

In cooperation with  
Suffolk County Department of Health Services

# Concentrations of Insecticides in Selected Surface Water Bodies in Suffolk County, New York, Before and After Mosquito Spraying, 2002-04



Open-File Report 2005-1384

U.S. Department of the Interior  
U.S. Geological Survey

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By Irene J. Abbene, Shawn C. Fisher, and Stephen A. Terracciano

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**U.S. Department of the Interior**  
**U.S. Geological Survey**

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## Conversion Factors, Abbreviations, and Vertical Datum

<b>Multiply</b>	<b>By</b>	<b>To obtain</b>
<b>Length</b>		
inch (in.)	25,400	micrometer ( $\mu\text{m}$ )
inch (in.)	25.4	millimeter (mm)
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
<b>Area</b>		
acre	0.4047	hectare (ha)
acre	0.004047	square kilometer ( $\text{km}^2$ )
square mile ( $\text{mi}^2$ )	2.590	square kilometer ( $\text{km}^2$ )
<b>Concentration in Water</b>		
micrograms per liter ( $\mu\text{g/l}$ )	1,000	nanograms per liter ( $\text{ng/l}$ )
micrograms per liter ( $\mu\text{g/l}$ )	1.0	part per billion (ppb)
milligrams per liter ( $\text{mg/L}$ )	1.0	part per million (ppm)

Temperature in degrees Celsius ( $^{\circ}\text{C}$ ) may be converted to degrees Fahrenheit ( $^{\circ}\text{F}$ ) as follows:  $^{\circ}\text{F}=(1.8\times^{\circ}\text{C})+32$

Temperature in degrees Fahrenheit ( $^{\circ}\text{F}$ ) may be converted to degrees Celsius ( $^{\circ}\text{C}$ ) as follows:  $^{\circ}\text{C}=(^{\circ}\text{F}-32)/1.8$

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius ( $\mu\text{S/cm}$  at  $25^{\circ}\text{C}$ ).

All times are reported in Eastern Standard Time (EST).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

# Concentrations of Insecticides in Selected Surface Water Bodies in Suffolk County, New York, Before and After Mosquito Spraying, 2002-04

By Irene J. Abbene, Shawn C. Fisher, and Stephen A. Terracciano

## Abstract

Concentrations of insecticides sprayed from truck or helicopter onto selected surface-water bodies in Suffolk County, N.Y., during the summers of 2002-04 decreased to below detection limits within 4 days after application. The U.S. Geological Survey (USGS), in cooperation with Suffolk County Department of Health Services (SCDHS), sampled surface waters from selected wetlands for insecticides that were sprayed seasonally from a truck or helicopter as part of the county's West Nile Virus vector-control program. A total of 72 samples were collected from 27 sites and analyzed for 6 compounds—malathion, methoprene, methoprene acid, piperonyl butoxide (PBO), resmethrin, and sumithrin—that are typically used to help control mosquitoes. PBO was the most frequently detected analyte (33.3%), followed by resmethrin (11.1%), methoprene (9.7%), and methoprene acid (2.4%). Sumithrin and malathion were not applied and were not detected in any of the samples. Maximum recorded concentration of compounds in surface water were: PBO (59,800 ng/L), methoprene (9,030 ng/L), methoprene acid (1,710 ng/L), and resmethrin (293 ng/L). PBO and resmethrin were detected more often in samples when the compounds were applied by a helicopter rather than a truck. This report describes the 27 sampled locations, the sampling methods, and presents the initial results of the study. Detail is provided about concentrations of the applied compounds with respect to time as well as comparisons between the two application processes (truck versus helicopter). All data collected are presented in a table.

## Introduction

The West Nile Virus (WNV) causes infections in humans and animals and has emerged as a public health threat throughout Long Island. The principal transmitting vector is mosquitoes. Possible symptoms of WNV include fever, headache, body aches, skin rash, and swollen lymph glands; and rarely meningitis or encephalitis.

The WNV was first detected in birds and mosquitoes within Suffolk County in 2000 by the Suffolk County Department of Health Services (SCDHS). In response to the public health concern, the U.S. Geological Survey (USGS), in cooperation with the SCDHS, began a 3-year study in 2002 to sample surface waters from selected wetlands (fig. 1) for insecticides that were sprayed seasonally from a truck or helicopter as part of the county's vector-control program. The study was part of a larger USGS investigation to develop analytical methods for detection of synthetic organic compounds at extremely low concentrations (as low as 5 nanograms per liter). The 3-year sampling program was designed to provide data (1) for an environmental-risk assessment (conducted by Suffolk County) of the insecticides used to control mosquito populations suspected of carrying the West Nile Virus, and (2) to aid in the development of spray-management guidelines to ensure that harmful amounts of these compounds do not reach lakes or streams.

This report describes the methods of sample collection and analysis and presents the concentrations measured at the 27 sites chosen to be sampled between 2002-04. The data are given in table 1 and summarized in figures. Further detail about concentration versus time is given in tables 2 and 3; and comparison between application processes is summarized in a figure.

## Approach and Methods

Water samples were collected in June, July, and August of 2002, 2003, and 2004. The late spring and early-summer samplings followed the application of the larvicide methoprene (an insect-growth regulator) for treatment of the waterborne mosquito larvae, whereas the middle- and late-summer samplings followed applications of adulticide, mainly Scourge™, which targeted adult mosquitoes and contains a 1:3 ratio of the pyrethroid resmethrin to the synergist piperonyl butoxide (PBO). Two of the compounds for which samples were tested (sumithrin and malathion) were not applied during the 2002-04 sampling season.

## 2 Concentrations of Insecticides in Selected Surface Water Bodies in Suffolk County, New York, Before and After Mosquito Spraying, 2002-04

Sampling localities were chosen through a review of Suffolk County insecticide-application plans and public announcements of local spraying events released by the Suffolk County Department of Public Works Vector Control (SCVC). Final site selection was based on a USGS reconnaissance of potential sampling locations, and sampling was conducted without the county's knowledge to ensure unbiased insecticide applications, except in the field season of 2004, when the USGS and Suffolk County Vector Control collaborated with two local universities (State University of New York at Stony Brook and Southampton College) to compare results.

Samples were collected by techniques described by the U.S. Geological Survey (1997-2004). Some sites were sampled more than once after spraying to measure the changes in the insecticide concentration over time (table 1).

The sample water at each site was measured for four physical and chemical properties (temperature, specific conductance, pH, and dissolved oxygen concentration) and between two and four liters of water were collected at each site for laboratory analysis. All sites were sampled at the water surface, where the sprayed insecticide is first deposited, but at two sites, additional samples were collected at a 6-in. depth to provide data for the cooperating universities' studies. Wetland streams with appropriate conditions were sampled through

an equal-width-incremental (EWI) method that obtains a representative sample for the stream's entire cross section. Most of the sampling sites were shallow and permitted the collection only of surface ("grab") samples. These samples are the easiest to obtain and also minimize the potential for sample contamination because the sampler does not descend far or disturb the natural stratification of the water column.

Samples were collected at each site before an insecticide application (2003-04) as a basis for comparison with post-application samples. The first year's sampling (2002) was done at 13 sites. All samples were "grab" samples and were collected within 60 min. after a spray application (except sites L and V, fig. 1). The 2003 season entailed sample collection at 14 sites, generally once before a spray application and once within the next 6 hours. The third (2004) sampling was done at three sites (F, X, and Y) during August and entailed collection of six pre-spray samples and six additional samples at five times over five days after the spray application. The samples at these three sites were collected at the surface and at a depth of 6-in. to provide data on the decrease in insecticide concentration after spraying.

All water samples were collected in dark-brown glass bottles and filtered into 1-L dark-brown glass bottles to prevent the breakdown of the insecticides through photochemical degradation. All samples were filtered

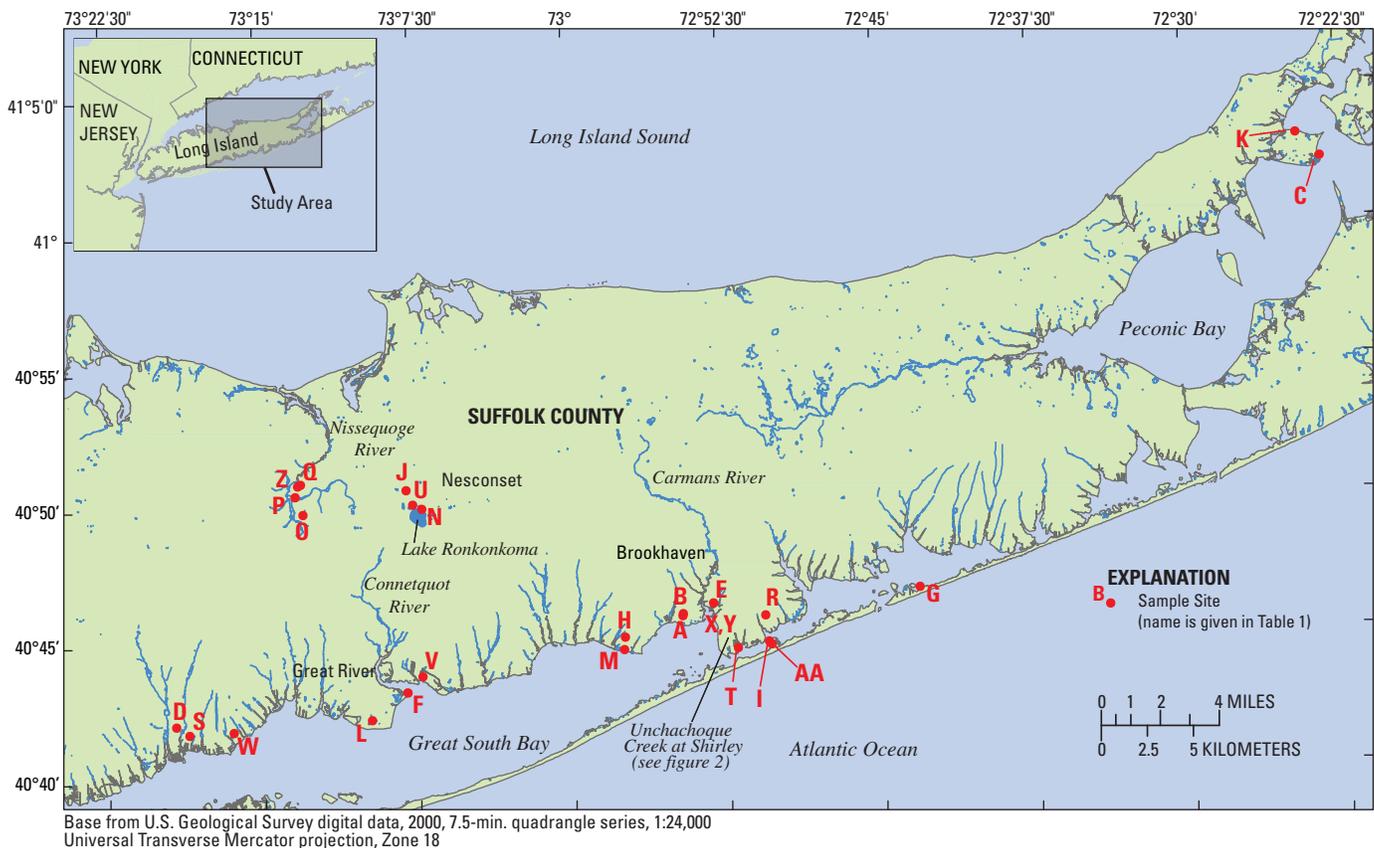


Figure 1. Locations of sampling sites in Suffolk County, N.Y., 2002-04.

within 3 hours of collection through a baked glass filter with a 0.7- $\mu$ m pore diameter. Samples were placed on ice and shipped overnight to the USGS Organic Geochemistry Research Laboratory in Lawrence, Kansas. Each sample was analyzed for six compounds—malathion, methoprene, methoprene acid (except in 2004), the synergist PBO, resmethrin, and sumithrin. Malathion kills adult insects and is used domestically and commercially. Methoprene is an insect growth regulator whereas resmethrin and sumithrin are pyrethroid insecticides synthesized from pyrethrum (*Chrysanthemum*) flowers. Methoprene acid is a by-product of methoprene and is not applied directly as a pesticide. Piperonyl butoxide, a synergist, is commonly used in combination with resmethrin or sumithrin. A synergist is an agent that is used to increase the effectiveness of another agent, such as an insecticide. All six compounds are typically used in the control of mosquitoes. Methoprene is applied early in the season to prevent the mosquito larvae from developing into the adult stage and resmethrin is applied later in the season to kill the adult mosquito. The laboratory routinely tests for all six as a standard analyzing technique, even though each spray application was only one insecticide. Laboratory analyses were conducted as described in Zimmerman and others (2001).

Field blank samples consisting of deionized water were collected in 2003 and 2004 for quality-assurance and quality-control (QA/QC) purposes. Field-blank sample preparation consisted of pouring the deionized water into dark-brown glass bottles (same as the sample bottles) at the field site 30 min. after insecticide application. The pre-application and field-blank samples were prepared for laboratory analysis in the same manner as the post-application samples (filtered, iced, and shipped). The locations, dates, times, and conditions for each sampling are given in table 1A; the concentrations of each analyte are given in table 1B. These data are also available in the USGS annual hydrologic data reports (Spinello and others, 2003, 2004, and 2005). Analytical results from sequential replicate samples in 2003 and further analysis of these insecticides are given in Zulkosky and others (2005). Tables 2 and 3 give further detail about the affect of time and the analyte concentration.

## Pesticide Concentrations Before and After the Spray Applications

The most frequent detections of the applied insecticides at each of the 27 sites were in samples collected within 1 hour after the application (table 1B). None of the six compounds were detected in any of the pre-application or field blank samples. The following sections describe results from four of the sampling areas. These sites were chosen to further describe the varying sampling techniques from each year and to compare the change in insecticide concentration over time.

### 2002 Sampling at Three Sites in the Lake Ronkonkoma Area (Resmethrin and PBO)

All samples collected in 2002 were surface (grab) samples obtained after an insecticide application. The applied insecticide was detected only in samples from two of the three sites (J, N, and U; fig. 1) within 1 hour after application (table 1B).

The application of Scourge™ (a resmethrin and PBO mixture) and its effectiveness in Nesconset, north of Lake Ronkonkoma (fig. 1), was of interest to the County during the summer of 2002 because WNV had been detected in birds and mosquitoes within the vicinity. Three sites (J, N, and U) were chosen to provide data on the applied concentration as an indication of whether it was reaching Lake Ronkonkoma. A sample was collected at each site 30 min. after the spray event. Both compounds were detected at two sites (J and U; fig. 1), but not at the third (site N). The Suffolk County Vector Control program reported the spray event to have been effective in decreasing the number of potentially infected mosquitoes by 85 percent (D. Ninivaggi, oral commun., 2004).

### 2003 Sampling at Carmans River (Methoprene)

Stream water at Carmans River at Brookhaven (Wertheim National Wildlife Refuge) (site E; fig. 1) was evaluated during the summer of 2003. Methoprene was applied by helicopter at the rate of 0.013 lb/acre (D. Ninivaggi, SCVC, oral commun., 2004). Four water samples were collected—one about 60 min. before the application, and three at specified time increments after the application (table 2).

As expected, no methoprene was detected in the sample collected before the application, and the highest concentration (9,030 ng/L) was found in the first sample collected after the application. The concentration in the second sample (39 ng/L) was considerably lower than in the third sample (846 ng/L). The second sample was collected during high tide, about 70 min. after the application, whereas the third sample was collected during a falling tide about 2.5 hours after the application.

### 2004 Sampling at Connetquot River (Methoprene) and Unchachoque Creek (Resmethrin and PBO)

Only two locations (three sites) were sampled during the 2004 season—Connetquot River in Great River (site F) and Unchachoque Creek in Shirley (sites X and Y) (fig. 1).

#### Connetquot River

No pre-application sample was collected at Connetquot River. Methoprene was detected in the samples obtained

**Table 1.** Summary of results from 27 pesticide-sampling sites in Suffolk County, N.Y., 2002-04.

[Lat./long. referenced to NAD 83. EST, Eastern Standard Time; EWI, equal width incremental; °C, degrees Celsius; µS/cm, microsiemens per centimeter; mg/L, milligrams per liter; ng/L, nanograms per liter; µg/L, micrograms per liter; n/r, no record; n/a, not analyzed; 00010, National Water Information System (NWIS) parameter code. Locations are shown by site code in fig. 1.]

**A. Site location, sample-collection data, tide conditions, and pesticide-application data.**

Site code	Station name and number	Latitude	Longitude	Sample-collection date	Sample-collection time (EST)	Tide or current	Type of sample	Spray time or duration	Spray method	Pesticide used
A	Beaver Dam Creek at Fireplace Neck 404551072550701	40° 45' 51"	072° 55' 07"	06/03/03	1230	flowing in	Grab	1245	helicopter	Methoprene
					1250	flowing in	Grab			
B	Beaver Dam Creek near Fireplace Neck 40455607250601	40° 45' 56"	072° 55' 06"	08/20/03	1855	flowing in	Grab	1900 - 2300	helicopter	Resmethrin
					2315	flowing out	Grab			
C	Cedar Beach Creek at Bayview 410213072234101	41° 02' 13"	072° 23' 41"	08/27/03	1850	flowing in	Grab	1830	helicopter	Resmethrin
D	Carl's Creek at Park Avenue at Babylon 01308600	40° 42' 07"	073° 19' 42"	08/26/02	2015	flowing out	Grab	1900 - 2300	helicopter	Resmethrin
E	Carmans River at Brookhaven 404618072533701	40° 46' 18"	072° 53' 37"	06/18/02	1400	flowing in	Grab	1330 - 1355	helicopter	Methoprene
				06/17/03	1336	flowing in	Grab	1440 - 1450	helicopter	Methoprene
					1515	flowing in	Grab			
					1600	high tide	Grab			
				07/29/03	1718	flowing out	Grab			
	1840	n/r	Grab	1235 - 1300	helicopter	Methoprene				
F	Connetquot River at mouth at Great River 404318073082301	40° 43' 14"	073° 08' 29"	06/10/03	0850	n/r	Grab	0845	helicopter	Methoprene
				06/24/03	0730	n/r	Grab	0740 - 0745	helicopter	Methoprene
					0750	n/r	Grab			
				08/03/04	0735	flowing in	Grab	0645 - 0655 (8/3)	helicopter	Methoprene
					0736	flowing in	Point			
					0850	flowing in	Point			
				08/04/04	0645	flowing out	Point			
08/05/04	0645	flowing out	Point							
08/07/04	0645	slack	Point							
G	Dune Road near Shinnecock E. County Park 404643072433601	40° 46' 43"	072° 43' 36"	07/16/02	0700	flowing in	Grab	0635 - 0654	helicopter	Methoprene
H	Dunton Lake at Bellport 404507072575501	40° 45' 07"	072° 57' 55"	07/15/03	1915	nontidal	Grab	1900 - 2300	truck	Resmethrin
					2300	nontidal	Grab			
I	End of Cranberry Lane at Mastic 404445072505101	40° 44' 45"	072° 50' 51"	07/31/02	2100	n/r	Grab	2000	truck	Resmethrin

**Table 1.** (Continued) Summary of results from 27 pesticide-sampling sites in Suffolk County, N.Y., 2002-04.

**A. Site location, sample-collection data, tide conditions, and pesticide-application data.**

Site code	Station name and number	Latitude	Longitude	Sample-collection date	Sample-collection time (EST)	Tide or current	Type of sample	Spray time or duration	Spray method	Pesticide used
J	Gibbs Pond at Nesconset 405041073082301	40° 50' 41"	073° 08' 23"	08/19/02	2045	slack	Grab	2000 - 2300	helicopter	Resmethrin
K	Goose Creek at Bayview 410305072245001	41° 03' 05"	072° 24' 50"	08/27/03	1610 2025	flowing out flowing in	Grab Grab	2007	helicopter	Resmethrin
L	Heckscher State Park at East Islip 404215073101401	40° 42' 15"	073° 10' 14"	07/24/02	0930	flowing out	Grab	1130 - 1145 (7/23)	helicopter	Resmethrin
M	Hedges Creek at mouth at Bellport 404440072575901	40° 44' 40"	072° 57' 59"	07/15/03 07/16/03	1825 0600	flowing out flowing in	EWI EWI	1900 - 2300	truck	Resmethrin
N	Lake Ronkonkoma County Park by Portion Rd 01306405	40° 49' 59"	073° 07' 38"	08/16/02 08/19/02	2157 2030	slack slack	Grab Grab	2000 - 2300 2000 - 2300	truck helicopter	Resmethrin Resmethrin
O	New Mill Pond near Hauppauge 404951073132301	40° 49' 51"	073° 13' 23"	08/26/03	2020	nontidal	Grab	2010	helicopter	Resmethrin
P	New Mill Pond near Smithtown 01303940	40° 50' 30"	073° 13' 43"	08/26/03	2025	slack	Grab	2015	helicopter	Resmethrin
Q	Nissequoge River near Smithtown 01304000	40° 50' 58"	073° 13' 29"	08/26/03	1816 2030	nontidal nontidal	EWI EWI	2020	helicopter	Resmethrin
R	Pattersquash Creek at Mastic Beach 01304964	40° 45' 49"	072° 51' 06"	09/10/02 06/25/03 08/18/04	2200 1920 2205 2200	nontidal nontidal nontidal nontidal	Grab Grab Grab Grab	1900 - 2300 1900 - 2300 1935 - 1945	truck truck helicopter	Resmethrin Resmethrin Resmethrin
S	Sampawam's Creek S. of Hawley's Pond 01308200	40° 41' 48"	073° 19' 04"	08/26/02	2030	flowing out	Grab	1900 - 2300	helicopter	Resmethrin
T	Shirley Boat Basin at Shirley 40443807252801	40° 44' 38"	072° 52' 28"	06/10/03	1630	n/r	Grab	1605 - 1620	helicopter	Methoprene
U	Spectacle Pond at Nesconset 405009073080401	40° 50' 09"	073° 08' 04"	08/19/02	2050	slack	Grab	2000 - 2300	helicopter	Resmethrin

**Table 1.** (Continued) Summary of results from 27 pesticide-sampling sites in Suffolk County, N.Y., 2002-04.

**A. Site location, sample-collection data, tide conditions, and pesticide-application data.**

Site code	Station name and number	Latitude	Longitude	Sample-collection date	Sample-collection time (EST)	Tide or current	Type of sample	Spray time or duration	Spray method	Pesticide used			
V	Thorn Lane at Oakdale 404349073074501	40° 43' 49"	073° 07' 45"	07/02/02	1312	flowing in	Grab	0900	helicopter	Methoprene			
W	Trues Creek S. on Pine Lake at W. Islip 01307695	40° 41' 52"	073° 16' 56"	08/26/02	2235	flowing out	Grab	1900 - 2300	helicopter	Resmethrin			
X	Unchachoque Creek at Shirley 404455072520501	40° 44' 55"	072° 52' 05"	08/25/04	1940	flowing out	Grab	1900 - 1910	helicopter	Resmethrin			
Y	Unchachoque Creek ditch at Shirley 404455072520401	40° 44' 55"	072° 52' 04"	08/03/04	1115	flowing in	Grab	1210 - 1220 (8/3)	helicopter	Methoprene			
					1116	flowing in	Point						
					1250	slack	Grab						
					1251	slack	Point						
					1425	flowing out	Point						
					08/04/04	1215	slack	Point					
					08/05/04	1215	flowing out	Point					
					08/07/04	1215	flowing in	Point					
					08/18/04	1630	flowing in	Grab	1935 - 1945 (8/18)	helicopter	Resmethrin		
					1631	flowing in	Point						
					2000	flowing in	Grab						
					2001	flowing in	Point						
					2130	flowing in	Point						
					08/19/04	0430	flowing out	Point					
					08/20/04	2015	flowing out	Point					
					08/22/04	2015	flowing out	Point					
					08/25/04	1745	slack	Grab	1900 -1910 (8/25)	helicopter	Resmethrin		
	1746	slack	Point										
	1940	flowing out	Grab										
	1941	flowing out	Point										
	2110	flowing out	Point										
	08/26/04	0430	flowing out	Point									
	08/27/04	1940	flowing out	Point									
	08/29/04	1940	slack	Point									
Z	Vail Pond at Smithtown 405054073133801	40° 50' 54"	073° 13' 38"	08/26/03	2030	nontidal	Grab	2020	helicopter	Resmethrin			
AA	Violet Rd. near Cranberry Dr. at Moriches Bay 404451072505801	40° 44' 51"	072° 50' 58"	09/10/02	2030	n/r	Grab	1900 - 2300	truck	Resmethrin			

**Table 1.** (Continued) Summary of results from 27 pesticide-sampling sites in Suffolk County, N.Y., 2002-04.

**B. Physical and chemical properties of sampled water and concentrations of pesticides.**

Site code	Station name and number	Sample-collection date	Sample-collection time (EST)	Water temp. (°C) 00010	Specific conductance (µS/cm) 00095	pH 00400	Dissolved oxygen concentration (mg/L) 00300	Concentration (replicates are in parentheses)						
								Malathion 39532	Methoprene 61757	Methoprene acid 61758	Piperonyl butoxide (PBO) 62765	Resmethrin 62768	Sumithrin 62763	
A	Beaver Dam Creek at Fireplace Neck 404551072550701	06/03/03	1230	19.9	19600	6.4	12.2	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	
			1250	--	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
B	Beaver Dam Creek near Fireplace Neck 40455607250601	08/20/03	1855	27.1	1890	8.0	13.3	n/r	n/r	n/r	n/r	n/r	n/r	
			2315	24.8	1120	7.9	14.4	< 5 ng/L	< 5 ng/L	< 20 ng/L	506 ng/L	< 5 ng/L	< 5 ng/L	
C	Cedar Beach Creek at Bayview 410213072234101	08/27/03	1850	27.5	42300	6.7	6.5	< 5 ng/L	< 5 ng/L	< 20 ng/L	40 ng/L	< 5 ng/L	< 5 ng/L	
D	Carl's Creek at Park Avenue at Babylon 01308600	08/26/02	2015	22.7	178	6.3	6.6	< 5 ng/L	< 5 ng/L	< 20 ng/L	41 ng/L	18 ng/L	< 5 ng/L	
E	Carmans River at Brookhaven 404618072533701	06/18/02	1400	24.1	1050	7.1	0.3	< 5 ng/L	631 ng/L	1710 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	
		06/17/03	1336	23.5	10700	7.0	8.8	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	
			1515	24.9	10900	6.9	9.3	< 5 ng/L	9030 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	
			1600	25.0	10300	7.0	8.9	< 5 ng/L	39 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L	
			1718	23.6	9830	6.7	8.0	< 5 ng/L	846 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
	07/29/03	1840	--	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	
F	Connetquot River at mouth at Great River 404318073082301	06/10/03	0850	17.9	26200	6.9	6.4	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	
		06/24/03	0730	21.6	30100	7.8	8.7	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	
			0750	--	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
		08/03/04	0735	25.0	3820	6.7	2.3	< 5 ng/L	216 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L	
			0736	25.0	3820	6.7	2.3	< 5 ng/L	82 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L	
			0850	26.1	3840	7.4	6.7	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L	
		08/04/04	0645	24.5	39600	6.6	2.6	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L	
08/05/04	0645	23.8	38600	6.5	1.5	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L			
08/07/04	0645	19.2	38800	6.5	3.1	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L			
G	Dune Road near Shinnecock E. County Park 404643072433601	07/16/02	0700	19.0	1260	6.2	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	
H	Dunton Lake at Bellport 404507072575501	07/15/03	1915	24.3	216	6.7	11.4	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	
			2300	--	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
I	End of Cranberry Lane at Mastic 404445072505101	07/31/02	2100	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L	

**Table 1.** (Continued) Summary of results from 27 pesticide-sampling sites in Suffolk County, N.Y., 2002-04.  
**B. Physical and chemical properties of sampled water and concentrations of pesticides.**

Site code	Station name and number	Sample-collection date	Sample-collection time (EST)	Water temp. (°C) 00010	Specific conductance (µS/cm) 00095	pH 00400	Dissolved oxygen concentration (mg/L) 00300	Concentration (replicates are in parentheses)					
								Malathion 39532	Methoprene 61757	Methoprene acid 61758	Piperonyl butoxide (PBO) 62765	Resmethrin 62768	Sumithrin 62763
J	Gibbs Pond at Nesconset 405041073082301	08/19/02	2045	30.3	228	7.5	12.0	< 5 ng/L	< 5 ng/L	< 20 ng/L	6910 ng/L	76 ng/L	< 5 ng/L
K	Goose Creek at Bayview 410305072245001	08/27/03	1610	25.7	43800	7.8	9.3	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
			2025	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
L	Heckscher State Park at East Islip 404215073101401	07/24/02	0930	23.9	3210	6.7	0.9	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
M	Hedges Creek at mouth at Bellport 404440072575901	07/15/03	1825	29.7	12700	6.8	6.9	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
		07/16/03	0600	22.5	17700	6.7	5.8	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
N	Lake Ronkonkoma County Park by Portion Rd 01306405	08/16/02	2157	28.2	263	6.3	2.7	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
		08/19/02	2030	29.0	276	6.4	3.8	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
O	New Mill Pond near Hauppauge 404951073132301	08/26/03	2020	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	20 ng/L	< 5 ng/L	< 5 ng/L
P	New Mill Pond near Smithtown 01303940	08/26/03	2025	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	691 ng/L	< 5 ng/L	< 5 ng/L
Q	Nissequoge River near Smithtown 01304000	08/26/03	1816	20.9	193	7.0	8.7	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
			2030	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	153 ng/L	6 ng/L	< 5 ng/L
R	Pattersquash Creek at Mastic Beach 01304964	09/10/02	2200	17.0	189	6.5	6.0	< 5 ng/L	< 5 ng/L	< 20 ng/L	5 ng/L	< 5 ng/L	< 5 ng/L
		06/25/03	1920	14.8	230	5.9	5.2	< 5 ng/L	< 5 ng/L	< 20 ng/L	8 ng/L (7 ng/L)	< 5 ng/L	< 5 ng/L
			2205	14.5	233	6.1	5.6	< 5 ng/L	< 5 ng/L	< 20 ng/L	17 ng/L (11 ng/L)	< 5 ng/L	< 5 ng/L
	08/18/04	2200	15.8	226	6.2	7.2	< 5 ng/L	< 5 ng/L	< 20 ng/L	117 ng/L	12 ng/L	< 5 ng/L	
S	Sampawam's Creek S. of Hawley's Pond 01308200	08/26/02	2030	22.3	200	6.2	5.9	< 5 ng/L	< 5 ng/L	< 20 ng/L	35 ng/L	< 5 ng/L	< 5 ng/L
T	Shirley Boat Basin at Shirley 40443807252801	06/10/03	1630	22.5	31300	8.1	12.9	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
U	Spectacle Pond at Nesconset 405009073080401	08/19/02	2050	26.8	265	6.6	2.7	< 5 ng/L	< 5 ng/L	< 20 ng/L	343 ng/L	21 ng/L	< 5 ng/L

**Table 1.** (Continued) Summary of results from 27 pesticide-sampling sites in Suffolk County, N.Y., 2002-04.

**B. Physical and chemical properties of sampled water and concentrations of pesticides.**

Site code	Station name and number	Sample-collection date	Sample-collection time (EST)	Water temp. (°C) 00010	Specific conductance (µS/cm) 00095	pH 00400	Dissolved oxygen concentration (mg/L) 00300	Concentration (replicates are in parentheses)					
								Malathion 39532	Methoprene 61757	Methoprene acid 61758	Piperonyl butoxide (PBO) 62765	Resmethrin 62768	Sumithrin 62763
V	Thorn Lane at Oakdale 404349073074501	07/02/02	1312	28.0	36000	8.2	0.1	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L
W	Trues Creek S. on Pine Lake at W. Islip 01307695	08/26/02	2235	23.4	167	6.1	9.4	< 5 ng/L	< 5 ng/L	< 20 ng/L	13400 ng/L	293 ng/L	< 5 ng/L
X	Unchachoque Creek at Shirley 404455072520501	08/25/04	1940	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	16 ng/L	< 5 ng/L	< 5 ng/L
Y	Unchachoque Creek ditch at Shirley 404455072520401	08/03/04	1115	27.6	38900	7.4	10.5	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
			1116	27.6	38900	7.4	10.5	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
			1250	28.1	38700	6.3	7.3	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
			1251	28.1	38700	6.3	7.3	< 5 ng/L	10 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
			1425	28.3	38700	6.8	5.4	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
		08/04/04	1215	29.1	38500	7.7	12.7	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
			1215	25.3	38700	7.5	9.0	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
		08/07/04	1215	23.8	41300	7.8	10.0	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
			1630	24.5	32300	9.6	1.9	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
		08/18/04	1631	24.5	32300	9.6	1.9	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
			2000	24.6	36300	7.9	11.3	< 5 ng/L	< 5 ng/L	n/a	59800 ng/L	270 ng/L	< 5 ng/L
		08/18/04	2001	24.6	36300	7.9	11.3	< 5 ng/L	< 5 ng/L	n/a	1310 ng/L	< 5 ng/L	< 5 ng/L
			2130	24.7	37100	8.2	12.4	< 5 ng/L	< 5 ng/L	n/a	457 ng/L	38 ng/L	< 5 ng/L
		08/19/04	0430	22.3	33300	5.0	2.4	< 5 ng/L	< 5 ng/L	n/a	61 ng/L	< 5 ng/L	< 5 ng/L
		08/20/04	2015	25.2	33300	6.5	0.9	< 5 ng/L	< 5 ng/L	n/a	6 ng/L	< 5 ng/L	< 5 ng/L
		08/22/04	2015	24.8	32600	6.5	3.2	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
		08/25/04	1745	25.7	34900	8.1	14.5	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
			1746	25.7	34900	8.1	14.5	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L
		08/25/04	1940	23.9	31700	7.6	12.8	< 5 ng/L	< 5 ng/L	n/a	12 ng/L	< 5 ng/L	< 5 ng/L
			1941	23.9	31700	7.6	12.8	< 5 ng/L	< 5 ng/L	n/a	15 ng/L	< 5 ng/L	< 5 ng/L
08/25/04	2110	23.6	32400	7.4	9.9	< 5 ng/L	< 5 ng/L	n/a	28 ng/L	< 5 ng/L	< 5 ng/L		
	0430	20.5	27200	6.7	6.9	< 5 ng/L	< 5 ng/L	n/a	113 ng/L	< 5 ng/L	< 5 ng/L		
08/27/04	1940	27.6	35800	8.1	12.0	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L		
08/29/04	1940	27.6	37400	8.0	10.1	< 5 ng/L	< 5 ng/L	n/a	< 5 ng/L	< 5 ng/L	< 5 ng/L		
Z	Vail Pond at Smithtown 405054073133801	08/26/03	2030	--	--	--	--	< 5 ng/L	< 5 ng/L	< 20 ng/L	774 ng/L	< 5 ng/L	< 5 ng/L
AA	Violet Rd. near Cranberry Dr. at Moriches Bay 404451072505801	09/10/02	2030	24.7	4410	7.7	7.0	< 5 ng/L	< 5 ng/L	< 20 ng/L	< 5 ng/L	< 5 ng/L	< 5 ng/L

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**Table 2.** Concentration of methoprene in water samples from Carmans River at Brookhaven (site E), Suffolk County, N.Y., before and after application June 17, 2003 1440-1450.

[Location is shown in fig. 1.]

Minutes before or after application	Sample-collection time	Concentration (nanograms per liter)
64 before	1336	< 5
25 after	1515	9030
70 after	1600	39
148 after	1718	846

**Table 3.** Concentrations of resmethrin and piperonyl butoxide (PBO) in ditch water at Unchachoque Creek (site Y), Suffolk County, N.Y., August 18-29, 2004.

[n/a, not applicable; ng/L, nanograms per liter; h, hour; min, minute. Location is shown in fig. 1.]

Date (August 2004)	Sampling time	Time elapsed	Sample type*	Direction of tide or current	Concentration, in ng/L		
					Resmethrin	PBO	
18	1630	--	Grab	flowing in	< 5	< 5	
	1631	--	Point	flowing in	< 5	< 5	
	spray time:1940	1930	--	Field blank	n/a	< 5	< 5
	2000	20 min	Grab	flowing in	270	59800	
	2001	21 min	Point	flowing in	< 5	1310	
	2130	1 h 50 min	Point	flowing in	38	457	
19	0430	8 h 50 min	Point	flowing out	< 5	61	
20	2015	48 h 35 min	Point	flowing out	< 5	6	
22	2015	96 h 35 min	Point	flowing out	< 5	< 5	
25	1745	--	Grab	slack	< 5	< 5	
	1746	--	Point	slack	< 5	< 5	
	spray time:1905	1940	35 min	Grab	flowing out	< 5	12
	1941	36 min	Point	flowing out	< 5	15	
	1942	37 min	Field blank	n/a	< 5	< 5	
	2110	2 h 5 min	Point	flowing out	< 5	28	
26	0430	9 h 25 min	Point	flowing out	< 5	113	
27	1940	47 h 25 min	Point	flowing out	< 5	< 5	
29	1940	95 h 25 min	Point	slack	< 5	< 5	

\* Grab sample, from water surface. Point sample, from 6-in. below water surface.

from the surface (216 ng/L) and from a 6-in. depth below the surface (82 ng/L), both of which were collected 30 min. after the application. Methoprene was not detected in the later samples (table 1B).

### Unchachoque Creek

Three applications were sprayed at Unchachoque Creek (fig. 1)—one of methoprene, and two of resmethrin and PBO.

Grab samples were collected from two sites (X and Y) along a manmade ditch (fig. 2) dug in the 1930s as part of a mosquito-control program in Long Island's estuarine marshes. The ditch is tidally affected; that is, it becomes partly filled and then drains completely, with the normal tidal cycle.

Samples were collected once before each application, then five times (approximately 0.5h, 2h, 9h, 48h, 96h) thereafter (table 3). The collection of post-application samples over four days was intended to provide a representative



Digital Orthophoto Quarter Quadrangle (DOQQ), 2001

**Figure 2.** Locations of sampling sites (X and Y) at an artificial ditch at Unchachoque Creek in Shirley, N.Y. (Location is shown in fig. 1.)

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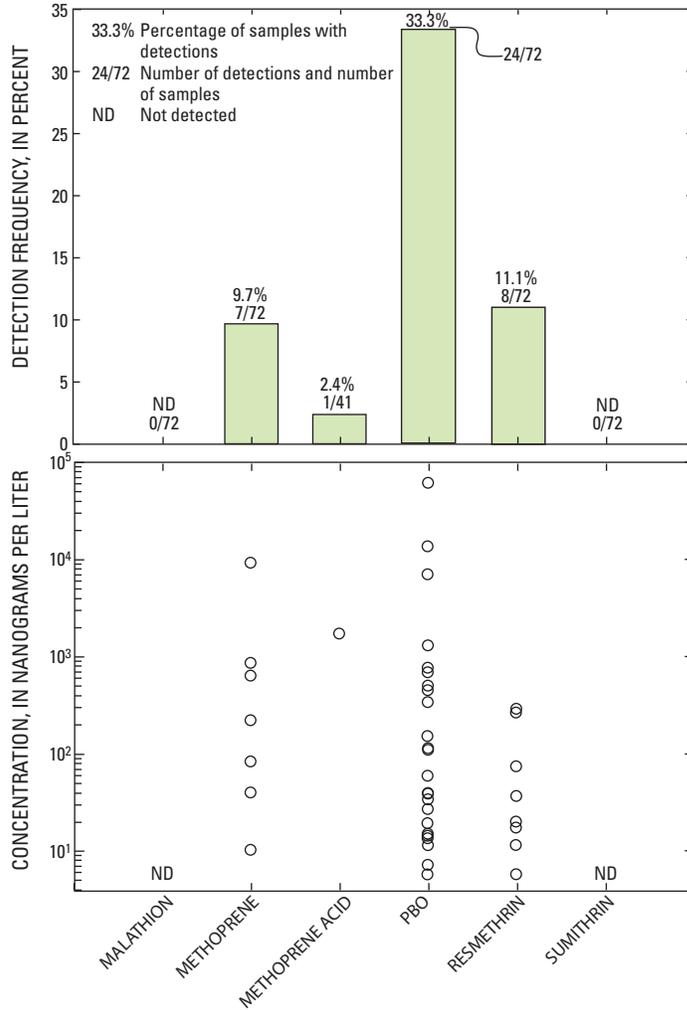


Figure 3. Detection frequency and reported concentrations for the 6 compounds analyzed in water samples from 27 surface water sites in Suffolk County, N.Y., 2002-04.

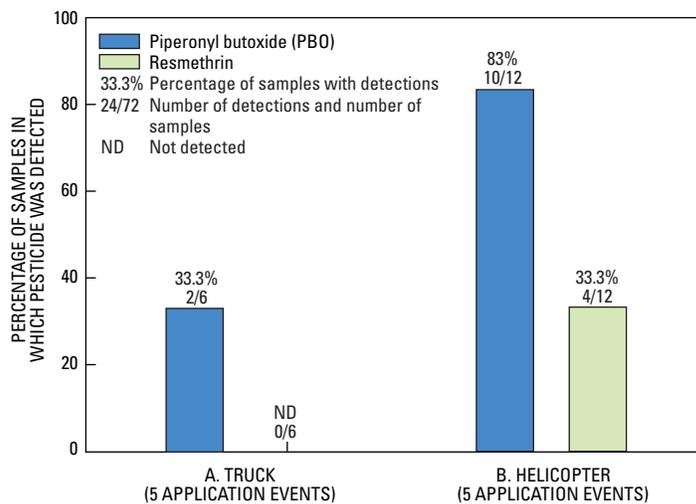


Figure 4. Percentage of samples containing piperonyl butoxide (PBO) and resmethrin after five spray application events of Scourge™ by (A) truck, and (B) helicopter, Suffolk County, N.Y., 2002-03.

sampling for use by the two cooperating universities. The pre-application samples, and the samples collected 30 min. after the application, were collected from the water surface and at the 6-in. depth. The remaining four samples were all collected at the surface.

As expected, no insecticides were detected in samples collected before the application. Methoprene (applied on Aug. 3, 2004) was detected only in the sample collected 30 min. after application. Concentrations of resmethrin and PBO decreased after the initial (August 18, 2004) application (table 3). Resmethrin and PBO concentrations also followed a typical exponential decrease during the four days after the August 18<sup>th</sup> application. PBO concentration after the second (August 25, 2004) application displayed a pattern similar to that of methoprene in the Carmans River at Brookhaven samples from June 17, 2003 (table 2).

## Data Summary

The applied insecticides were detected in many of the locations sampled 30 min. after spraying. A summary of the detection frequency and the concentration of the compounds is presented in figure 3. Of all the analytes, PBO was the most frequently detected (33.3%), followed by resmethrin (11.1%) and methoprene (9.7%) then methoprene acid (2.4%). Sumithrin and malathion were not applied and therefore the two compounds were not detected in any of the samples. Maximum recorded concentration of compounds in surface water were: PBO (59,800 ng/L), methoprene (9,030 ng/L), methoprene acid (1,710 ng/L), and resmethrin (293 ng/L).

The two different application processes (truck and helicopter) allowed for a generalized comparison of the results of detections collected in 2002 and 2003. Only grab (surface) samples collected within one hour of the application of resmethrin and PBO were used for the comparison. Samples were not collected following truck applications in 2004, and therefore samples from the 2004 field season were not used for the comparison. Detection of PBO and resmethrin after 5 application events of Scourge™ by truck (6 samples) and 5 application events of Scourge™ by helicopter (12 samples) are shown as a bar chart in figure 4. PBO was detected in 33.3 percent of 6 samples collected after truck application and in 83 percent of 12 samples collected after helicopter application. Resmethrin was detected only in samples collected after an application by helicopter.

## Summary

The West Nile Virus (WNV) causes infections that can be fatal to humans and animals and has emerged as a public health threat throughout Long Island. The principal transmitting vector of WNV is mosquitoes. The WNV was

first detected in birds and mosquitoes within Suffolk County in 2000. The U.S. Geological Survey (USGS), in cooperation with Suffolk County Department of Health Services (SCDHS), sampled surface waters from selected wetlands for insecticides that were sprayed seasonally from a truck or helicopter as part of the county's vector-control program. A total of 72 samples were collected from 27 sites during the summers of 2002-04 and analyzed for 6 compounds—malathion, methoprene, methoprene acid, piperonyl butoxide (PBO), resmethrin, and sumithrin—that are typically used to help control mosquitoes. PBO was the most frequently detected analyte (33.3%), followed by resmethrin (11.1%), methoprene (9.7%), and methoprene acid (2.4%). Sumithrin and malathion were not applied and were not detected in any of the samples. Maximum recorded concentration of compounds in surface water were: PBO (59,800 ng/L), methoprene (9,030 ng/L), methoprene acid (1,710 ng/L), and resmethrin (293 ng/L). The highest concentrations of insecticide were detected in surface waters in areas where samples were collected within the first hour after an application. Concentration of applied insecticide with respect to time was measured over five days at three sites. In general, the initial concentration measured after application was the greatest (except for August 25, 2004 application). All measured concentrations decreased by the fourth day to below the reporting limit of 5 ng/L. PBO and resmethrin were detected more often in samples when the compounds were applied by a helicopter rather than a truck.

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