Task 7: Wetlands Classification
Primary Study Areas

Submitted to:

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

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LIST OF ABBREVIATIONS AND ACRONYMS

Bti	*Bacillus thuringiensis* var *israelensis*
CDC	Centers for Disease Control
EEE	Eastern Equine Encephalitis
LIRR	Long Island Railroad
LIWRI	Long Island Wetland Restoration Initiative
LWRP	Local Waterfront Revitalization Program
MLW	Mean Low Water
MLLW	Mean Lower Low Water
MHW	Mean High Water
MHHW	Mean Higher High Water
NYSDEC	New York State Department of Environmental Conservation
OMWM	Open Marsh Water Management
PSA	Primary Study Area
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Service
SCDHS	Suffolk County Department of Health Services
SCVC	Suffolk County Vector Control
WNV	West Nile Virus

Executive Summary

Tidal and freshwater wetlands were selected from the north and south shores of Suffolk County for study as "Primary Study Areas" (PSAs). These 21 wetlands were chosen because of their exceptional environmental quality or for their value as archetypes for other sites in the County. Each PSA was also important to the County's vector control program as a known mosquito breeding area, a site managed by the Division of Vector Control, or a control site for the purposes of this project.

The management of freshwater and estuarine wetlands has always been and will remain a critical component of mosquito control. Historically, marsh ditching was the method of choice to minimize mosquito-breeding habitats. Ditching has been effective in draining some marshes to reduce standing water mosquito breeding areas. Ditching, however, may have altered marsh hydrology in other ways, marsh vegetation patterns, and wildlife habitats. Other methods of marsh management have been proposed for mosquito control that create marsh habitat for mosquito predators and access to these habitats from the tidal creeks. Open Marsh Water Management (OMWM) is one such method that seeks to create fish habitat, often using marsh pools and pannes, plugged ditches, or tidal creek channels and spurs connected to tidal flow. OMWM has been practiced successfully for mosquito control in other regions. One aspect of the study of existing marsh conditions is to make it possible to assess the impacts of OMWM or other marsh management techniques.

General descriptions of each marsh were created from public records, aerial photography and maps, and any specific reports published concerning the areas. These descriptions were then augmented by rigorous field observations, made according to an approval plan of study.

A portion of each PSA was studied. At a minimum, the effort included two to four primary ditches, tidal creeks, and upland areas. Observations were recorded for topography, vegetation type, wildlife, waterbodies present (*i.e.* tidal creeks, ponds and pannes), upland development, and stormwater discharge structures. Temperature, salinity, and dissolved oxygen concentrations were measured in ditches, pannes, ponds, and tidal creeks. Ditch orientation, spacing intervals, occlusions, bank erosion, water movement, depth, and substrate type were recorded. New or full moon tidal inundation was measured. Dominant marsh vegetation was identified and recorded on the aerial maps. Marsh vegetation was identified according to the New York State Department of Environmental Conservation (NYSDEC) zonation designations for intertidal and high marsh, along with areas dominated by the invasive plant, *Phragmites australis.*

1 Introduction

Tidal and freshwater wetlands were selected from the north and south shores of Suffolk County for study as “Primary Study Areas” (PSAs). These 21 wetlands were chosen because of their exceptional environmental quality or for their value as archetypes for other sites in the County. Each PSA was also important to the County’s vector control program as a known mosquito breeding area, a site managed by the Division of Vector Control, or a control site for the purposes of this project. General information regarding each PSA is presented in Table 1-1.

The management of freshwater and estuarine wetlands has always been and will remain a critical component of mosquito control. Historically, marsh ditching was the method of choice to minimize mosquito-breeding habitats. Ditching has been effective in draining some marshes to reduce standing water mosquito breeding areas. Ditching, however, may have altered marsh hydrology in other ways, marsh vegetation patterns, and wildlife habitats. Other methods of marsh management have been proposed for mosquito control that create marsh habitat for mosquito predators and access to these habitats from the tidal creeks. Open Marsh Water Management (OMWM) is one such method that seeks to create fish habitat, often using marsh pools and pannes, plugged ditches, or tidal creek channels and spurs connected to tidal flow. OMWM has been practiced successfully for mosquito control in other regions. One aspect of the study of existing marsh conditions is to make it possible to assess the impacts of OMWM or other marsh management techniques.

Each of the PSA wetlands was researched, sampled, and mapped. This was an extensive effort, designed to generate marsh specific information to enable the project to assess impacts of marsh management choices in well-defined settings. It is hoped that these specific discussions will have enough generic content to allow the findings from work on these sites to have applicability to other sites throughout the County.

Table 1-1 - Features of Priority Study Areas by SCVC

Type	Name	Size (S, M, L)	Aerial Larvicide	Tidally Restricted	Prior OMWM Site?	Adulticide in Vicinity?	Grid-Ditched?	Population Density 1/2 mi	Population Density 2 mi	Justification
Freshwater	Manorville Maple Swamp	S	N			Y		~34	~1235	major VC site; risk assessment site
Freshwater	Mastic freshwater	L	N			Y		3207	24366	major VC site; risk assessment site
Freshwater	Carlls River	S	N			Y		~3967	~53,787	common feature; may be local VC site; potential for restoration
North Shore Embayed	Crab Meadow	L	N	Y/N	N	N	Y	2,164	17,603	major NS marsh with no current VC problems; potential non-target invert site
North Shore Embayed	West Meadow	L	N	N	N	N	Y	3,467	19,868	Smaller NS marsh w/ few VC problems
South Shore Fringing	Stokes-Poges	S	Y	Y	N	N	Y	680	5,900	Samall South Shore Marsh w/VC problems
South Shore Fringing	Havens Point	M	N	N	N	N	Y	~337	~6298	South Shore Marsh w/ few VC problems
South Shore Fringing	Pepperidge Hall	L	Y	N	N	Y	Y	2,375	21,331	Islip GSB; VC problems; Caged fish site
South Shore Fringing	Pickman-Remmer	L	Y	Y	N	Y	Y	~2,000	~20,000	Islip GSB; tidally-restricted; VC problems
South Shore Fringing	Stillman Creek (Bluepoint)	M	Y	N	N	Y	Y	3,047	27,000	Islip GSB; manageable size; part of diverse complex; VC problems
South Shore Fringing	Namkee Creek	M	Y	Y	N	Y	Y	3,000	25,000	Islip GSB; manageable size; part of diverse complex; VC problems; tidally-restricted
South Shore Fringing	Pine Neck	M	N	N	N	N	Y	~363	~4542	DEC study area
South Shore Fringing	Johns Neck Creek	M	Y	N	N	Y	Y	5,915	19,525	Mastic; VC problems; caged fish site; risk assessment site
South Shore Barrier Is.	West Gilgo	L	Y	N	Y	Y	Y	29	29	Barrier Beach marsh capable of management
South Shore Islands	Captree West	L	N	N	N	Y	Y	~75	~195	Archetype for "natural" South Shore marsh
South Shore Barrier Is.	W. Watch Hill (Davis Park)	S	N	N	N	Y	Y	5	7	Barrier Beach marsh; Wilderness area; adjacent to Davis Park (risk assessmentr site)
South Shore Islands	Gilgo Island	M	N	N	N	Y	Y	330	389	"island" exemplar
Peconic Bay Fringing	Long Beach Bay (King St-Peters Neck Rd)	L	N	N	N	Y	Y	~195	~590	Cornell OMWM site
Peconic Bay Fringing	Hubbard Creek	L	N	N	Y	N	Y	1,100	6,324	restoration/reversion
Peconic Bay Fringing	Pipes Cove (south of 25)	L	Y	Y	N	N	Y	602	4,870	with Goose Creek; VC problem; large system; potential Non-target invert site
Peconic Bay Fringing	Cedar Beach Point (County Park)	M	N	N	N	N	Y	1,985	5,820	DEC study site; some VC problems.

Note: Size - S (small): < 5 acres, M (medium): 5-50 acres, L (large): > 50 acres

2 Methodology

Prior to any field work, each site was researched. Internet and other library searches were conducted to find any previously conducted work. Aerial photographs, USGS quad maps, census data, and Suffolk County Vector Control (SCVC) records were reviewed. Preliminary reports on each site were compiled and circulated to SCVC and Suffolk County Department of Health Services (SCDHS) for comment.

A representative portion of each PSA was selected as a study area. At a minimum, study areas included two to four primary ditches, tidal creeks, and upland areas. Observations were recorded for PSA topography, vegetation type, wildlife, waterbodies present (*i.e.* tidal creeks, ponds and pannes), upland development, and stormwater discharges.

Population estimates were obtained from the US Census website. Population estimates were made within ½-mile and 2-mile radii of the wetlands. Census blocks were included in the population estimates of the radii intersected the majority of the blocks.

Water quality parameters were measured and recorded. Temperature, salinity, and dissolved oxygen concentrations were measured in ditches, pannes, ponds and tidal creeks using a YSI 30 salinity-temperature-conductivity meter or a DUR OX 325 Oxi 340i oxygen meter. Locations were selected in two or more ditches from the mouth of the ditch in the tidal channel to the head of the ditch. To improve field mapping accuracy, locations were frequently selected near cross ditches. Locations were identified on large-scale aerial maps that were utilized in the field.

Tidal creeks, ponds, and pannes were identified on the aerials. Ditch orientation, spacing intervals, occlusions, bank erosion, water movement, depth, and substrate type were recorded. All sampling locations were recorded on a GIS map overlaid on a 2001 aerial map.

To measure the magnitude of tidal inundation at each PSA, wooden stakes coated with water-soluble glue were placed throughout each marsh prior to a lunar high tide. As the high tide rose, the glue was washed away to the elevation of high tide. After the high tide receded, measurements of the stakes and glue line were recorded. The measurement of the height of the stake and the distance from the marsh surface that the glue was washed away from the tide determined the amount of tidal inundation.

Dominant marsh vegetation was identified and recorded on the aerial maps. Marsh vegetation was identified according to the NYSDEC zonation designations for intertidal and high marsh (Table 2-1). The NYSDEC defines intertidal marsh as "the vegetated wetland zone lying between average high and low tidal elevation in saline waters. The predominant type of vegetation in this zone is low marsh cordgrass (*Spartina alterniflora).*" High marsh is defined by the NYSDEC as "the normal upper most tidal wetland zone usually dominated by salt meadow grass (*S. patens*) and spike grass (*Distichlis spicata*). This zone is periodically flooded by spring and storm tides and is often vegetated by low vigor *S. alterniflora*, and seaside lavender (*Limonium carolinianum*). The upper limits of this zone often include black grass (*Juncus gerardi*), chairmaker's rush (*Scirpus* spp.), marsh elder (*Iva frutescens*) and groundsel bush (*Baccharis halmifolia*)" (NYSDEC, 1999). Upland areas and growth of the common reed *Phragmites australis* were also identified. Vegetation locations were recorded in the field and subsequently transferred to GIS maps. Maps are found at the end of this report.

Table 2-1 - NYSDEC Marsh Zonation Designations

Marsh Designation	Common Name	Scientific Name
Intertidal Marsh	low marsh cordgrass	*Spartina alterniflora*
High Marsh	salt meadow grass	*Spartina patens*
	spike grass	*Distichlis spicata*
	low vigor cordgrass	Short form of *S. alterniflora*
	seaside lavender	*Limonium carolinianum*
	black grass	*Juncos gerardi*
	chairmakers rush	*Scirpus* spp.
	marsh elder	*Iva frutescens*
	groundsel bush	*Baccharis halmifolia*

NYSDEC, 1999

3 Crab Meadow

3.1 Selection Criteria and Current Condition

Crab Meadow was chosen as a PSA because it is a major north shore marsh with no current vector control problems. Crab Meadow is one of the very few large areas of undeveloped salt marsh remaining on Long Island's north shore.

3.2 Location, Size and Ownership

Crab Meadow is located in the Town of Huntington, west of Eaton's Neck on the North Shore, approximately one and one-half miles north of the Village of Northport. Crab Meadow is owned by the Town of Huntington.

The entire marsh is approximately 121 hectares (300 acres). The section of marsh west of the tidal creek was the focus of this study. This portion of the marsh studied measures approximately 21 hectares (53 acres).

3.3 Topography and Waterbodies

Crab Meadow is situated within Hydrogeologic Zone VIII, as delineated in the Long Island 208 Study. This zone is defined as the north shore shallow flow system, in which the groundwater primarily moves laterally. Some upward flow may take place in this area as the groundwater discharges to surface water bodies.

A single tidal inlet connects to a multi-branched tidal creek system throughout the entire marsh. The main tidal creek empties into the Long Island Sound. Two small creek systems drain into the marsh from the south. These systems lie on either side of the golf course, located to the south of the marsh. Both systems contain dammed ponds.

Numerous ponds and pannes were observed at Crab Meadow. Ponds ranged in size from 2 x 1 meters (6.5 x 3.2 feet), 8 centimeters (3 inches) deep to 20 x 10 meters (66 x 33 feet), 2 cm (0.7 inches) deep. The deepest pond was 18 cm (7 inches) and 5 x 3 meters (16 x 10 feet) wide, which contained an abundant amount of fish and grass shrimp. In addition to naturally occurring ponds, an artificial structure full of water was noted in the northern portion of the marsh. The structure is approximately 1 x 1½ meters (3 x 5 feet) in size and 40 cm (16 inches) deep. A moderate number of grass shrimp and fish were also observed in this structure.

3.4 Land Use and Population Density

Crab Meadow is bordered by undeveloped woodland, county parkland and a golf course to the south, beach-front (some seasonal) homes along the barrier beach to the north, low density residential development to the east (half acre to one acre lots) and higher density houses to the west (quarter acre and smaller lots). The population is 2,164 within one-half mile of Crab Meadow, and 17,603 within two miles.

3.5 Tidal Characteristics

3.5.1 Tidal Range

Crab Meadow is not tidally restricted. Based on tidal information for nearby Eaton's Neck Point, the mean tidal range for Crab Meadow is approximately 7.1 feet. The spring tidal range is approximately 8.2 feet and the mean tide is 3.9 feet.

3.5.2 Tidal Inundation

In order to assess the amount of tidal inundation on the marsh surface, a tidal inundation study was completed during the lunar high tide in November 2004. Before the lunar high tide, stakes were placed in areas of standing water throughout the high marsh on November 24th and inundation measurements were collected on November 27th.

Nine stakes were placed throughout the marsh at Crab Meadow. Stake S1 was placed adjacent to the northern boundary ditch. This area received 30.5 cm of water. Stake S2 was placed in high marsh vegetation consisting of *Spartina patens* and *Distichlis spicata*. This area received 33 cm of water. Stake S3 was placed in a small pond among mixed vegetation. This pond received 30 cm of water. Stake S4 was placed in high marsh vegetation in the upper portion of the marsh.

This area received 32.5 cm of water. Stake S5 was placed just west of Stake S4 in mixed low marsh/high marsh vegetation. This area received 33 cm of water. Stake S6 and S7 were placed in the upper marsh adjacent to the northern stand of *Iva frutescens*. Vegetation surrounding these stakes was a mix of *Spartina patens, Distichlis spicata* and *S. alterniflora*. Stake S6 received 30 cm of water and stake S7, placed west of stake S6 received 33.5 cm of water. Stake S8 was placed in high marsh adjacent to a terminus of a tidal creek branch. This area received 29 cm of water. Stake S9 was placed east of stake S8 in the same panel, which also received 29 cm of water.

The amount of inundation that occurred throughout the marsh was generally consistent. Stakes S8 and S9 received slightly lower amounts of inundation because the elevation at these locations is slightly higher than the rest of the marsh.

Table 3-1 - Crab Meadow Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Adjacent to ditch	30.5
S2	High marsh	33
S3	Pond	30
S4	High marsh	32.5
S5	Mixed vegetation	33
S6	Mixed vegetation	30
S7	Mixed vegetation	33.5
S8	High marsh	29
S9	High marsh	29

3.6 Stormwater

No stormwater discharge pipes were observed at Crab Meadow. The drainage system to the west is considerably larger than that to the east (the system to the east is essentially bounded by NYS Route 25-A; the system to the west extends into the hamlet of East Northport). There can be considerable run-off generated by the steep topography, and much of that will be directed into the southwest portion of the salt marsh.

3.7 Water Quality

Water quality measurements were collected from the head, mouth, and mid-point sections of the main tidal creek and three selected ditches (D1, D2 and D3). All ditches were analyzed at low tide.

Ditch D1 is approximately 279 meters (915 feet) in length, running north to south, in the northeastern portion of the marsh. Ditch D2 is approximately 176 meters (577 feet) in length, running from west to east in the northwestern portion of the marsh. Ditch D3 is approximately 168 meters (550 feet) in length, running from west to east in the southwestern portion of the marsh.

Temperature appeared to increase slightly from the head to the mouth of the ditches. Salinity remained constant across the marsh, while dissolved oxygen varied slightly. Lower dissolved oxygen levels were recorded at the head of ditch D3. This may be due to vegetation occluding this portion of the ditch.

Table 3-2. Crab Meadow Water Quality Data

Station	Sample Location Characteristics	Water Depth (centimeters)	Temp. (C)	Salinity (ppt.)	DO (mg/L)
TC-A	*Spartina alterniflora*	-	11.8	12.0	9.1
TC-B	*Spartina alterniflora*	-	15.4	2.0	9.4
TC-C	*Spartina alterniflora*	-	13.6	0.1	5.62
D1A	*Spartina alterniflora*	5	12.9	22.6	6.8
D1B	*Spartina alterniflora*	2	9.7	22.0	9.8
D1C	*Spartina alterniflora*	4	9.7	22.1	7.1
D2A	*Spartina alterniflora*	4	12.9	19.0	8.3
D2B	*Spartina alterniflora*	2	12.4	21.0	7.3
D2C	*Spartina alterniflora*	2	11.8	21.0	5.8
D3A	*Spartina alterniflora*	3	18.0	23.0	7.1
D3B	*Spartina alterniflora*	2	16.5	23.0	6.9
D3C	*Spartina alterniflora*	10	11.4	22.0	3.8

Note: Samples collected on 10/18/04; during low tide (9:00 a.m.)
D = ditch TC = tidal creek

3.8 Ecology

3.8.1 Tidal Vegetation

The study area of Crab Meadow is primarily dominated by *Spartina alterniflora.* Tall-form *S. alterniflora* is present along the edges of ditches and the branches of the tidal creek. Throughout the marsh, sections of low marsh are mixed with *Distichlis spicata* and *Spartina patens*.

A large stand of *Iva frutescens* is located along the northern boundary of the marsh, approximately 53 meters (175 feet) at the widest point. *Iva frutescens* and a relatively thin border of *Phragmites australis* dominate the western edge of the marsh. The uplands, where undeveloped, largely consist of second-growth hardwood forest.

3.8.2 Phragmites australis

Besides the thin border along the western portion of the marsh, *Phragmites australis* is notable through its general absence from the marsh.

3.8.3 Wildlife

Rainwater killifish (*Lucania parva*) were observed in moderate numbers toward the western end of ditch D2, as the ditch branches off into a series of small ponds. The vegetation near these ponds appears to be dead *S. patens*. Fish were not observed in either ditch D1 or ditch D3.

Varying amounts of fish were observed in the ponds at Crab Meadow. The amount of fish in the ponds appeared to increase with pond depth. Moderate numbers of ribbed mussels (*Geukensia demissa*), snails (*Melampus bidentatus*), and fiddler crab (*Uca pugnax*) holes were noted along the ditches and tidal creeks in areas of open mud and sparse vegetation. Canada geese (*Branta canadensis*) were observed utilizing the marsh during low tide and in the high marsh during the lunar high tide. Several osprey nest platforms are located throughout the marsh, some of which had signs of nesting activity.

3.9 Mosquito Habitat/History

3.9.1 Ditching and Ditch Condition

Parallel ditches cut through the majority of the marsh, perpendicular to the tidal creek. Ditches are spaced approximately 36.5 meters (120 feet) apart and are up to 293 meters (960 linear feet) in length. Some grid ditching occurs in the northwestern corner and other areas throughout Crab Meadow. All ditches appeared to have clear connections to the tidal creek.

Three ditches (D1, D2 and D3) were analyzed for general ditch characterization. All three ditches had a muddy substrate, except for the northernmost portion of ditches in the north section of the marsh, where the substrate was more firm and sandy. Ditch D2 becomes occluded with vegetation (*S. alterniflora, S. patens,* and *D. spicata*) towards the head of the ditch, before the ditch forms a series of pannes and ponds.

3.9.2 Pesticide Applications

Aerial larviciding does not take place on this marsh due to the low numbers of mosquitoes. No OMWM techniques have been installed at Crab Meadow.

4 West Meadow

4.1 Selection Criteria and Current Condition

West Meadow was selected as a PSA because it is a smaller marsh on the north shore with limited vector control issues.

4.2 Location, Size and Ownership

West Meadow is located in central Suffolk County on the north shore of Long Island near the hamlets of Stony Brook and Setauket. West Meadow Beach borders the West Meadow marsh on the west while West Meadow Creek meanders north to south through the marsh.

West Meadow is approximately 36 hectares (88 acres) in size. It is bounded by Trustee Road on West Meadow Beach to the west and residential development east of West Meadow Creek.

West Meadow is currently managed by the Ward Melville Heritage Organization (WMHO). WMHO retains ownership rights to the wetland. West Meadow Beach is located at the northernmost end of the marsh, which is owned and operated by the Town of Brookhaven.

4.3 Topography and Waterbodies

The majority of West Meadow consists of a mix of high marsh/low marsh vegetation, primarily dominated by tall-form *Spartina alterniflora*. High marsh areas consist mainly of *Iva frutescens, S. patens,* and *Distichlis spicata* with some *Phragmites australis* and cedar.

West Meadow resides in Hydrogeological Zone VIII, as designated in the Long Island 208 Study. This area is defined as likely to contribute water only to the shallow groundwater flow system and flow in the upper aquifer is essentially horizontal. West Meadow Creek drains a large portion of the hills to the east of the area and the creek has one large offshoot that heads east and splits halfway upstream into two smaller tributaries. The head of West Meadow Creek is an unusually large and deep forked basin that was created by dredging in the 1920s.

Several ponds and pannes were observed at West Meadow. Two small ponds were observed in the high marsh, approximately 5 x 5 meters (16 x 16 feet) and 4 x 2 meters (13 x 6.5 feet) in size. The depths of the ponds were 4 and 24 cm (1.5 and 9 inches) deep, respectively. Pannes ranged in size from 3 x 4 meters (10 x 13 feet) to 25 x 25 meters (82 x 82 feet).

4.4 Land Use and Population Density

Land use near West Meadow consists of residential development on large parcels. West of the marsh along Trustee Road were 93 cottages that have since been demolished in January 2005, as part of an agreement in 1996 to return the beach back to the general public.

The population is 3,467 within ½ mile of West Meadow and 19,868 within two miles of the site. The population of the hamlet of Setauket was recorded at 15,931 during the 2000 census and the population of the hamlet of Stony Brook was 13,727.

4.5 Tidal Characteristics

4.5.1 Tidal Range

West Meadow is connected to the Long Island Sound by West Meadow Creek in the southwest portion of the study area and is not tidally restricted. The mean tidal range of West Meadow, based on the nearest tide location, Port Jefferson, is 2 meters (6.61 feet). The spring tidal range at Port Jefferson is 2.18 meters (7.16 feet) and the mean tide level is 1.07 meters (3.53 feet).

4.5.2 Tidal Inundation

In order to assess the amount of tidal inundation on the marsh surface in areas of high marsh, a tidal inundation study was completed during the full moon in December 2004. Before the lunar high tide, stakes were placed in areas of standing water throughout the high marsh on December 10th and inundation measurements were collected on December 11th.

Six stakes were placed in high marsh vegetation, which is limited to the western portion of the marsh. Vegetation consists of *Distichlis spicata, Spartina patens,* and *Iva frutescens.* On average, 50.8 centimeters of inundation reached the high marsh in this region. The adjacent Trustee Road also became flooded because of the lunar high tide.

Table 4-1 - West Meadow Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	High marsh	50
S2	High marsh	65.5
S3	High marsh	46
S4	High marsh	44.5
S5	High marsh	50

4.6 Stormwater

No stormwater discharge pipes were observed at West Meadow.

4.7 Water Quality

Water quality measurements were collected from the head, mouth, and mid-point sections of the tidal creek and three selected ditches (D1, D2 and D3). All three ditches were analyzed during low tide.

Overall, temperature slightly increased in a northerly direction across the marsh. Salinity increased slightly towards the mouth of the ditches, while dissolved oxygen decreased.

Table 4-2 – West Meadow Water Quality Data

Station	Sample Location Characteristics	Water Depth (centimeters)	Temp. (C)	Salinity (ppt.)	DO (mg/L)
TC-A	*S. alterniflora*	-	12.1	25	9.8
TC-B	*S. alterniflora*	-	13.1	25.2	10.2
TC-C	*S. alterniflora*	-	13.1	20.1	11.7
D1A	*S. alterniflora*	10	11.5	24.8	3.5
D1B	*S. alterniflora, S. patens*	23	10.1	23.4	4.3
D1C	*S. alterniflora, S. patens*	10	11.8	24.3	7.1
D2A	*S. alterniflora*	7	12.2	25.3	2.7
D2B	*S. alterniflora, S. patens, D. spicata*	14	12.3	24.6	2.87
D2C	*S. patens, I. frutescens*	16	12.6	23.3	5.0
D3A	*S. alterniflora*	4	11.7	25.6	3.1
D3B	*S. alterniflora*	50	12.6	26.3	6.34
D3C	*S. alterniflora, S. patens, D. spicata*	5	13.0	24.9	3.8

Note: Samples were collected on 11/5/04 at low tide (11:00 a.m.)
D = ditch TC = tidal creek

4.8 Ecology

4.8.1 Tidal Vegetation

The majority of West Meadow is intertidal vegetation, consisting of tall and short-form *Spartina alterniflora*. Tall-form *Spartina alterniflora* is dominant along the ditches and tidal creek and becomes mixed with and short-form *S. alterniflora* and *Distichlis spicata* between ditches and in the west portion of the marsh.

High marsh vegetation consists mainly of *D. spicata. Iva frutescens* is present along the upper limits of the marsh and in areas of higher elevations. *S. patens,* cedar, *Limonium latifolium, Salicornia,* and *Solidago virgauria* are found in lesser numbers throughout the high marsh.

4.8.2 Phragmites australis

Phragmites australis is noticeably absent from the West Meadow marsh.

4.8.3 Wildlife

Few fish were observed in the ditches during low tide. Moderate numbers of fish and saltmarsh snails were observed the ponds.

4.9 Mosquito Habitat/History

4.9.1 Ditching and Ditch Condition

West Meadow is grid ditched at 30-meter (100 foot) intervals, with the majority of the ditches occurring in the western and northern portion of the marsh.

Three ditches (D1, D2 and D3) were analyzed for general ditch characterization during low tide. All three ditches bisect the marsh from west to east and are open with clear connections to the tidal creek. The majority of vegetation along the ditches consists of tall-form *S. alterniflora*. Tall-form *S. alterniflora* occludes ditch D2 and ditch D3 at the mid-length portions of the ditches. Vegetation towards the west becomes a mix of *S. alterniflora, D. spicata* and *S. patens.* All ditches terminate in a dense border of *Iva frutescens.* The ditches have a muddy substrate near the tidal creek, which becomes sandier toward the head of the ditches. All three ditches widened extensively at the mouth, almost doubling in width, resulting in the creation of large pannes.

4.9.2 Pesticide Applications

The site has historically not been aerially larvicided and adulticide has not been used in the area. No OMWM techniques have been implemented at this marsh.

5 Captree Island West

5.1 Selection Criteria and Current Condition

Captree Island West was selected as a PSA because it is the archetype for a "natural" south shore island marsh. The marsh has numerous natural marsh features including large ponds and extensive tidal creeks. It contains remnant ditches and significant, but localized, mosquito breeding on its northern edge that may contribute to problems on the mainland. It may be possible to install fish reservoirs and/or spurs along the upland edge to limit mosquito breeding, while minimizing the impact on vegetation.

5.2 Location, Size, and Ownership

Captree Island West is part of the Captree State Park complex, located in the Town of Babylon, west of the Robert Moses Twin Causeway. It is owned by the Town of Babylon and is situated north of the Fire Island Inlet, in Great South Bay. The entire complex is over 120 hectares in size. The size of the area studied measured approximately 640 x 360 meters.

5.3 Topography and Waterbodies

Captree Island is situated within Hydrogeologic Zone VII, as delineated in the Long Island 208 Study. This zone is defined as the south shore shallow flow system, in which the groundwater primarily moves laterally. Some upward flow may take place in this area as the groundwater discharges to surface water bodies.

Numerous and extensive tidal creeks drained the island. Many small inlets and islands lined its shoreline. Seven salt pannes, which increased in size in a northeasterly direction, were also present within the study area. Two areas of upland vegetation were located on the western half of the island and a third was located adjacent to Captree Island Road.

5.4 Land Use and Population Density

Light residential land use was present on Captree Island West, with 32 homes lining Captree Island Road. Moderate recreational land use was present on the east end of Captree State Park, which contained a fishing pier, boat basin, a promenade, picnic area and several parking fields. The population is approximately 75 within ½ mile of Captree Island West and 195 within two miles of the site.

5.5 Tidal Characteristics

5.5.1 Tidal Range

The mean tidal range (MHW–MLW) was 30 centimeters (1.0 foot) and the mean spring tidal range (MHHW-MLLW) was 30 centimeters (1.2 feet) (as measured at the Bay Shore benchmark).

5.5.2 Tidal Inundation

Five stakes measuring tidal inundation (Stakes S1-S5) were placed south of ditch #1 (D1), on November 8, 2004, several days before the monthly full moon. Retrieval and reading occurred on November 9, 2004. Stake S1 was placed in the upper marsh, along the edge of *Phragmites australis* growth. During the incoming tide, this area received 15 centimeters of water. Stake S2 was placed among the short form of *Spartina alterniflora* growing in the upper marsh. Tidal inundation in this area was 24 cm. Stake S3 was placed among *S. patens* plants in the middle marsh and received 27 cm of water. Stake S4 was positioned at the edge of a stand of *P. australis* mixed with *Iva frutescens* in the middle marsh. At high tide, 14 cm of water flooded this area. Stake S5 was placed in a pool, located in the middle marsh, surrounded by *S. alterniflora* (short form). This area received 25 cm of water during the flood tide. Inundation increased from the upper marsh (stake S1) to the middle marsh (stakes S2 and S3). Readings for stakes S3 and S5 were similar because they were placed at approximately the same height in the marsh (Table 5-1).

Table 5-1. Captree Island West-Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Upper	15
S2	Upper	24
S3	Middle	27
S4	Middle	14
S5	Middle	25

5.6 Stormwater

No stormwater discharge pipes were observed. Limited stormwater flow onto the marsh may come from Captree Island Road. Stormwater flow from the Robert Moses Causeway may also affect the wetland.

5.7 Water Quality

Ditch water depth decreased toward the middle marsh in ditch D1. Water depth values varied along ditch D3 because they were taken at disparate ponds. No samples were taken at station D3B as vegetation blocked water flow. The values for samples taken at station D3C were simply an estimate of water depth taken from the pond's edge.

Temperature and salinity were relatively constant throughout the ditches and pannes located within the marsh, with values increasing toward the center of the site (station P5) and decreasing as tidal creek influence increased at stations P7 and T1. An occlusion near station D3B precluded the measurement of water quality parameters. The temperature for the sample taken at station D3A was lower and the salinity reading was higher than that of the sample taken at station D3C. In the samples taken at stations along ditch D3, salinity generally decreased from the low marsh to the middle marsh (Table 5-2).

Table 5-2. Captree Island West Water Quality Measurements and Station Water Depth

Station	Station Location Characteristics	Station Water Depth (centimeters)	Temperature (ºC)	5.7.1.1.1.1.1 Salinity (ppt.)
D1A	Low marsh, mouth of D3	15.2-25.4	9.9	28.5
D1B	Middle marsh, at junction of pond and ditch	NR	9.5	28.3
D1C	Middle marsh	1.2	NR	NR
D2A	Low marsh	30.5	9.9	29
D3A*	Low marsh, tidal channel	NR	10.3	29.2
D3B	Middle marsh	NR	NR	NR
D3C	Middle marsh, pond along D3	0-3.8	15.2	28.1
P1	Low marsh	15.2-20.3	9.9	28.7
P2	Middle marsh	2.5-5.1	NR	NR
P3	Middle marsh, pond	15.2	12.6	27.6
P4	Middle marsh, south of D3	2.5-7.6	13.2	25.4
P5	Middle marsh, north of D2	NR	15.4	28.3
P6	Middle marsh, north of D1	Plugged w/ vegetation	10.1	28.5
P7	Middle marsh, between D2 & D3	15.2-25.4	11.2	29.3
T1	Middle marsh, main channel	NR	10.3	29.2

Note: NR-"not recorded" for specified samples.
D = ditch P = panne T = Tributary
A, B, C, D and E = samples taken along ditch
* = samples taken in tidal creek at mouth of ditch

5.8 Ecology

5.8.1 Tidal Vegetation

A mix of *Spartina patens* and the short form of *S. alterniflora* covered the upper to middle marsh area. *S. patens* is dominant in the eastern portion of the site toward the main tidal channel. Brown macroalgae is present at the pool near station D3C. It was also present in clumps at station P4 and on the surface of the mud in the pool at station P1. The presence of macroalgae in the pool at station P1 indicates that there is sufficient water depth at high tide to support algal growth.

5.8.2 Phragmites

Captree Island Road was bordered to the north by *Phragmites australis*. This reed, mixed with *Baccharis halmifolia* extended toward the middle marsh near Stake S4. *Phragmites australis* was present with *Iva frutescens* toward stake S5.

5.8.3 Upland Vegetation

Trees in the northwest corner of the study site followed the curve of Captree Island Road and formed the terrestrial edge of the study area. A band of *P. australis* surrounded the pocket of trees on all sides and extended toward the middle marsh. *Phragmites australis*, mixed with *Baccharis halmifolia* bushes, grew from the road toward the middle marsh, near stake S4. A small pocket of *I. frutescens* replaced *B. halmifolia* toward stake S5.

5.8.4 Wildlife

Fish, ribbed mussels (*Geukensia demissa*) and mud snails (*Ilyanassa obsoleta*) were common throughout the study area. However, fish were notably absent in areas where the water was stagnant (station D1A) or too shallow (stations P2 and P6). Amphipods, along with dead mud snails, were noted at station P5.

5.9 Mosquito Habitat/History

5.9.1 Ditching and Ditch Condition

The wetland was extensively ditched, with all ditches in a west-northwest orientation and spaced 60 meters apart. The ditches connected to many salt pannes (seven were noted in the study area) and tidal creek tributaries throughout the wetland. A mud bottom was common along all ditches. Ditch depth increased from the upper marsh (station D1C) to the middle marsh (station D1A and station D1B). In the samples taken at stations P2, P6, and T1, mud depth increased from the low marsh (P2) to the middle marsh (P6 and T1). This unexpected increase in mud depth, in middle marsh, could be the result of a tidal tributary flowing into the pannes located along ditch D2. The single bottom measurement recorded for ditch D3 could also be high due to the presence of the tidal creek comprising part of its length. Occlusions, resulting in areas of extremely shallow (stations D1D, D2B and D2C) or standing water (station D1E), were present along each of the three main ditches sampled. The sample from station D1D was taken along a remnant ditch that no longer served as a viable connection between ditches D1 and D2 because a portion of it had been clogged by plant growth (Table 5-3).

Table 5-3. Captree Island West-Mud Depth

Station Location	Station Location Characteristic	Mud Depth (centimeters)
D1A	Middle marsh	91
D1B	Middle marsh	91
D1C	Upper marsh	5-15
D3B	Middle marsh	91
P2	Low marsh	7-10
P6	Middle marsh	91
T1	Middle marsh	91

Note: Table 3 only lists samples for which bottom measurements were recorded.
D = ditch P = panne T = tributary
A, B and C = samples taken along ditch

5.9.2 Pesticide Applications

Captree Island West has received larvicide and adulticide applications due to significant, but localized, breeding on its northern edge. OMWM techniques have not been implemented on this island.

6 Havens Point

6.1 Selection Criteria and Current Condition

Havens Point State tidal wetland was selected as a PSA because it is a south shore fringing marsh with few vector control problems. The vegetation pattern of the marsh is characteristic of northeastern marshes. For example, *Spartina alterniflora* (tall form) is present in the low marsh, a mix of *Spartina patens* and *Distichlis spicata* covers the middle marsh, and *D. spicata* dominates the upper marsh. *Phragmites australis*, an invasive species, is also present in the upper marsh and has begun to invade lower areas as well. The presence of this plant tends to coincide with ditch erosion and blockage, leading to standing water and possibly the creation of mosquito breeding areas.

6.2 Location, Size, and Ownership

The Havens Point State tidal wetland, in the Town of Brookhaven, is owned by New York Department of Environmental Conservation (NYSDEC). It is located in East Moriches, approximately 18.5 kilometers south of Montauk Highway, between Harts Cove and Seatuck Cove, and across from Moriches Inlet. This wetland has undergone restoration by the Long Island Wetland Restoration Initiative (LIWRI). Suffolk County Vector Control works in partnership with the USFWS, NYSDEC, Ducks Unlimited, and other occasional cooperators, as part of LIWRI. LIWRI's goal is to restore and enhance wetlands damaged by dredge and fill projects, systematic grid ditching for mosquito control, *Phragmites australis* control and to protect critical environmental habitats found on Long Island.

The entire marsh, located on the eastern shore of the NYS Conservation Area, is approximately 3.76 hectares acres in size. Approximately 2.76 hectares (73 percent) were studied.

6.3 Topography and Waterbodies

The Havens Point State tidal wetland is situated within Hydrogeologic Zone VI, as delineated in the Long Island 208 Study. This south shore zone is a 'surface water impact area,' where groundwater discharges to Moriches Bay and the eastern portion of Great South Bay. Any contaminants present in the groundwater can have a major impact on surface waters in this area as flushing rates in this part of the Bay are low.

Hard, sandy soils, and even plant cover, due to a mix of *S. alterniflora* (short form) and *S. patens*, dominated the lower marsh of the study site. In the middle marsh, plant cover was even, but the soil was muddy. Upland topography consisted of clumps of grass and thick stands of *P. australis* (approximately 3.3 meters tall), along with wet muddy sediment. Thick stands of *P. australis* and muddy sediment were particularly prevalent near the pond.

A bell-shaped pond (approximately 60 x 38 meters) was located between the upland and the terrestrial border of the marsh. The pond contained approximately 10 centimeters of water and 45 centimeters of mud. Water movement was observed. A small creek branching from ditch 2, near the 2nd tidal inundation stake, had eroded banks and minimal water movement. The creek ended in a small pool that had a muddy bottom (60 centimeters deep).

6.4 Land Use and Population Density

The entire area was open space, with approximately 75 percent covered by wetlands and 25 percent covered by forest. Residential plots (approximately 0.2 hectares in size) bordered the wetland to the north. The population is approximately 337 within ½ mile of Haven's Point and 6,298 within two miles of the site.

6.5 Tidal Characteristics

6.5.1 Tidal Range

The mean tidal range (MHW–MLW) was 80 centimeters (2.9 feet) and the mean spring tidal range (MHHW-MLLW) was 100 centimeters (3.5 feet) (as measured at the Moriches Inlet, Moriches Bay).

6.5.2 Tidal Inundation

The wetland is exposed to a long fetch across Moriches Bay. Erosion from wave energy has exposed the roots of *Spartina alterniflora* plants growing along the shore.

Four stakes measuring tidal inundation (stakes S1-S4) were placed in the marsh on November 10, 2004, within two days of the monthly full moon. Retrieval and reading occurred on November 11, 2004. Stake S1 was placed in the low marsh, immediately west of the *Iva frutescens* and *P. australis* line bordering the seaward berm. Stake S1 revealed that the low marsh received 10 centimeters of water. Stake S2, placed near a small pool and approximately 6.0 meters from the first major parallel ditch, revealed the lower middle marsh received 13 centimeters of water. Stake S3 was placed in the upper middle marsh, near the entrance to the pond, revealed this area received 18 centimeters of water. Stake S4 was placed in the upper marsh, north of the pond and *P. australis* at the terrestrial border. During high tide, this area received 14 centimeters of water. The results indicate that inundation increases from the low marsh to the upper marsh, with the middle marsh receiving the greatest amount of water. This is likely the result of water entering the marsh from the south, and flowing north, through ditch D2 and ditch D3. Stake S1 had the lowest reading because it was placed away from any water sources, while stakes S2 and S3 were placed among water sources and stake S4 was placed approximately 15 meters from a water source. The highest reading, obtained near the pond, coincided with eroded banks and heavy *P. australis* growth in that area.

Table 6-1. Havens Point Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Low	10
S2	Middle-lower portion	13
S3	Middle-upper portion	18
S4	Upper	14

6.6 Stormwater

No stormwater discharge pipes were observed. Stormwater sheet flow onto the marsh is expected from the adjacent residential area, between Pine Edge Drive and Beach Boulevard and from the residential area east of an offshoot of Pine Edge Drive.

6.7 Water Quality

Water quality samples were taken at various locations along three ditches (D1, D2 and D3) and one pond (P1). Water flows, water depth, ditch width, and substrate firmness increased in a northerly direction. Salinity and temperature remained constant across the marsh in a north/south direction, but varied from the upland to the lower marsh areas. Salinity in the pond and upper marsh was less than the salinity in the lower marsh and was inversely proportional to tidal inundation. Conversely, temperature increased from the lower marsh to the upper marsh. An increase in temperature may have been due to a decrease in ditch water depth. Water quality measurements could not be taken in several areas along ditch D3 because they were occluded with plants or a piece of wood (Table 2). Trends in dissolved oxygen could not be analyzed due to instrument malfunction in the field.

Table 6-2 - Havens Point Station Water Depth and Water Quality Measurements

Sample Location	Station Location Characteristic	Station Water Depth (centimeters)	Temperature (ºC)	Salinity (ppt.)
D1A	Low marsh	25	6.2	24.2
D1B		20	5.3	24.7
D2A	Lower middle marsh	30	5.5	24.5
D2B		NR	6.2	24.1
D2C		NR	7	22.9
D2D		10-15	6.7	24.0
D3A	Upper middle marsh	0.0	NA	NA
D3B		15	10.4	23
D3C		45	10.1	23.4
D3D		5-7	NA	NA
D3E		0.0	NA	NA
P1	Upper middle marsh, large pond	10	9.7	22.2

NR-“not recorded” for a specified sample.
NA- “not available” due to a small amount of water present.
D = ditch P = pond
A, B, C and D = samples taken along a ditch

6.8 Ecology

6.8.1 Tidal Vegetation

A mix of salt marsh hay (*Spartina patens*) and the short form of smooth cordgrass (*Spartina alterniflora*) commonly covered the panels of land in between ditches; while the tall form of *S. alterniflora*, sea lavender (*Limonium carolinianum*) and marsh elder (*Iva frutescens*) were common along ditch edges. The common reed (*Phragmites australis*) dominated the upland border and surrounded the perimeter of a bell-shaped pond (approximately 60 x 38 meters) that was located between the upland and the terrestrial border of the marsh. *Phragmites australis* has also invaded the *S. patens/S. alterniflora* mix along the ditch draining the pond, and was present in the seaward border of the panels. The banks of the ditch draining the pond, along with several side ditches, were wet and highly eroded, with marsh grasses present in individual clumps. A berm bordering the seaward edge of the marsh allowed the existence of a second set of upland plants, such as *Baccharis halimifolia, I. frutescens, L. carolinianum, S. alterniflora, S. spicata* and some *P. australis*.

A white film was present on the surface of the mud near the roots of the *S. patens* and *S. alterniflora* (short form) mix, suggests the presence of bacteria or algae. Additionally, sea lettuce (*Ulva* spp.) was present at the shore.

6.8.2 Phragmites

The common reed (*Phragmites australis*) dominated the upland border and surrounded the perimeter of a bell-shaped pond (approximately 60 x 38 meters) that was located between the upland and the terrestrial border of the marsh. *Phragmites australis* has invaded the *S. patens/S. alterniflora* mix in middle marsh areas and along the ditch draining the pond. This plant was also present in the seaward border of the panels.

6.8.3 Upland Vegetation

The upland area is dominated by *P. australis*, while white pine (*Pinus strobus*), white oak (*Quercus alba*), red oak (*Q. rubra*), and eastern red cedar (*Juniperus virginiana*) trees comprised the terrestrial border.

6.8.4 Wildlife

Fish were present in all ditches, except those that had little or no water due to plant blockages. Ribbed mussels (*Geukensia demissa*) were present along the edge of several ditches in the southern part of the marsh. Songbirds were noted in the area where the marsh emptied into the cove and a flock of snow geese were seen flying over the marsh and landing in the cove. Geese and ducks likely frequent the large pond since a hunter's blind was spotted opposite the pond entrance.

6.9 Mosquito Habitat/History

6.9.1 Ditching and Ditch Condition

Grid ditching of the marsh has resulted in two main ditches parallel to Seatuck Cove and eight shorter ditches perpendicular to the cove. Two perpendicular ditches flanking the parallel ditch closest to the shore allow water to enter the marsh from the south, and exit from the north.

Several perpendicular ditches were partially or totally occluded with the tall form of *Spartina* and/or *Phragmites australis*. The area near station D3D was also occluded by a piece of wood. Tidal flow in these areas was restricted and water depth was minimal, ranging from zero inches to three inches. A soft muddy bottom (approximately 60 centimeters) was common in all ditches, with the exception of the northern-most perpendicular ditch. A hard, sandy bottom existed at the mouth of this ditch, while a hard muddy bottom (5 centimeters) existed along the rest of the ditch.

6.9.2 Pesticide Applications

Havens Point has not been subjected to larvicide or adulticide applications. OMWM techniques have not been implemented at this marsh.

7 Johns Neck Creek

7.1 Selection Criteria and Current Condition

Johns Neck is located on the south shore of the Long Island mainland, in the central portion of the Town of Brookhaven, within the Mastic-Shirley peninsula. The peninsula juts into Long Island's South Shore Estuary Complex, dividing the Great South Bay (to the west) from Moriches Bay (to the east). The two bays are connected by Narrow Bay, a shallow, and one-half to one-mile wide section of the South Shore Estuary.

Johns Neck was selected as a PSA because of the major vector control problems in the marsh and surrounding area, and because it was chosen as a risk assessment site and one of the caged fish study sites.

7.2 Location, Size and Ownership

Johns Neck is approximately 31 hectares (76 acres) in size and is divided into two separate areas by Johns Neck Creek, a tributary of Narrow Bay. The western portion of Johns Neck is approximately 16 hectares (40 acres) in size and is bounded by Unchachogue Creek to the west and Johns Neck Creek to the east. The eastern portion of Johns Neck is approximately 15 hectares (36 acres) in size and is bounded by Johns Neck Creek to the west and by freshwater wetlands and residential development to the east.

Johns Neck is a state-designated conservation area, managed by NYSDEC for conservation purposes and waterfowl hunting. The western marsh was the focus of this study.

7.3 Topography and Waterbodies

The entire Mastic Beach peninsula is situated within the Hydrogeologic Zone IV, as delineated in the Long Island 208 Study. This area is a portion of the south shore shallow flow system that discharges to Narrow Bay. Groundwater in this area primarily moves laterally toward the coastal waters, possibly with some degree of upward flow as the groundwater discharges to the bay.

Johns Neck vegetation is dominated mainly by *Spartina alterniflora* and *Distichlis spicata*. A large upland border of *Phragmites australis* and *Iva frutescens* exist on the eastern portions of the marsh.

One pond and six pannes were observed Johns Neck. The pond measures approximately 4 x 2 meters (13 x 6.5 feet) in size and panne sizes ranged from 5 x 1 meters (16 x 3 feet) to 8 x 18 meters (26 x 59 feet).

7.4 Land Use and Population Density

Dense residential development borders the northern portion of the marsh. Freshwater wetlands exist along the eastern boundary of the marsh.

Population is 5,915 within one-half mile, and 19,525 within two miles. Predominant land use north of the site is single-family residential development on small lots.

7.5 Tidal Characteristics

7.5.1 Tidal Range

Johns Neck is not tidally restricted. Based on tidal information for Mastic Beach, the mean tidal range for Johns Neck is approximately 15 centimeters. The spring tidal range is approximately 18 centimeters and the mean tide is six centimeters.

7.5.2 Tidal Inundation

In order to assess the amount of tidal inundation on the marsh surface in areas of high marsh, a tidal inundation study was completed during the lunar high tide in October 2004. Before the lunar high tide, stakes were placed in areas of standing water throughout on October 27th and inundation measurements were collected on October 28th.

Stake S1 and S2 were placed adjacent ditches amidst high marsh vegetation. Stake S1 received 12 cm of water and stake S2 received 11.5 cm of water. Stake S3 was placed in a panne surrounded by mixed high marsh and intertidal marsh vegetation. This panne received 31.5 cm of water. Stake S4 was placed in a pond located south of the panne. The pond received 14.5 cm of water. Stake S5 was placed in high marsh where inundation reached 18 cm. Stake S6 was placed in high marsh vegetation. This area received 13 cm of water.

Stakes S5 and S6 in the mid section of the marsh most likely receive inundation through spurs created off main ditches. The panne where stake S3 was placed received the most amount of inundation. This is likely due to the low topography of the surrounding area and the proximity to Unchachogue Creek.

Table 7.1 Johns Neck Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	High marsh	12
S2	Adjacent to ditch	11.5
S3	Panne	31.5
S4	Pond	14.5
S5	High marsh	18
S6	High marsh	13

7.6 Stormwater

No stormwater discharge pipes were observed at Johns Neck.

7.7 Water Quality

Water quality measurements were collected from the head, mouth, and mid-point sections of the tidal creek and two selected ditches (D1 and D2). Both ditches were analyzed at low tide.

Temperature, salinity, and dissolved oxygen increased with depth towards the mouth of ditch D1. Salinity was the lowest at the head of ditch D1 where *Phragmites australis* occluded the ditch. Temperature and dissolved oxygen also increased with depth towards the mouth of ditch D2. Salinity remained constant along ditch D2.

Table 7-2 - Johns Neck Water Quality Data and Ditch Water Depth

Station	Sample Location Characteristics	Water Depth (centimeters)	Temp. (C)	Salinity (ppt.)	DO (mg/L)
TC-A	*S. alterniflora*	>100	15.5	21.9	7.51
TC-B	*S. alterniflora*	>100	16.0	21.6	7.54
TC-C	*Phragmites*, steep bank	>100	16.7	21.6	7.82
D1A	*S. alterniflora, D. spicata*	35	16.8	21.5	5.45
D1B	*Iva frutescens*, berm	17	15.0	20.3	1.13
D1C	*S. alterniflora*	4	14.5	7.2	2.81
D2A	*S. alterniflora, D. spicata*	44	16.4	22.0	6.87
D2B	*Iva frutescens*, berm	32	15.6	22.8	4.35
D2C	*Phragmites*	6	14.4	21.5	4.31

Note: Samples collected on 10/13/04; 1:03 p.m. low tide
D = ditch TC = tidal creek

7.8 Ecology

7.8.1 Tidal Vegetation

The vegetation at Johns Neck consists predominantly of *Spartina alterniflora* mixed with *Distichlis spicata*. *Spartina alterniflora* becomes the dominant vegetation along the western portion of ditches and along the tidal creek. *Distichlis spicata, S. patens,* and *Iva frutescens* dominate the high marsh vegetation. *Iva frutescens* is more abundant along the eastern portions of the ditches and among ditch berms.

7.8.2 Phragmites australis

A large dense stand of *Phragmites australis* exists along the eastern boundary of the marsh where freshwater wetlands are present.

7.8.3 Wildlife

Few to moderate numbers of Atlantic silverside (*Menidia menidia*) were observed in the ditches during high tide. The pond and pannes contained few numbers of fish during the lunar high tide. One of the pannes also contained an abundant number of grass shrimp (*Palaemonetes pugio*).

7.9 Mosquito Habitat/History

7.9.1 Ditching and Ditch Condition

Johns Neck has been subject to ditching throughout the entire marsh. Parallel ditches run from east to west and are spaced approximately 61 meters (200 feet) apart. Perpendicular spurs and an upland perimeter ditch had also been constructed.

Two ditches (D1 and D2) were analyzed for general ditch characterization. These ditches have clear connections to Unchachogue Creek and terminate in *Phragmites australis*. The ditches at Johns Neck have muddy substrates.

Adjacent vegetation along the D1 consists mainly of *S. alterniflora*. Berms are present on the south and north side of D1 along the south side of D2. *Iva frutescens* is the dominant vegetation on the berms.

7.9.2 Pesticide Applications

Aerial larvicide applications are performed throughout the marsh during the mosquito-breeding season. Ground adulticide applications are applied near the marsh in the nearby residential areas. No OMWM techniques have been installed on this marsh.

8 Stillman Creek and Namkee Creek

8.1 Selection Criteria and Current Condition

The wetlands at Stillman Creek and Namkee Creek were selected as PSAs because they are south shore fringing marshes of manageable size that are part of a diverse complex, and are sites of vector control problems.

8.2 Location, Size and Ownership

Stillman Creek and Namkee Creek are located on the south shore of the Long Island. Stillman Creek, located within the western section of the Town of Brookhaven, drains into Patchogue Bay. Namkee Creek, located 350 meters (1,150 feet) west of Stillman Creek, is located within the Town of Islip and empties into Great South Bay.

Stillman Creek is approximately 7.6 hectares (19 acres) in size and Namkee Creek is approximately 10.5 hectares (26 acres). Both marshes are bounded to the east and west by residential development. Stillman Creek and Namkee Creek are state-owned tidal wetlands that are managed by NYSDEC for conservation purposes and waterfowl hunting.

8.3 Topography and Waterbodies

Stillman Creek and Namkee Creek are situated within Hydrogeologic Zone VI, as delineated in the Long Island 208 Study. This south shore zone is a 'surface water impact area,' where groundwater discharges to Moriches Bay and the eastern portion of Great South Bay. Any contaminants present in the groundwater can have a major impact on surface waters, as flushing rates in this part of the Bay are low.

The marshes at Stillman Creek and Namkee Creek are similar in topography in that they both have a large dense stand of *Phragmites australis* that dominates the northern portion of the marshes. A mixture of *P. australis* and *Baccharis halimifolia* border the southernmost portions of both marshes. Both sites have been grid ditched with extensive grid networks in the southern portions of the marshes.

Stillman Creek divides the Stillman Creek marsh in half laterally. The mouth of the creek is approximately three meters (9.8 feet) wide at high tide, allowing a clear connection to Great South Bay. Several pannes and ponds are located in the center portion of the marsh. The maximum depth of ponds measured 20 cm (8 inches) deep and the maximum size was 20 x 25 meters (65 x 80 feet) wide.

Namkee Creek runs along the eastern boundary of the Namkee Creek marsh. The creek empties into the bay via an underground drainage pipe. Namkee Creek also contains numerous pannes and ponds throughout the low-lying areas of the marsh. The depths of the ponds range from 11 to 22 cm (4 x 9 inches) deep, and were as large as 15 x 24 meters (50 x 80 feet).

8.4 Land Use and Population Density

Predominant land use near the two sites is residential development. The population is 3,047 within one-half mile of Stillman Creek and 27,000 within two miles. The population is 3,000 within one-half mile of Namkee Creek, and 25,000 within two miles.

8.5 Tidal Characteristics

8.5.1 Tidal Range

Stillman Creek has an unobstructed connection to the bay and, therefore, is not tidally restricted. Namkee Creek is tidally restricted due to the underground drainage pipe that empties into Great South Bay. Based on tidal location information at Patchogue, the mean tidal range for this area is approximately 20 cm (0.7 feet). The spring tidal range is approximately 25 cm (0.8 feet) and the mean tide is 10 cm (0.3 feet).

8.5.2 Tidal Inundation

In order to assess the amount of tidal inundation on the marsh surface, a tidal inundation study was completed during the full moon high tide in October 2004. Before the lunar high tide, stakes were placed in areas of standing water throughout the high marsh.

Seven stakes were placed throughout Stillman Creek on October 27th and inundation measurements were taken on October 28th. Two stakes were placed in ponds, two were placed in pannes and the rest were placed in the high marsh.

Stake S1 was placed amidst high marsh vegetation in the southeast section of the marsh. This area received 10 cm of inundation during the lunar high tide. Stake S2 was placed in the high marsh near the tidal creek. This area was surrounded by *Spartina patens* and received a maximum of 14 cm of water. Stake S3 was placed in a pond adjacent a ditch. This location is surrounded by mixed intertidal and high marsh vegetation. Tidal inundation in this pond measured 12 cm. Stake S4, placed in mixed vegetation adjacent to the tidal creek received 18 cm of water. Stake S5 was placed in a panne just north of the southern berm, and west of S1. Stake S5 received 29 cm of water, significantly higher than S1. This increase may be due to the increase of the height of the berm along the southern boundary of the marsh. This is also evident by the large amount of dead eel grass noted in the ditch adjacent to S5. Stake S6 was placed in a pond surrounded by mixed vegetation east of the tidal creek. This area received 13 cm of water, likely fed by an adjacent ditch, which is directly connected to the tidal creek. Stake S7 was placed in a panne east of the tidal creek surrounded by high marsh vegetation. This area received 9 cm of water. The elevation of this area was slightly higher, which may reason for less amount of inundation.

Table 8-1 - Stillman Creek Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	High marsh	10
S2	High marsh	14
S3	Pond	12
S4	High marsh	18
S5	Panne	29
S6	Pond	13
S7	Panne	9

Seven stakes were placed throughout Namkee Creek on October 27th and inundation measurements were collected on October 28th. Stake S1 was placed adjacent to a ditch in high marsh vegetation. This area received 13 cm of water during the lunar high tide. Stake S2 was placed amidst high marsh *Phragmites australis*. This area received 20 cm of inundation. Stake

S3 was placed in panne adjacent to Ditch 2. This panne received 13 cm of water. Stake S4 was placed on the edge of a pond surrounded by mixed vegetation. This area received 21 cm of water. Stake S5 was placed in a pond surrounded by intertidal vegetation. This area received the most amount of inundation with 27.5 cm of water. This is likely due to the low topography and extensive grid ditches in the area. Stake S6 was placed in a pond surrounded by mixed vegetation east of S5. This area received 19 cm of water. Stake S7 was placed in the northernmost section of the marsh in a pond surrounded by high marsh vegetation and *Phragmites*. This area received 9 cm of water. The elevation of the marsh is slightly higher towards in this area, which may be the result of less inundation. With the exception of stake S5, the stakes positioned closest to the tidal creek received more inundation. Stake S6 received similar inundation amounts as those near the tidal creek because of a natural ditch extending from the creek into the area of stake S6.

Table 8-2 - Namkee Creek Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Adjacent to ditch	13
S2	High marsh	20
S3	Panne	13
S4	Edge of pond	21
S5	Pond	27.5
S6	Panne	19
S7	Pond	9

8.6 Stormwater

No stormwater discharge pipes were observed at Stillman Creek or Namkee Creek. The creeks comprise minor drainage basins, between the larger Browns River (to the west) and Patchogue River (to the east) drainage basins. These very small, short streams only drain the immediate vicinity of the wetlands.

8.7 Water Quality

Water quality measurements were taken along three ditches (D1, D2, and D3) at Stillman Creek during ebb tide. Temperature increased towards the head of ditches D1 and D2. Salinity measurements varied but were highest at the head of ditch D1. Salinity measurements along ditch D2 were lowest at the head of the ditch. Dissolved oxygen decreased with higher temperature and salinity in ditches D1 and D2. Temperature recordings were highest along ditch D3. Temperature, salinity, and dissolved oxygen were similar along ditch D3.

Water quality measurements were collected along two ditches (D1 and D2) at Namkee Creek. Both ditches varied in all parameters. Higher temperature and salinity corresponded with greater ditch depth. Dissolved oxygen varied with depth along both ditches. Salinity varied along ditch D1 and temperature decreased slightly toward the mouth. This is mostly likely because the mouth of ditch D1 was taken at the junction of Namkee Creek, which is tidally restricted. Higher salinity readings at the head of ditch D1 may be the result of an adjoining ditch, which may receive sheet overflow from the bay.

Table 8-3. Stillman Creek Water Quality Data and Ditch Water Depth

Station	Sample Location Characteristics	Water Depth (centimeters)	Temp. (C)	Salinity (ppt.)	DO (mg/L)
TC-A	*Ammophila breviligulata*	16	9.8	15	4.65
TC-B	*S. patens, Phragmites*	29	10	5.8	4.38
TC-C	Upland vegetation	38	10.9	0.1	5.04
D1A	*S. alterniflora, S. patens*	-	13.5	2.4	9.96
D1B	*S. patens, Phragmites, Iva frutescens*	-	16.1	0.2	3.15
D1C	*S. alterniflora, S. patens*	-	16.7	4.8	1.02
D2A	*S. alterniflora*	-	17	17.5	1.34
D2B	*S. alterniflora*	-	17.8	18	0.40
D2C	*S. alterniflora*	-	20	15.5	0.74
D3A	*S. patens, Phragmites*	-	21.9	9.2	2.6
D3B	*S. alterniflora, S. patens*	-	22.1	9.9	3.01

Note: Samples collected on 10/7/04, 2 ½ hours before low tide
D = ditch TC = tidal creek

Table 8-4 - Namkee Creek Water Quality Data and Ditch Water Depth

Station	Sample Location Characteristics	Water Depth (centimeters)	Temp. (C)	Salinity (ppt.)	DO (mg/L)
TC-A	*Phragmites, Baccharis halimifolia, Toxicodendron radicans*	>100	9.3	8.8	2.97
TC-B	*Phragmites australis*	15	9.1	2.6	3.60
TC-C	*Phragmites australis*	8	10.4	0.2	1.34
D1A	*Phragmites australis*	15	15.1	9.3	3.9
D1B	*Phragmites australis, Distichlis spicata*	17	16	13.6	7.25
D1C	*Phragmites australis*	24	17.2	15.4	5.58
D2A	*Phragmites, B. halimifolia, T. radicans*	20	16.1	14.5	14.77
D2B	*Phragmites australis*	19	14.4	10.9	0.32
D2C	*Phragmites australis*	14	13.8	10.8	2.24

Note: Samples collected on 10/12/04, during low tide (4:30 p.m.)
D = ditch TC = tidal creek

8.8 Ecology

8.8.1 Tidal Vegetation

Spartina alterniflora is the dominant vegetation along the ditches and in a few low lying areas at Stillman Creek. The mid portions of the marsh, generally near ponds and pannes, are dominated by a mix of high marsh and intertidal vegetation. Clumps of *S. alterniflora* are present among ponds and pannes. *Distichlis spicata* and *S. patens* dominate the high marsh, tidal creek edges and perimeter of the marsh at Stillman Creek. *Iva frutescens, Baccharis halimifolia, Salicornia,* and *Phragmites australis* are also located throughout the high marsh. *Iva, Baccharis, Phragmites,* and *Toxicodendron radicans* (poison ivy) form a southern high marsh border.

Only a few small areas throughout the Namkee Creek marsh are dominated by intertidal vegetation. *S. alterniflora* is mainly mixed with high marsh vegetation, or in clumps among ponds and pannes. High marsh areas at Namkee Creek are dominated by large stands of *Phragmites australis*. *S. patens, D. spicata, Scirpus pungens, Pluchea purpurascens* and *Salicornia* are mixed with intertidal vegetation in the mid to lower section of the marsh.

8.8.2 Phragmites australis

An extensive amount of *Phragmites australis* is located in the upper portion and southern boundary of both Stillman Creek and Namkee Creek. *P. australis* is also abundant along the ditches and the west and eastern boundaries at Namkee Creek.

8.8.3 Wildlife

Few fish were observed in the ditches at Stillman Creek. Species of fish caught were mummichogs (*Fundulus heteroclitus*) and rainwater killifish (*Lucania parva*). A great blue heron (*Ardea herodias*), great white egret (*Casmerodius albus*) and mallards (*Anas Platyrhynchos*) were observed at Stillman Creek.

Mummichogs and rainwater killifish were moderately abundant in the ditches, pannes and ponds at Namkee Creek.

8.9 Mosquito Habitat/History

8.9.1 Ditching and Ditch Condition

Stillman Creek and Namkee Creek have an extensive network of grid ditches throughout each marsh. Ditch spacing ranges from approximately 15 to 60 meters (50 to 200 feet) and are perpendicular to the adjacent tidal creeks.

Three ditches (D1, D2, and D3) at Stillman Creek were analyzed for general ditch characterization. The ditches have a soft muddy substrate and berms were absent from ditch edges. Adjacent vegetation consists mainly of *S. alterniflora*; however, ditches D1 and D3 had small sections of high marsh vegetation consisting of *Phragmites australis, Iva frutescens,* and *S. patens.*

Two ditches (D1 and D2) were analyzed for general ditch characterization at Namkee Creek. The ditches had a muddy substrate, with an increasing amount of sand towards the west. High marsh is the dominant vegetation adjacent to the ditches, mainly consisting of *Phragmites australis, D. spicata, Althea officinalis, Baccharis halimifolia*, and *Toxicodendron radicans.*

Abundant amounts of fish were observed during high tide at the mid-length portion of ditch D1. None were noted at this location during low tide.

8.9.2 Pesticide Applications

Both sites receive aerial larvicide applications. No OMWM techniques have been implemented at either site.

9 Pepperidge Hall

9.1 Selection Criteria and Current Condition

The Pepperidge Hall State tidal wetland was chosen as a PSA because it is a south shore fringing marsh, with vector control problems, that is located adjacent to a residential area. Although the vegetation is relatively undisturbed, several berms limit tidal circulation into and out of the marsh. The wetland might lend itself to the installation of fish reservoirs and spurs that could limit mosquito breeding.

9.2 Location, Size, and Ownership

The Pepperidge Hall State tidal wetland is owned and managed by NYSDEC. It is located in the town of Oakdale, south of Montauk Highway and east of Vanderbilt Boulevard.

The wetland is approximately 22.0 hectares. Approximately 6.0 hectares of the total was studied. The site is bordered to the north by Blue Point Road, which also serves as an access road, and by Belvedere Drive, to the east.

9.3 Topography and Waterbodies

The Pepperidge Hall wetland is situated on the border of Hydrogeologic Zones VI and VII, as delineated in the Long Island 208 Study. This south shore Zone VI is a 'surface water impact area,' where groundwater discharges to Moriches Bay and the eastern portion of Great South Bay. Any contaminants present in the groundwater can have a major impact on surface waters in this area, as flushing rates in this part of the Bay are low. Zone VII is a south shore shallow flow systems, where groundwater generally flows laterally and can affect marine water quality.

A large tidal creek flowed along the northeastern edge of the wetland complex, while its southern shore was exposed to a substantial fetch across the Great South Bay. A small pond (<0.2 hectares) was found in the southwestern portion of the complex and a 0.8-hectare tidal pond connected to the tidal creek. Given the size of the tidal creek and the channel going into the larger pond, good tidal exchange in and out of the pond is highly possible. The tidal creek along the eastern edge of the wetland complex connected to a series of man-made lagoons located within residential developments.

There were five pannes in the study area, two in the low marsh, two in the middle marsh and one in the upper marsh. Three of the five pannes were located adjacent to an area dominated by *Phragmites australis*.

A substantial berm was located adjacent to the tidal creek along the northeastern edge of the wetland. The berm obstructed tidal flow into and out of all ditches along the northeastern segment of the marsh. Similarly, tidal flow was restricted along the western portion of the marsh by a berm running through the middle of the marsh, in a southeasterly direction.

9.4 Land Use and Population Density

Land use surrounding the Pepperidge Hall State tidal wetland was completely residential. Population density within ½ mile of the wetland is 2,375 and 21,331 within two miles of the wetland. Houses, situated on 0.25 acre and 0.5 acre plots, lined Belvedere Drive and Blue Point Roads and bordered the study site to the northeast.

9.5 Tidal Characteristics

9.5.1 Tidal Range

The mean tidal range (MHW–MLW) was 18 centimeters (0.6 feet) and the mean spring tidal range (MHHW-MLLW) was 21 centimeters (0.7 feet) (as measured at the Great River, Great South Bay).

9.5.2 Tidal Inundation

Tidal inundation measurements are pending.

9.6 Stormwater

No stormwater discharge pipes were observed in the study area.

9.7 Water Quality

Temperature increased from the low marsh to the high marsh in ditch 2 (D2), but was constant along ditches D3 and D4. Salinity increased toward the upper marsh in all three ditches, with salinity being slightly higher in ditch D2. The slightly higher temperature and salinity readings in ditch D2 were likely due to this ditch being located closer to a tidal pool, than ditches D3 and D4. Dissolved oxygen decreased toward the upper marsh in all ditches, with readings, again, being slightly higher in ditch D2. The trend in dissolved oxygen correlated with the trends displayed by the temperature and salinity readings (i.e. dissolved oxygen decreases as temperature and salinity increase). Temperature and salinity readings were highest and dissolved oxygen readings were lowest in salt panne P1, as is typical of salt pannes. Water quality measurements were not recorded for samples taken at stations D2C (middle marsh), D4E (upper marsh), and P2 (upper marsh) (Table 9-1).

Table 9-1. Pepperidge Hall-Water Quality Measurements

Station	Station Location Characteristics	Temperature (ºC)	Salinity (ppt.)	Dissolved Oxygen (mg/L)
D1A	Low marsh, inlet to ditch around pond	17.6	20.4	13.1
D1B	Low marsh, ditch around pond	16.7	20.5	11.7
D2A	Low marsh	16.5	20.6	12.8
D2B		17.0	20.6	9.8
D2C	Middle marsh	NR	NR	NR
D3A	Low marsh	17.0	20.2	11.3
D3B		17.7	19.5	11.2
D3C	Middle marsh	17.2	18.9	9.8
D3D		17.0	18.1	9.4
D3E	Upper marsh	17.4	17.3	10.0
D4A	Low marsh	17.6	19.9	11.6
D4B		17.5	19.1	12.6
D4C	Middle marsh	16.6	16.6	10.9
D4D		19.0	26.4	9.6
D4E	Upper marsh	NR	NR	NR
P1		19.0	18.3	13.5
P2		NR	NR	NR

Notes: D = ditch P = panne
A, B, C, D and E = samples taken along ditch
NR = not recorded

9.8 Ecology

9.8.1 Tidal Vegetation

Spartina alterniflora dominated the low marsh, while a mix of *S. alterniflora* (short form) and *S. patens* covered the middle and upper marsh. However, a narrow band of this mix surrounded the tidal pond. Clear vegetation patterns were evident along ditch edges where the tall form of *Spartina alterniflora* dominated. *Iva frutescens* was present in the transition zone from the low to middle marsh, along the edges of ditches D2 and D3, but was conspicuously absent in the same area along ditch D3.

9.8.2 Phragmites

The common reed, *P. australis*, formed an almost continuous border around approximately 75 percent of the study site, with a break of trees and *Spartina alterniflora* located in the northwestern portion of the border. *Phragmites australis* did not border the edge of the 0.8-hectare tidal pond or the main trench draining the pond.

9.8.3 Upland Vegetation

Approximately 90% of the upland was dominated by *P. australis*, with the remaining 10% being covered by trees in the northwest corner of the study site. Marsh elder (*Iva frutescens*), mixed with *P. australis*, was present in the northeastern corner of the study area, near station D.

9.8.4 Wildlife

Fish were present through out the site, declining in number toward the upland. A crab (possibly the green crab, *Carcinus maenas*) was spotted in the low marsh near station D3B. Amphipods were abundant in the large panne located west of stations D4D.

9.9 Mosquito Habitat/History

9.9.1 Ditching and Ditch Condition

The complex was extensively ditched, with virtually all the ditches on the eastern side of the marsh discharging either directly into the pond or into two large ditches that drained into the pond. The ditches were parallel to each other and spaced at approximately 30-meter intervals. Tidal circulation into the parallel ditches was good, primarily due to the presence of two large ditches running in a southeasterly and northwesterly direction from the pond. Water circulation from the pond extended into these two main ditches, and into the tributary ditches. Better circulation could be achieved if the berms that bordered the eastern and western edges of the marsh were removed.

Water depth was greatest along ditch D4 and lowest along ditch D2. The difference was probably caused by a difference in ditch length, as the upper portion of ditch D2 is overgrown with *P. australis*. Water depth was constant along each individual ditch. The substrate of ditch D2 was approximately 45 centimeters of mud, while approximately 60 centimeters of mud lined ditch D3.

9.9.2 Pesticide Applications

The Pepperidge Hall State tidal wetland has received applications of larvicide and adulticide. OMWM techniques have not been implemented at this marsh.

10 Pickman-Remmer

10.1 Selection Criteria and Current Condition

The Pickman-Remmer State tidal wetland was selected as a PSA because a canal has divided it into two distinct segments. The eastern segment is impounded by a dredge spoil berm, whereas the western segment retains good tidal flow. The vegetation pattern clearly reflects the differences in tidal exchange. The eastern segment is severely degraded with the common reed, *Phragmites australis*, as the dominant plant species, while the western segment retains a plant community more characteristic of healthy tidal marshes.

In the eastern segment, the large size of a berm bordering the marsh and the small size of three existing culverts do not permit sufficient tidal exchange to support the plant species characteristic of a healthy northeastern salt marsh. This is supported by the fact that the entire length of the marsh, in between the first and third culverts (approximately 273 meters) is covered by *P. australis*. *Phragmites australis* has spread since the last aerial image of the marsh was taken in 2001.

The Pickman-Remmer State tidal wetland supports mosquito populations that require control by the County. The eastern marsh is a prime candidate for tidal flow restoration. The following discussion highlights observed differences between the two marsh segments.

10.2 Location, Size, and Ownership

The Pickman-Remmer State tidal wetland is in the town of Oakdale and is owned by NYSDEC. It is located south of Montauk Highway and Idle Hour Boulevard. The Grand Canal divides the wetland into two separate segments. The western segment can be accessed via Central Boulevard and is approximately 16 hectares in size. Approximately 325 meters of the marsh border were examined. The southwestern portion of the eastern segment can be accessed by Riverview Court and is approximately 4.6 hectares in size. Approximately 1.2 hectares of this marsh segment were studied.

10.3 Topography and Waterbodies

The Pickman-Remmer wetland is situated on the border of Hydrogeologic Zones VI and VII, as delineated in the Long Island 208 Study. This south shore Zone VI is a 'surface water impact area,' where groundwater discharges to Moriches Bay and the eastern portion of Great South Bay. Any contaminants present in the groundwater can have a major impact on surface waters in this area, as flushing rates in this part of the Bay are low. Zone VII is a south shore shallow flow systems, where groundwater generally flows laterally and can affect marine water quality.

10.3.1 Eastern Segment

A dredge-spoil berm (approximately 1.5 meters high on the canal side and 60 centimeters on the marsh side) lined the east side of the canal and was composed of hard, sandy soil. A ditch separated the marsh from the berm. The small amount of marsh interior that was accessible contained grass clumps surrounded by mud.

A tidal creek (approximately 350 meters long) divided this marsh segment in half. The head of the creek was located in the southern part of the marsh, north of the intersection of Shore Drive and Fern Place, while the mouth of the creek was located across from the first section of houses lining the canal, and was blocked by the berm. A breach in the berm at the first culvert, along with culverts two and three, and the ditch behind the berm, were the only points at which the marsh directly connected to the canal.

10.3.2 Western Segment

The marsh surface in the western segment of the marsh was wet and hummocky. The ground had boggy characteristics when jumped on.

10.4 Land Use and Population Density

Land use within the vicinity of the Pickman-Remmer State tidal wetland was heavy residential development. The population within ½ mile of the marsh is approximately 2,000 people and

20,000 within two miles. Blocks of houses, situated on a quarter-acre and half-acre plots, lined the west bank of the canal and comprised the northern border of the western segment.

10.5 Tidal Characteristics

10.5.1 Tidal Range

The mean tidal range (MHW–MLW) is 21 centimeters (0.7 feet) and the mean spring tidal range (MHHW-MLLW) is 24 centimeters (0.8 feet) (as measured at Connetquot River, Great South Bay).

10.5.2 Eastern Segment Tidal Inundation

Two stakes were placed in the eastern marsh segment to measure tidal inundation on 5/9/2005 and retrieved the following day. Stake S1 was placed in a salt panne amongst the *Phragmites* and stake S2 at the junction of two ditches near the ditch mouth. The stakes were placed the day after the monthly full moon. Stake S1 was inundated with 19 centimeters of tidal water and stake S2 with 18 centimeters. The portion of the marsh near the berm is inundated at full moon high tide. Portions of this further east and upland were inaccessible due to the dense *Phragmites*.

10.5.3 Western Segment Tidal Inundation

Stakes measuring tidal inundation (stakes S3, S4, and S2) in the western segment were placed on 5/9/2005 and retrieved the following day. Stake S3 and S4 were placed in the high marsh near the upland. Stake S5 was located at the head of a tributary ditch in the high marsh midway between the tidal channel and the upland. The stakes revealed that at least the lower (western) portion of the marsh is inundated at full moon high tide (Table 10-1).

Table 10-1. Pickman-Remmer Tidal Inundation (Western Segment)

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Eastern segment – High marsh	19
S2	Eastern segment – High marsh	19
S3	Western segment – High marsh	27
S4	Western segment – High marsh/upland	8
S5	Western segment – High marsh	19

10.6 Stormwater

10.6.1 Eastern Segment

Three culverts (approximately 45 centimeters in diameter) penetrated the berm to allow drainage of the marsh. Culvert C1, located directly across from the small marsh on the opposite side of the canal, was covered with sand and completely blocked with sediment. Culvert C2 was partially blocked with sediment and pieces of the common reed, *Phragmites australis*, while culvert C3 had water flowing through it. The 2001 aerial photograph of the site depicts an indentation in the berm edge, north of culvert C2, indicating the existence of a fourth culvert. However, a fourth culvert was not observed.

10.6.2 Western Segment

Stormwater discharge pipes were not observed in the western segment.

10.7 Water Quality

10.7.1 Eastern Segment

Temperature, salinity, and dissolved oxygen readings were highest near culvert C1. Otherwise, temperature readings were similar, while salinity at culvert C1 also differed from the rest of the sampling stations. It was sandy and hard versus muddy (60 centimeters deep). The area near culvert C1 was the only location where tidal exchange occurred freely, due to a breach in the berm. Additionally, dissolved oxygen was lowest in the canal, near culvert C3 (Table 10-2).

Table 10-2. Pickman-Remmer Water Quality Measurements (Eastern Segment)

Station	Station Location Characteristic	Temperature (ºC)	Salinity (ppt.)	Dissolved Oxygen (mg/L)
D1A*	Adjacent to berm, near C1	5.8	18.9	8.2
D1B	Behind berm, near D1A	4.9	18.1	8.4
D2A	Behind berm, C2	5.0	16.9	5.5
D3A	Behind berm, in D4	5.0	17.0	6.7
D4A*	In canal, infront of C3	5.3	17.6	3.1

Note: D = ditch C = culvert
A and B = samples taken along ditch
* = samples taken in main canal

10.7.2 Western Segment

Two ditches (D1 and D2) were sampled for temperature, salinity and dissolved oxygen in the low marsh, middle marsh, and upper marsh areas. Temperature and salinity displayed little variation throughout the marsh (Table 10-3). Water quality measurements varied most in the middle marsh samples, but were similar in the upper and low marsh samples. The variation among middle marsh samples was likely caused by a difference in ditch length. Dissolved oxygen readings varied most in the low marsh, from 11.7 mg/L to 3.2 mg/L. Readings for dissolved oxygen were constant in the middle and upper marsh samples. Overall, better tidal circulation in the western segment of the marsh, may have accounted for salinity being higher in the western segment versus the eastern marsh segment. Likewise, higher temperature in the western segment, versus the eastern segment, may account for lower dissolved oxygen there.

Table 10-3. Pickman-Remmer Water Quality Measurements (Western Segment)

Station	Station Location Characteristic	Ditch Water Depth (centimeters)	Temperature (ºC)	Salinity (ppt.)	Dissolved Oxygen (mg/L)
D1A*	Low Marsh	NR	6.8	20.0	11.7
D1B	Middle Marsh	30	6.6	20.2	8.9
D1C	Middle Marsh	5	6.3	18.9	6.5
D1D	Upper Marsh	17	6.2	19.1	6.8
D2A*	Low Marsh	10	7.6	20.5	3.2
D2B	Middle Marsh	45	6.5	19.2	8.9

Note: NR- “not recorded” for a specified sample
D = ditch A, B, C and D = samples taken along ditch
* = samples taken in tidal creek at mouth of ditch

10.8 Ecology

10.8.1 Eastern Segment Tidal Vegetation

Typical tidal vegetation was lacking in all areas of the marsh, with the exception of two triangular panels *S. patens* near culvert C3 and a band of *S. patens* present south of where sampling station D3A. The tall form of *S. alterniflora* was growing along the berm/canal interface. It is important to note that the vegetation pattern reflected in the 2001 aerial photographs has since changed.

10.8.2 Western Segment Tidal Vegetation

Tidal vegetation in the western segment consisted of the tall form of *S. alterniflora* growing along the edges of ditches and the canal, while clumps of *S. patens*, mixed with *D. spicata* and the short form of *S. alterniflora*, covered the middle and upper marsh.

10.9 Phragmites

10.9.1 Eastern Segment

The presence of the common reed, *Phragmites australis*, was so overwhelming that at first glance, the site appeared monospecific. This plant dominated the entire length of the marsh, between culverts C1 and C3 (approximately 273 meters.). *Spartina patens* persisted in two small areas. Reeds approximately three meters high lined the marsh perimeter, while plants, approximately one meter high, covered the marsh interior.

10.9.2 Western Segment

Phragmites australis was growing along the terrestrial border, following the curve of Riverview Court and tapering off toward the eastern edge of the marsh. *P. australis* was also growing along the banks of ditches in the upper and middle marsh areas. A corridor of *P. australis*, which extended from upper marsh to the middle marsh, was present west of ditch D1.

10.10 Upland Vegetation

10.10.1 Eastern Segment

The berm supported sea myrtle (*Baccharis halmifolia*), marsh elder (*Iva frutescens*) switch grass (*Pancium virgatum*), white oak (*Quercus alba*), red oak (*Q. rubra*), scrub oak (*Q. ilcifolia*) white pine (*Pinus strobus*), and eastern red cedar (*Juniperus virginiana*). The upland area is dominated by *P. australis,* while *Pinus strobus*, *Quercus alba*, and *Juniperus virginiana* comprised the terrestrial border. A stand of trees (approximately 122 x 43 meters.), including *Pinus strobus* and *Quercus alba*, were found west of the creek.

10.10.2 Western Segment

A thin line of *Quercus alba* and *Q. rubra,* along with some willow trees (*Salix* spp.) bordered Riverview Court. *Baccharis halmifolia* bushes were mixed with *P. australis* along the marsh border and *Iva frutescens* was mixed with *P. australis* along ditch edges. *Iva frutescens* was also present in a thin band west of ditch D1.

10.11 Wildlife

The only wildlife observed in the eastern segment was a muskrat near the location of station D2A. Fish and mallard ducks were present in the canal that bordered the western segment and songbirds were present in the trees of the upland border.

10.12 Mosquito Habitat/History

10.12.1 Ditching and Ditch Condition

Ditches west of the creek were parallel to each other and were angled toward the canal. Ditches east of the creek were also parallel to each other, but were angled toward the creek. All of these ditches led to a main ditch running the length of the berm. Several areas along the main ditch were highly eroded or dry. The few angled ditches that were visible from the berm had highly eroded banks were irregular in width and contained sizeable quantities of *P. australis* detritus.

Ditches were parallel to each other and perpendicular to the canal. The mouths of these ditches have been eroded to shelves and contained dead plant matter. Ditch D2 was clogged with a mix of *S. patens* and *S. alterniflora* (short form). No water movement and no fish were present in this ditch.

10.13 Pesticide Applications

The marsh has received larvicide and adulticide applications. OMWM techniques have not been implemented at this site.

11 Pine Neck

11.1 Selection Criteria and Current Condition

The Pine Neck wetland was selected as a PSA because it is a south shore fringing marsh with few vector control problems and a healthy vegetation pattern. The wetland appears to be in transition. *Phragmites australis* surrounds the wetland, ditches are filling, and numerous cedars have died. Minimal ditch maintenance may be changing the vegetation pattern and the intensity of mosquito breeding.

11.2 Location, Size, and Ownership

The Pine Neck wetland, in the Town of Southampton, is owned and managed by the NYSDEC. The wetland is located south of Montauk Highway, between Pine Neck Point and the mouth of Weesuck Creek, bordering Shinnecock Bay. The entire tidal wetland complex is less than six hectares in size. The study area can be accessed via Widgeon Lane and measures approximately 180 x 270 meters.

11.3 Topography and Waterbodies

The Pine Neck wetland is situated within Hydrogeologic Zones V, which includes the western south fork as delineated in the Long Island 208 Study. Groundwater from the Pine Neck wetland discharges to Shinnecock Bay, where flushing rates are high.

The southern edge of the marsh has been exposed to a several mile southwesterly fetch that could regularly alter the shape of the shoreline. South of Widgeon Lane, in the northeastern corner of the site, seven similarly sized pools (all approximately 3.0 to 4.5 meters wide) were present among numerous dead shrub and tree stumps. Several small pools (all approximately 1 meter wide) were interspersed throughout the middle marsh in the areas near ditches D1 and D2. A small salt panne, surrounded by *Spartina patens* and *Phragmites australis* growth, was present in the upper marsh.

Phragmites australis and upland forest surrounded the wetland on all sides, except the seaward edge. The tree line and *P. australis* growth were thinnest in the area between Widgeon Lane and the head of ditch D1. Two areas of dead trees were adjacent to the *P. australis* growth on the eastern edge of the site and extended north toward the head of ditch D1. *Iva frutescens* and *Baccharis halimifolia* were mixed with *P. australis*, south of the dead tree stump areas.

11.4 Land Use and Population Density

Land use in the surrounding area was residential. A boat landing was present east of the study area and houses on half-acre and quarter-acre plots bordered the wetland to the north and east. Many of the houses to the north possessed in-ground swimming pools.

11.5 Tidal Characteristics

11.5.1 Tidal Range

The mean tidal range (MHW–MLW) is 73 centimeters (2.4 feet) and the mean spring tidal range (MHHW-MLLW) is 82 centimeters (2.7 feet) (as measured at the Shinnecock Bay, Inside Outer Bar benchmark).

11.5.2 Tidal Inundation

Five stakes were used to measure tidal inundation (S1-S5) on October 26, 2004, one day before the monthly new moon. Retrieval and reading occurred on October 27, 2004. S1 was placed in the upper marsh on the edge of a salt panne that was surrounded by *S. patens* and *P. australis* growth. During flood tide this area received 30 centimeters of water. Stake S2, placed amidst *S. patens* growth and approximately 15 meters north of a cross ditch, revealed the upper middle marsh received 24 centimeters of water. Stake S3 was placed in the center of the middle marsh, near a pool. This area received 50 centimeters of water. Stake S4 was placed in the lower portion of the middle marsh, approximately 1.5 meters east of D2, among *P. australis* growth. This area of the marsh received 17 centimeters of water. Stake S5 was also placed in the lower portion of the middle marsh, among *S. patens* growth, approximately 7.5 meters east of stake S4. Tidal inundation in this area was 26 centimeters. The highest readings were obtained at stake S1 and stake S3 because they were taken in areas that contain water at low tide. These areas should therefore contain a greater amount of water at high tide than areas that were dry during low tide. The readings were similar for stake S2 and S5, indicating that the middle marsh received roughly the same amount of inundation. Despite being placed only 7.5 meters apart, the readings for stakes S4 and S5 differed by more than 8 centimeters. The area near stake S4 received less water than the area near stake S5. Growth of *P. australis* along ditch D2 was noted to be 15-20 cm higher than the ditch. Ditch maintenance may have increased elevation and facilitated *Phragmites australis* growth along this ditch. The difference in the vegetation present at stake S4 (*P. australis*) versus stake S5 (*S. patens*) correlates with lower tidal inundation in the area near stake S4.

Table 11-1 - Pine Neck Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Upper	30
S2	Middle-upper portion	24
S3	Middle	50
S4	Middle-lower portion	17
S5	Middle-lower portion	26

11.6 Stormwater

No stormwater discharge pipes were observed at Pine Neck.

11.7 Water Quality

Temperature was similar (around 12.5 ºC) within and among the three ditches (D1, D2 and D3) studied. The highest reading among ditch samples was recorded at station D2B, in the middle marsh, where water temperature was generally lower than the temperature of the upper marsh. Salinity decreased toward the upper marsh, with the highest reading at station D2B. Ditch water depth increased toward the upper marsh along ditches D1 and D3, with depth being greater in ditch D1 versus ditch D3. This difference could be the result of ditch D1 being wider than ditch D3 and a partial blockage present at sample D3 B.

Temperature and salinity readings taken at each of the salt pannes (P1-P3), with the exception of the temperature reading from station P1, were greater than the temperature and salinity readings associated with ditches D1-D3. This trend typifies salt pannes. Trends in dissolved oxygen could not be analyzed due to instrument malfunction in the field (Table 11-2).

Table 11-2. Pine Neck Water Quality Measurements and Station Water Depth

Station	Station Location Characteristic	Temperature (°C)	Salinity (ppt.)	Water Depth (cm)
D1A	Middle-lower	12.2	28.4	38
D1B	Middle	12.9	25.1	30
D2C	Middle-lower	12.1	28.7	NR
D2B	Middle-lower	15.3	29.7	NR
D2A	Middle-upper	12.5	28.5	25
D3A	Middle-lower	12.7	29.6	15
D3B	Middle	12.5	26.5	5
P1	Middle-upper	12.6	27.9	15
P2	Upper marsh	16.4	26.0	NR
P3	Upper marsh	17.2	27.9	15

Note: NR indicates measurements that were "not recorded" for a specified sample
D = ditch P = panne
A, B, and C = samples taken along ditch

11.8 Ecology

11.8.1 Tidal Vegetation

The vegetated wetland extended to the seaward edge of the study site, with no apparent sandy beach. Low marsh vegetation was primarily *S. alterniflora,* with *S. patens* and *P. australis* present along ditch edges. Middle marsh areas were covered with *Spartina patens* mixed with the short form of *S. alterniflora*. The area between ditches D2 and D3 was monospecific with the tall form of *S. alterniflora*. Large pockets of *S. alterniflora* were present in area between ditch D1 and D2. Upper marsh areas were dominated by *S. patens*, which surrounded the wetland. Macroalgae was present in the middle marsh near station D1B.

11.8.2 Phragmites

The common reed, *Phragmites australis*, bordered the entire wetland complex. This plant was present along ditch edges through out the study site; with growth heaviest along ditch D2 and the cross ditch joining ditches D2 and D3.

11.8.3 Upland Vegetation

Shrubs of *Iva frutescens* and *Baccharis halimifolia* were growing among *P. australis* along the eastern edge of the study area.

11.8.4 Wildlife

Fish were noted along D1 and D2. Shrimp and ribbed mussels were present in the low marsh at station D1A. It is also possible that animals such as muskrat travel utilize this marsh as runnels were observed in the middle marsh.

11.9 Mosquito Habitat/History

11.9.1 Ditching and Ditch Condition

Five northerly oriented ditches crossed the wetland along with one ditch oriented perpendicular to the others. Ditch water depth was greatest along ditch D1. Growth of *P. australis* along ditch D2 was noted to be 15-20 cm higher than the ditch. Ditch D3 had two occlusions due to *S. alterniflora* growth: the area near station D3B and the area toward the ditch mouth.

11.9.2 Pesticide Applications

Pine Neck has not been subjected to larvicide or adulticide applications. OMWM techniques have not been implemented at this site.

12 Stokes Poges

12.1 Selection Criteria and Current Condition

Stokes-Poges tidal marsh was selected as a PSA because it has vector control problems and is located in the middle of a residential area. It is a small, south shore fringing marsh with a healthy vegetation pattern despite tidal flow restriction. The installation of fish reservoirs and spurs might limit mosquito breeding, while minimizing the impact on vegetation. The wetland is included in the Town of Southampton's Area Management Plan for potential enhancement through wetland restoration and provisions of limited walking trails, a small-scale kayak launch, and an observation station.

12.2 Location, Size, and Ownership

The Stokes-Poges wetland is in Remsenburg in the Town of Southampton. Ownership is both private (1.2 hectares or 3.0 acres) and by the Town of Southampton (5.4 hectares or 13.3 acres). It is located south of Main Street, between Tuthill Lane and Halsey Road, and can be accessed via Bay View Road. The entire wetland measures approximately 6.6 hectares and the size of the area studied is approximately 180 x 1,320 meters.

12.3 Topography and Waterbodies

The Stokes-Poges wetland is situated within Hydrogeologic Zone VI, as delineated in the Long Island 208 Study. This south shore zone is a 'surface water impact area,' where groundwater discharges to Moriches Bay and the eastern portion of Great South Bay. Any contaminants present in the groundwater can have a major impact on surface waters in this area, as flushing rates in this part of the Bay are low.

Clumps of *Spartina patens* mixed with *Spartina alterniflora* (short form) covered the marsh. The ground between the clumps was muddy and wet. Numerous channels traversed the marsh, indicating animals, such as muskrat, regularly traveled through the marsh. The upland area was dry and consisted of *Phragmites australis* mixed with *Iva frutescens* and *Baccharis halimifolia*.

Trees, such as Eastern Red Cedar (*Juniperus virginiana*), formed the terrestrial boundary of the marsh.

The wetland emptied into Moriches Bay, which opened to the ocean through Moriches Inlet. The northern portion of the wetland complex was narrow and contained the headwaters of a tidal creek. The creek spanned the entire length of the marsh and was approximately 0.2 meters long. The creek measured approximately three meters across in the southern portion and approximately 4.5 meters across in the northern portion, toward the headwaters. The straightness of its path suggested it has been channelized as part of the ditching process. The creek drained a series of small ponds south of South Country Road (Main Street). Various sized ponds were present throughout the wetland complex, three on the western edge, one on the eastern edge, and two in the center region. A pond that appeared on the 1956 USGS topographic map, in the southeastern portion of the wetland, has apparently dried up in the recent past, as vegetation appeared on the 2001 aerial photograph. Similarly, there was no evidence of another pond shown on the 1956 USGS map on the southern edge of the wetland. A series of salt pannes were present in the northern and southern portions of the study area.

12.4 Land Use and Population Density

Land use within the area was large-lot residential. Many of the houses bordering the marsh to west appear to have in-ground swimming pools. The Town of Southampton has plans (South Shore Estuary Wetlands Restoration Study) to restore and enhance the wetland "using a combination of dredge spoil displacement and regrading and open marsh water management techniques." The estimated population density within 0.8 kilometers of the wetland is 680 people.

12.5 Tidal Characteristics

12.5.1 Tidal Range

The mean tidal range (MHW–MLW) was 15 centimeters (0.5 feet) and the mean spring tidal range (MHHW-MLLW) was 18 centimeters (0.6 feet) (as measured at Potunk Point, Moriches Bay).

12.5.2 Tidal Inundation

Five stakes were used to measure tidal inundation (S1-S5) on May 9, 2005 one day after the monthly full moon. Retrieval and reading occurred the following day. All the stakes were placed in the high marsh and on the eastern side of the marsh due to access limitations. Stakes S1, S2, and S5 were placed at the edge of the *Phragmites*. Stake S3 was placed inside the *Phragmites* and stake S4 inside a salt panne. All of the marsh is inundated at full moon high tide even as far upstream as the location of stake S5.

Table 12-1 – Stokes Poges Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	High marsh	20
S2	High marsh	14
S3	High marsh	14
S4	High marsh	28
S5	High marsh	19

12.6 Stormwater

Several roadways end at the wetland complex and may therefore contribute to runoff. No stormwater discharge pipes were observed.

12.7 Water Quality

Temperature was lowest toward the middle marsh and higher in the low marsh and upper marsh. The temperature in ditches D1 and D3 were higher than the temperature along ditch D4, while temperature along ditch D2, which was also the main creek, was constant. Salinity decreased slightly toward the upper marsh and was highest near the bay. The lowest reading (23.7 ppt.) was recorded at stations D3C and D4B. The saltier water of the creek indirectly influenced station D4A, which was located at the junction of ditch D4 and a cross ditch. Station D3C was located at a pond tributary, and likely had a lower salinity reading because it received freshwater input from the pond. The temperature and salinity measured in salt pannes P1 and P2 were similar to each other, with salinity being higher in panne P1. A direct connection between panne P1 and the tidal creek may be the reason for the difference in salinity between the two salt pannes. Dissolved oxygen measurements could not be analyzed due to instrument malfunction in the field. Ditch water depth was greatest in the middle marsh, with readings being higher along ditch D2 and lower along ditch D1. Lower water depth along ditch D1 could be the result of this ditch not being directly connected to the creek or the bay (Table 12-2).

Table 12-2. Stokes-Poges and Station Water Depth and Water Quality Measurements

Station	Station Location Characteristic	Water Depth (centimeters)	Temperature (ºC)	Salinity (ppt.)
D1A	Low marsh	45	10.6	30.5
D1B		45	9.8	30.5
D2A*		110	11.3	30.3
D2B*	Middle marsh	110	11.4	30.3
D2C*		110	11.5	30.3
D2D*		0.2	11.5	30.2
D3A		60	10.8	30.4
D3B		30	11.0	29.9
D3C	Upper marsh	20-25	12.0	23.7
D4A	Middle marsh	25	12.8	30.1
D4B	Upper marsh	25	12.2	23.7
P1	Middle marsh	0.45	11.5	30.3
P2		25	12.3	29.7

Note: D = ditch P = panne
A, B, C, and D = samples taken along a ditch
* = samples taken along tidal creek

12.8 Ecology

12.8.1 Tidal Vegetation

The low marsh was covered by the short form of *Spartina alterniflora* and the tall form of *S. alterniflora* along ditch edges. The short form of *S. alterniflora* became mixed with *S. patens* in the middle marsh, with *S. patens* becoming dominant toward the upper marsh. The common glasswort, *Salicornia europaea*, was present in the salt pannes.

12.8.2 Phragmites

The common reed (*Phragmites australis*) lined the entire perimeter of the site, clockwise, starting at the western edge, from Cutler Lane, north to Old Pond Road and continuing south to Bay View Road. Growth was heaviest along the eastern edge of the site and in the area which surrounded ditch D2, between Old Pond Road and Godfrey Lane.

12.8.3 Upland Vegetation

Shrubs of *I. frutescens* and *B. halimifolia* were mixed with *Phragmites australis* along the eastern and western borders of the study area. Bayberry (*Myrica pensylvanica*) was part of this mix on the western edge, near Cutler's Lane.

12.8.4 Wildlife

Large numbers of fish were observed along the northern portion of the tidal creek, with smaller numbers present in the salt pannes.

12.9 Mosquito Habitat/History

12.9.1 Ditching and Ditch Condition

The wetland has been grid ditched throughout the complex. Although the ditches do not always connect to the pannes, they do connect to all the ponds. The banks of the tidal creek were highly eroded, particularly in the central portion of the study area. Creek width was greatest toward the headwaters (approximately 3.3 meters). Ditch D3 traveled through several salt pannes. Mud (approximately 0.7 meters deep) lined all pannes and ditches, with the exception of the mouth of ditch D2. Samples taken at stations D2A and D2B revealed this area had a hard, sandy bottom. Water exiting the marsh at the mouth of the tidal creek has deposited a considerable amount of material into the bay. It is possible that this material eroded from the western shore of the marsh and was "pushed" out into the bay by ebb-tide flow from the creek. The difference in substrate type at the mouth of ditch D2 (hard and sandy) was likely the result of the fast flowing water noted in this area.

12.9.2 Pesticide Applications

The Stokes-Poges wetland has regularly received larvicide applications. OMWM techniques have not been implemented at this marsh.

13 Gilgo West

13.1 Selection Criteria and Current Condition

The West Gilgo Beach salt marsh was chosen as a PSA because it is part of a barrier beach system located adjacent to a residential area. The marsh possesses a healthy vegetation pattern within the existing ditch system. It might be possible to install fish reservoirs and spurs along the upland edge to limit mosquito breeding, while minimizing the impact on vegetation.

The ditch that runs the length of the marsh in an east/west direction limits the spread of *Phragmites australis.* The current ditch system effectively drains the marsh. At low tide, much of the ditch grid is dry or has stagnant water present. Numerous pannes are present throughout the marsh.

13.2 Location, Size, and Ownership

The West Gilgo Beach salt marsh is located on Jones Island, a barrier island that separates the Atlantic Ocean from the Great South Bay. Over 120 hectares of "back barrier" marshes are located just west of Gilgo State Park. These salt marshes are included in the USEPA's "Reference Wetlands on Long Island" (USEPA, 2000). The publication states, "Nearly one half of Long Island's high salt marshes are located west of Gilgo Beach to Jamaica Bay." The marsh is owned by the NYS Department of Parks, Recreation, and Historical Preservation. The portion of the marsh studied is approximately 120 x 580 meters large.

13.3 Topography and Waterbodies

Gilgo West is situated within Hydrogeologic Zone VII, as delineated in the Long Island 208 Study. This zone is defined as the south shore shallow flow system, in which the groundwater primarily moves laterally. Some upward flow may take place in this area as the groundwater discharges to surface water bodies.

A dredged channel, approximately 7.5 meters wide, separated the western from the eastern portion of the wetlands. An extension of this channel ran parallel to the barrier beach and provided boat access to the residents. A second channel, located on the western edge of the wetlands, provided additional boat access. Both channels connected to the 15 meters wide State Boating Channel that ran parallel to the beach and opened to the Bay. Because of the channels, most of the marsh edges were abrupt transitions to deeper water.

The channels effectively divided the West Gilgo Beach salt marshes into two segments. The western segment had short tidal creeks present at the northern edge, which ended in the low marsh. It also had numerous salt pannes, a fringe of *Phragmites australis* on the southern edge and little transition to marsh upland. The eastern segment had several lengthy tidal creeks extending into the middle marsh, patches of shrub upland, and a number of salt pannes.

13.4 Land Use and Population Density

Land use within this area was primarily recreational, including boating, fishing, and swimming. A small residential community borders the southern edge of the eastern segment. The population within a ½ mile radius of the Gilgo West study area is approximately 29 residents and the population within a two-mile radius is also approximately 29 residents.

13.5 Tidal Characteristics

13.5.1 Tidal Range

The mean tidal range (MHW-MLW) was 30 centimeters (1.0 foot) and the mean spring tidal range (MHHW-MLLW) was 30 centimeters (1.2 feet) (as measured at the Bay Shore benchmark).

13.5.2 Tidal Inundation

Five stakes measuring tidal inundation (stakes S1-S5) were placed in the marsh on October 8, 2004. Retrieval and reading occurred on October 9, 2004. Stake S1 was placed in the upper marsh, west of ditch D3, among *Spartina patens*. This area was covered by 29 cm of water during high tide. Stake S2 was fixed in the middle marsh, among *Iva frutescens*, west of ditch D3 and in line with stake S1. This area received 35 cm of water. Stake S3, also fixed in the middle marsh, was placed in the middle of a large salt panne, between ditches D2 and D3. This area was inundated with 42 cm of water during high tide. Stake S4 was placed in the lower portion of the middle marsh, in the middle of a salt panne that was at the start of a salt panne chain. The surrounding area received 59 cm of water. Stake S5 was placed in the low marsh, among *S. patens*. The area near this stake received 32 cm of water during flood tide. Tidal inundation appeared not to follow the typical trend of decreasing toward the upper marsh as readings were greatest in the middle marsh. This may have been due to numerous salt pannes being present in the middle marsh. The reading obtained in the low marsh (stake S5) may be similar to the reading obtained in the middle marsh (stake S2) because the areas were similar in elevation. This was supported by the existence of *S. patens* (Table 13-1).

Table 13-1. Gilgo West Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Upper marsh	29
S2	Middle marsh	35
S3	Middle marsh	42
S4	Middle marsh, toward low marsh	59
S5	Low marsh	32

13.6 Stormwater

No stormwater discharge pipes were observed at the study site.

13.7 Water Quality

Many ditches were dry at low tide (stations D2D and D2B east) and contained some *S. alterniflora*. Others contained stagnant water (stations D2B west and D2E), due to lack tidal exchange. Low elevation favored *Spartina alterniflora* growth in these ditches. Dry ditches contained less than one cm of water, while ditch areas with no water movement contained sizeable amounts of standing water. Temperature increased toward the upper marsh, while salinity varied with sample location. Low dissolved oxygen readings were consistent with the presence of stagnant water (Table 13-2).

Table 13-2. Gilgo West Water Quality Measurements and Ditch Water Description & Depth

Station	Station Location Characteristic	Water Depth (cm)	Temperature (ºC)	Salinity (ppt.)	Dissolved Oxygen (mg/L)
D2A*	Low marsh	17	19.2	27.5	10.0
D2B west	Middle marsh stagnant	12	22.4	30.9	3.5
D2B east	Middle marsh dry with *S. alterniflora* in ditch	<1	NA	NA	NA
D2C	Upland area	NA	NA	NA	NA
D2D	D Middle marsh dry, with *S. alterniflora* in ditch	<1	NA	NA	NA
D2E	E Middle marsh stagnant	30	23.5	28.5	3.0
D2F	Middle marsh	5	23.7	33	NR

Note: NA-"not available" due to the small amount of water present, or "not applicable", if the sample location was an upland area (2C).
NR-"not recorded" for a specified sample D = ditch
A, B, C, D,E and F = samples taken along ditch * = sample taken in tidal creek at mouth of ditch

13.8 Ecology

13.8.1 Tidal Vegetation

Upper marsh vegetation was dominated by *Spartina patens*. A depression in the upper marsh contained Glasswort (*Salicornia europaea*), *Spartina alterniflora* and dead *S. patens*. *Spartina patens* became mixed with the short form of *S. alterniflora* toward the low marsh and covered the entire middle marsh area of the study site, with the exception of occasional pockets of *S. patens* and a horizontal strip of upland vegetation spanning the area between ditches D1-D4. The upland area supported spike grass (*Distichlis spicata*), sea myrtle (*Baccharis halmifolia*), marsh elder (*Iva frutescens*), bay berry (*Myrica pennsylvanica*), sea lavender (*Limonium nashii*) and poison ivy (*Toxicodenderon radicans*). The low marsh vegetation primarily consisted of *S. alterniflora*, with the short form present toward the middle marsh and the tall form present at the water's edge. A moderately sized, oval-shaped area of *S. patens* was also present in the low marsh, near Stake S5 and north of the upland area. Common rock weed (*Fucus vesiculosis*) was present at the mouth of ditch D2, which bordered Great South Bay.

13.8.2 Phragmites

The southern edge of the study site was lined with *Phragmites australis* and was separated from the rest of the marsh by a trench approximately 2.4 to 3.0 meters wide. Some *P. australis* was present on the northern side of the trench and was present in areas covered by *S. patens*.

13.8.3 Upland Vegetation

Phragmites australis covered the northern edge of the study site that was separated from the rest of the marsh by a trench. A fringe of trees growing along Ocean Parkway flanked the *P. australis* border to the north, marking the terrestrial edge of the marsh.

13.8.4 Wildlife

Fiddler crabs (*Uca* spp.), mud snails (*Ilyanassa obsoleta*.), and ribbed mussels (*Geukensia demissa*) were present in the low marsh, at the mouth of ditch D2. A white crane was sighted wading in the low marsh. Large numbers of fish were noted in the middle marsh at station D2A and a small number of fish were noted in the salt panne near station D2E. Fish were notably absent from the areas near stations D2B (west) and 2E as water was stagnant in these areas.

13.9 Mosquito Habitat/History

13.9.1 Ditching and Ditch Condition

The West Gilgo Beach wetlands were regularly ditched every 61 meters (200 feet), in an approximately north-south orientation. Ditch water depth was highest at the mouth of D2 and decreased toward the upper marsh. Several areas adjacent to ditch D2 (stations 2B east and 2D) were essentially dry (less than 1.2 cm of water) due to *S. alterniflora* occlusions. The small amount of water that was present was stagnant. Bottom type varied from fine sand in the low marsh to mud in the middle marsh.

13.9.2 Pesticide Applications

West Gilgo beach marshes have regularly received larvicide applications. Adulticides have been applied near the small residential area adjacent to the marsh. OMWM techniques have been implemented in this area.

14 Gilgo Island

14.1 Selection Criteria and Current Condition

Gilgo Island was selected as a Primary Study Area because it is a medium-size, uninhabited, island exemplar.

14.2 Location, Size and Ownership

Gilgo Island is located in southwest Suffolk County in the western reaches of the Great South Bay. Gilgo Island is the largest of a series of islands that are positioned just north of Gilgo Beach, which is located on Jones Island, the barrier island west of Fire Island. Other islands near Gilgo Island are: Great Island, Elder Island, Wansers Island, Little Island, and Townsend Island.

Gilgo Island is approximately 110 hectares (273 acres). The island contains approximately 16 hectares (40 acres) of uplands and 94 hectares (233 acres) of marshland.

14.3 Topography and Waterbodies

Gilgo Island is located in Hydrogeological Zone VII as designated by the Long Island 208 Study. Hydrological Zone VII is an area likely to contribute water only to the shallow groundwater flow system and in general has horizontal flow.

Gilgo Island is dominated by low-marsh and high-marsh vegetation. It also includes significant upland areas. The low-marsh vegetation is predominantly tall and short-form *Spartina alterniflora*, with some *Salicornia* and *Limonium carolinianum*. High-marsh areas are dominated by *S. patens*, *Distichlis spicata*, *Iva frutescens*, *Phragmites australis*, and *Baccharis halimifolia*.

Gilgo Island is not tidally restricted. Two major tidal creeks run through the marsh, both heading west-east and entering the Great South Bay on the eastside of the island. The southernmost tidal creek begins as two tidal creeks that rejoin to create a larger tidal waterway.

Numerous ponds exist throughout Gilgo Island. Ponds observed in the study area range in size from 4 x 2 meters (13 x 6.5 feet), 3 centimeters (1 inch) deep to 45 x 15 meters (147 x 49 feet), 4 centimeters (1.5 inches) deep. One panne was observed, 8 x 2 meters (26 x 6.5 feet) in size, surrounded by dead *Salicornia*.

14.4 Land Use and Population Density

Gilgo Island is an uninhabited island that is the property of Suffolk County. Several of the surrounding islands are designated State Tidal Wetlands and the undeveloped Gilgo State Park is located to the southeast of Gilgo Island. Two small barrier beach communities, Gilgo Beach and West Gilgo Beach, can be found south of Gilgo Island on Jones Island. Both of these communities have a mix of summer-only and year round residents.

The population of the Gilgo Island area is 330 within ½ mile radius and 389 within a two-mile radius.

14.5 Tidal Characteristics

14.5.1 Tidal Range

The mean tidal range of Gilgo Island, based on the tidal information for nearby Gilgo Heading, is 34 centimeters (1.1 feet). The spring tidal range is 40 centimeters (1.3 feet) and the mean tide level is 15 centimeters (0.5 feet).

14.5.2 Tidal Inundation

In order to assess the amount of tidal inundation on the marsh surface, a tidal inundation study was completed during the lunar high tide in April 2005. Before the lunar high tide, stakes were placed in areas of standing water throughout the high marsh on April 8 and inundation measurements were collected later that day once the high tide had receded.

Stake S1 was placed in the high marsh amidst *Distichlis spicata*. This area received 9.5 centimeters of inundation. Stake S2 was also placed in high marsh among *Distichlis spicata* vegetation. This area received nine centimeters of inundation. Stake S3 was placed on the edge of a pond surrounded by *D. spicata* and *Spartina patens*. This area received eight centimeters of inundation. Stake S4 was placed in standing water adjacent to a ditch in *D. spicata* and *S. patens* vegetation. This area received 10.5 centimeters of inundation. Stake S5 was placed in standing water amidst *Salicornia*. This area received seven centimeters of inundation.

Skate S4 received the greatest amount of inundation. Ditch spurs located near this section allowed more inundation to reach this area. High marsh areas received approximately the same amount of inundation except for stake S5. Although stake S5 was placed in a low-lying area, ditch spurs from an adjacent ditch were directed away from this area.

Table 14-1 - Gilgo Island Tidal Inundation

Stake Number	Marsh Placement	Tidal Inundation (centimeters)
S1	High marsh	9.5
S2	High marsh	9
S3	Edge of pond in high marsh	7
S4	High marsh	10.5
S5	High marsh	7

14.6 Stormwater

No stormwater discharge pipes were observed at Gilgo Island.

14.7 Water Quality

Water quality measurements were collected from the head, mouth, and mid-point sections of the tidal creek and two selected ditches. Both ditches were analyzed at low tide. Temperature decreased slightly towards the mouth of both ditches and dissolved oxygen levels increased. Salinity remained constant across the marsh.

Table 14-2 - Gilgo Island Water Quality Measurements and Ditch Water Depth

Station	Sample Location Characteristics	Water Depth (centimeters)	Temp. (C)	Salinity (ppt.)	DO (mg/L)
TC-A	Intertidal marsh	>200	9.2	31.0	8.0
TC-B	Intertidal marsh	-	8.5	31.2	7.5
TC-C	Intertidal marsh	20	7.3	31.2	7.4
D1A	Mouth of Ditch 1	42	8.4	31.3	7.4
D1B	Mid section of Ditch 1	24	9.0	31.2	8.0
D1C	Head of Ditch 1	3	10.9	30.3	2.1
D2A	Mouth of Ditch 2	71	8.7	31.3	7.4
D2B	Mid section of Ditch 2	45	8.5	31.3	6.7
D2C	Head of Ditch 2	10	9.3	31.0	4.0

14.8 Ecology

14.8.1 Tidal Vegetation

Spartina alterniflora is generally found in low-lying areas between ditches, and along the perimeter of the island. Most of the marsh is a mix of intertidal and high marsh vegetation, mainly *S. alterniflora, S. patens,* and *Distichlis spicata. Limonium carolinianum* is evident in low lying areas throughout the marsh. *Iva frutescens, Baccharis halimifolia, Phragmites australis* are common along sections of the outer border of the marsh.

14.8.2 Phragmites australis

Phragmites is found in few areas throughout Gilgo Island. *Phragmites* is located in sections of slightly higher elevation along the western and southern border of the marsh. *Phragmites* is noticeably absent from the interior of the marsh.

14.8.3 Wildlife

No fish were detected in the ditches or ponds. Sandpipers were observed utilizing a large pond (45 x 15 meters, 4 centimeters deep). Short-eared owls and a red fox were observed in high marsh areas.

14.9 Mosquito Habitat/History

14.9.1 Ditching and Ditch Condition

Parallel ditches cut through the majority of the marsh with numerous spurs. Gilgo Island is grid ditched and ditches are generally 61 meters (200 feet) apart. All ditches appear to have clear connections to the tidal creek.

Two ditches were analyzed at Gilgo Island (D1 and D2). Both ditches were open with clear connections to the tidal creek. Ditch D1 has a muddy substrate along the length of the ditch, while the substrate of ditch D2 was sandier.

14.9.2 Pesticide Applications

Gilgo Island is not aerially larvicided and no OMWM techniques have been implemented at this site. Adulticide is used to control mosquitoes near Gilgo Island.

15 West Watch Hill

15.1 Selection Criteria and Current Condition

West Watch Hill was chosen as a PSA because it is a barrier beach marsh and is directly adjacent to the hamlet of Davis Park and just west of the federally designated Wilderness Area.

15.2 Location, Size and Ownership

West Watch Hill is located within the Fire Island barrier island, due south of Patchogue, in the Town of Brookhaven. Great South Bay is located north of Fire Island and the Atlantic Ocean is south of the island.

West Watch Hill is approximately 9 hectares (23 acres) in size and is part of the Fire Island National Seashore. The Fire Island National Seashore contains the Otis G. Pike Wilderness Area, the only federally designated Wilderness Area in New York State. The Wilderness Area is approximately 500 hectares (1,300 acres) in size and stretches for nearly eight miles from Watch Hill to Smith Point County Park.

15.3 Topography and Waterbodies

West Watch Hill is located in Hydrogeological Zone VI, as defined by the Long Island 208 Study. This area contains a thin freshwater lens groundwater regime, and does not lie in any of the major Long Island drainage basins.

The southern portion of West Watch Hill is dominated by dense stands of *Phragmites australis*. The center and northern portion of the marsh contains several ponds. However, this portion of the marsh is continually covered with approximately one foot of dark murky water, making it difficult to decipher the existence and boundaries of the ponds. No tidal creek exists at West Watch Hill.

15.4 Land Use and Population Density

Watch Hill is a family beach destination, accessible by private boat, ferry (from Patchogue), or a short walk from Davis Park. It is one of the promoted locales within the Fire Island National Seashore and features a 200-slip marina, campsites, nature walks, public showers, and a lifeguarded beach. Slips accommodate boats up to 18 meters (60 feet) in length and the marina provides electric, water and a pump-out facility; it is open from May 15th through October 15th. The year-round population is only five within one-half mile of West Watch Hill and seven within two miles of the study area. Summer-time transient populations within the Seashore and resort populations in Davis Park will amount to several thousand.

15.5 Tidal Characteristics

15.5.1 Tidal Range

West Watch Hill is significantly tidally restricted. Based on tidal information for nearby Point O' Woods, the mean tidal range for West Watch Hill is approximately 20 centimeters (0.7 feet). The spring tidal range is approximately 25 cm (0.8 feet) and mean tide is 10 cm (0.3 feet).

15.5.2 Tidal Inundation

In order to assess the amount of tidal inundation on the marsh surface in areas of high marsh, a tidal inundation study was completed during the lunar high tide in November 2004. Before the lunar high tide, stakes were placed in areas of standing water throughout the high marsh on November 25th and inundation measurements were collected on November 26th.

The inundation study revealed that West Watch Hill did not receive any inundation. A large berm on the north side of the marsh restricts tidal inundation from Great South Bay.

Table 15-1 - West Watch Hill Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Standing water in high marsh	0
S2	High marsh, edge of Ditch 2	0
S3	Standing water in high marsh	0
S4	Standing water in high marsh	0
S5	Western perimeter	0
S6	Standing water in high marsh	0
S7	Standing water in high marsh	0
S8	Mid-length Ditch 1	0
S9	Eastern perimeter	0

15.6 Stormwater

No stormwater discharge pipes were observed at West Watch Hill.

15.7 10.7 Water Quality

West Watch Hill has very low salinities due to tidal restrictions and salt water entering the system only during larger storms and northerly winds. Water may also enter and leave the marsh system through groundwater.

Water quality measurements were collected from the head, mouth, and mid-point sections of two select ditches (D1 and D2). Water quality measurements were collected from the head, mouth, and the mid-point sections of ditches D1 and D2 during low tide.

Overall, temperature and salinity remained constant across the marsh. Dissolved oxygen decreased towards the mouths of both ditches.

Table 15-2 - West Watch Hill Water Quality Data

Station	Sample Location Characteristics	Water Depth (centimeters)	Temp. (C)	Salinity (ppt.)	DO (mg/L)
D1A	*Phragmites australis*	70	10.6	0.6	0.96
D1B	*S. patens, P. purpurascens, Scirpus maritimus*	33	9.7	1.0	0.28
D1C	*S. patens, P. purpurascens, S. maritimus, P. australis*	45	10.5	0.5	2.03
D2A	*P. purpurascens, S. maritimus, S. americanus, S. alterniflora*	76	11.3	1.2	0.89
D2B	*P. purpurascens, D. spicata, S. alterniflora, S. maritimus, Lemna minor*	70	10.8	1.1	1.09
D2C	*Phragmites, S. patens, P. purpurascens, Baccharis halimifolia*	77	10.7	1.1	1.25

Note: Samples collected on 11/2/04, during low tide
D = ditch

15.8 Ecology

15.8.1 Tidal Vegetation

Small amounts of *Spartina alterniflora* is mixed in with high marsh vegetation throughout the areas of the marsh not dominated by *Phragmites australis*. *Pluchea purpurascens* (saltmarsh fleabane), *Scripus maritimus* (saltmarsh bulrush), and *Scirpus pungens* (common three-square) are the dominant vegetation in the high marsh. Other vegetation occurring throughout the high marsh includes *Spartina patens, Distichlis spicata* and *Baccharis halimifolia*.

15.8.2 Phragmites australis

A large dense stand of *Phragmites australis* exists along the east, south and west perimeter of the marsh. A thin stand of *P. australis* dominates the berm along the northern boundary. The terminuses of all of the ditches running north to south become occluded with *P. australis*. Ferns are also present with the *P. australis* in the southern portion of the marsh.

15.8.3 Wildlife

No fish were observed in the ditches, ponds, or areas of standing water throughout the marsh. Deer tracks were evident throughout the stands of *P. australis*.

15.9 Mosquito Habitat/History

15.9.1 Ditching and Ditch Condition

West Watch Hill has been subject to grid ditching that has not been maintained since the 1960s. The ditches are spaced approximately 60 meters (200 feet) apart. Due to the policies of the Fire Island National Seashore, there is very little active mosquito management in the marsh.

Two ditches (D1 and D2) were analyzed for general ditch characterization. Due to the significant amount of dark water across the marsh surface, it was difficult to characterize and measure the ditches. Both ditches were open but had no clear connections to the bay. Ditch D1 is occluded with *P. australis* near its mouth and with debris and wrack along its length. It eventually terminates in a large pond. Large amounts of duckweed (*Lemna minor*) were noted in the mid-section of ditch D2. The substrate of both ditches varied. Ditch D1 has a more muddy/peat substrate, while the substrate of ditch D2 is sandier.

15.9.2 Pesticide Applications

West Watch Hill does not receive aerial larvicide applications; however, adulticide has been applied in the vicinity at Davis Park. No OMWM techniques have been implemented at West Watch Hill.

The National Park Service has its own mosquito control plan that is available at on its website.

16 Hubbard Creek

16.1 Selection Criteria and Current Condition

The Hubbard Creek wetland was chosen as a PSA because it is relatively undisturbed, has experienced limited ditching, and is surrounded on most sides by a substantial forested area. The large buffer and sparsely populated surroundings contribute to minimal mosquito problems in this area. The Hubbard Creek marsh is also an USEPA “Reference Wetland,” chosen “for its high quality landscape condition, intact freshwater hydrology, and large number of high quality adjacent natural communities” (MacDonald and Edinger, 2000).

Tidal inundation measurements indicate that upper marsh areas receive little or no tidal flow. The ditches present in this marsh are partially or totally occluded with plant growth.

16.2 Location, Size, and Ownership

The 102-hectare Hubbard Creek marsh is owned by Suffolk County. It is part of the Hubbard County Park, in Flanders, in the Town of Southampton. It is located north of Riverhead-Hampton Bays Road and Red Creek Road and can be accessed via Upper Red Creek Road. Approximately 9.6 hectares (or 10 percent of the area) east of the creek mouth were studied. The study area is roughly bell-shaped and is widest at the low marsh (approximately 60 meters in width) and narrows toward the upper marsh (approximately 25 meters in width).

16.3 Topography and Waterbodies

16.3.1 Entire Area

The Hubbard Creek marsh is situated within Hydrogeologic Zone IV, as delineated in the Long Island 208 Study. This portion of the zone is a shallow flow system that discharges to streams and the marine waters of the Peconic Bay.

According to MacDonald and Edinger (2000), pannes cover approximately 6.5 hectares and those at the landward marsh margin contain up to 11 species of vascular plants. The Hubbard

Creek wetland drains several smaller ponds inside Hubbard County Park and a series of ponds in the adjacent Sears-Bellows Pond County Park. Penny Pond is located in the eastern portion of the park, below Lower Red Creek Road. Hubbard Creek discharges at Cow Yard Beach, in Flanders Bay, which is in the western portion of Peconic Bay.

16.3.2 Study Area

Muddy, uneven ground in the low marsh became dry and firm in the middle marsh. In the upper marsh, the ground was sometimes muddy and uneven, with vegetation present in clumps. Numerous pannes of *Distichlis spicata* and the common glasswort, *Salicornia europaea*, were common throughout the middle marsh. Two separate areas of upland vegetation, which included stands of dead cedar trees, were present in the middle marsh.

A creek tributary, flowing through the study area, was widest in the low marsh and gradually narrowed toward the upland. An oval shaped pool (approximately six meters in diameter) was present in the low marsh, east of the widest part of the tributary.

16.4 Land Use and Population Density

The population density with in 0.8 kilometers of the Hubbard Creek marsh has been estimated by the County to be 1,100 people.

16.5 Tidal Characteristics

16.5.1 Tidal Range

The mean tidal range (MHW–MLW) was 80 centimeters (2.8 feet) and the mean spring tidal range (MHHW-MLLW) was 100 centimeters (3.3 feet) (as measured at the Jamesport benchmark).

16.5.2 Tidal Inundation

Five stakes to measure tidal inundation (stakes S1-S5) were placed in the marsh on November 9, 2004, within several days of the monthly full moon. Stake retrieval and reading was completed on November 10, 2004. Tidal inundation data is found in Table 16-1. Stakes S3 and S5 are listed as receiving a *maximum* of two centimeters of water because the stakes had moved two centimeters out of the ground. Consequently, the distance between the portion of the stake in the soil and the treated portion of the stake was two centimeters. It was not possible, therefore, to determine whether inundation had occurred, though it would have been a maximum of two centimeters if it had occurred.

Stake S1 was placed in the upper marsh, amidst *Distichlis spicata*, 9.1 meters from cross ditch Da, near the terrestrial edge. It received two centimeters of water. The area near stake S1 likely received water from cross ditch Da, which is fed by the creek tributary.

Stake S2 was placed near the junction of ditches D2 and Db, near the middle marsh. This area received no measurable inundation during flood tide. The area near stake S2 may not have received a measurable amount of water due to its elevation.

Stake S3 was placed in the middle marsh, east of a stand of upland vegetation. The presence of upland vegetation near stake S3 suggests that this area probably received little, if any, tidal inundation.

Stake S4, placed on the edge of a stand of *Phragmites australis* in the low marsh received two centimeters of water. Stake S5 was placed immediately adjacent to an area of *Spartina patens*, *Scirpus pungens* (three-square sedge), and *Panicum virgatum* (switch grass). The presence of *P. australis* near stake S5 suggests that the area probably received little, if any, tidal inundation. This is confirmed by the presence of *Scirpus pungens*, a freshwater plant with low tolerance for saltwater. The source of freshwater is likely groundwater seepage.

Table 16-1. Hubbard Creek Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Upper, near terrestrial border	2
S2	Upper, near middle marsh	0
S3	Middle	2
S4	Low, near middle marsh	2
S5	Low, near low marsh	2

16.6 Stormwater

No stormwater discharge pipes were observed. A single, small roadway bordered the marsh. Stormwater from the roadway flows into the adjacent upland area and probably has minimal impact on the marsh.

16.7 Water Quality

Water quality samples were taken at various stations along three ditches (ditches D1, D2 and D3) and one salt panne (panne P1) (Table 16-2). All water quality parameters in ditch D1 varied considerably. Lower temperature and higher salinity corresponded with greater ditch depth. Water quality variation in ditch D1 is explained by its direct connection to the bay. Water depth at stations D2A, D2B, and D3A was constant. This is probably because station D3A was taken at the junction of ditches D2 and D3, which is also the mouth of ditch D2. Temperature and salinity were similar along ditch D2, possible because of ditch occlusions that restricted water flow. Temperature and salinity varied along ditch D3 as well. Temperature was lowest and salinity was highest at the junction of ditch D3 and the creek tributary, likely the result of direct tidal influence from the bay.

The temperature and salinity at station P1 differed from other samples taken along the creek tributary (stations D1A, D1B, and D1C) and along ditch D2. These differences may be due to the proximity of station P1 to the bay. Trends in dissolved oxygen could not be analyzed due to instrument malfunction in the field.

Table 16-2 - Hubbard Creek Water Quality Measurements and Ditch Water Depth

Station	Station Location Characteristic	Water Depth (centimeters)	Temperature (ºC)	Salinity (ppt.)
D1A*	Low marsh	NR	6.5	22.7
D1B*	Middle marsh	5-7	6.9	21.4
D1C*	Middle marsh	30	7.3	17.4
D1D	Upper marsh	61	6.5	22.7
D2A	Middle marsh, across from D1B	15	7.9	16.7
D2B	Middle marsh, across from D1C	15	8	16.6
D3A	Low marsh, junction of D2	15	7.6	17.2
D3B	Upper marsh	NR	8.3	15.7
P2	Low marsh in panne	NR	6.6	24.7

Note: NR-"not recorded" for a specified sample.
D = ditch P = panne
A, B, C and D = samples taken along ditch
* = samples taken in tidal creek which was also part of ditch 1

16.8 Ecology

16.8.1 Vegetation

Distichlis spicata dominated the upper and middle marsh, with the tall form of *S. alterniflora* present along ditch edges. Toward the low marsh, *D. spicata* blended into *S. patens*, and *S. patens* was mixed with the short form of *S. alterniflora*. Green sea lettuce (*Ulva* spp.) and rockweed (*Fucus* spp.) were present at the water's edge near station D1A.

According to MacDonald and Edinger (2000), four rare plant species were observed in the wetland in 1997 and 1998 (*Fimbristylis castanea*, marsh fimbry; *Tripsacum dactyloides*, northern gamma grass; *Salicornia bigelovii*, dwarf glasswort; and seaside plantain, *Plantago maritime*).

16.8.2 Phragmites

The common reed (*Phragmites australis*) was present in a lobe shaped pattern along the southern edge of the study area, encroaching upon areas dominated by *D. spicata*. A smaller stand of *P. australis* was also present in the low marsh, west of ditch D3.

16.8.3 Upland Vegetation

Baccharis halimifolia was present in the upper marsh, west of Eastern Red Cedar trees (*Juniperus virginiana*) and near stake S1. Shrubs of *Iva frutescens* were present near cross ditch Da. *Iva frutescens* was also mixed with *P. australis* between cross ditches Db and Dc. Two separate areas of upland vegetation (*B. halimifolia, I. frutescens*, and *J. virginiana*) were present in the middle marsh. A larger upland area (approximately 90 x 30 meters) was located south of the tributary, near cross ditch Dd, and a smaller upland area was located south of ditch D2. Many dead *J. virginiana* were among the vegetation present in these two upland areas. Switch grass (*Panicum virgatum*) mixed with three-square sedge (*Scirpus pungens*) occurred south of the smaller pocket of upland vegetation. *Scirpus pungens* was also found in the upper marsh, along with *D. spicata*, north of where the tributary ends. The terrestrial border was composed of red oak (*Quercus rubra*), white oak (*Q. alba*), white pine (*Pinus strobus*) and numerous *J. virginiana*.

16.8.4 Wildlife

Deer tracks were visible in the mud of the path along the marsh border and several live deer were sighted in the upper marsh and the terrestrial border. Ribbed mussels (*Geukensia demissa*) were only present at station D1A.

16.9 Mosquito Habitat/History

16.9.1 Ditching and Ditch Condition

Three main ditches, the creek tributary (D1), one parallel ditch (ditch D2), and one perpendicular ditch (ditch D3), along with four cross ditches (Da, Db, Dc, and Dd) were present. Ditch D2, along with cross ditches Da, Db, Dc, were partially to totally occluded with *D. spicata* and the tall form of *S. alterniflora*. These occlusions occurred along part of cross ditch Da, at the junction of ditches D2 and Db, and along part of cross ditch Dc and between cross ditches Dc and Dd. A hard sandy bottom was common to all ditches, with the exception of cross ditch Da, which had a muddy bottom (approximately 30 cm. in depth). The different bottom types may be due to the lack of tidal flow beyond cross ditch Da. The area around station panne P1 was wet and muddy, with a distinct sulfur odor present.

16.9.2 Pesticide Applications

The Hubbard Creek wetland is a prior OMWM site. It has not received larvicide or adulticide applications.

17 Cedar Beach

17.1 Selection Criteria and Current Condition

Cedar Beach was selected as a PSA because mosquito breeding occurs in the section of the marsh north of Cedar Beach Road and because this marsh might be a good candidate for restoration of tidal flow.

17.2 Location, Size and Ownership

Cedar Beach is located in the Town of Southold, at the southeast tip of Great Hog Neck. The marsh is bounded to the east and south by Little Peconic Bay (Hog Neck Bay) and to the west by Cedar Beach Creek. Cedar Beach Creek extends north of Cedar Beach Road to a small extension of the saltmarsh. This section measures approximately six hectares (15 acres) and was the focus of this study. This section of Cedar Beach is privately owned amongst seven individuals.

17.3 Topography and Waterbodies

The wetlands at Cedar Beach lie in Hydrogeologic Zone IV, as delineated in the Long Island 208 Study. Fresh groundwater on the North Fork of Long Island is contained within a series of hydraulically isolated lenses that decline in thickness eastward. These lenses are isolated from the rest of the Long Island fresh groundwater system and have no adjacent freshwater to provide recharge.

Cedar Beach Creek runs along the western boundary of the marsh and continues underneath Cedar Beach Road via a culvert pipe and empties into Hog Neck Bay.

Numerous pannes and ponds exist were observed throughout the marsh. Most of the ponds are surrounded by a series of pannes with clumps of vegetation throughout. Ponds range in size from 1 x 1 meters (3.2 x 3.2 feet), 8 centimeters (7 inches) deep to 10 x 20 meters (33 x 66 feet) 29 centimeters (11 inches) deep and are located in areas of low marsh, high marsh and

Phragmites. Several of the ponds observed had a murky green or murky white coloration on the water surface. These ponds are located in areas of high marsh and *Phragmites*. The discoloration on the water surface may be the result of certain bacteria within the mud of the pond. These bacteria produce sulfur as a byproduct of photosynthesis, which creates a white-colored layer on the marsh surface.

17.4 Land Use and Population Density

Cedar Beach is bounded by undeveloped woodland to the north, low-density residential development to the west (half acre to one acre lots) and higher density houses to the east (quarter acre and smaller lots). The population within one-mile of the marsh is 1,985, and 5,820 within two miles.

17.5 Tidal Characteristics

17.5.1 Tidal Range

Cedar Beach is tidally restricted via the culvert pipe underneath Cedar Beach Road. Based on the tidal information for Southold, the mean tidal range for Cedar Beach is approximately 70 centimeters. The spring tidal range is approximately 80 centimeters and the mean tide is 40 centimeters.

17.5.2 Tidal Inundation

In order to assess the amount of tidal inundation on the marsh surface in areas of high marsh, a tidal inundation study was completed during the lunar high tide in November 2004. Before the lunar high tide, stakes were placed in areas of standing water throughout the high marsh on November 11th and inundation measurements were collected on November 12th during low tide.

Five stakes were placed throughout the marsh. Stake S1 was placed in a panne surrounded by mixed high marsh and low marsh vegetation. This area received 13 cm of water. Stake S2 was placed in a panne also surrounded by mixed vegetation. This panne received 13 cm of water. Stake S3 was placed in a pond in the high marsh at the terminus of a ditch. This pond received the highest amount of inundation with 26.5 cm of water. Stake S4 was placed in a pond surrounded by *Spartina patens* and *Phragmites australis*. A white film was noted on the water surface of this pond. This pond received 15 cm of water. Stake S5 was placed along the bank of the tidal creek near the culvert pipe amidst *Phragmites australis* and upland vegetation. This area received 5.5 cm of water.

With the exception of stake S3, the amount of inundation in the ponds and pannes were generally consistent throughout the marsh. The pond at stake S3 received the highest amount of inundation, possibly because it is located at the terminus of a ditch.

Table 17-1 - Cedar Beach Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Panne	13
S2	Panne	13
S3	Pond	26.5
S4	Pond	15
S5	Edge of Cedar Creek near outfall pipe	5.5

17.6 Stormwater

No stormwater discharge pipes were observed at Cedar Beach.

17.7 Water Quality

Water quality measurements were collected from the head, mouth, and mid-point sections of the tidal creek and two selected ditches (ditches D1 and D2). Both ditches bisect the marsh laterally. Both ditches were analyzed at low tide.

Overall, parameters remained constant with ditch depth along ditches D1 and D2. Dissolved oxygen became higher towards the mouth of ditch D2 as the water depth decreased.

Table 17-2 - Cedar Beach Water Quality Data and Ditch Water Depth

Station	Sample Location Characteristics	Water Depth (centimeters)	Temp. (C)	Salinity (ppt.)	DO (mg/L)
TC-A	*Spartina alterniflora*	>100	12.8	28.5	8.7
TC-B	*Phragmites australis*	>100	12.9	28.8	8.98
TC-C	*Phragmites australis*	11	13.3	-	6.51
D1A	*Phragmites, S. patens, D. spicata*	24	12.7	29.0	7.9
D1B	*S. alterniflora*	25	12.3	29.0	7.8
D1C	*Phragmites, Baccharis halimifolia*	50	12.3	28.8	8.1
D2A	*S. alterniflora, Iva frutescens, S. patens, D. spicata*	1	12.2	28.4	8.9
D2B	*Spartina alterniflora, S. patens, D. spicata*	8	12.3	28.5	7.1
D2C	*Phragmites, B. halimifolia, S. patens, D. spicata*	13	11.7	29.0	7.3

Note: Samples collected on 11/11/04; 2 hours before low tide
D = ditch TC = tidal creek

17.8 Ecology

The portion of the marsh north of Cedar Beach Road consists mainly of high-marsh/low-marsh mixed vegetation with a large perimeter border of *Phragmites australis*. Numerous ponds and pannes exist throughout the center portion of the marsh.

17.8.1 Tidal Vegetation

Spartina alterniflora is the dominant vegetation in small sections along a small number of ditches. The majority of the inner marsh consists of a mix of *S. alterniflora, S. patens,* and *Distichlis spicata*. High marsh areas are limited to small segregated sections abutting the inner *Phragmites* border. These high marsh areas are dominated by *D. spicata* and *S. patens*. *Iva frutescens* and *Baccharis halimifolia* are also found sparsely throughout the high marsh, existing mostly along the perimeter of the marsh or in elevated areas of the marsh.

17.8.2 Phragmites Australis

A large dense border of *Phragmites australis* surrounds the mid section of the marsh. This thick border of *P. australis* accounts for approximately one-half of the vegetation at Cedar Beach.

17.8.3 Wildlife

Moderate amounts of fish were observed in the ditches and few were noted in ponds. No waterfowl was noted utilizing the marsh during site visits.

17.9 Mosquito Habitat/History

17.9.1 Ditching and Ditch Condition

The marsh at Cedar Beach has been subject to grid ditching. Ditches are spaced approximately 60 meters (200 feet) apart and run perpendicular to Cedar Beach Creek.

Two ditches (ditches D1 and D2) were analyzed for general ditch characterization. Both ditches run from east to west in the center portion of the marsh. The ditches are open with clear connections to the tidal creek and have a peat substrate. A berm approximately one meter (three feet) in length, dominated by *Iva frutescens,* exists at the mid-section of ditch D1. No berms were present along ditch D2. Both ditches have one connection to another ditch.

17.9.2 Pesticide Applications

Cedar Beach is not subject to aerial larviciding or adulticide applications in upland areas. No OMWM techniques have been implemented at either marsh at Cedar Beach.

18 Long Beach Bay

18.1 Selection Criteria and Current Condition

The Long Beach Bay wetlands were chosen as a PSA because mosquito breeding continues to occur at unacceptable levels despite the fact that OMWM techniques have been implemented.

18.2 Location, Size, and Ownership

Long Beach Bay is a 105 hectare wetland complex located in Orient, in the Town of Southold. A large portion of the complex is owned and managed by the New York State Department of Environmental Conservation (NYSDEC). O'Connor and Terry (1972) estimated that it represents 24 percent of the 435 hectares of tidal marsh in the Township. The study site is adjacent to an agricultural area that is situated east of King Street and west of Peters Neck Road. The size of the study area is approximately 670 x 130 meters.

18.3 Topography and Waterbodies

The wetlands of Long Beach Bay lie in Hydrogeologic Zone IV, as delineated in the Long Island 208 Study. Fresh groundwater on the North Fork of Long Island is contained within a series of hydraulically isolated lenses that decline in thickness eastward. These lenses are isolated from the rest of the Long Island fresh groundwater system and have no adjacent freshwater to provide recharge. Groundwater in Zone IV discharges to streams and the marine waters of the Peconic Bay.

King Street and Peters Neck Road bordered the study area to the north and east. Upland vegetation was present at the northern corner of the site, bordering King Street and in the southeastern end of the site, near Peters Neck Road. Much of the northeastern portion of the marsh was wet, except for a dry region of *Spartina patens* toward the seaward edge of the study area. A berm, likely from grading, bordered the entire eastern edge of the study area. The berm separated the residential and agricultural land from the marsh and supported upland vegetation.

Long Beach Bay is a semi-enclosed body of water that opens to Orient Harbor through a narrow channel at Peters Neck Point. The bay is bounded to the south by Orient Beach State Park, which is a narrow barrier dune system. The western portion of the wetland complex, adjacent to Orient Harbor, is narrow (maximum of 150 meters wide), and is bordered by a six to nine meter wide sandy beach. The wetland ends at Peters Neck Point.

A tidal creek flowing in from Orient Bay crossed through the study area. It began at an oval-shaped pool (approximately six meters in diameter), near the adjacent home present on the agricultural land and emptied into the bay by the bridge extending off Peters Neck Road. Several creek tributaries branched off the main creek and drained three oblong shaped ponds at the berm/marsh interface. Much of the ground in the areas surrounding the creek and ponds was wet.

18.4 Land Use and Population Density

One large residential lot and agricultural land were located east of the berm. Four homes were built on the upland area at the southern end of Peters Neck Road. The population within a ½ mile radius of the Long Beach Bay study area is approximately 195 residents, while the population within a two-mile radius is approximately 590 residents.

18.5 Tidal Characteristics

18.5.1 Tidal Range

The mean tidal range (MHW–MLW) was 76 centimeters (2.5 feet) and the mean spring tidal range (MHHW-MLLW) was 84 centimeters (2.8 feet) (as measured at the Shelter Island Sound, Orient Harbor benchmark).

18.5.2 Tidal Inundation

Four stakes to measure tidal inundation (stakes S1-S3) were placed in the marsh, on October 12, 2004, one day before the monthly full moon. Retrieval and reading occurred on October 13, 2004. Stakes S1-S3 were placed in the northwestern end of the site. Stake S1 was placed in the upper marsh, near a salt panne that is located at the southern edge of an *Iva frutescens* peninsula. This area of the marsh received 11 centimeters of water. Stake S2 was placed, in the middle marsh (approximately 45 meters south of stake S1), at the southern edge of a stand of *I. frutescens* that was surrounded by *Spartina patens*. During the flood tide, this area received 20 centimeters of water. Stake S3 was fixed at the edge of the *S. patens* and *S. alterniflora* interface, in the middle marsh (approximately 22 meters from stake S2). Tidal inundation by stake S3 was 20 centimeters (Table 18-1). The similarity in readings for stake S2 and stake S3 may be due to proximity of the stakes to one another.

Table 18-1. Long Beach Bay Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	Upper	10
S2	Middle	20
S3	Low	20

18.6 Stormwater

No stormwater discharge pipes were observed.

18.7 Water Quality

18.7.1 Ditches

Temperature and salinity in ditches D1 and D2 were slightly higher in the middle marsh and dissolved oxygen increased toward the berm. Ditch water depth increased toward the low marsh (stations D1A to D3A) (Table 18-2).

Table 18-2 – Long Beach Bay Ditch Water Depth and Water Quality Measurements

Station	Sample Location Characteristic	Water Depth (centimeters)	Temperature (°C)	Salinity (ppt.)	Dissolved Oxygen (mg/L)
D1A	Low marsh seaward edge of site	NR	14.3	26.7	9.7
D1B	Middle marsh seaward edge of site	5	14.5	27.1	9.7
D1C	Middle marsh seaward edge of site	10	14.1	26.4	9.3
D2A	Middle marsh middle of site	10	14.7	27.7	10.2
D2B	Upper marsh middle of site	NR	14	26.5	10.3
D3A	Low marsh near berm	15-25	14	26.4	7.4
D3B	Upper marsh near berm	30	14	26.5	10.3

Note: NR- measurements “not recorded” for a specified sample
D = ditch
A, B, and C = samples taken along a ditch

18.8 Tidal Creek

Overall, dissolved oxygen readings were similar throughout the tidal creek Temperature was highest, while salinity and dissolved oxygen were lowest at T2. Water depth in the creek was approximately four times greater toward the mouth of the creek (T2) than at the head of the creek (T4). Samples at T1 was taken directly in Long Beach Bay, where temperature was lower and salinity and dissolved oxygen were higher (Table 18-3).

Table 18-3. Long Beach Bay, Tidal Creek Water Quality Measurements

18.8.1.1.1.1 Station	Station Location Characteristic	Water Depth (centimeters)	Temperature (ºC)	Salinity (ppt.)	Dissolved Oxygen (mg/L)
T1	Bridge over creek	NR	15.9	29.1	10.6
T2	Low marsh, southeastern corner	22	22.86	16.2	10.2
T3	Middle marsh, bend in creek	91.4	14.8	27.4	10.6
T4	Head of creek, middle marsh	10.2	NR	NR	10.4

Note: NR = measurements not recorded
T = tributary

18.8.2 Ponds

Temperature and salinity were slightly higher, while dissolved oxygen was slightly lower, in the pond (P1) versus the main tidal creek. Temperature and salinity may have been higher in the pond because it was an isolated body of water that is only indirectly influenced by water from the bay (Table 18-4). Water quality measurements between ponds P1 and P2 could not be compared because the second pond completely drained during low tide.

Table 18-4. Pond Water Quality Measurements

Station	Station Location Characteristic	Water Depth (centimeters)	Temperature (ºC)	Salinity (ppt.)	Dissolved Oxygen (mg/L)
P1	Upper marsh	15-45	14.9	28.8	10.0
P2	Upper marsh	NA	NA	NA	NA

Note: NA = “not available” due to the small amount of water present
P = pond

18.9 Ecology

18.9.1 Tidal Vegetation

This study site was dominated by *Spartina patens* with pockets of *S. alterniflora* mixed in toward upland area #1. *Spartina alterniflora* was present in the low marsh and along the seaward edge of the site. Dead *S. alterniflora* was present near the head of the tidal creek, at station T2. Red and green macroalgae (*Enteromorpha* spp. and *Ulva* spp.) were present at pond P2.

18.9.2 Phragmites

The common reed (*Phragmites australis*) was present along the berm.

18.9.3 Upland Vegetation

Upland vegetation was present at in the northern corner of the site, bordering King Street and in the southeastern end of the site, near Peters Neck Road. *Baccharis halimifolia* and *Iva frutescens* were growing along the entire length of the berm. A strip of Japanese knotweed (*Polygonium cuspidatum*) was present south of the residential property.

18.9.4 Wildlife

A small number of fish were found in ditches D1 and D2, while ribbed mussels (*Geukensia demissa*) were present in ditch D3. A small number of fish and mud snails (*Ilyanassa obsoleta*) were found near station T4. Larger fish, mud snails (*I. obsoleta*) and a greater number of *G. demissa* were observed in the samples taken in the northeastern part of the marsh (near stations T2 and T3).

18.10 Mosquito Habitat/History

18.10.1 Ditching and Ditch Condition

Partial to total occlusions were common in the three main ditches (D) in the northwestern portion of the study site, which emptied into the head of the tidal creek. Clumps of *S. alterniflora* were growing in the middle of ditch D2, while eroded bases of *S. alterniflora* plants, along with collapsed banks and fast flowing water were present at the mouth of ditch D3. Occlusions were absent from the areas sampled along the main tidal creek (stations T1-T4). Ditch D4, located just east of station T2, no longer functions because it was completely filled in with *S. alterniflora*. The largest pond (P2) (approximately 30 x 7 meters) located toward the middle of the study site, completely drained during low tide. A muddy area inhabited with mud snails and red and green macroalgae (*Enteromorpha* spp. and *Ulva* spp.) remained. The presence of these types of macroalgae indicates that eutrophication may have occurred in this area.

18.10.2 Pesticide Applications

This wetland is a prior OMWM site. It has received no larvicide or adulticide applications.

19 Pipes Cove

19.1 Selection Criteria and Current Condition

Pipes Cove Creek was selected as a PSA because it is a large wetland system fringing the Peconic Bay with vector control problems.

19.2 Location, Size and Ownership

Pipes Cove is located on the south side of the North Fork of Long Island in the eastern portion of the Town of Southold. The southern portion of the marsh, south of Route 25 was the focus of this study.

The marsh at Pipes Cove is approximately 13 hectares (32 acres) in size and is divided laterally by the Long Island Rail Road (LIRR) train tracks. This marsh is privately owned amongst five individuals.

19.3 Topography and Waterbodies

The wetlands of Pipes Cove lie in Hydrogeologic Zone IV, as delineated in the Long Island 208 Study. Fresh groundwater on the North Fork of Long Island is contained within a series of hydraulically isolated lenses that decline in thickness eastward. These lenses are isolated from the rest of the Long Island fresh groundwater system and have no adjacent freshwater to provide recharge. Groundwater in Zone IV discharges to streams and the marine waters of the Peconic Bay.

Pipes Cove is predominantly high marsh vegetation, consisting of *Distichlis spicata*, Spartina patens, and with intertidal vegetation fringing the ditches and tidal creek.

Pipes Cove Creek runs along the west side of the marsh and terminates north of Route 25. One pond and one panne are present within the marsh. The pond measures approximately 2 x 1 meters (6.5 x 3 feet) in size and was 13 centimeters (5 inches) deep during low tide in November. No fish were observed in the pond.

19.4 Land Use and Population Density

Predominant land uses surrounding the marsh are light residential and commercial (one welding and supply company). The population within one-half mile of Pipes Cove is 602 and 4,870 within two miles.

19.5 Tidal Characteristics

19.5.1 Tidal Range

Pipes Cove Creek empties into the waters of Pipes Cove. The creek is tidally restricted by a small peninsula with an opening less than six meters (20 feet) wide. Based on tidal information for Southold, the mean tidal range for Pipes Cove is approximately 70 centimeters (2.3 feet). The spring tidal range is approximately 82 centimeters (2.7 feet) and the mean tide is 39 centimeters (1.3 feet).

19.5.2 Tidal Inundation

In order to assess the amount of tidal inundation on the marsh surface, a tidal inundation study was completed during the lunar high tide in November 2004. Before the lunar high tide, stakes were placed in areas of standing water throughout the high marsh on November 11^{th} and inundation measurements were collected on November 12^{th}.

Stake S1 was placed in the high marsh in the western portion of the marsh. This area received 7 cm of water. Stake S2 was placed in a small dry panne. This panne received 34 cm of water. Stake S3 was placed in a small pond surrounded by high marsh vegetation. This pond received 39 cm of water. Stake S4 was placed amidst *D. spicata*. This area received 30.5 cm of water.

A greater amount of inundation was received in the eastern portion of the marsh, with the exception of the pond and panne, which may receive more inundation due to their low topography.

Table 19-1 - Pipes Cove Tidal Inundation

Stake	Marsh Placement	Tidal Inundation (centimeters)
S1	High marsh	7
S2	Panne	34
S3	Pond	39
S4	High marsh	30.5

19.6 Stormwater

No stormwater discharge pipes were observed at Pipes Cove.

19.7 Water Quality

Water quality measurements were collected from the head, mouth, and mid-point sections of the tidal creek and two select ditches (D1 and D2) south of the LIRR tracks. Both ditches were analyzed during low tide.

Temperature and salinity remained constant throughout the marsh. Temperature and salinity were highest at the mid portion of ditches D1 and D2. Dissolved oxygen showed an increase towards the mouth of both ditches.

Table 19-2 - Pipes Cove Water Quality Data and Ditch Water Depth

19.7.1.1.1.1	Sample Location Characteristics	Water Depth (centimeters)	Temp. (C)	Salinity (ppt.)	DO (mg/L)
TC-A	*S. alterniflora*	-	12.7	27.1	9.95
TC-B	*S. alterniflora*	-	13.6	14.3	7.1
TC-C	*Phragmites australis*	-	12.3	3.8	6.7
D1A	*S. alterniflora*	9	13.0	21.0	7.5
D1B	*S. alterniflora*	26	14.1	26.1	3.7
D1C	*S. alterniflora*	3.5	12.9	22.2	1.3
D2A	*S. alterniflora*	15	13.8	18.6	7.0
D2B	*S. alterniflora*	4	14.0	22.9	6.9
D2C	*S. alterniflora*	7	13.3	21.8	6.6

Note: Samples were collected on 10/22/04, during low tide (12:20 p.m.)
D = ditch TC = tidal creek

19.8 Ecology

19.8.1 Tidal Vegetation

Tall-form and short-form *S. alterniflora* are the dominant vegetation types along the ditches and lower portions of the tidal creek. Intertidal vegetation becomes sparse at the mouths of ditches and in some areas along sections the ditch edges.

A mix of *Distichlis spicata* and *S. patens* are the dominant vegetation in the high marsh. *Iva frutescens* appears in greater abundance along the edges of ditches north of the LIRR tracks.

19.8.2 Phragmites australis

Phragmites is very dense along the south side of Pipes Cove Creek and increases in vigor towards the head of the creek. *Phragmites* becomes mixed with *Iva frutescens* and *Baccharis halimifolia* in the northern border of the marsh.

19.8.3 Wildlife

Moderate numbers of mummichogs (*Fundulus heteroclitus*) and grass shrimp (*Palaemonetes pugio*) were observed in the ditches at Pipes Cove. Numerous fiddler crab (*Uca pugnax*) holes and ribbed mussels (*Geukensia demissa*) were noted in the areas of open mud along the banks of the tidal creek and exposed edges of ditches. Deer tracks and evidence of raccoons were also apparent throughout the marsh. An osprey nest exists south of the tidal creek on a small strip of marsh.

19.9 Mosquito Habitat/History

19.9.1 Ditching and Ditch Condition

The marsh at Pipes Cove has been ditched. Ditches south of the LIRR tracks are widely spaced apart with few perpendicular ditches. The section of marsh north of the tracks has been grid ditched. Ditches in this section are spaced approximately 30 meters (100 feet) by 25 meters (80 feet) apart.

Two ditches (D1 and D2) were analyzed for general ditch characterization. The ditches are unplugged with clear connections to the tidal creek. Both ditches have a soft muddy substrate. The ditches widen at the mouth, almost doubling in width, creating open areas of mud with sparse vegetation.

19.9.2 Pesticide Applications

Aerial larvicide applications are performed throughout the marsh during the mosquito-breeding season. No OMWM techniques have been installed on this marsh.

20 Carlls River

20.1 Selection Criteria and Current Condition

The Carlls River corridor was chosen as a PSA because it may be a local vector control site with potential for restoration.

As most of its watershed is heavily urbanized, stormwater exerts a major influence on the system. Stormwater flooding creates numerous temporary wet areas within the Carlls River corridor. Most of the area is criss-crossed by small pools and marshes, which may be connected to the river. Three large water bodies are important elements within the system.

20.2 Location, Size, and Ownership

The wetland corridor is approximately 5 kilometers in length and surrounds the banks of the Carlls River in Belmont Lake State Park. It is located in the Town of Babylon and is owned by New York State. The corridor is bordered to the north by August Road and to the south by Park Avenue. It is transected by Southern State Parkway, Sunrise Highway, and numerous dirt roads (accessible only to authorized vehicles).

20.3 Waterbodies and Topography

The Carlls River corridor lies in Hydrogeologic Zone VII, as delineated in the Long Island 208 Study. This zone is defined as the south shore shallow flow system, in which the groundwater primarily moves laterally. Upward flow also takes place in this area as the groundwater discharges to the surface water bodies of the corridor.

Belmont Lake, Carlls River, Southards Pond and three creeks are located within the wetland corridor. Belmont Lake is approximately 8 hectares (19 acres) in size and is located between August Road and Southern State Parkway. Carlls River begins in Belmont Lake and extends more than seven kilometers (25,000 feet) south, toward Great South Bay. Southards Pond is fed by two creeks, one draining Belmont Lake and one draining Elda Lake (located on the corridor's eastern branch), and drains via a third creek at its southern border. The pond is approximately 8 hectares (19 acres) in size (NYSDEC, 2005).

An unnamed pond and a stormwater basin are also located within the wetland corridor. The pond is in the eastern branch of the corridor and is fed by the tributary connecting Elda Lake and Southards Pond. The stormwater basin is associated with a housing development on Alicia Drive, which is located on the corridor's northeastern edge.

The northern portion of Belmont Lake State Park is a red maple-black gum swamp and mesic transition forest. The area surrounding Belmont Lake is primarily landscape cover with a riparian community present in a narrow band along the lake's north shore. Red maple-black gum swamp and mesic transition forest are present in the area between Southern State Parkway and Sunrise Highway, while red maple-black gum swamp, mesic transition forest, and upland forest are present south of Sunrise Highway to Park Avenue (Edinger, 2002; Suffolk County Executive Office, 1980). These areas are typically moist, wet, and hummocky, with hollows or crypts common at the base of trees. Stagnant pools are present in areas along the dirt roads that traverse the park. Palustrine cultural areas are present along the shores of Belmont Lake, Southards Pond and portions of the southern end of Carlls River.

20.4 Land Use

Heavily populated areas surround the wetlands, with the majority of the houses situated on lots smaller than a quarter acre. Two schools and a housing development are adjacent to the northeast portion of the corridor. The entire park is used for recreational pursuits year round, with boating, fishing, and swimming permitted in Belmont Lake and Southards Pond during the warmer months

20.5 Stormwater

It is likely that stormwater discharges directly into the system since most of the surrounding watershed areas are heavily urbanized. Stormwater flooding creates numerous stagnant pools along the unpaved roadways within Belmont Lake State Park. Stormwater pipes are present under the dirt road that runs parallel to Lafayette Road along the western edge of the park and in the stream channel that empties into the northwest corner of Southards Pond.

20.6 Ecology

20.6.1 Freshwater Wetlands

The wetland communities include those that typically characterize riverine systems, including the coastal plain streams and ponds, red maple-black gum swamp and several cultural palustrine environs (Edinger, 2002).

Coastal plain streams are typically slow moving, darkly stained, and support various species of submerged and floating aquatic vegetation. Table 20-1 lists the plant species commonly found in coastal plain streams. Coastal plain ponds occur in kettle holes or depressions and support unique assemblages of plants due to the seasonal variation in water levels (Edinger, 2002). These types of environments are considered to be regionally rare and support a large number of rare species (U.S. Fish and Wildlife Service, 1997).

The types of trees listed in Table 20-2 typically surround coastal plain ponds. A dense understory of shrubs, such as sweet pepperbush (*Clethra alnifolia*) and winterberry (*Ilex verticillatum*), grow along the pond perimeter. Sedges, grasses, and flowering herbs are present in years of low water (U.S. Fish and Wildlife Service, 1997). Species such as Walter's sedge (*Carex walteriana*), tall-beaked rush (*Rhynchospora macrostachya*), panic grasses (*Panicum* spp.), and bladderworts (*Utricularia purpurea*) are common (U.S. Fish and Wildlife Service, 1997). In contrast, floating leaved species such as waterweed (*Elodea* spp.), pondweed (*Potamogeton oakesianus*), white water lily (*Nymphaea odorata*), bayonet-rush (*Juncus militaris*), water milfoil (*Myriphyllum humile*), and naiad (*Najas flexilis*) dominate in years of highwater (Edinger, 2002). Table 20-3, Table 20-4, and Table 20-5 provide a listing of plant species commonly found in each zone.

20.7 Inland Wetland Transitional Areas

Red maple-black gum swamp is present in the northern portion of Belmont Lake State Park, the area between Southern State Parkway and Sunrise Highway, and south of Sunrise Highway to Park Avenue (Edinger, 2002; Suffolk County Executive Office, 1980). This type of hardwood swamp derives its name from a red maple-black gum (*Acer rubrum*, *Nyssa sylvatica*), or black gum (*N. sylvatica*) dominated canopy. Drier areas of the swamp may be inhabited by stands of pitch pine (*Pinus rigida*).

A dense shrub layer is present and is characterized by numerous species such as: sweet pepperbush (*Clethra alnifolia*), high bush blueberry (*Vaccinium corymbosum*) and swamp azalea (*Rhododenderon viscosum*) (Edinger, 2002). Table 20-6 provides a list of species present in the shrub layer of a red maple-black gum swamp.

The herbaceous layer and groundcover consist of few species and may not be well developed. Cinnamon fern (*Osmunda cinnamomea*), netted chain fern (*Woodwardia areolata*), and skunk cabbage (*Symplocarpus foetidus*) comprise the herbaceous layer, while peat moss (*Sphagnum* spp.) covers the ground (Edinger, 2002). Table 20-7 provides a list of the herbaceous layer and ground cover species commonly found in a red maple-black gum swamp.

Beech-maple mesic transition forest is characterized by plant species adapted to living in a moderately moist habitat and are located between swamp and upland areas. Trees such as American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), American elm (*Ulmus americana*), and red oak (*Quercus rubra*) dominate the canopy. A sparse shrub layer commonly includes small trees and tall shrubs such as American hornbeam (*Carpinus caroliniana*) and witch hazel (*Hamamelis virginiana*) (Reschke, 1990), along with numerous tree seedlings and saplings. Groundcover plants include blue cohosh (*Caulophyllum thalictroides*) and jack-in-the-pulpit (*Arisaema triphyllum*). This habitat type is can be found in the northern portion of Belmont Lake State Park, the area between Southern State Parkway and Sunrise Highway, and south of Sunrise Highway to Park Avenue (Edinger, 2002; Suffolk County Executive Office, 1980). Species from each zone are listed in Table 20-8, Table 20-9 and Table 20-10.

Palustrine cultural areas are wetlands that have been created or modified by human activities to the extent that the composition of the present community markedly differs from the original community (Edinger, 2002). Examples of this type of subsystem can be found along the shores of Belmont Lake, Southards Pond, and along portions of the southern end of Carlls River.

20.8 Upland Vegetation

Upland forest vegetation is present in the area between Sunrise Highway and Park Avenue (Suffolk County Executive Office, 1980). These areas are dominated by white oak (*Quercus alba*), red oak (*Q. rubra*), sassafras (*Sassafras albidium*), red maple (*Acer rubrum*) and poison ivy (*Toxicodenderon radicans*).

20.9 Wildlife

Fish commonly found in the slow moving, darkly stained waters of coastal plain streams and ponds are listed in Table 20-11. The non-indigenous Asian clam (*Corbicula flumminea*) may also be present, as it has recently become established in coastal plain streams throughout New York State (Edinger, 2002).

Belmont Lake and Southards Pond support resident populations of warm water fishes, such as yellow perch (*Perca flavescens*) and large mouth bass (*Micropterus salmoides*). Trout are stocked into these waterbodies in the spring and fall. The shallow depth (approximately 3 meters) of these areas prevents sustainment of trout during summer months (NYSDEC, 2005). Table 20-12 lists the species of fish present in Belmont Lake and Southards Pond.

Edinger (2002) states: “more data on characteristic fauna are needed,” but similarities in plant species between red maple swamps and red maple-black gum swamps indicates that animal species that may inhabit red maple black gum swamps likely include wood ducks (*Aix sponsa*), beaver (*Castor canadensis*), and spotted salamanders (*Ambystoma maculatum*).

20.10 Mosquito Information

20.10.1 Habitat/Species

Mosquitoes are commonly found in wet depressions and among the root systems of the trees and grasses within the wetland corridor (Photograph 1). Mosquitoes are also found in areas that contain large numbers of warm-blooded animals, such as farms and stables. The Belmont horse stable is located inside the Carlls River corridor.

In 2004, the County placed two gravid mosquito traps and three CDC light mosquito traps inside the park at the Belmont horse farm near Peconic Avenue and at a school located in the upper portion of the park's eastern branch. (SCDHS pers. communication, 2005). Mosquitoes carrying West Nile Virus (WNV) were trapped near the Belmont horse stable, while mosquitoes carrying WNV and Eastern Equine Encephalitis (EEE) were trapped near the horse stable by Peconic Avenue.

Table 20-1. Plant species associated with coastal plain streams

Common Name	Scientific Name
pondweeds	*Potamogeton pusillus*
	P. ephihydrus
naiads	*Najas flexilis*
	N. guadalupensis
waterweeds	*Elodea nuttallii*
	E. canadensis
	E. densa
stonewort	*Nitella* spp.
bladderwort	*Utricularia vulgaris*
duckweed	*Lemna minor*
tuckerman's quillwort	*Isoetes tuckermanii*
white water crowfoot	*Ranunculus trichophyllus*
watercress	*Nasturtium officinale*

Source: Edinger, 2002

Table 20-2. Trees associated with Coastal plain ponds

Common Name	Scientific Name
white oak	*Quercus alba*
red oak	*Quercus rubra*
red maple	*Acer rubrum*
eastern red cedar	*Juniperus virginiana*
black cherry	*Rosaceae prunus*

Source: Edinger, 2002

Table 20-3. Coastal plain pond shrubs

Common Name	Scientific Name
leatherleaf	*Chamaedaphne calyculata*
highbush blueberry	*Vaccinium corymbosium*
sweet pepper bush	*Clethra alnifolia*
male-berry	*Lyonia lingustrina*
fetterbush	*Leucothoe racemosa*
buttonbush	*Cephalanthus occidentalis*
winterberry	*Ilex verticillatum*

Source: US Fish and Wildlife Service, 1997

Table 20-4. Coastal plain pond low water plants

Common Name	Scientific Name
pipewort	*Eriocaulon aquaticum*
walter's sedge	*Carex walteriana*
tall-beaked rush	*Rhynchospora macrostachya*
panic grasses	*Panicum* spp.
sundews	*Drosera* spp.
canadian st. john's wort	*Hypericum canadense*
gratiloa	*Gratioloa aurea*
bladderworts	*Utricularia* spp.
large yellow-eyed grass	*Xyris smalliana*
purple loosestrife	*Lythrum salicaria*

Source: US Fish and Wildlife Service, 1997; Swearingen, 2002

Table 20-5. Coastal plain pond high water plants

Common Name	Scientific Name
water shield	*Brasenia schreberi*
white water lily	*Nymphaea odorata*
bayonet rush	*Juncus militaris*
spikerush	*Eleocharis* spp.
purple loosestrife	*Lythrum salicaria*
purple bladderwort	*Utricularia purpurea*
water milfoil	*Myriphyllum humile*
naiad	*Najas flexilis*
waterweed	*Elodea* spp.
pond weed	*Potamogeton oakesianus*
peat moss	*Sphagnum macrophyllum*

Source: Edinger, 2002; Swearingen, 2002

Table 20-6. Red maple-black gum swamp shrubs

Common Name	Scientific Name
inkberry	*Ilex glabra*
highbush blueberry	*Vaccinium corymbosum*
sweet pepperbush	*Clethra alnifolia*
swamp azalea	*Rhododendron viscosum*
fetterbush	*Leucothoe racemosa*
dangleberry	*Gaylussacia frondosa*
greenbrier	*Smilax glauca*
virginia creeper	*Parthenocissus quinquefolia*
poison ivy	*Toxicodenderon radicans*

Source: Edinger, 2002

Table 20-7. Red maple-black gum swamp herbaceous layer and ground cover plant species

Common Name	Scientific Name
Cinnamon Fern	*Osmunda cinnamomea*
Netted Chain Fern	*Woodwardia areolata*
Skunk Cabbage	*Symplocarpus foetidus*
Peat Moss	*Sphagnum* spp.

Source: Edinger, 2002

Table 20-8. Beech-maple mesic transition forest tree species

Common Name	Scientific Name
american beech	*Fagus grandifolia*
tulip poplar	*Liriodenderon tulipfera*
sweetgum	*Liquidambar styraciflua*
pignut hickory	*Carya cordiformis Juglandacea*
american elm	*Ulmus americana*
white oak	*Quercus alba*
red oak	*Q. rubra*
eastern hop hornbeam	*Ostrya virginiana*

Source: Reschke, 1990

Table 20-9. Beech-maple mesic transition forest shrub species

Common Name	Scientific Name
american hornbeam	*Carpinus caroliniana*
witch hazel	*Hamamelis virginiana*
hobblebush	*Viburnum lantanoides*
alternate leaved dogwood	*Cornus alterniflora*
striped maple	*Acer pensylvanicum*

Source: Reschke, 1990

Table 20-10. Beech-maple groundcover species

Common Name	Scientific Name
blue cohosh	*Caulophyllum thalictroides*
christmas fern	*Polystichum acrosticoides*
jack-in-the-pulpit	*Arisaema triphyllum*
white baneberry	*Actaea pachypoda*
bloodroot	*Sanguinaria canadensis*
false solomon’s seal	*Smilacina racemosa*

Source: Reschke, 1990

Table 20-11. Coastal plain stream and pond fish species

Common Name	Scientific Name
american eel	*Anguilla rostrata*
redfin pickerel	*Esox americanus*
eastern banded killifish	*Fundulus diaphanus*
pumpkinseed	*Lepomis gibbosus*
banded sunfish	*Enneacanthus obesus*
swamp darter	*Etheostoma fusiforma*
largemouth bass	*Micropterus salmoides*
chain pickerel	*Esox niger*
brown bullhead	*Ictalurus nebulosus*
white perch	*Morone americana*
black crappie	*Pomoxis nigromaculatus*
yellow perch	*Perca flavescens*
bluegill	*Lepomis macrochirus*

Source: Edinger, 2002

Table 20-12. Fish species present in Belmont Lake and Southards Pond

Category	Common Name	Scientific Name
Resident	yellow perch	*Perca flavescens*
	common carp	*Cyprinus nebulosus*
	pumpkinseed	*Lepomis gibbosus*
	brown bullhead	*Ictalurus nebulosus*
	largemouth bass	*Micropterus salmoides*
	bluegill	*Lepomis macrochirus*
Southards Pond only	chain pickerel	*Esox niger*
Stocked	brown trout	*Salmo trutta*
	brook trout	*Salvelinus fontinalis*
	rainbow trout	*Oncorhynchus mykiss*

Source: NYSDEC, 2005

21 Manorville Red Maple Swamp

21.1 Selection Criteria and Current Condition

The Manorville Red Maple Swamp was chosen as a PSA because of its status as a unique and sensitive habitat and the presence of Eastern Equine Encephalitis (EEE). The area includes a regionally rare wetland community and is adjacent to two coastal plain ponds, which are also considered regionally rare wetland communities. The swamp contains rare species such as the tiger salamander (*Ambystoma tigrinum*), spotted turtle (*Clemmys guttata*), and Eastern hognose snake (*Heterodon platyrhinos*) (U.S. Fish and Wildlife Service, 1997).

21.2 Location and Ownership

The swamp is owned by Suffolk County. It is part of the Robert Cushman Peconic River County Park, which is located in the Town of Riverhead, south of the former Calverton Naval Weapons Industrial Reserve Plant. Swan Pond Road comprises the site's northern border, while River Road and a dirt road bisect the site. The swamp wraps around the northeast corner of Swan Pond and covers the northern corridor between Swan Pond and an unnamed pond (west of Connecticut Avenue).

21.3 Topography and Waterbodies

The Manorville swamp is located in the eastern portion of Hydrogeological Zone III. This zone is characterized by deep groundwater flow and Magothy recharge. Groundwater in this area is referred to as exceptionally high quality. The Manorville swamp also lies within the Central Suffolk Special Groundwater Protection Area (SGPA). Manorville swamp groundwater generally discharges to the Peconic River as shallow flow.

Two coastal plain ponds lie in close proximity to the swamp, Swan Pond (approximately 24 hectares or 60 acres) and an unnamed pond (approximately 700 x 200 meters). These ponds are hydrologically connected by groundwater and by surface flow from the Peconic River (Edinger, 2002). The ponds occur in kettle holes or depressions in the Ronkonkoma moraine and support a unique assemblage of plants due to a seasonal variation in water levels (Edinger, 2002).

Red maple swamps commonly exist in poorly drained areas of inorganic soil. Numerous depressions and hummocks dominated by graminoid vegetation are typically present**.**

21.4 Land Use and Population Density

The areas adjacent to the swamp are rural and undeveloped, with the exception of the Swan Pond Golf Club and the former Calverton Naval Weapons Industrial Reserve Plant. Surrounding areas, such as Robert Cushman Peconic River County Park and the Peconic River, are used for outdoor recreation. The population density within a ½ mile of the study area is approximately 34 people and the population within two miles of the study area is approximately 1, 235 people.

21.5 Stormwater

No stormwater discharge pipes were observed. Stormwater sheet flow onto the swamp is expected from the Swan Pond Golf Club and the two roads that bisect the area.

21.6 Ecology

21.6.1 Upland Vegetation

This type of swamp derives its name from a red maple (*Acer rubrum*) dominated canopy. Red maples may be co-dominant with several other hardwoods such as ashes (*Fraxinus excelsior*), elms (*Ulmus americana*), yellow birch (*Betula alleghaniensis*) and swamp white oak (*Quercus bicolor*). Bitternut hickory (*Carya cordiformis*), butternut (*Juglans cinerea*), black gum (*Nyssa sylvatica*), ironwood (*Carpinus carolinianus*) and white pine (*Pinus strobus*) trees are also present in smaller numbers. Table 21-1 provides a list of the tree species present in a typical red maple-hardwood swamp.

A dense shrub layer is present and is characterized by numerous species such as: spicebush (*Lindera benzion*), winterberry (*Ilex verticillata*), and high bush blueberry (*Vaccinium* *corymbosum*) (Edinger, 2002). Reschke (1990) also adds three other species that are common to southeastern New York red maple hard wood swamps: black gum (*Nyssa sylvatica*), sweet pepperbush (*Clethra alniflora*), and swamp azalea (*Rhododendron viscosum*). Table 21-2 provides a list of the species typically present in the shrub layer of a red maple-hardwood swamp.

The herbaceous layer is primarily composed of ferns, such as the sensitive fern (*Onoclea sensibilis*) and cinnamon fern (*Osmunda cinnamomea*) and herbs, such as skunk cabbage (*Symplocarpus foetidus*) (Edinger, 2002). Table 21-3 provides a list of the herbaceous layer species commonly found in a red maple-hardwood swamp.

21.6.2 Wildlife

Red maple swamps support numerous wildlife species, such as wood duck (*Aix sponsa*), and obligate wetland breeders, such as spring peepers and the regionally rare tiger salamander (*Ambystoma tigrinum*) (U.S. Fish and Wildlife Service, 1997). Table 21-4 lists the types of fauna occurring in red maple swamps.

21.7 Mosquito Information

21.7.1 Habitat/Species

Culiseta melanura is commonly found in wet depressions and among the root systems of the trees and grasses of red maple swamps. This mosquito species has a flight range of up to five miles and primarily obtains blood meals from birds. It is a known vector of EEE and has been found to be field positive for West Nile Virus.

21.7.2 Pesticide Applications

The last time the County applied adulticide to the area was 1994 and 1996 in response to the presence of EEE (Suffolk County Vector Control, 2005). A few ‘spot treatments’ with Scourge were applied in 1996 and 1997 in response to complaints (Suffolk County Vector Control, 2005).

Table 21-1. Red Maple Hardwood Swamp Trees

Common Name	Scientific Name
red maple	*Acer rubrum*
ashes	*Fraxinus pennsylvannica*
	F. nigra
	F. americana
elms	*Ulmus americana*
	U. rubra
yellow birch	*Betula alleghaniensis*
swamp white oak	*Quercus bicolor*
butternut	*Juglans cinerea*
bitternut hickory	*Carya cordiformis*
black gum	*Nyssa sylvatica*
ironwood	*Carpinus carolinianus*
white pine	*Pinus strobus*

Source: Edinger, 2002

Table 21-2. Red Maple Hardwood Swamp Shrubs

Common Name	Scientific Name
winterberry	*Ilex verticillata*
spicebush	*Lindera benzoin*
alders	*Alnus incana (sub species rugosa)*
	A. serrulata
viburnums	*Viburnum recognitum*
	V. cassinoides
highbush blueberry	*Vaccinium corymbosum*
common elderberry	*Sambucus canadensis*
shrubby dogwoods	*Cornus sericea*
poison sumac	*Toxicodendron vernix*
black ash	*Fraxinus nigra*
black gum	*Nyssa sylvatica*
sweet pepperbush	*Clethra alniflora*
swamp azalea	*Rhododendron viscosum*

Source: Edinger, 2002; Reschke, 1990

Table 21-3. Red Maple-Hardwood Swamp Herbaceous Layer Species

Plant Type	Common Name	Scientific Name
Ferns	sensitive fern	*Onoclea sensibilis*
	cinnamon fern	*Osmunda cinnamomea*
	royal fern	*O. regalis*
	marsh fern	*Thelypteris palustris*
	crested wood fern	*Dryopteris critata*
	spinulose wood fern	*D. carthusiana*
Herbs	skunk cabbage	*Symplocarpus foetidus*
	white hellebore	*Veratum viride*
	sedges	*Carex stricta*
		C. lacustris
		C. intumescens
	jewelweed	*Impatiens capensis*
	false nettle	*Boehmeria cylindrica*
	arrow arum	*Peltandra virginica*
	tall meadow rue	*Thalictrum pubescens*
	marsh marigold	*Caltha palustris*

Source: Edinger 2002

Table 21-4. Fauna occurring in red maple swamps

Category	Common Name	Scientific Name
Birds	wood duck	**21.7.2.1.1.1.1.1 Aix sponosa**
	american black duck	*Anas rubripes*
	northern water thrush	*Seiurus noveboracensis*
Mammals	beaver	*Castor canadensis*
	river otter	*Lutra canadensis*
	mink	*Mustela vison*
	muskrat	*Odatra zibethica*
Amphibians	spring peeper	*Psuedacris c. crucifer*
	american toad	*Bufo americanis*
	wood frog	*Rana sylvatica*
	spotted salamander	*Ambystoma maculatum*
	tiger salamander	*A. tigrinum*
	common red-backed salamander	*Plethodon cinereus*
Reptiles	eastern hognose snake	*Heterodon platyrhinos*
	common garter snake	*Thamnophis sirtalis*
	snapping turtle	*Chelydra serpentina*

Source: Edinger, 2002; U.S. Fish and Wildlife Service, 1997

22 Mastic Freshwater Complex

22.1 Selection Criteria and Current Condition

The Mastic Freshwater Complex was selected as a PSA because it is a freshwater wetland site in a heavily populated area on Long Island's south shore. The area is also a Suffolk County vector control location and a risk assessment site. Further information can be found in Mastic Beach-Shirley LWRP (Cashin Associates, 2003).

22.2 Location, Size and Ownership

The Mastic Freshwater Complex is located on the south shore of the Long Island in central Suffolk County. The study area is located between Pattersquash Creek to the west and Odell's Creek/William Floyd Estate to the east. The Mastic Freshwater Complex is defined as the freshwater wetlands located within these boundaries. The Complex is broken into several smaller sections by a matrix of roads on the peninsula.

The Mastic Freshwater Complex is comprised of 30 hectares (75 acres) on privately owned residential lots. The William Floyd Estate, run by the National Park Service in Forge Point, is 248 hectares (613 acres) in size.

22.3 Topography and Waterbodies

The entire Mastic Beach peninsula is situated within the Hydrogeological Zone IV, as delineated in the Long Island 208 Study. This area is a portion of the south shore shallow flow system that discharges to Narrow Bay.

Groundwater plays a large role in the Mastic Freshwater Complex. Annual variations in the levels of the water table affect the moisture available to plants and animals in the area. Groundwater in this area primarily moves laterally toward the coastal waters, possible with some degree of upward flow as the groundwater discharges to the bay.

22.4 Land Use and Population Density

Most of the properties in the Mastic Freshwater Complex are residential development, although they sit within NYSDEC defined freshwater wetlands. This is mostly a result of housing development that occurred before the designation and regulation of freshwater wetlands in the state.

The majority of the homes in the area are single family built on lots of ranging from one-eight and one-half acre, and some larger. Several of the existing homes are "bungalows" that were previously designated for summertime use only but have been converted into year-round dwellings. The more recent residential developments are larger and more expansive. Population is 3,207 within one-half mile and 24,366 within two miles. The total population of Mastic Beach is 11,543.

22.5 Tidal Characteristics

22.5.1 Tidal Range

The Mastic Freshwater Complex is influenced by the tidal effects of the Great South Bay, Pattersquash Creek, and Odell's Creek. Tidal wetlands of the Mastic Freshwater Complex are connected by a series of culverts passing underneath the roadways that bisect the wetland habitats. Well-developed ditches connect the wetlands throughout the system. Some of the ditches were blocked either by manmade or natural obstructions.

Tidal variation in the Mastic Freshwater Complex is relatively small due to the degree that the system lies upstream from the salt marsh systems. Areas of fresh and brackish marsh have larger tidal ranges than the freshwater systems further inland.

The tidal variation in the nearby Great South Bay at Moriches inlet has a mean range of 2.9 feet, with a spring tide range of 3.5 feet, and a mean tide level of 1.5 feet.

22.6 Stormwater

No stormwater discharge pipes were observed at Mastic Beach. Due to the low elevation along the south shore, stormwater sheet flow onto the southernmost portions of the Mastic Freshwater Complex is expected from Narrow Bay.

22.7 Ecology

22.7.1 Upland Vegetation

Freshwater marshes occur in areas where the tide affects the flow of waters but where the average salinity is below 0.5 parts per thousand (ppt). Vegetation in these marshes is extremely diverse and consists predominantly of herbaceous species. Vegetation within the Mastic Freshwater Complex is characteristic of red maple – black gum swamps, freshwater tidal marshes, and shallow emergent freshwater marshes. There are large expanses of salt and brackish water marshes closer to the bays that influence the freshwater marshes in the area.

Red maple swamps are hardwood swamps that occur in poorly drained depressions, usually on inorganic soils. In any given stand, red maple is either the only canopy dominant, or it is co-dominant with one or more others including black ash, American elm, swamp white oak, butternut, and butternut hickory (Cashin, 2004). The shrub layer is usually well developed and may be quite dense. The herbaceous layer is often dominated by ferns. Plants species identified in the area and adjacent uplands are identified in Table 22-1.

Table 22-1 - Vegetation Species Identified in the Mastic Freshwater Complex

Trees	black cherry	*Prunis serotina*
	black tupelo	*Nyssa sylvatica*
	eastern red cedar	*Juniperous virginiana*
	gray birch	*Betula populifolia*
	pitch pine	*Pinus rigida*
	red maple	*Acer rubrum*
	swamp white oak	*Quercus bicolor*
	weeping willow	*Salix babylonica*
Shrub layer	common reed	*Phragmites australis*
	greenbrier	*Smilax* spp.
	groundsel bush	*Baccharis halimifolia*
	highbush blueberry	*Vaccinium corymbosum*
	honey suckle	*Lonicera spp.*
	multiflora rose	*Rosa multiflora*
	northern arrowood	*Virburnum recognitum*
	northern bayberry	*Myrica pensylvanica*
	poison ivy	*Rhus radicans*
	shadbush	*Amelanchier arborea*
	swamp azalea	*Rhododendron viscosum*
	sweet pepperbush	*Clethra alnifolia*
	three-square rush	*Scirpus americanus*
	virginia creeper	*Parthenocissus quinquefolia*
	winged sumac	*Rhus copallinum*
Herbaceous layer	cinnamon fern	*Osmunda cinnamomea*
	golden rod	*Solidago virgauria*
	marsh fern	*Thelypteris palustris*
	marsh mallow	*Athaea officinalis*
	queen anne's lace	*Daucus carota*
	royal fern	*Osmunda regalis*
	skunk cabbage	*Symplocarpus foetidus*
	swamp smartweed	*Polygonum coccineum*

22.7.2 Wildlife

Table 22-2 lists the types of fauna that are common to freshwater marshes.

22.8 Mosquito Habitat/History

22.8.1 Ditching and Ditch Condition

Several of the salt and brackish marshes of the Mastic Freshwater Complex have been ditched and in places, these ditches extend into the tidal freshwater wetlands. Many of the freshwater wetlands are ditched and drain into the bays. There are a series of culverts that allow the ditches to flow naturally since the roadways bisect the freshwater wetlands,. Some flow rates in the freshwater wetlands are considerably high.

22.8.2 Pesticide Applications

The Mastic Freshwater Complex has major vector control problems. Adulticides and larvicides are applied near the Mastic Freshwater Complex during the mosquito-breeding season.

Table 22-2 - Fauna Common to Freshwater Marshes

Mammals	White-tailed Deer	*Odocoileus virginianus*
	Muskrat	*Ondatra zibethicus*
	Raccoon	*Procyon lotor*
Birds	Red-winged Black Bird	*Agelaius phoeniceus*
	American Coot	*Fulica americana*
	Canada Goose	*Branta canadensis*
	Belted Kingfisher	*Ceryle alcyon*
	Northern Harrier	*Circus cyaneus*
	American Black Duck	*Anas rubripes*
	Canvasback	*Aythya valisineria*
	Mallard	*Anas platyrhynchos*
	Great Egret	*Casmerodius albus*
	Snowy Egret	*Egretta thula*
	Black-crowned Night Heron	*Nycticorax nycticorax*
	Great Blue Heron	*Ardea herodias*
	Green Heron	*Butorides striatus*
	Osprey	*Pandion haliaetus*
	Tree Swallow	*Iridoprocne biocolor*
	Marsh Wren	*Cistothorus palustris*
	Common Yellowthroat	*Geothlypis trichas*
Reptiles	Eastern Mud Turtle	*Kinosternon subrubrum subrubrum*
	Snapping Turtle	*Chelydra serpentina*
	Spotted Turtle	*Clemmys guttata*
Amphibians	Eastern Ribbon Snake	*Thamnophis saurtius*
	Northern Water Snake	*Nerodia sipedon*
	Red-spotted Newt	*Notophthalmus viridescens viridescens*
	Spotted Salamander	*Ambystoma maculatum*
	Fowler’s Toad	*Bufo woodhousei fowleri*
	Spring Peeper	*Hyla crucifer*
	Grey Treefrog	*Hyla versicolor*
	Wood Frog	*Rana sylvatica*
Insects	Black-winged Damselfly	*Calopteryx maculata*
	Green Darner	*Anas junius*
	Mosquito	*Culicidae*
	Spicebush Swallowtail	*Papilio Troilus*

FIGURES

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