Peconic Estuary Program

Environmental Indicators Report

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Abstract

While the Peconic Estuary continues to show signs of stress, overall the indicators point to a healthy system, especially relative to other estuaries nationwide. Significant open space protects natural habitats, groundwater recharge areas, and surface water quality. Dissolved oxygen levels in most of the estuary support abundant flora and fauna. Clean bathing beaches afford recreational opportunities for residents and visitors alike. Other indicators show signs of environmental stress. Low dissolved oxygen conditions occur in the tidal Peconic River, western Flanders Bay and tidal creeks; eelgrass beds are now virtually absent west of Shelter Island, and those that do exist are not expanding; and numerous pesticides have been detected in groundwater. In addition, local fisheries, especially bay scallops and winter flounder, no longer support commercial harvests. It is important to note that some of these declines, such as those seen with eelgrass and the winter flounder population, have been seen throughout New England and the Mid-Atlantic, and it is difficult to discern how local factors may be contributing to the problem. Nevertheless, the Peconic Estuary Program (PEP) continues to focus efforts on improving the environmental quality of the estuary and its watershed.

The Peconic Estuary Program aspires to play a major role in protecting and restoring the estuary, both as a coordinating entity and through its many stakeholders. There are numerous examples of efforts that have been successful to date, such as: funding Brown Tide research; working to reduce nitrogen loads from sewage treatment plants, agricultural operations and golf courses; developing a prioritization system for open space acquisitions; implementing a Vessel Waste No Discharge Zone for the entire estuary; supporting the establishment of spawner sanctuaries for bay scallops; and discouraging the installation of shoreline hardening structures. The PEP will use the findings, conclusions, and recommendations in this indicators report to evaluate the effectiveness of initiatives and to determine what new programs should be pursued to address existing and emerging priorities, so we can chart a course for the future.

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Acronyms

BNL	-	Brookhaven National Laboratory
CCE	-	Cornell Cooperative Extension of Suffolk County
CCMP	-	Comprehensive Conservation and Management Plan
CLPS	-	Critical Lands Protection Strategy
CPF	-	Community Preservation Fund
CWA	-	U.S. Clean Water Act
DDT	-	Dichlorodiphenyltrichloroethane
DEC	-	New York State Department of Environmental Conservation
DIN	-	Dissolved Inorganic Nitrogen
DO	-	Dissolved Oxygen
DON	-	Dissolved Organic Nitrogen
EC_{50}	-	Effective Concentration, the dose that is lethal to 50% of exposed organisms
EPA	-	United States Environmental Protection Agency
ER-L	-	Effects Range-Low
ER-M	-	Effects Range-Medium
ESA	-	Ethanesulfonic Acid
FWS	-	United States Fish and Wildlife Service
GIS	-	Geographic Information Systems
MCL	-	Maximum Contaminant Level
MTBE	-	Methyl Tertiary Butyl Ether
NADP-NTN	-	National Atmospheric Deposition Program – National Trends Network
NDA	-	Vessel Waste No Discharge Area
NOAA	-	National Oceanic and Atmospheric Administration
NOEL	-	No Observable Effect Level
NYCRR	-	New York Environmental Conservation Rules and Regulations
NY	-	New York State
NYS	-	New York State
NYSDEC	-	New York State Department of Environmental Conservation
OA	-	Oxanilic Acid
OMWM	-	Open Marsh Water Management
PAHs	-	Polycyclic Aromatic Hydrocarbons
PCBs	-	Polychlorinated Biphenyls
PEP	-	Peconic Estuary Program
PPB	-	Parts Per Billion

PPM	-	Parts Per Million
SAV	-	Submerged Aquatic Vegetation
SC	-	Suffolk County
SCDHS	-	Suffolk County Department of Health Services
SCPD	-	Suffolk County Planning Department
TN	-	Total Nitrogen
USGS	-	United States Geological Survey
YSI	-	Yellow Springs Instruments

Executive Summary

Introduction

Estuaries, by their very nature, are in a constant state of change. The twice daily flooding and ebbing tides mix ocean water with freshwater from rivers, creeks, and groundwater to form a rich cradle of life. Likewise, the watershed surrounding the estuary also changes: homes are built on open space; some land is preserved in its natural state for the benefit of humans and wildlife; farmland is tilled or is left to lie fallow; an individual makes a decision about whether to apply fertilizers or pesticides, or to clean up after a pet. The cumulative effects of natural events and human actions (or inaction) will ultimately influence the Peconics, its watershed, and everything in them.

At the present time, the Peconic Estuary is in relatively good condition, especially when compared to nearby estuaries adjacent to more urban population centers. Fortunately, the Peconics were spared a past of heavy industry, the remnants of which still plague neighboring waterways. The Peconics did not hit "rock bottom" before a concerned citizenry called on and then joined with governments to conserve and manage this important natural resource. The story of the Peconic Estuary is not fully written yet, but a plan (a Comprehensive Conservation and Management Plan) has been prepared to help guide what the future may be. Elected officials and agencies at all levels of government, together with businesses, trade and environmental organizations, residents and visitors all play a role in shaping the future that lies ahead.

Environmental Indicators

From time to time it is important to take stock and answer some very basic questions: Is the water clean? Are our living resources healthy? Is the land better protected? These seemingly simple questions, however, are difficult to answer in a changing system such as the Peconic Estuary. In this first *Peconic Estuary Program Environmental Indicators Report*, we attempt to answer these questions. To do this, we have identified 18 indicators that we intend to use to help answer these basic questions, draw conclusions, and pose recommendations. For some of these indicators, we have large amounts of data and can use that information to show where we have been and where we are now, and even forecast where we are heading. For others, we have only just begun or are about to begin collecting the information necessary to answer the questions at hand. For each indicator, there is a brief summary statement and then a description of the significance of the indicator. This is followed by information on causes or threats and a presentation of the relevant data. Each section concludes with information on what can be done to help improve environmental conditions.

Findings, Conclusions, and Recommendations

Overall, the Peconic Estuary is in good condition. However, there are significant signs of stress, particularly in the more densely developed areas and in the tidal creeks. These stresses are likely to worsen as the population increases and land uses intensify, unless steps are taken to reduce pollutant loadings and protect habitats from physical alterations. It is possible to reverse some trends through the combined efforts of government, businesses, organizations and citizens to preserve open space, reduce pollution from existing development, and ensure that any future development is done in a way that minimizes its impact on the environment.

Key Findings and Conclusions

The following key findings and conclusions present good news, some bad news, and cautionary notes.

1. Brown Tide blooms have not occurred in almost a decade, but the species most affected (bay scallops and eelgrass) have not rebounded.
2. Low dissolved oxygen conditions are evident in the western estuary, many tidal creeks and occasionally in Flanders Bay, totaling approximately 3% of the estuary's surface waters. The limited data available do not suggest that areas with extreme dissolved oxygen problems are growing with time.
3. Total nitrogen concentrations throughout the main stem of the estuary seem to be decreasing. Whether these declines are due to decreased loading, increased uptake in the food web, or these mechanisms in combination with others, is not known.
4. Eelgrass continues to be in decline, with an areal decrease of at least 82% since the 1930s. Despite generally good water quality, eelgrass beds, currently at 1,550 acres, are not expanding.
5. Tidal wetlands, while generally holding their own at over 5,500 acres, are threatened by degradation of surrounding buffer areas and the invasive common reed. There have also been recent documented losses from unknown causes.
6. Though numerous habitat restoration projects have been completed, significantly more work to restore ecosystems is needed.
7. Bay scallop and winter flounder populations no longer support commercial harvests.
8. The number of nesting pairs of threatened piping plovers, while stable over a 12-year period, is less than the target of 115 pairs. The number of osprey nests in the Peconics also seems relatively stable, ranging from 171 to 215 from 1997 to 2003.
9. Only 4.3% (5,222 acres) of the Peconic Estuary is closed to shellfish harvesting due to water quality concerns, though this includes many highly productive areas. This includes administrative closures of approximately 1000 acres.
10. Bathing beaches remain high quality, with only 6 closures since 1980.
11. There is widespread pesticide use in the Peconic watershed; these pesticides and other toxic substances are being detected in surface waters, bay bottom sediments and groundwater; some are present at levels that exceed State drinking water standards.
12. There are some State health advisories in place regarding human consumption of finfish, crustaceans and wildlife from the Peconic System. Similar advisories are in place for other New York State marine waters.
13. Runoff, and pollutants transported with it, remains problematic due to the pollutants themselves, impervious surface areas, and lack of infiltration/vegetated filters to intercept runoff.
14. There are nearly 30 miles of hardened shoreline; this has significantly reduced intertidal habitats and caused a displacement or loss of plants and animals that depend on these areas. There is an additional 9 miles of docks.
15. There is a significant amount of preserved open space in the watershed (37,771 acres or over 33%), and more continues to be protected. However, acquisition efforts are being outpaced by development, with an average of nearly 600 acres of open space developed each year.

Findings and Conclusions by Indicator

Brown Tide Cell Counts: There have been no significant Brown Tide blooms in the Peconics since 1995, with most cell counts at or near non-detect levels. Unfortunately, bay scallop populations and eelgrass, both known to be greatly affected by Brown Tide, have not rebounded in the absence of blooms. Although there have been many scientific investigations looking at what causes and sustains these devastating blooms, no definitive answers have been found. Some of the most promising research points to healthy filter feeder populations and controlling nitrogen loads as playing roles in preventing blooms; the most promising avenues of research should be pursued.

Dissolved Oxygen Levels: Some parts of the estuary (approximately 3% of the total surface area), consisting mostly of poorly flushed creeks in the western part of the system and even some of the open waters of Flanders Bay, occasionally do not meet existing water quality standards for dissolved oxygen. Like humans, fish and other aquatic life need oxygen in order to live. Oxygen levels in water are greatly influenced by temperature and the amount of decaying organic matter. Because plants and animals use oxygen at night, oxygen levels are typically lowest just before dawn. Managing nutrient loads can help prevent nuisance algal blooms, which in turn can help prevent low dissolved oxygen conditions.

Total Nitrogen Levels: Of eight sampling stations analyzed for percent exceedances of the PEP 0.45 mg/l TN guideline from 1999-02, only 3 (all in the Peconic River/Flanders Bay area) showed violation in greater than 10% of samples. Average total nitrogen concentrations in Flanders Bay varied greatly from 1986 through 1994; however, from 1994 to the present, there is an overall decrease in total nitrogen. Nitrogen is an essential nutrient for healthy ecosystems. The relationship between excessive nitrogen loads and low dissolved oxygen levels in estuaries is well documented. Algae, including macroalgae (*i.e.*, seaweeds) and filter feeders play an important role in influencing ambient nitrogen levels. Sources of nitrogen include agricultural and residential fertilizers, on-site disposal systems, atmospheric deposition, nutrient-enriched bay bottom sediments, and sewage treatment plants. Locally, nitrogen loads can be controlled by implementing best management practices for fertilizers (using fertilizers only when necessary and in such a way that eliminates or reduces losses to ground and surface waters).

Water Clarity: Generally, in non-Brown Tide years, water clarity has been sufficient to support the presence of rooted seagrasses in near shore areas. Eelgrass and widgeon grass (important nursery and spawning habitats for finfish and shellfish) need sunlight in order to grow and survive. Reduced water clarity can be caused by algal blooms, eroded sediments, or bottom sediments placed in suspension by runoff, wind or human activities (*e.g.*, boating, use of personal watercraft, dredging). When sediments settle, they can smother bottom dwelling organisms and their habitats. Managing nutrient loads can help prevent algal blooms, which in turn can improve water clarity, as can reducing erosion and minimizing bottom disturbances. Increasing populations of filter feeders may also help improve water clarity and quality.

Extent of Eelgrass Beds: In a 2000 inventory, there were 1,550 acres of eelgrass in 119 beds, the vast majority in the eastern part of the Estuary. Eelgrass meadows have declined by at least 82% since the 1930s and are proving difficult to re-establish. Eelgrass stabilizes sediments, oxygenates bottom waters, acts as a nutrient sink (preventing dissolved nutrients from directly entering the water column), and is an important habitat for many estuarine species, including bay scallops and many types of fish. Many eelgrass beds were decimated by a slime mold wasting disease that appeared in the 1930s and further impacted by reduced light penetration due to the Brown Tide blooms of 1985-95. Excess nitrogen may directly affect eelgrass, as will anchor scarring, boating in shallow water and some shellfish harvesting methods. Attempts to re-establish eelgrass have proven to be labor intensive, difficult and costly, though some new and promising methods are being tested. Conserving existing eelgrass beds and re-establishing new ones will be most successful if there is good water quality and clarity, and minimal physical disturbance and predators.

Extent of Tidal Wetlands: As of 1994, there are approximately 5,700 acres of estuarine wetlands in the Peconic Estuary, of which about 3,600 are emergent salt marsh. Tidal wetlands are generally "holding their own" due to laws protecting them, with less than 2% lost since 1972. Tidal wetlands are an important habitat for many species, especially birds, fish and shellfish. They also help to prevent upland flooding by absorbing runoff and storm surges and improve water quality by filtering out sediments and pollutants. Wetland losses from 1972 to 1994 are believed to be due mostly to erosion, but also some dredging and filling. While wetland losses are now relatively uncommon, recent investigations have identified losses for unknown causes. There are increasing concerns due to erosion, the invasive common reed (*Phragmites australis*), sea level rise, and losses and disturbance of upland buffer areas. Protecting wetlands from degradation from surrounding land use activities, controlling invasive species and undertaking restoration projects are all important to the future of wetlands systems.

Habitat Restoration Projects: Numerous habitat restoration projects have been documented, but they have covered only a small percentage of the estimated habitat restoration needs in the Peconics. Habitat loss, fragmentation and degradation are frequently the result of alterations from human activities. Marshes and creeks have historically been dredged, ditched, filled, bulkheaded and dammed. Uplands have been cleared for agricultural and residential use. Impediments to restoration projects include (1) a large proportion of the land needing restoration is privately owned; (2) habitat restoration is an evolving science; (3) restoration of certain habitats, like eelgrass, is proving to be difficult and costly; and (4) it can take years to document whether a restoration project has been successful. A "Habitat Restoration Plan for the Peconic Estuary," detailing 72 projects with an estimated cost of $42 million, has been prepared.

Bay Scallop Commercial Landings: Bay scallop landings are now a tiny fraction of what was once a nationally significant fishery. From the 1970s to mid-1980s, the commercial landings of scallops ranged from approximately 100,000 to 700,000 pounds of meat. Since 1996, commercial landings have ranged from 0 to just under 6,000 pounds. For ecological, cultural, and economic reasons, the bay scallop is important to the Peconic Estuary, and the loss of the recreational and commercial harvest has been greatly felt on Long Island's East End. Scallops generally live only one and one-half to two years and usually spawn only once, in their second year. This makes them extremely susceptible to environmental stressors such as Brown Tide and loss of habitat. Scallops are harvested during the period of October through March at a size that captures post-spawning individuals. Good water quality can help support populations of bay scallops directly, as well as the habitats they need to survive, particularly during sensitive life stages. Sufficient food must also be present (research has shown that the Brown Tide algae is not a desirable food source for bay scallops). Human intervention through the establishment and stocking of spawner sanctuaries and additional large scale seeding may help bay scallops rebound.

Winter Flounder Population Abundance: Winter flounder are considered an overfished species, and overfishing continues on the Southern New England/Mid-Atlantic stock. This species is exhibiting record low levels of spawning stock biomass and poor recruitment. During the 1950s and 1960s, it was one of the top five commercially landed species in the Peconics. There is no longer a significant commercial harvest from the Peconics. There is little information on recreational landings specific to the Peconic Estuary. Winter flounder spawn in the shallows waters of the Peconics from late winter to early spring. They are most abundant in the Peconics from early spring to late summer, after which they move to deeper, cooler waters within the estuary. It is important to strictly follow harvesting guidelines. It is also necessary to protect and manage the sandy or mud-bottom habitats, including submerged aquatic vegetation and macroalgal beds, important to this species.

Piping Plover Nests and Nesting Pairs: The number of nesting pairs of piping plovers in the Peconic region declined from 1998-2001, from 64 pairs to 45 pairs, respectively, with an increase to 57 pairs observed in 2002. Nesting productivity ranged from 0.68 to 1.59 young per nest over the same period. Piping plovers are listed as a Federally threatened and New York State endangered species. Protection and monitoring efforts began in the 1980s. They are small shorebirds that nest on beaches, and as a result, their nesting and reproduction are susceptible to human intrusion, storm tides and predators. The breeding season is spring to summer. Both survey and nest protection efforts have increased since the piping plover was given Federal threatened status in 1986. Reducing human intrusion and predators can help increase nesting pair numbers and nesting productivity.

Osprey Nests and Nesting Pairs: Between 1997 and 2003, the number of osprey nests in the Peconic region has generally remained stable, ranging from 171 to 215. Average annual nesting productivity over the 7-year period was somewhat lower in the Peconic region (0.89 young per nest) as compared to the rest of Long Island (1.43 young per nest). The osprey is a large fish-eating bird that is highly migratory and nests on Long Island from mid-March to September. The osprey is a success story due to its resurgence since the banning of the persistent pesticide DDT, which caused eggs to have thin, brittle shells that were vulnerable to breakage.

Shellfish Bed Closures: Approximately 4.3% of the Peconics is closed to shellfishing (5,222 acres) for reasons including water quality concerns. Water quality in larger bodies of water in the Peconics supports unrestricted shellfishing, unlike Flanders Bay and some more sheltered and poorly flushed creeks and embayments. Commercial and recreational harvests of safe shellfish are a benefit to the local economy. Importantly, closed areas tend to contain some of the most productive shellfish beds. Many areas were closed to shellfishing from 1980 to 1995, but since that time, there has been a net increase of 211 acres of certified or seasonally certified shellfish lands in the Peconics. The major threats to shellfish harvesting areas are contaminated stormwater runoff from developed and agricultural areas (carrying wastes from domestic animals, livestock, and wildlife, especially waterfowl), illegally discharged wastes from boats, failing septic systems, and disinfection system failures at sewage treatment plants. Preventing or controlling runoff from new developments and improving and maintaining stormwater systems in existing developments can maintain and improve water quality. It is also important to prevent domestic animal, livestock and wildlife wastes from getting into runoff, properly maintain septic systems, and observe Vessel Waste No Discharge laws.

Bathing Beach Closures: Since 1980, there have been only 6 bathing beach closures (in 2001, 2002 and 2004), 5 of which were precautionary. The Peconic Estuary boasts over 450 miles of shoreline and 31 bathing beaches permitted by Suffolk County. The permitted bathing beaches are located in areas that are generally free from pollution and provide a safe and healthy recreational environment. The threats to bathing beach water quality are the same as those to shellfishing areas: runoff; waste from domestic and wild animals and livestock; illegal vessel waste discharges; failing septic systems; and operational problems at sewage treatment plants. Maintaining high quality bathing beaches requires mitigating these potential sources of pollutants.

Pesticides in Ground and Surface Waters: Since 1997, the Suffolk County pesticide monitoring program has identified 63 pesticide-related chemicals in groundwater. Most of these compounds have been found at low levels, though 13 have been detected at concentrations that exceed State drinking water standards. Suffolk County surface water monitoring has detected 37 pesticide-related compounds in streams that feed the Peconic Bays. Aldicarb, an herbicide banned in the early 1980s, and its degradates are particularly pervasive in Peconic ground and surface waters. Pesticides can enter the Estuary with runoff, in groundwater, or by direct application. Though no causal link has been identified, low levels of pesticides (and other toxic substances) may be affecting the biota of the Peconic Estuary, especially during sensitive early life stages. To reduce the potential adverse consequences of pesticides, they must be used only when necessary, and instructions for proper use and disposal must be strictly followed.

Other Toxic Substances in Sediments, Biota and Groundwater: While toxic substances have been detected in bay and creek bottom sediments and some State-regulated wildlife consumption advisories exist (see www.health.state.ny.us/nysdoh/fish/fishbrochure.htm), toxic substances should not pose a significant problem to aquatic life at current levels. Increased urbanization and more intense land use activities may result in contamination and stresses to aquatic life in the future. Suffolk County also monitors nitrate concentrations in groundwater due to concerns about drinking water contamination; five wells in agricultural areas showed an increasing trend in nitrate concentrations for the years 1998-2002. Other chemicals of concern are MTBE and perchlorate. Several studies are underway to further assess toxic contamination in the Peconic Estuary. Toxic pollutants come from diverse activities and land uses, including stormwater runoff, sewage treatment plant effluent, septic system leaching, mosquito control measures, marinas and boating, treated lumber, leaking underground storage tanks, and atmospheric deposits from sources near and far. Preventing toxic substances from getting into the bays and aquatic life can be carried out on many fronts, including following pollution prevention techniques (reduce, reuse, recycle) and using non or less toxic materials when possible.

Extent of Impervious Surface: The Peconic Estuary Program is currently involved in an effort to estimate the amount of impervious surface in the watershed. Impervious surfaces include roads, parking areas, sidewalks, driveways, and rooftops; the extent of impervious surfaces is thus directly correlated to development. In addition, unpaved areas can act as impervious surfaces if soils become compacted enough to inhibit infiltration. Impervious surfaces promote the mobility of sediments, nutrients, toxic substances and pathogens to the estuary by minimizing or bypassing the mitigating effects of wetland and open space areas and percolation through subsurface soils to groundwater flow. They are also reflective of habitat and open space losses. Excess runoff can contribute to flooding in developed areas, scouring and degradation of habitats, and stresses on living things due to sediments and pollutants. Minimizing impervious surfaces can decrease runoff volumes and pollutant transport to surface waters. Intercepting runoff and providing for infiltration can also reduce or eliminate impacts. Impervious surfaces should be minimized or eliminated to the extent possible.

Extent of Shoreline Hardening: In 2000, approximately 29 miles of hardened shoreline (bulkheads, seawalls, etc.) and 9 miles of docks were inventoried across the Peconic Estuary coastline. This represents over 6% of coastline. The shoreline, or more broadly the intertidal zone, is home to a variety of plants and animals that are specially adapted to the twice-daily inundations of seawater. The installation of hard structures along the shoreline has led to the loss of wetlands and beaches as well as the scouring of shallow areas, which impacts shallow water benthic communities. Docks and piers can shade and adversely impact important habitats. Bulkheads, rip-rap and other structures have been widely used to stabilize waterfront property but can result in erosion or deposition of sediments up or down stream of the structure, often resulting in adjacent landowners installing structures of their own. The scour in front of these structures eliminates protective features and habitats of intertidal areas (*e.g.*, habitat for finfish, shellfish and horseshoe crabs). Structures also prevent the shoreward migration of salt marshes, and many structural materials leach toxic substances. Eliminating or limiting new shoreline hardening structures is an important step in preserving the habitats, and therefore the living resources, of the Peconic Estuary. Natural shoreline stabilization techniques should be pursued and encouraged and restoration projects identified and carried out. When the installation of new or replacement structures does take place, non-toxic or low toxicity materials should be used.

Land Protection: Of the 113,892 acres of land in the Peconic Watershed's five eastern towns, over 33% (37,771 acres) is protected, while a little more than 22% (25,271 acres) is still available for development (as of 2001). A significant amount of additional open space has been preserved since then. Benefits of land protection include preserving unique species and natural communities, protecting surface water and groundwater quality, and preserving the quality of life and amenities that make the East End special. The towns and County in particular have been significant players in acquiring and protecting open space, though State and private land trusts have also helped the effort. There is still a significant amount of unprotected, vacant land in the watershed, in addition to developed properties that can be further subdivided and developed. Funding is needed to acquire properties before they are lost to development. Clearing restrictions and clustering requirements can also help guide the future of existing open spaces.

Recommendations

The following 12 recommendations constitute a summarized response plan based on the preparation of this Environmental Indicators Report.

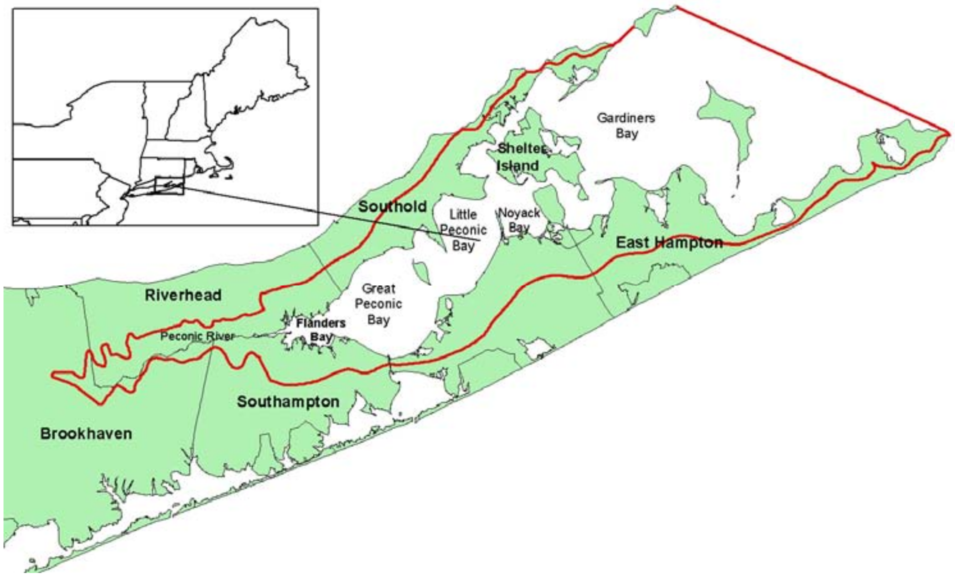
1. Prevent the introduction of excessive nitrogen to the estuary, especially by reducing loads due to fertilizer use.
2. Keep pollutants out of stormwater runoff, reduce impervious surfaces to reduce runoff volumes, and provide for the infiltration of any runoff that remains.
3. Preserve priority open spaces, particularly coastal properties.
4. Restore healthy filter feeder populations (*i.e.*, bay scallops, clams, etc.) through: spawner sanctuaries; restocking and seeding; maintaining good water quality and improving water quality where necessary; habitat protection and improvements; and obeying harvesting laws.
5. Conserve existing eelgrass beds and work to restore historic eelgrass coverage.
6. Protect freshwater wetlands, tidal wetlands and their upland buffers. Re-establish and/or maintain natural buffers bordering wetlands and surface waters.

7. Use and handle toxic substances, especially pesticides, judiciously and carefully; dispose of unneeded and unwanted materials responsibly.
8. Maintain and increase natural shorelines and the habitats of endangered species.
9. Restore degraded habitats and shorelines, and reduce the spread of invasive species. Assist with promising restoration projects and secure funding for pre-restoration planning, permitting, implementation and post-restoration monitoring.
10. Obey laws - one transgression may not be significant, but the cumulative effects across the estuary and watershed can be important.
11. Conduct research to understand environmental issues in order to design programs that respond to them.
12. Communicate with the public on what can be done and what they can do personally to improve the environmental health of the Peconics.

Introduction

Just 80 miles east of New York City lays an invaluable natural treasure – the Peconic Estuary (see Figure 1). Nearly 128,000 acres of land and over 158,000 acres of surface water compose the Peconic Watershed. The Nature Conservancy has designated the Peconic system as one of the "Last Great Places" due to the high concentration and diversity of rare and endangered species and assemblages of natural communities. At the present time, the Peconic Estuary is in relatively good condition, especially when compared to nearby estuaries adjacent to more urban population centers. The Peconics did not hit "rock bottom" before a concerned citizenry called on and then joined with governments to conserve and manage this important natural resource.

Figure 1: Peconic Estuary Program Study Area.



In 1992, the Peconic Estuary was designated by the U.S. Environmental Protection Agency (EPA) as an "Estuary of National Significance" under the Federal Clean Water Act (CWA). The Peconic Estuary Program, consisting of governmental and non-governmental stakeholders, was convened to develop and implement a Comprehensive Conservation and Management Plan (CCMP). The CCMP was approved by EPA Administrator Whitman in November 2001, with the concurrence of New York State Governor Pataki. The overall focus of the Peconic CCMP is on protection and preservation of water quality, living resources and habitats, along with restoration where degradation has occurred. Priority management topics in the Peconic CCMP include: Brown Tide; nutrients; habitats and living resources; pathogens; toxics; and critical lands protection. Public education and outreach, financing and post-CCMP implementation are management topics also addressed in the CCMP.

The CCMP includes objectives for each management topic; there are a total of 47 such objectives (see Appendix A). Examples include "minimize heath risks due to the human consumption of shellfish" and "restore degraded habitats to maintain or increase native species and community diversity, provide connectivity of natural areas, and expand existing natural areas." The Plan also includes measurable goals for each management topic; there are a total of

48 measurable goals (see Appendix B). Measurable goals are expressed in terms of environmental conditions (*e.g.*, "maintain current eelgrass coverage") or programmatic activity (e.g., "establish a vessel waste no discharge area"). There are 85 generally broad actions in the Plan, and each action is broken down into one or more steps. In total, there are 340 steps, including 79 that the program has identified as priorities. Each action is linked to one or more objectives. Measurable goals and actions are also linked. Finally, the CCMP includes an Environmental Monitoring Plan which includes 32 core elements to assist in determining whether the CCMP measurable goals are being met (see Appendix C). The core elements of the environmental monitoring plan include both existing and proposed activities.

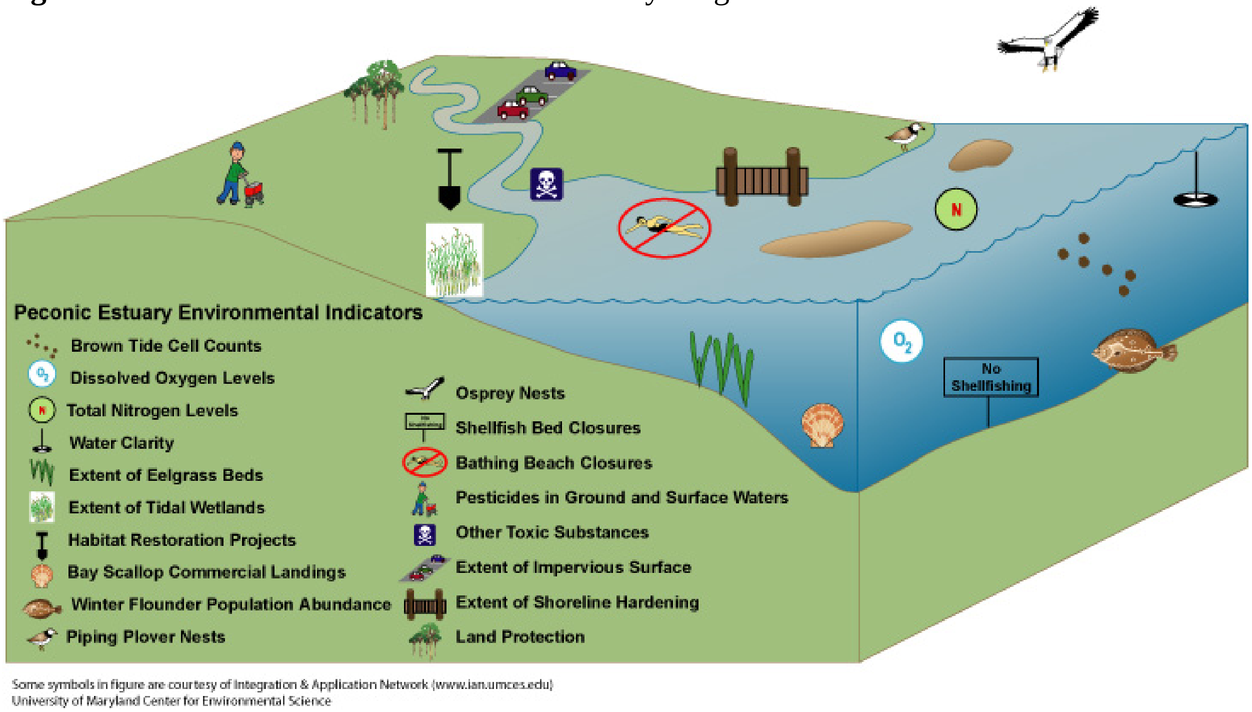
Through the CCMP, the PEP commits to completing a programmatic review (to evaluate success in implementing actions in the plan) every three years. The first review was prepared in June 2001; a second review was completed in June 2004. The PEP has also committed to reporting on environmental outcomes every three years; this is the first such report in response to that commitment.

The Peconic Estuary Program developed a specific list of indicators, the Primary Environmental Indicators, to be used in reporting on environmental outcomes. The indicators are related to key measurable goals in the CCMP and elements of the Environmental Monitoring Plan. Considerations in developing the Primary Environmental Indicators list included: 1) identifying information and measurements that are meaningful and understandable to the public across the range of management topics in the plan and 2) the availability of data that could be used to report current conditions and trends over time. The final list of indicators is as follows:

- Brown Tide cell counts
- Dissolved oxygen levels
- Total nitrogen levels
- Water clarity
- Extent of eelgrass beds
- Extent of tidal wetlands
- Habitat restoration projects
- Bay scallop commercial landings
- Winter flounder population abundance
- Piping plover nests and nesting productivity
- Osprey nests and nesting productivity
- Shellfish bed closures
- Bathing beach closures
- Pesticides in ground and surface waters
- Other toxic substances in sediments, biota and groundwater
- Extent of impervious surfaces
- Extent of shoreline hardening
- Land protection

Figure 2 gives a pictorial representation of the breadth of these 18 indicators.

Figure 2: Schematic Overview of Peconic Estuary Program Environmental Indicators.



Each indicator section is grouped according to general management issue (*e.g.*, nutrients). The report on each of these environmental indicators follows a similar format and includes background information on the parameter; a summary of the data, status and trends (to the extent possible); a discussion regarding limitations of the data; and recommendations of actions that can be taken to improve environmental conditions.

Environmental Indicators

Environmental Indicator for Brown Tide

What is Brown Tide and why is it a concern? Brown Tides are caused by a proliferation of single-celled marine plants called phytoplankton. Although phytoplankton of many types are found in all natural freshwater and marine ecosystems, blooms of the Brown Tide organism (*Aureococcus anophagefferens*) literally turn the water deep brown, making it unappealing to swimmers and fishermen alike. Brown Tides are part of a growing worldwide incidence of harmful algal blooms.

While not harmful to human health, the presence of Brown Tide is a problem for bay scallops and eelgrass, and to a lesser degree finfish and other shellfish. Soon after Brown Tide bloomed in the Peconics in 1985, the population of bay scallops declined significantly, contributing to a near collapse of the estuary's commercial shellfishing industry. Some of the negative impacts related to high concentrations of Brown Tide (reported from field and laboratory experiments) include:

- High mortality and impaired reproduction of Peconic bay scallops
- Eelgrass die-offs
- Inhibited feeding rates of juvenile and adult blue mussels and hard clams
- Inhibited growth of juvenile hard clams

Brown Tide is believed to impact bay scallops and other shellfish in several ways. For example, the presence of Brown Tide may impede their ability to derive sustenance through feeding. There have been indications that the feeding cilia of shellfish are narcotized in the presence of Brown Tide. It is also possible that Brown Tide cells have low nutritional value or clog the filter feeding mechanism due to their small size. Dense and long-lasting Brown Tide blooms impact eelgrass by reducing the amount of light reaching this plant that is rooted in the sediment, thereby reducing its photosynthetic capability and its ability to grow and propagate.

What causes Brown Tide to bloom? Various theories have been investigated, but scientists still do not have a clear explanation of what causes Brown Tide blooms. Some accepted research at this point concludes that:

- Compared to other algae, Brown Tide can photosynthesize under extremely low light conditions.
- Brown Tide usually acts like an autotroph (plant), producing its own food through photosynthesis. However, in low light conditions, Brown Tide may behave like a heterotroph (animal) metabolizing organic carbon and nitrogen.
- Brown Tide bloom onset conditions may be optimized by elevated ratios of available dissolved organic nitrogen (high "DON") in surface waters, with respect to the supply of dissolved inorganic nitrogen (low "DIN"). These nitrogen constituents may be related to groundwater inputs and weather patterns – onset conditions may be optimal in a dry year (low DIN supply from groundwater) that follows a wet year.
- Clams and other suspension-feeders can exert significant feeding pressure on phytoplankton, including Brown Tide at low levels. In an experimental setting, hard

clams have been shown to play a pivotal role in determining whether Brown Tide blooms become established.

Is Brown Tide an issue in the Peconic Estuary? Brown Tide blooms persisted in high concentrations for extended periods in all or part of the Peconics from 1985 through 1988, 1990 through 1992, and 1995. Brown Tide has not bloomed in high concentrations in the Peconics since then, but it continues to be an important management topic, especially as efforts are mounted to restore shellfisheries and eelgrass.

What is being and can be done to improve environmental quality with respect to Brown Tide? Continued research, monitoring, and information sharing are needed to find out the cause of Brown Tide and actions that can be taken to prevent, or at least mitigate, the effects of Brown Tide.

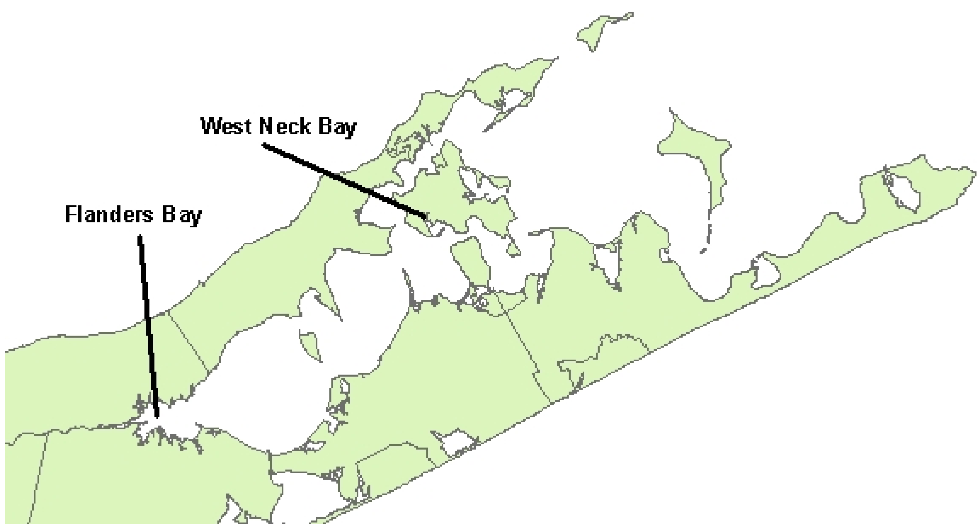
What is the environmental indicator for Brown Tide? The Peconic Estuary Program has chosen peak Brown Tide cell counts in Flanders Bay as an environmental indicator.

Environmental Indicator: Brown Tide Cell Counts

Background: In the Peconics, bloom conditions have been consistently most severe in Flanders Bay (in the Towns of Riverhead and Southampton) and West Neck Bay (in the Town of Shelter Island). Brown Tide is unlike most other algal blooms because of its unusually high concentrations, the extent of area it covers and the length of time it persists. Brown Tide events become visible "blooms" (a light brown discoloration of the water is usually observed) at about 200,000 cells per milliliter of water, but they have been found to affect shellfish at concentrations as low as 30,000 cells per milliliter. Peak Brown Tide cell counts have historically exceeded one million cells per milliliter of water, as compared to a normal, mixed phytoplankton assemblage that would typically range from 100 to 100,000 cells per milliliter.

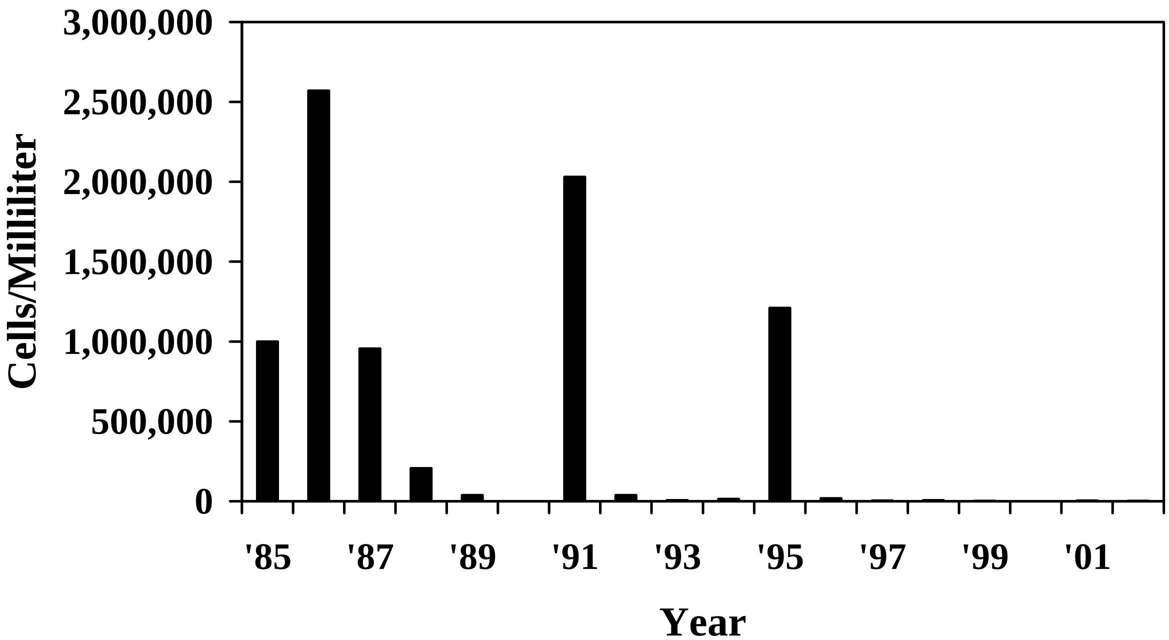
Data on Brown Tide Counts: In the Peconic Estuary, Brown Tide counts are part of the Suffolk County Department of Health Services's (SCDHS) regular surface water monitoring protocol for Flanders Bay and West Neck Bay (see map in Figure 3). If a Brown Tide bloom is detected at these sites, other stations may be monitored.

Figure 3: Map Depicting Flanders Bay and West Neck Bay, Sentinel Sites for Brown Tide.



The SCDHS laboratory uses polyclonal antibodies and epifluorescence microscopy to count Brown Tide cells. Figure 4 indicates that Brown Tide cell counts in Flanders Bay peaked in 1986; however, it is likely that the 1985 bloom, which was not measured during its peak, exceeded that of 1986. Other spikes occurred in 1991 and 1995, with no significant numbers being found since 1995.

Figure 4: Flanders Bay Peak Brown Tide Cell Counts.



Limitations on these data: SCDHS's Brown Tide cell counts have routinely been made on water samples collected from each of eight "main stem" stations extending from Flanders Bay to Gardiners Bay. The data are extrapolated to characterize the surface waters that surround each sampling location. The data are believed to be accurate, and most Brown Tide researchers have used the SCDHS counts in their own studies.

What can be done: Some of the most promising research points to healthy filter feeder populations and controlling nitrogen loads as playing a role in preventing blooms; the most promising avenues of research should be pursued.

Environmental Indicators for Nutrients

What are nutrients and why are they a concern? A nutrient is any substance that is required for growth by plants and animals. Nitrogen is the nutrient that generally limits productivity in estuarine systems and thus can have adverse effects on water quality, habitats and aquatic life if present in excess. Excess nutrients can cause:

- Nuisance algal blooms that can lead to dissolved oxygen deficits (affecting finfish and shellfish), decreased water clarity (affecting eelgrass), and reduced recreational and aesthetic value of the estuary;
- Changes in the overall food web, including the composition of the phytoplankton community;
- Direct adverse impacts on eelgrass; and,
- Macroalgae to potentially out-compete eelgrass.

Where do nutrients come from? Nitrogen that enters estuarine systems originates from a myriad of sources, including excessive agricultural and residential fertilizer use, atmospheric deposition, on-site disposal systems (septic systems or cesspools), sewage treatment plant discharges, stormwater runoff, and flux from bay bottom sediments that have become enriched from these sources.

Are nutrients an issue in the Peconic Estuary? About 97 percent of the Peconic Estuary's surface waters are classified as high quality when measured against New York State's dissolved oxygen standard. However, due to poor tidal flushing and pollutant inputs, the environmentally sensitive western estuary (more specifically, the tidal Peconic River, Meetinghouse Creek and East Creek in Riverhead) is critically stressed. These areas have elevated nitrogen levels and frequently do not meet the dissolved oxygen standard. Other tidal creeks may also be stressed, especially in the warm summer months. Furthermore, considering that an estimated 22 percent of the Peconic watershed is still subject to development, as well as changes that are occurring such as the conversion of seasonal homes to year-round homes and increases in lawns and landscaped areas that are heavily fertilized, the challenge of reducing nutrient loads to prevent problems from occurring in the future is a formidable one.

The important role filter feeders play in removing nutrients from an ecosystem also needs to be recognized. As algae use nutrients in the water to grow and reproduce, scallops, hard clams, mussels, oysters, sponges and other filter feeders can remove the algae from the water and also grow in the process. When shellfish are harvested, nitrogen is being removed from the system.

What is being and can be done to improve environmental quality with respect to nutrients? Reducing nitrogen loads is a priority for the Peconic Estuary Program. The PEP is pursuing several initiatives, including:

- Imposing limits on the amount of nitrogen that is discharged from the major sewage treatment plants and upgrading treatment systems to meet the limits;
- Supporting open space acquisition, particularly in nitrogen-stressed sub-watersheds (a benefit of natural lands protection is controlling nitrogen loads);
- Working with farmers to reduce the fertilizer (nitrogen) load from agriculture by 25%.

- Working with the 35 golf courses on the East End to reduce the amount of fertilizer (nitrogen) that leaches to groundwater and surface water;
- Developing more specific recommendations for homeowners and landscapers to reduce or eliminate fertilizer (nitrogen) losses to groundwater and runoff from lawn care and landscape maintenance;
- Promoting the use of the treated wastewater from the Riverhead Sewage Treatment Plant to irrigate and "fertigate" the adjacent golf course;
- Working with the boating community to ensure compliance with the "Vessel Waste No Discharge Zone" regulations for the entire Peconic Estuary;
- Sponsoring shellfish and wetland restoration projects (both can help improve water quality);
- Supporting the construction of Crescent Duck Farm's treatment plant to better treat processing waters;
- Working with governments to implement additional/improved stormwater remediation projects on roadways;
- Investigating opportunities to reduce nutrient loadings from on-site wastewater disposal systems (septic systems or cesspools); and,
- Adopting the innovative policy of water quality preservation in the eastern estuary to accompany necessary mitigation projects.

What are the environmental indicators related to nutrients? The Peconic Estuary Program has identified three environmental indicators that are related to nutrients. These are: (1) dissolved oxygen levels (2) total nitrogen levels, and (3) water clarity, as measured by Secchi disk depth.

Environmental Indicator: Dissolved Oxygen Levels

Background: Like land animals and humans, fish and other aquatic organisms need oxygen to live. If there is not enough dissolved oxygen (the amount of gaseous oxygen in the water column), fish and other aquatic life are forced to leave the area, become stressed, or die. Bottom dwelling organisms and those that cannot move or can only move very slowly are particularly vulnerable. The condition of low dissolved oxygen is known as hypoxia.

Dissolved oxygen gets into the water by wave and current turbulence, diffusion, and as a product of photosynthesis (the process by which plants utilize the sun's energy). In the water, oxygen is consumed by the respiration of aquatic animals, by bacteria breaking down organic matter, and by plants and algae in the absence of sunlight. Water temperature is also important because as water becomes warmer, it can hold less dissolved oxygen. During the night hours, in the absence of photosynthesis, dissolved oxygen levels in the water decline; therefore, dissolved oxygen levels are lowest just before dawn, especially in the warm summer months.

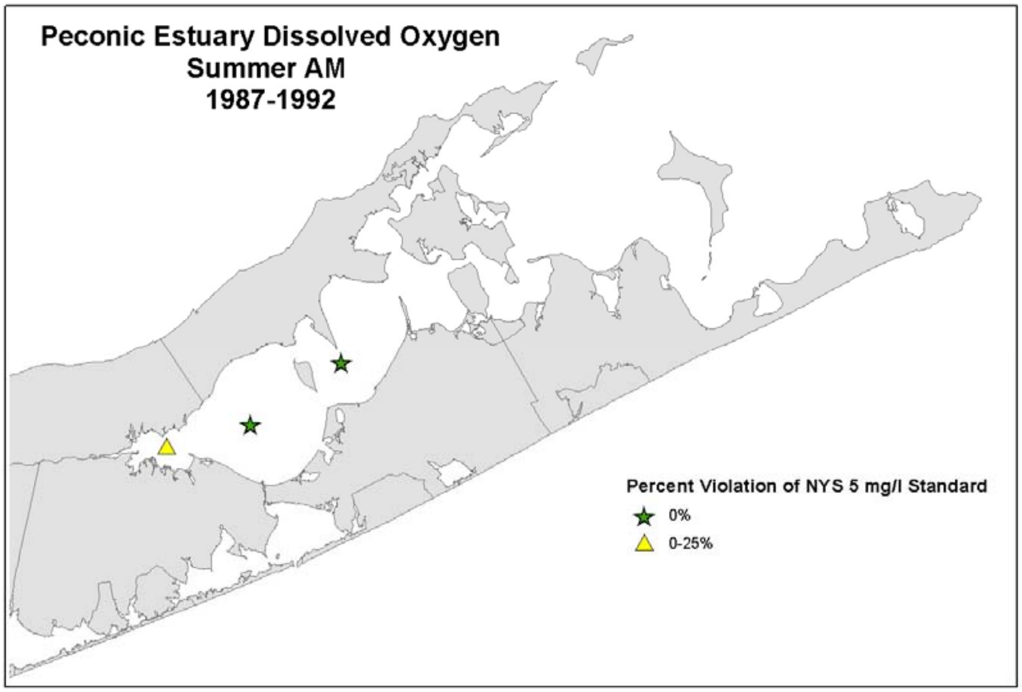
New York State has a water quality standard for dissolved oxygen of no less than 5.0 mg/l for all class SA, class SB, and class SC waters (see 6 NYCRR Part 703.3) – all of the estuarine waters in the Peconic Estuary fall within these classifications. The 5.0 mg/l standard is considered extremely protective, and scientists believe that levels slightly below 5 mg/l can be sustained without harming marine life. For example, the Long Island Sound Study has developed the following dissolved oxygen benchmarks: 5.0 mg/l to be fully protective; 3.5 mg/l (one day average) to be protective of most species; and 2.0 mg/l (at all times) to prevent major loss.

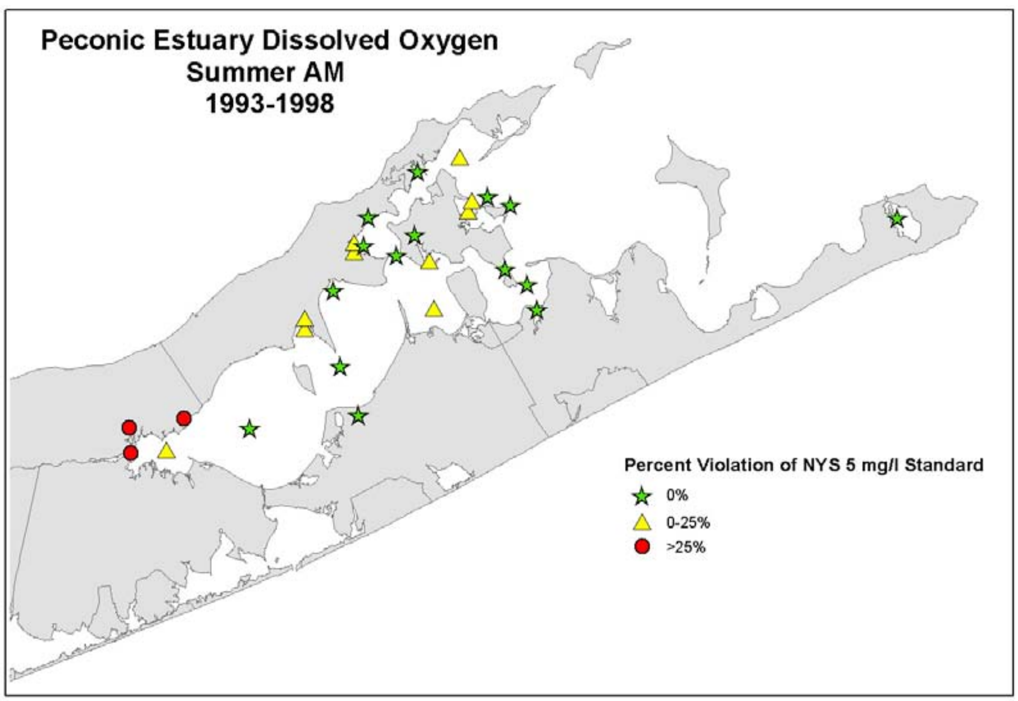
Dissolved Oxygen Data: Dissolved oxygen (DO) is generally measured using a Yellow Springs Instruments (YSI) handheld digital meter. The maps in Figure 5 depict the percent of samples that violated the New York State dissolved oxygen standard (5 mg/l) for various areas within the Peconic Estuary, over three time periods. All samples were taken in the summer months (June through August) in the morning (before 9 a.m.) to get the best estimate of dissolved oxygen deficiency. Red circles denote that greater than 25% of samples were in violation of the standard (*i.e*., DO less than 5 mg/l), yellow triangles indicate 0-25% violation, and green stars depict no violation.

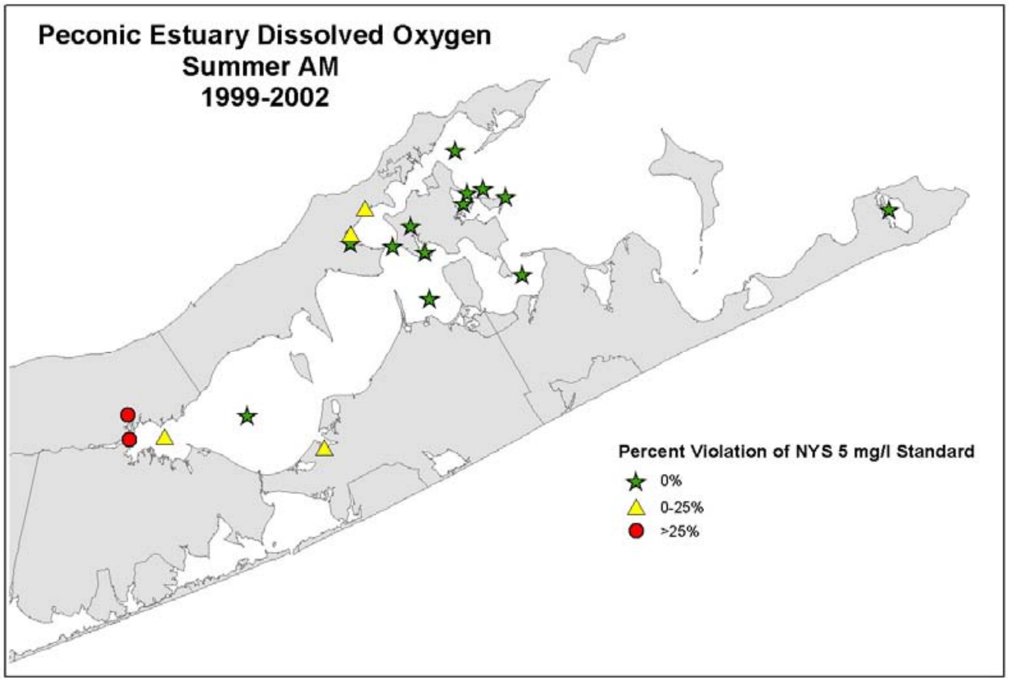
As noted in red circles, the tidal Peconic River, Meetinghouse Creek, and East Creek in the Town of Riverhead continue to experience frequent and serious violations of the New York State dissolved oxygen standard (The PEP considers levels below 3.5 mg/l & 2.0 mg/l as "serious"). No other stations in the estuary showed serious violations of the dissolved oxygen standard. Approximately 3% of the total surface area of the estuary experiences dissolved oxygen stresses if the occasional violations in the western bays are included. The limited data that are available have not suggested that areas with extreme dissolved oxygen problems have grown with time.

As per the Long Island Sound Study benchmarks, one would expect to see significant ecological impacts from depressed dissolved oxygen levels in the tidal Peconic River, Meetinghouse Creek, and East Creek in the Town of Riverhead. Flanders Bay and some creeks on the North Fork appear to be experiencing some ecological stress. It is likely that the rest of the estuary does not experience negative ecological impacts attributable to dissolved oxygen depression.

Figure 5: Peconic Areas that Have Violated NYS Dissolved Oxygen Standard, by Time Period.

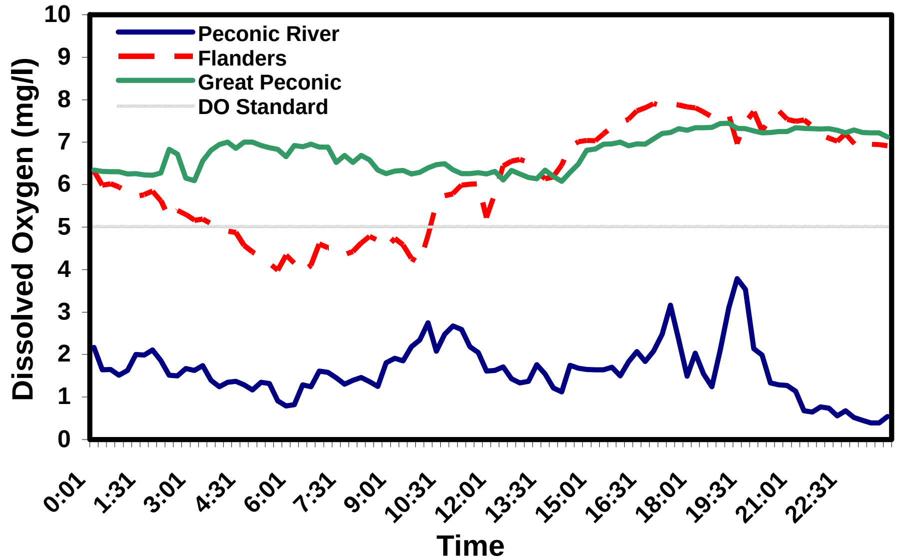






For the past few years, three YSI continuous monitoring devices have been deployed in the main stem of the estuary to characterize the health of the estuary with respect to dissolved oxygen concentrations. The monitoring devices download information every fifteen minutes and are deployed approximately one meter off the bay bottom. Figure 6 depicts the dissolved oxygen concentrations experienced on July 15, 2004, a typical summer day. As per the graphic, the tidal Peconic River station, the most landward monitoring site of the three, suffers from dissolved oxygen problems that are well below the New York State dissolved oxygen standard of 5.0 mg/l. Of the three sites, these waters have the least amount of ocean flushing and are the most affected by land uses and sewage treatment plant effluent discharge. Great Peconic Bay, the most seaward of the monitoring stations, is not experiencing any dissolved oxygen problems on July 15th, most likely a result of the flushing from low nitrogen ocean waters. Flanders Bay, a station between that in the tidal Peconic River and Great Peconic Bay, shows diurnal depressions in dissolved oxygen levels.

Figure 6: YSI Continuous Monitoring Data for Three Main-Stem Stations – July 15, 2004.



Limitations on these data: Dissolved oxygen is one of the many parameters measured as part of the SCDHS's surface water quality monitoring program. Because Figure 5 includes samples taken only in the morning during the summer months, several of the monitoring stations have small sample sizes. A minimum sample size of 2 was needed to be included as a data point in the DO figures. More stations were sampled and more samples were taken per station from 1993 through 1998 than in the other time periods shown. In addition, there are inherent problems with comparing four-year periods with the 6-year period of 1987-1992. None of the percent violation data should be taken as statistically significant. While limitations in sampling frequency prohibit drawing definitive conclusions regarding dissolved oxygen trends over time, the dataset is robust and allows for an overall assessment of the Peconic's health as discussed above.

What can be done: Managing nutrient loads can help prevent nuisance phytoplankton and macroalgal blooms, which in turn can help prevent low dissolved oxygen conditions.

Environmental Indicator: Total Nitrogen Levels

Background: The relationship between excessive nitrogen and low dissolved oxygen levels in estuaries is well documented. When excessive levels of nitrogen are introduced to the estuary, nuisance algae and "seaweed" blooms are likely to result. Oxygen is consumed by plant growth at night ("water column respiration"), contributing to low dissolved oxygen levels by the early morning hours. Excessive aquatic plant growth can also create problems as it settles to the bay bottom and is decomposed by bacteria, a process that consumes oxygen.

Sources of nitrogen include excessive agricultural and residential fertilizer use, on-site disposal systems (septic systems or cesspools), atmospheric deposition, nutrient-enriched bay bottom sediments, sewage treatment plants, and stormwater runoff. Most of the nitrogen enters the bay from the atmosphere (rainfall) and groundwater, although sewage treatment plants are an important factor in select localized areas.

In an effort to minimize the risk of dissolved oxygen depression below the 5.0 mg/l New York State dissolved oxygen standard, a total nitrogen threshold of 0.45 mg/l was empirically derived from Peconic Estuary data (1994-96) by correlating surface water total nitrogen levels with the frequency of dissolved oxygen standard violations. The Peconic Estuary Water Quality Model, currently being used to address the depressed dissolved oxygen levels in the western estuary, will help to evaluate whether the current nitrogen guideline is still a useful tool.

Total Nitrogen Data:

Figure 7 shows total nitrogen (TN) data for 1999-2002. The percentage of samples with a TN over 0.45 mg/l was calculated for each of the eight sampling stations shown on the map. The 0.45 mg/l TN threshold was empirically derived from Peconic Estuary data (1994-96), based on correlating surface water TN levels with the frequency of DO standard violations. Green stars indicate no exceedances, yellow triangles indicate 0-10% of the samples over 0.45 mg/l and red circles greater than 10% exceedances.

Figure 7: Peconic Estuary Areas that Have Exceeded 0.45 mg/l Total Nitrogen Guideline.

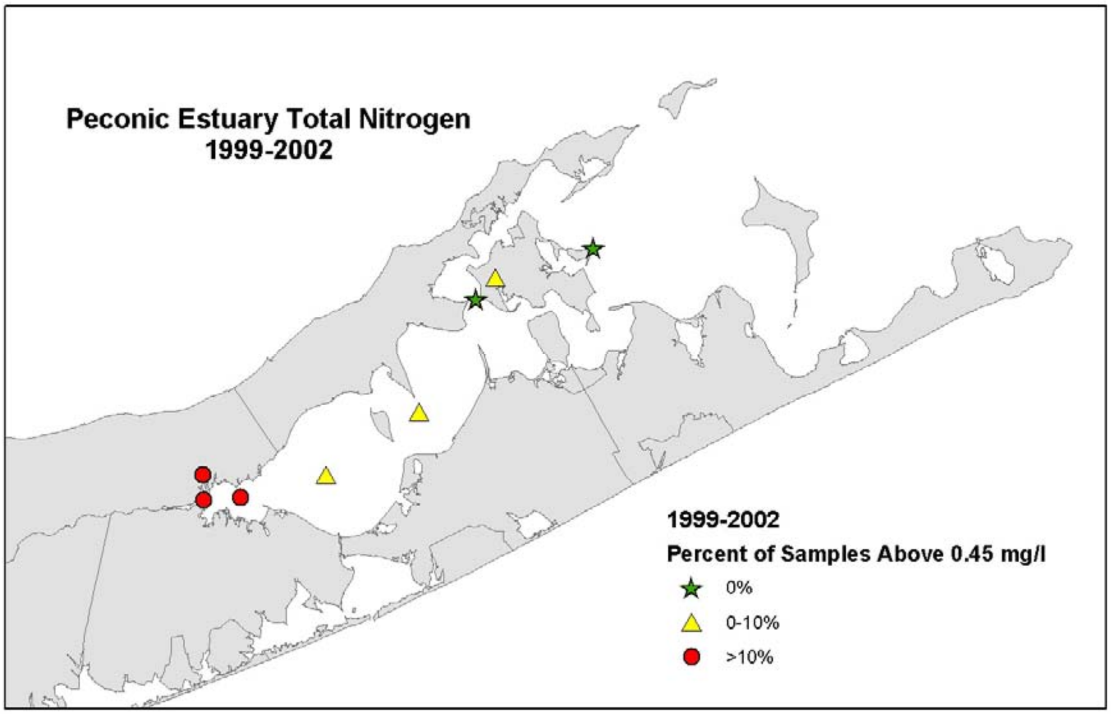


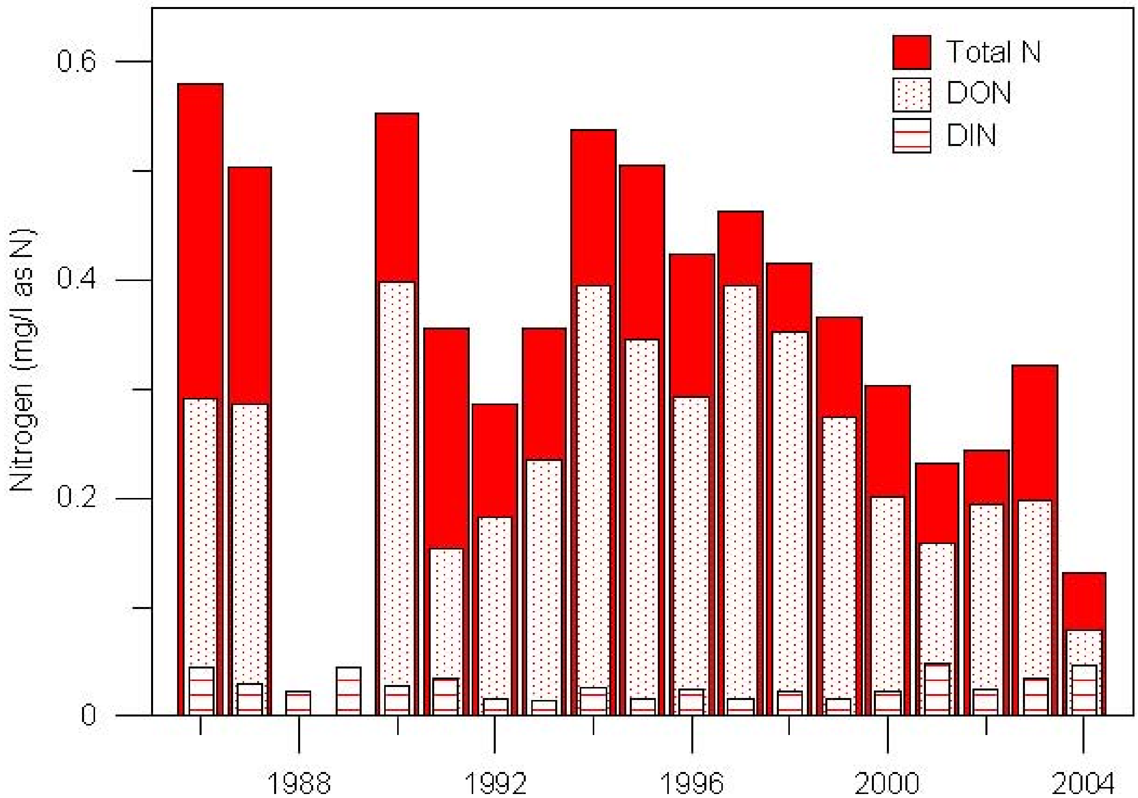
Figure 8 depicts the average nitrogen concentrations in Flanders Bay, an area that shows signs of dissolved oxygen stress. Total nitrogen values varied greatly from 1986 through 1994, ranging from a high of 0.58 mg/l to a low of 0.13 mg/l. From 1994 to the present, there is an overall decrease in total nitrogen. The variation in total nitrogen during these years is due almost entirely to the dissolved organic nitrogen (DON) fraction ($r^2 = 0.97$). Data from 1988 and 1989 were excluded due to laboratory error.

The main stem stations in the Peconic Estuary are affected by the introduction of low-nitrogen ocean waters. Because the residence time of water decreases as the bays approach the Atlantic Ocean, the more seaward sites exhibit lower relative nitrogen concentrations than those landward. In the 1980s, total nitrogen concentrations in Flanders Bay were more than double that of Gardiners Bay. In recent years, the total nitrogen concentrations in Flanders Bay are much closer to ocean boundary conditions.

Further decreases in nitrogen concentrations in the western Peconic Estuary may be due to decreases in loadings to the system, increased uptake in the food web, or some combination of these two mechanisms (and perhaps others). Decreases in loadings may be attributed to the Riverhead Sewage Treatment Plant tertiary treatment upgrade completed in May 2001and decreases in the nitrogen load contributed from the freshwater portion of the Peconic River (a marked decrease in nitrogen concentrations from the freshwater portion of the Peconic River has been seen in the past 20 years). Changes in subregional land uses and agricultural practices also may have an impact on nitrogen concentrations in groundwater (*e.g.*, conversion of agricultural land to residential uses, and row crops to vineyards – vineyards being less heavily fertilized). It should be noted that the roles macroalgae, sediment nutrient flux, and filter feeders play in affecting the surface water concentrations of nitrogen are believed to be significant; ambient total nitrogen water quality levels should not be considered the only indicator of eutrophication stress.

Taken as a whole, it is encouraging that nitrogen levels in surface waters are decreasing, though low dissolved oxygen conditions exist. Nitrogen loads are still likely experiencing an overall net increase (due to increases in population, more intensive turf and landscape maintenance, etc.). Some study is warranted as to where this excess nitrogen is going and why DO conditions are not improving.

Figure 8: Flanders Bay Average Nitrogen Concentrations (1986-2004).



Limitations on these data: Nitrogen is one of the many parameters measured as part of the SCDHS's surface water quality monitoring program. Nitrogen components in the water samples are measured using various analytical methods at the SC Public and Environmental Health Laboratory. While SCDHS's dataset is robust and allows for an overall assessment of the Peconic's health, none of the percent violation data presented above should be taken as statistically significant. Data continue to be analyzed and refinements of this information will undoubtedly occur in the future.

What can be done: Managing nutrient loads can help prevent nuisance phytoplankton and macroalgal blooms, which in turn can help prevent low dissolved oxygen conditions and improve water clarity. A healthy, balanced ecosystem, including abundant filter feeders, is also important.

Environmental Indicator: Water Clarity (Secchi Disk Depth)

Background: Turbidity (water cloudiness) is driven by two main factors: plankton (free-floating microscopic organisms including phytoplankton, zooplankton, and bacteria) abundance and suspended sediment (organic and inorganic). Increases in either in the water column result in reduced water clarity, which has a direct impact on subsurface communities that require high light levels. The most obviously affected are the benthic communities, such as rooted vegetation (*e.g.*, eelgrass) and benthic macroalgae, but subsurface phytoplankton are also jeopardized. Sediment in the water column may also smother benthic communities as it settles to the bottom and can cover hard surfaces that serve as critical habitat for aquatic wildlife (*e.g.*, oysters). If an estuary is excessively turbid over long periods, its health and productivity can be greatly diminished. One of the primary concerns of improved water clarity is to improve conditions for seagrasses.

Seagrasses, including widgeon grass and especially eelgrass, are very important habitats in the Peconic Estuary, providing foraging, nursery and spawning areas. Because they are true grasses, rooted in the bay bottom, a decrease in the amount of light reaching the plant can have devastating effects on its growth, health, survival and reproduction. Reduced water clarity, in combination with other factors, can severely stress this critical resource and the communities it supports.

Sources of excessive turbidity in estuarine waters include:

- wind
- shoreline erosion
- soil erosion from activities such as construction and agricultural operations
- stirred up bottom sediments from human activities, including boating, jet-skiing, dredging activities, and some shellfish harvesting techniques
- algal growth

The Secchi disk is an instrument used to measure the transparency of water. It is a plate-sized white, or black and white, disk that is lowered into the water on a calibrated line until it disappears. The Secchi disk is then pulled up, and the depth at which the disk reappears is called the Secchi disk depth. Depth levels are recorded to the nearest quarter foot. The deeper the measurement, the clearer the water.

Extremely clear water may also be problematic, as it may signal nutrient and algal levels unnaturally low for an estuary in this area; there is therefore an optimal level. The PEP is especially interested in optimizing water quality in all existing or potential eelgrass habitat areas, identified as shallow estuary waters (three meters or less).

Secchi Disk Data: Average Secchi disk depths from the SCDHS's main stem surface water quality monitoring stations (1992 through 2002) are depicted in Figure 10. Station locations are shown in Figure 9. Secchi disk readings are taken at sampling stations throughout the year. Readings that equaled the maximum water depth at sampling time were excluded from the dataset. Sample sizes ranged from 349-646 readings. As noted in the literature and generally shown in the graph below, estuarine waters located near the ocean generally register higher Secchi depths because of increased flushing. According to the Smithsonian Environmental Research Center, the Chesapeake Bay, which has shallow, moderately to highly turbid waters, has an average Secchi disk depth of 3 to 6.5 feet - many of the Peconic Estuary values fall within this range.

Figure 9: Map Showing Location of SCDHS's Surface Water Quality Monitoring Stations.

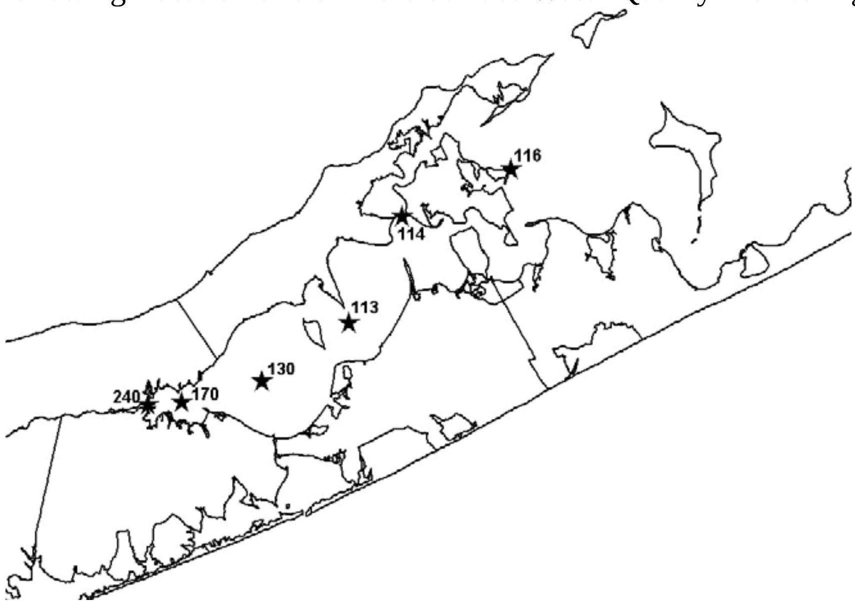
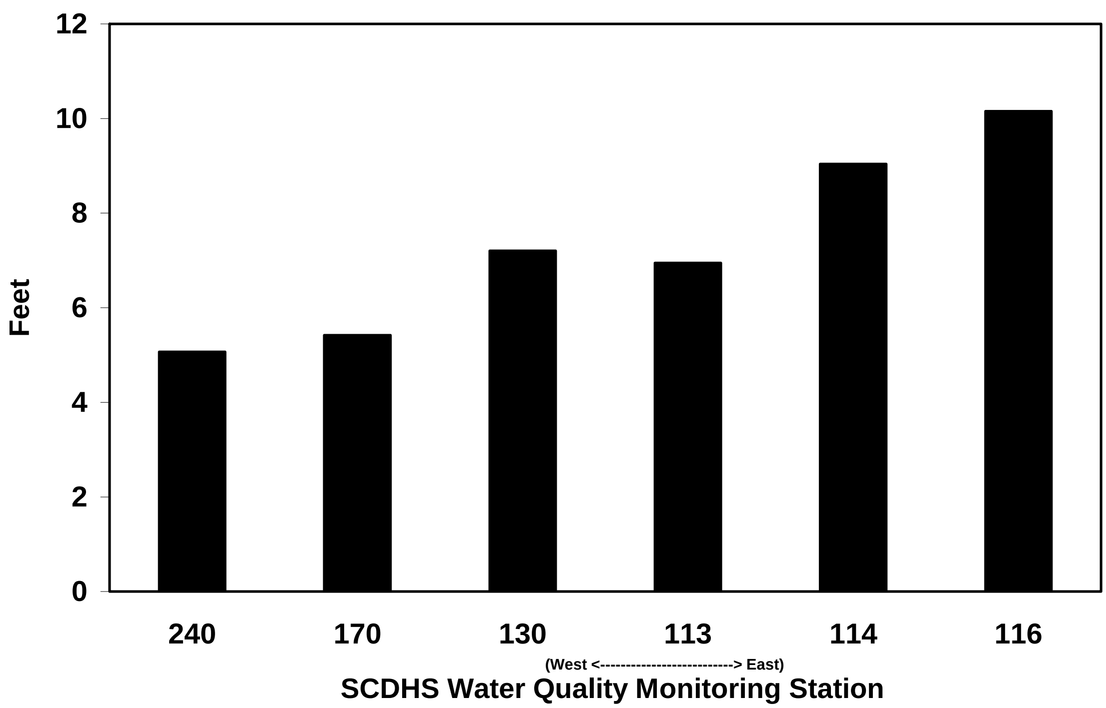


Figure 10: Average Secchi Disk Depths from SCDHS's Surface Water Quality Monitoring Stations.



Limitations on these data: Several factors may affect Secchi disk readings, including the eyesight of the viewer, the time of day the readings are taken and the reflectance of the disk. Of the four commonly used methods to measure turbidity in estuary waters, Secchi disks are used primarily for their simplicity. More accurate means of assessing turbidity are with a turbidity meter, a nephelometer, or by collecting water samples to be sent to a laboratory for analysis of total suspended solids (a parameter measured as part of the SCDHS surface water quality monitoring program). Light extinction through the water column (*i.e.*, percent irradiance at depth) can be measured directly with an irradiometer.

What can be done: Managing nutrient loads can help prevent nuisance algal blooms, which in turn can improve water clarity, as can reducing erosion and minimizing bottom disturbances. Increasing populations of filter feeders may also help improve water clarity and quality.

Environmental Indicators for Habitats & Living Resources

What are estuarine habitats & living resources and why are we concerned about them? By definition, estuaries—areas where fresh and salt water meet and mix—are unique habitats. Estuarine habitats range from sandy or rocky bottom in the marine zone at the estuary's mouth to seagrass beds and salt marshes in the bays to riparian zones of tidal creeks. Because of the varied habitats and high productivity, estuaries support an incredible diversity and abundance of plant and animal life. However, human encroachment and exploitation, resulting in excess nutrient and chemical inputs, the introduction of invasive species, and physical alterations, have resulted in signs of stress in some estuarine habitats and species assemblages.

Are impacts to habitats & living resources an issue in the Peconic Estuary? The Peconic watershed encompasses a variety of habitats—from dwarf pitch pine forests to salt marshes to soft bay-bottom communities—all of which are important to the ecology and productivity of the estuarine ecosystem. Some of these habitats are found nowhere else in New York State and are rarely found elsewhere in the United States. Unfortunately, certain habitats are in danger of becoming fragmented, degraded, overused, or completely lost. The Peconic Estuary habitat supports 111 documented species that are endangered, threatened, rare, or a "species of concern." Also, many economically important species, such as the bay scallop, weakfish, and winter flounder, spend all or part of their life in the estuary. One species in particular, the bay scallop, has experienced the most visible decline, having been virtually eradicated since the onset of Brown Tide in 1985.

What is being and can be done to improve environmental quality with respect to habitats & living resources? The PEP is undertaking initiatives estuary-wide to protect and restore plant and animal populations and the habitats in which they live. In 1996, scientists were convened by the PEP to identify areas of particular ecological significance; seventeen "critical natural resource areas" were identified for the purpose of focusing protection efforts. In addition, the PEP supports numerous projects that address the protection of shellfish, finfish and endangered species and the habitats that support them, including eelgrass, wetlands and natural shorelines. Some PEP recommendations are being pursued by local governments, such as those that address shoreline hardening and the proliferation of docks and piers. Multiple habitat restoration projects, such as those occurring at Cassidy Preserve, Three Mile Harbor and Paynes Creek, have succeeded in removing invasive, non-native vegetation (common reed, also known as *Phragmites*) and regrading the site to allow natural tidal flooding and the return of native wetland plants. In addition, open space preservation is protecting habitats and natural resources before they are fragmented or lost entirely.

What are the environmental indicators for habitats & living resources? The Peconic Estuary Program environmental indicators for habitats and living resources are: (1) extent of eelgrass beds; (2) extent of tidal wetlands; (3) habitat restoration projects; (4) bay scallop commercial landings; (5) winter flounder population abundance; (6) piping plover nests and nesting productivity; and (7) osprey nests and nesting productivity.

Environmental Indicator: Extent of Eelgrass Beds

Background: Eelgrass (*Zostera marina*) is a rooted, vascular plant, which is an important species of submerged aquatic vegetation (SAV) found in temperate areas along the East Coast. It is limited to areas of high light penetration, usually down to 6-10 feet of water. Eelgrass and other SAVs support abundant populations of invertebrates that are food for waterfowl and fish. SAVs stabilize sediment, oxygenate bottom waters, and are critical habitat for many estuarine species, most notably juvenile bay scallops that attach to the eelgrass fronds. Eelgrass beds provide nursery and feeding habitat for many fish species, including winter flounder, toadfish, juvenile bluefish, striped bass and weakfish. Some waterfowl, primarily brant and mergansers, feed on eelgrass.

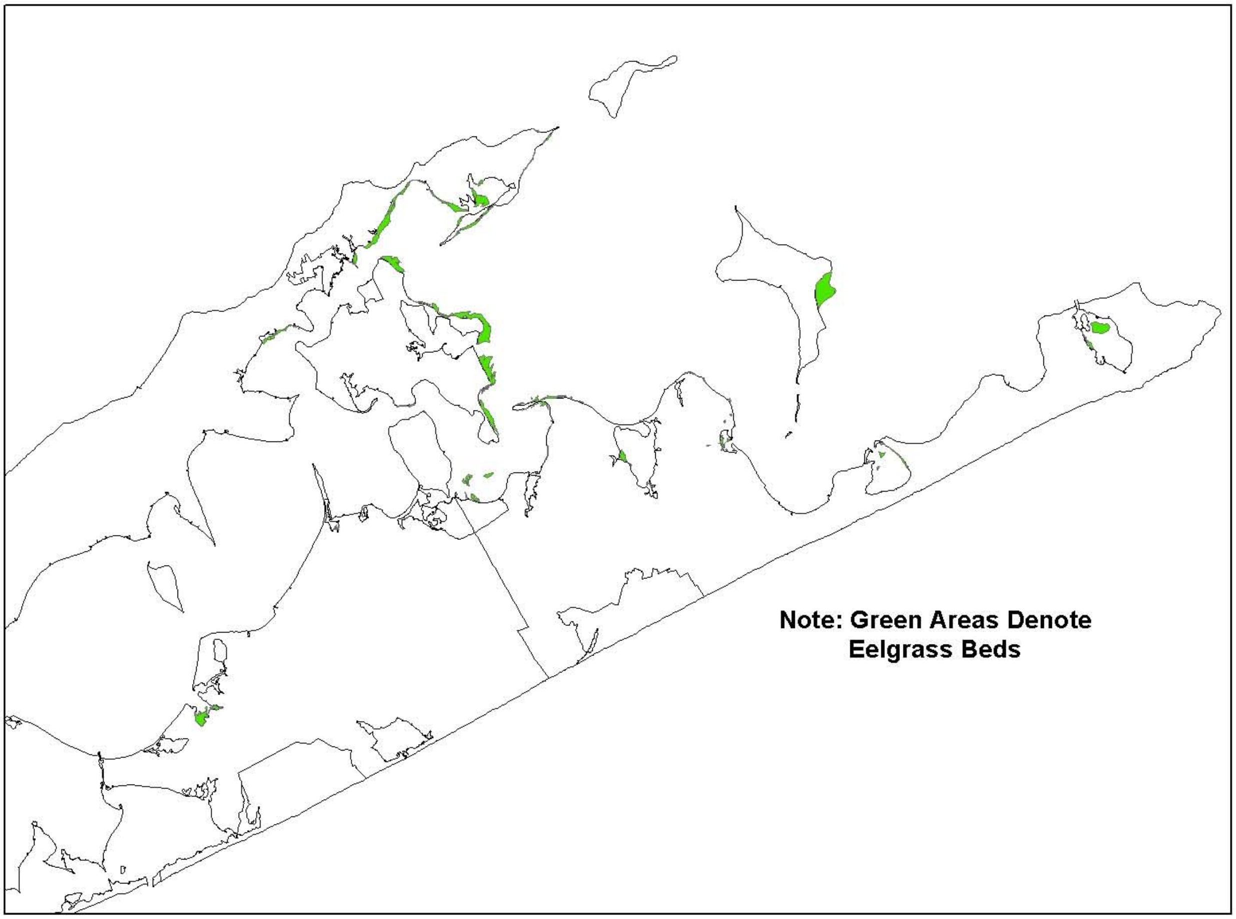
Due to wasting disease, nuisance algal blooms, and human disturbance of the near shore environment, eelgrass has suffered numerous acute and chronic die-offs over the last century. While wasting disease (caused by the slime mold *Labyrinthula macrocystis*) is not a significant problem in the Peconic's eelgrass beds today, this pathogen decimated the Peconic's eelgrass beds in the early 1930s. Eelgrass beds in the Peconics were further impacted by the periodic Brown Tide blooms in the 1980s and 1990s which reduced light penetration. Eelgrass can be impacted by turbidity, which influences light penetration, and increased nutrients, which promote the growth of epiphytes and algae. Eelgrass can also be damaged by anchor scarring, boating in shallow water and by some shellfish harvesting activities such as tonging, raking or dredging.

Status & Trends: According to Cornell Cooperative Extension of Suffolk County (CCE), there were over 8,700 acres of eelgrass (a conservative estimate) in the Peconic Estuary during the 1930s. Of the submerged aquatic vegetation beds delineated by the U.S. Fish and Wildlife Service (FWS) using 2000 aerial photographs, only 1,550 acres of eelgrass (comprised of 119 beds) remain. Presently, eelgrass beds are found most frequently east of Shelter Island, in and around Gardiners Island, Northwest Harbor, Long Beach Bay, and in many creeks and coves. West of Shelter Island, eelgrass is found in Sag Harbor and Bullhead Bay. Figure 11 shows the eelgrass beds delineated by the FWS and groundtruthed by CCE in 2000.

Through the Peconic Estuary Program, CCE conducts long-term monitoring of six eelgrass beds in the Peconic Estuary. Although the health of the eelgrass in the estuary is generally good, there appears to be an overall decline in eelgrass shoot density year after year. This trend may be a natural response to better water clarity in these areas or an artifact of small sample sizes in earlier data sets (1997-1999). Two of the six beds monitored have decreased in areal extent, most likely caused by human activities (*e.g.*, prop wash, mooring anchor scouring, etc.).

CCE has attempted to reestablish eelgrass in numerous locations in the Peconic Estuary. These projects have shown some success in areas east of Shelter Island and in Sag Harbor, but projects in other areas, including Cedar Point, Corey Creek, and Cutchogue Harbor, have not been as successful.

Figure 11: Eelgrass Coverage in the Peconics, 2000.



Limitations on these data: The 2000 FWS inventory represents a single snapshot of the areal extent of eelgrass in the Peconic Estuary. Continued mapping efforts are especially important for coastal resource management as such studies are necessary to document recovery due to restoration efforts, reduced pollution inputs, or other management strategies employed to promote SAV growth and improve water quality. Unfortunately, due to personnel and funding constraints, CCE, as part of the PEP, monitors only 6 of the 119 eelgrass beds found in the Peconic Estuary. Information on the stability or dynamics of the other beds can only be inferred and noted through anecdotal information.

What can be done: Attempts at re-establishing eelgrass have proven to be labor intensive, difficult and costly, though some new and promising methods are being tested. Conserving existing eelgrass beds and re-establishing new ones will be most successful if there is good water quality and clarity, minimal physical disturbance, and few predators.

Environmental Indicator: Extent of Tidal Wetlands

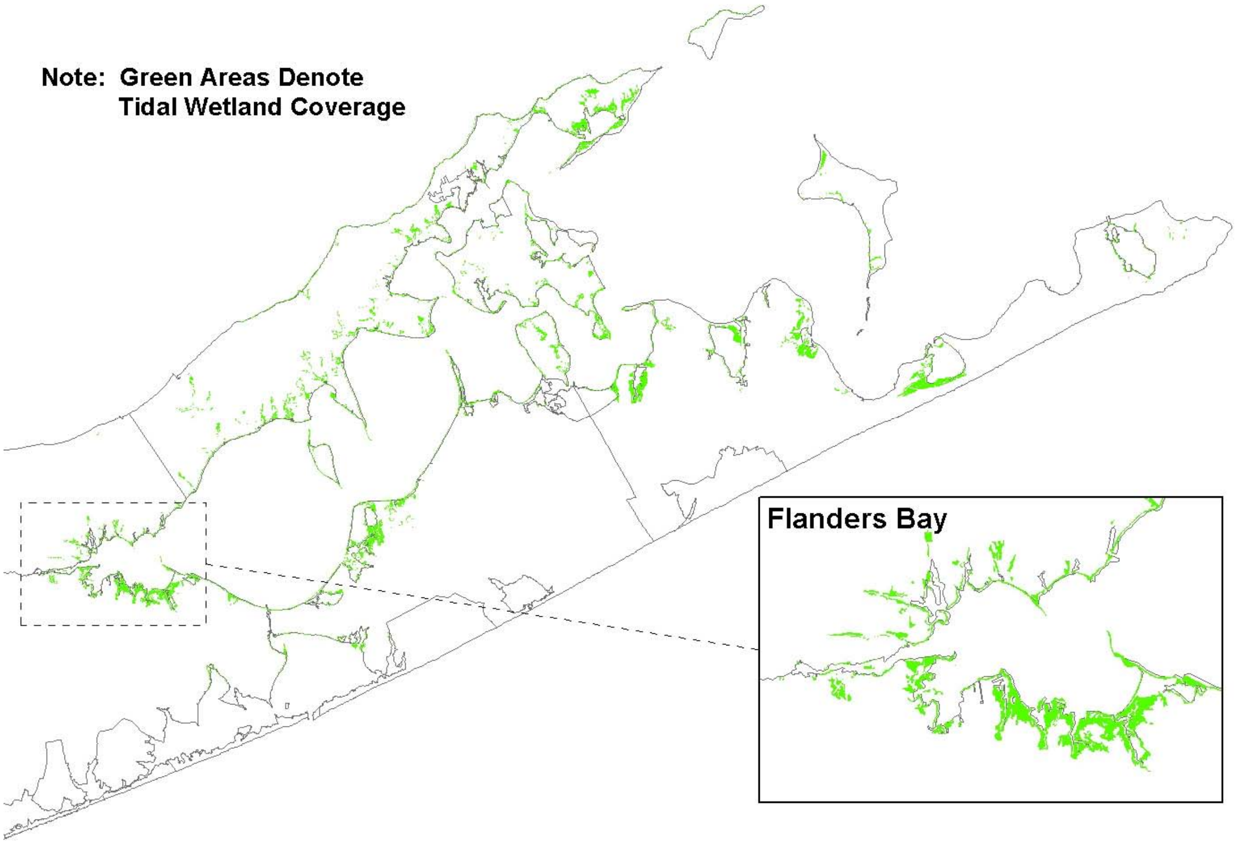
Background: Tidal wetlands are some of the most diverse habitats in the coastal region and form the transition zone between the upland and open water. They are among the most productive habitats on earth, and some biologists believe they are rivaled only by coral reefs and tropical rainforests with regard to their primary productivity. Tidal wetlands are composed of low marsh, intertidal areas dominated by cordgrass (*Spartina alterniflora*), and high marsh, occasionally flooded areas with a variety of plant species such as *Spartina patens*, *Distichlis spicata* and *Juncus gerardii*. Wetlands trap sediments, recycle nutrients and organic matter, attenuate floodwaters, and are important feeding, breeding, and nursery habitats for waterfowl, wading birds, shorebirds, fish and invertebrates. Two-thirds of commercially harvested fish, sportfish and shellfish depend upon tidal wetlands for at least part of their life cycle. Freshwater wetlands are also critical habitats in estuarine systems.

Buffers surrounding wetlands provide multiple environmental benefits that are frequently proportional to the size or depth of the buffer. They provide high quality coastal wildlife habitat for native plants as well as foraging and nesting grounds for resident and migratory bird species. Buffer areas also intercept nonpoint pollutants such as sediments, suspended and dissolved solids, nutrients associated with fertilizers, and other chemical compounds that affect the water quality of the Peconic Estuary and its tributaries. The root system of the vegetation helps to stabilize the shoreline, minimizing the risk of erosion.

Prior to the adoption of tidal wetlands laws and regulations in 1972, wetlands were subject to intense development pressure and were ditched, dredged, filled and bulkheaded. While these laws and regulations prevent the filling of wetlands, there are many current threats, including the loss of upland buffers, stormwater runoff, erosion, ditching for mosquito control, and invasion by common reed (*Phragmites australis*), which can displace native species.

Data, Status & Trends: According to 1994 data, there are approximately 5,700 acres of estuarine wetlands in the Peconics (see Figure 12), of which about 3,600 acres are emergent salt marsh. The Flanders Bay inset in Figure 12 shows a more detailed view of the wetland coverage. As of 1998, about 8% of wetlands were dominated by *Phragmites*. The most extensive wetland losses occurred prior to 1972, but about 115 acres, or 2%, of salt and brackish marsh were lost between 1972 and 1994. The largest losses were due to erosion and some dredging and filling. There are a number of wetlands restoration projects in the Peconics, including those at Paynes Creek in Sag Harbor, Davis Creek, Cassidy Preserve and Long Beach Bay. The New York State Department of Environmental Conservation (NYSDEC) acquired new aerial photography in 2004 to further assess wetlands status, but the data have not been analyzed yet. NYSDEC has also spot-checked several areas in the Peconics (Corey Creek, Cedar Beach and Hubbard Creek) and digitally compared new photography with historic photos to evaluate losses, both at the marsh edge and internally. In Corey Creek from 1974 to 2002, there was a 27% loss in vegetated tidal wetlands. There was a 43% loss in vegetated tidal wetlands near Cedar Beach from 1974 to 2002. Causes of these losses are speculative at this point but could include sediment budget disruption, sea level rise, subsidence, over-enrichment by nitrogen, and disease.

Figure 12: Tidal Wetland Coverage in the Peconic Estuary, 1994.



Limitations on these data: There is poor documentation of the extent of tidal wetlands prior to 1972. The target mapping unit for the 1994 photography was one acre, so smaller wetland areas may have been missed. Until the analysis of newer photography is completed, it is difficult to evaluate the changes in wetlands, and unless the historical and new photography are digitized, small losses, especially those in the interior of the marsh, will be hard to determine.

What can be done: Protecting against degradation from surrounding land use activities, controlling invasive species, undertaking restoration projects, and ensuring compliance with wetland laws on public and private property are all important to wetland systems. Vegetative buffers should be established or maintained within 100 feet of wetlands to provide a preliminary filter. Targeted research into the causes of the documented wetland losses is also necessary.

Environmental Indicator: Habitat Restoration Projects

Background: Habitat loss, fragmentation, and degradation are usually the result of human activities. In the Peconic system, marshes and creeks have historically been dredged, ditched, filled, bulkheaded or dammed. Uplands have been cleared for agricultural and residential use. Although the Peconics have been somewhat less affected by these practices than other areas of Long Island, there has been a decline in critical habitat necessary for many species of fish, birds and invertebrates. In some cases, invasive species such as *Phragmites* have led to a lessening of habitat function and value. The *Habitat Restoration Plan for the Peconic Estuary* (2000) identified a wide range of habitat types as priority habitats, ranging from submerged aquatic vegetation and tidal wetlands to coastal grasslands and forests. It details 72 restoration projects for an estimated cost of $42 million. Impediments to restoration projects include the large area that is under private control and in some cases, such as eelgrass restoration, an incomplete understanding of the factors necessary for success. The logistics of restoration, including costs and permitting, can also be onerous.

Status & Trends: Increased development pressure on the East End of Long Island points out the need for continued habitat preservation and restoration activities in the Peconic watershed. It is estimated that about 3,358 acres of habitat have been lost in the Peconic Estuary watershed since 1972. There have been a wide variety of habitat restoration projects in the estuary, addressing *Phragmites* control, anadromous fish passage, and restoration of eelgrass, intertidal marsh, grassland and beaches and dunes. Most projects have been small, ranging in size from one-tenth acre to several acres, but there have been several Open Marsh Water Management (OMWM) and grassland projects of about 50 acres. Many of the restoration projects have been undertaken by local governments with funding through the NYS Clean Air/Clean Water Bond Act and other sources. The following projects were awarded New York State Clean Water/Clean Air Bond Act funds in 2000, 2001 and 2004:

Project Type: Habitat Restoration

- Cassidy Preserve Salt Marsh Restoration: Phase III (2000; Grant Recipient: NYS Department of Environmental Conservation) $53,000
- Sag Harbor/Paynes Creek Wetland Restoration (2000; Grant Recipient: Town of Southampton) $25,695 (see Figure 13)
- Restore eelgrass and initiate bay scallop restoration in Sag Harbor Cove (2004; Grant Recipient: Town of Southampton) $54,500

Figure 13: Image of Paynes Creek Restoration Site.

A significant new source of funding through the Suffolk County ¼% sales tax, which may amount to several million dollars per year, is also available for water quality improvement and habitat restoration projects.

Limitations on these data: There is a critical need for better long-term monitoring data for the restoration projects. For certain habitat types, such as tidal wetlands, it can take five or more years to determine whether a restoration has been successful. For other projects, such as eelgrass restoration in the western estuary, additional information is needed on why the restoration was not successful.

What can be done: A *Habitat Restoration Plan for the Peconic Estuary* has been prepared. It is now necessary to assist with promising restoration projects and secure funding for pre-restoration planning, permitting, implementation and post-restoration monitoring. The primary need right now is to conduct pre-restoration planning of promising projects to determine how to appropriately restore the habitat. Residents can help prevent the need for future restoration efforts by observing existing laws; eliminating or reducing chemical loadings, physical alterations and the introduction of non-native and invasive plant species; and by establishing or maintaining vegetative buffers within 100 feet of surface waters and wetlands to provide a preliminary filter.

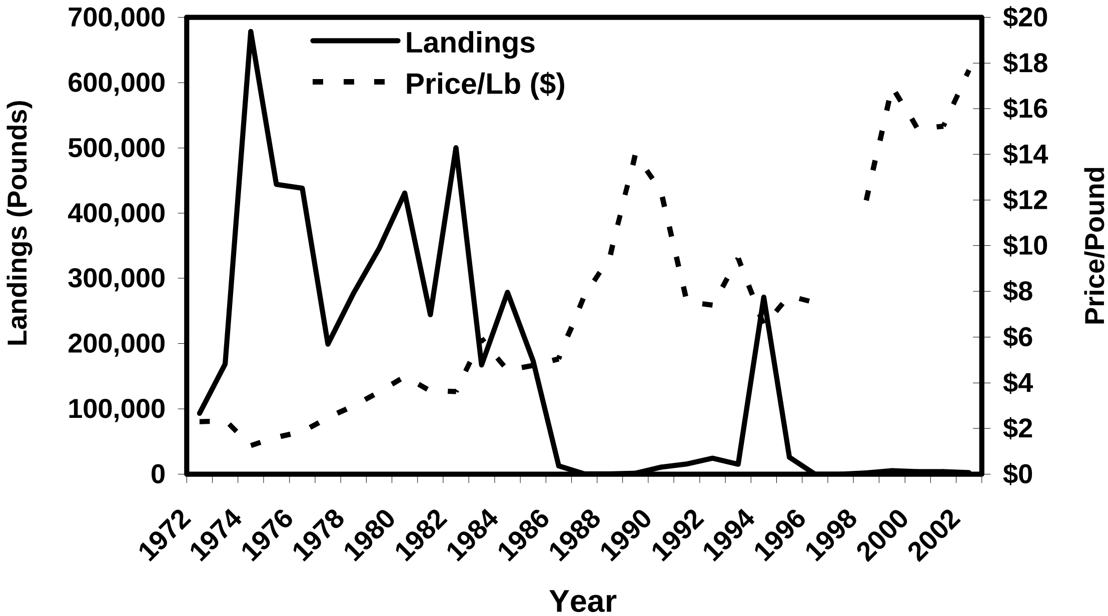
Environmental Indicator: Bay Scallop Commercial Landings

Background: Bay scallops (*Argopecten irradians*) are a commercially and recreationally important bivalve. Unlike the other bivalve shellfish commonly harvested in New York (clams, mussels and oysters) which either burrow into the sediment or attach permanently to substrate (semi-permanently for mussels), scallops remain on the sediment surface and have the ability to swim by contracting their adductor muscle. Scallops are hermaphroditic and spawn in late spring through early summer. The planktonic larval stage lasts about 2 - 3 weeks, after which the spat settle, usually attaching to eelgrass blades or other structure. Scallops generally live only one and a half to two years and usually spawn only once, in their second year. This makes them extremely susceptible to environmental stressors such as Brown Tide or loss of habitat. Scallops are harvested during the period of October - March, at a size that generally only captures post-spawning individuals. The Peconic Bay system has historically produced the majority of the New York harvest.

Status and Trends: Commercial landings of bay scallops in New York are shown in Figure 14. Through the 1970s to the mid-1980s, the NY scallop harvest ranged from about 100,000 to 700,000 pounds of meat (usually, only the adductor muscle is used). Beginning in 1986, the year following the first Brown Tide event in 1985, the reported scallop harvest began a precipitous decline. By 1988, only 250 pounds were reported as harvested. There was a small increase in the reported harvest through the early 1990s until 1994 when harvest rebounded dramatically to pre-Brown Tide bloom levels. It is likely that the dramatic decline to zero pounds reported in 1997 was a result of the major Brown Tide bloom in 1995. Even though there has not been a significant Brown Tide bloom since that time, the scallop population has not recovered.

The price of scallops has shown an inverse relationship to harvest levels. Prices have skyrocketed in response to the dramatically reduced supply, from $1.25 per pound in 1974 to $17.69 in 2002 (see Figure 14).

Figure 14: Commercial Landings and Value of Bay Scallops in New York (1972-2002).



Attempts to reestablish scallop populations through introduction of seed or the use of spawner sanctuaries has had limited success. In 2004, NYSDEC began a pilot study in cooperation with Cornell Cooperative Extension of Suffolk County, The Nature Conservancy, Southampton College, and the Town of East Hampton on the use of spawner sanctuaries to replenish the scallop population, looking at factors such as spawning, fertilization success, recruitment and overwintering. Approximately 300,000 scallop seed will be grown and placed in the sanctuary. Approved for funding through the Suffolk County ¼% Sales Tax Program in September 2004, Cornell Cooperative Extension of Suffolk County and Long Island University will launch a four-year, large-scale bay scallop seeding effort in the Peconic Estuary. This effort may very well be the largest reseeding effort to take place in the nation.

Limitations on these data: The landings data do not include recreational harvest nor do they indicate specific areas where scallops were found (*i.e.*, Peconics vs. other New York waters). However, the reported landings are likely a reasonable estimate of the entire harvest and the general health of the scallop population in the Peconics.

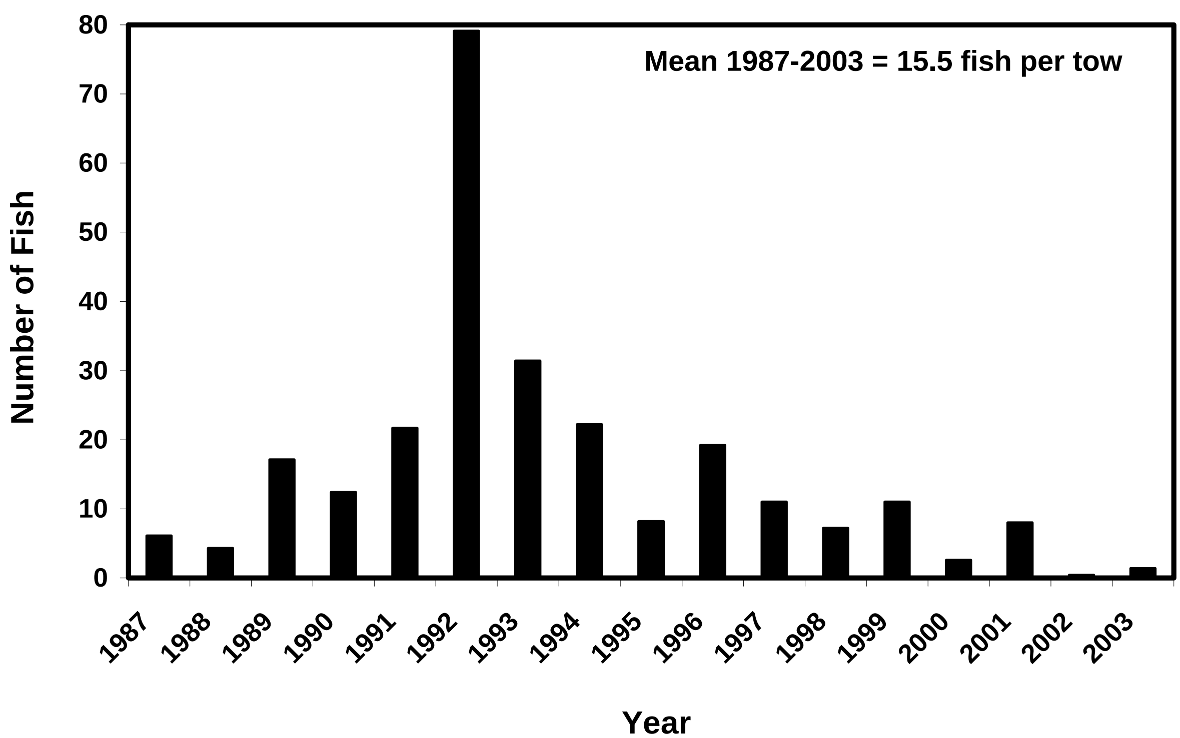
What can be done: Good water quality can help support populations of bay scallops directly, as well as the habitats (particularly eelgrass) they need to survive, particularly during sensitive life stages. Sufficient food must also be present (research has shown that the Brown Tide algae is not a desirable food source for bay scallops). The establishment and stocking of spawner sanctuaries and additional large scale seeding may help bay scallops rebound.

Environmental Indicator: Winter Flounder Population Abundance

Background: Winter flounder (*Pleuronectes americanus*) are recreationally and commercially important right-eyed flat fish. Their small mouths help to distinguish them from other bottom fish. They are most abundant in the Peconic Estuary from early spring to late summer, with numbers declining thereafter as they move to deeper, cooler waters. These fish spawn in the shallow waters of the Peconics from late winter to early spring, depending on temperature. Temperature and salinity are the controlling factors of the viability of the eggs. In the 1950s and 1960s, winter flounder were among the top five species (by weight) landed in the Peconic Bays commercial fishery. The current gear restrictions throughout most of the Peconic Estuary and coast-wide decline in abundance have essentially ended any significant commercial harvest from the Peconics.

Status & Trends: Winter flounder are considered an overfished species, and they continue to be fished at an unsustainable level. The population has exhibited a decline in abundance throughout the northeastern United States. Fourteen percent of fish caught in the annual NYSDEC small mesh trawl survey are juvenile winter flounder, amounting to the second most abundant species for the period of 1987 - 1995. The highest recorded catch during that time occurred in 1992 with a mean catch/tow of 79.1 fish (see Figure 15). This was much higher than both previous and subsequent years. The average catch/tow from 1987 to 1995 was 15.6 winter flounder. Since 1996, the mean catch/tow has declined from 19.2 fish (1996) to 0.4 and 1.4 in 2002 and 2003, respectively.

Figure 15: Winter Flounder Index of Abundance (Mean Catch Per Tow).



Limitations on these data: Since there has been a decline in winter flounder abundance throughout the Northeast, it is difficult to determine how effectively the winter flounder data can be used as an indicator of Peconic environmental health. Furthermore, the DEC trawl data began only in 1987 and is not comparable to historical commercial landings data. There is little information on recreational landings.

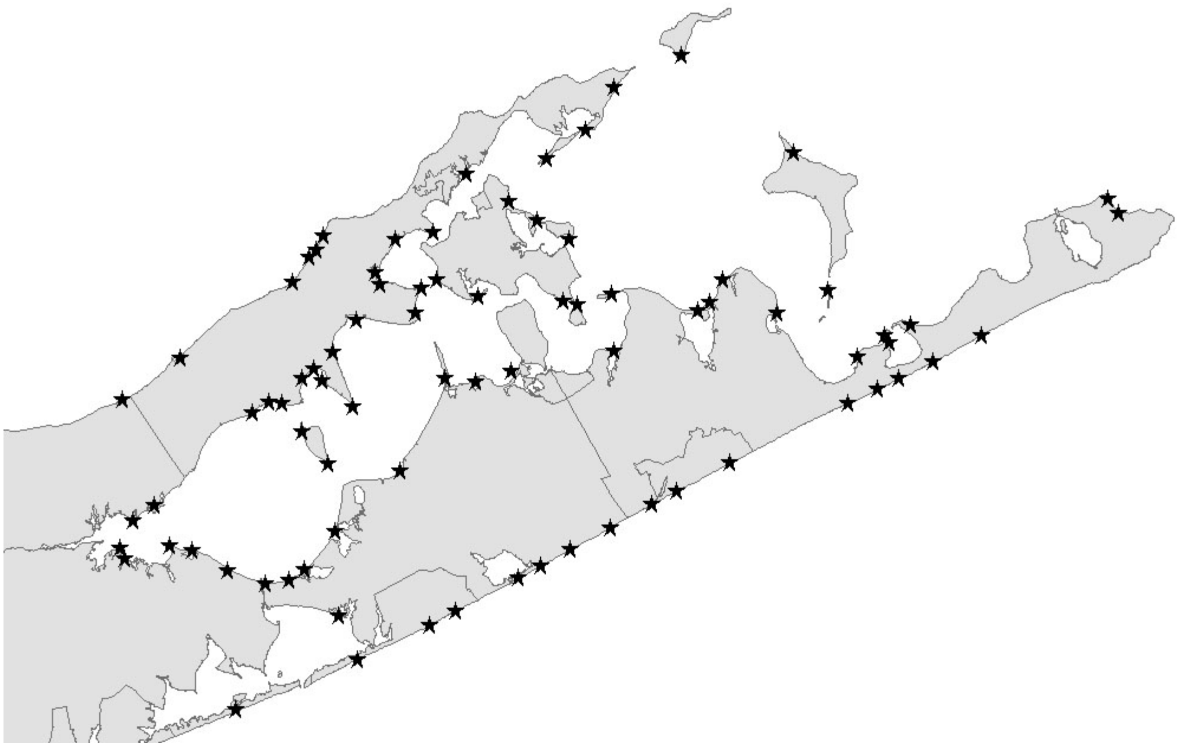
What can be done: It is important to strictly follow harvesting guidelines. It is also necessary to protect and manage the sandy or mud-bottom habitats, including submerged aquatic vegetation and macroalgal beds, important to this species in the Peconic Estuary. A coast-wide analysis needs to be performed to identify potential causes of the low abundance (*e.g.*, poor habitats, ammonia toxicity, seawater temperature rise, entrainment and impingement, and low dissolved oxygen).

Environmental Indicator: Piping Plover Nests and Nesting Productivity

Background: Piping plovers (*Charadrius melodus*) are listed as a Federally threatened and New York State endangered species. They are small shorebirds that nest on beaches, and as a result, their nesting and reproduction are susceptible to human intrusion, storm tides and predators. Protection and monitoring efforts began in the mid-1980s. The bulk of the New York piping plover populations are found on the Atlantic Ocean beaches where there is a large amount of suitable habitat. The breeding season is spring to summer.

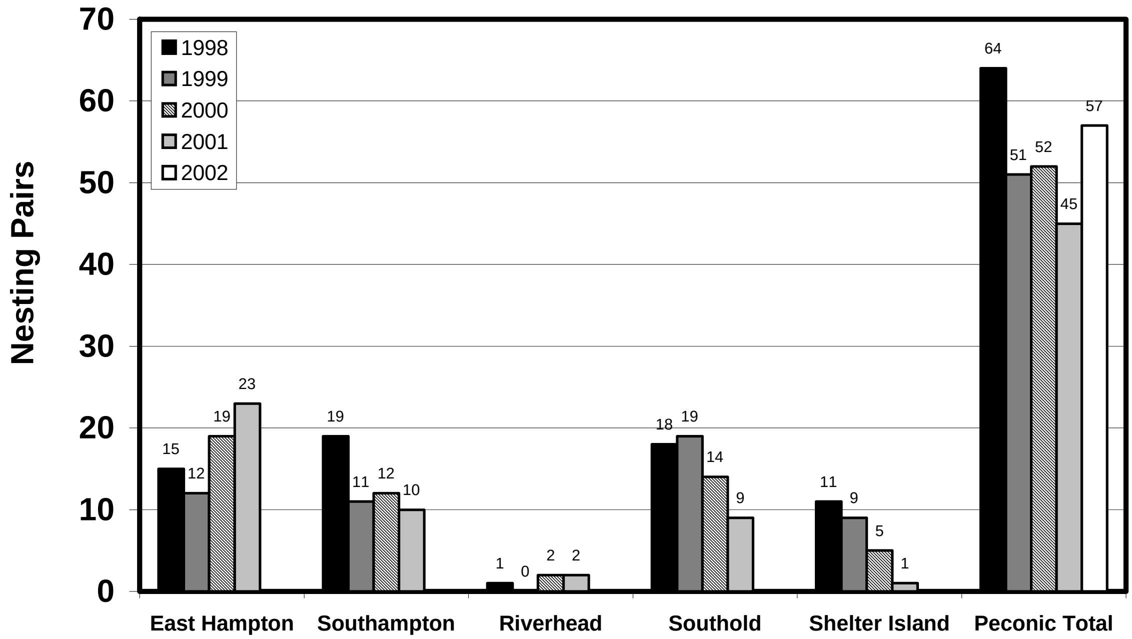
Status and trends: Figure 16 shows a map of recent piping plover nesting sites on eastern Long Island.

Figure 16: Location of Piping Plover Nest Sites on Eastern Long Island.



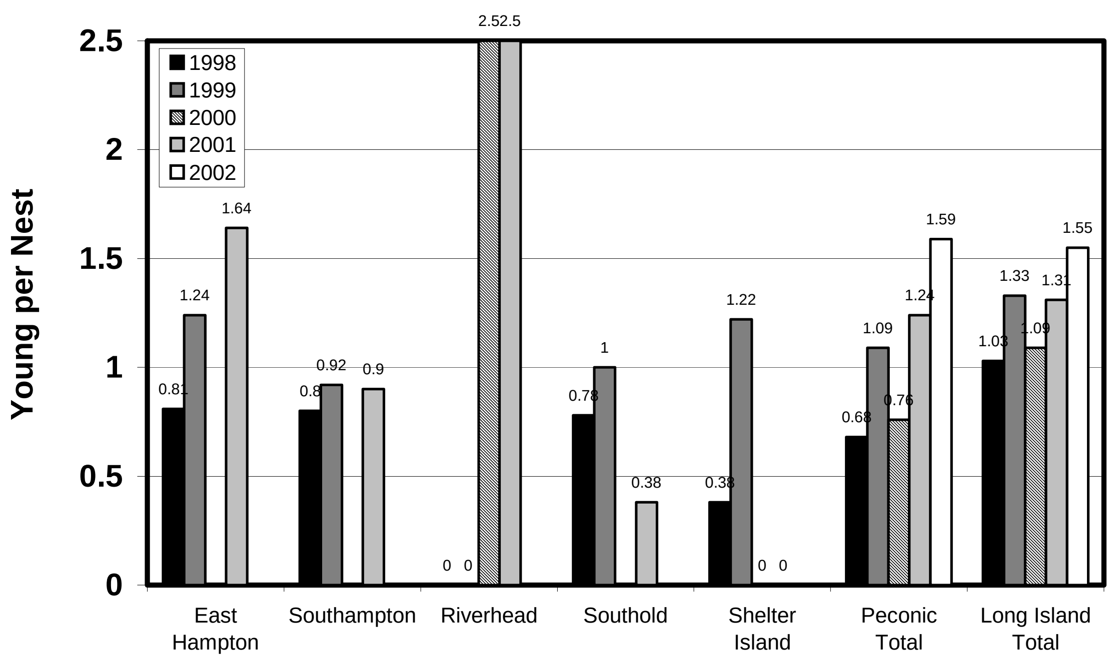
Breeding pairs on Long Island have generally increased since the mid-1980s when the total population was slightly over 100 pairs. The number of pairs increased to 249 by 1995, of which 63 were located in the Peconic region. By 2002, the number of Long Island breeding pairs rose to 369, of which 57 were found in the Peconics. During the period of 1998 to 2002, piping plover populations (pairs) in the Peconics have fluctuated between a low of 45 in 2001 and a high of 64 in 1998 (see Figure 17). There does not appear to be any strong trend in the Peconic region since the mid-1990s.

Figure 17: Number of Piping Plover Nesting Pairs By Town in the Peconic Estuary.



While the number of breeding pairs in the Peconics does not appear to be increasing, nesting success seems to be improving. As shown in Figure 18, in 1998, reproduction in the Peconics averaged 0.68 young birds per nest. By 2002, the number of young per nest rose to 1.59.

Figure 18: Piping Plover Nesting Productivity by Town in the Peconic Estuary, Relative to All of Long Island.



Limitations to these data: There are missing pair number and nesting productivity data for some towns in certain years.

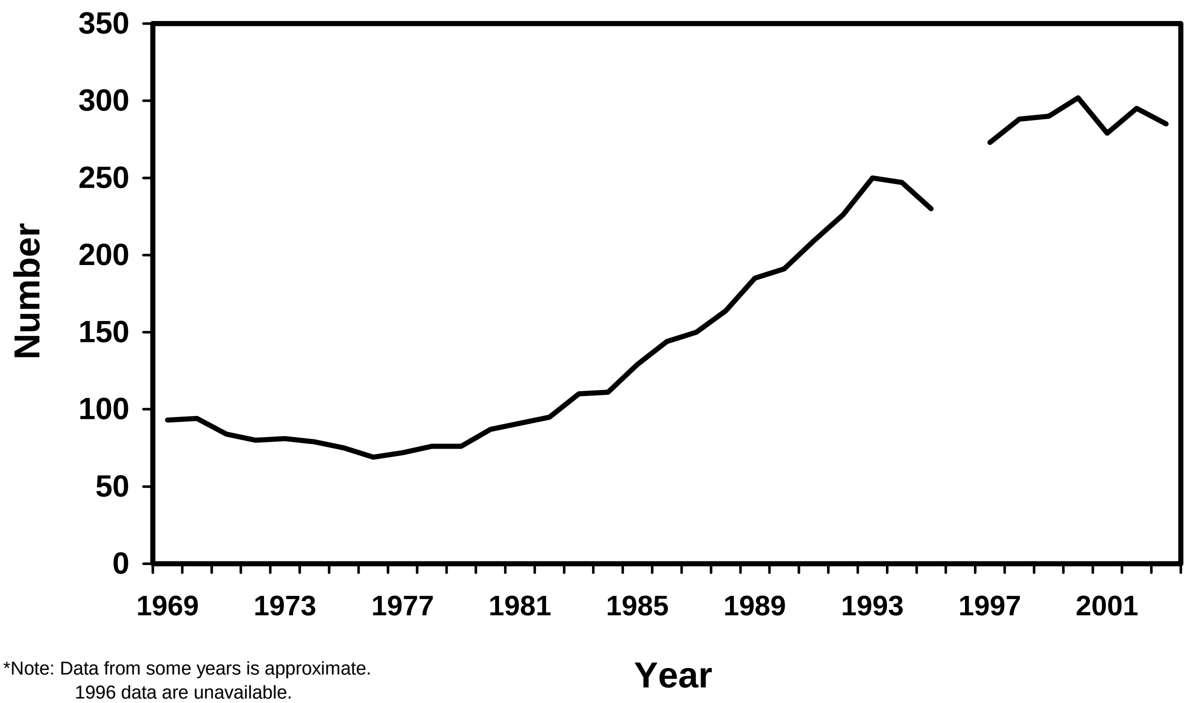
What can be done: Both survey and nest protection efforts have increased since the piping plover was given Federal threatened status in 1986. Reducing human intrusion and predators can help increase nesting pairs and nesting productivity.

Environmental Indicator: Osprey Nests and Nesting Productivity

Background: The osprey (*Pandion haliaetus*), or fish hawk, is a large, fish-eating raptor with a wingspan of up to 6 feet. It is a highly migratory bird which is resident on Long Island between mid-March and September. Breeding occurs spring to early summer. The osprey is viewed as a success story due to its increasing numbers since the banning of the persistent pesticide DDT. The Peconic region is home to more than half of the ospreys found on Long Island.

Status and Trends: The osprey population in New York decreased dramatically during the 1950s and 1960s due to the effects of pesticides, particularly DDT, which caused the eggs to have thin, brittle shells that were vulnerable to breakage. Since 1980, when there were less than 90 active nests on Long Island, the number of nests has increased to about 300 (see Figure 19), with a production of 262 young in 2003.

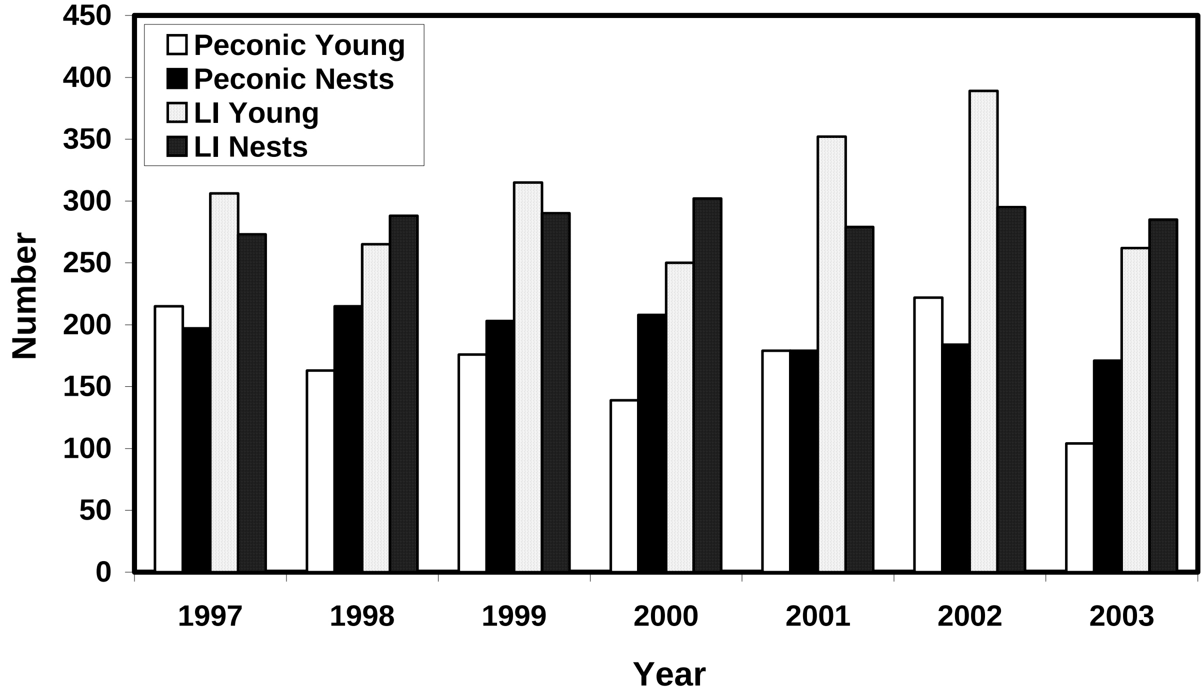
Figure 19: Number of Active Osprey Nests in Long Island.



*Note: Data from some years is approximate.
1996 data are unavailable.

Figure 20 shows the number of osprey nests and young produced for the Peconic region and Long Island as a whole. In the Peconics, there have been approximately 200 nests per year since 1997, with the number of young ranging between 104 and 222. There does not appear to be a significant trend during the period of 1997 - 2002, though productivity was lower in the Peconic region as compared to the rest of Long Island. Over the 7-year period, juvenile survival averaged 0.89 young per nest in the Peconics versus 1.43 young per nest in other parts of Long Island. A productivity of 1.43 is comparable to values seen along the Atlantic seaboard, while 0.89 is on the low end of the typical range of reproductive success. For example, regions of Chesapeake Bay showed productivities of 0.88 to 1.53 fledglings per nest in 2000 and 2001.

Figure 20: Annual Estimate of Active Osprey Nests and Young Produced for the Peconic Region and Long Island.



Some speculate that the osprey population began to decline prior to the use of DDT – a decline that coincided with the collapse of the menhaden *(Brevoortia tyrannus)* population. Menhaden form large schools and feed at the surface, making them easy prey for ospreys. The recent declines in winter flounder abundance, another common prey species, may also compromise nesting productivity. Growing populations of double-crested cormorant (*Phalacrocorax auritus*), which did not historically occur in the Peconics, may be causing heavy inter-specific competition with the ospreys for food.

Questions remain as to why nesting productivity is lower in the Peconics when compared to the rest of Long Island. Menhaden and winter flounder population sizes are down throughout the Mid-Atlantic and New England, so that alone does not explain the fledgling survival rate in the Peconic watershed. It is possible that there are fewer prey species alternatives in the Peconics. Osprey nests in the Peconics may also be more exposed to the elements, especially on Gardiners Island, making them more susceptible to catastrophic nestling mortality in the event of a severe storm. As a result of reductions in prey species abundance and encroachment on breeding habitats, osprey populations may never again approach their historic abundance.

Limitations to these data: Historic and newly reported nesting sites are surveyed; however, there is a likelihood that there are unreported nesting sites that are not included in the survey.

What can be done: Although ospreys have made a strong recovery since the ban on DDT, programs to create and maintain osprey nesting platforms should continue. Adults establishing or re-establishing traditional nesting platforms in mid to late March can be disturbed by construction activities that are less than 300 feet from their nesting platforms. Limiting construction activities during the critical period of courtship and egg incubation may further assist the continued recovery of this species. Preservation of open space and natural osprey nesting habitat is important. In addition, analyses to explain the relatively lower productivity in the Peconics should be conducted, and any possible causes should be mitigated (*e.g.*, increase food availability by rebuilding prey species populations).

Environmental Indicators for Pathogens

What are pathogens and why are they a concern? Pathogens are viruses, bacteria, fungi, and protozoans that cause diseases in humans, other animals or plants. Pathogens that may be found in marine waters include those causing gastroenteritis, salmonellosis, and hepatitis A. A pathogen (a slime mold) is also responsible for the wasting disease affecting eelgrass, a disease responsible for the massive die-off of eelgrass on the Atlantic seaboard in the 1930s. High pathogen levels may lead to closed bathing beaches and shellfishing beds to protect public health. These closures can have economic ramifications by deterring tourism and putting fishermen out of work.

Where do pathogens come from? Pathogens can enter marine waters via untreated or inadequately treated human sewage and by way of wild or domestic animal wastes. Stormwater runoff, waste discharges from boats, and improperly maintained septic systems are all pathogen sources.

Are pathogens an issue in the Peconic Estuary? Stormwater runoff is the largest contributor of pathogens to the Peconic Estuary. Domestic and wild animals (including waterfowl) are the most important sources of pathogens to stormwater. The great majority of the Peconic Watershed uses on-site disposal systems for waste treatment; if improperly maintained, these septic systems (or "cesspools") can introduce pathogens to localized areas. Illegally discharged sanitary wastewater from boats, particularly in the enclosed waters around marinas and mooring areas, may also contribute to problems locally. Pathogen contamination, or even the mere threat of pathogen contamination, results in shellfishing restrictions for significant areas of bay bottom.

Most bathing beaches are located in areas that are least likely to be contaminated by pathogens. For example, bathing beaches are not sited in the immediate vicinity of sewage treatment plant outfalls due to the unlikely event that wastewater disinfection systems fail or malfunction.

What is being and can be done to improve environmental quality with respect to pathogens? The PEP has proposed a concerted effort to reduce the pathogen load to the Peconic Estuary, recognizing that controlling runoff from existing development is an extremely expensive and often complicated proposition that needs to be addressed over time. Many road runoff mitigation projects have been completed or are underway across the Peconic Watershed, undertaken at the State, County, town, and village levels. In June 2002, the entire Peconic Estuary was approved as a Vessel Waste No Discharge Area (NDA) to eliminate the discharge of boat wastes. Numerous free municipal pump-out boats and shore-based facilities aid compliance with the NDA.

Other important management components are the New York State Department of Environmental Conservation Shellfish Sanitation Program and the Suffolk County Department of Health Services bathing beach monitoring program. Because measuring the concentration of specific pathogens in seawater is so difficult, scientists and regulators use fecal and total coliform bacteria, as well as enterococcus bacteria, as indicators of pathogen contamination. Managers use the monitoring data to establish shellfish harvesting and bathing beach closures necessary to protect public health.

What are the environmental indicators for pathogens? The Peconic Estuary Program has identified two environmental indicators for pathogens. These are: (1) shellfish bed closures and (2) bathing beach closures.

Environmental Indicator: Shellfish Bed Closures

Background: The New York State Department of Environmental Conservation conducts sanitary surveys in approximately 121,000 acres of shellfish growing areas in the Peconics for conformity with the guidelines of the National Shellfish Sanitation Program. The surveys consist of two parts: a pollution source inventory/evaluation and water quality monitoring. Coliform bacteria are measured as an indicator of the potential presence of human pathogens. NYSDEC classifies growing areas as certified (open) or uncertified (closed) based on the results of the surveys. Closures are based on bacteriological water quality or are administrative, based on the presence of pollution sources such as sewage treatment plants or large concentrations of boats. NYSDEC also regulates certain growing areas via seasonal or conditional certification based on fluctuations in coliform levels related to changes in season or precipitation.

The major threats to shellfish harvesting areas are contaminated stormwater runoff from developed areas (runoff from paved roads and parking lots, etc.) and runoff contaminated by waterfowl and other wildlife. Failing septic systems, improperly treated effluent from wastewater treatment plants, and illegally discharged wastes from boats also contribute to loadings, although to a lesser degree. Inadequately planned or implemented new development could undoubtedly increase the potential for additional shellfish closures due to increased stormwater runoff and loss of natural buffers, though runoff considerations are generally now taken into account.

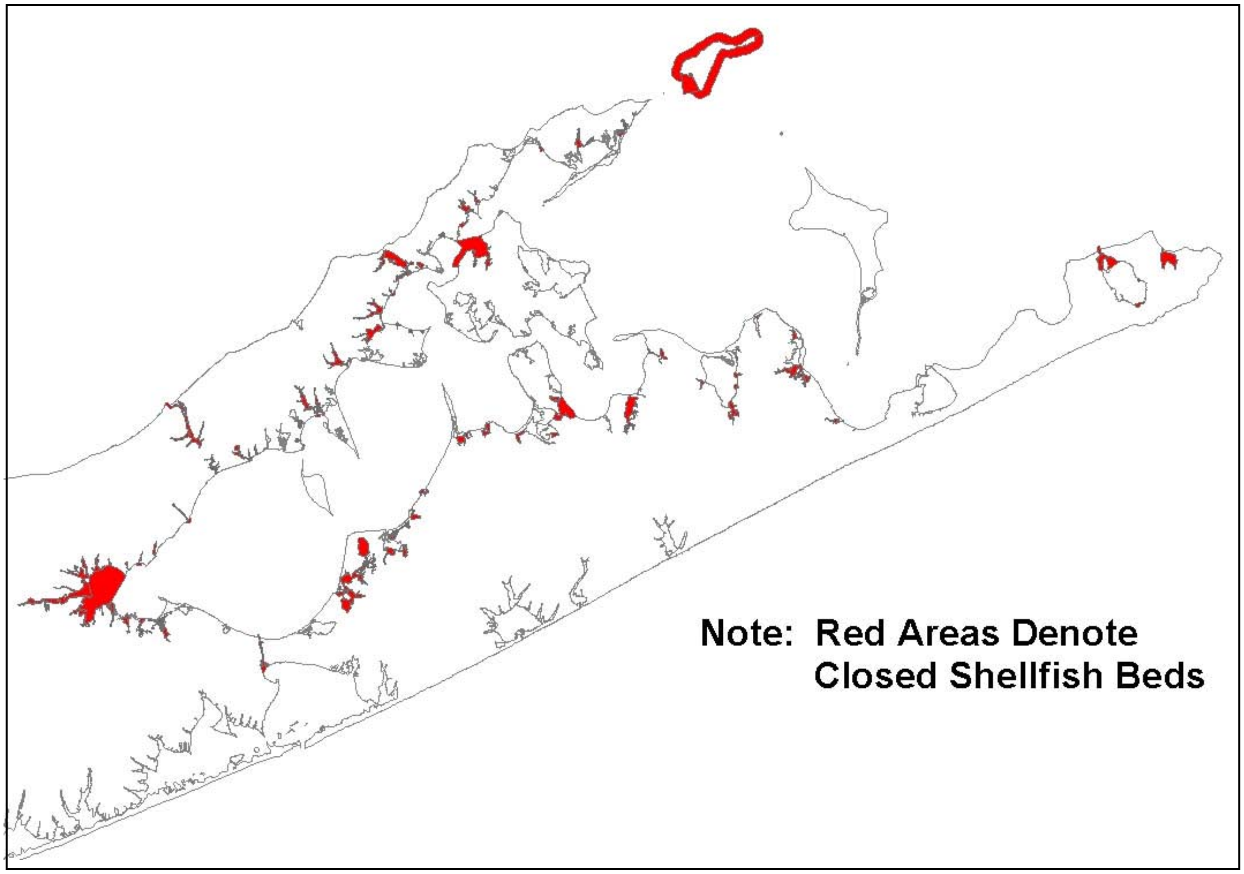
The bacteriological water quality criteria for shellfish growing areas are more conservative than that used for bathing because shellfish are filter feeders that have the ability to concentrate human pathogens. If an area meets the shellfishing standards, it is also safe for all other uses. Thus, shellfish growing area classification acts as an "early warning system" indicating that bacteria or other pollutants may be affecting the area. Safe shellfish are a benefit to the local economy due to both commercial and recreational harvests, as well as for cultural reasons.

Status and Trends: Bacteriological water quality is generally good throughout most of the larger bodies of water in the Peconic system. Shellfish closures occur to a larger extent in Flanders Bay and in some of the more sheltered creeks and bays, which are often productive areas. There are also some administrative closures around Plum Island and in Shelter Island Sound. In 2003, there were Conditional Harvesting Programs in some of the uncertified portions of Hallocks Bay, Sag Harbor, Northwest Creek and Accabonac Harbor. In previous years there have been conditional programs in Flanders Bay, North Sea Harbor and Hashamomuck Pond.

Figure 21 shows the areas in the Peconics that are currently uncertified year-round or seasonally. During the period of 1996 - 2004 there was a net increase of 211 acres of certified or seasonally certified shellfish lands in the Peconic Estuary. Of the 121,000 acres of shellfish lands, 115,778 acres (or 95.7%) are available for shellfish harvesting. As of January 1, 2004, there were 3419 acres uncertified and 1803 acres seasonally certified. The trend has been relatively flat since 1995, following a period of fairly rapid increase in closed areas between 1980 and 1995, from about 1200 acres to about 5200 acres. The relatively large amount of acreage closed between 1980 and 1995 may, in part, be due to increased sampling effort required by modifications to the

National Shellfish Sanitation Program sampling protocol, so it is difficult to separate out reclassifications due to an actual decline in water quality from those resulting from increased sampling.

Figure 21: Current Peconic Estuary Shellfish Bed Closures.



Limitations on these data: Shellfish growing areas are usually sampled 6 to 10 times per year. More frequent sampling may be done under specific precipitation conditions when local governments request Conditional Harvesting Programs for an area. Evaluations are based on a minimum of 30 samples. Administrative closures amount to approximately 1000 acres of the 5222 acres currently closed and may not reflect actual bacteriological water quality. In addition, acreage is now calculated using geographic information systems (GIS), as opposed to the old dot count methodology, which resulted in some variations not related to any changes in classification.

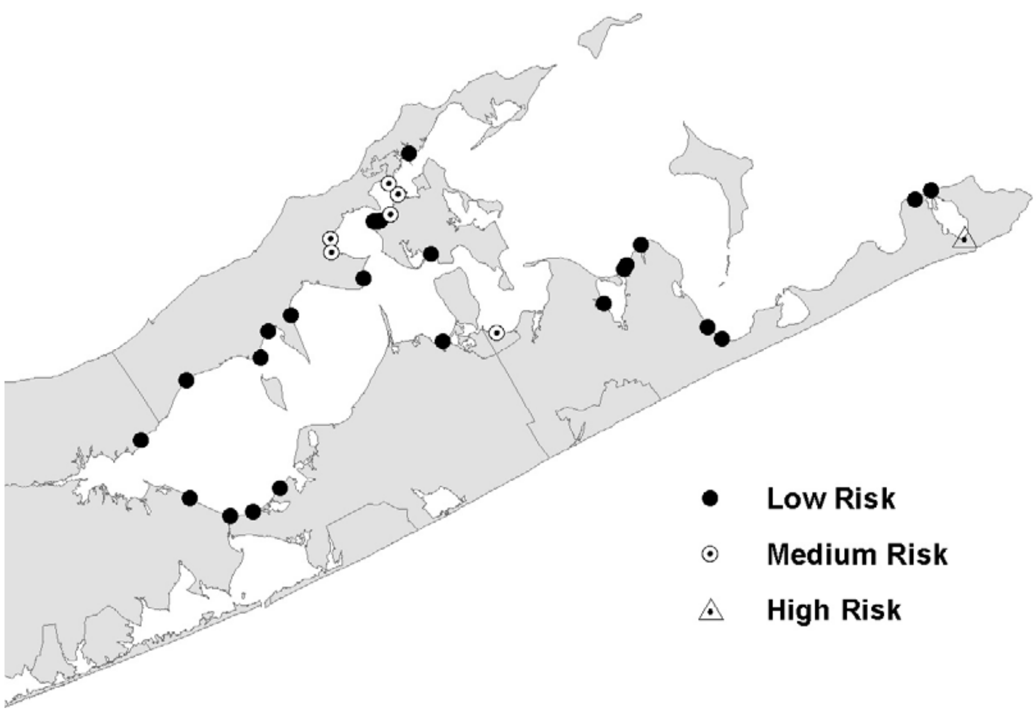
What can be done: Preventing or controlling runoff from new developments and improving and maintaining stormwater systems in existing developments can maintain and improve water quality. It is also important to properly maintain septic systems, observe vessel waste no-discharge laws, and prevent domestic animal, livestock and wildlife wastes from getting into runoff.

Environmental Indicator: Bathing Beach Closures

Background: The Peconic Estuary boasts over 450 miles of shoreline and 31 public bathing beaches permitted by Suffolk County. While they are generally pollution free and provide a safe and healthy recreational environment, some beaches are subject to influences that can adversely affect water quality, possibly exposing bathers to microbial pathogens. These influences may include stormwater runoff, waterfowl and other wildlife waste, poorly functioning septic systems, illegally discharged vessel wastes, limited tidal flushing, and malfunctions at sewage treatment plants. Based on such influences, Suffolk County ranks beaches in tiers according to the potential risk (low, medium, or high) associated with their use. The Suffolk County Department of Health Services tests bathing beaches at least monthly at low risk beaches and at least weekly at high risk beaches for total and fecal coliform bacteria, and, since 2003, enterococcus bacteria, as indicators of beach water quality. Beach closures also occur for reasons other than high bacteria levels, such as stinging jellyfish and algal blooms. Preemptive closures may occur after excessive rainfall, runoff from which is likely to carry pollutants into the surface water. Recent investigations suggest that coliforms found in the estuary are primarily of non-human origin (*e.g.*, wildlife or domestic animals).

Status & Trends: The majority (24, or 77.4%) of bathing beaches in the Peconic Estuary are classified as low risk. Six (19.3%) are classified as medium risk, and only one (3.3%) is considered high risk. The South Lake Drive Beach on Lake Montauk is the high risk site. Water quality at that location is adversely impacted by stormwater runoff and upland drainage received in flow from an adjacent stream. Figure 22 shows a map of all bathing beaches in the Peconic Estuary permitted by Suffolk County and also indicates the risk level of each beach.

Figure 22: Location & Risk Level of Peconic Bathing Beaches Permitted by Suffolk County.



Since 1980, there have only been six bathing beach closures within the Peconic Estuary. Details of the closures are in Table 1. All four Shelter Island closures were precautionary closures due to a problem with the operation of the Shelter Island Heights Sewage Treatment Plant. The East Hampton town beach on the south end of Lake Montauk was closed twice in 2004—once due to elevated enterococci levels and once as a precaution following heavy rains. Several possible sources of the enterococcus contamination at Lake Montauk have been suggested, including waterfowl and other wildlife, as well as shallow sanitary systems in the Ditch Plains community south of the lake. Due to continuing concerns at this site, this beach will now be closed after each heavy rainfall.

Table 1: Peconic Estuary Bathing Beach Closures Since 1980.

Year	Area	Bathing Beach	Days Closed
2001	Shelter Island	Camp Quinipet	3
2001	Shelter Island	Crescent Beach	3
2001	Shelter Island	Shelter Island Heights Beach Club	7
2002	Shelter Island	Shelter Island Heights Beach Club	10
2004	Lake Montauk	South Lake Drive Beach	6
2004	Lake Montauk	South Lake Drive Beach	14

Limitations on these data: The areal extent of bathing beach data is extremely limited**,** covering only the area immediately adjacent to the beach. Additional data are available from routine monitoring of the estuary and its point sources. As most of the pathogen indicators found in the Peconic Estuary are from non-human sources, as opposed to other areas that may be in the vicinity of large municipal wastewater treatment plants served by a combined sewer system (*e.g.*, the New York City metropolitan area), the actual potential for human disease may be significantly less than suggested by the bacterial values.

What can be done: Maintaining high quality bathing beaches requires managing runoff, controlling animal wastes, properly maintaining septic systems, observing vessel waste no discharge laws, and properly operating sewage treatment plants. Research to better define ambient conditions (*i.e.*, the naturally expected introduction of bacteria) and the relationship of non-human pathogens to public health is required.

Environmental Indicators for Toxic Substances

What are toxic substances and why are they a concern? Toxic pollutants include human-made and natural substances that can be harmful to people and other living things. Toxic substances can be present in bay and creek waters, bottom sediments, groundwater, soils, and in plants and animals. Toxic substances can affect the ability of fish, shellfish, and other wildlife to survive or reproduce. Some toxic substances can accumulate in the edible parts of fish, shellfish, and other wildlife, making them an unsafe food source for people and/or wildlife. Toxic contamination can also impact dredging and dredged material placement operations because limited placement options are available for contaminated sediments.

Where do toxic substances come from? Toxic contaminants come from diverse activities and land uses. Potential sources include: stormwater runoff from private homes and businesses, construction sites, roads and parking lots; sewage treatment plants; individual septic systems; pesticide use associated with residences, farms, golf courses, and mosquito control measures; marinas and recreational boating; Federal and State Superfund sites; treated lumber used for bulkheading, docks and piers; leaking underground storage tanks; and atmospheric deposits from sources near and far.

The introduction of pharmaceuticals and personal care products into the environment via treated or untreated sewage is an emerging concern. These substances have been detected in groundwater and surface waters worldwide and may have adverse effects on life, even at very low concentrations.

Are toxic substances an issue in the Peconic Estuary? Relative to other estuaries nationally, toxic contamination is not currently a significant problem in the Peconic Estuary. However, toxic substances have been found in the Estuary, and impacts from toxic substances have been documented. The PEP has completed a number of studies to better assess the effects that toxic substances have on the system, both individually and cumulatively. At some locations, detailed investigations and clean-ups are occurring under Federal and State hazardous waste clean-up laws.

What is being and can be done to improve environmental quality with respect to toxic substances? Clean-ups of known problem areas, such as sites identified under Federal and State hazardous waste clean-up laws, address pollution that occurred in the past and return these areas to environmentally sound conditions and productive uses. Because the clean-up of toxic contamination is an expensive proposition, preventing toxic contamination is the preferred management approach. Limiting the inputs of toxic substances to the system, particularly pesticides applied for aesthetic reasons, is an important management strategy to prevent problems from occurring in the future, particularly as the population in the watershed increases. The focus of the CCMP is targeting those land uses and activities that contribute toxic substances to the system and taking steps to prevent them from getting into and adversely impacting the ecosystem.

The proposed voluntary *Suffolk County Agricultural Stewardship Program* centered on Agricultural Environmental Management, whole farm planning, an Advisory Council, technical support, and 100% cost sharing should be fully funded and implemented.

In 2005, the Suffolk County Department of Health Services will modify the rain monitoring National Atmospheric Deposition Program – National Trends Network (NADP-NTN) site at Cedar Beach, Southold to monitor mercury deposition and hence be part of the NADP – Mercury Deposition Network. The Cedar Beach NADP-NTN site is situated within the Peconic Watershed and has been active since January 2004, with weekly rain samples sent to the Illinois State Water Survey for laboratory testing.

What are the environmental indicators for toxics? The Peconic Estuary Program has identified two environmental indicators for toxics. These are: (1) pesticides in ground and surface waters; and (2) other toxic substances in sediments, biota and groundwater.

Environmental Indicator: Pesticides in Ground and Surface Waters

Background: Pesticides are an emerging concern in the Peconic Estuary system and elsewhere. Our groundwater and surface waters are no longer pristine. Pesticides may enter the Peconic system from suburban areas such as homes, golf courses, and public and private lawns and landscaped areas, as well as through agricultural operations and mosquito control measures. They can enter the estuary with runoff, in groundwater, or by direct application. Though no causal link has been identified, low levels of pesticides (and other toxic substances) may be affecting the biota of the Peconic Estuary, especially during sensitive early life stages.

Several pesticides were banned years ago due to their high toxicity and purported links to reproductive, neurological, and/or immune system damage in humans and wildlife. However, even pesticides that are banned or not being applied can cause or contribute to environmental problems due to improper storage or disposal. In addition, some banned pesticides take a long time to degrade so they persist in the groundwater and surface waters of the Peconic Estuary.

Data, Status & Trends: To ensure the environment is protected and that pesticides are used properly, several authorities oversee pesticide management and environmental monitoring. The Suffolk County Department of Health Services monitors local groundwater and surface waters for pesticide contamination, and the NYSDEC certifies commercial applicators and tracks some pesticide sales and applications. Public and private water suppliers also test waters destined for use as drinking water. Information on pesticides in bay bottom sediments and biota is included in the section that follows.

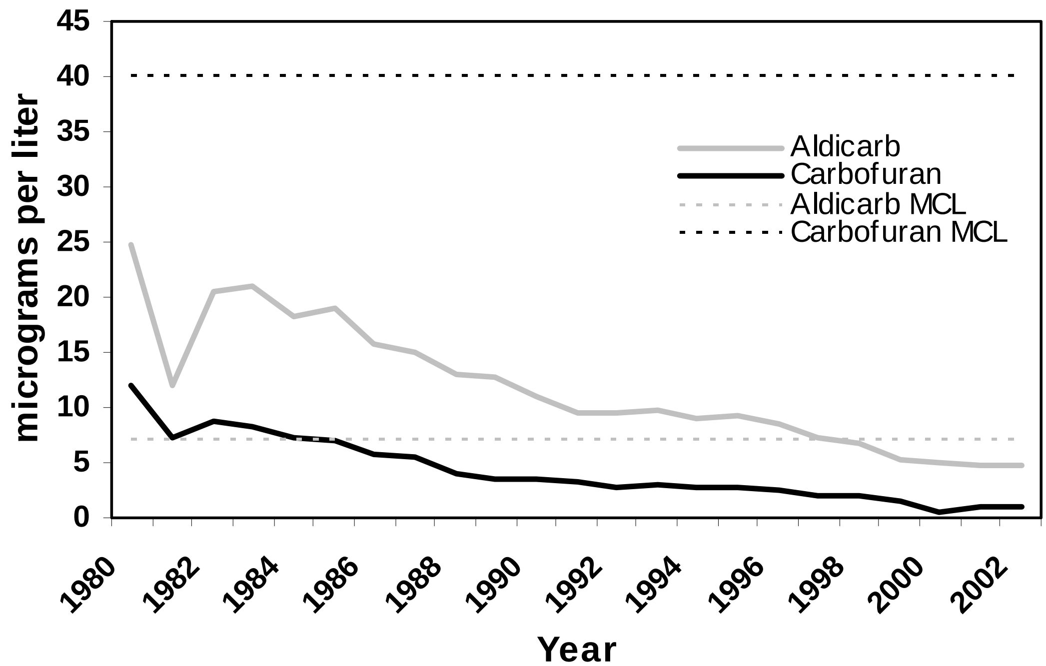
Pesticides in Groundwater

Despite improvements in pesticide management, some pesticides are still being detected in groundwater at levels that exceed drinking water standards and are therefore potentially harmful to public health where there is no or not enough treatment between the source and the tap. This reinforces the need for continuing aggressive pesticide monitoring, public education, and management.

Since 1997, the Suffolk County pesticide monitoring program has identified 63 pesticide-related chemicals in groundwater. Detection levels ranged from approximately 0.2 to 766 parts per billion. While sampling was not exclusively in the Peconic Watershed, it is likely representative of contamination in the Watershed. Most of these pesticide compounds have been found at low levels; only thirteen have been detected in concentrations that exceed the New York State drinking water standard or Maximum Contaminant Level (MCL). The use of approximately one-third of these chemicals is now prohibited in Suffolk County. However, groundwater discharges containing herbicide compounds and their degradates into the Peconics is an emerging concern. There are indications that even low levels (parts per billion) can inhibit the growth of algae (including phytoplankton) and eelgrass, which in turn affects the habitat and food supply of other organisms.

Figure 23 shows long-term trend analyses for two pesticides, aldicarb and carbofuran (trade names Temik and Furadan). Both were banned in the early 1980s, but they or their break down products (degradates) persist in groundwater, though at decreasing concentrations. Note that in Suffolk County, median aldicarb and carbofuran levels, when detected, are below the NYS drinking water standards in recent years.

Figure 23: Median Total Concentration of Two Pesticides in Suffolk County Groundwater Over Time, Relative to the NYS Maximum Contaminant Level.



Median concentrations of the herbicides alachlor and metolachlor and their most common metabolites (ethanesulfonic acid-ESA and oxanilic acid-OA) when detected in Suffolk County well testing are shown in the following two charts (Figures 24-25). The drinking water MCL for alachlor is 2 ppb while its degradates have no specific drinking water MCLs. Alachlor and metolachlor degradates routinely co-occur in the same wells. Alachlor has been detected at concentrations in excess of levels thought to cause negative ecological consequences. The no observable effect level (NOEL, 0.35 µg/L) and EC_{50} (Effective Concentration, the dose that is lethal to 50% of exposed organisms) for green algae (1.64 µg/L) are often exceeded in groundwater (Figure 24) in the Peconic Estuary Watershed. Alachlor and metolachlor have not been labeled for sale in Suffolk County since 1999 and 2000, respectively, but are still legal in other parts of New York State. The cumulative effects of related herbicide compounds with a similar mode of action have not been adequately studied.

Figure 24: Median Annual Concentration of Alachlor & Degradates in Public & Private Wells.

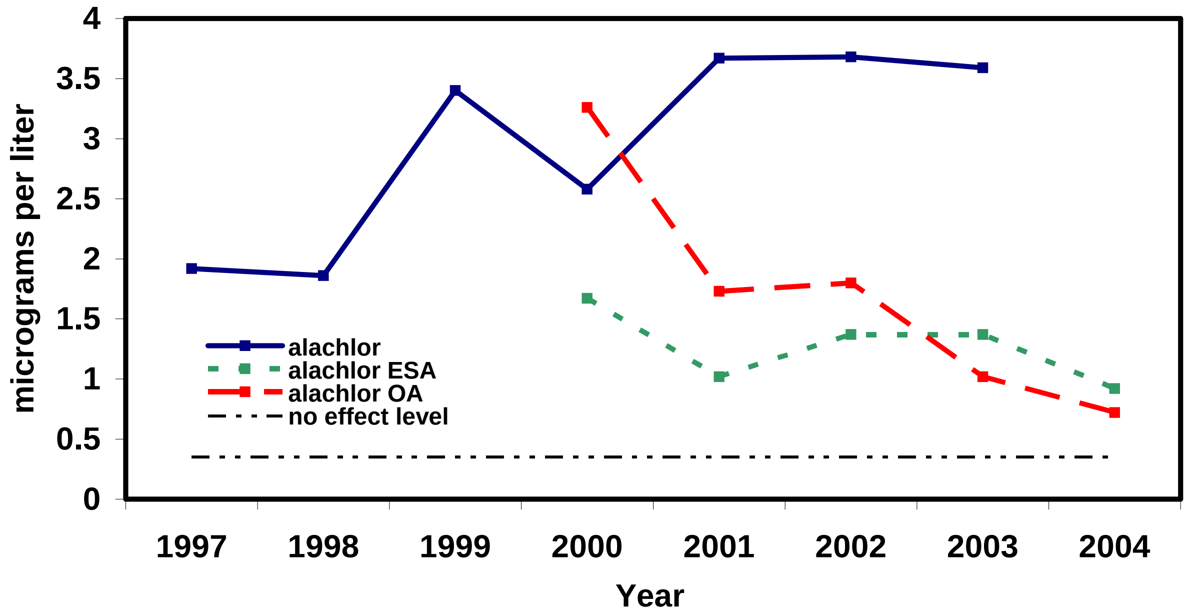
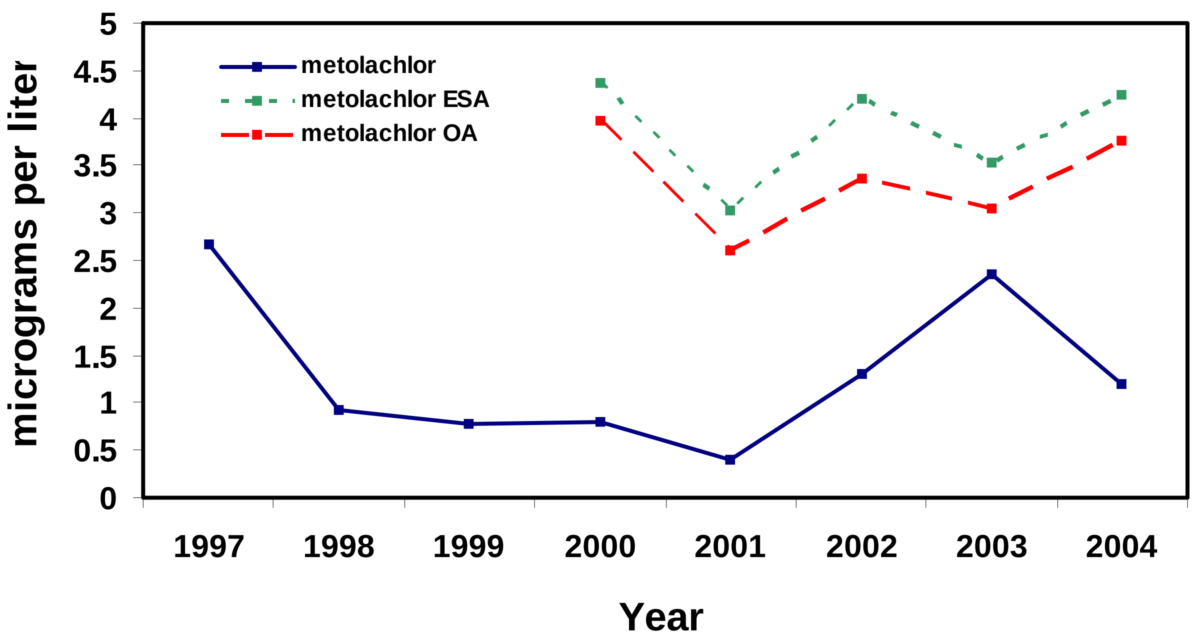


Figure 25: Median Annual Concentration of Metolachlor & Degradates in Public & Private Wells.



Pesticides in Surface Waters

SCDHS monitoring of the water quality of streams discharging to the Peconic Estuary has identified 37 pesticide-related compounds. The pesticides most frequently detected are the metabolites of the carbamate insecticide aldicarb (aldicarb sulfoxide and aldicarb sulfone), the herbicides alachlor and metolachlor (and their oxanilic acid and ethanesulfonic acid metabolites), and the fungicide metalaxyl.

Median and maximum concentrations when detected in the streams for the past several years are depicted in Figures 26 and 27, respectively. The concentrations of the pesticide chemicals in streams discharging to the Peconics very closely resemble the concentrations detected in public and private drinking water wells. This correlation is expected, as the stream baseflow is derived from groundwater discharge. Some of these pesticides have been detected at concentrations in excess of levels thought to cause negative ecological consequences. For example, median total alachlor concentrations when detected in streamflow to the Peconics routinely exceed the NOEL (0.35 µg/L) and EC_{50} for green algae (1.64 µg/L) for parent alachlor (Figures 26-27).

Figure 26: Median Pesticide Concentrations in 16 North Fork Streams Discharging to Peconic Estuary.

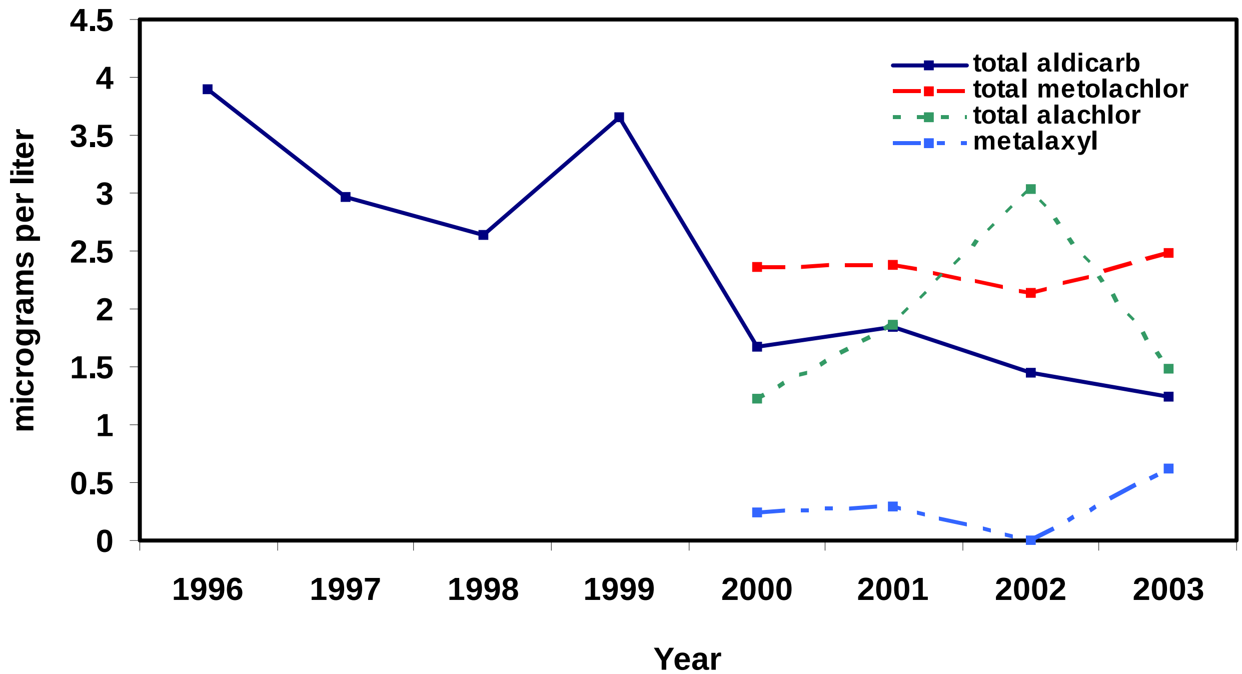
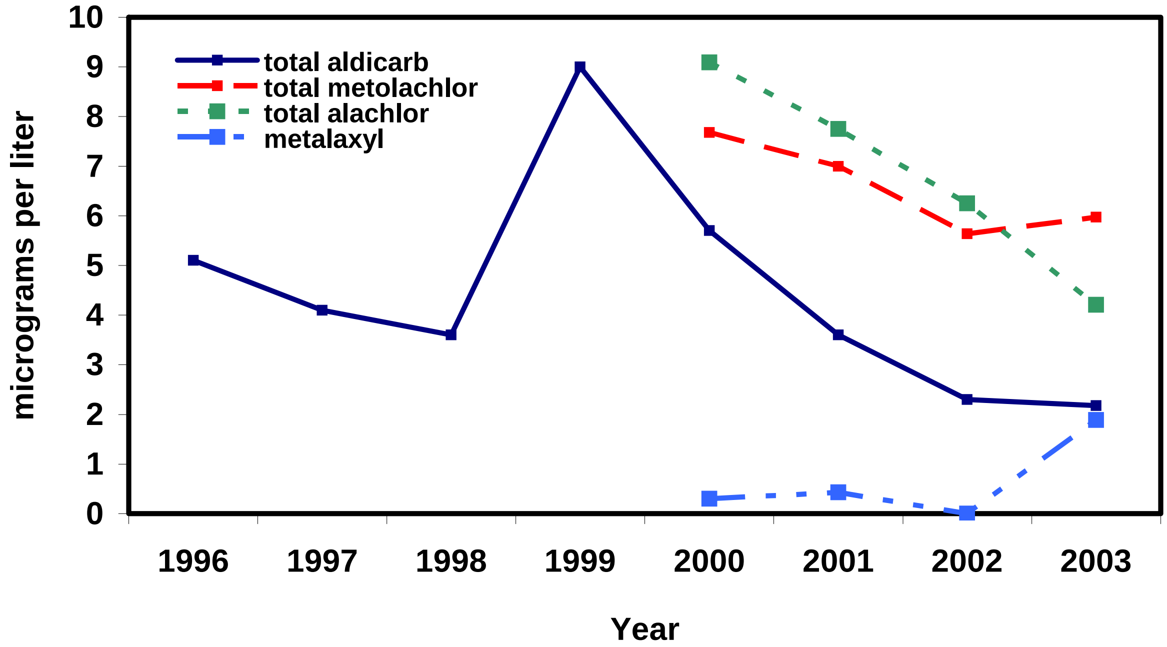


Figure 27: Maximum Pesticide Concentrations in 16 North Fork Streams Discharging to Peconic Estuary.



Limitations on these data: The pesticide detection data only include information on compounds tested for by SCDHS, so it is possible that other pesticide compounds are present.

What can be done: It is important to use pesticides only when necessary and to carefully follow label instructions. Proper storage and disposal are imperative. The Long Island Agricultural Stewardship Program should be funded and implemented to advance best management practices for pesticide use.

Environmental Indicator: Other Toxic Substances in Sediments, Biota and Groundwater

Background: Until the establishment of the Peconic Estuary Program, there was relatively little data available on toxic substances in bay bottom sediments and in finfish, shellfish and crustaceans. Toxic substances enter estuarine systems from many different sources. Aside from pesticides (discussed in the previous section), toxic substances associated with stormwater (including heavy metals and polycyclic aromatic hydrocarbons-PAHs), particularly in poorly flushed tidal creeks, are of concern. Other emerging concerns include MTBE, perchlorate and nitrates in groundwater.

Toxic Substances in Bay Bottom Sediments

Toxic substances sometimes settle in water bodies and become incorporated in bottom sediments. They can thus impact benthic organisms and re-enter the water column through sediment flux or resuspension. Toxic contamination can also impact dredging and dredged material placement since the placement of contaminated sediments can be challenging (*e.g.*, permits, identifying a location, and transport).

Toxic Substances in Biota

Fish, shellfish, and other wildlife may be exposed to toxic substances in the waters where they live or in the foods they eat. Over time, toxic materials may accumulate in the body, particularly in fatty tissues, leading to a magnified concentration in older individuals. The Peconics are not thought to have high toxic pollutant levels, but fish and other wildlife found in the Peconics are not free of contamination. A compounding variable exists for migratory wildlife – if they inhabit more contaminated areas during certain times of the year, detection of toxic substances may be a result of exposure to toxic pollution in areas outside of the Peconic Estuary. This is true especially for species that spend time in freshwater, such as mergansers and striped bass.

Toxic Substances in Groundwater

Water located in underground aquifers is the sole source of Long Island's public water supply. Our groundwater is no longer pristine. Any water-soluble contaminants can be transported to groundwater. Groundwater contamination can be caused by poor housekeeping practices at businesses, homes and elsewhere; leaking underground storage tanks; improper pesticide and fertilizer use; and even pollutants that are deposited from the atmosphere. Toxic substances poured down a drain may also reach groundwater via septic systems.

Excessive nitrogen in drinking water is potentially toxic to humans. High levels of inorganic nitrogen (nitrates) in drinking water may cause methemoglobinemia ("blue baby syndrome"). When ingested, nitrates are converted to nitrites, potentially compromising the oxygen carrying capacity of blood. The Environmental Protection Agency (EPA) has set a public water supply maximum contaminant level (MCL) of 10 milligrams per liter (mg/l) which is equal to 10 parts per million (ppm) for nitrate-nitrogen. This level provides a margin of safety against a significant risk for human health. EPA believes water containing nitrate-nitrogen at or below this level is acceptable for daily drinking over a lifetime and does not pose a methemoglobinemia health risk for infants or adults.

Data, Status, and Trends: Many studies have been conducted in recent years to assess the level of toxic contamination in the sediments, biota and groundwater of the Peconic Estuary. The sediments and biota data are still undergoing review so unfortunately cannot be presented in this report. The following tables present the information that is known, and the ongoing projects are discussed.

Toxic Substances in Bay Bottom Sediments
In a 1996 study conducted by the PEP, sediments from 12 locations were sampled for the presence of 98 naturally occurring and synthetic substances. Five stations were selected to characterize "main bays" water quality. The other seven were chosen because of specific management concerns. The toxic substances of concern in sediments and potential sources of those toxic substances identified in this study are presented in Table 2. Additional toxic substances of concern may be identified in the future, and modifications of the existing listing may be appropriate based on additional sampling.

Table 2: Toxic Substances of Concern in Peconic Estuary System Sediments, 1996.

Contaminant	Measured Levels and Area of Impact	Potential Sources
Polychlorinated Biphenyls (PCBs)	ER-L[a] exceeded for sediments in Meetinghouse Creek; elevated levels in freshwater fish on-site at Brookhaven National Lab (BNL)	Potential sources are outside of the Peconics aside from evidence of historical discharges from BNL
DDT[b] (banned from use in the 1970s)	ER-Ls exceeded for sediments at Upper Sag Harbor Cove, East Creek, and Meetinghouse Creek	Residual DDT from applications for agriculture and mosquito control
PAHs	ER-Ls exceeded for sediments in East Creek, mouth of Peconic River, Upper Sag Harbor Cove, and Meetinghouse Creek	Atmospheric deposition from the burning of fossil fuels, road runoff, and boat wet exhaust
Arsenic	ER-Ls exceeded for sediments in six sites (Great Peconic Bay, West Neck Bay, Fish Cove, East Creek, Mouth of the Peconic River, and Meetinghouse Creek)	Pesticides and stormwater runoff; treated lumber
Copper	Elevated levels in Peconic River sediments at BNL	BNL
Lead	ER-Ls exceeded for sediments in four sites (West Neck Bay, East Creek, Upper Sag Harbor Cove, and Meetinghouse Creek)	Primarily historic anthropogenic sources such as lead additives in gasoline
Mercury	ER-Ls exceeded for sediments at two sampling sites (West Neck Bay and Meetinghouse Creek); elevated levels in Peconic River sediments outside BNL	Atmospheric deposition, stormwater and urban runoff; BNL
Silver	ER-Ls exceeded for sediments at two sampling sites (mouth of Peconic River and Meetinghouse Creek); elevated levels in Peconic River sediments outside BNL	Stormwater and urban runoff; BNL
Radionuclides	Water, sediment, and fish samples taken from Peconic River outside BNL contain measurable levels of radioactive materials; however, observed concentrations are well below State established criteria	BNL

[a]Under NOAA's effects range values for toxics in sediments, concentrations below the ER-L (effects range-low) represent conditions in which adverse effects on bottom dwelling organisms would rarely be observed. Concentrations equal to and above the ER-L, but below the effects range-median (ER-M) represent a possible effects range within which effects would

frequently be observed.
[b]Concentrations of other organochlorine pesticides did not exceed ER-L concentrations in any of the tested sediments.
[c]Natural occurring radioactivity and fallout from atmospheric nuclear weapon tests also contribute to measurable levels of radioactivity, including areas not affected by releases from BNL.

In 1998, 2000 and 2001, EPA collected sediments from over 60 locations across the estuary for analysis. Locations for the EPA surveys were selected to be representative of the range of typical land uses in the estuary (undeveloped, developed residential, agricultural, and mixed-use urban/industrial). Sediments were analyzed for a total of 108 toxic contaminants, including PCBs, PAHs, pesticides, and metals. In addition to the analysis of individual chemical constituents, the sediment was evaluated for overall sediment toxicity using the marine amphipod *Ampelisca abdita*. These toxicity tests lasted 10 days, and the endpoint measurement was mortality. Toxicity testing is a valuable gauge because the results provide an assessment of the overall toxicity resulting from exposure to multiple contaminants. Fully interpreted results of the EPA sediment surveys are not yet available.

Toxic Substances in Biota

The New York State Department of Health issues annual consumption advisories for local sportfish and game. Advisories are similar for all of New York's marine waters, and Table 3 shows the current advisories that apply to the Peconic Estuary. This list is a reasonable indicator of toxic substances present in the Peconic system. The Peconic Estuary Program strongly encourages you to consult the full text of the current New York State Health Advisories, available at www.health.state.ny.us/nysdoh/fish/fish.htm or by calling 1-800-458-1158, ext. 27815.

Table 3: Peconic Estuary Sportfish and Game Consumption Advisories.

Species	Advisory	Contaminant(s) of Concern
Fish & Shellfish		
American Eel	Eat no more than one meal per week	PCBs
Bluefish	Eat no more than one meal per week	PCBs
Crab & Lobster hepatopancreas	Do not eat the hepatopancreas (sometimes called mustard, tomalley or liver); do not eat crab or lobster cooking liquid	PCBs, cadmium, dioxin
Striped Bass	Eat no more than one meal per week	PCBs
Freshwater fish	Eat no more than one meal (½ pound) per week of fish from NY's freshwaters	Unidentified
Waterfowl		
Mergansers	Avoid eating	PCBs, mirex, chlordane, DDT
Other waterfowl	Eat no more than two meals per month (also skin them and remove all fat before cooking & discard stuffing after cooking	PCBs, mirex, chlordane, DDT

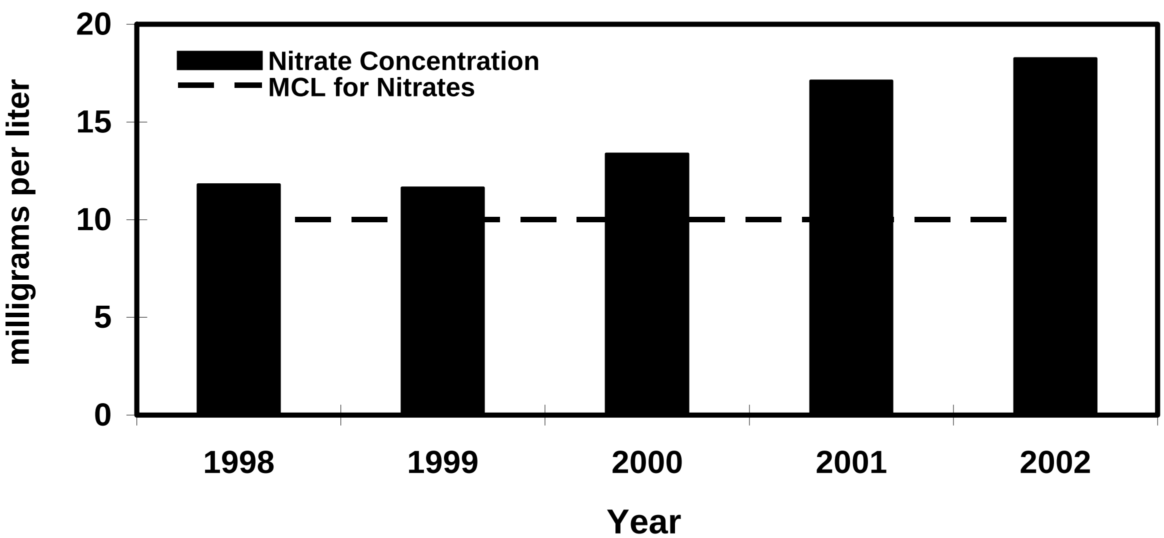
Other		
Snapping Turtles	Kids and women of childbearing age should avoid eating snapping turtles or soups made with their meat; Others who choose to eat snapping turtles can reduce exposure to contaminants by carefully trimming away all fat and discarding the fat, liver, and eggs prior to cooking the meat or preparing soup.	PCBs

Based upon the relative paucity of data available on the concentrations of toxic substances in the living resources of the Peconic Estuary, EPA initiated a "Peconic Estuary Fish, Shellfish and Crustacean Toxics Survey" in 1999. The species that were collected for analysis included: striped bass (bluefish and weakfish were alternate species), American eel, fluke/summer flounder (bluefish and weakfish were alternative species), hard clams, bay scallops, blue crabs, and lobsters. Samples will be analyzed for a comprehensive suite of toxic chemicals including metals, pesticides, PCBs, dioxins, furans, as well as radiological isomers of strontium, cesium, and plutonium and gross alpha, beta, and gamma radiation. Fully interpreted data are not yet available.

Toxic Substances in Groundwater (not including pesticides)
To assess nitrate levels in groundwater near farms, SCDHS has monitored wells at five different agricultural sites on the East End since 1998 (see Figure 28 for well locations). Two of the wells are located outside the Peconic Watershed boundary, but similar land uses and groundwater hydrology suggest that the concentrations are indicative of groundwater near agricultural sites in the Peconics. The drinking water standard or Maximum Contaminant Level (MCL) for nitrate (10 mg/l) was exceeded in more than two-thirds of the 180 samples. This is especially a concern where public water is not provided, and shallow groundwater from private wells is used for drinking purposes. See Figure 29, which shows an increasing trend in nitrate concentrations for the years 1998-2002.

Figure 28: Suffolk County Agricultural Monitoring Wells.

Figure 29: Average Annual Nitrate Concentration at Five East End Agricultural Wells.



Other chemicals of concern in the Peconics include MTBE and perchlorate. MTBE is a gasoline additive that was banned in New York State on January 1, 2004, but it continues to taint local groundwater from historic leaks and spills. Perchlorate is the principal component of rocket fuel and also a contaminant in fertilizer; it was found in 13% of private wells tested by Suffolk County.

Other Data on Toxic Substances

Beginning in 2000, sampling has occurred in the Peconic Estuary under the National Coastal Assessment Program. The purpose of this program is to assess the health or condition of the estuarine waters of the United States and trace changes in that condition through time. There are twelve sampling sites in the Peconic Estuary. The core suite of parameters includes sediment chemistry, sediment toxicity, and contaminants in fish (in addition to water quality parameters, benthic community composition, fish community composition and fish pathology). No data are presently available from the National Coastal Assessment Program.

Additional data on toxic substances are available from studies completed under the Federal Superfund law by Brookhaven National Laboratory (BNL).

Limitations on these data: Toxic substances of concern, potential sources, and consumption advisories are based on currently available data and information. Additional toxic substances of concern may be identified in the future.

The nitrate data were collected at only five wells in agricultural areas, only three of which are in the estuary watershed.

What can be done: Preventing toxic substances from getting into Peconic bays, aquatic life, and groundwater can be carried out on many fronts, including conducting stormwater abatement projects, implementing boating best management practices, using non or less toxic materials when possible, and following pollution prevention techniques (reduce, reuse, recycle). Pesticides and other chemicals should be used only when necessary, and instructions for proper use and disposal must be strictly followed. You can benefit from eating the fish you catch and minimize your exposure to chemical contaminants by following State’s advisories, see: www.health.state.ny.us/nysdoh/fish/fish.htm.

Environmental Indicators for Urbanization

What is urbanization and why is it a concern? Urbanization occurs when humans encroach on natural areas, thus modifying their ecological value or function. The net results can be: damaging increases in pollutants including nutrients, pathogens, toxic substances, and sediments; degradation, fragmentation or outright loss of habitats for plants and animals, including species that might be rare or endangered; adverse impacts to individual organisms, populations or entire natural communities; and altered water flows, including groundwater and surface waters.

Who exerts urbanization stresses? Urbanization or sub-urbanization stresses are exerted, to one degree or another, by any individual or group that enters the watershed. The degree to which stress is exerted depends on the number of people and the types of activities undertaken.

Is urbanization an issue in the Peconic Estuary? The relatively high environmental quality of the Peconic Estuary is undoubtedly related to the area's comparatively low population density, and thus large amounts of open space, and to an only recently increasing rate of urbanization in the watershed. The open space includes both areas that have been acquired by governmental and non-governmental entities to be protected in their natural state and those that are not protected and may therefore be developed at some point in the future. Although increasing development and population pressures threaten the Peconic Estuary with a variety of changes, it is possible to lessen the impact with respect to pollutant loading, habitats, and hydrology through the planning and permitting process and with good stewardship. It is also important to understand changes that are occurring within existing developed areas, such as conversions of seasonal homes to year-round homes, more intensively managed lawns and landscaped areas, and increased impervious surfaces, such as driveways, sidewalks, etc.

What is being and can be done to improve environmental quality with respect to urbanization concerns? A wide range of activities is underway by governmental and non-governmental entities and private citizens to address the suite of problems associated with urbanization. Many of these efforts are endorsed and supported by the Peconic Estuary Program and are described in the CCMP. Examples include:

- PEP Critical Lands Protection Strategy (CLPS), an effort to prioritize land for protection;
- Community Preservation Fund, a program through which open space is acquired; and
- Efforts to maintain the coastline of the Peconics in its natural state by discouraging shoreline hardening structures through regulatory and non-regulatory means.

What are the environmental indicators for urbanization? The Peconic Estuary Program has identified three environmental indicators that are related to urbanization. These are: (1) extent of impervious surface; (2) extent of shoreline hardening; and (3) land protection.

Environmental Indicator: Extent of Impervious Surface

Background: Impervious surfaces include any land cover that does not allow infiltration of water to the soil, including roads, driveways, parking lots, and sidewalks. In addition, unpaved areas can act as impervious surfaces if soils become compacted enough to inhibit infiltration. Impervious surface areas promote the mobility of sediments, nutrients, toxic substances, and pathogens to the Peconic Estuary system by minimizing or bypassing the mitigating effects of wetland areas and percolation through subsurface soils for groundwater flow. Measuring the change in impervious surface area, when linked with water quality change, will afford the Peconic Estuary Program the chance to evaluate how impervious surface affects the Peconic Estuary system, and to a lesser degree how impervious surface relates to groundwater recharge ability. Peconic Watershed land cover classifications, including the impervious surface information, will help localities administer best management practices to maintain and preserve not only the Peconic Estuary system's health, but also the sole-source aquifer that provides drinking water for Long Island.

Data, Status and Trends: Under an agreement with the Peconic Estuary Program, the U.S. Geological Survey (USGS) is classifying the current land cover in the Peconic Watershed at a scale that can relate to local features and data. The USGS will also calculate the impervious surface in the watershed. Resulting land cover and impervious surface statistics will be broken down by town and village boundaries. This project will provide a baseline from which future changes in land cover can be compared and historical land cover changes can be extrapolated. To understand what the land area in the Peconic watershed is contributing to the estuary, not only must the land cover be analyzed, the change in land cover must be measured and linked to changes in estuarine condition. The land cover classification needed to calculate inputs from the land to the estuary must be of appropriate scale and in meaningful classes to understand how different land covers affect water quality in the estuary.

High-resolution (1:24,000-scale) land cover for the Peconic Watershed is being compiled from Spring 2001 aerial photographs supplied by Suffolk County. USGS photo interpreters are in the process of delineating and classifying the land surface using GIS software. The land cover will be classified using a modified Anderson II and C-Cap land cover classification system, including the classes of industrial, open space, and estuarine emergent wetland. Field work and ancillary data, such as map sources and National Wetlands Inventory data, will be used to supplement decisions about the land cover classes.

The USGS will use the same color imagery to delineate all impervious surfaces in a raster format. The ½ meter resolution pixels that are considered impervious will be identified using an unsupervised classification in ERDAS Imagine. A photo interpreter will then add, delete, or modify those pixels which are misrepresenting impervious or pervious surfaces. Ultimately, the resulting raster product can be used to determine percent impervious surfaces within the watershed.

Limitations on these data: (not applicable as data are not yet available)

What can be done: Eliminating or minimizing impervious surfaces can decrease runoff volumes and pollutant transport to surface waters. In addition, intercepting runoff and providing for infiltration (*e.g.*, by establishing or maintaining vegetated buffers) before it reaches surface waters can effectively mitigate some of the impacts from impervious surfaces, including runoff volumes, associated pollutants, and physical effects (such as scour).

Environmental Indicator: Extent of Shoreline Hardening

Background: In an estuary, where the water meets the land, the shoreline, or more broadly the intertidal zone, is home to a wide variety of plants and animals that are specially adapted to the twice-daily inundations of seawater. Wetlands that are present in the intertidal zone play an important role in estuarine ecology. These vegetated areas stabilize the shoreline and protect small tidal ponds and creeks, which are ideal areas for juvenile fish and invertebrates to grow and reproduce. The installation of hard structures along the shoreline has led to the loss of wetlands and beaches as well as the scouring of shallow areas, which impacts shallow water benthic communities.

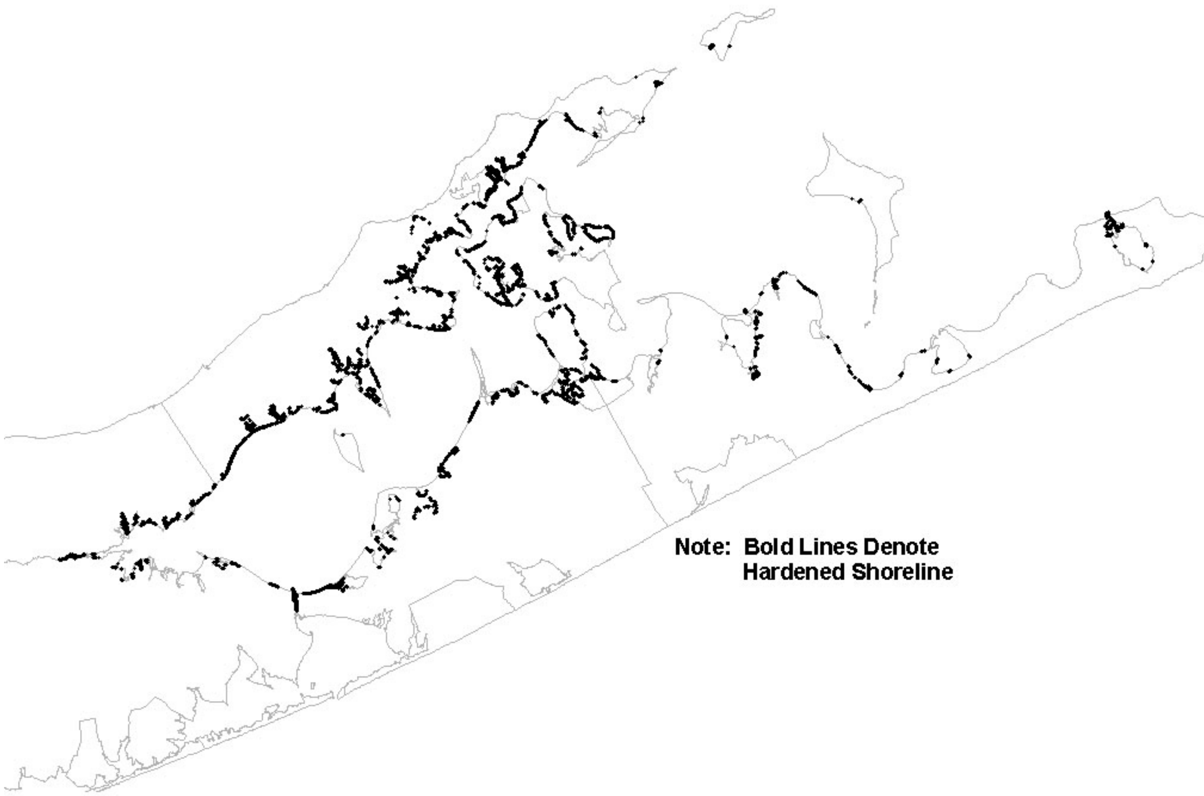
Bulkheads, rip-rap and other structures have been widely used to stabilize waterfront property throughout the estuary. Bulkheads can result in erosion or deposition of sediments up or downstream of the structure, which may result in the destabilization of the shoreline and encourage adjacent landowners to install additional hardening structures. The scour in front of hardened structures could also eliminate the productive and protective features of intertidal and shallow water areas. Loss of shallow-water habitats negatively impacts shellfish, forage and juvenile fish and other species that use these areas for spawning, feeding, or mating (*e.g*., horseshoe crabs and birds). This "domino effect" of replacing natural shoreline with human-made structures in a relatively short period of time is increasing in some areas and resulting in considerable risk to remaining natural, vegetated shorelines. Furthermore, hardened shorelines prevent the natural shoreward migrations of salt marshes, which is particularly important to consider with respect to rising sea level. In addition to the loss of beach and inter-tidal habitats, bulkheads can adversely impact the living resources through the leaching of toxins such as copper, chromium and arsenic that are used to treat lumber.

Hardened Shoreline Data: The FWS inventoried the Peconic's hardened shoreline using a digital transfer scope to delineate the features onto digital orthophotoquarterquads. Seven categories of hardened shorelines were inventoried; docks were mapped as well. Aerial photographs used for this project were 1:14,400 true color photos acquired from September through November 2000 by the PEP. The hardened shoreline delineations were groundtruthed by the Peconic BayKeeper. There is no previous known effort to accurately determine the extent of hardened shoreline features in the Peconics. The percent coverage of hardened shoreline (bulkheads, seawalls, etc.) by town generated by this study is shown in Table 4, and the map of total hardened shoreline is shown in Figure 30. In total, there are 28.6 miles of hardened shoreline in the Peconics. There is an additional 9 miles of docks.

Table 4: Hardened Shoreline By Town.

Town	Miles of Hardened Shoreline (Number of Structures)	Miles of Shoreline	Percent Hardened Shoreline
East Hampton	4.3 (173)	115.1	3.77%
Riverhead	2.6 (113)	19.8	13.03%
Shelter Island	3.6 (176)	60.9	5.95%
Southampton	5.4 (209)	117.5	4.64%
Southold	12.6 (603)	139.6	9.03%
Total Peconic	28.6	453.0	**6.31%**

Figure 30: Hardened Shoreline in the Peconic Estuary.



Limitations on these data: After the FWS released their report, The Nature Conservancy compared sections of the final hardened shoreline GIS coverage from the FWS report to Spring 2001 aerial orthophotos and cautions that the FWS report's hardened shoreline estimates may be conservative.

What can be done: Eliminating or limiting new shoreline hardening structures and docks is an important step in preserving the habitats and therefore the living resources of the Peconic Estuary. Natural shoreline stabilization techniques should be pursued and encouraged and restoration projects identified and carried out. When the installation of new or replacement structures does take place, non-toxic or low toxicity materials should be used.

Environmental Indicator: Land Protection

Background: Seemingly ever increasing development pressure is leading to the loss of open spaces and natural habitats, threatening ground and surface water quality and stressing remaining natural communities. The region's growing population and rate of development in the past 10 years in particular has underscored the need for immediate action to protect the remaining developable acreage in the Peconic Estuary Study Area. There are many benefits to land protection, including preserving unique species and natural communities, controlling nitrogen loads to optimize dissolved oxygen in the water for fish and shellfish, and protecting surface water quality and groundwater recharge areas from other adverse effects. In addition, the public has exhibited a strong attachment to the natural resources of, and amenities provided by, the Peconic Estuary region, even if they do not use them directly or frequently.

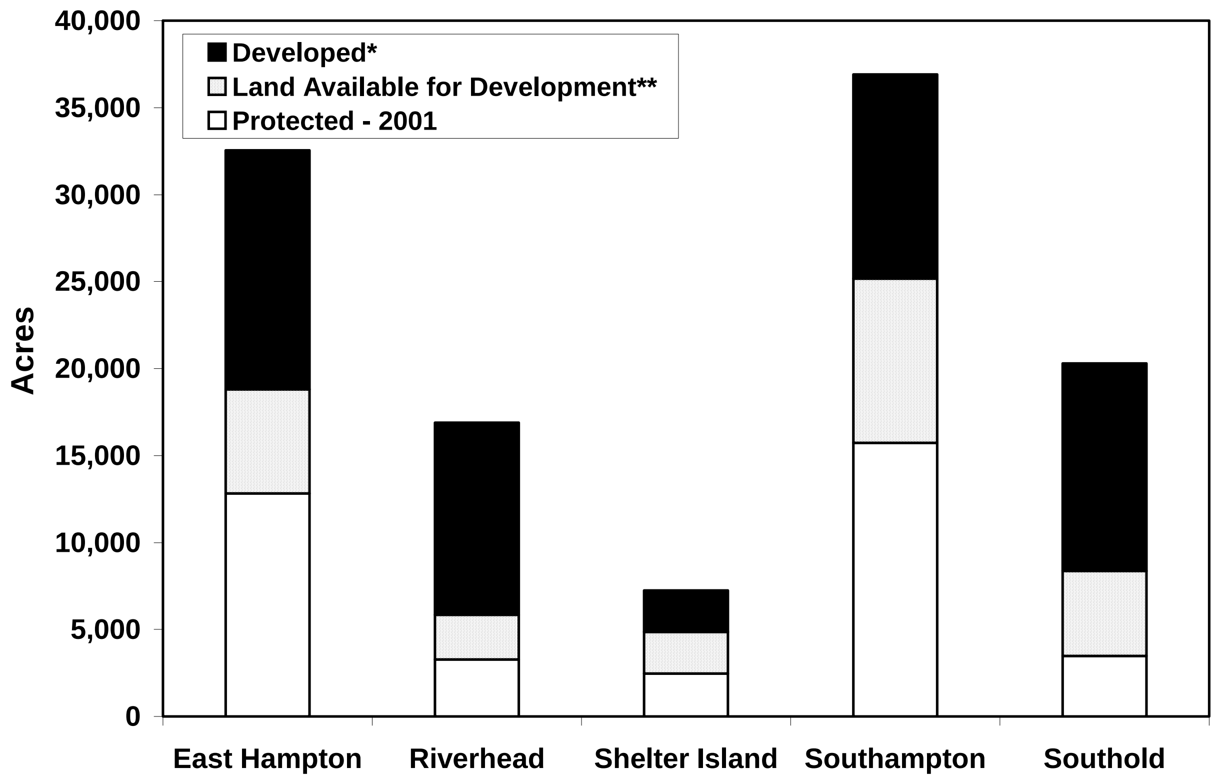
The most significant source of funding for land protection is the Community Preservation Fund (CPF), administered by the five East End towns. This funding is supplemented by County and State governments, and not-for-profit organizations (especially The Nature Conservancy and the Peconic Land Trust). The Peconic Estuary Program has developed maps depicting the land still available for development (including developed lands that can be further subdivided) that also meet criteria used to determine land protection priorities. These criteria include: (1) proximity to shorelines or tidal creeks; (2) categorization as a freshwater or tidal wetland, as classified by the FWS National Wetlands Inventory; (3) location within a Critical Natural Resource Area; and (4) location within a nitrogen-stressed subwatershed. The Program is sharing this information with the towns for use in establishing acquisition/protection priorities.

While the CPF will raise significant funding (hundreds of millions of dollars), it alone will be insufficient to protect more than an estimated 5-10% of the total amount of remaining land available for development. The Peconic Estuary Program is therefore investigating and developing additional tools and recommendations to help protect the Peconic Estuary Watershed.

Data, Status, and Trends: In 1995, the Suffolk County Planning Department (SCPD) completed a GIS database of existing land use at the tax map scale for the entire Peconic Watershed. The Nature Conservancy (TNC), with support from local governments, updated the database in 2001 as part of the Critical Lands Protection Plan. In the Peconics, about 550 acres of land per year were converted to developed uses from 1976 to 1995. Alarmingly, this average increased from 1995 to 2001 with an average of 583 acres developed per year. As of 2001, there were a little more than 25,000 acres left that could be developed (either vacant or subdividable) in the Peconic Watershed within the five East End Towns (see Figure 31).

While land has been developed for residential, commercial, and other uses, steps have also been taken to protect open space. Based on 2001 data, over 33% (37,771 acres) of the Peconic Watershed in the five East End Towns is protected (see Figure 31). From 1995 to 2001, over 11,600 acres were converted to open space and recreational lands (including golf courses).

Figure 31: Land Use in the Peconic Watershed, by Town, 2001.



* includes agricultural land and golf courses
** vacant and subdividable land

Limitations on these data: The Critical Lands Protection Plan 2001 analysis does not include the Town of Brookhaven because the effort to identify lands for the purpose of protection was viewed as a redundant effort to the Pine Barrens Protection Plan. Also, according to the PEP Existing Land Use Inventory (SCPD, 1997), only approximately 7% of the town's acreage is within the Peconic Watershed. Brookhaven National Laboratory alone comprises 44% of the town within the Peconic Estuary Study Area. Recreation and open space property, primarily owned by Suffolk County, accounts for another 21% of the total Peconic Watershed acreage in the Town of Brookhaven (1995 estimate).

What can be done: A Critical Lands Protection Strategy and Plan has been developed by the PEP to prioritize lands for acquisition based on environmental concerns and should be utilized. Funding is needed to acquire properties before they are lost to development. Other tools are being used, such as zoning, and still others are being developed, such as clearing restrictions and development clustering, to help guide the future of existing open spaces.

Findings, Conclusions, and Recommendations

Overall, the Peconic Estuary is in good condition, though there are significant signs of stress, particularly in the more densely developed areas and in the tidal creeks. The stresses are likely to worsen as the population increases and land uses intensify unless steps are taken to reduce pollutant loadings and protect habitats from physical alterations. It is also possible to reverse some trends through the combined efforts of government, businesses, organizations and citizens to preserve open space, reduce pollution from existing development, and ensure that any future development is done in a way to minimize its impact on the environment.

Key Findings and Conclusions

The following key findings and conclusions present good news, some bad news, and cautionary notes.

1. Brown Tide blooms have not occurred in almost a decade, but the species most affected (bay scallops and eelgrass) have not rebounded.
2. Low dissolved oxygen conditions are evident in the western estuary, many tidal creeks and occasionally in Flanders Bay, totaling approximately 3% of the estuary's surface waters. The limited data available do not suggest that areas with extreme dissolved oxygen problems are growing with time.
3. Total nitrogen concentrations throughout the main stem of the estuary seem to be decreasing. Whether these declines are due to decreased loading, increased uptake in the food web, or these mechanisms in combination with others, is not known.
4. Eelgrass continues to be in decline, with an areal decrease of at least 82% since the 1930s. Despite generally good water quality, eelgrass beds, currently at 1,550 acres, are not expanding.
5. Tidal wetlands, while generally holding their own at over 5,500 acres, are threatened by degradation of surrounding buffer areas and the invasive common reed. There have also been recent documented losses from unknown causes.
6. Though numerous habitat restoration projects have been completed, significantly more work to restore ecosystems is needed.
7. Bay scallop and winter flounder populations no longer support commercial harvests.
8. The number of nesting pairs of threatened piping plovers, while stable over a 12-year period, is less than the target of 115 pairs. The number of osprey nests in the Peconics also seems relatively stable, ranging from 171 to 215 from 1997 to 2003.
9. Only 4.3% (5,222 acres) of the Peconic Estuary is closed to shellfish harvesting due to water quality concerns, though this includes many highly productive areas. This includes administrative closures of approximately 1000 acres.
10. Bathing beaches remain high quality, with only 6 closures since 1980.
11. There is widespread pesticide use in the Peconic watershed; these pesticides and other toxic substances are being detected in surface waters, bay bottom sediments and groundwater; some are present at levels that exceed State drinking water standards.
12. There are some State health advisories in place regarding human consumption of finfish, crustaceans and wildlife from the Peconic System. Similar advisories are in place for other New York State marine waters.
13. Runoff, and pollutants transported with it, remains problematic due to the pollutants themselves, impervious surface areas, and lack of infiltration/vegetated filters to intercept

runoff.

14. There are nearly 30 miles of hardened shoreline; this has significantly reduced intertidal habitats and caused a displacement or loss of plants and animals that depend on these areas. There is an additional 9 miles of docks.
15. There is a significant amount of preserved open space in the watershed (37,771 acres or over 33%), and more continues to be protected. However, acquisition efforts are being outpaced by development, with an average of nearly 600 acres of open space developed each year.

<u>Recommendations</u>

The following 12 recommendations constitute a summarized response plan based on the preparation of this Environmental Indicators Report.

1. Prevent the introduction of excessive nitrogen to the estuary, especially by reducing loads due to fertilizer use.
2. Keep pollutants out of stormwater runoff, reduce impervious surfaces to reduce runoff volumes, and provide for the infiltration of any runoff that remains.
3. Preserve priority open spaces, particularly coastal properties.
4. Restore healthy filter feeder populations (*i.e.*, bay scallops, clams, etc.) through: spawner sanctuaries; restocking and seeding; maintaining good water quality and improving water quality where necessary; habitat protection and improvements; and obeying harvesting laws.
5. Conserve existing eelgrass beds and work to restore historic eelgrass coverage.
6. Protect freshwater wetlands, tidal wetlands and their upland buffers. Re-establish and/or maintain natural buffers bordering wetlands and surface waters.
7. Use and handle toxic substances, especially pesticides, judiciously and carefully; dispose of unneeded and unwanted materials responsibly.
8. Maintain and increase natural shorelines and the habitats of endangered species.
9. Restore degraded habitats and shorelines, and reduce the spread of invasive species. Assist with promising restoration projects and secure funding for pre-restoration planning, permitting, implementation and post-restoration monitoring.
10. Obey laws - one transgression may not be significant, but the cumulative effects across the estuary and watershed can be important.
11. Conduct research to understand environmental issues in order to design programs that respond to them.
12. Communicate with the public on what can be done and what they can do personally to improve the environmental health of the Peconics.

By continuing to track the selected environmental indicators, the PEP will have its finger on the pulse of the Peconics. Taken together, the indicators help the PEP determine which initiatives should be continued and which need to be adjusted, as well as which new initiatives should be pursued. By assessing progress as well as challenges, the PEP goal to protect and restore the Peconic Estuary is more readily achievable.

Appendix A
CCMP Objectives

Brown Tide

1. Determine the chemical, physical and biological factors responsible for producing, sustaining and ending blooms of the Brown Tide organism, *Aureococcus anophagefferens.*
2. Determine what management actions can be undertaken to prevent or, if that is not possible, to mitigate the effects of recurrent Brown Tide blooms on the ecosystem and economy of the Peconics.

Nutrients

1. <u>No net increase in western estuary.</u> Immediately prevent net increases in nitrogen loading to the surface waters of the western estuary (Peconic River and Flanders Bay) to prevent worsening of current dissolved oxygen (DO) stresses in the marine surface waters of the area.
2. <u>Long-term reductions in western estuary.</u> Develop and implement a long-term nitrogen load reduction strategy to the western estuary, to optimize surface water conditions for dissolved oxygen, with ancillary consideration of potential benefits to submerged aquatic vegetation (especially eelgrass) habitat.
3. <u>Eelgrass habitat optimization in shallow water.</u> Maintain and, where cost-effective, improve conditions with respect to nitrogen (and related chlorophyll-a, light extinction, and possibly other parameters) in shallow waters (less than three meters) to optimize eelgrass habitat.
4. <u>Water quality preservation in eastern waters.</u> Implement a “water quality preservation” policy in eastern estuary waters (east of Flanders Bay) to prevent degradation which could adversely impact the high quality of those surface waters.
5. <u>Subwatershed management.</u> Focus on characterization of peripheral creeks and embayments and management of their subwatersheds; optimize surface water quality in these areas, which are often highly productive but poorly flushed and subject to environmental stresses.
6. <u>Load allocation in the entire watershed.</u> Develop and implement a load allocation strategy for point and nonpoint sources in the entire estuary, which accomplishes the above objectives.

Habitat & Living Resources

1. Preserve and enhance the integrity of the ecosystems and natural resources present in the study area so that optimal quantity and quality of fish and wildlife habitat and diversity of species can be assured and conservation and wise management of the consumable, renewable natural resources of the estuary are promoted and enhanced.
2. Protect and enhance biogeographical areas within the Peconic watershed with concentrations of high quality spawning, breeding, feeding, and wintering or seasonal habitat for shellfish, finfish, waterfowl, shorebirds, anadromous fish, and rare plant, animal, and natural communities.
3. Protect and enhance the ecosystems and the diversity of ecological communities

and habitat complexes throughout the system, particularly tidal wetlands, eelgrass meadows, and beaches and dunes by preventing or minimizing loss, degradation, and fragmentation and by maintaining and restoring natural processes essential to the health of the estuary and its watershed.
4. Restore degraded habitats to maintain or increase native species and community diversity, provide connectivity of natural areas, and expand existing natural areas.
5. Foster recreational and commercial uses of the Peconic Estuary that are sustainable and compatible with protection of biodiversity.
6. Protect and enhance species which are endangered, threatened, or of special concern throughout the system by mitigating stresses to these species and ensuring essential habitats crucial for their survival.
7. Promote coordination and cooperation among Federal, state, and local governments and stakeholders to maximize protection, stewardship, and restoration of the Peconic Estuary.
8. Develop and carry out an estuary-wide research, monitoring, and assessment program to guide and evaluate management decisions concerning the estuary and to ensure management and policy decisions are based on the best available information.

Pathogens

1. To minimize heath risks due to human consumption of shellfish.
2. To promote, to the maximum practicable extent, the social and economic benefits which have been associated with the Peconic Estuary system.
3. To maintain the current status of certified (seasonally and year-round) shellfish beds and re-open uncertified beds by eliminating or reducing pathogen (indicator) inputs to the Peconic Estuary system.
4. To minimize the closure of bathing beaches in the Peconic Estuary while adequately protecting human health.

Toxics

1. Measure the levels of toxics in the environment to discern trends in environmental quality and to determine the effectiveness of management programs.
2. Minimize human health risks due to the consumption of shellfish, finfish, and drinking water.
3. Protect and improve water and sediment quality to ensure a healthy and diverse marine community.
4. Eliminate where possible, and minimize where practicable, the introduction of toxic substances to the environment, through regulatory and non-regulatory means.
5. Where toxic contamination has occurred, ensure clean-ups occur quickly, and according to the most appropriate and stringent environmental standards.

Critical Lands Protection

1. Compile a Geographic Information System (GIS) database of lands already identified for protection in the Peconic Estuary watershed by various levels of government.
2. Apply the PEP criteria developed to achieve water quality and habitat protection goals for the Peconic Estuary to land available for development in the Peconic Estuary watershed.
3. Determine the degree to which Community Preservation Fund (CPF) plans address PEP

watershed management needs.
4. Identify additional parcels, not on CPF protection lists, appropriate for estuarine and watershed protection, satisfying the PEP land prioritization criteria.
5. Estimate funding needed for land protection, quantify benefits (where feasible), and evaluate funding sources available for that protection.
6. Involve a broad cross section of stakeholders in the process.
7. Accelerate land protection in the Peconic Estuary.
8. Coordinate protection recommendations, to the extent possible, with the protection recommendations of the Pine Barrens and special groundwater protection area initiatives.
9. Integrate and coordinate the PEP Critical Lands Protection process with Smart Growth and Sustainable Development tools, initiatives, and ordinance modifications, etc. to assist communities in assigning development to appropriate areas.
10. Develop a strategy for the management of underwater lands which preserves and enhances the region’s critical natural resources.

Public Education & Outreach

1. Improve the understanding of human interactions with, and impacts on, the estuary.
2. Promote action-oriented stewardship of the system's resources.
3. Increase awareness of the Peconic Estuary as a regional and national resource.
4. Increase communication and cooperation among the estuary’s many and diverse stakeholder groups.
5. Engender support for the PEP CCMP and its recommended management actions.

CCMP Financing

1. At a minimum, continue to fund Federal, State, County, and local programs at current levels.
2. Aggressively seek additional public and private funds.
3. Utilize innovative financial sources and incentives to fully implement the CCMP.

Post-CCMP Management

1. Create a stable and effective management structure for CCMP implementation.
2. Ensure widespread public agency participation/representation and use existing authorities to the maximum extent possible.
3. Develop and implement an integrated long-term monitoring plan for water quality and habitats/living resources issues with a coordinated data management strategy.
4. Track the progress of CCMP implementation (commitments, outcomes, and environmental effects), providing routine reporting and allowing for refining of management approaches.

Appendix B
CCMP Measurable Goals

Note: See the Peconic Estuary Program CCMP for the Full Text of Measurable Goals

Measurable Brown Tide Goals
- Coordinate and expand Brown Tide research
- Continue water quality sampling

Measurable Nutrient Goals
- Decrease Nitrogen
- Improve DO (Western)
- Shallow water Nitrogen below 0.4mg/l
- Nitrogen & DO maintained or improved East of Flanders
- Develop quantitative Nitrogen load allocation strategy
- Implement quantitative Nitrogen load allocation strategy
- No substantial Nitrogen increase East of Flanders
- Research
- Open space acquisition

Measurable Habitat and Living Resource Goals
- Protect Critical Natural Resource Areas
- Reduce shoreline hardening structures
- Increase eelgrass
- Restore degraded wetlands
- Restore mosquito-ditched lands
- Increase piping plovers
- Reduce dredging impacts
- Support fisheries and biodiversity
- Improve shellfish abundance
- Link land use and habitat quality
- Link aquaculture with other PEP goals
- Initiate 5% Habitat Restoration Workgroup projects annually

Measurable Pathogen Goals
- Maintain & improve shellfish harvesting acreage
- Reduce stormwater runoff
- Eliminate vessel waste discharge
- No stormwater discharge in new subdivisions

Measurable Toxics Goals
- Improve environmental quality
- Timely compliance with hazardous waste regulations
- Decrease air emissions

- Eliminate storage of unwanted pesticides/toxics
- Decrease pesticide use in East End
- Eliminate pesticides use on public lawns
- Eliminate exempt underground storage tanks
- Decrease treated lumber used in marine/estuarine environment
- Reduce 2-stroke engine usage

Measurable Critical Lands Protection Goals

- Evaluate and identify lands for protection and identify funding
- Integrate above process with other initiatives and ordinances affecting the Estuary

Measurable Education & Outreach Goals

- Begin a new public education effort annually
- Conduct a student program annually
- Conduct major event annually
- Support creation of a new tidal creek association annually

Measurable Financing Goals

- Effectively use existing and new governmental funding sources
- Secure new or additional private funding

Measurable Management and Implementation Goals

- Implement monitoring plan
- Produce annual reports
- Update municipal officials
- Develop sub-watershed plans

Appendix C
CCMP Environmental Monitoring Plan Core Elements

Brown Tide Issues

- Brown Tide

Nutrients Issues

- Nutrients
- Dissolved Oxygen
- Light Extinction
- Groundwater
- Point Sources
- Land Use

Habitat and Living Resources Issues

- Eelgrass
- Finfish and Macroinvertebrates
- Wetlands
- Shoreline Hardening
- Piping Plovers, Shorebirds, Raptors, and Other Birds
- Dredging
- Restoration
- Bay Scallops
- Aquaculture and Transplanting Activities

Pathogens Issues

- Coliform Bacteria
- *Pfiesteria* and *Alexandrium*
- Vessel Waste No Discharge Areas

Toxics Issues

- Sediment
- Coastal 2000
- Biota (Fish, Shellfish, and Crustaceans)
- NOAA Mussel Watch Program
- Surface Water
- Groundwater
- Hazardous Waste Sites
- Point Source Discharges
- Federal Toxics Release Inventory
- Pesticide Use
- Two Stroke Marine Engines
- Underground Storage Tanks
- Treated Lumber in the Marine Environment

www.peconicestuary.org

Peconic Estuary Program Sponsoring Agencies:

Suffolk County Department of Health Services
SCDHS-Office of Ecology
Riverhead County Center
Riverhead, NY 11901
(631) 852-2077
www.co.suffolk.ny.us

U.S. Environmental Protection Agency
290 Broadway
24th Floor
New York, NY 10007
www.epa.gov

New York State Department of Environmental Conservation
205 North Belle Mead Road, Suite 1
East Setauket, NY 11733
www.dec.state.ny.us

The Peconic River, Watershed, and Estuary were collectively designated as an Estuary of National Significance in 1992 under the Federal Clean Water Act.