientific Surveillance

Current Program:

- Presence or absence of larvae
- Collect and process 10,000-12,000 larval and adult mosquito samples
- Collect and process approximately 75,000 mosquitoes for arbovirus surveillance
- Integration of Geographic Information System (GIS) and Global Positioning System (GPS) technology for surveillance information
- 27 permanent NJ traps; 80 CDC trap-nights per week.

Long-Term Plan Recommendations*:*

- Increase surveillance capabilities.
- Increase staff for surveillance for both SCVC and the ABDL.
- Increase permanent NJ trap network to 30.
- Increase CDC trapping to 105 trap-nights per week.
- Conduct quantitative mosquito assessment prior to EVERY adulticide event.
- Conduct post-spray efficacy monitoring.

Indicators of Success

- Degree to which current program and Long-Term Plan recommendations are implemented. E.g.:
  - Number of staff-days dedicated to surveillance.
  - Number of mosquito samples processed.
  - Number of CDC light traps deployed and NJ traps maintained.
  - Number of pre-adulticide mosquito counts.
  - Annual reports on surveillance analysis, including post-spray efficacy.

C. Source Reduction/Control

Current Program:

- Public education program (above).
- Response to citizen complaints.
- Catch basin and recharge basin control efforts.

Long-Term Plan Recommendations:

- Expand surveillance of catch basins from 10,000 to 40,000 inspections.
- Augment education component (County tire collection effort, private storm water management system outreach effort, increase interaction between SCVC and highway departments)

Indicators of Success

- Catch basins inspected.
- Records on response to complaints.
- Improve waste management and county departments tire management

D. Biocontrols

Current Program:

Mosquito fish, (Gambusia spp.)

Long-Term Plan Recommendations:

- Fathead minnows; other disease free fish native to the area.
- Predacious Copepods

Indicators of Success

- Research alternatives and explore other states initiatives
- Same or increased level of biodiversity after introduction of biocontrol
- Reduced mosquito larvae counts in sampling

E. Larval control

Current Program:

- Biorational larvicides, Bacillus thuringiensis var. israelensis (Bti), Bacillus sphaericus (Bs), and methoprene
- Surveillance of the nearly 2,000 breeding points in the County

- 15,000 inspections of breeding sites and other surveillance findings (includes catch basins and sumps)
- Approximately 4,000 acres of the County's salt marshes aerial larvicided

Long-Term Plan Recommendations:

- Increased surveillance
- Surveillance of the 2,000 breeding points in the County
- 15,000 inspections of breeding sites and other surveillance findings
- Identify problem breeding sites
- Expanded catch basin and recharge basin larviciding
- Implementation of ecological controls
- Implementation of formal resistance testing and management
- Water management - 75% percent reduction goal in acreage treated

Indicators of Success

- Number of inspections/surveillance events.
- Area larvicided (frequency and extent).
- Record and analyze dip counts in relation to reduction in treatments (results).
- Annual larvicide efficacy reports (results).
- Reduced adulticide events expected after successful larvicide control in known problem areas.

F. Adult control (only if necessary)

Current Program:

- Resmethrin, sumithrin, malathion, permethrin and natural pyrethrin
- Adulticide-directed surveillance, decision-making procedures, and efficacy and resistance testing

Long-Term Plan Recommendations:

- Criteria for spraying
  - Evidence of mosquitoes biting humans – service requests mapped
  - Verification of problem-New Jersey trap counts > 25 females /night
  - CDC light trap counts > 100; Landing rates of one to five per minute
  - Control is technically feasible Weather conditions suitable (no rain, winds<10 mph, temperature 65 ° or above)
- Improved spray technology ("Adapco Wingman") to minimize pesticide application and optimize mosquito control.
- Augment the New Jersey light trap network from 27 to 30. Expand as resources allow (see surveillance).
- Increase the number of CDC light traps from 27 to 35. Expand as resources allow (see surveillance).
- Increase CDC trap-nights to 105 per week.
- Reduce adulticide usage (currently less than 2% of County in non-emergency situations).

Indicators of Success

- Reduction in adulticide usage.
- Efficacy tests post treatment indicate 90 – 99% population reduction.
- Efficacy tests posted annually on county web page and in annual reports.
- Aerial application efficacy released within a week or so of the application.
- Post Health Emergency reductions in the parity and infection rates for the target mosquito species (if staff and lab resources available).

G. Water Management:

Current Program

- Hand maintenance/machine maintenance limited to < 200,000 linear ft/yr
- Machine work limited to repair and replacement of existing structures
- No new machine ditching
- Machine maintenance limited to 50,000 ft/year (no more than 50 affected acres), and only when essential for public health or ecological reasons.
- Natural Process (No action/ reversion)
- Culvert repair/ maintenance when tidally restricted
- Stop gap ditch plug

Long-Term Plan Recommendations

- Develop a strategy for managing Suffolk County's 17,000 acres of tidal wetlands, irrespective of Vector Control concern (goal: 12-year implementation window).
- Reversion priorities, allowing natural processes to fill ditches (approx. 4,000 acres; no vector control).
- Candidates for possible restoration/water management (currently routinely larvicided; approx. 4,000 acres). Marsh health is paramount objective.
- Areas requiring more assessment (approx. 9,000 acres); low-impact best management practices are possible.
- The pre-existing policy of "no new ditching" will be continued.
- Less than four percent of the County's tidal wetlands (~ 600 acres) subject to machine ditch maintenance over the next decade.

Indicators of Success

Implementation of Plan recommendations (above).

4) Wetlands Stewardship Program – Accomplishments and Plans

Long-Term Plan Recommendations

- Develop a comprehensive assessment and management plan for the 17,000 acres of tidal wetlands within three years
- Ensure the protection and preservation of functions, values, and health
- Use Vector Control Wetlands Management Plan as foundation (Goodbred Report; primary study area results)
- Inventory/assess wetlands County-wide

- Review and evaluate major wetland restoration projects
- Implement early action demonstration projects
- Develop Long-term strategies

Indicators of Success

- Existence/adoption of strategy
- Acres/subsystems assessed
- Acres /subsystems restored
- Integrated plans implemented

5) Recommended Plan Updates and Amendments

Plan updates and amendments will be made, as needed. Updates may be recommended by involved agencies, the Citizens Advisory Committee, Technical Advisory Committee, and/or Wetlands Stewardship Committee. Updates require review/approval of the Steering Committee.

Appendix 2 to the Statement of Findings: Structure of the Wetlands Stewardship Committee

SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT LONG-TERM PLAN

Wetlands Stewardship Committee (WSC) – Overview *

Membership (Tentative)

Estuary programs

Long Island Sound Study representative
Peconic Estuary Program representative
South Shore Estuary Reserve Program representative

State

New York State Department of Environmental Conservation Region I

New York State Department of Environmental Conservation Bureau of Marine Resources
New York State Department of State

Non-governmental Organizations (NGOs)

Two appointed by County Legislature
Two appointed by County Executive

County

County Legislature – Presiding Officer
County Executive
Suffolk County Department of Environment & Energy - will serve as Chair of Committee

Council on Environmental Quality

Suffolk County Department of Health Services

Suffolk County Department of Public Works

Suffolk County Department of Planning
Suffolk County Department of Parks

Town (only when projects proposed in a Town)

1 Supervisor and 1 Trustee rep

Nature of Committee; Support from Work Group, Agencies, and Contractor

The Stewardship Committee is comprised of policymakers, high-ranking agency officials, and NGOs from agencies and organizations with responsibility for wetlands management. The Committee will meet on a quarterly basis, or as needed to vote on wetlands management projects. The Committee will be supported by professional staff at the Suffolk County Departments of Environment, Health, and Public Works. Suffolk County Capital Program 8730 (Wetlands Planning) is also expected to support the Committee and the Wetlands Stewardship Program ("WSP," see below), via a contracted workplan. A "Wetlands Management Work Group," consisting of technical experts from agencies, NGOs, and academia, will meet more frequently, and will report to the Stewardship Committee. The work group will conduct many of the functions formerly performed by the Long-Term Plan's "Wetlands Subcommittee" (i.e., will guide monitoring, assessment, and project design).

Wetlands Stewardship Committee - Charges

- Oversee and make recommendation all major aspects of the Wetlands Stewardship Program.
- Meet to review and make recommendations on all proposed wetlands projects which propose use of Best Management Practices 10 through 15 in Long-Term Plan.

- Review and make recommendations on proposed wetlands projects which propose use of Best Management Practices 5 through 9 in Long-Term Plan, at Committee's discretion.
- Provide review and recommendations on the water management component of the Triennial Long-Term Plan Update. This update shall incorporate results of the Wetlands Stewardship Program.

The WSP is a cooperative effort between the Wetlands Stewardship Committee and various Suffolk County Departments (Environment and Energy as the committee chair, Health Services as Stewardship Program project manager, Public Works as project sponsor, and Planning and Parks as key partners). The WSP is charged with developing indicators of wetlands health, assessing wetland health, establishing preservation and restoration priorities, and designing and implementing pilot projects. The WSP will also coordinate activities among estuary programs.

Within three years, the WSP will develop a Wetlands Stewardship Strategy (WSS) to address the assessment and management needs of all tidal wetlands in Suffolk County (approximately 17,000 acres), not just those wetlands of concern with respect to vector control. Marsh health will be the paramount objective. The scope of WSC activity will generally be limited to tidal wetlands. However, freshwaters and freshwater wetlands which are closely hydrologically connected, and integral to a tidal wetlands subsystem, may be considered on a case-by-case basis. Federal, state, town and village jurisdictions are encouraged to participate in the Stewardship Committee (e.g., in terms of project review), but are not required to do so.

*Working outline, subject to establishment of final membership, by-laws and procedures by Suffolk County Dept. of Environment & Energy

Appendix 3 to the Statement of Findings: Adopting Resolution 1150-2007

Intro. Res. No. 1150-2007 Laid on Table 2/6/2007
Introduced by Deputy Presiding Officer Viloria-Fisher

RESOLUTION NO. 285 -2007, ADOPTING THE SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT LONG-TERM PLAN AND A STATE ENVIRONMENTAL QUALITY REVIEW ACT FINDINGS STATEMENT FOR THE FINAL GENERIC ENVIRONMENTAL IMPACT STATEMENT

WHEREAS, it is the policy of Suffolk County to reduce or eliminate pesticide usage, to the extent practicable; and

WHEREAS, Suffolk County is committed to preserving and restoring its tidal wetlands, which have been dramatically altered by an extensive vector control grid ditch network which was substantially created in the 1930s; and

WHEREAS, the West Nile Virus threat highlighted the need to further optimize an already effective Vector Control Program, which is essential to protect public health, and also has important ancillary quality of life benefits; and

WHEREAS, in acknowledgement of the need to develop a comprehensive long-term vector control plan to protect public health and welfare, while reducing pesticide usage and enhancing wetlands which may be affected by Vector Control, in Resolution No. 688-2002, this Legislature authorized the development of a Suffolk County Vector Control and Wetlands Management Long-Term Plan (hereinafter "Long-Term Plan," dated October 2006, annexed hereto, incorporated by reference and made a part hereof), designated itself as lead agency under the State Environmental Quality Review Act (hereinafter "SEQRA", N.Y. Environmental Conservation Law Article 8) and its implementing regulations (subject to appropriate coordination), classified the action as Type I, and adopted a Positive Declaration for the Long-Term Plan, causing a Generic Environmental Impact Statement (hereinafter "GEIS") to be prepared; and

WHEREAS, this Legislature adopted the Final Scope for the Generic Environmental Impact Statement, pursuant to Resolution No. 1122-2003; and

WHEREAS, the Long-Term Plan and GEIS were prepared in a public and open process with extensive input and guidance from Citizens and Technical Advisory Committees, as well as the Council on Environmental Quality (hereinafter the "CEQ"), interested citizens of the County, and Local, State, and Federal agencies; and

WHEREAS, comments from agencies, advisory committees, the public, and the CEQ resulted in multiple voluntary iterations of the Long-Term Plan (including publications in September 2005, May 2006, and October 2006), and, as a result, the Plan has been substantially improved; and

WHEREAS, the Departments of Health Services, Public Works, and Energy and the Environment caused the preparation of a Draft GEIS in accord with the procedures and rules of SEQRA as defined in 6 NYCRR Part 617; and

WHEREAS, pursuant to Chapter 279 of the Suffolk County Charter, the Council on Environmental Quality evaluated the Draft GEIS and found it to be complete according to the standards set forth under SEQRA; and

WHEREAS, the Council on Environmental Quality then solicited public comments on the Draft GEIS, including holding two public hearings; and

WHEREAS, this Legislature, on the advice of the Council of Environmental Quality, found that comments received on the Draft GEIS were substantive in nature, requiring the preparation of Final GEIS, as per Resolution No. 1103-2006; and

WHEREAS, the Suffolk County Departments of Health Services, Public Works, and Energy and the Environment therefore caused the preparation of a Final Generic Environmental Impact Statement in accordance with the procedures and rules of SEQRA as defined in 6NYCRR Part 617; and

WHEREAS, the Final GEIS was filed with the Council on Environmental Quality and made available to the general public; and

WHEREAS, the Council on Environmental Quality forwarded the Long-Term Plan, the Final GEIS, and the Final GEIS Addendum, together with its comments and recommendations and those received from the public with this Legislature, for consideration at the January 29, 2007 meeting of the Environment, Planning and Agriculture Committee of the Suffolk County Legislature, as part of CEQ Resolution No. 08-07; and

WHEREAS, the Suffolk County Departments of Health Services, Public Works, and Energy and the Environment caused the preparation of a draft Findings Statement; now, therefore be it

1st RESOLVED, that the Legislature adopts the Long-Term Plan as an appropriate, comprehensive, long-term wet lands management and vector control plan to protect public health and welfare, while reducing pesticide usage and protecting wetlands; and be it further

2nd RESOLVED, that, pursuant to 6 NYCRR Part 617 and Chapter 279 of the Suffolk County Charter, the Legislature hereby adopts the Statement of Findings annexed hereto, incorporated by reference and made a part hereof, certifies that the requirements of SEQRA have been met, and certifies that, consistent with social, economic and other essential considerations, the proposed Long-Term Plan has been developed from among the reasonable alternatives available, as the choice that avoids or minimizes potential adverse, environmental impacts, to the maximum extent practicable; and be it further

3rd RESOLVED, that the Legislature certifies that adverse environmental impacts will be avoided or minimized to the maximum extent practicable by incorporation, as conditions within the Statement of Findings, where those mitigative measures that have been identified as practicable; and be it further

4th RESOLVED, that the Legislature finds that there is a need for a strategy to address the management needs of the County's 17,000 acres of tidal wetlands, not just the 4,000 acres of tidal wetlands of greatest concern to Vector Control; and be it further

5th RESOLVED, that the Legislature supports the Wetlands Stewardship Committee concept described in the Findings Statement, as a means of coordinating and overseeing future marsh management projects, as well as overseeing development of a strategy to address the management needs of the County's 17,000 acres of tidal wetlands, consistent with applicable laws; and be it further

6th RESOLVED, that the Commissioner of the Suffolk County Department of Environment and Energy, or her designee, is hereby authorized and directed to serve as Chair of the Wetlands Stewardship Committee, and to oversee development and implementation of appropriate procedures and by-laws of that Committee, including membership and voting, which procedures and by-laws shall be consistent with applicable laws; and be it further

7th RESOLVED, that the Suffolk County Department of Environment and Energy will prepare a report on Wetlands Stewardship Committee activities to this Suffolk County Legislature within three years, with said report containing a strategy to address the management needs of the County's 17,000 acres of tidal wetlands.

DATED: March 20, 2007

APPROVED BY:

/s/ Steve Levy
County Executive of Suffolk County

Date: March 22, 2007